2015 MARINE SURVIVAL FORECAST OF SOUTHERN BRITISH COLUMBIA COHO

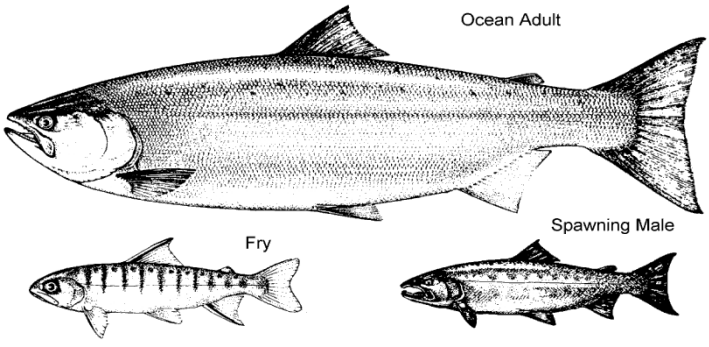

Figure 1: Coho salmon at three life stages: freshwater rearing fry; ocean rearing adult; and returning male. This image has been used on previous coho Stock Status reports, origin unknown.

Figure 2: The Province of British Columbia, showing the major rivers in the South Coast, Lower Fraser and Interior BC areas.

SUMMARY

Indicator marine survivals and aggregate abundances from 2014 were generally lower than the previous year with the exceptions of Inch Hatchery and Carnation Wild which showed very modest increases. In particular, the marine survival of Big Qualicum Hatchery and Black Wild were 50% and 58% lower from the previous year, respectively and the Interior Fraser Aggregates were 54% and 61% lower.

The 2015 forecast for coho indicators are generally increasing over the previous year, with most indicators forecast to increase and two (Area 12 aggregate, Quinsam Hatchery) decreasing modestly.

The Distribution Index is forecasting a moderate 'outside' distribution of coho in the Strait of Georgia. Over the last four years this index has indicated a week to strong 'Inside' distribution, which was reinforced by the large number of coho encounters by the recreational fishery in early summer in the Strait of Georgia in recent years.

Ocean climate indices are all consistent with a low marine survival of coho returning to the west coast of Vancouver Island in 2015 however the Marine Growth model forecasts a high marine survival. Due to this inconsistency in model results, caution should be used in developing fishery regulations.

The trend of low marine survivals that started in the 1990's is continuing although the tread over the last few years suggest a slight rise. Restrictive fishing regulations have been eased recently with openings on marked hatchery coho and some localized unmarked openings.

INTRODUCTION

Previously, marine survival or aggregate abundance forecasts for southern BC coho stock groups have been published as Science Advisory Reports. Starting in 2012, this information is set out in an unpublished internal document for use in coho stock management processes.

Descriptions of the assessment methods, data sets, forecast models and sources of uncertainty have been documented in previous papers and will not be described herein. For more information see Simpson et al. (2004), DFO (2006), DFO (2007), DFO (2008), DFO (2009) and DFO (2012). Baillie et al. (2005), DFO (2011), DFO (2013) and DFO (2014) are similar reports that are unpublished but are available from the author.

Exploitation Rate

A change in the methodology used to estimate the exploitation rate for adipose fin clipped coho indicators has been incorporated into the 2015 forecast exercise. When direct coho exploitation by Canadian commercial and recreational fisheries was stopped in the late 1990s, an effort based Exploitation Rate model was developed by DFO staff to estimate the level of release mortality of coho as by-catch from the various fishing sectors. This model assumed that coho were not targeted and that all of the catch was released and used scalars to alter the base period exploitation rate as appropriate. These assumptions have become more and more violated as fishing regulations have changed over the last 12 years. A review of issues associated with using the MRP data for Exploitation Rate estimates is presented in Appendix 1.

Directed commercial and recreational fisheries on coho were severely restricted in the late 1990s in response to decreasing stock abundances. Until recently most exploitation of coho was incidental catch in commercial fisheries that targeted other species. Generally, non-retention of unmarked coho is in effect in most areas except for Food, Social and Ceremonial fisheries for First Nations in specific areas where local abundances allow for retention of unmarked coho (PSC 2013).

Data Sources

The data set used for the Area 12/13 aggregates is based on a subset of coho populations from each Area. The forecast is based on the expected total return to the average stream in the area (derived via the P_{max} methodology to standardize escapements in the aggregate area). For the Interior Fraser aggregates, the data represents the estimated total abundance for those areas. Each datum includes Natural Spawners, Broodstock removals and Fishery catches, both recreational and commercial. All other indicators in this forecast use the survival rate between release of smolts and the resulting return of adult coho.

Forecast Models

The forecast is chosen from a variety of both time-series and biologically based methods which are evaluated and selected based on performance criteria. See Simpson *et al.* (2004) for a description of the times series models, and the CPUE and sibling regression models. The other model used (Growth) is described in Trudel et al. (2008).

Climate Indicators

Large scale climate indicators have been shown to be correlated to biological processes, including marine survival of Pacific salmon (Trudel *et al*., 2008). Figure 3 shows correlations for three ocean climate indicators, plus juvenile coho salmon growth data, regressed against the observed marine survivals for coho salmon from Robertson Creek Hatchery. The climate data is matched to the year of ocean entry of the coho salmon. The green triangles represent the 2014 data, for salmon returning in 2015. This figure shows the divergence between the PDO, SST and NPGO climate indicators (low marine survival) and the Summer Growth model (high marine survival).

The marine survival forecast models in this report use direct data input from the specific populations and a marine survival forecast is generated in a naïve manner with respect to climate trends. In this year's annual report the marine climate indicators will be included as a description with a comment about possible effects on marine survival of coho salmon. Specifically, marine climate indicators such as the Pacific Decadal Oscillation (PDO), North Pacific Gyre Oscillation (NPGO), El Nino Southern Oscillation (ENSO), and Sea Surface Temperature (SST) will be included.

The procedure to examine the relationship between ocean climate data and marine survival of coho salmon is to rank the values from the current 17 year data set from 1 ('best' year) to 17 ('worst' year). The quantitative ranking is based on whether the high or low end of the range is correlated with good marine survival of coho salmon. Subsequently, the rankings from the climate indicators can be averaged and correlated with the corresponding marine survival of coho salmon, based on the ocean entry year to provide a forward looking indication of marine survival.

