

British Columbia Lingcod Egg Mass Survey 2010



Photo by LEMS volunteer: Jackie Hildering

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Introduction

This year marked the 17th anniversary of the Lingcod Egg Mass Survey (LEMS). Initiated in the winter of 1994 by the Marine Life Sanctuaries Society (MLSS), the survey uses volunteer divers to census spawning of lingcod. Since 1996, the Vancouver Aquarium has promoted and collated data for the census, encouraging a record number of participants.

Throughout the last century lingcod have undergone biomass reduction from commercial fishing. In the late 1980s, lingcod stocks in the Strait of Georgia collapsed to approximately 3-5% of original biomass. As a result, in 1990 the Strait was closed to commercial fishing, and sport fishing regulations were established in 1992. Even with these precautionary actions implemented the depressed state of lingcod abundance was still a concern and thus Whytecliff Park was designated as a no-take closure area in 1993 under the Fisheries Act of Canada. In 2002, all sport fishing for lingcod was banned in the Strait of Georgia and surrounding waters. This ban was lifted on the east coast of Vancouver Island in 2006 but remained in place for the Vancouver area.

Lingcod spawn from December through to early April in the Strait of Georgia, with peak egg mass abundance in late February. The males guard the egg masses, which resemble styrofoam, for over a month, until hatching. The behavior of the guarding male and the distinctive appearance of the egg masses are easily identified by volunteer divers.

Dives logged during the annual Lingcod Egg Mass Survey are performed by volunteer divers as well as staff from the Vancouver Aquarium. The volunteer divers are enlisted through a variety of sources including dive organizations, stores, charters, magazines, and personal contacts. For the most part, dives by Aquarium staff have been limited to Howe Sound.

In 2004, Fisheries and Oceans Canada created more than 90 Rockfish Conservation Areas (RCAs) throughout British Columbia. In 2007, Fisheries and Oceans Canada established 164 Rockfish Conservation Areas (RCAs) in British Columbia, including 11 RCAs in Howe Sound and 57 in the Strait of Georgia. All of these RCAs serve to protect lingcod as well as rockfish. These RCAs were introduced in order to provide protection for BC's inshore rockfish populations, which are severely depleted following decades of unsustainable harvesting. These RCAs will also provide protection for and assist in the recovery of local lingcod populations. Owing to extreme low abundance of lingcod in Howe Sound and Burrard Inlet (Area 28), all hook-and-line fishing for groundfish (lingcod and rockfish) was banned in summer of 2007.

Biology of Lingcod

Lingcod spawn primarily in January/February in crevices on rocky shores of western North America where strong currents allow for egg respiration. Eggs are adhesive to each other and resemble a clump of styrofoam. Females can begin to spawn at three years old; their egg masses would be about one liter volume. A four-year female lays an egg mass of about 2-2.5 liters, and then above five-years old the fish lay much larger egg masses. In 1995 reference sizes were created based on whether the egg mass resembled in size a grapefruit (under one liter, from a 3-yr female), a cantaloupe (ca. two liters, from 4-yr female), or watermelon (5-yr or older). Most lingcod spawning occurs within a depth range safe for scuba diving.

Most nests are guarded by the male parent, although smaller males tend to flee temporarily when approached by seals or divers. Smaller males may sneak in and partially fertilize some eggs during spawning, so a spawning reef often has more male lingcod than nests. The guarding male is the fish that attracted the female and initiated courtship and spawning, and is usually the principal sire of the egg mass. A dominant male may guard two or three adjacent egg masses. The guarding behavior of the male parent tends to indicate the location of the eggs, which vary from white when newly laid to dark gray toward hatching. If the egg mass remains lodged in a crevice where currents force flow through the eggs, and the male remains to prevent predation, embryos survive to the hatching stage of development.



Photo of male lingcod guarding eggmass. Photo by volunteer diver Terrance Fidler.

Eggs incubate for 5-11 weeks depending on temperature. Hatch success varies with strength of currents: egg mortality occurs from respiratory failure in low flows. Newly hatched larvae swim rapidly to the surface, orient into currents and swim offshore by selecting stronger currents. This takes them into tidal current drift and rapidly disperses them through the spawning area. Little is known about the extent of larval dispersal, but over-fished areas do not seem to receive any rescue effect from spawning populations in remote areas. Adults are relatively sedentary, only the females showing a seasonal depth migration for summer feeding.

