Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities

2015–2016

AQUACULTURE MANAGEMENT

Fisheries and Oceans Canada
Pêches et Océans Canada

Canada

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Purpose

This report, *Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities 2015-2016*, provides an overview of the marine finfish aquaculture industry's performance in meeting the regulatory requirements under the *Pacific Aquaculture Regulations* and the *Aquaculture Activities Regulations*. *Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities 2015-2016* follows the earlier publication of the same report, which provided an overview of compliance from 2011-2014[1]. DFO aims to produce this publication on an annual basis to increase information available on the industry's performance in meeting conditions of licence and on DFO's monitoring activities, as part of the Department's commitment to ensuring a sustainable, world-class aquaculture industry in Canada. All data presented in this document is accurate to the best of our knowledge at the time of publishing. Information presented on the Department's public reporting web pages are updated as new information is received and may differ from this report.

[1] A copy of *Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities 2011-2014* can be downloaded here: www.pac.dfo-mpo.gc.ca/aquaculture/docs/mar-rep-rap-2011-2014/index-eng.html

Summary of Marine Finfish Aquaculture in British Columbia

In British Columbia, the aquaculture industry is primarily regulated and managed by Fisheries and Oceans Canada (DFO). DFO began licensing aquaculture facilities in BC in December 2010. In 2015, there were 116 licensed marine finfish aquaculture facilities ("fish farms" or "(farm) sites"). In 2016, DFO approved three new operations for a total of 119 licensed farms; about half of these farms have fish on site at any given time. At the end of 2016 the approved total combined peak production of all marine finfish facilities was 297,099 metric tonnes (MT). A list of all current licence holders for marine finfish aquaculture is available on the DFO website: www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html.

Marine Finfish Species Cultivated in British Columbia

Most marine finfish aquaculture facilities grow salmon, with Atlantic salmon (*Salmo salar*) and Chinook salmon (*Oncorhynchus tshawytscha*) being the most commonly farmed fish in BC. Some other species are also cultivated on a smaller scale, such as sablefish/black cod (*Anoplopoma fimbria*).

Atlantic salmon is the prevalent species in marine finfish cultivation around the world because these fish feed well on pellets, are efficient at converting food to body mass, grow quickly, and are well adapted to the confines of a net pen.

Locations of Marine Finfish Aquaculture Facilities

Marine finfish aquaculture facilities are mainly located around northern and western Vancouver Island. There are clusters of sites in several areas, such as Clayoquot Sound, the Port Hardy area, the Broughton Archipelago, and the Discovery Islands. All marine finfish aquaculture facilities with a valid licence on December 31, 2016 are shown in Figure 1.

Figure 1. Map of Marine Finfish Aquaculture Facilities in BC, 2016

How Aquaculture Facilities Are Regulated

DFO Responsibilities and Licences

The most important pieces of legislation governing marine finfish aquaculture activities in British Columbia (BC) are the *Fisheries Act*, the *Fishery (General) Regulations*, the *Pacific Aquaculture Regulations,* and the newly implemented *Aquaculture Activities Regulations (AAR)*. The AAR, which came into force in 2015, set out the conditions under which specific deleterious substances can be used by aquaculture operators across the country. DFO is responsible for enforcing the *Fisheries Act* and regulations.

Through the BC Aquaculture Regulatory Program (BCARP), DFO

- **develops and implements** policies, regulations, and licence conditions related to BC aquaculture
- **assesses** applications for new licences and amendments to licences
- **monitors** aquaculture facilities to ensure that they are operating according to the regulations and that they conform to the required environmental standards
- **engages** with First Nations and stakeholders
- **coordinates** with partner departments and agencies at various levels of government regarding how aquaculture facilities are to be governed

Licences for marine finfish facilities require that all of the following be managed and monitored: which species are cultured, production levels, containment of fish, the introduction and transfer of fish, fish health, sea lice, incidental catch of wild fish (bycatch), escapes, interactions with marine mammals and the impacts to fish habitat. Additional site-specific licence conditions may be imposed where required. DFO has a monitoring, audit and surveillance program to ensure that each company complies with the licence conditions.

Responsibilities of Other Federal Agencies

Other federal agencies also have legal responsibilities relating to aquaculture activities. For example, the Canadian Food Inspection Agency has responsibilities under the *Feeds Act*, and *Health of Animals Act*; Health Canada under the *Food and Drug Act* and the *Pest Control Products Act*; Environment Canada under the *Canadian Environmental Protection Act* and Transport Canada under the *Navigation Protection Act* and the *Canada Shipping Act*.

Responsibilities of Provincial and Local Governments

The Province of British Columbia is responsible for issuing Crown land tenures, which authorize the use of Crown land for aquaculture activities, including the use of the seabed under and around finfish facilities. Separate provincial legislation regulates how farmed fish are processed, how the processing wastewater is disposed of and how dead fish are disposed of on land. The provincial government is also responsible for the management and regulation of business and labour aspects of aquaculture in BC. Local governments are not directly involved with marine finfish aquaculture, but are responsible for land zoning and water usage for other aquaculture sectors in BC.

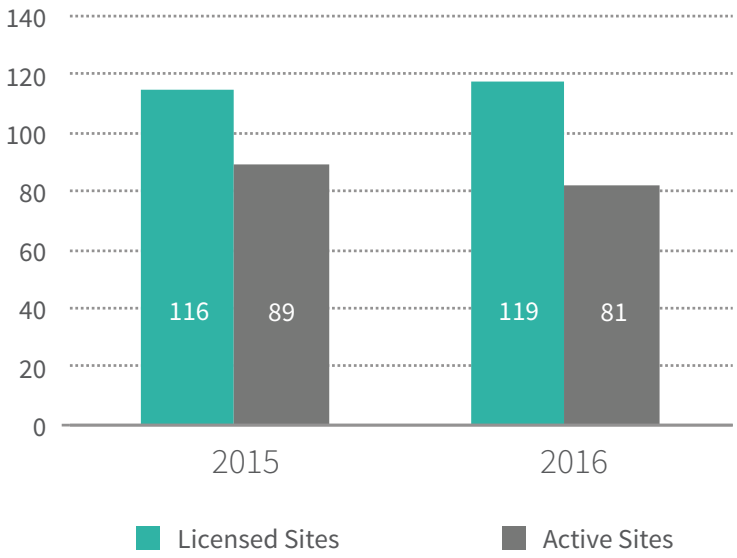
More information on aquaculture in BC can be found at: www.pac.dfo-mpo.gc.ca/aquaculture/index-eng.html.

Assessing Compliance

How DFO Assesses the Performance of Aquaculture Facilities

DFO conducts audits, monitoring and surveillance activities to establish a clear picture of the BC fish farming companies' ("aquaculture industry's") operational and environmental performance. Information gained through these activities allows the Department to assess its current regulatory approach and inform future management decisions. DFO analyzes the results of site inspections and technical audits and reports the results online to give the public a view of the industry performance. Figure 2 shows the number of facilities that were licensed in 2015 and 2016 and the number that were stocked with fish, or "active", for at least one day in a calendar year. It is important to note that not all facilities are stocked with fish at the same time due to the normal cycle of finfish farming.

Figure 2. Marine Finfish Aquaculture Facilities in BC



In 2015 and 2016, site visits were conducted year round by Fishery Officers and other DFO staff including veterinarians, biologists, and fish health technicians.

