Fisheries rebuilding success indicators: 2018

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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, and 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 pursuing it 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 of the state of Canada's fisheries and providing an assessment of how the government is managing them. The results showed that Canadian fisheries are in trouble: only one-third of our stocks were considered healthy and 13 per cent were in critical condition (Oceana Canada 2017a). Further, the health of 36 per cent were uncertain. What was more concerning was that only three rebuilding plans were in place to rebuild 26 critically depleted populations.

The *Fishery Audit* built upon the Oceana Canada 2016 report (Baum and Fuller 2016) to develop nine indicators that provide the essential information to measure progress toward maintaining or rebuilding fisheries to healthy levels in Canada and to track how well Fisheries and Oceans Canada (DFO) is implementing its commitments from year to year (Oceana Canada 2017b). The current report uses newly available information published over the last year to examine changes in these indicators one year after releasing the initial audit, demonstrating the extent of DFO's progress toward rebuilding and updating the status of Canada's marine fish and invertebrate populations.

Indicators to measure progress toward 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 and prioritizing where rebuilding plans are needed. This indicator provides a snapshot of the overall health of Canada's marine fish and invertebrate stocks.

2. **Stocks going from uncertain to having a status (or vice versa):** The number of stocks identified as having an unknown or uncertain status that now have a status assigned. 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 success

of fisheries rebuilding efforts, more stocks should move out of the critical and cautious zone and into the healthy zone.

4. **Biomass/abundance known:** The number and percentage of stocks 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.

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 associated 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 and to allow it to vary. The sum of fishing and natural mortality is termed total mortality (Z). In some mortality estimation approaches, only total mortality can be estimated. For some stocks, the data available or the most appropriate modelling approach simply does not allow for an estimation of all sources of mortality. An increase in these indicators from year to year will indicate managers have the 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, they 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, including rebuilding from the cautious to the healthy zone. A transparent, fully accessible 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/electronic monitoring, dockside monitoring and logbooks that record the entire catch. Accurate estimates of how much of each species is caught and how much is discarded provides fisheries managers with the key information required for informed fisheries-management decision making. This indicator assesses how well our stocks are monitored. There are many ways to monitor the catch, but these are among the most common tools, each with 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 (e.g.,

video) monitoring record the entire catch, both retained and discarded. However, 100 per cent coverage is 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, they are not always required to record bycatch species, and catches identified using species guides may not be reported accurately. 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 catch-monitoring policy (CESD 2016), more attention is expected from DFO to determine and ensure an appropriate type and frequency of catch monitoring in all our fisheries. This indicator 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 (PA). The PA 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 Fishery Audit 2017 stock list (n = 194 stocks) was the most complete and available to date, 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 2017a) and the addition of any stocks with newly available information from departmental reports (see Oceana Canada 2017b for further details on stock list creation). 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] but several minor stocks are still missing. There is no comprehensive list of all fish stocks subject to management in Canada. In 2018, efforts were made to continue to strive towards a comprehensive stock list by adding to the dataset any further stocks found during the update in newly available information from departmental reports or departmental work plans (i.e., DFO 2017b, DFO 2018a). However, to make comparisons from year to year, this report focuses only stocks included in the 2017 stock list (i.e., the 194 index stocks).

To update the stock information in the dataset and other 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, Science Research Documents and Science Response Reports published since the last Fishery Audit (June 19th, 2017) until July 1st, 2018. 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 2017 were carried forward.

The update process resulted in minor changes to definitions of stocks included in the index stock list.[3] These changes were made to both years included in the dataset to facilitate annual comparisons, with the record for

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

[2] The 2016 Sustainability Survey for Fisheries includes 170 stocks (an increase over the 159 stocks included in 2015), of which 131 are marine fish and invertebrates and 39 stocks are marine mammals, anadromous fish or freshwater fish.

