Fisheries rebuilding success indicators: 2019

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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 or remain in draft form. 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. And it means considering the impacts of climate change and the cumulative effects of multiple stressors on species across populations. Canada's policy framework, the Sustainable Fisheries 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. The results from that audit and from last year's update showed that Canadian fisheries are in trouble, with only slightly over one-third of our stocks considered healthy and 13 per cent in critical condition (Oceana Canada 2017a, Oceana Canada 2018a). Further, the health of 37 per cent were uncertain. What was more concerning was that rebuilding plans have been developed for only three of Canada's 26 critically depleted populations.

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 Fisheries and Oceans Canada (DFO) is implementing its commitments from year to year (Oceana Canada 2017b, Oceana Canada 2018b). The current document uses newly available information published over the last year to examine changes in the nine indicators over the last three years, updating the status of Canada's marine fish and invertebrate populations and demonstrating the extent of DFO's progress towards rebuilding fish stocks.

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. 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 status 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 an 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 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 by allowing 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 our stocks. An increase in 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. 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 and 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 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 anticipated release of a National Fishery Monitoring Policy (CESD 2016), more attention is expected from DFO to determine and ensure the appropriate type and frequency of catch monitoring in all our fisheries. Part of the proposed steps will be ensuring there are specific and measurable catch monitoring objectives in all IFMPs. In anticipation of the finalization of the National Fishery Monitoring Policy and its implementation, the number and percentage of stocks with specific 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 incorporating the precautionary approach. 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 the additional requirements included to rebuild the stock out of the critical zone (DFO 2009), 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, based on marine fish and invertebrate stocks[1] included in Oceana Canada's 2016 report (Baum and Fuller 2016), combined with those included in the 2015 results of the Sustainability Survey for Fisheries (SSF; DFO 2019a), with the addition of any stocks with newly available information from departmental reports that year. It 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[2] (DFO 2019b), 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 2018 and 2019 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 workplans (i.e., DFO 2017, DFO 2018a, DFO 2019c) or new additions to the SSF (DFO 2019a). 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.

As per last year, 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 Response reports published since the last *Fishery Audit* (i.e., between July 2, 2018 and July 1, 2019). For stocks assessed by Regional Fisheries Management Organizations (RFMO) 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 2018 were carried forward. A few minor errors (e.g., assessment year based on publication date, not last year of data used) found in previous records were corrected when found during the 2019 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 most of 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, Oceana Canada 2018b). Briefly, the health status of each stock was updated. In some cases, Oceana Canada was able to find this

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

[2] The 2017 Sustainability Survey for Fisheries includes 179 stocks (an increase over the 159 stocks included in 2015 and 170 included in 2016), of which 134 are marine fish and invertebrates and 45 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 2019b).

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 sometimes-long time lapse (i.e., years) between when assessments are conducted and when the results are published (see Oceana Canada 2018c, Oceana Canada 2019a). 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, beginning in 2019, 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 assessment, indicating whether trends in proxies for biomass/abundance are being evaluated in the absence of complete assessments.

In 2017, the only source of mortality included was fishing mortality. Natural and total mortality 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). 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, natural or total mortality. In such cases, Oceana Canada simply recorded whether exploitation rates, exploitation rate indices or relative F (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 "developed" are often used with little indication as to whether the reference points have been accepted and implemented. Oceana Canada recognized 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. In this case, 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 varying 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. In 2019, the requirement to use electronic VMS or 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 of the National Fishery Monitoring Policy and its implementation, the number and percentage of stocks with specific catch monitoring objectives appearing in their IFMPs was recorded in 2019.

Results/Discussion

The 2019 index stock dataset includes 194 marine fish and invertebrate stocks[3] 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/FisheryAudit2019).[4] For a visualization of most indicators by DFO administrative region, see Appendix 1 of this document.

1. **Status:** In 2019, only 29.4 per cent (57) of Oceana Canada's marine fish and invertebrate index stocks can be confidently considered healthy. Further, 15.5 per cent (30 stocks) are in the cautious zone, 17.0 per cent (33 stocks) are in the critical zone, and the status of 38.1 per cent (74 stocks) remains uncertain. Uncertain stocks likely are 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 on the northeast and Avalon coats of Newfoundland). These results indicate a recent change in the overall status of the fisheries as compared to the last two years (Figure 1, Table 1), with fewer healthy stocks, slightly more uncertain stocks and a startling increase in the number of critically depleted stocks.

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

[4] In 2019, 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, workplans or new additions to the SSF. This resulted in a dataset that grew from 215 marine fish and invertebrate stocks in 2018 to 223 stocks in 2019. Results calculated using all stocks did not differ greatly from those using index stocks and are available in Table 2.

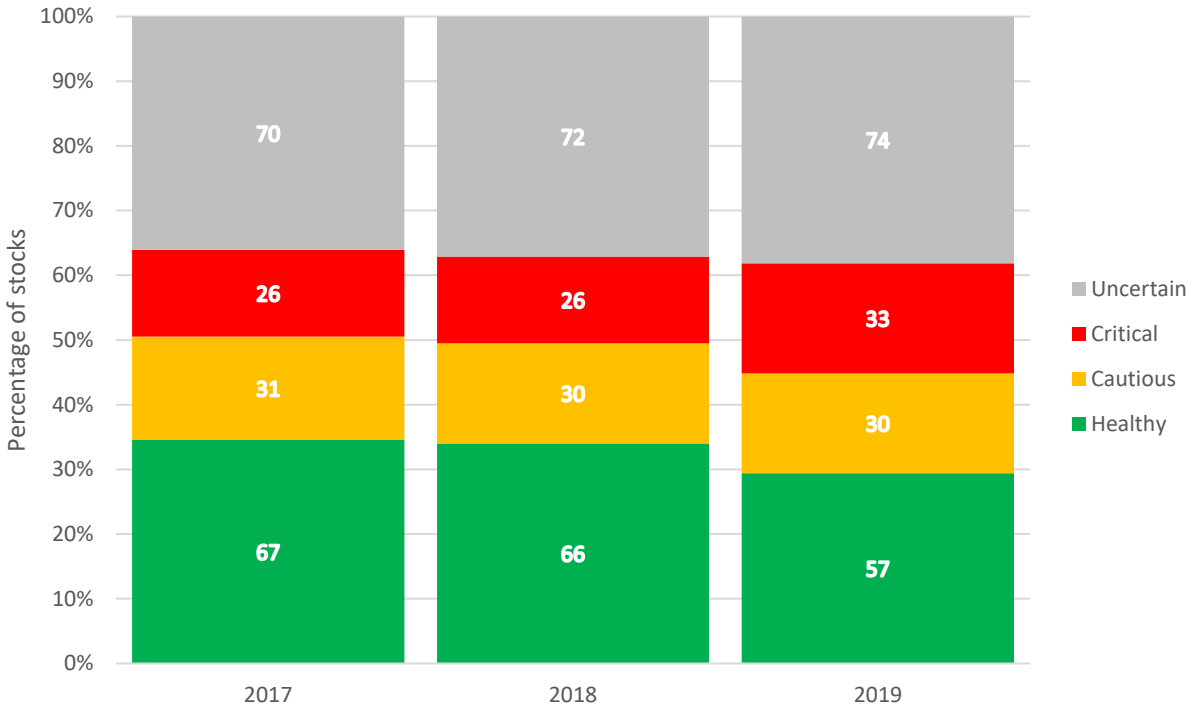

Figure 1. The percentage of Oceana Canada index stocks (n = 194 stocks) in each of the health status zones described in DFO's Precautionary Approach (PA) framework in 2017, 2018 and 2019. The number of stocks in each status zone is indicated in a white font within the bars.

Most of the critically depleted stocks are groundfish (12 stocks) and flatfish (six stocks) located in the Atlantic Ocean (Figures 2, 3, 4). However, within the last three years, a notable number of invertebrate stocks have become critically depleted in the Atlantic (three stocks in 2019) and in the Pacific Ocean (four stocks in 2019). Over the same time period, invertebrates in these two oceans saw the largest decreases in the number of healthy stocks: from 20 to 16 stocks in the Atlantic and 17 to 11 stocks in the Pacific Ocean. In addition, two forage fish stocks in the Pacific Ocean became critically depleted in 2019, as did one forage fish stock in the Atlantic Ocean (increasing the total from two to three in 2019). The status of the few stocks in the Arctic have remained relatively unchanged (Figure 4).

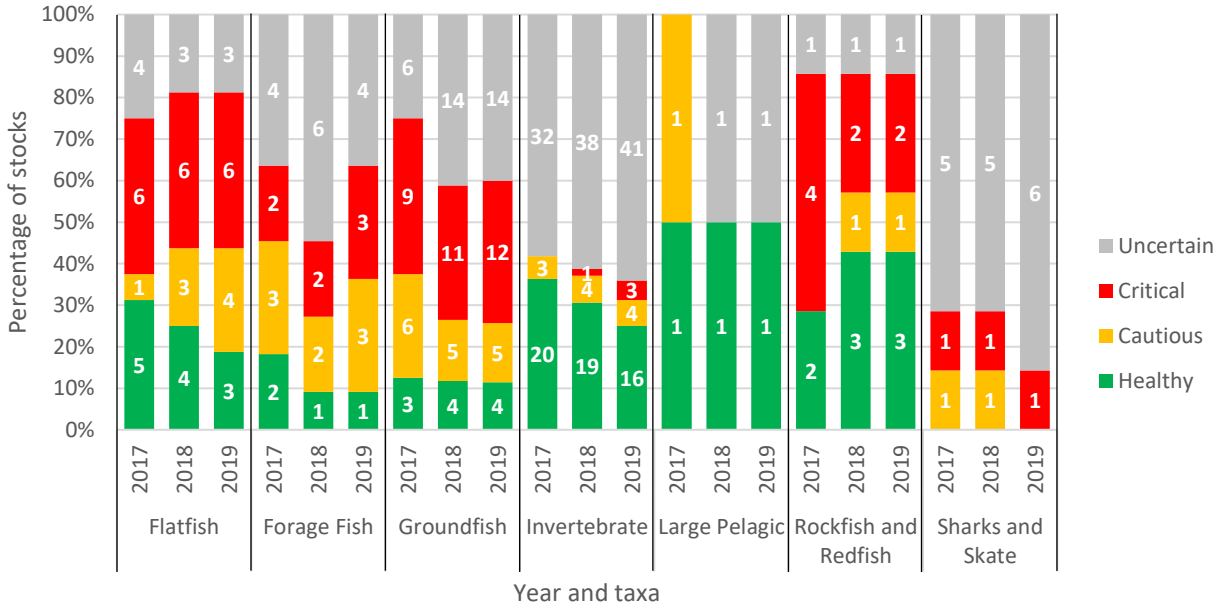

Figure 2. The percentage of Oceana Canada index stocks (n = 194) in each of the health status zones described in DFO's Precautionary Approach (PA) framework, by taxa groups, in the Atlantic Ocean in 2017, 2018 and 2019. The number of stocks in each year-taxa-status combination are reported in white font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

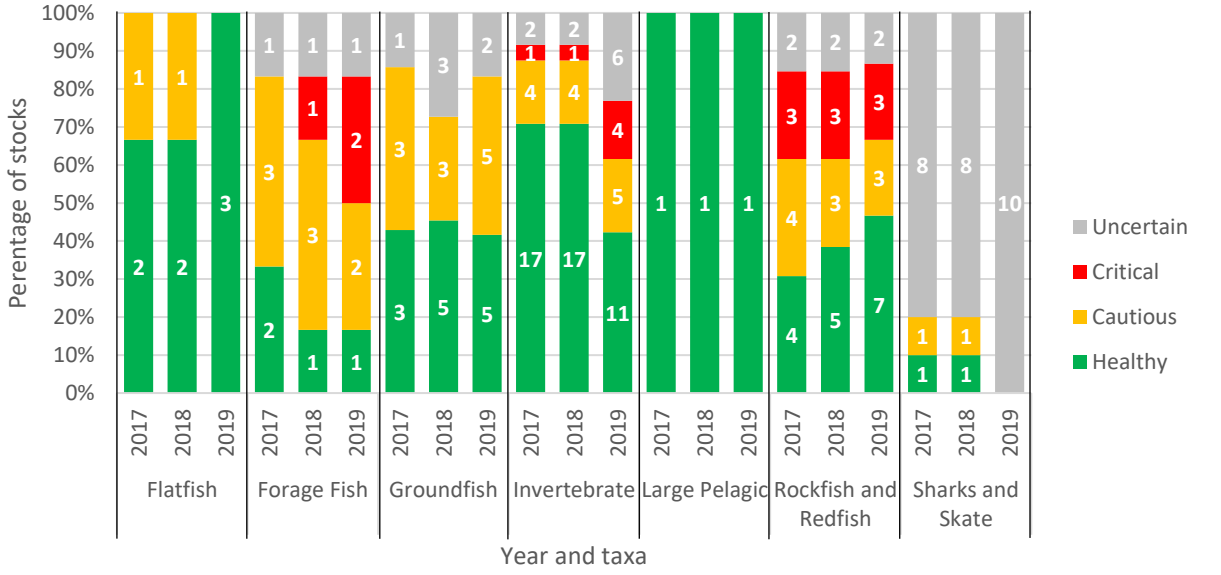

Figure 3. The percentage of Oceana Canada index (n= 194) stocks in each of the health status zones described in DFO's Precautionary Approach (PA) framework, by taxa groups, in the Pacific Ocean in 2017, 2018 and 2019. The number of stocks in each year-taxa-status combination are reported in white font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

