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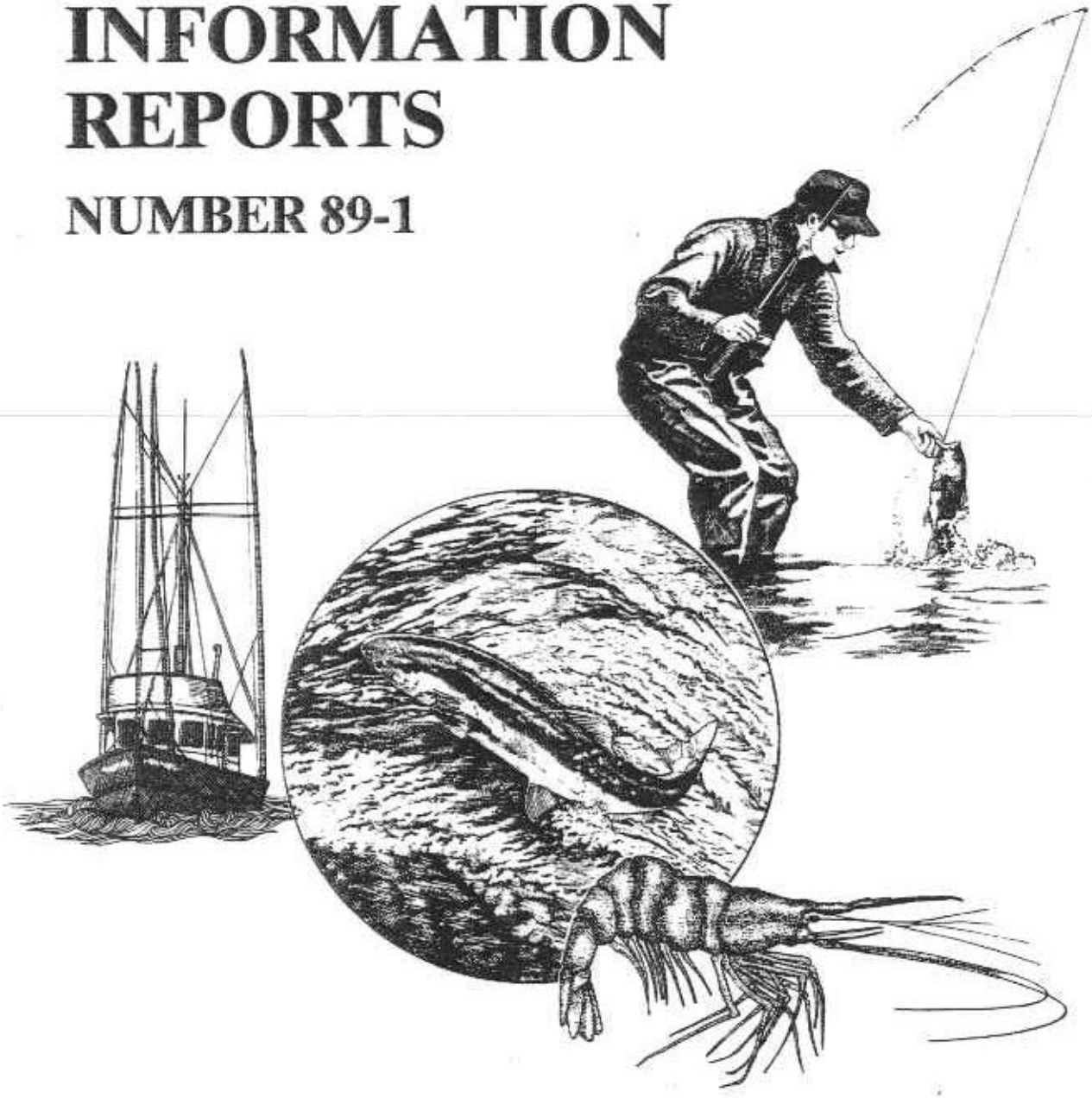

FISH DIVISION

Oregon Department of Fish and Wildlife

Estimated Run Size of Winter Steelhead in
Oregon Coastal Streams, 1980-85

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INTRODUCTION

The Comprehensive Plan for Production and Management of Oregon's Anadromous Salmon and Trout Part III: Steelhead Trout (Oregon Department of Fish and Wildlife 1986) lists 22 problems that hamper achievement of its objectives. Two of them are:

Problem 8: Data on abundance of hatchery and wild stocks and their contribution to fisheries are generally inadequate to manage fisheries.

Problem 10: Harvest and effort estimates and data gathering systems are inadequate for effective fishery management.

Populations of winter steelhead *Oncorhynchus mykiss* exist in virtually every watershed along the Oregon coast. Actual run size of these populations are unknown. The purpose of this report is to present estimates of the run size of wild and hatchery winter steelhead in Oregon coastal streams.

Fishery managers in Oregon have previously estimated run sizes of steelhead in Oregon streams. As part of a statewide fish and wildlife planning effort, begun in 1970 by the Oregon State Game Commission, a fish resource inventory was created by estimating the distribution and abundance of fish in individual streams. Passage counts, where available, were used to determine the total combined escapement in streams above the counting facility. In areas where total escapement was not counted, estimates of escapement were derived using steelhead recreational catch statistics, estimates of the proportion of hatchery and wild stocks in the catch, and

estimates of exploitation rate (25% and 50% for wild and hatchery steelhead, respectively). Spawning escapement within individual streams was apportioned using the best judgement of the district biologist. These estimates are generally referred to as the 1977 planning forms.

The variable methodology used in different basins and the general lack of documentation of estimation parameters has limited the use of these planning forms. New information regarding recreational catch composition and fishery exploitation rates warrant another attempt at estimating run size.

