Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities

2011–2014

AQUACULTURE MANAGEMENT

Fisheries and Oceans Canada
Pêches et Océans Canada

Canada

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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 B.C. in December 2010. Between 2010 and 2014, DFO licensed up to 123 marine finfish aquaculture facilities ("fish farms") with a total combined peak production of over 280,000 metric tonnes of fish. Generally, about half of these facilities have fish on site at any given time. A list of all current licence holders for marine finfish aquaculture is available on the DFO website: http://www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html.

Marine Finfish Species Cultivated in British Columbia

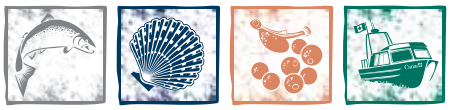
The majority of marine finfish aquaculture licences are issued for salmon, with Atlantic salmon (*Salmo salar*) and chinook salmon (*Oncorhynchus tshawytscha*) being the most commonly farmed fish in B.C. Some other species are also cultivated on a smaller scale, including sablefish/black cod (*Anoplopoma fimbria*) and coho salmon (*Oncorhynchus kisutch*).

Atlantic salmon is the preferred species for 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

The majority of the marine finfish aquaculture facilities are 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 (Figure 1).

Figure 1. Locations of Marine Finfish Aquaculture Facilities in B.C., 2014



How Aquaculture Facilities Are Regulated

DFO Responsibilities and Licences

The most important pieces of legislation governing marine finfish aquaculture activities in B.C. are the *Fisheries Act*, the *Fishery (General) Regulations* and the *Pacific Aquaculture Regulations*. DFO is responsible for enforcing the Act and regulations.

In B.C., DFO is the primary regulator and manager of the aquaculture industry. Through the B.C. Aquaculture Regulatory Program (BCARP), DFO

- **develops and implements** policies, regulations, and licence conditions related to B.C. 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 under the *Pacific Aquaculture Regulations* 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, incidental catch of wild fish (bycatch), 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 facility complies with its 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 *Health of Animals Act*; Health Canada under the *Food and Drug Act* and the *Pest Control Products Act*; and Transport Canada under 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. Local government is responsible for land zoning and water usage.

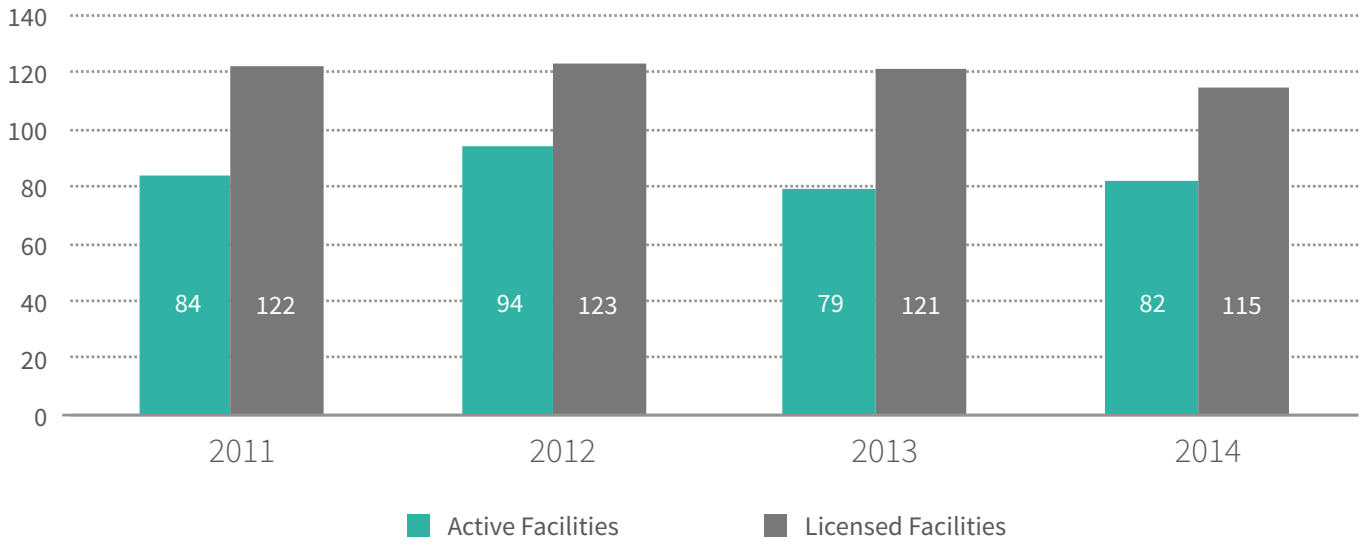
More information on aquaculture in B.C. can be found at: http://www.pac.dfo-mpo.gc.ca/aquaculture/index-eng.html.

Assessing Compliance

How DFO Assesses the Performance of Aquaculture Facilities

DFO uses audits, monitoring, and surveillance to develop a full understanding of the B.C. aquaculture industry's operational performance. It uses this understanding to assess its current regulatory approach and to provide a basis for future decisions. DFO analyzes the results of site inspections and technical audits and reports the results online to give the public an accurate view of how well the industry operates and its impacts on the environment. Figure 2 shows the number facilities that were licensed in 2011 to 2014 and the number that were active for at least a portion of each year. It is important to note that even though many licences were renewed annually, not all facilities were stocked with fish at the same time.

Figure 2. Marine Finfish Aquaculture Facilities



In 2011 to 2014, site visits were conducted year round by Fishery Officers and other DFO staff including veterinarians, biologists, fish health technicians, and resource managers.

Monitoring and surveillance activities included:

Assessing compliance with licence conditions

- complete and accurate records and paperwork
- no culturing of unlicensed species
- production 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
- site debris being managed appropriately
- 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 procedures for reporting incidental catch visiting processing plants to confirm that records have been submitted to DFO by licence holders

Responding to reported concerns related to specific aquaculture facilities

During site inspections, DFO staff assess compliance based on the marine finfish licence conditions: http://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 2011, DFO focused on establishing protocols and standard procedures for site inspections and technical audits. Where aquaculture facilities did not comply with the requirements, Fishery Officers promoted compliance through education and corrective measures.

In 2012, the goal for Fishery Officers was to visit as many marine finfish aquaculture sites as possible to assess how many were complying with the requirements stated in their licences. Fishery Officers continued to use an educational and corrective approach.

In 2013, Fishery Officers shifted towards a priority-based and risk-based inspection program, with increased corrective measures to address non-compliance.

In 2014, Fishery Officers continued to conduct inspections on compliance with the conditions of licence, as well as marine mammal interactions assessment, incidental catch at fish processing plants, and proper harvest procedures and reporting.

Enforcement Options

Fishery Officers are responsible for enforcing the *Fisheries Act*, the *Fishery (General) Regulations* and the *Pacific Aquaculture Regulations* as they pertain to the aquaculture industry in B.C., and they are responsible for investigating violations of the Act and regulations. The enforcement option used is based on the severity of the violation.

Education

Used to promote compliance through education 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 to deal with individuals who have allegedly committed an offence. Restorative justice is one method designed to address offending behaviour and conflict in a formally recognized dispute resolution 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 may take place before or after charges are laid.