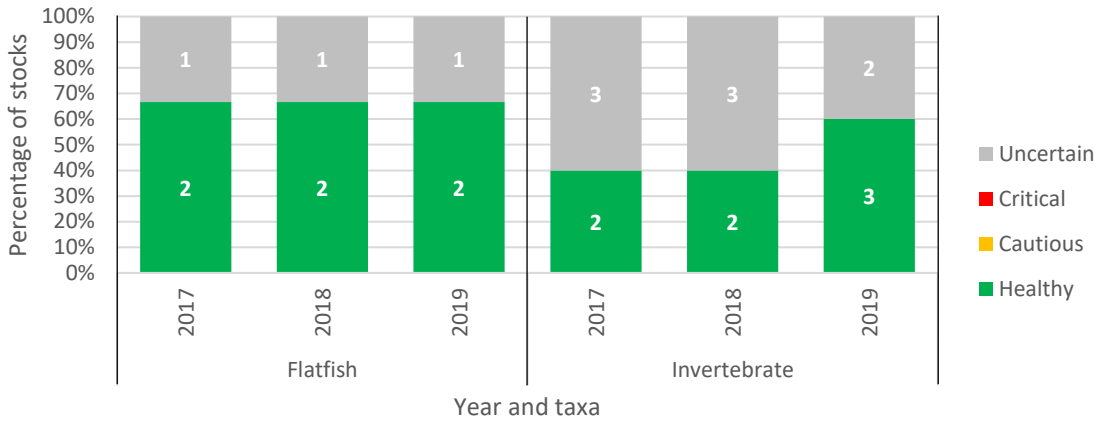

Figure 4. The percentage of Oceana Canada index stocks (n= 194) in each of the health status zones described in DFO's Precautionary Approach (PA) framework, by taxa groups, in the Arctic Ocean in 2017, 2018 and 2019. The number of stocks in each year-taxa-status combination are reported in white font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

The 2019 status results reported here differ from the most recent (2017) results of the DFO SSF where 10.1 per cent (18 stocks) were critically depleted, 14.0 per cent (25 stocks) were cautious, 35.2 per cent (63 stocks) were healthy and the status of 40.8 per cent (73 stocks) were uncertain (DFO 2019a). Some of these differences are due to the inclusion of non-marine fish and invertebrate stocks in the SSF, but even when these are excluded, differences remain.[5] This is 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 2019d) and released nearly a year after the survey year (i.e., 2017 results are released in late 2018). The 2019 statuses reported here are based on information available up to and including July 1, 2019 and are therefore informed by more recent information not available when the 2017 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). Therefore, although the index dataset used here includes all stocks from the SSF at the time it was first published,[6] it also includes several stocks (44 stocks) not included in the 2017 SSF in any form[7]. Of the 2019 index dataset stocks not overlapping with the 2017 SSF stock list, 11 are critical (25.0 per cent), six are cautious (13.6 per cent), five are healthy (11.4 per cent) and 22 are

[5] When the 2017 SSF results are filtered to include just marine fish and invertebrates the results are as follows: 11.9 per cent critical (16 stocks), 14.2 per cent cautious (19 stocks), 39.6 per cent healthy (53 stocks), and 34.3 per cent (46 stocks) uncertain.
[6] 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 workplans (i.e., DFO 2017, DFO 2018a, DFO 2019c) or new additions to the SSF (DFO 2019a). The larger stock dataset includes all stocks appearing in the 2017 SSF, and results calculated using it are available in Table 2.
[7] When the 2019 index dataset is filtered to just stocks that overlap with the SSF, the differences between Oceana Canada's results and the SSF results remain. The filtered results break down as follows: 14.7 per cent critical (22 stocks), 16.0 per cent cautious (24 stocks), 34.7 per cent healthy (52 stocks), and 34.7 per cent (52 stocks) uncertain. However, these are more similar to the 2017 SSF results that are filtered to include just marine fish and invertebrates (noted in footnote 5 above).

uncertain (50 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.[8]

Stocks selected for the SSF are based on economic, cultural or ecological importance (DFO 2019d). In the two surveys published since 2015, two stocks were removed,[9] the definition of at least one stock was changed,[10] and many other stocks have been added, resulting in a net increase in the number of "major" stocks from 159 to 179 (DFO 2019a). Although there are criteria for the selection of "major" stocks to include in the survey (DFO 2019d), these appear have recently changed[11] and been inconsistently applied, likely given the subjectivity of some of the factors for inclusion.[12] Arguably, many of the stocks included here that are not in the SSF could be added to the SSF based on DFO's criteria.[13] Ideally, all stocks managed by DFO would be included in the survey and subject to the amended *Fisheries Act* and associated regulations, given the newly defined purpose of the *Act* is to ensure proper management and control of fisheries and the conservation and protection of fish and fish habitat (House of Commons of Canada 2019). However, under the new *Act* the Minister is only required to implement measures to maintain *major* fish stocks at or above the level necessary to promote the sustainability of the stock (House of Commons of Canada 2019). The definition of "major" stocks and consistency in its application will become increasingly important if it is used to assign stocks subject to regulations under the newly amended *Fisheries Act*.

2. **Stocks whose health status has shifted from uncertain to certain (or vice versa):** In 2019, six index stocks went from having an unknown/uncertain status in 2018 to having one assigned due to new information (Table 1). One was assigned as healthy,[14] three as cautious[15] and two as critical.[16] Eight stocks underwent the reverse change, with Oceana Canada unable to determine their status with certainty (five from healthy[17] and three from cautious[18] to uncertain), which resulted in an overall increase in the total number stocks with uncertain status from to 72 in 2018 to 74 in 2019 (Table 1, Figure 1). These results are like last year, where several stocks went from uncertain to certain status, but more underwent the reverse change. These changes have resulted in net increases in the number of stocks of uncertain status over the last three years from 70 in 2017 to 74 in 2019 (Table 1, Figure 1), the opposite direction than expected given the continued development of reference points and improved stock assessments.

[8] Additionally, in Oceana Canada's larger dataset there are 36 critical zone stocks and only 27.4 per cent of stocks (61 of 225 stocks) are healthy. This dataset includes some additional "major" stocks listed in the SSF but mostly stocks that are not listed in the SSF.
[9] Whelk in NAFO 2J3K3L4R and Pacific herring spawn on kelp were included in the 2015 SSF but do not appear in the 2017 SSF.
[10] Greenland halibut in NAFO 0A and 0B were initially merged together in SSF 2015 but are separate records in SSF 2017.
[11] The 2016 SSF webpage (no longer accessible) indicated that to be included as major fish stocks, the stocks must meet one of several criteria, which included if a stock has been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as being threatened, endangered or of special concern (regardless of whether or not it is listed on the *Species at Risk Act* (SARA)) and is the target of a directed fishery or is caught as bycatch. The major stock definition associated with the survey now indicates that several factors determine which fish stocks are for the survey and that normally more than one factor applies to a selected stock. These factors no longer include COSEWIC-assessed species.
[12] For example, DFO has not defined "important" in the factor "an *important* stock for: cultural reasons, iconic value, ecosystem reasons" [emphasis added]. Nor has it defined "significant" in the factor "in a depleted state but were part of a *significant* commercial fishery and thus are a candidate for or subject to a rebuilding plan under the Precautionary Approach policy" [emphasis added].
[13] For example, one of the factors that determined whether a stock was included in the 2017 SSF is that the stock is an international stock. Yet American plaice on Grand Banks (NAFO 3LNO) and Atlantic cod on the Southern Grand Banks (3NO) are excluded.
[14] Uncertain to healthy: striped shrimp in the Eastern Assessment Zone
[15] Uncertain to cautious: Atlantic herring in NAFO 5YZ, Pacific cod in the Queen Charlotte Sound and witch flounder in NAFO 3NO
[16] Uncertain to critical: Atlantic herring spring spawners in NAFO 4R and haddock in NAFO 3Ps
[17] Healthy to uncertain: intertidal clam on the Central Coast (Heiltsuk Manila), American lobster on the Quebec north shore and Anticosti island, rock crab in Lobster Fishing Areas 23, 24, 25, and 26A, dogfish – outside Pacific population and witch flounder St. Pierre Banks (NAFO 3Ps)
[18] Cautious to uncertain: euphausiids in the Pacific, dogfish – inside Pacific population and thorny skate in NAFO 3LNO

3. **Change in status:** In 2019, 13.4 per cent of index stocks (26 of 194 stocks) had a different health status as compared to 2018 (Table 1). As outlined above, many of these changes (14 stocks) were stocks that moved from uncertain to certain or the reverse. In addition, 10 stocks were identified as more at risk, with five stocks declining from healthy levels to the cautious zone[19] and two stocks declining from healthy to the critical zone.[20] The majority of these declining stocks are shrimp stocks located in both the Atlantic and Pacific Oceans. Three stocks declined from the cautious zone to critical levels:[21] one shrimp stock located in the Pacific Ocean, a Pacific herring stock and a snow crab stock in the Atlantic Ocean. Only two stocks were identified as less at risk, both increasing from the cautious zone to healthy levels.[22] The results in the change in status from these index stocks over the last three years indicate an overall decrease in the health of Canada's marine fish and invertebrate stocks.

4. **Biomass/abundance known:** In 2019, 58.8 per cent of index stocks (114 of 194 stocks) had a biomass or abundance estimate within the last five years. This is another slight decrease in this indicator for the second year in a row (Figure 5, Table 1). This was because although many (50) stocks had more recent biomass estimates in 2019 than they did in 2018, most of these were already less than five years old. Meanwhile, several stocks assessed in 2013 (i.e., six years ago) haven't been reassessed since and are now considered outdated in this year's analysis, adding to those that already had dated biomass estimates. Of the 41.2 per cent of index stocks (80 stocks) without complete assessments in the last five years, 18.8 per cent (15 stocks) have had an interim update reporting on trends in proxies for biomass/abundance. This means that 66.5 per cent of index stocks have at least had some sort of evaluation in trends in abundance or biomass indices evaluated within the last five years to support fisheries management. 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). This is likely a result of the newness of this policy (2016) pertaining to interim updates requiring indicator evaluations.[23]

5. **Sources of mortality known:** In 2019, 19.1 per cent of index stocks (37 of 194 stocks) had an estimate of fishing mortality, a slight increase over 2018 (18.0 per cent) but not quite returning to 2017 levels (20.6 per cent; Figure 5, Table 1). This means roughly one in five stocks have robust enough 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 (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,[24] while eight additional stocks clearly indicate they at least partially account for sources other than reported commercial landings.[25]

[19] Healthy to cautious: intertidal clams – depuration on the coast of British Columbia, northern shrimp in the Prince Rupert District management area, side-striped shrimp in the Prince Rupert District management area, northern shrimp in Shrimp Fishing Area (SFA) 4 and northern shrimp in SFA 5
[20] Healthy to critical: northern shrimp in the Fraser River management area and side-striped shrimp in Shrimp Management Area 14
[21] Cautious to critical: Pacific herring in the Prince Rupert District, side-striped shrimp in the Shrimp Management Area (SMA) 18–19 and Snow Crab on the Scotian Shelf (NAFO 4X)
[22] Cautious to healthy: Icelandic and sea scallop around the Magdalen Islands and Pacific halibut, the latter of which was a result of clearer documentation of the LRP and USR equivalents for this jointly managed stock rather than increased biomass levels (although the stock has grown from 40 per cent to 43 per cent of unfished levels).
[23] Several stocks with complete assessments within the last 5 years have also had more recent interim updates with indicators evaluated (six stocks), but there are also many stocks (at least 25 stocks) with complete assessments after 2016 and more recent updates that have not had indicators to evaluate.
[24] Pacific halibut and winter skate in the Gulf of St. Lawrence (NAFO 4T)
[25] 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 cod off the NE coast of Newfoundland (northern cod; NAFO 2J3KL), Atlantic cod on Eastern Georges Bank (NAFO 5Zjm), Pacific cod in the Hecate Strait (5CD), Pacific cod in the Queen Charlotte Sound (5AB) and the yelloweye rockfish inside population

Several approaches have been developed to estimate natural mortality within models and/or to allow it to vary. In 2019, 13.9 per cent of index stocks (27 of 194 stocks) have an estimate of natural mortality, an increase over last year (8.8 per cent of index stocks). In some mortality estimation approaches, only total mortality can be estimated. In 2019, 8.8 per cent of index stocks (17 of 194 stocks) have an estimate of total mortality, a slight increase over last year (6.7 per cent of index stocks).

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 its absence, 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 provides an indication of fishing pressure. In 2019, less than half (39.2 per cent; 76 of 194 stocks) of index stocks have exploitation rate or indices reported. At a minimum, it is important to know the volume of fish landed. In 2019, the majority of index stocks (98.5 per cent; 191 of 194 stocks) have estimates of reported landings included in their most recent stock assessments.

6. **Reference points:** In 2019, 64.4 per cent of index stocks (125 of 194 stocks) have LRPs and 46.4 per cent (90 stocks) have USRs. These values have continually increased since 2017, most notably with an increase of more than 10 per cent in index stocks with LRPs (Figure 5, 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 these results indicate they are making progress. But with more than a third of the marine fish and invertebrate stocks lacking LRPs and more than half still 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, just under one-third of these stocks are missing USRs (critical zone, 33.3 per cent or 11 stocks missing USRs; cautious zone, 23.3 per cent or seven stocks missing USRs). If stocks that are not doing well lack a USR, there is no target for rebuilding them to a healthy state. While development of new USRs has occurred, the rate of implementation over the last three years is much slower than for LRPs.

7. **Management plans in place:** In 2019, 89.7 per cent of index stocks (174 of 194 stocks) were included in an IFMP.[26] There has been a continual increase in this indicator over the last three years, with nearly a 20 per cent increase since 2017, much of which occurred over the last year as several new multi-stock IFMPs were published (Figure 5, Table 1). In 2019, 172 of the index stocks were included in IFMPs that are available online in 47 unique IFMPs. Only two index stocks included in IFMPs are not available online. Each stock should be included in an IFMP, and entire IFMPs (not just summaries) should be publicly available. Without inclusion in a management plan, fish stocks 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 2019b), so it is expected that this indicator will continue to rise.

[26] Two of these stocks are only partially included in IFMPs, meaning the entire stock area is not included in the IFMP(s) in which they appear.

