Regulating and Monitoring British Columbia's Marine Finfish Aquaculture Facilities

2018

AQUACULTURE MANAGEMENT

Fisheries and Oceans Canada
Pêches et Océans Canada

Canada

Marine Finfish Aquaculture in BC

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 as of December 31, 2018 are shown in the map on the following page.

MARINE FINFISH SPECIES CULTIVATED IN BC

Most 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 BC. Some other species, such as Sablefish (*Anoplopoma fimbria*), are also cultivated on a smaller scale. Atlantic Salmon is the preferred species for cold water 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.

SHARE OF PRODUCTION BIOMASS BY SPECIES

Atlantic Salmon
95.7%

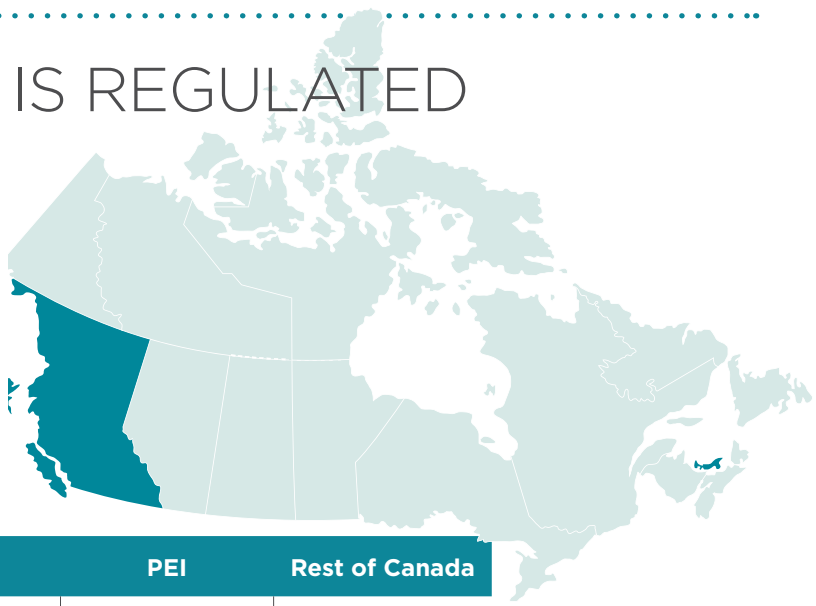
Chinook Salmon
2.7%

Sablefish
1.6%

HOW FISH FARMING IS REGULATED IN CANADA

Fish farming is jointly managed among federal, provincial and territorial governments. How it's managed varies across provinces and territories.

Across Canada, fish farming is managed sustainably under the *Fisheries Act*. Federal partners work together to make sure fish are healthy and safe to eat.



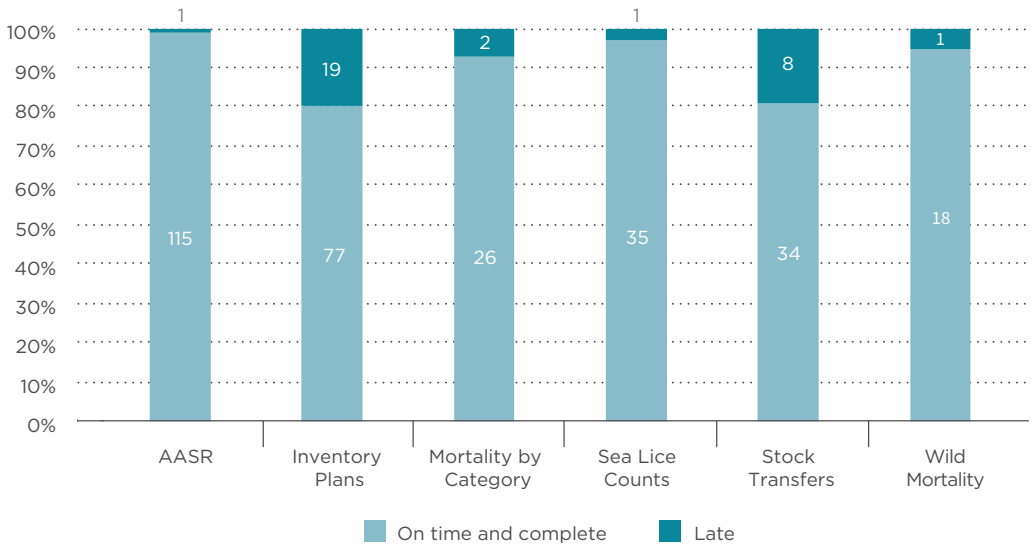
	BC	PEI	Rest of Canada
Site Approval	Shared	Shared	Provincial
Land Management	Provincial	Federal	Provincial
Day-to-day Operations & Oversight	Federal	Federal	Provincial
Introductions & Transfers	Shared	Shared	Shared
Drugs & Pesticide Approvals	Shared	Shared	Shared
Food Safety	Federal	Federal	Federal