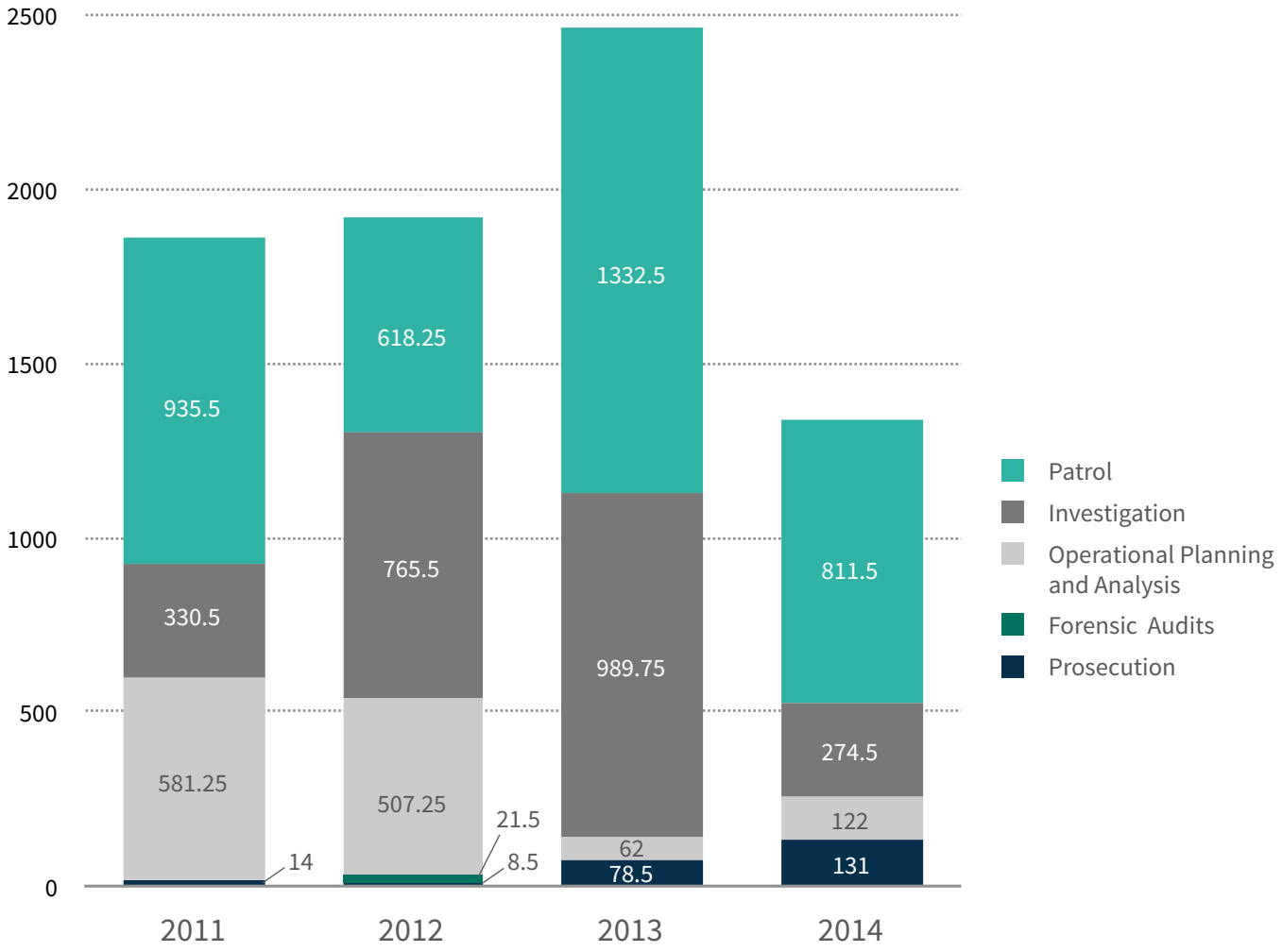
Summary of Charges and Convictions, 2011–2014

Fishery Officers conducted several investigations of non-compliance with the Marine Finfish licence conditions between 2011 to 2014. There were no charges and convictions in 2011, 2012 and 2014 related to the licence conditions, however, in 2013, Marine Harvest Canada was fined for exceeding the maximum production levels allowed by their licence at one aquaculture facility.

Details of Fishery Officer Activities

Figure 3 shows the number of hours that Fishery Officers dedicated to various aspects of monitoring marine finfish aquaculture activities between 2011 and 2014. It also shows the number of sites they visited. All inspections by Fishery Officers were unannounced visits to the aquaculture facilities.

Figure 3. Fishery Officer Hours Dedicated to Monitoring Marine Finfish Aquaculture Facilities, 2011–2014



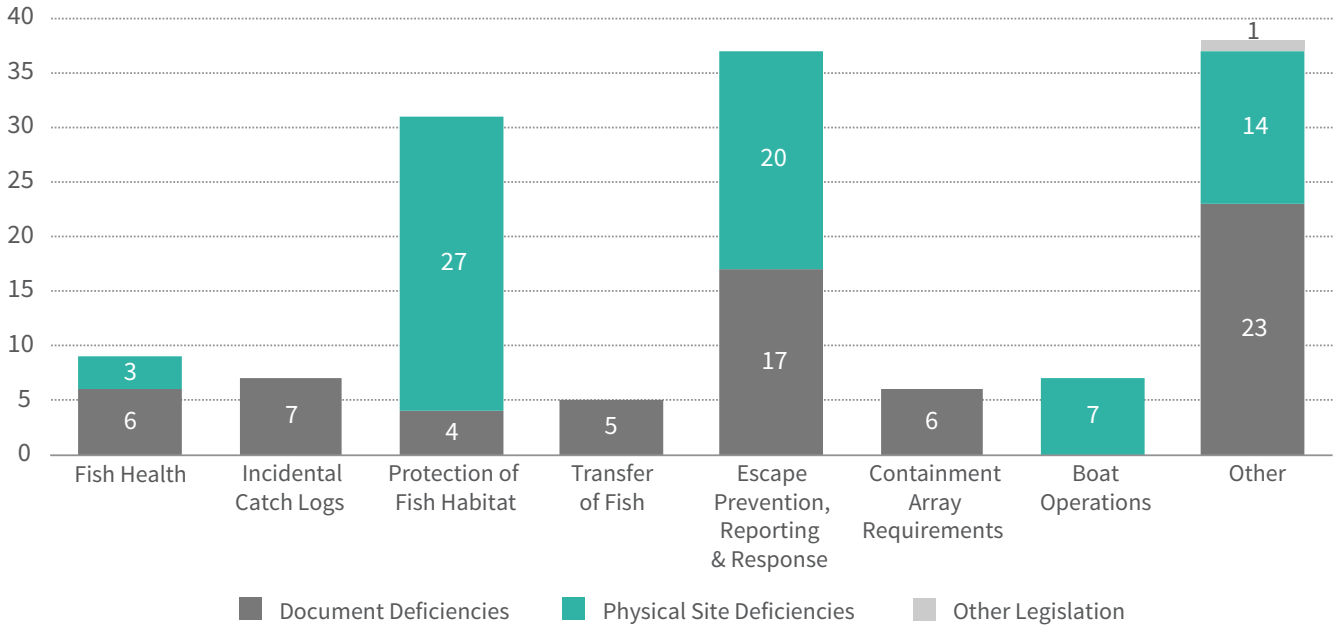
Many facilities received multiple warnings during site inspections in 2011. Licence conditions are updated annually to ensure appropriate management of the aquaculture industry.

As licence holders have become more familiar with the licence conditions, Fishery Officers have noticed a sharp decline overall in document deficiencies and non-compliance issues.

Deficiencies in 2011

In 2011, Fishery Officers inspected 79 marine finfish sites and issued a total of 140 warnings; a warning was issued for each component of the inspection that was non-compliant with licence conditions ("deficiencies") (Figure 4). Differences between the new federal regulations and the provincial regulations may have caused some of the non-compliance. Because 2011 was considered a transitional year for the marine finfish aquaculture industry, no charges were laid for these deficiencies. Approximately 49% of deficiencies in 2011 were related to insufficient documentation or the inability to produce records at the facility. Approximately 51% of deficiencies were physical site deficiencies related to infrastructure or equipment.

