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Relative Performance of Alsea Hatchery Winter Steelhead Produced from Traditional and Wild Broodstocks

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Abstract

The Alsea River, on the central Oregon coast, historically boasted a premier winter steelhead *Oncorhychus mykiss* fishery, with harvest estimates exceeding 10,000 fish (hatchery and wild combined) between years 1963-85. By the early 1990s, the hatchery program had experienced a precipitous decline in adult return rates and harvest estimates, which prompted a change in management. Beginning in 2001, two winter steelhead broodstocks were used for smolt production: 1) a new broodstock comprised by "wild", native steelhead returning to the basin and 2) the "traditional" segregated hatchery broodstock. To evaluate performance of these two broodstocks, three groups of differentially marked smolts were released into the Alsea River during each of three years (2012-2014). Results from creel surveys and trap monitoring (based on 2-salt returns) indicate that the wild broodstock had a longer more uniform run timing versus early season (December) front loading of the traditional stock, fewer detections of Alsea stock steelhead at non-release trapping sites at <7% over 3 seasons, greater harvest 3 out of 4 months sampled each season, and in-river harvest up to a 3:1 ratio over the "traditional" stock. The effectiveness of a lower river smolt release strategy to elicit a prolonged sport fishery in the lower river was assessed and found to provide minimal harvest to lower river anglers and had the lowest total adult return rate (harvest + trap catch) of all groups at <1% in each of the three years.

Introduction

The Alsea River basin has a long history of hatchery operations and research on winter steelhead (*Oncorhynchus mykiss*). The original broodstock used for the Alsea River hatchery winter steelhead program was developed in the late 1930s using native winter steelhead collected at the Alsea Hatchery fish trap on the North Fork of the Alsea River. Initial releases of Alsea Hatchery winter steelhead were largely unmarked unfed fry and/or pre smolts with native winter steelhead as the prime source in the broodstock through the 1940s. It wasn't until the spring of 1952 that "marked", yearling smolts were released on an annual basis. As production levels of smolt out-plants increased through the 1950s, a propagation approach to what is currently considered a segregated stock began by using first generation hatchery returns as the broodstock source (Chapman 1958, Wagner 1967). Marked adults made up only 7% of hatchery trap returns during the 1953/54 season (first year of marked returns). By 1963, over 2,000 (96%) of the adult winter steelhead collected at the Alsea Hatchery were marked hatchery fish (Wagner 1967).

The Alsea winter steelhead early returning "traditional" segregated stock was widely used throughout the north and central Oregon Coast from the early 1940s until the 1990s when native in-basin winter steelhead broodstocks ("wild brood") were starting to be developed in many coastal basins. Because the Alsea traditional stock was used for numerous coastal programs, hatchery practices were to collect and spawn broodstock as early as possible during the adult return migration period. This practice was reported early on by (Chapman 1958) and concluded that spawning only early migrating fish for hatchery broodstock selected for marked hatchery fish to return early in the winter. This has also been widely recognized by management and anglers over the course of the program and became a fundamental concern for the sport fishery having a condensed early run timing of fast migrating and early maturing fish.

For many coastal steelhead programs pre 1990s, including the Alsea River, broodstock was collected, spawned and reared at the Alsea Hatchery then released at various sites within a river basin (scatter planted), often without any acclimation. The management intent of multiple release sites within a basin was to provide a distributed fishery through time and space. However, this practice likely increased the number of adult returns observed to the fishery and trapping facilities in the Alsea River from out-of-basin smolt releases (Lindsay et al. 2001; Kenaston and MacHugh (1986); MacHugh (1981).

Beginning with the 2001 brood year, native Alsea River winter steelhead were collected and spawned to develop a wild broodstock, with an annual goal of using only native steelhead for this stock. The intent of establishing the wild broodstock was to provide a fishery spatially and temporally similar to the native winter steelhead run timing, provide more angler opportunity and harvest, and minimize impacts from strays on spawning grounds. These basic goals were influenced from years of research on winter steelhead programs along the Oregon coast through the Oregon Department of Fish and Wildlife's Steelhead Production Factors program conducted during the 1980s and 1990s.

The purpose of this study (The Alsea Winter Steelhead Evaluation Project) was to provide managers with information that will assist in developing a prolonged fishery that is relatively distributed river wide and maximizes angler benefits. The project objectives compare the two Alsea River broodstocks (wild vs. traditional) in their 1) respective harvest level to the in-river sports angler; 2) determine if a lower river smolt release enhances a lower river fishery; and 3) determines the source(s) of non-basin hatchery steelhead releases observed in the Alsea River Basin.

Methods

The Alsea Winter Steelhead Evaluation Project was designed to evaluate the relative performance of two broodstocks used in the Alsea River basin, as measured through their contribution to an in-river recreational fishery, and to determine the source(s) of non-basin releases of hatchery winter steelhead into the Alsea River Basin. The project entailed uniquely marking hatchery steelhead smolts in the Alsea basin from two broodstocks released from either the Alsea Hatchery, located in the upper river basin, or a lower river release site near the confluence with Five Rivers (Figure 1). The project also included uniquely marked groups of winter steelhead smolts released from adjacent river basins, the Yaquina River using a traditional Alsea broodstock and the Siuslaw River which uses an integrated broodstock developed from the Siuslaw River Basin. (Figure 2). The Alsea wild broodstock production goal is 60,000 smolts released from the Alsea Hatchery and the Alsea traditional broodstock has a split release of 20,000 smolts from the Alsea Hatchery and 40,000 smolts released in the lower river. The production goal for the Yaquina River smolt release is 20,000 smolts of the traditional Alsea River stock and the production goal for the Siuslaw Basin release is 85,000 smolts of an integrated Siuslaw River stock (includes spawning of in-basin wild and hatchery steelhead adults).

