NATIVE CHAR UTILIZATION
LOWER CHEHALIS RIVER AND
GRAYS HARBOR ESTUARY
ABERDEEN, WASHINGTON

Prepared for:

U.S. Army Corps of Engineers, Seattle District

Seattle, Washington 98124

Prepared by:

R2 Resource Consultants

Redmond, Washington

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1. INTRODUCTION

The Grays Harbor Federal Navigation Channel (Navigation Channel) begins in the Pacific Ocean and continues through Grays Harbor to the Chehalis River near the city of Cosmopolis in Grays Harbor County, Washington. The navigation channel is approximately 22 miles long (covering ~ 1,300 acres) and is divided into 11 reaches. The US Army Corps of Engineers (Corps) dredge annually to maintain the Navigation Channel's dimensions. Channel maintenance involves dredging selected areas that have developed shoals as well as maintaining turning basins. The upstream reaches of the navigation channel are within the river's thalweg near the mouth of the Chehalis River. These reaches, especially the turning basins, often require more extensive dredging to meet the target channel dimension because they accumulate bedload transported downstream from the Chehalis River.

The U.S. Fish and Wildlife Service (USFWS) has expressed concern that channel maintenance in the Chehalis River may impact coastal/Puget Sound bull trout (*Salvelinus confluentus*), a native species of char that is listed as threatened under the Endangered Species Act (64 *Federal Register* 58910). Specifically the USFWS believes that channel maintenance activities may exclude native char from habitats in the lower Chehalis River due in large part to the reduced water quality associated with the dredge plume, and from the loss of benthic prey resources while disturbing river or estuarine sediments. Currently, the USFWS has restricted the Corps to allow in-water work to occur from July 16 through 31 August, and 15 October through 15 February, a period "when bull trout are least likely to be in those designated areas of the estuary" (USFWS 2003). The timing window was based on migration information for native char provided by Kraemer (1994), which indicated that native char in northern Puget Sound, Washington migrate to the estuary from April through May and then re-enter the river from August through November. Most adult fish enter the estuary in February and March and leave the estuary between May and June to return upstream.

In response to previous USFWS "bull trout work windows" for the Navigation Channel, the Corps initiated several conservation measures to minimize the detrimental effects of channel maintenance activities to native char residing in the Chehalis River basin. In addition, the USFWS required the Corps to design and conduct a three-year native char monitoring plan as a Reasonable and Prudent Measure under the Biological Opinion for Grays Harbor and Chehalis River Navigation Dredging (USFWS Reference 1-2-00-F-0577). The monitoring plan, designed in consultation with the USFWS (J. Chan, Fish Biologist, USFWS), would

establish patterns of native char use within lower Chehalis River/Grays Harbor estuary to substantiate bull trout work windows. In January 2001, the Corps contracted with R2 Resource Consultants, Inc. (R2), to conduct biological monitoring within the upper segments of the Grays Harbor Federal Navigation Channel. The overall objective of this study was to determine whether native char are present in the lower Chehalis River/Grays Harbor estuary (Cosmopolis to the mouth of the Hoquiam River) during the periods spanning from 14 February through 30 September. Specifically, the scope of work identified four tasks:

- Determine the presence/periodicity of native char in the lower Chehalis River/Grays Harbor estuary;
- Determine the age and growth of native char inhabiting the lower Chehalis River/Grays Harbor estuary;
- Determine the genetic composition of native char inhabiting the lower Chehalis River/Grays Harbor estuary; and
- Collect age/growth, genetic, and stomach samples from cutthroat trout inhabiting the lower Chehalis River/Grays Harbor estuary.

To assess the presence/periodicity of native char in the lower Chehalis River/Grays Harbor estuary, R2 conducted two separate but interrelated work items. First, a thorough literature search was conducted to determine the historical observations of native char in the lower Chehalis River. Secondly, a study plan was designed to assess the current presence/periodicity of native char in the lower Chehalis River/Grays Harbor estuary using beach seine surveys as the primary capture technique. The beach seine surveys focused on the periods of time when historical observations indicated that native char were either migrating into the lower Chehalis River or outmigrating to the Pacific Ocean. The following report describes the methods and results of R2's analysis of native char presence/periodicity in the lower Chehalis River/Grays Harbor estuary.

2. ENVIRONMENTAL SETTING

2.1 STUDY AREA

Grays Harbor is located on the Washington coast at the mouth of the Chehalis River, approximately 45 miles north of the mouth of the Columbia River and 110 miles south of the entrance to the Strait of Juan de Fuca. Grays Harbor receives discharge from a 2,550 mi^2 watershed containing the Chehalis, Humptulips, Hoquiam, Wishkah, Johns, and Elk rivers (Figure 1), making it the fourth largest estuarine environment in the western United States (Seiler 1989; USACE 1998). The Chehalis River drains approximately 2,200 mi^2 and contributes greater than of 80 percent of the freshwater flow into Grays Harbor estuary making it the largest watershed in Washington outside of the Columbia River system (Seiler 1989; USACE 1998).

Extreme semi-diurnal tides fluctuate over nine feet in the spring causing expansive mudflats to be exposed in Grays Harbor and an extensive labyrinth of channels forming at ebb tide (Figure 1). The surface area of Grays Harbor ranges from approximately 38 mi^2 at mean low water to 94 mi^2 at mean high water (USACE 1998). Grays Harbor is composed of both estuarine and open-water (ocean) habitats (Levinton 1982). The lower Chehalis River and inner harbor are heavily populated and industrialized (Seiler 1989). The outer harbor (i.e., North and South bays) is sparsely populated, considerably wider, and primarily comprised of shallow estuarine habitats enclosed by two spits, Point Brown to the north and Point Chehalis to the south (Seiler 1989; USACE 1998).

The study area within the Navigation Channel is located within the extent of tidal influence on the floodplain of the brackish-tidal freshwater transition zone of the lower Chehalis River. The study area begins at the mouth of the Hoquiam River and extends upstream approximately 5.5 miles to the city of Cosmopolis, Washington. The study area is located within the upstream segments of the Navigation Channel. The study area can generally be divided into three segments: the upstream segment (upstream from Cosmopolis) is primarily rural in nature with undeveloped shrub/scrub forested shorelines; the middle segment (Cosmopolis downstream to Highway 101) is predominantly channelized and confined between riprap levees with increased industrialization and commercial development; while the downstream segment (Highway 101 downstream to the mouth of the Hoquiam River) is comprised of a broader channel and exposed to increased wave action from Grays Harbor estuary.

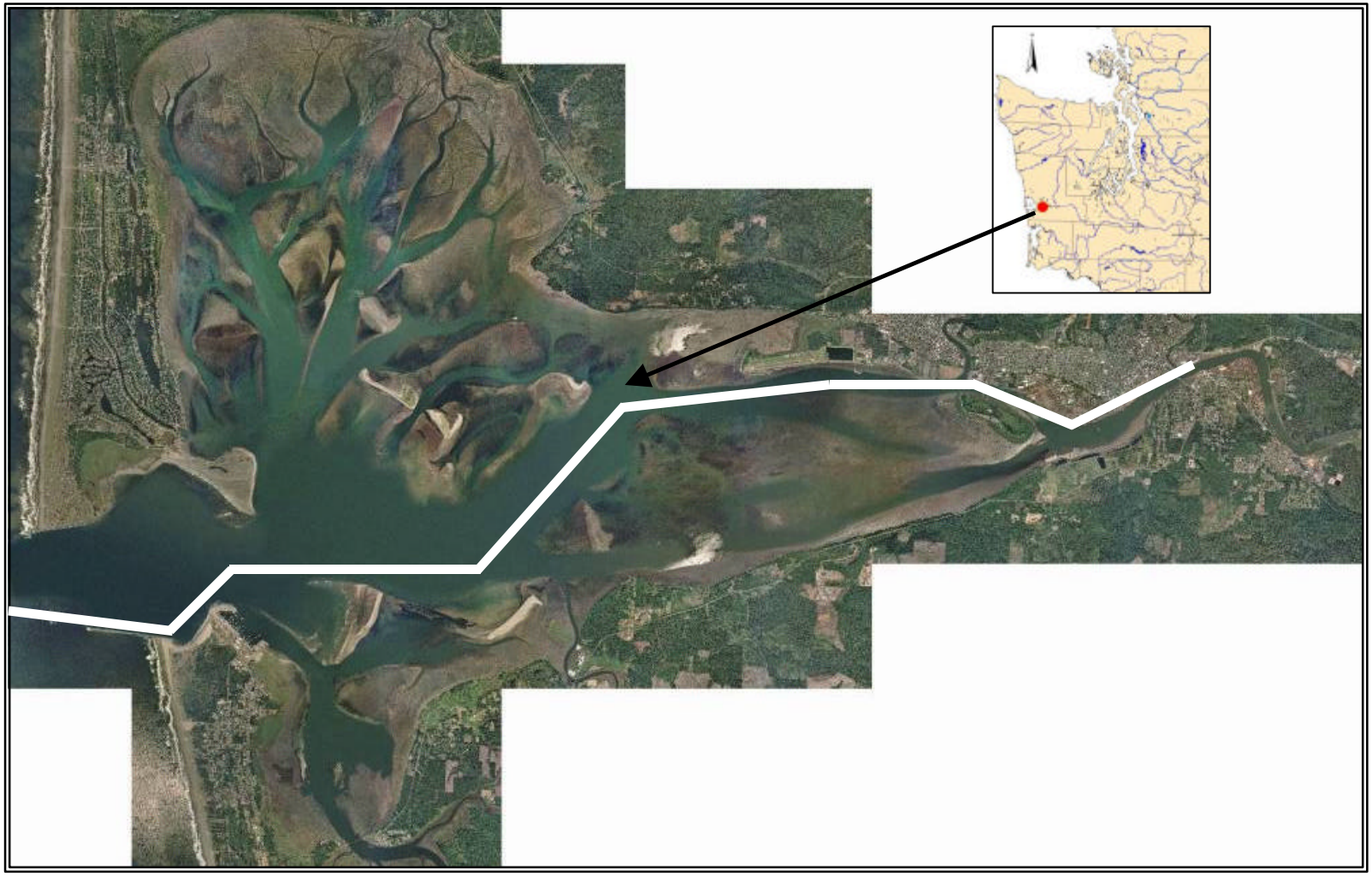

Figure 1. Grays Harbor Federal Navigation Channel, Westport, Washington.

2.2 AQUATIC RESOURCES

Both anadromous and euryhaline fish species inhabit Grays Harbor (Simenstad et al. 2001). Deschamps et al. (1971) found more than 20 fish species during beach seining activities conducted in upper Grays Harbor. Over fifty resident and anadromous fish species have been documented to occur in Grays Harbor, including six species of salmonids (USACE 1998). Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), and coho (*O. kisutch*) salmon, steelhead (*O. mykiss*), coastal cutthroat trout (*O. clarki clarki*), and native char (*Salvelinus spp.*) frequent the waters of Grays Harbor. Various other perch, sculpin, flatfish, rockfish, and herring-like fishes inhabit Grays Harbor, most notably shiner perch (*Cymatogaster aggregata*), Pacific staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), black rockfish (*Sebastes melanops*), and surf smelt (*Hypomesus pretiosus*). The following sections describe key life history characteristics and residency periods for the salmonid species present within the project area. The native char section includes the presence/periodicity information that was collected during the literature search that was conducted to determine the historical observations of native char in the lower Chehalis River/Grays Harbor.

2.2.1 Native Char

Bull trout and Dolly Varden (*S. malma*) are two native char species present in western Washington. Bull trout and Dolly Varden are difficult to distinguish based on physical characteristics, and both have similar life history traits and habitat requirements (WDFW 1998). Because the species are closely related and have similar biological characteristics, the Washington Department of Fish and Wildlife (WDFW) manages bull tout and Dolly Varden together as "native char" (WDFW 1998). Section 4(e) of the ESA provides for the listing of a non-threatened species if the listing of this species provides a greater level of protection to the listed species. The USFWS indicated in January 2001 that Dolly Varden are being considered for listing as threatened due to their similarity of appearance to bull trout (66 *Federal Register* 1628).

Bull trout can exhibit numerous life history strategies including an anadromous form, and three diadromous forms; adfluvial, fluvial, and resident (Pratt 1992). Historically, in Washington bull trout were primarily thought of as an inland, freshwater species (WDFW 1998). Recent studies indicate that anadromous populations are present in coastal and Puget Sound drainages (F. Goetz, US Army Corps of Engineers, *pers. comm.*). Anadromous bull trout are now thought to only exist where their coastal ranges overlap with Dolly Varden

(Haas and McPhail 1991; Haas and McPhail 2001). Studies in the Skagit and Snohomish River systems provide information on the migration patterns of native char, but in most cases no differentiation was made between bull trout and Dolly Varden so they are grouped together as native char (WDFW 1999). In Puget Sound, native char sub-adults migrate downstream between April and May at two or three years of age. Sub-adult native char in the Skagit River are approximately 150-160 mm total length when they are captured in the screw trap (~ RM 17.0) near Burlington, Washington (D. Seiler, WDFW, *unpublished data*). Yates (2001) capture of eleven native char in the Swinomish Channel (weighted mean length = 157.3 mm) implies that sub-adult char may move quickly through the lower reaches of their natal river and enter marine environment to rear during the spring and most of the summer. The distribution of char in the marine waters is hypothesized as correlated to the nearshore distribution of baitfish (WDFW 1999); however no formal dietary analysis of anadromous bull trout has been conducted. During their marine residence, sub-adult native char experience rapid growth, perhaps as much as 25-40 mm per month (Kraemer 2003). By early autumn sub-adult native char are approximately 250-300 mm long when they move back to the lower portions of their natal streams where they are thought to overwinter. Native char migrate back to the marine environment as early as February where they spend several months in preparation for the spawning migration. Mature native char (age=4, >400 mm in length) leave the tidal waters in May through July and begin their upstream spawning migration.