Fishery managers will be able to use this information for basin planning and the fishery management programs contained therein.

METHODS

To calculate the number of adult steelhead returning to Oregon coastal streams I used statistics on steelhead recreational catch, estimates of hatchery:wild composition in the catch, and estimates of exploitation rates for those fisheries.

Estimates of annual steelhead harvest are made for 41 Oregon coastal watersheds. Steelhead recreational catch estimates for Oregon coastal streams (Oregon Department of Fish and Wildlife 1987) were calculated from returned salmon-steelhead catch records and expanded for nonresponse bias (Hicks and Calvin 1964). These salmon-steelhead catch records have been previously referred to as "punchcards" or "tags." In this report I will refer to them as catch records. Monthly estimates of catch were divided between summer and winter steelhead based on local run timing. Monthly estimates were summed across all appropriate months to estimate catch by run year. For example, winter steelhead fisheries commonly occur in November and December in calendar year i and January through March in year i + 1.

Hatchery:wild composition in some rivers was estimated from scale samples collected by anglers in those recreational fisheries (Kenaston and MacHugh 1983, 1985; ODFW unpublished data). Where the scale collection for an individual river totalled fewer than 20 fish, an average composition, calculated from all streams with at least 20 scale samples, was applied. Independent averages were calculated for streams managed exclusively for wild fish and for those stocked with hatchery steelhead smolts.

I reviewed the literature for exploitation rates in steelhead fisheries. Values ranged from 8% to 70% and represented early (1940s) to recent (1980s) recreational fisheries throughout the Northwest (Table 1). I found no significant difference ($P > 0.05$) between the average exploitation rate for winter steelhead fisheries and that for summer steelhead fisheries.

Rather than apply a single average exploitation rate to a widely diverse collection of recreational fisheries, I hypothesized three levels of exploitation, corresponding to high intensity, moderate intensity, and low intensity fisheries. These fishery intensity groupings subjectively considered the number of anglers, size of the river, and distribution of the fishery along its length. I calculated exploitation rates for Oregon fisheries from passage counts and recreational catch estimates. I also used data for Oregon fisheries from Table 1. I subjectively assigned a level of intensity to the examples based on the criteria stated above. Assignment of intensity level was independent of the estimated exploitation rate. Table 2 lists exploitation rates by steelhead race and intensity of the fishery. Exploitation rates within intensity levels are similar and the magnitude of exploitation increases with higher levels of intensity.

Table 1. Estimates of exploitation rates for recreational fisheries on steelhead obtained from the literature. WA = Washington, OR = Oregon, CA = California, ID = Idaho.

Race, river	Exploitation rate	Year	Reference
Winter steelhead:			
Green River, WA	0.43	1940	Pautzke and Meigs (1940)
Green River, WA	0.54	1941	Meigs and Pautzke (1941)
Smith River, OR	0.22	1947	Gharrett (1948)
Smith River, OR	0.08	1948	Memo to P.R. Needham, director of fisheries from L.M. Mathisen (1948)
Samish River, WA	0.40	1954	Larson and Ward (1954)
Grays River, WA	0.155	1956	Rothfus et al. (1956)
Columbia River	0.13-0.21	1956	Korn (1961)
Summer steelhead:			
Wooley Creek, CA	0.11	1968	Lanse (1970)
Shasta River, CA	0.20	1970	Lanse (1972)
Salmon River, ID	0.22	1971-74, 1976-78, 1981-83	Thurow (1983)
Clearwater River, ID	0.23	1972-73 and 1973-74	Lukens 1982
Deschutes River, OR	0.28	1977, 1980-83	Jonasson and Lindsay (1983)
Snake River and tributaries, ID	0.41	1977-78	Ortman (1979)
Salmon River, ID	0.60	1978	Reingold (1979)
Pashimeroi River, ID	0.67	1981-82	Ball (1985)
Pashimeroi River, ID	0.70	1982-83	Ball (1985)

Table 2. Exploitation rates of different Oregon recreational fisheries grouped by steelhead race and intensity of fishery.

Type and intensity of fishery	Years	Number of years	Exploitation rate	Coefficient of variation
WINTER STEELHEAD				
High intensity:				
Sandy River	1960-66	7	0.40	20
Alsea River	1982-85	4	0.42	26
Moderate intensity:				
Willamette River, upper	1981-85	5	0.21	14
Smith River	1947-48	2	0.15	67
North Umpqua River	1970-83	14	0.20	25
Low intensity:				
North Umpqua, upper	1984-85	2	0.08	51
Rogue River, upper	1984-85	2	0.08	13
SUMMER STEELHEAD				
High intensity:				
Willamette River, upper	1981-84	4	0.44	11
North Umpqua River, upper	1984-85	2	0.39	15
North Umpqua River	1970-83	14	0.46	22
Moderate intensity:				
Deschutes River	1977, 1980-83	5	0.28	18
Low intensity:				
Rogue River, upper	1984-85	2	0.11	82

I estimated total run size by dividing recreational catch by an estimate of exploitation rate. For each coastal stream listed by the Oregon Department of Fish and Wildlife (1987), I subjectively classified each stream by intensity level and assigned the average winter steelhead exploitation rate for that level from Table 2. The total run for each stream was apportioned into its wild component by applying an estimate of the proportion wild in the catch. The data used for calculating total run size and the wild steelhead portion is presented in **APPENDIX A.**

RESULTS AND DISCUSSION

Table 3 lists estimated run sizes of winter steelhead in Oregon coastal streams for the 1980-81 through 1984-85 seasons. Wild steelhead run sizes calculated by this methodology show substantial variation among years.

I compared my estimates of the average total winter steelhead run size in 28 coastal watersheds to estimates of total run size on the 1977 planning forms (ODFW unpublished data). I found good correlation (r = 0.887) between my estimates of run size and those recorded on the planning forms (Figure 1).

