

OLRS gate change February 23, 2021

From: Reimer, Shaun FLNR:EX <s.15
s.15
s.15
To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: February 22, 2021 12:38:23 PM PST
Received: February 22, 2021 12:38:23 PM PST

Hi Greg. As discussed, please make the following changes Tuesday February 23, 2021. We are aiming for a 5 m3/s increase throughout the system. I have let OTID know this is coming. They have managed to de-ice another gate on Zosel Dam for operation.

23-Feb-21

Gate Changes				
	Change to:			
# of gates	Existing setting	# of gates	New setting	
McIntyre	2	66%	2	72%
Skaha	2	60	77	60
OK Dam	4	16	4	19

Thanks...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Phone: 778-622-6826 Please note this is a new number.

Fax: 250-490-2231

RE: Okanagan River increase February 23, 2021

From: Jay O'Brien <otidjay@nvinet.com>
To: Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>
Cc: Derek Mendoza <otiddm@nvinet.com>
Sent: February 22, 2021 12:45:42 PM PST
Received: February 22, 2021 12:45:47 PM PST

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Thanks for working with us on this.

From: Reimer, Shaun FLNR:EX

Sent: Monday, February 22, 2021 12:44 PM

To: 'JAY O'BRIEN'

Cc: 'John Arterburn' ; 'Anna Warwick Sears' ; 'Dawn Machin' ; 'Martin.Suchy@canada.ca' ; Xia, Cenling FLNR:EX ; Zanolto, Tony FLNR:EX ; Burdock, Greg W FLNR:EX ; 'otiddm@nvinet.com' ; 'kalex@syilx.org' ; 'thut461@ECY.WA.GOV'

Subject: RE: Okanagan River increase February 23, 2021

Hi Jay. As discussed, we are increasing Okanagan flows tomorrow (Tuesday) by approximately 5 m³/s (177 cfs) in the Oliver section of the river. Aiming for a resultant flow that should be approximately 23 m³/s (812 cfs) going into Osoyoos Lake. This will likely be the flow we see for the next few weeks until we get a new inflow forecast for Okanagan Lake; we will re-evaluate at that time.

Cheers...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Office Phone: 778-622-6826

Cell: 250-809-7762

Fax: 250-490-2231

OLRS gate change to tweak Tuesday changes

From: Reimer, Shaun FLNR:EX s.15
s.15

To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: February 25, 2021 8:06:40 AM PST
Received: February 25, 2021 8:06:41 AM PST

Hi Greg, as discussed, could you please make the following changes at Okanagan Lake and Skaha Lake dams to tweak our flow change from Tuesday. No change at McIntyre.

25-Feb-21

	Gate Changes			
			Existing:	Change to:
	# of gates	setting	# of gates	setting
McIntyre	2	72%	2	72%
Skaha	2	77	2	82
OK Dam	4	19	4	21

Thanks
Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection
Okanagan Shuswap District
Ministry of Forests, Lands, Natural Resource Operations, & Rural Development
102 Industrial Place
Penticton, BC V2A 7C8
Phone: 778-622-6826 Please note this is a new number.
Fax: 250-490-2231

RE: Okanagan Lake Forecast

From: Reimer, Shaun FLNR:EX .s.15
s.15
To: s.22
Sent: February 25, 2021 1:12:59 PM PST
Received: February 25, 2021 1:12:59 PM PST

Hello s.22

Thank you for your note. We are currently dropping the level of Okanagan Lake in anticipation of a larger than normal runoff. Flood protection is our first priority. However, we do have to manage for other interests as well as per the federal-provincial agreement which sets my target levels. If we drop the lake too quickly, we will de-water the kokanee eggs which have been laid along the shore and those eggs will die; the shore-spawning kokanee numbers this cycle were the highest since the 1970's. Also, if we release too much water in the river too early, we risk scouring the sockeye salmon eggs that have been laid there.

Please understand that we are taking a conservative approach this year to the lake level, particularly in the face of what has occurred in three out of the last four years. Fortunately, although we have a higher than normal snowpack for this time of year, it is not as high as it was last year or in 2018.

Regards...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection
Okanagan Shuswap District
Ministry of Forests, Lands, Natural Resource Operations, & Rural Development
102 Industrial Place
Penticton, BC V2A 7C8
Phone: 778-622-6826 Please note this is a new number.
Fax: 250-490-2231

From: s.22
Sent: February 24, 2021 11:24 AM
To: Reimer, Shaun FLNR:EX
Subject: Okanagan Lake Forecast

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Hello Shaun,

s.22 and usually call to get your opinion on the projected consequences of this year's snowpack and rain forecast.

You are acutely aware of the difficulties many of us have faced in the last 4 seasons and I have to ask you one question.

Why do you not open the floodgates all the way prior to or during the initial influx of runoff?

It seems to me that the current situation allows for no margin for error if you do not let enough water out of the lake in time but, should there be less than predicted inflow, you can easily compensate by reducing the outflow volume later in the season.

I would greatly appreciate your response.

Thank you very much for your help.

s.22

RE: COBTWG March 2nd Meeting Agenda

From: Ogden, Athena <athena.ogden@dfo-mpo.gc.ca>
To: Colette Louie <CLouie@oib.ca>, Allan, Dean <Dean.Allan@dfo-mpo.gc.ca>, Dawn Machin <dmachin@syilx.org>, Elinor (emcgrath@syilx.org) <emcgrath@syilx.org>, Eric FLNR:EX Hegerat (Eric.Hegerat@gov.bc.ca) <Eric.Hegerat@gov.bc.ca>, Howie Wright <hwright@syilx.org>, Hyatt, Kim <Kim.Hyatt@dfo-mpo.gc.ca>, Jocelyn Campbell (Jocelyn.Campbell@gov.bc.ca) <Jocelyn.Campbell@gov.bc.ca>, Karilyn Alex (kalex@syilx.org) <kalex@syilx.org>, Levitt, Brian <Brian.Levitt@dfo-mpo.gc.ca>, Mark Phillpotts (Mark.Phillpotts@gov.bc.ca) <Mark.Phillpotts@gov.bc.ca>, Michie, Dale <Dale.Michie@dfo-mpo.gc.ca>, Rich (rbussanich@syilx.org) <rbussanich@syilx.org>, Ryan Benson (RBenson@syilx.org) <RBenson@syilx.org>, Ryde, Kory <Kory.Ryde@dfo-mpo.gc.ca>, Samantha Pham <spham@syilx.org>, Scroggie, Jamie <Jamie.Scroggie@dfo-mpo.gc.ca>, Selbie, Daniel <Daniel.Selbie@dfo-mpo.gc.ca>, Shaun Reimer <shaun.reimer@gov.bc.ca>, Tara White <tara.white@gov.bc.ca>, Tyler Weir (Tyler.Weir@gov.bc.ca) <Tyler.Weir@gov.bc.ca>, Zunti, Barry <Barry.Zunti@dfo-mpo.gc.ca>, Elinor (emcgrath@syilx.org), Hegerat, Eric FLNR:EX, XT:Wright, Howie Okanagan Nation Alliance EAO:IN, Campbell, Jocelyn FLNR:EX, Karilyn Alex (kalex@syilx.org), Phillpotts, Mark G FLNR:EX, Rich (rbussanich@syilx.org), Ryan Benson (RBenson@syilx.org), Reimer, Shaun FLNR:EX, White, Tara FLNR:EX, Weir, Tyler FLNR:EX
Sent: March 2, 2021 12:41:56 PM PST
Received: March 2, 2021 12:42:10 PM PST
Attachments: Stockwell_etal2020OkSpawnTimingEmergTemp.pdf

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hello all,
Here is Margot's Sockeye fry emergence Data Report as per request.
Athena

From: Colette Louie

Sent: Monday, March 1, 2021 1:41 PM

To: Allan, Dean ; Dawn Machin ; Elinor (emcgrath@syilx.org) ; Eric FLNR:EX Hegerat (Eric.Hegerat@gov.bc.ca) ; Howie Wright ; Hyatt, Kim ; Jocelyn Campbell (Jocelyn.Campbell@gov.bc.ca) ; Karilyn Alex (kalex@syilx.org) ; Levitt, Brian ; Mark Phillpotts (Mark.Phillpotts@gov.bc.ca) ; Michie, Dale ; Ogden, Athena ; Rich (rbussanich@syilx.org) ; Ryan Benson (RBenson@syilx.org) ; Ryde, Kory ; Samantha Pham ; Scroggie, Jamie ; Selbie, Daniel ; Shaun Reimer ; Tara White ; Tyler Weir (Tyler.Weir@gov.bc.ca) (Tyler.Weir@gov.bc.ca) ; Zunti, Barry

Subject: COBTWG March 2nd Meeting Agenda

Hi COBTWG;

Attached is the agenda for our virtual meeting tomorrow, 9am -12pm. The goto Link was sent in previous email. Please review the meeting minutes from December prior our meeting. I have listed the Action Items below:

NEW ACTION ITEMS:

1. **Kari** to set up and chair a meeting with Kim, Jocelyn, Dean/replacement to review the Data Sharing agreement.
2. **Cory** to provide update on RAMs in March/June meeting when data available.
3. **Kari** to provide update at June meeting on Floodplain GAP Analysis.

OUTSTANDING AND ONGOING ACTION ITEMS:

1. In-Lake publication reviews are needed by Tara, Howie, and Ryan. No Action.
2. Ryan to provide guidance on how to proceed with WFN on Objective 3 of the RM&E plan for discussions with WFN.
3. **Kim** to look at incoming data and samples pertaining to 2018 year outcomes of flooding for fish and losses of fish occurred and does this have a bearing for decision rules for water stewardship to work under – emergence report is in draft (in progress).

4. Cumulative Impacts letter to Environmental Protection. **Tara/Kim** to draft a follow up letter by next COBTWG meeting (unresolved and new impacts since this discussion have occurred).

Thanks,
COBTWG Secretariat
Colette

Methods and Summary Observations of Okanagan Sockeye Salmon Spawn Timing, Fry Emergence, and Associated Water Temperatures (Brood Years 2002- 2018)

Margot M. Stockwell, Kim D. Hyatt, Kari Alex, Colette Louie, and Dawn Machin

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, B.C.
V9T 6N7

2020

**Canadian Data Report of
Fisheries and Aquatic Sciences 1300**



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Canadian Data Report of Fisheries and Aquatic Sciences

Data reports provide a medium for filing and archiving data compilations where little or no analysis is included. Such compilations commonly will have been prepared in support of other journal publications or reports. The subject matter of the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

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Rapport statistique canadien des sciences halieutiques et aquatiques

Les rapports statistiques servent de base à la compilation des données de classement et d'archives pour lesquelles il y a peu ou point d'analyse. Cette compilation aura d'ordinaire été préparée pour appuyer d'autres publications ou rapports. Les sujets des rapports statistiques reflètent la vaste gamme des intérêts et politiques de Pêches et Océans Canada, notamment la gestion des pêches, la technologie et le développement, les sciences océaniques et l'environnement aquatique, au Canada.

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Les rapports statistiques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement d'origine dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 25 de cette série ont été publiés à titre de Records statistiques, Service des pêches et de la mer. Les numéros 26-160 ont été publiés à titre de Rapports statistiques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 161.

Canadian Data Report of
Fisheries and Aquatic Sciences 1300

2020

METHODS AND SUMMARY OBSERVATIONS OF OKANAGAN SOCKEYE SALMON
SPAWN TIMING, FRY EMERGENCE, AND ASSOCIATED WATER TEMPERATURES
(Brood Years 2002-2018)

by

Margot M. Stockwell¹, Kim D. Hyatt¹, Kari Alex², Colette Louie², and Dawn Machin²

¹ Fisheries and Oceans Canada
Pacific Biological Station, 3190 Hammond Bay Road,
Nanaimo, B.C. V9T 6N7

² Okanagan Nation Alliance,
#101 3535 Old Okanagan Highway,
Westbank, B.C. V4T 3L7

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ABSTRACT

Stockwell, M. M., Hyatt, K. D., Alex, K., Louie, C., and Machin, D. 2020. Methods and Summary Observations of Okanagan Sockeye Salmon Spawn Timing, Fry Emergence, and Associated Water Temperatures (Brood Years 2002-2018). Can. Data. Rep. Fish. Aquat. Sci. 1300: vii + 61 p.

Annual observations of Sockeye Salmon (*Oncorhynchus nerka*) spawning, fry emergence, and associated water temperatures were collected from the Okanagan River near Oliver, British Columbia, Canada from 2002 to 2018. These data were required to support operational deployment of the Okanagan Fish and Water Management Tool (FWMT) Decision Support System (DSS) and to validate its sub-model predictions of peak adult spawn-timing and fry emergence-timing for wild-origin Okanagan Sockeye Salmon that rear in Osoyoos Lake. The FWMT Sockeye sub-model uses observed and predicted daily mean water temperatures to estimate the timing of peak spawning activity in the fall and of subsequent fry emergence in the spring.

Standardized visual surveys of variations in adult Sockeye spawner abundance were completed on an approximately weekly basis between late September and early November of each year. Escapement data (live and dead fish) are summarized in this document by survey date and location in the Okanagan River. Additional data on redd counts (2002-2011) and adult behaviour (holding or spawning status, 2004-2018) are also presented. Emergent and actively migrating Sockeye fry were captured during weekly, nighttime sampling with fyke-nets, below the Okanagan River spawning grounds, between March and early May of each year. Sub-sets of captured fry were sent to the Okanagan Nation Alliance laboratory for further analysis of biological traits (i.e. developmental stage and mean total length). Annual results on fry abundance and developmental stage by survey date are also presented here.

Continuous, daily mean water temperature data are monitored at two Water Survey of Canada (WSC) hydrometric gauges located in the Okanagan River near the terminal spawning grounds. HOBO® Data Loggers have been deployed in the surface gravel of the river at multiple locations (mainly the uppermost reach of the spawning grounds) between 2001 and 2015. Additionally, 7 individual data loggers were deployed throughout the Index Section of the spawning grounds at variable depths during the 2000-2001 incubation year to assess potential spatial variability in thermal conditions. Daily mean water temperature data from all monitoring programs are summarized in this report by spawning and incubation period (September 15 to May 15 the following year).

RÉSUMÉ

Stockwell, M. M., Hyatt, K. D., Alex, K., Louie, C., and Machin, D. 2020. Methods and Summary Observations of Okanagan Sockeye Salmon Spawn Timing, Fry Emergence, and Associated Water Temperatures (Brood Years 2002-2018). Can. Data. Rep. Fish. Aquat. Sci. 1300: vii + 61 p.

Des observations annuelles du frai du saumon rouge (*Oncorhynchus nerka*), de l'émergence des alevins et des températures correspondantes de l'eau ont été recueillies dans la rivière Okanagan, près d'Oliver (Colombie-Britannique, Canada) de 2002 à 2018. Ces données étaient nécessaires pour appuyer le déploiement opérationnel du Système d'aide à la décision (SAD) de l'Outil de gestion des eaux et des poissons dans l'Okanagan (FWMT) et pour valider les prévisions, par son sous-modèle, de la période de frai de pointe des adultes et de la période d'émergence des alevins pour le saumon rouge d'origine sauvage de l'Okanagan qui se reproduit dans le lac Osoyoos. Le sous-modèle du FWMT pour le saumon rouge utilise les températures moyennes quotidiennes observées et prévues de l'eau pour estimer le moment de l'activité de frai de pointe à l'automne et de l'émergence subséquente des alevins au printemps.

Des relevés visuels normalisés des variations de l'abondance des reproducteurs adultes ont été effectués tous les ans, environ chaque semaine entre la fin septembre et le début novembre. Les données sur les échappées (poissons vivants et morts) sont résumées dans le document par date et lieu de relevé dans la rivière Okanagan. Des données supplémentaires sur les nombres de nids de frai (2002-2011) et le comportement des adultes (rassemblement ou état de frai, 2008-2018) sont également présentées. Des alevins de saumon rouge émergents et en migration active ont été capturés au cours d'un échantillonnage hebdomadaire nocturne réalisé à l'aide de verveux, en aval des frayères de la rivière Okanagan, chaque année entre mars et début mai. Des sous-ensembles d'alevins capturés ont été envoyés au laboratoire de l'Okanagan Nation Alliance pour une analyse plus poussée des caractéristiques biologiques (c.-à-d. stade de développement et longueur totale moyenne). Les résultats annuels concernant l'abondance et le stade de développement des alevins par date de relevé sont également présentés ici.

Deux jauges hydrométriques de Relevés hydrologiques du Canada (RHC) situées dans la rivière Okanagan, près des frayères de l'estuaire, surveillent en continu la température moyenne quotidienne de l'eau. Des enregistreurs de données HOBO^{MD} ont été déployés dans le gravier de surface de la rivière à plusieurs endroits (principalement dans le tronçon supérieur des frayères) entre 2001 et 2015. De plus, sept enregistreurs de données individuels ont été posés dans le tronçon de référence des frayères à des profondeurs variables au cours de l'année d'incubation 2000-2001 afin d'évaluer la variabilité spatiale potentielle des conditions thermiques. Les données moyennes quotidiennes de la température de l'eau de tous les programmes de surveillance sont résumées dans le présent rapport par période de frai et d'incubation (du 15 septembre au 15 mai de l'année suivante).

ACKNOWLEDGEMENTS

Surveys to determine abundance and biological traits of Okanagan Sockeye Salmon during this study involved variable levels of cost-sharing and collaborative efforts among Fisheries and Oceans Canada (PST funding), the Okanagan Nation Alliance and Washington State Public Utility Districts. The latter are “co-sponsors” for either the Fish and Water Management Tools (FWMT) Project (Douglas County Public Utility District) or the Skaha Sockeye Reintroduction (SSR) Project (Chelan and Grant Public Utility Districts).

INTRODUCTION

The Okanagan River in British Columbia and Wenatchee River in Washington State support the only two remaining self-sustaining Sockeye Salmon populations out of more than a dozen that historically returned to the Columbia River (Fulton 1970, Fryer 1995). A third remnant stock, comprising less than 0.1% of current Columbia Sockeye that returns to the Snake River, is listed under the US Endangered Species Act, and is maintained through hatchery production. Fryer (1995) and Hyatt and Rankin (1999) provide further details regarding historic abundance, biological traits, and factors leading to the general decline of Columbia and Okanagan Sockeye respectively. In the latter case, average returns to Canadian portions of the Okanagan Basin, between the years 1975-2000, were inadequate to sustain even small ceremonial and subsistence fisheries by First Nations (Bijsterveld and James 1986).

In 1997, the Okanagan Nation Alliance (ONA), a First Nations Council in Canada, convened a workshop of salmon experts to discuss:

- Factors contributing to the historic decline of salmon returns to the Okanagan River;
- The ONA vision to restore anadromous salmon populations throughout their ancestral range in the Okanagan basin;
- The feasibility of restoring existing and extirpated populations of Okanagan salmon.

Following the 1997 workshop, personnel from the ONA, Fisheries and Oceans Canada (DFO), and British Columbia’s Forests, Lands, Natural Resource Operations, and Rural Development (BC-FLNRORD) Ministry agreed to pool resources and expertise to form the three-party Canadian Okanagan Basin Technical Working Group (COBTWG) dedicated to sustainable management and restoration of fish populations and freshwater ecosystems in Canada’s Okanagan Basin. Beginning in 1998, COBTWG facilitated the ongoing development of an integrated plan that has helped guide the identification, implementation and assessment of outcomes from a suite of salmon restoration projects (reviewed in Hyatt and Stockwell 2019). One of these projects, Fish-and-Water Management Tools (FWMT) was designed to improve “fish-friendly” flows in the regulated Okanagan Lake and River System (OLRS) as a means of contributing to rebuilding the population of wild-origin, Osoyoos Lake Sockeye Salmon (Hyatt et al. 2001, Hyatt et al. 2015).

The FWMT project created a decision support system (DSS) consisting of a coupled set of four biophysical sub-models of key relationships (among climate, hydrology, fish, water supply and property) that interact with a fifth water management “rules” sub-model used to predict the potential consequences of water management decisions for fish and other water users. FWMT

software (Alexander et al. 2018) allows system users to explore potential impacts of water management decisions by employing current data (real-time mode), historic data (retrospective mode) or synthetic, future data (prospective mode). The Sockeye Salmon sub-model within the FWMT-DSS (Hyatt et al. 2013) uses current year observations and/or predictions of adult Sockeye Salmon spawn timing and fry emergence timing to establish the year-specific, calendar interval during which incubating Sockeye eggs and alevins will be potentially vulnerable to losses due to either flood-and-scour or drought-and desiccation events. Historically, a significant portion of these events has been a consequence of conflicted water management decisions (see Hyatt and Stockwell 2010, Alexander et al. 2018, Hyatt et al. 2015 for details). Data summarized in the current report were gathered to support real-time use of the FWMT-DSS as well as to provide direct observations of adult Sockeye spawn timing and fry emergence to test the reliability of FWMT sub-model predictions for timing of these life history events.

STUDY AREA

The Okanagan Lake and River System (OLRS) lies within a valley in south-central British Columbia, bounded by the Monashee Mountains, Okanagan Highlands, and the Thompson Plateau. The basin is characterized by a series of six large lakes joined by rivers, all set in a north to south, chain configuration along the valley bottom. Wood (900 ha) and Kalamalka (2570 ha) lakes drain into Okanagan Lake (35,000 ha) from the northeast. At its southern end, Okanagan Lake drains into the Okanagan River which flows through Skaha (1960 ha), Vaseux (290 ha), and then Osoyoos (2320 ha) lakes (Figure 1). Osoyoos Lake, at the bottom of the chain, straddles the international border with the United States. From here, the watershed drains into the Okanogan River (U.S. spelling) in Washington State, on through to the Columbia River, and ultimately out to the Pacific Ocean near Astoria, Oregon.

The OLRS is a snowmelt-dominated system, with a spring freshet that occurs from April through June, accounting for as much as 90% of the annual inflows (Dobson 2004). By July, the freshet declines and inflows to the system remain very low for the summer, fall, and following winter. Because of the arid to semi-arid climate in the valley, most summer precipitation evaporates or soaks into the ground and does not contribute directly to surface water flow. The wide fluctuations between spring and summer flows are moderated by water regulation at a series of dams in the basin. Penticton Dam at the outlet of Okanagan Lake is the main control point; however, water levels and river flow can be manipulated to a minor extent by adjusting floodgates on dams at Skaha (Okanagan Falls Dam) and Vaseux lakes (McIntyre Dam). Zosel Dam, at the outlet of Osoyoos Lake, is controlled by the Washington Department of Ecology primarily to maintain seasonal target lake levels that are mandated by the International Joint Commission (Bourget and Claman 1998).

The Okanagan River has been significantly altered by land development (e.g. agricultural, urban) and construction of numerous irrigation and flood control dams. Much of the river's length has been straightened and is now confined to a flood control channel by dikes. Compared to their historic state (pre-1950's), channel length and aquatic habitat area have been reduced by 53%, associated wetland area has been reduced by 88%, and the average gradient has roughly doubled from about 0.1% to 0.19% (Gaboury 2002). Readers should see Symonds (2000) for a more thorough chronology of development and change to water management in the OLRS.

Okanagan River Sockeye Salmon

Sockeye Salmon return to the Okanagan Basin to spawn following two years in the Pacific Ocean. On average, 95% of the population of returning adults are 4-year-old fish with the remaining 5% being made up of 3- and 5-year olds. However, in some years, an unusually, large proportion of fish have returned as 3-year-old jacks and jills (e.g. 2007-28%, 2011-18%, 2013-17%; M. Stockwell unpublished data). Hyatt et al. (2003) provide additional details regarding seasonal migration timing through the Columbia River and factors influencing successful returns to terminal spawning areas in the Okanagan River. Wild¹, adult Sockeye spawn principally in the Okanagan River between Osoyoos and Skaha Lakes (Figure 1) during October. Fry emerge during late April to early May and migrate downstream to the lake where they rear for one year. Smolts leave Osoyoos Lake, commonly in the last week in April, to continue their downstream migration to the Pacific Ocean. Okanagan Sockeye spawning and juvenile rearing occurs exclusively in the Canadian portions of the Okanagan basin.

Spawning Ground Description

The majority of Sockeye Salmon (>75%) spawn in the 24 km section of the river between Vaseux and Osoyoos Lakes. However, the highest quality spawning habitat is located in a much smaller, 8 km reach of natural and semi-natural river between McIntyre Dam and the town of Oliver, B.C. A 4 km natural reach (McIntyre Dam to Hwy 97 Bridge; Figure 1) remains unaltered by channelization and still includes broad areas of riparian vegetation, numerous gravel bars, vegetated islets, and side channels. These features work to create natural pools, riffles, and glides of variable depths and variable water velocities throughout the reach (Long et al. 2006). Below this, a semi-natural section (4 km) of river is bounded by set-back dikes that allow some natural meanders, side channels, and riparian vegetation. These two sections together are identified as an Index Section for the purpose of adult enumeration surveys (Hyatt and Rankin 1999, Stockwell and Hyatt 2003).

The remainder of the river has been channelized with heavily riprapped dikes on each side built to contain rapidly moving water during freshets that consequently exert sufficient force to induce gravel scour ($> 28.3 \text{ m}^3/\text{sec}$; Alexander et al. 2018) and loss of incubating salmon eggs or alevins. The dikes confine the channel to a stable width of about 30 m. Within the channelized section, between the town of Oliver and Osoyoos Lake, there are 13 engineered, vertical, drop structures (VDS) that provide gradient/velocity control (e.g. Figure 2). Additionally, there are four vertical drop structures in the channel between Vaseux and Skaha lakes. Sockeye adults utilizing these engineered channel sections for spawning are generally distributed in the 30-50 m zone directly above each VDS where suitable substrates for spawning and egg incubation accumulate.

Optimal flows for adult migration, spawning, and egg and alevin incubation in the Okanagan River are generally managed in accordance with the Okanagan Basin Implementation Agreement guidelines (Table 1; Anonymous 1982) and advice provided through discussions with the FWMT Operational Team (e.g. Hyatt and Stockwell 2010).

¹ Hatchery reared fry were introduced to Skaha Lake beginning in 2004 (Wright and Smith 2003, Alexander and Hyatt 2015).

METHODS

Sockeye Salmon Escapement Observations

Wells Dam

Wells Dam and the associated fish-ways represent the final manufactured barrier on the Columbia River that Okanagan Sockeye must pass before returning to terminal spawning areas located in the Okanagan River in Canada. Personnel from Douglas County Public Utility have monitored the daily numbers of adult salmon migrating through two fish ladders at Wells Dam since it first began operation in 1967. Recent year counts are derived from 24-hour video monitoring that takes place from May 1 to November 15 each year. Douglas County staff review videotaped footage and record daily abundance of fish (per species) utilizing the ladders. Prior to 1996, personnel stationed in front of viewing windows, carried out visual counts for 50 minutes per hour, 16 hours per day, throughout the migratory season. These counts were subsequently expanded to represent hourly passage rates. The remaining 8 hours were video taped for enumeration the following day (Stockwell and Hyatt 2003). Annual data sets for Sockeye counted at Wells Dam were obtained from the Columbia River D.A.R.T.² website at <http://www.cbr.washington.edu/dart/dart.html> (last accessed 2-Jul-19).

Okanagan River Terminal Spawning Grounds

Field crews from the ONA Fisheries Department have executed FWMT contract work to conduct standardized counts of live and dead Sockeye Salmon in the Okanagan River since 2001. This includes surveys of both the Index and Channel Sections described above (Figure 1). The upper channel between McIntyre Dam and Okanagan Falls at Skaha Lake was added to enumeration surveys in 2010 (partial season in 2009) when a retrofit of the water control gates at McIntyre Dam allowed Sockeye passage to the river above Vaseux Lake (Associated Engineering 2006). Sockeye Salmon that continue migration past Okanagan Falls Dam are considered to be hatchery-origin returns from the Skaha Lake reintroduction program and are enumerated separately by biologists from that program (Alexander and Hyatt 2015).

Okanagan River spawning grounds are readily accessible to field crews from Highway 97, side roads that run parallel to the Okanagan River, and walking paths along the channel. River flows near Oliver during the spawning season are, on average, 11 m³/sec (2000-2017), equating to a mean depth of approximately 0.7 m. Under most circumstances and in the majority of locations, visibility is clear to the bottom of the river. For each survey date, a 3 to 4-person crew completes a combination of boat float, in-stream walks, and bank walks from mid to late September through to early November; typically, every 3 to 5 days with the more frequent surveys occurring during heavier spawning periods. Observers record counts by standard sections or reaches and include the abundance of live Sockeye as well as carcasses. They separate (beginning 2004) live count observations into 2 categories based on whether spawners are exhibiting holding or spawning behaviour and record these counts accordingly. This behavioural observation supplies additional information with respect to the date of peak spawn by salmon as opposed to just the date of peak abundance, which can vary with run size or changes in river flows. Although the primary focus of the surveys is enumeration of Sockeye

² Columbia River Data Access in Real Time (D.A.R.T.), Columbia Basin Research, School of Aquatic & Fishery Sciences, University of Washington, Seattle, WA.

spawners, the survey crews also record the numbers of Chinook Salmon (usually <20 annually) or kokanee salmon observed. Data for these species are not included in this report.

As part of enumeration surveys for the years 2002 to 2011, field crews routinely counted and recorded the number of Sockeye redds they observed. Redd abundance over time was collected as an alternate method to confirm the date of peak spawning because the date on which the highest redd count is observed may also be considered as the peak spawn date (Dauble and Watson 1997). However, as Sockeye started to return in record-breaking numbers (beginning 2008), counting redds became increasingly time consuming and difficult for the field crews to assess accurately. Additionally, individual redd counts were difficult to discern because of the prevalence of superimposition and gravel disturbance from the high abundance of spawners (Hyatt et al. 2009). Consequently, redd counting was discontinued in years after the fall of 2011.

Index Section: The Index Section is divided into 4 geographical reaches for the purpose of Sockeye enumeration surveys (Figure 1).

- Reach 1A: McIntyre Dam to Deer Park Estates (approximately 1200m below McIntyre)
- Reach 1B: Deer Park Estates to Highway 97 Bridge
- Reach 2: Highway 97 Bridge to VDS 13
- Reach 3: VDS 13 to Oliver Bridge at VDS 12

Field crews complete Sockeye enumerations of Reach 1A by walking downstream along the left bank and recording numbers of fish observed. For the remaining 3 reaches, three observers float the river in an inflatable boat with observers 1 and 2 counting live fish on either the left or right side of the thalweg; observer 3 counts carcasses. Information is recorded when the crew gets to the end of each reach. The crew also take time to stop and count spawners in major side channels along the survey course. For all float trips, observers are equipped with polarized sunglasses and tally counters. Tally counters are calibrated in single, 10, or 100 unit increments depending on location and fish densities. In addition to fish numbers, the survey crew records water and air temperature along with any notes regarding visibility, weather, or other conditions that may affect survey quality.

Channel Sections: Once surveys of the Index Section are complete, 2 observers move on to the Channelized Section downstream of VDS12 while 1 observer works upstream of McIntyre Dam. Observers walk the footbridge across the top of each drop structure, counting fish as far upstream as visibility allows (generally 50-60m). Attempts are made to view Sockeye in the deep water below each drop structure; however, poor visibility caused by turbulence cascading over the drop structure generally prevents systematic counting in these pools. Counts are recorded separately for each VDS section.

Sockeye Salmon Fry Emergence

Sampling events for Sockeye fry emergence occurred each year (2002-2019) from early March until the end of the first week in May. A field crew of 2-3 persons generally began each season by initially sampling weekly and then every 3 to 4 days as the abundance of captured fry increased. A fyke net (0.63 m X 0.33 m; 3 mm mesh) was attached to the bottom of a rigid frame suspended from the upstream, walkway fence at the central bay of Vertical Drop Structure 13. This site was chosen because it is immediately downstream of the main spawning

area thus ensuring minimal fry losses at this point (e.g. due to predation, etc.). For each set, the fyke-net was deployed until fully submerged mid-way in the water column. Net deployment depth below surface varied depending upon date-specific flow rate and associated river depth. At the completion of a single set, crew members would empty the captured fry into buckets of river water, count and record fry numbers, and then release them back into the river. During freshet, if river discharge rates increased to greater than 35 m³/sec, conditions became unsafe for the gear and crew and therefore, sampling was terminated for the season. In 2017, attempts were made to sample when flows reached as high as 72 m³/sec near the end of the sampling season; however, the gear was damaged by floating debris and sampling was terminated prematurely.

In 2002, sampling routines were highly variable with sessions beginning as early as 16:00 and ending as late as 08:00 the next morning. Net soak times for individual sets ranged from 5 to 255 minutes. By 2003, the fyke sampling sessions were restricted to the hours between 18:00 and 02:00 with one set completed every 2 hours. Soak times were reduced to 5 or 10 minutes in order to avoid damage to entrained fry. From 2004 to 2007, a new sampling protocol was established whereby a session would begin between 20:00 and 22:00, ending between 0:00 and 02:00 because past years of observation indicated that the majority of emergent fry actively migrate downriver during this period³. During this interval, effort expended consisted of one 10-minute set completed every hour.

By 2008, sessions were further refined such that the first set began at or shortly after 21:00 with the last set occurring between 00:00 and 00:30. A review of all the previous year's results (M. Stockwell, unpublished data) revealed this was the period of time when the largest proportion of emergent fry were actively migrating and were caught in fyke-nets (e.g. Figure 3). Thus, the length of time the field crew was committed to each night was greatly reduced with little impact on emergence timing results. Crews made either 4 fyke sets with a soak time of 15 minutes each or 8 sets with 7.5 minutes soak time (or a combination of the two) such that a total of 1 hour's soak time was completed each night. The shorter soak times were required with high volumes of fry or when excessive debris began to accumulate in the nets. Soak times alone do not fully standardize sampling efforts when river discharge changes within season or if net sampling efficiency varies due to debris accumulation. Therefore, beginning in 2008, a flow meter was inserted at the mouth of the fyke-net during deployment so that fry counts from a given set could be subsequently adjusted to a constant volume of water sampled.

Field methods for emergence timing in 2018 varied from the standard protocols described above. In the spring of 2018, extremely high snowpack and subsequent melt necessitated maximum release rates of water from Penticton Dam in order to reduce flooding around Okanagan Lake and River. Anticipating the extremely high flows, the survey crew re-configured the fyke-net system (e.g. additional anchor ropes) such that the equipment could handle the extremely high discharges (up to 85 m³/sec). Sampling times and the number of fyke sets were also modified in order to accommodate challenges created by high discharge rates. Initially, sampling was conducted to determine if eggs and undeveloped fry were being scoured from the gravel at high flows. Assuming that any scour impacts would occur throughout a 24-hour period, sampling was conducted only during daylight hours to maximize the safety of the field crew. For each session, the crew generally conducted three sets including one 7.5-minute set to

³ Sunset at Kelowna, B. C. occurs at approximately 19:30 at April 1 increasing to 20:15 by April 30.

test for debris impacts related to high flows and two 15-minute sets to catch emergent fry. No fry were caught in the first 4 sessions so the crew added a night session to each sampling date to check for the presence of fry that may have volitionally emerged from the gravel.

Sampling procedures to identify fry development were added to the collection process beginning in the spring of 2008. At the completion of each set, crew members separated captured fry according to the developmental stage (yolk sac absorption; Figure 4) of individual fish. Additionally, sub-samples of fry were retained and returned to the ONA lab for validation of the proportion of each stage in the night's catch as well as for length and weight measurements. The field crew was instructed to take samples such that in sets where less than 100 fry were caught, all fry were kept for lab analysis. When more than 100 fish were caught, 100 were retained for the lab. All remaining fry were released back into the river. Laboratory processing of fresh, retained fry samples was generally conducted the following morning.

Okanagan River Water Temperature

Water Survey of Canada Data: Continuous, daily mean water temperature data (2002-2019) were assembled from Water Survey of Canada (WSC) hydrometric monitoring stations on the Okanagan River. The WSC is the national authority responsible for the collection, interpretation, and dissemination of standardized water resource data and information in Canada⁴. WSC maintains several hydrometric gauges on the Okanagan River and its tributaries from Penticton Dam at Okanagan Lake to Road 18 near the town of Oliver (Figure 1). The gauges were originally installed to monitor discharge and water levels but key locations were retrofitted beginning in 2002, to accommodate real-time water temperature instrumentation for the FWMT project. WSC provided the authors with finalized, temperature data sets covering September 2002 through January 2016 for stations Okanagan Falls (08NM002) and Okanagan River near Oliver (08NM085)⁵. Data from February 2016 through May 2019 for the same stations were downloaded at approximately monthly intervals directly from the WSC real-time monitoring website⁶. Water temperature data from WSC stations is classified as preliminary, because, unlike the water level and discharge data, it does not go through a quality control process prior to posting (L. Campo⁵). Daily mean water temperatures listed in this report are derived from data recorded at hourly intervals over 24 hours. Water temperatures are included in this document for the Sockeye Salmon spawning and egg/alevin incubation intervals, September 15 through May 15 for each brood year.

Transect 2 Data Loggers: Water temperatures were monitored at sites within the main spawning area in order to independently verify the WSC gauge readings. HOBO® Tidbit Data Loggers were installed in the surface gravel of the natural side-channel habitat at Transect 2 (Figure 1) September 15 to May 15 from 2001 to 2015. Daily mean water temperatures are derived from data recorded at hourly intervals over 24 hours. ONA technicians checked the data loggers on a monthly basis to confirm original placement as well as operational function. Temperature data were also downloaded at this time.

⁴ <https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html>

⁵ Email dated 22-Jan-2016 to Margot Stockwell, DFO, Nanaimo from Lynne Campo, Senior Hydrometric Technician, Water Survey of Canada, Vancouver, B.C. V6C 3S5.

⁶ Real-time Hydrometric Data at: https://wateroffice.ec.gc.ca/index_e.html

Multi-Data Logger Set 2001: Intra-gravel and surface water temperatures were monitored at 7 high-density, spawning locations in the Index Section of the river using Onset® HOBO® Data Loggers from October 2000 to September 2001 (Figure 1). All data loggers were installed on October 25, 2000 although some were found to be non-functional and activated a month later. ONA technicians periodically inspected the temperature loggers and downloaded the data. Daily mean water temperatures are derived from data recorded at 4-hour intervals.

DATA SUMMARY and DISCUSSION

Escapement

This report presents annual Okanagan River Sockeye escapement estimates derived from Wells Dam ladder counts (1967-2018; Table 2) and terminal spawning ground surveys (2002-2018; Tables 3 and 4). Wells Dam counts may be regarded as absolute counts with respect to the abundance of sockeye that could potentially be available to reach the Okanagan terminal spawning grounds. However, these values do not account for removals (fisheries and brood-stock collection) or natural, pre-spawn mortalities that occur over the 3 to 4 months between passage at Wells Dam and the commencement of spawning in the Okanagan River (e.g. see Fryer et al. 2017). Wells Dam counts from 2007 to 2018 also include ONA hatchery returns to Skaha Lake but in general, these fish comprise less than 10% of the total Sockeye returns to the Okanagan basin (Alexander and Hyatt 2015, Hyatt and Stockwell 2019). However, preliminary estimates of Skaha returns in 2018 suggest that hatchery fish may have comprised up to 50% of the Sockeye passing Wells Dam in that year (Ryan Benson, ONA, Westbank, B.C. pers. com.).

Adult Sockeye counts from the terminal spawning grounds are summarized by location and survey date in Tables 3 and 4. Table 3 includes annual observations of live and dead fish as well as redd abundance while Table 4 breaks out the live Sockeye observations into behavioural traits (holding or spawning). Over the last seventeen years, peak live plus dead counts have ranged from a low of 2,789 fish in 2002 to a high of 96,896 fish in 2010.

Return year 2008 marked the beginning of record-breaking returns of Sockeye (Tables 2 and 3) with abundances far exceeding the recommended escapement level of 65,000 (as Wells Dam counts; Hyatt and Rankin 1999). As a consequence of the higher escapements, several categories of new fisheries for Sockeye developed above Wells Dam including: Washington State recreational, Colville Confederated tribal, Osoyoos Lake (B.C.) recreational, and ONA economic, food, and ceremonial. In addition to the above removals from fisheries, the ONA Sockeye reintroduction program requires the collection of several hundred Osoyoos wild, adult Sockeye Salmon from the terminal spawning grounds for hatchery brood-stock. Annual, adult removals for brood-stock are summarized in Table 5.