Historically, little effort has made to separate bull trout from Dolly Varden during surveys conducted in Washington State, the assumption being that the two species have very similar life histories. This suggests that the known life history patterns of Dolly Varden will be applicable to sympatric populations of anadromous bull trout. Bernard et al. (1995) studied the anadromous migration of the southern form of Dolly Varden, whose range extends from the Aleutian Islands to the Washington coast. Although life history patterns among Dolly Varden populations are variable, most reside up to four years in their natal streams. They migrate downstream in the spring, and reside in nearshore, sub-tidal waters. Mature Dolly Varden return to their natal streams in the autumn to spawn and were believed to spend the winter in freshwater. However, 14-58% of the anadromous Dolly Varden in the study population did not return to freshwater in the autumn and were thought to overwinter at sea (Bernard et al. 1995).

Sympatric populations of bull trout and Dolly Varden on the Washington coast and in the Puget Sound were documented by Leary and Allendorf (1997) and McPhail and Taylor (1995), respectively. Samples taken from the East Fork of the Quinault River revealed bull

trout and Dolly Varden, but only Dolly Varden were found in smaller tributaries. No evidence of hybridization was found in the bull trout or Dolly Varden, but other recent studies have found hybridization between the two species in British Columbia (Taylor et al. 2001). Genetic analysis conducted by Hagen and Taylor (2001) and Taylor et al. (2001) indicated that hybridization between bull trout and Dolly Varden occur in the Thutade Lake watershed in north-central British Columbia; however, despite this genetic introgression, the authors concluded that the bull trout and Dolly Varden populations have distinct gene pools. McPhail and Taylor (1995) found hybridization as well as backcrossing between upper Skagit River bull trout and Dolly Varden. More recent genetic analyses indicate that, within Puget Sound, all native char residing within the anadromous zones are bull trout, while Dolly Varden are only found upstream from anadromous barriers (M. Downen, WDFW, *pers. comm*.).

Historical occurrence of native char within the project area

Ten native char subpopulations exist in five river basins on the western Washington coast including; Quinault (5), Hoh (2), Queets (1), Quillayute (1), and Chehalis (1) rivers (64 *Federal Register* 58913). Together, subpopulations of native char on the Washington coast appear to be in low abundance and are thought to be at the southern end of the range for coastal bull trout and Dolly Varden (64 *Federal Register* 58913). According to the WDFW (1998), native char stocks in the Quinault and Queets rivers are healthy. Olympic National Park biologists have snorkeled the rivers and have observed native char in the anadromous sections of both rivers. The Hoh River is thought to have the largest population of native char on the Washington coast, but the population declined substantially from 1982 to 1992. Olympic National Park biologists documented native char during snorkel surveys, and anglers in the anadromous section of the river commonly catch char. Native char have been observed above the anadromous barrier in the Quillayute River, but there are no documented reports of native char within the anadromous zone.

Previous to this study, little information was available concerning the population status of native char in the Chehalis River/Grays Harbor system. Most of the data is from anecdotal accounts from sport fishermen reporting that the majority of native char are "457 millimeters or larger fish" (WDFW 1998) or from juvenile salmonid survival studies that captured native char in beach seine surveys incidentally. These studies typically examined the outmigration patterns of juvenile salmonids, focusing on coho salmon, chum salmon, and chinook salmon, and were conducted from 1966 through 2000. Native char were not targeted during these studies and so in many cases, length, weight, and age/growth information is not available. An exhaustive search of the juvenile salmonid literature from lower Chehalis River/Grays

Harbor documented 15 native char captures (see Appendix A for original report excerpts) beginning in 1966 and most recently in 2000 (Table 1; Figure 2). Juvenile salmonid surveys were also conducted in Grays Harbor estuary, as well as river tributaries to the system.

A large native char (5 lb male) was captured by Deschamps and Wright (1970) in a beach seine in 1966 near Cow Point in April. Tokar et al. (1970) caught three native char in May 1968 near Cow Point. Brix (1974) collected one native char near Moon Island on 4 March 1973, and one native char on 19 March 1973 near Oakville on the Chehalis River (approximate RM 47). Brix et al. (1974) captured three native char near Moon Island in 1974. One char was captured on 20 May and two were captured in July (1 July and 14 July). Brix (1981) collected three native char near Moon Island in 1977 (18 March, 2 May, and 15 June). Simenstad and Eggers (1981) reported catching two native char at Cow Point in March 1981, measuring 550 mm and 440 mm. The most recent char capture occurred in April 2000 by Simenstad et al. (2001) while monitoring a slough restoration site near Cosmopolis. Unfortunately, raw data records for that specific char could not be located (C. Simenstad, University of Washington, *pers. comm.*; A. Wick, Anchor Environmental, *pers. comm.*).

Two native char have been reported in the Chehalis River, upstream from Cosmopolis. As mentioned previously, Brix (1974) collected one native char in a beach seine on 19 March 1973 near RM 47 (Oakville) on the Chehalis River. The other reported native char was a juvenile observed in a downstream migrant trap near RM 50 by the WDFW in 1997 (WDFW 1998). The data record for this char does not exist, however, and the identification of this fish as a native char is questionable (D. Seiler, WDFW, *pers. comm.*). Thus, this observation while noted, is not included in the fifteen historical observations. Brix and Seiler (1977; 1978) operated an inclined-plane screen trap at RM 50 on the Chehalis River in 1976 and 1977. The trap was operated between April 15 and 25 May in 1976, and between 14 April and 22 May in 1977. Juvenile chinook, coho, steelhead and cutthroat trout were captured, but no native char were observed. Brix (1981) also conducted beach seine surveys on the Wynoochee, Satsop, and Humptulips from 1973 through 1980, and on the Skookumchuck and Wishkah Rivers in 1979 and 1980; however, they did not catch native char in those rivers.

A total of 1,073 beach-seine hauls and 181 tow-net/purse-seine hauls were performed from 1954 through 1980 in the lower Chehalis River/Grays Harbor (see Table 1 for a total reference list). These surveys resulted in a total of 1,254 total hauls (Table 2). Overall, the surveys primarily occurred from February through October, with only 12 hauls conducted in

January, November and December. Some historical survey sites were outside of the project area (i.e., Hoquiam River upstream to Cosmopolis). In 1968, sixty-three of the beach-seine hauls and 3 tow-net hauls conducted by Tokar (1970) were either below Moon Island or above Cosmopolis. In 1969, thirty-six beach-seine hauls and 4 tow-net hauls were also conducted below Moon Island or above Cosmopolis. Fyke net surveys have more recently been conducted on two estuarine sloughs in the lower Chehalis River near Cosmopolis (Simenstad 2001). A fyke net was installed at the outlet to two different sloughs (one restoration and one reference slough), and as the tide ebbed, all fish within the sloughs were captured. This work occurred monthly, from March through June in 1990-1992, 1995, and again in 2000 (total effort = 90 slough-sampling-days).

Beach seine, boat electrofishing, and fish traps surveys have been conducted to sample fish residing in tributaries to Grays Harbor. A total of 2,933 beach-seine hauls were conducted from March through October, 1973-1980 (Table 3). A total of 8 man days (hrs not available) were also spent electrofishing the Chehalis River in June through October in 1974 (Brix et al. 1974). A downstream migrant fish trap was operated year-round at a water diversion site on the Wynoochee River (~RM 8) from 1952 through 1955 (Deschamps and Wright 1970). An inclined-plane trap was operated 24-hours a day from 15 April through 15 May 1976 and again from 4 April through 22 May 1977 (Brix and Seiler 1977).

Overall, seine/tow net surveys conducted in the lower Chehalis River/Grays Harbor were generally targeting juvenile salmonids and were primarily focused on the period of time when they were likely to be present (i.e., February through October). Seine/tow net surveys were conducted during the months of November, December, and January at a decreased level of effort (Tables 2 and 3). Overall, within this sampling period, a total of 4,187 seine/tow net hauls captured 15 native char in the lower Chehalis River/Grays Harbor from 4 March through 14 July (0.004 char haul^{-1}). The majority of the native char captures (N=12; 80%) occurred during the months of March (N=5; 33%), April (N=2; 14%), and May (N=5; 33%). The March through May time period generally corresponds to months with the highest overall effort (March = 11.23%, April = 18.75%, May = 20.49%, June = 17.94%, and July = 10.27%).

Table 1. Historical native char observations, Chehalis River basin, Aberdeen, Washington.

Char No.	Source	Location	Year	Date	Comments
1	Deschamps and Wright (1970)	Cow Point	1966	27 April	5 lb. male
2	Tokar (1970)	Cow Point	1968	3 May	
3	Tokar (1970)	Cow Point	1968	17 May	
4	Tokar (1970)	Cow Point	1968	28 May	
5	Brix (1974)	Moon Island	1973	4 March	
6	Brix (1974)	Oakville	1973	19 March	~RM 47
7	Brix et al. (1974)	Moon Island	1974	20 May	
8	Brix et al. (1974)	Moon Island	1974	1 July	
9	Brix et al. (1974)	Moon Island	1974	14 July	
10	Brix (1981)	Moon Island	1977	18 March	
11	Brix (1981)	Moon Island	1977	2 May	
12	Brix (1981)	Moon Island	1977	15 June	
13	Simenstad and Eggers (1981)	Cow Point	1981	March	440 mm
14	Simenstad and Eggers (1981)	Cow Point	1981	March	550 mm
15	Simenstad et al. (2001)	Cosmopolis	2000	April	~ RM 6 slough

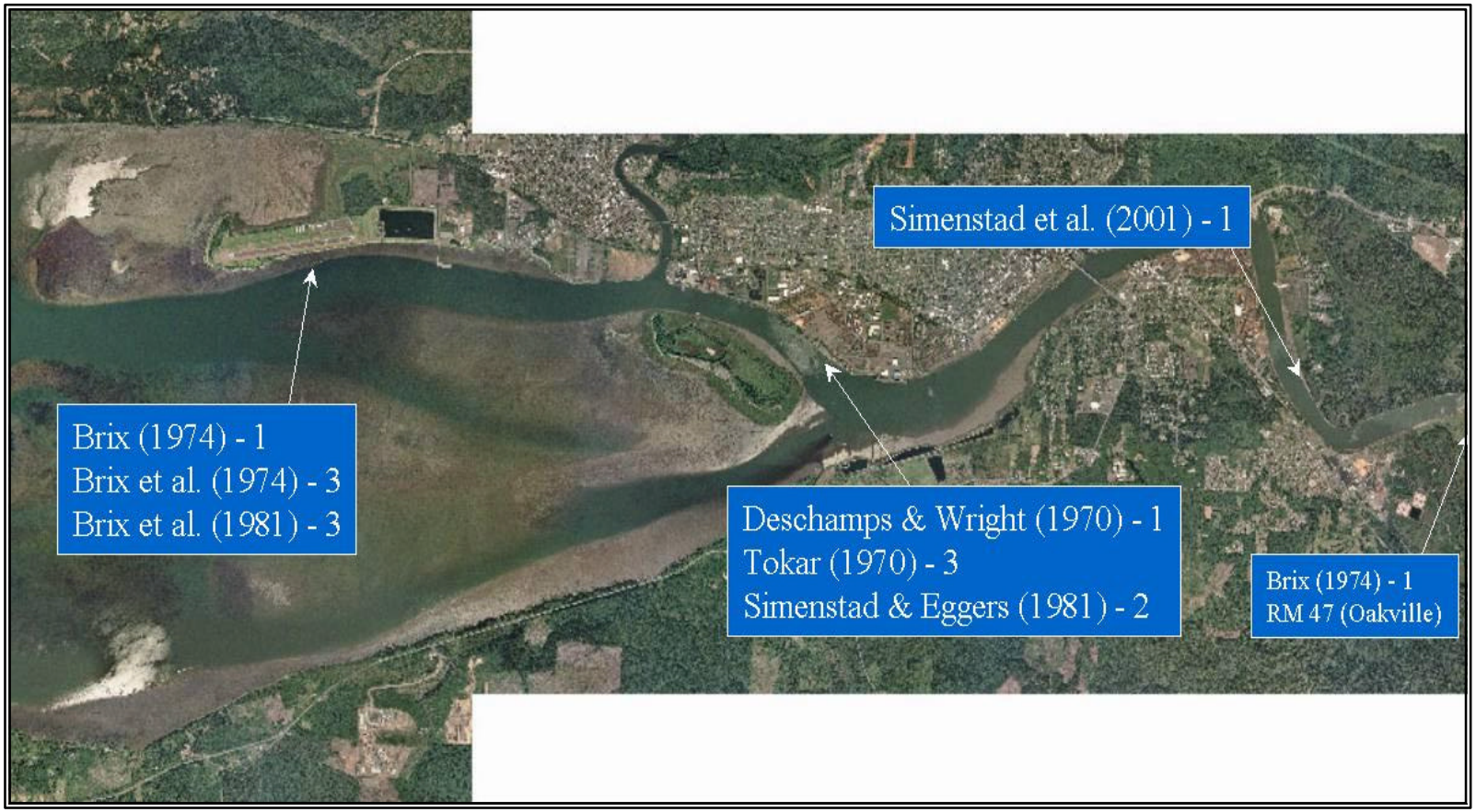

Figure 2. The location of fifteen (15) historical native char observations in the Chehalis River basin, Washington, 1966-2000.