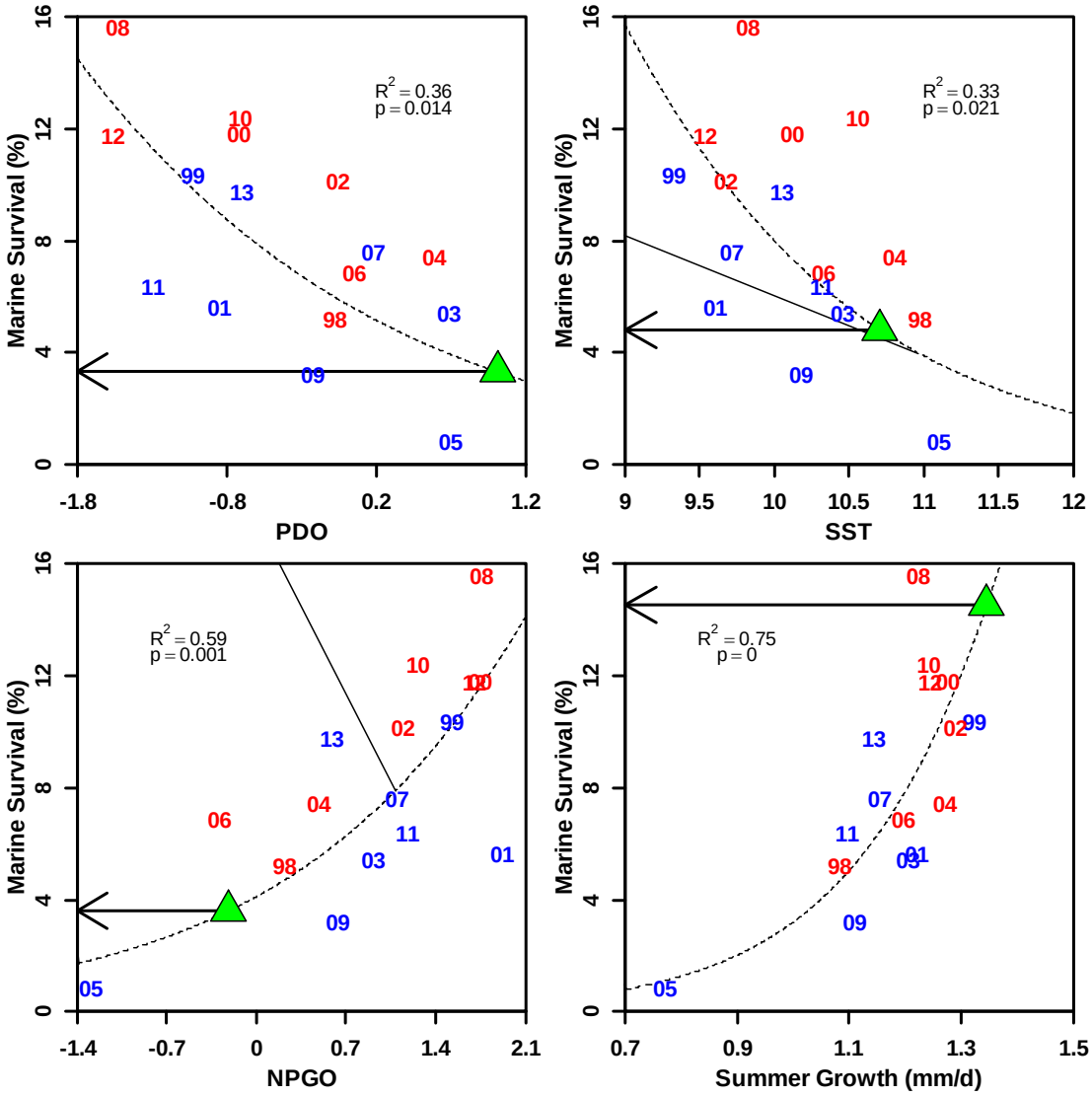

Figure 3. Regression of three Marine Climate data and Summer Growth data, against observed marine survival of coho as represented by the hatchery stock Robertson (Stamp) Creek.

RESULTS

Graphical depictions of the observed marine survival or aggregate abundance for all coho indicators used in this forecast are shown in Appendix 2 while Appendix 3 is a table that shows the observed 2013 and 2014 values, and the forecast for 2015 returns.

Johnstone Strait/Mainland Inlets

In 2014 the observed return in Area 12 was 22% higher than forecast and the Area 13 return was about 26% lower than forecast. The Area 12 return saw a doubling of the 2011 brood return and only slightly lower than what was estimated for the previous year

return (2013). The Area 13 return demonstrated a 15% decrease in abundance relative to the brood year (2011) and 35% lower than the previous year's return (2013). Based on the observed 2014 returns at the systems in the two areas, marine survival had improved in Area 12 but not in Area 13 relative to the 2013 return.

The Area 12 and 13 2015 forecasts are slightly higher than the brood returns in 2012. The Area 12 and 13 forecasts are respectively 5% lower and 19% higher than the 2013 observed indices. Coho abundance in this region is varied and can be characterized as 'average' for Area 12 stocks and 'below average' for Area 13 stocks. See Simpson et al., 2004 for description of characterizations. Keep in mind that these more recent year returns do not have the high levels of exploitation as in the past and these forecasts are highly uncertain.

Georgia Basin – West

The Hatchery indicators for this Management Unit are Quinsam, Big Qualicum, and Goldstream Hatcheries. This will be the final year that Goldstream will be included because the last coded-wire tagged coho cohort was the 2011 brood year which returned in 2014 and there will be no continuing dataset. The Wild indicator is Black Creek.

Observed 2014 marine survival rates hatchery indicators decreased from the 2013 levels by 44-67%, reversing a trend of slowly increasing marine survivals since the mid-2000s.

For the indicator system at Black Creek, smolt production in 2013 was about average (56,000). 2014 Marine survival decreased from 1.7% down to 1.0%

The best performing models for the Big Qualicum Hatchery indicator is the "Like Last Year", and for the other two hatcheries and Black Creek the "Three Year Average" is the preferred model. The 2015 forecast for the hatchery indicators is for a slight decrease from the 2014 levels, to 0.9% to 1.7%. The Black Creek wild indicator is forecast to improve to 1.5% marine survival.

Lower Fraser

The Hatchery indicator for this Management Unit is Inch Hatchery. Previously Chilliwack Hatchery and Salmon River (wild) were used as indicators but are no longer in use.

The observed 2014 marine survival from Inch Creek hatchery decreased 5% from the 2013 level, similar to the Georgia Basin West Hatchery indicators. Under the retrospective analysis the time series model "Like Last Year" has performed better than the other forecast models therefore the 2015 forecast will be similar to the observed survival of 2014.

Interior Fraser
The observed 2014 abundance for both the Thompson River and Interior Fraser Aggregates were less than half of the observed 2013 abundance, and both were lower than the forecast by 47% and 41%, respectively.

