



WHAT IS INCIDENTAL CATCH?

Fish accidentally captured by commercial and recreational fisheries when fishing for other fish species has been managed for many years. Likewise, incidentally captured fish require management at marine salmon farms. At a farm, the incidental catch is defined as any wild finfish caught during fish handling events

such as sampling, treatments, harvest, fish movement between pens or facilities or during net removal. It occurs after wild fish swim through the nets containing the farmed salmon and either choose to take refuge in the nets or grow to a size that they can no longer swim out.



HOW IS INCIDENTAL CATCH REGULATED?

Each salmon farm has an aquaculture license issued by DFO. Under the Conditions of the Licence,

"the licence holder must design and use nets and equipment and conduct operations in a manner that causes the least amount of harm to incidental catch or the residence of the individuals of any species listed as threatened or endangered under the Species at Risk Act or its critical habitat and does not jeopardize the survival and recovery of these species." (1)

Farmers must have mitigations in place to sort wild fish during handling, transfer of fish between facilities, harvest and net removal, and make reasonable efforts to minimize the transfer of wild fish between facilities and processing plants. Any live wild fish must be immediately returned to waters outside the aquaculture facility in a manner that causes the least harm. All dead incidental catch must be retained and disposed of in the same manner that farmed salmon carcasses are disposed of on land. Each farm must report the incidental catch (alive and dead) to DFO each quarter according to the license conditions (Figure 1).

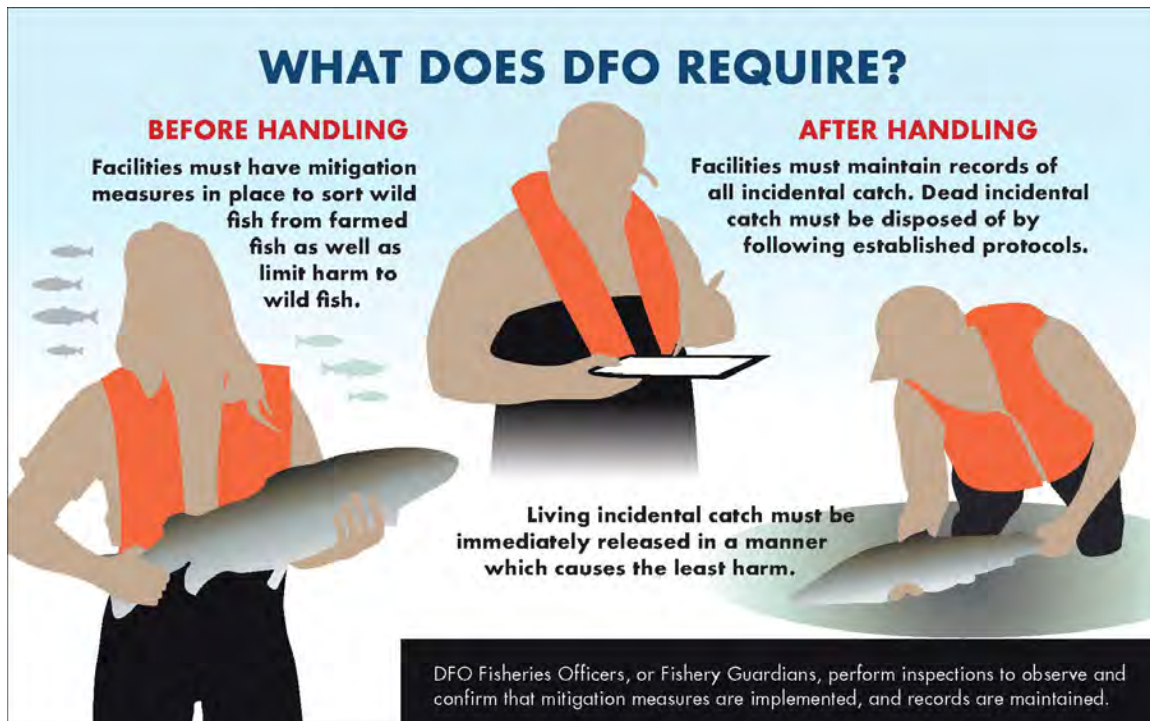


Figure 1. Regulatory requirements for minimizing incidental catch at salmon farms in BC.