Figure 4. Deficiencies in 2011



Document Deficiencies

There were 68 document deficiencies recorded (Figure 4), the most frequent being:

- fish escape plans not posted on site
- incidental catch logs not up to date
- veterinary attestations (statements) not available for inspection

Physical Site Deficiencies

There were 71 physical site deficiencies recorded (Figure 4), the most frequent being:

- poor or non-existent containment of secondary fuel or equipment powered by fuel
- incomplete or missing fish escape kits
- poor net maintenance or missing net coverings (also known as "bird lids")
- poor signage at fish mortality floats

Other Legislation Deficiencies

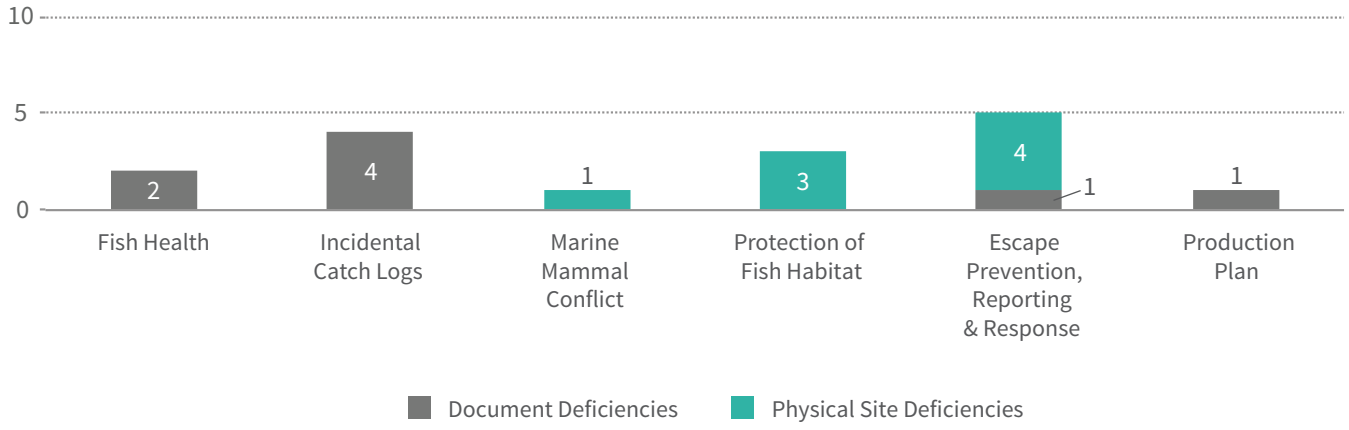
There was also one violation of the *British Columbia Sport Fishing Regulations*, where fish caught under a recreational fishing licence were not properly labelled ("Other" on Figure 4).

Deficiencies in 2012

In 2012, Fishery Officers inspected 38 facilities. As a result of the inspections, 16 warnings were issued for non-compliance with licence conditions (Figure 5). In addition, Fishery Officers used DFO's air surveillance program to check that sites reported as fallow (empty) by industry were not in operation.

Due to an outbreak of infectious haematopoietic necrosis (IHN) virus , Fishery Officer inspections were suspended from July to September 2012 in line with protocols to prevent the spread of disease. Although there were fewer site visits in 2012 than in 2011, there was a reduction in non-compliance. Deficiencies were evenly divided between document and physical deficiencies in 2012.

Figure 5. Deficiencies in 2012



Document Deficiencies

Eight document deficiencies were recorded (Figure 5), the most frequent being:

- incomplete incidental catch records, veterinary attestations, and escape prevention procedures
- harvest logs unavailable for inspection

Physical Site Deficiencies

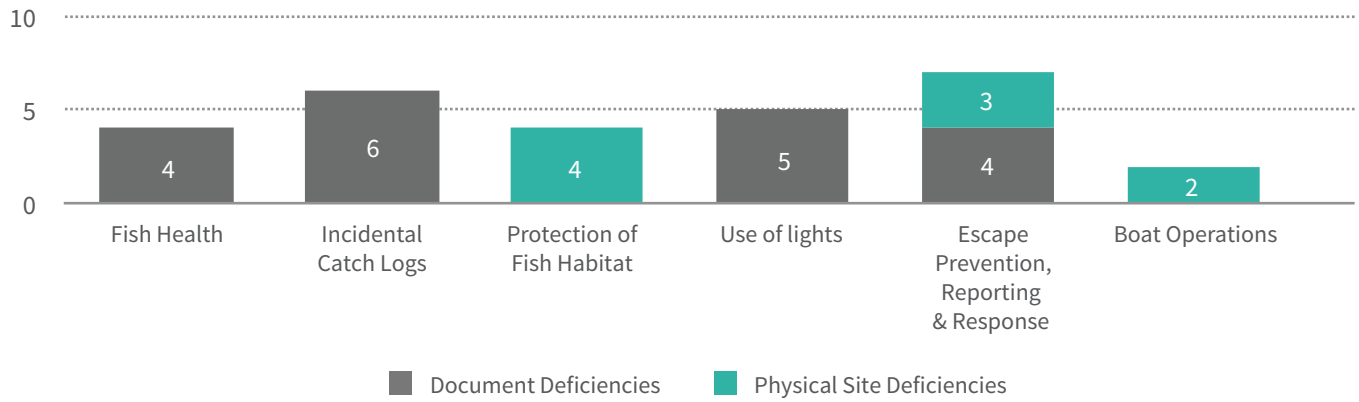
Eight physical site deficiencies were recorded (Figure 5), the most frequent being:

- net tags that did not correspond with office records
- poor or non-existent secondary fuel containment
- small holes observed in nets
- predator netting not properly installed

Deficiencies in 2013

In 2013, DFO moved to a production-cycle inspection system whereby each active site would be inspected at least once during a production cycle. Fishery Officers inspected 70 sites, issued 28 warnings for non-compliance with licence conditions (Figure 6), and laid one charge. Document deficiencies made up 68% and physical deficiencies made up 32%.

Figure 6. Deficiencies in 2013



Document Deficiencies

There were 19 document deficiencies recorded (Figure 6), the most frequent being:

- incidental catch logs not up to date
- incomplete use-of-lights reports
- veterinary attestations (statements) not available for inspection
- net tags that did not correspond with office records

Physical Site Deficiencies

Nine physical site deficiencies were recorded (Figure 6), the most frequent being:

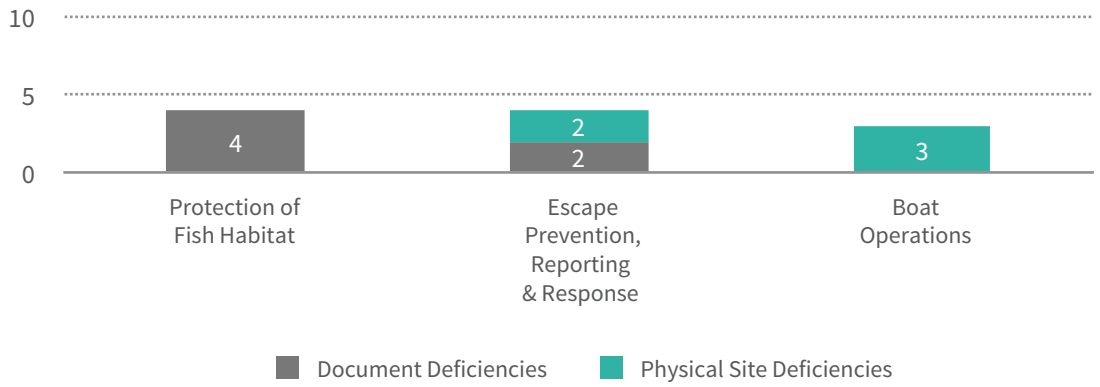
- poor or non-existent secondary fuel containment or leaking equipment
- fish mortality storage floats without signage (to restrict access by boats not involved in cultivation of fish)
- equipment missing from fish escape kits

Deficiencies in 2014

In 2014, Fishery Officers inspected 37 sites, issued 11 warnings for non-compliance with licence conditions (Figure 7).