Monitoring and surveillance activities can include:

Assessing compliance with licence conditions to ensure

- complete and accurate records and paperwork
- no culturing of unlicensed species
- production is at or below the licensed maximum
- appropriate markings and signage
- appropriate storage and tagging of equipment, feed, and chemicals
- compliance with Fish Health Management Plans
- appropriate management of farm debris
- complete and accurate containment array plans, marine mammal management plans, and fish escape prevention plans

Inspecting nets, cage arrays, and other physical structures

Auditing fish health and sea lice records

Assessing the effects on the surrounding environment using benthic (seabed) surveys

Conducting watershed surveys to search for escaped farmed salmon

Reviewing protocols for fish health management

Observing harvests and transfer to assess mitigation and reporting of incidental catch, visiting processing plants to confirm that records have been submitted to DFO accurately

Responding to reported concerns related to specific aquaculture facilities

During site inspections, DFO assesses compliance based on the marine finfish licence conditions: www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html. Deviations from these conditions are noted as "deficiencies" which licence holders are required to address.

In 2015, DFO Conservation and Protection (C&P) Aquaculture Fishery Officers focused on inspecting shellfish aquaculture facilities regularly for compliance and aimed to inspect marine finfish aquaculture facilities at least once during a production cycle. These officers spent 27% of their total patrol hours on marine finfish aquaculture; their remaining time was spent on other aquaculture sectors. Fishery Officers found that marine finfish aquaculture licence holders were highly compliant with the conditions of licence. Overall, the industry has a high standard of environmental performance within their own operating procedures in order to achieve certification standards.

In 2016, DFO C&P Aquaculture Fishery Officers and aquaculture biologists conducted joint inspections of marine finfish aquaculture facilities. C&P continued to focus their inspections and investigations on unlicensed shellfish facilities and spent 14% of patrol hours on marine finfish aquaculture. Due to an increase in the whale population on the Pacific coast, there were several whale entanglements at marine finfish facilities in the fall that required investigation by Fishery Officers. Two investigations have been completed and it has been determined that the licence holder was compliant with licence conditions. A third investigation is ongoing.

Enforcement Options

Fishery Officers are responsible for enforcing the *Fisheries Act*, the *Fishery (General) Regulations*, the *Pacific Aquaculture Regulations* and the *Aquaculture Activities Regulations* as they pertain to the aquaculture industry in BC and are responsible for investigating potential violations. Reports, complaints and discoveries of potential violations are recorded by Fishery Officers as "occurrences" and must be validated before an enforcement action is taken. The response is determined based on the severity of the violation. There are a number of enforcement options available:

Education

Used to promote compliance and corrective measures.

Warnings

Issued to the violator and form part of the permanent compliance record for the individual or company. Follow-up inspections and corrective measures may be required.

Charges

An individual or company may face formal charges laid in court for one or more violations. The Fisheries Act allows a maximum penalty of a $100,000 fine and/or one year in jail for summary convictions and a $500,000 fine and/or two years in jail for an indictable conviction. Extra costs may also be imposed, and seized items may be forfeited.

Alternative Measures

These are measures outside the judicial process. In some cases, the accused will be offered the opportunity to engage in alternative measures or a restorative justice process instead of proceeding to court. Restorative justice is designed to address offending behaviour and conflict in a formally recognized dispute resolution process. Restorative justice may take place before or after charges are laid.

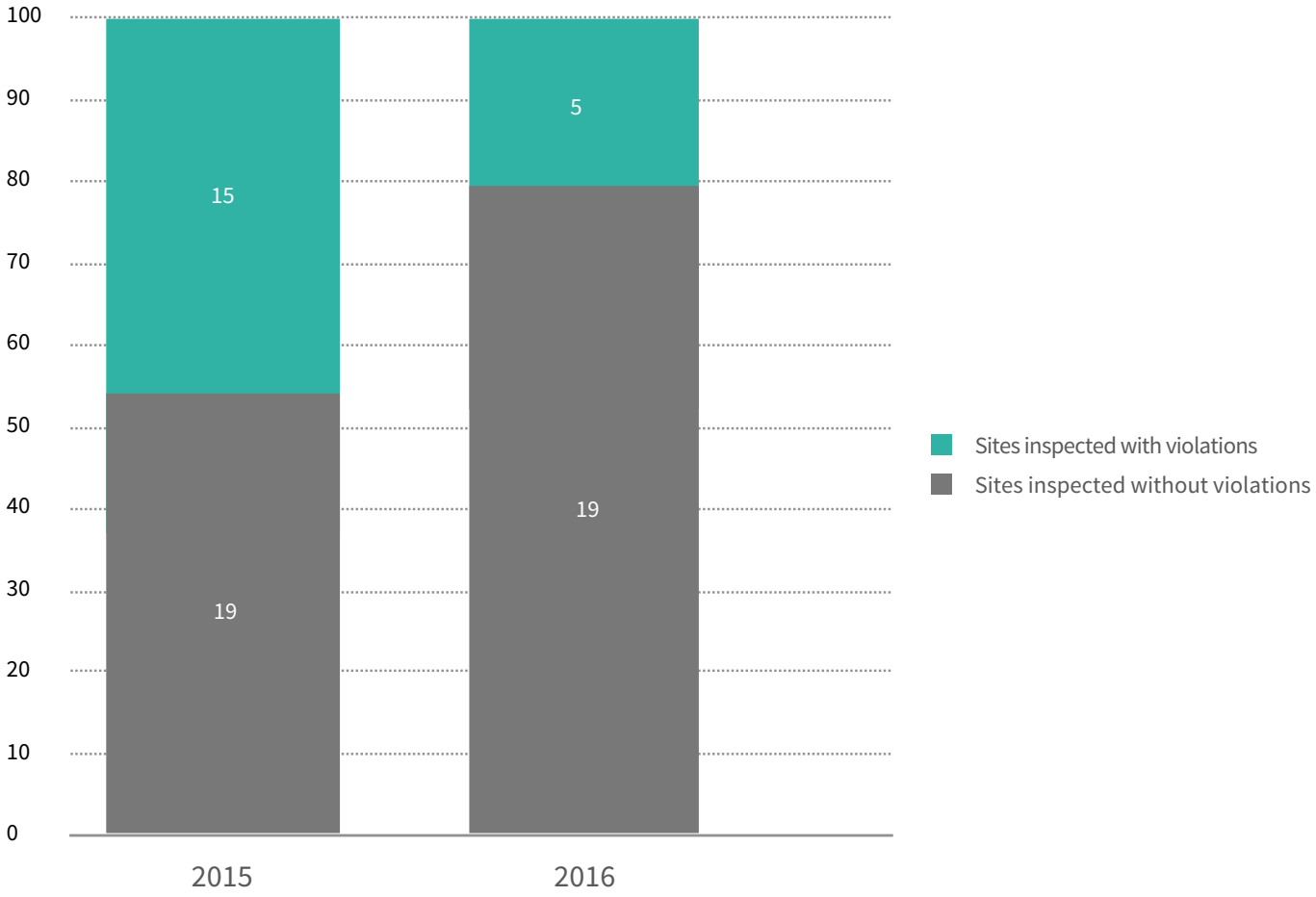
Summary of Charges and Convictions, 2015–2016

In 2015, there were no charges or convictions related to marine finfish operations. One charge is still pending for eight counts of failure to report under the conditions of licence in 2016.