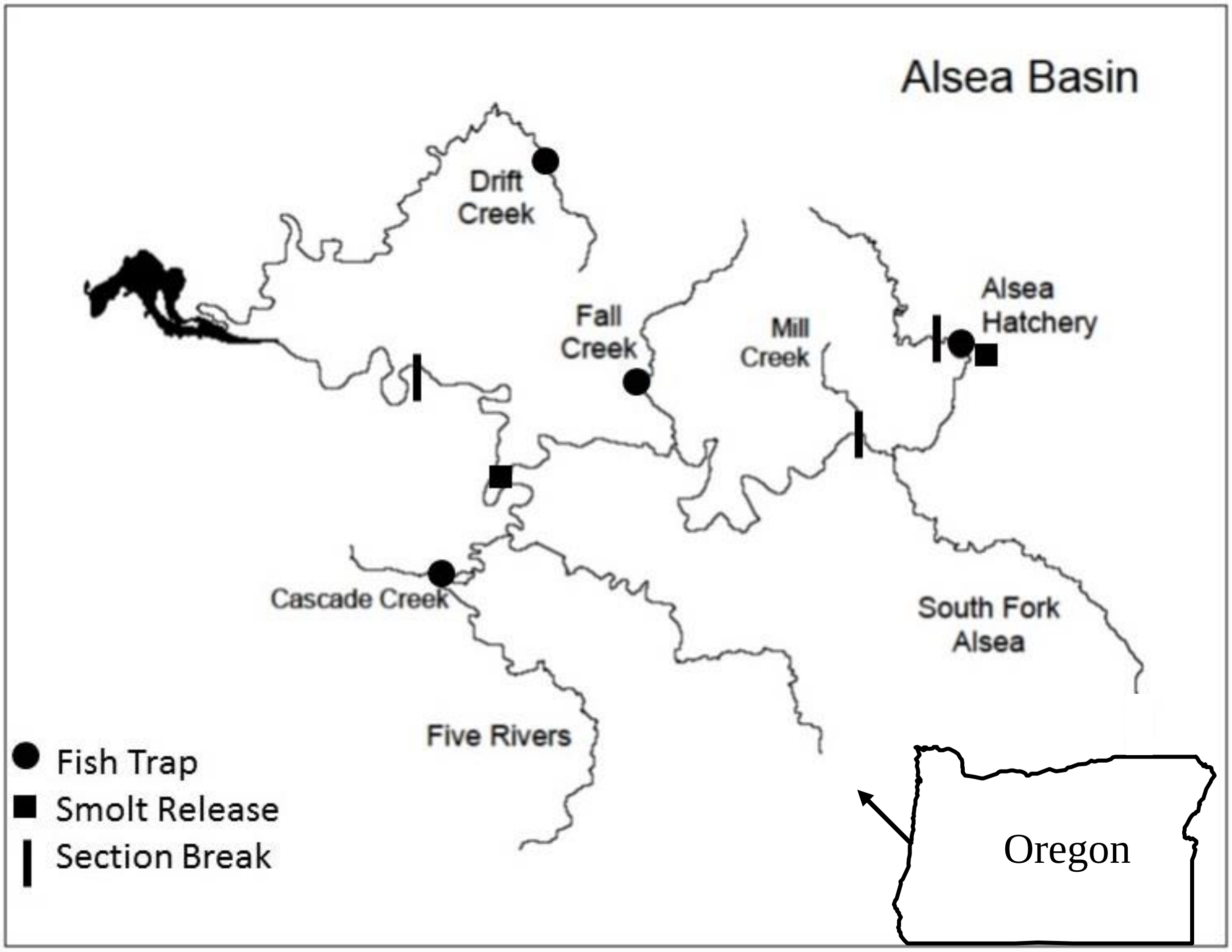

Figure 1. Major tributaries of Alsea River and locations of four in-basin adult steelhead trapping sites, smolt release locations, and creel section breaks.

The traditional broodstock was collected from December through February at the fish ladder and trap entering the Alsea Hatchery. They are held until maturity when the females are live spawned and the males are killed spawned. The wild broodstock was collected using two primary methods. The main source is by volunteer anglers catching wild adult winter steelhead from December through March. Wild broodstock caught by anglers were held in holding tubes at designated sites along the river and then picked up by hatchery staff. Once at the hatchery, adults were held in large circular tanks until ready for live spawning. After spawning they were released back into the river. Up to 20% of the total broodstock needs were also collected at the Alsea Hatchery North Fork water intake dam fish trap and at the water intake dam fish trap at the Oregon Hatchery Research Center on Fall Creek, a large tributary to the Alsea River (Figure 1). Broodstock eggs were incubated in trays, ponded indoors as fry, transferred to outdoor raceways by July, and released the following spring as one year olds at an average size of 6 fish per pound.