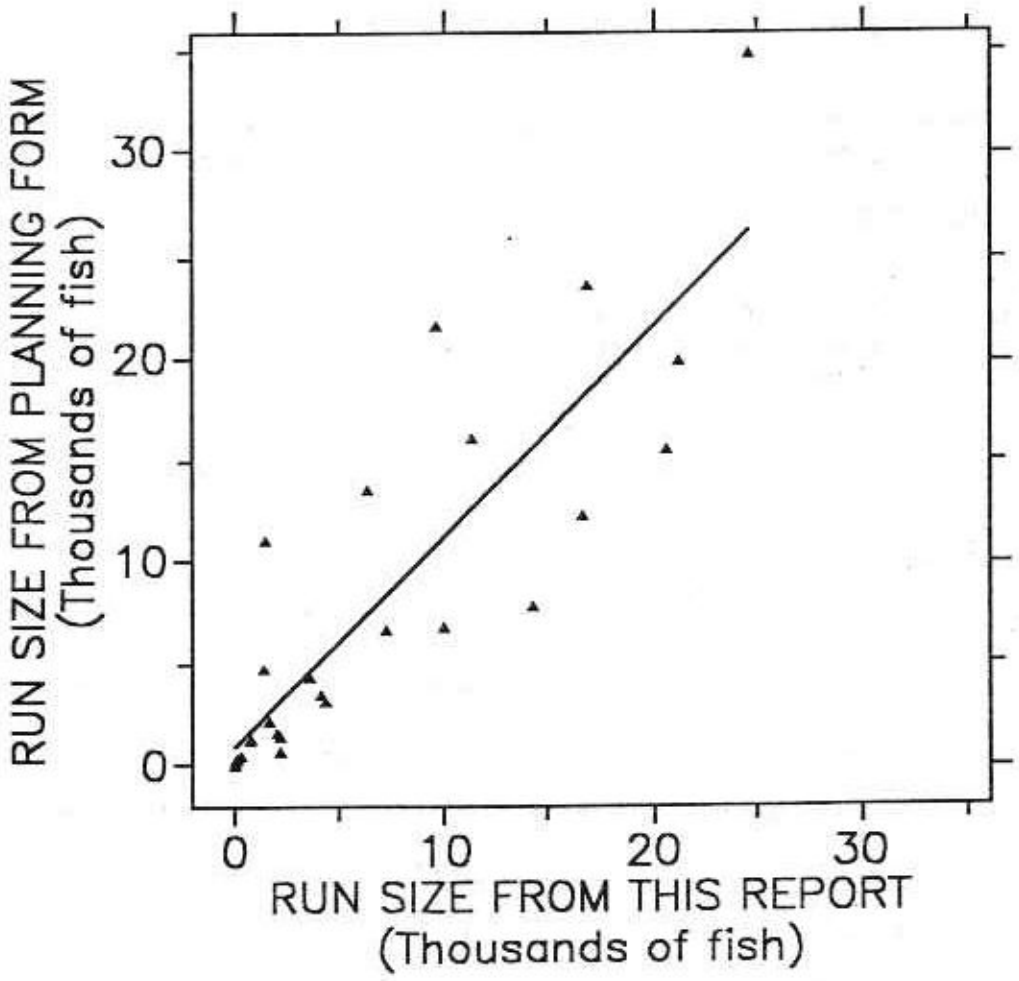

Figure 1. Comparison of my run size estimates with estimates from the 1977 planning forms for 28 coastal watersheds. Line represents linear correlation with r = 0.887, $P \leq 0.01$.

Table 3. Estimates of run size of winter steelhead in Oregon coastal streams, 1980-81 through 1984-85 run years. N.Fk. = North Fork, S.Fk. = South Fork, E.Fk. = East Fork, W.Fk. = West Fork, M.Fk. = Middle Fork, Co = County.

Stream	1980-81		1981-82		1982-83		1983-84		1984-85		5-year average	
	Total run	Wild run	Total run	Wild run	Total run	Wild run	Total run	Wild run	Total run	Wild run	Total run	Wild run
Alsea River and Bay	13,515	1,757	10,512	2,102	4,593	413	12,873	2,703	21,407	3,425	12,580	2,080
Drift Creek	3,850	500	1,788	358	775	70	3,725	782	2,075	332	2,442	408
Fall Creek	775	101	2,575	515	1,112	100	988	207	350	56	1,160	196
Five Rivers	1,212	158	900	180	300	27	1,225	257	1,462	234	1,020	171
N.Fk. Alsea River	2,959	385	4,746	949	1,824	164	4,229	888	5,149	824	3,781	642
S.Fk. Alsea River	363	47	211	42	216	19	568	119	505	81	373	62
Total, Alsea River basin	22,674	2,948	20,732	4,146	8,820	794	23,608	4,958	30,949	4,952	21,357	3,559
Beaver Creek (Lincoln Co)	38	23	162	102	50	34	(a)	(a)	238	100	98	52
Big Creek (Lane Co)	637	395	1,179	743	626	426	900	675	326	137	734	475
Brush Creek (Curry Co)	0	0	62	39	50	34	88	66	162	68	72	41
Cape Creek (Lane Co)	412	256	962	606	425	289	250	188	300	126	470	293
Chetco River and Bay	7,612	3,578	6,085	2,252	1,922	346	5,398	2,861	14,993	6,897	7,202	3,187
Coos River and Bay	721	296	147	49	142	27	821	189	6,537	1,830	1,674	478
Millicoma River	107	44	78	26	7	1	51	12	410	115	131	40
E.Fk. Millicoma River	416	170	542	179	268	51	1,247	287	4,100	1,148	1,315	367
W.Fk. Millicoma River	5,258	2,156	2,426	801	547	104	1,447	333	7,442	2,084	3,424	1,095
S.Fk. Coos River	10,512	4,310	3,338	1,101	612	116	4,725	1,087	19,212	5,380	7,680	2,399
Total, Coos River basin	17,015	6,976	6,531	2,155	1,578	300	8,292	1,907	37,701	10,556	14,223	4,379
Coquille River and Bay	4,789	1,964	1,584	285	716	150	2,911	407	9,553	2,675	3,911	1,096
N.Fk. Coquille River	2,832	1,161	916	165	174	36	484	68	9,532	2,669	2,787	820
E.Fk. Coquille River	1,547	634	974	175	289	61	3,658	512	4,484	1,256	2,191	528
Middle Creek	150	61	62	11	(a)	(a)	75	11	350	98	128	36
S.Fk. Coquille River	8,212	3,367	6,466	1,164	1,168	245	7,129	998	11,793	2,005	6,954	1,556
M.Fk. Coquille River	1,863	764	542	98	268	56	895	125	789	221	872	253
Total, Coquille River basin	19,394	7,951	10,544	1,898	2,616	549	15,152	2,121	36,501	8,923	16,841	4,289