Enforcement Activities

In 2015, Fishery Officers inspected 34 marine finfish farms, and found violations of the marine finfish aquaculture conditions of licence at 15 of these sites (Figure 3). In 2016, Fishery Officers inspected 24 marine finfish facilities, and found violations at five sites (Figure 3).

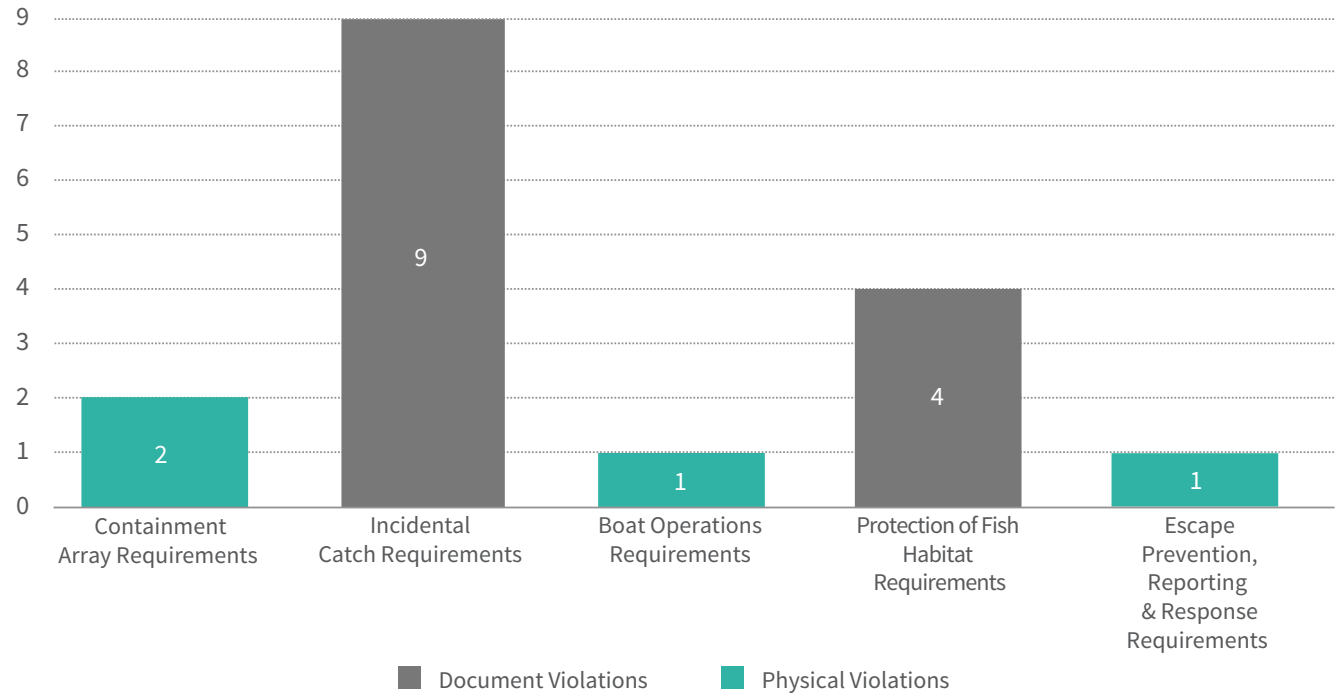
Figure 3: Violations at Inspected Aquaculture Facilities, 2015-2016



Violations in 2015

A total of 17 violations at 15 sites were recorded in 2015, however, only 14 warnings were issued as some farm operators were able to correct the issue in a timely manner.

Figure 4. Breakdown of Violations 2015



Document-related Violations

Thirteen of the 17 violations were document violations found during the site inspections and investigations (Figure 4), including:

- failure to produce septic waste records (Protection of Fish Habitat Requirements)
- failure to produce Use of Chemicals, Feed and Other Substances records (Protection of Fish Habitat Requirements)
- failure to produce biofouling records (Protection of Fish Habitat Requirements)
- failure to produce incidental catch records (Incidental Catch Requirements)

Physical Site Violations

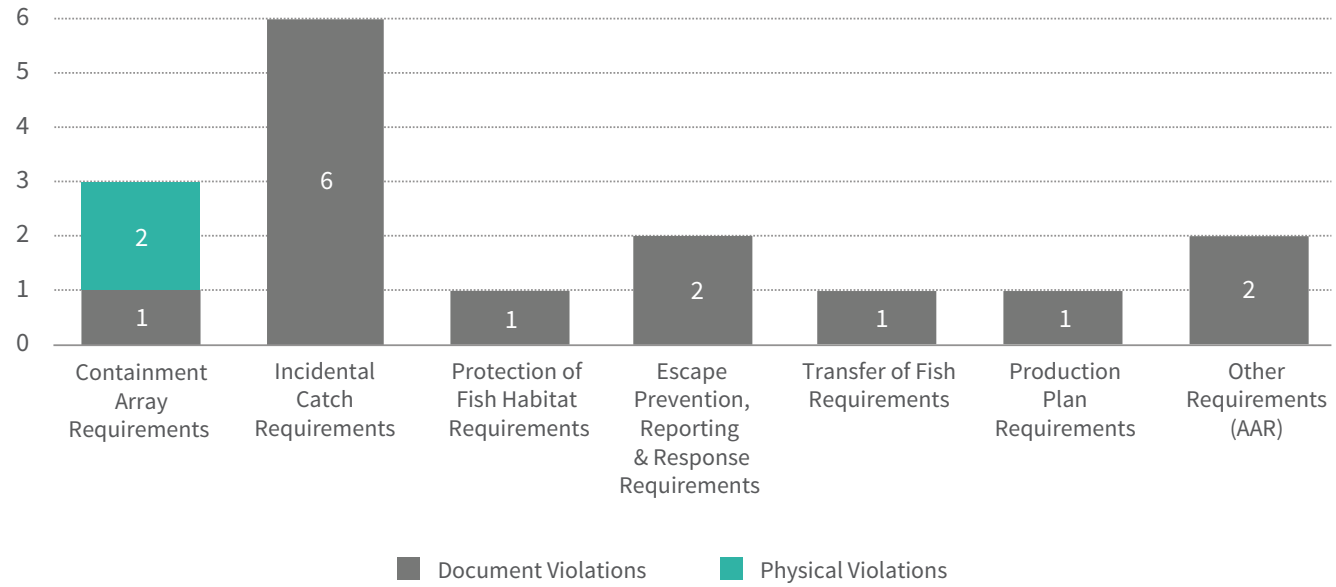
There were four physical site violations found including (Figure 4):

- failure to move or remove transfer pens (Containment Array Requirements)
- nets not marked with an inventory control number (Containment Array Requirements)
- no clear signage on site (Boat Operations Requirements)
- poor net maintenance - holes in nets (Escape Prevention, Reporting and Response Requirements)

Violations in 2016

A total of 16 violations were recorded at five sites in 2016, however, only 2 warnings were issued as some farm operators were able to correct the issue in a timely manner. There is one charge is pending for eight counts of failure to report under the conditions of licence.