Notably low returns of 6,374 Sockeye were observed on the terminal spawning grounds in 2015 (Table 3). This is in striking contrast to the 510,706 that passed Bonneville Dam or the 186,964 fish counted past Wells Dam that same year. Several weeks of record high water temperatures in the Columbia River during the peak of Sockeye migration led to exceptionally high stress and

disease related mortalities throughout the entire migration route (NOAA 2016). Estimates of total Sockeye loss for 2015 are as high as 95% of the total Columbia River population (Fryer et al. 2017).

Historic Okanagan Sockeye Salmon escapement data from the terminal spawning grounds (1947 to 2001) can be found in Stockwell and Hyatt (2003). However, note that data tabulated in the 2003 report were gathered from non-standardized surveys that included a wide variety of methods, effort, geographical coverage, and agencies.

Fry Emergence

Emergent fry were caught during annual fyke-net sampling sessions that were conducted on the Okanagan River at VDS 13 over the course of approximately 8 weeks from mid-March to early May (2002-2019). Catch per unit effort (fry/hour) results from each night's sampling efforts are presented in Table 6. Sampling was terminated prior to the completion of all fry emergence in some years (e.g. 2013, 2016, and 2017, 2018) because in-stream discharge rates increased to levels that prohibited proper functioning of the fyke-net and jeopardized the safety of the field crew. During the sampling sessions in 2002, fyke sets were very erratic with respect to their frequency, soak times, and time of day at which sets occurred. For example, sessions often began as early as 17:00 in the afternoon with a final set completed the next morning at 07:00. Soak times were from as few as 15 minutes each to a total of 4 hours. Relatively few fish were caught in sets done before dark or after midnight. In an effort to provide relatively standardized observations reported here, the 2002 data summarized in Table 6 reflect only observations from fyke sets conducted between 21:00 and 01:00. Results from the modified sampling effort in 2018 are presented separately in Table 7. Although few fry were caught in total in 2018, the results indicate that even under extreme flow conditions, fry were not continually flushed out over 24 hours but rather, exhibited volitional emergence under darkness as in any non-scour year. That is, ≤ 4 fry were caught in any daylight set, while up to 112 fry were caught in a standard night session.

Table 8 presents fry abundance by date and developmental stage as assessed by personnel in the field. Corresponding results from modified sampling effort in 2018 are presented separately in Table 9. Comparative staging of fry plus size results from lab analyses of sub-samples from the above field samples are presented in Table 10. Variation in the relative proportions of fry developmental stages identified from field versus corresponding lab results may be attributable to the superior observational conditions in the lab environment for conducting the assessments (light quality, etc.).

Water Temperature

Water temperature data were retrieved from WSC hydrometric gauges or in-stream data loggers at various locations in the Okanagan River between McIntyre Dam and Osoyoos Lake. In most cases, data is continuous from September 15 through to May 15 of each year, thereby covering the intervals of adult Sockeye migration to the spawning grounds (September-October), spawning (October-November), and egg incubation through to completed fry emergence (October-May). Missing data are due to equipment malfunction or in the case of in-stream data loggers, loss of equipment. Summaries of daily mean water temperature data include:

- Data from Water Survey of Canada continuous 24-hour monitoring in Table 11 (Okanagan River at Okanagan Falls, Station 08NM002 from September 2002 to May 2011) and Table 12 (Okanagan River near Oliver, Station 08NM085 from September 2010 to May 2018),
- Data from independent Tidbit data loggers installed at Transect 2 from September 2001 to May 2010 (Table 13A) and September 2010 to May 2015 (Table 13B). Tidbit installations were discontinued after 2015.
- Data from supplementary water temperature data loggers installed at various locations and depths throughout the Okanagan River Sockeye Salmon spawning grounds in 2000-2001 where locations are described in Table 14A with summary data provided in Table 14B.

Although the WSC gauge installation (08NM085) on the Okanagan River near Oliver has been operational with respect to temperature collection since September 2002, we have not documented data prior to 2009 due to data inconsistencies and a continually high temperature bias in the data compared to the WSC gauge at Okanagan Falls and Tidbit monitors at Transect 2 (Hyatt et al. 2010). WSC replaced the Oliver gauge in April 2008.

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FIGURES

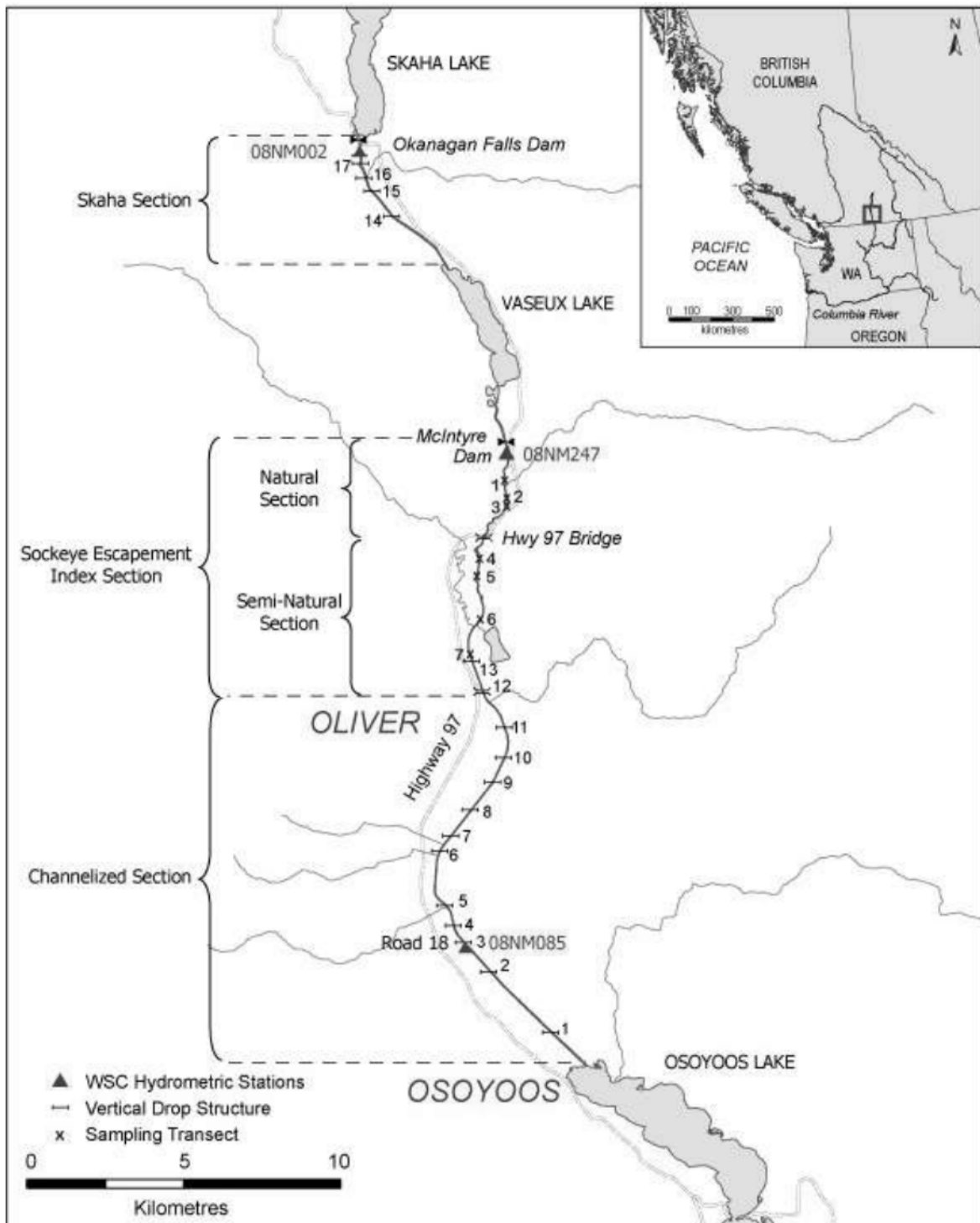


Figure 1. Okanagan River Sockeye Salmon terminal spawning grounds.



Figure 2. Example of a Vertical Drop Structure on the Okanagan River, B.C.

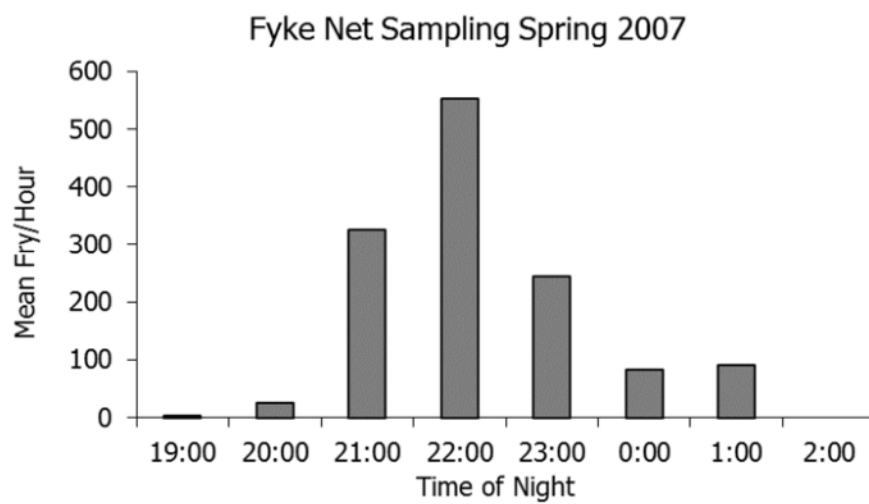
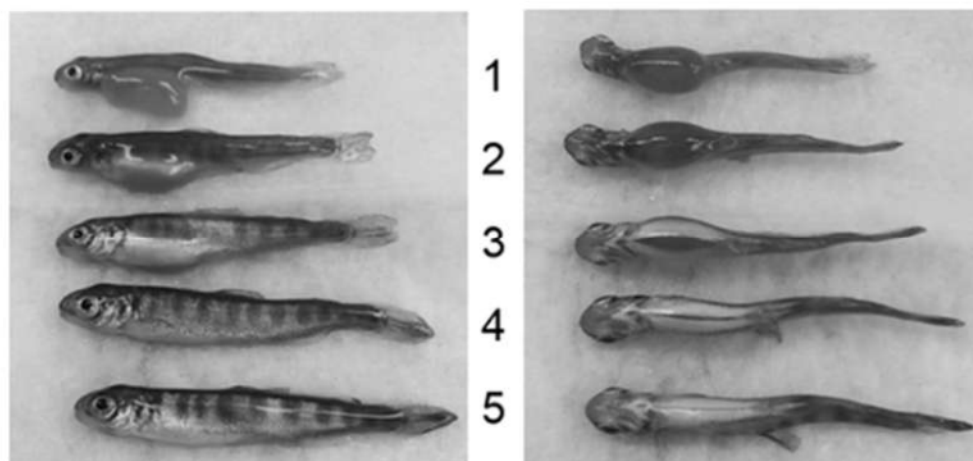


Figure 3. Example of abundance of fry caught in fyke nets by time of night.



1. Little or no absorption of the posterior lobe of the yolk sac
2. Posterior lobe is absorbed
3. Yolk sac is less than half visible in lateral view; top of yolk sac is silver
4. Skin is pigmented on sides and lateral part of ventral surface; yolk is visible in scar
5. Yolk sac scar is healed

Figure 4. Depiction of five developmental stages of Chinook Salmon fry based on yolk sac absorption. Photo source: Fuhrman et al. 2018. Descriptive text from Shepherd and Inkster 1995.

TABLES

Table 1. Recommended flows for Sockeye Salmon at various life history stages in the Okanagan River near Oliver, B.C. (Anon. 1982).

Sockeye Life History Stage	Dates	Preferred Range (m³/sec)
Adult migration	Aug. 1 - Sept. 15	8.5 - 12.7
Spawning	Sept. 16 - Oct. 31	9.9 - 15.6
Incubation	Nov. 1 – Feb. 15	5.0 - 28.3 Incubation flows ≥ 50% spawning
Fry migration	Feb. 16 – Apr. 30	5.0 - 28.3

Table 2. Annual totals (1967-2018) of Sockeye Salmon passage over Wells Dam, WA. Source: Columbia River D.A.R.T., Columbia Basin Research, University of Washington. (2018). Adult Passage Graphics and Text. http://www.cbr.washington.edu/dart/query/adult_graph_text .

Return Year	Total Sockeye	Return Year	Total Sockeye	Return Year	Total Sockeye
1967	113,232	1985	52,989	2002	10,659
1968	81,530	1986	34,788	2003	28,965
1969	17,352	1987	40,120	2004	77,492
1970	50,667	1988	33,978	2005	55,553
1971	48,172	1989	15,976	2006	22,075
1972	33,398	1990	7,609	2007	22,272
1973	37,178	1991	27,490	2008	165,334
1974	16,716	1992	41,951	2009	134,937
1975	22,286	1993	27,894	2010	291,764
1976	27,619	1994	1,666	2011	111,507
1977	21,973	1995	4,892	2012	326,012
1978	7,644	1996	17,701	2013	129,993
1979	26,655	1997	24,621	2014	490,318
1980	26,573	1998	4,666	2015	186,964
1981	28,234	1999	12,388	2016	216,031
1982	19,005	2000	59,944	2017	42,299
1983	27,925	2001	74,486	2018	153,637
1984	81,054				

Table 3. Abundance of live, dead, and total Sockeye spawners (2002-2018) and redds (2002-2011) by survey date and location on the terminal spawning grounds.

Survey Date	Index Section				Channel Section				Above McIntyre			Section Totals		
	Live	Dead	Total	Redds	Live	Dead	Total	Redds	Live	Dead	Total	Live	Dead	Total
28-Aug-02	0	0	0	0	0	0	0	0				0	0	0
11-Sep-02	18	0	18	0	2	0	2	0				20	0	20
20-Sep-02	3	0	3	0	1	0	1	0				4	0	4
24-Sep-02	26	0	26	0	4	0	4	0				30	0	30
2-Oct-02	141	0	141	1	11	0	11	0				152	0	152
7-Oct-02	702	2	704	23	223	0	223	0				925	2	927
12-Oct-02	1,315	14	1,329	268	153	0	153	5				1,468	14	1,482
17-Oct-02	2,088	9	2,097	529	494	0	494	99				2,582	9	2,591
22-Oct-02	2,322	33	2,355	752	433	1	434	47				2,755	34	2,789
25-Oct-02	2,086	103	2,189	1,000	568	1	569	n/c				2,654	104	2,758
30-Oct-02	562	145	707	681	189	2	191	70				751	147	898
17-Sep-03	19	0	19	0	0	0	0	0				19	0	19
26-Sep-03	577	0	577	0	6	0	6	0				583	0	583
3-Oct-03	2,318	5	2,323	0	128	0	128	0				2,446	5	2,451
8-Oct-03	5,390	34	5,424	78	25	15	40	6				5,415	49	5,464
14-Oct-03	9,286	62	9,348	2,194	160	0	160	5				9,446	62	9,508
18-Oct-03	10,036	198	10,234	2,582	155	1	156	25				10,191	199	10,390
21-Oct-03	9,164	569	9,733	3,231	263	0	263	41				9,427	569	9,996
24-Oct-03	5,110	1,144	6,254	n/c	117	4	121	45				5,227	1,148	6,375
27-Oct-03	3,007	1,785	4,792	1,942	110	6	116	48				3,117	1,791	4,908
3-Nov-03	341	700	1,041	1,721	51	5	56	29				392	705	1,097
15-Sep-04	15	0	15	0	0	0	0	0				15	0	15
20-Sep-04	267	0	267	0	36	0	36	0				303	0	303
25-Sep-04	1,353	0	1,353	0	84	0	84	0				1,437	0	1,437
30-Sep-04	5,399	1	5,400	40	134	1	135	0				5,533	2	5,535
4-Oct-04	12,478	6	12,484	164	n/c	n/c	n/c	n/c				12,478	6	12,484
7-Oct-04	20,986	63	21,049	836	257	2	259	5				21,243	65	21,308
10-Oct-04	19,922	266	20,188	2,119	227	0	227	67				20,149	266	20,415
14-Oct-04	19,005	669	19,674	2,669	n/c	n/c	n/c	n/c				19,005	669	19,674
19-Oct-04	16,966	3,410	20,376	2,204	n/c	n/c	n/c	n/c				16,966	3,410	20,376
22-Oct-04	14,969	4,169	19,138	4,407	224	30	254	73				15,193	4,199	19,392
27-Oct-04	3,786	6,245	10,031	3,882	194	43	237	142				3,980	6,288	10,268
3-Nov-04	739	3,397	4,136	2,895	374	0	374	55				1,113	3,397	4,510

Survey Date	Index Section				Channel Section				Above McIntyre			Section Totals		
	Live	Dead	Total	Redds	Live	Dead	Total	Redds	Live	Dead	Total	Live	Dead	Total
13-Sep-05	43	0	43	0	3	0	3	0				46	0	46
20-Sep-05	212	0	212	0	7	0	7	0				219	0	219
27-Sep-05	788	0	788	0	151	0	151	0				939	0	939
4-Oct-05	6,499	0	6,499	87	597	0	597	33				7,096	0	7,096
10-Oct-05	14,115	13	14,128	1,842	n/c	n/c	n/c	235				14,115	13	14,128
13-Oct-05	17,370	189	17,559	645	755	1	756	310				18,125	190	18,315
16-Oct-05	16,050	496	16,546	3,033	655	6	661	310				16,696	502	17,198
19-Oct-05	21,787	1,778	23,565	1,488	568	28	596	311				22,355	1,806	24,161
22-Oct-05	7,759	2,690	10,449	3,281	714	96	810	260				8,473	2,786	11,259
25-Oct-05	5,356	4,150	9,506	2,734	262	149	411	133				5,618	4,299	9,917
28-Oct-05	1,758	7,153	8,911	864	145	115	260	85				1,903	7,268	9,171
3-Nov-05	319	1,699	2,018	489	73	50	123	0				392	1,749	2,141
22-Sep-06	31	0	31	0	6	1	7	0				37	1	38
27-Sep-06	466	0	466	8	25	0	25	0				491	0	491
3-Oct-06	1,704	2	1,706	2	194	0	194	0				1,898	2	1,900
6-Oct-06	3,385	31	3,416	171	432	0	432	0				3,817	31	3,848
10-Oct-06	4,897	0	4,897	313	614	3	617	12				5,511	3	5,514
13-Oct-06	6,605	120	6,725	1,040	1,070	0	1,070	0				7,675	120	7,795
16-Oct-06	8,980	398	9,378	2,106	974	0	974	46				9,954	398	10,352
19-Oct-06	8,290	577	8,867	1,410	952	1	953	19				9,242	578	9,820
22-Oct-06	16,704	912	17,616	2,276	468	2	470	149				17,172	914	18,086
25-Oct-06	6,915	1,405	8,320	1,586	542	3	545	68				7,457	1,408	8,865
30-Oct-06	2,237	711	2,948	1,142	307	21	328	84				2,544	732	3,276
3-Nov-06	1,334	649	1,983	913	188	33	221	49				1,522	682	2,204
3-Oct-07	949	0	949	0	72	0	72	0				1,021	0	1,021
9-Oct-07	4,107	0	4,107	56	81	0	81	0				4,188	0	4,188
12-Oct-07	8,201	9	8,210	3,866	72	1	73	0				8,273	10	8,283
17-Oct-07	6,117	144	6,261	2,221	102	0	102	0				6,219	144	6,363
19-Oct-07	6,627	140	6,767	1,806	74	0	74	36				6,701	140	6,841
24-Oct-07	5,225	719	5,944	1,824	92	4	96	52				5,317	723	6,040
27-Oct-07	3,526	451	3,977	2,741	285	212	497	278				3,811	663	4,474
30-Oct-07	1,579	854	2,433	1,952	65	10	75	52				1,644	864	2,508
2-Nov-07	718	388	1,106	6,779	n/c	n/c	n/c	n/c				718	388	1,106
5-Nov-07	361	547	908	539	35	13	48	6				396	560	956

Survey Date	Index Section				Channel Section				Above McIntyre			Section Totals		
	Live	Dead	Total	Redds	Live	Dead	Total	Redds	Live	Dead	Total	Live	Dead	Total
17-Sep-08	1,599	1	1,600	0	118	1	119	0				1,717	2	1,719
24-Sep-08	4,423	5	4,428	0	554	2	556	0				4,977	7	4,984
29-Sep-08	16,980	11	16,991	35	1,187	0	1,187	0				18,167	11	18,178
2-Oct-08	25,285	12	25,297	329	n/c	n/c	n/c	n/c				25,285	12	25,297
5-Oct-08	51,144	13	51,157	1,344	1,384	0	1,384	0				52,528	13	52,541
8-Oct-08	43,496	139	43,635	3,334	1,377	1	1,378	7				44,873	140	45,013
11-Oct-08	52,418	213	52,631	2,412	1,413	2	1,415	12				53,831	215	54,046
14-Oct-08	70,618	1,004	71,622	1,802	965	11	976	0				71,583	1,015	72,598
17-Oct-08	46,032	2,733	48,765	3,301	1,113	34	1,147	0				47,145	2,767	49,912
20-Oct-08	42,720	4,481	47,201	3,710	n/c	n/c	n/c	n/c				42,739	4,513	47,252
23-Oct-08	29,077	3,766	32,843	2,518	977	152	1,129	1				30,054	3,918	33,972
28-Oct-08	18,288	11,392	29,680	2,768	642	350	992	43				18,930	11,742	30,672
30-Oct-08	13,225	13,782	27,007	6,603	556	398	954	112				13,781	14,180	27,961
5-Nov-08	2,421	12,082	14,503	855	304	321	625	97				2,725	12,403	15,128
16-Sep-09	222	0	222	0	7	0	7	0				229	0	229
23-Sep-09	512	4	516	1	31	0	31	0				543	4	547
28-Sep-09	1,121	4	1,125	1	36	1	37	0				1,157	5	1,162
2-Oct-09	5,755	1	5,756	14	152	0	152	0				5,907	1	5,908
4-Oct-09	9,264	3	9,267	116	395	0	395	0				9,659	3	9,662
7-Oct-09	19,461	4	19,465	312	465	1	466	0				19,926	5	19,931
10-Oct-09	24,369	16	24,385	510	659	4	663	4				25,028	20	25,048
13-Oct-09	25,182	38	25,220	803	643	2	645	4	1,835	2	1,837	27,660	42	27,702
16-Oct-09	31,961	246	32,207	2,342	600	2	602	44	1,678	1	1,679	34,239	249	34,488
19-Oct-09	39,618	960	40,578	1,688	577	1	578	17	3,171	1	3,172	43,366	962	44,328
22-Oct-09	32,614	2,582	35,196	2,196	584	6	590	15	2,368	4	2,372	35,566	2,592	38,158
25-Oct-09	22,948	8,089	31,037	3,381	479	34	513	30	1,326	6	1,332	24,753	8,129	32,882
29-Oct-09	6,304	4,318	10,622	2,059	244	93	337	27	742	45	787	7,290	4,456	11,746
2-Nov-09	1,927	4,140	6,067	2,235	180	142	322	31	352	113	465	2,459	4,395	6,854
9-Nov-09	327	7,160	7,487	3,226	n/c	n/c	n/c	n/c	57	213	270	384	7,373	7,757
16-Nov-09	28	5,690	5,718	5,279	2	177	179	8	1	157	158	31	6,024	6,055
24-Nov-09	8	10,014	10,022	4,656	1	172	173	11	0	154	154	9	10,340	10,349

Survey Date	Index Section				Channel Section				Above McIntyre			Section Totals		
	Live	Dead	Total	Redds	Live	Dead	Total	Redds	Live	Dead	Total	Live	Dead	Total
7-Sep-10	824	19	843	4	28	1	29	0	2,375	67	2,442	3,227	87	3,314
14-Sep-10	3,210	24	3,234	61	71	2	73	0	4,401	70	4,471	7,682	96	7,778
27-Sep-10	27,440	62	27,502	333	601	1	602	25	5,675	63	5,738	64,515	172	64,687
1-Oct-10	57,380	52	57,432	624	671	3	674	5	6,464	117	6,581	45,309	222	45,531
4-Oct-10	39,780	171	39,951	963	537	2	539	12	4,992	49	5,041	74,436	303	74,739
7-Oct-10	68,990	207	69,197	4,087	1,247	11	1,258	0	4,199	85	4,284	85,513	1,202	86,715
10-Oct-10	80,430	1,084	81,514	11,590	909	31	940	0	4,174	87	4,261	82,842	1,430	84,272
13-Oct-10	81,380	1,344	82,724	10,123	844	21	855	25	618	65	683	90,831	6,065	96,896
16-Oct-10	87,190	5,942	93,132	12,390	971	43	1,014	67	2,670	80	2,739	59,942	8,509	68,451
19-Oct-10	57,770	8,371	66,141	11,190	716	75	791	74	1,456	63	1,519	47,079	9,627	56,706
22-Oct-10	45,383	9,435	54,908	6,135	657	87	744	156	1,039	105	1,144	34,036	13,169	47,205
25-Oct-10	32,610	12,937	45,547	8,085	471	116	587	258	955	116	1,071	21,756	13,459	35,215
28-Oct-10	20,810	13,170	33,980	10,790	272	142	414	227	674	147	821	3,247	14,173	17,420
4-Nov-10	3,023	13,725	16,748	6,748	119	216	335	281	105	232	337	33,716	126	33,842
14-Sep-11	12	0	12	0	0	0	0	0	17	6	6	29	6	35
21-Sep-11	27	2	29	0	4	0	4	0	87	0	0	118	2	120
26-Sep-11	312	1	313	0	3	0	3	0	83	1	1	398	2	400
30-Sep-11	1,199	2	1,201	0	184	1	185	0	262	5	5	1,645	8	1,653
2-Oct-11	3,042	0	3,045	23	109	0	109	0	371	8	8	3,522	8	3,530
5-Oct-11	5,272	5	5,277	70	569	0	569	0	480	2	2	6,321	7	6,328
8-Oct-11	6,850	15	6,865	796	692	0	692	12	1,180	30	30	8,722	45	8,767
11-Oct-11	13,870	55	13,925	757	818	1	819	12	379	14	14	15,067	70	15,137
14-Oct-11	17,698	104	17,802	878	775	0	775	9	851	6	6	19,324	110	19,434
17-Oct-11	18,771	413	19,184	1,508	733	3	736	33	860	4	4	20,364	420	20,784
20-Oct-11	20,409	2,096	22,505	3,057	665	16	681	107	1,010	32	32	22,084	2,144	24,228
23-Oct-11	13,824	3,354	17,178	5,938	612	25	637	106	767	41	41	15,203	3,420	18,623
26-Oct-11	9,434	2,418	11,852	3,572	496	57	553	196	470	69	69	10,400	2,544	12,944
29-Oct-11	4,386	2,984	7,370	2,997	358	68	426	233	514	61	61	5,258	3,113	8,371
1-Nov-11	2,957	2,471	5,428	3,282	352	61	413	242	286	85	85	3,595	2,617	6,212
4-Nov-11	1,758	3,542	5,300	3,187	184	48	232	309	211	67	67	2,153	3,657	5,810
7-Nov-11	1,051	5,182	6,233	3,438	165	71	236	309	100	87	87	1,316	5,340	6,656
10-Nov-11	531	3,900	4,431	2,773	61	59	120	300	66	75	75	658	4,034	4,692

Survey Date	Live	Index Section Dead	Index Section Total	Redds	Live	Channel Section Dead	Channel Section Total	Redds	Above McIntyre Live	Above McIntyre Dead	Above McIntyre Total	Section Totals Live	Section Totals Dead	Section Totals Total
19-Sep-12	996	9	1,005		40	2	42		323	4	327	1,359	15	1,374
27-Sep-12	3,919	36	3,955		61	5	66		305	12	317	4,285	53	4,338
3-Oct-12	6,426	18	6,444		589	4	593		310	20	330	7,325	42	7,367
7-Oct-12	33,515	48	33,563		526	3	529		1,441	14	1,455	35,482	65	35,547
11-Oct-12	35,748	52	35,800		742	5	747		1,548	10	1,558	38,038	67	38,105
14-Oct-12	34,529	114	34,643		836	1	837		1,069	21	1,090	36,434	136	36,570
17-Oct-12	44,931	597	45,528		932	9	941		647	32	679	46,510	638	47,148
20-Oct-12	44,849	2,806	47,655		964	22	986		1,162	28	1,190	46,975	2,856	49,831
24-Oct-12	29,878	5,964	35,842		767	67	834		1,320	14	1,334	31,965	6,045	38,010
27-Oct-12	18,298	7,199	25,497		700	92	792		233	1	234	19,231	7,292	26,523
31-Oct-12	10,345	5,673	16,018		622	143	765		468	34	502	11,435	5,850	17,285
6-Nov-12	3,489	9,785	13,274		94	100	194		46	49	95	3,629	9,934	13,563
15-Nov-12	281	8,413	8,694		53	379	432		3	31	34	337	8,823	9,160
19-Sep-13	0	2	2		2	0	2		18	0	18	20	2	22
26-Sep-13	611	13	624		39	1	40		141	1	142	791	15	806
03-Oct-13	6,312	21	6,333		664	2	666		356	0	356	7,332	23	7,355
07-Oct-13	10,189	14	10,203		706	1	707		557	0	557	11,452	15	11,467
11-Oct-13	17,398	51	17,449		730	0	730		779	3	782	18,907	54	18,961
15-Oct-13	21,353	121	21,474		622	1	623		1,238	6	1,244	23,213	128	23,341
18-Oct-13	19,760	552	20,312		514	4	518		1,220	3	1,223	21,494	559	22,053
21-Oct-13	9,110	2,285	11,395		762	26	788		733	11	744	10,605	2,322	12,927
25-Oct-13	6,806	5,717	12,523		433	87	520		563	42	605	7,802	5,846	13,648
29-Oct-13	2,429	1,683	4,112		223	83	306		217	18	235	2,869	1,784	4,653
04-Nov-13	508	1,806	2,326		116	71	187		109	45	154	733	1,922	2,655
03-Oct-14	17,740	12	17,752		522	6	528		223	1	224	18,262	241	18,281
10-Oct-14	37,920	37,470	75,390		721	1	722		666	3	669	38,927	38,137	76,115
16-Oct-14	64,624	516	65,140		948	13	961		567	3	570	66,069	1,096	66,104
19-Oct-14	79,680	2,103	81,783		828	10	838		791	34	825	81,248	2,904	82,655
22-Oct-14	67,073	4,253	71,326		1,968	38	2,006		459	14	473	69,495	4,750	73,346
24-Oct-14	60,914	7,845	68,759		2,940	87	3,027		585	29	614	64,439	8,517	71,815
27-Oct-14	42,905	10,575	53,480		2,280	191	2,471		409	41	450	45,594	11,175	55,992
30-Oct-14	26,020	29,315	55,335		1,570	277	1,847		206	55	261	27,796	29,798	57,237
06-Nov-14	4,069	11,218	15,287		309	661	970		35	17	52	4,413	11,914	16,274

Survey Date	Index Section					Channel Section					Above McIntyre			Section Totals		
	Live	Dead	Total	Redds		Live	Dead	Total	Redds		Live	Dead	Total	Live	Dead	Total
24-Sep-15	194	1	195			3	1	4			27		27	224	2	226
01-Oct-15	856	5	861			2	0	2			82	2	84	940	7	947
05-Oct-15	1,873	8	1,881			58	0	58			54	2	56	1,985	10	1,995
09-Oct-15	3,783	13	3,796			131	0	131			20	0	20	3,934	13	3,947
13-Oct-15	5,648	81	5,729			292	4	296			75	1	76	6,015	86	6,101
16-Oct-15	5,589	145	5,734			549	1	550			86	4	90	6,224	150	6,374
22-Oct-15	3,382	953	4,335			427	14	441			61	4	65	3,870	971	4,841
25-Oct-15	2,016	1,092	3,108			268	19	287			29	8	37	2,313	1,119	3,432
29-Oct-15	910	724	1,634			170	28	198			12	8	20	1,092	760	1,852
05-Nov-15	156	334	490			40	25	65			0	0	0	196	359	555
19-Sep-16	37	3	40			n/c	n/c	n/c			n/c	n/c	n/c			
29-Sep-16	3,147	3	3,150			142	0	142			93	5	98	3,382	8	3,390
07-Oct-16	15,531	12	15,543			848	1	849			226	3	229	16,605	16	16,621
11-Oct-16	23,239	35	23,274			1,159	0	1,159			297	2	299	24,695	37	24,732
14-Oct-16	24,546	120	24,666			1,054	0	1,054			210	1	211	25,810	121	25,931
17-Oct-16	41,560	264	41,824			1,100	1	1,101			348	4	352	43,008	269	43,277
20-Oct-16	26,012	826	26,838			946	6	952			270	7	277	27,228	839	28,067
23-Oct-16	14,176	2,758	16,934			972	49	1,021			159	18	177	15,307	2,825	18,132
27-Oct-16	6,424	4,107	10,531			716	178	894			57	33	90	7,197	4,318	11,515
31-Oct-16	2,324	1,716	4,040			237	206	443			65	34	99	2,626	1,956	4,582
26-Sep-17	563	5	568			15	1	16			12	0	12	590	6	596
02-Oct-17	726	4	730			34	0	34			26	0	26	786	4	790
06-Oct-17	2,062	10	2,072			235	0	235			28	1	29	2,325	11	2,336
11-Oct-17	4,271	16	4,287			462	1	463			45	0	45	4,778	17	4,795
14-Oct-17	3,851	32	3,883			682	0	682			90	0	90	4,623	32	4,655
17-Oct-17	3,599	31	3,630			400	0	400			50	0	50	4,049	31	4,080
20-Oct-17	3,827	119	3,946			668	0	668			70	1	71	4,565	120	4,685
23-Oct-17	3,289	238	3,527			642	8	650			52	5	57	3,983	251	4,234
26-Oct-17	2,357	530	2,887			452	18	470			48	3	51	2,857	551	3,408
31-Oct-17	845	371	1,216			310	21	331			37	3	40	1,192	395	1,587

Survey Date	Index Section				Channel Section				Above McIntyre			Section Totals		
	Live	Dead	Total	Redds	Live	Dead	Total	Redds	Live	Dead	Total	Live	Dead	Total
28-Sep-18	666	4	670		n/c	n/c	n/c		n/c	n/c	n/c	666	4	670
03-Oct-18	2,443	2	2,445		538	0	538		17	1	18	2,998	3	3,001
06-Oct-18	5,485	1	5,486		784	2	786		64	0	64	6,333	3	6,336
11-Oct-18	14,608	20	14,628		955	1	956		101	1	102	15,664	22	15,686
14-Oct-18	14,580	59	14,639		1,074	2	1,076		97	0	97	15,751	61	15,812
17-Oct-18	15,904	171	16,075		907	5	912		99	0	99	16,910	176	17,086
21-Oct-18	15,820	1,141	16,961		691	23	714		50	2	52	16,561	1,166	17,727
23-Oct-18	11,280	1,867	13,147		758	43	801		104	2	106	12,142	1,912	14,054
26-Oct-18	7,104	2,429	9,533		644	70	714		89	6	95	7,837	2,505	10,342
01-Nov-18	1,360	775	2,135		220	85	305		61	15	76	1,641	875	2,516

Table 4. Abundance of Sockeye spawners (2004 - 2018), designated as holding or spawning, in the Index Section of the Okanagan River. Behavioral traits of adults were not recorded in 2007.