[3] There are two species of surfclam fished in the Gulf of St. Lawrence: *Mactromeris polynyma* (Arctic or Stimson's surfclam) and *Spisula solidissima* (Atlantic surfclam). The 2017 Fishery Audit dataset included three stocks, which upon further investigation, should have been only two. "Arctic surfclams Gulf of St. Lawrence NAFO 4RST" should have been merged with "Stimpson Surf Clams – North Shore," which was done in 2018 with the new stock name "Stimpson Surf Clams – Quebec coastal waters," reflecting that this species with two common names is also harvested around the Magdalen Islands. Another stock change occurred with scallops managed in the Quebec region: sea scallop (*Placopecten magellanicus*) and the Iceland scallop (*Chlamys islandica*). The 2017 dataset included two records of scallop stocks in the region: sea scallop in the "Inshore waters of Quebec SFA 16–20" and "Iceland scallop SFA 16ef, 18a." Both species are not distinguished in

2017 adjusted as required using only information available prior to the publication of the previous Fishery Audit. The number of stocks in the resulting final index stock list did not change (n = 194 stocks). A few minor errors (e.g., assessment year based on publication date, not last year of data used) found in 2017 records were corrected when found during the 2018 update process. These minor errors did not change indicator values significantly, and annual comparisons are made using the corrected 2017 indicator dataset.

The majority of indicators remained the same in 2018, and during the update process information was interpreted in the same manner. See Oceana Canada (2017b) for further details. Briefly, health status was updated as stated in documents searched, using biomass estimates in relation to reference points, or 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 assess how recent the estimate was. This reduced the confusion from the sometimes-long time periods (i.e., years) between assessments and their publication date (see Oceana Canada 2018a). Additionally, only complete assessments with a new biomass (or proxy) estimate were accepted as an assessment; interim updates of indicators were not. See DFO (2016) for further details on the difference. Although these updates provide valuable information on major changes to stock status, they are most often based on trends in survey and catch data and not biomass estimates expressed in relation to reference points.

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. Only estimates of mortality rates were accepted; exploitation rates (i.e., catch/survey biomass) were not but were noted in the dataset comments if found. Within CSAS documents, the language describing reference points can be ambiguous, with terms such as "calculated" or "developed" but often little indication as to whether they have been accepted and implemented. It was 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 currently assessed biomass was less than B_{LIM} or less than 40 per cent of B_{MSY}, the critical zone was assigned). Similarly, if there was a B_{LIM} indicated, this was counted as 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 accepted as analogous to LRPs.

Often, more than one fishery catches a given stock, making assessments of catch monitoring on a given stock challenging (i.e., different targeted levels of at-sea observer coverage varying by gear type). Therefore, possible indicator values were considered to be broad enough (e.g., complete, varying levels) to allow for an amalgamation of values. 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.

Results/Discussion
The 2018 index stock dataset includes 194 marine fish and invertebrate stocks[1] that are managed within Canada and subject to targeted or incidental commercial fishing pressure (Table 1). The complete dataset of stocks and indicators is available online (see oceana.ca/FisheryAudit2018).[4]

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the fishery and are assessed together, with Quebec waters divided into 24 scallop fishing areas grouped into three sectors: the North Shore, the Gaspé Peninsula and the Magdalen Islands. Our stock definitions now reflect the combined-species three-sector definitions. Finally, the stock definition of witch flounder in the Gulf of St. Lawrence was reduced from NAFO 4RST to reflect stock assessment definitions of 4T, in both years of the dataset.

[4] Efforts to continue to build a comprehensive stock list by adding to the dataset any additional stocks found during the update using newly available information from departmental reports or departmental work plans resulted in a dataset with 215 marine fish and invertebrate stocks. Results calculated using all stocks did not differ greatly from those using index stocks and are available in Table 2.

1. **Status:** In 2018, 34.0 per cent (66) of our marine fish and invertebrate index stocks can confidently considered to be healthy. Further, 15.5 per cent (30 stocks) are cautious, 13.4 per cent (26 stocks) are critical, and the status of 37.1 per cent (72 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 little change in the overall status of our fisheries from last year to the present (Figure 1, Table 1), with slightly fewer healthy stocks, slightly more cautious and uncertain stocks and the same number of critically depleted stocks.