Figure 5. Breakdown of Violations 2016



Document-related Violations

Fourteen of the 16 violations in 2016 were document violations (Figure 5), these include:

- failure to produce containment array plan (Containment Array Requirements)
- failure to produce incidental catch records (Incidental Catch Requirements)
- failure to produce biofouling report (Protection of Fish Habitat Requirements)
- failure to produce escape prevention and response plan (Escape Prevention, Reporting and Response Requirements)
- failure to produce net maintenance records (Escape Prevention, Reporting and Response Requirements)
- failure to produce Introductions and Transfers of Fish licence and veterinary attestations (Transfer of Fish Requirements)
- failure to produce inventory records (Production Plan – Peak Biomass Requirements)
- failure to produce benthic reports (Other - AAR Reporting Requirements)
- failure to submit annual AAR report (Other – AAR Reporting Requirements)

Physical Site Violations

Two physical site violations were recorded (Figure 5):

- 2 nets not marked with an inventory control number (Containment Array Requirements)

Aquaculture Fishery Officers also investigate potential violations under other Acts and Regulations that took place on or near aquaculture facilities. In 2015, Fishery Officers investigated three occurrences of potential violations. Two occurrences did not require enforcement action, and one warning was issued related to a violation of the *Fisheries (General) Regulations*. In 2016, aquaculture Fishery Officers investigated five occurrences of potential violations. Four occurrences did not result in any enforcement actions, one occurrence is under investigation.

Reporting Requirements and Submissions

Reporting Requirements

Under the *Pacific Aquaculture Regulations* (PAR), licence holders are required to submit to DFO reports that fall into two broad categories: scheduled reports and event-based reports. DFO receives over 700 reports and documents per year from marine finfish aquaculture licence holders. All reports are reviewed by DFO to validate content, to ensure that they contain all elements required by the licence conditions, and to determine if they were submitted on time. When a report contains only minor administrative omissions or errors, and the licence holder corrects these in a timely manner, the reports may be considered complete and on time. Beginning in 2016, some reporting components required under *PAR* were removed to avoid duplication with reporting requirements under the new *Aquaculture Activities Regulations (e.g. use of pesticides and therapeautants)*. Data for these reports are collected and reported nationally.

Scheduled Reports

Reports are submitted on a pre-determined schedule (monthly, quarterly or annually):

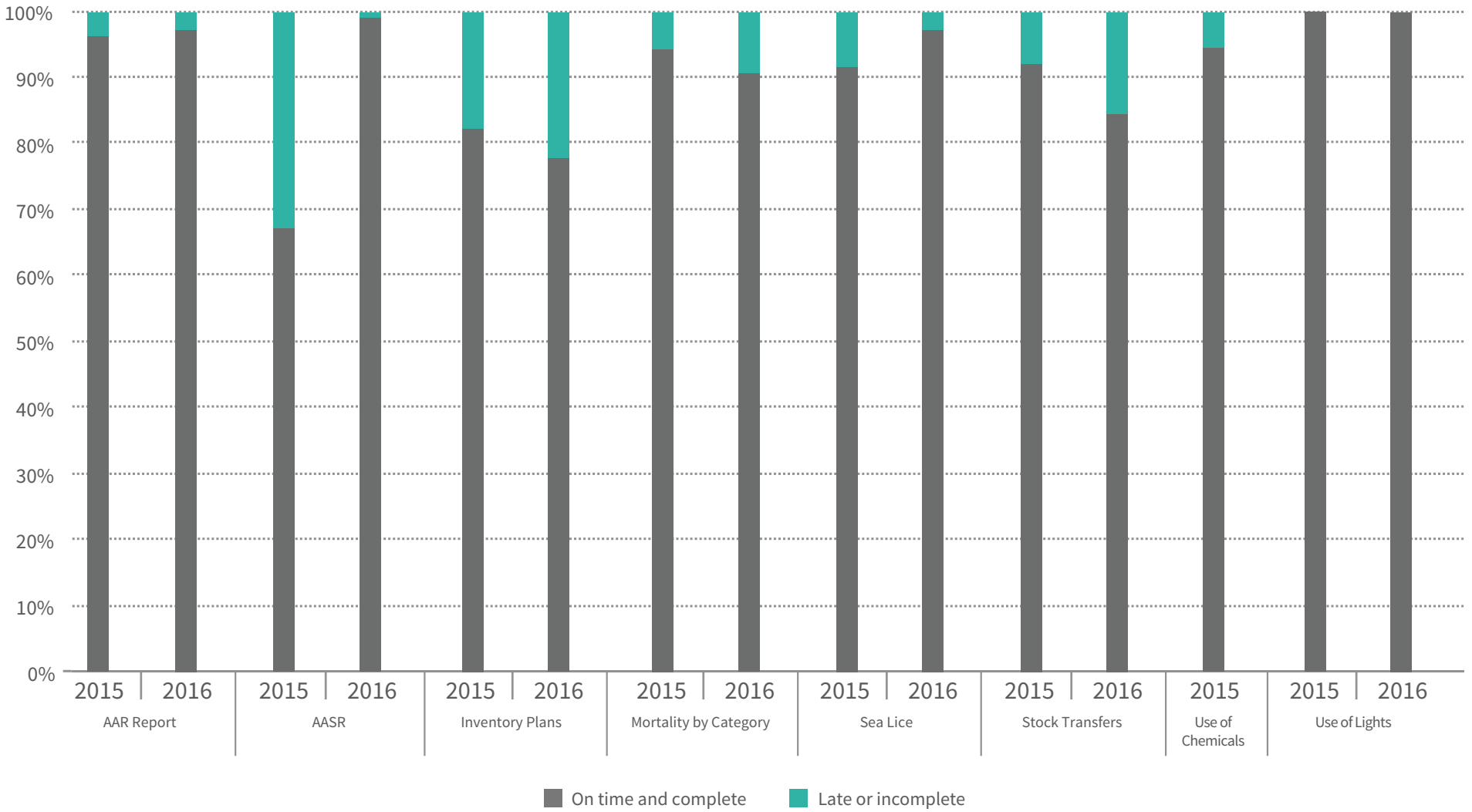
- *Aquaculture Activities Regulations (AAR)* Reports[2]
- Annual Aquaculture Statistical Report (AASR)
- inventory plans
- mortality by category
- stock transfers
- sea lice
- use of chemicals, feed and other substances[3]
- use of lights

Figure 6 summarizes the scheduled reports submitted to DFO from 2015 to 2016 and shows how many were complete and whether they were submitted on time.

[2] The 2016 AAR reporting results in Figure 6 are based on an initial review of the submissions received on April 1, 2017. Results may change after further verification by DFO.

[3] The use of chemicals, feed and other substances report was discontinued after the introduction of the *AAR* in July 2015. From 2016 onwards, this data is reported on the annual *AAR* Report.

Figure 6. Scheduled Reports Submitted to DFO, 2015-2016



Event-based Reports

Event-based reports are submitted following specific incidents or events identified in the licence conditions. These reports include:

- benthic (BOD) monitoring[4]
- escapes
- marine mammal drownings
- marine mammal authorized predator control activities
- incidental catch
- urgent mortality event and follow up reports
- alternate cage array use

Data on the event-based reports can be found in subsequent sections of this report.

For specific reporting timelines and detailed requirements for each report, please refer to the marine finfish conditions of licence: www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html.

[4] Although no longer required under the PAR, benthic, or biochemical oxygen-demanding matter (BOD) monitoring is now required under the authority of the AAR, and therefore DFO staff in BC continue to review benthic monitoring results to assess the environmental performance of the industry.