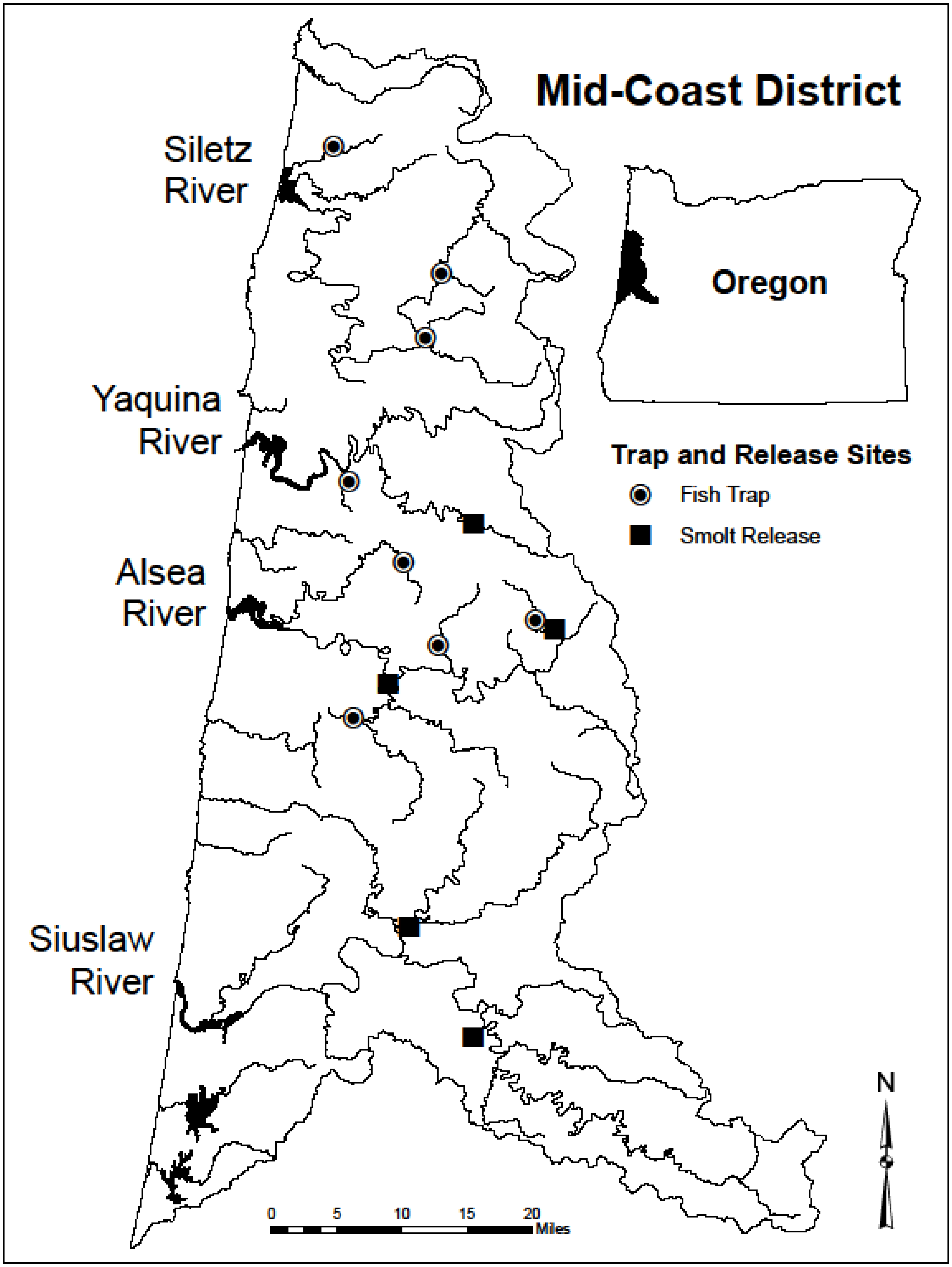

Figure 2. Project area showing adult steelhead trapping sites and steelhead smolt releases sites associated with the study.

Hatchery winter steelhead smolt release groups consisting of five different groups per year were uniquely marked using a combination of adipose fin clip and maxillary clips, and/or the presence of a coded-wire tag. Smolt from each group were marked in December prior to their spring release. They were anesthetized in MS-222 (Tricaine Methanesulfonate) and given an adipose fin clip to identify them as a hatchery fish. Depending on the release group, the removal of a maxillary (either left or right side) and/or the addition of a coded wire tag by injection into the snout of the smolt was also performed. Quality control was checked throughout the marking process and again just prior to release to obtain an estimate of marked smolt released for each group. Three consecutive years of smolt releases occurred within the Alsea, Yaquina and Siuslaw basins for this study as outlined in Table 1.

Table 1. Study smolt release groups by year, release site, stock, size, mark type(s) and release estimate.

Release Year	Release Site	Stock	Release Size[1]	Mark Type[2]	% Marked[3]	% Coded Wire Tagged[4]	Release Estimate[5]
2012	Alsea Hatchery	Alsea Wild	6 per lb.	AdRm	100		62,753
	Alsea Hatchery	Alsea Traditional	6 per lb.	AdLm	100		21,394
	Alsea Lower River	Alsea Traditional	6 per lb.	AdLm -CWT	100	97.1	41,198
	Yaquina Basin	Alsea Traditional	6 per lb.	AdRm-CWT	100	99.2	21,446
	Siuslaw Basin	Siuslaw	6 per lb.	Ad-CWT	100	95.1	57,205
2013	Alsea Hatchery	Alsea Wild	6 per lb.	AdRm	99.2		63,241
	Alsea Hatchery	Alsea Traditional	6 per lb.	AdLm	100		20,607
	Alsea Lower River	Alsea Traditional	6 per lb.	AdLm -CWT	100	98.5	42,241
	Yaquina Basin	Alsea Traditional	6 per lb.	AdRm-CWT	100	94.9	21,388
	Siuslaw Basin	Siuslaw	6 per lb.	Ad-CWT	100	93.8	76,833
2014	Alsea Hatchery	Alsea Wild	6 per lb.	AdRm	100		63,297
	Alsea Hatchery	Alsea Traditional	6 per lb.	AdLm	100		21,203
	Alsea Lower River	Alsea Traditional	6 per lb.	AdLm -CWT	100	96.7	41,002
	Yaquina Basin	Alsea Traditional	6 per lb.	AdRm-CWT	100	99.4	20,009
	Siuslaw Basin	Siuslaw	6 per lb.	Ad-CWT	97.3	96.4	55,589

[1]The number of smolt per pound at release

[2]Specific mark(s) for each release group. Ad=adipose; Lm=left maxillary; Rm=right maxillary; CWT=presence of a coded wire tag

[3]The percent of accurately marked fish just prior to release

[4]The percent of wire tagged smolt just prior to release

[5]The smolt release estimate adjusted by percent marked and/or coded wire tagged just prior to release

