



WCVI Salmon Bulletin 24 June 2021 Assessment Update and Reforecast Area 23 Sockeye—Barkley Sound/Alberni Inlet

FISHERY MANAGEMENT

For 2021 fishery management purposes, the Area 23 roundtable agreed to begin fisheries in the “low” zone for early season harvest management, using a management forecast for Somass Sockeye of 350,000 adults. See Table 1 (below) for details of the June fishing plan.

Table 1. Standardized plan for June Sockeye fisheries in Area 23. Plan is in effect until a formal in-season reforecast is adopted, and may be altered in-season through discussions at the roundtable. Fisheries thus far have operated according to a predicted run size in the “Low” zone.

MGT ZONE	FORECAST RUN SIZE	MAANULTH FIRST NATIONS	REC	TSUMASS FIRST NATIONS	COMMERCIAL SEINE*	COMMERCIAL GILLNET
Critical	Less than 200,000	no harvest	no harvest	no harvest	no harvest	no harvest
Very Low	200,000 to 350,000	Open, fishing to target through limited effort (designated g/n vessels)	2 fish/day + Area restrictions + Late opening	Community/elder seine 1 day/week g/n	no harvest	1 day/week starting 64 (1 day total)
Low	350,000 to 500,000	Open, fishing to target through limited effort (designated g/n vessels)	2 fish/day + Area restrictions	Community/elder seine 2 days/week g/n	seine fishing to target	1 day/week starting 63 (2 days total)
Moderate	500,000 to 700,000	Open, fishing to target through limited effort (designated g/n vessels)	4 fish/day (time-area closures if required)	Community/elder seine 3 days/week g/n	seine fishing to target	1 day/week starting 62 (3 days total)
High	700,000 to 1,000,000	Open, fishing to target through limited effort (designated g/n vessels)	4 fish/day (time-area closures if required)	Community/elder seine 4 days/week g/n	seine fishing to target	1 day/week starting 62 (3 days total)
Abundant	1,000,000 +	Open, fishing to target through limited effort (designated g/n vessels)	4 fish/day	Community/elder seine 5 days/week g/n	seine fishing to target	1 day/week starting 61 (4 days total)

REPORTED CATCH

Total retained catch for this week was 6,190 Sockeye in Tsu-ma-uss EO fisheries, 3,765 in Tsu-ma-uss FSC fisheries, 522 in the test fishery, 21,700 in the Area D fishery, 7,400 in Maa-nulth fisheries, and approximately 1,657 in the sport fishery.

Table 1. Total reported Area 23 Sockeye catch to 24 June 2021.

Sector	Reported catch	TAC @ 350k	Remaining
Test fishery	2,440	5,000	2,560
Tsu-ma-uss FSC	11,425	10,000	0
Tsu-ma-uss EO	6,190	21,363	15,173
Maa-nulth	12,200	13,250	1,050
Area D	21,700	6,770	0
Area B	0	10,133	10,133
Recreational	2,696	21,000*	18,304
Stewardship	0	0	
Total	56,651	82,500	25,849

*Expected catch

ESCAPEMENT ESTIMATES

The total adult Sockeye escapement to the Somass system is estimated at about 69,857 adults (31,801 through Sproat fishway; 38,056 through Stamp Falls fishway) as of Tuesday, 22 June. Approximately 54% of the observed adult escapement to date is from the Great Central Lake population. *Note.*—an important caveat in this week's escapement data is that age results from the previous week's biosamples are pending and will likely indicate significantly higher proportions of jack Sockeye than currently estimated, particularly in the Sproat Lake population.

Below are two figures (Figures 1 & 2) that show 2021 Sockeye escapement observations relative to average escapement timing for the period from 2002–2020. Although informative, in some years the observed escapement rate relative to average escapement timing may be a poor indication of final run abundance. In contrast to *run timing* (the return of Sockeye to Alberni Inlet), escapement timing tends to be more variable and is affected by fisheries and environmental conditions, such as river temperature and flow (see Figure 3 below for summary of river temperatures).