IS INCIDENTAL CATCH PUBLICLY REPORTED?

Yes. Through salmon farm licence conditions, DFO requires the reporting of all wild fish releases and mortalities by species and number. This information is then made available on DFO's public website (2)

WHAT FISH SPECIES ARE POTENTIALLY CAUGHT AT SALMON FARMS?

There are several types of fish that can be captured as incidental at salmon farms. Pacific herring, cod, surfperch, and rockfish comprise most of the incidental catch at farms. Most species are caught in low numbers and are often grouped into categories by DFO:

- o groundfish (perch, cod species, sculpin, rockfish, sablefish),
- o pelagic fish (pollock, hake, northern anchovy),
- o other (example kelp greenling, flounder), and
- o salmon/trout/.



HOW DO SALMON FARMERS REDUCE POTENTIAL INCIDENTAL CATCH MORTALITY?

Staff are required to uphold the DFO licence conditions related to incidental catch. They undergo training to ensure they can correctly identify wild fish species, accurately record numbers, and report to DFO. Staff must also be familiar with in-house protocols related to the handling and operation of the equipment associated with the mitigation measures. They are encouraged to suggest improvements to existing mitigation measures as part of their work plan.

On vessels, salmon farmers often use grader systems comprised of parallel bars set a certain distance apart to separate the larger farmed fish from the much smaller wild fish (Figure 2). The distance between the bars is calibrated to the size

of the farmed fish so they cannot slip through the gaps while the smaller incidental catch can. The farmed salmon are directed to another net pen or into another vessel, depending on the purpose of the transfer. The incidental catch is directed to a sorting table where farm staff count and identify the fish before quickly returning them to a holding tank and the ocean to reduce the risk of mortality.

Prior to handling, if wild fish are observed, staff will assess the situation and monitor to ensure the placement of the seine net avoids the fish or postpone the activity. Occasionally, a dip net can be used to remove the wild fish before handling.