Document deficiencies made up 55% of all deficiencies in 2014, and physical deficiencies made up 45%.

Figure 7. Deficiencies in 2014



Document Deficiencies

Six document deficiencies recorded (Figure 7), including:

- inability to produce net inventory records,
- no sewage disposal records.

Physical Site Deficiencies

Five physical site deficiencies were recorded (Figure 7), including:

- fish mortality storage floats without signage (to restrict access by boats not involved in cultivation of fish),
- net inventory control numbers did not match records.

Reporting Requirements and Reports Submitted

Overall Reporting Requirements

Licence holders are required to submit to DFO reports that fall into two broad categories: scheduled reports and incident reports. All reports are reviewed by DFO to validate content, ensure that they contain all elements required by the licence conditions, and determine if they were submitted on time. When a report contains only minor administrative omissions or errors, and if the licence holder corrects these in a timely manner, the reports may be considered complete and on time.

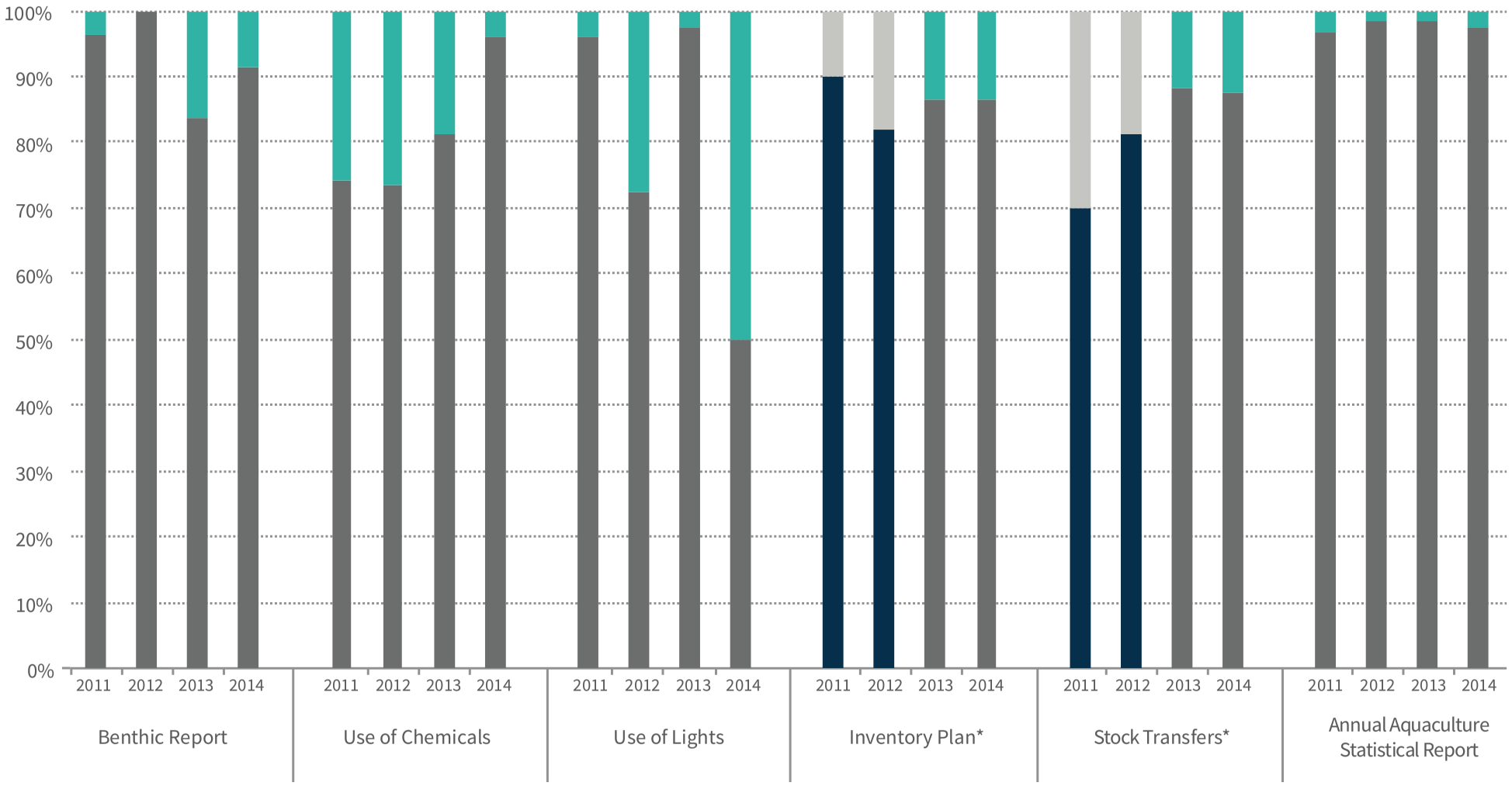
Scheduled Reports

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

- inventory plans
- stock transfers
- sea lice
- mortality by cause
- escapes (2011–2012)
- use of lights
- use of chemicals, feed and other substances
- Annual Aquaculture Statistical Report (AASR)

Figure 8 summarizes the scheduled reports submitted to DFO from 2011 to 2014 and shows how many were complete and on time.

Figure 8. Scheduled Reports Submitted to DFO, 2011–2014



Incident Reports

Incident reports are submitted following specific incidents or events identified in the licence conditions:

- benthic monitoring
- escapes
- marine mammal drownings
- marine mammal authorized predator control activities
- incidental catch
- urgent notification and follow up reports
- alternate cage array use

For specific reporting timelines and detailed requirements for each report listed above, please refer to the Marine Finfish Conditions of Licence: http://www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html.

Tables 1 to 5 summarize the number of incidents that were reported to DFO in 2011–2014:

- Table 1 – Escapes
- Table 2 – Incidental Catch
- Table 3 – Marine Mammal Drownings
- Table 4 – Authorized Predator Control
- Table 5 – Fish Health Events

Table 1. Incident Reports – Escapes

Year	Number of Incidents	Number of Escaped Fish
2011	1	12
2012	4	2,754
2013	1	200-300
2014	0	0

Table 2. Incident Reports – Incidental Catch

Year	Number of Incidents	Incidental Catch Quantity
2011	52	11,712
2012	50	19,135 + 2.55 t*
2013	30	26,850
2014	21	19,343

*In 2012, incidental catch of herring occurred during a planned depopulation to control the spread of infectious haematopoietic necrosis virus (IHNv); the quantity of herring caught was measured in metric tonnes.

Table 3. Incident Reports – Marine Mammal Interactions: Drownings

Year	Number of Incidents (Marine Mammals Drowned)
2011	8
2012	20
2013	4
2014	13

Table 4. Incident Reports – Marine Mammal Interactions: Authorized Predator Control

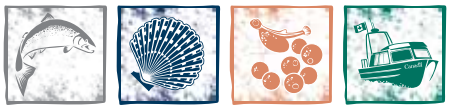
Year	Number of Incidents (Marine Mammals Killed)
2011	294*
2012	9
2013	3
2014	2

*In 2011, following a high number of reported marine mammal shootings, DFO met with industry members to clarify the circumstances under which killing marine mammals is permitted.