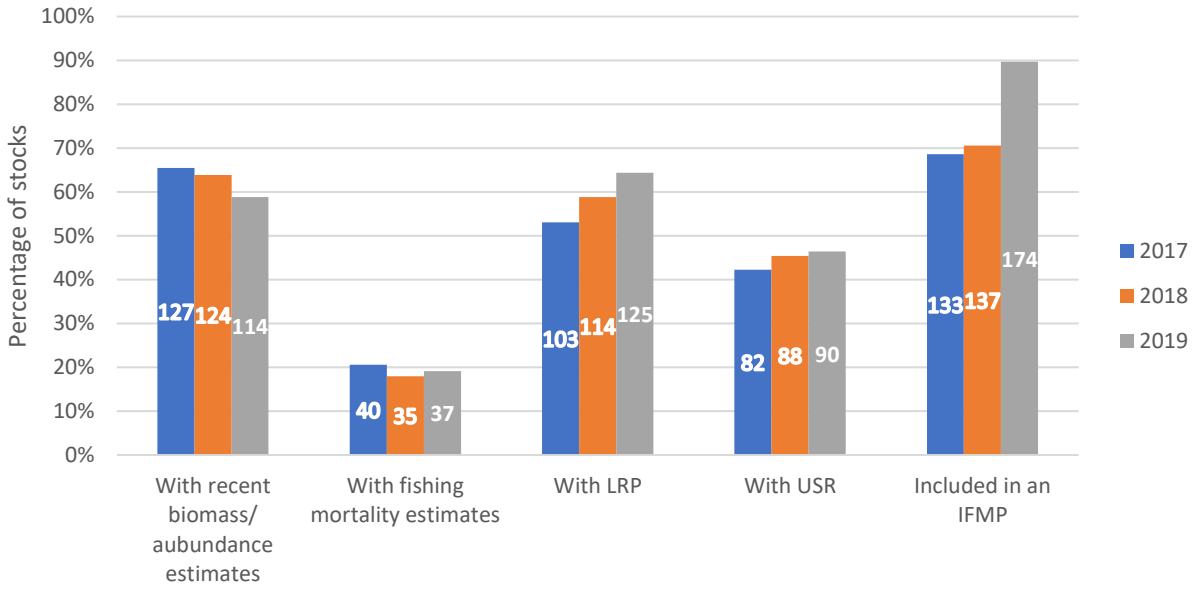

Figure 5. An assessment of how stocks perform on five indicators, based on Oceana Canada's index stock dataset (n = 194 stocks) in 2017, 2018 and 2019. The indicators included the percentage of stocks: 1) with a biomass/abundance estimate within the last five years; 2) with fishing mortality estimates; 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 indicated in a white font within the bars. See the text introduction and methods sections for further details on indicator definitions and calculations.

8. **Catch monitoring:** In 2019, 83.5 per cent of index stocks (162 of 194 stocks) have fisheries with at-sea observer or electronic (i.e., video) monitoring (Figure 6, 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 18.4 per cent of stocks (41 stocks), representing a decrease in uncertainty of more than 10 per cent since 2017 (Figure 6, Table 1). This is likely due in large part to the increasing transparency from the increasing inclusion of stocks in, and availability of, IFMPs. A recent review of catch monitoring tools in major Canadian fisheries also provided increased clarity on targeted at-sea coverage levels (Beauchamp et al. 2019).

   In 2019, 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 27.3 per cent of index stocks (53 of 194 stocks); 69.1 per cent (134 stocks) have fisheries where logbooks are used but it was not clear from the materials searched whether the entire catch is recorded; and there is uncertainty about the use of logbooks in the fisheries of 3.6 per cent of stocks (7 stocks). There is more certainty about general logbook use, and details recorded, since 2017, again likely due in large part to the increasing transparency from the increasing availability of IFMPs.

   In 2019, 87.1 per cent of index stocks (169 of 194 stocks) have fisheries that require some level of dockside monitoring of landings. Of these 169 stocks, 75.1 per cent (127 stocks) have fisheries that are required to have 100 per cent of landings verified by a certified independent dockside monitor and 24.9 per cent (42 stocks) have dockside monitoring requirements but the level of monitoring is varied or unknown. The use of dockside monitoring in the fisheries of 12.9 per cent of stocks (25 stocks) is uncertain. Since 2017, there has been increased certainty in general use of dockside monitoring, to

whom it applies and the levels targeted (Figure 6, Table 1). Again, this is likely due in large part to the increasing transparency from the increasing availability of IFMPs and the recent review of catch monitoring tools in major Canadian fisheries (Beauchamp et al. 2019).

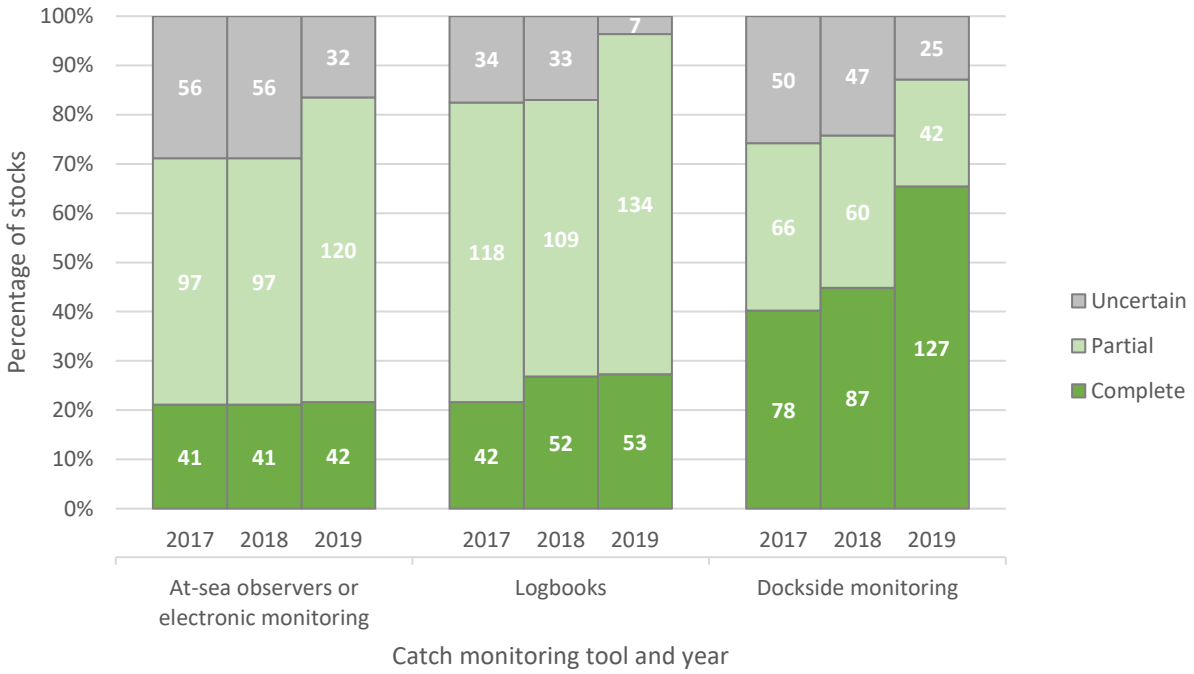

Figure 6. The percentage of stocks in Oceana Canada's index stock dataset (n = 194 stocks) in 2017, 2018 and 2019 that have the following catch-monitoring tools in place: 1) at-sea observer or electronic (i.e., video) monitoring; 2) logbooks recording the entire catch (i.e., targeted species and bycatch); or 3) independent dockside monitoring. The number of stocks with each level of monitoring is indicated in a 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-observer or electronic monitoring is not necessary for all fisheries.

In 2019, 58.2 per cent of index stocks (113 of 194 stocks) have fisheries with at least some vessels requiring electronic location monitoring, either via a VMS or AIS. About one-quarter (24.7 per cent or 48 of 194 stocks) do not require any vessels to be electronically monitored, while the use of this tool is uncertain in 17.0 per cent of index stocks (33 of 194 stocks). Of the113 stocks with some use of VMS/AIS, 67 stocks have fisheries with 100 per cent of vessels requiring electronic location monitoring at all times, 31 stocks have fisheries that use the tool for some but not all vessels, and 15 stocks have fisheries with the tool used but it is uncertain if it is used by all vessels or at all times.

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 by high number of stocks in the partial use categories. The increase in certainty of tool use since 2017 is largely due to increased availability of IFMPs. Often, more than one fishery (i.e., gear type or vessel size class) 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 has provided increased clarity on tool use and targeted levels for most stocks and fishery sub-units (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). DFO is currently reviewing the catch monitoring of fisheries in Canada, acknowledging the current weakness, and is developing a National Fishery Monitoring Policy originally intended to be released in 2017 (CESD 2016). It is expected that one requirement of the policy will be for specific, measurable catch monitoring objectives to be included in IFMPs. This will be an improvement over the current situation, where it was found in 2019 that no stocks in the index dataset had specific catch monitoring objectives in their IFMP. It is expected this new indicator will increase in future years as the policy is finalized and implemented.

Good data provides the foundation for good management. When armed with accurate estimates of how much of each species is caught and discarded, fisheries managers will have the key information required for rigorous fisheries management and decision making. That is why Oceana Canada is calling for the finalization and timely implementation of the current draft National Fishery Monitoring Policy (Oceana Canada 2019c), while acknowledging that the precautionary approach means being cautious when scientific knowledge is uncertain and not using the absence of rigorous information as a reason not to take conservative measures.

9. **Critical stocks with rebuilding plans:** In 2019, 18.2 per cent of index stocks in the critical zone (six of 33 stocks) have rebuilding plans in place.[27] This is the first increase in this indicator since 2017 (when 11.5 per cent or three of 26 critical stocks were included in rebuilding plans). Three more critical stocks were included in rebuilding plans published since last year, adding to the three stocks previously included in the Pacific Region multi-species groundfish rebuilding plan.[28] The rebuilding plan for northern shrimp in Shrimp Fishing Area 6 off the northeast coast of Newfoundland was published in November 2018, the rebuilding plan for Atlantic cod in southwest Nova Scotia/Bay of Fundy (NAFO 4X5Y) was published in January 2019, and the rebuilding plan for Atlantic cod on the eastern Georges Bank (NAFO 5Zjm) was published in June 2019. Like IFMPs, rebuilding plans provide the framework for management, but with the additional requirements to rebuild depleted fish stocks out of the critical zone, ideally into the healthy zone.

   DFO has committed to developing rebuilding plans for all major stocks in the critical zone (CESD 2016), and annual fiscal year workplans indicated the expected addition of one more stock in a rebuilding plan in addition to those noted above (DFO 2017, DFO 2018a, DFO 2019c). There has been no recent update on the status of the rebuilding plan for the iconic northern cod stock (Atlantic cod in NAFO 2J3KL), which was committed for completion by the end of March 2019 (see Oceana Canada 2019b for further details).

   The 2019/20 fiscal year workplan outlines progress towards the development of rebuilding plans for 19 stocks,[29] three[30] of which are noted above as being completed and publicly available, two of which

[27] One uncertain stock (yellowtail flounder on Georges Bank (NAFO 5Zjm) and one spawning component of a cautious zone stock (southwest Nova Scotia/Bay of Fundy spawning component of the 4VWX Atlantic herring stock) are also included in rebuilding plans.
[28] The Pacific Region multi-species groundfish rebuilding plan includes bocaccio rockfish, yelloweye rockfish outside population and yelloweye rockfish inside population.
[29] Including some stocks in the cautious zone and some with uncertain status, as well as marine mammal and diadromous fish stocks.
[30] Note that the DFO fiscal year workplan 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 workplan was released in 2017, while the inside population was added to the Pacific multi-species groundfish rebuilding plan on schedule and as indicated by the workplan in 2018. Bocaccio rockfish were also already included in a rebuilding plan at the time the

the department indicates are no longer required,[31] and one which was developed and recently published this year for a stock with uncertain status, but for which serious harm is possible (yellowtail flounder on Georges Bank or NAFO 5Z).[32]

In the next year, it is expected that the delayed rebuilding plan for northern cod will be completed and published, as well as a rebuilding plan for Atlantic mackerel on the Atlantic coast (NAFO areas 2 and 3). That leaves nine stocks out of the 19 for which rebuilding plans need to be developed by the end of March 2021. The 2019/20 fiscal year workplan also includes developing rebuilding plans for four stocks in addition to the 19 listed in the first fiscal year workplan in 2017 (DFO 2017, DFO 2019d). One of these four new stocks is a critical stock already included in a rebuilding plan,[33] one is a critical stock that was included in a rebuilding plan that recently expired[34] and needs updating, another is a critical stock with a target completion date of March 2021,[35] and one is in the cautious zone and declining, with work scheduled to begin immediately but with no target completion date.[36]

It is encouraging to see the addition of new stocks, including a "minor" critical zone stock[35] and a declining cautious zone stock. According to DFO's guidelines for rebuilding plan development, rebuilding plans should be developed when stocks are declining in the cautious zone,[37] ideally so a plan is in place before a stock reaches the critical zone (DFO 2013). However, considering the track record on rebuilding plan completion to date, and the fact that so many of these rebuilding plans are targeted for completion by the end of March 2021, there is a lot of work to do to ensure they get done. Recent investments to support the implementation of stock assessments and rebuilding provisions in a renewed *Fisheries Act*, which start in fiscal 2019/20,[38] 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.

Summary

Canada's marine fish and invertebrate stocks remain in a state of concern, with less than one-third that can confidently be considered healthy. There are more stocks at increased risk of depletion as compared

first fiscal year workplan was released. Therefore, although six stocks are included in rebuilding plans, only four were part of this commitment.

[31] At the recently formed Redfish Advisory Group meeting 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 (2011–13), 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.

[32] The status of yellowtail flounder on Georges Bank (NAFO 5Z) is uncertain because reference points have not been defined. The results of the most recent (2017) DFO Sustainability Survey for Fisheries also indicates uncertain status, with serious harm possible.

[33] Bocaccio rockfish was included in a rebuilding plan in 2014.

[34] Atlantic cod in the northern Gulf of St. Lawrence (NAFO 4RS3Pn) was included in a rebuilding plan that expired in Mary 2018.

[35] Witch flounder in NAFO 23KL was identified as a potential stock for which a rebuilding plan should be developed, but no specific deliverables were identified for fiscal 2019/20. Note, this stock is not included as a major stock in the SSF.

[36] Northern shrimp in the Gulf of St. Lawrence is not currently in the critical zone; however it is anticipated to be soon. Work will begin immediately. Target date to be determined.

[37] In addition to those rebuilding plans mentioned for critical-zone stocks above, DFO already has one rebuilding plan for one spawning component of a cautious zone stock (southwest Nova Scotia/Bay of Fundy spawning component of the 4VWX Atlantic herring stock). However, given the stock has further declined since its implementation in 2013, this plan should likely be revisited.