Survey Date	Holding	Spawning	Total Live	Dead	Total Live + Dead
15-Sep-04	15		15	0	15
20-Sep-04	267	0	267	0	267
25-Sep-04	1,353	0	1,353	0	1,353
30-Sep-04	5,399	0	5,399	1	5,400
4-Oct-04	12,478	0	12,478	6	12,484
7-Oct-04	18,478	2,508	20,986	63	21,049
10-Oct-04	13,565	6,357	19,922	266	20,188
14-Oct-04	10,273	8,732	19,005	669	19,674
19-Oct-04	4,160	12,806	16,966	3,410	20,376
22-Oct-04	0	14,969	14,969	4,169	19,138
27-Oct-04	0	3,786	3,786	6,245	10,031
3-Nov-04	0	739	739	3,397	4,136
13-Sep-05	43	0	43	0	43
20-Sep-05	212	0	212	0	212
27-Sep-05	788	0	788	0	788
4-Oct-05	4,020	2,479	6,499	0	6,499
10-Oct-05	350	13,765	14,115	13	14,128
13-Oct-05	0	17,370	17,370	189	17,559
16-Oct-05	0	16,050	16,050	496	16,546
19-Oct-05	0	21,787	21,787	1,778	23,565
22-Oct-05	0	7,759	7,759	2,690	10,449
25-Oct-05	0	5,356	5,356	4,150	9,506
28-Oct-05	0	1,758	1,758	7,153	8,911
3-Nov-05	0	319	319	1,699	2,018
22-Sep-06	31	0	31	0	31
27-Sep-06	466	0	466	0	466
3-Oct-06	1,704	0	1,704	2	1,706
6-Oct-06	2,872	513	3,385	31	3,416
10-Oct-06	3,858	1,039	4,897	0	4,897
13-Oct-06	3,160	3,445	6,605	120	6,725
16-Oct-06	2,010	6,970	8,980	398	9,378
19-Oct-06	4,235	4,055	8,290	577	8,867
22-Oct-06	6,829	9,875	16,704	912	17,616
25-Oct-06	1,210	5,705	6,915	1,405	8,320
30-Oct-06	0	2,237	2,237	711	2,948
3-Nov-06	0	1,334	1,334	649	1,983
17-Sep-08	1,599	0	1,599	1	1,600
24-Sep-08	4,423	0	4,423	5	4,428
29-Sep-08	16,980	0	16,980	11	16,991
2-Oct-08	24,818	467	25,285	12	25,297
5-Oct-08	48,454	2,690	51,144	13	51,157
8-Oct-08	36,210	7,286	43,496	139	43,635
11-Oct-08	38,072	14,346	52,418	213	52,631
14-Oct-08	38,230	32,388	70,618	1,004	71,622
17-Oct-08	27,620	18,412	46,032	2,733	48,765
20-Oct-08	10,850	31,870	42,720	4,481	47,201
23-Oct-08	3,923	25,154	29,077	3,766	32,843
28-Oct-08	4,924	13,364	18,288	11,392	29,680
30-Oct-08	922	12,303	13,225	13,782	27,007
5-Nov-08	137	2,284	2,421	12,082	14,503

Survey Date	Holding	Spawning	Total Live	Dead	Total Live + Dead
16-Sep-09	512	0	512	4	516
23-Sep-09	1,121	0	1,121	4	1,125
28-Sep-09	5,856	2	5,755	1	5,859
2-Oct-09	9,250	14	9,264	3	9,267
4-Oct-09	18,933	528	19,461	4	19,465
7-Oct-09	23,795	574	24,369	16	24,385
10-Oct-09	20,910	4,272	25,182	38	25,220
13-Oct-09	19,480	12,481	31,961	246	32,207
16-Oct-09	32,120	7,498	39,618	960	40,578
19-Oct-09	28,470	4,144	32,614	2,582	35,196
22-Oct-09	9,582	13,366	22,948	8,089	31,037
25-Oct-09	940	5,364	6,304	4,318	10,622
29-Oct-09	1,006	921	1,927	4,140	6,067
2-Nov-09	129	198	327	7,160	7,487
9-Nov-09	18	10	28	5,690	5,718
16-Nov-09	2	6	8	10,014	10,022
24-Nov-09	512	0	512	4	516
7-Sep-10	812	12	824	19	843
14-Sep-10	3,080	130	3,210	24	3,234
21-Sep-10	High turbidity in Section – no count				
27-Sep-10	26,050	1,390	27,440	62	27,502
1-Oct-10	53,680	3,700	57,380	52	57,432
4-Oct-10	35,090	4,690	39,780	171	39,951
7-Oct-10	53,790	15,200	68,990	207	69,197
10-Oct-10	53,980	26,450	80,430	1,084	81,514
13-Oct-10	49,330	32,050	81,380	1,344	82,724
16-Oct-10	46,550	40,640	87,190	5,942	93,132
19-Oct-10	26,980	30,790	57,770	8,371	66,141
22-Oct-10	16,243	29,140	45,383	9,435	54,908
25-Oct-10	7,670	24,940	32,610	12,937	45,547
28-Oct-10	4,310	16,500	20,810	13,170	33,980
4-Nov-10	793	2,230	3,023	13,725	16,748

Survey Date	Holding	Spawning	Total Live	Dead	Total Live + Dead
14-Sep-11	12	0	12	0	12
21-Sep-11	27	0	27	2	29
26-Sep-11	312	0	312	1	313
30-Sep-11	1,199	0	1,199	2	1,201
2-Oct-11	3,042	0	3,042	0	3,045
5-Oct-11	5,252	20	5,272	5	5,277
8-Oct-11	4,160	2,690	6,850	15	6,865
11-Oct-11	13,296	574	13,870	55	13,925
14-Oct-11	14,244	3,454	17,698	104	17,802
17-Oct-11	10,070	8,701	18,771	413	19,184
20-Oct-11	4,029	16,380	20,409	2,096	22,505
23-Oct-11	744	13,080	13,824	3,354	17,178
26-Oct-11	1,294	8,140	9,434	2,418	11,852
29-Oct-11	1,463	2,923	4,386	2,984	7,370
1-Nov-11	795	2,162	2,957	2,471	5,428
4-Nov-11	348	1,410	1,758	3,542	5,300
7-Nov-11	361	690	1,051	5,182	6,233
10-Nov-11	192	339	531	3,900	4,431
19-Sep-12	996	0	996	9	1,005
27-Sep-12	3,769	150	3,919	36	3,955
03-Oct-12	6,426	0	6,426	18	6,444
07-Oct-12	31,284	2,231	33,515	48	33,563
11-Oct-12	29,746	6,002	35,748	52	35,800
14-Oct-12	25,232	9,297	34,529	114	34,643
17-Oct-12	22,593	22,338	44,931	597	45,528
20-Oct-12	12,807	32,042	44,849	2,806	47,655
24-Oct-12	9,343	20,535	29,878	5,964	35,842
27-Oct-12	9,060	9,238	18,298	7,199	25,497
31-Oct-12	2,527	7,818	10,345	5,673	16,018
06-Nov-12	1,345	2,144	3,489	9,785	13,274
15-Nov-12	127	154	281	8,413	8,694
19-Sep-13	0	0	0	2	2
26-Sep-13	611	0	611	13	624
03-Oct-13	6,312	0	6,312	21	6,333
07-Oct-13	8,978	1,211	10,189	14	10,203
11-Oct-13	8,320	8,478	16,798	51	16,849
15-Oct-13	7,133	14,220	21,353	121	21,474
18-Oct-13	2,800	16,960	19,760	552	20,312
21-Oct-13	790	8,320	9,110	2,285	11,395
25-Oct-13	840	5,966	6,806	5,717	12,523
29-Oct-13	320	2,109	2,429	1,683	4,112
04-Nov-13	5	503	508	1,818	2,326
03-Oct-14	16,853	887	17,740	12	17,752
10-Oct-14	17,294	20,626	37,920	53	37,973
16-Oct-14	19,543	45,081	64,624	516	65,140
19-Oct-14	11,190	68,490	79,680	2,103	81,783
22-Oct-14	5,334	61,739	67,073	4,253	71,326
24-Oct-14	2,644	58,270	60,914	7,845	68,759
27-Oct-14	1,615	41,290	42,905	10,575	53,480
30-Oct-14	90	25,930	26,020	29,315	55,335
06-Nov-14	0	4,069	4,069	11,218	15,287

Survey Date	Holding	Spawning	Total Live	Dead	Total Live + Dead
24-Sep-15	194	0	194	1	195
1-Oct-15	852	4	856	5	861
5-Oct-15	1,173	700	1,873	8	1,881
9-Oct-15	1,521	2,262	3,783	13	3,796
13-Oct-15	1,074	4,574	5,648	81	5,729
16-Oct-15	573	5,016	5,589	145	5,734
19-Oct-15	453	4,576	5,029	468	5,497
22-Oct-15	580	2,802	3,382	953	4,335
25-Oct-15	317	1,699	2,016	1,092	3,108
29-Oct-15	142	768	910	724	1,634
5-Nov-15	41	115	156	334	490
19-Sep-16	37	0	37	3	40
29-Sep-16	3,060	87	3,147	3	3,150
7-Oct-16	9,436	6,095	15,531	12	15,543
11-Oct-16	3,352	19,887	23,239	35	23,274
14-Oct-16	4,380	20,166	24,546	120	24,666
17-Oct-16	2,469	39,091	41,560	264	41,824
20-Oct-16	1,387	24,625	26,012	826	26,838
23-Oct-16	1,043	13,133	14,176	2,758	16,934
27-Oct-16	1,290	5,134	6,424	4,107	10,531
31-Oct-16	0	2,324	2,324	1,716	4,040
26-Sep-17	563	0	563	5	568
2-Oct-17	726	0	726	4	730
6-Oct-17	1,739	323	2,062	10	2,072
11-Oct-17	1,846	2,425	4,271	16	4,287
14-Oct-17	799	3,052	3,851	32	3,883
17-Oct-17	705	2,894	3,599	31	3,630
20-Oct-17	554	3,273	3,827	119	3,946
23-Oct-17	574	2,715	3,289	238	3,527
26-Oct-17	601	1,756	2,357	530	2,887
31-Oct-17	151	694	845	371	1,216
4-Nov-17	101	221	322	227	549
28-Sep-18	666	0	666	4	670
3-Oct-18	2,441	2	2,443	2	2,445
6-Oct-18	3,295	2,190	5,485	1	5,486
11-Oct-18	4,098	10,510	14,608	20	14,628
14-Oct-18	2,020	12,560	14,580	59	14,639
17-Oct-18	1,510	14,394	15,904	171	16,075
21-Oct-18	940	14,880	15,820	1,141	16,961
23-Oct-18	580	10,700	11,280	1,867	13,147
26-Oct-18	1,271	5,833	7,104	2,429	9,533
1-Nov-18	1,114	246	1,360	775	2,135

Table 5. Annual abundances of Sockeye Salmon removed from the Okanagan River terminal spawning grounds for the Okanagan Nation Alliance's Skaha Lake reintroduction program. (Data Source: Ryan Benson, ONA Fisheries, Westbank, B.C.).

Return Year	Females	Males	Total Sockeye
2003	218	240	458
2004	650	750	1,400
2005	684	780	1,464
2006	661	760	1,421
2007	405	550	955
2008	685	900	1,585
2009	488	550	1,038
2010	450	490	940
2011	434	530	964
2012	444	570	1,014
2013	No Broodstock collected		
2014	1,157	1,239	2,396
2015	217	303	520
2016	2,531	5,502	8,033
2017	569	708	1,277
2018	2,278	444	2,722

Table 6. Fry emergence sampling results from fyke-net sampling conducted each spring (2002-2019) at Vertical Drop Structure 13 on the Okanagan River. Mean nightly discharge is taken from WSC gauge near Oliver (Station 08NM085).

Brood Year	Sampling Date	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Mean Fry per Hour (Volume Calibrated)	Daily Mean Discharge (m3/sec)
2001	15-Mar-02	2	395	44	7		15.8
	20-Mar-02	3	417	396	62		15.9
	25-Mar-02	3	360	357	69		16.0
	29-Mar-02	3	30	58	66		16.0
	4-Apr-02	4	55	386	406		16.0
	7-Apr-02	4	60	663	663		16.6
	10-Apr-02	4	60	1,694	1,694		16.1
	13-Apr-02	4	40	2,126	2,126		17.7
	16-Apr-02	4	30	1,575	4,725		19.2
	19-Apr-02	4	25	931	2,793		19.5
	24-Apr-02	2	30	459	918		34.6
	30-Apr-02	3	32	26	35		36.0
2002	2-Apr-03	4	60	357	308		7.2
	5-Apr-03	4	40	237	356		6.8
	8-Apr-03	4	40	720	1,080		6.6
	11-Apr-03	4	20	597	1,791		7.1
	14-Apr-03	4	20	220	660		9.3
	17-Apr-03	4	40	366	549		10.4
	23-Apr-03	4	40	116	174		13.5
	2-May-03	2	20	4	12		10.7
	12-May-03	3	70	3	2		12.8
	20-May-03	3	90	1	0		10.2
2003	14-Apr-04	5	50	48	58		9.9
	19-Apr-04	5	50	192	230		7.1
	21-Apr-04	5	50	1,514	1,817		9.2
	26-Apr-04	5	50	1,316	1,579		9.4
	29-Apr-04	5	50	289	347		7.7
	3-May-04	5	50	184	221		11.0
	6-May-04	5	50	64	77		12.2
	10-May-04	5	50	32	38		10.2
	13-May-04	5	50	6	7		12.7
	19-May-04	5	50	2	2		7.4
	25-May-04	5	50	0	0		8.0
2004	08-Apr-05	4	40	51	77		27.0
	13-Apr-05	6	60	84	84		26.8
	20-Apr-05	5	50	63	76		27.2
	27-Apr-05	5	50	63	76		29.4
	03-May-05	4	40	64	96		25.9
	06-May-05	5	50	19	23		27.9
	10-May-05	1	10	0	0		28.9
	13-May-05	6	60	0	0		26.7

Brood Year	Sampling Date	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Mean Fry per Hour (Volume Calibrated)	Daily Mean Discharge (m ³ /sec)
2005	6-Apr-06	4	40	215	323		20.6
	12-Apr-06	3	30	750	1,500		20.3
	18-Apr-06	4	40	2,080	3,120		19.7
	22-Apr-06	4	35	976	1,941		21.1
	26-Apr-06	4	22	659	1,530		23.5
	1-May-06	4	25	67	131		22.6
	7-May-06	4	30	7	20		34.3
	19-May-06	4	40	0	0		56.7
2006	11-Apr-07	6	60	286	286		22.5
	17-Apr-07	6	60	157	157		21.6
	20-Apr-07	6	60	387	387		19.8
	24-Apr-07	6	60	443	443		19.9
	28-Apr-07	6	60	211	211		20.9
	02-May-07	6	60	118	118		21.9
	07-May-07	6	60	108	108		22.9
	10-May-07	6	60	35	35		23.8
	23-May-07	6	60	1	1		14.5
2007	19-Mar-08	5	75	4	3	1	6.9
	26-Mar-08	4	60	26	6	9	7.1
	2-Apr-08	4	60	2	2	3	8.9
	9-Apr-08	5	75	5	4	5	15.1
	15-Apr-08	4	60	38	38	50	13.2
	21-Apr-08	4	60	264	264	319	10.8
	25-Apr-08	6	60	446	547	1,152	10.6
	28-Apr-08	6	60	424	497	976	10.7
	02-May-08	6	60	359	437	865	12.2
	05-May-08	6	60	304	327	580	14.2
	09-May-08	6	60	48	57	103	15.2
	12-May-08	6	60	45	51	84	14.6
	16-May-08	6	60	1	1	1	22.2
2008	19-Mar-09	5	75	23	22	32	5.9
	26-Mar-09	5	75	39	38	61	5.8
	1-Apr-09	5	75	25	24	80	5.8
	7-Apr-09	5	75	143	141	300	6.9
	10-Apr-09	5	75	489	489	1,331	6.1
	14-Apr-09	5	75	244	243	926	6.2
	17-Apr-09	5	75	625	624	1,708	6.0
	22-Apr-09	5	75	2,326	2,326	4,387	7.7
	26-Apr-09	5	75	872	872	1,784	8.0
	30-Apr-09	5	75	946	946	1,192	7.6
	4-May-09	5	75	815	815	1,211	9.1
	8-May-09	5	75	634	634	839	8.7
	13-May-09	5	75	128	128	191	8.7

Brood Year	Sampling Date	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Mean Fry per Hour (Volume Calibrated)	Daily Mean Discharge (m ³ /sec)
2009	17-May-09	5	75	172	172	266	9.6
	21-May-09	5	75	18	18	22	10.2
	29-May-09	5	75	1	0	0	9.6
	11-Mar-10	4	60	19	19	39	5.5
	18-Mar-10	4	60	140	140	n/a	6.5
	24-Mar-10	5	75	70	56	112	6.2
	01-Apr-10	4	60	349	348	502	6.5
	06-Apr-10	4	60	491	583	1,249	6.0
	09-Apr-10	4	60	849	849	2,118	6.4
	13-Apr-10	5	60	2,289	2,479	7,014	5.8
	16-Apr-10	7	60	4,513	4,606	17,000	6.1
	20-Apr-10	4	60	1,403	1,403	2,134	7.6
	25-Apr-10	5	60	32	26	66	9.6
	29-Apr-10	4	60	158	158	160	11.1
2010	16-Mar-11	4	60	12	12	40	7.2
	24-Mar-11	4	60	43	43	77	7.1
	31-Mar-11	4	60	174	174	226	7.5
	07-Apr-11	4	60	339	339	581	7.9
	11-Apr-11	4	60	226	226	423	11.4
	14-Apr-11	4	60	350	350	785	19.7
	20-Apr-11	4	60	448	448	995	20.5
	23-Apr-11	3	57	1,263	1,087	1,207	20.4
	26-Apr-11	8	60	1,216	1,216	5,574	21.1
	29-Apr-11	8	60	629	629	3,434	21.8
	02-May-11	8	60	596	596	2,024	21.3
	05-May-11	4	60	1,018	1,018	2,905	24.3
	09-May-11	4	60	296	296	631	35.2
2011	21-Mar-12	4	61	16	16	31	5.80
	27-Mar-12	4	60	25	25	50	5.61
	3-Apr-12	4	62	45	45	71	7.07
	10-Apr-12	4	60	287	287	437	7.76
	19-Apr-12	4	60	450	450	692	11.63
	21-Apr-12	4	60	1,203	1,203	1,892	11.80
	23-Apr-12	4	37.5	2,377	3,960	9,010	12.82
	1-May-12	6	46.5	146	186	242	43.40
	3-May-12	8	56	41	50	74	52.76
2012	19-Mar-13	4	60	26	26	29	26.6
	4-Apr-13	4	60	546	546	585	27.8
	11-Apr-13	4	60	506	506	516	27.9
	17-Apr-13	4	60	764	764	835	25.6
	23-Apr-13	7	60	637	980	1,753	27.5
	29-Apr-13	8	56	681	730	1,430	30.1
	3-May-13	8	56	264	283	425	44.61

Brood Year	Sampling Date	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Mean Fry per Hour (Volume Calibrated)	Daily Mean Discharge (m ³ /sec)
2013	18-Mar-14	4	60	3	3	4	24.2
	31-Mar-14	4	60	5	5	6	22.9
	09-Apr-14	4	60	23	23	27	22.7
	16-Apr-14	4	60	21	21	25	20.3
	19-Apr-14	8	64	745	722	1,411	21.4
	22-Apr-14	7	56	1,004	1,076	2,284	22.4
	25-Apr-14	8	56	994	1,065	2,202	25.8
	28-Apr-14	8	56	1,057	1,133	2,311	27.0
	01-May-14	8	56	1,369	1,467	2,878	29.1
	04-May-14	4	28	91	195	327	38.3
2014	11-Mar-15	4	60	43	43	50	20.07
	18-Mar-15	4	60	88	88	117	18.79
	25-Mar-15	3	45	66	88	106	21.12
	01-Apr-15	4	60	262	262	301	24.67
	06-Apr-15	4	65	1,064	966	1,214	22.80
	09-Apr-15	7	52.5	652	745	1,926	22.23
	12-Apr-15	8	60	1,584	1,584	3,689	21.85
	15-Apr-15	8	60	2,736	2,736	6,565	21.29
	19-Apr-15	8	60	3,979	3,979	9,214	22.17
	22-Apr-15	8	60	3,360	3,360	7,693	23.80
	28-Apr-15	7	52.5	1,415	1,127	2,639	22.87
	04-May-15	3	45	255	340	346	24.07
2015	23-Mar-16	4	60	5	5	6	25.51
	30-Mar-16	4	60	21	21	29	26.04
	03-Apr-16	7	60	386	305	422	26.87
	06-Apr-16	8	60	419	419	810	26.13
	09-Apr-16	8	60	346	346	655	27.55
	11-Apr-16	8	60	324	324	607	26.92
	13-Apr-16	7	60	132	140	266	27.81
	Sampling terminated for season – net broken						
2016	03-Apr-17	4	60	55	55	59	22.25
	09-Apr-17	4	60	47	47	49	25.25
	13-Apr-17	4	60	338	338	346	26.04
	17-Apr-17	7	60	655	574	1,120	25.65
	20-Apr-17	8	60	1,599	1,599	2,990	27.81
	23-Apr-17	8	60	1,763	1,763	3,673	28.96
	27-Apr-17	8	60	2,259	2,259	3,105	49.88
	03-May-17	2*	15	126	504	668	72.00
*Sampling terminated at 3 rd set – ropes broken							

Brood Year	Sampling Date	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Mean Fry per Hour (Volume Calibrated)	Daily Mean Discharge (m ³ /sec)
2017	See Table 7						
2018	14-Apr-19	4	60	122	122	na	17.28
	17-Apr-19	4	60	237	237	260	17.19
	20-Apr-19	7	60	2,054	2,038	3,849	20.16
	23-Apr-19	8	60	3,449	3,449	6,556	19.62
	25-Apr-19	8	60	2,764	2,764	5,311	19.94
	27-Apr-19	8	60	1,593	1,593	3,176	19.44
	29-Apr-19	8	60	2,011	2,011	4,403	18.42
	3-May-19	4	60	1,773	1,773	2,144	17.76
	7-May-19	4	60	591	591	651	19.17

Table 7. Fry emergence sampling results from modified fyke-net sampling conducted during exceptionally high flows in 2018. Mean discharge is taken from WSC gauge near Oliver (Station 08NM085).

Brood Year	Sampling Date	Time of Day	Number of Sets	Total Soak Time (Minutes)	Total Fry Caught	Mean Fry per Hour	Daily Mean Discharge (m ³ /sec)
2017	16-Mar-18	Day	3	22.5	0	0	31.0
	21-Mar-18	Day	4	105.0	0	0	31.6
	27-Mar-18	Day	3	45.0	0	0	52.6
	30-Mar-18	Day	4	97.5	1	2	54.2
	4-Apr-18	Day	4	52.5	2	2	63.2
	4-Apr-18	Night	3	45.0	18	24	63.2
	9-Apr-18	Day	4	52.5	2	2	67.8
	9-Apr-18	Night	3	45.0	36	48	67.8
	12-Apr-18	Day	4	52.0	1	2	71.7
	12-Apr-18	Night	3	45.0	28	37	71.7
	18-Apr-18	Day	4	52.0	2	2	72.7
	18-Apr-18	Night	3	45.0	33	44	72.7
	24-Apr-18	Day	4	52.0	2	2	72.1
	24-Apr-18	Night	3	45.0	112	149	72.1
	3-May-18	Day	4	52.0	4	6	84.8
	3-May-18	Night	3	45.0	49	65	84.8

Table 8. Abundance of Sockeye Salmon fry by developmental stage (Figure 4) as determined from fish captured in fyke nets at Vertical Drop Structure 13.

Brood Year	Date	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
2007	19-Mar-08	0	0	0	0	4	4
	26-Mar-08	0	1	1	1	3	6
	2-Apr-08	0	1	0	1	0	2
	9-Apr-08	0	1	1	0	3	5
	15-Apr-08	0	0	3	12	23	38
	21-Apr-08	3	9	13	28	202	255
	25-Apr-08	0	0	6	16	416	438
	28-Apr-08	0	0	8	5	404	417
	02-May-08	0	0	3	81	275	359
	05-May-08	0	0	21	61	222	304
	09-May-08	0	0	1	15	27	43
	12-May-08	0	0	0	21	14	35
2008	19-Mar-09	5	1	1	3	12	22
	26-Mar-09	20	4	7	0	8	39
	1-Apr-09	6	3	10	2	4	25
	7-Apr-09	6	21	70	20	26	143
	10-Apr-09	19	40	219	33	178	489
	14-Apr-09	10	13	70	41	110	244
	17-Apr-09	14	29	211	34	337	625
	22-Apr-09	25	58	555	638	1,050	2,326
	26-Apr-09	0	3	61	147	661	872
	30-Apr-09	0	3	85	176	682	946
	4-May-09	0	0	72	175	569	816
	8-May-09	0	1	49	119	465	634
	13-May-09	0	0	10	24	94	128
	17-May-09	0	0	10	18	144	172
	21-May-09	0	0	0	2	16	18
2009	11-Mar-10	2	4	1	2	10	19
	18-Mar-10	11	50	40	16	23	140
	24-Mar-10	2	15	33	10	11	71
	31-Mar-10	from two sets / fry not staged					247
	01-Apr-10	3	17	55	105	169	349
	06-Apr-10	0	4	47	145	295	491
	09-Apr-10	1	3	19	30	796	849
	13-Apr-10	0	3	33	275	1,978	2,289
	16-Apr-10	2	25	67	94	4,325	4,513
	20-Apr-10	1	5	120	457	820	1,403
	25-Apr-10	0	0	0	8	24	32
	29-Apr-10	0	0	3	15	140	158
2010	16-Mar-11	3	3	0	0	3	9
	24-Mar-11	4	1	18	10	6	39
	31-Mar-11	3	50	73	35	10	171
	07-Apr-11	4	35	136	135	25	335
	11-Apr-11	0	15	73	71	62	221
	14-Apr-11	0	16	107	113	114	350
	20-Apr-11	0	1	51	57	339	448

Brood Year	Date	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
2010	23-Apr-11	0	4	22	76	1,161	1,263
	26-Apr-11	0	3	67	123	1,023	1,216
	29-Apr-11	0	0	26	57	546	629
	02-May-11	0	0	12	42	542	596
	05-May-11	0	1	44	19	954	1,018
	09-May-11	0	1	10	82	203	296
2011	21-Mar-12	1	6	2	2	5	16
	27-Mar-12	0	1	6	4	14	25
	3-Apr-12	4	7	19	7	8	45
	10-Apr-12	29	38	68	77	69	281
	19-Apr-12	1	2	13	61	151	228
	21-Apr-12	2	14	86	295	806	1,203
	23-Apr-12	0	3	71	944	1,359	2,377
	1-May-12	0	1	35	64	46	146
	3-May-12	0	1	15	8	17	41
2012	19-Mar-13	7	10	1	4	4	26
	4-Apr-13	0	35	221	286	24	566
	11-Apr-13	1	14	189	228	74	506
	17-Apr-13	0	4	153	168	439	764
	23-Apr-13	0	2	36	119	480	637
	29-Apr-13	0	1	31	140	509	681
	3-May-13	0	0	1	102	161	264
2013	31-Mar-14	0	0	0	0	0	0
	09-Apr-14	0	3	0	0	6	0
	16-Apr-14	1	1	17	2	2	1
	19-Apr-14	0	4	3	7	7	0
	22-Apr-14	0	0	5	129	611	0
	25-Apr-14	0	0	7	79	918	0
	28-Apr-14	0	0	0	102	892	0
	01-May-14	0	0	0	98	959	0
	04-May-14	0	0	0	419	950	0
2014	11-Mar-15	8	10	6	17	2	8
	18-Mar-15	23	23	19	20	0	23
	25-Mar-15	16	10	10	25	5	16
	01-Apr-15	2	19	60	171	6	2
	06-Apr-15	2	76	193	218	431	2
	09-Apr-15	0	22	92	386	162	0
	12-Apr-15	0	33	152	611	788	0
	15-Apr-15	0	29	150	889	1,668	0
	19-Apr-15	0	22	128	1,034	2,530	0
	22-Apr-15	0	0	35	1,080	1,426	0

Brood Year	Date	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Total
2015	23-Mar-16	0	0	3	2	0	5
	30-Mar-16	0	0	0	17	4	21
	03-Apr-16	0	0	16	163	207	386
	06-Apr-16	0	3	9	147	260	419
	09-Apr-16	0	1	21	181	143	346
	11-Apr-16	1	0	13	201	109	324
	13-Apr-16	0	0	0	12	7	19
2016	03-Apr-17	3	12	14	21	5	55
	09-Apr-17	1	4	18	20	4	47
	13-Apr-17	1	13	107	163	54	338
	17-Apr-17	0	1	107	268	279	655
	20-Apr-17	0	3	136	510	950	1,599
	23-Apr-17	0	2	37	300	1,424	1,763
	27-Apr-17	0	1	20	374	1,864	2,259
	03-May-17	0	0	9	40	77	126
2017	See Table 9						
2018	14-Apr-19	1	18	31	52	16	118
	17-Apr-19	1	11	45	142	37	236
	20-Apr-19	0	19	263	1,386	384	2,052
	23-Apr-19	1	16	165	2,018	1,193	3,393
	25-Apr-19	0	2	1	30	60	93
	27-Apr-19	0	3	33	523	1,033	1,592
	29-Apr-19	0	4	26	684	1,287	2,001
	3-May-19	0	0	12	553	1,201	1,766
	7-May-19	0	0	14	207	368	589

Table 9. Abundance of Sockeye Salmon fry by developmental stage (Figure 4) as determined by modified fyke net sampling at Vertical Drop Structure 13 in 2018, an extremely high flow year (Table 6).

Brood Year	Date	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Dead
2017	16-Mar-18 (day)	0	0	0	0	0	0
	21-Mar-18 (day)	0	0	0	0	0	0
	27-Mar-18 (day)	0	0	0	0	0	2
	30-Mar-18 (day)	0	1	0	0	0	0
	04-Apr-18 (day)	0	1	0	0	0	0
	04-Apr-18 (night)	0	8	8	2	0	5
	09-Apr-18 (day)	0	2	0	0	0	0
	09-Apr-18 (night)	1	7	22	5	1	0
	12-Apr-18 (day)	1	0	0	0	0	0
	12-Apr-18 (night)	1	3	9	19	1	0
	18-Apr-18 (day)	0	1	1	0	0	0
	18-Apr-18 (night)	1	3	9	19	1	1
	24-Apr-18 (day)	0	0	0	2	0	0
	24-Apr-18 (night)	0	0	16	76	20	5
	3-May-18 (day)	0	0	0	0	0	4
	3-May-18 (night)	0	0	0	35	14	0

Table 10. Summary of counts by developmental stage and size (as mean length in cm) from lab analysis of sub-sets of Sockeye Salmon fry captured in fyke nets (Table 7).

Brood Year	Sampling Date	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
		Count	Length	Count	Length	Count	Length	Count	Length	Count	Length
2007	21-Apr-08	0		1	2.5	3	2.67	43	2.83	62	2.88
	25-Apr-08	0		0		3	2.60	2	2.55	97	2.73
	28-Apr-08	0		0		1	2.80	28	2.89	68	2.94
	2-May-08	0		0		2	2.70	21	2.69	78	2.71
	5-May-08	0		0		7	2.56	20	2.65	73	2.69
	9-May-08	0		0		1	2.70	28	2.89	15	2.82
	12-May-08	0		0		1	2.90	24	2.83	14	2.87
2008	19-Mar-09	5	2.24	1	2.40	1	2.70	3	2.73	12	2.67
	26-Mar-09	20	2.40	4	2.60	7	2.69	0		8	3.20
	1-Apr-09	6	2.40	3	2.50	10	2.66	2	2.80	4	2.88
	7-Apr-09	3	2.47	17	2.61	53	2.75	14	2.91	13	2.94
	10-Apr-09	2	2.47	14	2.64	51	2.73	14	2.80	23	2.91
	14-Apr-09	0		7	2.56	34	2.67	27	2.81	28	2.89
	17-Apr-09	0		5	2.56	30	2.75	28	2.85	39	2.89
	22-Apr-09	1	2.50	4	2.53	9	2.71	32	2.82	54	2.89
	26-Apr-09	0		1	2.50	6	2.62	20	2.79	75	2.87
	30-Apr-09	0		1	2.50	11	2.73	16	2.84	73	2.91
	4-May-09	0		0		10	2.83	30	2.85	61	2.90
	8-May-09	0		0		11	2.75	29	2.83	66	2.89
2009	11-Mar-10	2	2.45	4	2.60	1	2.80	1	2.90	10	2.86
	18-Mar-10	8	2.54	43	2.59	32	2.77	12	2.79	20	2.81
	24-Mar-10	2	2.50	15	2.57	33	2.71	10	2.82	11	2.90
	31-Mar-10	0		2	2.70	3	2.47	34	2.72	8	2.80
	1-Apr-10	0		2	2.45	16	2.54	35	2.55	47	2.59
	6-Apr-10	0		1	2.40	8	2.69	22	2.80	70	2.93
	9-Apr-10	0		0		6	2.60	15	2.75	91	2.95
	13-Apr-10	0		1	2.70	8	2.63	12	2.78	80	2.85
	16-Apr-10	0		1	2.60	2	2.65	10	2.80	92	2.88
	20-Apr-10	1	2.30	0		18	2.64	38	2.69	42	2.78
	25-Apr-10	0		0		1	2.60	8	2.69	24	2.78
	29-Apr-10	0		0		2	2.70	7	2.73	81	2.74
2010	16-Mar-11	3	2.10	3	2.53	0		0		3	2.80
	24-Mar-11	4	2.38	1	2.50	18	2.61	10	2.80	6	2.82
	31-Mar-11	2	2.15	31	2.52	43	2.65	18	2.76	6	2.90
	7-Apr-11	4	2.40	29	2.48	29	2.63	26	2.78	4	2.93
	11-Apr-11	1	2.40	14	2.47	43	2.54	23	2.75	15	2.85
	14-Apr-11	1	2.10	19	2.28	35	2.42	33	2.50	13	2.54
	17-Apr-11	0		1	2.20	36	2.38	35	2.47	23	2.51
	20-Apr-11	0		1	2.30	22	2.37	14	2.48	63	2.53
	23-Apr-11	1	2.50	2	2.65	6	2.72	19	2.82	73	2.89
	26-Apr-11	0		3	2.30	11	2.35	24	2.47	63	2.51
	29-Apr-11	0		0		3	2.40	22	2.45	73	2.51
	2-May-11	0		0		1	2.50	6	2.47	43	2.52

Brood Year	Sampling Date	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
		Count	Length	Count	Length	Count	Length	Count	Length	Count	Length
2011	21-Mar-12	1	2.10	6	2.52	2	2.60	2	3.00	5	2.82
	27-Mar-12	0		1	2.80	6	2.72	4	2.90	14	2.90
	3-Apr-12	4	2.55	7	2.67	19	2.72	7	2.81	8	2.85
	10-Apr-12	6	2.43	17	2.62	17	2.72	27	2.77	34	2.89
	19-Apr-12	1	2.40	2	2.45	13	2.62	45	2.73	103	2.85
	21-Apr-12	0		1	2.70	13	2.78	30	2.87	56	2.93
	23-Apr-12	0		0		4	2.80	29	2.85	69	2.87
	30-Apr-12	0		0		11	2.72	36	2.76	7	2.80
	3-May-12	0		1	2.50	15	2.62	8	2.69	17	2.69
2012	19-Mar-13	7	2.44	11	2.65	1	2.70	4	2.78	4	2.88
	4-Apr-13	0		7	2.56	45	2.71	51	2.85	3	2.90
	11-Apr-13	1	2.10	9	2.59	48	2.70	27	2.84	21	2.90
	17-Apr-13	0		0		28	2.71	25	2.85	48	2.91
	23-Apr-13	0		1	2.50	13	2.78	29	2.84	53	2.88
	29-Apr-13	0		0		8	2.75	33	2.78	52	2.82
	3-May-13	0		0		0		48	2.72	52	2.78
2013	31-Mar-14	0		3	2.43	0		0		0	
	9-Apr-14	1	2.00	1	2.30	17	2.42	2	2.40	2	2.65
	16-Apr-14	0		4	2.30	3	2.47	7	2.41	2	2.45
	19-Apr-14	0		0		0		28	2.74	7	2.53
	22-Apr-14	0		0		2	2.45	11	2.76	78	2.83
	25-Apr-14	0		0		0		26	2.79	84	2.84
	28-Apr-14	0		0		0		35	2.76	61	2.83
	1-May-14	0		0		0		46	2.79	78	2.84
	4-May-14	0		0		1	2.4	57	2.78	56	2.83
2014	11-Mar-15	8	2.26	10	2.51	5	2.64	12	2.85	0	
	18-Mar-15	20	2.29	26	2.42	23	2.56	13	2.70	3	2.80
	25-Mar-15	16	2.34	11	2.51	10	2.59	25	2.77	5	2.88
	1-Apr-15	2	2.25	8	2.50	27	2.64	61	2.76	1	2.90
	6-Apr-15	2	2.40	4	2.58	14	2.61	37	2.71	38	2.81
	9-Apr-15	0		13	2.50	19	2.72	60	2.78	10	2.91
	12-Apr-15	0		4	2.45	8	2.66	56	2.81	42	2.80
	15-Apr-15	0		3	2.47	10	2.62	50	2.77	38	2.87
	19-Apr-15	0		0		3	2.67	49	2.75	30	2.84
	22-Apr-15	0		0		3	2.60	59	2.74	38	2.83
2015	23-Mar-16	0		3	2.70	0		1	2.90	0	
	30-Mar-16	0		0		0		20	2.80	1	2.90
	03-Apr-16	0		0		9	2.63	141	2.75	53	2.80
	06-Apr-16	0		2	2.40	8	2.43	18	2.57	137	2.70
	09-Apr-16	0		1	2.50	12	2.53	99	2.72	58	2.75
	11-Apr-16	1	2.00	0		12	2.51	121	2.67	46	2.77
	13-Apr-16	0		0		7	2.56	96	2.73	39	2.76
2016	3-Apr-17	3	2.37	14	2.61	14	2.70	21	2.81	3	2.93
	9-Apr-17	1	2.70	3	2.67	20	2.78	19	2.92	2	3.00
	13-Apr-17	0		6	2.67	54	2.78	29	2.95	8	2.95
	17-Apr-17	0		0		36	2.79	51	2.92	19	2.97
	20-Apr-17	0		0		9	2.68	65	2.84	59	2.89
	23-Apr-17	0		0		4	2.75	33	2.88	68	2.88
	27-Apr-17	0		0		1	2.70	28	2.86	71	2.89
	3-May-17	0		0		6	2.77	19	2.81	10	2.86

Brood Year	Sampling Date	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
		Count	Length	Count	Length	Count	Length	Count	Length	Count	Length
2017	30-Mar-18	0		1	2.60	0		0		0	
	4-Apr-18	0		11	2.57	7	2.70	2	2.70	0	
	8-Apr-18	0		0		1	2.70	0		0	
	9-Apr-18	1	2.30	7	2.64	21	2.74	5	2.92	1	3.10
	12-Apr-18	2	2.30	5	2.56	11	2.66	5	2.74	6	2.95
	18-Apr-18	1	2.20	4	2.60	11	2.75	19	2.83	0	
	24-Apr-18	0		0		15	2.70	76	2.83	19	2.91
2018	14-Apr-19	1	2.4	14	2.61	26	2.74	37	2.82	11	2.90
	17-Apr-19	0		8	2.56	22	2.74	51	2.85	8	2.96
	20-Apr-19	0		3	2.57	11	2.69	74	2.87	15	2.89
	23-Apr-19	0		5	2.58	13	2.72	56	2.86	28	2.92
	25-Apr-19	0		2	2.60	11	2.66	61	2.84	48	2.90
	27-Apr-19	0		2	2.30	7	2.76	73	2.86	47	2.93
	29-Apr-19	0		1	2.60	4	2.65	59	2.84	40	2.92
	3-May-19	0		0		2	2.60	45	2.83	50	2.86
	7-May-19	0		0		9	2.73	41	2.83	24	2.86

Table 11. Daily mean water temperatures during Okanagan Sockeye spawning and incubation September 2002 to May 2011 from Water Survey of Canada gauge Okanagan River at Okanagan Falls (Station 08NM002; Figure 1).