a *Calculated run size in this year was 0 because there was no catch recorded by the Oregon Department of Fish and Wildlife (1987).*

Table 3. Continued.

Stream	1980-81 Total run	1980-81 Wild run	1981-82 Total run	1981-82 Wild run	1982-83 Total run	1982-83 Wild run	1983-84 Total run	1983-84 Wild run	1984-85 Total run	1984-85 Wild run	5-year average Total run	5-year average Wild run
Cummins Creek (Lane Co)	362	225	100	63	(a)	(a)	38	28	100	42	120	72
D River and Devils Lake	(a)	(a)	125	79	50	34	38	28	(a)	(a)	42	28
Elk Creek (Clatsop Co)	162	101	150	94	175	119	125	94	225	94	168	100
Elk River (Curry Co)	1,517	941	1,663	1,048	537	365	1,117	838	2,090	878	1,385	814
Euchre Creek (Curry Co)	911	565	153	96	95	64	32	24	416	175	321	185
Hunter Creek (Curry Co)	2,000	1,240	326	206	432	293	174	130	1,168	491	820	472
Necanicum River	5,146	2,110	2,939	647	2,195	198	3,105	124	7,159	2,004	4,109	1,017
Nehalem River and Bay	5,717	2,344	2,266	748	2,193	526	7,339	1,248	12,129	1,941	5,929	1,361
N.Fk. Nehalem River	3,837	1,573	2,493	823	3,288	789	11,068	1,882	10,817	1,731	6,300	1,359
Cook Creek	750	308	662	219	812	195	5,225	888	8,525	1,364	3,195	595
Rock Creek	(a)	(a)	275	91	138	33	338	57	200	32	190	43
Salmonberry River	1,325	822	800	504	838	570	1,462	980	700	294	1,025	634
Total, Nehalem River basin	11,629	5,046	6,496	2,384	7,268	2,113	25,432	5,055	32,371	5,361	16,639	3,992
Neskowin Creek	400	248	179	113	(b)	(b)	(b)	(b)	(b)	(b)	289	180
Nestucca River	20,159	7,862	18,515	5,369	7,124	1,710	14,315	3,149	18,468	4,986	15,716	4,615
Beaver Creek	162	101	(a)	(a)	88	60	125	94	288	121	132	75
Little Nestucca River	4,421	1,724	3,779	1,096	2,747	659	4,500	990	5,616	1,516	4,213	1,197
Three Rivers	4,551	1,775	5,312	212	2,607	156	4,273	342	6,571	1,840	4,663	865
Total, Nestucca basin	29,293	11,462	27,606	6,678	12,567	2,585	23,213	4,575	30,942	8,463	24,724	6,753
New River, Floras Creek, and Floras Lake	1,811	1,123	1,021	643	579	394	874	655	3,342	1,404	1,525	844
Fourmile Creek	462	287	100	63	(a)	(a)	75	56	138	58	155	93
Total, New River basin	2,273	1,409	1,121	706	579	394	949	712	3,480	1,461	1,680	936
Pistol River	2,750	1,705	1,625	1,024	1,088	740	812	609	4,675	1,964	2,190	1,208
Rock Creek (Lane Co)	88	54	225	142	38	26	75	56	(a)	(a)	85	56
Rogue River and Bay, lower	8,995	3,688	5,066	1,672	7,298	2,773	727	138	14,688	7,785	7,355	3,211
Applegate River	2,942	1,206	1,005	332	447	170	3,253	618	3,411	1,808	2,212	827
Illinois River	15,762	9,773	9,962	6,276	4,800	3,264	6,575	6,115	14,375	6,038	10,295	6,293
Rogue River, upper	(c)	(c)	(c)	(c)	(c)	(c)	4,042	768	4,116	2,181	4,079	1,475
Total, Rogue River basin	27,700	14,667	16,034	8,280	12,545	6,207	14,597	7,639	36,589	17,811	21,493	10,921

[b] *This stream was closed to angling.*
[c] *Harvest estimates were not made prior to the 1983-84 run year.*

Table 3. Continued.