[38] In the 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.

to last year, with fewer index stocks considered healthy (29.4 per cent in 2019 compared to 34.0 per cent in 2018) more considered critically depleted (17.0 per cent in 2019 compared to 13.4 per cent in 2018), and the same number of cautious zone stocks (30 stocks or 15.5 per cent in both years). While there continues to be slightly more stocks of uncertain status (38.1 per cent in 2019 compared to 37.1 per cent in 2018). The composition of critically depleted stocks has also changed, with an increasing number of invertebrate stocks in both the Atlantic and Pacific now in the critical zone, reflective of that taxa group having the largest decreases in the number of healthy stocks over the last three years.

There has been continued and improved efforts made towards rebuilding and maintaining healthy fisheries in Canada, but much more work remains to be done. In 2019 there were continued small increases in the percentage of index stocks having USRs, but relatively large increases in the percentages of stocks having LRPs and included in IFMPs, which increased by about 10 and 20 per cent, respectively, since 2017. There was also increasing clarity on the use and levels of catch monitoring via three key monitoring tools. However, over the last three years there were continual slight decreases in the percentage of index stocks with recent biomass estimates, and the percentage with fishing mortality estimates has remained about the same, at about one in five index stocks. There is plenty of room for improvement in most indicators, indicating current progress by DFO has been insufficient to deliver on commitments to implement the Sustainable Fisheries Framework, now in place for 10 years (DFO 2009). However, considering the recent strong improvement in the percentages of stocks having LRPs and included in IFMPs, there are signs that efforts to improve are progressing. It is important that this momentum continues and incorporates the implementation of other aspects of the Sustainable Fisheries Framework.

The continued improvement and annual public release of the Sustainability Survey for Fisheries (DFO 2019a) and the public release of workplans in response to the CESD audit (DFO 2017, DFO 2018a, DFO 2019c) is encouraging progress towards increasing transparency in fisheries management in Canada. The workplans include departmental priorities for the development of LRPs, harvest control rules, IFMPs, rebuilding plans and, as of 2019/20, USRs. As these deliverables are met, it is expected the reference point and management plan indicators will continue to rise and will result in increased clarity on the types and targeted levels of catch-monitoring tools in place. In fact, if all deliverables outlined in the fiscal year workplans were completed,[39] the percentage of index stocks with LRPs would continue to rise by nearly 10 per cent, the percentage with USRs would rise more than 10 per cent and the percentage included in IFMPs would increase to 93 per cent (see Oceana Canada 2019b for further details). DFO should maintain the practice of updating the fiscal year workplans annually and making them publicly available and ensure enough resources are allocated to deliver on commitments. Success will also require continued and sustained investment in science capacity, so key stocks can continue to be assessed regularly and improvements can be made in assessing more of those that are rarely assessed. This, in turn, should also improve estimates of all sources of mortality.

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 2019 results, most of Canada's marine fish and invertebrate stocks have some catch-monitoring tools in place,

[39] It should be noted that the wording of deliverables has been clarified in the recent workplan and the majority of 2019/20 deliverables are not expected to be completed in fiscal year 2019/20. Instead, DFO aims to make progress towards their completion. At this time next year, Oceana Canada expects these indicators to rise less: the percentage of marine fish and invertebrate stocks included in our Fishery Audit index dataset with LRPs should increase to at least 71.1 per cent, the percentage of stocks with USRs should increase slightly to 46.9 per cent, and the percentage of stocks included in IFMPs should rise to 92.2 per cent. Two more rebuilding plans are expected, which will increase the percentage of critical zone stocks with rebuilding plans at this time next year to 24.2 per cent. See Oceana Canada (2019b) for further details.

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. DFO does not provide a clear rationale for determining targeted levels of at-sea coverage and lacks systematic controls to ensure targets are met (CESD 2016). DFO is working on a National Fishery Monitoring Policy, including guidance on assessing risk of fisheries to sensitive habitats and species caught as bycatch and assessing data quality and dependability. This policy was originally anticipated to be completed in 2017 (CESD 2016) but was not released for consultation until late 2018. The priority must be to complete this commitment as soon as possible. With improved catch monitoring, fisheries managers will have the data required to effectively manage Canada's fisheries.

For the first time, in 2019 there was an increase in the number of critically depleted marine fish and invertebrate index stocks included in a rebuilding plan (from three to six stocks). This is encouraging, but at the same time there has been an increase in the number of critically depleted index stocks (from 26 to 33 stocks), meaning there is still a very low percentage of critically depleted stocks with rebuilding plans (18.2 per cent of critical zone index stocks). According to the PA Framework, all stocks within the critical zone must have rebuilding plans (DFO 2009). With DFO's commitment to accomplishing this (CESD 2016, DFO 2017, DFO 2018a, DFO 2019c), 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, this indicator is expected to improve in coming years. If all stocks currently indicated for inclusion in rebuilding plans in the fiscal year workplans (DFO 2017, DFO 2018a, DFO 2019c) were completed, the percentage of index stocks in the critical zone with rebuilding plans would rise to nearly 50 per cent (see Oceana Canada 2019b for further details).

However, considering the track record on rebuilding plan completion to date, and the fact that so many of these rebuilding plans are targeted for completion by the end of March 2021, there is a lot of work to do to ensure they are get done. Before the 2020 *Fishery Audit*, it is expected that the delayed rebuilding plan for northern cod (Atlantic cod in NAFO 2J3KL) will be completed and published, as well as the expected rebuilding plan for Atlantic mackerel on the Atlantic coast (NAFO areas 2 and 3). 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 future plans). 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 consider climate change and the cumulative impact of human activities on marine ecosystems.

Conclusions and recommendations

The state of Canada's marine fish and invertebrate stocks remains concerning, especially given the recent decreases in health. Most depleted stocks are found in the Atlantic Ocean, where the distribution of species is shifting and communities are changing (DFO 2019e). Climate change is one of the key drivers of these changes, while other human activities like fishing, coastal development and resource exploitation are having an impact as well (DFO 2019e). There are now more depleted stocks in the Canadian Pacific Ocean, which is also undergoing changes (Chandler et al. 2018). While there have not been major changes in the health status of Arctic Ocean stocks yet, climate change is impacting biodiversity in it (CAFF 2017). It is 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, ensuring they remain a significant part of our culture and our economy and a vital source of sustainable protein for the future. There has been continued and improved progress

made towards their implementation over the last three years covered by the *Fishery Audit*, but progress is insufficient to address the changes required in a reasonable timeframe. At the current rate of progress,[40] it will take six more years until all index stocks have an LRP, 26 more years until all have a USR, and 24 more years until all critically depleted index stocks are included in a rebuilding plan.

To enable acceleration of the implementation of these important tools, DFO needs to invest resources in fisheries science. Scientists provide the evidence and advice required to implement most of the policy framework, but the percentage of stocks with recent stock assessments is decreasing, 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, 2019a). Furthermore, the percentage of stocks with uncertain status is not decreasing as expected. Improvements to these indicators will also require better data collection. DFO needs to finalize and publish the National Fishery Monitoring Policy and provide enough funds to ensure it is implemented in all fisheries as quickly as possible. Without improved quality of data, it will be difficult to improve the science, even if capacity is increased.

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 in 2020 and beyond to create change on the water, increasing the number of stocks in the healthy zone and building resilience to climate change. In the year ahead Oceana Canada recommends DFO's top priorities should be:

- Completing regulations to bring into force the new provisions in the *Fisheries Act*, including identifying major stocks and requiring targets and timelines for rebuilding plans.
- Addressing inconsistencies in catch monitoring by implementing the National Fishery Monitoring Policy; and
- Developing and implementing high-quality rebuilding plans that include targets and timelines for critical stocks identified in the 2019/20 workplans

In the interim, at minimum it is expected that DFO will continue to add to, update and publicly release the fiscal year workplans developed in response to the Commissioner of the Environment and Sustainable Development (CESD) Audit (DFO 2017, DFO 2018a, DFO 2019c) 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.
- Address the causes of delays in the publication of science information.
- Continue to prioritize the development of reference points in workplans to define health status zones and develop associated harvest control rules (HCRs) for each zone. Specifically, fulfill commitments ongoing or delayed from previous workplans and what is outlined for completion this fiscal year:

[40] Based on the average annual increase in the percentage of index stocks with each indicator over the last three years

- Develop LRPs for 11 more stock groups,[41] ensuring at least six more index stocks[42] have new or updated LRPs next year, increasing the percentage of index stocks with LRPs to 71.1 per cent.
- Develop USRs for one more stock group,[43] ensuring at least one more index stock[44] has a new or updated USR next year, increasing the percentage of index stocks with USRs to 46.9 per cent.
- Develop HCRs for three more stock groups,[45] ensuring at least three more index stocks[46] have new or updated HCRs next year.

Monitoring

- Complete and publish a National Fishery Monitoring Policy, making it mandatory for all commercial fisheries to have sufficient monitoring to ensure accurate estimates of all retained and discarded catches.
  - Include a published workplan to guide implementation of the policy.

Management

- Continue to prioritize the completion and publication of management plans. Specifically, fulfill commitments ongoing or delayed from previous workplans and what is outlined for completion this fiscal year:
  - Develop and publish IFMPs for 19 stock groups,[47] ensuring at least 12 more index stocks[48] are included in a publicly available IFMP next year, increasing the percentage of index stocks with IFMPs to 92.2 per cent.
  - Develop and *publish* rebuilding plans for two more stocks:
    - Atlantic cod – northern cod
    - Atlantic mackerel – Atlantic coast
- Report on progress towards rebuilding plans for the remaining 12 stocks that DFO has committed to developing.[49]
- Set priorities and timelines for completing rebuilding plans for all stocks in the critical zone.

[41] Stock groups noted in the 2019/20 workplan for completion of LRP development, updating or revision by the end of the fiscal year, plus any outstanding LRP commitments from previous workplans. Note this tally is based off Table 2 in Oceana Canada (2019b) and may include diadromous fish, freshwater fish and marine mammals. Stock groups that should have only been in the USR workplan were excluded (Greenland halibut (turbot) – 4RST, Atlantic herring – Maritimes Region).
[42] Marine fish and invertebrate stocks included in Ocean Canada's Fishery Audit index dataset.
[43] Stock groups noted in the 2019/20 workplan for completion of USR development, updating or revision by the end of the fiscal year, plus any outstanding USR commitments from previous workplans. Note this tally is based off Table 4 in Oceana Canada (2019b) and may include diadromous fish, freshwater fish and marine mammals.
[44] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset.
[45] Stock groups noted in the 2019/20 workplan for completion of HCR development, updating or revision by the end of the fiscal year, plus any outstanding HCR commitments from previous workplans. Note this tally is based off Table 2 in Oceana Canada (2019b) and may include diadromous fish, freshwater fish and marine mammals.
[46] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset.
[47] Stock groups noted in the 2019/20 workplan for completion of IFMP development, updating or revision and posting by the end of the fiscal year, plus any outstanding IFMP commitments from previous workplans. Note this tally is based off Table 6 in Oceana Canada (2019b) and may include diadromous fish, freshwater fish and marine mammals.
[48] Marine fish and invertebrate stocks included in Oceana Canada's Fishery Audit index dataset.
[49] Stock groups noted in the 2019/20 workplan for completion of rebuilding plan development or revision not covered above. Note this tally is based off Table 5 in Oceana Canada (2019b) with deliverable dates outlined and may include diadromous fish, freshwater fish and marine mammals.

- Ensure rebuilding plans are informed by recent stock assessments and include targets and timelines with probability estimates of meeting them, as well as evidence-based management measures to promote rebuilding.

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Tables

Table 1. The percentage and number of marine fish and invertebrate[50] stocks for each indicator in the 2017, 2018 and 2019 index stock datasets (n = 194 stocks; the same stocks in each year).

Indicator	Details	2019	2018	2017
	Number of stocks		194	194
1. Status	%/# of "healthy" stocks	29.4% / 57	34.0% / 66	34.5% / 67
	%/# of "cautious" stocks	15.5% / 30	15.5% / 30	16.0% / 31
	%/# of "critical" stocks	17.0% / 33	13.4% / 26	13.4% / 26
	%/# of "uncertain" stocks	38.1% / 74	37.1% / 72	36.1% / 70
2. Stocks going from uncertain to certain status (or vice versa) in the past year	# of stocks that went from uncertain status to known	6	4	Baseline year
	# of stocks that went from known status to uncertain	8	6	Baseline year
3. Change in status from previous year	%/# of stocks that have changed status	13.4% / 26†	10.8% / 21†	Baseline year
	# of stocks whose status improved	2	5	Baseline year
	# of stocks whose status worsened	10	6	Baseline year
	%/# of stocks whose status remained the same	86.6% / 168	89.2% / 173	Baseline year
4. Biomass/ abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	58.8% / 114	63.9% / 124	65.5% / 127
	%/# of stocks without recent assessments that have had interim updates of indicators since last complete assessment	18.8% / 15	Not available – new indicator	Not available – new indicator
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	19.1% / 37	18.0% / 35	20.6% / 40
	# of stocks that clearly incorporate all sources of F in its estimation	2	Not available – new indicator	Not available – new indicator
	%/# of stocks with natural mortality (M) known	13.9% / 27	8.8% / 17	Not available – new indicator
	%/# of stocks with total mortality (Z) known	8.8% / 17	6.7% / 13	Not available – new indicator
	%/# of stocks with exploitation rate known	39.2% / 76	Not available – new indicator	Not available – new indicator
	%/# of stocks with landings known	98.5% / 191	Not available – new indicator	Not available – new indicator
6. Reference points	%/# of stocks with limit reference points	64.4% / 125	58.8% / 114	53.1% / 103

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

Indicator	Details	2019	2018	2017
	%/# of stocks with upper stock reference points	46.4% / 90	45.4% / 88	42.3% / 82
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan**	89.7% / 174	74.2% / 144	70.6% / 137
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 21.6% / 42	Yes — 100% 21.1% / 41	Yes —100% 21.1% / 41
		Yes — coverage varies or level is uncertain 61.9% / 120	Yes — coverage varies or level is uncertain 50.0% / 97	Yes — coverage varies or level is uncertain 50.0% / 97
		Uncertain 16.5% / 32	Uncertain 28.9% / 56	Uncertain 28.9% / 56
	%/# of stocks with logbooks	Yes — and records bycatch species 27.3% / 53	Yes — and records bycatch species 26.8% / 52	Yes — and records bycatch species 21.6% / 42
		Yes — but unclear if records bycatch species 69.1% / 134	Yes — but unclear if records bycatch species 56.2% / 109	Yes — but unclear if records bycatch species 60.8% / 118
		Uncertain 3.6% / 7	Uncertain 17.0% / 33	Uncertain 17.5% / 34
	%/# of stocks with dockside monitoring	Yes — 100% 65.5% / 127	Yes — 100% 44.8% / 87	Yes — 100% 40.2% / 78
		Yes — coverage varies or level is uncertain 21.6% / 42	Yes — coverage varies or level is uncertain 30.9% / 60	Yes — coverage varies or level is uncertain 34.0% / 66
		Uncertain 12.9% / 25	Uncertain 24.2% / 47	Uncertain 25.8% / 50
	%/# of stocks with electronic Vessel Monitoring Systems (VMS)/Automated Identification System (AIS)	Yes — 100% of vessels always 34.5% / 67	Not available – new indicator	Not available – new indicator
		Yes — some vessels but not all vessels 16.0% / 31		
		Yes — but uncertain if all vessels or all times 7.7% / 15		
		Uncertain 17.0% / 33		
		No 24.7% / 48		
	%/# of stocks with specific catch monitoring objectives in their IFMP	0.0% / 0	Not available – new indicator	Not available – new indicator
9. Critical stocks with rebuilding plans	%/# of critical zone stocks with rebuilding plans	18.2% / 6	11.5% / 3	11.5% / 3

†This value includes those that changed status to, or from, uncertain.
**Sometimes it is not possible to estimate mortality with available data or models.*
***These values include stocks only partially included in IFMPs, meaning the entire stock area is not included in the IFMP(s) in which they appear. This occurred with four index stocks in 2017, four index stocks in 2018 and two index stocks in 2019.*

Table 2. The percentage and number of marine fish and invertebrate stocks[51] for each indicator in 2018 (n = 215 stocks) and 2019 (n = 223 stocks) using all stocks in the dataset, including those added during the updates in addition to the index stock dataset.