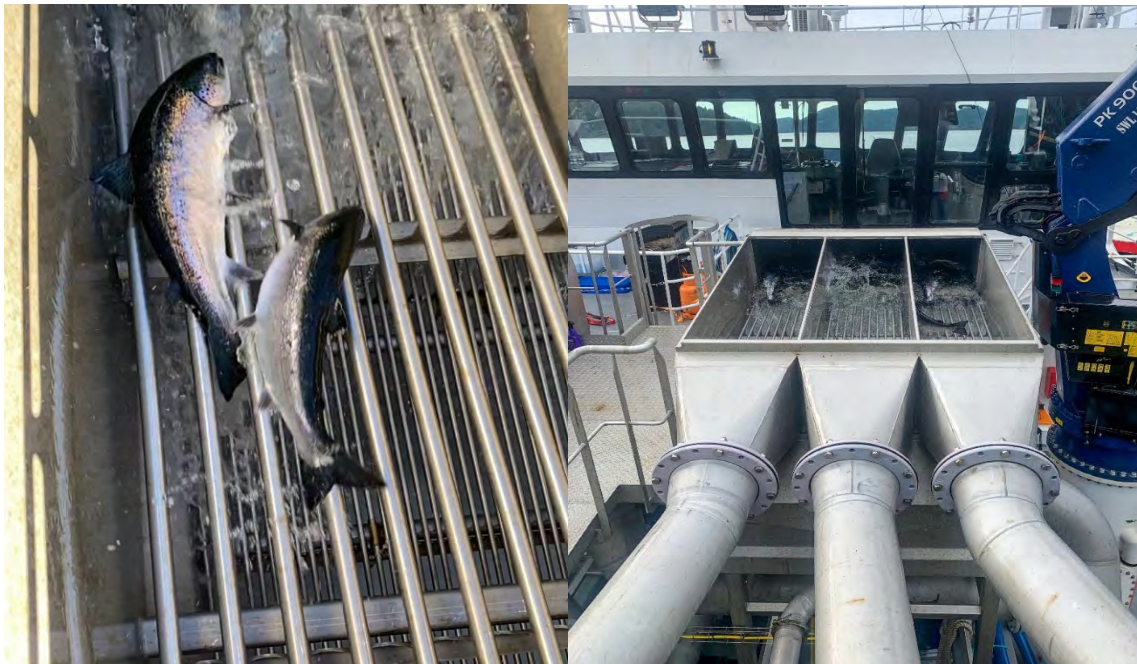


Figure 2. Example of grader bar system on a mechanical treatment vessel.



DO LIGHTS ATTRACT FISH?

Yes, some fish are likely attracted to lights; however, improved lighting technology at farms has virtually eliminated visible light beyond the edge of the net pens (Figure 3).

Atlantic salmon farms use lights during the night for a portion of the production cycle to control the salmon stock's early maturation (grilsification) during their first year at sea. Salmon (grilse) tend to be smaller, often with poorer flesh quality. Additionally, grilsification often compromises the fish's health status, making them more susceptible to disease(3).

The first lights used at BC salmon farms were high-powered incandescent or metal

halide lights that were visible to fish beyond the net pen array. Approximately ten years ago, salmon farmers began transitioning to high-efficiency-emitting diode (LED) lighting systems that use specific wavelengths to manage grilsification (Figure 4). The LED lights are installed within the net pen array at specific depths to increase the efficacy of the light on the farm-raised salmon and are directed into the net pens to reduce ambient light outside of the pens. This has resulted in about a 7-fold reduction of light penetration beyond the cages compared to incandescent lighting. The change to LED lights appears to have significantly reduced the potential of wild fish interaction.



Figure 3. Example of lights at net pens at night. Note the light penetration is focused within the cage.