The 2015 forecast is for a 73% - 88% increase from the 2014 abundance for the two aggregates, and similar to the 2013 abundances.

Southwest Vancouver Island
The two indicators in this Management Unit are Robertson Creek Hatchery and Carnation Creek, both located in Barkley Sound. For the Robertson Indicator the estimate of coho abundance is based on the estimated count at the Stamp Falls fishway.

The observed 2014 marine survival for both hatchery and wild indicators were similar to the previous year. The Robertson Indicator marine survival was 19% lower while the Carnation Indicator was 10% higher than the previous year.

The 2015 marine survival, based on a marine growth metric, is forecast to increase 200% and 48% from the 2014 observed levels for the Carnation and Robertson indicators, respectively, to 6.6% and 14.5%. The metric used for this model was the highest value over 17 years of data which suggests a high level of marine survival.

Distribution
The distribution Index is a metric that uses salinity in the Strait of Georgia to forecast whether coho will be present in the Strait during their final summer ("inside") or wait until fall to re-enter the Strait ("outside"). In Figure 4, the central red line indicates the base period average distribution of coho catches between Strait of Georgia and WCVI fisheries. Deviations from this line suggest a greater 'Inside' or 'Outside' catches of coho, if the same fisheries regimes were in place.

This model is based on the relationship between salinity and the relative quantity of coho that were harvested, using data from a base period (1975-1997). As fisheries have been restricted since the late 1990's the relationship is fixed and cannot be updated or have a retrospective analysis.

From 2011 to 2014 the Index has been between 0.51 and 0.67 which are interpreted as weak to strong "inside" years. This has manifested as a higher encounter rate by the Recreational community in the early summer period on the Strait of Georgia.

The 2015 forecast is 0.266, indicating a moderate outside distribution of coho. This suggests that coho abundance in the Strait of Georgia will be much lower than the levels observed in the previous four years. Figure 4 shows the time series of data used for the Salinity/distribution relationship (1975-1997) and the result of the model (1998-present).

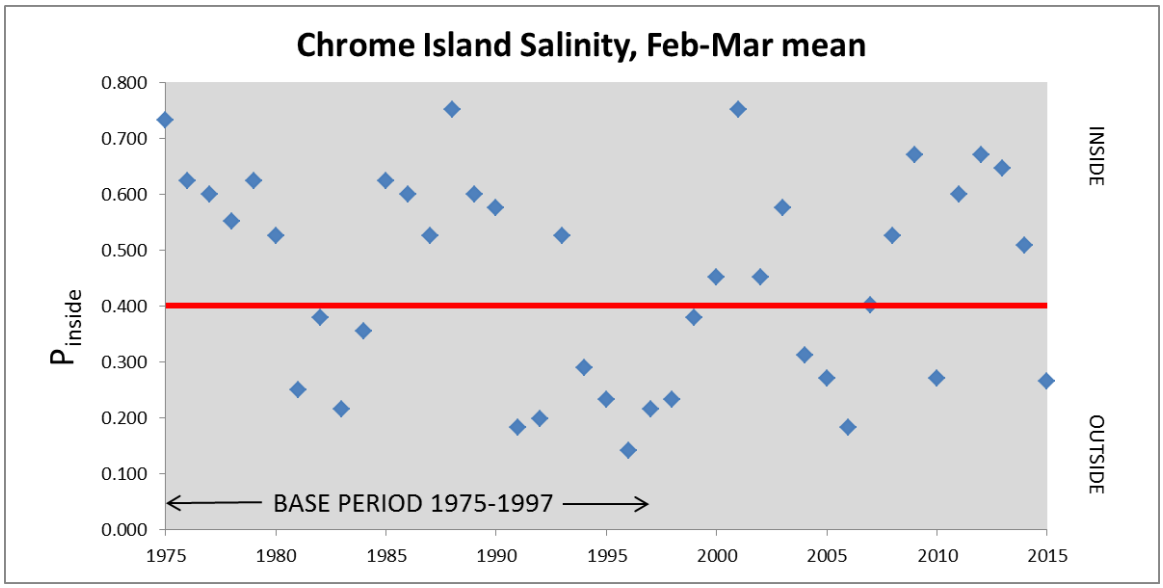

Figure 4. Distributional index for Strait of Georgia Coho, with observed data from 1975-1997, and results from the salinity based model for 1998-present.

Marine climate indicators (summarized from a presentation at the 2015 State of the Ocean meeting – Trudel *et al.* 2015, in prep.)

The global climate indicators in the Pacific Ocean (PDO, NPGO, ENSO, SST) for the 2014 ocean entry year for the 2015 returning coho salmon, were ranked 17, 15, 15, and 14 out of 17 annual data points, thus are collectively suggesting a marine survival at the lowest range of observations (0.7% - 1.7% for Carnation Creek Wild; 3.3% - 5.3% for Robertson (Stamp). As noted above under the Results for Southwest Vancouver Island, the Marine Growth model is showing a marine growth at the highest range of observations. As a result of these contra-indicators, caution must be exercised when using the forecasted Marine Survival.

Environmental Variables	***1998***	***1999***	***2005***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***
PDO (May-Sep)	10	4	16	2	9	7	3	1	8	17
NPGO (May-Sep)	14	5	17	2	11	6	7	4	12	15
ENSO (May-Sep)	8	2	11	6	17	1	5	14	4	15
Mean SST - WCVI (Amphitrite) - Mar-Jun	16	1	17	6	9	13	10	2	7	14
WCVI Coho Summer Growth	16	2	17	8	14	7	15	6	13	1
Mean Rank	12.8	2.8	15.6	4.8	12.0	6.8	8.0	5.4	8.8	12.4
Rank of Mean Ranks	16	1	17	2	13	6	7	3	10	14

Figure 5. Ranked data by year for the four Climate Indices (PDO, NPGO, ENSO and SST) and the Summer Growth Index. Not all years are shown. The right side column shows the low ranking for the climate indices, and, in contrast, the Summer Growth Index for coho salmon that entered the ocean as smolts in 2014, returning in 2015.

ACKNOWLEDGEMENTS

The coho forecast for southern British Columbia requires data from many sources and is very much a collaborative document. Steve Baillie completed analysis of Strait of Georgia and WCVI indicators. Data analysis of the Lower Fraser and Interior Fraser Management Units was completed by Lynda Ritchie and Johnstone Strait by Pieter Van Will.