Indicator	Details	2019	2018
	Number of stocks	223	215
1. Status	%/# of "healthy" stocks	27.4% / 61	31.6% / 68
	%/# of "cautious" stocks	14.3% / 32	14.2% / 31
	%/# of "critical" stocks	16.1% / 36	13.0% / 28
	%/# of "uncertain" stocks	42.2 % / 94	40.9 % / 88
2. Stocks going from uncertain to certain status (or vice versa) in the past year	# of stocks that went from uncertain status to known†	7	4
	# of stocks that went from known status to uncertain†	8	6
3. Change in status from previous year	%/# of stocks that have changed status†	12.1% / 27††	10.8% / 21††
	# of stocks whose status improved †	2	5
	# of stocks whose status worsened †	10	6
	%/# of stocks whose status remained the same†	84.3% / 188	89.2% / 173
4. Biomass/ abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	60.1% / 134	64.2% / 138
	%/# of stocks without recent assessments that have had interim updates of indicators since last complete assessment	16.9% / 15	Not available – new indicator
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	17.9 % / 40	16.7 % / 36
	# of stocks that clearly incorporate all sources of F in its estimation	2	Not available – new indicator
	%/# of stocks with natural mortality (M) known	14.8% / 33	11.2% / 24
	%/# of stocks with total mortality (Z) known	8.1% / 18	6.0% / 13
	%/# of stocks with exploitation rate known	39.5% / 88	Not available – new indicator
	%/# of stocks with landings known	97.3% / 217	Not available – new indicator
6. Reference points	%/# of stocks with limit reference points	61.0% / 136	56.3% / 121
	%/# of stocks with upper stock reference points	43.0% / 96	42.3% / 91

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

Indicator	Details	2019	2018
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan**	87.9% / 196	71.2% / 137
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 22.0% / 49	Yes — 100% 20.9% / 45
		Yes — coverage varies or level is uncertain 59.6% / 133	Yes — coverage varies or level is uncertain 48.8% / 105
		Uncertain 18.4% / 41	Uncertain 30.2% / 65
	%/# of stocks with logbooks	Yes — and records bycatch species 27.3% / 53	Yes — and records bycatch species 26.0% / 56
		Yes — but unclear if records bycatch species 69.1% / 134	Yes — but unclear if records bycatch species 56.3% / 121
		Uncertain 4.0% / 9	Uncertain 17.7% / 38
	%/# of stocks with dockside monitoring	Yes — 100% 62.8% / 140	Yes — 100% 44.7% / 96
		Yes — coverage varies or level is uncertain 22.9% / 51	Yes — coverage varies or level is uncertain 28.4% / 61
		Uncertain 14.3% / 32	Uncertain 27.0% / 58
	%/# of stocks with electronic Vessel Monitoring Systems (VMS)/Automated Identification System (AIS)	Yes — 100% of vessels always 32.3% / 72	Not available – new indicator
		Yes — some vessels but not all vessels 17.9% / 40	
		Yes — but uncertain if all vessels or all times 8.1% / 18	
		Uncertain 19.3% / 43	
		No 22.4% / 50	
	%/# of stocks with specific catch monitoring objectives in their IFMP	0.0% / 0	Not available – new indicator
9. Critical stocks with rebuilding plans	%/# of critical zone stocks with rebuilding plans	16.7 % / 6	11.1 % / 3

† Some stocks included in the 2018 and 2019 "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.*

*** These values include stocks only partially included in IFMPs, meaning the entire stock area is not included in the IFMP(s) in which they appear. This occurred with five stocks in the 2018 "all stocks" dataset and three stocks in the 2019 "all stocks" dataset.*

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

In addition to the National Capital Region based in Ottawa, Fisheries and Oceans Canada (DFO) currently has six administrative regions across the country,[52] 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

Figure 1. Map of Fisheries and Oceans Canada (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[53] (Figure 2) and select indicator values summarized by region in each year available (Figures 3 to 16).

[52] DFO (2014). Regions. http://www.dfo-mpo.gc.ca/regions/index-eng.htm

[53] In the Fishery Audit dataset there are two records for redfish in Unit 1 and 2, with units combined and species separate (deepwater and Acadian redfish) as per the most recent science-based stock definitions. Both records are assigned to two regions, the Newfoundland and Labrador (Unit 2) and Quebec regions (Unit 1). The science on Unit 1 is led by the Quebec Region while the Gulf Region traditionally lead management. The science on Unit 2 is led by the Newfoundland and Labrador Region, which also traditionally lead management. Both units are currently managed by the National Capital Region, but it is unclear if that will continue. For the visualizations in this appendix, Acadian redfish in Units 1 and 2 were assigned to Newfoundland and Labrador Region since most of the biomass of that

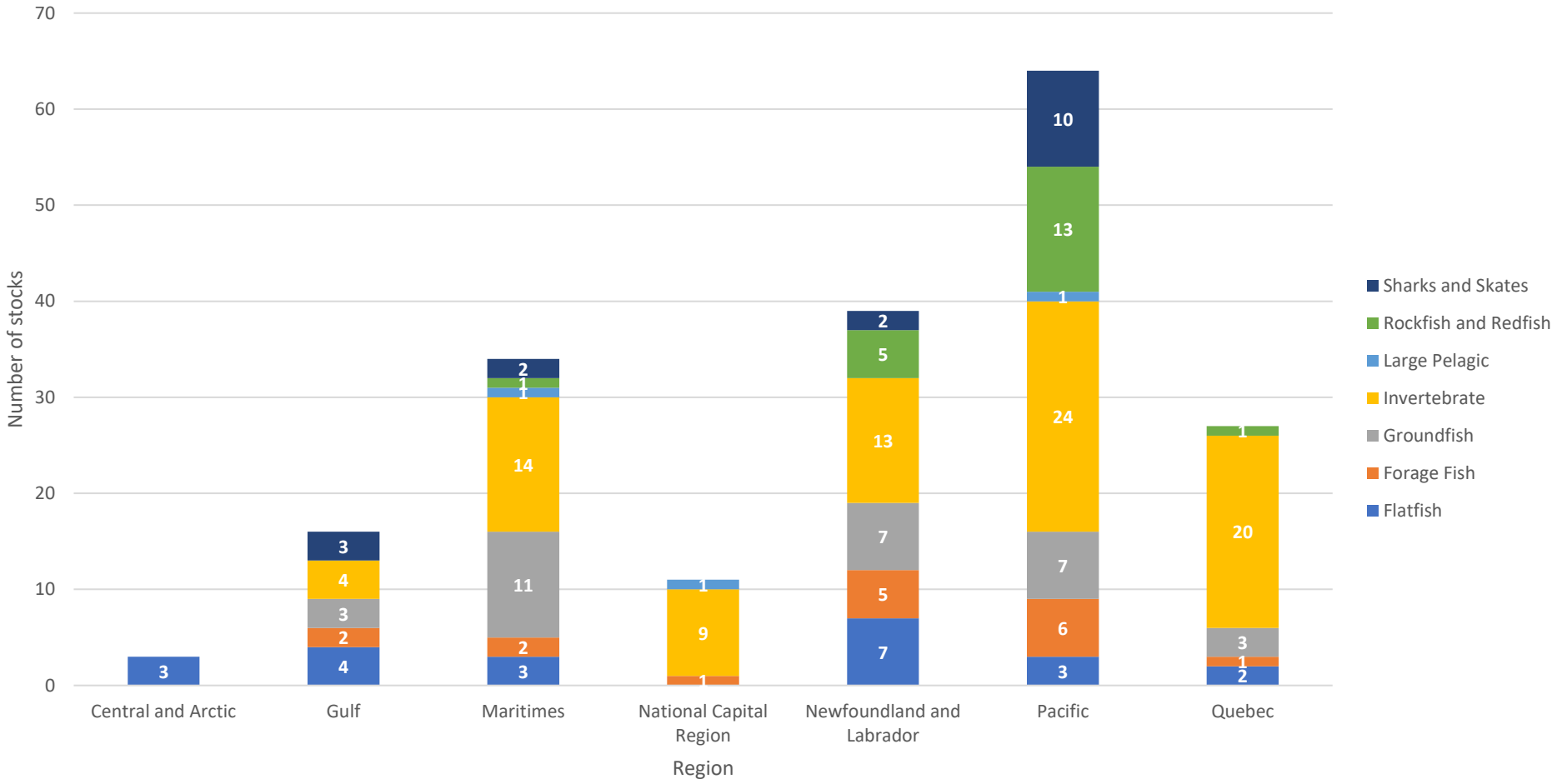

Figure 2. The number of Oceana Canada index stocks (n = 194 stocks) within each DFO administrative region and taxa group. The number of stocks in each region-taxa combination are reported in white font within the bars.

species was in Unit 2 at the time of the last assessment, and deepwater redfish and Units 1 and 2 were assigned to the Quebec Region since most of biomass of that species was located in Unit 1 at the time of the last assessment.

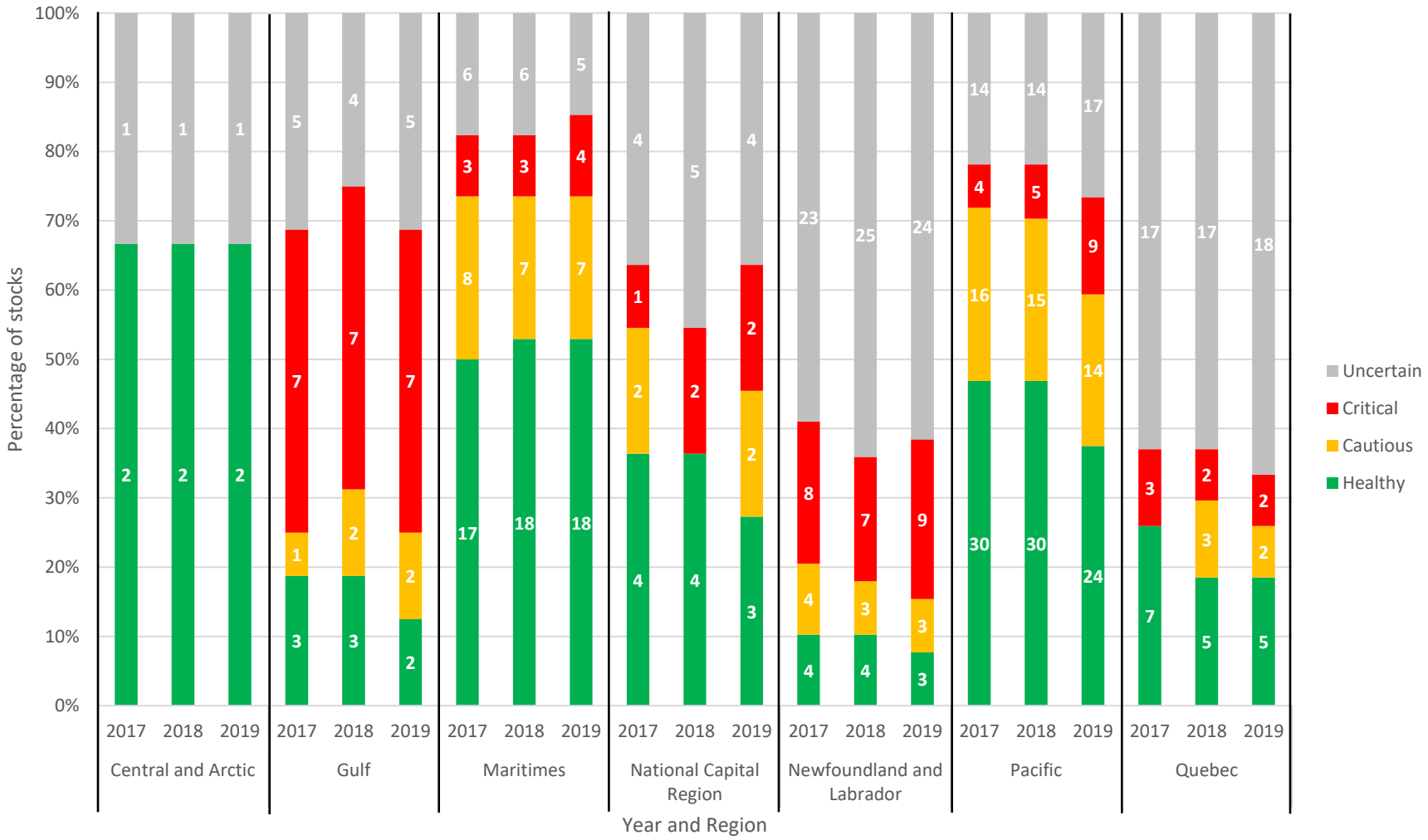

Figure 3. The percentage of Oceana Canada index stocks (n = 194 stocks) in each of DFO's Precautionary Approach (PA) framework health status zones in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-status combination are reported in white font within the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