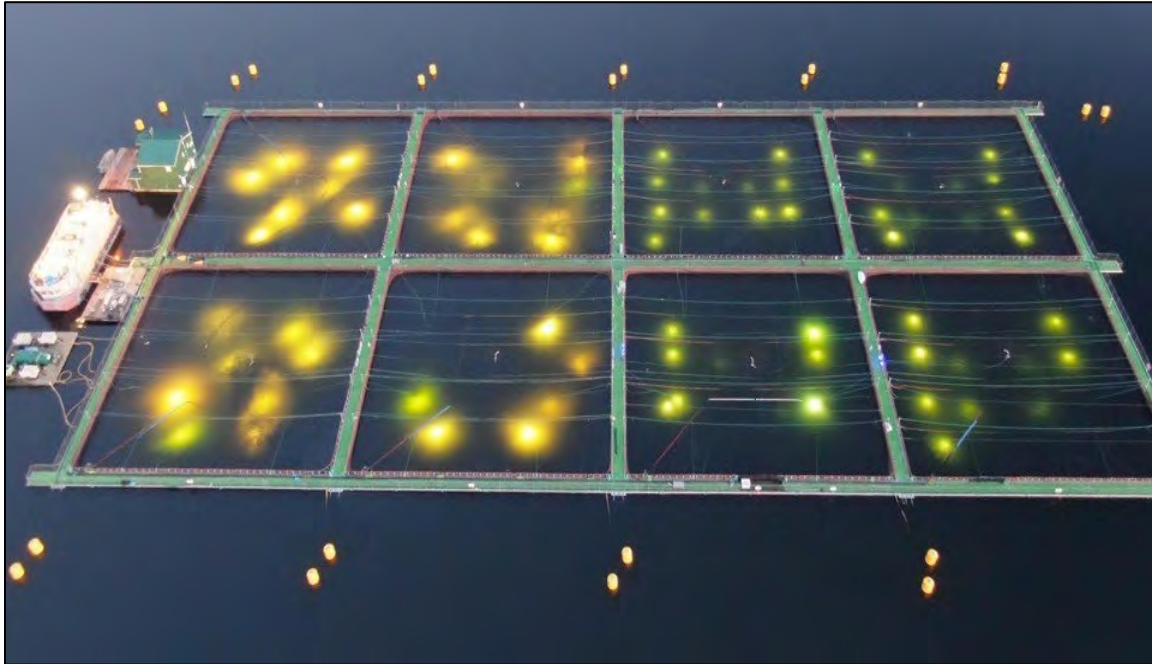


Figure 4. Metal halide lights (on the left) compared to LED lights (on the right).

HOW MUCH INCIDENTAL CATCH IS THERE AT SALMON FARMS?

In total, there were 1,520,457 incidental catch mortalities at salmon farms in British Columbia from 2011 to 2022 (Table 1). The total number of incidental catch mortalities at farms per year for each fish type is shown in Figure 5. Pacific herring were by far the most common type of incidental catch, making up 94.4% of the total mortalities during this period (4).

In total, there were 84,523 non-herring incidental catch mortalities at salmon farms in British Columbia from 2011 to

2022 (Table 1) (4). This translates to an average of 7,044 mortalities per year for the entire sector. Given that the average number of farms operating during this period was 73, this represents an average of 97 mortalities per year per farm.

While all incidental catch mortalities are unfortunate, the good news is that farming practices have been very successful at minimizing these interactions.



Table 1. Total number of incidental catch mortality by fish type for all BC salmon farms (2011 to 2022).

Source: DFO Incidental catch at BC marine finfish aquaculture sites (4, 5) Note that groundfish total excludes rockfish and sablefish, and pelagic excludes herring and salmon/trout

Fish Type	2011	2012	2013	2014	2015	2016	2017
Groundfish	358	2,161	2,023	859	13,553	2,476	16,840
Herring	7,833	11,215	23,374	24,342	28,412	45,848	75,240
Other	56	207	69	7	60	70	12
Pelagic	1,320	208	257	546	346	2,472	677
Rockfish	1,753	38	2	46	30	1,453	10,250
Sablefish	6	43	50	-	48	1,134	2,425
Salmon/Trout	58	87	43	19	58	25	6
Total	11,384	13,959	25,818	25,819	42,507	53,478	105,450

Cont'd below

Fish Type	2018	2019	2020	2021	2022	Total
Groundfish	1,493	283	425	5,657	686	46,814
Herring	15,760	4,489	28,410	154,696	1,016,315	1,435,934
Other	84	27	139	6	9	746
Pelagic	720	899	295	44	17	7,801
Rockfish	3,370	138	26	4,448	178	21,732
Sablefish	1,047	105	383	1,760	14	7,015
Salmon/Trout	11	6	50	37	15	415
Total	22,485	5,947	29,728	166,648	1,017,234	1,520,457