Fresh water creel survey data were provided by Lower Fraser STAD staff, and Joan Bennett (Strait of Georgia). The marked coho escapement for Robertson Creek Hatchery was supplied by Jeff Till. Cheryl Lynch provided escapement data from the hatcheries. Wild coho data were provided by Jim Meldrum (Atlegay First Nation - Black Creek) and Dr. Peter Tschaplinski (BC Ministry of Environment - Carnation Creek). Nicholas Komick provided the description of MRP CWT expansion models. Thanks to Dr. Marc Trudel for contributing the Growth Model for forecasting marine survivals of WCVI salmon stocks and information on Ocean Climate indicators.

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FOR MORE INFORMATION

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Appendix 1. Exploitation Rate estimation. Summarized from Simpson *et al.* 2004, Kuhn *et al.* 1988, Kathryn Fraser, pers. comm. and Nicholas Komick, pers. comm.

Marine survival (MS) is defined as *Catch + Escapement / Smolt release*. For Coho Salmon this calculation is relatively straightforward exercise given the life history of this species. Although coho juveniles can spend anywhere from six months to two years (occasionally more) in freshwater prior to smolting, it is the number of juveniles that migrate to marine water during April-June are used for the denominator in the MS equation (*Smolt release*). Subsequent to ocean entry, these fish almost invariably return to freshwater to spawn after 1 ½ years. This cohort of spring migrant coho is joined by coho that have left freshwater at other times of the year, or are straying from adjacent populations. This additional contribution can comprise a significant proportion of the adult spawners therefore a method must be incorporated to follow the cohort of spring migrant smolts through to adults returning to freshwater to spawn (*Escapement*). The method adopted and used by Fisheries and Oceans Canada is the coded-wire tag, with an external mark of the adipose fin clip to denote the presence of the tag. In addition, the coded-wire tag allows identification of these stocks in the catches of First Nations, Commercial and Recreational fisheries (*Catch*).

Through the 1990s coho abundances, particularly stocks in the Interior Fraser and Strait of Georgia areas, decreased to very low levels. Total exploitation by the various sectors on these stocks was 60%-80% and, while a contributing factor, was not the only reason for the population collapse. In response DFO restricted all directed commercial and recreational fisheries on coho salmon, and required release of all coho that were inadvertently caught when fishing for other species. Subsequently, the persistent low abundance of these stocks indicated that factors controlling the survival of coho between entering marine water and returning to freshwater to spawn were preventing abundances from returning to pre-collapse levels.

With the lack of retention fisheries on stocks, particularly Interior Fraser/Thompson River coho, the largest source of anthropogenic based mortality was the release mortality from caught and released coho as by-catch in fisheries that were target at other species. In order to estimate the level of mortalities based on releases, an Effort-based model was developed by DFO in the early 2000s. This model used catch data expressed as the average exploitation rate over the base period from 1987-1997. For a given indicator, fishery type, location and month, the base period exploitation was scaled by the ratio of effort in the current year, a catch scalar that represents both fleet efficiency and whether coho was targeted, and release mortality. Specific release mortalities were used for each fishery type. These scalars were examined periodically and adjusted to reflect changes in fishery regulations. This method of estimating Exploitation Rate was used for both marked and unmarked indicators. The results from the Effort based model were used to estimate the exploitation rate of coho for all indicators, and have been used in the annual coho marine survival forecast and for domestic planning purposes until the 2015 Forecast.

The exception was the Goldstream Hatchery. When the Effort based model was developed, Goldstream Hatchery was not part of the coho indicator system so the base period data for this stock was not included in the model. Coded-wire tagged coho smolts were initially released in 1998 (Brood year 1996) and forecasts were started for the 2007 return. The catch results from MRP were used to estimate the Exploitation Rate. These results (BY 1996-2005 – 54%) varied considerably from the Effort-based model results for the other hatchery indicators (Big Q – 6.1%, Inch – 6.0%, Quinsam – 5.2%). The Goldstream hatchery coho do have a different Marine distribution than the other hatchery coho, but the difference in Exploitation could not be attributed to just southern fisheries.

Mass marking using the adipose fin clip of hatchery origin coho with a small portion tagged with a CWT was initiated with the 1995 brood year, for adult salmon returning in 1998. This corresponded with wide scale non-retention of unclipped coho regulations being put in place. Although retention of marked coho was allowed, the proportion of these fish that had a coded-wire tag was low (<10%). This change had implications on several levels:

1. Recreational fishers, given the low occurrence of the CWT in clipped coho, were not motivated to turn the heads from their catch in to head recovery depots.
2. With no directed commercial coho fisheries, the only coho catch was as bycatch in fisheries directed at other species. Budget constraints restricted large scale monitoring in landing areas for the low number of tagged fish.
3. All clipped coho would have to be 'wanded' to test for the presence of a CWT prior to head submission.

Meanwhile, the DFO Mark-Recapture Program (MRP) was continuing to operate with the head recovery data that they were collecting. Major exploitive fisheries such as Alaska, Northern Troll, and southern US sectors were still monitoring clipped coho tags, and some heads were being turned in from the southern BC recreational fisheries. The methodology used to expand the observed CWTs in commercial fisheries to an estimate of the represented stock group is documented in Kuhn *et al.*, 1988.

The method used to estimate catches from CWTs in Canadian recreational fisheries have changed since 1988. The following descriptions are summarized from Nick Komick (pers. comm.).

The submission rates for catch regions and temporal strata that were not surveyed by the Creel program have been estimated using the following three methods:

1. **Monthly Pooling** – Head submission rate from May to September are pooled and applied to time periods that are not part of the Creel Survey period. The pooling of submission rates is strictly an average, no weighting occurs for total catch or recoveries.

   With Monthly Pooling, specific criteria are applied to the averaging of submission rates. For pooled months that do not have recoveries or the mark rate is zero, the submission rate for the month is set to 0.25 and this fixed value is incorporated into the pool. Also, if the submission rate for the pooled month is greater than 0.5 then

the submission rate is set to 0.5. This upper limit of 0.5 for the Monthly Pooling method is unique to this pooling method.

