Cowlitz River Eulachon (*Thaleichthys pacificus*): Tribal Heritage and Spawning Stock Biomass (SSB) 4th-year Results

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Cowlitz Tribe NRD Mission Statement:

To protect, conserve, restore and promote culturally-relevant species and landscapes integral to the unique identity of the Cowlitz People. To further educate the community and inspire future leaders and participants in this vision.

Project Staff:

PI: Cowlitz NRD Director Taylor Aalvik
Technical coordinator: Nathan Reynolds
Project Field Staff: Dalton Fry, Stuart Freitas, AJ Ulibarri, Emma Johnson

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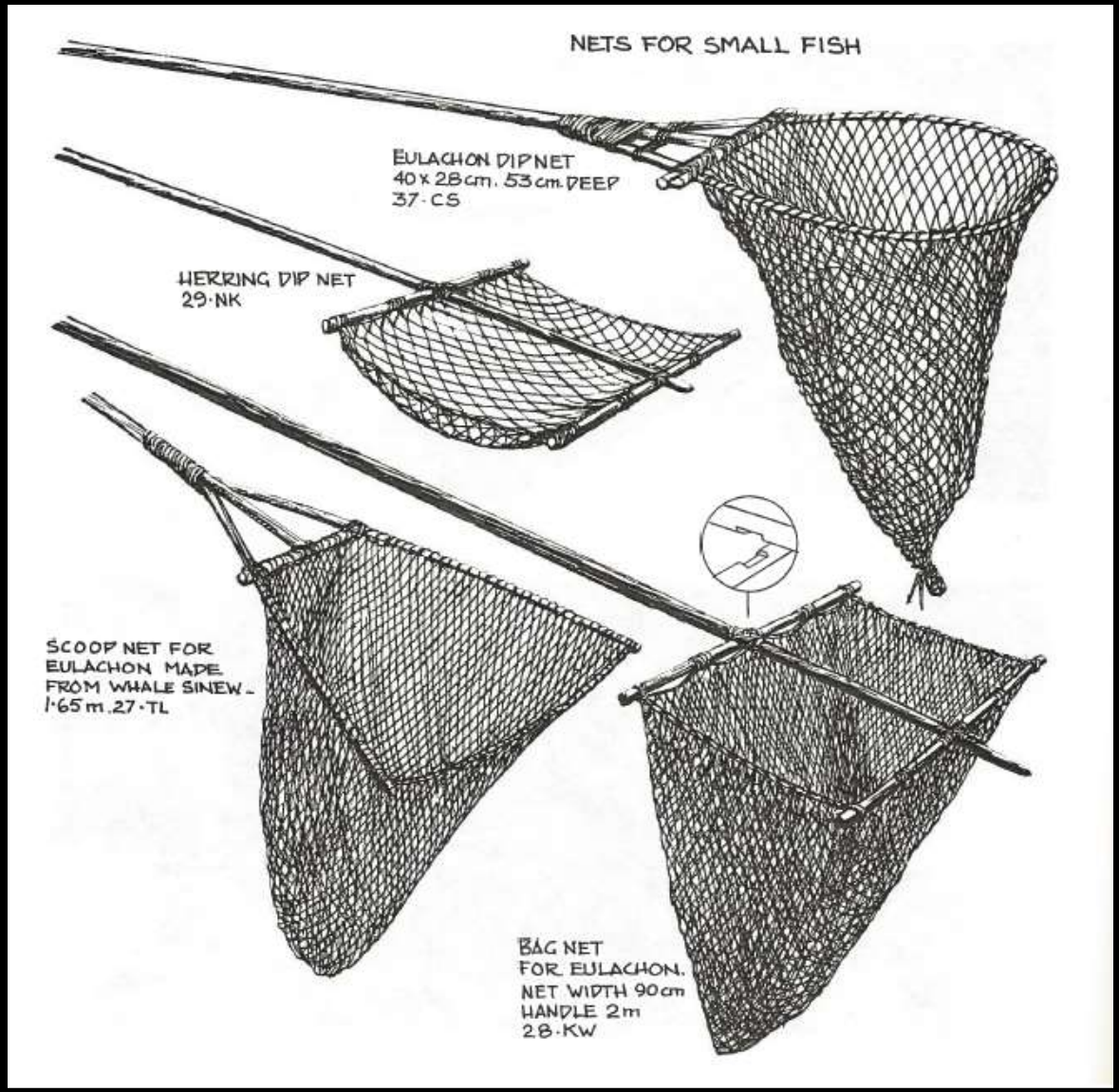
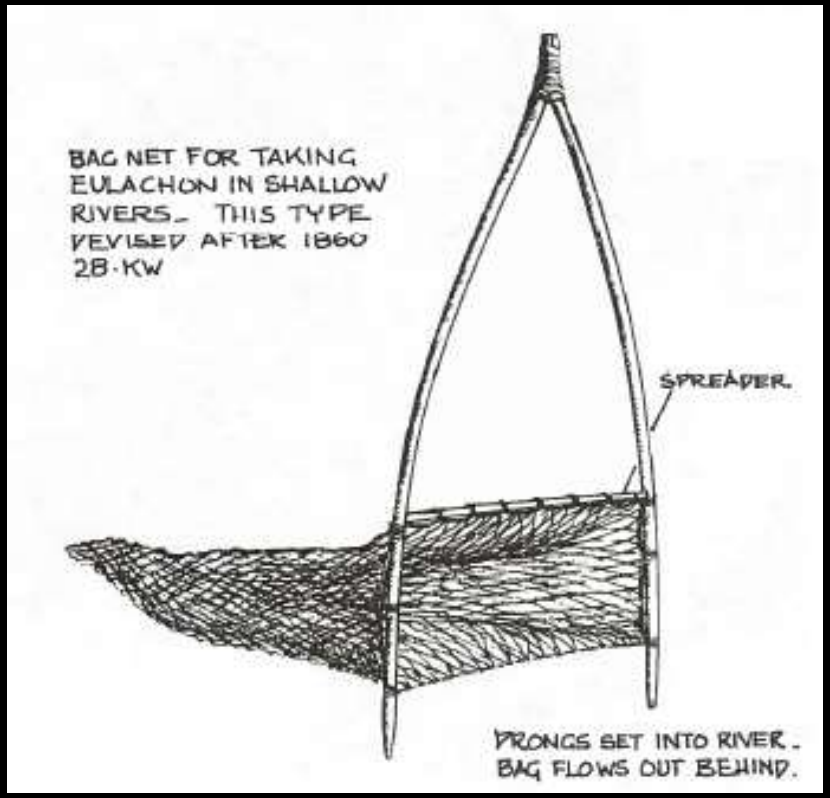
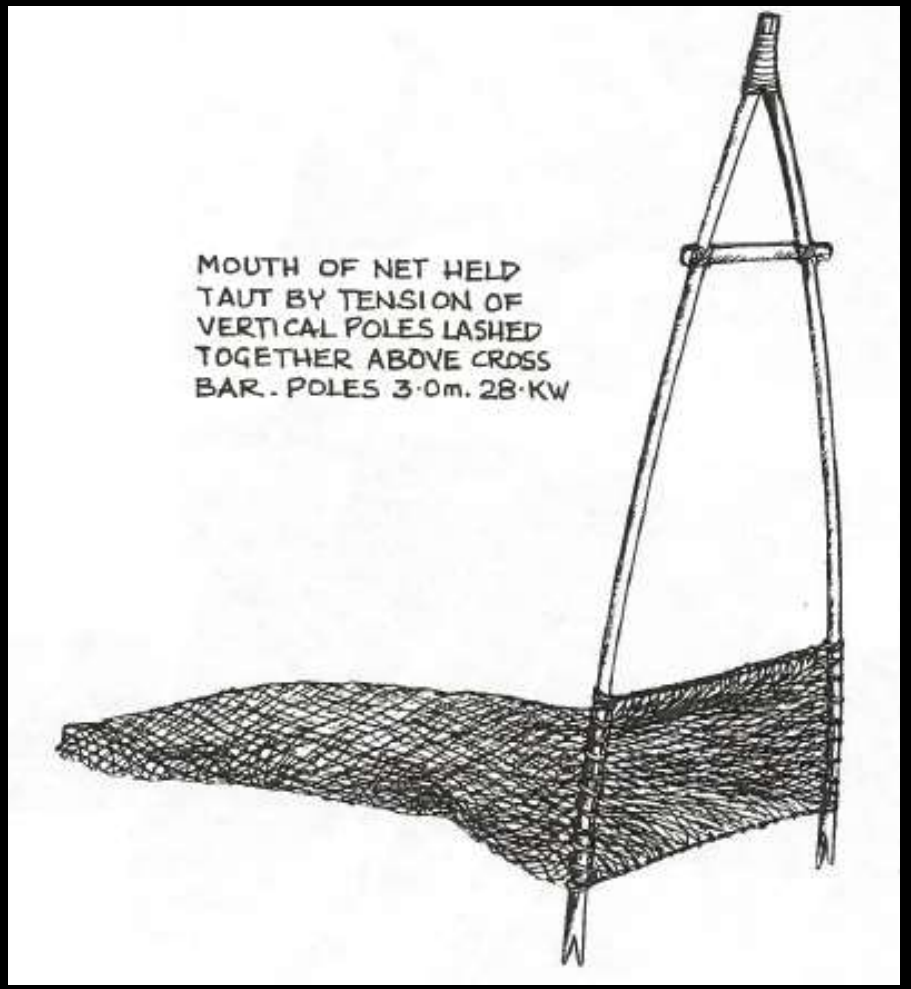
YR 2-4 ('15-'16, '16-'17 and '17-'18) funded by the Cowlitz Indian Tribe

