2014 MARINE SURVIVAL FORECAST OF SOUTHERN BRITISH COLUMBIA COHO

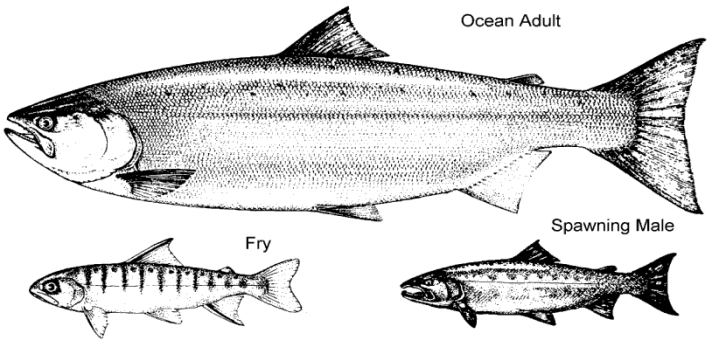

Figure 1: Coho salmon at three life stages: freshwater rearing fry; ocean rearing adult; and returning male. This image has been used on previous coho Stock Status reports, origin unknown.

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 2013 were generally higher than the previous year with the exceptions of Inch Creek Hatchery and Thompson River Aggregate. In particular, the marine survival of Goldstream River Hatchery and Robertson Creek Hatchery (Stamp Falls) indicators were more than double the marine survival from the previous year.

The 2014 forecast for coho indicators are predicting lower marine survivals and aggregate abundances than the 2013 observed metrics. This forecast direction is common to indicators that use both time series and biological based models. The only exception to this direction is the Strait of Georgia Hatchery Aggregate indicator which uses the CPUE forecast model.

The Distribution Index is forecasting a weak 'inside' distribution of coho in the Strait of Georgia, suggesting lower levels of abundance. Over the last three years this index has indicated a 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 2013.

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 Starting in 2012, this information is set out in an unpublished internal document for use in coho stock management processes.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) and DFO (2013) are similar reports that are unpublished but are available from the author.

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.

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).

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).

Graphical depictions of the observed marine survival or aggregate abundance for all coho indicators used in this forecast are shown in Appendix 1.

RESULTS

Appendix 2 shows the observed 2012 and 2013 values, and the forecast for 2014 returns.

Johnstone Strait/Mainland Inlets

In 2013 the observed return in Area 12 was 59% higher than forecast and the Area 13 return was about 27% higher than forecast. The Area 12 return was 56% greater than the 2010 brood return and approximately 11% higher than what was estimated for the previous year's return (2012). The Area 13 return demonstrated a 42% increase in abundance relative to the brood year (2010) and 49% higher than the previous year's return (2012). For the indicator system at Keogh, smolt production in 2012 was well

above average (108,000). Based on the observed 2013 returns at those and other system in the area, marine survival had improved in both Area 12 and Area 13 relative to the 2012 return.

The Area 12 and 13 2014 forecasts are higher than the brood returns in 2011. The Area 12 and 13 forecasts are respectively 24% lower and 18% lower than the 2013 observed indices. Coho abundance in this region remains low and can be characterized as 'below average' for both Area 12 and 13 stocks. See Simpson et al., 2004 for description of characterizations. Smolt production in 2013 was well above average for Keogh River (111,000 vs. 64,000). 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. The Wild indicator is Black Creek.

Observed 2013 marine survival rates for both hatchery and wild indicators surpassed the forecast level by 17-114% and were near the upper 50% confidence interval. All these forecasts were based on a time series type model. The biologically based model of CPUE for the Hatchery Aggregate performed much better as the observed marine survival for this metric was slightly lower than the forecast. For the wild indicator system at Black Creek, smolt production in 2012 was well below average (32,000).

The 2013 observed marine survivals were also improvements over the observed 2012 values but are still lower than historic levels seen in the 1990s.

The 2014 forecast for the hatchery and wild indicators is for a slight decrease from the 2013 levels, however the models used for these are based on time series and are poor models when conditions are changing. The Biological model that uses CPUE of hatchery clipped coho juveniles has forecast a 50% increase in marine survival over 2013.

