Northwest Science Notes

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Observations of Eulachon, *Thaleichthys pacificus,* in the Elwha River, Olympic Peninsula Washington

Abstract

This paper summarizes a pilot study conducted in spring 2005 that documents, for the first time, eulachon, *Thaleichthys pacificus,* in the Elwha River. General morophometrics of the Elwha eulachon are comparable to those found in other northwest systems. Eulachon abundance in the Elwha appears much lower than in other northwest rivers with documented eulachon runs. Theories for fish presence in the Elwha include straying, and reestablishment of a remnant stock. The local historic observations of eulachon in the Elwha (but not other Olympic Peninsula rivers) up until the mid 1970's , combined with the severely degraded habitat of the lower Elwha River, indicate that the Elwha eulachon are a remnant population. Upcoming dam removals will restore riverine sediment processes, including delivery of sand gravel size material suitable for eulachon spawning to the now severely sediment starved lower river . Dam removals are therefore anticipated to have restoration benefit to eulachon and may play a role in regional restoration of severely depleted northwest eulachon stocks.

Introduction

The Elwha River, located on the north Olympic Peninsula in Washington State, drains an area of 800 km^2. Over 85% of the drainage protected by the Olympic National Park lacks anadromous fish because two hydroelectric dams constructed in the early 20th century block fish passage (Figure 1). The two dams are slated for removal beginning in 2009.

Two reservoirs behind the dams trap all coarse sediments (i.e., sand, gravel, cobble), woody debris transported from the upper river, and diminish nutrient transport downstream. Unconstrained, low gradient channel reaches in the Elwha lower river historically contained extensive side channel habitat with sand gravel substrate suitable for eulachon spawning. Truncation of sediment transport to the lower river along with channelization and the systematic removal of LWD has caused channel incision and an increase in bed substrate size (Pohl 2000; Figure 2). Much of the lower river substrate is now characterized by platter size cobble, much too large for eulachon spawning.

A small sample of eulachon (*Thaleichthys pacificus*), historically also called candlefish, was captured in the lower Elwha River in spring 2005 during ongoing work to document juvenile salmonid outmigration. Eulachon are members of the smelt family that spawn in sand/gravel alluvial habitats of Pacific Northwest rivers from February to May (Hart, 1980; Hay et al. 2002; Hay and McCarter 2000). This was the first observation of