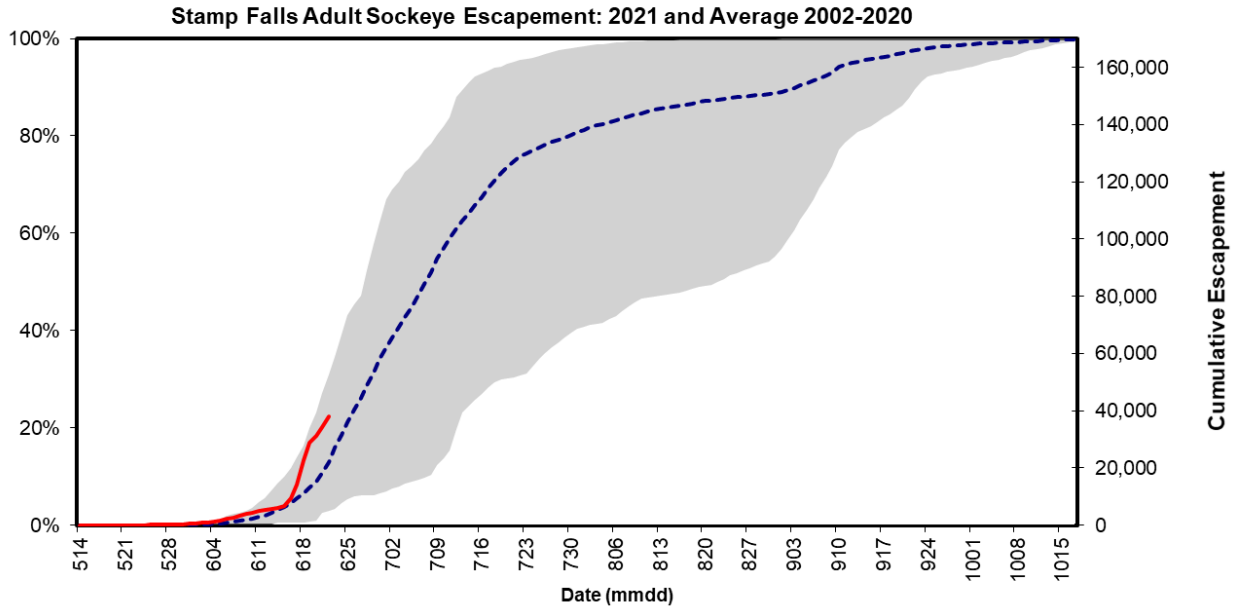


Figure 1. 2021 Stamp Falls Sockeye escapement relative to average escapement timing. The total expected escapement is based on the management forecast of 350,000 with a corresponding Somass escapement target of 262,500 and predicted proportion of 65% Great Central Lake Sockeye.

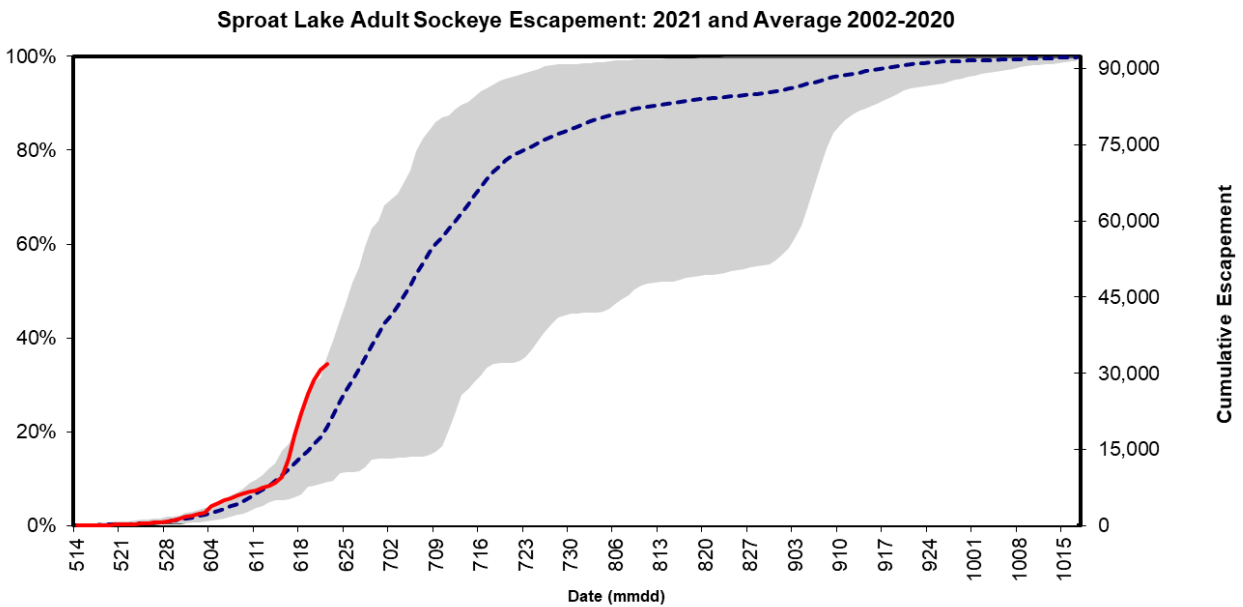


Figure 2. 2021 Sproat Lake Sockeye escapement relative to average escapement timing. The total expected escapement is based on the management forecast of 350,000 with a corresponding Somass escapement target of 262,500 and predicted proportion of 35% Sproat Lake Sockeye.

TEST FISHERY

The test fishery operated from 21–22 June. The estimates of abundance outside 10-mile point and inside 10-mile point were 32,500 and 6,000 Sockeye, with average catches per set of 72 and 15, respectively. The average weight of caught fish was 4.1 lbs; average fork lengths were 541 mm and 544 mm for the outside and inside areas, respectively. The test boat captain reported that fish were abundant but scattered in the outside area and appeared to be backing out between 10-mile Point and Pocahantas Point. In the inside area, very few fish were showing and those seen appeared to be backing out as well.

The 2021 test fishery data are publically available [here](#).

BIOLOGICAL MONITORING

DNA and scale age results have been prepared from this week's test fishery. *Note.*—the Henderson proportion in the present sample is not significantly different from 0.

DNA results:

Stat Week	Date	Area	Sample	Great Central	Sproat	Henderson
61	7 June	Outside	96	52.3% (5.5%)	47.1% (5.5%)	0.6% (1.0%)
	8 June	Inside	95	57.7% (5.4%)	42.2% (5.4%)	0.1% (0.7%)
62	14 June	Outside	96	62.0% (5.5%)	38.0% (5.5%)	0.0% (0.6%)
	15 June	Inside	95	63.8% (5.5%)	36.2% (5.5%)	0.0% (0.6%)
63	21 June	Outside	94	62.8% (5.4%)	37.1% (5.4%)	0.1% (0.8%)
	22 June	Inside	46	69.8% (7.0%)	30.2% (7.0%)	0.6% (1.0%)

Scale age results:

Gilbert-Rich	Brood Yr.	Frequency	Percent
6 ₃	2015	23	16.5%
6 ₄	2015	2	1.4%
5 ₂	2016	52	37.4%
5 ₃	2016	12	8.6%
4 ₂	2017	37	26.6%
4 ₃	2017	1	0.7%
3 ₂	2018	12	8.6%
Total:		139	100%

PREDICTED SOMASS STOCK PROPORTIONS

Weekly DNA samples from the test fishery in first three weeks of June (stat weeks 62, 63, and 64) provide a good indication of the relative proportions of Great Central Lake and Sproat Lake in the final return. Analysis using simple linear regression is used to relate proportions of GCL from the weekly test fishing samples to predict final proportion in the Somass Sockeye return. Models use data averaged for Inside and Outside fishing areas and weeks collected in June test fishing samples.