Stream	1980-81 Total run	1980-81 Wild run	1981-82 Total run	1981-82 Wild run	1982-83 Total run	1982-83 Wild run	1983-84 Total run	1983-84 Wild run	1984-85 Total run	1984-85 Wild run	5-year average Total run	5-year average Wild run
Salmon River	8,800	3,608	9,347	2,617	5,658	1,075	6,658	1,531	18,658	5,224	9,824	2,811
Slick Rock Creek	250	102	225	63	212	40	(a)	(a)	(b)	(b)	172	51
Total, Salmon River basin	9,050	3,710	9,572	2,680	5,870	1,115	6,658	1,531	18,658	5,224	9,962	2,852
Sand Lake (Tillamook Co)	38	23	362	228	138	94	125	94	138	58	160	99
Siletz River and Bay	11,005	3,081	8,973	3,500	4,505	1,171	10,939	2,516	16,851	3,539	10,455	2,761
Schooner Creek	800	496	700	441	262	178	975	731	275	116	602	392
Drift Creek	6,584	1,844	4,216	2,445	1,984	516	2,447	563	4,611	968	3,968	1,267
N.Fk. Siletz River	4,888	1,369	2,250	878	2,025	526	2,400	552	5,662	1,189	3,445	903
Rock Creek	175	49	875	341	312	81	588	135	438	92	478	140
S.Fk. Siletz River	2,650	742	1,075	419	3,025	786	2,212	509	2,612	549	2,315	601
Total, Siletz River basin	26,102	7,580	18,089	8,024	12,114	3,260	19,561	5,006	30,449	6,452	21,263	6,064
Siltcoos River and Lake	625	388	388	244	100	68	462	347	600	252	435	260
Woahink Lake	(a)	(a)	50	32	(a)	(a)	112	84	362	152	105	54
Total, Siltcoos River basin	625	388	438	276	100	68	575	431	962	404	540	313
Siuslaw River and Bay	7,512	3,080	5,488	1,976	2,249	292	4,793	1,102	10,285	2,366	6,065	1,763
Lake Creek	3,244	1,330	2,978	1,072	1,188	154	2,941	677	3,100	713	2,690	789
Deadwood Creek	438	179	550	198	50	6	300	69	475	109	362	112
Indian Creek	1,300	533	550	198	300	39	300	69	275	63	545	180
Munsel Lake	(c)	(c)	(c)	(c)	(c)	(c)	112	84	188	79	150	82
N.Fk. Siuslaw River	942	386	926	333	342	44	1,158	266	3,026	696	1,279	345
Sweet Creek	705	289	389	140	95	12	532	122	168	39	378	121
Total, Siuslaw River basin	14,141	5,798	10,882	3,917	4,223	549	10,136	2,390	17,518	4,065	11,380	3,344
Sixes River	2,716	1,684	1,084	683	700	476	821	616	3,000	1,260	1,664	944
Sutton Creek and Lake	200	124	188	118	175	119	550	412	175	74	258	169
Tahkenitch Creek and Lake	(a)	(a)	(a)	(a)	(a)	(a)	38	28	125	52	32	16
Tenmile Creek (Coos Co)	1,083	444	178	59	346	66	1,861	447	3,607	180	1,415	239
Eel Lake	(a)	(a)	(a)	(a)	88	17	88	21	(a)	(a)	35	1
Total, Tenmile Creek basin	1,083	444	178	59	434	82	1,948	468	3,607	180	1,450	24

Table 3. Concluded.

Stream	1980-81 Total run	1980-81 Wild run	1981-82 Total run	1981-82 Wild run	1982-83 Total run	1982-83 Wild run	1983-84 Total run	1983-84 Wild run	1984-85 Total run	1984-85 Wild run	5-year average Total run	5-year average Wild run
Tenmile Creek (Lane Co)	353	219	879	554	221	150	695	521	958	402	621	369
Tillamook Bay	(a)	(a)	89	30	74	14	163	38	311	87	127	34
Kilchis River	3,458	1,418	2,447	1,175	2,605	495	3,468	486	6,016	4,752	3,599	1,665
Miami River	1,921	788	1,911	630	779	148	2,711	352	3,637	1,018	2,192	587
Tillamook River	1,268	520	1,421	469	932	177	2,863	659	3,811	1,067	2,059	578
Trask River	4,724	2,929	3,720	2,343	2,100	1,428	4,256	2,596	4,861	2,187	3,932	2,297
N.Fk. Trask River	1,000	620	863	544	637	433	732	446	632	284	773	465
Total, Trask River basin	8,637	5,355	6,633	4,179	3,787	2,575	6,188	3,774	6,380	2,871	6,325	3,751
Wilson River	11,012	4,515	10,095	2,827	7,168	1,505	8,502	1,445	9,400	1,786	9,236	2,416
Devils Lake Fork Wilson River	62	26	238	66	138	29	125	21	200	38	152	36
Little N.Fk. Wilson River	488	200	275	77	(a)	(a)	125	21	150	28	208	65
Total, Wilson River basin	11,562	4,740	10,608	2,970	7,306	1,534	8,752	1,488	9,750	1,852	9,596	2,517
Umpqua River and Bay	18,468	7,572	20,579	6,791	9,216	1,751	16,305	3,750	27,874	13,101	18,488	6,593
North Umpqua River, lower	9,337	5,789	7,421	4,675	4,821	3,278	3,611	2,888	4,163	1,665	5,871	3,659
North Umpqua River, upper	(c)	(c)	(c)	(c)	(c)	(c)	1,179	943	4,616	1,846	2,897	1,395
Total, North Umpqua River basin	9,337	5,789	7,421	4,675	4,821	3,278	4,789	3,832	8,779	3,512	7,029	4,217
Smith River	6,163	3,636	5,637	1,353	2,716	516	4,932	2,269	12,405	3,598	6,371	2,274
N.Fk. Smith River	1,200	708	2,395	575	826	157	1,521	700	4,179	1,212	2,024	670
Total, Smith basin	7,363	4,344	8,032	1,928	3,542	673	6,453	2,968	16,584	4,809	8,395	2,944
South Umpqua River	11,532	5,305	6,737	2,156	3,142	597	5,753	3,279	11,000	2,310	7,633	2,729
Cow Creek	(c)	(c)	(c)	(c)	(c)	(c)	142	81	453	95	297	88
Total, South Umpqua basin	11,532	5,305	6,737	2,156	3,142	597	5,895	3,360	11,453	2,405	7,752	2,764
Winchuck River	741	460	449	283	100	68	534	401	2,005	842	766	411
Yachats River	563	349	368	232	463	315	1,163	872	1,184	497	748	453
Yaquina River and Bay	650	266	588	194	(a)	(a)	212	49	400	112	370	124
Big Elk Creek	4,611	1,890	3,579	1,181	1,442	274	3,642	838	6,611	1,851	3,977	1,207
Total, Yaquina River basin	5,261	2,157	4,166	1,375	1,442	274	3,855	887	7,011	1,963	4,347	1,331
Unclassified	(a)	(a)	1,475	929	1,350	918	562	422	1,475	620	972	578