Dip nets

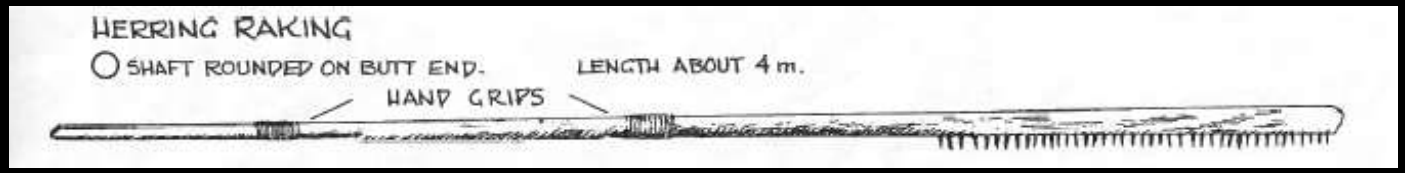

NETS FOR SMALL FISH
EULACHON DIP NET
40 x 28 cm. 53 cm. DEEP
37-CS
HERRING DIP NET
29-NK
SCOOP NET FOR
EULACHON MADE
FROM WHALE SINEW.
1·65 m. 27-TL
BAG NET
FOR EULACHON.
NET WIDTH 90 cm
HANDLE 2 m
28-KW