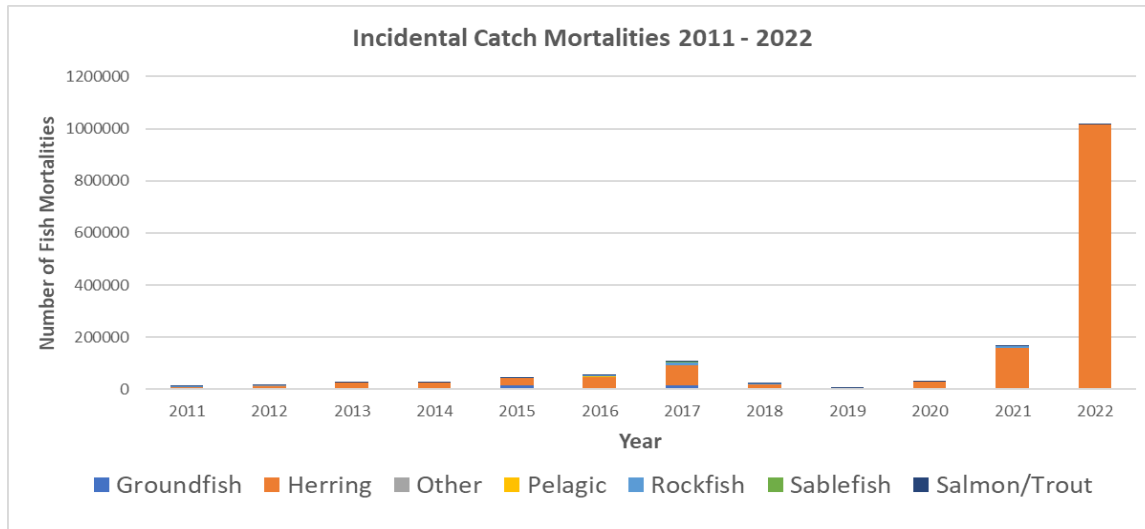


Figure 5. *Incidental catch mortalities at BC salmon farms by fish category (2011 to 2022).*

Source: [Government of Canada Open Data website](#) (4) Note that groundfish total excludes rockfish and sablefish, and pelagic excludes herring and salmon/trout.

Excluding herring mortalities, there is an average of 97 mortalities per year per farm which is less than 2 wild fish mortalities per week.

PELAGIC FISH

Pelagic fish are those that inhabit the water column (not near the bottom or the shore) of coasts, open oceans, and lakes. Many oceanic pelagic fish such as pollock, northern anchovy, herring, eulachon and salmon travel in schools and several of these species, including herring, eulachon, and salmon, have a phase of their lives when they spawn near shore (herring) or in freshwater (salmon and eulachon). Salmon farms have incidentally captured all the species listed above. Excluding herring, salmon, and eulachon incidental catch, which are discussed individually in this document, 7,801 pelagic fish were incidentally caught by salmon farms from

2011 to 2022. The annual average is 650 fish, which is less than nine fish per farm based on an average of 73 farms operating at any one time from 2011 to 2022.



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**PACIFIC HERRING**

Pacific herring incidental catch mortalities at salmon farms are not consistent from year-to-year. Adult herring move around and do not always spawn at the same locations. DFO has estimated that up to 18% of BC coastline is classified as herring spawning habitat, although only 1.8% is intensively utilized by spawners in a typical season (6).

Based on an estimated average weight of Pacific herring mortalities of 20 grams per fish, the cumulative weight of all the mortalities over a 12-year period was approximately 2.39 metric tonnes per year from 2011 to 2022. For context, the Pacific herring incidental catch mortalities at salmon farms in BC is 0.014% of the commercial catch fisheries per year (Table 2).

Table 2. Pacific herring incidental catch mortalities at salmon farms in BC compared to the total commercial capture fishery (roe fisheries, food and bait and special use) from 2011 to 2022.

Source: [DFO Incidental catch at BC marine finfish aquaculture sites](#) (4, 5)

Year	Commercial Fishery (metric tonnes)	Salmon Farm Incidental Catch Mortalities (metric tonnes)	Incidental Catch Mortalities at Salmon Farms as a % of the Commercial Fishery
2011	7,275	0.16	0.002
2012	12,722	0.22	0.002
2013	18,574	0.47	0.003
2014	23,000	0.49	0.002
2015	22,757	0.57	0.003
2016	23,948	0.92	0.004
2017	28,128	1.51	0.005
2018	19,484	0.32	0.002
2019	21,419	0.09	0.0004
2020	10,439	0.57	0.005
2021	14,396	3.09	0.021
2022	4,672	20.33	0.43
Total	206,814	28.72	0.014

Pacific herring incidental catch mortalities at salmon farms in BC has been approximately 2.39 metric tonne per year. This is **0.014%** of the **average annual Pacific herring commercial catch fishery (2011 to 2022)**.

