

Fisheries and Oceans Canada

Pêches et Océans Canada

# WCVI Salmon Bulletin 15 July 2021 Assessment Update 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.

On 24 June, an in-season management abundance of 500,000 adults was adopted, and then on 30 June the management abundance was upgraded to 550,000 adults.

# **REPORTED CATCH**

Total retained catch for this week was 9,453 Sockeye in Tsu-ma-uss fisheries, 273 in the test fishery, and approximately 11,046 in the sport fishery.

Sector	Reported catch	TAC @ 550k	Remaining
Test fishery	6,240	8,000	1,760
Tsu-ma-uss	50,989	60,363	9,374
Maa-nulth	20,555	*19,609	-946
Area D	35,777	29,511	-6,266
Area B	35,110	44,267	9,156
Recreational	27,992	†49,500	†21,508
Stewardship	0	10,000	10,000
Total	176,620	218,750	42,130

Table 1. Total reported Area 23 Sockeye catch to 15 July 2021.

\*Includes 2,500 additional catch to address previous years' Henderson underages \*Expected catch

*Table 2.* Estimated catch of Henderson Sockeye to 15 July 2021. These estimates will be updated when more accurate DNA samples are processed analyzed.

Sector	Estimated catch
*Test fishery	25
Tsu-ma-uss	1,450
Maa-nulth	353
Area D	849
Area B	265
*Recreational	t <sub>M</sub> A
Total	2 976

\*Not party to the Henderson sharing agreement.

<sup>†</sup>CREEL DNA samples have not yet been analyzed.

## **ESCAPEMENT ESTIMATES**

The total adult Sockeye escapement to the Somass system is estimated at about 91,531 adults (35,964 through Sproat fishway; 55,567 through Stamp Falls fishway) as of 13 July 2021. Approximately 61% of the observed adult escapement to date is from the Great Central Lake population. Henderson Lake escapement was estimated at 600 Sockeye as of 13 July 2021.

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 550,000 with a corresponding Somass escapement target of 325,000 and predicted proportion of 63% 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 550,000 with a corresponding Somass escapement target of 325,000 and predicted proportion of 37% Sproat Lake Sockeye.

# **TEST FISHERY**

The test fishery operated from 11–12 July. The estimates of abundance outside 10-mile point and inside 10-mile point were 20,000 and 120,000 Sockeye, with average catches per set of 80 and 571, respectively. Average fork lengths were 518 mm and 535 mm at the outside and inside areas, respectively. On the outside, fish appear to be aggregating in scattered schools and look fresh. On the inside, fish are milling near Hocking Point and appear to be building up from Underwood Cove to Sproat Narrows. Some inside fish are beginning to darken.

The 2021 test fishery data are publically available here.

## **BIOLOGICAL MONITORING**

Stat		A	Area Castar	Comula	Estimated (SE) proportion by stock		
Week	Date	Area	Sector	Sample -	Great Central	Sproat	Henderson
64	7 June	Outside	Test	96	52.3% (5.5%)	47.1% (5.5%)	0.6% (1.0%)
61	8 June	Inside	Test	95	57.7% (5.4%)	42.2% (5.4%)	0.1% (0.7%)
	14 June	Outside	Test	96	62.0% (5.5%)	38.0% (5.5%)	0.0% (0.6%)
62	15 June	Inside	Test	95	63.8% (5.5%)	36.2% (5.5%)	0.0% (0.6%)
	21 June	Outside	Test	94	62.8% (5.4%)	37.1% (5.4%)	0.1% (0.8%)
63	22 June	Inside	Test	46	69.8% (7.0%)	30.2% (7.0%)	0.6% (1.0%)
	22 June	Outside	Area D	149	65.9% (4.1%)	31.4% (4.1%)	2.7% (1.4%)
	28 June	Outside	Test	76	58.7% (6.3%)	39.9% (6.2%)	1.5% (1.9%)
	27 June	Inside	Test	93	65.4% (5.2%)	34.6% (5.2%)	0.0% (0.6%)
64	27–29 June	Inside	Area B	119	66.0% (5.5%)	32.4% (5.3%)	1.6% (1.7%)
	30 June	Outside	Area D	99	63.8% (5.5%)	34.4% (5.5%)	1.8% (1.6%)
	5 July	Outside	Test	98	62.1% (5.5%)	27.6% (5.0%)	10.3% (3.4%)
71	4 July	Inside	Test	100	53.4% (5.4%)	44.7% (5.4%)	1.9% (1.6%)
	4 July	Inside	Area B	98	72.7% (4.9%)	27.2% (4.9%)	0.0% (0.7%)
	11 July	Outside	Test	94	43.5% (6.0%)	39.4% (5.4%)	17.1% (4.2%)
72	12 July	Inside	Test	95	53.6% (5.7%)	34.6% (5.2%)	11.7% (3.7%)

DNA results (from all 2021 samples to date):

## 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. The predicted proportion of GCL Sockeye in the final return is 63%.

Regression predictors	Predicted	Upper 95%	Lower 95%	R <sup>2</sup>
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	62.9%	74.1%	51.6%	0.90

# ACCOUNTING TO DATE

The following table summarizes the accounting for Somass Sockeye to 15 July 2021.