2018 Active and Inactive Marine Finfish Aquaculture Sites in British Columbia

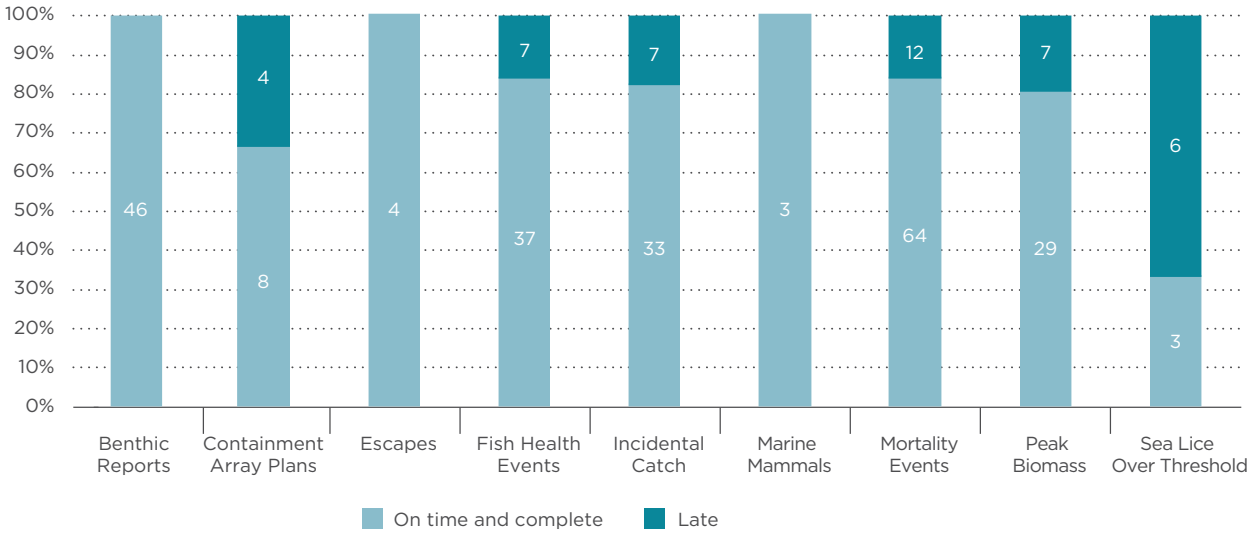
Reporting Requirements

Under the *Pacific Aquaculture Regulations*, licence holders are required to submit to DFO reports that fall into two broad categories: scheduled reports and event-based reports. 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.

2018 Scheduled Reports Submitted to DFO



2018 Event Based Reports Submitted to DFO




MUSTANG
SURVIVAL

What Happens During a Fish Health Audit?

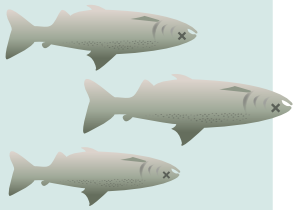
Fisheries and Oceans Canada (DFO) requires operators of marine salmon farms to follow strict measures to keep fish healthy and conducts routine, random site inspections to ensure compliance.

In BC, farm operators must follow a DFO-approved Health Management Plan (HMP). This plan outlines how the farm will manage biosecurity, water quality, medication treatment and other measures to maximize fish welfare. Industry must monitor the health of their fish and report their findings to DFO.

1

SAMPLING AND OBSERVATION

A team of 2 or 3 DFO biologists spend about 4 hours on each site. Auditors observe fish in each pen, noting any behaviour or signs that might indicate poor health, such as slow swimming or visible abnormalities. They then select up to 10 recently deceased fish (called "silvers") for sampling.



2

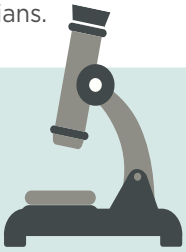
TISSUE COLLECTION

Tissue samples are taken on site and then sent to a laboratory accredited by the Standards Council of Canada and the American Association of Veterinary Laboratory Diagnosticians.

3

LAB ANALYSIS

The lab analyzes samples for specific viruses and health conditions of concern, including infectious salmon anaemia virus (ISA), Infectious Hematopoietic Necrosis virus (IHNv), and heart and skeletal muscle inflammation (HSMI).



4

REVIEW AND PUBLISH RESULTS

Results are reviewed by DFO veterinarians and reported on DFO's website at: www.dfo-mpo.gc.ca/aquaculture/protect-protege/reduce-disease-reduire-maladie-eng.html

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Certain serious infectious diseases, such as ISA and IHNv, are listed under the *Health of Animals Act*. If found, they must be reported immediately to the Canadian Food Inspection Agency, which investigates and develops a plan to prevent the disease from spreading.

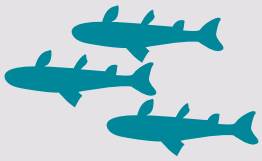
HOW DFO INSPECTS FISH HEALTH AT BC AQUACULTURE SITES

Auditors use a checklist of 60 items to ensure a farm is operating as licensed and following its HMP. Any deficiencies are noted and reviewed with the farm operator so that improvements can be made. Results are also reported publicly on DFO's website.

FISH BEHAVIOUR AND HEALTH
are monitored

WATER QUALITY
is monitored routinely and can be addressed if needed

BIOSECURITY PROTOCOLS
such as equipment disinfection, visitor restriction and the use of footbaths, are followed



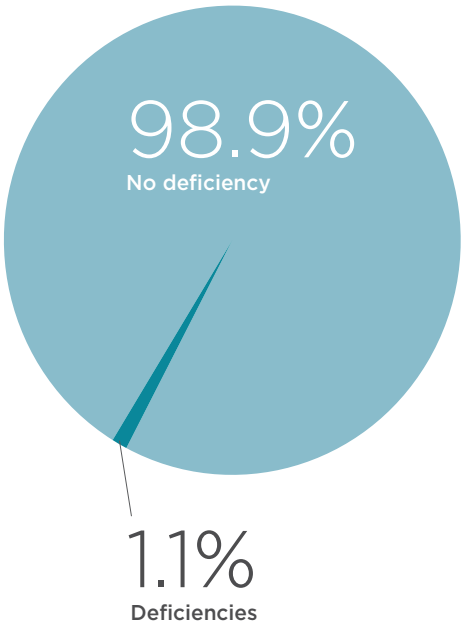
COLLECTION & CLASSIFICATION
of deceased fish is frequent and acceptable

FEED, NUTRITION & MEDICATION RECORDS
are complete and up-to-date

Results are reviewed by DFO veterinarians and reported on DFO's website at:
www.dfo-mpo.gc.ca/aquaculture/protect-protege/reduce-disease-reduire-maladie-eng.html

2018 DFO FISH HEALTH MANAGEMENT PLAN INSPECTIONS

This figure summarizes the 35 deficiencies observed during Fish Health Management Plan inspections by DFO in 2018. A total of 120 Health Management Plan (HMP) inspections were completed.