Several simplifications and assumptions were made in order to calculate estimates of run size. I used harvest estimates generated from returned catch records (Oregon Department of Fish and Wildlife 1987) as accurate measures of the recreational catch. Pereira (1985) pointed out in a review of Oregon's harvest estimation procedures that the bias corrections developed in 1961 and used in generating estimates of catch were only intended to provide a statewide total estimate of catch. Using the bias corrections to generate catch estimates by river by month would be, at best, only rough approximations. Fortunately, these rough approximations show the same interannual trends as catch estimates derived in another way. Trends in catch on the Alsea River estimated by catch records is similar to trends estimated from an intensive creel survey (Figure 2).

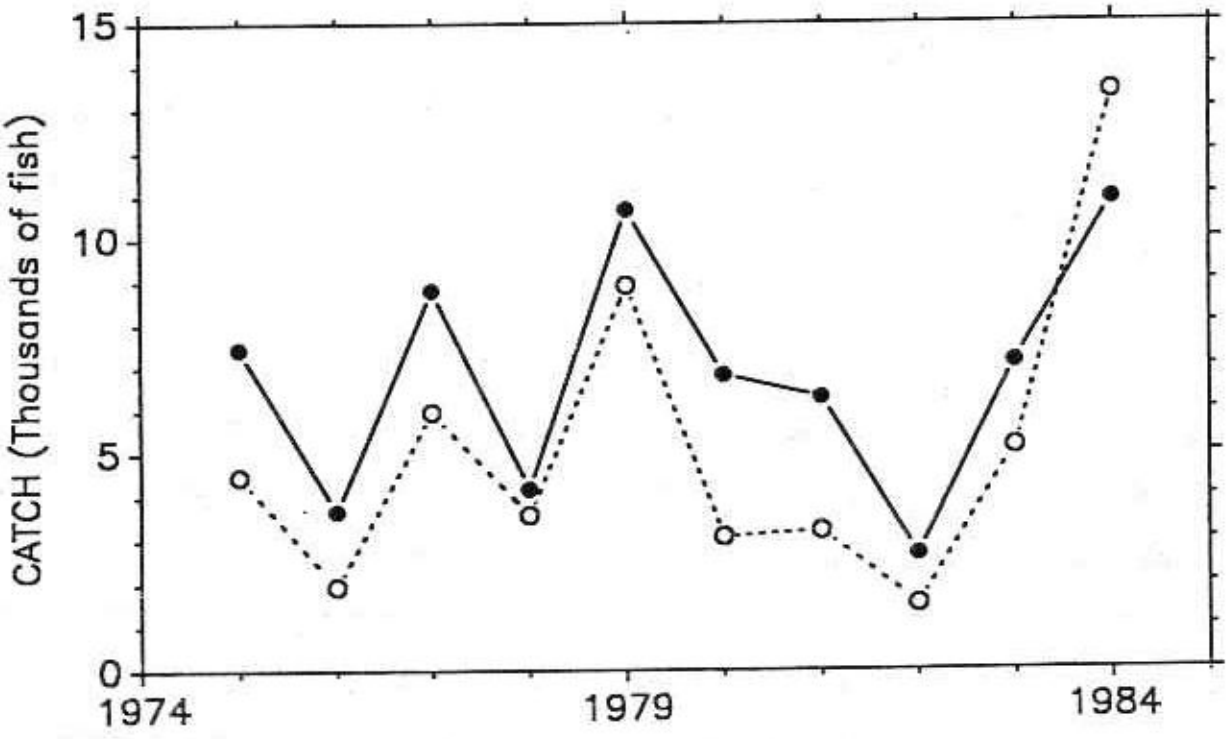

Figure 2. Catch of winter steelhead on the Alsea River estimated from catch records (Oregon department of Fish and Wildlife 1987) and from creel survey (Kenaston and MacHugh 1985). Solid line represents estimates from catch records; dashed line represents estimates from creel survey.

My classification of fisheries as high, moderate, or low intensity may be in error because I subjectively classified. Misclassification of intensity can greatly affect the run size estimate. For instance, given a catch estimate of 1,000 fish, run sizes corresponding to low, moderate, and high intensity fisheries would be estimated at 12,500, 5,263, and 2,439 fish, respectively.

I used a constant exploitation rate for an individual stream for all years. Most likely fishery intensity does vary between years as abundance of steelhead varies and fishing conditions change. The variation in exploitation rates used in Table 2 reveals coefficients of variation that ranged from 11% to 82% for winter steelhead fisheries. I did not have a good measure of how that intensity varied for each year for each fishery so I used the same exploitation rate for each year.