Monitoring of adult returns was accomplished by a probabilistic creel survey on the Alsea River and through multiple adult steelhead trapping sites within and outside the Alsea basin (Figure 2). The creel survey was set up as an access-based survey. It was designed using nonuniform probability, where sampling probability was greater at some places and times since anglers are not uniform in distribution or through time. A sampling plan utilizing special knowledge (from fisheries managers and anglers) of the fishery that mimics the real world versus assumed uniform distribution increases precision with the creel survey by assigning sampling effort in proportion to angling effort, Table 2. This improves the efficiency of angler contact by sampling in strata with the most fishing effort while decreasing the variance of the collected data (Stanovick and Nielsen 1991). This strategy is most effective in areas that have been previously surveyed and data is available, as the Alsea has over several decades. Probability sampling with nonuniform probability is an unbiased process as the weighted mean of all possible estimates will equal the true value (Hayne 1991). Anglers were interviewed at the completion of their fishing trip at designated points. They were questioned about their fishing trip length (effort), how many fish they caught (catch) and how many they kept (harvest). Harvested fish were inspected for marks and scanned for a coded wire tag to determine the site of their release. Released hatchery and wild fish were also recorded during the creel. The number of anglers and total catch were counted directly and the total effort and catch rate was estimated from angler reported values. The angler answers became the data that were used in the stratified sampling design to estimate harvest, catch, and effort, Bernard et al (1998) and (Hayne 1991). The survey was stratified by location (upper and lower river), seasonally by month and weekly (week day vs weekend). Each stratum had its own estimate of amount and success of fishing with the primary sampling unit as a day selected at random within a time block. The sample day was then sampled at random for a work period that must be observed by the creel clerk exactly to ensure a complete survey. Not all anglers leave a fishery at the same time during a work period so creel clerks kept a complete count of all departing anglers so records could be expanded proportionally with reference to angler pressure and success (Hayne 1991). Angler effort and catch were recorded separately and estimated as:

$$\text{Effort} = \frac{\text{Observed angler hours}}{\text{Probability of observing the angler}} \qquad \text{Catch} = \frac{\text{Observed catch}}{\text{Probability of observing the catch}}$$

The catch per unit of fishing effort (catch rate) was then estimated for each stratum by dividing the total number of fish harvested by the total fishing effort. The catch rate was applied to estimates of total catch (total effort X catch rate) for each stratum such as weekly (weekdays and weekends), seasonally (month), broodstock (release groups), and physical stratum (river section).

The survey was conducted December – March utilizing two creel clerks for three consecutive seasons. The Alsea River was divided into two sections: 1) an upper bank fishing only section from Mill Creek (river mile 42) until just upstream from the Alsea Hatchery and; 2) the lower river from just upstream from the head of tide until the Mill Creek boat ramp (see Figure 1). Creel clerks worked three randomly selected week days and all weekends during one of two eight hour shifts for a given day.

Adult trapping sites were located within the Alsea (4 sites), Yaquina (1 site) and Siletz (3 sites) (Figure 2). Trapping sites were operated throughout the steelhead spawning season (typically November – May) and checked multiple times per week. All hatchery fish were examined for specific marks and scanned for the presence of a coded wire tag. All adults captured at the fish traps were recorded by sex and mark(s) if present and entered into a long term data base. This information was used to identify specific stocks of fish to each trap, i.e. wild or source of hatchery release, percent of non-basin released returns at each trap and overall for a basin by stock and as a total, and to account for total number of returns based on a 2-salt spawning migration, in combination with creel results.

Table 2. Nonuniform sampling probabilites (%) by river section and sampling location related to river gauge height(s) and month.

		December			**January**			**February**			**March**		
Section	**Creel Location**	< 4.5 ft	4.5 to 6.5 ft	> 6.5 ft	< 4.5 ft	4.5 to 6.5 ft	> 6.5 ft	< 4.5 ft	4.5 to 6.5 ft	> 6.5 ft	< 4.5 ft	4.5 to 6.5 ft	> 6.5 ft
Upper	Alsea Hatchery Bank Area	15	40	60	15	40	60	15	60	60	15	50	70
	Clemons Park Bank Area	20	30	40	20	30	40	30	30	40	30	40	30
	Stanton Bank Upper	25	20	0	25	20	0	40	10	0	40	5	0
	Stanton Bank Lower	40	10	0	40	10	0	15	0	0	15	5	0
Lower	Mill Park Boat Ramp	0	0	0	0	0	0	0	0	0	0	0	0
	Campbell Boat Ramp	15	30	40	0	30	40	0	30	40	0	40	40
	Salmonberry Boat Ramp	0	35	50	0	35	50	0	35	50	0	40	50
	Missouri Bend Boat Ramp	0	10	10	0	10	10	0	10	10	0	10	10
	River Edge Boat Ramp	0	5	0	0	5	0	0	5	0	0	5	0
	Five Rivers Boat Ramp	10	15	0	10	20	0	10	20	0	10	5	0
	Ermie Walters Boat Ramp	10	0	0	10	0	0	10	0	0	10	0	0
	Blackberry Boat Ramp	20	0	0	20	0	0	20	0	0	20	0	0
	Mike Bauer Boat Ramp	20	5	0	30	0	0	30	0	0	30	0	0
	Hellion Rapids Boat Ramp	5	0	0	5	0	0	5	0	0	5	0	0
	Barclays Break Boat Ramp	20	0	0	25	0	0	25	0	0	25	0	0

Results

Objective 1). Determine if a recently developed steelhead broodstock from wild fish contributes to fisheries at a higher level than a traditional (segregated) broodstock developed in the late 1930s.

During the three year evaluation period, the wild broodstock was harvested on average at a 2:1 ratio when compared to the traditional broodstock. Annual variation was 3:1, 1.4:1, and 2:1 respectively, Table 3. The wild broodstock was also harvested at a higher percentage three out of four months sampled each season (Figure 3).