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DFO has five major herring stock assessment areas along the BC coastline: Haida Gwaii, Prince Rupert District, Central Coast, Strait of Georgia and West Coast Vancouver Island (WCVI). Table 3 summarizes the cumulative spawning biomass of the five areas as well as the specific spawning biomass for WCVI for the 2013 to 2022 period.



The highest number of Pacific herring incidental catch mortality at salmon farms, primarily located on the west coast of Vancouver Island, occurred in 2022, which was associated with an extremely large 2021 spawning biomass in the WCVI stock assessment area.

By comparison, the total combined incidental catch mortality of Pacific herring at all salmon farms was a tiny fraction, less than nine-one-hundredths of a percent (0.086 %) of the surrounding Pacific herring spawning biomass associated with the WCVI area.

On average, during the 2013 to 2022 period, the percentage of Pacific herring incidental catch mortalities at salmon farms to the WCVI standing spawning biomass was less than two-one-hundredths of a percent (0.015%).

**Table 3. Cumulative spawning biomass for the five BC herring stock assessment areas**

Comparison of Pacific herring incidental catch mortalities at salmon farms with WCVI stock assessment area (PFMA 23 - 25) 2013 to 2022. Source: [Stock Status Update with Application of Management Procedures for Pacific Herring in BC](#): Status in 2022 and Forecast for 2023 (7)

Year	Province-wide Estimated Spawning Biomass (metric tonnes)	West Vancouver Island Estimated Spawning Biomass - PFMA 23 - 25, (metric tonnes)	Salmon Farm Mortality (metric tonnes)*	Incidental Catch Mortalities at Salmon Farms as a % of the spawning biomass for PFMA 23 - 25
2013	158,000	12,258	0.47	0.004
2014	175,405	13,937	0.49	0.004
2015	178,459	11,323	0.57	0.005
2016	208,411	20,528	0.92	0.005
2017	142,566	16,476	1.51	0.009
2018	151,053	28,107	0.32	0.001
2019	165,137	17,030	0.09	0.001
2020	223,893	18,761	0.57	0.003
2021	180,307	29,339	3.09	0.011
2022	172,736	23,707	20.33	0.086
Total	1,755,967	191,466	28.36	N/a

*For all calculations of incidental catch at salmon farms, Pacific herring weight was estimated as 20g.

PACIFIC SALMON

There are very few incidental catch mortalities of wild Pacific salmon at BC salmon farms. From 2011 to 2021, there were 402 wild Pacific salmon incidental catch mortalities at farms. Almost all of the salmon weighed less than 500 grams. For

context, during the same time period, commercial and recreational capture fisheries landed 73,694,320 wild Pacific salmon in BC (Table 4, note that the data does not include 2022 catch data or Indigenous fisheries).

Table 4. Comparison of the number of Pacific salmon mortalities by sector in BC, 2011 to 2021.

Source: North Pacific Anadromous Fish Commission Statistics, Incidental catch at BC marine finfish aquaculture sites - Data (4, 8)

Year	Commercial Fishery (number of fish)	Recreational Fishery (number of fish)	Salmon Farm Incidental Catch (number of fish)
2011	9,731,480	618,850	58
2012	3,012,930	408,400	87
2013	14,527,170	658,730	43
2014	14,836,650	871,180	19
2015	5,434,600	701,400	58
2016	6,848,290	425,570	25
2017	3,824,180	481,270	6
2018	5,337,840	603,520	11
2019	953,480	568,460	6
2020	2,448,090	260,660	50
2021	668,090	473,480	39
Total	67,622,800	6,071,520	402





GROUNDFISH

The groundfish category includes fish like halibut, sablefish, rockfish, cod, dogfish and perch that live near or on the seafloor. In British Columbia, the groundfish commercial fishery focuses primarily on halibut, sablefish, rockfish, lingcod, and dog fish. Since 2011, the commercial groundfish fishery has landed approximately 112,000 metric tonnes (112,000,000 kg) of fish per year (Figure 6). The figure specifies the major groundfish species that were captured including rockfish and sablefish. These two species are discussed in further detail below.