Regression X values	Predicted	Upper 95%	Lower 95%	R ²
Week 62 Average	62.0%	77.2%	46.8%	0.87
Week 63 Average	64.8%	80.7%	48.9%	0.82
Week 62 and 63 Average	64.8%	80.5%	49.1%	0.87
Week 62, 63 and 64 Average				0.90

ACCOUNTING TO DATE

The following table summarizes the accounting for Somass Sockeye to 24 June 2021.

Area 23 Sockeye Abundance Estimate

	Estimate	Lower CI
Inner inlet catch	21,576	
Total adult escapement	69,857	
*Lower river abundance estimate	10,098	4,665
<i>Subtotal</i>	<i>101,531</i>	<i>96,098</i>
<i>Harvest Rate</i>	<i>21%</i>	<i>22%</i>
Outer inlet catch	35,096	
Inner Inlet abundance estimate	6,000	3,000
Outer Inlet abundance estimate	32,500	16,250
<i>Subtotal</i>	<i>73,596</i>	<i>54,346</i>
<i>Harvest Rate</i>	<i>48%</i>	<i>65%</i>
Total	175,127	155,877
Total Harvest Rate	32%	36%

*Between Papermill Dam and the Sproat and Stamp counters.

ENVIRONMENTAL MONITORING

Daily water temperatures over the week of 16–23 June 2021 ranged from 17.6–21.8°C (average: 19.3°C) at the Sproat River fishway and from 14.5–19.5°C (average: 17.1°C) at the Stamp Falls fishway. Figure 3 (below) shows 2021 river temperatures relative to the recent historical averages. The test fishery recorded average sea surface temperatures of 19°C and 20°C in the areas outside and inside 10-mile point, respectively. Figure 4A (below) shows 2021 temperature measurements recorded by the test fishery and by Catalyst Paper in the Somass River estuary.