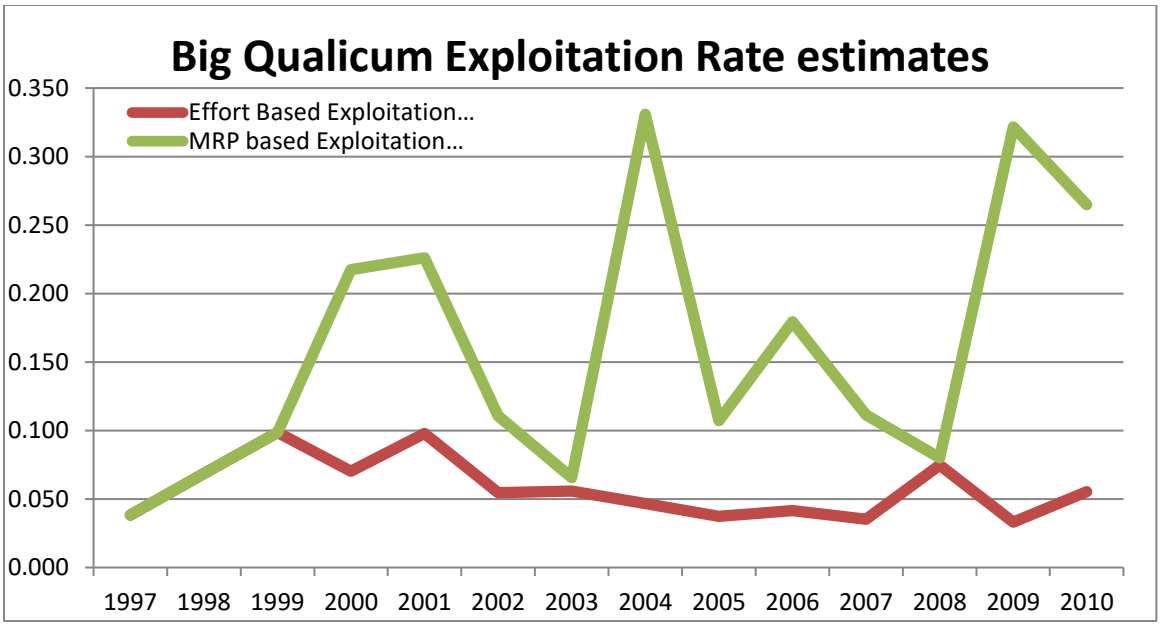
2. **Creel Survey Monthly Pooling** - The Creel Survey Monthly Pooling method is similar to Monthly Pooling (Section 1); however, the pooling month range of observed recoveries is dependent upon creel survey date ranges. Only recoveries that occur during the creel survey reported dates in the identified area are used in the calculation of the submission rate.

   In addition to the use of creel survey dates, Creel Survey Monthly Pooling catch regions are globally pooled in a special way. Unlike the Monthly Pooling method, the no-tag recoveries are rejected from the global pool.

3. **Global Pooling** - Global Pooling of submission rates incorporates both spatial and temporal averaging to estimate submission rates for catch regions that do not have creel surveys conducted. The total catch, mark rates, and observed recoveries from catch regions that are Monthly Pooled or Creel Survey Monthly Pooled are combined to calculate a global submission rate at the month level. Similar to the Monthly Pooling method, the Globally Pooled unique submission rates from May to September are averaged to produce submission rates for the other months. However, to produce the globally pooled unique rates for May through September, a *weighted average* approach is used with the total catch, total number of fish sampled for adipose-clipped status, total number of fish adipose-clipped, and the total observed recoveries are combined to calculate the submission rates for each month.

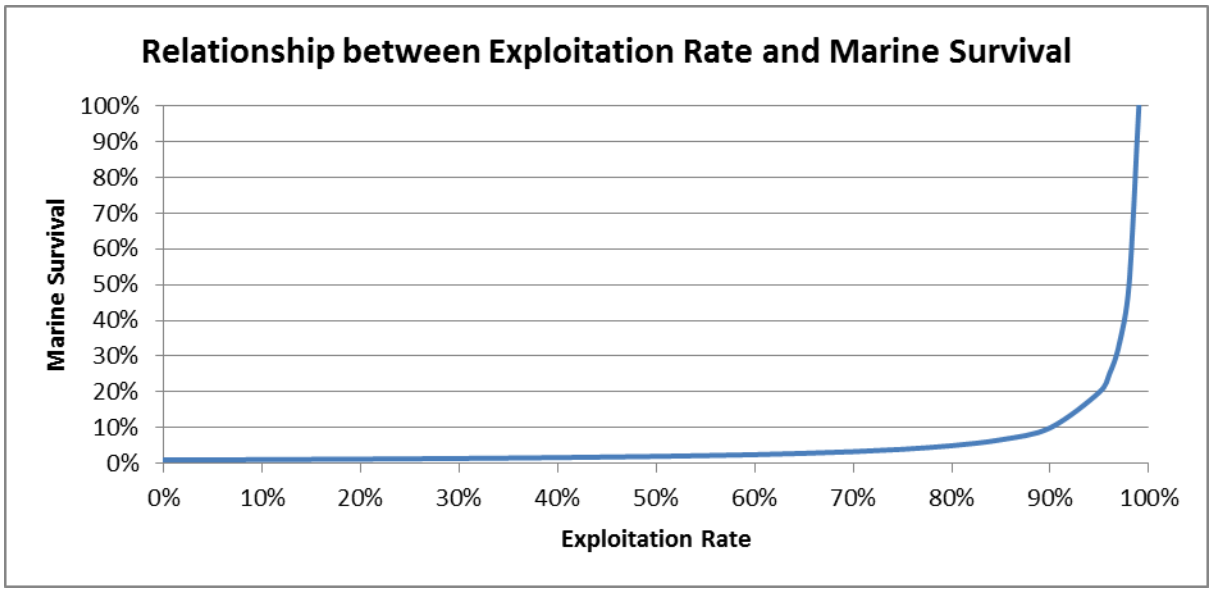
The original decision to use the Effort based model for estimating Exploitation was that the primary source of mortality due to catch was from releasing coho. This is no longer true and hasn't been since mark selective recreational fishery regulations were put in place in 2000, for adipose clipped coho. For the 2015 forecast the Effort based exploitation was discontinued for clipped hatchery coho stocks, but retained for unclipped wild stocks. Further, the exploitation rate for these hatchery stocks was back-calculated to the return year 2000 when Mark Selective fisheries were initiated.

The change in estimate method resulted in an increase in Exploitation Rate, and despite the magnitude of some of the increases, the resulting change in Marine survival was minimal.



Exploitation rate estimates, based on the Effort-based model and the Mark-Recapture Program.