Carcass retrieval protocol or record keeping needs improvement (3)

Disease contingency or Mass mortality information or records needs improvement (3)

Husbandry or record keeping as per Conditions of Licence Appendix VIII-A or VIII-B needs improvement (4)

Lice protocol or lice records as per Conditions of Licence Appendix VII or VII-A needs improvement (17)

Mooring signage needs improvement (3)

Nutritional or medicated feed protocol concerns (1)

Transfer records are not complete or up-to-date (2)

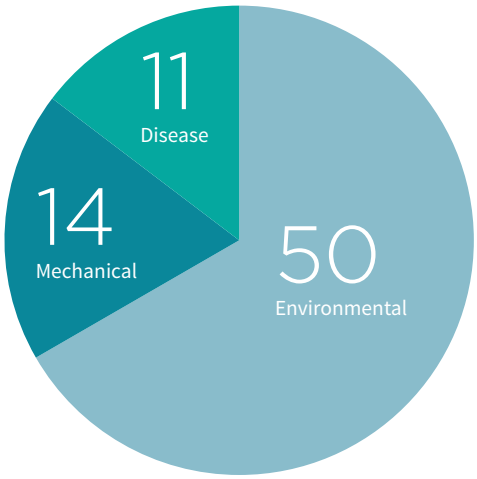
Wild fish mortality records needs clarification (2)

INDUSTRY REPORTED EVENTS

2018 Mortality Events

This figure summarizes mortality events as reported by industry for active facilities in 2018.

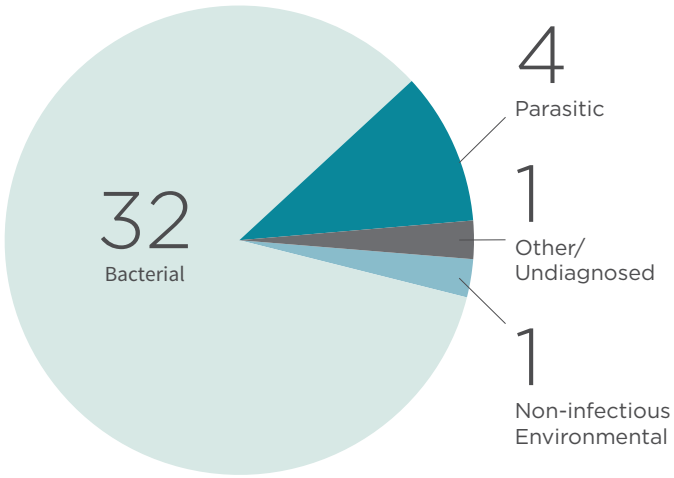
A mortality event occurs if the amount of dead fish at a marine finfish aquaculture facility exceeds thresholds outlined in conditions of licence.



2018 Fish Health Events

This figure summarizes fish health events as reported by industry for active facilities.

A fish health event is any suspected or active disease that occurs within an aquaculture facility that requires the involvement of a veterinarian and warrants mitigation measures.



Fish Health

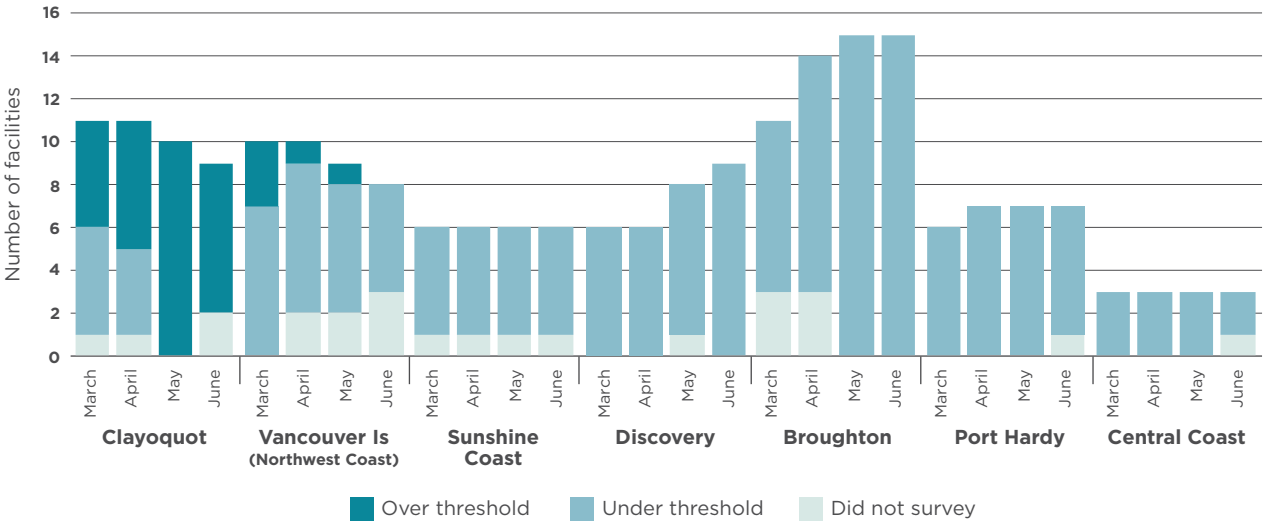
SEA LICE

Minimizing the sea lice levels on farms through mandatory monitoring, mitigation, treatment and reporting, as well as DFO audits/inspections to ensure compliance are critical components of sustainable aquaculture management. DFO assesses sea lice abundance in farmed salmon and verifies the accuracy of industry submitted data. This provides DFO with timely information regarding the operational performance and compliance of aquaculture facilities.