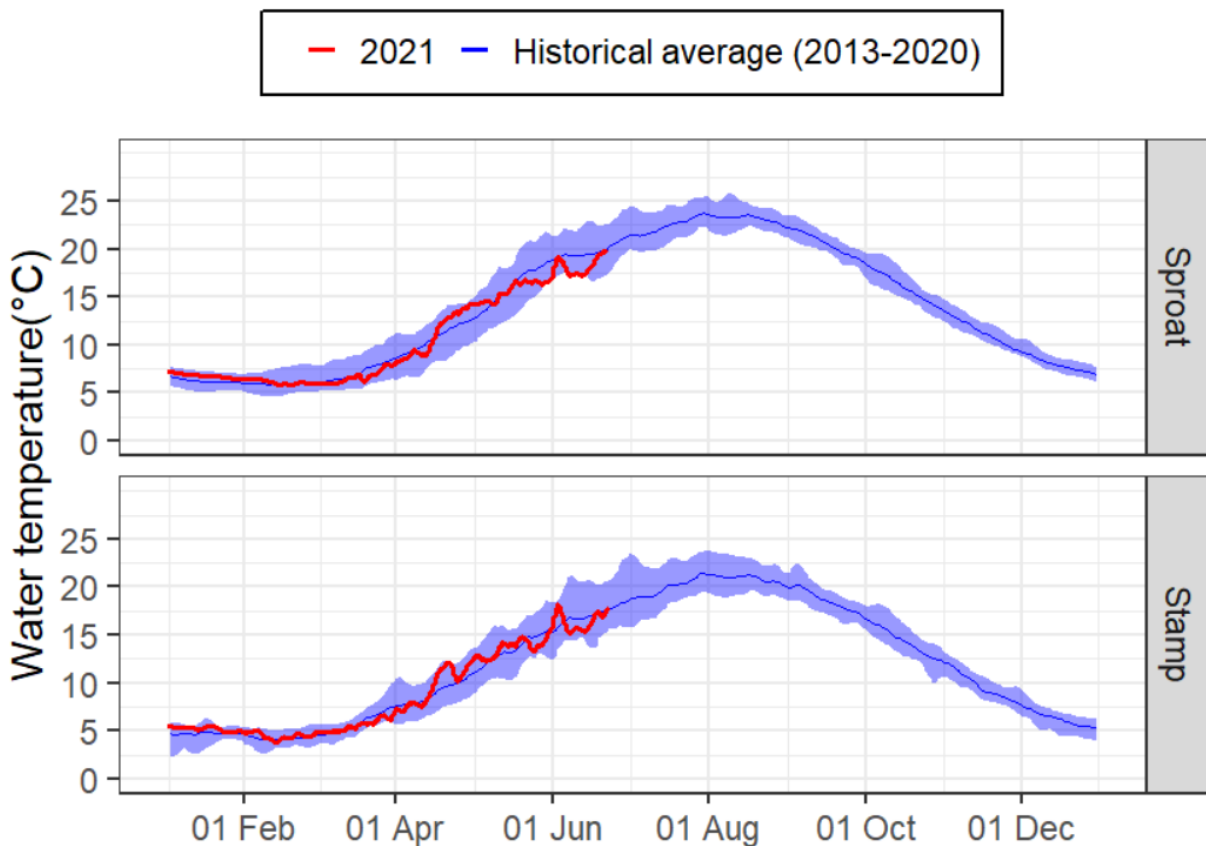


Figure 3. Current year (2021) Sproat River and Stamp River temperatures compared to historical data. All temperature measurements were collected by Hydromet stations installed at the fishways on both rivers in 2013. Current data are publically available [here](#). Coloured lines in both panels show the 5-day rolling averages. The shaded area around the historical data shows its 5-day rolling 90% quantile.

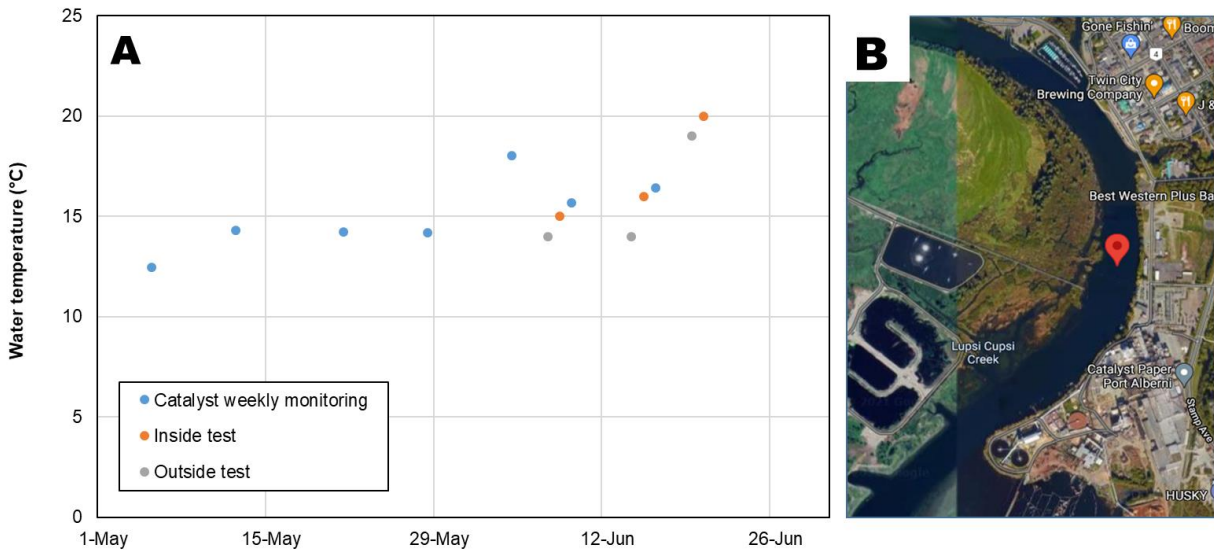


Figure 4. (A) Time series of water temperature point observations recorded by the test fishery and by Catalyst Paper. (B) The approximate location in the Somass River estuary where Catalyst Paper temperature data are recorded is indicated by the red pin.

MANAGEMENT CONSIDERATIONS

- Escapement target:** At a management forecast of 350–500k, the June escapement target is 85–100k. Total escapement to date is just shy of 70k. If upstream migration rates observed through the week of 15–22 June are sustained, the June escapement target will be met. However, the high harvest rate in the past week (34%) will curtail escapement numbers over the coming week. Additionally, a record heatwave is forecast for BC over the coming week. If water temperatures in the Somass River or Estuary approach 23°C, upstream migration will slow considerably and fish behavior in the Inlet will be unpredictable.
- Somass stock proportions:** DNA data from the test fishery over the past two weeks is indicating a more unbalanced split between Great Central Lake and Sproat Lake Sockeye in the total Somass return (65% GCL / 35% SPL). When the proportions deviate beyond a roughly 60% / 40% split, management decisions are tapered such that the Somass TAC is constrained to the maximum allowable harvest rate on the weaker stock.
- June harvest rate:** Target HR for June is 25% at 350,000 run size, current is 32%.
- The test fishery captain reported that fish appeared to be retreating back down the Inlet and estimated a lower total abundance/influx compared to previous weeks.
- Age compositions in the escapement have not been updated with the most recent week's samples. Visual observations through the counters and of fish biosampled indicate that a large proportion of the Sproat escapement in the last week has been comprised of jacks.

IN-SEASON REFORECAST

Three forecast models have presently been employed to predict the final 2021 run size of Somass Sockeye: 1) The pre-season multivariate forecast (see Background Information, below), based on returns of younger siblings from returning 2021 brood years and on sea surface temperatures present in Barkley Sound during juvenile outmigration, is predicting a run of approximately 370,000 adults; 2) The run-timing model, which calculates the expected final return based on the total accounting to date and the expected proportion of the run observed to date, is predicting a run of approximately 550,000 adults, assuming a 50% return date of 1 July; 3) The Area D CPUE regression model, which uses the catch-per-unit-effort in late June gillnet fisheries to predict the final return, is predicting a run of approximately 1,000,000 adults.