Table 2. Monthly level of effort (seine/tow net hauls) for historical native char observations within the lower Chehalis River/Grays Harbor, Aberdeen, Washington (BS=beach seine; TN=tow net; PS=purse seine).

Source	Gear Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Deschamps and Wright (1970)	50 ft BS	1954			4	8	12	8	8	8					48
	50 ft BS	1955						2	6	4					12
	50 ft BS	1956						2	2	6	2				12
	50 ft BS	1957	2	6	8	6	10	8	8	4					52
	50 ft BS	1961		4	4	2	4		2	2					18
	100 ft BS	1965	2	4	6	6	6	8	6	2	1				41
	50 ft BS	1965	2	3	6	6	6	8	6	4	4	2			47
	50 ft BS	1966			1	12	15	3		2	7				40
Tokar (1970)	100 ft BS	1968			1	6	22	14	30	16	19	15	1		124
	TN	1968							3	4	2	4			13
	100 ft BS	1969		9	9		9	10	12	6	8	6	3		72
	TN	1969			8		9	5	4			2	1	1	30
Brix (1974)	75 ft BS	1973			17	15	17	23	19	14	15				120
Brix (1981)	75 ft BS	1974			10	11	12	10	12	15	8				78
	75 ft BS	1975			6	20	12	13	11	8					70
	75 ft BS	1976				15	11	12	14	5					57
	75 ft BS	1977			3	8	11	10	4						36
	75 ft BS	1978			6	8	8	7	6	3					38
	75 ft BS	1979			4	11	6	7	6						34
Simenstad and Eggers (1981)	121 ft BS	1980			20	21	20	21	20	21	20	21			164
	207 ft PS	1980			18	19	18	19	18	19	18	19			148
Total Effort			6	26	131	174	208	190	197	143	104	69	5	1	1,254
Percentage of Total Effort			0.48	2.07	10.45	13.88	16.59	15.15	15.71	11.40	8.29	5.50	0.40	0.08	100.00

Table 3. Monthly level of effort (seine/tow net hauls) for historical native char observations within the tributaries to Grays Harbor, Washington (BS=beach seine; TN=tow net; PS=purse seine).

Source	Gear Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Brix (1974)	75 ft BS	1973			106	110	126	85	90	85	81	39			722
Brix (1981)	75 ft BS	1974			42	59	80	70	88	83	82	46			550
	75 ft BS	1975			43	96	87	80	80	50	10				446
	75 ft BS	1976			13	66	68	59	33	5					244
	75 ft BS	1977			7	71	43	29							150
	75 ft BS	1978			42	46	44	45							177
	75 ft BS	1979			38	78	100	94							310
	75 ft BS	1980			48	85	102	99							334
Total Effort					339	611	650	561	233	223	175	85	0	0	2,933
Percentage of Total Effort			0.00	0.00	11.56	20.83	22.16	19.13	7.94	7.60	5.97	2.90	0.00	0.00	100.00

2.2.2 Other Salmonid Species

Other salmonid species inhabiting Grays Harbor include chinook, chum and coho salmon, rainbow/steelhead and coastal cutthroat trout. Resident and/or anadromous salmonids may be present in the lower Chehalis River/Grays Harbor project area throughout the year (Deschamps et al. 1971).

Chinook salmon

Mixed (native and non-native origin) spring and fall chinook occur in the Grays Harbor system (WDFW et al. 1994). Timing of entry into estuaries varies considerably for juvenile chinook salmon (Healey 1982; 1991). Most juvenile chinook that migrate to salt water as subyearlings (fry), termed ocean-type, are primarily progeny of fall chinook stocks (Healey 1991). A smaller percentage of juvenile chinook that enter salt water as yearlings (termed stream-type) are the progeny of spring chinook stocks. Peak yearling migration occurs in late April through early June, while fry migration to salt water occurs earlier, typically from April through late May (Simenstad et al. 1982; Healey 1991). Congleton et al. (1982) reported that chinook fry (42-60 mm FL) were abundant in the Skagit River estuary from late April through May. Brix (1981) found peak catches of chinook fry in Grays Harbor during mid-June, but continued to capture subyearling chinook near the mouth of the Hoquiam River from early March through September. Estuarine residency periods of juvenile chinook

can range from as short as six weeks (northern Puget Sound) to 29 weeks (Grays Harbor) (Simenstad et al. 1982). Owing to their many life history patterns, juvenile chinook occupy the widest variety of estuarine habitats (Healey 1982; Simenstad et al. 1982; Healey 1991). Chinook fry frequent the same estuarine habitat as chum fry, while yearling chinook are generally found in neritic habitats, bypassing shallow water estuarine habitats (Healey 1991). After rearing in the estuary, chinook salmon will typically spend three to four years in the ocean before returning to spawn. Peak river entry timing for Chehalis River spring chinook is not known, but is believed to be in January and February (WDFW et al. 1994). Fall chinook will begin to enter Grays Harbor in early September, and peak in October (WDFW et al. 1994).

Chum salmon

Juvenile chum salmon seaward migration is directly related to latitude, and typically peaks in Washington during late March through early May (Simenstad et al. 1982; Salo 1991). Congleton et al. (1982) found that juvenile chum abundance increased from March through early May, peaking in late April and early May, in the Skagit River estuary. After the first week in May, chum abundance declined until only "a few hundred" remained by the end of June, and no chum fry were captured in early July. Juvenile chum in the Skagit River estuary ranged from 40-48 mm FL. Deschamps et al. (1971) captured juvenile chum salmon (38-40 mm mean FL) in upper Grays Harbor (near mouth of Hoquiam River) from early February through mid-June. Juvenile chum salmon estuarine residence periods have been reported as short as five weeks (Quillayute River estuary), to as long as 23 weeks (Hood Canal) (Simenstad et al. 1982). Chum fry often reside in schools in shallow sublittoral areas (e.g., salt marshes and shallow bays containing eelgrass) until they reach 50-60 mm fork length, when they become more common in deeper neritic habitats (Healey 1982; Simenstad et al. 1982; Salo 1991). Adult chum typically return from the ocean to Grays Harbor in early October, with peak entry in early November (WDFW et al. 1994).

Coho salmon

Coho salmon migrate to salt water during April and June, after spending one year of residency in fresh water habitats (Sandercock 1991). Durkin (1982) captured coho smolts (110-160 mm FL) in the upper Columbia River estuary for six weeks between late April and early June, peaking from 6-17 May. Migration of larger smolts usually occurs earlier and more rapidly than smaller coho smolts. Catches of juvenile coho salmon (71-106 mm FL) peaked in mid- and late May and again in early July on the lower Snohomish River (Pentec 1992). Brix (1981) reported catching yearling chinook in upper Grays Harbor from April through June, peaking in early May. Like yearling chinook salmon, coho generally spend

less time in shallow water areas, and enter neritic habitats almost immediately upon entry to the estuary, preferring exposed cobble or gravel beaches (Healey 1982; Simenstad et al. 1982; Sandercock 1991). Adult coho return to Grays Harbor from mid- to late-September through mid-December (WDFW et al. 1994).

Rainbow trout

Steelhead, the anadromous form of rainbow trout, spend the first one to several years of their life in freshwater before migrating to saltwater. Steelhead typically return to freshwater to spawn within 2 to 4 years (Busby et al. 1996). Unlike the other Pacific salmon species, steelhead do not die after spawning and are capable of spawning in successive years (iteroparous). Steelhead are divided into two groups based on sexual maturity when entering freshwater. Summer (termed stream maturing) steelhead enter freshwater in an immature state, while winter steelhead (termed ocean maturing) enter freshwater with well-developed sexual organs (Busby et al. 1996). Two wild summer and eight wild winter steelhead stocks have been identified in the Grays Harbor watershed (WDFW et al. 1994). Approximately 130,000 to 350,000 hatchery winter steelhead smolts and 40,000 to 50,000 summer steelhead smolts are stocked in the Chehalis River system annually (Busby et al. 1996). Chehalis River steelhead are classified as part of the southwest Washington ESU (1 of 15 west coast steelhead Evolutionarily Significant Unit). The National Marine Fisheries Service (NMFS) concluded that the southwest Washington ESU is presently not in danger of extinction nor likely to become endangered in the foreseeable future (Busby et al. 1996).

Coastal cutthroat trout

Coastal cutthroat trout exhibit early life history characteristics similar to coho and steelhead whereby juveniles spend an extended time rearing in freshwater before outmigrating as smolts (Leider 1997). Cutthroat trout are also iteroparous, spawning several times during their lifetime. Within a given drainage basin, resident (non-migratory), fluvial (freshwater migrants), and anadromous (marine migrants) life history patterns are often present. Age at first anadromy can vary, but due to their proximity to rough costal waters, cutthroat trout in the Chehalis River probably emigrate to the estuary between ages 3 and 5 (8-10 inches TL) (Johnston 1982). Most coastal cutthroat return to freshwater the same year they migrate to the ocean. Grays Harbor coastal cutthroat have been placed into the Southwestern Washington/Columbia River ESU by the NMFS (Johnson et al. 1999). Habitat degradation along with poor ocean and estuarine conditions have combined to severely restrict the life history diversity of this species. Anadromous coastal cutthroat are virtually extirpated from at least two Oregon rivers draining into the Columbia River. Based on surveys conducted by Weyerhaeuser Corporation and the Quinault Indian Nation in the West Branch Hoquiam

River, it is believed that coastal cutthroat trout are abundant and widespread in Chehalis River/Grays Harbor (WDFW 2000). The Southwestern Washington/Columbia River coastal cutthroat trout were proposed as threatened under the Endangered Species Act by the NMFS and the USFWS on 5 April 1999 (64 *Fed. Regist.* 16397-16414), but were withdrawn from listing on 5 July 2002 (67 *Fed. Regist.* 44934-44961).

3. METHODS

As previously mentioned, R2 conducted two separate but interrelated work items. First, a thorough literature search was conducted to determine the historical observations of native char in the lower Chehalis River. Secondly, a study plan was designed to assess the current presence/periodicity of native char in the lower Chehalis River/Grays Harbor estuary using beach seine surveys as the primary capture technique. The beach seine surveys focused on the periods of time when historical observations indicated that native char were either migrating into the lower Chehalis River or outmigrating to the Pacific Ocean. Beach seine surveys were conducted in the lower Chehalis River/Grays Harbor estuary during three separate study periods:

- 21 June through 25 July 2001 (weekly);
- 21 February through 15 March 2002 (weekly); and
- 18 June through 27 September 2002 (one survey per two weeks).

The project area extended from the city of Cosmopolis downstream to the Cow Point Turning Basin near the mouth of the Hoquiam River (Figure 3). Beach seine surveys were conducted at eleven (11) locations in 2001 and twelve (12) locations in 2002 that were selected by the Corps in consultation with the USFWS to provide representative sample coverage of the nearshore habitat within the project reach. The 2002 survey locations were the same as in 2001 except for an additional study location to test a new seine design. A total of 16 survey trips occurred during the study period (2001=4 survey trips; 2002=12 survey trips). Each trip consisted of one day and one night survey (seine haul) at each location resulting in a total of 376 seine hauls (2001=4 trips X 2 surveys X 11 sites=88 seine hauls; 2002=12 trips X 2 surveys X 12 sites=288 beach seine tows). When feasible, day/night surveys corresponded with the either the high or low slack tide. Day and night surveys were conducted within the same 24-hr period; however, since night surveys typically finished after midnight, all night survey dates correspond to the day following daytime sites for clarity.

The survey locations, pre-selected by the Corps in consultation with USFWS, began at the mouth of the Hoquiam River and proceeded upstream to a point approximately 0.25 miles upstream of the Cosmopolis boat launch (Figure 3). The survey sites were identical during the 2001 and 2002 study periods except for the Test Site (Site 11/T1), which was added during the 2002 study period (see Appendix B for site photographs). The Test Site (Site

11/T1) was located immediately (~50 ft) downstream from Site 10 for comparison purposes (see Table 4 for physical description of each survey site).