Licence holders must count sea lice at active Atlantic Salmon facilities throughout the year. Sampling for sea lice occurs monthly from July to February, and every two weeks from March 1 to June 30 when wild salmon smolts out-migrate. 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 sea lice per fish during the wild salmon outmigration period.

Sea lice abundance exceedances over the current threshold have been relatively rare since 2011; however, as part of an adaptive management approach, DFO is examining its current sea lice Conditions of Licence (COL) with a view to changing the conditions by 2020 to coincide with the next wild salmon outmigration window. A number of proposed enhancements to current licence conditions are being considered to align with the new approach to aquaculture and support Area Based Management and in consultation with First Nations, industry, and environmental non-governmental organisations.

2018 Sea Lice Over Threshold by Area



SEA LICE MANAGEMENT AT BC SALMON FARMS

WHAT ARE SEA LICE?

Sea lice are parasites that have lived in BC's coastal waters for thousands of years. Farmed fish are free of sea lice when they enter the ocean but can pick them up in the marine environment.

The species of sea lice that most affects wild and farmed salmon is called *L. salmonis*

YEAR ROUND

Farm operators must routinely conduct counts of sea lice on their fish and report these numbers monthly to DFO.

MAR 1 TO JUN 30

WILD JUVENILE OUTMIGRATION PERIOD

This is when young, wild salmon journey from their freshwater birthplaces to the ocean.

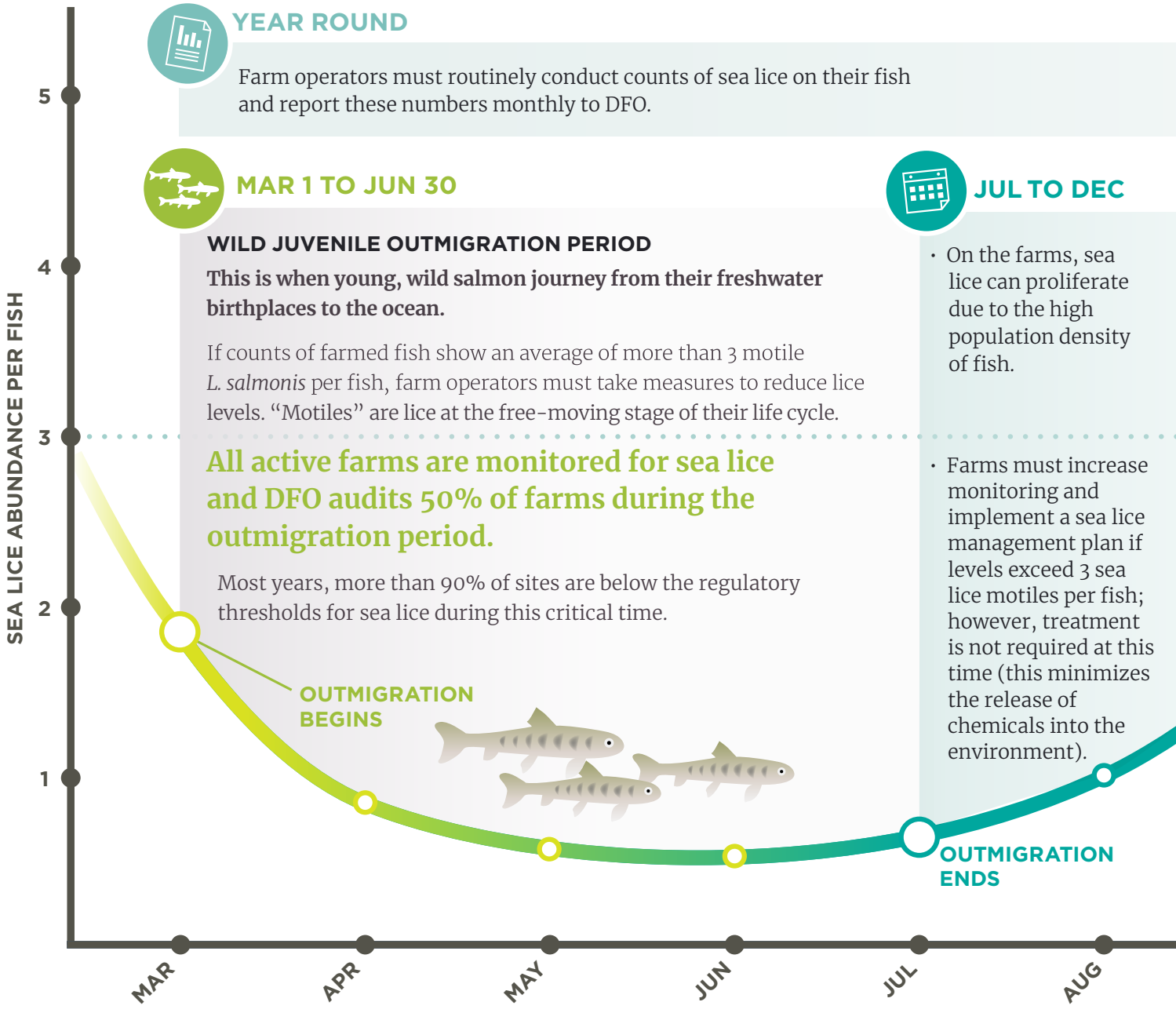
If counts of farmed fish show an average of more than 3 motile *L. salmonis* per fish, farm operators must take measures to reduce lice levels. "Motiles" are lice at the free-moving stage of their life cycle.