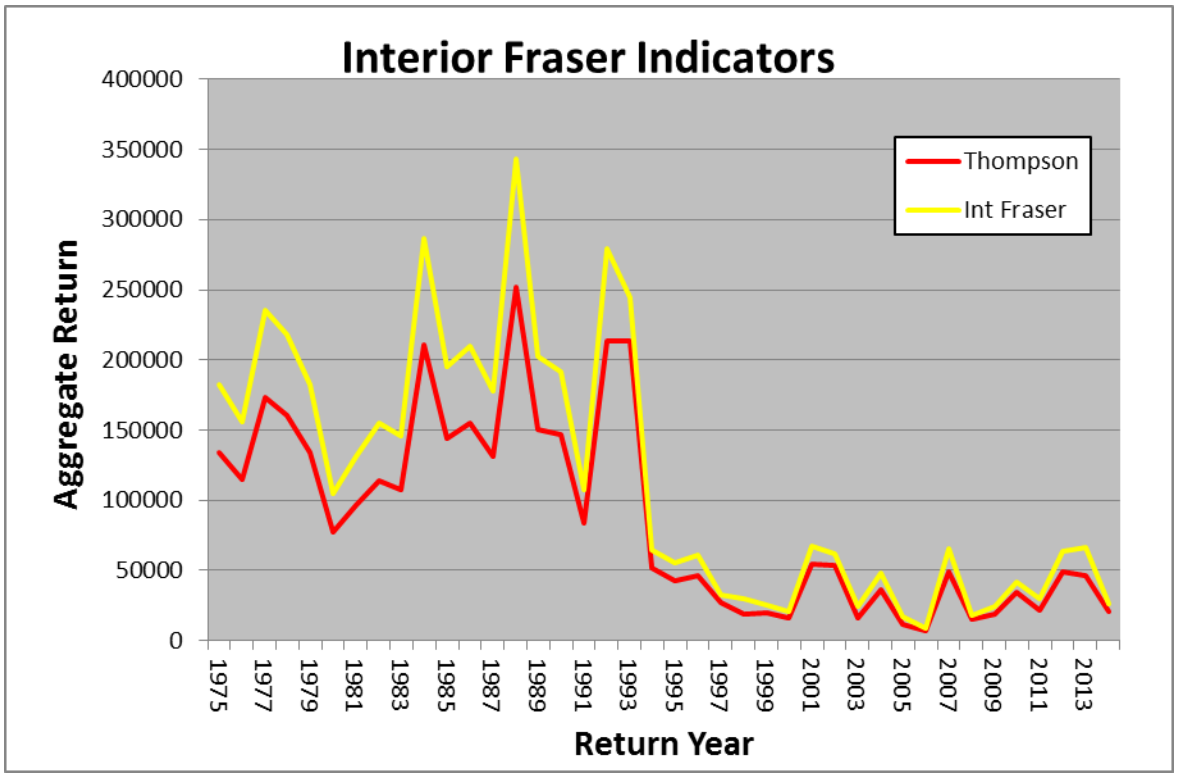
The relationship between Exploitation Rate and Marine Survival is shown in the figure below. This relationship is based on a hypothetical stock that assumes a 1% smolt to spawning adult (similar to observed data) and shows what the Marine Survival rate would be under different Exploitation Rate levels. This figure shows that the estimated Marine survival would remain low until Exploitation Rate approach 80%.