Run-timing model

The Area 23 Sockeye return has historically exhibited a predictable pattern of abundance distribution over time, which has allowed development of run timing curves that are used to predict the final run size based on weekly total accounting. Based on the total accounting to 24 June, the predicted run size ranges from approximately 360,000–700,000 Sockeye

Timing	50% date	Predicted % of run to date	Estimate	Lower CI
1-wk early	24-Jun	49%	358,000	319,000
average	1-Jul	32%	550,000	489,000
1-wk late	6-Jul	25%	697,000	621,000

Area D CPUE regression model

The gillnet CPUE data in late June have historically provided a good indication of final Somass run size ($R^2 = 0.89$). The average catch per vessel hour estimated from the Area D opening on 22 June was 15 fish. The corresponding prediction from the regression model is 1,020,443 (95% prediction interval: 587,655–1,453,231; Figure 5)

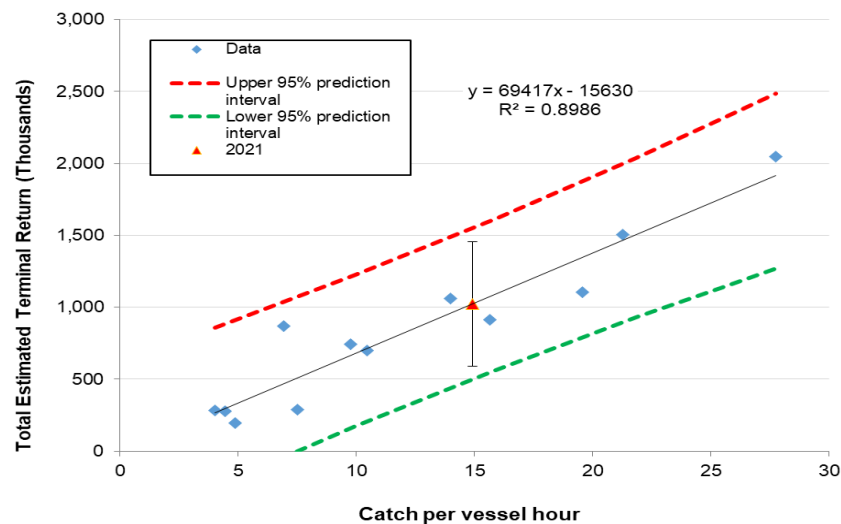
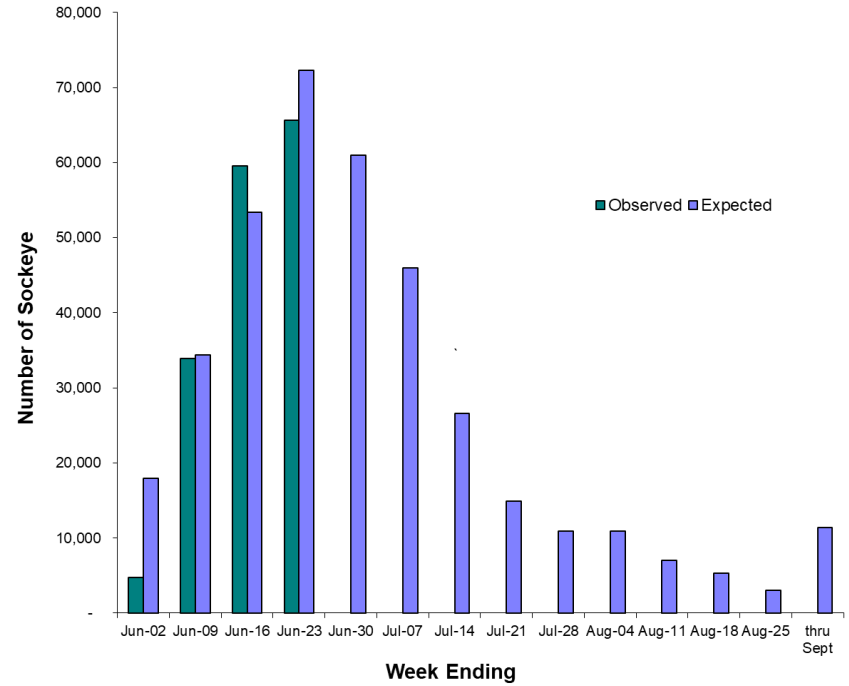
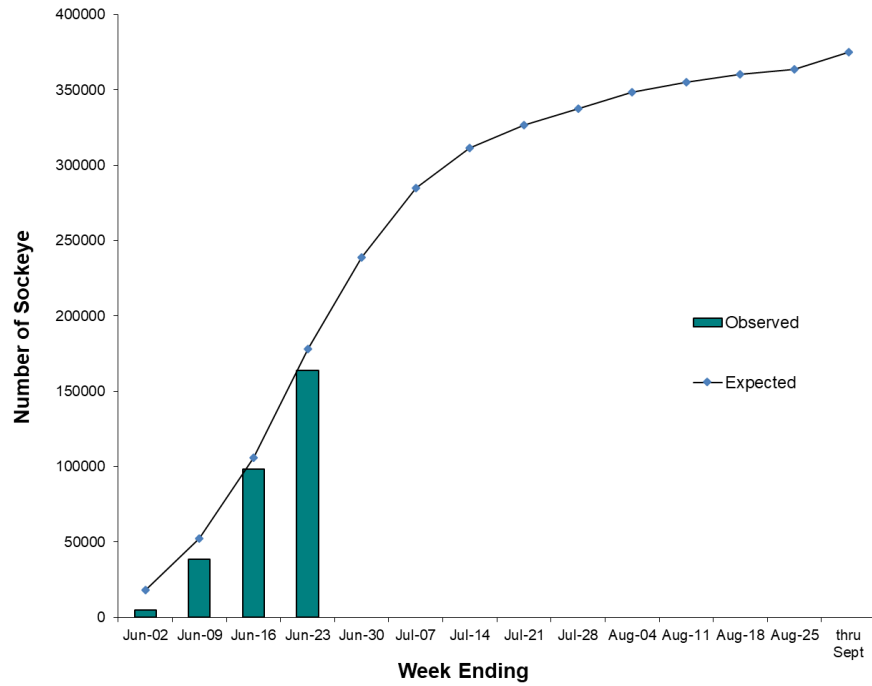