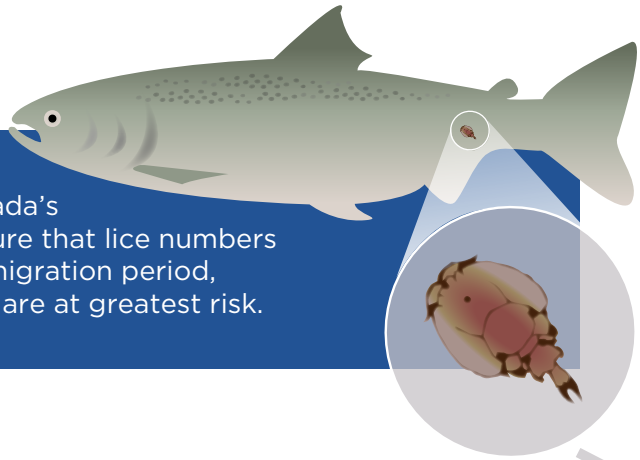
All active farms are monitored for sea lice and DFO audits 50% of farms during the outmigration period.

Most years, more than 90% of sites are below the regulatory thresholds for sea lice during this critical time.

JUL TO DEC

- On the farms, sea lice can proliferate due to the high population density of fish.
- Farms must increase monitoring and implement a sea lice management plan if levels exceed 3 sea lice motiles per fish; however, treatment is not required at this time (this minimizes the release of chemicals into the environment).





Sea lice generally do not harm adult fish, but can harm small juvenile salmon.

Fisheries and Oceans Canada's (DFO's) requirements ensure that lice numbers are lowest during the outmigration period, when wild juvenile salmon are at greatest risk.

Sea lice abundance varies from year to year and is influenced by environmental conditions like ocean salinity and temperature.

- In late summer, wild salmon start to return to their spawning grounds. These wild fish naturally carry sea lice, which they can transfer to farmed salmon. This is why lice levels on farms begin to increase in late summer and peak in early winter.

SEA LICE TREATMENTS APPLIED

UNMANAGED LICE LEVELS

3-MOTILE OUTMIGRATION THRESHOLD

DFO conducts sea lice audits to verify the accuracy of industry reporting.

In 2018 DFO sampled 2,880 Atlantic Salmon during 49 sea lice audits.

JANUARY AND FEBRUARY

Farms begin taking measures to reduce lice levels, if needed. This can include harvesting or the use of an in-feed or bath treatment approved by Health Canada.

This graph represents lice levels at an average farm during an average year.

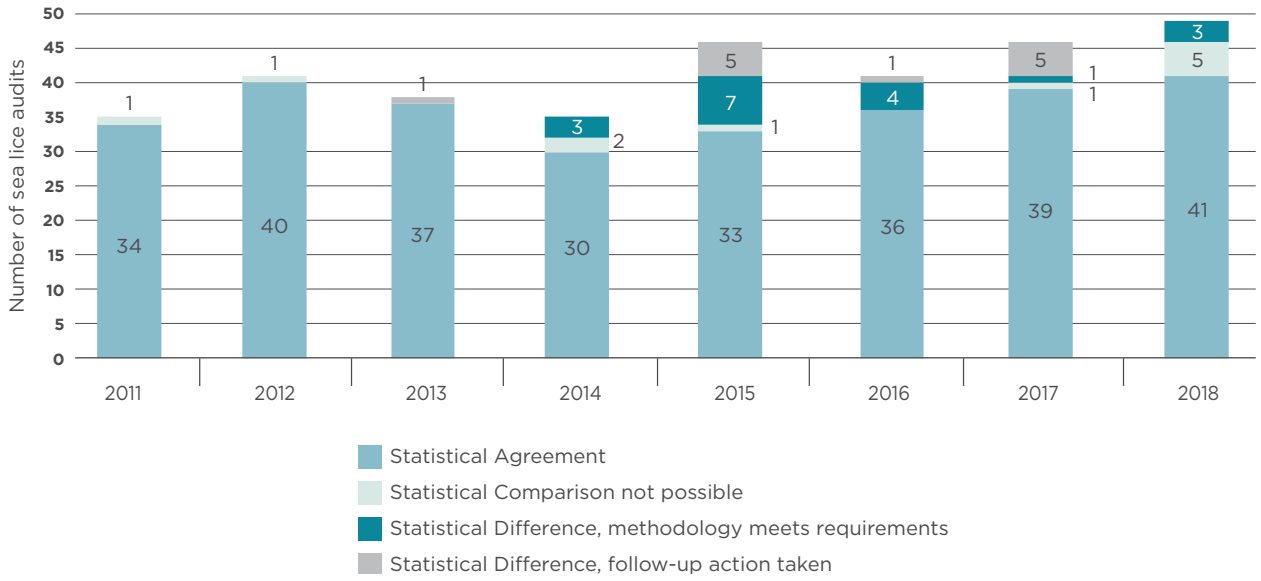
SEP OCT NOV DEC JAN FEB

INTEGRATED PEST MANAGEMENT

SLICE® (*emamectin benzoate*) is a commonly used chemotherapeutant licensed for sea lice management in farmed salmonids. In BC, SLICE® resistance has emerged in some farmed Atlantic salmon populations, necessitating the development of alternative treatments to ensure lice management and prevent wide-spread resistance. Having alternative treatment options is a key feature of Integrated Pest Management and involves numerous methods of controlling and reducing sea lice in order to reduce reliance on chemotherapeutants and prevent the development of resistance. Some examples include utilizing SLICE® on a rotational basis with alternative treatments like hydrogen peroxide baths and/or mechanical sea lice removal (e.g., using a hydrolicer boat).