A total of 1206 released hatchery steelhead were estimated over the course of the three year project (335, 471, and 400 fish, respectively). However, these fish could not be included in the evaluation of the broodstocks because specific mark(s) could not be confirmed by the creel clerks. Catch and release for wild, non-marked, winter steelhead were also estimated for each season (359, 1736 and 147 respectively).

Table 3. Annual creel harvest estimates of Alsea hatchery winter steelhead broodstocks by month and river section (upper or lower).

Release group by location in thousands	December		January		February		March		Total	Percent Harvest of Alsea Broodstocks
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper		
2014										
Traditional (Upper)-20K	66	9	175	61	0	27	10	0	348	16.48%
Traditional (Lower)-40K	52	0	72	0	36	6	0	12	178	8.43%
Wild Brood (Upper)-60K	39	0	201	127	682	152	12	372	1585	75.08%
2015										
Traditional (Upper)-20K	36	27	21	154	10	61	0	0	309	20.78%
Traditional (Lower)-40K	0	40	85	85	54	55	0	0	319	21.45%
Wild Brood (Upper)-60K	6	0	166	214	47	268	8	150	859	57.76%
2016										
Traditional (Upper)-20K	7	26	0	74	0	62	0	17	186	12.80%
Traditional (Lower)-40K	14	30	18	144	0	100	0	0	306	21.05%
Wild Brood (Upper)-60K	13	13	30	272	199	251	0	183	961	66.13%

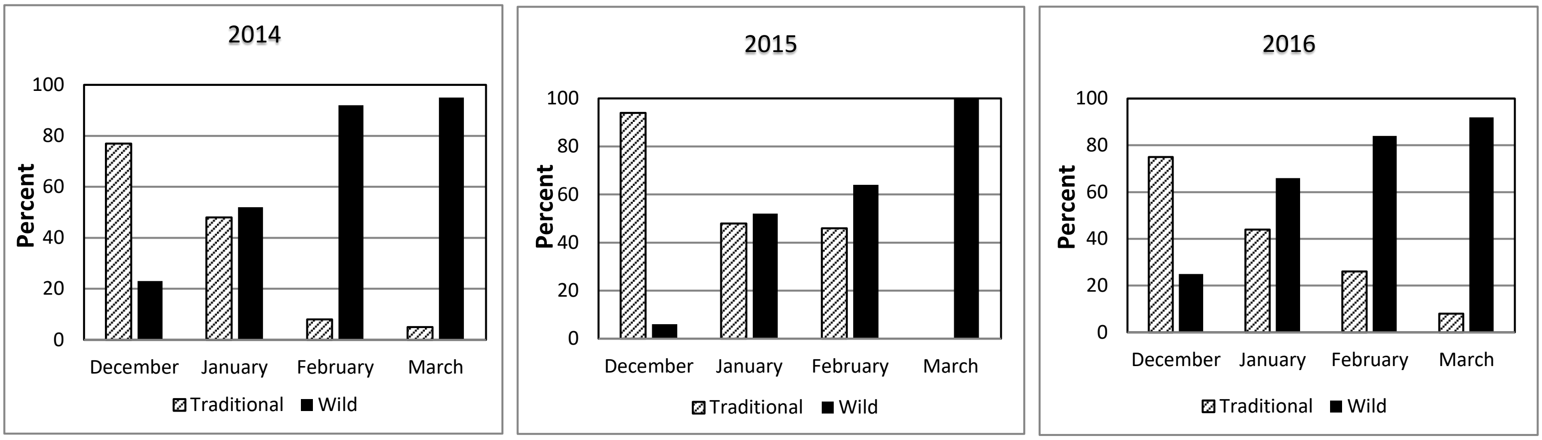

Figure 3. Percent total monthly harvest of the Alsea winter steelhead broodstocks by study year.

Objective 2). Determine if shifting the release location of two thirds of the traditional smolts (40,000) to the lower river establishes a fishery in the area without contributing excessively to out of basin migration.

Results from the creel survey detected harvest of the lower river release group by lower river anglers each year but at relatively low levels over the course of the project (Figure 4). However, the number of adult steelhead harvested in the lower river was comparable to the harvest estimate of the traditional upper release group, which has half the smolt release. Overall harvest estimates of the upper and lower traditional brood release groups basin -wide were similar, despite the annual smolt release differences (Table 4).

Trap returns from all three groups show that the lower river release group had the least total returns to the Alsea Hatchery. It also had the lowest total return percentage with a three year average of 0.82%, Table 4.