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

Most of the critically depleted stocks are finfish located in the Atlantic Ocean, where nine groundfish, six flatfish, two redfish and two forage fish stocks are in the critical zone (Figure 2).
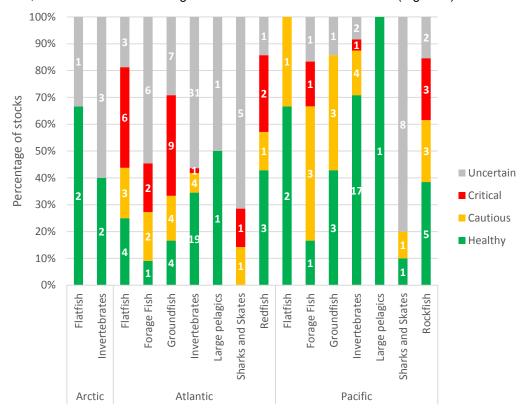

Figure 2 The percentage of stocks in each of DFOs Precautionary Approach (PA) framework health status zones in each taxa and ocean in Oceana Canada's index stock dataset (n = 194 stocks) in 2018. The number of stocks in each status zone-taxa-ocean combination is indicated in a white font within the bars.

2. **Stocks going from uncertain to having a status (or vice versa):** In 2018, four index stocks went from having an unknown/uncertain status in 2017 to having one assigned due to incorporating new information (Table 1). One was assigned as healthy (haddock in NAFO 4X5Y), two as cautious (Iceland and sea scallop in the Magdalen Islands and witch flounder in NAFO 3Ps) and one as critical (winter flounder in NAFO 4T). Six stocks underwent the reverse change, with the newly available reports unable to determine their status with certainty (one from healthy and four from cautious to uncertain), which resulted in an overall increase in the total number stocks with uncertain status from to 70 in 2017 to 72 in 2018 (Table 1).

3. **Change in status:** In 2018, 10.8 per cent of index stocks (21 of 194 stocks) had a different health status as compared to 2017 (Table 1). Many of those changes (10 stocks) were those outlined above, moving from uncertain to having a status or the reverse, but 11 stocks changed health status zones. Six stocks were identified as more at risk, with four stocks declining from healthy levels to the cautious zone (Greenland halibut and northern shrimp in the Gulf of St. Lawrence, snow crab in 4X, and Pacific herring in the Prince Rupert District) and two stocks declining from the cautious zone to critical levels (northern shrimp in Shrimp Fishing Area 6 and Pacific herring in Haida Gwaii). Five stocks were identified as less at risk, two increasing from critical levels to the cautious zone (witch flounder in the Gulf of St. Lawrence, Acadian redfish in units 1 and 2), one increasing from critical to healthy (deepwater redfish in units 1 and 2) and two from cautious to healthy (Pacific Ocean perch in Queen Charlotte Sound and snow crab in North-Eastern Nova Scotia).

4. **Biomass/abundance known:** In 2018, 63.9 per cent of index stocks (124 of 194 stocks) have a biomass or abundance estimate within the last five years, which is a slight decrease over 2017 (65.5 per cent or 127 stocks) (Figure 3, Table 1). This was because although many (59) stocks have more recent biomass estimates in 2018 than they did in 2017, most of these were already less than five years old. Meanwhile, several stocks assessed in 2012 (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. Framed another way, this indicator reveals that 36.1 per cent of index stocks have health statuses that are based on outdated information.[5]

5. **Sources of mortality known:** In 2018, 18.0 per cent of index stocks (35 of 194 stocks) have an estimate of fishing mortality (Figure 3, Table 1), a slight decrease from 20.6 per cent (40 stocks) in 2017. This means fewer stocks have the robust data or modelling approach that allows for the estimation of fishing mortality, which is valuable in assessing whether overfishing is occurring (NOAA 2013) and ideally includes all sources of fishing mortality (Gilman et al. 2013): commercially directed, recreational, bait, food-social-ceremonial and bycatch. Several approaches have been developed to estimate natural mortality within models and to allow it to vary. In 2018, 8.8 per cent of index stocks (17 of 194 stocks) have an estimate of natural mortality. In some mortality estimation approaches, only total mortality can be estimated. In 2018, 6.2 per cent of index stocks (12 of 194 stocks) have an estimate of total mortality. 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.