A 121 ft-long, 6.5-ft (37- X 2-m) deep beach seine constructed of two 59-ft (18-m) wings, each composed of 0.25-inch (6-mm) mesh, was used during each sample effort. The central bag measured 6.5-ft (2-m) deep by 3-ft (1-m) wide and was constructed of 0.2-inch (5-mm) treated knotless nylon mesh. Each wing was attached to 2-in. (51 mm) diameter, 6.5-ft (2-m) long wooden poles with a stainless steel ring at the center of the leads. The test net was constructed to the exact dimensions as the regular seine, except utilizing 1.5-inch (35-mm) mesh wing material and 0.5-inch (13-mm) mesh in the central bag. The beach seine was deployed by boat using 100-ft (30-m) long lead ropes attached to the stainless steel rings. One end of the seine was pulled in a semi-circular fashion while the other end was secured to the shore using a fluke-style anchor. The seine was manually retrieved parallel to shore using the lead ropes for the first 66 ft (20-m) with wings approximately 130 ft (40-m) apart, and from a distance of approximately 33 ft (10-m) apart for the final 33 ft (10-m) to shore. As utilized in this configuration, the beach seine samples approximately an area of 5,597 ft^2 (520 m^2) and volume of 27,915 ft^3 (790 m^3) (Simenstad et al. 1991).

All fish were collected immediately from the bag and transferred to a holding tank (live car) where they were identified and enumerated; non-salmonid species were released. Salmonids were anesthetized with 70 mg l^{-1} buffered tricaine methanesulfonate (MS-222), measured for fork length (mm), and released within 100 ft of their capture site. Due to overwhelming numbers, gunnel/prickleback, sole, sculpins, and smelt were not identified to species. Native char and cutthroat trout were immediately removed from the bag and transferred to a separate live car. Both species were anesthetized with 70 mg l^{-1} buffered tricaine methanesulfonate (MS-222), measured for fork and total length (mm), and weighed to the nearest 1.0 g. A tissue and scale sample was collected from both species. Tissue samples were preserved in 95% ethanol; scale samples were placed in envelopes for analysis. Cutthroat trout were gastrically lavaged for dietary analysis; gut contents were preserved in 90% formalin and shipped to the WDFW for analysis (J. Jaquet, WDFW, *pers. comm.*). Native char and cutthroat trout were released within 40 m of their capture site. On some occasions, adult chinook and coho salmon were removed from the beach seine with a dip net to preserve the set.

Figure 3. The location of twelve (12) native char beach seine survey sites in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Table 4. Name, site number, and physical habitat description of the 12 native char beach seine survey sites, lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Site Name	Site Number	Upper Intertidal Habitat	Lower Intertidal Habitat	River Bank Location
Otterville	1	Low sloping grassy bank with bench	Soft mud substrate, low gradient	Left
Powerline	2	Low sloping grassy bank with bench	Soft mud substrate, low gradient	Left
Big Stump	3	Moderately low sloping forested bank	Low gradient soft mud substrate	Right
Lumberyard	4	Moderately steep bank with riparian vegetation	Sand, cobble substrate	Left
Lakeside Industries	5	Open gravel cobble moderately low slope	Gravel, cobble substrate	Right
Weyerhaeuser	6	Low gradient, shrub cover	Moderately low gradient, sand and gravel substrate	Left
Top Foods	7	Moderately low gradient grassy bank	Soft mud substrate	Right
Boat Launch	8	Low sloping grassy bank	Moderate gradient, hard gravel substrate	Left
Chip Mill	9	Moderately steep bank with some riparian vegetation	Gravel cobble substrate	Right
Bird Island	10	Sandy low gradient slope, protected island	Soft sand substrate, low gradient	Left
Test Site[a]	11/T1	Sandy low gradient slope, protected island	Soft sand substrate, low gradient	Left
Hoquiam River	12	Sandy low gradient slope, protected island	Soft mud and sand substrate	Left

[a] Test Site (Site 11/T1) surveyed only during 2002 study period

Ages of native char were estimated by counting the number of annuli on a scale (Devries and Frie 1996). After preliminary experimentation, it was determined that the relatively low (~10-20X) magnification of a microfiche reader did not provide the detail necessary to analyze native char scales. A binocular microscope (100X magnification) was used to provide the magnification needed to identify the annuli and subsequently the age of the fish. A Canon PowerShot™ A40 2.1-megapixel digital camera was used to take digital images of scales through the eyepiece of the microscope. Digital images were manipulated in Adobe Photoshop to maximize the clarity of the annuli on the scales. Images of the scales were printed to aid in the aging procedure.

The native char aging procedure generally followed the guidelines published by Ericksen (1999), Williamson and Macdonald (1997), and Minard and Dye (1998). To minimize within-reader error, each scale was analyzed three times. The previously determined ages were kept unknown to minimize bias by the reader. The mode of the three ages (if present) was identified as the estimated age (Minard and Dye 1998). If a mode was not apparent after three examinations, a fourth or fifth examination was conducted until an age could be assigned (Minard and Dye 1998).

Fork length at age was back-calculated for the native char using the Fraser-Lee method. This method has been widely accepted (DeVries and Frie 1996) and is applicable when the relationship between fish length and annuli radius is not zero. The formula for this calculation is:

$$L_i = \frac{L_c - a}{S_c} S_i + a$$

where:
L_i = back-calculated length of the fish when the i^{th} annuli was formed,
L_c = fork length of the fish at capture,
S_c = radius of the scale at capture,
S_i = radius of the annuli at the i^{th} increment; and
a = intercept parameter.

There are multiple methods in which to determine the intercept parameter (a). The standard parameter (a) is calculated as the intercept of the regression for fish length at capture on scale radius at capture. However, in order for this regression to result in an accurate intercept, there must be a large sample size with a wide distribution of fish sizes/ages. A more recent approach, and the method used on the lower Chehalis River/Grays Harbor native char, is to generate a biologically determined intercept, defined as the fish length at which scale length equals zero. Juvenile native char swim-up fry in the Skagit River (FL=28-30 mm) have been captured with scales formed (C. Kraemer, WDFW, *pers. comm.*). An intercept parameter (a) of 30 was used to back-calculate length at age of native char in the lower Chehalis River/Grays Harbor.

During the summer 2002 study period (18 June-27 Sept), water quality measurements were collected at the downstream, middle and upstream sites (Sites 1, 8, and 12) using a Hydrolab

Quanta® backpack style water quality monitoring system. Salinity, water temperature, dissolved oxygen and pH were collected at these sites during both the day and night surveys. The Hydrolab Quanta® was calibrated the day previous to all sampling occasions. All fish and water quality data were entered electronically using MS Excel™ and cross-referenced with original field data forms for QA/QC purposes. All data analyses were conducted in MS Excel™, except if otherwise noted.

4. RESULTS

4.1 BEACH SEINE DATA

We conducted a total of 16 survey trips on the lower Chehalis River/Grays Harbor. Each trip consisted of one day and one night survey (seine haul) at each location resulting in a total of 376 seine hauls within the project area (mouth of Hoquiam River upstream to approximately Cosmopolis). A total of 24 different species or species assemblages were captured during the study period including chinook, chum, and coho salmon, steelhead and cutthroat trout and native char (Table 5). More than 77,000 individuals were captured, among them Peamouth chub (*Mylocheilus caurinus*), shiner perch (*Cyamatogaster aggregata*), Pacific staghorn/prickly sculpin (*Cottus asper/Leptocottus armatus*), and gunnel/prickleback species (*Pholidae spp./Stichaeidae spp.*) were the most numerous non-salmonid species (Table 6). Crabs (primarily dungeness [*Cancer magister*]) were the only invertebrate species enumerated; however, numerous shrimp (*Crangon spp.*) were observed.

4.1.1 Native Char

Eight (8) native char were captured during the study periods; seven (88%) were captured from 7 March 2002 through 15 March 2002, and one was captured on 19 June 2002 (Table 7). No char were captured during the 2001 study period. All but one (1) native char were captured in the regular-meshed seine, the remaining char was captured at the Test Site (Site 11) on 7 March, during the same survey trip that a char was captured in the regular-meshed seine at Bird Island (Site 10) on the night survey. Fork lengths of native char ranged from 224 to 520 mm (mean FL=325 mm). Native char were not captured upstream from the Lakeside Industries (Site 5) (Figure 4). Five (5) native char were aged at 3+ (FL=224-326 mm), two char were 4+ (FL=372-388 mm), while one char was estimated at 6+ (FL=520 mm) years of age (Table 7). Multiple native char captures occurred at Top Foods (Site 7) and at Bird Island (Site 10). The capture at Top Foods (Site 7) occurred during the same seine haul (night of 15 March), while the multiple capture at Bird Island occurred on different seine hauls (8 March and 19 June).

Table 5. Common and scientific names of species captured in beach seine surveys conducted in the Chehalis River estuary, Washington 2001 and 2002.

Common Name	**Scientific Name**
Northern anchovy	*Engraulis mordax*
Bluegill	*Lepomis macrochirus*
Native char	*Salvelinus malma/S. confluentus*
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon	*O. keta*
Coho salmon	*O. kisutch*
Rainbow trout	*O. mykiss*
Coastal cutthroat trout	*O. clarki clarki*
Dungeness crab	*Cancer magister*
Gunnel spp. (Gunnel spp. not differentiated from Prickleback spp.)	*Pholidae spp.* (gunnel) *Stichaeidae spp.* (prickleback)
Pacific herring	*Clupea harengus*
River lamprey	*Lampetra ayresi*
Peamouth chub	*Mylocheilus caurinus*
Shiner perch	*Cyamatogaster aggregata*
Northern pikeminnow	*Ptychocheilus oregonensis*
Bay pipefish.	*Syngnathus leptorhynchus*
Redside shiner	*Richardsonius balteatus*
Sculpin spp. (Prickly not differentiated from P. Staghorn)	*Cottus asper* *Leptocottus armatus*
Smelt spp. (Longfin not differentiated from Surf)	*Spirinchus Thaleichthys* *Hypomesus pretiosus*
Flounder spp. (English sole not differentiated from Sand sole or P. sanddab)	*Parophrys vetulus* *Pserttichthys melanostictus* *Citharichthys sordidus*
Starry flounder	*Platichthys stellatus*
Largescale sucker	*Catostomus macrocheilus*
Threespine stickleback	*Gasterosteus aculeatus*
Pacific tomcod	*Microgadus proximus*
Yellow perch	*Perca flavescens*

Table 6. Date and number of species captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Species	20 Jun 01	21 Jun 01	28 Jun 01	29 Jun 01	6 Jul 01	7 Jul 01	12 Jul 01	13 Jul 01	21 Feb 02	22 Feb 02	28 Feb 02	1 Mar 02	7 Mar 02	8 Mar 02	14 Mar 02	15 Mar 02	18 Jun 02	19 Jun 02	24 Jun 02	25 Jun 02	10 Jul 02	11 Jul 02	24 Jul 02	25 Jul 02	15 Aug 02	16 Aug 02	29 Aug 02	30 Aug 02	12 Sep 02	13 Sep 02	26 Sep 02	27 Sep 02	Total
N. Anchovy	19	353			17	17		1,210														2				29				99			1,746
Bluegill																						2											2
Native char													2	2		3		1															8
Chinook	139	107	68	29	57	93	61	115	66	45	8	3	4	2	15	4	128	90	81	133	78	128	28	45	38	12	30	16	13	8	3	2	1,652
Chum									76	10	59	37	241	626	318	44																	1,411
Coho	2		2		2	2		1		1	1	1		0	4	4	13	2	3	1	4	1									2		48
D. Crab	52	147	20	109	107	103	43	132		5		10		9			43	99	45	170	48	161	115	228	141	97	22	314	208	257	107	602	3,394
Cutthroat	4	2			5	6	3	3									6	1	3	6	2	10	2	4	1		4	9	6	1	2		80
Gunnel spp.	3	167	9	91	5	118	4	45	1	17		7		3		22	30	33	18	65	25	131	19	141	18	66	69	671	40	802	63	2,163	4,846
P. Herring	12	22	8	25	4	5		53	3	13		2			1		2	12	2		3	3	4	10		7		51	4	4	11	3	264
R. Lamprey							1														1									1			3
Peamouth Chub			462	121	84	226	917	192		9		117		23	3	308	438	614	1,009	627	428	111	391	126	119	20	90	23	103	6	93	3	6,663
Shiner Perch	132	553	1,242	748	313	2,667	2,268	1,960				1					561	319	753	846	3,363	2,798	3,867	3,909	761	1,769	1,676	1,713	2,613	2,479	1,308	1,572	40,191
N. Pikeminnow	102	30	2	5														2		1	1	3	1					1					148
B. Pipefish			1	1				2						1									3	1	1	6	3			2	1	1	23
Rainbow				3			4	1				1	1	2		1																	13
Redside Shiner																													1				1
Sculpin spp.	67	93	106	195	12	292	57	329	16	45	13	142	18	130	57	239	228	445	439	219	210	248	382	474	86	153	111	412	74	670	109	561	6,632
Smelt spp.	852	686	220	48	571	256	62	122	97	11		31	16	35	1	7	312	158	38	44	7	3	9	1	16	3	9	93	5	1	30	7	3,751
Flounder spp.	11	90	43	38	52	91	37	50		3		1	2	3			53	15	15	146	34	137	86	285	98	35	93	66	95	127	72	196	1,974
S. Flounder	12	13	29	48	17	47	26	36	9	4	5	3	5	4	13	12	32	55	36	17	16	14	85	82	61	12	167	76	98	89	131	60	1,314
L.S. Sucker									1			3			1	6				2													13
T.S. Stickleback	53	6	22	8	11	3	433	6	46	19	5	8	145	25	20	29	468	294	319	105	197	38	41	21	147	50	64	5	4	22	1		2,615
P. Tomcod		1		2		4		1		1		2									1	41	11	57	1	81	9	67	59	111	15	94	558
Y. Perch														2		2																	4
Grand Total	1,460	2,270	2,234	1,471	1,257	3,930	3,916	4,258	315	183	91	369	434	867	433	681	2,314	2,140	2,761	2,382	4,418	3,831	5,044	5,384	1,488	2,340	2,347	3,517	3,323	4,679	1,948	5,264	77,348