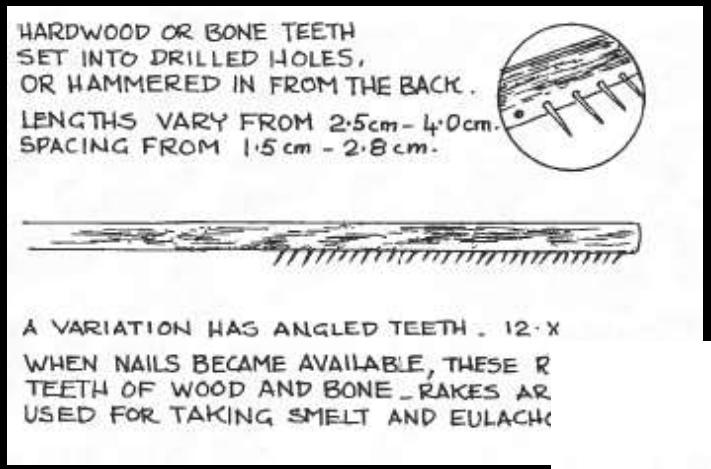
Bag Nets

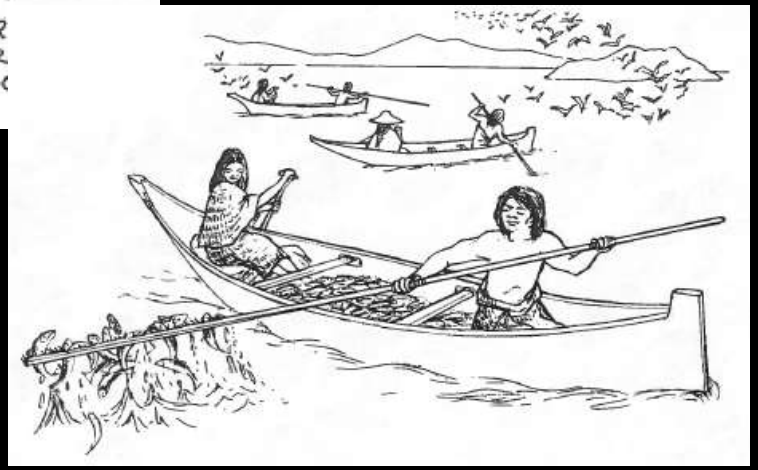

BAG NET FOR TAKING EULACHON IN SHALLOW RIVERS. THIS TYPE REVISED AFTER 1860
28·KW
SPREADER.
PRONGS SET INTO RIVER. BAG FLOWS OUT BEHIND.


MOUTH OF NET HELD TAUT BY TENSION OF VERTICAL POLES LASHED TOGETHER ABOVE CROSS BAR. POLES 3·0m. 28·KW

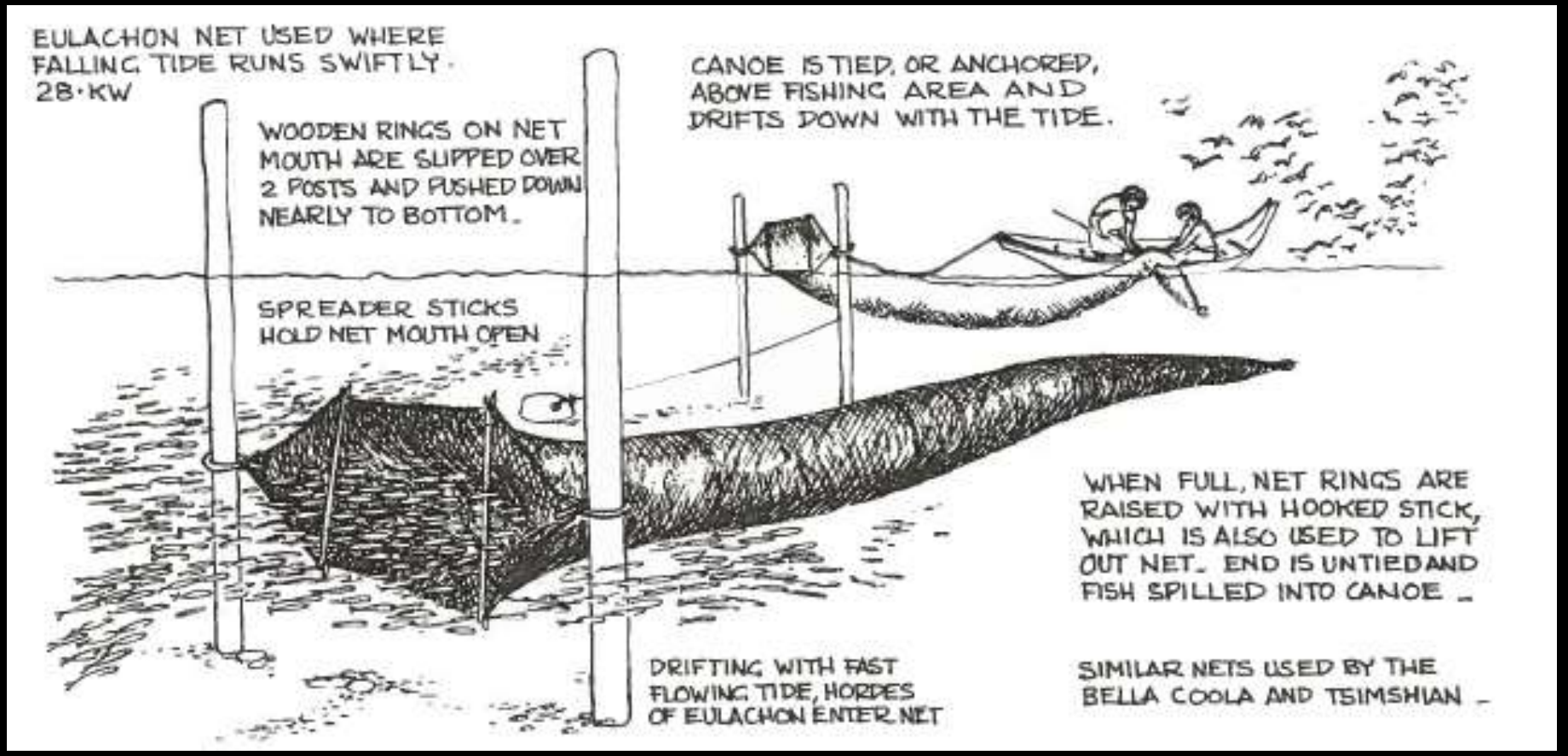
Rake


HERRING RAKING
SHAFT ROUNDED ON BUTT END.
LENGTH ABOUT 4 m.
HAND GRIPS


HARDWOOD OR BONE TEETH
SET INTO DRILLED HOLES,
OR HAMMERED IN FROM THE BACK.
LENGTHS VARY FROM 2·5cm - 4·0cm.
SPACING FROM 1·5 cm - 2·8 cm.
A VARIATION HAS ANGLED TEETH. 12·X
WHEN NAILS BECAME AVAILABLE, THESE R
TEETH OF WOOD AND BONE _ RAKES AR
USED FOR TAKING SMELT AND EULACH