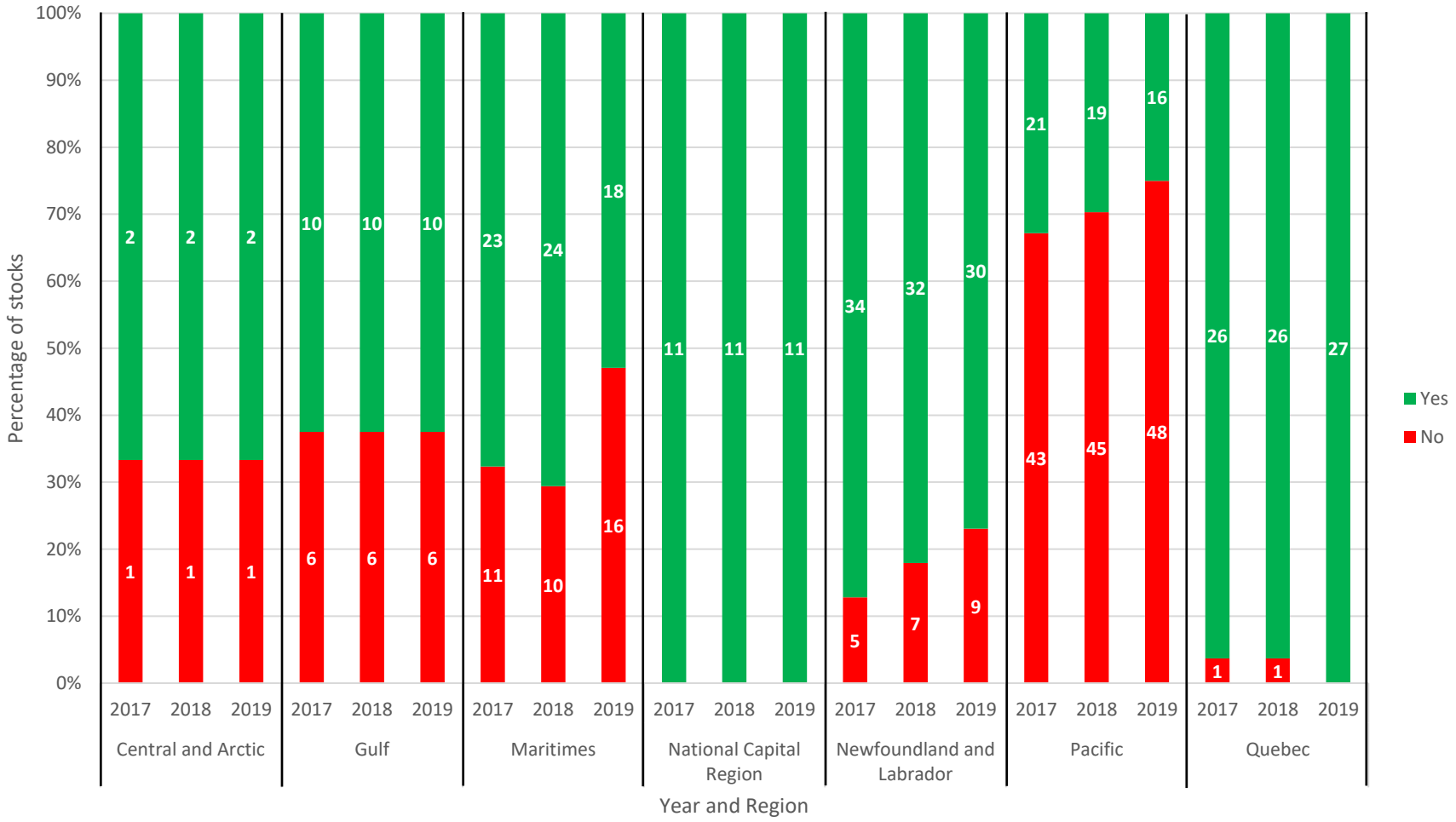

Figure 4. The percentage of Oceana Canada index stocks (n = 194 stocks) with recent (< 5 years old) biomass or abundance estimates in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

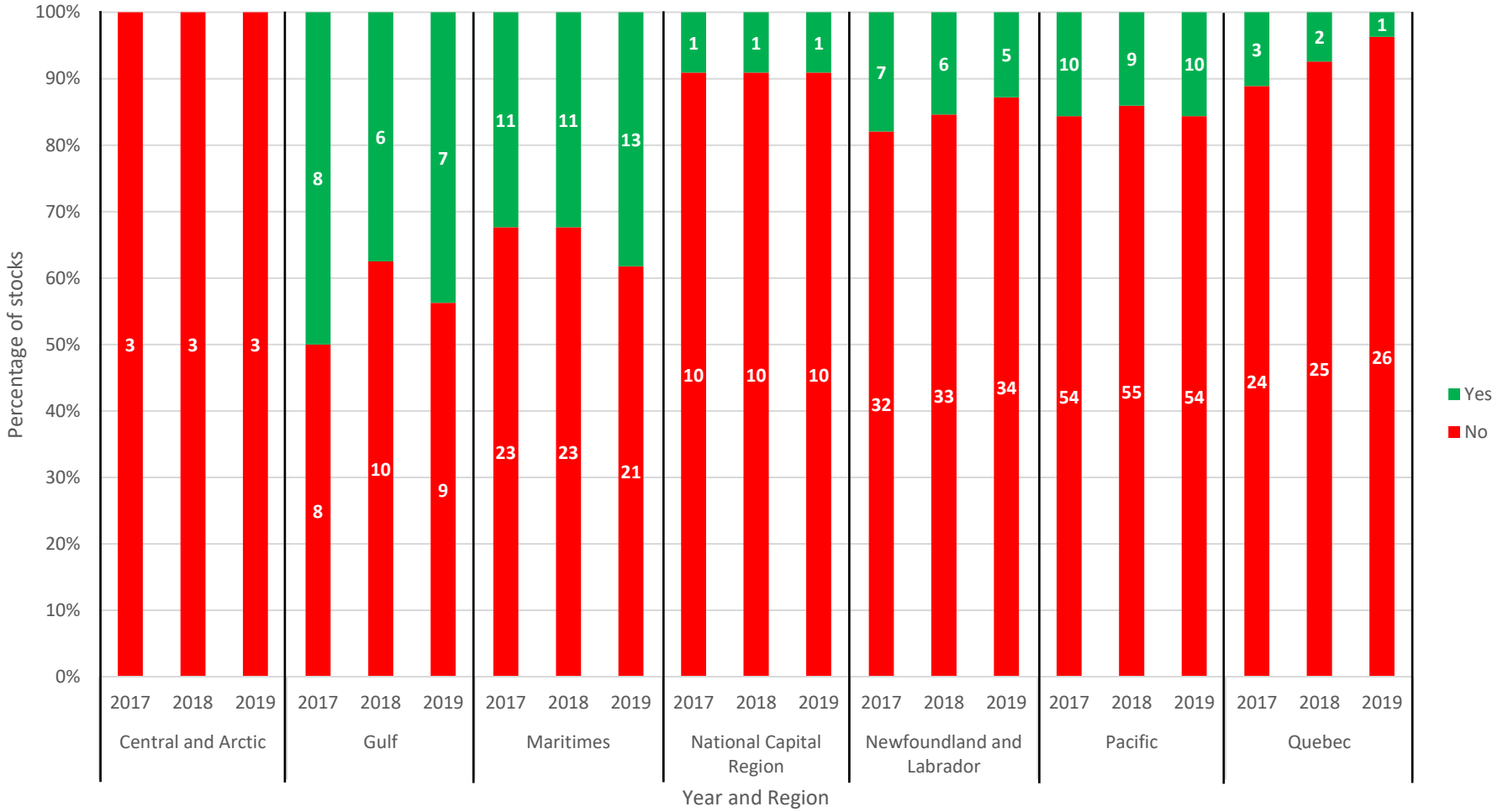

Figure 5. The percentage of Oceana Canada index stocks (n = 194 stocks) with fishing mortality (F) estimates in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

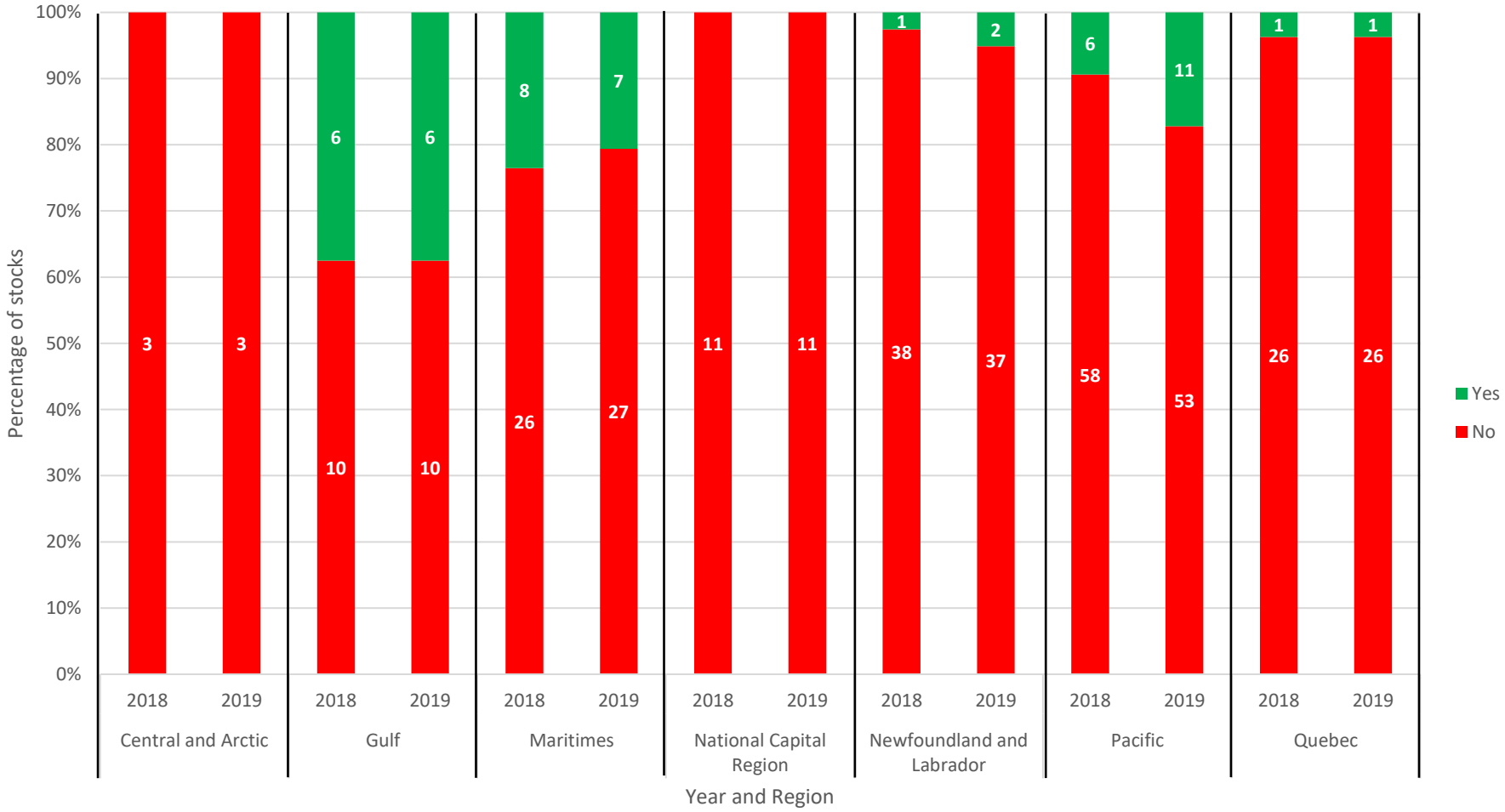

Figure 6. The percentage of Oceana Canada index stocks (n = 194 stocks) with natural mortality (M) estimates in each DFO administrative region in 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

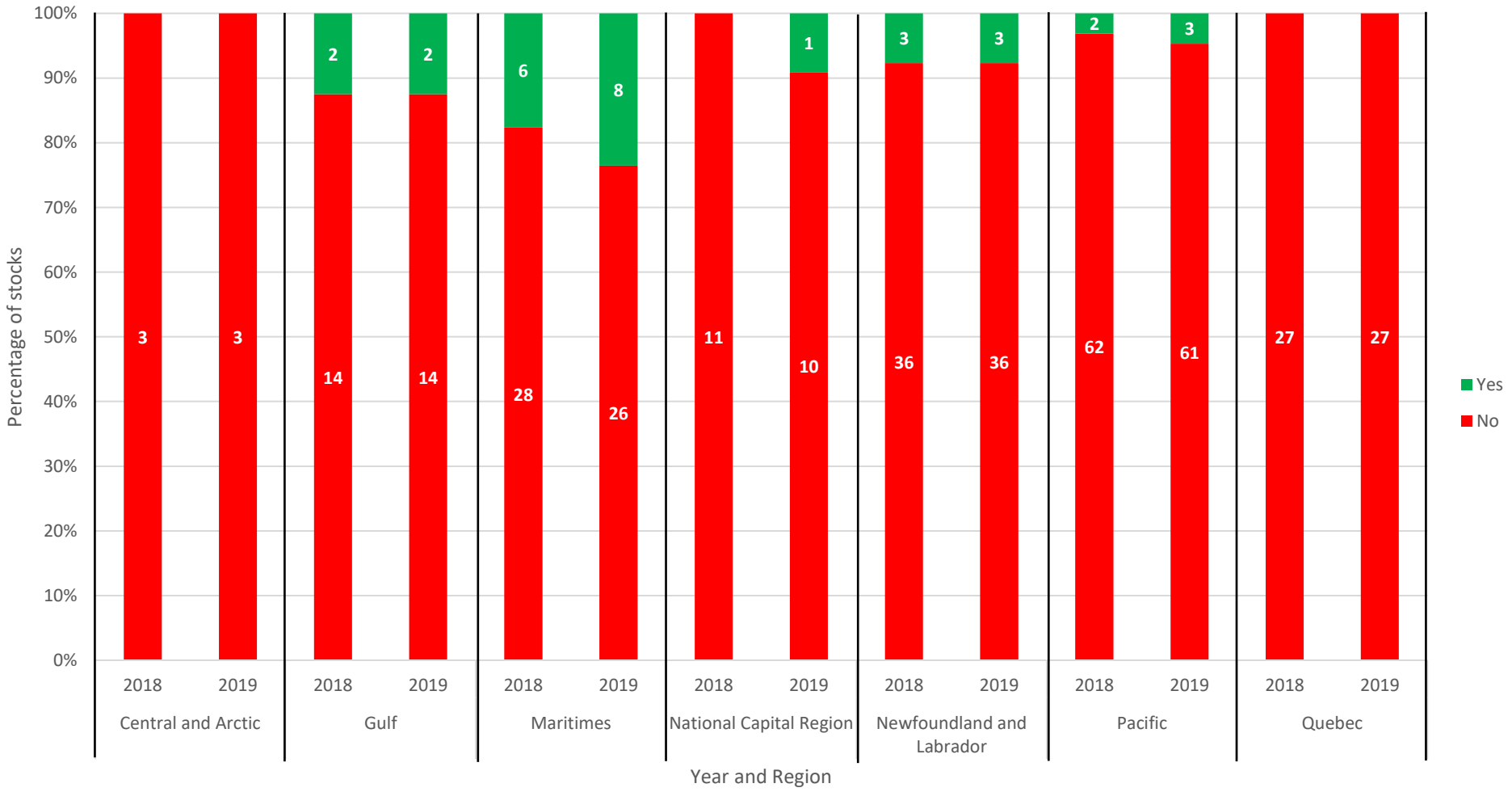

Figure 7. The percentage of Oceana Canada index stocks (n = 194 stocks) with total mortality (Z) estimates in each DFO administrative region in 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