Table 7. Capture date, site name, fork length (mm), and age of native char captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Char No.	Capture Date	Site No.	Site Name	Strata	Fork Length (mm)	Age
1	7 March 2002	6	Weyerhaeuser	Day	242	3+
2	7 March 2002	(11/T1)	Bird Island	Day	326	3+
3	8 March 2002	5	Lakeside Ind.	Night	224	3+
4	8 March 2002	10	Bird Island	Night	296	3+
5	15 March 2002	7	Top Foods	Night	231	3+
6	15 March 2002	9	Chip Mill	Night	372	4+
7	15 March 2002	7	Top Foods	Night	388	4+
8	19 June 2002	10	Bird Island	Night	520	6+

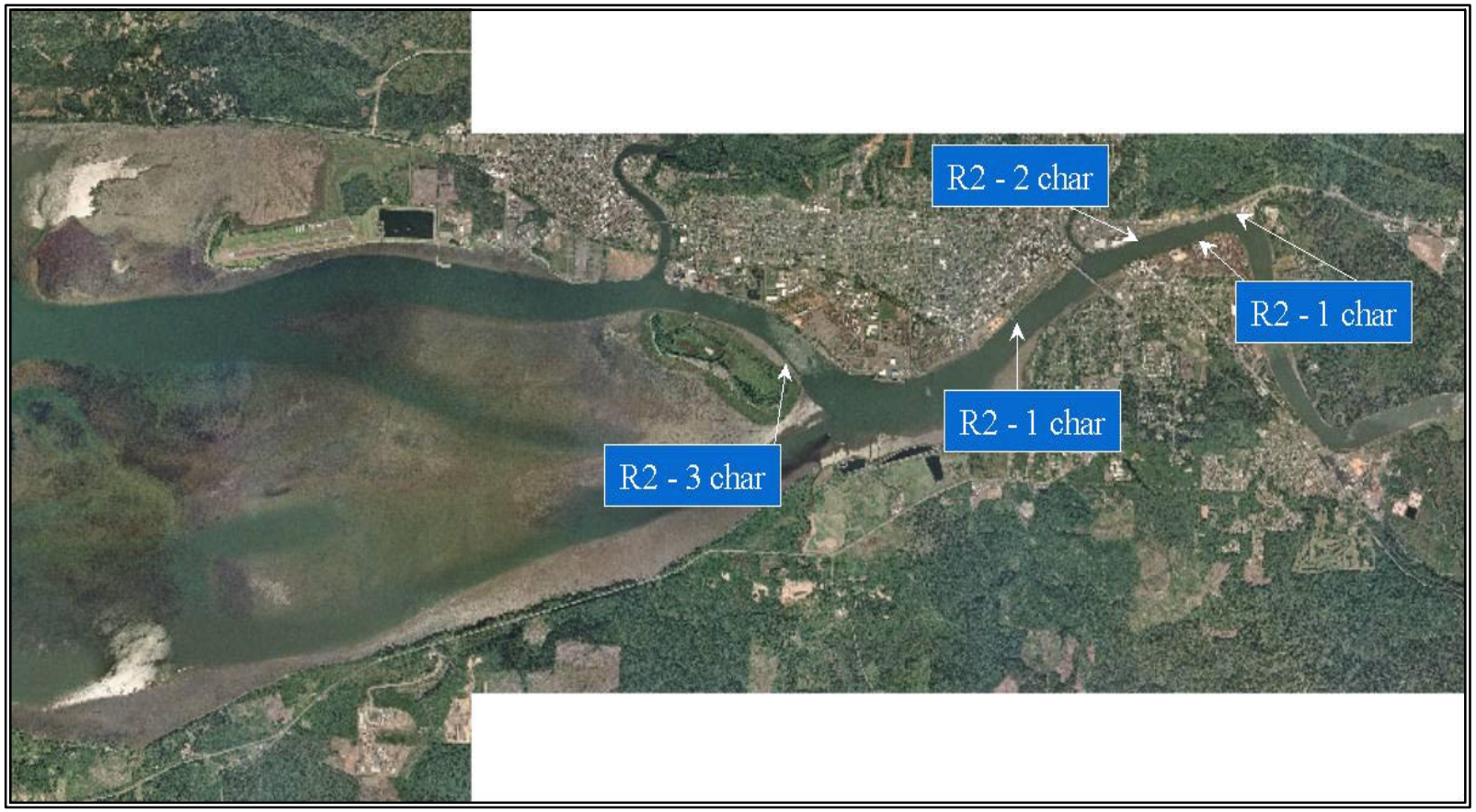

Figure 4. The location of eight (8) native char captures during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

4.1.2 Salmonids

A total of 3,212 salmonids were captured during the 2001-2002 beach seine surveys conducted in the lower Chehalis River/Grays Harbor (Table 8). Juvenile chinook salmon were the most numerous salmonid captured (N=1,652; 51%) followed by juvenile chum salmon (N=1,411, 44%). The remaining salmonids in order of decreasing capture frequency were of cutthroat trout (N=80; 3%), coho salmon (N=48; 1%), rainbow trout (N=13; <1%), and native char (N=8; <1%). Chum fry were only captured during the February-March study period, with peak capture the first week of March (see Appendix C for complete salmonid capture records).

In 2002, mean chinook capture frequency increased steadily from the initial survey in February through June and early July, decreasing from there until the last survey was conducted in September (Table 8). Small numbers of coho fry were captured from mid-March to mid-July (N=48). Two adult coho were captured in September; however, other large coho were removed from the beach seine before the seine was complete to avoid complications with the set. The majority (N=76, 95%) of the captured cutthroat trout were considered overyearling fish (>150 mm FL) the remaining four were considered juvenile. Rainbow trout were subjectively classified as overyearling (N=12; FL=275 mm) or adult (N=1; FL=570 mm) based on their length frequencies (Table 9). During 2002, mean length of juvenile chum (mean FL=39.6 mm) remained fairly constant during the period of capture (February-March), indicating quick movement through the study area. The length of chinook fry increased beginning in February (FL~40 mm) through the entire study period whereby in September (mean FL=117 mm) indicating an extended residence period of juvenile chinook salmon in the lower Chehalis River/Grays Harbor (Table 9). Overall, juvenile salmonid capture frequencies peaked during the survey trip conducted on the 7-8 March 2002. More than 27 percent (N=880) of the total number of salmonids (N=3,212) were captured on this survey trip (Table 8).

Table 8. Number of salmonids captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Species	20 Jun 01	21 Jun 01	28 Jun 01	29 Jun 01	6 Jul 01	7 Jul 01	12 Jul 01	13 Jul 01	21 Feb 02	22 Feb 02	28 Feb 02	1 Mar 02	7 Mar 02	8 Mar 02	14 Mar 02	15 Mar 02	18 Jun 02	19 Jun 02	24 Jun 02	25 Jun 02	10 Jul 02	11 Jul 02	24 Jul 02	25 Jul 02	15 Aug 02	16 Aug 02	29 Aug 02	30 Aug 02	12 Sep 02	13 Sep 02	26 Sep 02	27 Sep 02	Total
Chinook	140	107	68	29	59	93	61	115	66	45	8	3	4	2	15	4	128	90	81	133	78	128	28	45	38	12	30	16	12	9	3	2	*1,652*
Chum									76	10	59	37	241	626	318	44																	*1,411*
Coho	2		2		2	2		1		1	1	1			4	4	13	2	3	1	4	1									2		*48*
Cutthroat	4	2			5	6	3	3									6	1	3	6	2	10	2	4	1		4	9	6	1	2		*80*
Native char													2	2		3		1															*8*
Rainbow				3			4	1				1	1	2		1																	*13*
Grand Total	*146*	*109*	*70*	*32*	*66*	*101*	*68*	*120*	*142*	*56*	*68*	*42*	*248*	*632*	*337*	*56*	*147*	*94*	*87*	*140*	*84*	*139*	*30*	*49*	*39*	*12*	*34*	*25*	*18*	*10*	*7*	*2*	*3,212*

Table 9. Mean fork length (mm) of salmonids captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Species/ Lifestage	20 Jun 01	21 Jun 01	28 Jun 01	29 Jun 01	6 Jul 01	7 Jul 01	12 Jul 01	13 Jul 01	21 Feb 02	22 Feb 02	28 Feb 02	1 Mar 02	7 Mar 02	8 Mar 02	14 Mar 02	15 Mar 02	18 Jun 02	19 Jun 02	24 Jun 02	25 Jun 02	10 Jul 02	11 Jul 02	24 Jul 02	25 Jul 02	15 Aug 02	16 Aug 02	29 Aug 02	30 Aug 02	12 Sep 02	13 Sep 02	26 Sep 02	27 Sep 02	Overall Mean
Chinook fry	77.7	77.4	72.0	77.4	77.2	79.1	75.4	78.1	40.0	39.3	41.9	54.7	37.0	66.0	48.1	53.8	69.2	70.3	73.2	71.9	76.8	77.5	80.3	80.6	86.2	78.8	92.2	90.9	101.6	103.6	115.0	116.5	*73.6*
Chinook overyearling													140.0													256.5							*239.9*
Chum fry									38.9	38.0	39.5	40.0	40.2	40.3	39.9	39.8																	*40.0*
Coho adult																															675.0		*675.0*
Coho fry					69.0						42.0				38.0		74.9	71.5	73.7	57.0	65.5	52.0											*67.7*
Coho overyearling	104.5		98.0		106.0	94.5		98.0		120.0		95.0			106.5	111.3																	*104.4*
Cutthroat adult	170.8	205.0			208.6	228.8	214.0	170.7									167.3	183.0	272.0	175.8	170.0	252.6	321.5	227.5	290.0		215.0	246.0	237.0	265.0	225.0		*221.8*
Cutthroat overyearling																	142.5		144.0	145.0													*143.8*
Native char adult																		520.0															*520.0*
Native char sub-adult													284.0	260.0		330.3																	*297.0*
Rainbow adult													570.0																				*570.0*
Rainbow overyearling				271.0			367.3	333.0				155.0		185.0		160.0																	*275.0*

4.1.3 Other Species

Shiner perch were by far the most prolific species captured (N=40,191; 52%), followed by peamouth chub (N=6,663; ~1%) and sculpin *spp.* (primarily Pacific staghorn sculpin) (N=6,632; ~1%) (Table 6). The test Site (Site 11/T1) captured only 205, generally larger, individuals such as starry flounder, char, pacific tomcod, sole, smelt *spp.* and crab (Table 10). More individuals were captured during the night surveys (N=43,567; 56%) compared to daytime surveys (N=33,781; 44%). In general, the summer study period (June-September) was more productive than the February-March study period (Table 6). The test net captured fewer species, and selected for larger individuals (Table 10). Of the more than 77,000 individuals captured during the beach seine surveys conducted in the lower Chehalis River/Grays Harbor, the Top Foods (Site 7) and Big Stump (Site 3) were the most productive individual sites with 13,214 (~17% of total) and 12,798 (~16% of total) individuals captured, respectively (Table 10). Lakeside Industries (Site 5) was the least productive of the sites surveyed with only 2,662 individuals captured using the regular-meshed seine.

4.2 WATER QUALITY DATA

Beginning in the summer study period, water temperature, pH, dissolved oxygen and salinity were collected at Otterville (Site 1), Boat Launch (Site 8), and the Hoquiam River (Site 12) (Table 11). Water quality measurements are not available for the night surveys conducted on 19 June and 16 August because of battery failure. Water temperatures were recorded on those dates with hand-held thermometers. Water quality parameters were strongly influenced by tidal cycles in the lower Chehalis River/Grays Harbor. At low tide, the water quality parameters of the lower Chehalis River are the dominant influence, while the incoming seawater largely controls the water quality on an incoming tide (Tables 11 and 12). Mean daily discharge in the lower Chehalis River was greater during the spring study period (February-March) than during the summer (June-September) study period. Spring discharge ranged from approximately 10,000 to 35,000 cfs and summer discharge was generally less than 2,000 cfs during the 2002 study period (US Geological Survey; online data).