My estimates of exploitation rate may not reflect the actual exploitation rate that was operating. I used a reference collection of a few fisheries, which may not be entirely representative of the diverse steelhead fisheries along the coast. The broad range in exploitation rates in Tables 1 and 2 demonstrates that harvest rates can vary tremendously between fisheries. Although this kind of error occurs across a broad range of stream sizes and fisheries, the problem becomes most noticeable for small streams where no catch may not mean no run of fish. Access for fishermen and stream morphology and characteristics can influence catch more than abundance of fish.

Further, I assumed that hatchery and wild steelhead were harvested at the same rate. By contrast, planning form estimates assumed that hatchery fish were harvested at twice the rate wild fish were harvested. We have observed differences in spawning time between hatchery and wild fish, but we know

little of their river entry time and residence in the areas available to the fisheries. These run size estimates may be minimum run sizes where a substantial number of winter steelhead enter the river after the close of the fishing season.

Another problem inherent in this methodology involves the distribution of catch within a basin. Any steelhead that is caught is usually migrating to somewhere else. For example, mainstem catch includes fish bound for some upriver tributary. Thus, estimates of run size, based on tributary catch, underestimates the run size in the tributaries and leaves a large proportion of the total return to the basin unassigned to any subbasin. Therefore, I recommend caution in using run size estimates for any individual tributary.

These estimates are one of the few attempts that have been made to present run sizes of steelhead. As estimates of the recreational catch, harvest rate, and catch composition improve, these run size estimates will become more accurate. Until then these can serve as starting points for basin planning.

REFERENCES

Ball, K. 1985. Evaluation of transplanting Snake River steelhead trout to the Pashimeroi River, 1983. Idaho Department of Fish and Game, Project IPC-26, Annual Progress Report, Boise.

Gharrett, J.T. 1948. The winter steelhead run of the Umpqua River, 1946-47. Fish Commission of Oregon Research Briefs 1(1):13-17.

Hicks, R.H., and L.D. Calvin. 1964. An evaluation of the punch card method of estimating salmon-steelhead sport catch. Oregon State University Agricultural Experimental Station Technical Bulletin 81, Corvallis.

Jonasson, B.C., and R.B. Lindsay. 1983. An ecological and fish cultural study of Deschutes River salmonids. Oregon Department of Fish and Wildlife, Fish Research Project F-88-R-13, Annual Progress Report, Portland.

Kenaston, K.R., and N.M. MacHugh. 1983. Steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Project 240-740-10, Annual Progress Report, Portland.

Kenaston, K.R., and N.M. MacHugh. 1985. Coastal steelhead production factors. Oregon Department of Fish and Wildlife, Fish Research Projects F-120 and F-120-R-1, Annual Progress Report, Portland.

Korn, L. 1961. A winter steelhead tagging program on the Columbia River. Fish Commission of Oregon Contribution 26, Portland.

Lanse, R.I. 1970. The Wooley Creek surveys, 1967 and 1968. California Department of Fish and Game, Anadromous Fisheries Branch, Administrative Report 70-1, Sacramento.

Lanse, R.I. 1972. The 1970 sport harvest--Shasta River, Siskiyou County, including the proportion of the adult steelhead *(Salmo gairdneri gairdneri)* population harvested by anglers. California Department of Fish and Game, Anadromous Fisheries Branch, Administration Report 72-1, Sacramento.

Larson, R.W., and J.M. Ward. 1954. Management of steelhead trout in the State of Washington. Transactions of the American Fisheries Society 84:261-274.

Lukens, J.R. 1982. Clearwater River steelhead investigations. Idaho Department of Fish and Game, Project F-73-R-4, Annual Progress Report, Boise.

Meigs, R.C., and C.F. Pautzke. 1941. Additional notes on the life history of the Puget Sound steelhead *(Salmo gairdneri)* with suggestions for management of the species. Washington Department of Game, Biological Bulletin 5, Olympia.

Oregon Department of Fish and Wildlife. 1986. Comprehensive plan for production and management of Oregon's anadromous salmon and trout, Part III: Steelhead trout, Portland.

Oregon Department of Fish and Wildlife. 1987. Oregon salmon and steelhead sport catch statistics 1975-85. Fish Division Data Summary Report, Portland.

Ortman, D.W. 1979. Estimates of the 1978 harvest of salmon and steelhead (survey). Idaho Department of Fish and Game, Project F-73-R-1, Annual Progress Report, Boise.

Pautzke, C.F., and R.C. Meigs. 1940. Studies on the life history of the Puget Sound steelhead *(Salmo gairdnerii)*. Washington Department of Game, Biological Bulletin 3, Olympia.

Pereira, C. 1985. Salmon-steelhead tag harvest estimates. Oregon Department of Fish and Wildlife, Revised Internal Report to J. Lichatowich, Assistant Chief of Fisheries, Portland.

Reingold, M. 1979. Evaluation of transplanting Snake River steelhead trout to the Pashmimeroi River, 1978. Idaho Department of Fish and Game, Project IPCC-26, Annual Progress Report, Boise.

Rothfus, L.O., W.D. Ward, and E. Jewell. 1956. A Columbia River tributary steelhead trout enumeration study. Part II, Grays River steelhead trout population study, December 1955 through April 1956. Draft report.

Thurow, R. 1983. Middle Fork Salmon River fisheries investigations. Idaho Department of Fish and Game, Project F-73-R-5, Annual Progress Report, Boise.

APPENDIX A

Data used to estimate run size of winter steelhead from steelhead harvest estimates. N.Fk. = North Fork, S.Fk. = South Fork, E.Fk. = East Fork, W.Fk. = West Fork, M.Fk. = Middle Fork, Co = County.