Smolt production at Black Creek in 2013 was close to average (57,000 vs. 58,000).

Georgia Basin – East

The only indicator in this Management Unit, Myrtle Creek, has been discontinued due to lack of resources. The hatchery and wild indicators for the Georgia Basin – West, will be used as surrogates.

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 2013 marine survival from Inch Creek hatchery decreased from the 2012 level and from the 2013 forecast by 40%, unlike other hatchery indicators in the Strait of Georgia that showed increases.

The marine survival forecast for 2014, using the "Like Last Year" model, is for the same level.

Interior Fraser

The observed 2013 abundance for both the Thompson River and Interior Fraser Aggregates were within 10% of the observed 2012 abundance, and both were much higher than the forecast by 39 and 56%, respectively.

The 2014 forecast is for a 22% - 26% decrease from the 2013 abundance for the two aggregates.

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 2013 marine survival for both hatchery and wild indicators were greater than the previous year by 132% and 43%, respectively. The Robertson Indicator marine survival surpassed the 2013 forecast while the Carnation Indicator was less than the forecast.

The 2014 marine survival, based on a marine growth metric, is forecast to drop 58% and 20% from the 2013 observed levels for the Robertson and Carnation indicators, respectively.

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"). 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.

Over the last three years the Index has been between 0.60 and 0.67 which are interpreted as 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 2014 forecast is 0.509, indicating a weak inside distribution of coho. This suggests that coho abundance in the Strait of Georgia will be lower than the levels observed in 2013.

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. The CPUE data were collected by Chrys Neville and her staff. Cheryl Lynch provided escapement data from the hatcheries. Wild coho data were provided by Dave Nagtegaal (Black Creek) and Dr. Peter Tschaplinski (BC Ministry of Environment - Carnation Creek). Thanks to Dr. Marc Trudel for contributing the Growth Model for forecasting marine survivals of WCVI salmon stocks.