Within two to three months of hatching, larvae settle at about 70 mm length and start feeding on juvenile herring. Lingcod reach 21 cm length in their first year, 30 cm at 20 months age, and 45 cm (0.8 kg weight) in their third year, as two-year olds (age 2+). Males grow rapidly until 8 years age, and live to a maximum of about 14 years. Females grow until 12-14 years age, and live to about 20 years. The size record is 150 cm and 32 kg. An age 13 male averages 84 cm and 6.1 kg, versus an age 13 female at 103 cm and 11.9 kg. Female lingcod of 10-12 years age are about twice the weight of males that age.

Methods

The Lingcod Egg Mass Survey occurs over a five week period centered on the third weekend in February, a time when most lingcod egg masses have been spawned but not much hatching has occurred. Divers are given an information packet that has all the pertinent information to complete the census, this packet is available online or by contacting the Aquarium. For each dive the following information is recorded:

Date - The month/day/year.

Diver Information - The first and last names of both divers and all pertinent contact information.

General Location – There are 11 general areas we have divided the coast into; please note the appropriate area.

Specific Location - Divers often identify sights by local names, which can make it difficult for us to know where the data were collected. Identify the specific location you are diving in.

Bottom Time - Be sure to note the bottom time for your dive.

Comments – Be sure to record if no eggmasses are found or if the dive was primarily on soft bottom (versus bedrock or boulders).

Nest Information -

Depth – Note the depth where you found the egg mass in feet.

Size – Estimate if the egg mass is roughly the size of a Grapefruit, Cantaloup or Watermelon (G, C, W).

Condition – You may want to bring a dive light along with you. This will aid in determining the condition of the egg mass. Recently extruded eggs will generally be white/pink (N=New). Older eggs will be eyed/dark grey (E=Eyed), or rotten (R=Rotten).

Situation – Note how the egg mass is situated, either loose (L) in a crevice, secure (S) in a crevice,
or loose in the open (O).

Nest Guarding Male – Often one male may guard more than one egg mass. If the male is guarding only one egg mass, indicate so with “P”. If the male is guarding multiple egg masses, indicate so with “P2”. If this is observed, record each egg mass as an individual egg mass and be sure to indicate the nest guarding male as “P2” for each egg mass. If there is an egg mass without a guarding male, indicate the absence of the male with “A”.

Sample dive slate with nest information:

Nest #	Depth (ft)	Size	Condition	Situation	Nest Guarding Male
1	18 ft	W	N	S	P2
2	18 ft	W	E	S	P2
3	20 ft	C	R	O	A
4	35 ft	G	E	L	P
5	32 ft	W	N	O	A
6	33 ft	C	E	S	P

All data is sent to the Aquarium or entered online. Once we have sorted the data we calculate the index of abundance by using the Count Per Unit Effort (CPUE). The CPUE is the number of egg masses sighted per hour and is calculated by multiplying the number of egg masses times 60, divided by the dive time. Please return data reports promptly, to ensure a timely summary report.

Results and Discussion of 2010 Survey

The 17th annual LEMS was conducted between February 6 and March 7, 2010. Volunteers from around British Columbia and Aquarium staff undertook 125 dives totaling 5,292 minutes underwater. In all, 357 egg masses were sighted, 61 in Howe Sound (the principal area of focus) and 256 in all other areas.

Howe Sound is currently closed to all hook and line jigging; this includes lingcod and all other groundfish. Results this year in Howe Sound (excluding Porteau Cove) were slightly lower than last year with a CPUE of 4.87 (2009 was 5.82) and the percent of W sized egg masses was higher at 46% than 2009 (37%).

Porteau Cove had a similar count to last year with a CPUE of 7.06 (2009 was 6.86). The percent of W sized egg masses at Porteau, indicating more mature fish, increased dramatically to numbers similar to 2008 with 63% W sized egg masses (67% in 2008, 49% in 2009).

