Forestry & Salmon

A Report on Oregon's
Coastal Watersheds
and the
Need for Forestry Reform

Coast Range Association
Corvallis, Oregon

Introduction

This report, *Forestry & Salmon* presents the best argument to date on the need to protect and restore all coastal watersheds in order to recover coastal salmon. The report is intended for decision makers, watershed advocates, watershed council participants and concerned members of coastal communities.

Two aspects of the report warrant your attention. First, powerful data, much of it not previously brought to public attention, is used to make the case for salmon recovery. Secondly, we present the entire data rich report as an understandable story that walks the reader through the connection of landscape to habitat to salmon. The references and data used are the best available. The report covers fourteen major coastal basins.

Acknowledgements

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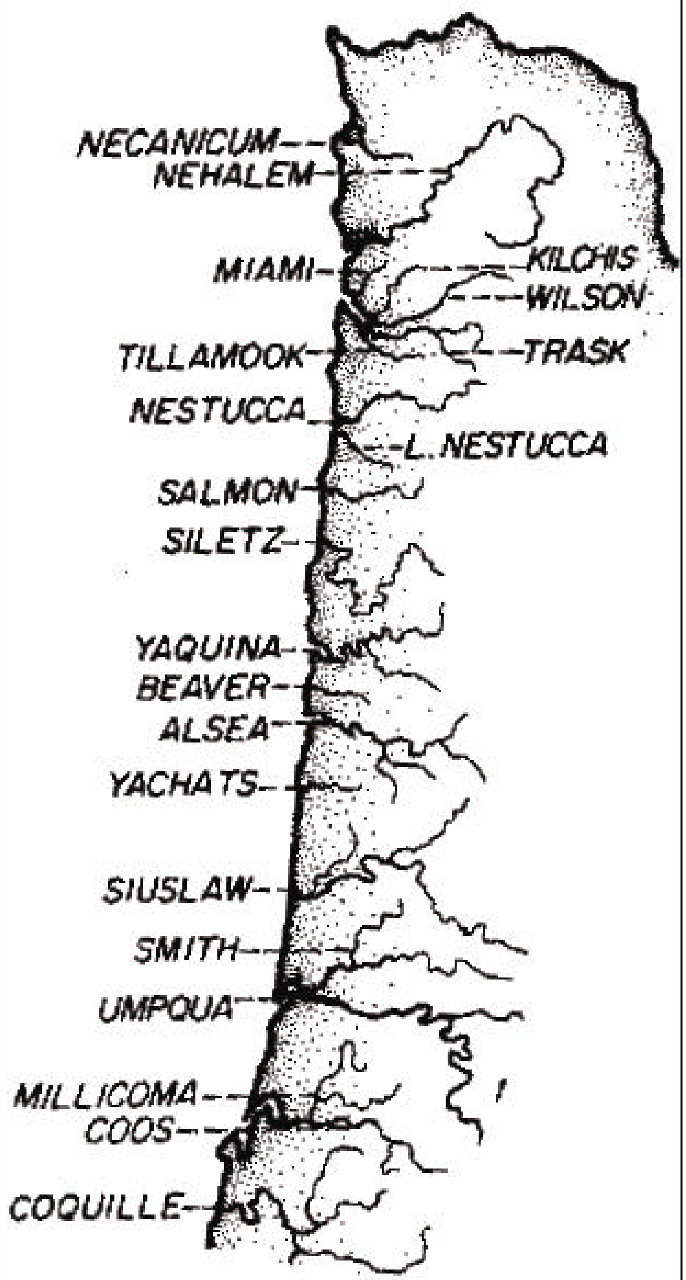
Coastal Oregon Watersheds

Endangered Coho Area



Forestry & Salmon

In the past, coastal watersheds contained the big forests of Western Oregon. No other factor shaped and maintained coastal stream habitat for salmon as greatly as the forest. The coastal forests supplied streams with plentiful large wood, moderated sediment and stream flows, and buffered the watershed from the effects of intense winter storms.

Today, the coastal forests are much different, and so is the story of native fish populations. Coastal forests in every basin are dramatically younger, big logs in the streams are all but nonexistent (something the scientists say is essential for salmon), and populations of native salmon and steelhead are a fraction of their former numbers.

Scientists tell us that salmon and their habitat must be thought of as one thing. Recently, the state of Oregon appointed a blue-ribbon Independent Multi-disciplinary Science Team (IMST) to make recommendations for recovering Western Oregon's salmon. The IMST emphasized the connection between habitat and salmon by saying "*Salmonids and their habitat comprise a single coevolved unit that cannot be separated for management purposes*" (IMST, p. 12). In other words, if we are to restore salmon populations, we must restore habitat.

The best available science makes clear that saving and recovering coastal salmon—particularly coho—require forestry practices that leave the land closer to its historic forest condition. As the IMST stated, "*the goal of* [forest] *management and policy should be to emulate (not duplicate) natural processes within their historic range*" (IMST Preface, p. v). "*We believe emulation of the historic range and distribution of conditions at the landscape level is essential to accomplishing the mission of the Oregon Plan*" (IMST, p. 34).