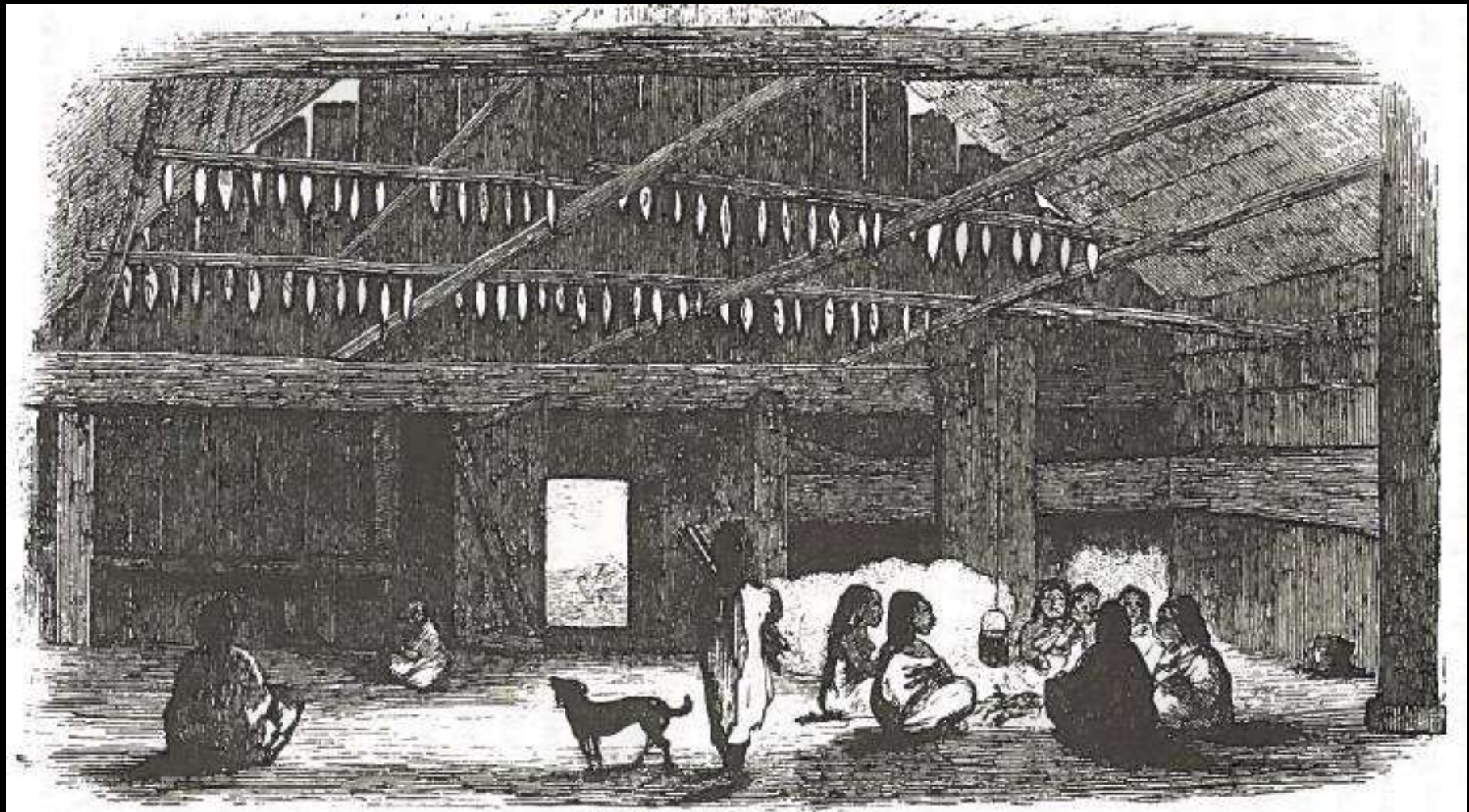


Tide Nets

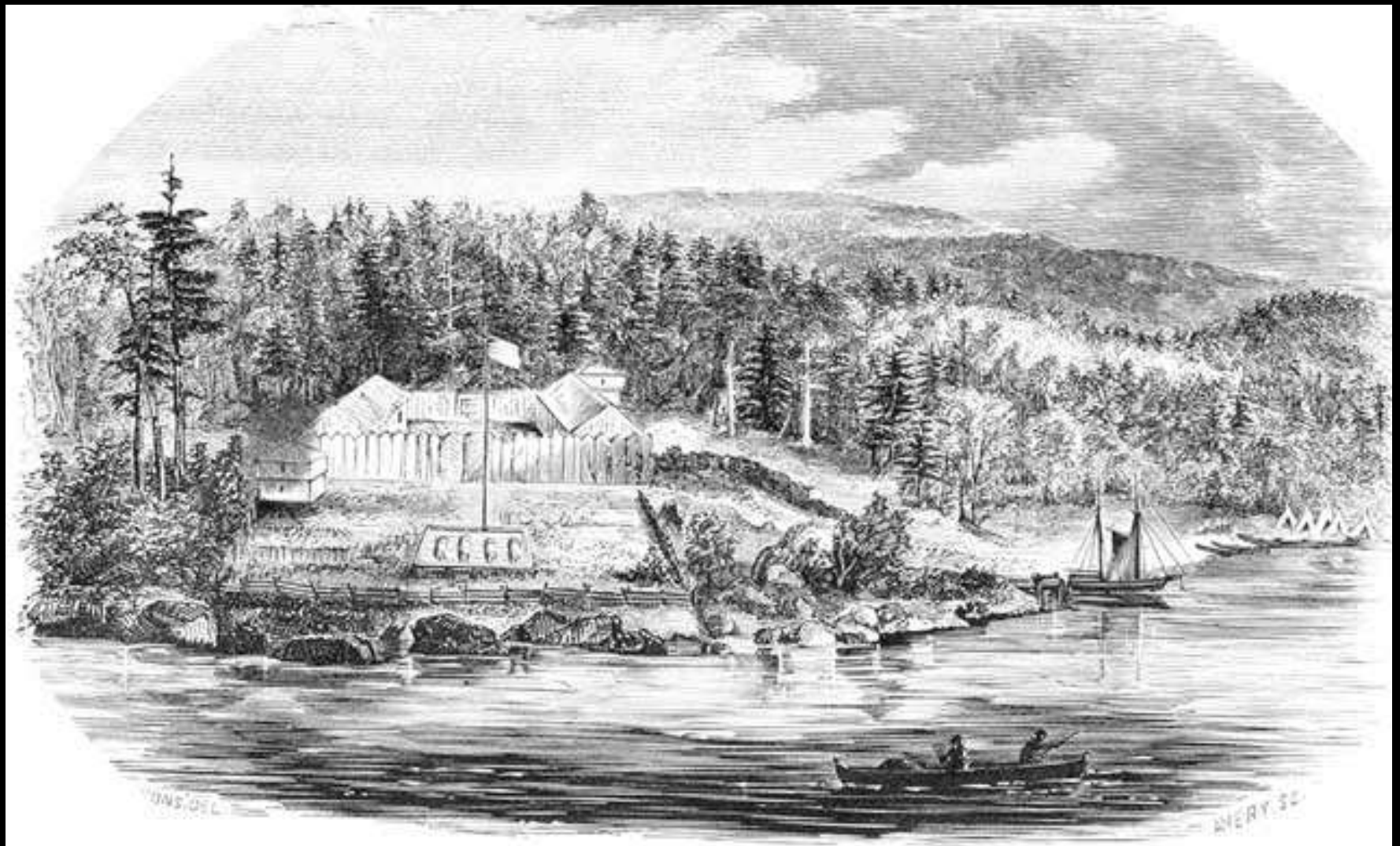

EULACHON NET USED WHERE FALLING TIDE RUNS SWIFTLY. 28·KW
WOODEN RINGS ON NET MOUTH ARE SLIPPED OVER 2 POSTS AND PUSHED DOWN NEARLY TO BOTTOM.
CANOE IS TIED, OR ANCHORED, ABOVE FISHING AREA AND DRIFTS DOWN WITH THE TIDE.
SPREADER STICKS HOLD NET MOUTH OPEN
WHEN FULL, NET RINGS ARE RAISED WITH HOOKED STICK, WHICH IS ALSO USED TO LIFT OUT NET. END IS UNTIED AND FISH SPILLED INTO CANOE.
DRIFTING WITH FAST FLOWING TIDE, HORDES OF EULACHON ENTER NET
SIMILAR NETS USED BY THE BELLA COOLA AND TSIMSHIAN.

of small fish which now begin to run and are
taken in great quantities in the Columbia R
about 40 miles above us by means of skiming
or scooping nets. on the page shown maner
the likeness of them as large as life, it
as perfect as I can make it with my
pen and will serve to give a
general idea of the fish. the
rays of the fins are bony but
not sharp the somewhat pointed.
the small fin on the back
next to the tail has no
rays of bone being a
membranous fulliche
to the gills have
each. three of the
eight each, then
are 20 and 8
that of the back
the fins are of
it of a bluish
the the lower
is of a silver
part the
behind the
second of
the purple
a silver
and
the

three men
the fins and
eleven rays
abdomen have
of the pinnacent
half formed in front
has eleven rays. all
a white colour. the back
dusky colour and that of
part of the sides and belly
of white. no spots many
first bone of the gills next