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FOR MORE INFORMATION

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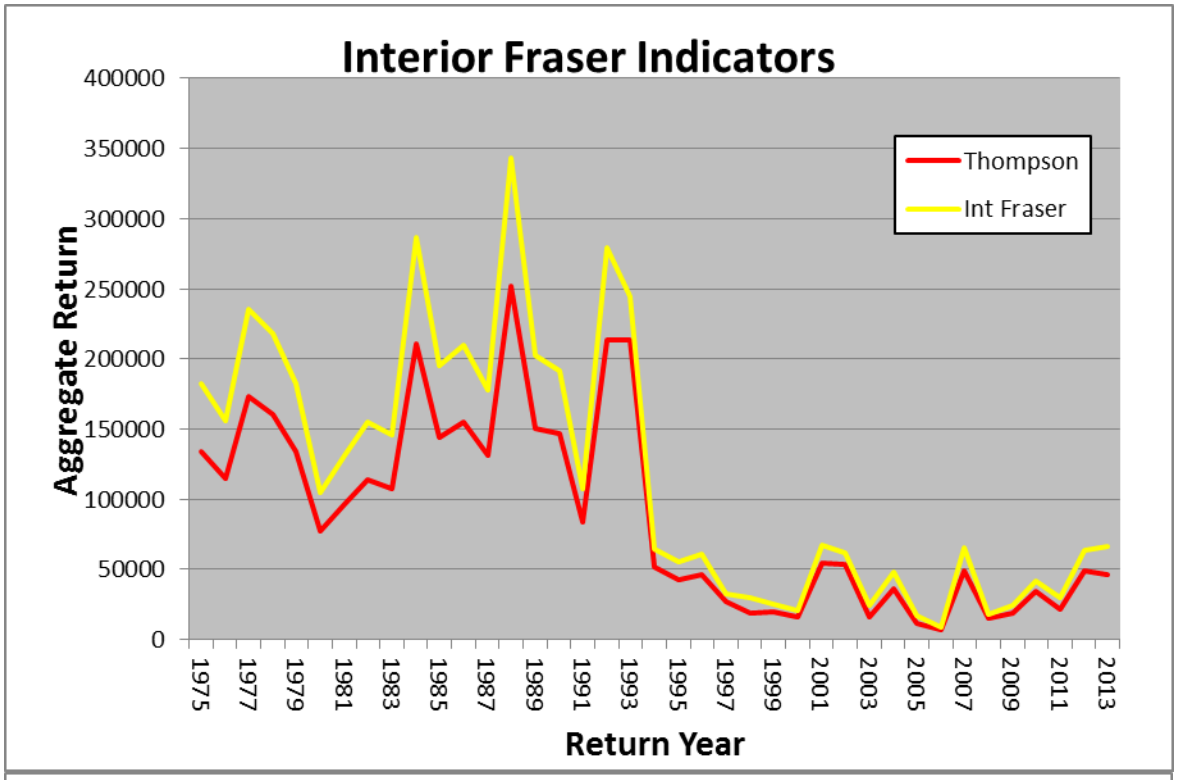
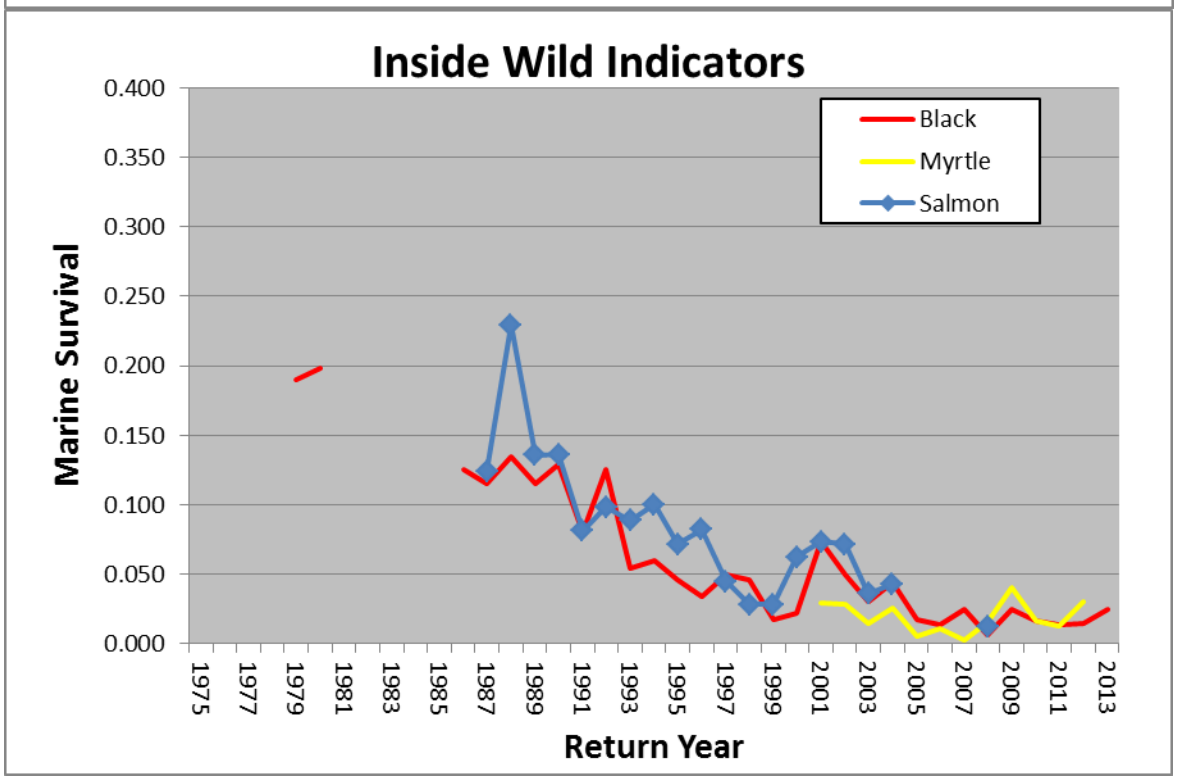
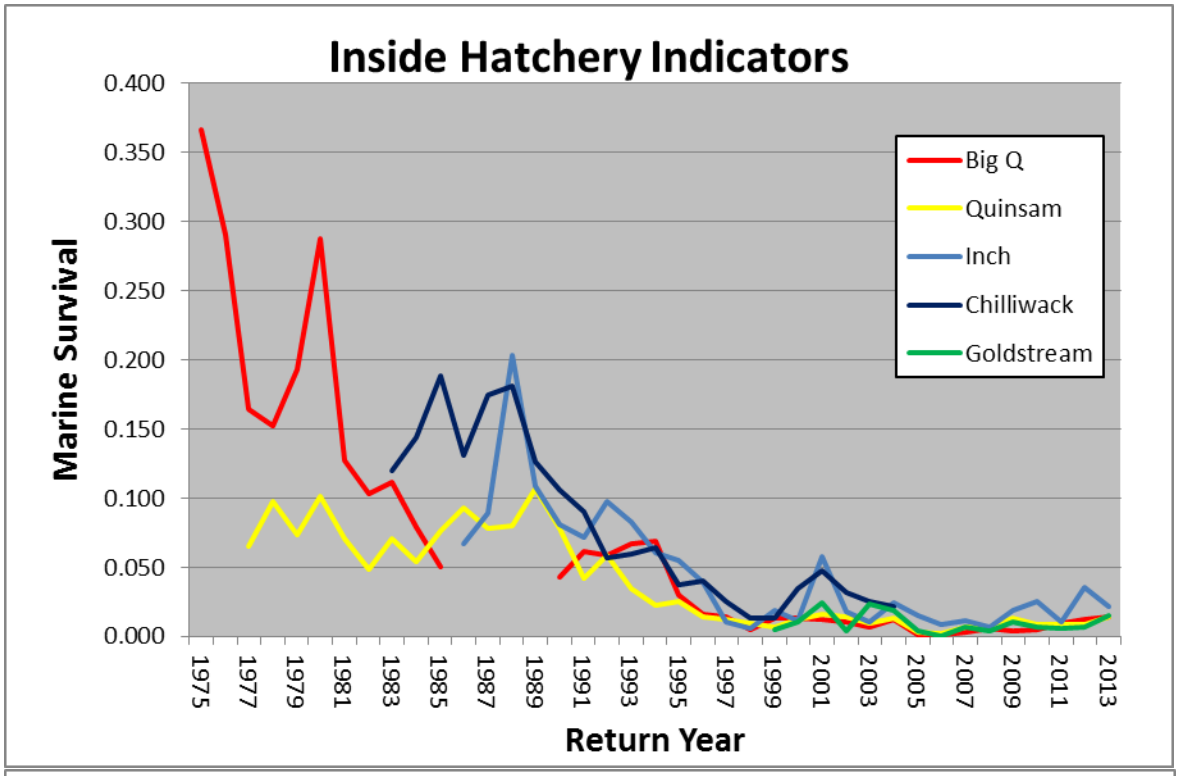
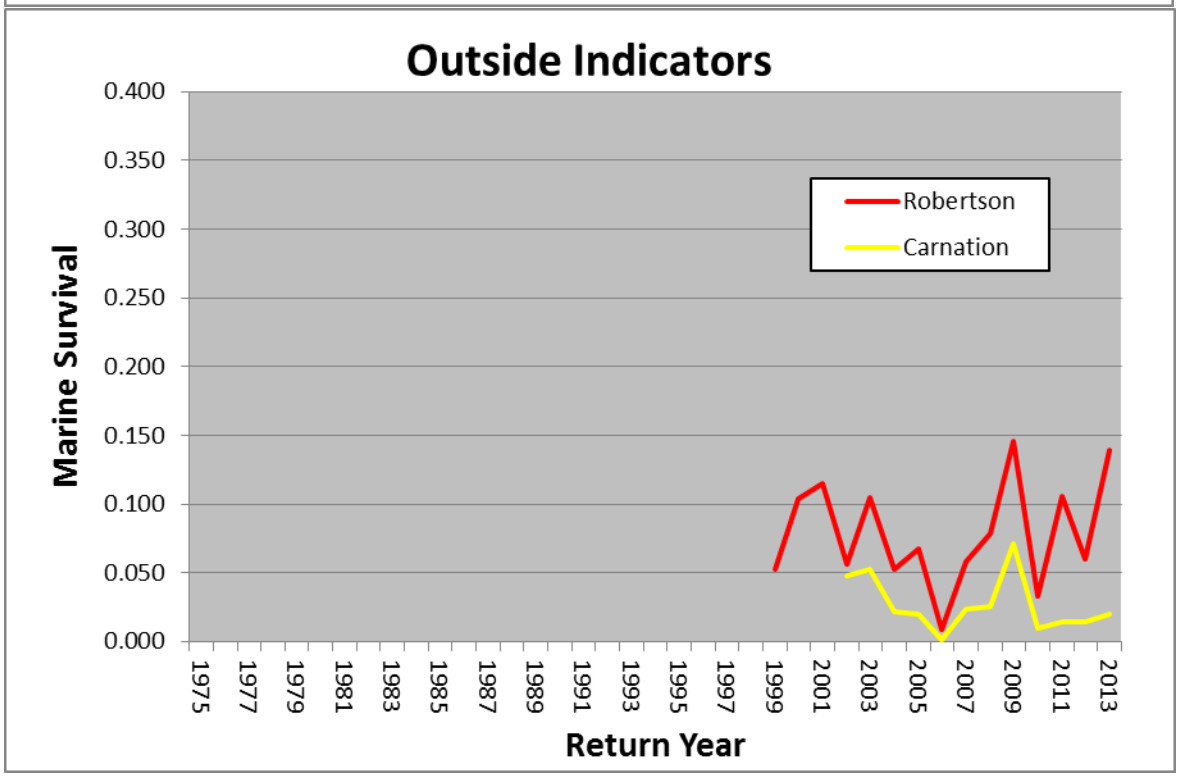