Monitoring and Audits

DFO is committed to a regulatory approach that ensures the aquaculture industry operates sustainably and with minimal impacts to wild fish stocks. Prior to 2015, all marine finfish licences were licensed on an annual basis. As of 2015, marine finfish facilities outside of the Discovery Islands are eligible for a six-year licence term. Facilities in the Discovery Islands (Fish Health Zone 3.2) are not eligible for a multi-year licence and licence holders must apply to have these licences renewed each year.

The Minister of Fisheries, Oceans and the Canadian Coast Guard may revise the licence conditions at any time during the licence term if there are conservation concerns or in response to legislative changes. The inspection component of the field program can change if there is a change in licence conditions or monitoring priorities.

Monitoring and Audits: Fish Health

Fish Health Management Plans

Aquaculture companies are required to regularly report to DFO on the health of their stocks, and any treatments they have used. These reports are reviewed by DFO veterinarians to assess whether appropriate measures are being taken and to detect any potentially serious diseases as early as possible.

DFO fish health professionals also inspect sites and ensure that aquaculture licence holders farming salmon are complying with their Health Management Plans (HMPs), or in the case of non-salmonid facilities, their Carcass Management Plans (CMPs). The methods and protocols for this monitoring can be found at www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/health-sante/index-eng.html.

At active salmon farms, DFO staff conduct fish health and sea lice audits and inspections throughout the year to check that the farmed fish are healthy and that the facility's HMP is being followed.

During on-site fish health inspections, DFO staff check the following:

- biosecurity measures
- feed, nutrition, and medication records and usage
- water quality monitoring
- carcass retrieval protocols
- fish health records and husbandry records
- sea lice – handling, counting, and assessment procedures
- fish welfare, handling, and euthanasia
- disease outbreak management plan

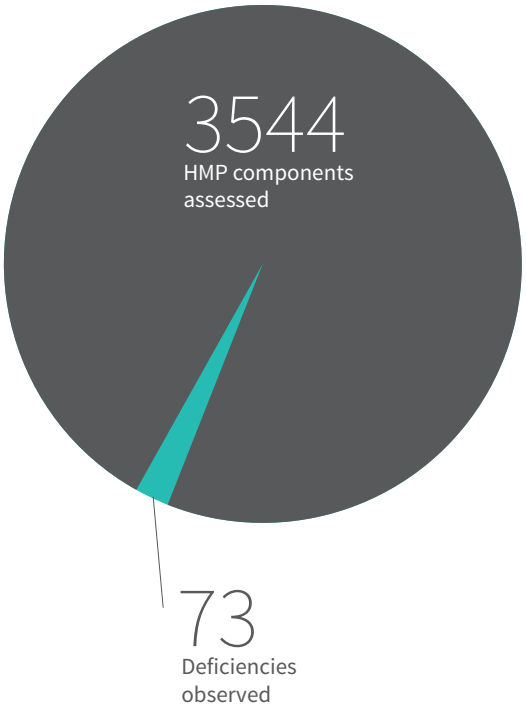
During inspections, DFO staff collect recently dead ("silver") carcasses to audit and compare the reports that are submitted by aquaculture companies each calendar quarter. For example, 820 carcasses were sampled in 2015 and 845 carcasses were sampled in 2016.

Fish Health in 2015

Figure 7 summarizes the results of Fish Health Management Plan (HMP) inspections by DFO in 2015. A total of 124 HMP inspections were completed. No Carcass Management Plan (CMP) inspections were conducted.

DFO observed no deficiencies in 78 of the 124 HMP visits in 2015. A total of 3544 HMP components were assessed during the 124 HMP inspections and 73 deficiencies were observed. The most frequently observed deficiencies included: carcass retrieval protocol or record keeping needs improvement, lice protocol or lice records as per the conditions of licence needs improvement, and mooring signage needs improvement.

Figure 7. DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in BC, 2015



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
23

Current licence was not posted at facility
1

Footbaths or sanitizers needs improvement
2

Husbandry or record keeping as per COL Appendix VIII-A or VIII-B needs improvement
7

Lice protocol or lice records as per COL Appendix VII or VII-A needs improvement
19

Mooring signage needs improvement
10

Nutritional or medicated feed protocol concerns
3

Training documentation is not up-to-date
5

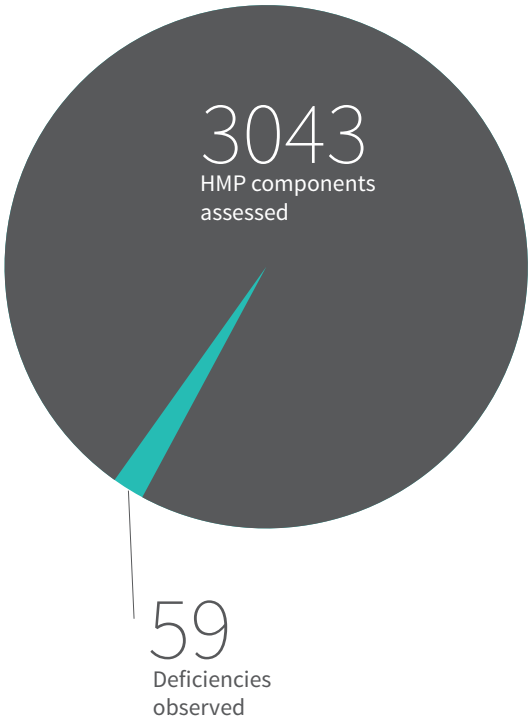
Transfer records are not complete or up-to-date
3

Fish Health in 2016

Figure 8 summarizes the results of the Fish Health Management Plan inspections by DFO in 2016. A total of 118 HMP inspections were completed and no CMP inspections were conducted.

DFO observed no deficiencies in 74 of the 118 HMP visits in 2016. A total of 3043 HMP components were assessed during the 118 HMP inspections and 59 deficiencies were observed. The most frequently observed deficiencies included: carcass retrieval protocol or record keeping needs improvement, disease contingency or mass mortality information or records needs improvement, and lice protocol or lice records as per the conditions of licence needs improvement.

Figure 8. DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in BC, 2016



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
21

Current licence was not posted at facility
1

Disease contingency or mass mortality information or records needs improvement
10

Footbaths or sanitizers needs improvement
4

Husbandry or record keeping as per COL needs improvement
2

Lice protocol or lice records as per COL Appendix VI or VI-A needs improvement
9

Mooring signage needs improvement
6

Mortality assessment or classification needs improvement
1

Transfer records are not complete or up-to-date
3

Wild fish mortality records need clarification
2

Sea Lice

Licence holders must count sea lice at active Atlantic salmon facilities throughout the year subject to a few exceptions outlined in the conditions of licence. Sampling for sea lice occurs monthly from July 1 to February 28, and every two weeks from March 1 to June 30 when wild salmon smolts outmigrate. The licence holder must report to DFO within seven days if the average number of motile *Lepeophtheirus salmonis* (a species of sea lice) exceeds three motiles per fish during the wild salmon outmigration period.

Pacific salmon must be monitored for sea lice on a quarterly basis; observations must be recorded and made available to a Fishery Officer or Fishery Guardian for inspection. If the average number of motile sea lice exceeds three lice per cultivated Pacific salmon, the licence holder must notify the Department within seven days of discovery.