eye is of a bluis cast and the
a light goald colour nearly white
of the eye is black and the iris of
white. the under jaw exceed the upper
the mouth opens to great extent folding
that of the herring. it has no teeth.
the abdomen is obtuse and smooth, in this
differing from the herring, shad, anchovy
&c of the Malacopterygians Cuv. & Class
Clupea

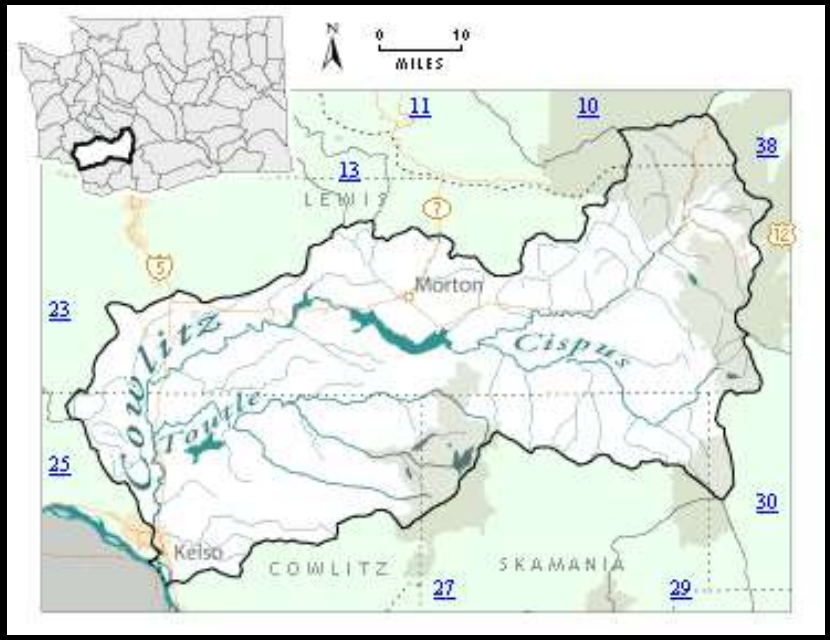


INSIDE OF AN INDIAN LODGE.



ASTORIA, AS IT WAS IN 1813.

Columbia River Watershed



Cowlitz River Watershed

Spawning Stock Biomass (SSB):

Calculation of SSB for eulachon in the Cowlitz River was accomplished via the following equation:

$$B = P/(F*R) \qquad \text{Eq. 1}$$

where:
B = Biomass: total number of mature fish in the return
P = total Production of the population (larvae and egg flux)
F = mean Fecundity (the number of eggs produced per female), and
R = the proportion of mature females in the population (sex Ratio)

Sampling Days:

Usual: 1/week sampling; fyke nets on Mondays, retrieved Tuesdays; Plankton net samples collected on Mondays.

Adaptive: 2/week sampling during periods of peak abundance; fyke nets on Monday and Thursday, retrieved Tues and Fri; plankton net samples collected Mondays and Thursdays

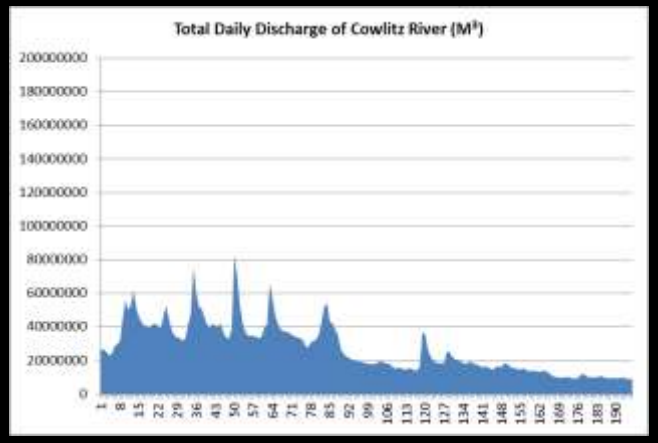
SSB Year	*Total Weeks*	*Double Weeks*	*Start*	*End*
2014-2015	*28*	*9*	*17-Nov-2014*	*31-May-2015*
2015-2016	*23*	*7*	*23-Nov-2015*	*25-Apr-2016*
2016-2017	*22*	*4*	*28-Nov-2016*	*24-Apr-2017*
2017-2018	*20*	*0*	*27-Nov-2017*	*10-Apr-2018*