Table 5. Incident Reports – Fish Health Events

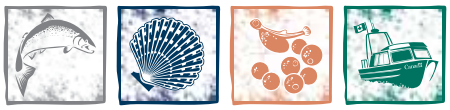
Year	Number of Incidents	Type and Number of Reported Fish Health Events
2011	12	Harmful algae (9) Low dissolved oxygen (3)
2012	18	Harmful algae (11) Low dissolved oxygen (4) Infectious disease (1) Non-infectious disease (1) Other*
2013	2	Low dissolved oxygen (1) Other environmental (1)
2014	21	Harmful algae (9) Low dissolved oxygen (5) Non-infectious disease (4) Bacterial disease (1) Maturation (1) Unknown (1)

*Reportable diseases are reported directly to the Canadian Food Inspection Agency (CFIA). Visit the CFIA aquatic animals website for surveillance test results: http://www.inspection.gc.ca/animals/aquatic-animals/diseases/eng/1299156296625/1320599059508.



Monitoring and Audits

DFO is committed to a regulatory approach that ensures the aquaculture industry operates sustainably and with minimal impacts on wild fish stocks. Since 2010, marine finfish aquaculture licences have been valid for a maximum period of one year. The licence conditions are reviewed yearly in consultation with industry, First Nations, and environmental non-government organizations (ENGOs) to strengthen regulatory requirements and streamline some reporting requirements. As a result, from 2011 to 2014, some reporting requirements and reporting frequencies were changed. The inspection component of the field program also changed due to changing licence conditions and a shift in monitoring priorities.



Monitoring and Audits: Fish Health

Fish Health Management Plans

Aquaculture facility operators are required to regularly report to DFO on the health of their stocks, as well as on treatments that are applied. 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 are complying with their Health Management Plans (HMPs). The methods and protocols for this monitoring can be found at http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/health-sante/index-eng.html.

At active salmon facilities, DFO staff conduct fish health audits and inspections throughout the year to check that the cultivated 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

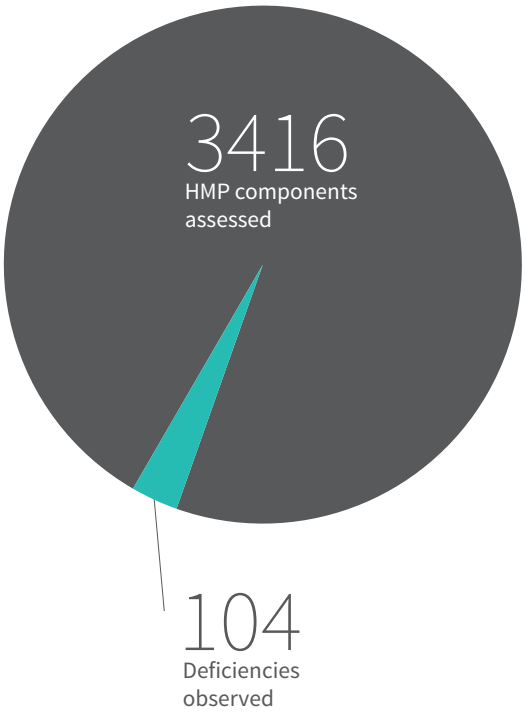
During inspections, DFO collects recently dead ("silver") carcasses to verify the facility veterinarians' routine monitoring and reporting of natural diseases common to B.C.'s wild and farmed fish. During fish health audits, DFO compares inspection results to reports submitted by the aquaculture companies each calendar quarter.

Fish Health in 2011

Figure 9 summarizes the results of Fish Health Management Plan (HMP) inspections by DFO in 2011. A total of 71 HMP inspections were completed.

During 24 of those visits, no deficiencies were observed. Of the 3,416 HMP components assessed during the inspections, DFO observed 104 deficiencies.

Figure 9. 2011 DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in B.C.



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
10

Disease contingency or mass mortality information or records needs improvement
2

Fish handling, euthanasia protocol or records
3

Husbandry or record keeping as per COL needs improvement
9

Lice protocol or lice records as per COL improvement
22

Mooring signage needs improvement
22

Nutritional or medicated feed protocol concerns
2

Transfer records are not complete or up-to-date
25

Visitor protocol communication needs improvement
7

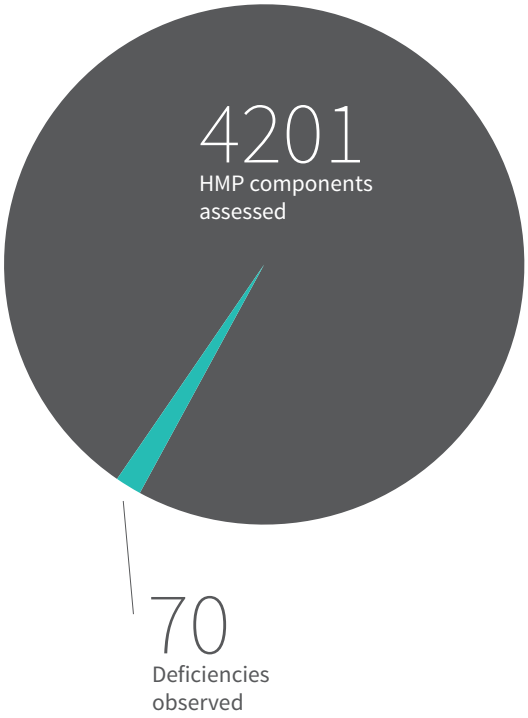
Water quality monitoring, equipment or record keeping needs improvement
2

Fish Health in 2012

Figure 10 summarizes the results of the Fish Health Management Plan inspections by DFO in 2012. A total of 118 HMP inspections were completed.

During 77 of those visits, no deficiencies were observed. Of the 4,201 HMP components assessed during the inspections, 70 deficiencies were observed.

Figure 10. 2012 DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in B.C.



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
10

Current licence was not posted at facility
1

Disease contingency or mass mortality information or records needs improvement
1

Fish handling, euthanasia protocol or records
1

Footbaths or sanitizers needs improvement
1

Husbandry or record keeping as per COL needs improvement
8

Lice protocol or lice records as per COL Appendix VI or VI-A needs improvement
16

Mooring signage needs improvement
8

Nutritional or medicated feed protocol concerns
1

Training documentation is not up-to-date
6

Transfer records are not complete or up-to-date
11

Visitor protocol communication needs improvement
3

Water quality monitoring, equipment or record keeping needs improvement
2

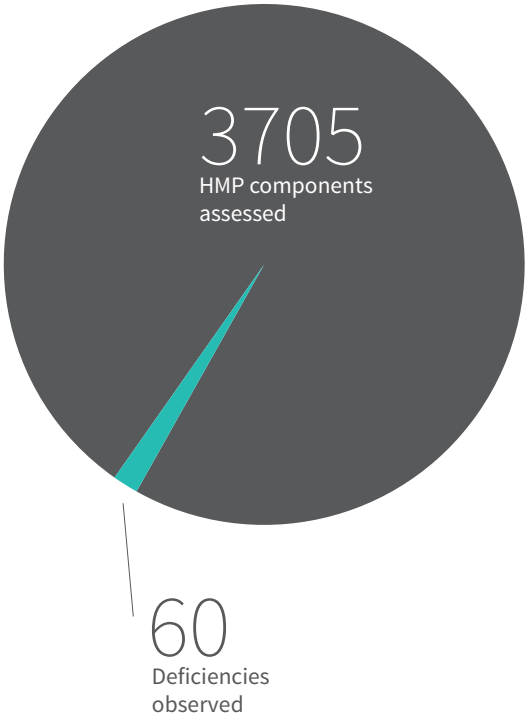
Wild fish mortality records need clarification
1

Fish Health in 2013

Figure 11 summarizes the results of the Fish Health Management Plan inspections by DFO in 2013. A total of 120 HMP inspections were completed.

During 83 of those visits, no deficiencies were observed. Of the 3,705 HMP components assessed during the inspections, 60 deficiencies were observed.