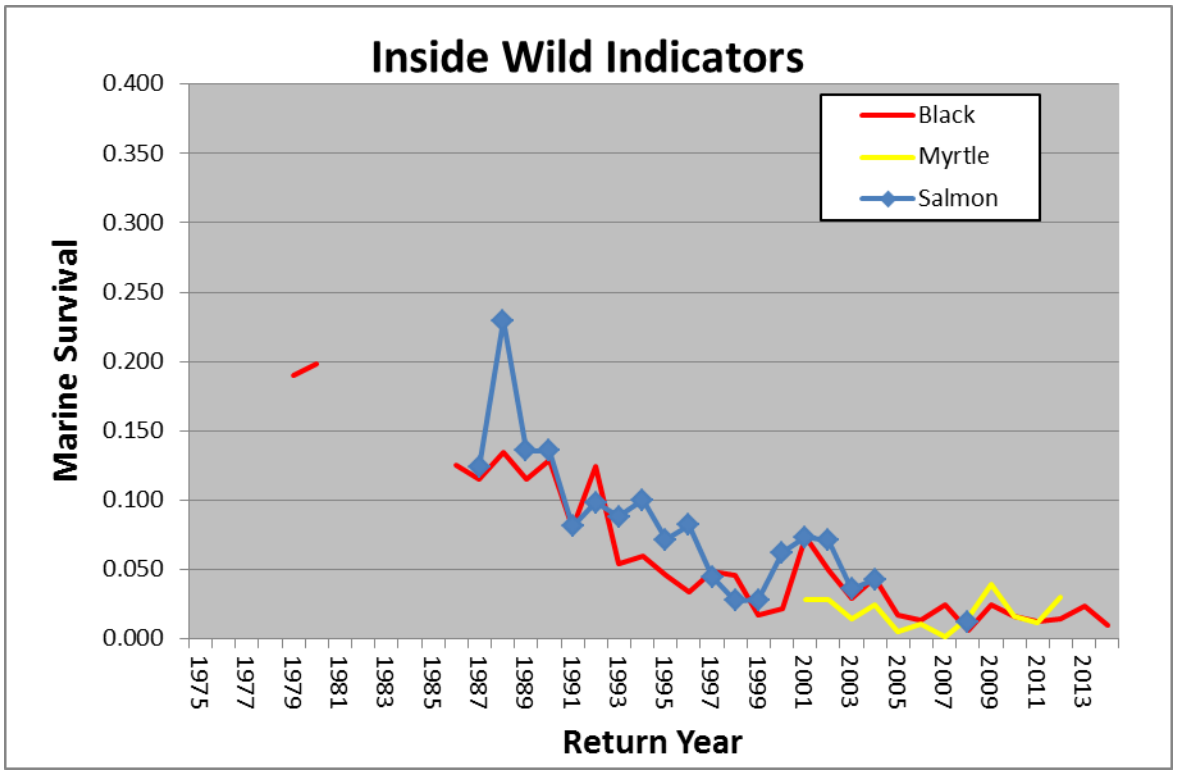


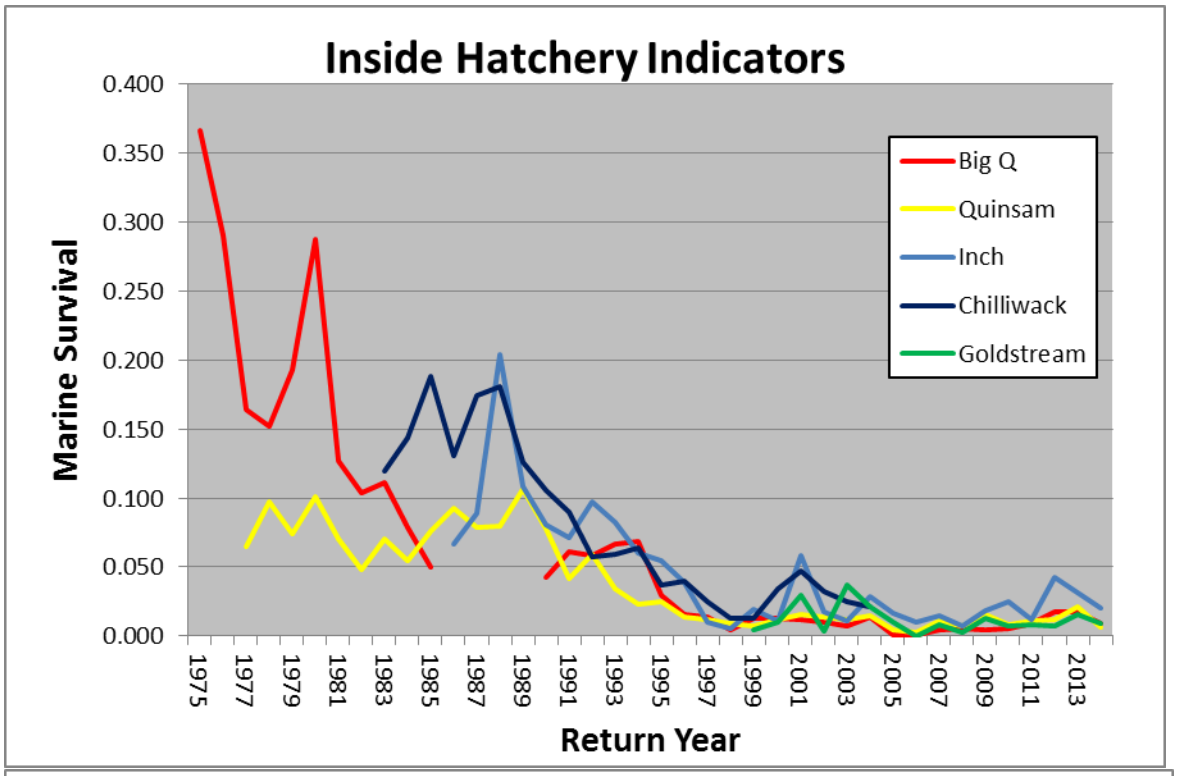
Relationship between Exploitation Rate and Marine Survival under low Marine Survival conditions.

What is described above does not say that Exploitation Rate drives the level of Marine Survival; it merely depicts the formula relationship between Exploitation Rate and Marine Survival. What it does show is that at the current low Marine Survival levels (1%), the estimate of Exploitation Rate that is used in the calculation of Marine Survival has almost no effect on Marine Survival until a high level of exploitation is present.

Appendix 2. Marine survival or aggregate abundances for southern BC coho indicators.






Inside Hatchery Indicators
Marine Survival
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
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2001
2003
2005
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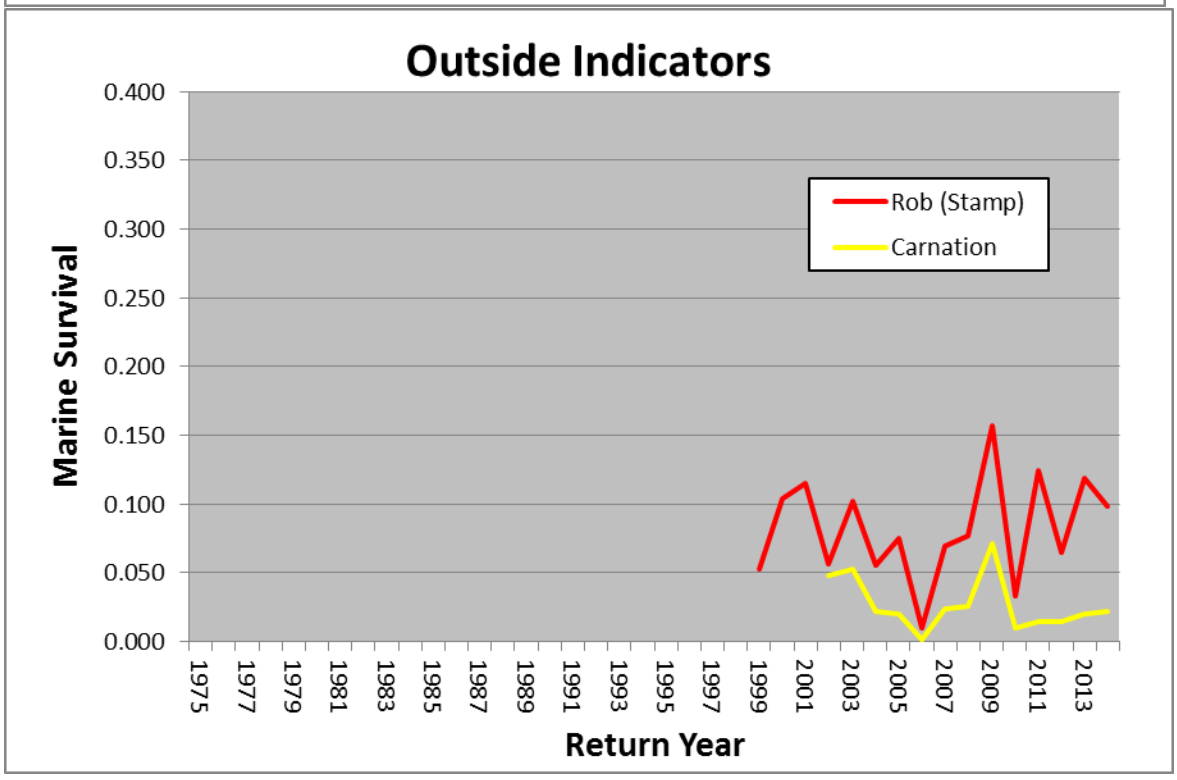
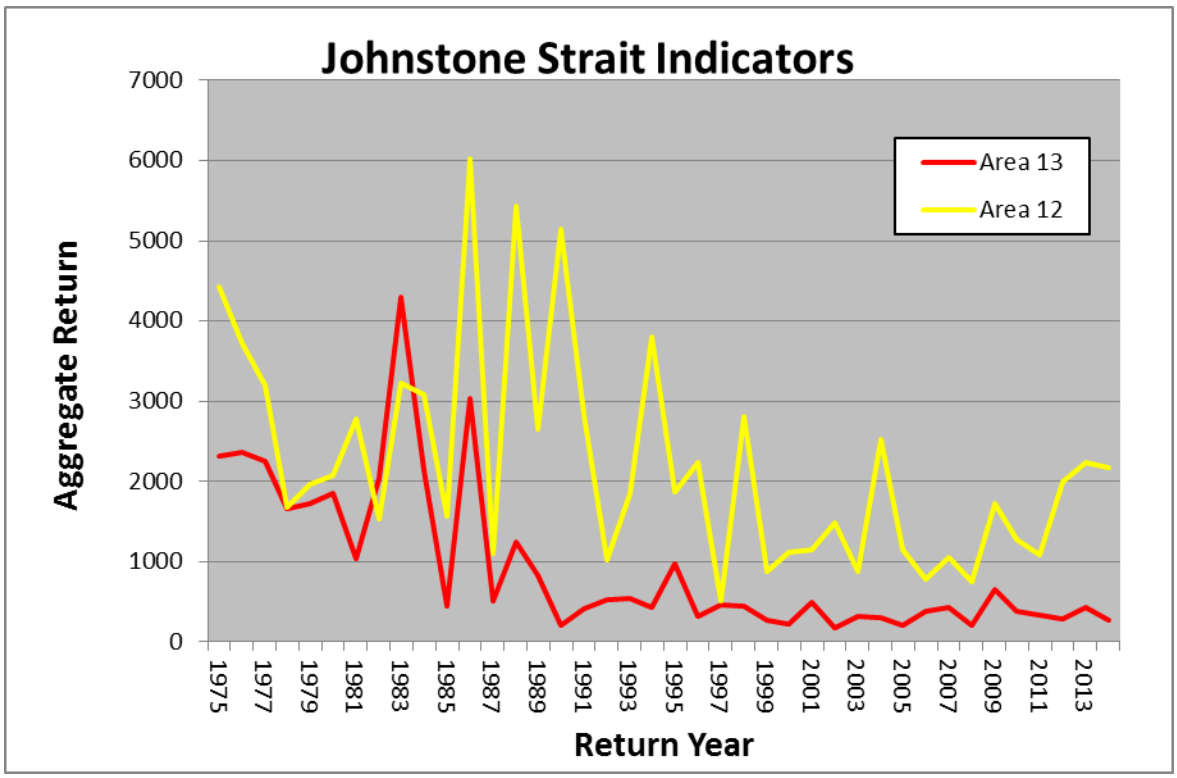
2011
2013
Return Year
Big Q
Quinsam
Inch
Chilliwack
Goldstream