Methods: Finding “P” Production (Plankton Flux)

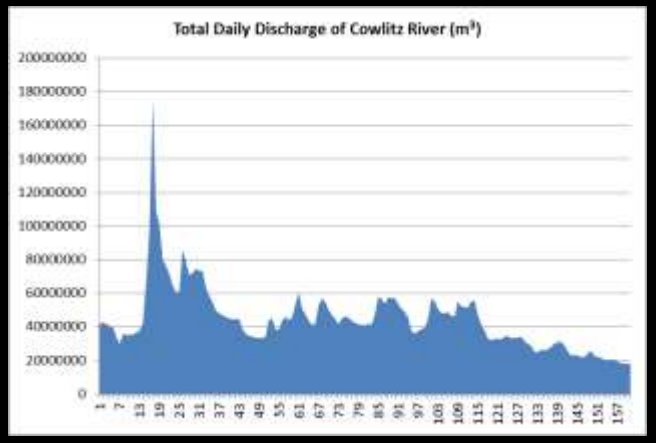
Flow Volume: Entire Cowlitz River Flow obtained by summing values obtained from:

- USGS Cowlitz River gage at Castle Rock, WA
- WA Dept. of Ecology gage for the Coweeman River, (trib to Cowlitz below Castle Rock)
- +3.63% volume modifier calculated for Arkansas Creek, Ostrander Creek and other small unnamed creeks below Castle Rock (WDFW flow analysis, 2015)

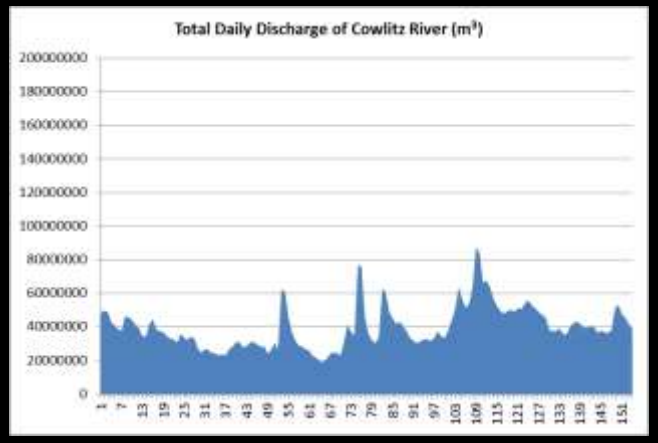
Results: Cowlitz River Flow



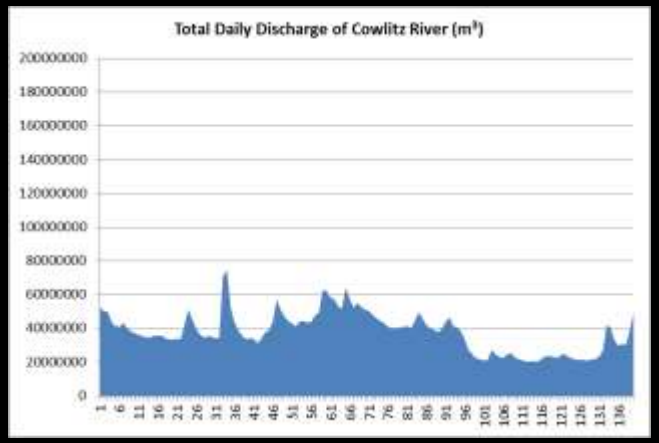
2014-2015: 196 days



2015-2016: 161 days



2016-2017: 154 days



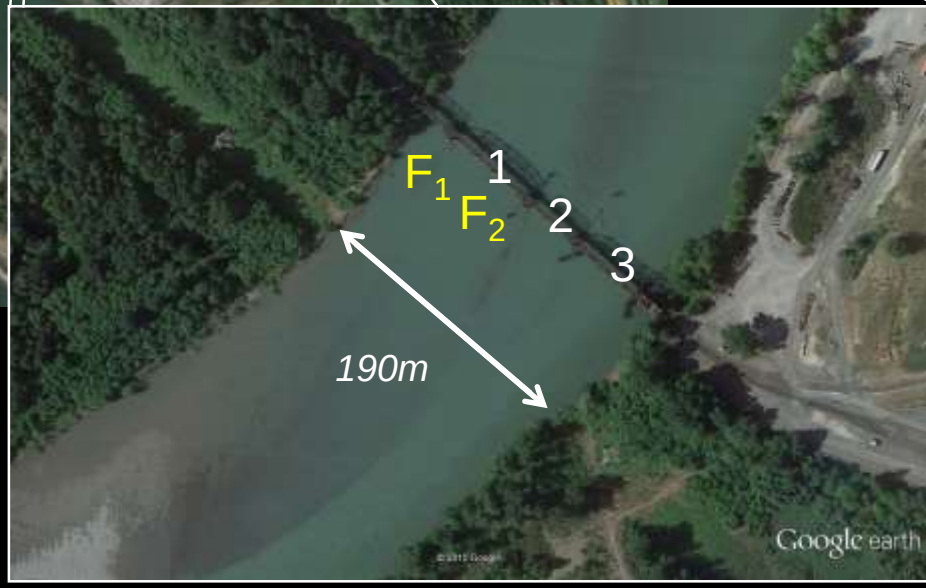
2017-2018: 140 days

Methods: Finding “P” Production (Plankton Flux)

Deployed plankton nets from boat at 3 locations on transect across Cowlitz River

Plankton nets equipped with a General Dynamics Flow meter to record volume of sampled water.

Plankton washed into cod end of nets and collected in sample bottles.