Figure 11. 2013 DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in B.C.



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
4

Current licence was not posted at facility
2

Footbaths or sanitizers needs improvement
3

Husbandry or record keeping as per COL needs improvement
10

Lice protocol or lice records as per COL Appendix VI or VI-A needs improvement
15

Mooring signage needs improvement
7

Nutritional or medicated feed protocol concerns
3

Transfer records are not complete or up-to-date
10

Visitor protocol communication needs improvement
4

Water quality monitoring, equipment or record keeping needs improvement
1

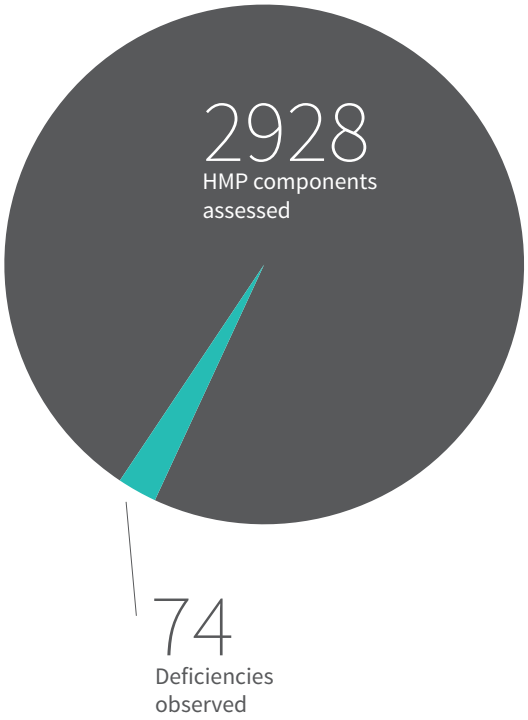
Wild fish mortality records need clarification
1

Fish Health in 2014

Figure 12 summarizes the results of the Fish Health Management Plan inspections by DFO in 2014. A total of 114 HMP inspections were completed.

During 70 of those visits, no deficiencies were observed. Of the 2,928 HMP components assessed during the inspections, 74 deficiencies were observed.

Figure 12. 2014 DFO Fish Health Management Plan Inspections at Salmon Aquaculture Facilities in B.C.



Deficiencies Observed

Carcass retrieval protocol or record keeping needs improvement
23

Footbaths or sanitizers needs improvement
11

Husbandry or record keeping as per COL needs improvement
3

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

Mooring signage needs improvement
6

Nutritional or medicated feed protocol concerns
1

Training documentation is not up-to-date
5

Transfer records are not complete or up-to-date
4

Visitor protocol communication needs improvement
2

Sea Lice

Licence holders must count sea lice at active marine finfish facilities throughout the year: monthly from July 1 to February 28, and every two weeks from March 1 to June 30 when wild salmon smolts out-migrate. If the average number of motile *Lepeophtheirus salmonis* (a species of sea lice) exceeds three per fish, the licence holder must report the finding to DFO within seven days.

DFO performs their own 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.

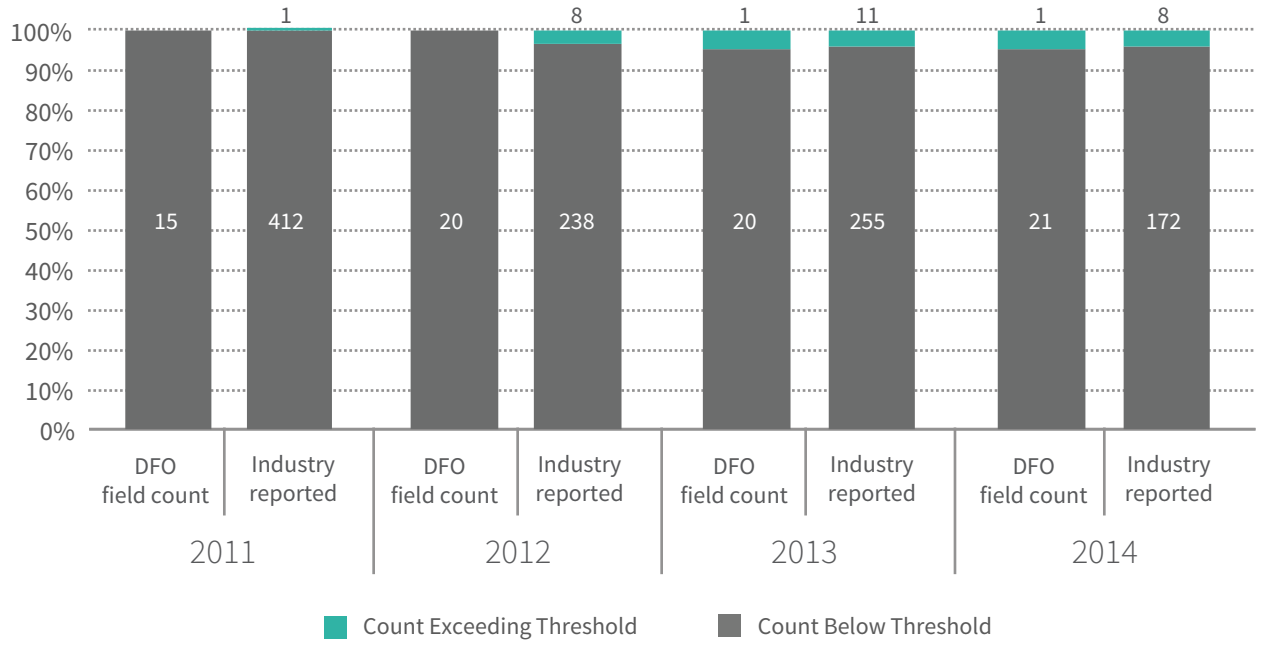
At certain times, counting sea lice may be risky or harmful to farmed fish because some natural phenomena, including algal blooms and low dissolved oxygen (hypoxia), can stress or kill finfish. During these, handling of farmed fish to perform sea lice counts is curtailed.

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. The chart below illustrates the percentage of sites where the average number of motile *Lepeophtheirus salmonis* lice per fish exceeded the threshold, as reported by industry and through DFO's own sea lice audits.

Figure 13 summarizes the sea lice counts performed by industry and DFO. In 2012, sea lice monitoring requirements in B.C. were suspended following an outbreak of infectious hematopoietic necrosis (IHN). Between 2011 and 2014, during the wild salmon outmigration period from March 1 to June 30, an average of 96% of sites were below the sea lice thresholds of three lice per fish.

More detailed monitoring results can be found on DFO's website: http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/lice-pou-eng.html.

Figure 13. Counts of Motile Sea Lice *Lepeophtheirus salmonis* between March and June, 2011–2014



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 Cause report describes the number and causes of all fish deaths (wild or cultured) at the facility and must be submitted quarterly to DFO. This report also states any therapeutants and 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 "major mortality event" as defined by the licence conditions. 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, number of dead fish, and percentage of the population lost must be submitted within ten days. For events that persist, update reports must be submitted every ten days until the mortality levels return to normal.

From 2011 to 2014, the most common causes of mortality events were harmful algal blooms and low dissolved oxygen. During this time, 42 reported mortality events were attributed to those causes. During the same period, other causes such as infectious disease, non-infectious disease, bacterial disease, and maturation accounted for 11 more mortality events.

Table 5 (page 15) summarizes the total number of Fish Health Events notifications received by DFO from 2011 to 2014. For detailed information on mortality by cause and mortality events submitted by industry and from DFO audits, please visit: http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/health-sante/facility-installation-eng.html.