Scientists also attest to the interdependence of salmon. Each basin's unique family of salmon is necessary for the survival of the larger community of salmon along the whole Oregon coast. Therefore, we can't write off any watershed — every coastal watershed and every local population of coho is important for long term recovery.

What This Report Does

This report: **1)** Explains how coastal forests provided for native salmon historically; **2)** Presents important data about the condition of coastal forests and salmon habitat; and **3)** Includes a set of recommendations for restoring coastal salmon.

While all the data in this report has been widely available to researchers, much of ***it has never before been brought to the public's attention***. In addition, we have organized a wide range of information into an understandable explanation of the causes of coastal salmon decline. In the final analysis, the land use and habitat numbers within this report explain much of what happened to coastal native salmon. Although the situation appears difficult, there is hope in the emerging ***picture of how forestry must change***. One thing is beyond debate: a change in forest practices—particularly on those lands owned by big industrial companies—must occur if coastal coho are to recover.

Table 1. Major Coastal Watersheds (North to South)

Name	Acres	Dominant Ownership Type(s)
Necanicum & Ecola	86,396	Industrial Forest
Nehalem Basin	544,922	Industrial & State Forest
Tillamook Basin	350,512	Industrial & State Forest
Nestucca Basin	203,066	Federal& State Forest
Salmon River	47,690	Industrial & Federal Forest
Devil Lake – Drift Creek	40,704	Industrial & Federal Forest Federal
Siletz Basin	193,748	Industrial Forest
Yaquina Basin	158,690	Industrial Forest
Alsea Basin	299,704	Industrial & Federal Forest
Yachats River	27,753	Federal Forest
Cummins to Mercer Lake	68,853	Federal Forest
Siuslaw Basin	495,887	Industrial & Federal Forest
Siltcoos/Lakes	83,158	Industrial Forest
Tenmile Lake	64,797	Industrial Forest, State
Umpqua River	738,530	Industrial & Federal Forest
Coos River	399,579	Industrial & State Forest
Coquille River	310,555	Industrial & Federal Forest
Total Acres	4,114,544	

What Was the Original Coast Forest Like?

The best available science demonstrates that recovery of coastal salmon depends upon the return of the forest landscape closer to past natural conditions (IMST, 1999). Salmon abundance is intimately tied to natural processes that provide for salmon habitat. In turn, re-establishing natural processes raises the question of what **past landscape condition** supported abundant salmon. That condition is often called the **reference condition**.

Historic Range of Variability (HRV)

Past natural conditions were not static. Over time, forest structure and composition and the associated watershed processes exhibited a range of variability. Within the scientific community, the **historic range of variability** (HRV) is a concept used to describe past natural conditions. HRV assumes that ecosystems are naturally dynamic and that native species have adapted to disturbance-driven fluctuations over millenia (Egan & Howell, 2001).

Rather than attempting to picture how the land looked at one point in time, HRV provides a framework for understanding the landscape patterns and processes that maintain native species. With this in mind, the IMST recommends that "the goal of [forest] management and policy should be to emulate (not duplicate) natural processes within their **historic range of variability**" (IMST, 1999).

The best scientific estimates of the characteristics of the original Coast Range forest are based on studies of fire scars and pollen and charcoal taken from lake sediments. These site-specific analyses indicate that before European settlement, the forest was much older and contained much larger trees than today's forest. More often than not throughout its past history, the Coast Range valleys were old growth, filled with trees more than 200 years old. Given the close proximity to the ocean, it is very likely that the percentage of old growth in coastal basins was higher than the regional average.

Recent analysis by researchers at Oregon State University and the U.S. Forest Service's Pacific Northwest Research Station provide powerful evidence in support of a large, older Coastal forest. Their analysis suggests that old growth covered an average of 48 percent of the Coast Range over the past 3,000 years, and that forests containing trees greater than 80 years old covered an average of 71 percent of the land (Wimberly, p. 31).

The contrast between historic and current conditions is stark. The 630,000-acre Siuslaw National Forest — which runs for 135 miles between the Umpqua River at Reedsport and the Nestucca River south of Tillamook — now contains between five percent and 16 percent old growth. All federal lands in the Coast Range (24 percent) contain an estimated 11 percent old growth and 26 percent late successional forest (Wimberly, p. 10). But the largest landowner group within coastal watersheds, 37 percent, are private industrial forest owners who have logged all but a tiny fraction of their old trees, replacing them with young plantations which are cut every 30-60 years. Over the whole Coast Range region an estimated one percent old growth and five percent late successional forest remain on nonfederal land.

Old-growth forest is now at one-ninth of its historic average (5 percent vs. 47 percent), and late successional forest is at one-seventh of its historic average (11 percent vs. 71 percent). The Coast Range landscape is now very different from the historic condition that provided for abundant salmon.

What Do Salmon and Trout Need to Thrive?