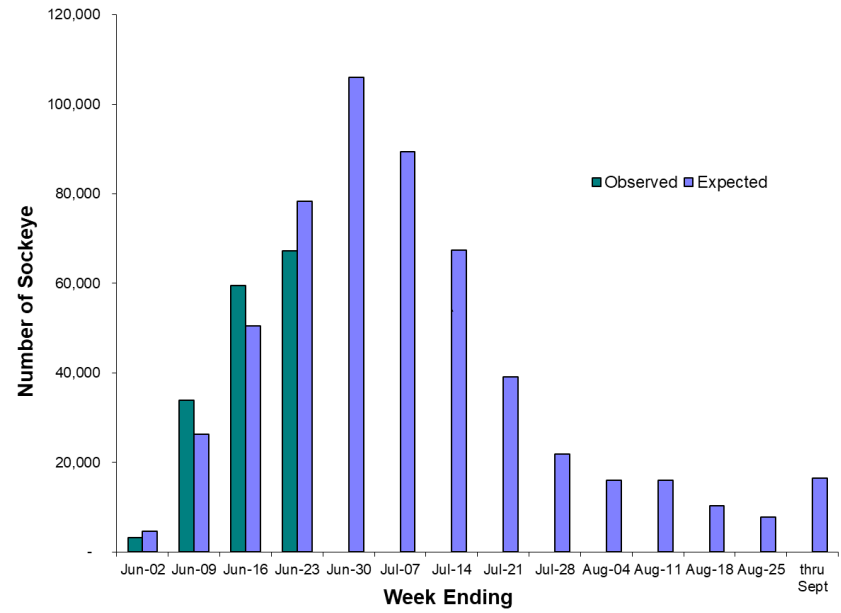
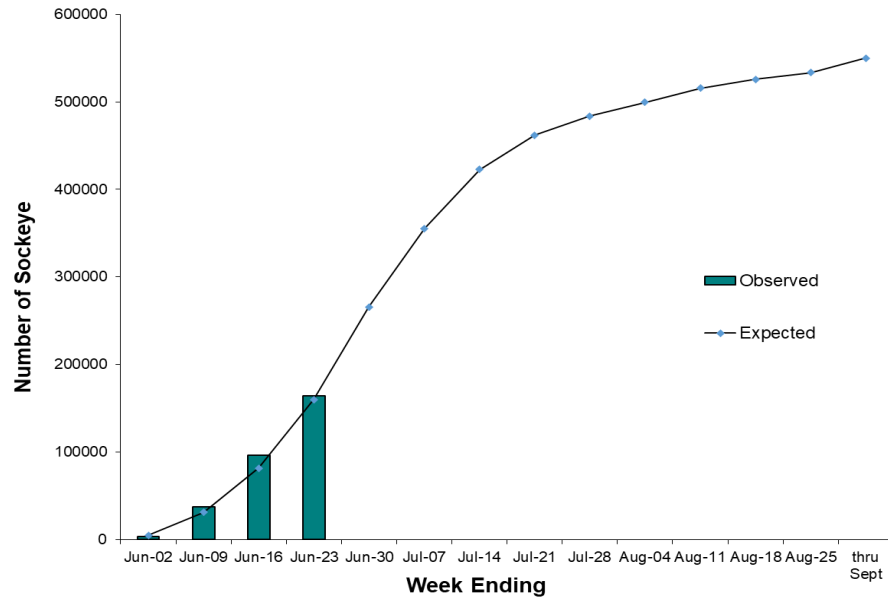
Figure 5. Final Somass Sockeye return plotted as a function of the catch per vessel hour of Sockeye in late June gillnet fisheries from 2000–2020. The 2021 predicted final return is shown as an orange triangle, with its whiskers denoting the 95% prediction interval.