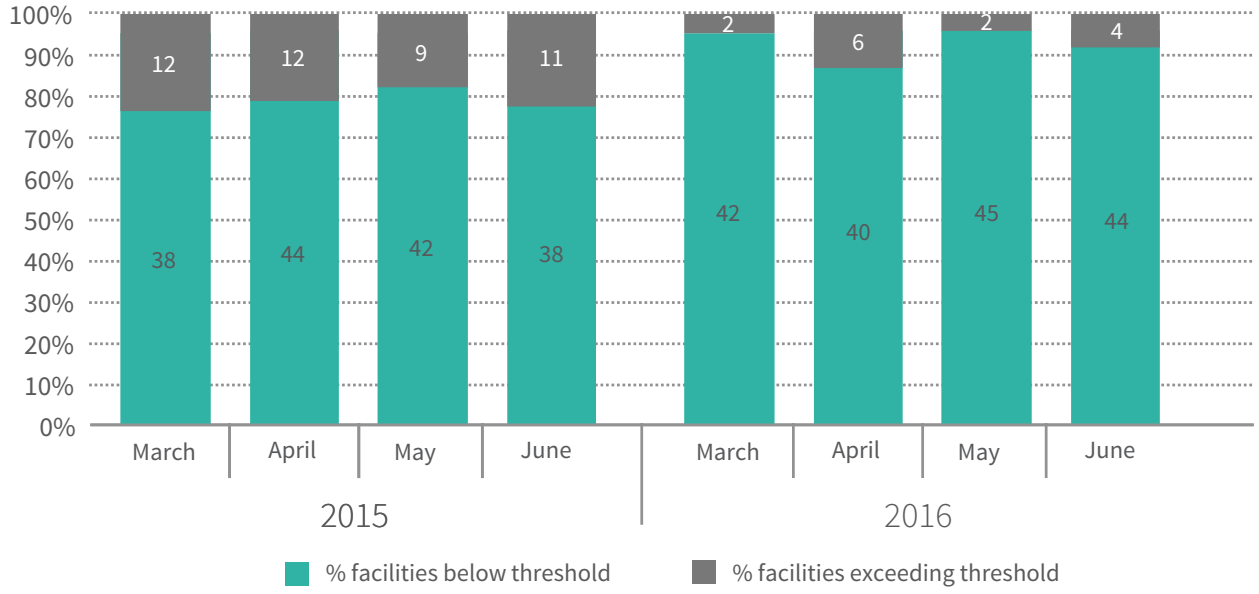
Sablefish facilities do not require sea lice monitoring as there is evidence that these fish do not carry sea lice.

DFO performs sea lice counts at selected active Atlantic salmon farms to assess industry's sea lice counting procedures. DFO also audits records to verify the accuracy of industry reporting.

At certain times, counting sea lice may be risky or harmful to farmed fish because some natural phenomena, including algal blooms and low dissolved oxygen (hypoxia), can stress or kill fish. During these natural events, handling of farmed fish to perform sea lice counts is curtailed. All possible effort is made by DFO biologists to reschedule these audits.

Although various species and life stages of lice are counted, management actions are only required when the motile *Lepeophtheirus salmonis* threshold has been exceeded at a farm. Figure 9 below illustrates the percentage of sites where the average number of motile *Lepeophtheirus salmonis* lice per fish exceeded the threshold, as reported by industry.

Figure 9: Industry's Counts of Motile Sea Lice *Lepeophtheirus salmonis* between March and June, 2015-2016



In 2015, during the wild salmon outmigration period from March 1 to June 30, licence holders conducted 206 sea lice counts at active farms and reported that an average of 78.6% of counts were below the management threshold of three motile lice per fish. In 2016, licence holders conducted 185 sea lice counts with an average of 95.8% of counts below the sea lice threshold.

DFO audited 31 farms in 2015 and 24 farms in 2016. Approximately 25% of the farms were audited during the outmigration period in select fish health zones. DFO's audit results can differ from industry's results since fish are not sampled at the same time, and sea lice levels can fluctuate over time. Audit count agreement is evaluated statistically and agreement between DFO and industry's results are about 93%.

Higher than normal sea lice abundance in 2015 in some areas was associated with a warm and dry fall and winter in 2014/2015. Under these conditions, lice management strategies effective in normal years failed to keep abundance below threshold during the outmigration period. As the figure demonstrates, management strategies were effective again in 2016. DFO and the industry both recognized that it was an anomalous year, and saw that sea lice abundance returned to a normal level in 2016.

More detailed monitoring results can be found on DFO's website: www.dfo-mpo.gc.ca/aquaculture/protect-protege/parasites-eng.html.

Fish Mortality

Licence holders are required to report on the numbers and causes of fish deaths at aquaculture facilities. Low levels of mortality normally occur in any large population of animals. A Mortality by Category report describes the number of dead fish within specified mortality categories at the farm and must be submitted quarterly to DFO. This report also lists any therapeutants, pest control products or anaesthetics used to treat the cultured fish during that quarter. The licence holder must send an Urgent Notification to DFO within 24 hours of discovering a "mortality event" as defined by the licence conditions[5]. This notification provides as much detail as possible to DFO about the nature and extent of the event. After the Urgent Notification, a detailed report with information on the total weight of dead fish (or percentage of the population), number of dead fish, and cause of the mortality event must be submitted within ten days. For events that persist, updated reports must be submitted every ten days until mortality levels return to normal.

Table 1 summarizes the number of reports and the cause of the mortality event reported by industry. In 2015 and 2016, the most common causes of mortality events were harmful algal blooms and low dissolved oxygen. During this two year period, 49 reported mortality events were attributed to those causes. During the same period, causes such as non-infectious disease, bacterial disease, other environmental conditions, maturation and mechanical causes accounted for the other 13 mortality events.

[5] "Mortality event" means:
(a) fish mortalities equivalent to 4000 kg or more, or losses reaching 2% of the current facility inventory, within a 24 hour period; or
(b) fish mortalities equivalent to 10,000 kg or more, or losses reaching 5%, within a five day period;

Table 1. Event-based Report – Mortality Events

Year	Number of Events	Type and Number of Reported Mortality Events
2015	27	Harmful algae (8) Low dissolved oxygen (15) Other environmental (2) Maturation (2)
2016	35	Harmful algae (10) Low dissolved oxygen (16) Non-infectious disease (2) Bacterial disease (3) Other environmental (2) Maturation (1) Mechanical (1)

Monitoring and Audits: Environmental

Benthic (Seabed) Monitoring

The aquaculture industry is required to conduct benthic, or biochemical oxygen-demanding matter (BOD), monitoring at all of their farms that grow more than 2.5 tonnes of fish annually. This ensures that the impacts of organic waste (mainly fish feces) from the sites are restricted in extent and intensity. As part of its monitoring program, DFO staff conduct benthic audits as well as information-gathering surveys. During the audits, DFO follows the same procedures as industry, samples within the same time frame (within 30 days before or after the peak biomass date), and samples similar locations. DFO benthic audit results are therefore directly comparable to industry results.

At sites with a hard ocean substrate (seabed), video data is gathered using remotely operated vehicles (ROVs) with underwater cameras. At least two transects (lines along the seabed) are monitored at each site. Video is taken from the cage edge to at least 140 metres away on at least two sides of the fish farm site.

The video collected is assessed by industry representatives and DFO staff, who observe and record various types of information. The zone of compliance for hard bottom sites is between 100 and 124 metres from the cage array, although video is always also taken closer and farther away.

The zone of compliance is divided into six segments, each four metres long, and each of the segments is assessed. If required, the post-compliance zone (124–140 metres away from the cage array) is also assessed.