Coho salmon and steelhead trout require a variety of stream conditions for reproducing and rearing. Spawning and rearing generally take place in tributary streams, usually with a gradient of less than three percent. For spawning, coho require clean gravel, ranging from the size of a pea to the size of an orange. Rearing requires cool water temperatures: the fish prefer the water between 53 degrees and 58 degrees Fahrenheit, but may tolerate temperatures up to 68 degrees. Young coho and steelhead (fry) emerge between February and early June, and occupy backwater pools and the margins of streams. During summer, coho prefer pools in small streams. In winter, they prefer off-channel alcoves, beaver ponds and dam pools.

How Does a Large Forest Shape Salmon Habitat?

Large forests slow sediments moving from the hillsides to the streams. When landslides in forests or debris torrents in upper-watershed streams occur, they may deliver large wood along with coarse sediment (rocks and gravel) to lower watershed streams. In the lower, gentler streams, large wood interacts with sediment to create the complex channels that provide good rearing habitat for juvenile salmon. The complex habitat created by the interaction of sediment and large wood provides the safe habitat necessary during relentless coastal winter rains.

Large Wood

A critical component in creating good coho habitat — clean gravel, backwater pools, side channels, and off-channel alcoves — is the large conifer wood provided by forests that are older than 80 years. The importance of large wood for coastal streams can hardly be overstated. According to ***Upstream: Salmon and Society in the Pacific Northwest***, a 1996 report produced by the prestigious National Academy of Sciences, "*Perhaps no other structural component of the environment is as important to salmon habitat as is large woody debris, particularly in [Northwest] coastal watersheds…"* (Upstream, p. 194).

Large wood also controls the way sediment moves through the stream system. Large wood and coarse sediment, including rocks and small boulders, are the building materials of stream beds that enable a stream to connect with its flood plain, form side channels, and exchange nutrients with riparian vegetation and the flood plain water table. Beavers add to the complexity by creating pools within the low-gradient streams. The important point to remember is that the complex habitat created by large wood and sediment plays an important protective role during winter storms — storms that may prove fatal for salmon in today's simplified stream conditions.

Recruiting large wood to coastal streams requires forest land that contains large trees. The National Marine Fisheries Service suggests that at least 80 pieces of wood larger than 24" in diameter and 20 feet long, considered **key large wood**, should be present in each mile of stream. Poor habitat has fewer than 30 pieces of key large wood per mile, and sections with fewer than 15 such pieces per mile are considered nonfunctioning. Take a look at a coastal stream and see if 24" diameter or larger logs are present.

Locally, large wood enters coastal streams when trees die from disease, are knocked down by wind, come rushing down steep slopes in landslides or are released from steep upper streams in debris torrents. Not all large wood is the same. Very large pieces are particularly important and come from the big spruce, hemlocks and Douglas firs. Large wood enters streams primarily from within 300 feet (98 meters) of the water. But scientists note that unstable upper slopes and stream beds are also an important source of large wood (IMST, p. 23).

Our brief description of how forests provide for salmon habitat is well established in the technical literature and is familiar to many folks working in coastal watershed councils. The role of large wood in salmon habitat is well described in numerous scientific publications and the state's ***Oregon Watershed Assessment Manual*** (Watershed Professionals Network, 1999).

The Condition of Today's Coastal Forests

The regional shift from an abundant large forest to a small, timber-poor forest is clear throughout coastal watersheds. An analysis of forest vegetation conducted in 1995 by the Coastal Landscape Analysis and Modeling Study (CLAMS) project of the Forest Service's Pacific Northwest (PNW) research office in Corvallis offers a regional picture of coastal forest conditions.

Table 2 indicates that 3,168,691 forested acres lie within the fourteen major coastal basins we assessed for their **potential to recruit large wood** to streams. Of those acres, 55 percent are covered with trees less than 10" in diameter at breast height (DBH), or by non-conifer trees of all DBH sizes. We consider land covered with non-conifer or small conifer trees a **poor** source of large wood for streams. Another 18 percent of the coastal region is covered with conifers and mixed stands between 10" and 20" DBH, which we consider to have only a **moderate** potential to recruit large wood. Only 26 percent of the forest land in the study areas contains conifer or mixed stands over 20" DBH. We consider forests with trees 20" DBH or larger **good** land for recruiting large wood to streams.

The Reversal of Historic Coastal Forest Conditions

Forest Age

Historic Forest - 70 Percent of trees older than 80 years

Current Forest - 70 Percent of trees younger than 55 years

Forest Size

Historic Forest - 70 Percent of trees larger than 30" DBH

Current Forest - 55 Percent of trees smaller than 10" DBH

(DBH = Diameter at breast height)

It is worth noting that 55 percent of coastal basin forest is made up of non-conifer trees or conifer trees less than 10" DBH. This represents a **complete reversal of historic forest conditions** where, on average, 70 percent of the Coast Range was made up of trees likely larger than 30" DBH.

The basin with the **lowest potential** to recruit large wood is the Coastal Clatsop set of watersheds which includes the Necanicum, Ecola, Arch Cape streams. Only 24 percent of the Coastal Clatsop forest is moderate or good for large wood recruitment. The Coastal Clatsop area also happens to be the basin with the highest percentage of private industrial forest land – 93 percent (see Table 11).