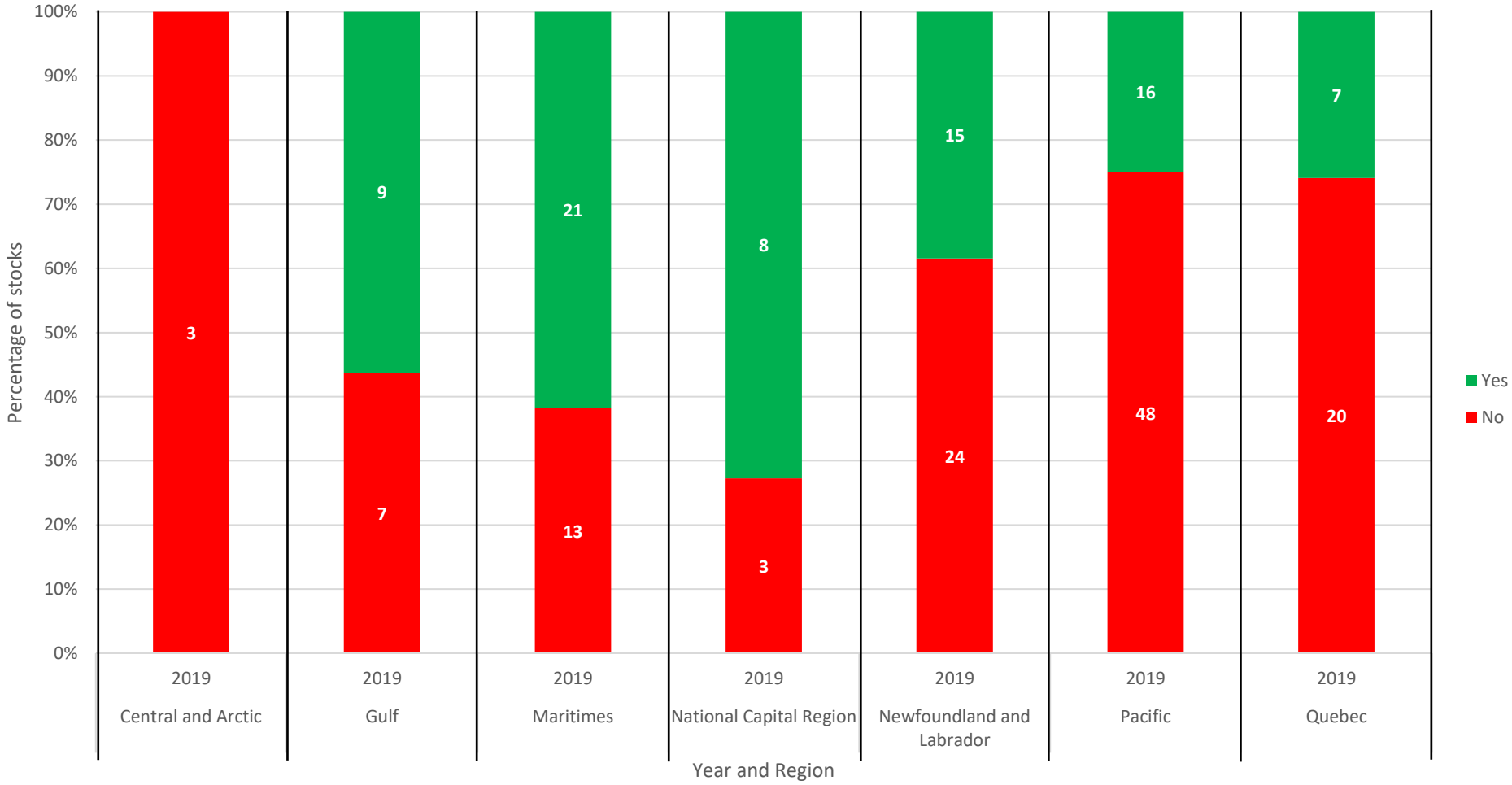

Figure 8. The percentage of Oceana Canada index stocks (n = 194 stocks) with exploitation rate estimates in each DFO administrative region in 2019. The number of stocks in each region-category combination are reported in white font within the bars.

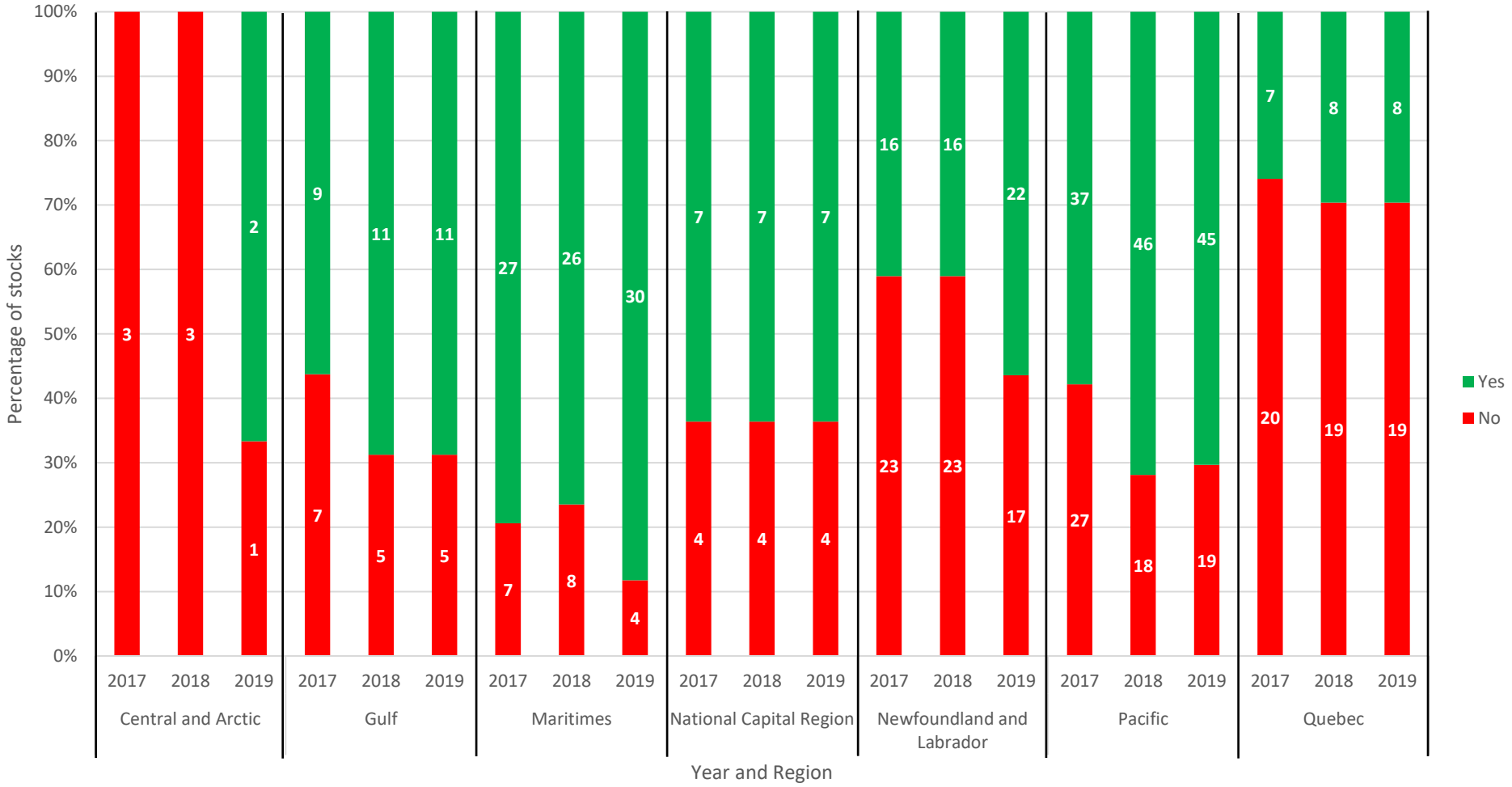

Figure 9. The percentage of Oceana Canada index stocks (n = 194 stocks) with Limit Reference Points (LRP) in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

Figure 10. The percentage of Oceana Canada index stocks (n = 194 stocks) with Upper Stock Reference points (USR) in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are 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 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.

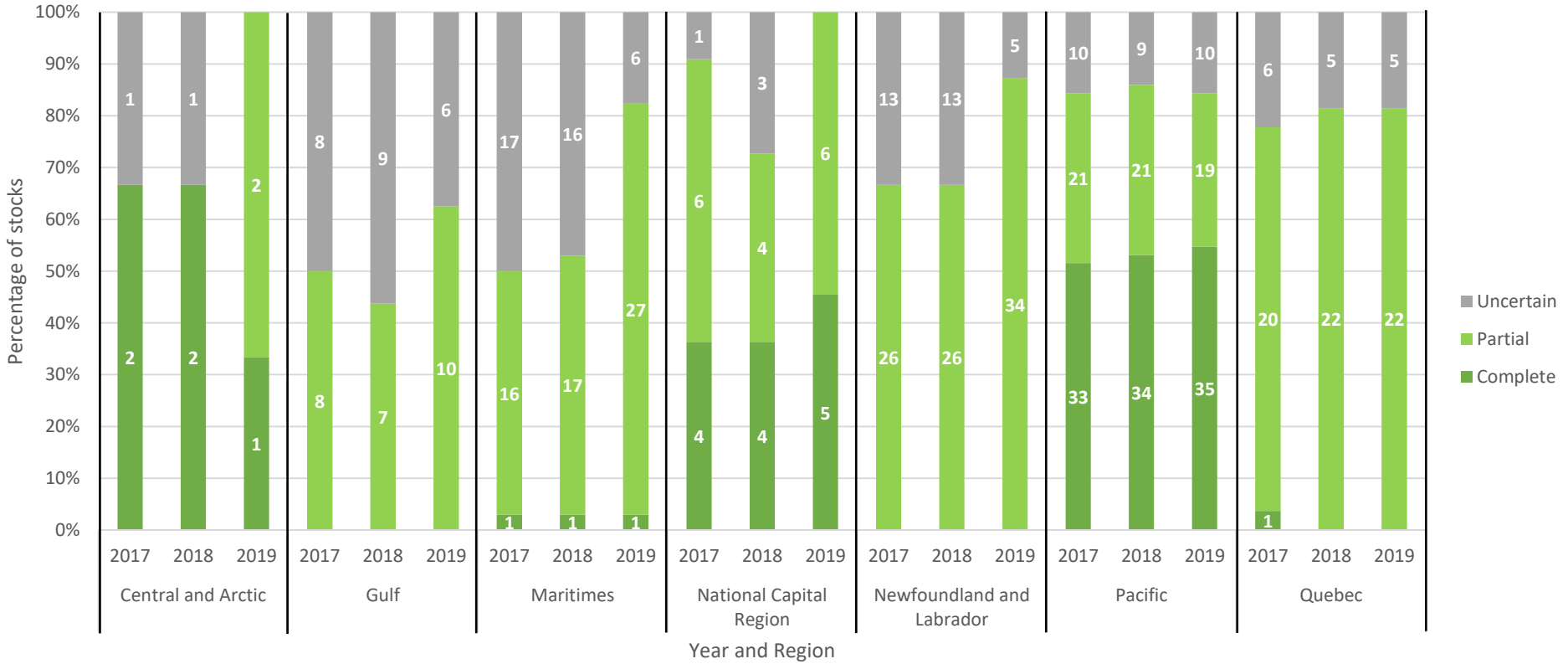

Figure 12. The percentage of Oceana Canada index stocks (n = 194 stocks) that have at-sea observer or electronic (i.e., video) monitoring in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars. "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-observer or electronic monitoring is not necessary for all fisheries.