6. **Reference points:** In 2018, 59.8 per cent of index stocks (116 of 194 stocks) have LRPs and 45.9 per cent (89 stocks) have USRs. These are increases over 2017 values for both types of reference points (53.6 per cent with LRP and 42.8 per cent with USR in 2017; Figure 3, 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 some 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 critical zone and almost all cautious zone index stocks (97 per cent, 32 stocks) have LRPs or their equivalent. However, roughly two-thirds of these stocks are missing USRs (critical zone, 34.6 per cent or nine stocks missing USRs; cautious zone, 33.3 per cent or 11 stocks missing USRs). For those stocks that are not doing well, without an USR there is no target for rebuilding to a healthy state.

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[5] Some of these health status assignments would have been carried forward in 2018 from the 2017 dataset, where they may have originated from expert opinion of respondents to the 2015 SSF and were presumably based on evidence. Some stocks not assessed by the CSAS process are monitored annually, but the results are not subject to peer review and the information is not published publicly (i.e., Dungeness crab surveys), although some research survey trends are made publicly available (i.e., multi-species survey trends on Georges Bank).

7. **Management plans in place:** In 2018, 74.2 per cent of index stocks (144 of 194 stocks) are included in an IFMP. (Four 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.) This represents a slight increase over 2017, when 70.6 per cent (137) stocks were included in an IFMP (Figure 3, Table 1). 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), so it is expected that this indicator will continue to rise. In 2018, 117 of the index stocks are included in IFMPs that are available online in 35 unique IFMPs. The Pacific region is leading the way, with 96.9 per cent of its index stocks (62 of 64 stocks) included in IFMPs, all of which are available online. However, unlike other regions where complete IFMPs are uploaded, the Pacific region only includes IFMP summaries on their webpage (but does upload complete IFMPs to the federal science library). Complete IFMPs should be publicly available and easy to access, as they are intended to be an important reporting tool and source of information for managers, other departmental staff, rightsholders and stakeholders, as well as the general public (DFO 2013a). Without inclusion in a management plan, fish stocks lack the framework required for conservation and sustainable use, and if they are not easily accessible it is difficult for stakeholders and the public to assess how a fishery is being managed. Most stocks are included in an IFMP, and this indicator is increasing, but with a quarter of stocks lacking inclusion in a plan, there is still room for improvement. Importantly, those without IFMPs include five stocks in the cautious zone and five in the critical zone.
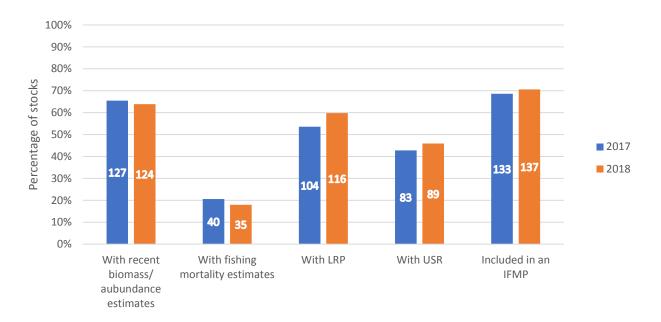

Figure 3. An assessment of how stocks perform on five indicators, based on Oceana Canada's index stock dataset (n = 194 stocks) in 2017 and 2018. The indicators included the percentage of stocks: 1) with a biomass/abundance estimate within the last five years; 2) with fishing mortality estimates; 3) 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 2018, 71.6 per cent of index stocks (139 of 194 stocks) have fisheries with at-sea observer or electronic (e.g., video) monitoring (Figure 4, Table 1). Of these 139 stocks, 41 have fisheries with 100 per cent monitoring, while 98 have fisheries with varying monitoring levels. The presence of at-sea or electronic monitoring was uncertain in 28.4 per cent of stocks (55 stocks). There is little change in these values since 2017 (Figure 4, Table 1).