The basin area with the **highest potential** is the Cummins/Mercer set of watersheds between the coastal towns of Yachats and Florence, where 62 percent of the area contains **moderate** or **good** forest land to recruit large wood to streams. The Cummins/Mercer area contains two small federal wilderness areas, has the highest overall federal ownership and the lowest private industrial ownership of all coastal basin areas – five percent.

Table 2. Coastal Watersheds Ranked for Stream Large Wood Recruitment Potential

Basin	Poor Acres	% Poor Acres	Moderate Acres	Good Acres
Coastal Clatsop	65,094	76%	13,379	6,793
Yaquina Basin	107,282	69%	15,785	33,367
Coos	260,989	67%	37,372	91,987
Siletz/Drift Basin	140,452	61%	44,400	46,546
Coquille	183,022	59%	39,099	87,319
Salmon River	26,004	55%	9,964	11,518
Tillamook Basin	188,475	54%	82,939	78,196
Nestucca River	109,179	54%	32,155	61,311
Nehalem Basin	286,626	53%	145,835	111,671
Alsea Basin	138,102	46%	54,418	106,665
Siuslaw Basin	223,648	45%	90,545	178,797
Yachats	12,457	45%	5,322	9,936
Cummins/Mercer	26,186	38%	14,721	27,135
Totals	1,767,516	55%	585,934	815,241
Percentages	55%		18%	27%

A Coast Range Association interpretation of the 1995 CLAMS vegetation layer for stream large wood recruitment

Coastal Stream Habitat

The Oregon Department of Fish and Wildlife (ODFW) has collected a huge amount of stream habitat data. Between 1990 and 2000, over 10,000 stream surveys were conducted in Oregon. In the coastal coho watersheds covered in this report (Necanicum to the Coquille), approximately 1,962 surveys were conducted. The ODFW stream survey data contains all habitat data collected on private, state and federal Bureau of Land Management (BLM) lands. A separate set of stream surveys has been done by the Siuslaw National Forest using a reporting method different from ODFW.

In both sets of surveys, the methods used are credible and the data gives an accurate picture of stream habitat conditions. One concern is that stream survey locations were not chosen randomly, and therefore might not reflect overall habitat conditions. However, a new randomly located set of stream surveys, begun in 1998, indicates that the non-random stream surveys are accurate representations of overall habitat conditions.

No report to our knowledge has presented regionwide survey results to the public. This report does. One reason for the lack of public exposure is that the ODFW stream surveys contain only numeric values for habitat conditions. The surveys themselves and the supporting documentation do not suggest how to interpret the mass of numbers. How can a lay person understand the numbers?

Interpreting Habitat Data -- The Use of Benchmarks

How many pieces of large wood should lie in a thousand feet of coastal stream? How many pools should exist in a stream for good salmon habitat? What percent of a stream's surface area should be pools? The answers to these and similiar questions will tell us if sufficient habitat for native salmon is present. To our knowledge, no scientific assessment of coastal Oregon stream habitat has established the historic range (HRV) of habitat conditions. Thus, restoration work by watershed councils proceeds without reliable goal posts (reference conditions) to work towards.

In place of a regional study to determine reference condition, ODFW has suggested a set of benchmark criteria for interpreting stream survey data. The benchmarks were published in the OWEB *Watershed Assessment Manual*. **Table 3** presents a small sample of stream survey values for large wood found in several Siletz streams. For example, in Rogers Creek, Reach 1, the survey crew counted 5.1 pieces of large wood. In Roots Creek, Reach 1, they counted 18.9 pieces of large wood. As mentioned earlier, ODFW stream surveys only contain number values like 5.1, 18.9, etc. for each habitat element. To the right of the habitat number we have listed the appropriate benchmark statement of **desirable** (good) or **undesirable** (bad).

Oddly, there is a range of data between desirable and undesirable which ODFW did not characterize by a benchmark. We therefore have used the federal convention of **at risk** for this data range. **Table 4** describes ODFW survey habitat elements and presents the element's common name, abbreviated name and a brief description.

Coastal Stream Habitat Condition

When stream survey data is interpreted using the benchmarks just described, stream habitat appears to be in severe trouble. Of the 1,445 ODFW Surveys measuring for *key large wood,* results show that only five percent contained **a desirable** level! Of the remaining surveys, 75 percent were **undesirable** and 20 percent were **at risk**. The same pattern held for *complex pools* — pools with a large wood component — where 95 percent were found to be either **undesirable** (87 percent) or **at risk** (8 percent). In the two remaining *large wood* habitat elements, 69 percent were **undesirable** or **at risk** in *large wood pieces* and 68 percent were **undesirable** or **at risk** in *large wood volume.* Such numbers lead to only one conclusion, coastal streams have a severe problem with adequate large wood.

Unfortunately, the problems with stream habitat aren't limited to large wood. In Table 6, of the seven habitat elements measured other than large wood, coastal streams ranked best in shade. The high marks for *shade,* however, appear to be a result of where ODFW chose to conduct their surveys. The coastal habitat element rated second best is *percent pools,* where 40 percent were found to be in **desirable** condition. In five other important habitat elements - *pool depth, pool ratio, stream bottom, width to depth ratio, and percent gravel* - coastal streams were deficient 67 percent to 78 percent of the time.