Run timing scenarios

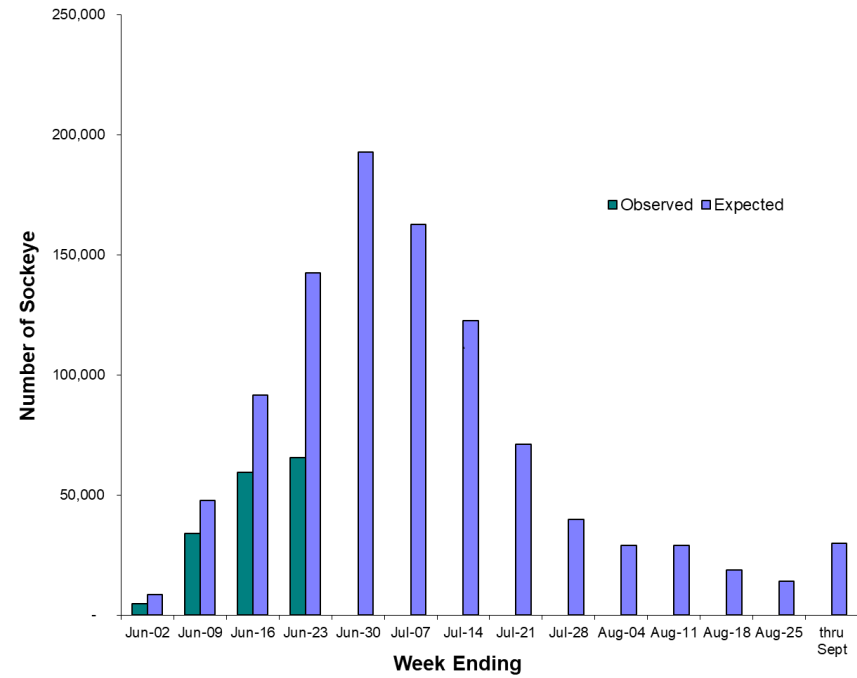
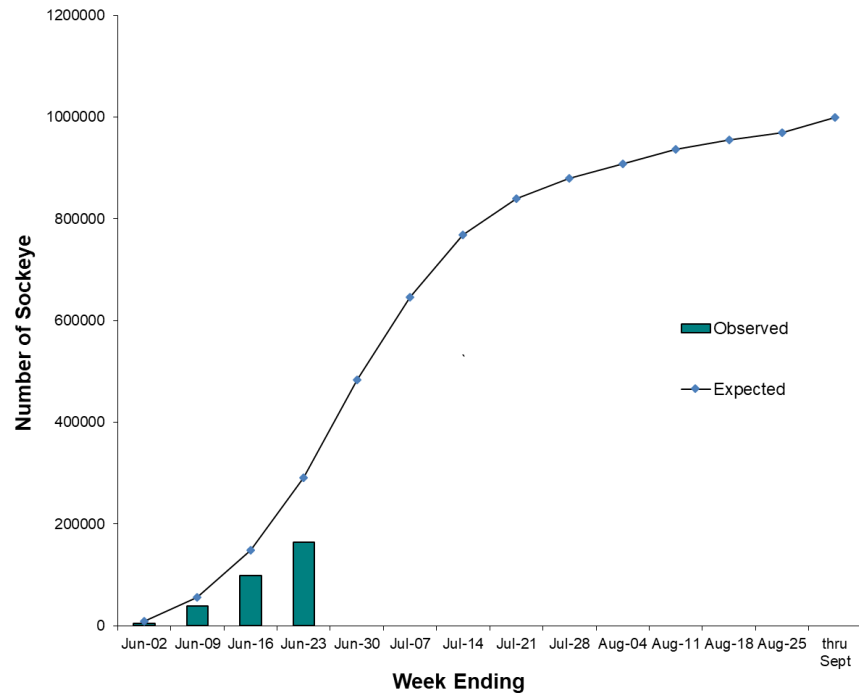
1. One week early (24 June peak) at 375k (pre-season forecast)



2. Average timing (1 July peak) at 550k (run timing-based forecast)



3. Average timing (1 July peak) at 1M (Area D regression forecast)



Management scenarios associated with the different run size forecasts:

Model	Point prediction	TAC	Current HR*	Target June HR	MGT Adjusted 40% SPR	MGT Adjusted TAC
Early timing	359,000	82,500	15.8%	25%	314,125	63,750
Avg timing	551,000	210,750	10.3%	35%	482,125	137,833
Late timing	698,000	342,000	8.1%	50%	610,750	254,500
Area D	1,000,000	690,333	5.7%	60%	875,000	467,000

*Calculated as observed catch (56,651) / model point prediction

Based on the accounting to date, the stock assessment analyses detailed above, and discussions at the 24 June Area 23 round table, fishery management will be based on an abundance of **500,000** Sockeye going forward in conjunction with the June fishing plan. This updated run prediction will be used to set the catch targets for Area B and Maa-nulth in the coming week.

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BACKGROUND INFORMATION

Pre-season run size expectations

Somass Sockeye: For 2021 fishery management purposes, the Area 23 roundtable agreed to begin fisheries in the “low” zone for early season harvest management, using a pre-season forecast for Somass Sockeye of 369,009 adult Sockeye.

There was moderate uncertainty in the 2021 pre-season forecast. The predictions varied from 324,960 in the sea-surface temperature based Survival Stanza Model (SStM) to 523,934 in the Coho Leading Indicator model (CLI), where Coho survivals in the same ocean entry year are applied to Sockeye. Forecast model predictions for the 2021 aggregate Somass Sockeye return were: 367,007 (Sibling), 324,960 (SStM), 523,934 (CLI), and 369,009 (multivariate).

The forecast from the multivariate model suggested a relatively balanced ratio (43%/57%) of Great Central Lake to Sproat Lake Sockeye in the 2021 return, indicating the combined returns to Great Central Lake and Sproat Lake would likely meet the aggregate abundance benchmark of 157,210.

The age of return for Sockeye to Sproat and Great Central lakes ranges from 3–6 years, with ages 4 and 5 fish predominant. Sockeye produced from brood years 2015–2018 are returning in 2021, with 2016 and 2017 being the main contributing brood years.

Henderson Sockeye: The recommended management outlook for Henderson Sockeye is the “very low” zone for harvest management, corresponding to an expected return of less than 15,000. The key factors influencing this outlook are the low spawner abundances in the main contributing brood years (9,700 Sockeye in 2016; 22,000 Sockeye in 2017) for the 2021 return, as well as low marine survival rates experienced by these two brood years.