Monitoring and Audits: Environmental

Benthic (Seabed) Monitoring

The aquaculture industry is required by their licence conditions to conduct benthic monitoring at all of their sites. 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, all of which allows DFO results to be directly compared with 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. More sampling may be required as outlined in the licence or as prescribed by DFO.

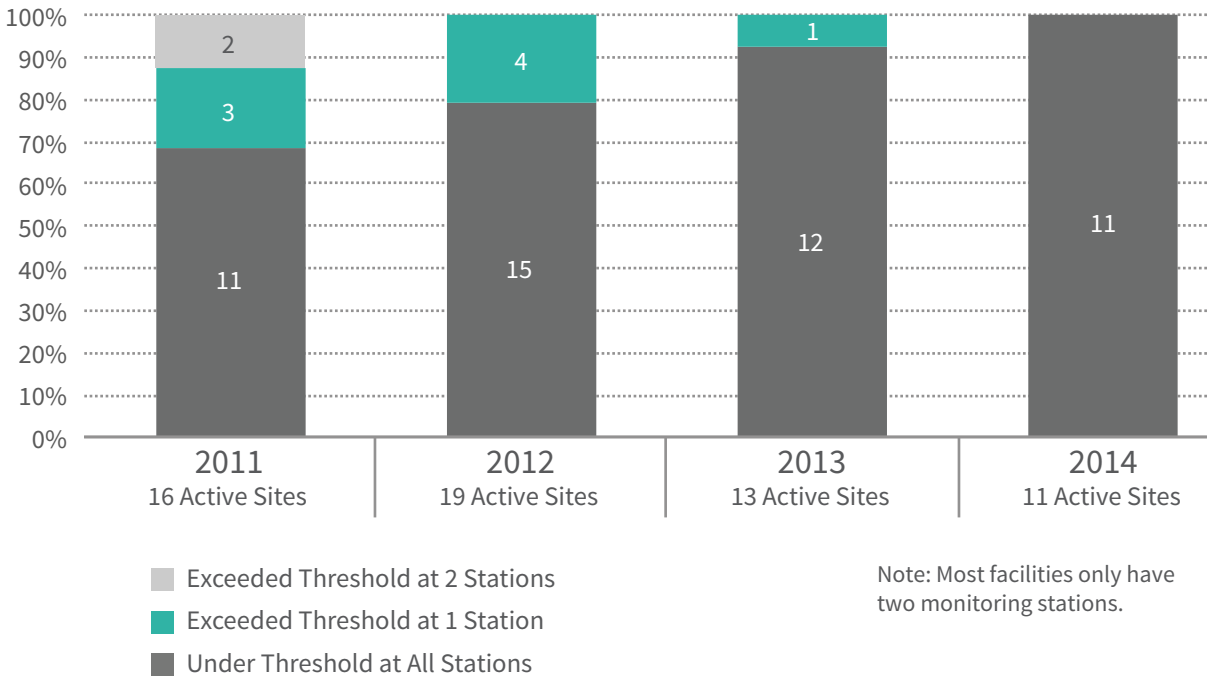
The video collected is assessed by industry representatives and DFO staff, who observe and record various types of information. The zone of compliance for hard bottom sites is between 100 and 124 metres from the cage array, although video is always also taken closer and farther away. The zone of compliance is divided into six segments, each 4 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 check whether hard-bottom sites comply with the licence conditions, 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 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 site must be fallowed (left empty) until further monitoring shows that it has recovered sufficiently.

Figure 14 summarizes the seabed sampling reports for facilities over hard or mixed seabed submitted by industry between 2011 and 2014. Industry-submitted data showed that for facilities over a hard seabed, an average of 80% of active facilities were under the allowable threshold at all monitoring stations.

Figure 14. Industry-Reported Seabed Monitoring at Peak Biomass for Facilities over Hard or Mixed Seabed

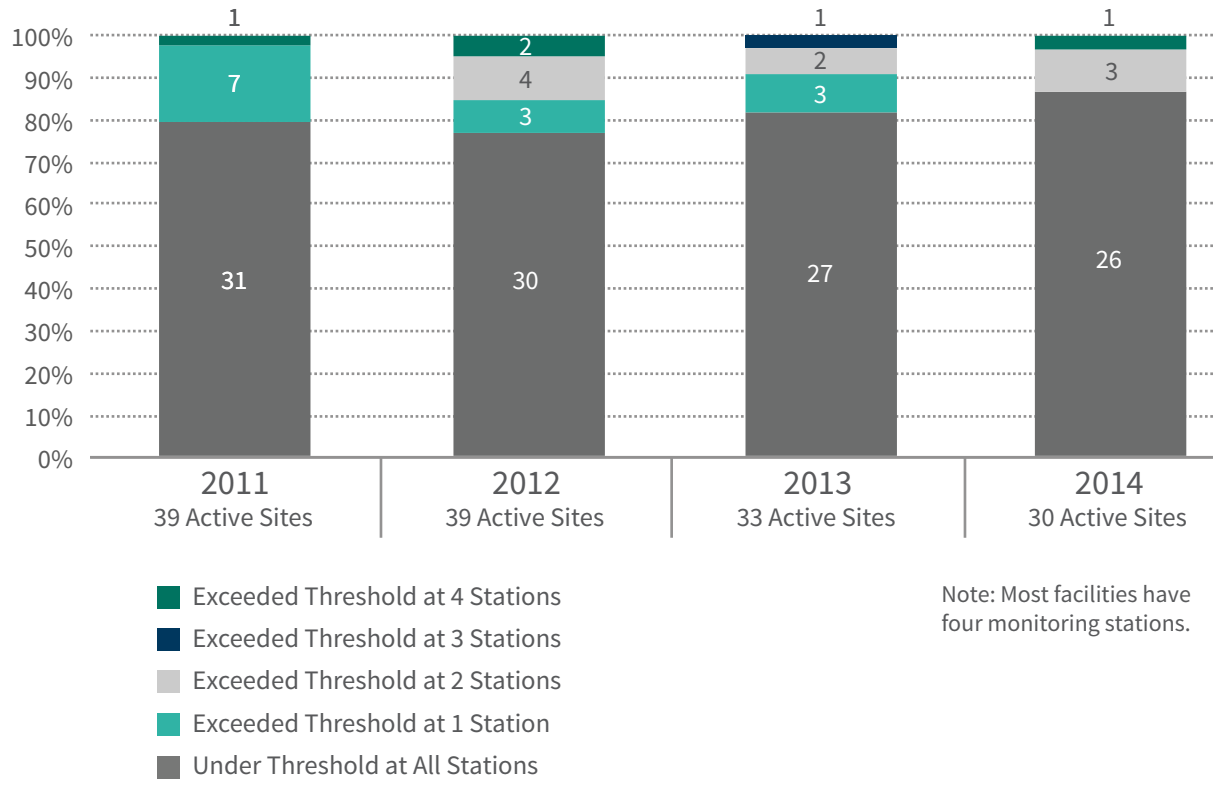


At sites with a soft ocean substrate (seabed), at least two transects (lines across the seabed) are monitored by taking sediment samples at 0, 30, and 125 metres from the cage edge and analyzing the physical and chemical properties of the samples. Only data gathered from the 30 metre and 125 metre stations is used for regulatory purposes. Sediment sampling must occur at two sides of the cages and where the most impact is expected. More sampling may be required as outlined in the licence 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 allowable amounts 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 15 summarizes the benthic sampling reports for facilities over soft or mixed seabed submitted by industry between 2011 and 2014. Industry-submitted data showed that over 75% of active facilities were under the allowable threshold at all monitoring stations.

Figure 15. Industry-Reported Seabed Monitoring at Peak Biomass for Facilities over Soft or Mixed Seabed



Note: Most facilities have four monitoring stations.