   In 2018, only 26.8 per cent of index stocks (52 of 194 stocks) have fisheries with mandatory logbooks where it was clearly indicated in the materials searched that the entire catch (targeted species and bycatch) is recorded; 56.2 per cent (109 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 17.0 per cent of stocks (33 stocks). There was little change in overall use of logbooks since 2017 (Figure 4, Table 1). But, there is more certainty in the use of logbooks that record the entire catch (as clearly indicated in documents searched), increasing more than five percentage points in 2018, largely due to newly available IFMPs.

   In 2018, 75.8 per cent of index stocks (147 of 194 stocks) have fisheries that require some level of dockside monitoring of landings. Of these 147 stocks, 45.4 per cent (88 stocks) have fisheries that are required to have 100 per cent of landings verified by a certified independent dockside monitor and 30.4 per cent (59 stocks) having varied or unknown levels of dockside monitoring requirements. The use of dockside monitoring in the fisheries of 24.2 per cent of stocks (47 stocks) is uncertain. There was little change in overall use of dockside monitoring since 2017 (Figure 4, Table 1). But, again there is more certainty in the percentage of stocks that require it on 100 per cent of landings (as clearly indicated in documents searched), increasing almost five percentage points in 2018, also largely due to newly available IFMPs.

   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, as indicated by high number of stocks in the uncertain categories and the increase in certainty in 2018 over 2017, 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., different levels of at-sea observer coverage varying by gear type). Until DFO ensures that all stocks are included in IFMPs and that these and their associated gear-type/vessel-size specific Conservation Harvesting Plans for each fishery are made public, the real types and levels of catch monitoring in Canadian fisheries will remain difficult to estimate. DFO is currently reviewing the catch monitoring of fisheries in Canada, acknowledging the current weakness, and is developing a national catch-monitoring policy originally intended to be released in 2017 (CESD 2016). Good data provides the foundation for good management. The precautionary approach means being cautious when scientific knowledge is uncertain, not using the absence of rigorous information as a reason not to take conservative measures. 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 decision making.
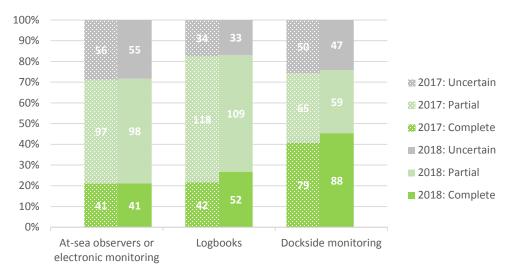
Figure 4. The percentage of stocks in Oceana Canada's index stock dataset (n = 194 stocks) in 2017 and 2018 that have the following catch-monitoring tools in place: 1) at-sea observer or electronic (i.e., video) monitoring; 2) logbooks recording the entire catch (i.e., targeted species and bycatch); 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 was level 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.