Incidental catch of groundfish at salmon farms is comprised of the same species as the commercial groundfish capture fishery, with the addition of perch and sculpin. Cod and rockfish represented 50.7% and 30.1% respectively of the groundfish incidental catch at salmon farms from 2011

to 2022. These species are discussed in more detail below.

Groundfish incidental catch mortalities at salmon farms in BC has been approximately 3.09 metric tonnes per year. This is **0.003%** of the **average annual commercial catch fishery of 112,000 metric tonnes from 2011 to 2021.**

The total number of groundfish incidental catch mortalities at salmon farms from 2011 to 2021 was 75,561 fish (Table 1). This is approximately 37.132 tonnes (based upon an average weight of 491 grams per fish) or 3.09 metric tonnes per year. Based on the average yearly catch for both sectors, the incidental catch mortalities at salmon farms was 0.003% of the annual commercial capture fishery.

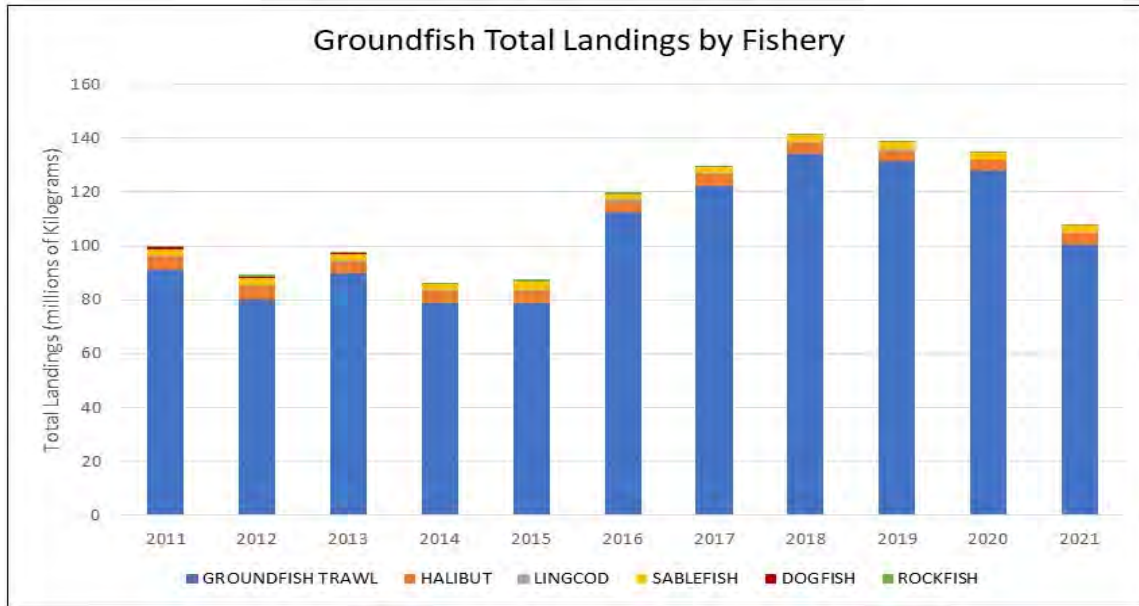


Figure 6. *Groundfish Total Landed Volume by Fishery 2011 to 2021.*

Source: The landed volume and value are calculated from the Dockside Monitoring Program landings, Groundfish Fishery Observations System and sales slip prices Reference Integrated fish (9).