### Area 23 Sockeye Abundance Estimate

	Estimate	Lower CI
Inner inlet catch	119,534	
Total adult escapement	91,536	
*Lower river abundance estimate	8,284	3,815
Inner Inlet abundance estimate	120,000	60,000
Subtotal	339,354	274,885
Outer inlet catch	58,124	
Outer Inlet abundance estimate	20,000	10,000
Subtotal	78,124	68,124
Total	† <b>404,432</b>	315,050
Total Harvest Rate	44%	56%

\*Between Papermill Dam and the Sproat and Stamp counters.

<sup>†</sup>All Tsu-ma-uss catch over the week of 7–14 July and a portion of the previous week's sport catch are subtracted out to avoid double-counting in the test boat's abundance estimate.

### **ENVIRONMENTAL MONITORING**

Daily water temperatures over the period from 7–14 July 2021 ranged from 22.7–25.3°C (average: 24.3°C) at the Sproat River fishway and from 16.8–22.3°C (average: 19.8°C) at the Stamp Falls fishway. The recent dip in temperatures at Stamp Falls is likely driven by increased outflows from the Ash River dam. Figure 3 (below) shows 2021 river temperatures relative to the recent historical averages. Catalyst Paper initiated a pulse flow release from the Great Central Lake dam on the afternoon of 15 July to coincide with a moderate low pressure system. The Stamp river flow rate will increase from  $\approx 29 \text{ m}^3 \cdot \text{s}^{-1}$  to a peak of  $\approx 40 \text{ m}^3 \cdot \text{s}^{-1}$  (6 inch increase in water level at Robertson Creek) by Friday, 16 July, and decrease back to  $\approx 29 \text{ m}^3 \cdot \text{s}^{-1}$  by Monday, 19 July.



*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 <u>here</u>. 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.

The test fishery recorded average sea surface temperatures of 17°C and 20°C in the areas outside and inside 10-mile point, respectively. Figure 4A (below) shows 2021 water temperature measurements recorded by the test fishery and by Catalyst Paper in the Somass River estuary.



*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.

Despite the recent heatwave and persistent air temperatures above the seasonal average, conditions in the deeper marine waters of Alberni Inlet remain permissible for holding Sockeye. Below the halocline at  $\approx$ 7 m depth, temperatures are cool (< 12°C) and dissolved oxygen levels are moderate (> 4 mg/L) to about 30 m depth. However, lower dissolved oxygen concentrations have recently begun to encroach on shallower depths. See figures below for detailed data.



*Figure 5.* Time series of the salinity–depth profile recorded at 4 sites in Alberni Inlet during Catalyst Paper's 2021 Harbour Survey. Black points show raw CTD measurements and black lines show 2 ppt contours. Values between surveys are interpolated.



*Figure 6.* Time series of the temperature–depth profile recorded at 4 sites in Alberni Inlet during Catalyst Paper's 2021 Harbour Survey. Black points show raw CTD measurements and black lines show 2°C contours. Values between surveys are interpolated.



*Figure 7.* Time series of the dissolved oxygen–depth profile recorded at 4 sites in Alberni Inlet during Catalyst Paper's 2021 Harbour Survey. Black points show raw CTD measurements and black lines show 2 mg·L<sup>-1</sup> contours. Values between surveys are interpolated.

## **IN-SEASON RE-FORECASTING**

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 525,000 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 486,000–621,000 Sockeye

Timing	50% date	Presumed % of run to date	Estimate	Lower CI
1-wk early	24-Jun	84%	486,000	378,000
average	1-Jul	77%	525,000	409,000
1-wk late	6-Jul	65%	621,000	484,000

#### Area D CPUE regression models

The gillnet CPUE data in the third week of 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 11)



*Figure 11*. Final Somass Sockeye return plotted as a function of the catch per vessel hour of Sockeye in gillnet fisheries during the third week of June from 2000–2020. The 2021 predicted final return is shown as an orange triangle, with its whiskers denoting the 95% prediction interval.

The average catch per vessel hour estimated from the Area D opening on 30 June was 14 fish. The corresponding prediction from the regression model is 855,298 (95% prediction interval: 201,682–1,508,914; Figure 12). This relationship has historically proven weaker ( $R^2 = 0.40$ ).



*Figure 12.* Final Somass Sockeye return plotted as a function of the catch per vessel hour of Sockeye in gillnet fisheries during the fourth week of June 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. Average timing (1 July peak) at 550,000.







3. Average timing (1 July peak) at 500,000.

### MANAGEMENT CONSIDERATIONS

- **Escapement target:** At the current management forecast of 550,000, the June escapement target was 85,000 and the total escapement target is 331,250. Total escapement to date is 91,000. Escapement rates have slowed dramatically in the past two weeks in conjunction with rising river temperatures.
- 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 (63% GCL / 37% 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.

Based on the accounting to date and the stock assessment analyses detailed above, fishery management going forward will be based on an abundance of **525,000** Sockeye. The table below outlines remaining catch and escapement based on the current management abundance.

Sector	Catch	TAC @ 525k	Remaining
Test fishery	6,240	8,000	1,760
Tsu-ma-uss	50,945	54,065	3,119
Maa-nulth	20,555	18,981	(1,574)
Area D	35,777	26,432	(9,345)
Area B	35,110	39,647	4,537
Recreational	27,992	47,250	19,258
Stewardship	-	5,000	5,000
Total catch	176,620	196,875	20,255
Escapement	91,536	328,125	236,589
Total	268,156	525,000	256,844

For more information, please contact:

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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 <u>here</u>). 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:

- 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.