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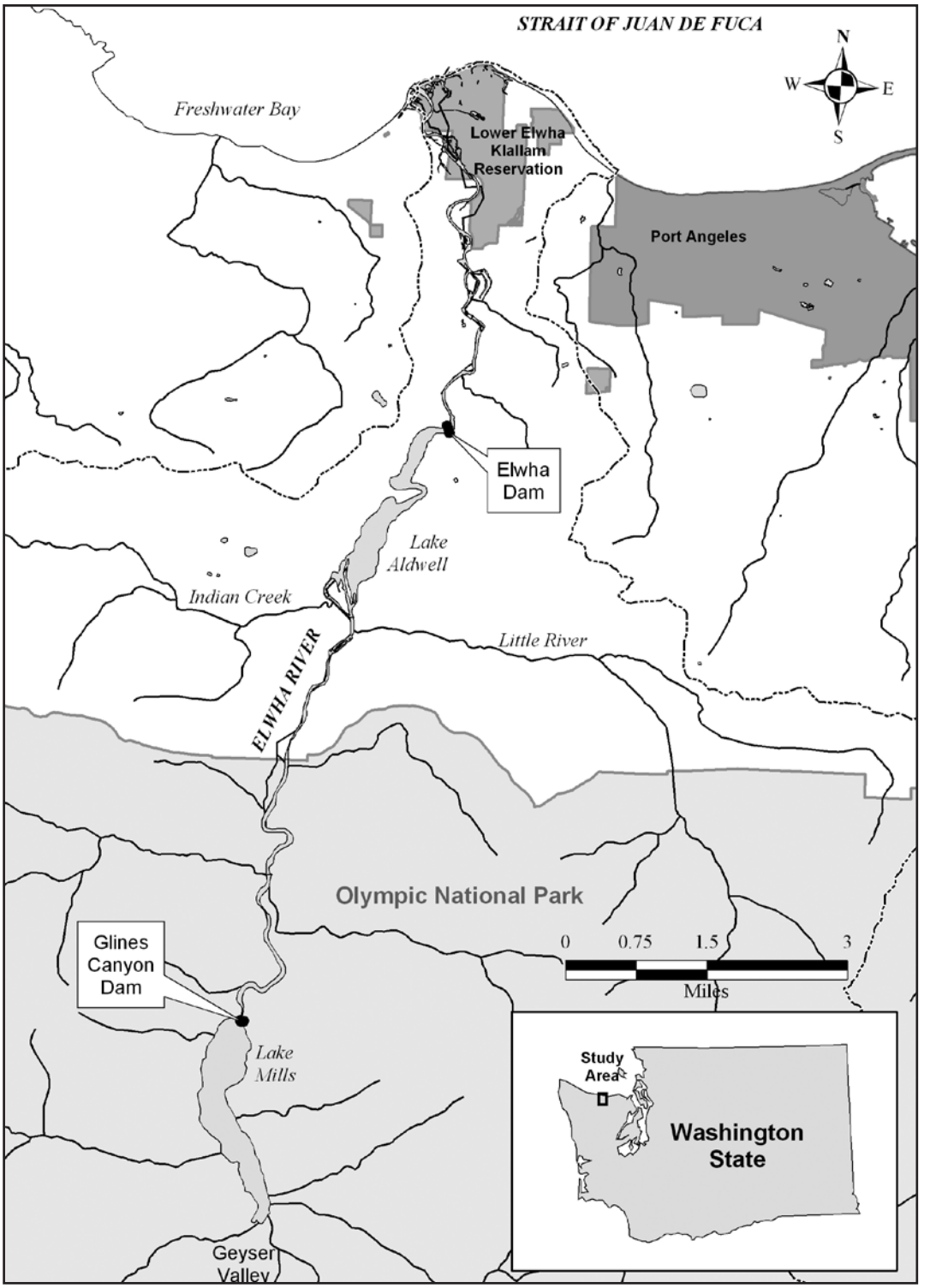

Figure 1 Study site and location of the Elwha and Glines Canyon dams.

eulachon in the Elwha River since the 1970's, and the first formal documentation of eulachon in this river. In this paper we summarize observations of eulachon in the lower Elwha River and discuss the relationship of the upcoming dam removals on future use of the river by eulachon.

Methods

An eight foot screw trap was placed on the Elwha as part of ongoing work to document juvenile salmonid outmigration of the Elwha. The trap fished nearly continuously, with some minor breaks due to flooding and mechanical breakage from 15 March until 3 July 2005. The trap was positioned in the lower river (RM 0.2) and was tidally influenced. The trap was inspected daily and salmonid fishes entrained in the trap were identified, counted, and released. Adult eulachon collected from the trap were fixed in 10% formalin and later analyzed for basic metrics, including length, weight, and fecundity, This was the first year a screw trap was used in the Elwha. A five foot screw trap was placed in the Dungeness River at RM 0.2 for the same period and fished similarly.

Results

Fifty-eight adult eulachon were collected in the screw trap at the lower quarter mile of the Elwha River from 18 March to 28 June 2005. None were collected in the Dungeness River. Twenty five of the fish collected from the Elwha were retained for analysis. Average total length was 169.9 mm (sd=25.41) and average weight was 32.0 grams-(sd=11.8) (Table 1). All had empty stomachs and only residual teeth. Of these 25 fish, 18 were female and 7 were males (Table 2). Three females were sexually immature with the remainder either ripe, extruding eggs, or spent. Three female fish ovaries were subsampled for egg count. Total eggs per ovary are summarized in Table 3.

Figure 2. A view of the lower Elwha River showing platter size cobble indicative of long term severe sediment starvation.