Stream	Exploitation rate	Percentage wild fish				
		1980-81	1981-82	1982-83	1983-84	1984-85
Alsea River and Bay	0.41	13	20	9	21	16
Drift Creek	0.08	13	20	9	21	16
Fall Creek	0.08	13	20	9	21	16
Five Rivers	0.08	13	20	9	21	16
N.Fk. Alsea River	0.41	13	20	9	21	16
S.Fk. Alsea River	0.19	13	20	9	21	16
Beaver Creek (Lincoln Co)	0.08	62	63	68	75	42
Big Creek (Lane Co)	0.19	62	63	68	75	42
Brush Creek (Curry Co)	0.08	62	63	68	75	42
Cape Creek (Lane Co)	0.08	62	63	68	75	42
Chetco River and Bay	0.41	47	37	18	53	46
Coos River and Bay	0.19	41	33	19	23	28
Millicoma River	0.41	41	33	19	23	28
E.Fk Millicoma River	0.19	41	33	19	23	28
W.Fk. Millicoma River	0.19	41	33	19	23	28
S.Fk. Coos River	0.08	41	33	19	23	28
Coquille River and Bay	0.19	41	18	21	14	28
N.Fk. Coquille River	0.19	41	18	21	14	28
E.Fk. Coquille River	0.19	41	18	21	14	28
Middle Creek	0.08	41	18	21	14	28
S.Fk. Coquille River	0.41	41	18	21	14	17
M.Fk. Coquille River	0.19	41	18	21	14	28
Cummins Creek (Lane Co)	0.08	62	63	68	75	42
D River and Devils Lake	0.08	62	63	68	75	42
Elk Creek (Clatsop Co)	0.08	62	63	68	75	42
Elk River (Curry Co)	0.41	62	63	68	75	42
Euchre Creek (Curry Co)	0.19	62	63	68	75	42
Hunter Creek (Curry Co)	0.19	62	63	68	75	42
Necanicum River	0.41	41	22	9	4	28
Nehalem River and Bay	0.41	41	33	24	17	16
N.Fk. Nehalem River	0.41	41	33	24	17	16
Cook Creek	0.08	41	33	24	17	16
Rock Creek	0.08	41	33	24	17	16
Salmonberry River	0.08	62	63	68	67	42

Appendix A (continued).

Stream	Exploitation rate	Percentage wild fish 1980-81	1981-82	1982-83	1983-84	1984-85
Neskowin Creek	0.19	62	63	68	75	42
Nestucca River	0.41	39	29	24	22	27
Beaver Creek	0.08	62	63	68	75	42
Little Nestucca River	0.19	39	29	24	22	27
Three Rivers	0.41	39	4	6	8	28
New River, Floras Creek, and Floras Lake	0.19	62	63	68	75	42
Fourmile Creek	0.08	62	63	68	75	42
Pistol River	0.08	62	63	68	75	42
Rock Creek (Lane Co)	0.08	62	63	68	75	42
Rogue River and Bay, lower	0.41	41	33	38	19	53
Applegate River	0.19	41	33	38	19	53
Illinois River	0.08	62	63	68	93	42
Rogue River, Upper	0.19	41	33	19	19	53
Salmon River	0.19	41	28	19	23	28
Slick Rock Creek	0.08	41	28	19	23	28
Sand Lake (Tillamook Co)	0.08	62	63	68	75	42
Siletz River and Bay	0.41	28	39	26	23	21
Schooner Creek	0.08	62	63	68	75	42
Drift Creek	0.19	28	58	26	23	21
N.Fk. Siletz River	0.08	28	39	26	23	21
Rock Creek	0.08	28	39	26	23	21
S.Fk. Siletz River	0.08	28	39	26	23	21
Siltcoos River and Lake	0.08	62	63	67	75	42
Woahink Lake	0.08	62	63	68	75	42
Siuslaw River and Bay	0.41	41	36	13	23	23
Lake Creek	0.41	41	36	13	23	23
Deadwood Creek	0.08	41	36	13	23	23
Indian Creek	0.08	41	36	13	23	23
Munsel Lake	0.08	62	63	68	75	42
N.Fk. Siuslaw River	0.19	41	36	13	23	23
Sweet Creek	0.19	41	36	13	23	23
Sixes River	0.19	62	63	68	75	42
Sutton Creek and Lake	0.08	62	63	68	75	42
Tahkenitch Creek and Lake	0.08	62	63	68	75	42
Tenmile Creek (Coos Co)	0.41	41	33	19	24	5
Eel Lake	0.08	41	33	19	24	5

Appendix A (concluded).

Stream	Exploitation rate	Percentage wild fish 1980-81	1981-82	1982-83	1983-84	1984-85
Tenmile Creek (Lane Co)	0.19	62	63	68	75	42
Tillamook Bay	0.19	41	33	19	23	28
Kilchis River	0.19	41	48	19	14	79
Miami River	0.19	41	33	19	13	28
Tillamook River	0.19	41	33	19	23	28
Trask River	0.41	62	63	68	61	45
N.Fk. Trask River	0.19	62	63	68	61	45
S.Fk. Trask River	0.08	62	63	68	61	45
Wilson River	0.41	41	28	21	17	19
Devils Lake Fork Wilson river	0.08	41	28	21	17	19
Little N.Fk. Wilson River	0.08	41	28	21	17	19
Umpqua River and Bay	0.19	41	33	19	23	47
North Umpqua River, lower	0.19	62	63	68	80	40
North Umpqua River, upper	0.19	62	63	68	80	40
Smith River	0.19	59	24	19	46	29
N.Fk. Smith River	0.19	59	24	19	46	29
South Umpqua River	0.19	46	32	19	57	21
Cow Creek	0.19	41	33	19	57	21
Winchuck River	0.41	62	63	68	75	42
Yachats River	0.19	62	63	68	75	42
Yaquina River and Bay	0.08	41	33	19	23	28
Big Elk Creek	0.19	41	33	19	23	28
Unclassified	0.08	62	63	68	75	42