Sample Date	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011
15-Sep		18.16	17.87	18.50	18.93	18.88	17.89	19.67	17.50
16-Sep		17.89	17.63	18.20	18.59	18.70	18.04	19.14	18.00
17-Sep		17.69	17.28	18.17	18.43	18.34	18.13	19.48	18.00
18-Sep	19.40	16.56	16.93	18.13	18.01	17.97	18.12	19.21	17.60
19-Sep	18.89	16.00	16.69	17.92	17.99	17.77	18.24	18.64	17.40
20-Sep	18.12	16.87	16.37	17.80	17.60	17.56	18.23	18.21	17.20
21-Sep	17.71	16.85	16.44	17.55	17.14	17.32	17.96	18.10	16.80
22-Sep	17.71	17.03	16.32	17.01	16.94	17.05	17.44	18.15	16.70
23-Sep	17.96	17.08	16.19	16.58	17.01	16.56	16.95	18.07	16.50
24-Sep	17.90	16.86	16.16	16.26	17.22	16.45	16.59	18.47	15.90
25-Sep	17.70	16.94	16.24	16.45	17.29	16.30	16.38	18.46	15.10
26-Sep	17.22	17.13	16.52	16.30	17.19	16.31	16.22	18.50	14.90
27-Sep	17.02	17.16	16.66	16.00	17.45	16.08	16.09	17.76	15.80
28-Sep	16.92	17.13	16.80	15.75	17.66	15.80	15.89	17.48	15.70
29-Sep	16.58	17.13	16.71	15.94	17.82	15.28	16.05	16.97	15.90
30-Sep	16.06	17.29	16.27	15.74	17.47	12.44	16.19	16.54	16.10
1-Oct	15.92	17.20	16.02	15.40	16.95	13.51	16.46	16.19	16.30
2-Oct	15.79	17.09	15.93	14.92	16.50	13.67	16.48	15.85	16.60
3-Oct	15.74	16.99	16.02	14.68	16.03	13.55	16.15	15.18	16.40
4-Oct	15.62	16.88	15.95	14.68	15.59	13.36	15.79	14.90	16.30
5-Oct	15.56	16.77	15.54	14.41	15.82	13.28	15.29	14.72	16.00
6-Oct	15.62	16.71	15.42	14.26	16.07	13.15	14.99	14.65	15.80
7-Oct	15.60	16.47	15.16	14.11	15.40	12.22	13.31	14.50	15.80
8-Oct	15.61	15.47	14.87	13.85	15.19	11.84	13.82	14.04	15.60
9-Oct	15.43	13.62	14.65	13.80	14.98	12.93	13.39	12.89	13.90
10-Oct	14.87	14.33	14.44	13.05	14.73	12.93	12.98	12.72	13.60
11-Oct	14.05	14.02	14.32	12.87	14.74	12.83	12.63	12.48	14.10
12-Oct	13.77	12.37	14.27	13.44	14.80	12.85	12.72	12.07	14.10
13-Oct	13.85	12.77	14.57	12.94	14.82	12.81	12.73	11.87	13.80
14-Oct	13.62	13.51	14.69	12.91	14.63	12.84	12.61	11.84	13.50
15-Oct	13.52	13.01	14.40	12.87	14.55	12.67	12.27	11.91	13.20
16-Oct	13.54	12.29	14.15	12.79	14.29	12.65	12.26	11.94	13.00
17-Oct	13.54	10.95	13.66	12.72	13.63	12.23	11.98	11.97	12.80
18-Oct	13.44	11.88	13.45	12.57	13.52	11.48	11.95	12.18	12.80
19-Oct	13.30	11.60	13.25	12.32	13.45	11.44	11.71	12.15	12.70
20-Oct	13.21	12.07	13.09	12.31	13.37	11.06	11.55	12.06	12.60
21-Oct	13.10	12.46	12.55	12.10	12.97	10.67	11.50	12.04	12.60
22-Oct	12.95	12.89	12.17	12.06	12.69	10.68	11.34	11.81	12.50
23-Oct	12.78	12.39	11.72	12.28	12.63	10.85	10.63	11.64	12.30
24-Oct	12.45	12.03	11.23	12.23	12.53	10.68	10.26	11.31	12.20
25-Oct	12.21	12.03	10.85	12.10	12.30	10.47	10.22	10.72	11.90
26-Oct	11.78	11.82	10.65	11.86	11.67	10.15	9.95	10.53	11.70
27-Oct	11.42	12.00	10.44	11.42	10.42	10.05	9.72	10.01	11.60
28-Oct	11.29	11.96	10.14	11.14	11.15	10.03	9.76	9.98	11.40
29-Oct	10.58	11.28	10.10	11.10	10.45	9.92	9.61	9.65	11.20
30-Oct	10.13	10.37	9.70	10.69	9.40	9.63	9.56	8.80	11.00
31-Oct	9.84	9.41	9.31	10.25	9.00	9.45	9.67	8.87	10.90
1-Nov	9.36	9.49	8.87	9.83	8.81	9.20	9.73	8.69	10.30
2-Nov	9.11	9.40	8.57	10.04	8.85	8.71	9.95	8.75	9.17
3-Nov	8.80	8.60	8.35	9.66	8.49	8.71	9.67	8.59	9.96
4-Nov	8.43	8.42	8.35	9.15	8.43	8.78	9.49	8.39	10.00
5-Nov	8.34	8.17	8.02	8.69	8.46	8.51	9.14	8.28	10.20
6-Nov	8.29	8.05	8.11	8.60	8.60	8.42	8.66	8.32	10.20
7-Nov	8.36	7.91	8.08	8.16	8.73	8.55	8.85	7.92	10.10
8-Nov	8.45	7.71	7.95	7.91	8.32	8.60	8.84	7.80	9.65
9-Nov	8.58	7.84	7.80	7.75	8.07	8.62	8.91	7.72	9.17
10-Nov	8.53	8.17	7.88	7.46	7.71	8.63	8.88	7.72	9.31

Sample Date	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011
11-Nov	8.58	8.06	7.66	7.74	7.67	8.37	8.55	7.51	9.09
12-Nov	8.46	7.66	7.59	7.44	7.57	7.60	8.57	7.09	8.97
13-Nov	8.40	7.57	7.43	7.28	7.45	7.56	8.09	6.78	8.81
14-Nov	8.31	7.44	7.25	6.93	7.20	7.04	7.57	6.73	8.66
15-Nov	8.01	7.51	7.34	6.72	6.87	6.77	7.25	6.48	8.59
16-Nov	7.73	7.24	7.28	6.62	7.19	7.23	7.40	6.63	8.49
17-Nov	7.59	7.42	7.00	6.54	6.98	7.44	7.22	7.02	8.28
18-Nov	7.49	7.29	7.04	6.69	6.80	7.08	7.30	6.69	7.69
19-Nov	7.64	7.17	7.18	6.72	6.70	6.33	6.96	6.49	6.52
20-Nov	7.82	6.84	6.92	6.61	6.88	6.05	6.84	6.80	5.19
21-Nov	7.83	5.37	6.63	6.69	6.81	5.72	6.80	6.79	4.40
22-Nov	7.86	4.96	6.45	6.50	6.73	5.35	6.63	6.52	4.05
23-Nov	7.52	5.43	6.61	6.18	6.59	5.19	6.52	6.44	2.77
24-Nov	7.10	5.27	6.57	6.03	6.42	4.63	6.35	6.58	3.42
25-Nov	6.71	5.23	6.56	5.98	6.15	4.86	6.30	6.56	3.53
26-Nov	6.38	5.45	6.30	5.91	5.56	4.61	6.04	6.61	3.93
27-Nov	6.17	5.14	6.20	5.65	3.56	4.71	5.89	6.36	4.46
28-Nov	6.03	5.01	6.06	5.47	1.47	4.75	5.73	6.10	4.59
29-Nov	6.00	5.52	5.64	5.32	1.99	4.72	6.06	5.98	4.15
30-Nov	5.97	5.11	5.56	5.30	2.48	4.21	6.10	6.10	4.06
1-Dec	5.99	4.75	5.73	5.12	3.00	4.04	6.10	5.67	4.41
2-Dec	5.86	4.86	5.74	4.79	3.10	3.88	5.91	4.86	4.53
3-Dec	5.81	5.11	5.76	4.47	3.08	4.54	5.32	4.44	4.21
4-Dec	5.92	4.71	5.80	4.20	2.98	5.71	4.94	4.32	4.07
5-Dec	5.85	4.58	5.73	3.46	2.87	5.40	4.92	4.17	3.64
6-Dec	5.80	4.75	5.63	3.94	3.00	4.92	4.99	3.83	3.66
7-Dec	5.99	4.85	5.50	3.48	2.97	4.02	5.26	3.18	3.65
8-Dec	5.79	4.73	5.43	3.09	3.02	3.03	5.36	2.73	4.09
9-Dec	5.64	4.65	5.51	2.77	2.98	3.19	5.18	3.06	4.19
10-Dec	5.59	3.83	5.50	3.27	3.16	3.23	5.16	2.95	4.34
11-Dec	5.51	3.74	5.40	3.00	3.13	2.89	5.04	2.82	4.08
12-Dec	5.60	3.74	5.01	2.80	3.45	3.21	4.70	2.93	4.14
13-Dec	5.87	4.04	4.95	2.79	3.52	3.27	4.06	2.54	4.29
14-Dec	5.98	4.16	4.94	2.73	3.33	3.32	3.14	1.10	4.29
15-Dec	6.23	4.01	5.11	2.76	3.24	3.33	1.86	1.65	3.94
16-Dec	5.99	3.88	5.16	2.59	3.01	3.41	1.24	2.61	3.77
17-Dec	5.63	3.78	5.16	2.57	2.88	3.41	1.72	2.83	3.75
18-Dec	5.52	3.89	5.14	2.41	2.45	3.41	2.15	3.04	3.34
19-Dec	5.35	3.74	5.09	2.36	2.40	3.44	0.27	3.12	3.24
20-Dec	5.16	3.60	4.99	2.94	2.78	3.51	0.52	3.12	3.12
21-Dec	5.05	3.66	4.80	3.16	2.63	3.14	0.54	3.26	3.27
22-Dec	4.81	3.63	4.59	3.18	2.73	2.97	0.74	2.56	3.24
23-Dec	4.99	3.73	4.50	3.23	2.68	2.81	0.84	1.76	3.43
24-Dec	4.90	3.74	4.38	3.48	2.63	2.96	1.05	1.33	3.31
25-Dec	4.59	3.81	4.44	3.55	2.76	2.67	1.20	1.57	3.54
26-Dec	4.89	3.68	4.50	3.55	2.73	2.68	1.23	1.69	3.55
27-Dec	4.75	3.19	4.37	3.58	2.58	2.53	1.45	1.56	3.26
28-Dec	4.67	3.19	4.31	3.54	2.03	2.54	1.63	1.59	3.36
29-Dec	4.60	3.03	4.31	3.44	1.97	2.51	1.66	1.98	2.98
30-Dec	4.36	2.56	4.24	3.38	2.09	2.31	1.80	2.11	2.03
31-Dec	4.43	2.65	3.77	3.45	2.45	2.43	1.92	2.45	1.95
1-Jan	4.31	2.67	3.12	3.49	2.05	2.34	2.06	2.73	1.74
2-Jan	4.50	1.95	2.62	3.51	1.99	2.03	2.12	2.86	2.24
3-Jan	4.72	0.41	2.28	3.57	2.28	2.44	1.99	3.01	2.37
4-Jan	4.74	0.02	1.73	3.49	2.33	2.58	2.01	2.91	2.77
5-Jan	4.75	0.13	1.42	3.43	2.12	2.84	2.09	2.78	2.69
6-Jan	4.57	0.24	2.01	3.59	2.12	2.55	1.99	2.56	2.79
7-Jan	4.26	0.33	1.89	3.72	2.32	2.50	2.08	2.49	2.78
8-Jan	3.98	0.65	1.53	3.68	2.32	2.34	2.12	2.47	2.71
9-Jan	3.80	1.09	1.21	3.65	2.32	2.50	2.02	2.49	2.35
10-Jan	3.54	1.33	1.41	3.92	1.97	2.32	2.08	2.65	2.16
11-Jan	3.65	1.45	1.53	3.98	0.36	2.50	1.91	2.69	2.22
12-Jan	3.77	1.70	1.71	3.72	0.11	2.51	1.77	2.75	2.04
13-Jan	3.76	1.81	1.93	3.67	0.27	2.56	1.75	2.79	2.44

Sample Date	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011
14-Jan	3.89	1.95	1.50	3.85	0.55	2.52	1.80	2.80	2.50
15-Jan	3.75	1.96	1.09	3.62	0.70	1.92	1.82	2.81	2.60
16-Jan	3.79	2.06	0.87	3.38	0.87	1.71	1.71	2.78	2.69
17-Jan	3.75	2.15	0.95	3.24	0.98	2.09	1.65	2.85	2.77
18-Jan	3.57	2.23	1.13	3.37	1.04	2.29	1.50	2.87	2.25
19-Jan	3.39	2.32	1.35	3.22	1.08	2.29	1.43	2.83	2.02
20-Jan	3.57	2.47	1.51	3.14	1.15	1.92	1.32	2.83	2.22
21-Jan	3.57	2.52	1.77	3.23	0.92	1.26	1.23	2.85	2.35
22-Jan	3.33	2.55	1.89	2.90	0.83	0.94	1.27	2.65	2.34
23-Jan	3.44	2.65	2.02	3.07	0.75	1.04	1.29	2.55	2.40
24-Jan	3.74	2.65	2.04	3.14	0.89	1.13	1.10	2.23	2.46
25-Jan	3.86	2.30	2.10	3.25	1.03	1.22	0.58	2.62	2.46
26-Jan	3.96	2.18	2.22	3.19	1.19	1.36	0.66	2.63	2.49
27-Jan	3.82	1.76	2.29	3.19	1.25	1.45	0.58	2.47	2.57
28-Jan	3.75	1.54	2.34	3.34	0.94	1.39	0.59	2.57	2.63
29-Jan	3.65	1.62	2.41	3.23	0.79	1.13	0.62	2.73	2.15
30-Jan	3.69	1.64	2.46	3.21	0.62	0.61	0.65	2.80	1.33
31-Jan	3.69	1.69	2.53	3.14	0.62	0.60	0.76	3.00	1.25
1-Feb	3.78	1.52	2.50	3.19	0.70	0.54	0.77	3.03	1.38
2-Feb	3.75	1.35	2.51	3.39	0.72	0.61	0.85	3.14	1.66
3-Feb	3.69	1.18	2.54	3.37	0.60	0.66	0.72	3.12	1.81
4-Feb	3.57	1.27	2.56	3.41	0.65	0.67	0.72	3.19	1.96
5-Feb	3.61	1.15	2.62	3.39	0.70	0.69	0.86	3.22	2.19
6-Feb	3.55	1.29	2.30	3.43	0.76	0.77	0.98	3.35	2.06
7-Feb	3.55	1.65	2.23	3.28	0.83	0.87	0.98	3.42	2.13
8-Feb	3.45	1.69	2.11	3.30	0.91	1.01	1.05	3.35	2.01
9-Feb	3.48	1.69	2.15	3.23	1.00	1.12	1.01	3.42	1.90
10-Feb	3.43	1.65	2.21	3.03	1.08	1.29	0.90	3.39	1.88
11-Feb	3.29	1.71	2.31	2.97	1.09	1.31	0.98	3.39	1.73
12-Feb	3.09	1.68	2.40	3.16	1.15	1.43	0.92	3.46	1.98
13-Feb	3.18	1.78	2.40	3.09	1.20	1.49	1.00	3.62	2.17
14-Feb	3.65	1.80	2.31	2.94	1.16	1.57	0.99	3.75	2.33
15-Feb	3.87	1.80	2.12	2.83	1.16	1.62	1.04	3.61	2.34
16-Feb	3.94	1.88	2.04	2.60	1.32	1.71	1.01	3.73	2.50
17-Feb	4.00	1.97	1.88	2.12	1.49	1.80	0.86	3.63	2.51
18-Feb	3.99	2.10	2.06	1.81	1.62	1.92	0.97	3.60	2.54
19-Feb	4.14	2.16	1.82	1.65	1.58	2.01	0.84	3.51	2.05
20-Feb	4.17	2.27	1.92	1.79	1.68	2.10	0.90	3.30	1.94
21-Feb	4.22	2.12	1.93	2.02	1.83	2.02	0.99	3.16	1.93
22-Feb	3.98	2.04	2.00	2.16	1.84	2.06	1.05	3.21	1.79
23-Feb	3.35	1.93	2.22	2.38	1.75	2.15	1.15	3.29	1.56
24-Feb	3.12	1.99	2.38	2.40	1.67	2.12	1.28	3.30	1.24
25-Feb	3.02	2.16	2.53	2.11	1.79	2.25	1.28	3.59	0.92
26-Feb	3.37	2.26	2.57	2.04	1.91	2.25	1.10	3.66	0.85
27-Feb	3.58	2.53	2.65	2.54	1.94	2.26	1.26	3.90	0.92
28-Feb	3.62	2.60	2.68	2.70	1.85	2.41	1.19	4.19	1.15
29-Feb		2.71				2.49			
1-Mar	3.75	2.75	2.75	2.73	1.77	2.53	1.19	4.42	1.13
2-Mar	3.86	2.82	2.80	2.57	1.74	2.63	1.33	4.40	1.15
3-Mar	4.00	2.71	3.02	2.70	1.80	2.57	1.26	4.44	1.31
4-Mar	4.19	2.87	3.12	2.80	1.87	2.59	1.45	4.62	1.51
5-Mar	4.28	2.90	3.29	2.85	1.87	2.65	1.51	5.01	1.66
6-Mar	3.90	2.93	3.18	3.03	2.01	2.91	1.62	5.10	1.85
7-Mar	2.70	3.19	3.38	3.06	2.17	3.22	1.70	5.00	2.04
8-Mar	2.38	3.72	3.44	2.94	2.26	3.41	1.52	4.87	1.85
9-Mar	2.52	3.98	3.55	2.92	2.50	3.37	1.40	4.38	1.86
10-Mar	3.17	3.95	3.65	2.96	2.60	3.41	1.37	4.33	2.16
11-Mar	3.49	3.79	3.91	3.00	2.77	3.78	1.58	4.17	2.09
12-Mar	3.81	4.28	4.04	3.07	3.10	3.63	1.65	4.39	2.12
13-Mar	4.65	4.32	4.05	3.24	2.89	3.80	1.51	4.47	2.39
14-Mar	4.89	4.72	4.14	3.23	2.86	4.01	1.50	4.57	2.59
15-Mar	4.62	4.47	4.25	3.30	2.89	4.29	1.43	5.18	2.81
16-Mar	4.76	4.34	4.10	3.27	3.19	4.35	1.55	5.32	2.83
17-Mar	5.08	4.79	4.21	3.47	3.22	4.48	1.71	5.34	3.01

Sample Date	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011
18-Mar	5.13	4.75	4.49	3.54	3.40	4.42	1.94	5.20	3.22
19-Mar	4.95	4.31	4.32	3.69	3.61	4.49	2.08	5.58	3.03
20-Mar	5.03	4.63	4.31	3.89	3.63	4.33	2.25	5.57	3.12
21-Mar	5.13	5.02	4.40	3.88	3.80	4.44	2.31	5.45	3.37
22-Mar	5.39	5.47	4.41	3.92	3.63	4.38	2.27	5.64	3.60
23-Mar	5.28	5.78	4.51	4.16	3.79	4.54	2.38	6.06	4.06
24-Mar	5.44	5.80	4.58	4.37	3.98	4.25	2.53	6.06	3.53
25-Mar	5.60	5.46	4.84	4.37	4.21	4.31	2.70	6.00	3.41
26-Mar	5.49	5.55	4.56	4.49	4.47	4.22	2.88	6.00	3.87
27-Mar	5.92	5.27	4.47	4.39	4.61	4.36	3.24	6.11	3.81
28-Mar	6.28	5.40	4.74	4.54	4.55	4.06	2.95	5.98	4.32
29-Mar	6.25	5.92	4.75	5.23	4.69	4.29	3.07	6.02	4.65
30-Mar	6.14	5.97	4.93	5.52	4.84	4.63	3.07	5.51	4.56
31-Mar	6.48	6.15	5.07	5.61	5.18	4.67	3.31	5.66	4.60
1-Apr	6.48	6.48	4.99	6.24	5.13	4.73	3.28	5.76	4.89
2-Apr	6.14	6.89	4.97	6.24	4.98	5.09	3.56	5.47	5.08
3-Apr	5.91	6.86	5.18	5.74	4.90	5.17	3.80	5.25	5.07
4-Apr	6.18	7.14	5.53	5.96	4.89	5.10	3.77	5.59	4.78
5-Apr	6.35	7.81	5.46	5.92	5.17	5.11	4.31	5.72	5.00
6-Apr	6.31	7.96	5.35	6.23	5.56	5.17	4.72	6.15	5.02
7-Apr	6.25	8.49	5.66	6.35	6.19	5.25	5.47	5.78	5.02
8-Apr	6.53	8.51	5.79	6.63	6.55	5.34	5.27	6.01	5.41
9-Apr	6.89	8.65	6.24	6.46	5.73	5.28	5.83	5.86	5.73
10-Apr	6.48	9.08	6.39	5.84	5.77	5.75	5.68	5.99	5.98
11-Apr	6.86	9.28	5.72	6.20	6.10	5.81	5.76	6.15	5.66
12-Apr	7.06	7.73	5.74	5.74	6.54	6.10	5.79	6.46	5.41
13-Apr	7.28	7.50	5.83	5.83	6.48	5.97	5.45	6.75	5.48
14-Apr	7.18	8.36	6.07	5.69	5.71	5.96	5.50	7.04	5.19
15-Apr	7.05	8.37	6.10	5.65	6.56	5.73	6.11	7.56	5.27
16-Apr	6.96	8.63	5.70	5.90	6.52	6.05	6.55	8.43	5.42
17-Apr	6.79	8.87	5.92	6.20	5.71	6.63	6.13	8.67	5.49
18-Apr	6.90	9.51	6.52	6.44	6.38	6.42	5.92	9.03	5.64
19-Apr	6.97	8.62	7.11	6.29	6.83	5.84	6.70	9.16	5.78
20-Apr	7.58	6.73	7.41	6.51	7.05	5.85	6.61	10.50	5.87
21-Apr	8.24	7.79	8.12	6.34	6.94	6.11	7.12	11.20	5.88
22-Apr	9.02	8.73	8.54	6.62	7.21	6.43	7.71	11.60	6.36
23-Apr	9.27	8.26	8.03	7.17	7.92	6.35	7.11	11.30	6.65
24-Apr	8.34	7.57	8.60	7.74	8.19	6.23	6.73	10.20	6.45
25-Apr	7.79	9.39	9.81	8.05	8.58	6.72	6.85	10.60	6.13
26-Apr	8.19	9.63	11.47	7.54	8.22	7.31	7.49	8.92	6.17
27-Apr	8.61	8.55	11.85	8.38	7.64	6.79	8.05	6.91	6.42
28-Apr	9.49	9.03	11.68	9.24	7.52	6.82	8.03	7.77	5.80
29-Apr	10.52	10.12	11.65	9.09	7.91	7.20	7.65	8.91	6.18
30-Apr	11.63	11.47	11.61	8.71	8.43	7.35	8.30	9.58	6.83
1-May	11.91	11.99	12.05	9.11	8.39	7.51	9.04	10.10	7.50
2-May	10.29	10.93	12.50	9.49	8.47	7.46	9.68	10.30	6.91
3-May	9.17	11.74	12.12	10.07	8.77	7.79	8.51	9.55	6.67
4-May	10.27	11.78	12.64	10.62	9.27	8.64	6.96	9.15	7.11
5-May	10.58	12.34	12.79	9.94	9.69	10.03	6.79	9.54	6.94
6-May	11.12	12.06	14.09	9.36	9.63	10.78	6.51	10.40	7.78
7-May	10.87	12.60	14.65	9.67	9.60	10.95	6.54	10.50	8.10
8-May	11.00	13.06	14.94	9.57	9.81	11.10	7.58	10.60	8.50
9-May	11.61	11.33	14.67	9.96	9.22	11.29	8.86	11.30	8.96
10-May	12.14	12.22	14.58	10.31	11.13	8.83	9.45	11.80	9.55
11-May	12.69	12.26	15.21	10.13	11.61	7.94	8.55	12.30	7.95
12-May	13.19	12.65	16.49	10.28	12.05	9.88	8.88	13.00	7.37
13-May	13.07	13.80	14.66	10.42	12.56	10.43	9.12	13.40	9.02
14-May	9.73	13.78	13.40	10.99	12.76	10.71	7.39	12.30	9.44
15-May	10.22	12.57	13.63	12.62	12.30	11.92	9.02	12.10	9.50

Table 12. Daily mean water temperatures during Okanagan Sockeye spawning and incubation September 2010 to May 2019 from the Water Survey of Canada gauge Okanagan River near Oliver (Station 08NM085; Figure 1).

Sample Date	2010-2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018	2018 - 2019
15-Sep	17.50	19.40	18.30	21.60	17.30	16.90	18.18	18.02	16.71
16-Sep	18.10	18.70	18.20	21.40	17.60	16.95	18.40	17.41	16.43
17-Sep	18.20	18.20	18.10	20.80	17.60	16.25	18.26	16.74	16.22
18-Sep	17.40	18.50	18.00	20.60	17.50	16.77	17.98	16.65	16.40
19-Sep	17.10	18.40	18.10	19.80	17.80	16.35	16.90	15.93	16.06
20-Sep	16.50	17.70	18.10	19.40	17.70	17.15	16.51	15.31	16.08
21-Sep	16.20	17.40	18.10	19.30	17.80	16.45	16.60	15.68	16.29
22-Sep	15.70	17.30	18.00	18.40	17.80	15.86	16.62	15.56	16.49
23-Sep	15.40	18.30	18.10	17.70	17.80	15.77	15.97	15.65	16.03
24-Sep	15.40	18.30	17.80	17.20	17.60	15.81	16.25	15.22	15.75
25-Sep	15.70	17.70	18.10	16.20	17.30	15.79	16.99	15.42	15.74
26-Sep	16.10	15.70	17.50	16.40	17.00	15.68	16.88	15.90	15.90
27-Sep	16.50	16.30	17.30	15.30	17.20	14.97	17.08	16.08	16.35
28-Sep	16.60	15.80	17.20	15.30	17.10	15.04	16.22	16.05	16.19
29-Sep	16.10	15.40	17.40	14.70	16.80	14.89	16.05	15.87	15.27
30-Sep	16.20	15.60	17.00	14.20	16.50	14.99	16.20	15.73	14.81
1-Oct	16.30	15.40	16.40	13.70	15.90	14.99	15.94	15.09	14.79
2-Oct	16.50	15.50	15.40	13.20	15.70	14.66	15.23	14.52	14.22
3-Oct	16.30	15.20	14.30	13.20	14.90	14.34	15.10	14.18	13.04
4-Oct	16.30	15.30	14.00	12.80	15.40	13.98	14.87	13.75	13.35
5-Oct	15.80	14.50	13.90	12.70	15.40	13.91	15.16	13.66	12.79
6-Oct	15.30	14.60	13.70	12.80	15.70	13.61	14.77	13.01	13.34
7-Oct	15.20	14.20	13.80	12.90	15.90	13.81	14.69	13.16	12.71
8-Oct	15.60	13.60	14.10	12.70	16.00	14.33	13.98	12.96	12.78
9-Oct	15.10	13.90	14.10	12.40	15.50	14.85	14.16	12.20	12.89
10-Oct	15.10	13.80	13.20	12.70	15.30	14.58	12.79	12.36	12.61
11-Oct	14.30	13.90	13.90	11.80	15.20	14.18	12.31	11.59	13.15
12-Oct	14.10	13.40	13.90	12.40	14.80	14.09	11.95	11.36	12.51
13-Oct	14.00	12.80	13.80	12.10	14.60	13.91	11.88	11.59	12.12
14-Oct	13.60	12.60	14.00	11.60	14.80	13.34	12.03	10.62	11.72
15-Oct	13.40	12.20	14.10	11.40	14.40	13.08	11.57	10.88	11.71
16-Oct	12.50	12.00	13.70	12.20	13.70	12.89	11.62	10.88	11.64
17-Oct	12.00	12.10	12.70	11.50	13.60	12.99	11.74	11.32	11.48
18-Oct	11.90	11.90	12.60	11.30	13.40	13.33	11.50	10.44	11.30
19-Oct	11.80	12.00	12.40	11.20	14.10	13.96	11.26	10.95	11.35
20-Oct	11.70	12.20	11.80	11.30	13.50	13.61	11.26	11.21	11.30
21-Oct	11.60	11.70	10.90	11.50	13.60	12.57	10.92	9.89	11.34
22-Oct	11.80	11.70	10.50	11.40	12.70	12.56	11.23	10.13	11.12
23-Oct	11.60	11.20	10.70	11.60	12.80	11.92	11.24	9.76	11.04
24-Oct	11.70	10.80	10.40	11.30	12.10	11.34	11.47	9.74	11.41
25-Oct	11.10	10.40	10.40	11.10	12.40	11.56	11.55	9.72	11.24
26-Oct	10.90	9.55	10.10	10.90	12.20	11.96	11.03	9.53	11.31
27-Oct	11.00	9.45	9.68	10.60	11.60	11.57	11.34	9.46	10.64
28-Oct	10.80	9.29	10.10	10.00	11.00	11.24	11.27	9.27	10.89
29-Oct	10.80	9.10	10.30	9.35	11.20	11.45	10.65	9.29	10.81
30-Oct	10.80	9.31	10.20	8.94	11.30	11.29	10.92	8.68	10.39
31-Oct	10.60	9.25	10.40	9.36	11.40	11.20	10.95	8.35	10.51
1-Nov	10.50	8.65	10.50	8.74	10.90	10.97	10.94	8.90	10.36
2-Nov	10.40	8.16	10.20	9.19	10.10	10.82	10.74	8.35	10.77
3-Nov	9.52	8.33	10.50	8.83	10.20	10.11	10.71	6.69	10.44
4-Nov	9.05	7.85	10.70	8.31	10.90	9.38	10.42	6.16	10.46
5-Nov	9.77	6.83	11.00	7.66	10.40	9.65	10.59	5.60	9.93
6-Nov	10.10	6.44	10.10	7.82	10.80	9.16	10.78	5.18	9.61
7-Nov	10.40	5.91	10.10	7.71	10.50	9.43	10.60	5.26	9.18
8-Nov	8.80	6.36	8.66	8.02	9.65	9.87	10.60	5.61	7.99
9-Nov	8.29	6.89	8.08	7.26	9.72	9.21	10.43	5.53	7.67
10-Nov	8.53	6.69	6.98	7.76	8.82	8.10	10.28	5.74	7.95
11-Nov	8.03	6.45	5.88	7.92	7.70	8.30	10.27	5.97	7.50

Sample Date	2010-2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018	2018-2019
12-Nov	7.86	6.49	6.41	7.74	6.30	7.36	10.56	6.17	7.24
13-Nov	7.82	6.15	7.06	8.29	5.75	8.31	9.90	6.60	7.11
14-Nov	8.12	5.67	7.44	7.81	5.11	8.58	9.86	6.37	6.78
15-Nov	7.97	5.14	7.24	7.13	4.62	8.18	9.45	6.26	6.59
16-Nov	7.95	3.95	7.22	7.03	4.45	7.23	9.24	6.17	6.86
17-Nov	7.80	4.49	7.20	6.51	4.06	6.98	8.69	5.93	6.30
18-Nov	7.24	4.79	7.16	6.72	4.13	7.05	8.85	5.77	5.80
19-Nov	5.65	4.54	7.21	7.26	4.85	6.73	8.63	5.76	5.52
20-Nov	4.21	4.12	7.57	4.79	5.24	5.68	8.65	5.75	5.19
21-Nov	3.22	3.98	7.27	4.09	5.05	5.41	8.73	5.81	5.36
22-Nov	2.00	4.78	6.27	4.00	5.01	5.40	8.49	6.35	5.95
23-Nov	0.42	6.21	6.41	3.83	4.81	5.65	8.43	6.93	5.93
24-Nov	0.26	4.80	6.56	4.17	4.35	5.01	8.03	6.06	5.67
25-Nov	0.68	4.64	5.68	4.19	4.59	3.42	8.01	6.19	5.54
26-Nov	1.34	4.57	4.91	3.97	3.63	2.99	8.13	6.20	5.68
27-Nov	2.70	4.68	5.04	3.80	5.11	2.99	7.93	5.71	5.79
28-Nov	2.79	4.10	5.49	4.16	4.76	2.99	7.80	5.48	6.07
29-Nov	2.11	4.25	5.68	3.74	0.97	2.91	7.36	5.40	6.11
30-Nov	2.28	4.45	6.07	4.08	0.36	2.42	7.25	5.41	6.22
1-Dec	2.96	3.32	6.72	4.30	0.60	2.29	7.17	5.38	6.03
2-Dec	2.92	3.12	6.47	3.80	0.69	2.56	6.71	5.16	5.77
3-Dec	2.62	3.70	6.01	1.73	1.42	3.22	6.70	4.97	5.14
4-Dec	2.54	3.46	6.40	1.32	2.18	3.87	6.35	4.13	4.06
5-Dec	1.59	2.98	5.87	0.58	2.49	3.97	5.57	4.03	3.68
6-Dec	2.17	2.79	5.60	0.75	2.88	4.12	5.18	3.99	2.99
7-Dec	2.29	2.59	4.83	0.21	3.22	4.73	3.99	4.35	3.04
8-Dec	2.92	2.28	4.60	0.34	3.21	4.84	3.57	4.12	3.67
9-Dec	3.13	2.06	3.96	0.63	3.85	5.15	3.45	3.78	3.76
10-Dec	3.26	1.81	4.36	0.65	4.19	4.23	3.43	3.72	3.92
11-Dec	2.99	2.38	4.31	0.76	3.81	4.25	3.43	3.78	3.66
12-Dec	2.83	1.99	4.30	1.63	3.33	4.24	2.54	3.54	3.52
13-Dec	3.51	1.41	4.01	1.84	2.84	4.14	1.43	3.68	4.01
14-Dec	3.59	2.01	3.62	1.77	3.17	4.19	1.06	3.81	4.15
15-Dec	2.66	2.08	3.57	2.43	3.26	3.16	0.63	3.71	3.89
16-Dec	2.63	2.22	3.32	2.45	3.14	3.11	0.20	3.34	4.01
17-Dec	2.87	2.51	3.34	2.31	3.46	2.25	0.20	3.21	4.48
18-Dec	2.01	2.92	2.54	2.39	3.82	2.95	0.22	3.51	4.92
19-Dec	2.35	1.82	2.40	1.26	4.01	3.27	0.60	3.15	4.21
20-Dec	2.18	2.10	3.07	1.19	4.12	2.99	1.28	2.77	4.55
21-Dec	2.31	1.87	2.98	1.37	4.22	2.91	1.45	1.74	4.17
22-Dec	2.30	0.91	2.88	1.77	3.63	3.08	1.60	1.92	3.35
23-Dec	2.57	1.62	3.23	2.25	3.81	2.80	1.43	1.18	3.70
24-Dec	2.88	1.97	3.67	2.06	3.93	2.93	1.91	0.54	3.93
25-Dec	2.98	2.28	3.28	1.62	3.45	2.68	1.50	0.82	3.83
26-Dec	2.90	1.80	3.35	1.94	3.35	1.83	1.13	0.51	3.23
27-Dec	2.48	2.55	3.59	1.63	3.12	1.68	1.64	0.89	3.39
28-Dec	2.98	3.26	3.42	1.81	3.38	2.03	1.45	1.29	2.79
29-Dec	2.52	3.30	2.96	1.92	2.76	2.11	1.82	1.35	2.55
30-Dec	1.03	3.24	2.96	1.93	0.84	1.82	1.66	0.99	3.11
31-Dec	0.41	2.19	2.55	2.35	0.90	1.00	1.09	0.88	2.62
1-Jan	1.85	2.13	1.99	1.98	1.06	0.52	1.52	1.10	2.53
2-Jan	2.33	1.96	1.83	2.32	0.79	0.92	1.06	1.01	2.67
3-Jan	2.19	2.46	1.85	2.51	0.96	1.38	0.31	0.95	2.69
4-Jan	1.04	3.31	1.72	1.79	1.17	1.49	0.21	1.45	3.44
5-Jan	1.07	2.90	1.72	1.05	0.84	2.11	0.43	1.54	3.17
6-Jan	1.18	2.37	2.04	1.25	2.01	2.76	0.31	2.32	3.47
7-Jan	1.08	1.73	1.92	1.75	2.49	3.21	0.25	2.26	2.75
8-Jan	1.77	2.48	1.94	2.06	2.62	3.12	0.45	2.43	2.26
9-Jan	2.55	2.98	2.00	2.36	2.35	3.03	0.81	2.53	2.37
10-Jan	2.61	2.51	1.35	2.64	2.20	2.93	0.29	2.47	3.15
11-Jan	3.39	0.89	0.79	3.27	2.17	2.86	0.26	1.81	3.39
12-Jan	3.09	0.54	0.35	2.82	2.45	2.72	0.28	1.82	2.93
13-Jan	2.50	1.13	0.81	3.11	2.06	3.05	0.30	2.58	3.05
14-Jan	2.55	1.34	1.07	3.01	2.20	3.16	0.25	2.99	2.91

Sample Date	2010-2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018	2018-2019
15-Jan	2.61	0.59	0.68	2.91	2.13	2.68	0.22	3.03	2.71
16-Jan	3.39	0.64	1.25	2.64	2.44	2.59	0.30		2.75
17-Jan	3.09	0.63	1.28	2.92	2.33	3.23	0.34		2.57
18-Jan	2.49	0.19	1.47	2.95	2.61	3.42	0.43		2.87
19-Jan	1.71	0.20	1.57	3.05	2.41	3.39	1.12		3.22
20-Jan	2.13	0.20	1.57	3.12	1.98	3.65	1.62		2.94
21-Jan	2.15	0.21	1.56	2.90	2.19	3.92	1.71		2.41
22-Jan	2.12	0.23	1.27	2.99	2.45	4.28	1.98		2.29
23-Jan	2.63	0.29	1.43	2.95	2.77	3.46	2.23		2.25
24-Jan	2.67	0.50	1.76	3.24	2.97	3.53	2.34		2.33
25-Jan	3.05	1.39	1.80	3.14	3.22	3.71	2.45		2.42
26-Jan	3.18	1.53	2.08	2.95	3.17	3.52	2.47		2.50
27-Jan	3.24	0.85	2.05	3.13	3.17	3.89	2.26		2.66
28-Jan	3.22	0.99	1.98	3.21	3.16	4.30	2.37		2.38
29-Jan	3.19	2.00	2.17	2.86	3.18	3.53	2.22		1.85
30-Jan	1.51	2.17	2.34	2.88	3.28	3.36	2.28		1.85
31-Jan	0.99	2.18	2.16	2.14	3.18	3.56	1.90		2.05
1-Feb	1.05	2.83	2.06	1.30	3.08	3.46	1.36		2.41
2-Feb	2.16	2.29	1.88	1.80	3.24	3.34	1.27		2.68
3-Feb	2.16	1.76	2.09	1.13	3.28	2.30	1.45		1.57
4-Feb	2.23		2.42	0.84	3.35	3.21	1.79		0.08
5-Feb	3.00	2.22	2.47	0.70	3.62	3.51	1.61		0.10
6-Feb	2.74	2.37	2.43	0.24	4.42	3.56	1.13		0.11
7-Feb	2.92	2.27	2.60	0.51	4.54	3.07	0.66		0.20
8-Feb	2.38	2.51	2.50	0.50	4.65	3.15	0.31		0.35
9-Feb	1.83	3.14	2.82	0.87	4.80	3.03	0.81		0.24
10-Feb	2.38	3.38	2.80	1.53	4.98	3.50	1.82		0.13
11-Feb	2.67	3.77	2.58	1.53	5.08	4.08	1.55		0.19
12-Feb	3.34	3.89	2.78	2.63	5.11	4.32	1.03		0.35
13-Feb	3.53	3.83	2.87	2.86	5.08	4.49	1.15		0.48
14-Feb	3.92	2.68	3.02	2.85	5.14	4.48	1.04		0.26
15-Feb	3.94	2.57	3.09	2.48	5.01	4.79	2.02		0.68
16-Feb	4.11	2.74	3.17	3.12	4.70	4.98	2.64		1.10
17-Feb	3.48	3.41	3.18	2.91	4.49	4.94	2.47		1.09
18-Feb	3.93	3.77	3.04	2.44	4.23	4.53	2.21		0.31
19-Feb	2.40	3.65	3.33	2.68	4.15	4.21	2.77	1.23	0.50
20-Feb	2.06	3.76	3.01	2.80	4.46	4.47	2.92	0.73	0.76
21-Feb	2.66	3.86	3.06	2.72	4.54	4.05	3.06	0.83	0.97
22-Feb	3.68	3.73	3.22	2.49	3.97	4.20	2.91	1.49	0.53
23-Feb	2.55	4.24	3.51	2.38	3.88	4.10	2.85	1.04	1.02
24-Feb	1.71	3.98	3.17	2.04	4.25	4.33	3.16	2.22	1.14
25-Feb	0.64	4.37	3.33	1.91	4.21	4.29	3.06	2.36	0.91
26-Feb	1.07	3.84	3.34	1.70	4.62	4.30	3.37	2.47	0.55
27-Feb	1.38	2.29	3.66	2.02	4.43	5.24	2.70	2.52	0.50
28-Feb	2.55	2.85	3.64	2.18	4.21	4.93	2.92	2.32	1.17
29-Feb		3.44				5.26			
1-Mar	2.58	3.79	4.15	1.73	4.15	4.83	3.13	2.41	1.44
2-Mar	2.39	3.80	4.34	1.51	4.39	5.09	3.20	2.20	1.15
3-Mar	2.81	4.53	4.02	1.61	3.96	5.52	3.43	2.19	1.12
4-Mar	3.05	5.30	3.93	1.80	3.86	5.56	3.66	2.07	0.79
5-Mar	3.79	5.53	3.93	1.93	4.05	6.44	2.83	2.19	0.82
6-Mar	4.22	4.13	3.95	2.61	4.47	6.54	2.93	2.47	1.31
7-Mar	4.49	4.23	4.09	2.95	4.81	6.01	2.52	2.48	1.56
8-Mar	3.89	4.37	4.42	3.26	5.14	6.07	3.28	2.57	1.66
9-Mar	4.25	4.90	4.55	3.89	5.30	5.61	2.84	2.93	1.45
10-Mar	5.08	5.92	4.52	3.90	5.44	6.35	3.46	2.83	1.43
11-Mar	4.75	6.01	4.68	3.93	6.50	6.27	3.41	3.10	1.26
12-Mar	4.67	4.09	5.35	4.17	7.02	6.49	3.65	3.33	1.47
13-Mar	5.11	4.99	5.85	4.27	6.61	5.92	3.91	3.54	1.51
14-Mar	5.31	4.29	6.01	4.74	7.48	6.12	4.42	3.67	1.76
15-Mar	5.33	5.22	5.96	4.77	6.39	6.18	4.62	4.00	2.26
16-Mar	5.31	5.91	5.95	5.13	6.73	6.15	4.94	4.16	2.19
17-Mar	5.36	4.94	5.89	5.00	7.13	6.35	4.11	4.37	2.62
18-Mar	5.83	4.73	5.57	5.01	7.60	6.28	4.87	4.70	2.89

Sample Date	2010-2011	2011 - 2012	2012 - 2013	2013 - 2014	2014 - 2015	2015 - 2016	2016 - 2017	2017 - 2018	2018-2019
19-Mar	5.52	5.26	5.36	5.07	7.59	6.38	4.20	4.65	3.17
20-Mar	5.44	5.36	5.53	5.06	7.56	6.49	4.31	4.94	3.48
21-Mar	6.53	5.34	5.37	5.02	7.36	6.96	4.71	5.20	3.73
22-Mar	7.04	6.53	5.24	4.71	6.85	7.03	5.02	5.08	4.12
23-Mar	6.61	6.29	5.38	5.23	7.26	6.99	5.24	4.74	4.63
24-Mar	6.13	5.74	5.56	5.26	7.58	7.09	4.89	4.69	4.18
25-Mar	6.10	5.44	5.52	5.23	7.45	7.43	5.38	4.84	4.79
26-Mar	7.00	5.69	5.77	5.68	7.88	7.50	4.73	4.59	4.83
27-Mar	7.11	6.59	6.32	6.08	8.09	7.31	5.39	4.93	4.86
28-Mar	7.31	7.43	7.02	5.66	8.25	7.28	5.43	5.04	5.21
29-Mar	7.96	7.02	7.16	5.92	8.00	7.60	5.91	5.10	5.43
30-Mar	8.61	7.90	8.03	5.99	8.79	8.16	5.92	5.52	5.95
31-Mar	8.98	7.12	8.36	6.24	8.41	8.63	6.27	5.55	6.52
1-Apr	8.53	7.46	8.75	6.69	7.92	9.01	6.77	5.50	6.62
2-Apr	7.88	7.30	9.09	6.98	8.14	9.20	6.81	5.58	7.04
3-Apr	8.34	8.09	9.40	7.05	8.34	9.83	6.94	5.31	7.24
4-Apr	8.23	7.67	9.16	7.12	8.32	9.42	6.79	5.19	7.49
5-Apr	8.01	7.73	8.99	6.97	8.38	8.89	6.63	5.12	7.43
6-Apr	7.52	7.96	8.53	7.47	8.80	9.53	6.50	5.37	7.07
7-Apr	7.45	8.47	7.60	7.77	8.93	10.12	6.39	5.30	7.63
8-Apr	8.28	8.47	8.31	8.30	9.08	10.64	6.38	5.56	7.20
9-Apr	8.89	9.54	8.50	8.66	9.43	10.37	6.65	5.75	7.91
10-Apr	8.66	9.64	8.42	8.99	8.97	10.22	6.33	5.92	7.75
11-Apr	9.29	9.77	8.02	9.10	9.11	10.41	7.07	6.23	7.86
12-Apr	8.25	9.97	7.52	9.62	8.52	10.37	6.95	6.25	8.46
13-Apr		10.10	7.75	9.67	8.79	10.44	7.42	6.34	8.23
14-Apr		9.53	7.77	9.59	8.74	9.92	7.60	6.33	8.31
15-Apr	8.47	10.60	7.90	9.65	8.98	10.09	7.81	6.63	8.55
16-Apr	8.51	9.68	8.26	9.62	9.51	10.66	7.69	6.91	8.48
17-Apr	8.29	9.93	8.21	9.79	9.85	10.87	8.27	6.86	9.63
18-Apr	8.40	10.40	8.55	9.70	10.23	11.16	8.60	7.01	10.01
19-Apr	8.58	9.77	9.00	9.23	10.84	11.18	8.30	7.27	9.95
20-Apr	8.60	10.70	9.32	9.87	11.34	11.69	8.52	7.92	10.13
21-Apr	8.38	10.60	8.63	9.76	11.85	11.75	7.88	8.13	10.09
22-Apr	8.96	11.60	8.82	9.63	11.46	11.77	9.33	8.42	9.96
23-Apr	9.38	12.40	9.00	9.42	10.89	12.11	9.11	8.52	10.63
24-Apr	9.35	12.20	9.43	9.59	10.54	11.85	9.40	8.77	10.51
25-Apr	9.59	11.30	9.87	9.85	10.22	12.16	9.32	9.26	10.33
26-Apr	9.83	8.72	10.10	10.20	11.13	12.28	9.89	9.76	11.01
27-Apr	9.97	7.92	10.10	9.61	11.14	13.01	9.62	10.05	10.39
28-Apr	9.44	9.68	9.78	10.00	11.79	13.54	9.79	9.65	10.52
29-Apr	9.35	10.70	9.28	10.50	11.89	13.81	9.45	9.73	10.71
30-Apr	10.10	10.50	9.38	10.80	11.45	13.67	9.42	9.95	10.58
1-May	10.60	10.50	9.67	11.40	12.02	13.84	9.32	10.25	10.81
2-May	9.60	10.60	10.10	11.60	12.34	14.38	9.49	10.44	11.10
3-May	9.88	9.92	10.60	11.20	12.20	14.49	9.64	10.94	12.12
4-May	10.50	9.48	10.90	11.30	12.49	14.38	10.16	11.32	12.92
5-May	10.40	9.50	11.20	11.00	11.56	13.94	9.69	11.49	13.63
6-May	10.70	9.93	11.70	11.00	11.78	14.03	9.33	11.72	13.57
7-May	10.40	9.99	12.20	11.60	12.35	14.81	9.70	11.69	13.92
8-May	10.70	10.20	12.50	11.80	12.74	15.14	10.00	12.18	14.00
9-May	11.00	10.30	12.90	11.00	13.03	14.44	10.51	11.86	14.39
10-May	11.20	9.99	13.40	10.90	13.43	14.48	11.48	10.95	15.10
11-May	10.70	9.96	13.80	11.20	13.64	14.61	11.52	11.74	15.90
12-May	10.20	10.70	13.70	11.40	13.41	14.86	10.94	12.31	16.05
13-May	10.40	11.30	13.40	12.00	13.21	15.14	10.86	13.00	16.28
14-May	10.00	12.00	12.70	12.70	13.44	15.24	10.66	13.60	15.27
15-May	9.41	12.40	13.40	13.40	14.01	15.69	10.15	13.82	14.87

Table 13A. Daily mean water temperatures during Okanagan Sockeye spawning and incubation September 2001 to May 2010. Water temperatures are from the HOBO Tidbit temperature sensors installed at Transect 2 in the Okanagan River. Blocks of missing data are due to instruments being washed out or inadvertently removed.