Discussion

This work documents, for the first time, eulachon presence in the Elwha River. Comparing our findings with other Pacific Northwest systems reveals a number of similarities. Adult fish size, weight, and egg count are consistent with metrics reported from other areas of Puget Sound and Canada (Garrison and Miller 1982). The empty gut and resorbed teeth are also consistent with semelparity observed in other British Columbia systems (Hay et al. 20002).

The number of eulachon retrieved in this study is much lower than documented and

TABLE 1. Summary of adult eulachon collected in the Elwha River April-May 2005.

Date collected	Sex	Reproductive condition	Total length (mm)	Total Wt (g)	Gonad Wt (g)	Gonad Wt: Total Wt (g)
20-Apr	F	extruding	163	30	5	0.17
	F	not ripe	188	27	1	0.04
	M		171	36	2	0.06
	F	Ripe	176	40	13	0.33
	F	Ripe	175	34	8	0.24
	F	Ripe	179	31	3	0.10
22-Apr	F	Ripe	144	17	3	0.18
	M		175	37	1	0.03
	M		182	38	1	0.03
	M		172	39	2	0.05
	M		173	35	2	0.06
26-Apr	F	Ripe	136	16	3	0.20
	F	Ripe	147	22	7	0.31
	F	Ripe	250	58	15	0.25
3-May	M		193	48	2	0.04
	M		195	49	3	0.06
	F	extruding	167	36	9	0.25
	F	no eggs	173	26	0	0.00
	F	no eggs	172	33	0	0.00
	F	Ripe	175	35	6	0.17
4-May	F	Ripe	190	49	8	0.16
	F	Ripe	136	18	3	0.17
11-May	F	not ripe	145	17	1	0.03
	F	not ripe	125	11	1	0.09
	F	Ripe	145	21	4	0.20
Average			173	32	4	0.14
SD			24	12	4	0.10

estimated in other northwest rivers with eulachon runs (Hay et al. 2002; Hay and McCarter 2000, Table 4). Two possible reasons for the observed low numbers of adult Elwha fish are; 1) The fish observed are strays, or; 2) The fish observed are the last vestiges of a historic spawning stock.

TABLE 2. Morphometric summary of eulachon from the Elwha River by sex. Standard deviation is given in parentheses.

Metric	Female (n=18)	Male (n=7)
Average total length (mm)	170 (25)	176 (27)
Average total weight, (g)	32.12 (11.80)	35.71 (11.72)
Gonad weight:length	0.03 (0.02)	0.03 (0.03)

Straying by eulachon is well documented in the literature. Hay and McCarter (2000) noted significant interannual variation in eulachon spawning location. These authors conclude that eulachon do not imprint to a specific river, but instead to estuarine areas associated with rivers. Hay et al. (1996) state that straying is commonly associated with environmental events such as El Nino, and does not lead to established populations. The relatively small size and degraded nature (due to sediment starvation) of the Elwha estuary may make the Elwha indistinguishable from other nearshore Strait systems and thereby be used by straying eulachon.

TABLE 3. Estimated egg counts for gravid female Eulachon collected from the lower Elwha River April-May 2005.

Date collected	Total Length (mm)	Total Wt (g)	Gonad Wt (g)	Egg Wt/ subsample	#Eggs in subsample	# Eggs/ gram	Estimated #eggs/ovary
26-Apr 1	36	16.12	3.196	0.689	1657	2405	7686.17
	147	22.21	6.976	0.474	1245	2627	18323.04
	250	57.60	14.530	0.253	911	3601	52319.49
Average				0.472	1271	2877	26109.57
SD				0.218	374	636	23313.21

TABLE 4. Eulachon metrics and run size published for other areas of the Pacific Northwest

Parameter	Geographic area	Number/Range	Reference
Fecundity (eggs)			
	British Columbia	17,000-40,000	Hart and McHugh 1944*
	Fraser River	32,000	Hay et al 2002
	Columbia River	7,000-31,000	Parente and Snyder 1970*
	Columbia River	20,000-60,000	Smith and Saalfeld 1955*.
Average size/wt			
	Fraser River	53-178 mm	McHugh 1939*
	Fraser River	158.26 mm/40.63 g	Hay et al 2002
Estimated annual number of spawners per commercial catch (cc)			
	British Columbia	3.2 million spawners	Hay and McCarter 2000
	Columbia River	257,000 fish (cc)	Smith and Saalfeld 1955
	Kalama River	2,800 fish (cc)	Smith and Saalfeld 1955