Table 10. Site number and number of fish captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Total
N. Anchovy	1	4	14	171	14	0	1,023	39	138	123	0	219	1,746
Bluegill	1	0	0	0	0	1	0	0	0	0	0	0	2
Native char	0	0	0	0	1	1	2	0	1	2	1	0	8
Chinook	33	61	145	142	123	98	166	190	245	235	0	211	1,652
Chum	26	203	160	69	92	40	254	238	184	56	0	89	1,411
Coho	0	3	2	3	1	7	3	16	6	2	0	3	48
D. Crab	42	40	268	145	57	173	617	247	282	424	162	937	3,394
Cutthroat	1	1	7	6	2	3	18	10	14	7	0	11	80
Gunnel spp.	104	399	432	629	39	122	1,757	516	512	94	0	242	4,846
P. Herring	19	0	41	6	10	3	4	18	33	93	0	37	264
R. Lamprey	1	0	0	0	0	0	0	0	0	1	0	1	3
Peamouth Chub	734	1,139	3,463	349	172	203	286	271	44	0	0	2	6,663
Shiner Perch	3,648	3,351	5,689	3,425	1,161	2,196	6,561	4,858	2,914	2,066	5	4,317	40,191
N. Pikeminnow	22	17	38	13	11	6	20	20	1	0	0	0	148
B. Pipefish	2	2	3	0	0	3	0	4	1	1	0	7	23
Rainbow	1	0	2	0	1	1	5	0	0	0	0	3	13
Redside Shiner	1	0	0	0	0	0	0	0	0	0	0	0	1
Sculpin spp.	617	907	1,462	444	251	537	1,019	520	326	190	0	359	6,632
Smelt spp.	132	81	275	188	232	431	372	260	510	699	3	568	3,751
Flounder spp.	12	33	124	100	5	153	457	240	148	36	3	663	1,974
S. Flounder	137	115	296	99	1	94	279	124	79	40	16	34	1,314
L.S. Sucker	5	5	1	0	0	0	2	0	0	0	0	0	13
T.S. Stickleback	75	263	285	132	484	206	322	214	165	203	1	265	2,615
P. Tomcod	20	52	91	46	5	14	47	48	24	98	13	100	558
Y. Perch	0	1	2	0	0	0	0	1	0	0	0	0	4
Grand Total	5,634	6,677	12,798	5,967	2,662	4,292	13,214	7,833	5,627	4,369	*205*	8,068	77,349

Table 11. Site name, date, survey strata, time, tide, pH, salinity, temperature and dissolved oxygen concentration measured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, 2002.

Name	Date	Strata	Time	Tide	pH	Salinity (ppt)	Temp (C)	DO (mg/L)
Otterville	18-Jun	Day	08:30	Ebb	7.99	8.33	16.81	8.72
Boat Launch	18-Jun	Day	11:40	Ebb	8.38	10.77	16.74	9.14
Hoquiam River	18-Jun	Day	01:10	Ebb	8.47	15.11	16.84	11.31
Otterville	19-Jun	Night	01:30	Ebb			16.1	
Boat Launch	19-Jun	Night	23:30	Ebb			16.1	
Hoquiam River	19-Jun	Night	21:15	Ebb			16.1	
Otterville	24 Jun	Day	08:00	Flood	8.29	6.41	17.31	9.03
Boat Launch	24-Jun	Day	11:00	Flood	8.53	6.22	17.95	9.24
Hoquiam River	24-Jun	Day	12:20	Flood	8.39	10.28	17.40	9.41
Otterville	25-Jun	Night	12:00	Flood	8.48	5.76	17.99	8.87
Boat Launch	25-Jun	Night	20:45	Flood	8.56	5.19	18.04	9.91
Hoquiam River	25-Jun	Night	19:40	Flood	8.79	14.40	17.74	10.63
Otterville	10-Jul	Day	08:30	Flood	7.40	1.47	18.27	8.61
Boat Launch	10-Jul	Day	10:50	Flood	7.19	7.24	17.97	9.15
Hoquiam River	10-Jul	Day	12:00	Flood	7.85	15.68	19.00	8.05
Otterville	11-Jul	Night	23:20	Flood	7.64	8.77	18.00	8.90
Boat Launch	11-Jul	Night	21:15	Flood	7.68	8.16	18.14	9.55
Hoquiam River	11-Jul	Night	20:00	Ebb	7.63	16.85	17.85	9.15
Otterville	24-Jul	Day	08:00	Ebb	7.88	2.41	20.49	9.27
Boat Launch	24-Jul	Day	10:50	Flood	7.86	8.98	19.79	8.39
Hoquiam River	24-Jul	Day	12:00	Flood	8.00	18.08	19.00	9.00
Otterville	25-Jul	Night	23:50	Flood	7.93	8.08	20.01	8.03
Boat Launch	25-Jul	Night	21:20	Flood	7.97	10.05	19.71	8.32
Hoquiam River	25-Jul	Night	20:15	Flood	8.04	19.42	18.50	8.75
Otterville	15-Aug	Day	07:00	Flood	7.45	10.68	18.92	8.22
Boat Launch	15-Aug	Day	09:40	Ebb	7.77	15.14	18.50	7.69
Hoquiam River	15-Aug	Day	10:50	Ebb	7.97	19.55	18.29	8.24
Otterville	16-Aug	Night	02:10	Ebb			18.5	
Boat Launch	16-Aug	Night	23:50	Ebb			18.5	
Hoquiam River	16-Aug	Night	21:30	Flood			18.5	
Otterville	29-Aug	Day	12:40	Flood	7.35	9.66	19.07	8.06
Boat Launch	29-Aug	Day	10:40	Ebb	7.73	11.31	18.66	8.87
Hoquiam River	29-Aug	Day	09:30	Ebb	7.65	17.58	17.90	8.71
Otterville	30-Aug	Night	22:20	Ebb	7.65	12.85	18.32	7.80
Boat Launch	30-Aug	Night	20:05	Ebb	7.65	16.93	18.33	9.47
Hoquiam River	30-Aug	Night	18:30	Ebb	8.00	22.88	17.69	10.35
Otterville	12-Sep	Day	02:20	Flood	7.69	6.48	18.22	8.68
Boat Launch	12-Sep	Day	12:00	Flood	7.63	11.43	17.77	9.50
Hoquiam River	12-Sep	Day	09:50	Flood	7.66	11.12	17.52	9.40
Otterville	13-Sep	Night	22:00	Ebb	7.86	11.30	18.12	8.72
Boat Launch	13-Sep	Night	19:40	Ebb	8.03	18.78	17.58	11.36

Table 11. Site name, date, survey strata, time, tide, pH, salinity, temperature and dissolved oxygen concentration measured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, 2002.

Name	Date	Strata	Time	Tide	pH	Salinity (ppt)	Temp (C)	DO (mg/L)
Hoquiam River	13-Sep	Night	18:20	Ebb	7.98	24.89	16.70	10.35
Otterville	26-Sep	Day	09:20	Ebb	7.32	7.90	16.77	8.69
Boat Launch	26-Sep	Day	11:40	Flood	7.47	11.15	16.64	8.87
Hoquiam River	26-Sep	Day	12:45	Flood	7.77	19.10	16.68	8.68
Otterville	27-Sep	Night	22:20	Ebb	7.33	7.43	17.45	10.05
Boat Launch	27-Sep	Night	19:50	Ebb	7.74	17.15	16.38	8.61
Hoquiam River	27-Sep	Night	18:30	Ebb	7.84	22.77	15.98	7.25

Table 12. Predicted timing of high and low tides during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Survey Date	Survey Strata	High	Low	High	Low
20 June 01	Day	0025	0718	1351	1913
21 June 01	Night	0107	0803		
28 June 01	Day	0734	1348	2028	0244
29 June 01	Night	0849			
6 July 01	Day	0146	0839	1521	2039
7 July 01	Night	0224	0916		
12 July 01	Day	0559	1217	1903	0114
13 July 01	Night	0700			
21 February 02	Day	0648	1413	2044	0153
22 February 02	Night	0758			
28 February 02	Day	0204	0749	1356	2015
1 March 02	Night	0243			
7 March 02	Day	0716	1424	2106	0220
8 March 02	Night	0827			
14 March 02	Day	0136	0727	1330	1943
15 March 02	Night	0205			
18 June 02	Day	0742	1405	2045	0300
19 June 02	Night	0901			
24 June 02	Day	0047	0740	1420	1936
25 June 02	Night	0132	0826		
10 July 02	Day	0113	0810	1454	2008
11 July 02	Night	0157	0853		
24 July 02	Day	0118	0807	1450	2007
25 July 02	Night	0202	0847		
15 August 02	Day	0721	1304	1925	0215
16 August 02	Night	0837			
29 August 02	Day	0600	1129	1751	0044
30 August 02	Night	0659			
12 September 02	Day	0607	1144	1755	0043
13 September 02	Night	0712			
26 September 02	Day	0454	1023	1622	2317
27 September 02	Night	0542			

5. DISCUSSION AND CONCLUSIONS

The objective of this study was to determine presence/periodicity of native char use in the lower Chehalis River/Grays Harbor. Previous to this study, periodic accounts of native char residing in the lower Chehalis River (see Appendix D for pre-study literature review prepared for Corps by HDR). To achieve this objective, we conducted two separate, but interrelated tasks. The first component involved a thorough search of the historical research data that has been collected within the Chehalis River basin to obtain records of native char captures. Secondly, based on documented historic captures of native char, we prepared a study plan to examine the presence of native char in the lower Chehalis River/Grays Harbor outside of the time period that was established from the historical captures. The Corps, as a conservation measure, instituted this study for native char residing within the Navigation Channel in order to minimize negative impacts to a threatened species.

5.1 NATIVE CHAR PRESENCE/PERIODICITY IN PROJECT AREA

Fifteen (15) historical native char captures were documented within the Chehalis River basin from 1966 through 2000. We captured eight (8) native char during the 2001-2002 survey periods. Our study results are consistent with the historical native char captures that indicate native char are present in the lower Chehalis River beginning in early March and continuing through mid-July. The relatively low number of native char (N=23) documented in this study should not be confused as an estimate of abundance as it likely a result of the difficultly encountered in studying this species in large estuarine environments (Pentec 2001). Similar results have been obtained from beach seine surveys conducted in the estuaries of the Puyallup (F. Goetz, USACE, *pers. comm.*), Snohomish (Pentec 2002), and Skagit (E. Connor, Seattle City Light, *pers. comm.*) rivers, as well as the nearshore Puget Sound (Taylor Associates 2002). For example, beach seine surveys within the Federal Navigation Channel in the lower Snohomish River captured 0.054 native char per haul (1 char 19 seine hauls^{-1}), similar to the 0.021 char per seine haul (1 char 47 seine hauls^{-1}) that was experienced in the lower Chehalis River/Grays Harbor during the 2001-2002 study period.

Including the beach seine surveys conducted in 2001-2002, 23 native char captures have occurred in the Chehalis River from a minimum of 4,563 beach seine/tow net/purse seine hauls (0.005 char haul^{-1}) (Figure 5). One documented native char capture was the result of fyke net surveys conducted in a slough restoration site near Cosmopolis (Simenstad et al.

2001). Effort data from this and other similar surveys is not included, thus the 4,563 should be considered a minimum estimate of effort. Despite these overwhelming odds, the presence/periodicity of native char should remain constant throughout the survey period. Native char have not been documented in the lower Chehalis River/Grays Harbor from 15 July through the end of February. On 27 January 2003 the USFWS revised the in-water work window for lower Chehalis River/Grays Harbor by restricting the Corps to conduct channel maintenance activities from 16 July through 31 August and again from 15 October through 15 February (Figure 6). The periods beginning 16 February through 15 July and 1 September through 14 October represented the windows when "bull trout are most likely to be in those designated areas of the estuary" (USFWS 2003a). In March 2003, the USFWS rescinded the 1 September through 15 October recommended closure and adopted the previous window that allowed the Corps to conduct channel maintenance activities in the lower Chehalis River/Grays Harbor from 16 July through 15 February (USFWS 2003b).

A substantial body of evidence collected through this study indicates that native char are least likely to be present in the lower Chehalis River/Grays Harbor from 16 July through the end of February (Figure 6). In order to further substantiate this prescribed work window, native char surveys should continue to be conducted in the lower Chehalis River/Grays Harbor. In addition, an ultrasonic biotelemetry study would provide definitive results of the presence/periodicity of native char utilization of the lower Chehalis River/Grays Harbor. Based on preliminary results of a similar, but larger in scope, study conducted on the lower Snohomish River, native char show similar periodicity patterns as the char residing in the Chehalis River (F. Goetz, USACE, *pers. comm.*). Unlike the Snohomish River, native char do not appear to spawn in the Chehalis River basin and probably originate from spawning populations of native char in the Quinault or Queets rivers, both located more than 60 miles north of subsequent capture locations in lower Chehalis River/Grays Harbor (Figure 7).