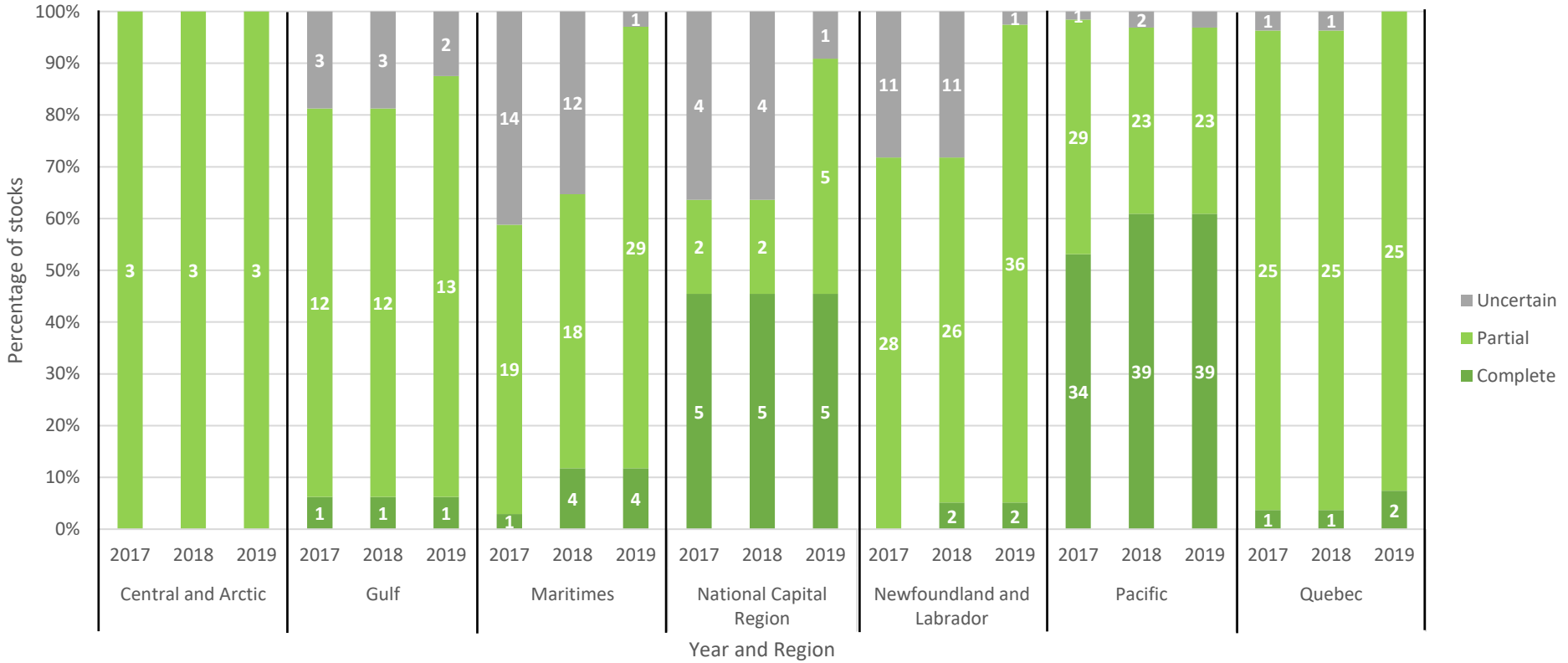

Figure 13. The percentage of Oceana Canada index stocks (n = 194 stocks) that require logbooks recording the entire catch (i.e., targeted species and bycatch) in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white 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.

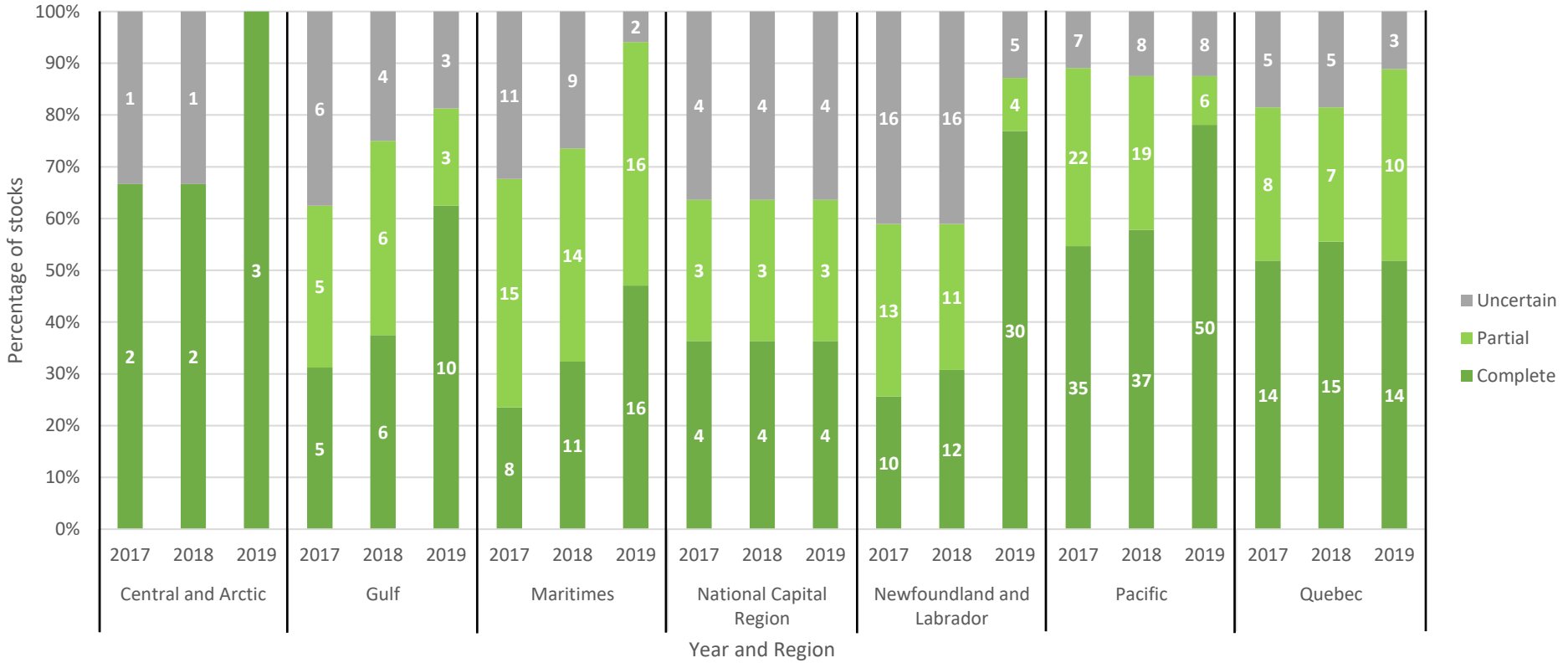

Figure 14. The percentage of Oceana Canada index stocks (n = 194 stocks) that have independent dockside monitoring in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars. "Uncertain" was assigned 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.

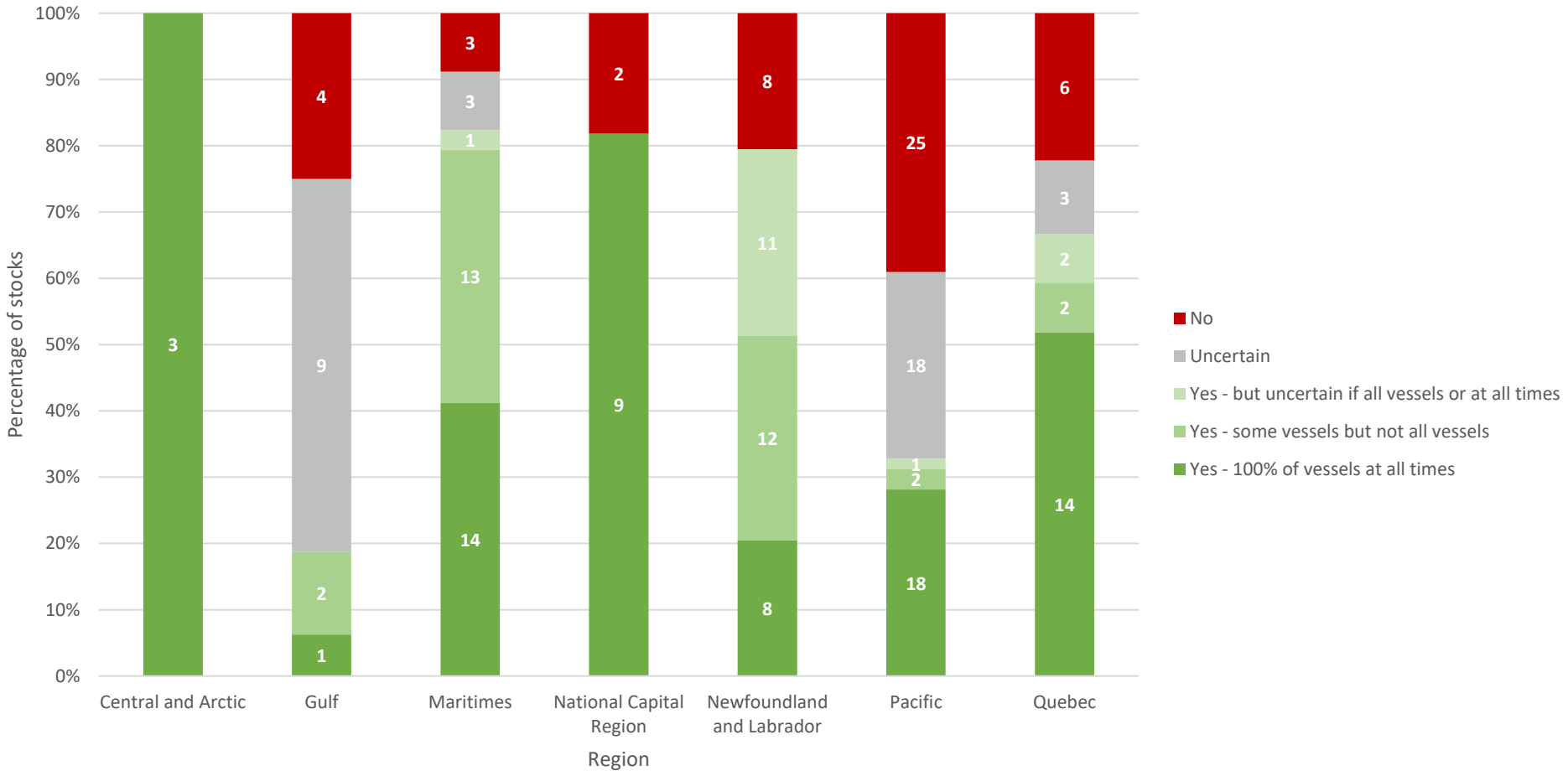

Figure 15. The percentage of Oceana Canada index stocks (n = 194 stocks) that have vessels requiring electronic location monitoring, either via Vessel Monitoring Systems (VMS) or Automated Identification System (AIS), in each DFO administrative region in 2019. The number of stocks in each region-category combination are 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 while 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).

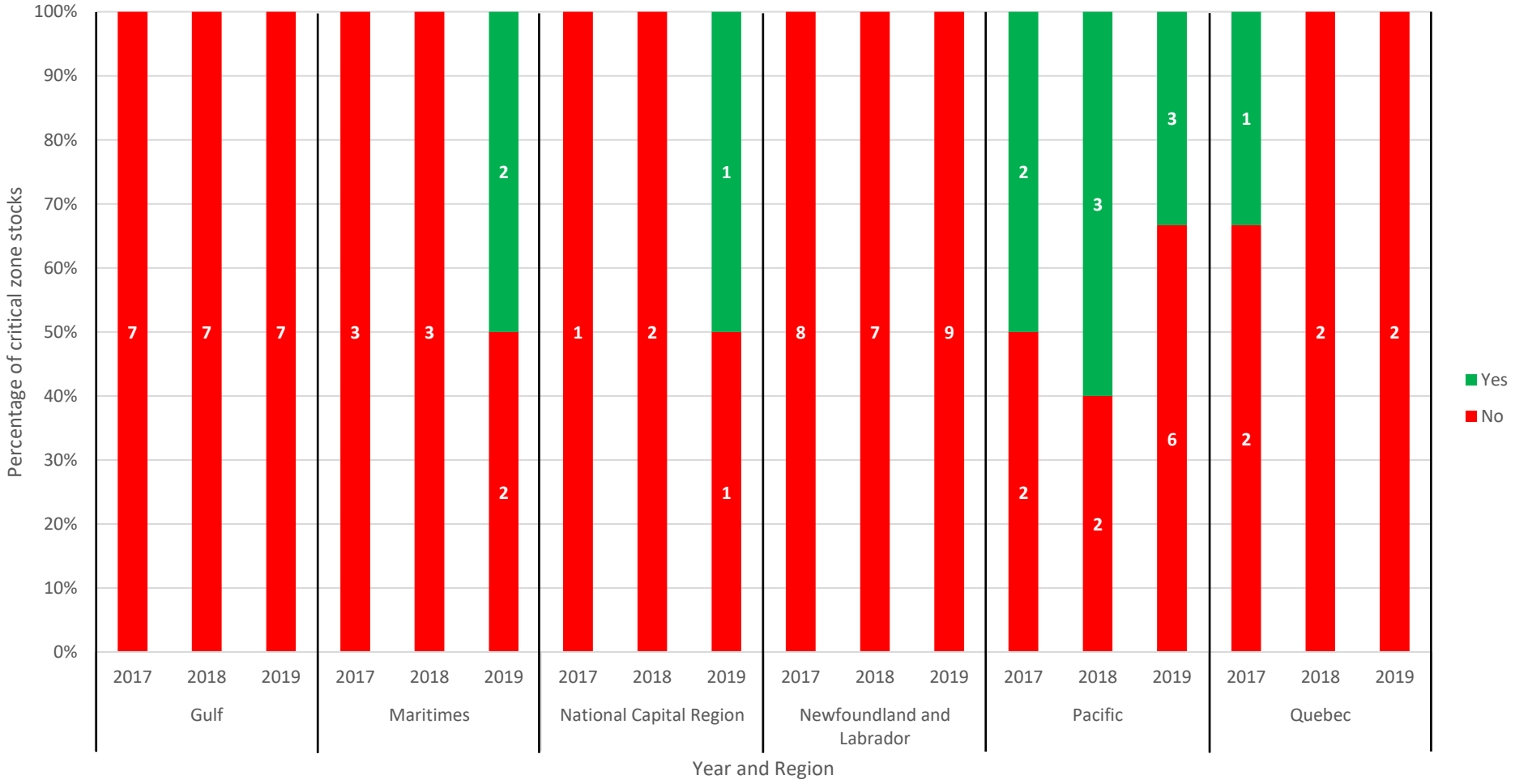

Figure 16. The percentage Oceana Canada index stocks (n = 194 stocks) in the critical zone and included in rebuilding plans in each DFO administrative region in 2017, 2018 and 2019. The number of stocks in each year-region-category combination are reported in white font within the bars.