DFO Marine Finfish Aquaculture Sea Lice Audits in BC, 2011 to 2018

DFO audits aquaculture facilities to verify the accuracy of industry procedures and reporting. On the day of the sea lice audit, DFO and industry conduct sea lice counts on an equal number of fish. The results of DFO and industry counts are compared to determine statistical agreement. DFO also assesses industry's counting procedures, and in cases where DFO and industry counts do not agree, the difference may be attributed to sample selection and not methodology. In these cases no follow up action is required. If the lice levels are very low then statistical comparison is not possible.



MORE ABOUT THE MONITORING AND AUDIT PROCESS

DFO PERFORMS ABOUT 120 FISH HEALTH AUDITS EACH YEAR

ON AVERAGE, THE INDUSTRY COMPLIANCE RATE IS **98%**

EVERY 3 MONTHS DFO RANDOMLY SELECTS 25% OF ACTIVE* SALMON FARMS IN BC FOR AUDIT

*An active farm is one that has had at least three full pens of fish for at least 30 days of a calendar quarter

Learn more at

www.pac.dfo-mpo.gc.ca/aquaculture/index-eng.html

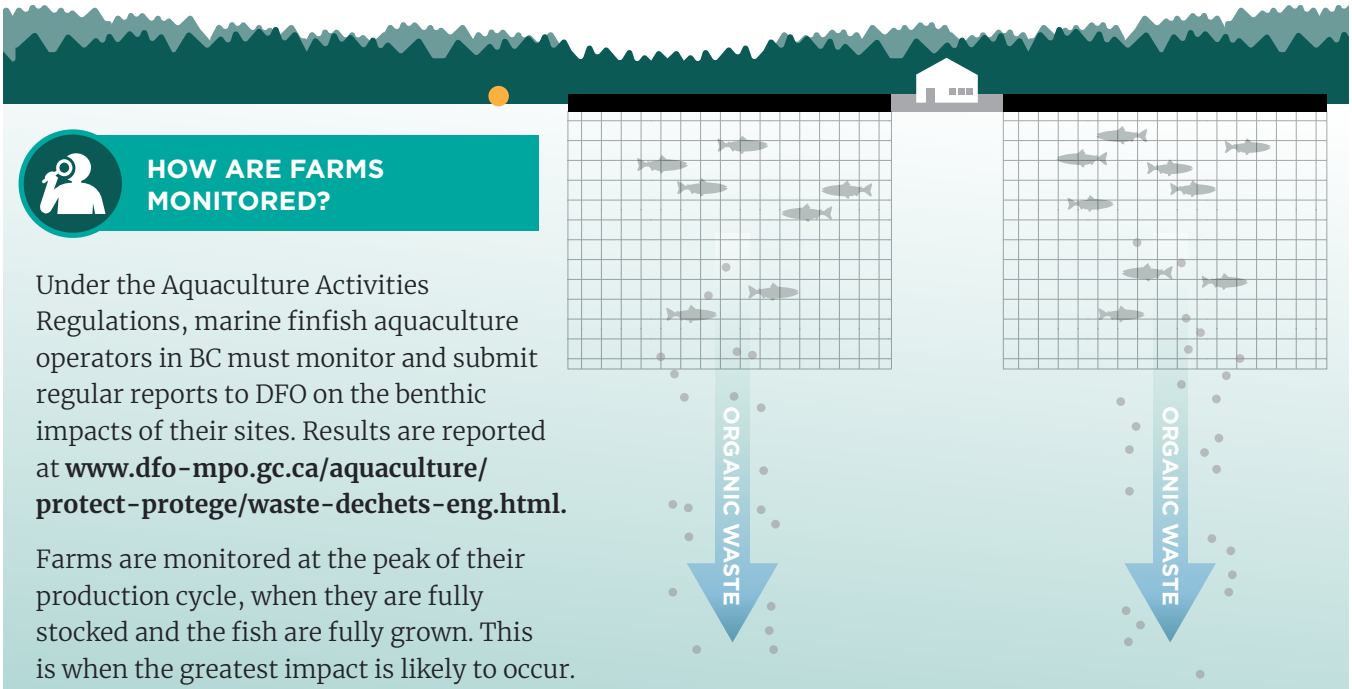

anadä

Environmental

WHAT IS BENTHIC (SEABED) MONITORING?

Benthic means "of, or relating to, or occurring at the bottom of a body of water." In BC, Fisheries and Oceans Canada's (DFO's) comprehensive benthic monitoring, auditing and regulation framework restricts the effects of fish farms on the surrounding environment.

Organic waste from fish farms, including feces and excess food, falls to the sea floor below and around aquaculture sites. In small amounts this provides food for species living below, but if too much accumulates, organisms can be smothered or the seabed altered. With time, the seabed will recover.



HOW ARE FARMS MONITORED?

Under the Aquaculture Activities Regulations, marine finfish aquaculture operators in BC must monitor and submit regular reports to DFO on the benthic impacts of their sites. Results are reported at **www.dfo-mpo.gc.ca/aquaculture/protect-protege/waste-dechets-eng.html.**

Farms are monitored at the peak of their production cycle, when they are fully stocked and the fish are fully grown. This is when the greatest impact is likely to occur.

100% of farms at peak production (40 to 50 each year) must conduct benthic monitoring and submit results to DFO.

DFO performs regular audits to verify industry results and methodology.