Table 3. Sample Habitat Numbers and Their Benchmark Values (Large Wood)

Sample Portion of ODFW Stream Survey				*Oregon Watershed Assessment Manual* Benchmark Value for the large wood count
Basin	Stream	Reach	Large Wood Count	
Siletz	Rogers Creek	1	5.1	Undesirable
Siletz	Roots Creek	1	18.9	At Risk
Siletz	Roots Creek	2	25.4	Desirable
Siletz	Roots Creek	3	50.1	Desirable
Siletz	Roy Creek	1	11.6	At Risk
Siletz	S. F. Buck Creek	1	13.5	At Risk
Siletz	Sam Creek	1	0	Undesirable
Siletz	Sam Creek	2	3.4	Undesirable
Siletz	Sam Creek	3	3.8	Undesirable
Siletz	Sand Creek	1	10.1	At Risk
Siletz	Sand Creek	2	20.9	Desirable

Siuslaw National Forest Surveys

Table 7's Siuslaw National Forest habitat data is not much more encouraging than the ODFW data. We employ the descriptive standards used by the Forest Service for characterizing habitat, that of **not properly functioning, at risk** and **functioning**. The habitat elements we report in Table 7 are only for those elements for which the agency provided quantitative values.

The 933 Siuslaw surveys mirror the poor habitat condition of the ODFW surveys. For example, *key large wood* was found to be **not properly functioning** or **at risk** in 94 percent of surveyed reaches. *Pool quality*, a measurement of pool depth, was deficient in 80 percent of the surveyed reaches. *Side channel habitat*, a habitat element not included in the ODFW form but particularly important as an indicator of good winter rearing habitat, was found **not properly functioning** or **at risk** in over 97 percent of the surveys.

Table 4. ODFW Benchmarked Habitat Elements

1. **Percent Pools** (PCTPOOL) The combined percentage (by area) of scoured and dammed pools.
2. **Pool Frequency** (CWPOOL) The frequency of pools found in a stream reach.
3. **Pool Depth** (RESIDPD) The depth of pools found in the stream.
4. **Width to Depth Ratio** (WDRATIO) The ratio of the stream's width to its depth.
5. **Percent Gravel** (PCTGRAVEL) The percent of gravel on the stream's bottom.
6. **Stream Bottom** (RIFSNDOR) The average percent of sand, silt, and organics (bad stuff) on the stream's bottom in those parts of the stream that are riffles.
7. **Shade** (SHADE) Amount of shade on the stream due to trees or mountains.
8. **Large Wood Pieces** (LWDPIECE1) Pieces of large wood (>15cm x 3m) per 100m of stream.
9. **Large Wood Volume** (LWDVOL1) Volume of large wood per 100m of stream length.
10. **Key Large Wood** (KEYLWD1) Pieces of large wood per 100m of stream length bigger than >60cm diameter & ≥10m long.
11. **Pools with Wood** (COMPOOL_KM) Number of pools with wood in them.
12. **Conifers > 20"** (CON_20PLUS) Number of conifer trees over 50cm dbh per 1000ft of stream.
13. **Conifers > 36"** (CON_36PLUS) Number of conifer trees over 90cm dbh per 1000ft of stream.

Table 5. ODFW Benchmark Values (Western Oregon)

	UNDESIRABLE	CRA AT RISK	DESIRABLE
1. Percent Pools (PCTPOOL)	<10	>10 & <35	>35
2. Pool Frequency (CWPOOL)	>20	>8 & <20	5-8
3. Pool Depth (RESSIDPD)			
Small Streams(<7m width)	<0.2	>0.2 & <0.5	>0.5
Medium Streams(≥ 7m and < 15m width)			
Low Gradient (slope <3%)	<0.3	>0.3 & <0.6	>0.6
High Gradient (slope >3%)	<0.5	>0.5 & <1.0	>1.0
Large Streams (≥15m width)	<0.8	>0.8 & <1.5	>1.5
4. Width to Depth Ratio (WDRATIO)	>30	>15 & <30	<15
5. Percent Gravel (PCTGRAVEL)	<15	>15 & <35	≥35
6. Stream Bottom (RIFSNDOR)			
Volcanic Parent Material	>15	>8 & <15	<8
Sedimentary Parent Material	>20	>10 & <20	<10
Channel Gradient <1.5%	>25	>12 & <25	<12
7. Shade (Average % Of Reach)			
Stream Width <12 meters	<60	>60 & <70	>70
Stream Width >12 meters	<50	>50 & <60	>60
8. Large Wood Pieces (LWDPIECE1)	<10	>10 & <20	>20
9. Large Wood Volume (LWDVOL1)	<20	>20 & <30	>30
10. Key Large Wood Pieces (KEYLWD1)	<1	>1 & <3	>3
11. Pools with wood (COMPOOL_KM)	<1.0	>1.0 & <2.5	>2.5
12. Stream Conifers >20" (CON_20)	<150	>150 & <300	>300
13. Stream Conifers >32" CON_32)	<75	>75 & <200	>200

* Values for Streams in Forested Basins

What Does It All Mean?