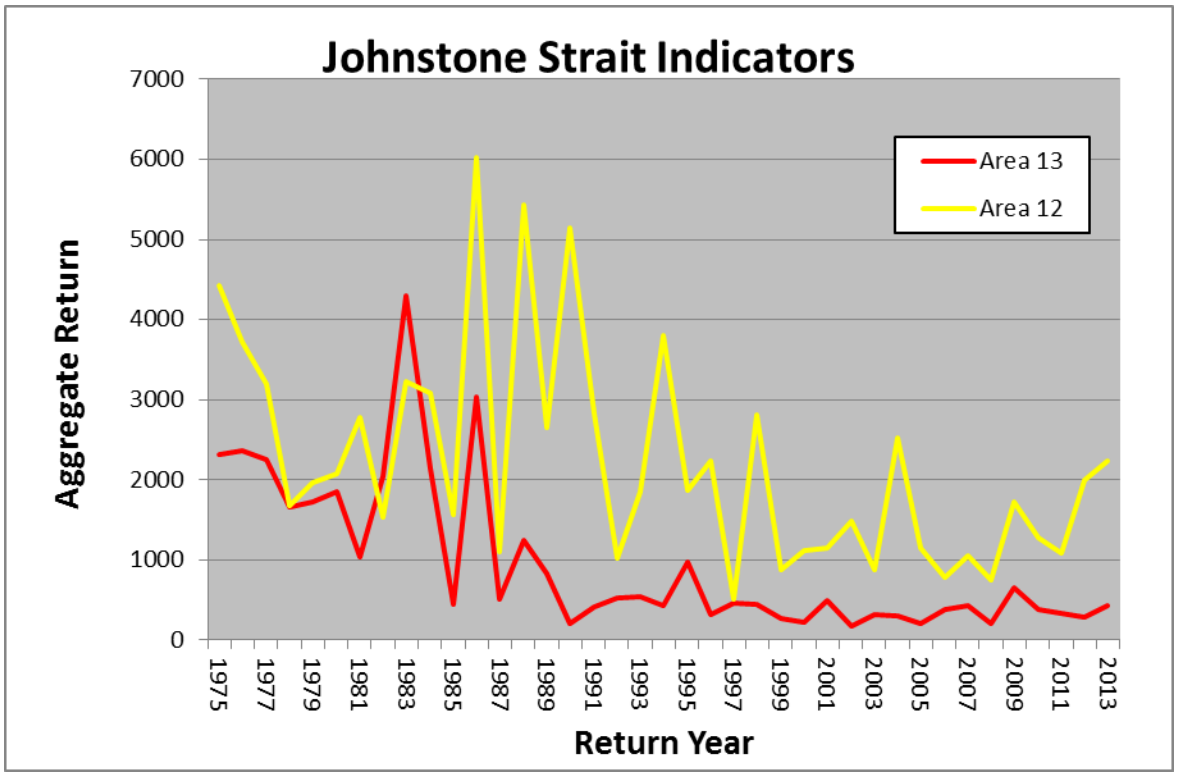
Appendix 1. Marine survival or aggregate abundances for southern BC coho indicators.