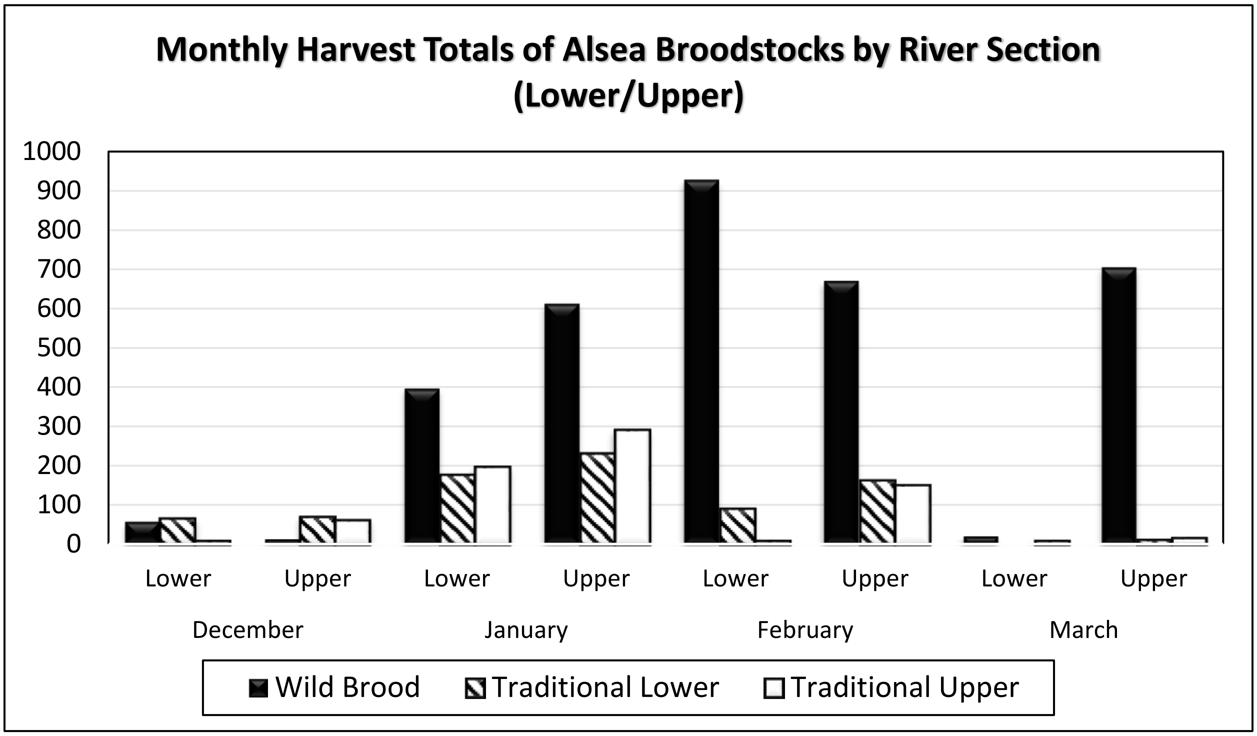

Figure 4. Three year total harvest by month and river section of the two Alsea River broodstocks.

Table 4. Alsea winter steelhead trap returns, angler harvest and return rates.

Release Group	Alsea Hatchery Trap Returns: December	January	February	March	April	Total Trap Return	Percent Trap Return[1]	Harvest Estimate[2]	Percent Harvest[1]	Percent Total Return[3]
2014										
Traditional (Upper)	0	226	143	43	4	416	1.94	348	1.62	3.56
Traditional (Lower)	0	78	78	35	2	193	0.46	178	0.43	0.89
Wild Stock (Upper)	0	43	330	535	124	1032	1.64	1585	2.52	4.16
2015										
Traditional (Upper)	215	622	200	8	0	1045	5.07	309	1.49	6.56
Traditional (Lower)	13	30	2	0	0	45	0.10	319	0.75	0.85
Wild Stock (Upper)	25	223	192	236	0	676	1.06	859	1.35	2.41
2016										
Traditional (Upper)	559	845	179	23	0	1606	7.57	186	0.87	8.44
Traditional (Lower)	5	3	1	0	0	9	0.01	306	0.74	0.75
Wild Stock (Upper)	39	228	129	267	21	684	1.08	961	1.51	2.59

[1]Percent based on 2-salt adult returns divided by associated smolt release estimate.

[2]Total in river sport harvest estimated from creel survey.

[3]Sum of trap returns and harvest estimates based on 2-salt adult returns divided by associated smolt release estimate.

Objective 3). Determine source(s) of the out-of-basin hatchery steelhead observed in the Alsea River.

The creel survey detected a mixture of non-basin released winter steelhead harvested by sport anglers (Table 5). The Siuslaw and Yaquina river releases were the largest contributors, respectively accounting for 348 and 192 total fish harvested over the three years. An unknown stock(s) was also detected in the sport harvest. These were adult winter steelhead with only an adipose fin clip to distinguish them as hatchery origin, thereby preventing specific stock identification and/or release location. Use of only an adipose fin clip to identify hatchery origin in steelhead is commonly used in Oregon and the Pacific Northwest. The three year average of non-basin steelhead harvest detected in the creel was 11.5%. However, the variation from each year was wide with 11%, 20%, and 2% respectively over the three seasons.

Trap returns of non-basin released winter steelhead to the Alsea Hatchery for all three years were 4.9%, 3.5% and 1.2% respectively. Detection of hatchery steelhead (including in-basin release groups) to other in-basin trapping sites, (Figure 1), during our study was substantially higher. The three other in-basin trapping sites had total observations of hatchery steelhead of 22%, 23% and 15% respectively and was a mixture of in and out-of-basin hatchery winter steelhead, (Table 6). The Alsea wild broodstock had no detections at non-basin trapping sites and minimal detection at the three other Alsea in-basin trapping sites.

Table 5. Creel harvest estimates of non-basin released winter steelhead in the Alsea River sport fishery.

					2014				
	December		**January**		**February**		**March**		
Release location	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	**Total**
Yaquina River	25	9	19	21	6	12	0	4	96
Siuslaw River	17	0	23	0	35	0	5	0	80
Unknown	21	0	8	27	18	0	7	0	81
					2015				
Yaquina River	0	15	66	8	0	7	0	0	96
Siuslaw River	0	0	98	50	54	37	0	5	244
Unknown	0	0	10	0	0	21	0	0	31
					2016				
Yaquina River	0	0	0	0	0	0	0	0	0
Siuslaw River	0	0	0	7	6	11	0	0	24
Unknown	0	0	0	0	0	0	0	3	3

Table 6. Annual adult winter steelhead trapping results by release group and recapture site.