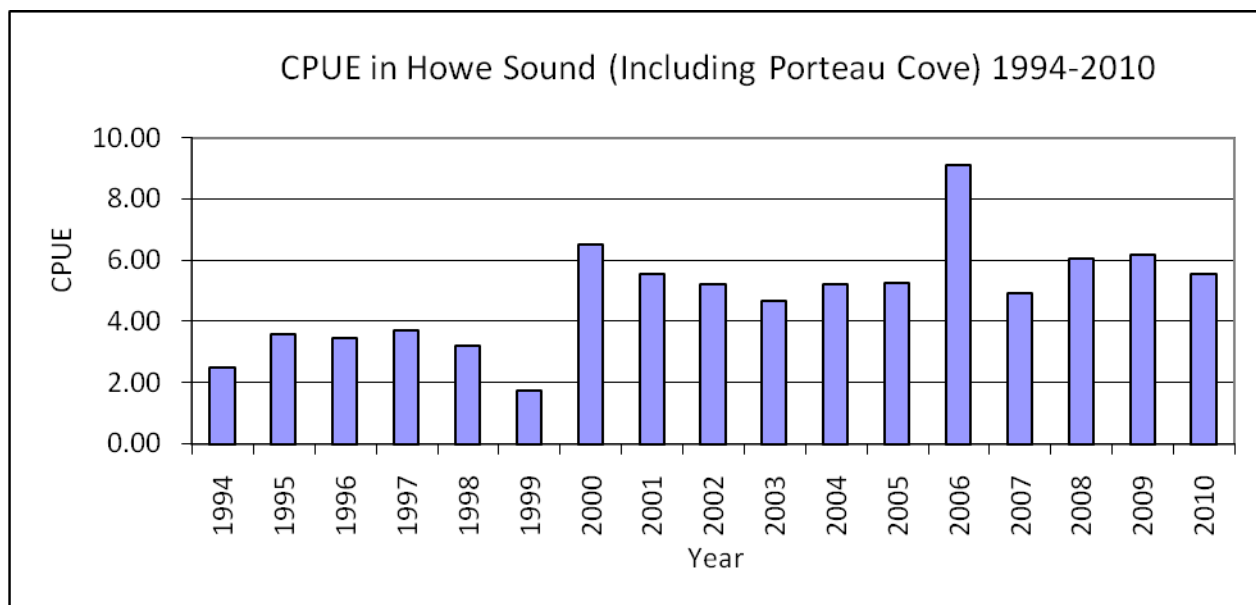


Fig. 1 – Count Per Unit Effort (CPUE) of egg masses in Howe Sound including Porteau Cove from 1994-2010. Windstorms restricted survey effort in 1999, but may also have dislodged egg masses. DFO undertook a sea-to-sky enforcement campaign in 2004/2005.

In all BC areas outside Howe Sound, a CPUE of 3.89 egg masses an hour was calculated. The percent of W sized masses is similar to last year (52%) with 57% this year. An abundance of W sized egg masses indicates that larger females were laying the egg masses. For detailed information on each region outside of Howe Sound

please see the attached table at the end of this document.

When you look at Howe Sound in comparison to the rest of the sites (Fig. 2 & 3) you can notice a trend of decreasing CPUE outside Howe Sound that was reported during the latter half of the last decade. That is, looking first at the average CPUE from 1994-2010, in Howe Sound you can see that there has been an increase from a CPUE of about 3.0 in the 1990s to CPUEs of about 6.0 through this decade (excluding the outliers – extreme low 1999 [low effort due to storms] and extreme high in 2006). Outside Howe Sound there is more of a bell shape curve, with low CPUEs in the '90s leading to a peak in 2003 and now going from about 5.5 in 2005 to the low of 1.94 in 2009. A slight recovery was evident in 2010 but may have been a result of Aquarium staff effort at Hornby Island.