An obvious advantage of the biotelemetry pilot study is that the level of effort to obtain one observation is much lower when compared to beach seine surveys. Native char can be implanted with transmitters during beach seine surveys and fixed monitoring stations will serve to collect the majority of the information, thus requiring little extra effort. A disadvantage is that the transmitters must be surgically implanted and increase handling time for each captured individual. The additional information collected from a pilot biotelemetry study in the lower Chehalis would undoubtedly outweigh the disadvantages in this case and serve to help unlock some of the uncertainties that are related to native char in the Pacific Northwest.

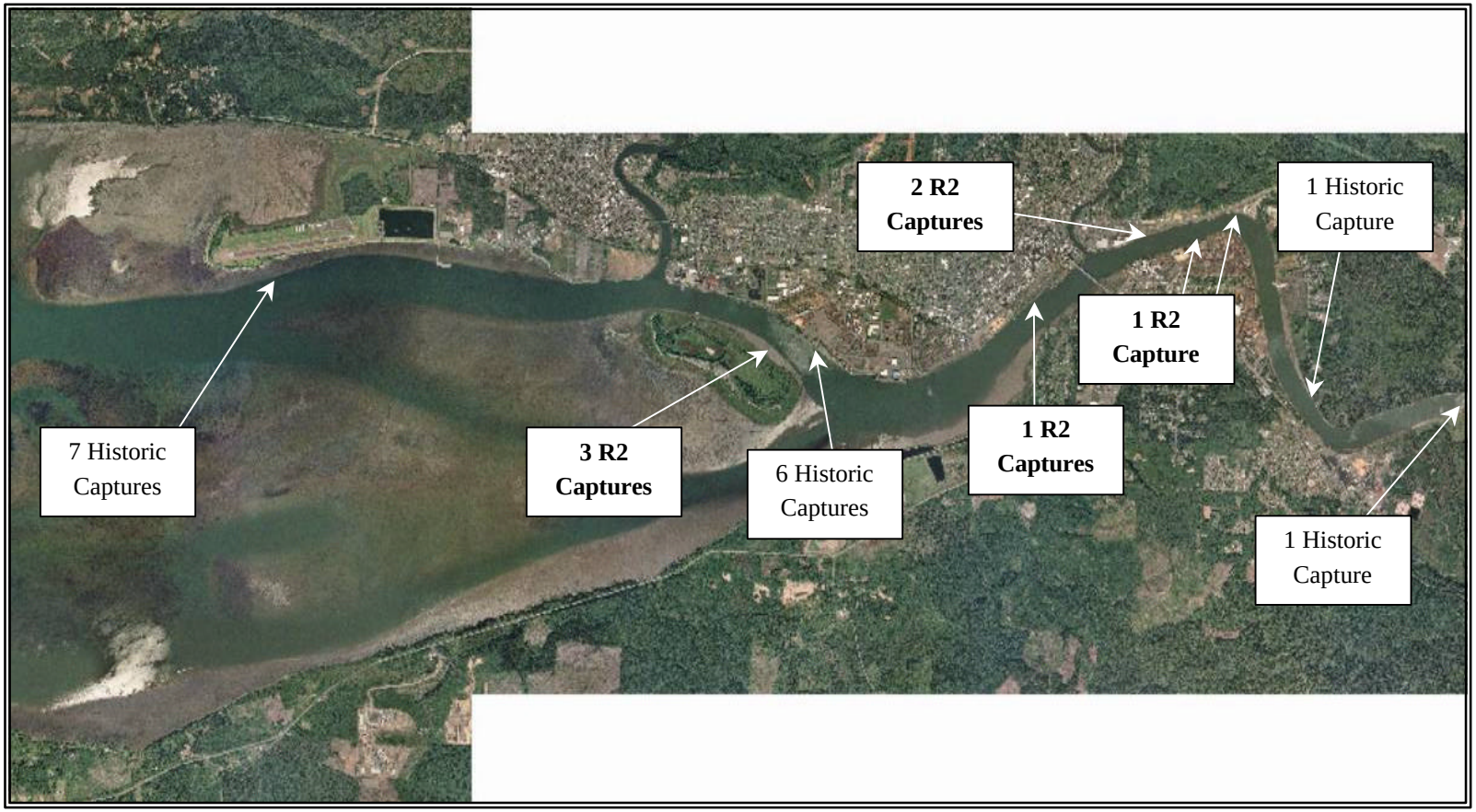

Figure 5. The location of 23 (15 historic and 8 R2) native char captures during beach seine surveys conducted in the Chehalis River basin, Washington, 1966-2002.

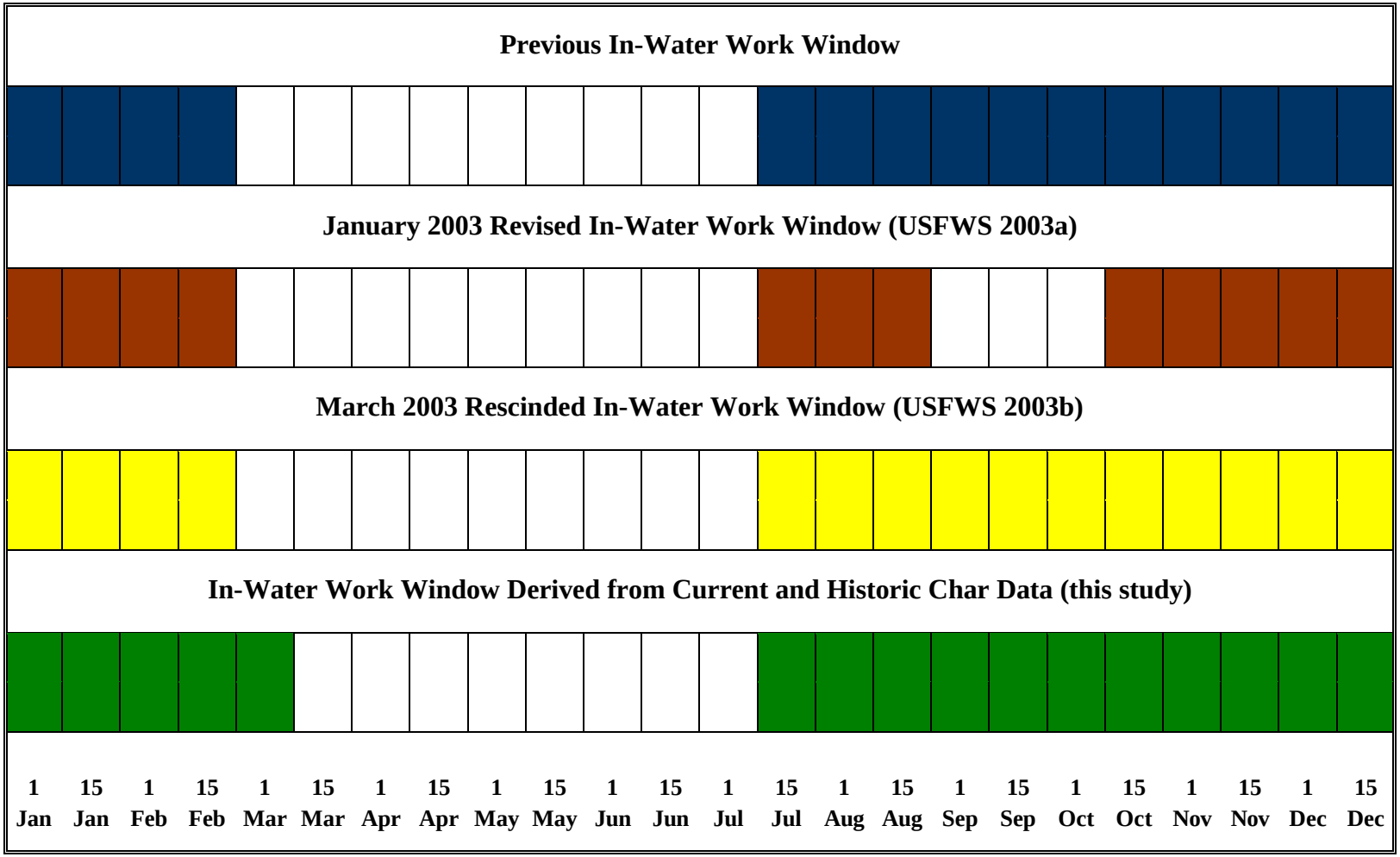

Figure 6. Chronology of native char in-water work windows, lower Chehalis River/Grays Harbor Federal Navigation Channel.

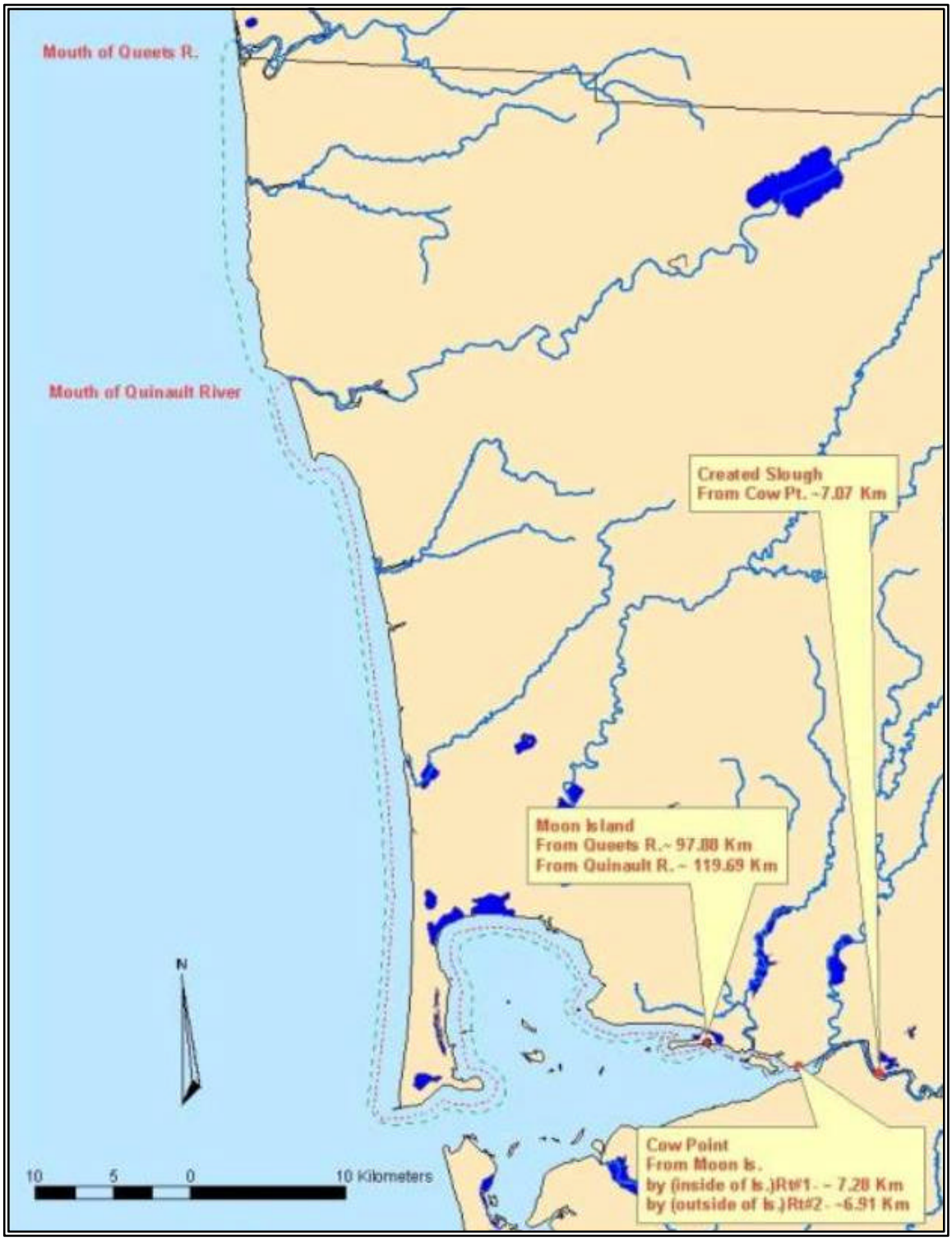

Figure 7. Location of Quinault and Queets river basins relative to lower Chehalis River/Grays Harbor, Washington (adapted from USACE, *unpublished data*).

5.2 NATIVE CHAR AGE/GROWTH

In addition to studying the presence/periodicity, an additional objective of this study was to determine the age and genetic origin of native char in the lower Chehalis River/Grays Harbor. Tissue samples collected from this study will be processed with a larger sample size to determine both the identity of the species (bull trout or Dolly Varden) as well as the origin or core population of the individuals.