Methods: Sample Location RM 1

Methods: Finding “P” Production (Plankton Flux)

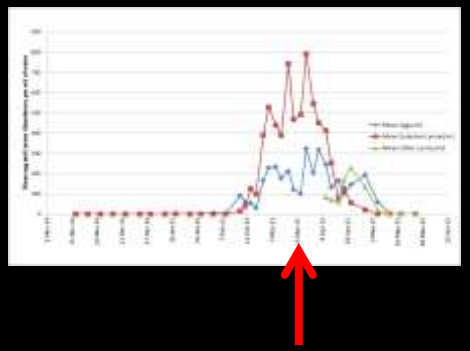
Bottles taken to NRD lab and plankton counted using 4x magnifying lamp

Water volume of sample calculated from flow meters to generate density values of Eggs and Larvae/m^3

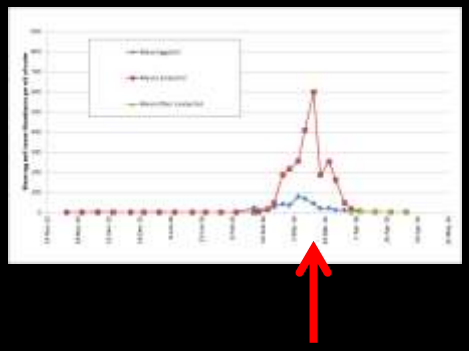
sample values combined to derive daily Mean and CI values

Results: Finding “P” Production (Plankton Flux)

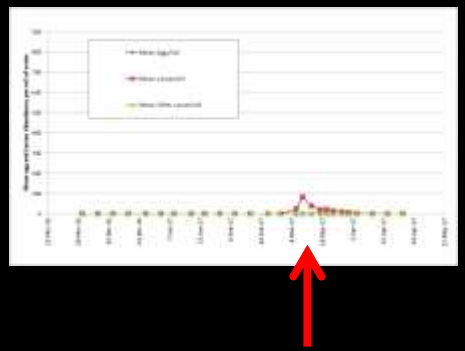
SSB Year	*#Samples*	*E. eggs*	*E. larvae*	*“Other” Larvae*
2014-2015	*111*	*14,648*	*24,268*	*3249*
2015-2016	*90*	*6426*	*14,010*	*489*
2016-2017	*78*	*556*	*7188*	*19*
2017-2018	*60*	*68*	*271*	*19*



21-Mar-2015



14-Mar-2016



9-Mar-2017

9-Mar-2017

Methods: Bootstrap Procedure for weekly plankton flux density

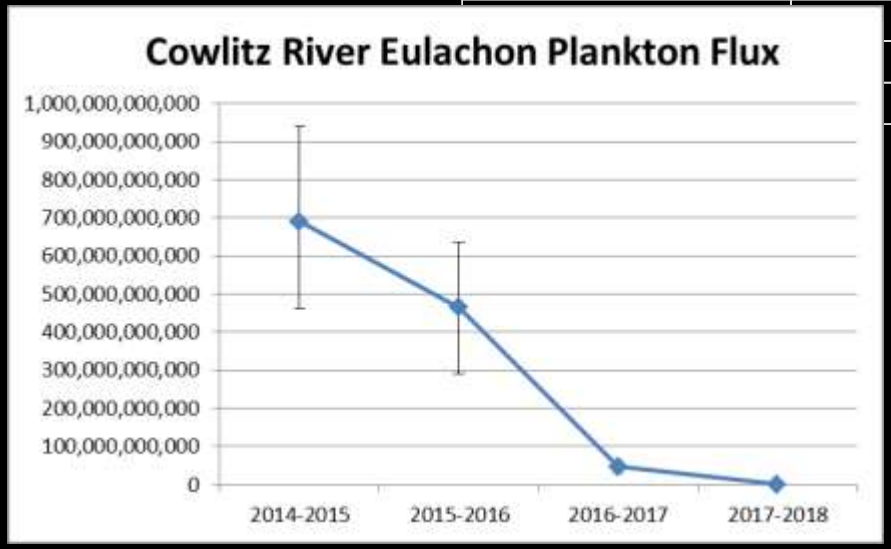
Weekly Bootstrap analysis randomly re-picks sample values from within from weekly blocks to derive means and variability.

Bootstrap iterations set at 1000 for each weekly block

Weekly plankton flux density values applied against Cowlitz River weekly flow totals

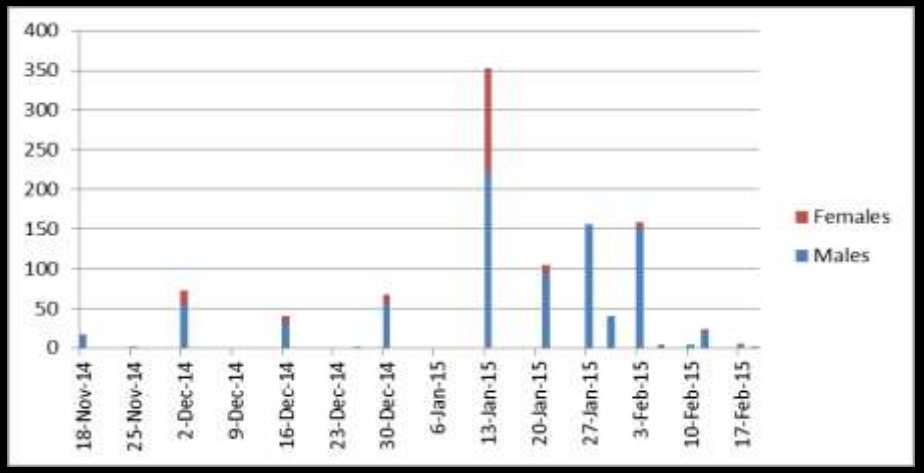
Cowlitz River Interannual Eulachon Plankton Flux

Cowlitz River Plankton Flux Descriptive Stat	2014-2015	2015-2016	2016-2017	2017-2018
Max	1,077,582,000,000	717,014,000,000	67,624,000,000	787,000,000
Upper 95% CI	938,587,000,000	633,557,000,000	61,134,000,000	782,000,000
Mean	690,395,000,000	464,116,000,000	46,512,000,000	502,000,000
Lower 95% CI	463,294,000,000	289,621,000,000	31,802,000,000	296,000,000
Min	381,083,000,000	196,625,000,000	24,922,000,000	295,000,000
Interannual Change		-33.5%	-90.6%	-98.8%
		-32.5%	-90.4%	-98.7%
		-32.8%	-90.0%	-98.9%
		-37.5%	-89.0%	-99.1%
		-48.4%	-87.3%	-98.8%
Cumulative change				-99.9%
				-99.9%
				-99.9%
				-99.9%
				-99.9%