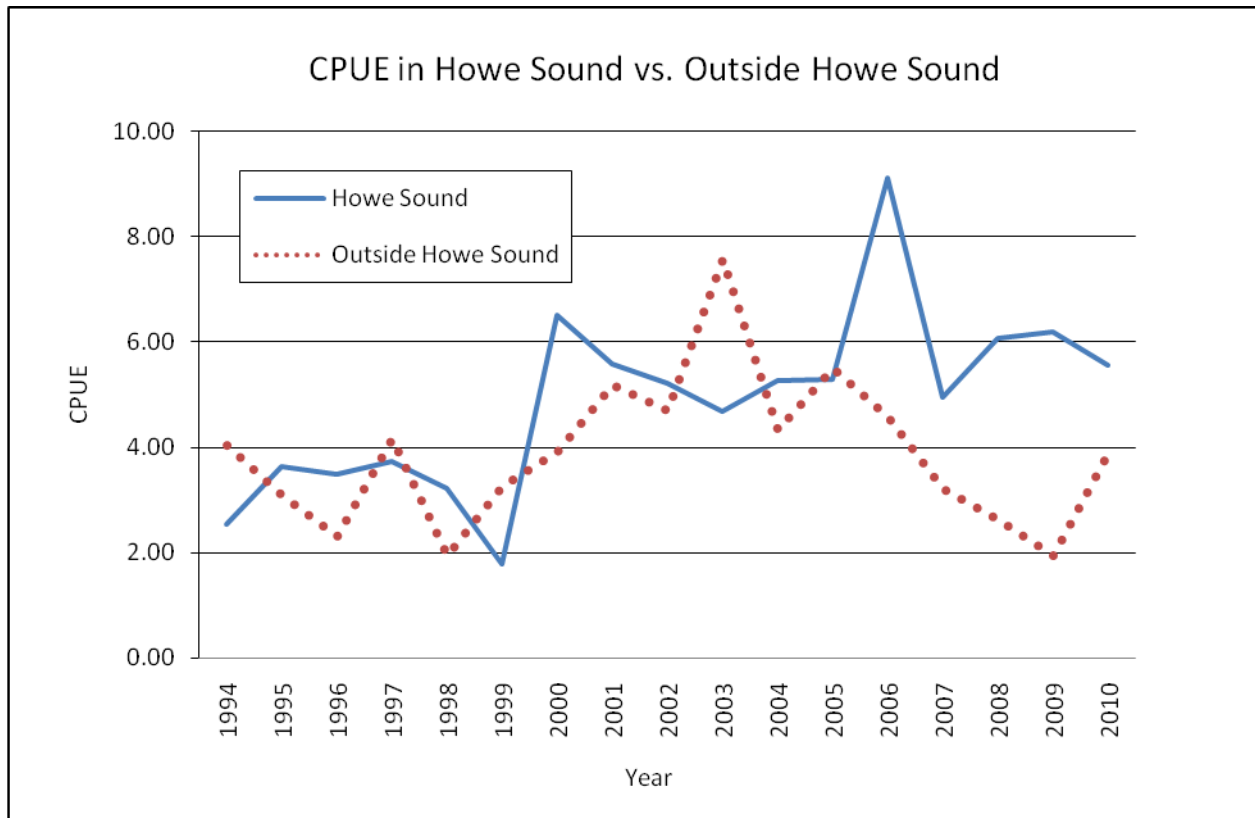


Fig. 2 – Count Per Unit Effort (CPUE) of lingcod egg masses in Howe Sound (including Porteau Cove) and in areas outside of Howe Sound from 1994-2010.

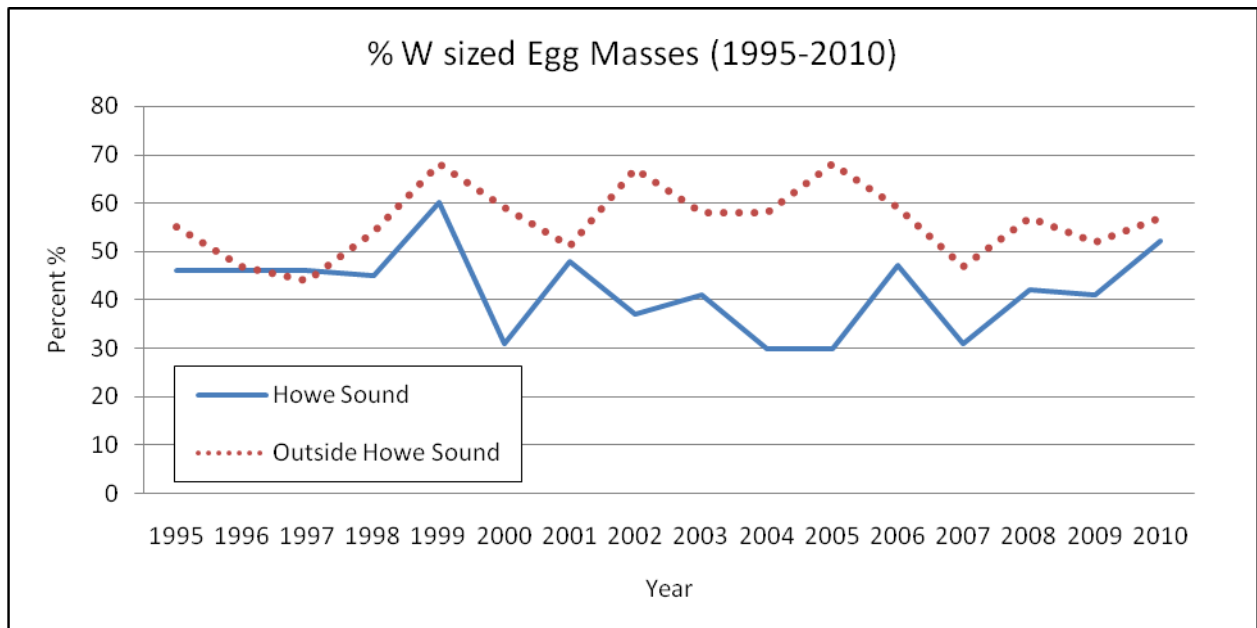


Fig. 3 – Percent of watermelon (W) sized egg masses in Howe Sound (including Porteau Cove) and in areas outside of Howe Sound from 1995-2010.