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
1997
1999
2001
2003
2005
2007
2009
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
Robertson
Carnation


Johnstone Strait Indicators
Aggregate Return
7000
6000
5000
4000
3000
2000
1000
0
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
Return Year
Area 13
Area 12

Appendix 2. 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.

2012 Observed: The values in this column represent either the aggregate value (whole numbers) or the estimated marine survival (decimal numbers), from the 2012 return year.

2013 Forecast, 50% CI, and Model refer to the forecast for the 2013 return year. The actual forecasted value is given first, followed by the 50% confidence interval, then the forecasting model used.

2013 Observed, Change from forecast and Change from 2012 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.

2014 Forecast, 50% CI and Model refer to the forecast for the current year.

Change from 2013 is the change in value from the observed 2013 to the 2014 forecast. Each changed is highlight in green or pink, depending on whether the change is up, or down.

Stock	2012	2013			2013	Change from	Change	2014			Change
	Observed	Forecast	50% CI	Model	Observed	forecast	from 2012	Forecast	50% CI	Model	from 2013
Johnstone Strait/Mainland Inlets											
Area 12	2,002	1,405	935 - 2111	3YRA	2,232	**59%**	**11%**	1,652	1167 - 2452	3YRA	**-24%**
Area 13	280	330	220 - 494	3YRA	419	**27%**	**49%**	345	236 - 505	3YRA	**-18%**
Georgia Basin - West											
Big Qualicum Hatchery	0.012	0.012	0.001 - 0.022	LLY	0.014	**17%**	**17%**	0.014	0.008 - 0.024	LLY	**0%**
Quinsam Hatchery	0.008	0.008	0.005 - 0.011	3YRA	0.014	**75%**	**75%**	0.010	0.007 - 0.014	3YRA	**-29%**
Goldstream Hatchery	0.007	0.007	0.003 - 0.016	3YRA	0.015	**114%**	**114%**	0.009	0.004 - 0.021	3YRA	**-40%**
Black Creek (wild)	0.014	0.015	0.010 - 0.021	3YRA	0.024	**60%**	**71%**	0.017	0.012 - 0.024	3YRA	**-29%**
Lower Fraser											
Inch Hatchery	0.035	0.035	0.021 - 0.060	LLY	0.021	**-40%**	**-40%**	0.021	0.012 - 0.035	LLY	**0%**
St Geo Hatchery aggregate	0.018	0.018	0.016 - 0.020	CPUE	0.016	**-11%**	**-11%**	0.024	0.021 - 0.027	CPUE	**50%**
Interior Fraser											
Interior Fraser watershed	62,018	42,729	27,091 - 67,393	3YRA	66,982	**57%**	**8%**	49,472	31,477 - 77,754	3YRA	**-26%**
Thompson River aggregate	47,699	33,342	20,986 - 52,972	3YRA	46,421	**39%**	**-3%**	36,100	22,857 - 57,013	3YRA	**-22%**
South-west Vancouver Island											
Robertson (Stamp Falls) Hatchery	0.060	0.086	0.069 - 0.106	Growth	0.139	**62%**	**132%**	0.058	0.046 - 0.072	Growth	**-58%**
Carnation Creek (wild)	0.014	0.034	0.024 - 0.049	Growth	0.020	**-41%**	**43%**	0.016	0.011 - 0.023	Growth	**-20%**
Distribution Index (P_{inside})		0.647	0.547 - 0.736	Salinity				0.509	0.408 - 0.609	Salinity	