It is important to stop for a moment and review what the ODFW and Siuslaw habitat numbers mean. When 80 and 90 percent of key habitat elements are failing, it isn't the time to scratch one's head and say "gee, I don't know." These are powerful numbers that shout for forest practices reform -- particularly reform that restores large wood to streams. We suggest that the reader look carefully at tables 6 and 7. It is amazing how well-documented the loss of habitat is.

The use of benchmarks for intrepreting data, i.e. **desirable, properly functioning**, etc., is potentially misleading. We know that Coast Range streams once had abundant habitat. No one knows exactly how the reduction in habitat affects salmon abundance. We do know that as available habitat declines fish populations decline. We believe, the whole benchmark system needs to be approached very cautiously. For example, we all live in houses or apartments. Imagine if 25percent of the roof of your house were removed. Then 10 percent of the outer walls were removed. You would quickly see the **integrity** of the house undermined, and its suitability as long-term living habitat compromised.

A more appropriate assessment of a stream's salmon habitat would evaluate overall habitat integrity. Whole streams would then be characterized as **functioning**, **at risk** or **not properly functioning**. We believe habitat integrity is the real issue for Coast Range streams and the lack of overall habitat integrity explains much of the decline in coastal salmon populations.

Key Findings of this Report

- A shift from an abundant large timber forest to a small, timber poor forest set the stage and caused much of the salmon crisis.
- Coastal stream habitat data indicates a severe crisis in stream large wood. Unfortunately, in five other important habitat elements – pool depth, pool ratio, stream bottom, width to depth ratio, and percent gravel - coastal streams were deficient 67 percent to 78 percent of the time.
- The state of native coho salmon populations show the predictable effect of extreme habitat loss. Current coho abundance is in the range of 1 percent to 4 percent of historic abundance.
- 55 percent of all coastal watershed area is made up of forest that is a poor source of habitat building stream large wood. Not surprizingly, the five basins with the forest condition least able to provide for stream large wood, are also the five basins with the highest percentage of private land ownership.
- We conclude that to recover coastal coho and other salmon a big change in private and state forest practices is required. Forest practices reform that moves the condition of the forest closer to its historic condition is necessary to recover coastal salmon.

Table 6. Overall Stream Habitat Condition
Private, State and BLM Lands
Coastal Watersheds

HABITAT ELEMENT	NO. Of SURVEYS	UND	%	AT RISK	%	DES	%
Trees Along The Stream							
Over 21" Diameter	1,445	1,376	95%	61	4%	7	<1%
Habitat Building Wood in the Stream							
Complex Pools/wood	1,080	938	87%	85	8%	56	5%
Key Large Wood	1,445	1,088	75%	280	19%	76	5%
Large Wood Volume	1,620	870	54%	220	14%	529	33%
Large Wood Pieces	1,620	633	39%	482	30%	504	31%
Pool Conditions							
Percent Pools	1,685	378	22%	638	38%	668	40%
Residual Pools	1,691	262	15%	1,060	63%	369	22%
Other Stream Conditions							
W-D_Ratio	1,666	406	24%	782	47%	477	29%
Percent Gravel	1,677	222	13%	920	55%	535	32%
Silt/Sand/Organics	1,538	609	40%	449	29%	479	31%
Shade Condition	1,692	0		8	<1%	1,683	>99%

UND = Undesirable, **DES** = Desirable

Habitat surveys from 1991 to 1998.
Survey numbers vary because some surveys did not measure all elements.

Table 7. Overall Stream Habitat Condition
Siuslaw National Forest Coastal Lands

HABITAT ELEMENT	**NO. Of SURVEYS**	**N.P.F.**	%	**AT RISK**	%	**P.F.**	%
Habitat Building Wood in the Stream							
Key Large Wood	933	650	**70%**	226	**24%**	57	**6%**
Pool Conditions							
Deep Pools (>3’)	933	663	**71%**	79	**8%**	191	**20%**
Percent Pools	933	427	**46%**	218	**23%**	288	**31%**
Pool Frequency	928	65	**7%**	249	**27%**	614	**66%**
Other Stream Conditions							
W-D_Ratio	847	475	**56%**	127	**15%**	245	**29%**
Side Channels	933	868	**93%**	41	**4%**	24	**3%**
Percent Gravel	911	320	**35%**	296	**32%**	295	**32%**

N.P.F. = Not Properly Functioning, **P.F.** = Properly Functioning

Coastal Native Coho Populations

The state of native fish abundance for coastal basins shows the predictable effect of extreme habitat loss. Scientists can't be certain exactly how many fish returned to coastal basins a century or more ago, but canning records offer us a hint. In 1981, the Oregon Department of Fish & Wildlife published a report on the historic cannery catch for coastal Oregon and the lower Columbia (Mullen, 1981). Cannery records give an indication of the number of salmon returning to the local watersheds. Recently, the journal, ***Fisheries,*** published an article on historic and current salmon abundance for the Northwest and British Columbia (Gresh, 2000). In that report the authors indicate that the coastal Oregon commercial catch rate was approximately 40 percent of total salmon abundance.