	Alsea Basin Trapping Sites			Out-of-Basin Trapping Sites			
Release Groups	**Drift Creek**	**Fall Creek**	**Cascade Creek**	**Siletz Falls**	**Mill Creek Siletz**	**Schooner Creek Siletz**	**Mill Creek Yaquina**
2014							
Traditional (Upper)	12	5	1	0	0	0	0
Traditional (Lower)	0	2	1	0	1	0	3
Wild Brood (Upper)	4	0	0	0	0	0	0
Yaquina River	3	0	0	2	1	0	3
Siuslaw River	1	1	1	1	0	0	0
Unknown	5	6	0	7	0	10	6
2015							
Traditional (Upper)	1	25	0	0	0	0	0
Traditional (Lower)	0	15	6	0	0	0	3
Wild Brood (Upper)	3	0	0	0	0	0	0
Yaquina River	3	1	0	6	0	0	5
Siuslaw River	0	11	0	11	0	1	1
Unknown	5	19	2	0	0	0	0
2016							
Traditional (Upper)	3	8	0	0	0	0	0
Traditional (Lower)	1	3	3	0	0	1	2
Wild Brood (Upper)	0	0	0	0	0	0	0
Yaquina River	0	0	0	6	2	0	0
Siuslaw River	1	0	1	7	0	2	1
Unknown	3	0	1	20	0	0	0

Discussion

A desire of the angling community was to establish a prolonged fishery that included a lower river component that was more closely related to historical management practices when a lower river smolt release was commonly used. A perception by anglers in recent years was that the traditional Alsea stock quickly migrated to the hatchery early in the season and largely provided a fishery for only the upper river section (bank fishing only), thereby providing a limited timeframe for the lower river anglers to harvest these fish. One of the earliest studies conducted on the Alsea River (Chapman 1958) noted that the hatchery practices of collecting the winter steelhead egg quota first, before passing native fish into the spawning grounds (spawning only early migrating fish for hatchery broodstock) selected for hatchery fish to return early in the winter. The collection and spawning of early returning fish (F1s) from the traditional broodstock continued through the 1990s. This issue was largely addressed by creation of the localized "wild" broodstock, with the number of eggs taken throughout the course of the spawning season being proportional to the abundance of wild fish at the time, as determined through analysis of long term trap records from the Alsea Hatchery. Eggs collected from the traditional broodstock have similarly been taken with greater regard to run timing diversity, with the intent of distributing the migration run more evenly across the season. Results from the creel survey show that this management approach has been relatively successful. The wild broodstock appears to have a more protracted run timing similar to native steelhead runs in the Alsea basin and along the Oregon coast. The traditional broodstock returns comparatively early, contributes a greater proportion of the early-season harvest regardless of release location and provides for an early fishery both in the upper and lower river sections. Consequently, a higher portion of adult returns from this stock are ultimately trapped at the Alsea Hatchery before wild fish spawning begins, thereby reducing potential genetic and ecological risks.

The wild broodstock produced more angler harvest than the traditional brood stock, averaging a 2:1 ratio during the three year study. An evaluation of broodstocks conducted on the Nestucca River also reported similar results of a 2:1 harvest ratio (range 1.9 – 3.7) of a local in basin brood versus releases of a non-basin Alsea traditional stock (ODFW 2010). The annual variation in harvest between the two broodstocks in this study and ODFW (2010) was noted as being influenced by weather and run timing of the stocks. This pattern was expected as the traditional broodstock returns early in the season whereas the wild brood stock mimics the natural run timing of native winter steelhead in the Alsea basin. For example, in December of the 2013-14 run year, unusually cold and dry conditions likely influenced the harvest of only 18 hatchery adult steelhead harvested in the upper river, when 220 were harvested in the lower river. Conversely, the 2016 run season was relatively warm and wet, as influenced by a strong El Niño event. In this year, the lower river was high and turbid for much of the season. Accordingly, harvest in the upper river was approximately 4 times that of the lower river. The Steelhead Production Factors project on the Alsea River during the 1980s had the same conclusions of weather influencing the run timing and harvest during the course of a season, Kenaston and MacHugh (1987, 1986 and 1985). Still, the pattern represented in Figure 3 was the same for all three seasons where the traditional brood predominately return early in the season and the wild brood have a longer and later run timing.

The exact mechanisms for the wild broodstocks producing greater relative harvest are not understood. However, this study, as well as ODFW (2010) and Kenaston and MacHugh (1987) documented the increasing percentage of "wild" steelhead caught as the season progressed. A plausible mechanism is that the wild brood is simply subjected to a longer time period targeted by anglers because of their prolonged run timing and tendency to return in greater numbers as the season progresses. It could be that the wild brood is less domesticated and more willing to bite or are more aggressive. It could be something completely unrelated to stock selection such as angling pressure changes, learned angler techniques or changes in how angler information and word of mouth occur. Further evaluation is needed to determine a more precise explanation of why the wild brood has a higher harvest tendency.

During the three year study, the lower river smolt release of traditional stock did contribute to the lower river fishery. However, when considering the upper river release is only half the size at 20,000 smolts annually and that the annual variation in weather/river conditions tends to drive the migration timing of these early returning fish, the overall contribution to lower river anglers was comparatively small. This is evident when looking at the total number of harvested fish by stock and release location (Figure 5) and is supported by Kenaston and MacHugh (1985, 1986) that reported lower river releases of traditional broodstock in the Alsea from brood years 1980-1983 contributed less to the lower river sports fishery than did the comparative upper river release from the hatchery. This suggests the lower river release groups may not contribute well to the angler because they have lesser survival (smolt to adult returns) compared to their upriver release counterparts and/or have a higher tendency to distribute within basin or to other coastal river basins as returning adults. Overall, lower river releases of smolts tend to distribute from release locations at higher rates but still contribute to the in river fishery, just not necessarily at the location(s) intended (Lindsay et al. 2001; Kenaston et al. (2001).