9. **Critical stocks with rebuilding plans:** In 2018, 11.5 per cent of critical zone index stocks (3 of 26 stocks) have rebuilding plans in place, all three of which are included in the Pacific region multi-species groundfish rebuilding plan: Bocaccio rockfish, yelloweye rockfish outside population and the newly added yelloweye rockfish inside population. Northern Gulf of St. Lawrence Atlantic cod was previously included in a rebuilding plan, but the plan expired at the end of May 2018. As a result, the value of this indicator did not change from 2017 (Table 1). 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 stocks in the critical zone (CESD 2016). In 2017, DFO publicly committed to developing rebuilding plans for five stocks (northern cod, yelloweye rockfish inside population, southwest Nova Scotia cod, and redfish in unit 1 and unit 2; Canada 2017a, Canada 2017b), four of which were to be completed in 2017. However, only the yelloweye rockfish inside population was included in a rebuilding plan that is publicly available (although it can only be found via a search of the federal science library and is not available by navigating the DFO website). Southwest Nova Scotia Atlantic cod (NAFO 4X5Y) was included in a rebuilding plan, but the final approved plan is not yet publicly available. Progress continues on a rebuilding plan for the iconic northern cod stock (NAFO 2J3KL), expected in 2018/19. The other two stocks, redfish in units 1 and 2, were expected to be included in one plan encompassing both redfish species in both units combined. However, DFO announced in May that it will no longer be pursuing a rebuilding plan for these redfish stocks, because both species are now out of the critical zone in units 1+2 combined and a plan is therefore not required by policy. However, neither stock is included in a management plan (IFMP or rebuilding plan) that covers the entire stock area, and Acadian redfish remain in the cautious zone. According to DFO's guidelines for rebuilding plan development, rebuilding plans can be developed when stocks are in the cautious zone, ideally so a plan is in place before a stock reaches the critical zone (DFO 2013b). In addition to those rebuilding plans mentioned for critical-zone stocks above, DFO already has one for a cautious-zone stock (Atlantic herring in southwest Nova Scotia/Bay of Fundy). DFO included these five stocks in their departmental work plans released in response to the CESD (2016) audit, where it committed to developing rebuilding plans for 19 stocks by the end of 2020/21, including some stocks in the cautious zone (DFO 2017b, DFO 2018a). Meeting this commitment as soon as possible and getting plan development on track must be government priority if it is serious about investing in rebuilding abundance in Canadian fisheries.

Conclusions
From the results above, a few conclusions can be drawn:

1. Canada's marine fish and invertebrate stocks remain in a state of concern, with only slightly over one-third that can confidently be considered healthy. There was little change over last year, with slightly fewer index stocks considered healthy (34.0 per cent) or cautious (15.5 per cent), slightly more uncertain (37.1 per cent) and the same number of critically depleted index stocks (26 or 13.4 per cent).

2. Some progress has been made towards rebuilding and maintaining healthy fisheries in Canada, but much more work remains to be done. In 2018 there were slight increases in the percentage of index stocks having LRPs and USRs, as well as the percentage included in IFMPs. There is also increasing clarity on the levels of catch monitoring using two key monitoring tools. However, there were slight decreases in the availability of recent biomass and fishing mortality estimates, and the percentage of index stocks with estimates of natural mortality is low (8.8 per cent). Despite some improvement in a few indicators, most have plenty of room for improvement, indicating current progress by DFO has been insufficient to deliver on commitments.

3. The continued improvement and annual public release of the Sustainability Survey for Fisheries (DFO 2017a) and the public release of work plans in response to the CESD (2016) audit (DFO 2017b, DFO 2018a) is encouraging progress towards increasing transparency in fisheries management in Canada. The work plans include departmental priorities for the development of LRPs, IFMPs and rebuilding plans. 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 levels of catch-monitoring tools in place. In fact, if all deliverables outlined in the 2017/18 and 2018/19 fiscal year work plans were completed, the percentage of index stocks with LRPs and included in IFMPs would both increase by more than 10 percentage points over 2018 values and nearly all developed IFMPs would be available online (see Oceana Canada 2018b for further details). DFO should maintain the practice of updating the fiscal year work plans 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 made in assessing more of those that are rarely assessed. This, in turn, should also improve estimates of all sources of mortality.

4. 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 2018 results, most of our marine fish and invertebrate stocks have some catch-monitoring tools in place, but it remains difficult to know if the tools are monitoring the entire catch (targeted species and bycatch; both retained and discarded), what monitoring levels are being targeted and achieved and if 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 catch-monitoring policy, including guidance on assessing risk of fisheries and assessing data quality and dependability. This policy was anticipated to be completed in 2017 (CESD 2016) and was released for consultation in late 2018 (DFO 2018b). 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.