We then looked at cannery records from 1923 to 1940 and calculated the yearly catch average for seven coastal basins. The average catch number was then assumed to be 40 percent of total abundance. Dividing the acres in the local basin by the coho abundance number determines each basin’s ratio of acres per coho. Table 8 presents our figures.

Table 8. Historic Coho Abundance & Basin Area

Basin	**Actual Average Cannery Count***	**Abundance** Cannery = .40	Basin Area	Coho/Acre
Nehalem	53,000	132,500	544,922	4.1
Tillamook	43,600	109,000	350,885	3.2
Siletz	17,100	42,275	231,624	5.5
Yaquina	18,700	46,500	157,105	3.4
Alsea	23,700	59,250	370,610	6.3
Siuslaw River	24,200	60,500	494,673	8.2
Coos River	33,900	84,475	256,701	3
Totals	214,200	534,500	2,406,520	4.5

*For the years 1921 to 1940

Table 8 indicates that approximately 4.5 acres of coastal watershed land area provided for one returning coho salmon. We must note, however, that the underlying geology of a watershed will make watershed areas more habitable for different kinds of fish. For example, coho generally are found in areas with a sedimentary geology, while steelhead prefer a volcanic geology. Also, our use of cannery records for the years 1921 to 1940 may underestimate local historic coho abundance. For example, the recently completed draft, *Siuslaw Watershed Assessment,* estimates maximum Siuslaw coho abundance at over 300,000 fish. The Siuslaw Watershed Assessment used cannery records from an earlier period than our analysis. Using the CRA 4.5 basin acres per coho ratio suggests that the Siuslaw had an estimated historic abundance of approximately 110,000 coho spawners. Due to the Siuslaw's sedimentary (Tyee Sandstone) geology, the basin may very well have had coho numbers far in excess of our 4.5 acres per coho ratio.

How many coho salmon are left?

Starting in 1990, the ODFW conducted random surveys of coastal streams to determine wild coho spawner abundance. Over the decade of the 1990s, ODFW increased the number of survey points for many watersheds, thereby increasing the survey's reliability. For any one year, the numbers may not provide a reliable picture of coho abundance. But the increase in random survey data collection over the decade of the 1990s strengthens the reliability of each basin's population estimates. We believe the yearly averages presented in Table 9 are a fairly accurate representations of the actual coho abundance.

Low population numbers and concentration in a small portions of the stream system expose the population to catastrophic loss from a singular event such as a landslide or debris torrent.

Table 9. Coastal Wild Coho Spawner Abundance 1990 - 2000

Basin	Low Count Number & Year	High Count Number & Year	Total Coho Spawners 1990-2000	Yearly Average
North Coast Gene Group				
Necanicum & Elk Creek	191 (1990)	1,135 (1991)	6,234	567
Nehalem	1,057 (1996)	14,518 (2000)	34,181	3,107
Tillamook Basin	261 (1992)	3,000 (1991)	10,778	980
Nestucca	169 (1998)	2,201 (1999)	8,441	767
Mid Coast Gene Group				
Salmon River	8 (1998)	385 (1990)	2,062	187
Siletz River	336 (1997)	2,800 (2000)	11,078	1,007
Yaquina River	380 (1991)	5,668 (1995)	19,151	1,741
Devils Lake	0 (1991&'94)	3,366 (1999)	9,426	857
Alsea River	213 (1998)	7,029 (1992)	19,804	1,800
Yachats River	28 (1991)	337 (1992)	1,719	156
Siuslaw River	668 (1997)	7,625 (1996)	42,264	3,842
Mid-South Coast Gene Group				
Coos Basin	1,127 (1997)	16,545 (1992)	89,644	8,149
Coquille River	2,115 (1992)	16,169 (1996)	58,432	5,312
Totals	6,573	80,778	313,214	28,472

Salmon Distribution

The remaining native coastal coho are not evenly present among basins and within basins. This is borne out by snorkel surveys of fish presence conducted in midcoast basins by the Midcoast Watershed Council and north coast basins by several environmental groups. According to the snorkel assessments, coho and other native salmon appear to be concentrated in limited stream areas. Most likely, fry and juvenile coho are congregating in the few best habitat areas for summer conditions. Low population numbers and concentration in a small portions of the stream system expose the population to catastrophic loss from a singular event such as a landslide or debris torrent. That's why the scientists emphasize the importance of identifying the best remaining places, known as **refugia**, and protecting the landscape from any further destabilizing activity that may threaten the fish.

Table 10. Historic Coho Abundance Compared to Current Populations

Watershed	Cannery Estimated Historic Abundance*	CRA Historic Abundance Estimate (4.5/acre)	1990 to 2000 Average Annual Coho Return
Nehalem	132,500	121,093	3,107
Tillamook Bay	109,000	77,891	980
Siletz	42,275	43,055	1,007
Yaquina	46,500	35,264	1,741
Alsea	59,250	66,600	1,800
Siuslaw	60,500	110,197	3,842
Coos	84,475	88,795	8,149
Totals	**534,500**	**542,895**	**20,626**

The above numbers reflect a loss of native coho to less than four percent of historic abundance.
*For the years 1921 to 1940.