IN-SEASON ASSESSMENTS

Test Fishery

The objectives of the test fishery are to estimate abundance of Sockeye in the Alberni Canal, to collect biological specimens for assessment (age, stock composition, and parasite load), and to provide observations of fish behavior and condition. The test fishery uses a combination of hydro-acoustic soundings and seine sets to determine the abundance of Sockeye in Alberni Inlet. The boat follows a systematic route sounding throughout the canal by zig-zagging in transects from one side to another. Choice of set location is dependent on either identifiable Sockeye schools or typical holding areas. For both the area “inside” 10-mile point and for the area “outside” 10-mile point, an average catch per set is determined. These numbers are then expanded to total abundance for each area given scalars to account for the quality of sets/fishing conditions and also a scalar approximating the number of similar sets that are required to fish the entire area. There is considerable judgment and subjectivity involved in the determination of the abundance estimate; however, over the years this information has been an important component of the in-season re-forecast method.

Catch Monitoring

All harvesters in the Maa-nulth First Nation, Tsu-ma-uss Economic Opportunity, Area B Seine and Area D Gillnet fisheries are required to report catch; total catch is estimated from the sum of these reports. Verification programs are in place for the Maanulth, Tsu-mas-uss Economic Opportunity and Area D fisheries. All Area B catch is validated. Validation and verification information may be used to revise catch estimates generated from individual harvester reports.

The recreational catch is monitored and estimated through the WCVI Creel Survey program. Surveyors stationed at various landing sites in Area 23 conduct fisher interviews to collect catch data and take biological samples from landed catch. Twice weekly overflights (one weekday, one weekend) are used to collect effort data (boat-days). Catch is estimated from the average catch-per-unit-effort (CPUE) and estimated total effort.

Escapement monitoring

Fish counting operations on the Somass river system are run by the Hupačasath First Nation in cooperation with DFO. The objective of the program is to estimate escapement of Sockeye, Chinook, and coho using video counts from the Sproat and Stamp Falls fishways. Counting operations began on 13 April and 10 May at the Sproat and Stamp Falls fishways, respectively.

Fish passing through all fishways are recorded 24 hours per day (tunnels are illuminated at night) using a video monitoring system. Trained and experienced observers review migration on the recordings from both sites to estimate escapement into each system. For most time periods, observers typically review all 60 minutes of each hour. During periods of high migration, observers review clips varying from 5–30 minutes from each hour of video footage depending on fish density. Counts from these shortened clips are then expanded to estimate hourly totals.

Escapement for Henderson Lake Sockeye will be estimated through frequent surveys of the Clemens Creek spawning grounds through the fall, supplemented by a tagging program and beach spawner surveys, conditions permitting. The Uchucklesaht First Nation is working on developing an in-season monitoring program at the outlet to Henderson Lake.

Biological monitoring

Fish are sampled for age composition from all fisheries and escapement. Fish are sampled for stock composition (estimated through DNA analysis) from the test fishery, commercial fisheries, and occasionally from Maa-nulth fisheries.

Environmental monitoring

Other information is considered such as river or Inlet conditions that may impact run and escapement timing. River temperature, discharge, and barometric pressure are monitored remotely at Stamp Falls and the Sproat fishway (current data are available [here](#)). As river temperatures increase, the migration rate from Alberni Inlet to the Somass River system slows down, resulting in lower daily escapement rates and often higher “catchability” of fish in Alberni Inlet fisheries.

Fishery indices

In addition to information gathered through the test fishery and catch and escapement monitoring, there is a strong relationship between the commercial gillnet CPUE in *late* June and final run size. A “standardized early season fishing regime” was developed in 2012 is to plan more consistent early-season fisheries to gain assessment information. Additional monitoring data (e.g. effort, average CPUE) gathered through verification programs may support this initiative.

Run size estimation

To forecast the return of Somass Sockeye in-season, the most pertinent questions are: 1) what is the abundance accounted for to date? and 2) is the run on-time, early, or late? In the simplest form, the run re-forecast is the total abundance accounted for divided by the portion expecting to return by the re-forecast date. However, when considering these questions, uncertainty in the data must be accounted for. If most of the abundance is accounted for in either catch or escapement, then the data are fairly certain. On the other hand, if the bulk of the abundance is associated with test fishery estimates, the data are more uncertain. In the latter case, a more precautionary approach is warranted before major upgrades or downgrades in the forecast. The observed age and stock composition of the return provide indications of run timing and abundance, particularly when compared to pre-season expectations and long-term average observations. As well, environmental conditions that may affect “catchability” need to be considered. For example, extended holding of fish in Alberni Inlet due to inhospitable river conditions may create the impression of abundance when in fact new migration is insignificant.

SOURCES OF UNCERTAINTY

There are several sources of uncertainty in the in-season assessment and management process, most notably:

1. The test fishery assessment of the abundance of fish in Alberni Inlet is based on a subjective assessment by an experienced seine captain. Although this index has been reliable over the years, as source of uncertainty it becomes more of an issue when a large portion of the accounting is based on this number relative to more precise catch and escapement numbers. Both the overall accounting and harvest rate estimate rely on this assessment.
2. The in-season forecast expands the total accounting for the portion of the return that is normally accounted for by the date. However, run timing can vary significantly from year to year depending on factors such as environmental conditions and the age composition of the run. For this reason, the run size is not adjusted until the end of the June when about half the run has normally been accounted for.
3. The effects of adverse environmental conditions on spawners are not accounted for. Escapement is assessed at the Sproat and Stamp fishways prior to spawning. However, fish that hold in Alberni Inlet for prolonged periods and/or are subject to very high temperatures during their river migration might not spawn successfully.