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:

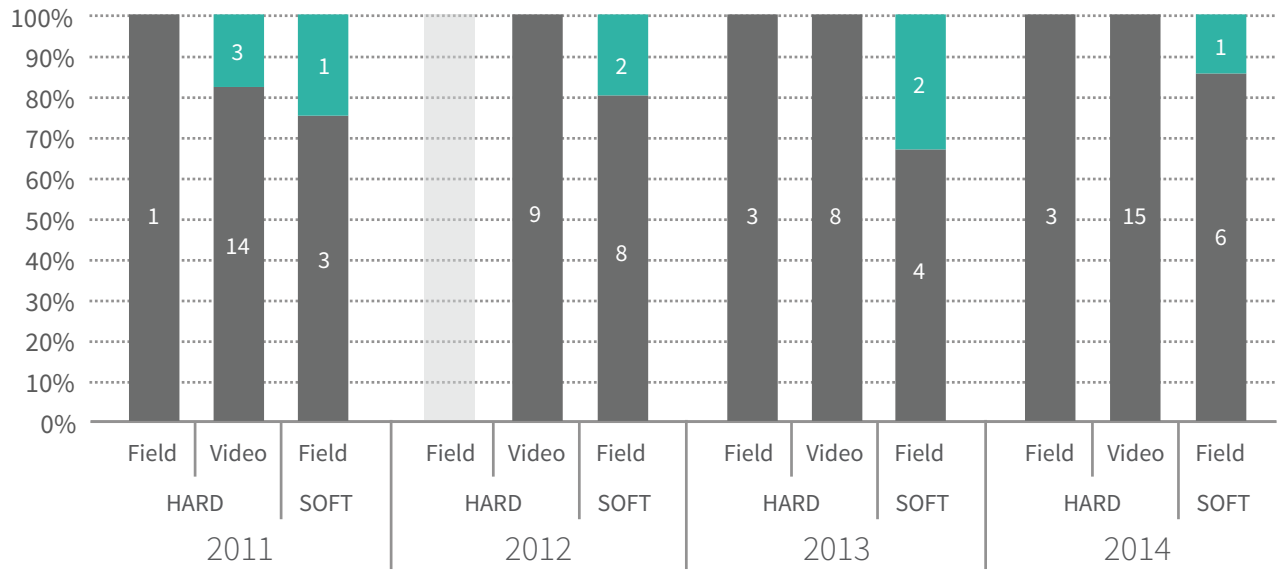
1. To compare industry-generated data with DFO-generated data to ensure that industry is following the correct procedures and that the two data sets are similar.
2. To determine whether the compliance sampling stations or transects used by industry are appropriate.
3. To investigate sites with poor environmental 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/or conducts a field assessment at the same location as industry.

Figure 16 summarizes the field and video audits of industry-submitted reports between 2011 and 2014. Twenty-two sites were audited in 2011, 19 in 2012, 17 in 2013, 25 in 2014. In this four-year period, an average of 89% of DFO's findings agreed with the industry-submitted reports.

Disagreement can arise in two ways: where industry found greater impact than DFO, and where industry found less impact than DFO. In the case of disagreement, DFO directs industry to use the monitoring results that show greater impact and to respond to the results as required by their licence.

Figure 16. DFO's Assessment of Seabed Monitoring Reports from Industry



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. In 2011 and 2012, DFO required a monthly report of any fish that could not be accounted for based on inventory records (including nil reports). The requirement to report escapes monthly was discontinued in 2013. Since 2013, escape reports are only required when an incident occurs.

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

Eight inspections were conducted in 2011, 14 in 2012, four in 2013 and four in 2014. All sites were found to be in compliance with the licence conditions.

To evaluate the risk associated with escaped Atlantic salmon, DFO staff periodically survey rivers to search for Atlantic salmon in B.C. waters. They focus on streams where Atlantic salmon are most likely to have established populations, based on sightings and captures reported to DFO. Extensive field work was conducted in 2011 and 2012 in 12 freshwater systems on Vancouver Island, and no Atlantic salmon at any life stage were identified.

Table 1 (page 14) summarizes the total number of escaped fish reported by industry from 2011 to 2014. Detailed information on the escape of cultured fish, including the description of each incident, can be found at http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/escape-evasion-eng.html.

Incidental Catch

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. Incidental catch are any wild fish caught or found dead within the facility during harvest, while fish are being moved within or between facilities, or during net removal. Aquaculture operations are not allowed to cultivate or sell any species of fish not listed on their licence. All incidental catch during transfer 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 incidental catch to waters outside the aquaculture facility in a manner that least harms the fish.

In 2011 and 2012, incidental catch was reported to DFO quarterly. In 2013 and 2014, reports were submitted within 14 calendar days of removing the nets after harvest. For facilities that continuously have fish present, records must be submitted every two years.

Table 2 (page 14) summarizes the total number of incidental catch reported by industry from 2011 to 2014. For detailed information on incidental catch, including the number of fish and species killed, please visit: http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/incidental-accidentel-eng.html.

DFO monitors fish harvests and transfers to ensure the proper handling, record-keeping, and identification of incidental catch. Field observations of harvest or transfer for the management of incidental catch began in 2013; no non-compliance has been found to date.

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 facility infrastructure and farmed fish. Industry must:

- have a Marine Mammal Conflict Mitigation 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.

Eight inspections were conducted in 2011; 14 in 2012; four in 2013; and four in 2014. Site inspections showed that marine mammal conflict management plans were being followed. DFO staff also review records on-site related to preventing escapes and managing marine mammal conflicts. 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.

Tables 3 and 4 (pages 14 and 15) summarize the total number of marine mammals drowned and killed from 2011 to 2014. In 2011, following a high number of reported marine mammal shootings, DFO met with industry members to clarify the circumstances under which marine mammals can legally be dispatched. During all site visits, DFO communicates best practices for dealing with marine mammals.

Use of Lights

Underwater lighting at marine finfish aquaculture sites is used to delay the start of sexual maturation. This 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 facility, visit: http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/lights-eclairage-eng.html.

DFO audits each report for completeness. See Figure 8 (page 13) for a summary of the industry's compliance.

Use of Chemicals, Feed, and Other Substances

Every year, the licence holder must submit a report summarizing:

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

The report must be submitted for the previous calendar year by January 15. DFO audits each report for completeness. See Figure 8 (page 13) for a summary of the industry's compliance.

Monitoring and Audits: Inventory & Aquaculture Statistics

Inventory Plans and Stock Transfers

Licence holders submitted inventory plans annually to DFO in 2011, 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 facility for the previous month, and the remaining six months must be projected inventory. A plan must be submitted even when no production is occurring. Any transfers of stock from one facility to another must be reported if the transfers occurred in the previous month.

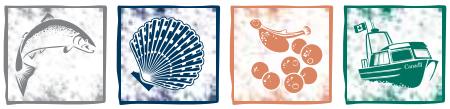
DFO audits the inventory plans by checking the following:

- Transfers and harvests agree with the inventory plan.
- Drastic drops in biomass are accounted for in harvest or transfer reports.
- Sites do not exceed their licensed production limit.

Detailed fish transfer information can be found at this link: http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/intro-trans-eng.html.

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. From 2011 to 2014, all marine finfish Annual Aquaculture Statistical Reports were submitted to DFO, with an average of 98% of reports submitted on time.



Summary

DFO staff inspect and audit all aspects of an aquaculture facility's operations that relate to the marine finfish licence conditions. A combined total of 945 site visits were completed by DFO staff from 2011 to 2014. These visits included checks on record keeping, physical inspections of equipment and structures, and review of site management practices. DFO also collected samples to audit data received from licence holders regarding benthic impact, fish health, and sea lice. DFO continues to update monitoring and reporting requirements to ensure a responsible, sustainable and economically prosperous aquaculture sector.

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