*From Garrison and Miller (1982)

Alternatively, if the Elwha historically supported a spawning population of eulachon, the current low numbers observed in the Elwha may be in part a result of the large scale loss of spawning habitat due to sediment starvation. Spawning habitat, including appropriate substrate size, is critical for eulachon success. Tributaries are also a critical feature of eulachon spawning (Hay and McCarter 2000). The Elwha River is dominated by degraded side channel habitat that, prior to damming, was comprised of gravel size sediment and tributaries appropriate for spawning.

Comparing Elwha eulachon observations of this study with work in other Peninsula rivers provides only a bit more information on the importance of the Elwha for eulachon. Unfortunately we have very limited historic information on eulachon distribution in Olympic Peninsula streams. The information we do have indicates that eulachon use may be limited to the Elwha. While local fishers have stated they were a regular, predictable feature in the Elwha until the mid 1970's, eulachon have not been observed in other Olympic Peninsula streams and rivers (Dick Goin, Olympic Sportsman Association, Personal Communication)). The lower rivers of central and western Strait streams and rivers including Dungeness, Salt Creek, East and West Twins, and Hoko Rivers currently and/or historically offered potentially suitable habitat for eulachon spawning. These systems have been consistently fished, surveyed, and smolt trapped by Tribes, resource agencies, and sport fishers for generations. In addition the Dungeness has had a screw trap in its lower river for at least three years, including the year of this study. If eulachon were present in these systems they likely would have been observed. It is possible that eulachon use of these areas went unobserved. While such an observation oversight of all other rivers except the Elwha is unlikely, intensive surveys of these rivers for eulachon over a multi year period are recommended to clarify contemporary comparative use information for the Olympic Peninsula. In absence of these intensive surveys, the continued observations of eulachon in the Elwha lead us to surmise that the Elwha eulachon are likely a remnant stock of the Elwha River rather than stray.

Dams have had a significant negative affect eulachon distribution in other Washington rivers (Smith and Saalfeld 1955), and the Elwha dams have had catastrophic impact on a number of native fish runs. It is therefore reasonable to assume that the dams have had a negative impact on eulachon use in the lower river and that the upcoming Elwha River dam removals, which will restore the natural transport of sand gravel material suitable for smelt spawning to the lower river, will restore potential spawning habitat for eulachon. Approximately 2-3 mcy of sand and gravel material will be delivered to the sediment starved lower river and nearshore within 5 years of dam removal (Randle et al. 1996). We may therefore predict an increase in eulachon abundance, and spawning, as the river recovers. Focused study is warranted to detail eulachon response to river recovery. Specifically, documentation of population size, spawning location and timing, demographics, and how dam removals can interact with attributes such as age structure, size structure, and sex ratio. Pre and post dam removal monitoring of basic metrics including size, age,

reproductive condition and sex of Elwha eulachon is warranted. Identification and long term monitoring of Elwha River eulachon spawning habitats are also fundamental to understanding the role of dam removals to future eulachon use of the Elwha and are also recommended. Additional monitoring of all Puget Sound streams for eulachon presence and spawning is also warranted. Monitoring at this larger scale would provide clarity of the role Elwha eulachon play in regional stocks historically and hopefully future restoration.

Whether as strays or remnant spawning stock, eulachon use the Elwha River. Eulachon numbers in the Elwha appear to have declined in the last 40 years. Declines observed in the Elwha system are consistent with those seen throughout the northwest coast eulachon stocks including Fraser River, Puget Sound, and Columbia River stocks . These declines have placed eulachon restoration as a stated priority for fishery managers (Eulachon Research Council 2000). The removal of the Glines Canyon and Elwha dams may play a significant role in regional management and recovery of northwest eulachon. We recommend additional focused work to clarify the extent.

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