Sample Date	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010
15-Sep			17.72	17.97		19.09	18.82	18.27	19.60
16-Sep			17.47	17.61		18.56	18.64	17.99	19.51
17-Sep			17.27	17.15		18.11	18.56	18.08	19.83
18-Sep			16.81	16.18		17.81	18.08	18.01	19.42
19-Sep			16.90	15.16		17.92	17.63	18.02	19.13
20-Sep			16.72	15.15	17.54	17.36	17.19	17.90	18.74
21-Sep	23.15		16.57	15.50	17.10	16.96	16.89	17.69	18.39
22-Sep	22.18		16.53	15.86	16.69	16.74	16.68	17.16	18.32
23-Sep	22.42		16.69	15.89	16.12	16.93	16.27	16.55	18.36
24-Sep	23.96		16.33	15.95	15.88	16.98	16.14	16.38	18.69
25-Sep	18.55		16.57	16.25	15.84	16.99	16.13	16.22	18.58
26-Sep	17.65		16.81	16.64	15.81	17.07	16.11	16.03	18.43
27-Sep	17.03		16.66	16.67	15.65	17.29	15.75	15.88	17.78
28-Sep	16.73		16.78	16.58	15.22	17.49	15.45	15.76	17.28
29-Sep	16.48		16.77	16.48	15.60	17.50	14.83	15.72	16.90
30-Sep	16.45		16.77	15.95	15.34	17.17	14.12	15.71	16.41
1-Oct	16.34		16.67	15.54	14.96	16.95	14.22	15.94	15.89
2-Oct	15.96		16.42	15.37	14.34	16.62	13.75	15.95	15.74
3-Oct	15.54		16.36	15.31	14.21	16.17	13.64	15.73	15.10
4-Oct	15.14		16.18	15.21	14.27	15.87	13.38	15.67	14.63
5-Oct	14.82		16.05	14.95	13.96	15.95	13.19	15.27	14.39
6-Oct	14.53		16.01	15.02	13.82	16.01	12.93	14.72	14.06
7-Oct	14.05		15.93	14.70	13.72	15.28	12.81	14.69	13.84
8-Oct	13.87		15.18	14.53	13.38	15.03	12.65	14.17	13.31
9-Oct	13.69		14.77	14.30	13.34	14.61	12.70	13.62	12.46
10-Oct	12.82		14.39	13.59	13.10	14.17	12.59	13.10	11.86
11-Oct	12.75	12.97	13.74	13.66	13.12	14.12	12.44	12.62	11.45
12-Oct	12.43	12.90	13.43	13.75	12.91	14.03	12.49	12.53	11.00
13-Oct	12.28	12.82	13.53	14.01	12.88	14.03	12.32	12.33	10.86
14-Oct	12.07	12.88	13.27	14.18	12.72	13.82	12.23	12.16	10.72
15-Oct	11.72	12.67	12.62	14.01	12.59	13.91	12.23	11.74	10.85
16-Oct	11.64	12.68	12.19	13.72	12.48	13.81	12.19	11.69	10.87
17-Oct	11.32	12.56	12.65	12.88	12.59	13.38	11.77	11.74	11.06
18-Oct	10.91	12.43	12.66	12.08	12.42	12.99	11.17	11.72	11.14
19-Oct	10.88	12.20	12.68	11.95	12.20	12.88	11.25	11.35	11.47
20-Oct	10.78	12.19	12.58	12.05	12.15	12.84	10.99	11.16	11.47
21-Oct	10.67	12.09	12.87	11.48	11.89	12.40	10.57	11.04	11.45
22-Oct	10.39	11.97	13.33	10.98	11.86	12.09	10.59	10.63	11.21
23-Oct	10.05	11.69	12.59	10.41	11.92	12.01	10.77	10.53	11.10
24-Oct	9.71	11.24	11.88	10.14	11.89	11.83	10.77	10.25	10.92
25-Oct	9.78	10.83	11.92	9.76	11.82	11.69	10.44	10.15	10.26
26-Oct	9.70	10.51	11.70	9.60	11.70	11.29	10.04	9.72	10.13
27-Oct	9.63	10.18	11.89	9.28	11.07	11.06	9.75	9.35	9.87
28-Oct	9.09	10.13	11.79	8.95	10.88	10.81	9.67	9.24	9.72
29-Oct	8.97	9.74	11.02	8.89	10.67	10.14	9.46	8.93	9.24
30-Oct	9.06	8.87	10.16	8.83	10.24	9.09	9.17	8.99	8.86
31-Oct	9.20	8.40	9.08	8.61	10.10	8.45	8.69	9.09	9.26
1-Nov	8.97	7.93	8.66	8.10	9.76	7.98	8.63	9.30	8.77
2-Nov	8.98	7.60	8.79	7.86	9.57	7.75	8.16	9.45	8.47
3-Nov	9.02	7.32	8.26	7.54	9.20	7.55	8.32	9.03	8.30
4-Nov	9.03	7.05	7.58	7.22	8.83	7.70	8.35	8.94	8.04
5-Nov	8.91	6.96	6.86	6.98	8.32	7.84	8.02	8.50	7.92
6-Nov	8.39	7.01	6.45	7.21	8.22	8.25	7.96	8.11	8.15
7-Nov	7.78	7.29	6.19	6.85	7.82	8.42	7.92	8.21	7.70
8-Nov	7.74	7.39	6.17	6.42	7.53	8.02	7.89	8.28	7.39
9-Nov	7.52	7.50	6.08	6.61	7.15	7.70	8.08	8.47	7.51
10-Nov	7.21	7.49	6.16	6.99	6.98	7.28	8.12	8.51	7.35
11-Nov	7.12	7.58	6.08	6.86	6.96	7.24	7.61	8.16	7.32
12-Nov	7.18	7.57	5.69	6.39	6.55	6.89	7.14	8.49	6.63

Sample Date	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010
13-Nov	7.45	7.66	5.56	6.23	6.58	6.77	6.98	7.99	6.30
14-Nov	7.89	7.67	5.37	6.19	6.22	6.55	6.32	7.42	6.04
15-Nov	8.18	7.24	5.59	6.46	5.80	6.24	6.28	7.22	5.54
16-Nov	7.94	7.14	5.47	6.00	5.85	6.29	6.71	7.06	5.58
17-Nov	7.57	6.92	5.54	5.67	5.53	5.96	6.65	6.88	6.01
18-Nov	7.02	7.00	5.49	5.88	5.78	6.02	6.23	6.94	5.48
19-Nov	7.12	7.29	5.29	5.89	5.67	5.98	5.55	6.52	5.42
20-Nov	7.37	7.54	4.95	5.71	5.73	6.00	5.16	6.31	5.64
21-Nov	7.40	7.43	3.85	5.36	5.66	5.93	4.72	6.12	5.43
22-Nov	7.37	7.57	2.99	5.36	5.43	5.67	4.57	6.07	5.31
23-Nov	7.33	7.23	2.96	5.38	5.26	5.61	4.16	5.68	5.24
24-Nov	6.86	6.48	3.24	5.27	4.90	5.33	3.79	5.51	5.36
25-Nov	6.71	6.04	3.05	5.47	4.68	5.04	3.69	5.44	5.41
26-Nov	6.65	5.67	2.79	5.02	4.62	4.34	3.14	5.21	5.49
27-Nov	6.27	5.60	2.64	4.85	4.18	2.64	3.21	4.91	5.17
28-Nov	5.79	5.15	2.88	4.76	3.94	0.64	2.87	4.85	4.82
29-Nov	5.64	5.90	3.01	4.21	3.79	0.37	2.79	4.96	4.89
30-Nov	5.34	6.01	2.50	4.23	3.56	0.60	2.46	4.90	4.91
1-Dec	5.37	6.04	2.18	4.22	3.30	0.77	1.98	5.03	4.29
2-Dec	5.37	5.71	2.48	4.20	3.08	0.88	1.84	4.84	3.59
3-Dec	5.23	5.69	2.64	4.10	2.80	1.05	2.98	4.10	3.14
4-Dec	5.00	5.80	2.01	4.05	2.42	1.30	3.80	3.54	3.33
5-Dec	4.90	5.86	2.40	4.08	2.15	1.16	3.31	3.69	2.85
6-Dec	4.67	5.86	2.59	3.86	1.55	1.40	3.08	3.84	2.32
7-Dec	4.39	5.84	2.30	3.81	1.13	1.46	2.50	3.84	1.30
8-Dec	4.34	5.69	2.56	3.84	1.27	1.52	1.46	3.83	0.95
9-Dec	4.13	5.61	2.58	3.76	1.52	1.50	1.21	3.70	1.23
10-Dec	3.79	4.45	2.05	3.93	1.64	1.76	1.38	3.82	1.19
11-Dec	3.87	4.29	1.77	3.99	1.50	1.92	1.11	3.43	1.32
12-Dec	3.52	4.35	2.00	3.52	1.69	1.96	1.25	3.31	1.47
13-Dec	3.49	4.75	1.93	3.36	1.96	2.05	1.29	2.74	1.84
14-Dec	3.65	4.87	2.08	3.56	1.84	1.72	1.37	1.70	1.16
15-Dec	3.04	5.40	1.60	3.74	1.87	2.00	1.46	0.40	1.25
16-Dec	3.46	5.00	1.79	3.80	1.90	1.53	1.58	1.46	1.75
17-Dec	3.52	4.73	1.62	3.80	1.71	1.61	1.58	0.10	2.00
18-Dec	2.99	4.71	1.49	3.96	1.59	1.57	1.60	0.12	1.80
19-Dec	2.89	4.57	1.44	3.93	1.52	1.74	1.80	0.11	1.77
20-Dec	2.65	4.18	1.54	3.74	1.80	1.96	1.78	0.11	1.72
21-Dec	2.40	4.13	1.75	3.60	2.03	1.98	1.32	0.16	1.99
22-Dec	2.41	3.83	1.75	3.45	2.08	1.94	1.37	0.23	1.69
23-Dec	2.39	3.82	1.67	3.41	1.89	1.98	1.33	0.18	1.14
24-Dec	2.43	3.90	1.86	3.30	2.35	1.80	1.29	0.25	1.41
25-Dec	2.43	3.62	1.98	3.30	2.23	2.04	0.84	0.30	1.61
26-Dec	2.30	3.73	1.81	3.32	2.30	1.85	0.93	0.15	1.73
27-Dec	2.21	3.42	1.41	3.31	2.42	1.76	0.62	0.28	1.86
28-Dec	2.12	3.27	1.47	3.19	2.43	1.29	0.79	0.37	1.63
29-Dec	2.23	3.10	1.17	3.09	2.59	1.16	0.72	0.29	1.57
30-Dec	2.08	2.98	0.82	3.14	2.68	1.31	0.59	0.21	1.49
31-Dec	2.12	3.15	1.08	2.78	2.79	1.44	0.34	0.34	1.38
1-Jan	2.17	4.59	1.15	2.31	2.93	1.23	0.38	0.33	1.51
2-Jan	2.35	4.84	0.97	1.63	3.00	1.42	0.61	0.30	1.70
3-Jan	2.53	5.11	0.34	1.09	3.03	1.57	0.93	0.11	1.72
4-Jan	2.54	5.16	0.26	0.57	3.10	1.53	1.14	0.16	1.45
5-Jan	2.57	5.06	0.49	0.16	3.17	1.24	1.36	0.34	1.75
6-Jan	2.72	4.95	0.48	0.38	3.26	1.64	0.87	0.35	1.41
7-Jan	3.23	4.62	0.74	0.60	3.38	1.85	1.12	0.64	1.37
8-Jan	3.33	4.58	1.04	0.62	3.33	1.73	1.11	0.84	1.76
9-Jan	2.92	4.27	1.13	0.62	3.49	2.00	1.28	0.51	2.04
10-Jan	2.99	3.92	1.31	0.56	3.71	1.62	1.23	0.63	2.17
11-Jan	2.97	4.04	1.24	0.54	3.64	0.55	1.38	0.84	2.30
12-Jan	3.13	4.25	1.21	0.58	3.28	0.63	1.32	0.94	2.10
13-Jan	3.07	4.24	1.27	0.47	3.50	1.23	1.50	1.04	2.18
14-Jan	2.78	3.20	1.29	0.44	3.67	1.23	1.49	1.09	2.33
15-Jan	2.60	2.66	1.31	0.50	3.19	0.92	0.73	1.15	2.43

Sample Date	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010
16-Jan	2.36	2.83	1.25	0.52	2.95	1.07	0.81	1.11	2.09
17-Jan	2.35	2.74	1.31	0.51	3.00	0.85	1.04	1.21	2.57
18-Jan	1.94	2.58	1.48	0.57	2.93	0.83	1.38	1.27	2.89
19-Jan	2.13	2.50	1.49	0.61	2.70	1.19	1.45	1.22	2.72
20-Jan	2.24	2.48	1.63	0.70	2.73	1.17	1.44	1.00	2.89
21-Jan	2.10	2.37	1.65	0.90	2.60	0.87	0.72	0.96	3.02
22-Jan	1.91	2.02	1.67	1.11	2.45	1.07	0.76	1.08	2.82
23-Jan	1.64	2.54	1.71	1.23	2.54	1.16	0.65	1.15	2.86
24-Jan	1.95	2.68	1.62	1.30	2.57	1.11	0.72	0.91	2.99
25-Jan	2.11	2.90	1.57	1.47	2.68	0.77	0.71	0.31	3.38
26-Jan	1.76	3.14	1.48	1.70	2.74	0.84	0.92	0.40	3.25
27-Jan	1.66	3.11		1.86	2.85	0.68	1.15	0.49	3.29
28-Jan	1.09	3.16		1.97	2.77	0.79	0.46	0.66	3.34
29-Jan	1.10	2.99		2.11	2.54	0.87	0.53	0.69	3.41
30-Jan	1.24	3.02		2.18	2.77	0.88	0.90	0.93	3.48
31-Jan	1.26	3.04		2.30	2.52	0.80	1.21	0.96	3.50
1-Feb	1.41	3.15		2.29	2.87	0.68	0.93	0.81	3.48
2-Feb	1.52	3.12		2.40	2.78	0.72	0.68	1.14	3.60
3-Feb	1.56	3.15		2.52	2.86	0.76	0.76	1.00	3.63
4-Feb	1.47	2.95		2.65	2.99	0.96	0.50	0.78	3.72
5-Feb	1.67	3.01		2.56	3.06	1.03	0.51	1.01	3.66
6-Feb	1.79	2.78		2.26	3.15	1.18	0.57	1.15	3.85
7-Feb	2.02	2.71		2.34	3.10	1.16	0.81	0.94	3.78
8-Feb	2.18	2.52		2.00	3.18	1.16	1.08	1.04	3.91
9-Feb	1.98	2.60		1.99	3.03	1.33	1.17	1.25	4.08
10-Feb	2.28	2.61		2.04	2.72	1.46	1.32	1.06	3.97
11-Feb	1.96	2.49		2.14	2.61	1.53	1.25	1.38	4.17
12-Feb	1.88	2.46		2.27	2.77	1.80	1.61	1.21	4.34
13-Feb	2.14	2.52		2.43	2.84	1.98	1.88	1.37	4.43
14-Feb	2.28	3.04		2.39	2.60	1.90	1.88	1.51	4.67
15-Feb	2.25	3.36		2.36	2.31	2.08	2.01	1.55	4.41
16-Feb	2.40	3.51		2.29	1.98	2.35	2.23	1.48	4.70
17-Feb	2.66	3.57		2.19	1.63	2.77	2.25	1.37	4.44
18-Feb	3.01	3.45		2.10	1.39	2.81	2.21	1.49	4.02
19-Feb	3.35	3.68		2.10	1.35	2.72	2.63	1.36	3.91
20-Feb	2.99	3.93		2.14	1.55	2.94	2.68	1.40	3.78
21-Feb	3.13	3.90		2.12	1.74	2.92	2.88	1.33	3.65
22-Feb	3.34	3.75		2.16	1.83	3.01	3.00	1.44	3.69
23-Feb	2.98	3.01		2.18	1.84	2.88	3.24	1.66	3.69
24-Feb	2.28	2.67		2.34	1.82	2.79	3.13	1.87	4.09
25-Feb	1.89	2.58		2.61	1.84	2.94	3.50	1.59	4.20
26-Feb	2.40	3.04		2.69	1.97	2.91	3.43	0.92	4.26
27-Feb		3.21		2.84	2.38	2.87	3.50	1.43	4.62
28-Feb		3.29		3.00	2.28	2.82	3.65	1.78	4.80
29-Feb							3.82		
1-Mar		3.37		3.30	2.43	2.65	3.77	2.14	4.97
2-Mar		3.63		3.39	2.46	2.45	3.92	2.21	5.03
3-Mar		3.81		3.53	2.63	2.43	4.09	2.10	5.15
4-Mar		3.96		3.81	2.68	2.35	4.22	2.31	5.44
5-Mar		4.35		3.95	2.82	2.39	4.18	2.26	5.54
6-Mar		3.99		4.00	3.19	2.73	4.50	2.29	5.56
7-Mar		2.88		4.26	3.30	3.11	5.03	2.57	5.63
8-Mar		2.38		4.26	3.16	3.13	5.49	2.38	5.50
9-Mar		2.41		4.48	3.19	3.49	5.23	2.23	5.27
10-Mar		3.30		4.63	3.11	3.50	5.34	1.77	5.28
11-Mar		3.59		4.77	3.26	3.71	5.21	2.48	5.18
12-Mar		4.01		4.83	3.28	4.31	4.97	2.93	5.43
13-Mar		5.26		5.01	3.41	4.28	5.09	3.01	5.62
14-Mar		5.56		5.17	3.56	4.38	5.26	3.10	5.66
15-Mar		5.20		5.41	3.79	4.37	5.43	3.18	6.28
16-Mar		5.52		5.21	3.89	4.44	5.48	3.41	6.70
17-Mar		5.61		5.29	4.10	4.60	5.71	3.64	6.67
18-Mar		5.71		5.63	4.13	4.78	6.08	3.87	6.64
19-Mar		5.67		5.51	4.34	5.00	5.57	4.23	6.58

Sample Date	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010
20-Mar		5.96		5.49	4.65	5.09	5.79	4.34	6.74
21-Mar		6.29		5.49	4.75	5.05	5.94	4.10	6.73
22-Mar		6.73		5.45	4.85	5.62	5.77	4.34	6.99
23-Mar		6.29		5.41	5.02	5.33	5.77	4.48	7.39
24-Mar		6.48		5.57		5.84	5.69	4.81	7.52
25-Mar		6.67		5.92		6.06	5.61	5.06	7.67
26-Mar		6.52		5.69		6.29	5.54	5.19	7.74
27-Mar		7.16		5.71		6.54	5.54	5.62	8.07
28-Mar		7.60		5.87		6.73	5.15	5.28	8.05
29-Mar		7.65		5.83		6.85	5.59	5.33	8.23
30-Mar		8.15		6.09		6.89	5.81	4.99	7.73
31-Mar		8.12		6.05		7.02	5.75	5.07	7.91
1-Apr		8.00		6.28		6.93	5.81	4.87	7.86
2-Apr		7.74		6.16		6.93	6.12	5.03	7.19
3-Apr		7.60		6.47		6.67	6.30	5.35	7.42
4-Apr		8.04		6.89		6.66	6.24	5.58	7.68
5-Apr		8.21		6.88		6.87	6.55	5.93	7.62
6-Apr		8.30		7.16		7.49	6.71	6.36	8.05
7-Apr		8.36		7.46		7.96	6.79	7.08	7.63
8-Apr		9.11		7.38		8.21	6.90	7.97	7.81
9-Apr		9.46		7.92		7.52	7.02	8.19	7.52
10-Apr		8.76		7.96		7.34	7.31	8.36	7.80
11-Apr		9.42		7.58		7.78	7.59	8.47	7.97
12-Apr		8.91		7.56		8.11	8.13	8.17	8.38
13-Apr		8.37		7.69		8.22	8.52	8.07	8.80
14-Apr		8.00		7.76		7.90	8.47	8.05	9.41
15-Apr		8.62		7.50		8.20	8.48	8.08	10.05
16-Apr		9.16		7.33		8.24	8.69	8.99	10.53
17-Apr		8.87		7.48		8.27	9.13	8.82	11.17
18-Apr		9.36		8.05		8.48	8.79	8.84	11.58
19-Apr		9.53		8.44		8.92	8.26	9.55	11.48
20-Apr		9.89		8.39		8.93	8.19	9.67	11.39
21-Apr		10.12		8.89		8.84	8.15	10.32	10.64
22-Apr		9.98		9.21		9.51	8.26	10.40	9.60
23-Apr		9.44		9.34		10.17	8.19	9.65	9.32
24-Apr		8.31		9.57		10.23	8.11	9.85	9.47
25-Apr		7.46		9.91		10.28	8.57	10.26	9.87
26-Apr		7.62		10.47		9.87	8.90	10.55	10.14
27-Apr		8.62		10.16		9.84	9.05	10.73	9.37
28-Apr		9.34		9.83		10.21	9.48	10.26	8.91
29-Apr		9.78		9.95		10.26	9.61	10.32	9.53
30-Apr		10.70		10.09		10.15	9.59	11.01	10.19
1-May		10.55		10.82		10.16	9.81	11.57	10.41
2-May		9.83		11.63		10.05	10.08	11.59	10.41
3-May		9.67		11.76		9.83	10.63	11.27	9.65
4-May		9.36		12.16		9.95	11.25	10.50	9.80
5-May		9.44		12.43		10.35	11.08	10.52	10.21
6-May		9.92		13.05		10.73	10.77	10.18	10.87
7-May		10.42		13.20		11.30	10.57	10.21	10.41
8-May		11.16		13.29		11.63	10.30	11.17	10.92
9-May		11.42		12.54		11.46	11.07	11.56	11.55
10-May		11.71		12.44		11.78	10.44	11.74	12.00
11-May		11.58		13.38		12.28	10.21	12.03	12.10
12-May		11.97		14.50		12.75	11.20	11.37	12.56
13-May		11.85		14.87		12.96	10.55	11.05	13.07
14-May		11.85		14.93		13.21	10.13	11.40	12.98
15-May		10.26		14.51		13.47	9.77	11.95	12.25

Table 13B. Daily mean water temperatures during Okanagan Sockeye spawning and incubation September 2010 to May 2016. Water temperatures are from the HOBO Tidbit temperature monitor installed at Transect 2 (Figure 1).

Sample Date	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
15-Sep			18.57	21.69	17.50
16-Sep			18.42	21.46	17.61
17-Sep			18.32	21.06	17.56
18-Sep	17.28		18.32	20.77	17.47
19-Sep	17.06		18.26	20.06	17.64
20-Sep	16.51		18.28	19.56	17.70
21-Sep	16.15		18.24	19.40	17.94
22-Sep	15.63	17.80	18.24	18.81	18.02
23-Sep	15.35	18.05	18.20	17.92	17.89
24-Sep	15.31	18.15	18.12	17.27	17.63
25-Sep	15.59	17.87	18.26	16.66	17.38
26-Sep	16.00	16.75	17.91	16.54	17.24
27-Sep	16.39	16.62	17.84	15.95	17.24
28-Sep	16.55	16.27	17.72	15.58	17.14
29-Sep	16.06	16.08	17.77	14.85	17.01
30-Sep	16.10	16.01	17.48	14.24	16.77
1-Oct	16.20	15.78	17.07	13.41	16.26
2-Oct	16.45	15.68	16.14	13.34	15.89
3-Oct	16.23	15.50	15.35	13.20	15.39
4-Oct	16.21	15.36	14.98	12.92	15.41
5-Oct	15.73	14.93	14.61	12.81	15.53
6-Oct	15.22	14.82	14.37	12.73	15.59
7-Oct	15.11	14.55	14.36	12.81	15.86
8-Oct	15.53	14.14	14.32	12.69	15.88
9-Oct	15.09	14.13	14.26	12.45	15.61
10-Oct	15.04	13.98	14.18	12.50	15.46
11-Oct	14.16	13.89	14.16	12.11	15.31
12-Oct	14.07	13.63	14.04	12.28	15.03
13-Oct	13.94	13.27	13.89	12.12	14.79
14-Oct	13.49	13.11	13.87	11.87	14.75
15-Oct	13.34	12.78	13.89	11.74	14.50
16-Oct	12.39	12.61	13.74	11.90	14.04
17-Oct	11.95	12.52	13.26	11.65	13.79
18-Oct	11.81	12.41	12.86	11.49	13.60
19-Oct	11.65	12.35	12.57	11.42	13.76
20-Oct	11.62	12.31	12.13	11.40	13.54
21-Oct	11.51	12.00	11.58	11.45	13.45
22-Oct	11.69	11.96	11.16	11.42	12.92
23-Oct	11.48	11.65	11.03	11.37	12.71
24-Oct	11.64	11.39	10.75	11.22	12.34
25-Oct	10.99	11.11	10.63	11.08	12.34
26-Oct	10.78	10.55	10.40	10.90	12.14
27-Oct	10.89	10.22	10.08	10.69	11.68
28-Oct	10.68	9.86	10.07	10.27	11.15
29-Oct	10.66	9.57	10.09	9.91	11.13
30-Oct	10.69	9.46	10.08	9.64	11.13
31-Oct	10.50	9.39	10.12	9.56	11.12
1-Nov	10.39	9.08	10.16	9.07	10.63
2-Nov	10.33	8.49	10.03	9.16	10.20
3-Nov	9.43	8.51	10.06	8.88	10.22
4-Nov	8.93	8.12	10.23	8.63	10.44
5-Nov	9.64	7.56	10.27	8.17	10.12
6-Nov	10.01	7.22	9.92	8.12	10.33
7-Nov	10.30	6.74	9.78	7.92	10.11
8-Nov	8.74	6.91	9.00	7.96	9.71
9-Nov	8.17	6.96	8.42	7.60	9.61
10-Nov	8.36	6.76	7.58	7.75	8.97
11-Nov	7.95	6.51	6.98	7.79	8.11
12-Nov	7.72	6.37	6.99	7.68	7.53
13-Nov	7.69	6.27	7.04	7.88	6.79

Sample Date	2010- 2011	2011- 2012	2012- 2013	2013- 2014	2014- 2015
14-Nov	7.98	5.83	7.19	7.76	6.07
15-Nov	7.86	5.45	7.00	7.28	5.56
16-Nov	7.82	4.74	6.99	7.00	5.13
17-Nov	7.69	4.70	6.95	6.65	4.81
18-Nov	7.16	4.65	6.67	6.64	4.71
19-Nov	5.57	4.43	6.83	6.84	4.89
20-Nov	4.12	4.12	6.95	5.47	4.89
21-Nov	3.08	3.95	6.71	4.92	4.70
22-Nov	1.87	4.29	6.21	4.68	4.68
23-Nov	0.27	5.01	6.12	4.43	4.43
24-Nov	0.03	4.29	6.22	4.48	4.19
25-Nov	0.46	4.33	5.65	4.33	4.13
26-Nov	1.13	4.12	5.24	4.11	3.97
27-Nov	2.48	4.15	5.23	3.96	4.26
28-Nov	2.63	3.85	5.19	3.95	4.03
29-Nov	1.97	3.91	5.31	3.68	1.73
30-Nov	2.07	3.93	5.48	3.74	0.83
1-Dec	2.77	3.30	5.84	3.77	1.06
2-Dec	2.76	3.21	5.70	3.48	1.27
3-Dec	2.45	3.32	5.59	2.34	1.71
4-Dec	2.37	3.25	5.78	1.69	1.86
5-Dec	1.41	2.91	5.59	1.24	1.97
6-Dec	1.98	2.81	5.30	1.27	2.11
7-Dec	2.10	2.60	4.92	0.95	2.21
8-Dec	2.71	2.30	4.59	1.20	2.28
9-Dec	2.95	2.07	4.26	1.02	2.64
10-Dec	3.08	2.07	4.30	1.18	2.72
11-Dec	2.86	2.06	4.09	1.25	2.43
12-Dec	2.61	1.78	4.04	1.47	2.24
13-Dec	3.34	1.45	3.91	1.36	2.36
14-Dec	3.43	1.72	3.68	1.37	2.53
15-Dec	2.52	1.64	3.53	1.63	2.57
16-Dec	2.43	1.74	3.39	1.63	2.50
17-Dec	2.70	1.89	3.27	1.72	2.70
18-Dec	1.87	1.97	2.83	1.74	2.96
19-Dec	2.15	1.49	2.63	1.39	3.13
20-Dec	2.01	1.66	2.77	1.37	3.25
21-Dec	2.12	1.43	2.72	1.65	3.40
22-Dec	2.14	1.10	2.50	1.63	3.12
23-Dec	2.37	1.37	2.78	1.74	3.29
24-Dec	2.70	1.57	2.77	1.46	3.21
25-Dec	2.82	1.64	2.65	1.38	3.03
26-Dec	2.73	1.44	2.77	1.61	2.93
27-Dec	2.31	1.73	2.82	1.48	2.77
28-Dec	2.78	2.08	2.77	1.54	2.77
29-Dec	2.36	2.05	2.54	1.53	2.15
30-Dec	0.88	2.05	2.49	1.62	1.05
31-Dec	0.22	1.61	2.30	1.77	0.86
1-Jan	0.86	1.74	1.89	1.60	0.83
2-Jan	1.10	1.59	1.83	1.80	0.70
3-Jan	1.14	1.84	1.75	1.72	0.91
4-Jan	1.13	2.26	1.64	1.55	0.95
5-Jan	1.20	2.01	1.54	1.46	0.94
6-Jan	1.47	1.86	1.59	1.61	1.36
7-Jan	1.55	1.62	1.44	1.74	1.46
8-Jan	1.45	1.98	1.33	1.82	1.46
9-Jan	1.02	2.10	1.42	1.83	1.42
10-Jan	1.19	1.76	1.11	1.88	1.48
11-Jan	1.29	0.99	0.77	2.20	1.49
12-Jan	1.21	0.96	0.60	1.95	1.58
13-Jan	1.42	1.21	0.89	2.20	1.64
14-Jan	1.78	1.21	1.02	2.16	1.69
15-Jan	1.85	1.08	0.97	2.32	1.65
16-Jan	2.05	1.16	1.20	2.32	1.86

Sample Date	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
17-Jan	2.02	0.80	1.22	2.42	1.81
18-Jan	1.85	0.12	1.33	2.46	1.99
19-Jan	1.66	0.27	1.43	2.53	2.01
20-Jan	1.92	0.57	1.41	2.51	1.91
21-Jan	2.00	0.85	1.41	2.42	2.05
22-Jan	1.97	0.89	1.12	2.49	2.20
23-Jan	2.09	0.95	1.29	2.58	2.33
24-Jan	2.09	0.74	1.62	2.62	2.33
25-Jan	2.23	0.91	1.66	2.54	2.48
26-Jan	2.29	0.86	1.95	2.55	2.49
27-Jan	2.43	0.60	1.91	2.64	2.54
28-Jan	2.39	0.66	1.84	2.58	2.58
29-Jan	2.27	1.06	2.04	2.41	2.65
30-Jan	1.60	1.24	2.20	2.37	2.71
31-Jan	1.63	1.31	2.02	1.95	2.72
1-Feb	1.88	1.62	1.93	1.74	2.74
2-Feb	2.21	1.40	1.73	1.80	2.75
3-Feb	2.09	1.38	1.95	1.35	2.88
4-Feb	2.15	1.51	2.27	1.17	2.95
5-Feb	2.56	1.83	2.33	0.93	3.16
6-Feb	2.05	1.91	2.29	0.82	3.73
7-Feb	2.36	1.98	2.46	1.04	3.79
8-Feb	1.97	2.15	2.37	0.89	3.98
9-Feb	1.82	2.29	2.68	1.07	4.18
10-Feb	2.05	2.33	2.67	1.13	4.35
11-Feb	2.17	2.50	2.45	1.09	4.51
12-Feb	2.45	2.49	2.65	1.60	4.55
13-Feb	2.50	2.48	2.73	1.69	4.65
14-Feb	2.75	2.16	2.69	1.91	4.71
15-Feb	2.83	2.35	2.76	2.44	4.52
16-Feb	2.91	2.43	2.87	2.55	4.33
17-Feb	3.22	2.74	2.89	2.41	4.12
18-Feb	3.18	2.75	2.85	2.34	4.01
19-Feb	2.38	2.71	2.91	2.39	3.95
20-Feb	2.62	2.92	2.79	2.43	4.13
21-Feb	3.00	2.66	2.87	2.42	4.03
22-Feb	3.29	3.02	2.95	2.32	3.72
23-Feb	2.61	3.06	3.02	2.18	3.69
24-Feb	1.96	3.09	2.95	1.96	3.87
25-Feb	1.52	3.45	3.00	1.75	3.98
26-Feb	1.86	2.90	3.02	1.62	4.16
27-Feb	1.89	2.70	3.18	1.63	4.10
28-Feb	2.28	3.05	3.26	1.68	3.89
29-Feb		3.31			
1-Mar	2.02	3.41	3.66	1.62	3.87
2-Mar	1.80	3.27	3.80	1.42	3.97
3-Mar	2.01	3.51	3.57	1.38	3.72
4-Mar	2.11	3.81	3.53	1.35	3.61
5-Mar	2.63	3.86	3.58	1.55	3.70
6-Mar	2.86	3.30	3.60	1.98	4.05
7-Mar	3.08	3.67	3.69	2.36	4.31
8-Mar	3.09	3.79	3.91	2.67	4.54
9-Mar	3.43	4.28	4.06	3.08	4.70
10-Mar	4.02	4.56	4.08	3.26	5.09
11-Mar	3.75	4.36	4.26	3.39	5.81
12-Mar	4.16	3.44	4.70	3.66	5.99
13-Mar	3.96	3.55	5.14	3.75	6.04
14-Mar	4.04	3.65	5.34	4.14	6.52
15-Mar	4.05	4.22	5.49	4.14	5.81
16-Mar	4.16	4.25	5.51	4.40	6.19
17-Mar	4.31	3.96	5.41	4.45	6.40
18-Mar	4.51	3.99	5.30	4.50	6.94
19-Mar	4.46	4.34	5.15	4.56	7.05
20-Mar	4.66	4.41	5.15	4.61	6.91

Sample Date	2010- 2011	2011- 2012	2012- 2013	2013- 2014	2014- 2015
21-Mar	5.25	4.65	5.04	4.67	6.55
22-Mar	5.62	5.01	4.98	4.54	6.27
23-Mar	5.56	4.94	5.09	4.71	6.59
24-Mar	5.26	4.88	5.16	4.83	7.01
25-Mar	5.85	4.76	5.11	4.77	6.99
26-Mar	5.81	4.94	5.35	5.06	7.14
27-Mar	5.88	5.55	5.82	5.38	7.40
28-Mar	6.13	5.84	6.31	5.26	7.23
29-Mar	6.58	5.89	6.68	5.35	7.24
30-Mar	6.78	6.42	7.48	5.50	7.70
31-Mar	7.32	6.09	7.87	5.66	7.29
1-Apr	7.27	6.31	8.17	6.17	7.13
2-Apr	6.99	6.38	8.45	6.46	7.48
3-Apr	7.49	6.84	8.76	6.48	7.75
4-Apr	7.25	6.60	8.67	6.33	7.70
5-Apr	7.34	6.89	8.18	6.37	7.73
6-Apr	7.00	7.22	7.62	6.81	8.09
7-Apr	7.10	7.41	7.12	7.11	8.09
8-Apr	7.46	7.52	7.64	7.47	8.40
9-Apr	7.96	8.29	7.87	7.94	8.65
10-Apr	8.01	8.55	7.65	8.09	8.47
11-Apr	8.01	8.80	7.33	8.47	8.34
12-Apr	7.71	8.88	7.08	8.90	8.11
13-Apr	7.97	9.10	7.14	9.09	8.28
14-Apr	7.71	9.13	7.17	8.99	8.23
15-Apr	7.77	9.60	7.30	8.96	8.31
16-Apr	7.96	9.36	7.53	8.93	8.71
17-Apr	7.89	9.29	7.56	9.06	8.40
18-Apr	8.11	9.43	7.82	8.95	9.44
19-Apr	8.14	9.19	8.18	8.75	10.03
20-Apr	8.06	9.68	8.51	9.02	10.43
21-Apr	7.97	9.75	7.99	9.13	10.71
22-Apr	8.36	10.32	8.12	9.03	10.41
23-Apr	8.55	10.33	8.32	8.94	10.11
24-Apr	8.54	10.65	8.52	9.10	9.76
25-Apr	8.79	9.61	8.96	9.24	9.56
26-Apr	9.09	7.06	9.17	9.56	10.09
27-Apr	9.28	7.04	9.04	9.15	10.29
28-Apr	8.89	8.76	8.51	9.40	10.72
29-Apr	9.05	9.63	8.24	9.72	10.75
30-Apr	9.51	9.29	8.54	10.02	10.59
1-May	9.66	9.33	8.75	10.44	11.38
2-May	9.18	9.50	9.13	10.42	11.24
3-May	9.45	9.22	9.56	10.37	11.29
4-May	9.76	8.92	9.57	10.34	11.51
5-May	9.68	9.00	9.57	9.93	10.80
6-May	9.86	9.24	9.95	10.06	11.02
7-May	9.88	9.39	10.27	10.60	11.62
8-May	9.96	9.54	10.48	10.65	11.96
9-May	10.27	9.51	10.84	9.97	12.32
10-May	10.30	9.21	11.25	9.86	12.61
11-May	9.90	9.22	11.59	10.23	12.97
12-May	9.20	10.05	11.70	10.47	12.81
13-May	9.49	10.47	11.51	11.15	12.66
14-May	9.00	11.06	11.28	11.60	12.67
15-May	8.35	11.29	12.20	11.88	12.71

Table 14A. Identity of supplementary water temperature data loggers installed at various locations and depths throughout the Index Section of the Okanagan River Sockeye Salmon spawning grounds in 2000-2001. (Summit 2002; Figure 1).