Outside Indicators
Marine Survival
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Return Year
Rob (Stamp)
Carnation


Johnstone Strait Indicators
Aggregate Return
7000
6000
5000
4000
3000
2000
1000
0
1975
1977
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1983
1985
1987
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1993
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1997
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2001
2003
2005
2007
2009
2011
2013
Return Year
Area 13
Area 12

Appendix 3. Observed and forecast marine survival and aggregate abundance indicators from southern BC coho indicator stocks.

Column Headings

Stock: The name of the Management Unit in **Bold**, followed by the individual indicator or stock grouping within that Management Unit.

2013 Observed: The values in this column represent either the aggregate value (whole numbers) or the estimated marine survival (decimal numbers), from the 2013 return year.

2014 Forecast, 50% CI, and Model refer to the forecast for the 2014 return year. The actual forecasted value is given first, followed by the 50% confidence interval, then the forecasting model used.

2014 Observed, Change from forecast and Change from 2013 refer to the estimated values for each indicator, then the % change from the forecasted value and the observed value in the previous year. The % change is in relation to the base value so a marine survival of 1.5% in year one increasing to 2.0% in the next year is expressed as a 33% change and is highlighted in green. A decrease of 2.0% to 1.5% is expressed as a – 25% change and is highlighted in pink. The values for Change from forecast have not been included due to the change in Exploitation Rate model. The 2014 Observed uses a different set of data values (see Appendix 1 for explanation) from those presented in the 2014 Forecast so a comparison is not possible.

2015 Forecast, 50% CI and Model refer to the forecast for the current year.

Change from 2014 is the change in value from the observed 2014 to the 2015 forecast. Each changed is highlight in green or pink, depending on whether the change is up, or down.

Distribution Index (P_{inside}) does not have an annual inside/outside measure so there are no Observed data to report or compare to.

Stock	2013	2014			2014	Change from forecast	Change from 2013	2015			Change from 2014
	Observed	Forecast	50% CI	Model	Observed			Forecast	50% CI	Model	
Johnstone Strait/Mainland Inlets											
Area 12	2,232	1,652	1167 - 2452	3YRA	2,170	**31%**	**-3%**	2,068	1428 - 2994	3YRA	**-3%**
Area 13	419	345	236 - 505	3YRA	274	**-21%**	**-35%**	327	224 - 476	3YRA	**19%**
Georgia Basin - West											
Big Qualicum Hatchery	0.018	0.014	0.008 - 0.024	LLY	0.009	**N/A**	**-50%**	0.009	0.005 - 0.016	LLY	**0%**
Quinsam Hatchery	0.021	0.010	0.007 - 0.014	3YRA	0.020	**N/A**	**-5%**	0.017	0.012 - 0.024	3YRA	**-15%**
Goldstream Hatchery	0.016	0.009	0.004 - 0.021	3YRA	0.011	**N/A**	**-31%**	0.011	0.004 - 0.028	3YRA	**0%**
Black Creek (wild)	0.024	0.017	0.012 - 0.024	3YRA	0.010	**-41%**	**-58%**	0.015	0.010 - 0.021	3YRA	**50%**
Lower Fraser											
Inch Hatchery	0.021	0.021	0.012 - 0.035	LLY	0.022	**5%**	**5%**	0.022	0.013 - 0.037	LLY	**0%**
Interior Fraser											
Interior Fraser watershed	66,982	49,472	31,477 - 77,754	3YRA	26,114	**-47%**	**-61%**	49,554	31,872 - 77,047	3YRA	**90%**
Thompson River aggregate	46,421	36,100	22,857 - 57,013	3YRA	21,178	**-41%**	**-54%**	38,206	24,531 - 59,505	3YRA	**80%**
South-west Vancouver Island											
Robertson (Stamp Falls) Hatchery	0.119	0.058	0.046 - 0.072	Growth	0.098	**N/A**	**-18%**	0.145	0.118 - 0.179	Growth	**48%**
Carnation Creek (wild)	0.020	0.016	0.011 - 0.023	Growth	0.022	**38%**	**10%**	0.066	0.044 - 0.086	Growth	**200%**
Distribution Index (P_{inside})		0.509	0.408 - 0.609	Salinity				0.266	0.194 - 0.352	Salinity	

2014 Observed for adipose clipped indicators (Quinsam, Big Qualicum, Inch, Goldstream and Robertson) are based on exploitation rates dirived from the Mark-Recapture Program

2014 Forecast is based on the previous data set, with exploitation based on the Effort-based model so a comparison is not appropriate