This year, Aquarium staff traveled to Hornby Island where we partook in LEMS surveys with the great folks up there. In doing this we discovered variance in numbers of egg masses spotted between the volunteer divers and the Aquarium staff. Aquarium staff calculated a CPUE of 15.57, while volunteers had CPUE of only 3.47.

This major difference is due to different diving techniques. Volunteer divers would go straight down to depth, then continue along their dive profile, and return to the surface. By doing this they were only in prime spawning habitat for a short period of time, during descent and ascent. Aquarium staff stayed in prime habitat between 15 and 40ft for most of the dive. For future surveys we will make it more clear what depths to be at and when to start and finish your timing so we have more accurate counts.

Other locations have not had such drastic differences between volunteers and Aquarium staff. For years we have been relying on volunteer data from Porteau Cove. This site is very straightforward on where you should be diving and looking for egg masses. It is hard to go too deep and miss the egg masses, so we have found that CPUEs from volunteers and Aquarium staff are very similar.

This year we returned to getting a high number of sites visited, including visits again to the new sites south of the border in Washington. We are glad that people got out diving again and were able to participate

Methods now emphasize surveying suitable habitat. In 2009 over a third (32%) of the dives conducted outside Howe Sound had no observations of lingcod spawning, versus zero for Howe Sound dives. This is the main reason there has been such a low CPUE for areas outside of Howe Sound. We had hoped that this year divers would increase dives on areas where they knew there was possible lingcod habitat (bedrock and boulders), and that seems to have happened. We cut the proportion of dives in half that did not have any egg masses on them with only 16% having zero counts outside of Howe Sound. Lingcod require rocky crevices for depositing their spawn, so analysis needs to focus on whether lingcod are depleted in an area, or whether the area never was suitable for lingcod spawning.

The Lingcod Egg Mass Survey is not the only census the Vancouver Aquarium conducts. Since the announcement of the initial RCAs, researchers for the Vancouver Aquarium have been conducting Rockfish Abundance Surveys both inside and outside the Howe Sound RCAs. We have continued this survey in order to assist in government decision-making on which areas afford the best protection for Howe Sound's inshore rockfish populations. We will continue to monitor the progress of rockfish populations inside and outside RCAs, and invite volunteer divers to participate in this survey throughout BC. The Aquarium now promotes the Rockfish Abundance Survey (RAS) for the period around Labor Day (Aug. 14 - Sept. 19). If you are interested in participating or have any questions about LEMS or RAS, please contact Kevin Kaufman via e-mail at lingcod@vanaqua.org, or phone 604-659-3440. See locations of RCAs at www.pac.dfo-mpo.gc.ca/recfish.

Please see the LEMS 2010 results table on the following page.

LEMS 2010 Results Table

	# of Dives	Total Minutes	Total Egg masses	CPUE	%W	%C	%G	# of Dives (%) with No Egg masses
Grand Total	137	5839	377	3.87	58%	32%	10%	20 (15%)
Howe Sound Total	16	660	61	5.55	52%	25%	23%	0 (0%)
Areas in BC Outside Howe Sound Total	108	4499	276	3.68	57%	34%	9%	18 (17%)
Puget Sound (Seattle Area)	13	680	40	3.53	72.5%	27.5%	0%	2 (15%)
Northern Gulf Islands	34	1592	124	4.67	40%	47%	13%	1 (3%)
Central/ East Vancouver Island	9	375	8	1.28	62.5%	37.5%	0%	0 (0%)
Johnstone Strait	4	134	26	11.64	92%	8%	0%	0 (0%)
Saanich Inlet	20	832	34	2.45	73.5%	26.5%	0%	6 (30%)
South Vancouver Island (Victoria)	23	860	33	2.3	64%	24%	12%	7 (30%)
Southern Gulf Islands	2	100	8	4.8	75%	0%	25%	0 (0%)
Sunshine Coast	6	270	24	5.33	50%	37.5%	12.5%	1 (17%)
Porteau Cove (Howe Sound)	5	204	24	7.06	63%	33%	4%	0 (0%)
Howe Sound (excluding Poteau Cove)	11	456	37	4.87	46%	19%	35%	0 (0%)
West Vancouver Island	10	336	19	3.39	68%	32%	0%	0 (0%)