5. From 2017 to 2018 there was no change in the number of critically depleted marine fish and invertebrate index stocks included in a rebuilding plan; almost all lack a plan (23 of 26 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 2017b, DFO 2018a) and the urgency with which the plans are needed, this indicator is expected to improve next year. If all stocks currently indicated for inclusion in rebuilding plans in the 2017/18 and 2018/19 fiscal year work plans (DFO 2017b, DFO 2018a) were completed, the percentage of critical-zone index stocks with rebuilding plans would rise to over 50 per cent (see Oceana Canada 2018b for further details). According to the work plans, we can expect rebuilding plans to be completed for at least three more critical-zone stocks by the end of the 2018/19 fiscal year (northern cod, Atlantic cod and yellowtail flounder on Georges Bank). 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 2018c for an assessment of the quality of existing rebuilding plans). Environmental conditions will pose challenges to the recovery of some stocks. To promote recovery, rebuilding plans will need to consider climate change and the cumulative impact of human activities on marine ecosystems.

Recommendations

Recent investments in science, actions on transparency and commitments to reference points, harvest control rules, management plans, rebuilding plans and a national catch-monitoring policy creates an unprecedented opportunity in Canada. That is, to accelerate the deployment of long-standing and critical policies to maintain and restore the health of Canada's oceans and fisheries, ensuring they remain a significant part of our culture, economy and a vital source of sustainable protein for the future.

It is expected that DFO will continue to add to, update and publicly release the fiscal year work plans developed in response to the Commissioner of the Environment and Sustainable Development (CESD) Audit (DFO 2017b, DFO 2018a) using the best available science to inform completion of deliverables. The following are recommended for priority action and for completion within the next year:

Science
- Prioritize the development of upper stock reference (USR) points in addition to limit reference points (LRPs) in work plans. Specifically,
  o Develop LRPs and harvest control rules (HCRs) for 32 more stock groups, ensuring at least 31[6] more stocks have new or updated LRPs and six**Error! Bookmark not defined.** have new or updated HCRs
- Invest resources in timely stock assessments that include estimates of mortality from all sources, prioritizing stocks assessments that are more than five years old
- Determine the cause of delay in the publication of science information
- Publish summaries of science advice from meetings online within one week

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
  o Include a published work plan to guide implementation of the policy

Management
- Complete all remaining 2017/18 and 2018/19 work plan deliverables (including IFMPs and rebuilding plans as itemized below)
- Develop and publish IFMPs for 29 stock groups, ensuring at least 78**Error! Bookmark not defined.** more individual stocks are included in an IFMP

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[6] Marine fish and invertebrate stocks included in our Fishery Audit index dataset. The DFO fiscal year workplans also include work on more stocks (anadromous fish, freshwater fish and marine mammal stocks as well as other "minor" marine fish and invertebrate stocks).

Management (cont.)

- Develop and *publish* rebuilding plans for five more stocks:
  - Atlantic cod – Scotian Shelf and Bay of Fundy
  - Atlantic cod – Georges Bank
  - Atlantic cod – northern cod
  - Northern shrimp – shrimp fishing area 6
  - Yellowtail flounder – Georges Bank
- Report on progress towards the development of rebuilding plans for the remaining 11 committed stocks
- Set priorities and timelines for completing rebuilding plans for all stocks in the critical zone
- 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[1] stocks for each indicator in the 2017 and 2018 index stock datasets (n = 194 stocks; the same stocks in each year).