Methods/Results: Finding "R" Sex Ratio

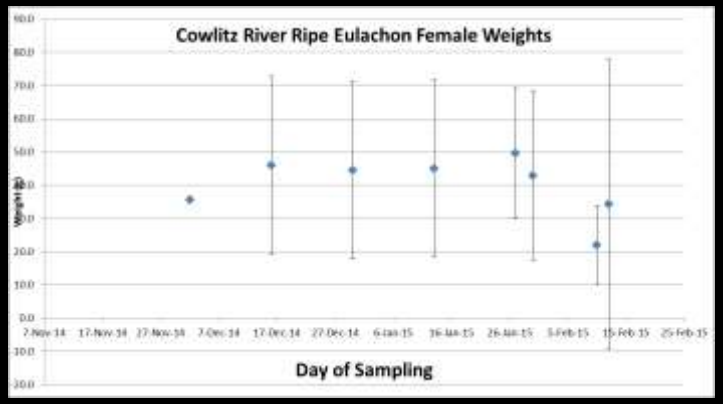
Fyke net sampling is also intended to illustrate M/F Sex ratio specific to the Cowlitz River.

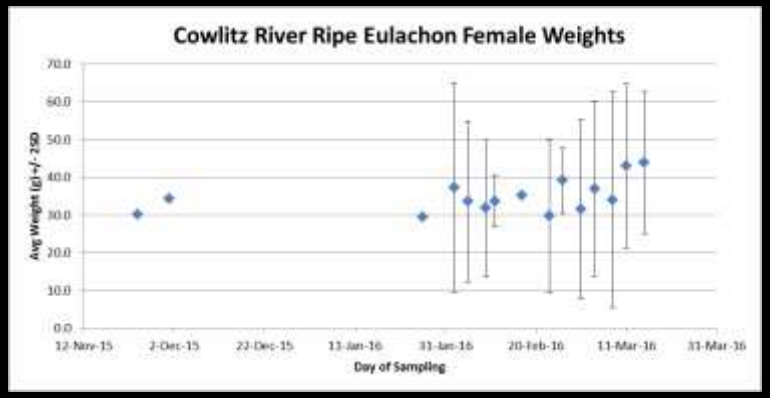


Representative 2014-2015 Fyke Net Results

SSB Year	Fyke net M	Fyke Net F	WDFW Creel data used?	Ratio
2014-2015	853	193	Yes (7382M:1613F)	4.53:1
2015-2016	654	294	Yes (5419M:385F)	3.08:1
2016-2017	165	25	None	?
2017-2018	144	20	None	?

Methods: Finding “F” Fecundity





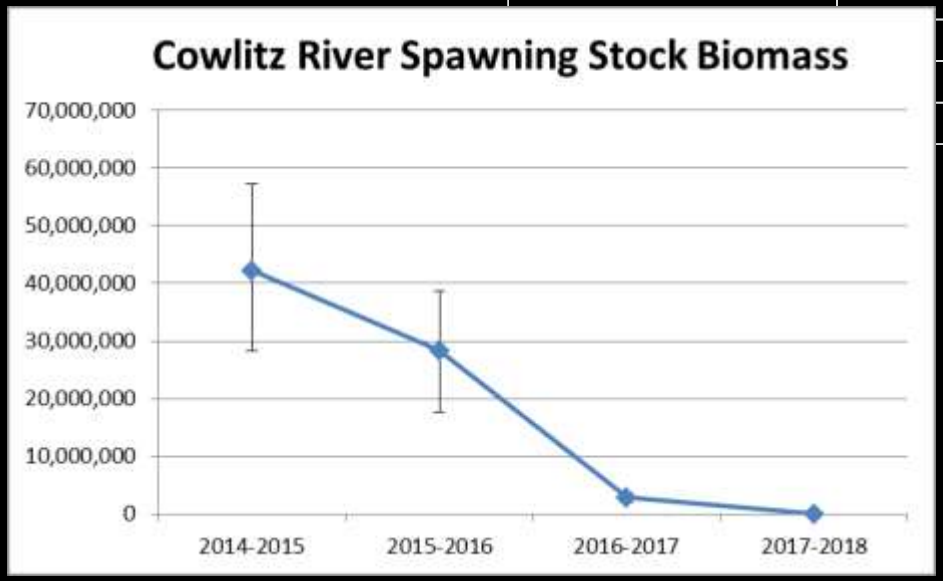
SSB Year	Fyke Net F	Mean wgt (g)	SD wgt
2014-2015	90	43.82	13.77
2015-2016	293	33.25	11.44
2016-2017	24	48.43	16.76
2017-2018	24	50.75	12.40

In YR 1 &2 we weighed ripe female fish to collect weights specific to the Cowlitz River. Low numbers in YR 3 & 4

States use Sex Ratio of 1:1
Mean Female fish weight of 40.84 g
802.255 eggs/g of female wgt…

Cowlitz River Spawning Stock Biomass

Cowlitz RiverSpawning Stock Biomass	2014-2015	2015-2016	2016-2017	2017-2018
Max	65,774,000	43,766,000	4,128,000	48,000
Upper 95% CI	57,290,000	38,672,000	3,732,000	48,000
Mean	42,141,000	28,329,000	2,839,000	31,000
Lower 95% CI	28,279,000	17,678,000	1,941,000	18,000
Min	23,261,000	12,002,000	1,521,000	18,000
Interannual Change		-33.5%	-90.6%	-98.8%
		-32.5%	-90.3%	-98.7%
		-32.8%	-90.0%	-98.9%
		-37.5%	-89.0%	-99.1%
		-48.4%	-87.3%	-98.8%
Cumulative change				-99.9%
				-99.9%
				-99.9%
				-99.9%
				-99.9%



Weaving Critical Themes: Tribal Heritage and Research

1. Ethno-Ecology is Process-Based
2. Protection, Conservation & Restoration is a continuation of Traditional Culture
3. Research is Ceremony
4. Abundance of Adult Spawning Eulachon in the Cowlitz River has declined >99.9% in the last 4 returns, from 42 million fish to 31 thousand.

Questions?

Nathan Reynolds
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