To affirm that hard-bottom sites comply with the regulated standards, DFO staff check the video footage to assess the area of the seabed covered by two indicators of organic waste: *Beggiatoa*- like species, which are bacteria that form visible mats in areas of organic enrichment, and opportunistic polychaete complexes (OPCs), which are worms found in the seabed and in areas of organic enrichment. Although these species actually help break down accumulated waste, their abundance indicates impact due to organic enrichment.

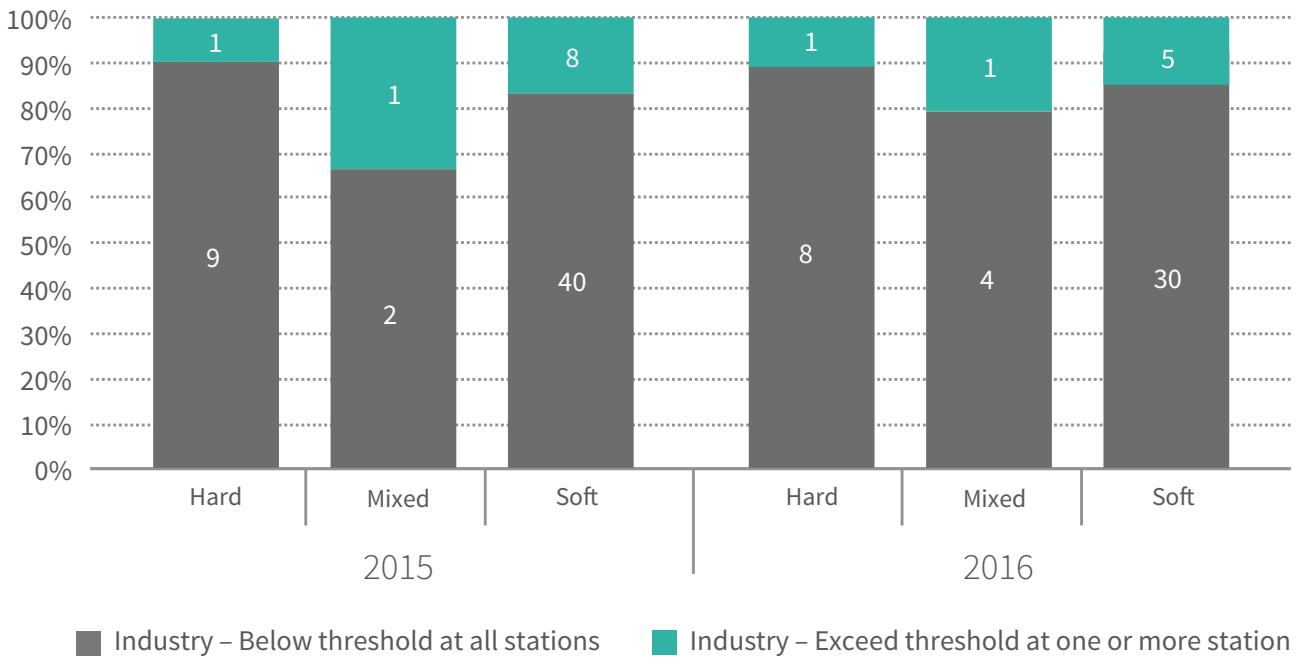
When allowable thresholds of *Beggiatoa*-like species or OPCs are exceeded, the farm must be fallowed (left empty) until further monitoring shows that it has recovered sufficiently.

Industry submits benthic monitoring data to DFO prior to stocking a farm, at peak production, or every 24 months for farms with fish continually on site. Table 2 summarizes the number of samples reported and the number of reports that were complete and on time.

Table 2. Event-based Report – Benthic Monitoring Reports

Year	Number of Sampling Events	Number of Reports Complete and On Time
2015	67	65
2016	50	41

Figure 10. Industry-reported Benthic Monitoring Events 2015 and 2016



At sites with a soft ocean substrate (seabed), at least two transects (lines across the seabed) are monitored by taking sediment samples at 30 and 125 metres from the cage edge and analyzing their physical and chemical properties. Sediment sampling must occur at two sides of the cages and where the most impact is expected. Additional sampling may be required as outlined in the AAR or as prescribed by DFO.

Compliance at soft seabed sites is determined by measuring the level of free sulphides. Free sulphides are related to the amount of oxygen in the sediment, which in turn contributes to the biodiversity (variety of living organisms) that the sediment can support. The standards for free sulphides are designed to manage the intensity of impact and ensure that the seabed can recover in a reasonable amount of time when fish are removed from marine net pens. When thresholds of free sulphides at the 30 metre and 125 metre stations are exceeded, the site must be fallowed (no fish) until further monitoring shows that it has recovered sufficiently.

Figure 10 summarizes the seabed sampling reports submitted by industry between 2015 and 2016.

Industry-submitted data showed that an average of 84% and 86% in 2015 and 2016, respectively, of all sampled farms were below the allowable environmental thresholds.

DFO's Benthic Audit Program

DFO assesses industry's benthic monitoring results by reviewing every incoming report and by conducting site audits. DFO site audits fulfill four purposes:

1. To compare industry-generated data with DFO-generated data to ensure that industry is following the correct procedures and that the two data sets are similar.
2. To determine whether the compliance sampling stations or transects used by industry are appropriate.
3. To investigate sites with poor environmental performance.
4. To learn more about benthic impacts during different parts of the production cycle and site recovery cycle.

For facilities with soft seabeds, DFO conducts field assessments in the same location as industry to compare the results. For facilities with hard seabeds, DFO reviews the video data captured by industry and conducts a field assessment at the same location as industry.

Benthic sampling reports submitted by industry between 2015 and 2016 generally matched DFO's field and video audits. Twenty-six site audits were conducted in 2015 and 29 site audits were conducted in 2016. DFO's audits indicated that 81% and 93% of results were consistent with industry-submitted reports in 2015 and 2016, respectively.

Disagreement can arise if industry finds more or less impact than DFO. If there is disagreement, DFO directs industry to use the monitoring results that show greater impact and to respond to the results as required by their licence.

Escapes

The aquaculture industry must take all reasonable measures to prevent the escape of cultivated fish, but in the unlikely event of an escape, the licence holder must take immediate action to control and confine it. Escapes are reported to DFO upon discovery, and a follow-up report is submitted within seven days after the escape or suspected escape.

During site inspections, DFO staff visually examine site integrity as well as records of cage maintenance and net integrity to ensure that nets are of the appropriate strength and age, are in good repair, are inspected regularly, and are deployed correctly.

Table 3. Event-based Report – Escapes

Year	Number of Incidents	Number of Confirmed Escaped Fish
2015	3	3
2016	4	23

Table 3 summarizes the total number of escaped fish reported by industry in 2015 and 2016. Detailed information on the escape of cultured fish, including the description of each incident, can be found at www.dfo-mpo.gc.ca/aquaculture/protect-protege/escape-prevention-evasions-eng.html.

Incidental Catch

Incidental catch are any wild fish caught or found dead within the farm during harvest, while fish are being moved within or between facilities, or during net removal. Wild fish sometimes swim into containment nets at marine finfish facilities and grow along with cultured fish until they are too large to swim out of the nets. Aquaculture operators are not allowed to cultivate or sell any species of fish not listed on their licence. All incidental catch during transfer of fish and harvest must be recorded and reported to DFO. The aquaculture industry must take reasonable care to reduce the risk of incidental catch and immediately return live incidentally-caught fish to waters outside the aquaculture facility in the least harmful manner possible.