Research on the Alsea River steelhead programs in the 1970s, 80s and 90s showed that a large portion of out-of-basin winter steelhead were largely from the Siuslaw River winter steelhead program or from other nearby river basins that were planted with Alsea River stock (Lindsay et al. 2001; Kenaston and MacHugh 1983; Kenaston and MacHugh 1985; Kenaston and MacHugh 1987; MacHugh 1981). In recent times, the general consensus among anglers and department staff has been that the out-of-basin strays observed in the Alsea River were from the Yaquina River release of traditional Alsea stock winter steelhead. This study confirmed the Yaquina River release of the traditional Alsea stock did migrate back to the Alsea River, their source of origin. They were detected in the sports fishery during each year of the creel survey and in adult trapping sites. However, the largest contributor to the non-basin released fish observed in the Alsea was from the Siuslaw River release. The harvest of the Siuslaw River stock in the Alsea River sports fishery nearly doubled that of the Yaquina releases as well as in detections at the adult trapping facilities (Tables 5 and 6). An unknown stock(s) was also observed in the Alsea River fishery and in adult trapping sites. Without an extensive individualized marking strategy coast wide for all steelhead smolt releases, the unknown stock(s) cannot be positively determined. Given results from this study and from past research on Oregon coastal steelhead programs, the likely sources of the unknown stock(s) are from other adjacent basins in the coastal region with steelhead programs, such as between the Tillamook Bay basin to the north and the Coquille River basin to the south.

Past research found non-basin released adult returns accounted for 44% and 32% of the annual Alsea River harvest (Kenaston and MacHugh 1986; MacHugh 1981). Similarly, Lindsay et al. (2001) reported that returns from transplanted Alsea releases accounted for 25-34% of the total hatchery return to the Alsea River. Comparatively, this study found the contribution to the Alsea sports fishery from non-basin releases varied 2 to 20% of the total basin harvest over three years, suggesting that the use of localized broodstocks in modern time likely reduces the amount of non-basin release adult returns. This is further supported by results from in-basin trapping facilities. Over the study, out-of-basin released steelhead detected at the Alsea Hatchery traps was less than 5% which is considerably lower from past results which ranged from 15% to 27% (Kenaston and McHugh 1986; Kenaston and MacHugh 1987; MacHugh 1981). The smaller contribution to the fishery observed in this study from non-basins releases and of those detected at basin trapping facilities is to be expected as more localized broodstocks are now used and releases of non-basin steelhead stocks have been nearly eliminated coast wide, including the elimination of the non-basin steelhead smolt release into the Yaquina after 2014.

Conclusion

The Alsea River wild broodstock appears to contribute more to angler harvest than the traditional brood stock. The observed benefits to the sport angler were a higher harvest level and prolonged run timing resulting in more potential angling days. From a conservation standpoint, the wild brood also appeared to have stronger overall return numbers and lower potential to move to other basins. The traditional broodstock does have benefits as well. Early season harvest is comprised primarily of traditional brood stock, regardless of release location, and a large percentage of this stock is collected at the Alsea hatchery trap thereby reducing conservation concerns. Results from the lower river release suggest that either this group does not contribute well to the angler, has poor survival (smolt to adult returns) or has a higher tendency to move outside of the Alsea River basin. Project findings from this study will be used in conjunction with the Oregon Department of Fish and Wildlife’s Coastal Multi Species Conservation Plan and Native Fish Conservation Policy to inform future management decisions for the Alsea River winter steelhead programs.

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Literature Cited

Bernard, D.R., A.E. Bingham, and M. Alexandersdottir. 1998. The mechanics of onsite creel surveys in Alaska. Alaska Department of fish and Game, Special Publication No. 98-1, Anchorage.

Chapman, D.W. 1958. Studies on the Life Histories of Alsea River Steelhead. J. of Wildlife Management. Vol 22 (2): 123-134.

Hayne, D.W. 1991. The access point creel survey: procedures and comparison with the roving-clerk creel survey. American Fisheries Society Symposium 12:123-138.

Kenaston, K.R., R.B. Lindsay, and R.K. Schroeder. 2001. Effect of Acclimation on the homing and survival of hatchery winter steelhead. N. Am. J. of Fisheries Management. Vol 21, Issue 4. Pp 765-773.

Kenaston, K.R., and N.M. MacHugh. 1986. Coastal Steelhead Production Factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120 and F-120-R-1. Annual Progress Report, Portland, Oregon, USA.

Kenaston, K.R., and N.M. MacHugh. 1987. Coastal Steelhead Production Factors. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R. Annual Progress Report, Portland, Oregon, USA.

Kenaston, K.R., and N.M. MacHugh. 1985. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project 2-4-0-740-10, Annual Progress Report, Portland, Oregon, USA.

Kenaston, K.R., and N.M. MacHugh. 1983. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project 2-4-0-740-10, Annual Progress Report, Portland, Oregon, USA.

Lindsay, R.B., K.R. Kenaston, and R.K. Schroeder. 2001. Reducing Impacts of Hatchery Steelhead Programs. Oregon Department of Fish and Wildlife, Fish Research Project F-120-R, Portland.

MacHugh, N.M. 1981. Steelhead Production Factors (formerly Genetic Studies of Anadromous Salmonids). Oregon Department of Fish and Wildlife. Annual Progress Report. AFS-73-4: Contract No. 14-16-0001-79-446. pp 1-25.

ODFW 2010. Nestucca Hatchery Winter Steelhead Evaluation 2002-2009 Brood Years. Oregon Department of Fish and Wildlife, North Coast Watershed District, Tillamook Oregon.

Stanovick, J.S., and L.A. Nielsen. 1991. Assigning nonuniform sampling probabilities by using expert opinion and multiple-use patterns. Am. Fish. Soc. Symposium 12:189-194.

Wagner, H.H. 1967. A Summary of Investigations of the use of Hatchery-Reared Steelhead in the Management of a Sport Fishery. Research Division, Oregon State Game Commission. Winter Steekhead Investigations. Fishery Report No. 5, 62 pp.

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