Transect	Name	Habitat Type	Data Logger Location
1	Redd 1	Run-end	Channel Bed: 0.2m deep in substrate, ~ 5m from water's edge
2	Redd 2	Margin	Channel Bed: 0.2m deep in substrate, ~ 7m from water's edge
2	Surface 2	Margin	Surface water
3	Redd 3	Side-channel	Channel Bed: 0.2m deep in substrate, mid-channel
4	Redd 4	Margin	Channel Bed: 0.3m deep in substrate, ~ 3m from water's edge
4	Surface 4	Margin	Surface water
5	Redd 5	Riffle	Channel Bed: 0.2m deep in substrate, ~ 5m from water's edge
6	Redd 6	Deep Riffle	Channel Bed: 0.2m deep in substrate, ~ 5m from water's edge
7	Redd 7	Deep Riffle	Channel Bed: 0.2m deep in substrate, ~ 5m from water's edge
7	Surface 7	Deep Riffle	Surface water

Table 14B. Supplementary water temperature observations by location (and depth) throughout the Index Section of the Okanagan River Sockeye Salmon spawning grounds in 2000-2001 (Summit 2002). Locations are identified in Table 12A and Figure 1.

Date	Redd 1	Redd 2	Surface 2	Redd 3	Redd 4	Surface 4	Redd 5	Redd 6	Redd 7	Surface 7
25-Oct-00					10.41	11.61			11.24	11.39
26-Oct-00					10.44	10.32			10.33	10.13
27-Oct-00					10.33	10.22			10.29	10.06
28-Oct-00					10.23	10.19			10.33	10.16
29-Oct-00					10.12	10.01			10.19	9.98
30-Oct-00					10.04	9.88			10.06	9.79
31-Oct-00					9.68	9.57			9.67	9.41
1-Nov-00					9.39	9.21			9.36	9.08
2-Nov-00					9.08	8.93			9.03	8.54
3-Nov-00					9.18	8.95			9.12	8.90
4-Nov-00					8.98	8.82			9.05	8.69
5-Nov-00					8.75	8.44			8.78	8.44
6-Nov-00					8.54	8.24			8.61	8.13
7-Nov-00					8.31	7.96			8.25	6.99
8-Nov-00					8.28	8.01			8.31	7.64
9-Nov-00					8.03	7.77			8.13	7.44
10-Nov-00					7.41	7.05			7.49	6.63
11-Nov-00					7.07	6.82			7.05	6.22
12-Nov-00					7.02	6.82			7.08	6.50
13-Nov-00					6.58	6.46			6.71	5.96
14-Nov-00	6.30	6.12			6.47		6.51	6.30	6.70	5.99
15-Nov-00	6.22	5.93			6.34		6.40	6.22	6.62	6.12
16-Nov-00	5.80	5.54			5.88		6.04	5.81	6.21	5.68
17-Nov-00	5.64	5.35			5.69		5.83	5.66	6.11	5.50
18-Nov-00	5.56	5.35			5.74		5.75	5.55	6.16	5.44
19-Nov-00	5.28	4.97			5.43		5.49	5.27	5.93	4.98
20-Nov-00	5.23	4.92			5.30		5.44	5.29	5.92	5.13
21-Nov-00	4.81	4.54			4.91		5.00	4.82	5.48	4.46
22-Nov-00	4.52	4.20			4.67		4.74	4.46	5.15	4.04
23-Nov-00	4.21	3.91			4.31		4.37	4.15	4.89	3.55
24-Nov-00	3.87	3.62			3.99		4.10	3.94	4.66	3.26
25-Nov-00	3.71	3.52			3.94		3.98	3.84	4.52	3.37
26-Nov-00	3.66	3.47			3.94		4.00	3.81	4.52	3.52
27-Nov-00	3.76	3.52			3.99		4.11	3.97	4.65	3.92
28-Nov-00	3.52	3.27			3.78		3.82	3.68	4.42	3.52
29-Nov-00	3.39	3.22			3.65		3.74	3.55	4.34	3.39
30-Nov-00	3.50	3.27			3.84		3.90	3.73	4.41	3.60

Date	Redd 1	Redd 2	Surface 2	Redd 3	Redd 4	Surface 4	Redd 5	Redd 6	Redd 7	Surface 7
1-Dec-00	3.60	3.32			3.94		4.00	3.89	4.52	3.89
2-Dec-00	3.55	3.32			3.86		3.92	3.81	4.47	3.68
3-Dec-00	3.42	3.22			3.68		3.82	3.68	4.36	3.60
4-Dec-00	3.24	3.08			3.55		3.53	3.39	4.03	3.13
5-Dec-00	3.26	3.03			3.49		3.61	3.44	4.05	3.37
6-Dec-00	3.05	2.88			3.31		3.37	3.16	3.95	3.05
7-Dec-00	3.00	2.68			3.23		3.32	3.18	3.92	2.98
8-Dec-00	2.79	2.53			3.07		3.24	3.00	3.79	1.76
9-Dec-00	2.57	2.34			2.84		2.90	2.73	3.50	0.94
10-Dec-00	1.89	1.60			1.91		2.21	1.94	3.01	-0.45
11-Dec-00	0.72	0.46			0.90		0.91	0.69	1.88	-1.31
12-Dec-00	0.69	0.41			0.95		0.97	0.74	1.66	0.41
13-Dec-00	0.90	0.71			1.19		1.23	0.98	1.98	0.81
14-Dec-00	0.66	0.46			0.95		1.02	0.74	1.85	0.44
15-Dec-00	0.37	0.02			0.50		0.51	0.29	1.45	0.04
16-Dec-00	0.66	0.46			0.90		0.78	0.56	1.32	0.15
17-Dec-00	1.14	0.86			1.40		1.39	1.22	1.90	0.97
18-Dec-00	0.90	0.71			1.22		1.18	0.98	1.77	0.67
19-Dec-00	1.17	0.96			1.51		1.63	1.49	2.08	1.37
20-Dec-00	0.72	0.46			1.00		1.02	0.82	1.72	0.60
21-Dec-00	0.93	0.66			1.22		1.28	1.09	1.82	0.97
22-Dec-00	1.12	0.91			1.51		1.55	1.33	2.01	1.29
23-Dec-00	1.17	1.01			1.62		1.65	1.54	2.27	1.55
24-Dec-00	1.25	1.01			1.78		1.76	1.65	2.32	1.63
25-Dec-00	1.22	1.06			1.76		1.81	1.65	2.43	1.71
26-Dec-00	1.41	1.26			1.92		2.00	1.89	2.51	2.00
27-Dec-00	1.41	1.26			1.86		1.97	1.83	2.59	1.90
28-Dec-00	1.25	1.06			1.75		1.65	1.54	2.30	1.39
29-Dec-00	1.46	1.31			1.89		1.94	1.75	2.43	1.71
30-Dec-00	1.57	1.36			1.99		2.02	1.83	2.59	1.82
31-Dec-00	1.78	1.55			2.20		2.24	2.07	2.72	2.08
1-Jan-01	1.92	1.75			2.42		2.42	2.28	2.90	2.34
2-Jan-01	1.89	1.65			2.36		2.37	2.25	2.90	2.21
3-Jan-01	1.84	1.65			2.28		2.32	2.17	2.90	2.11
4-Jan-01	1.97	1.85			2.47		2.42	2.25	2.93	2.29
5-Jan-01	2.16	1.95			2.55		2.69	2.54	3.19	2.58
6-Jan-01	1.81	1.60			2.15		2.16	1.91	2.80	1.79
7-Jan-01	1.76	1.50			2.02		1.92	1.67	2.54	1.50
8-Jan-01	1.97	1.70			2.28		2.18	1.96	2.61	1.84
9-Jan-01	2.26	2.04			2.68		2.72	2.52	3.03	2.53
10-Jan-01	2.39	2.19			2.81		2.85	2.68	3.24	2.71
11-Jan-01	2.18	1.94			2.58		2.61	2.41	3.11	2.40
12-Jan-01	2.31	2.19			2.76		2.74	2.60	3.16	2.61
13-Jan-01	2.41	2.19			2.81		2.87	2.68	3.32	2.77
14-Jan-01	2.39	2.14			2.84		2.74	2.62	3.24	2.53
15-Jan-01	2.31	2.04			2.68		2.79	2.62	3.29	2.58
16-Jan-01	1.89	1.70			2.26		2.16	1.94	2.77	1.74
17-Jan-01	2.05	1.90			2.39		2.32	2.12	2.72	2.00
18-Jan-01	2.31	2.14			2.71		2.63	2.46	2.90	2.35
19-Jan-01	2.31	2.09			2.66		2.66	2.49	3.03	2.45
20-Jan-01	2.05	1.90			2.47		2.50	2.33	2.95	2.26
21-Jan-01	1.94	1.80			2.36		2.42	2.20	2.85	2.21
22-Jan-01	2.02	1.85			2.47		2.48	2.36	2.90	2.35
23-Jan-01	1.97	1.82			3.26		2.41	2.29	2.73	3.78
24-Jan-01	1.86	1.70		2.95	2.28	2.05	2.37	2.25	2.46	2.16
25-Jan-01	1.89	1.70		3.24	2.23	2.16	2.21	2.10	2.27	2.13
26-Jan-01	2.05	1.85		3.19	2.44	2.29	2.50	2.36	2.61	2.40
27-Jan-01	1.86	1.70		2.92	2.31	2.08	2.37	2.20	2.46	2.16
28-Jan-01	1.49	1.35		3.03	1.94	1.68	1.89	1.75	2.00	1.63
29-Jan-01	1.46	1.31		2.98	1.86	1.63	1.87	1.70	1.90	1.61
30-Jan-01	1.57	1.41		2.98	1.80	1.68	1.84	1.70	1.85	1.66
31-Jan-01	1.81	1.65		3.37	2.26	2.08	2.32	2.18	2.43	2.16
1-Feb-01	1.57	1.40		3.19	1.94	1.84	2.00	1.78	2.06	1.87
2-Feb-01	1.86	1.65		3.37	2.34	2.18	2.45	2.36	2.67	2.50

Date	Redd 1	Redd 2	Surface 2	Redd 3	Redd 4	Surface 4	Redd 5	Redd 6	Redd 7	Surface 7
3-Feb-01	1.62	1.40		3.27	2.05	1.87	2.10	1.96	2.27	2.00
4-Feb-01	1.81	1.55		3.66	2.15	2.05	2.19	2.07	2.35	2.14
5-Feb-01	1.94	1.80		3.69	2.42	2.19	2.50	2.36	2.72	2.34
6-Feb-01	1.49	1.26		2.89	1.81	1.50	1.79	1.62	2.16	1.37
7-Feb-01	1.68	1.40		3.26	1.78	1.58	1.79	1.54	1.98	1.34
8-Feb-01	1.94	1.75		4.53	2.15	2.00	2.13	1.94	2.30	1.77
9-Feb-01	2.36	2.14		4.87	2.60	2.45	2.69	2.52	2.69	2.40
10-Feb-01	2.36	2.14		4.16	2.76	2.61	2.77	2.65	2.95	2.66
11-Feb-01	2.05	1.85		3.76	2.55	2.26	2.61	2.49	2.98	2.42
12-Feb-01	1.78	1.65		3.29	2.12	1.97	2.13	1.99	2.45	1.95
13-Feb-01	1.78	1.65		3.45	2.15	1.97	2.16	2.02	2.45	2.00
14-Feb-01	2.08	1.85		4.03	2.47	2.29	2.50	2.41	2.80	2.50
15-Feb-01	1.68	1.45		4.21	2.02	1.63	2.05	1.91	2.40	1.68
16-Feb-01	1.78	1.60		4.11	2.05	1.76	2.05	1.88	2.30	1.77
17-Feb-01	1.86	1.65		3.87	2.10	1.79	2.05	1.86	2.30	1.68
18-Feb-01	2.07	1.85		4.16	2.36	2.21	2.40	2.26	2.53	2.24
19-Feb-01	2.21	1.99		4.71	2.71	2.42	2.77	2.73	3.01	2.71
20-Feb-01		4.07	4.04	5.40	2.50	2.97	4.64	3.59	4.13	2.37
21-Feb-01		2.19	2.56	2.98	2.79	2.53	2.82	2.73	3.01	2.74
22-Feb-01		2.29	2.66	3.11	2.86	2.71	2.95	2.86	3.19	3.05
23-Feb-01		2.34	2.72	3.19	2.89	2.66	2.90	2.78	3.14	2.82
24-Feb-01		2.73	3.06	3.53	3.28	3.05	3.40	3.28	3.56	3.45
25-Feb-01		2.88	3.24	3.74	3.34	3.03	3.47	3.34	3.58	3.42
26-Feb-01		3.08	3.37	3.82	3.55	3.02	3.48	3.33	3.66	3.41
27-Feb-01		3.22	3.58	4.21	3.73	3.26	3.68	3.57	3.87	3.62
28-Feb-01		3.32	3.69	4.13	3.76	3.26	3.79	3.60	3.84	3.60
1-Mar-01		3.37	3.71	4.21	3.92	3.50	3.82	3.65	3.87	3.58
2-Mar-01		3.71	4.00	4.50	4.07	3.91	4.16	4.04	4.29	4.07
3-Mar-01		3.76	4.03	4.50	4.28	3.78	4.21	4.12	4.34	4.20
4-Mar-01		3.91	4.24	4.60	4.41	4.04	4.37	4.22	4.50	4.33
5-Mar-01		4.15	4.50	4.79	4.67	4.56	4.71	4.61	4.78	4.77
6-Mar-01		4.34	4.66	5.02	4.88	4.69	4.94	4.87	5.09	5.13
7-Mar-01		4.44	4.79	5.18	5.01	4.80	5.07	5.00	5.25	5.26
8-Mar-01		4.49	4.82	5.23	5.07	4.88	5.00	4.90	5.17	4.98
9-Mar-01		4.73	5.05	5.44	5.12	5.00	5.31	5.24	5.48	5.49
10-Mar-01		4.29	4.63	5.00	4.70	4.51	4.79	4.69	5.04	4.64
11-Mar-01		4.53	4.87	5.31	5.17	4.90	5.15	5.06	5.30	5.29
12-Mar-01		4.87	5.20	5.59	5.48	5.26	5.44	5.32	5.61	5.55
13-Mar-01		5.16	5.44	5.77	5.56	5.55	5.70	5.63	5.87	6.01
14-Mar-01		4.78	5.02	5.49	5.14	5.06	5.34	5.24	5.61	5.49
15-Mar-01		4.44	4.79	5.26	4.88	4.64	4.92	4.77	5.17	4.72
16-Mar-01		5.06	5.28	5.75	5.53	5.42	5.54	5.47	5.69	5.60
17-Mar-01		5.31	5.70	5.98	5.90	5.84	5.96	5.86	6.03	5.99
18-Mar-01		5.45	5.75	5.96	5.95	5.84	5.86	5.79	5.98	5.96
19-Mar-01		5.88	6.14	6.43	6.32	6.30	6.48	6.46	6.55	6.81
20-Mar-01		6.02	6.35	6.55	6.39	6.38	6.59	6.53	6.68	6.86
21-Mar-01		5.88	6.12	6.40	6.32	6.07	6.35	6.22	6.52	6.48
22-Mar-01		6.46	6.66	6.92	6.83	6.61	6.87	6.77	6.88	7.10
23-Mar-01		6.46	6.72	7.00	6.89	6.72	6.87	6.77	6.93	7.05
24-Mar-01		6.36	6.69	6.97	6.86	6.66	6.82	6.66	6.85	6.81
25-Mar-01		6.56	6.85	7.08	6.91	6.92	6.98	6.87	7.04	7.02
26-Mar-01		6.60	6.84	7.13	6.94	6.95	7.08	7.05	7.19	7.15
27-Mar-01		5.83	6.17	6.48	6.21	5.99	6.20	6.02	6.50	5.86
28-Mar-01		6.07	6.43	6.71	6.45	6.41	6.51	6.40	6.62	6.48
29-Mar-01		5.74	6.07	6.43	6.14	5.94	6.11	5.99	6.31	5.99
30-Mar-01		6.22	6.56	6.89	6.78	6.64	6.74	6.61	6.81	7.02
31-Mar-01		6.22	6.59	6.95	6.60	6.54	6.69	6.59	6.83	6.66
1-Apr-01		6.36	6.66	7.00	6.71	6.67	6.82	6.66	6.94	6.86
2-Apr-01		6.65	6.95	7.31	7.17	7.00	7.10	7.00	7.12	7.28
3-Apr-01		6.84	7.13	7.54	7.15	7.13	7.18	7.08	7.27	7.13
4-Apr-01		6.98	7.31	7.70	7.54	7.49	7.52	7.46	7.55	7.82
5-Apr-01		6.60	6.97	7.49	6.99	6.85	7.10	6.95	7.27	6.92
6-Apr-01		6.51	6.87	7.41	6.96	6.80	7.03	6.85	7.09	6.82

Date	Redd 1	Redd 2	Surface 2	Redd 3	Redd 4	Surface 4	Redd 5	Redd 6	Redd 7	Surface 7
7-Apr-01		6.89	7.29	7.62	7.48	7.26	7.44	7.31	7.48	7.61
8-Apr-01		7.37	7.62	7.93	7.77	7.70	7.78	7.65	7.78	7.77
9-Apr-01		7.71	7.96	8.19	8.08	8.08	8.14	8.03	8.12	8.34
10-Apr-01		7.85	8.11	8.34	8.23	8.24	8.35	8.21	8.27	8.28
11-Apr-01		7.95	8.14	8.37	8.28	8.18	8.32	8.21	8.27	8.38
12-Apr-01		8.00	8.22	8.42	8.41	8.29	8.40	8.24	8.30	8.36
13-Apr-01		8.28	8.50	8.60	8.65	8.49	8.63	8.52	8.56	8.69
14-Apr-01		8.81	8.97	8.97	9.14	9.01	9.17	9.01	9.00	9.36
15-Apr-01		9.05	9.20	9.22	9.32	9.37	9.46	9.35	9.31	9.67
16-Apr-01		9.34	9.53	9.46	9.73	9.66	9.66	9.60	9.54	9.90
17-Apr-01		9.77	9.92	9.74	9.97	10.14	10.16	10.04	9.95	10.23
18-Apr-01		9.24	9.51	9.38	9.37	9.39	9.53	9.39	9.54	9.49
19-Apr-01		9.72	9.79	9.69	9.99	9.76	9.87	9.73	9.67	10.08
20-Apr-01		10.44	10.44	10.18	10.58	10.51	10.59	10.50	10.29	10.93
21-Apr-01		10.64	10.70	10.44	10.74	10.76	10.88	10.79	10.65	11.09
22-Apr-01		10.44	10.57	10.26	10.61	10.53	10.70	10.53	10.47	10.60
23-Apr-01		10.20	10.44	10.05	10.43	10.32	10.55	10.38	10.42	10.44
24-Apr-01		10.83	10.96	10.55	11.10	11.22	11.14	11.07	10.85	11.47
25-Apr-01		11.21	11.30	10.86	11.47	11.77	11.71	11.67	11.45	12.17
26-Apr-01		10.15	10.36	10.00	10.54	10.55	10.88	10.71	11.01	11.06
27-Apr-01		9.53	9.77	9.59	10.07	10.06	10.47	10.30	10.68	10.62
28-Apr-01		7.66	7.96	8.32	8.28	8.09	8.91	8.34	9.33	8.23
29-Apr-01		8.52	8.65	8.91	8.88	8.80	8.89	8.75	9.07	8.87
30-Apr-01		8.91	9.12	9.27	9.34	9.32	9.27	9.22	9.41	9.29
1-May-01		9.20	9.35	9.38	9.60	9.50	9.51	9.42	9.59	9.57
2-May-01		10.35	10.28	9.98	10.59	10.61	10.39	10.40	10.31	10.91
3-May-01		10.11	10.18	9.92	10.43	10.45	10.52	10.43	10.50	10.47
4-May-01		10.15	10.18	9.87	10.43	10.40	10.47	10.35	10.42	10.49
5-May-01		9.68	9.90	9.64	10.09	9.96	10.31	10.25	10.39	10.44
6-May-01		10.20	10.21	9.95	10.51	10.45	10.41	10.35	10.42	10.70
7-May-01		10.68	10.68	10.18	10.90	10.92	10.88	10.84	10.86	11.16
8-May-01		10.83	10.86	10.31	11.18	11.17	11.09	11.10	11.01	11.42
9-May-01		10.78	10.91	10.47	11.26	11.15	11.24	11.20	11.22	11.44
10-May-01		11.35	11.35	10.80	11.70	11.66	11.58	11.59	11.50	11.83
11-May-01		11.88	11.92	11.32	12.24	12.15	12.02	12.05	11.89	12.40
12-May-01		12.12	12.07	11.53	12.50	12.49	12.38	12.44	12.20	12.71
13-May-01		12.17	12.13	11.56	12.55	12.54	12.51	12.57	12.46	12.78
14-May-01		11.07	11.17	10.68	11.54	11.38	11.84	11.64	11.91	11.52
15-May-01		10.87	10.91	10.50	11.29	11.22	11.42	11.30	11.50	11.40
16-May-01		11.21	11.27	10.72	11.65	11.56	11.55	11.56	11.60	11.81
17-May-01		11.21	11.24	10.65	11.49	11.43	11.50	11.41	11.53	11.39
18-May-01		12.17	12.15	11.30	12.45	12.38	12.02	12.16	11.99	12.50
19-May-01		13.23	13.14	12.02	13.33	13.39	13.16	13.29	12.95	13.56
20-May-01		13.08	13.00	11.92	13.36	13.34	13.18	13.19	13.08	13.46
21-May-01		13.76	13.68	12.41	13.96	14.01	13.70	13.87	13.52	14.24
22-May-01		14.29	14.28	12.85	14.61	14.67	14.38	14.57	14.16	14.94
23-May-01		14.63	14.52	13.29	14.92	14.93	14.72	14.91	14.55	15.23
24-May-01		15.27	15.15	13.79	15.50	15.58	15.22	15.38	14.92	15.73
25-May-01		15.76	15.57	14.08	16.00	15.98	15.67	15.88	15.31	16.20
26-May-01		16.39	16.20	14.41	16.56	16.61	16.33	16.49	15.81	16.78
27-May-01		16.48	16.36	14.25	16.53	16.53	16.44	16.41	15.92	16.56
28-May-01		15.85	15.62	13.83	15.87	15.92	16.17	16.04	15.79	15.93
29-May-01		14.34	14.20	12.75	14.55	14.38	14.63	14.35	14.60	14.44
30-May-01		14.87	14.70	13.16	15.00	14.88	14.77	14.67	14.57	14.84
31-May-01		16.34	16.23	14.25	16.38	16.56	16.06	16.28	15.57	16.65

FW: Bathymetry for Okanagan Lake

From: Ward, Hillary FLNR:EX <Hillary.Ward@gov.bc.ca>
To: Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>
Sent: March 4, 2021 11:03:42 AM PST
Received: March 4, 2021 11:03:43 AM PST
Attachments: 2021 Okanagan Bathymetry ndmp project proposal.pdf

Hi Shaun,

Just so you are up to speed... I'm going to be leading the science part to update the shore spawner sub model for FWMT. I had reached out to Anna at OBWB on the status of their flood mapping proposal. If this moves ahead, I suggested to Anna that I contribute to the RFP development so that we ensure it is collected in a way that also meets data needs for the shore spawner analysis work that needs to happen.

If you hear any updates here, please let me know.

Hillary

From: Anna Warwick Sears
Sent: March 4, 2021 8:39 AM
To: Ward, Hillary FLNR:EX
Subject: RE: Bathymetry for Okanagan Lake

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Hi Hillary,

We would love to collaborate. I'm supposed to hear back about the NDMP funding by the end of this month, and then we'd like to get the work up and running ASAP.

I've attached our funding application, which has a high level description of the project. EMBC approved the proposal (technical review etc.) and it's now in the hands of Public Safety Canada to decide whether it receives funding or not. Either way, we'd like to see this work completed.

Anna

PLEASE NOTE: In response to the COVID-19 pandemic, OBWB staff are working remotely as much as possible and all meetings are being held online until further notice.

Anna Warwick Sears, Ph.D. — Executive Director
Okanagan Basin Water Board
1450 KLO Road, Kelowna, BC V1W 3Z4
Office: 250.469.6251
Twitter : @AnnaWSears
www.obwb.ca

From: Ward, Hillary FLNR:EX <Hillary.Ward@gov.bc.ca>
Sent: March 4, 2021 8:32 AM
To: Anna Warwick Sears <anna.warwick.sears@obwb.ca>
Subject: Bathymetry for Okanagan Lake

CAUTION: This message was sent from outside the organization. Please do not click links, open attachments, or respond unless you recognize the source of this email and know the content is safe.

Hi Anna,

Hope you are doing well and enjoying what feels like the first few days of spring. I believe one of our GIS staff was in contact with you around Okanagan Lake bathymetry. He mentioned that OBWB had applied for EMBC funding to collect some near shore bathymetric data.

We need to move forward on updating our fisheries science around habitat and location of shore spawning kokanee and corresponding impacts of lake-level draw down on the survival of eggs. To do this, we need detailed bathymetric data (in conjunction with some field studies) to support this work. Have you heard back on your funding request to collect this data? If so, what is the timeline and do you know what the resolution of the data would be and location of the surveys? If this isn't approved, we may have some internal funding to support this type of work, and it would be good to discuss opportunities for collaboration here and potential additional funding options.

Thanks,

Hillary Ward PhD RPBio
Section Head, Research
Thompson Okanagan Region
Cell: 250-462-1827

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RE: Bathymetry for Okanagan Lake

From: Reimer, Shaun FLNR:EX s.15
s.15

To: Ward, Hillary FLNR:EX
Sent: March 4, 2021 11:59:55 AM PST
Received: March 4, 2021 11:59:55 AM PST

Thanks Hillary

From: Ward, Hillary FLNR:EX
Sent: March 4, 2021 11:04 AM
To: Reimer, Shaun FLNR:EX
Subject: FW: Bathymetry for Okanagan Lake

Hi Shaun,

Just so you are up to speed... I'm going to be leading the science part to update the shore spawner sub model for FWMT. I had reached out to Anna at OBWB on the status of their flood mapping proposal. If this moves ahead, I suggested to Anna that I contribute to the RFP development so that we ensure it is collected in a way that also meets data needs for the shore spawner analysis work that needs to happen.

If you hear any updates here, please let me know.

Hillary

From: Anna Warwick Sears <anna.warwick.sears@obwb.ca>
Sent: March 4, 2021 8:39 AM
To: Ward, Hillary FLNR:EX <Hillary.Ward@gov.bc.ca>
Subject: RE: Bathymetry for Okanagan Lake

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Hillary,

We would love to collaborate. I'm supposed to hear back about the NDMP funding by the end of this month, and then we'd like to get the work up and running ASAP.

I've attached our funding application, which has a high level description of the project. EMBC approved the proposal (technical review etc.) and it's now in the hands of Public Safety Canada to decide whether it receives funding or not. Either way, we'd like to see this work completed.

Anna

PLEASE NOTE: In response to the COVID-19 pandemic, OBWB staff are working remotely as much as possible and all meetings are being held online until further notice.

Anna Warwick Sears, Ph.D. — Executive Director
Okanagan Basin Water Board
1450 KLO Road, Kelowna, BC V1W 3Z4
Office: 250.469.6251
Twitter : @AnnaWSears
www.obwb.ca

From: Ward, Hillary FLNR:EX <Hillary.Ward@gov.bc.ca>
Sent: March 4, 2021 8:32 AM
To: Anna Warwick Sears <anna.warwick.sears@obwb.ca>
Subject: Bathymetry for Okanagan Lake

CAUTION: This message was sent from outside the organization. Please do not click links, open attachments, or respond unless you recognize the source of this email and know the content is safe.

Hi Anna,

Hope you are doing well and enjoying what feels like the first few days of spring. I believe one of our GIS staff was in contact with you around Okanagan Lake bathymetry. He mentioned that OBWB had applied for EMBC funding to collect some near shore bathymetric data.

We need to move forward on updating our fisheries science around habitat and location of shore spawning kokanee and corresponding impacts of lake-level draw down on the survival of eggs. To do this, we need detailed bathymetric data (in conjunction with some field studies) to support this work. Have you heard back on your funding request to collect this data? If so, what is the timeline and do you know what the resolution of the data would be and location

of the surveys? If this isn't approved, we may have some internal funding to support this type of work, and it would be good to discuss opportunities for collaboration here and potential additional funding options.

Thanks,

Hillary Ward PhD RPBio

Section Head, Research

Thompson Okanagan Region

Cell: 250-462-1827

Email: Hillary.Ward@gov.bc.ca

FWMT charts

From: Dawn Machin <dmachin@syilx.org>
To: Hugh Stimson <hstimson@essa.com>, Clint Alexander <calexander@essa.com>
Cc: White, Tara <Tara.White@gov.bc.ca>, athena.ogden@dfo-mpo.gc.ca, Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>, White, Tara FLNR:EX
Sent: March 9, 2021 4:49:27 PM PST
Received: March 9, 2021 4:49:37 PM PST
Attachments: 2021-03-09-10-20-32-Scen1922-KokaneeExportData.xlsx, 2021-03-09-10-20-32-Scen1922-MainAssessmentExportData.xlsx

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Hugh and Clint ,

The FWMT committee has a question regarding the lake chart showing a red bar for kokanee that has dates March 18 to March 24, this is after emergence is predicted to be complete. Provincial fisheries staff thinks the predicted emergence date (March 12) is too early. We are starting to look at dropping the lake and impacts to kokanee. Is the additional 12 days to accommodate the late cohort, or differences in timing of emergence in the quadrants utilized for spawning? There is no data in the emergence file for early and late cohorts but in the legend of the graph they are listed.

limlæmt | Thank You

Dawn Machin

Biologist, Fish-Water Management Tool

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

T 250 707 0095 ext. 110

F 250 707 0166 www.syilx.org

E dmachin@syilx.org

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RE: FWMT charts

From: Clint Alexander <calexander@essa.com>
To: Dawn Machin <dmachin@syilx.org>, Hugh Stimson <hstimson@essa.com>
Cc: White, Tara <Tara.White@gov.bc.ca>, athena.ogden@dfo-mpo.gc.ca, Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>, White, Tara FLNR:EX
Sent: March 9, 2021 5:11:04 PM PST
Received: March 9, 2021 5:11:08 PM PST

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Dawn,

Our team will look into this asap, and hopefully provide an answer March 10th.

-Clint

From: Dawn Machin <dmachin@syilx.org>

Sent: March 9, 2021 4:49 PM

To: Hugh Stimson <hstimson@essa.com>; Clint Alexander <calexander@essa.com>

Cc: White, Tara <Tara.White@gov.bc.ca>; athena.ogden@dfo-mpo.gc.ca; Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>

Subject: FWMT charts

Hi Hugh and Clint ,

The FWMT committee has a question regarding the lake chart showing a red bar for kokanee that has dates March 18 to March 24, this is after emergence is predicted to be complete. Provincial fisheries staff thinks the predicted emergence date (March 12) is too early. We are starting to look at dropping the lake and impacts to kokanee. Is the additional 12 days to accommodate the late cohort, or differences in timing of emergence in the quadrants utilized for spawning? There is no data in the emergence file for early and late cohorts but in the legend of the graph they are listed.

limlæmt | Thank You

Dawn Machin

Biologist, Fish-Water Management Tool

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

T 250 707 0095 ext. 110

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Fwd: FWMT charts

From: Dawn Machin <dmachin@syilx.org>
To: Tara White <Tara.White@gov.bc.ca>, Athena Ogden <athena.ogden@dfo-mpo.gc.ca>, Shaun Reimer <shaun.reimer@gov.bc.ca>, White, Tara FLNR:EX, Reimer, Shaun FLNR:EX
Cc: Karilyn Alex <kalex@syilx.org>, Chelsea Mathieu <CMathieu@syilx.org>
Sent: March 9, 2021 8:01:56 PM PST
Received: March 9, 2021 8:02:01 PM PST

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Waiting to hear back from ESSA.

Dawn

way xast sxlxalt

Sent from my iPhone

Begin forwarded message:

From: Margot Stockwell
Date: March 9, 2021 at 7:39:40 PM PST
To: Dawn Machin
Subject: Re: FWMT charts

Hi Dawn,

Really tired so if anything is confusing, please contact me again in the morning. The Kokanee in the model only have one cohort (so unrealistic) but the problem comes from the fact that the temperatures in the model only come from one source - Okanagan Lake at Kelowna, which turns out to be at the marina just north of the bridge. I think this is too warm for the model but it is the only monitored gauge available in real-time for the model. I think Kari had tidbits deployed to find the absolute discrepancies between temperature locations but I never learned the results. I may not be much help here but if Provincial sampling of emergence is occurring, their results would be best to go by. However! If push comes to shove, remember that the model still goes into red hazard mode for Kokanee at 15-20 cm drop in lake level when it should really be 25cm drop. We have discussed this many times but it was never re-written into FWMT code. Not sure if this helps or not but please feel free to contact me anytime.

Margot

On Mar 9, 2021, at 4:56 PM, Dawn Machin <dmachin@syilx.org> wrote:

Hi Margot,

We are having issues with the kokanee emergence date again. I can't find anything in the record of design about different cohorts for kokanee. Maybe it's a graphing error?

Dawn

From: Dawn Machin
Sent: Tuesday, March 9, 2021 4:49 PM
To: Hugh Stimson <hstimson@essa.com>; Clint Alexander <calexander@essa.com>
Cc: White, Tara <Tara.White@gov.bc.ca>; athena.ogden@dfo-mpo.gc.ca; Reimer, Shaun

FLNR:EX <shaun.reimer@gov.bc.ca>

Subject: FWMT charts

Hi Hugh and Clint ,

The FWMT committee has a question regarding the lake chart showing a red bar for kokanee that has dates March 18 to March 24, this is after emergence is predicted to be complete. Provincial fisheries staff thinks the predicted emergence date (March 12) is too early. We are starting to look at dropping the lake and impacts to kokanee.

Is the additional 12 days to accommodate the late cohort, or differences in timing of emergence in the quadrants utilized for spawning? There is no data in the emergence file for early and late cohorts but in the legend of the graph they are listed.

limlāmt | Thank You

Dawn Machin

Biologist, Fish-Water Management Tool

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

T 250 707 0095 ext. 110

F 250 707 0166 www.syilx.org

E dmachin@syilx.org

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<2021-03-09-10-20-32-Scen1922-KokaneeExportData.xlsx>

<2021-03-09-10-20-32-Scen1922-MainAssessmentExportData.xlsx>

[EXTERNAL] This email originated from outside of the organization.

RE: Reminder in-season meeting March 11

From: White, Tara FLNR:EX <Tara.White@gov.bc.ca>
To: Dawn Machin <dmachin@syilx.org>, athena.ogden@dfo-mpo.gc.ca, Chelsea Mathieu <CMathieu@syilx.org>, Hegerat, Eric FLNR:EX <Eric.Hegerat@gov.bc.ca>, Karilyn Alex <kalex@syilx.org>, Kim Hyatt <kim.hyatt@dfo-mpo.gc.ca>, Phillpotts, Mark G FLNR:EX <Mark.Phillpotts@gov.bc.ca>, Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>
Sent: March 10, 2021 9:27:35 AM PST
Received: March 10, 2021 9:27:36 AM PST
Attachments: image001.jpg

Hi Dawn:

As indicated, neither Eric and I are able to attend the meeting tomorrow. However I did a field check yesterday for kokanee emergence and have significant concerns regarding the impact of the current drawdown on shore spawning kokanee survival (2020 brood year). I am tied up this morning, but will try to summarize findings this afternoon for distribution

Tara



Tara White, R.P.Bio

Senior Fisheries Biologist

Government of British Columbia

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Okanagan Region, Penticton

P: 778.622.6839

From: Dawn Machin

Sent: March 9, 2021 5:33 PM

To: athena.ogden@dfo-mpo.gc.ca; Chelsea Mathieu ; Hegerat, Eric FLNR:EX ; Karilyn Alex ; Kim Hyatt ; Phillpotts, Mark G FLNR:EX ; Reimer, Shaun FLNR:EX ; White, Tara FLNR:EX

Subject: Reminder in-season meeting March 11

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hello,

Just a quick reminder,;

FWMT In-Season meeting

Thu, Mar 11, 2021 1:00 PM - 3:00 PM (PST)

We will discuss the March inflow forecast, proposed release schedule and potential impacts. We will resend the link Thursday morning

Please join my meeting from your computer, tablet or smartphone.

<https://global.gotomeeting.com/join/s.17>

You can also dial in using your phone.

(For supported devices, tap a one-touch number below to join instantly.)

Canada (Toll Free):^{s.17}

- One-touch: <tel:+18884551389>,^{s.17} #

Access Code:^{s.17}

New to GoToMeeting? Get the app now and be ready when your first meeting starts:

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limlæmt | Thank You

Dawn Machin

Biologist, Fish-Water Management Tool

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

T 250 707 0095 ext. 110

F 250 707 0166 www.syilx.org

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OLRS Gate Changes March 11,2021

From: Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>
To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: March 11, 2021 8:40:50 AM PST
Received: March 11, 2021 8:40:51 AM PST

Hi Greg, could you please make the following changes today. Aiming for a 6 m3/s reduction at Penticton and a 7 m3/s reduction at Skaha dam. OTID has been notified. Probably make another reduction (smaller) on Monday.

11-Mar-21

	Gate Changes			
	Existing:		Change to:	
	# of gates	setting	# of gates	setting
McIntyre	2	72%	2	60%
Skaha	2	82	2	56
OK Dam	4	21	4	15

Thanks...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection
Okanagan Shuswap District
Ministry of Forests, Lands, Natural Resource Operations, & Rural Development
102 Industrial Place
Penticton, BC V2A 7C8
Phone: 778-622-6826 Please note this is a new number.
Fax: 250-490-2231

RE: FWMT kokanee emergence

From: Clint Alexander <calexander@essa.com>
To: Dawn Machin <dmachin@syilx.org>, White, Tara <Tara.White@gov.bc.ca>, athena.ogden@dfo-mpo.gc.ca, Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>, White, Tara FLNR:EX
Cc: Frank Poulsen <frank@ashlu-environmental.ca>, Brian Ma <bma@essa.com>, Hugh Stimson <hstimson@essa.com>
Sent: March 11, 2021 11:40:39 AM PST
Received: March 11, 2021 11:40:48 AM PST
Attachments: Kokanee 100pcnt Emergence Report (model run 1926).PNG, MainHazardAssessment-Kokanee (model run 1926 March 11 2021).PNG, 2021-03-11-09-05-08-Scen1926-KokaneeExportData.xlsx

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Good morning,

I have added the following narrative entry to FWMT:

FWMT Operators,

Further to the email from Dawn Machin on March 9 2021, which raised a question surrounding the discrepancy between FWMT's detailed emergence report for kokanee and the main assessment hazard bar for kokanee having different emergence dates, here are ESSA's findings:

1// The correct 100% emergence prediction for kokanee this year is March 12 2021.