Table 4. Event-based Report – Incidental Catch

Year	Number of Incidents	Incidental Catch Quantity (Pieces)
2015	49	39,475
2016	54	50,060

Table 4 summarizes the total number of events where wild fish were discovered in an aquaculture farm, as well as the estimated number of fish reported by licence holders in 2015 and 2016. Fish that are released live are not included in this report. For detailed information on incidental catch, including the number of fish and species killed, please visit: www.dfo-mpo.gc.ca/aquaculture/protect-protege/removal-fish-retraits-poissons-eng.html.

Conditions of licence require companies to submit incidental catch reports within 15 calendar days after harvest; a follow up report is required if more incidental catch is discovered after nets are removed. For farms that continuously have fish present, records must be submitted annually for the previous 12 months. Industry achieved 45% compliance for incidental catch reporting in 2015 and 54% compliance in 2016. The low compliance rate for incidental catch reporting was mainly due to late report submissions.

DFO monitors fish harvesting and transfer activities to ensure proper handling, record-keeping, and identification of incidental catch. Although no non-compliance with incidental catch procedures has been found to date, ways to further mitigate incidental catch have been suggested and implemented. Several warning letters have also been issued to improve compliance around incidental catch reporting.

Interactions with Marine Mammals

Licence conditions require every aquaculture licence holder to take all reasonable measures to prevent marine mammals from coming into conflict with the farm infrastructure and farmed fish. Companies must:

- have a Marine Mammal Interaction Management Plan that DFO reviews for compliance with the licence
- report drownings and authorized predator control activities to DFO

DFO audits reports of marine mammal incidents to ensure that licence holders have taken reasonable preventative actions. If DFO has questions about the effectiveness of preventative actions, they follow up with the licence holder to review the details of the event.

DFO staff also review records on-site related to preventing escapes and managing marine mammal interactions. For example, dive records indicate net maintenance and repairs (often required as a result of damage by marine mammals) as well as incidents in which marine mammals became entangled and were released.

Table 5. Event-based Report – Marine Mammals Interactions - Drownings

Year	Number of Marine Mammals Drowned Events	Species
2015	24	Harbour Seals (14) California Sea Lions (10)
2016	7	Harbour Seals (1) California Sea Lions (4) Humpback Whales (2)

Table 6. Event-based Report - Marine Mammal Interactions – Authorized Predator Control

Year	Number of Authorized Predator Control Events	Species
2015	18	Harbour Seals (3) California Sea Lions (15)
2016	1	California Sea Lion (1)

Tables 5 and 6 summarize the total number of marine mammals drowned and killed in 2015 and 2016. One interaction not recorded in the tables was a Humpback whale that was entangled at a fallow farm in 2016, but as it was safely released it was not included in Table 5.

Use of Lights

Underwater lighting at marine finfish farms is used to delay the start of sexual maturation which improves feeding behaviour, growth rates, and the quality of fish flesh. Lights are used within net cages at night from autumn to spring, when there are fewer hours of daylight.

Research indicates that lights do not penetrate more than a few metres beyond marine nets, suggesting that their use has minimal effect on the surrounding environment. However, it is possible that lights may influence the behaviour of wild fish by attracting them to—or causing them to avoid—farm sites.

The licence holder must record and report on the use of lights to promote fish growth. This report is submitted to DFO annually by February 15 and summarizes data for the previous calendar year. For a detailed report on the use of lights by each farm, visit: http://www.dfo-mpo.gc.ca/aquaculture/protect-protege/alteration-habitat-eng.html.

DFO audits each report for completeness. See Figure 6 for a summary of the industry's compliance.

Use of Chemicals, Feed, and Other Substances

The Use of Chemicals, Feed, and Other Substances report included information on:

- the monthly dry weight of feed and its formulation
- materials directly or indirectly deposited into the water, such as disinfectants, anti-fouling agents, pesticides and therapeutants

This report was submitted under *Pacific Aquaculture Regulations (PAR)* until July 2015 when the *Aquaculture Activities Regulations (AAR)* came into force. See Figure 6 (page 13) for a summary of the industry's reporting compliance.

Aquaculture Activities Regulations

The *Aquaculture Activities Regulations (AAR)* clarify conditions under which aquaculture operators may install, operate, maintain or remove an aquaculture facility, or undertake measures to treat their fish for disease and parasites, as well as deposit organic matter, under sections 35 and 36 of the Fisheries Act. The AAR allow aquaculture operators to conduct these activities with restrictions to avoid, minimize and mitigate any potential detriments to fish and fish habitat. The Regulations also impose specific environmental monitoring and sampling requirements on the industry.

Under the AAR, owners and operators must notify Fisheries and Oceans Canada of:

- their intent to deposit pest control products
- any morbidity events of wild fish they observe outside the farm;
- any exceedances of biological oxygen demanding thresholds; and,
- when submitting an application to a provincial or territorial authority for a new or expanded farm.

These Regulations require aquaculture owners and operators to submit annual reports on their activities to the appropriate Regional Aquaculture Management Office no later than April 1 of the following year. The annual AAR report requires the submission of information on:

- deposits of drugs and pesticides
- measures to minimize detriment from deposit of feces, feed, pesticides and/or drugs
- monitoring of biochemical oxygen demanding (BOD) matter (see benthic monitoring)

More information about the AAR and the reporting requirements under the regulation can be found at this link: www.dfo-mpo.gc.ca/aquaculture/management-gestion/aar-raa-eng.htm. See Figure 6 (page 13) for a summary of the industry's reporting compliance.

Monitoring and Audits: Inventory & Aquaculture Statistics

Inventory Plans and Stock Transfers

Licence holders submit inventory plans annually in January to DFO, and monthly thereafter. An inventory plan outlines a seven-month rolling inventory plan for all licensed species, including biomass, number of fish, age class, and harvest activities. The first month of the plan must reflect the calculated inventory at the farm for the previous month, and the remaining six months must be projected inventory. A plan must be submitted even when no farming is occurring. Any transfers of stock from one farm to another must be reported if the transfers occurred in the previous month.

DFO audits the inventory plans by ensuring that:

- transfers and harvests agree with the inventory plan
- drastic drops in biomass are accounted for in harvest, transfer or escape reports
- farms do not exceed their licensed production limit

Detailed fish transfer information can be found at: www.dfo-mpo.gc.ca/aquaculture/management-gestion/rep-rap-eng.htm.

See Figure 6 (page 13) for a summary of the industry's compliance.

Annual Aquaculture Statistical Report

DFO collects information regarding fish production, processing, and sales for statistical purposes. This report is submitted to DFO no later than January 25 for the previous calendar year. In 2015 and 2016, all marine finfish Annual Aquaculture Statistical Reports were submitted to DFO, with an average of 98% of reports submitted on time. See Figure 6 (page 13) for a summary of the industry's compliance.

Summary

DFO aquaculture management is committed to the conservation of marine ecosystems and wild fish stocks. Dedicated DFO staff inspect aquaculture farms and audit industry-submitted reports. Based on the results of audit and reporting efforts, the industry has shown high level of compliance with the marine finfish aquaculture conditions of licence. DFO continues to update monitoring and reporting requirements to ensure a responsible, sustainable and economically prosperous aquaculture sector.

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