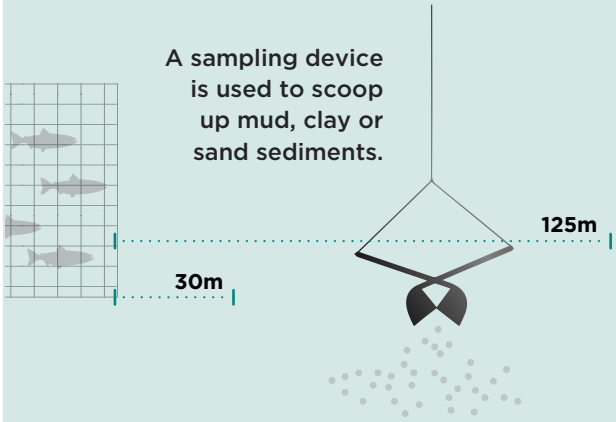
80% to 90% of sites are below impact thresholds (keep reading to learn more).

SOFT AND HARD BOTTOM SITES

Benthic monitoring activities depend on the sea floor beneath the farm. In BC, the sea floor is generally defined as soft bottom or hard bottom.

These are benthic monitoring procedures that the industry must follow. DFO biologists follow these same procedures during benthic audits:

SOFT-BOTTOM SITES



Sediment samples are taken at 30 and 125 metres from both sides of the cage edge.

Samples are brought to the surface and analyzed for their level of free sulphides. A healthy seabed with

plenty of oxygen will have low levels of sulphides.

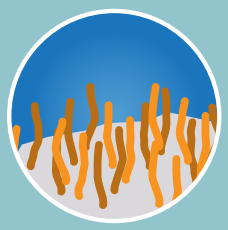
At 30m stations, the threshold is 1300µmol free sulphides.

At 125m stations, the threshold is 700µmol of free sulphides.

HARD-BOTTOM SITES

Underwater cameras take video of gravel, boulder or bedrock seabeds. The video is reviewed in-office for presence of *Beggiatoa* and opportunistic polychaete complexes (OPCs).

***Beggiatoa* are bacteria that form visible white mats**



OPCs are organisms that look like orange shag carpeting

These species can survive where others can't and help break down accumulated waste. Their presence is also an indicator of elevated sulphide levels.

Video of the area from 100 to 124 metres from the cage edge is assessed for impact.

This area is broken into 6 segments. If more than 4 have more than 10% cover of *Beggiatoa* or OPC, the threshold has been exceeded.

If thresholds are exceeded, the site cannot be restocked with fish until further monitoring shows that sufficient recovery has occurred.

INDUSTRY-REPORTED BENTHIC MONITORING EVENTS

Benthic Monitoring Data

This is a summary of the seabed sampling reports submitted in 2018. 14 site audits were conducted by DFO, and DFO's audits indicated that 100% of results were consistent with industry-submitted reports.

	Facilities below threshold at all stations	Facilities exceeding threshold at one or more station
Hard	8	1
Mixed	3	1
Soft	30	2

ENVIRONMENTAL REPORTS

Incidental Catch

Incidental catch is any wild fish that are caught or found dead within a facility as a result of aquaculture activities such as harvesting or transfer of fish. Efforts must be made to release live fish with the least harm. All incidental catch must be recorded and reported to DFO at the end of each production cycle.

As compared to a percentage of Total Allowable Catch (TAC) in the commercial fishery, the amount of incidental catch related to aquaculture in BC is negligible. For example, the 2017 herring incidental catch represents the estimated equivalent of 0.05% of the commercial TAC for the Strait of Georgia roe herring fishery.

	2011	2012	2013	2014	2015	2016	2017	2018
Herring	7,833	11,264	23,374	26,128	29,075	45,023	75,106	13,836
Pacific Cod	288	2,104	2,004	851	13,511	2,158	13,379	131
Rockfish Species	1,753	38	2	46	25	1,453	10,095	3,348
Perch Species	1,316	182	129	545	351	751	832	400
Pacific Salmon	58	89	43	20	58	25	5	10
Other	195	351	266	26	150	3,430	5,898	2,356
TOTAL	**11,443**	**14,028**	**25,818**	**27,616**	**43,170**	**52,840**	**105,315**	**20,081**

2018 Escapes

All reasonable measures must be taken to prevent the escape of cultured fish. If an escape occurs, licence holders must take immediate action to stop further escapes, correct the issue, and report the event. DFO staff perform regular inspections to ensure compliance with licence conditions.

4 ESCAPE EVENTS WERE RECORDED

13 FISH ESCAPED

2018 Marine Mammal Interactions

All reasonable measures must be taken to prevent marine mammals from coming into conflict with facility infrastructure and cultured fish. Interactions that result in the death or release of a marine mammal must be reported within 24 hours of discovery. DFO staff perform regular inspections to ensure compliance with licence conditions.

2 CALIFORNIA SEA LIONS DROWNED

1 HARBOR SEAL DROWNED

1 HUMPBACK WHALE WAS RELEASED


AQUACULTURE
MANAGEMENT
Fisheries and Oceans
Canada
ARC'TERYX

2019 and Beyond

AREA BASED MANAGEMENT

Fisheries and Oceans Canada is proposing that Federal, Provincial and Indigenous authorities work together along with the aquaculture industry, to adopt a more collaborative and "area-based" approach to the planning and management of aquaculture. This area based approach to aquaculture ensures planning and management occur at the best geographic scale, in partnership with Indigenous groups, governments, and the aquaculture industry.

The aim will be to first pilot test this approach in B.C. and then eventually in other parts of Canada, if successful.