Age/growth information collected from the eight (8) native char captured in the lower Chehalis River/Grays Harbor indicate that two mature adults (FL=520, 388 mm) and six sub-adults were present. The adult native char appeared to be age-6+ and age-4+, both maturing at age-4, spawning during the previous three seasons (6+), and the previous season (age-4+) (Figures 8 and 9) (C. Kraemer, WDFW, *pers. comm.*). The remaining six char were sub-adults of ages 3+ (N=5) and 4+ (N=1) with no definitive spawning checks (Figure 10). A spawning check was identified by an uneven scar appearing as cutting through the circuli (Pratt 1991). Age at maturity information from native char residing in the Chehalis River appears to be similar to Skagit River native char. Kraemer (2003) found that nearly all Skagit River native char mature at age-4, with only the rare fish maturing at age-3 or age-5. The age-4 sub-adult (FL=372 mm) had a possible spawning check; however, it was not definitive and was classified as a sub-adult. The classification of a spawning check is very subjective (C. Kraemer, WDFW, *pers. comm.*), and a thorough rationale should be developed before further effort is expended in this area of native char life history analysis.

Length at age information indicate that the majority native char captured in the lower Chehalis River/Grays Harbor appeared to have smolted at age-2+ as evidenced by the increase in fork length between age 2 and age 3 (Table 14). Overall, native char grew at an average of 67, 60, 88, 92, 94, and 102 mm. The overall growth witnessed between age-2 and age-3 (88 mm) was identified as an indication of smoltification. Definitive spawning checks were only identified on two native char scales (Char No. 7 and Char No. 8); the back-calculated length at age of maturity of those fish is 291 and 382 mm FL, respectively (Table 14). The age/growth information collected from lower Chehalis River/Grays Harbor native char coincides with the information collected from native char in northern Puget Sound. Fluvial native char in the Skagit River reach maturity at lengths of approximately 350 mm, while anadromous char average from 425-450 mm TL at maturity (Kraemer 2003). The majority of the char captured in smolt traps located on the lower Skagit River near Burlington are age-2+ (WDFW). Anadromous native char in the Skagit River frequently grow more than 100-, and in some cases 200, mm per season (Kraemer 2003). Recent

information also indicates that native char can switch life history patterns ostensibly to take advantage of a particular forage base (Kraemer 2003).

As additional information is collected from native char populations in the Pacific Northwest, there will no doubt be more unique life history attributes revealed for this adaptive species. As this information is obtained and disseminated, a more thorough life history model of native char in the Pacific Northwest will be developed that will hopefully aid in the recovery of this threatened species.

Table 13. Capture date, site name, fork length (mm), age, and definitive spawning checks observed in scales of native char captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Char No.	Capture Date	Site No.	Site Name	Fork Length (mm)	Total Age	Spawn Check(s)
1	7 March 2002	6	Weyerhaeuser	242	3+	-
2	7 March 2002	(11/T1)	Bird Island	326	3+	-
3	8 March 2002	5	Lakeside Ind.	224	3+	-
4	8 March 2002	10	Bird Island	296	3+	-
5	15 March 2002	7	Top Foods	231	3+	-
6	15 March 2002	9	Chip Mill	372	4+	?
7	15 March 2002	7	Top Foods	388	4+	1
8	19 June 2002	10	Bird Island	520	6+	3

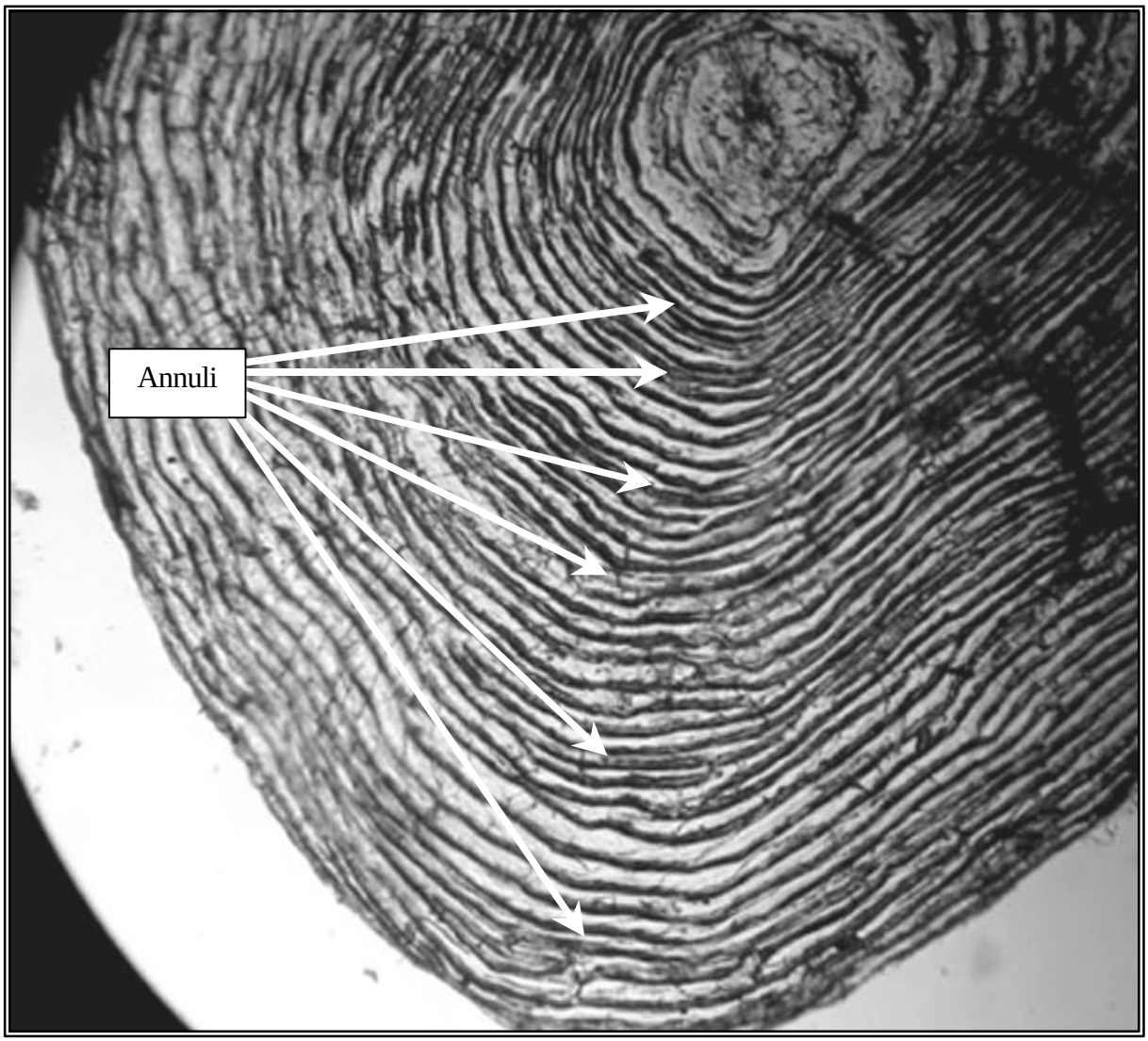

Figure 8. Scale sample from Char No. 8 (FL=520 mm; age-6+) denoting annuli, captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2002.

Figure 9. Scale sample from Char No. 7 (FL=388 mm; age-4+) denoting annuli, captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2002.

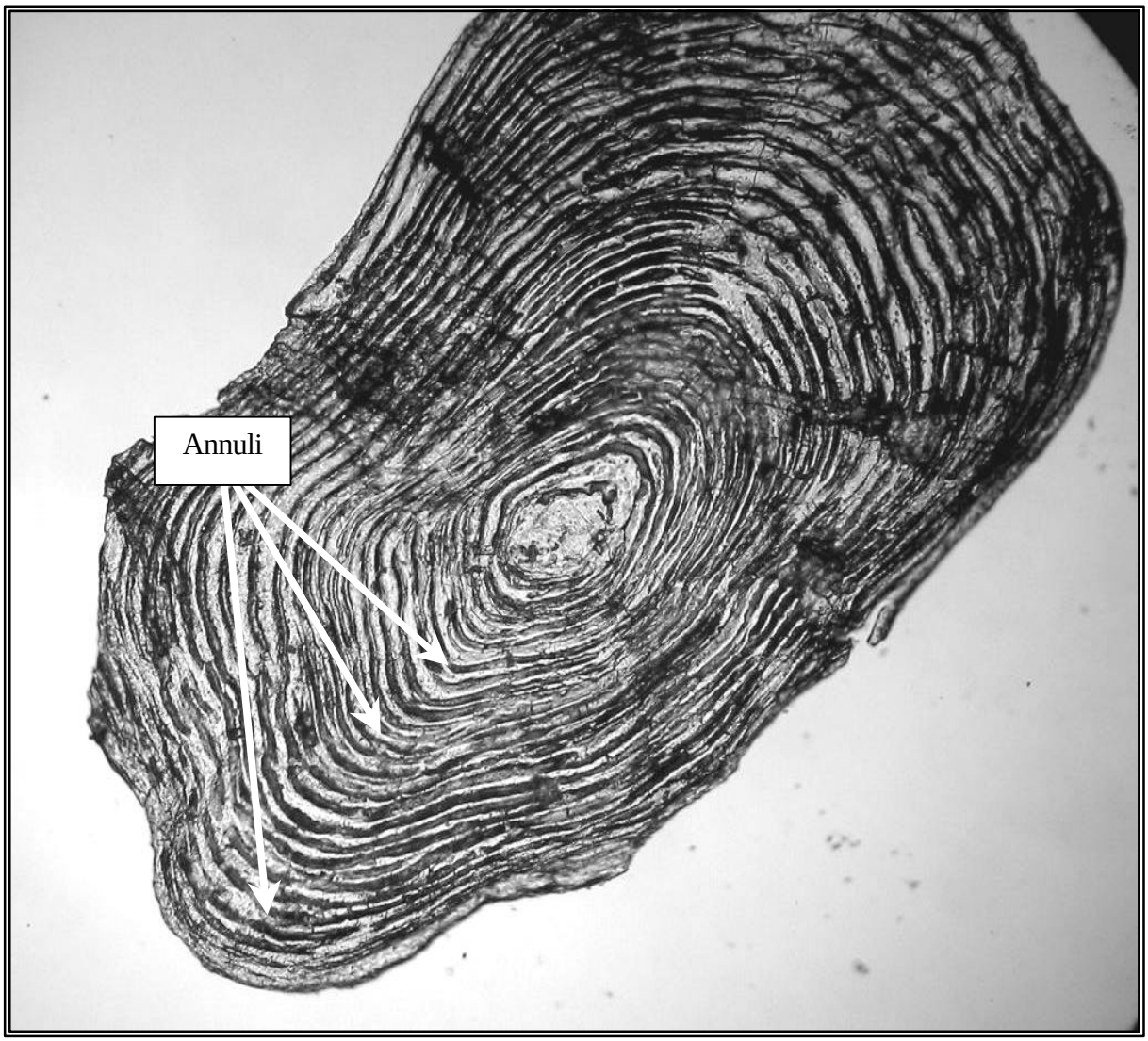

Figure 10. Scale sample from Char No. 2 (FL=326 mm; age-3+) denoting annuli, captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2002.

Table 14. Char number, fork length (mm), age, and back-calculated fork lengths (mm) at age observed in scales of native char captured during beach seine surveys conducted in the lower Chehalis River/Grays Harbor, Washington, 2001-2002.

Char No	Fork Length (mm)	Age	Back-calculated Fork Length (mm) at Age					
			1	2	3	4	5	6
1	242	3+	87.1	130.6	231.1			
2	326	3+	102.5	190.1	307.9			
3	224	3+	82.4	138.6	206.5			
4	296	3+	107.8	169.1	246.9			
5	231	3+	76.6	143.6	219.3			
6	372	4+	106.7	168.6	239.3	348.4		
7	388	4+	95.9	152.5	268.7	381.7		
8	520	6+	115.8	160.7	238.3	291.3	385.3	487.3

6. RECOMMENDATIONS

- Conduct beach seine surveys in the lower Chehalis River/Grays Harbor to further substantiate the presence/periodicity of native char within the project area. Surveys should concentrate on the tails of the work windows, specifically the period beginning in mid-February and continuing through March, and the period beginning in early September and continuing through October.

- Conduct hook and line surveys in locations where multiple native char captures have occurred. Hook and line surveys have proven to be an effective methodology to capture native char when beach seine surveys are otherwise not as effective (i.e., low capture rates) or the physical conditions of the study site will not allow for their implementation (e.g., highly irregular bottom profile).

- Collect tissue, age/growth, and stomach samples from all native char captured during beach seine and hook and line surveys. To date, no quantitative information is available on the diet of anadromous native char. The native char residing in the lower Chehalis River/Grays Harbor do not appear to spawn in the Chehalis River watershed, thus their presence is likely the result of their ability to opportunistically take advantage of a plentiful food base. Native char presence in the lower Chehalis River/Grays Harbor coincided with peak numbers of juvenile salmonids in the project reach. A thorough understanding of their forage items will aid in the understanding of their unique life history pattern, including their presence in this and other Federal Navigation Channels located in western Washington; and

- Initiate a pilot biotelemetry study using individuals captured during beach seine and hook and line surveys. Current capture methodologies, while effective for indicating presence/absence, are not a cost-effective method to provide multiple detections of an individual over the entire study period. A pilot study utilizing 8-10 individuals could yield multiple observations of native char for the fraction of the cost of the conventional methodology.

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