2// The Main hazard assessment report shows a date of March 18 2021. This is not the correct date, but is the date displayed because the kokanee submodel outputs delivered for the main hazard assessment are on a weekly time-step not daily time-step.

3// This means the main hazard assessment results for kokanee can be up to 6 days "late" (worst case).

4// Use the 100% emergence report prediction to obtain the precise estimate. It 'trumps' the timing found in the main hazard assessment report.

5// We removed an error from the detailed kokanee emergence Excel download that included legend entries for late cohorts. The kokanee submodel only uses one main cohort, not multiple as are used for sockeye. In using a 950 ATU target, as of March 12 2021, the bulk of kokanee eggs are estimated to be emerged, including for late-spawners and late developing eggs.

Okanagan Lake water temperatures for 2021 are warmer than average explaining the relatively early emergence.

See attached files.

-Clint Alexander

Please let me know if there are further questions on this matter.

-Clint

From: Clint Alexander <calexander@essa.com>

Sent: March 10, 2021 4:22 PM

To: 'Dawn Machin' <dmachin@syilx.org>; 'White, Tara ' <Tara.White@gov.bc.ca>; 'athena.ogden@dfo-mpo.gc.ca' <athena.ogden@dfo-mpo.gc.ca>; 'Reimer, Shaun FLNR:EX' <shaun.reimer@gov.bc.ca>

Cc: 'Frank Poulsen' <frank@ashlu-environmental.ca>; Brian Ma <bma@essa.com>; Hugh Stimson <hstimson@essa.com>

Subject: FWMT kokanee emergence

FWMT Operations Team -

The ESSA team has been working on this today and we nearly have a response and solution. There was an error in the main hazard report kokanee bar owing to an error mapping converting weekly resolution data to daily resolution information. Looking at the kokanee emergence report itself, Okanagan Lake water temperatures this winter were warmer than usual and so it looks like the March 12 prediction is the accurate value for kokanee emergence. Also,

the kokanee model does not use cohorts, only one primary cohort. Labelling of cohorts in the kokanee emergence report is an error and these legend entries are being removed. Inspection of the FWMT RoD Chapter 6 for kokanee indicates that the current estimate of 950C ATU to total emergence is a valid estimate and that it would incorporate the emergence of late-spawners and late developing eggs.

Confirmation of this and details to follow once I've had a chance to review the diagnosis from our developers in more detail and we have deployed code changes to FWMT itself (this should be completed tonight or tomorrow morning, March 11th).

Thank-you for bringing this issue to our attention and for your patience.

-Clint

From: Dawn Machin <dmachin@syilx.org>

Sent: March 9, 2021 4:49 PM

To: Hugh Stimson <hstimson@essa.com>; Clint Alexander <calexander@essa.com>

Cc: White, Tara <Tara.White@gov.bc.ca>; athena.ogden@dfo-mpo.gc.ca; Reimer, Shaun FLNR:EX <shaun.reimer@gov.bc.ca>

Subject: FWMT charts

Hi Hugh and Clint ,

The FWMT committee has a question regarding the lake chart showing a red bar for kokanee that has dates March 18 to March 24, this is after emergence is predicted to be complete. Provincial fisheries staff thinks the predicted emergence date (March 12) is too early. We are starting to look at dropping the lake and impacts to kokanee.

Is the additional 12 days to accommodate the late cohort, or differences in timing of emergence in the quadrants utilized for spawning? There is no data in the emergence file for early and late cohorts but in the legend of the graph they are listed.

limlæmt | Thank You

Dawn Machin

Biologist, Fish-Water Management Tool

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

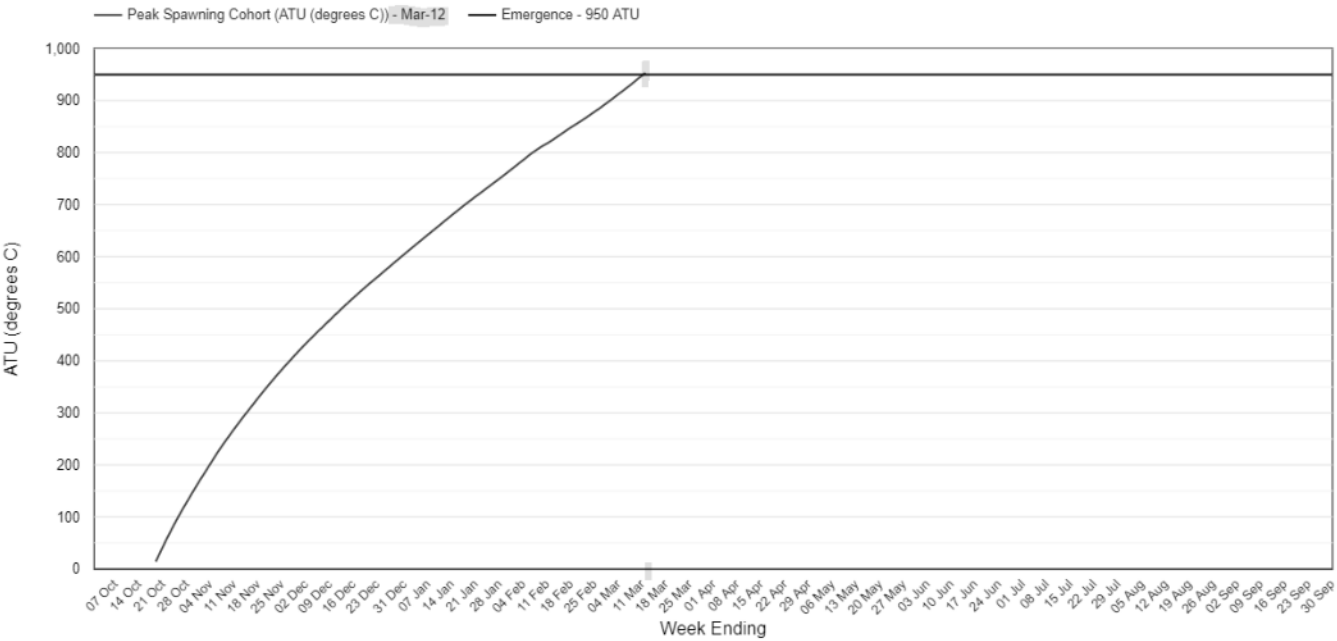
T 250 707 0095 ext. 110

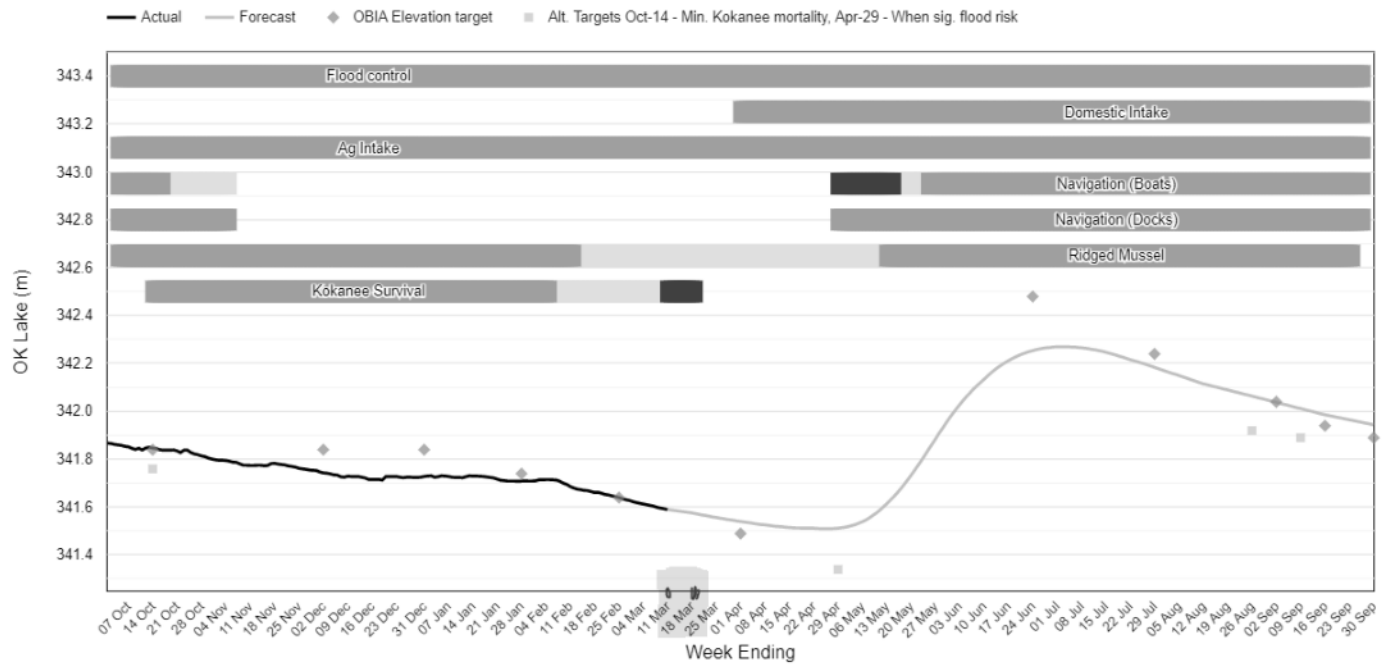
F 250 707 0166 www.syilx.org

E dmachin@syilx.org

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RE: FWMT- my notes

From: Reimer, Shaun FLNR:EX s.15
s.15

To: Karilyn Alex, Dawn Machin, Chelsea Mathieu, Ogden, Athena
Sent: March 11, 2021 1:40:35 PM PST
Received: March 11, 2021 1:40:36 PM PST

Tara found 'a few' stage 5 alevins but not as many as when she sampled in 2018.

From: Karilyn Alex
Sent: March 11, 2021 1:39 PM
To: Dawn Machin ; Chelsea Mathieu ; Reimer, Shaun FLNR:EX ; Ogden, Athena
Subject: FWMT- my notes

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

My notes for you dawn

Shaun, has downgraded flow inflow forecasts so will reduce the flows by 10cms to reduce lake draw down

Tara – noted dead kokanee eggs and no stage 5 alevins for shorespawners. So serious concerns for shorespawners

Dawn ask Tara if there are more shorespawning spot checks coming up?

Dawn – feedback from field crews if fall kokanee habitat was fully seeded and limiting (pushing kokanee into more marginal areas aka shallower redds)

There is a real disconnect between march 11th emergence prediction and potentially actual emergence

Group – noted difference in

- Adjusted the low temp ATU (<3 degrees) should be reading 4 degrees – ESSA question
- 25cm drawdown fix as a hazard bar – ESSA question
- Future discussion on shorespawning temperature further analysis – steering committee question

Next inflow forecast April 8th, next meeting potentially April 12th -

In case of issues, we will touch base earlier

Thanks

kari

limlæmt | Thank You

Karilyn Alex

Fisheries Biologist and Fluvial Geomorphologist, MSc., RPBio.

Okanagan Nation Alliance

101 – 3535 Old Okanagan Highway

Westbank, BC V4T 3L7

T 250 707 0095 ext. 130

F 250 707 0166 www.syilx.org

E kalex@syilx.org

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Okanagan River decrease March 11th and 15th, 2021

From: Reimer, Shaun FLNR:EX s.15
s.15

To: JAY O'BRIEN

Cc: John Arterburn, Anna Warwick Sears, Dawn Machin, 'Martin.Suchy@canada.ca', Xia, Cenling FLNR:EX, Zanotto, Tony FLNR:EX, Burdock, Greg W FLNR:EX, 'otiddm@nvinet.com', 'kalex@syilx.org', 'thut461@ECY.WA.GOV'

Sent: March 11, 2021 1:53:56 PM PST

Received: March 11, 2021 1:53:56 PM PST

Hi Jay. As discussed, we are decreasing Okanagan flows today by approximately 7 m³/s (245 cfs) in the Oliver section of the river. Aiming for a resultant flow that should be approximately 16 m³/s (530 cfs) going into Osoyoos Lake.

We will also be decreasing the flows by a further 4 m³/s (141 cfs) next Monday. These flows are scheduled to last for several weeks before we will start increasing again.

The reason for the decrease is a combination of a reduced inflow forecast (since February) and some sampled significant impacts to kokanee shore-spawned eggs in Okanagan Lake. The decrease will slow the drop of Okanagan Lake to mitigate impacts to those kokanee going forward. Previously, our modelling suggested that the kokanee would be emerged from the gravel by March 12th but sampling last week determined that the alevins had not emerged to the point where they could swim freely and therefore significant numbers would be stranded by further lake level drops.

Regards...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Office Phone: 778-622-6826

Cell: 250-809-7762

Fax: 250-490-2231

OLRS Gate changes March 15, 2021

From: Reimer, Shaun FLNR:EX -s.15
s.15

To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: March 15, 2021 8:21:23 AM PDT
Received: March 15, 2021 8:21:24 AM PDT

Hi Greg. Could you please make the following gate changes today.

15-Mar-21

	Gate Changes			
	Existing:		Change to:	
	# of gates	setting	# of gates	setting
McIntyre	2	60%	2	57%
Skaha	2	56	2	41
OK Dam	4	15	4	11

Thanks...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Phone: 778-622-6826 Please note this is a new number.

Fax: 250-490-2231

Okanagan River increase March 30th and 31st, 2021

From: Reimer, Shaun FLNR:EX .s.15
s.15

To: JAY O'BRIEN

Cc: John Arterburn, Anna Warwick Sears, Dawn Machin, 'Martin.Suchy@canada.ca', Xia, Cenling FLNR:EX, Zanotto, Tony FLNR:EX, Burdock, Greg W FLNR:EX, 'otiddm@nvinet.com', 'kalex@syilx.org', 'thut461@ECY.WA.GOV'

Sent: March 29, 2021 9:30:05 AM PDT

Received: March 29, 2021 9:30:05 AM PDT

Hi Jay. As discussed, we are increasing Okanagan flows tomorrow by approximately 5 m³/s (176 cfs) in the Oliver section of the river. We will also be increasing the flows by a further 5 m³/s (176 cfs) on Wednesday. Aiming for a resultant flow that should be approximately 22 m³/s (777 cfs) going into Osoyoos Lake.

We're hoping to have stable flows prior to the Easter long weekend but will likely increase another 5 m³/s (175 cfs) after that. I will advise you of that change before we make it.

Regards...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Office Phone: 778-622-6826

Cell: 250-809-7762

Fax: 250-490-2231

OLRS gate increase Tuesday March 30th, 2021

From: Reimer, Shaun FLNR:EX ↵
s.15

To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: March 29, 2021 1:17:23 PM PDT
Received: March 29, 2021 5:00:28 PM PDT

Hi Greg. Please make the following changes for March 30th. This is meant to increase flows by 5 m3/s. Note that I plan to make a similar increase on March 31st.

30-Mar-21

	Gate Changes			
	Existing:		Change to:	
	# of gates	setting	# of gates	setting
McIntyre	2	57%	2	64%
Skaha	2	41	2	61
OK Dam	4	11	4	16

Thanks...

Shaun Reimer, P.Eng.

Section Head - Public Safety & Protection

Okanagan Shuswap District

Ministry of Forests, Lands, Natural Resource Operations, & Rural Development

102 Industrial Place

Penticton, BC V2A 7C8

Phone: 778-622-6826 Please note this is a new number.

Fax: 250-490-2231

OLRS gate increase Tuesday March 31st, 2021

From: Reimer, Shaun FLNR:EX s.15
s.15

To: Burdock, Greg W FLNR:EX
Cc: Xia, Cenling FLNR:EX
Sent: March 30, 2021 3:48:31 PM PDT
Received: March 30, 2021 3:48:31 PM PDT

Hi Greg. Please make the following changes for March 31st. This is meant to increase flows by 5 m3/s.

31-Mar-21

	Gate Changes			
	Existing:		Change to:	
	# of gates	setting	# of gates	setting
McIntyre	2	64%	2	70%
Skaha	2	61	2	84
OK Dam	4	16	4	22

Thanks...

Shaun Reimer, P.Eng.

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Region 8 Fisheries Update

Penticton Flyfishers Club Meeting
April 01, 2021

Tara White, Senior Fisheries Biologist

Ministry of Forests, Lands and Natural Resource Operations and Rural Development, Fish and Wildlife Branch
102 Industrial Pl., Penticton, BC | Tara.White@gov.bc.ca | 778-622-6839



Region 8



Management Priorities:

- Conserve and restore e freshwater fish stocks and their habitat
- Protect First Nations cultural values and food, social and ceremonial needs;
- Ensure diverse and sustainable recreational opportunities for future generations



Okanagan Region:

- Challenges/Pressures:
 - Flood, fire, drought
 - Habitat loss & constraints
 - Urbanization/development
 - Aquatic Invasive species
 - Access changes/ Use
 - Non-compliance
- Regulation Changes
- FY2021 Fisheries Initiatives





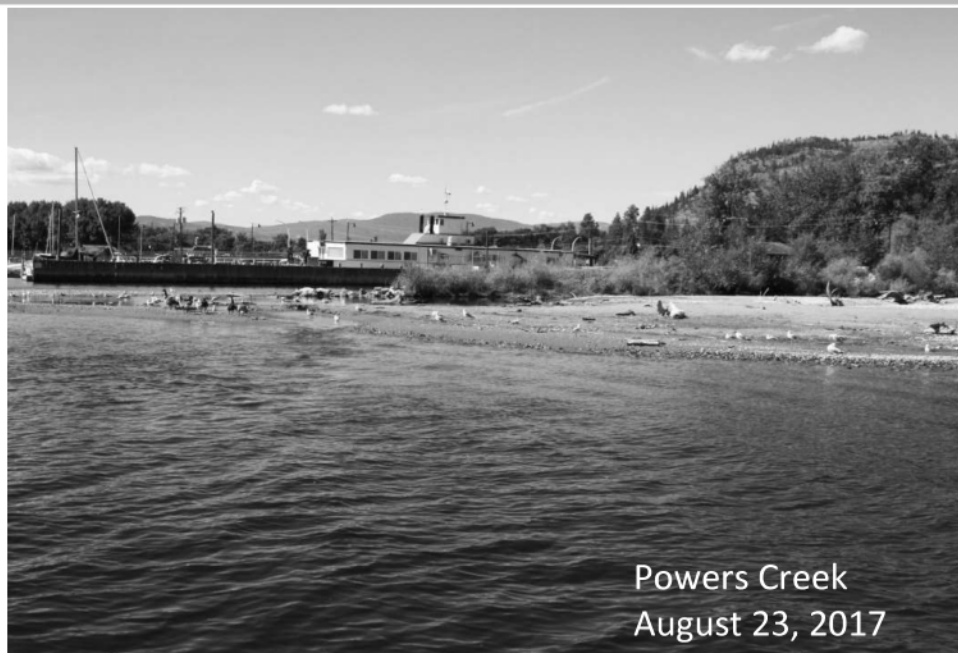
Region 8 – Flooding

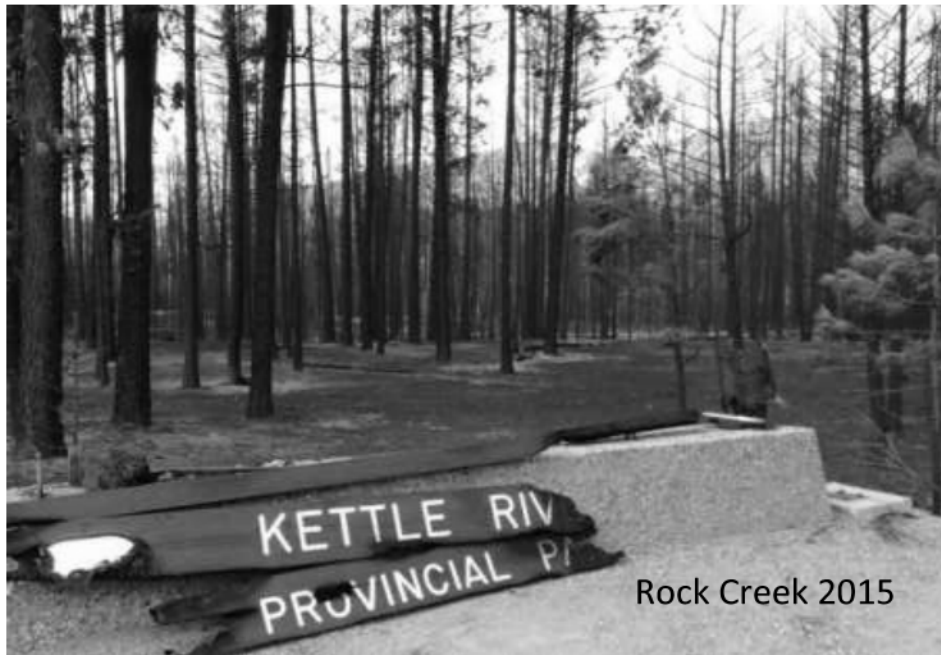


Regional Fisheries Management Challenge

- **Issue:**
 - Significant movement of bedload & deposition of material
 - Alteration/damage fish habitat
 - Also private property
- **Management Concern:**
 - Alevins still developing in gravel
 - Fish isolated once flows reduced
 - Restricted fish access out-migrating fry survival and returning spawners
 - Influx of applications from municipalities to work in stream outside of work window

Impacts of Flooding on Fish Habitat





Regional Fisheries Management Challenge:

Management Issue/Concern:

- Loss of cover and food input
- Impact fish survival
- Less fish in river
- Angling restrictions and access closures

What can we do?

- Public Education & Awareness
- Fishing regulation changes to protect stocks
- Habitat restoration projects to provide shelter and food

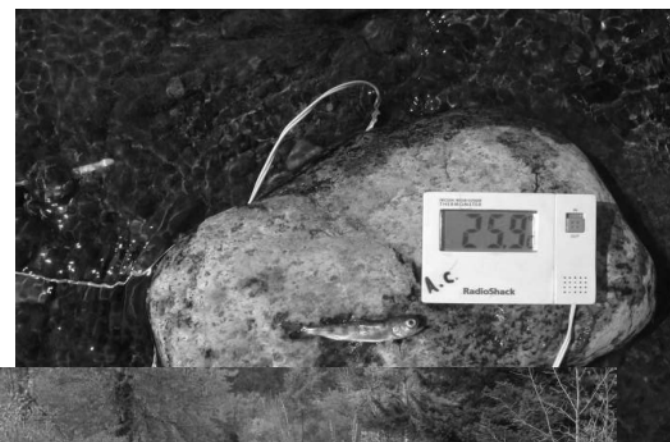
Is Drought Problem?

Management Concerns

- High water temperatures & Low stream flow
- Loss of cover
- Reduced food supply & habitat availability
- Reduced oxygen concentration
- Impeded fish migration & passage
- Stranding (spawners)
- Lack of in-stream rearing & deep water refuge areas
- Reduced growth & survival

What can we do?

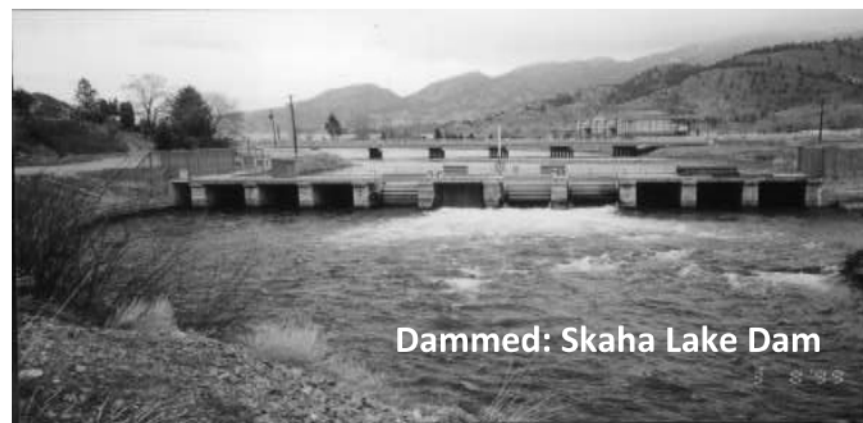
- Conserve & regulate water use
- Water Use & Drought response plans
- Close recreational fishery
- Enforcement (WSA, FPA, FFA)





Regional Fisheries Management Challenge:

- **Issue:** Dammed, diked, denuded and developed
- **Result:** Loss of Fish Stocks & Habitat
- **Response:** Habitat Restoration Initiatives
 - I.e. PCRI, MCRI, ORRI





Largemouth bass



Goldfish



Perch

Why is this a Problem?

- proliferate quickly
- compete for food/habitat
- consume native species
- tolerate warm water



Don't move live fish.

What can we do?

- Don't move live fish
- Follow freshwater fishing regulations



Northern Pike



Provincial AIS Policy

- **Does not promote freshwater recreational fisheries for AIS such as bass and yellow perch.**
- **It also does not support the future development of these angling opportunities.**
- **Where such species exist, every effort will be made to eliminate the risk they pose and to prevent their further spread.**



AIS Management Response:

- New introductions will not be tolerated. Lakes with new introductions or high-risk lakes may be closed indefinitely to ALL fishing until the risk has been addressed.
- Eradication is one tool to eliminate the threat of high-risk invasive species.
- Where eradication is not an option due to prohibitive costs and other factors, response tools will focus on managing the risk to prevent further spread.
- Fisheries managers may manage AIS fish as regulated fisheries where further impacts to native ecosystems and likelihood of spread are low.



Dam Ownership & Liability:

- Fisheries Section owns 18 dams on Small Lakes in Okanagan

Purpose:

- Water conservation use
- Support recreational opportunities
- Economic value: 100,000 angler days/yr = \$2.7M

Management Issue:

- Structures Aging
- Significant remediation work

Action:

- Annual cost up-keep (\$20-\$100K/yr)



Yellow Lake Dam





Why is ATV use a problem?

- Introduce sediment to water
- Damage riparian vegetation
- Degrade water quality & habitat
- Harms fish
- Alters access (ie. walk in)
- Causes shifts in angler demographics/use

Management Issue/Concern:

- Over the last 3 years we visited 106 Small Lakes
- Identified 80 lakes that had signage and/or access concerns

What can we do?

- Education & Outreach
 - STOP – Don't drive across streams
 - Don't damage streamside vegetation
- Install Signage and Area closures
- Changed management strategy/classification

Response: Road & Access Upgrades

- Currently working with Rec & Trails to improve FSR's & access (ie. Madden)



Do you know of any high use fisheries, where access has been degraded and is a problem ?

Challenge: Non-compliance



Why is non-compliance a concern?

- Angling infractions: highest non-compliance rate in Province (30-38% of anglers checked)
 - Over limit, gear violations, no license
- Won't be any fish left

What can we do?

- Education & Outreach
- Buy a fishing license (if > 16 yrs old)
- **Follow Freshwater Fishing Regulations**
- Don't take more than your limit



Small Lakes Management and Stocking Program:

- 597 small lakes in Region 8; historically >220 were stocked
- In 2019, completed a management review & overhaul
- Reduced stocking densities or changed the stocked fish strain for 21 fisheries
- Suspended stocking on an additional 78 lakes.
- **Goal:** to improve angling quality by increasing rainbow trout growth rates and maximum size



2021 Small Lakes Stocking Changes

The number one complaint from anglers – SMALL FISH

Why is fish size dropping?

- Natural Recruitment
- Over Stocking
- Strain Selection
- Reduced Harvest

What can we do?

- Eliminate Overstocking
- Better Strain Selection



Example: Stocking Changes

Example – Silver Lake

Previous: 5,000 2N Blackwater Yearlings

2020: Stocking Suspended

Why?

- 2019 stock assessment showed high recruitment and small fish (average <12 inch)
- Trying to grow bigger fish

Example – Peachland Lake

Previous: 3,000 2N Yearling

2020: Stocking Suspended

Why?

- Reports of natural recruitment
- Previous stocking rate was extremely low (30/ha)
- Good example of stocking on top of recruitment
- Trying to grow bigger fish

What can you do to help? GO FISHING!

Report Angling Data

- **Catch Rates**
- **Length / Weight**
- **Sex / Maturity**
- **Anything Unusual**

*Data sheets available from Eric.Hegerat@gov.bc.ca

Lake Management Categories

1. Wildstock & Wilderness: limited access, protect wildstock values, goal = >30 cm; 2 fish/day
2. Trophy Fisheries: Low stocking, fish size = >2.5 lbs, typically catch & release
3. Quality: Goal=1-2 lb fish; generally trout/char daily quota= 2, bait ban, single barbless and/or no ice fishing
4. Regional Regulations: variable stock, daily quota = 5; Mgmt goal= 20-35 cm sized fish
5. Family Fisheries: variable stock and size, lots of fish, but generally smaller
6. Kids Fisheries: put and take fisheries; stock with 30-35 cm fish



Quality/Trophy to Regional Regulations

- **Lakes:** Fly Fish #1 &2, Haggkvist, Leonard, Kentucky SE Pothole, Garrison, Spukunne
- **Rationale:**
 - Stock quality is not conducive to quality/trophy regulations.
 - Falling short of potential in terms of generating angling effort and satisfaction.
 - Cultural/Social shift: harvest reduced
- **Intent:**
 - Provide increase angler opportunity, for as many anglers as possible
 - Set the proper regulations for what the lakes are capable of
 - >60 yrs has had significant impact on invertebrate community & lake productivity

Regional to Quality Regulations

- **Lakes:** Clifford, Ricky and Thalia
- **Rationale:**
 - Recent stock assessment data indicates a quality stock with limited cohorts of older fish.
 - There are a limited number of lakes in the region have the productivity to grow large fish (>50cm).
- **Intent:**
 - Set the proper regulations for what the lakes are capable of.
 - Reduced harvest is intended to increase fish size and angler satisfaction.
 - Provide quality angling opportunity.

Removal of No Ice Fishing Stipulation

- **Lakes:** Deer, Crooked, Island, Dee and Alaric
- **Rationale:**
 - Detailed stock assessment data collected
 - Lakes where there are no stock conservation concerns
 - Underutilized fisheries
- **Intent:**
 - Provide additional winter angling opportunities in Region 8

Proposed Change Rescinded

- **Original Proposal:**

- No ice fishing
- Trout daily quota = 1 > 50cm; bait ban, single barbless hook
- Electric motors only

- **Rationale:**

- Unique & extremely productive lake, that produces fish > 10lbs.
- Significant annual aeration cost & investment
- Fishery used by a very small group of anglers
- Low angler effort

- **Intent:**

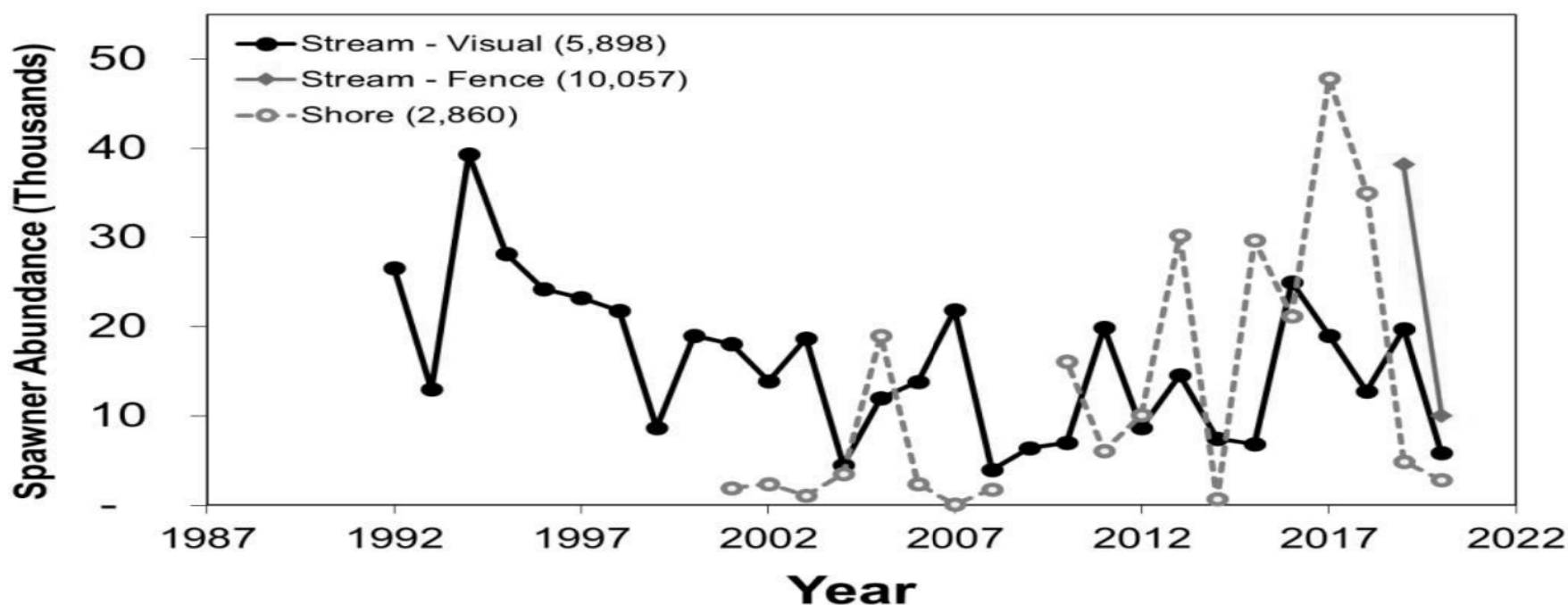
- Set the proper regulations for what the lakes are capable of
- Harvest & use of single barbless tackle would provide unique opportunity to harvest trophy sized fish
- To increase angler effort and angler satisfaction
- Would monitor to avoid over-exploitation

Douglas Lake Ranch Court Decision (Minnie & Stoney lakes)

- No Longer Public Access
- Suspended stocking of these Trophy Fisheries
- If you want to fish them, need to pay the Ranch for access

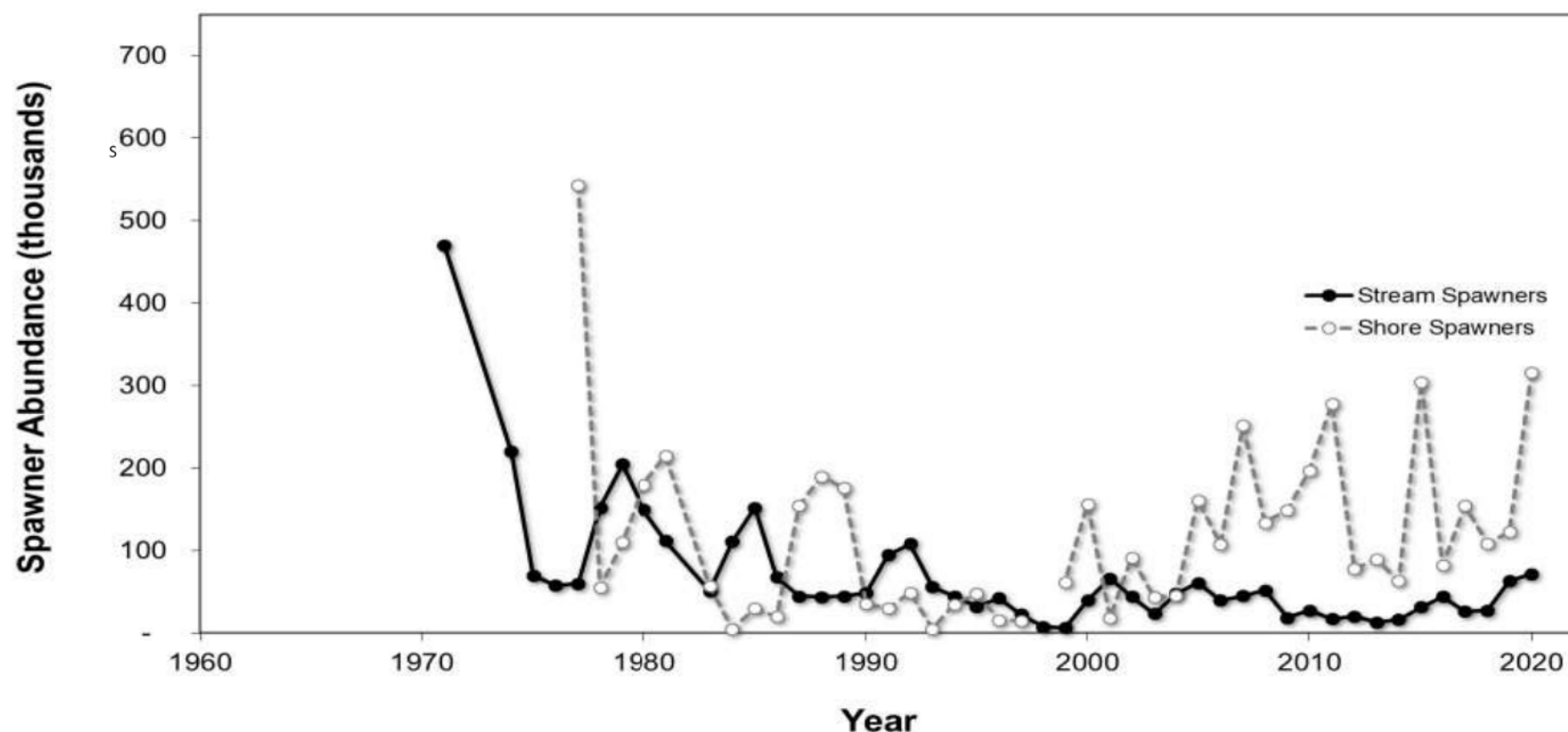
Kalamalka Lake

- Increase Kokanee Daily Quota from 2 to 5
 - Harmonization with Wood Lake Regulations
 - Detailed creel and spawner return surveys indicate the fishery is under-utilized and can support a significant increase in harvest.
 - Angler effort/harvest and stock status will continue to be monitored.

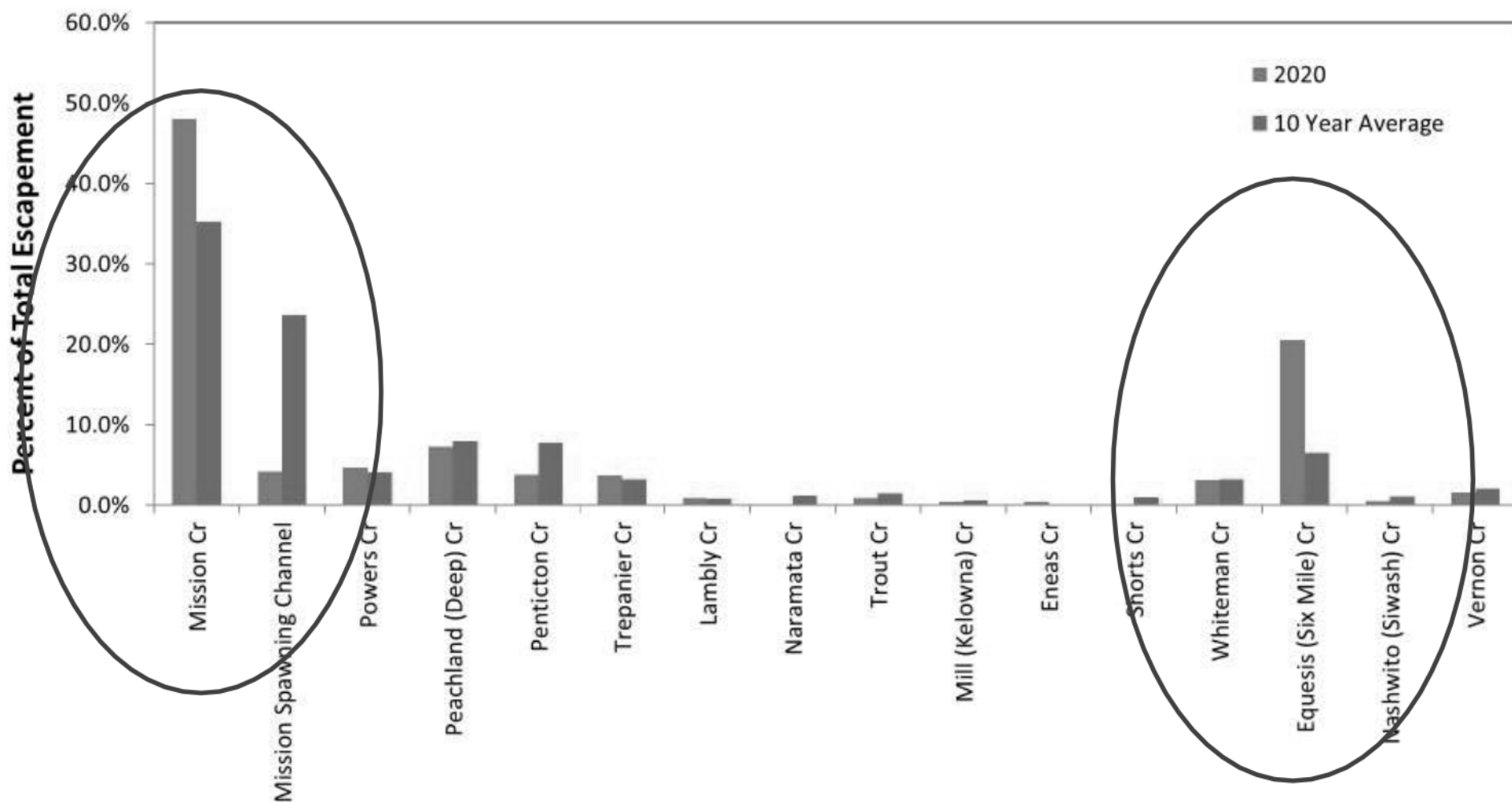


2020 Okanagan Lake Kokanee Returns:

- Stream – 72,034 (250% of 10 yr avg)
- Shore – 316,150 (214% of 10 yr avg)
- Total – 388,184 (200% of 10 yr avg)



Okanagan Kokanee Escapement by Stream (%)





Current Challenge: Okanagan Lake Drawdown

- Balancing flood mitigation vs. Kokanee Shore spawner Survival
- Need: quantify the effect of exceeding the FWMT kokanee threshold
- Lake drawdown on March 9, 2021 = 341.59; 89 cm below full pool (342.48) and 25 cm below peak spawn (341.84)



Okanagan Basin Sockeye Re-introduction Program:

- Continue to work with ONA & DFO on management, conservation & restoration of fish stocks and aquatic ecosystems in Okanagan Valley
- Completed joint Okanagan Basin RM&E Plan 2020
- Scheduled release of 4.2 M fry in 2021
- Monitoring & Evaluation of OK Basin Program
- Fish Passage Testing at Okanagan Lake Dam



Photo: M. Bezener

Okanagan Lake Dam Fish Passage

- **Fishway Testing :**
 - Tagged & released 41 SK in 2020
 - Controlled Access (trap at top-end)
 - Monitored spawning-site selection, spawn-timing, and interactions with resident stocks
 - High flows facilitated CH and SK access through gates (June-August)
- **Next Steps:**
 - Continue Fishway Testing & refinement in 2021
 - Secure funds for Fish Ladder and Trapping/Processing Facility



Sugar Lake Bull Trout Study_ Year 2 of 5:

- Only bull trout population in R8
- Status unknown
- Evidence bull trout population may be in decline
- Significant increase in development activity impacting habitat
- Current regulations may be insufficient to support a quality char fishery.