STUDY ON THE STATE OF SALMON AQUACULTURE TECHNOLOGY

The Government of Canada is committed to advancing innovation in aquaculture to support sustainable growth of the sector. The government is embarking on a study that will look at the economic feasibility of different aquaculture production technologies, along with their environmental impact. The Study on the State of Salmon Aquaculture Technology will allow a full examination of alternative technologies for salmon aquaculture to enable the sustainable economic growth of the sector.

AQUACULTURE REGULATORY REFORM

As part of the Government of Canada's commitment to modernize regulatory frameworks, DFO is proposing to develop a comprehensive set of aquaculture-specific regulations, which would simplify and streamline existing regulatory requirements for aquaculture in Canada by consolidating all federal aquaculture regulations into one.

The proposed regulations would include amending existing regulatory provisions, as well as additional improvements to further enhance regulatory oversight and transparency. Subsequent to this initiative, the Department plans to work with our provincial partners to develop a set of national aquaculture standards.

PRECAUTIONARY APPROACH

The Government of Canada is committed to following the precautionary approach, which recognizes that the absence of full scientific certainty shall not be used as a reason for postponing decisions where there is a risk of serious or irreversible harm.

The Department has developed an interim policy entitled *Framework for Aquaculture Risk Management* (FARM) to provide a consistent, predictable process for aquaculture risk management that ensures wild fish and their habitats are protected. This risk-management framework also explains how a precautionary approach for aquaculture decision-making is to be implemented.

An interim *Framework on the Transfer of Live Fish* has also been developed, providing guidance on the authorization of the movement of fish in marine environments and what, if any, additional mitigation measures are needed to protect wild stocks. The interim framework sets out a process for assessing the impact of transfers on wild fish and determining if testing for pathogens is warranted.

Both documents are currently open for public consultation until August 2, 2019. More detail can be accessed online at the below addresses:

Framework for Aquaculture Risk Management (FARM):
http://dfo-mpo.gc.ca/aquaculture/consultations/farm-cgra/farm-consult-cgra-eng.html

Framework on the Transfer of Live Fish:
http://dfo-mpo.gc.ca/aquaculture/consultations/live-fish-poissons-vivants/lf-consult-pv-eng.html

Important Web Links

DFO aquaculture page (national)
http://www.dfo-mpo.gc.ca/aquaculture/aquaculture-eng.html

DFO aquaculture page (Pacific Region)
http://www.pac.dfo-mpo.gc.ca/aquaculture/index-eng.html

BCARP Public Report directory
http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/index-eng.html

Aquaculture public reporting (national)
http://www.dfo-mpo.gc.ca/aquaculture/management-gestion/apr-rpa-reporting-eng.htm

Aquaculture regulations and compliance (Pacific Region-annual compliance report, IGMF, IMAPs)
http://www.pac.dfo-mpo.gc.ca/aquaculture/regs-eng.html

Aquaculture licensing (info on user fees, CoLs, report on applications and decisions, siting guidelines)
http://www.pac.dfo-mpo.gc.ca/aquaculture/licence-permis/index-eng.html

Aquaculture maps (facility locations, Fish Health zones, transfer zones)
http://www.dfo-mpo.gc.ca/aquaculture/bc-cb/maps-cartes-eng.html

CFIA reportable diseases
http://www.inspection.gc.ca/animals/aquatic-animals/diseases/eng/1299156296625/1320599059508

LINKS TO DFO AQUACULTURE PUBLIC REPORTS

1. **National Aquaculture Public Reporting Data**
   https://open.canada.ca/data/en/dataset/288b6dc4-16dc-43cc-80a4-2a45b1f93383
2. **Average monthly mortality of cultured salmon at British Columbia aquaculture sites**
   https://open.canada.ca/data/en/dataset/85986a45-b71d-4380-8990-d5763fdf19a5
3. **Carcass classification of cultured salmon at British Columbia aquaculture sites by facility**
   https://open.canada.ca/data/en/dataset/0a8c5505-ecb3-4d8b-8120-462bd7def6bb
4. **Carcass classification of cultured salmon at British Columbia aquaculture sites by fish health zone**
   http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/carcass-health-zone-sante/2017/index-eng.html
5. **DFO's fish health monitoring activities at British Columbia aquaculture sites**
   https://open.canada.ca/data/en/dataset/4dc95665-3d44-428c-bb26-12f981c57060
6. **Summary of DFO fish health inspections of British Columbia marine finfish aquaculture sites**
   http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/health-compliance-conform-sante/index-eng.html
7. **DFO marine finfish aquaculture audit activities in British Columbia**
   http://www.pac.dfo-mpo.gc.ca/aquaculture/reporting-rapports/mer-mar-audit-verif/index-eng.html
8. **Fish health events at British Columbia marine finfish aquaculture sites**
   https://open.canada.ca/data/en/dataset/deefd1d7-7184-44c7-83aa-ec0db91aad27
9. **Mortality events at BC marine finfish aquaculture sites**
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10. **Results of DFO fish health audits of British Columbian marine finfish aquaculture sites, by facility**
    https://open.canada.ca/data/en/dataset/6c891715-317c-4d4d-9fe8-ea425e01d9d2
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14. **Antibacterial use vs. Atlantic Salmon Production in British Columbia**
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18. **Benthic performance at marine finfish aquaculture sites in British Columbia**
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20. **Marine mammal fatalities at marine finfish aquaculture facilities in British Columbia**
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22. **Use of lights at BC marine finfish aquaculture sites (discontinued)**
https://open.canada.ca/data/en/dataset/6d18936d-3463-422c-97ab-69906e5b682e
23. **Escapes of cultured marine finfish from BC aquaculture sites**
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24. **Monitoring of Atlantic salmon escapes (under the Atlantic Salmon Watch Program)**
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25. **Managing transfers and fish health at British Columbia salmon farms**
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