Indicator	Details	2018	2017
	Number of stocks	194	194
1. Status	%/# of "healthy" stocks	34.0% / 66	34.5% / 67
	%/# of "cautious" stocks	15.5% / 30	16.0% / 31
	%/# of "critical" stocks	13.4% / 26	13.4% / 26
	%/# of "uncertain" stocks	37.1% / 72	36.1% / 70
2. Stocks going from uncertain to having a status (or vice versa)	# of stocks that went from "uncertain" status to known	4	Baseline year
	# of stocks that went from known status to "uncertain"	6	Baseline year
3. Change in status	%/# of stocks that have changed status	10.8% / 21[†]	Baseline year
	# of stocks whose status improved	5	Baseline year
	# of stocks whose status worsened	6	Baseline year
	%/# of stocks whose status remained the same	89.2% / 173	Baseline year
4. Biomass/abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	63.9% / 124	65.5% / 127
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	18.0% / 35	20.6% / 40
	%/# of stocks with natural mortality (M) known	8.8% / 17	Not available – new indicator
	%/# of stocks with total mortality (Z) known	6.2% / 12	Not available – new indicator
6. Reference points	%/# of stocks with limit reference points	59.8% / 116	53.6% / 104
	%/# of stocks with upper stock reference points	45.9% / 89	42.8% / 83
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan**	74.2% / 144	70.6% / 137
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 21.1% / 41	Yes —100% 21.1% / 41
		Yes — coverage varies or level is uncertain 50.5% / 98	Yes — coverage varies or level is uncertain 50.0% / 97
		Uncertain 28.4% / 55	Uncertain 28.9% / 56
	%/# of stocks with logbooks	Yes — and records bycatch species 26.8% / 52	Yes — and records bycatch species 21.6% / 42
		Yes — but unclear if records bycatch species 56.2% / 109	Yes — but unclear if records bycatch species 60.8% / 118

Indicator	Details	2018	2017
	%/# of stocks with dockside monitoring	Uncertain 17.0% / 33	Uncertain 17.5% / 34
		Yes — 100% 45.4% / 88	Yes — 100% 40.7% / 79
		Yes — coverage varies or level is uncertain 30.4% / 59	Yes — coverage varies or level is uncertain 33.5% / 65
		Uncertain 24.2% / 47	Uncertain 25.8% / 50
9. Critical stocks with rebuilding plans	%/# of "critical" stocks with rebuilding plans	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 stocks in 2017 and four index stocks in 2018.

Table 2. The percentage and number of marine fish and invertebrate[1] stocks for each indicator in 2018 using all stocks (n = 215) in the dataset, including those added during the update in addition to the index stock dataset.

Indicator	Details	2018
	Number of stocks	215
1. Status	%/# of "healthy" stocks	31.6% / 68
	%/# of "cautious" stocks	14.2% / 31
	%/# of "critical" stocks	13.0% / 28
	%/# of "uncertain" stocks	40.9 % / 88
2. Stocks going from uncertain to having a status (or vice versa)	# of stocks that went from "uncertain" status to known[†]	4
	# of stocks that went from known status to "uncertain"[†]	6
3. Change in status	%/# of stocks that have changed status[†]	10.8% / 21[††]
	# of stocks whose status improved [†]	5
	# of stocks whose status worsened [†]	6
	%/# of stocks whose status remained the same[†]	89.2% / 173
4.Biomass/abundance known	%/# of stocks with recent (≤ 5 years) biomass/abundance estimates	64.2% / 138
5. Sources of mortality known*	%/# of stocks with fishing mortality (F) known	16.3 % / 35
	%/# of stocks with natural mortality (M) known	8.4% / 18
	%/# of stocks with total mortality (Z) known	5.6% / 12
6. Reference points	%/# of stocks with limit reference points	57.2% / 123

Indicator	Details	2018
	%/# of stocks with upper stock reference points	42.8% / 92
7. Management plans in place	%/# of stocks in an Integrated Fisheries Management Plan**	71.2% / 137
8. Catch monitoring	%/# of stocks with at-sea/electronic monitoring	Yes — 100% 20.9% / 45
		Yes — coverage varies or levels is uncertain 49.3% / 106
		Uncertain 29.8% / 64
	%/# of stocks with logbooks	Yes — and records bycatch species 26.0% / 56
		Yes — but unclear if records bycatch species 56.3% / 121
		Uncertain 17.7% / 38
	%/# of stocks with dockside monitoring	Yes — 100% 45.1% / 97
		Yes — coverage varies or level is uncertain 27.9% / 60
		Uncertain 27.0% / 58
9. Critical stocks with rebuilding plans	%/# of "critical" stocks with rebuilding plans	11.1 % / 3

† Some stocks included in the 2018 "all stocks" dataset were added during this year's update process and thus were not part of the original 2017 dataset. In order to calculate change from the previous year, we 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.