Objectives:

- Determine the status of bull trout and implement a long-term strategy to detect changes in relative abundance.
- Identify, map and evaluate spawning habitat characteristics, potential limitations and disturbances
- Determine angler effort & exploitation
- Evaluate the meta-population structure within the Thompson EDU
- Assess the current angling regulations and implement management actions to conserve native bull trout stocks and sustain a quality char fishery.



Approach:

- Stock assessment
- Mark-recapture
- Creel census
- Habitat assessments
- Redd surveys
- Genetic sampling
- Indigenous knowledge and partnerships
- Education and outreach



Success to Date:

- Tagged 73 fish; 7 recaptured
- Creel Census in 2021
- Completed Aerial Recci Surveys
 - ID access, barriers, redd survey index sites, habitat characteristics
- Habitat assessments
 - Impact ID and mapping
 - Significant resource development (roads, forestry)
 - Investigated fish & fish habitat protection measures (ie. WHA's and FSZ's)
- WUP Review (draw down & releases)
- Collected genetic samples
- Signage installed
- Obtained support of indigenous partners & TEK



Sugar Lake Bull trout
>50 cm May 2020



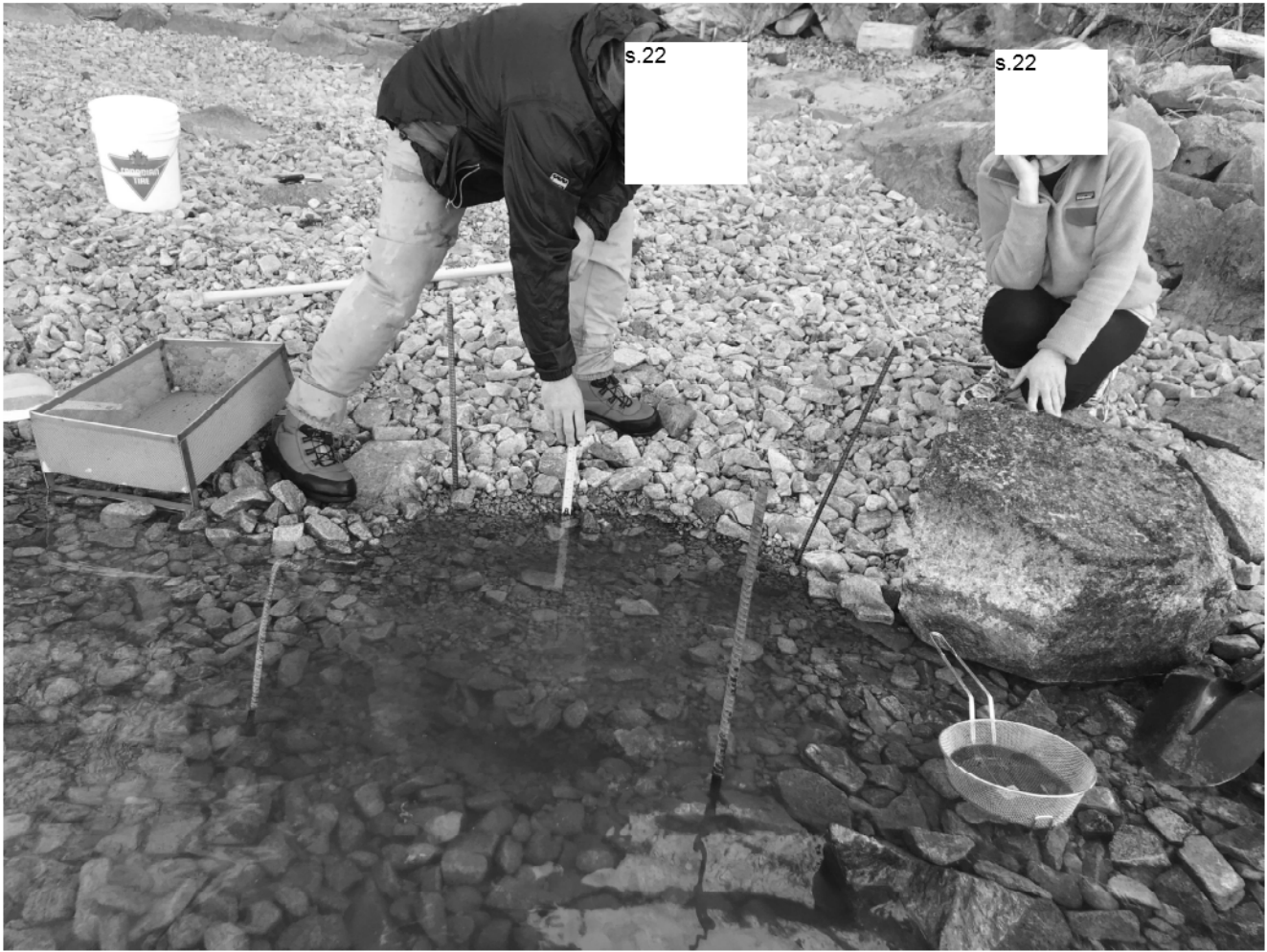
Questions:

Okanagan Fisheries Program Contacts:
Tara.White@gov.bc.ca | 778-622-6839
Eric.Hegerat@gov.bc.ca | 778-622-6840

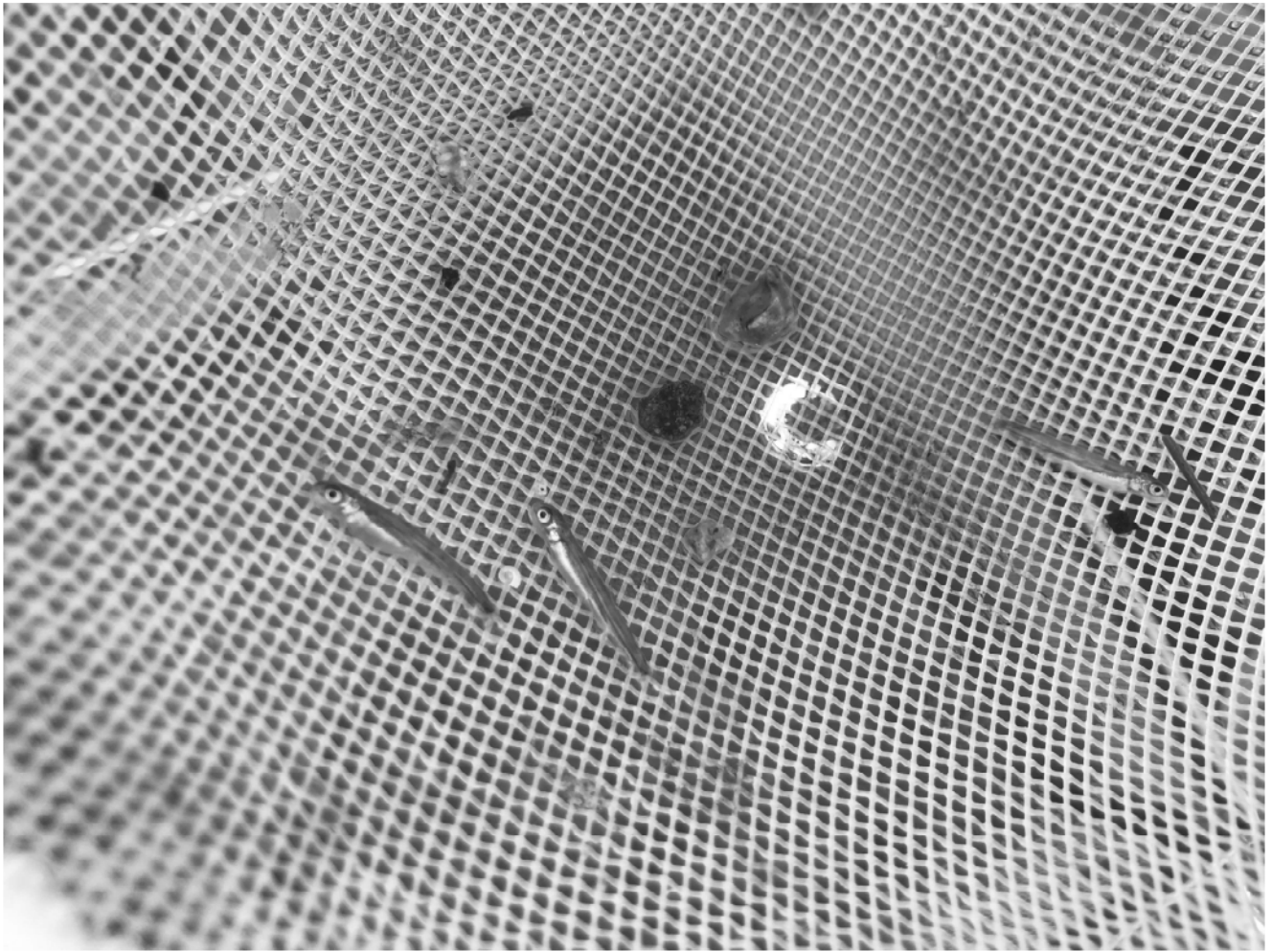


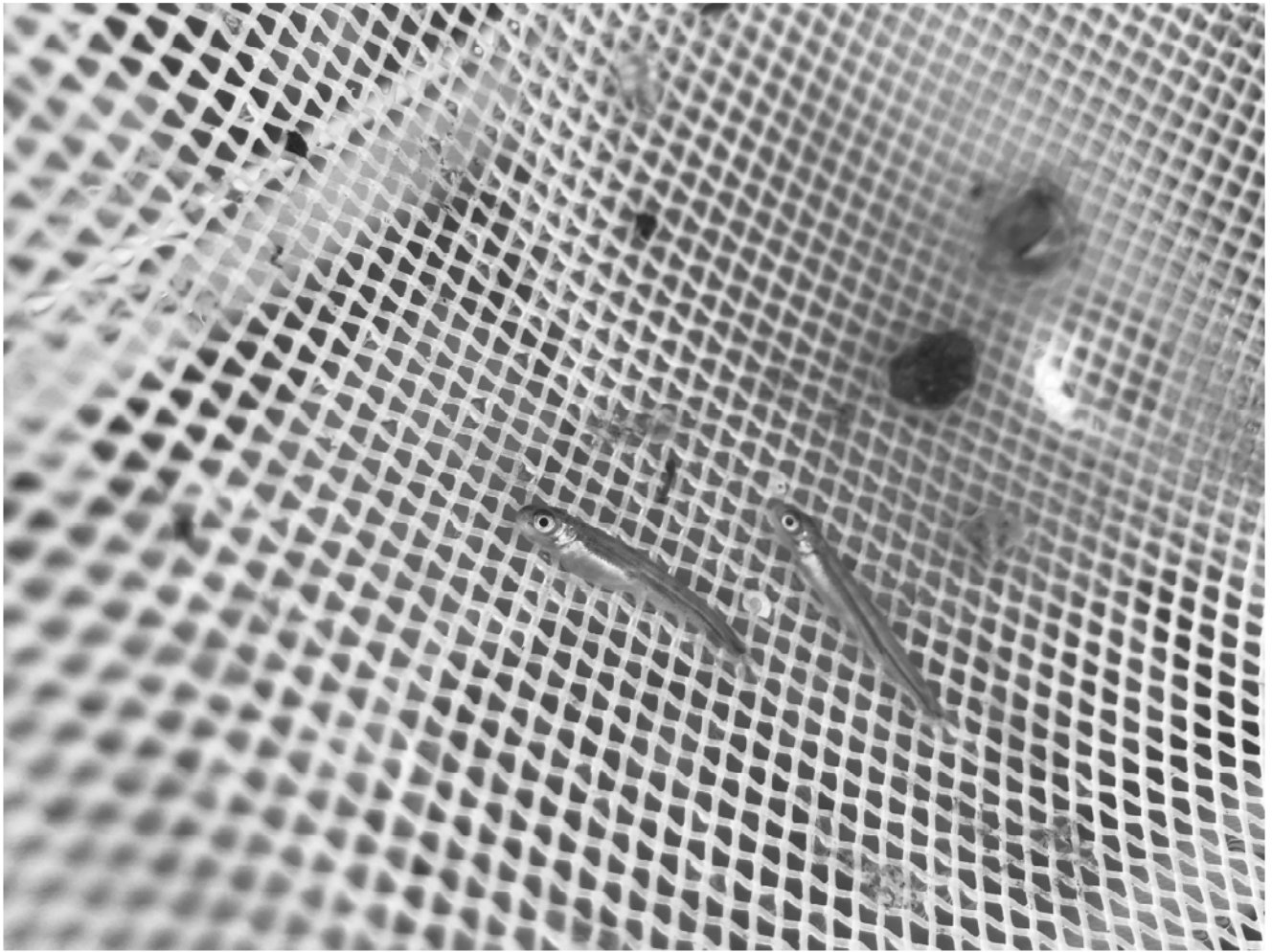


























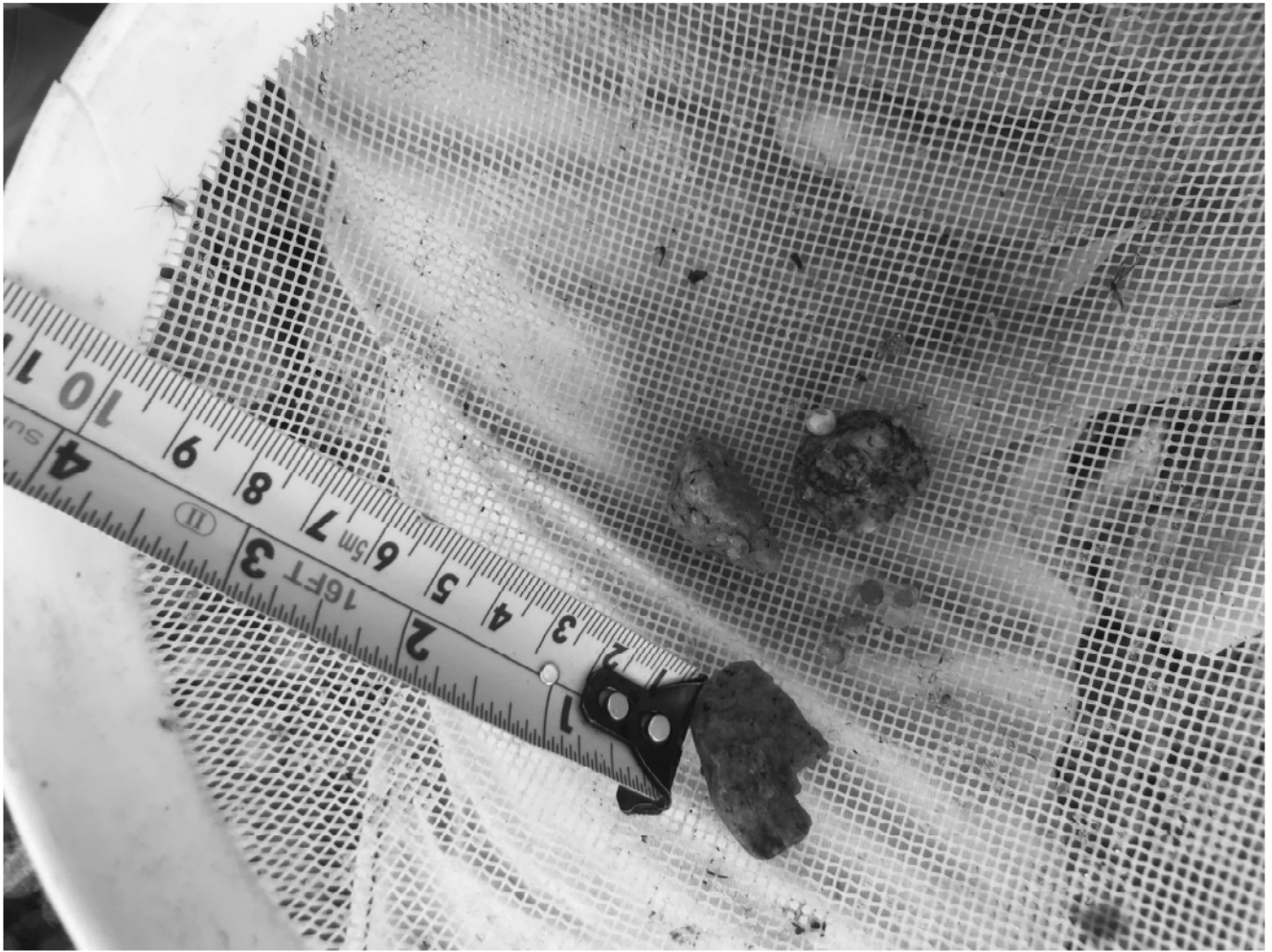


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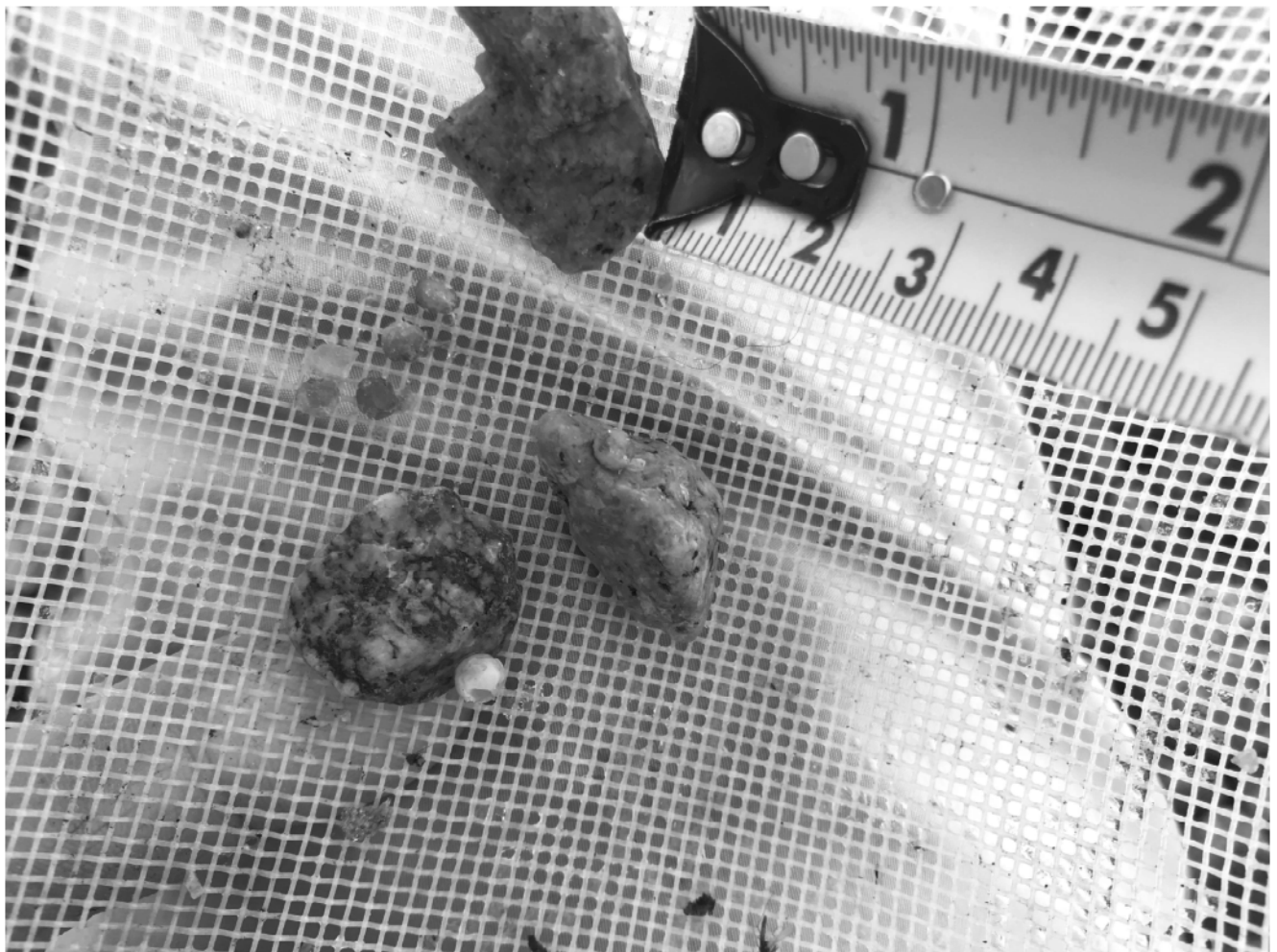












Summary Report – Field Investigation

Effects of Okanagan Lake Draw Down on 2021 Kokanee Shorespawner Egg

Development and Fry Emergence

Date: March 09 2021

Prepared by Tara White, Senior Fisheries Biologist, Okanagan

Management Issue/Background:

1. With climate change, freshet timing, inflow volume and uncertainty in the TOR is changing
2. 2020-21 was a high snow-pack year. Feb 1, 2021 inflow forecast was $635 \text{ kdam}^3 = 123\%$ of normal. The March-July 2021 runoff forecast was estimated at $540 \text{ kdam}^3 = 109\%$ of normal. As a result, WSD has received pressure to draw down Okanagan Lake for Flood Mitigation Purposes, potentially impacting Kokanee Survival.
 - Okanagan Lake level at Kokanee Peak Spawn on Oct 18, 2020 = 341.84m
 - The lake was drawn down (water released) in February and early March 2021 in anticipation of snowmelt and spring runoff.
 - Okanagan Lake Level on March 9, 2021 = 341.59 m, which equates to 89 cm below Full Pool (342.48 m) and 25 cm below Peak Kokanee spawn.
 - WSD has been dropping the lake at a rate of 1/3 cm/day (1/3 cm change in OK Lake = 12 cms)
 - On March 2, 2021 the Okanagan lake level was recorded at 341.62 m which = YELLOW in FWMT. Hit RED threshold on March 9, 2021 at 341.59m.
 - 2020 was the highest shore spawning kokanee return we have seen since the 1970's, as well as the kokanee crash, which resulted in closure of the recreational fishery 1995
 - The 2020 Okanagan Lake kokanee shore spawning escapement = 316,150 fish or 214% of the 10-year average.
 - **There is a need to quantify the impacts to Okanagan lake kokanee shore spawners from late fall/winter lake level drawdown (% impact on egg and fry survival).**
3. FWMT is identifying the Kokanee 100% emergence date as March 11, 2021
 - Doesn't seem accurate.
 - 100% Emergence = free swimming and feeding fry along the lake shore.
 - Need to verify kokanee development stage & emergence status and data input into the New FWMT
 - Need to ensure an accurate and realistic date & definition is depicted in FWMT for 100% kokanee hatch and 100% Kokanee emergence.

Survey Location: NE Quadrant, Reach 45, Okanagan Landing Rd, BLACK Zone (high density spawning site).
Approx. Coordinates: N 50° 12' 28.6", W 119° 24' 06.2"

Survey Crew: Tara White, Sr. Fish Biologist, FLNRORD and Jason Webster (Chara Consulting)

Field Survey Results:

- On March 9, 2021, Tara White and Jason Webster visited Reach 45 in the NE Quadrant to check for the stage of kokanee egg development and fry emergence.
- The location was chosen because it contained one of the highest densities of shore spawning kokanee in fall of 2020. It is also a designated BLACK ZONE and was also the same site visited in 2018.
- Water temperature = 4 C at surface and 1 foot depth on lake bottom.
- A 1m x 1m square grid was used to mark for each plot site. Rebar was pounded into the ground to mark each corner of the site
- Four plots were completed at each of two sites within Reach 45 (Photo 2).
 - Plot 1: 1mx1m grid at the wetted transition zone or waters edge (50% in wet and 50% in dry); (Photo 3).
 - Plot 2: Adjacent to and upslope of Plot 1; 1.5 m upslope from water edge (Photo 4).
 - Plot 3: Adjacent to and upslope of Plot 2; approx. 2.5 m upslope from water edge
 - Plot 4: Adjacent to and upslope of Plot 3; approx. 3.5 m upslope from water edge
- At each Plot, staff removed the gravel in layers (10 cm depth, 20 cm depth and 30 cm depth) and counted fry/eggs found and documented the stage of development
- 11% of kokanee found were located in Plot 1 (Transition Zone). Fry were found in wetted 50% of the plot site and were in Stage 4-5 of development.
- 15% of kokanee were located in Plot #2 (1.5 m up the shoreline from the waters edge). No kokanee fry or eggs were observed in the top layer of larger angular gravel (10 cm deep). All kokanee were found 20 cm subsurface in 'wetted' gravel. Kokanee were in various Stages 3-5 of development; dead and alive (Photo 5).
- 73 % of kokanee found were located in Plot#3 (2.5 m up the shoreline from the waters edge). The first layer of large angular gravel was removed by hand. Crews then dug down 20 cm from the surface, into the smaller 10-30 mm-sized gravel. Only dead eggs were found, frozen to the rocks (Photo 6-10). A visual estimate of egg location in relation to lake level elevation = 25-30 cm vertical drawdown (Photo 11)
- The majority of kokanee were found in Plot #3 at both sites. Plot #3 was dewatered and located 2.5 m upslope from the wetted shoreline of Okanagan lake. Dead eggs were found between 15-20 cm deep in the gravel, frozen to the rocks (at the frost level).
- No kokanee eggs or fry were found in Plot #4
- Developmental stage of kokanee fry which were found alive, ranged from Stage 3-Stage 5 (fully buttoned up). Fork length range =20-30mm. The majority of kokanee observed were still in egg stage and deceased.
- Peak spawn date: Oct 18, 2020 at 341.84.
- Ok lake level:
 - Oct 7, 2020 = 341.846
 - Oct 15, 2020 = 341.844

- Oct 18, 2020 = 341.84
- March 9, 2021: Lake elevation = 341.59 m which was equivalent to 25 cm of vertical lake draw down since in the past 6 weeks (since Feb)

Discussion:

- Since the kokanee stocks crashed in the mid-90's, and the recreational fishery was closed, millions of dollars have been spent on Okanagan Lake kokanee stock recovery.
- We have spent the past 28 years trying to recover kokanee stocks as well as the recreational fishery.
- The economic impact from the sport fishery closure, as well as recovery efforts through the Okanagan Lake Action Plan (OLAP) have been in the millions of dollars.
- The sensitive period when lake draw down can negatively impact kokanee development, emergence, and survival is between January and March of each year. This is the time frame when shore spawning kokanee are the most vulnerable. The eggs are hatching, but the fry have not yet absorbed their yolk sacs, emerged from the gravel. By April the kokanee fry have moved out of the gravel and are typically free swimming along the lakeshore.
- Fluctuations in lake level during this period are not recommended and may impact kokanee egg/fry survival.
- The field survey was conducted in Reach 45, near Okanagan Landing, in order to increase the probability of locating kokanee eggs/fry. Reach 45 is located in a designated BLACK Zone and is considered one of, if not, the highest density kokanee shore spawning sites on Okanagan lake.
- Due to the varying topography of the lake and gradient of the foreshore, it is difficult to determine the scale of impact the 2020 draw down had on the Okanagan lake shore spawning kokanee stocks (both at a Reach and lake wide scale).
- That said, 75% of the kokanee eggs & fry located were dead; the majority of which were found in dewatered sections of beach, embedded 15-20 cm deep in the gravel, and 2.5 m upslope of the wetted perimeter of Okanagan lake.
- It can therefore, be speculated that the late winter drawn down of Okanagan Lake, in Feb and March of 2021, had a direct impact on kokanee shore spawning egg development & fry survival. However, the scale of impact is unclear.

Recommendations:

- Future Okanagan Lake draw down should be completed either: 1). prior to kokanee spawning in the fall (ie. before October 1st), or 2). after peak kokanee emergence in the spring (ie. after April 1st) in order to mitigate impacts to kokanee stocks and provide room for flood mitigation.
- Clarification should be provided regarding the definition of kokanee emergence in the 'New' FWMT. 100% emergence = yolk sacs have been absorbed and kokanee have emerged from the gravel and are free swimming along the lake shore.
- Funding should be secured to quantify the impacts of Okanagan lake drawdown prior to April 1st on shore spawning kokanee stocks and recovery efforts. What is the incremental & proportional impact of various increments of vertical drawdown (ie. 5 cm phases) on egg development, fry survival and emergence success? What impact does vertical drawn down have on the high density spawning reaches along

Okanagan Lake (ie. Gradient along the foreshore differs, therefore the impact on KO eggs/alevins and proportion of KO affected from vertical drawdown may also differ)?



Photo 1. Google earth photo of sample site location_ Reach 45 on NE Quadrant of Okanagan Lake



Photo 2. North View of Reach 45 – Sampling Plots 1, 2 and 3



Photo 3. Plot #1_1 x1m grid at the wetted transition zone or waters edge (50% wet and 50% dry).



Photo 4. South view of Plot #2_ located 1 m upslope from Plot #1.

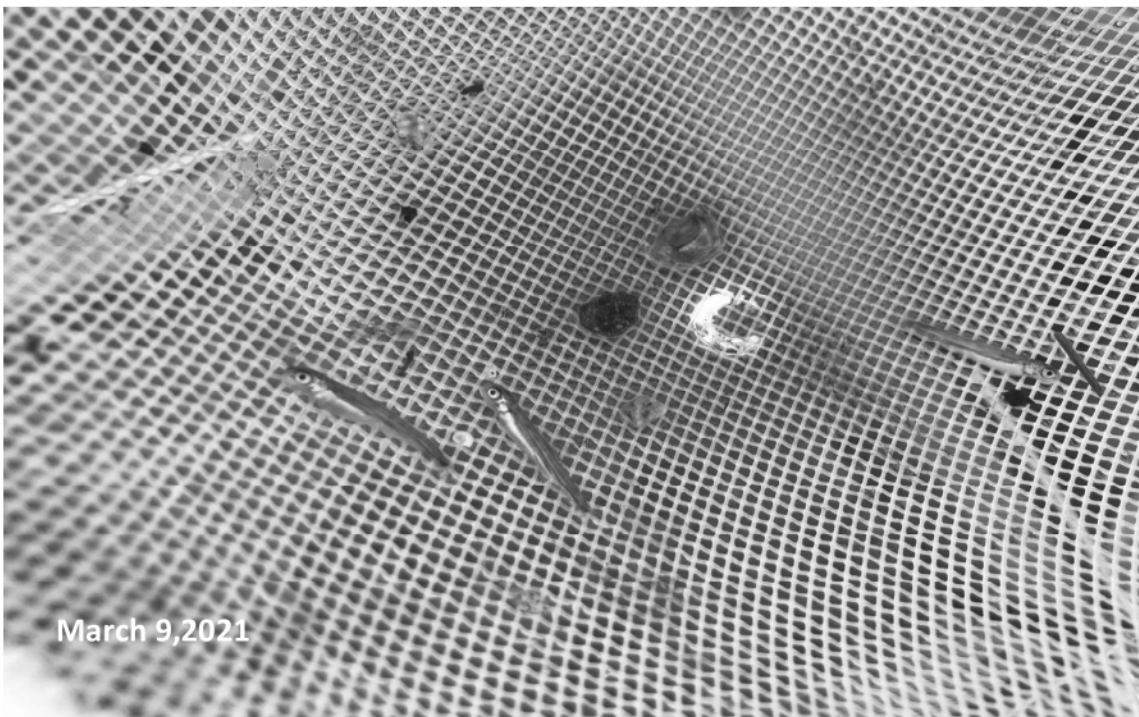


Photo 5. Live kokanee found in Plot #2, in various stages of development.

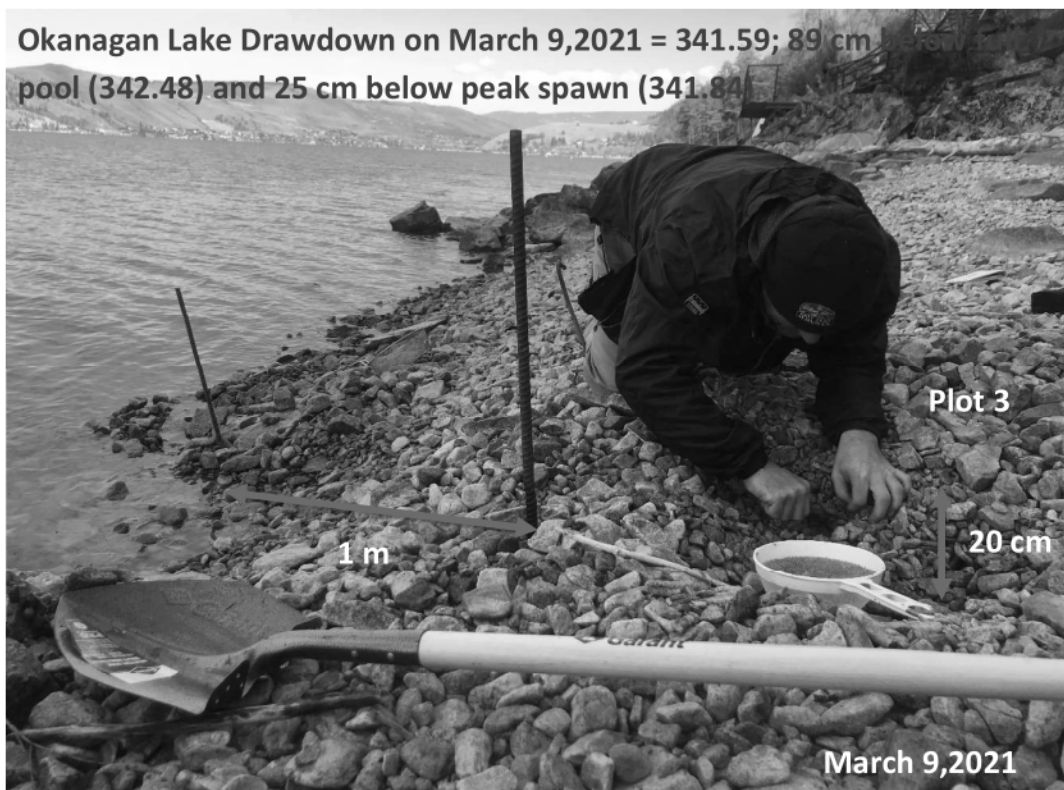


Photo 6. Sampling in Plot# 3, Reach 45, NE Quadrant





Photo 7. Close -up view of sampling in Plot # 3, Reach 45, NE Quadrant, March 9, 2021.



Photo 8. View of frozen dead egg in 10-30 mm sized gravel, Plot #3, Reach 45, NE Quadrant, March 9, 2021

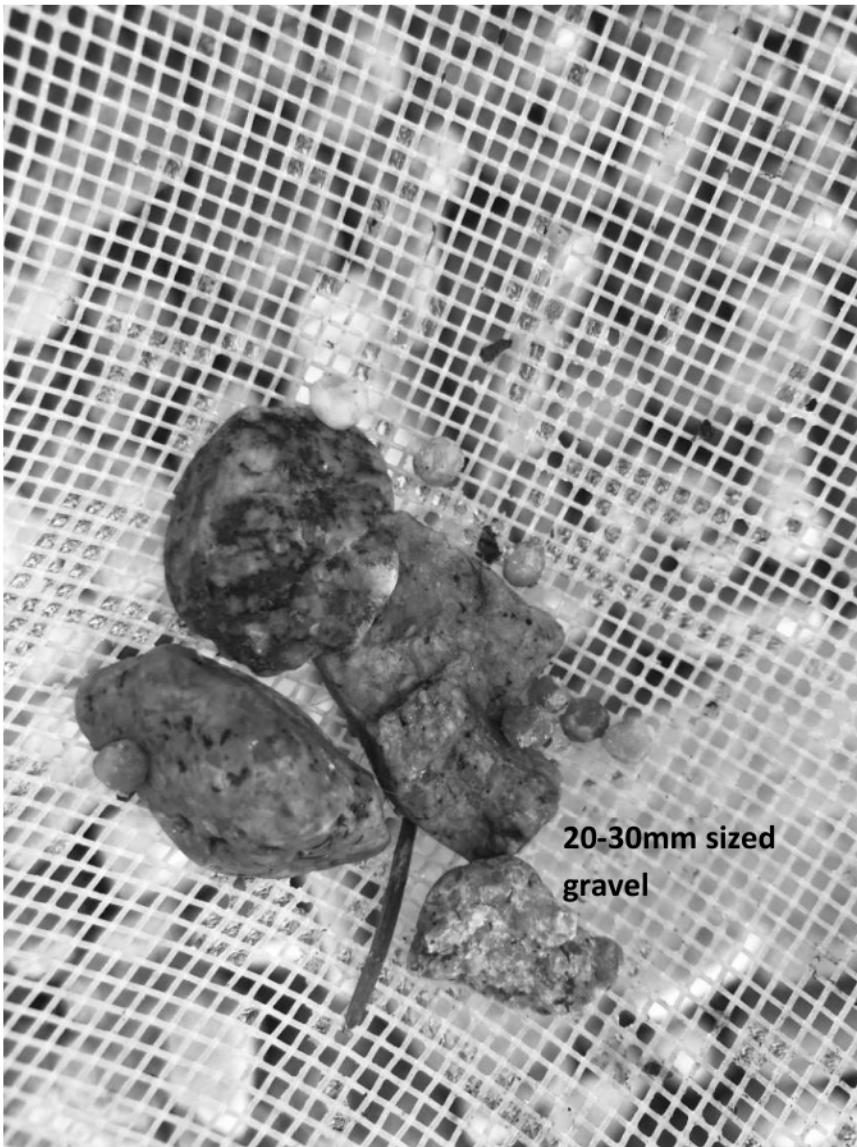


Photo 9. View of frozen dead eggs found buried 20 cm deep in the gravel in Plot #3, Reach 45, NE Quadrant, March 9, 2021.



Photo 10. View of dead eggs found in 20 mm sized gravel in Plot 3, Reach 45.



Photo 11. North View of Kokanee Shore spawning habitat (egg location) in Plot #3, in relation to lake level elevation and 25cm drawdown (Photo 11), Reach 45, March 9, 2021.