ROCKFISH

Rockfish are part of the total number of salmon farm groundfish incidental catch (Table 1). The total number of rockfish incidental catch mortality from 2011 to 2022 was 21,732 fish. With the exception of 2017, rockfish mortality numbers have been generally low, averaging about 16 rockfish per farm each year. Rockfish incidental catch is predominantly juvenile fish, based on their observed average weight of 150 grams. This means that there were approximately 3.26 metric tonnes of rockfish incidental catch mortalities at BC salmon farms over the past 12 years (i.e., 21,732 rockfish X 150-gram weight).





The recreational and commercial capture fisheries in British Columbia also result in incidental rockfish catch. Recent statistics for these fisheries are not available from DFO; however, Living Oceans Society estimated mortality associated with commercial fishing bycatch to be 650 metric tonnes between 1996 to 2011 (10). By comparison, the total cumulative rockfish incidental catch mortality at salmon farms from 2011 to 2022 salmon farms was 3.26 metric tonnes, which was 0.5% of the commercial fish mortality.

The total rockfish incidental catch mortality at **salmon farms from 2011 to 2022** was **0.5% of the incidental catch mortality associated with commercial capture fisheries** in BC from 1996 to 2011.

SABLEFISH

The sablefish commercial capture fishery is highly regulated in British Columbia and few licenses are issued compared to other capture fisheries. The allowable annual catch varies from year-to-year ranging between 2,200 – 2,600 metric tonnes. In 2022, 2,246 metric tonnes were landed (not including Indigenous and recreational fisheries). By comparison, the total number of sablefish incidental catch mortalities at salmon farms from 2011 to

2022 was 7,015. Based on the average weight of 1.6 kg of an individual sablefish mortality, the total weigh of sablefish incidental catch mortalities at BC salmon farms over the past 12 years was 11.39 tonnes (i.e., 7,015 sablefish x 1.624 kg). The annual average weight of the salmon farm incidental catch mortalities of sablefish was 0.95 metric tonnes per year, which represented 0.04 percent of the 2022 sablefish commercial catch.

EULACHON

Only one individual eulachon was reported as incidental catch at salmon farms from 2011 to 2022, indicating that incidental catch in net pens is not a factor in the low level of abundance associated with this species.

DO FARMED FISH EAT WILD FISH?

From the time they are in a hatchery, farm-raised salmon are trained to eat pelleted food, which meets all their nutritional needs, growth and well-being. Farm-raised fish are closely tracked at each farm through video, feed uptake, and physical sampling during the time that they are in the net pens. Fish feed, feeding practices, fish health and growth are key topics for the farming sector and are discussed in detail in Chapters 7 and 11.

From 2017 to 2019, DFO undertook a study at all salmon farming areas to investigate whether farm-raised salmon eat wild fish in the net pens (11). DFO staff visited processing plants to observe the stomach contents of farm-raised Atlantic and Chinook salmon. The stomach contents of 14,100 farm-raised fish were examined: eleven fish were found: eight Pacific herring, a fish that was likely a sand lance and the other two were not identifiable. From this, it was calculated that 0.08% of farm-raised fish had wild fish in their stomachs (12).





RESULTS ARE ENCOURAGING

We understand that all life in the ocean is precious, and we are responsible for effectively managing and minimizing incidental catch mortalities at our farms. Over the years, we have made significant investments and steps that have significantly reduced incidental catch mortality. The results are very encouraging - incidental catch mortality is low at farms. However, we know that the work of conservation is never fully done. Respect for nature and the traditional territories within which we operate pushes us to continuously review and innovate our practices.



Photo by Bill Pennell

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CHAPTER 7

CARING FOR THE ENVIRONMENT

FEED SUSTAINABILITY



This document describes the feed and feeding practices at salmon farms and discusses important sustainability initiatives

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