Who Owns the Coastal Forests?

It's no surprise that salmon habitat and coho numbers are so poor in coastal watersheds: past public and private forestry has radically transformed the landscape, upsetting natural patterns that are key to coho survival. According to Oregon Department of Forestry (ODF) records, ownership percentages vary between coastal basins. Table 11 gives the ownership breakdown for the major coastal basins.

It is worth noting that habitat numbers for large wood presence (Tables 6 & 7) and forest potential to recruit large wood (Table 2) are closely related to the kind of land ownership that dominates the basin. The five basins with the highest percentage of private land ownership are also the same five watersheds with the highest percentage of poor forest (based on tree size) to recruit large wood into streams.

It's no surprise that salmon habitat and coho numbers are so poor in coastal watersheds: past public and private forestry has radically transformed the landscape, upsetting natural patterns that are key to coho survival.

Table 11. Forest Ownership & Forest Size

Rank	Basin	Percentage Privately Owned	Moderate or Good Forest	Poor Large Wood Ranking
1.	Coastal Clatsop	93%	24%	# 1
2.	Siletz/Drift	80%	39%	# 4
3.	Coos	78%	33%	# 2
4.	Yaquina	73%	39%	# 3
5.	Coquille	72%	41%	# 5

Table 11 clearly shows the connection of private land to the problem of stream large wood presence. Compare these watershed numbers to those for the Cummins/Mercer area, the best coastal basin for a large wood recruitment. In that region, only 19% of the forest is privately owned, and 81 percent of the forest is rated as moderate or good for large wood recruitment.

Because the overwhelming percentage of private forest land is dedicated to a forestry driven by economic and commercial considerations it is worth taking a closer look at the issue of industrial forestry.

Industrial Forest Management

Because the coastal region has such fertile timberlands, private timber owners can grow a marketable log in a very short time. Therefore, industrial owners generally cut their forests on very short rotations of 30 to 60 years. Assuming a large industrial owner practices an even annual cut volume and a rotation of forty-five years, the owner's **average tree age** is twenty-two and half years. This practice radically changes the age and size of the forest from past reference conditions — one that averaged hundreds of years of age, to a forest one-tenth as old. To understand more about the economic drivers of industrial forest management we recommend the reader visit the Coast Range Association web site and see the *Forests That Work* document (http://coastrange.org/forestry/).

Watershed Disturbance

Past years of over-cutting of federal forests combined with the current short rotations on private lands have produced a forest of small trees and a history of land **disturbance** far outside of the historic natural range. In the past, watershed disturbance was driven by large, infrequent replacements of stands by fires and periodic, intense storms. In either case — storm or fire — the huge wood volume of large trees remained. Today, clearcutting leaves the land barren of large wood and exposes the freshly cut land to the impact of intense storms.

Large Wood Recruitment: The Problem in Coastal Basins

Through the cumulative effect of decades of clearcutting, the source of large wood for most coastal streams is depleted. The IMST concluded that "*Oregon streams and adjacent forests currently contain much lower levels of larger wood than they did historically, and under current management practices, the potential for recruitment will not result in its replacement*" (IMST, p. 22). Habitat so radically different from historic conditions, the team continued, "*is seriously hindering the recovery of wild salmonids*" (IMST p. 23). Logging practices in coastal watersheds are directly responsible for reducing the size of wood in streams; and the size of wood in streams is directly related to how much habitat is available for salmon. Studies have found that juvenile coho are more abundant in areas where large pools are abundant. But as logging increases sediments and reduces large wood in streams, the large pools are disappearing. One study on federal lands found a 60 percent reduction in large pools in western Oregon and Washington. In Oregon, those losses approached 80 percent (Upstream, p. 181). Another study found that the size of wood moving into streams decreased as logging increased. According to the IMST, "*Since the size of wood in the channel is directly related to pool size, this represented a direct loss of critical salmon habitat*" (IMST, p. 72).

Table 12. Coastal Forest Ownership

Basin	**Private Indust. Forest**	%	**Other Private Forest***	%	Federal Forest	%	State Forest	%
Coastal Clatsop	60,177	72%	17,350	21%		0%	6,300	8%
Nehalem	260,417	48%	70,062	13%	3,904	1%	209,627	39%
Tillamook	72,135	21%	45,421	13%	16,716	5%	214,662	62%
Nestucca	36,803	13%	31,645	11%	123,997	43%	97,376	34%
Salmon	25,162	53%	8,610	18%	12,827	27%	929	2%
Devils Lake	2,459	23%	6,102	57%	2,047	19%	107	1%
Siletz/Drift	159,493	69%	24,890	11%	38,854	17%	8,045	3%
Yaquina	67,839	43%	46,732	30%	23,138	15%	18,375	12%
Alsea	68,948	23%	39,184	13%	189,994	64%	616	
Yachats	4,713	17%	2,830	10%	20,138	73%	51	
Cummins/ Mercer	3,524	5%	9,751	14%	53,410	78%	2,195	3%
Siuslaw	154,739	31%	64,318	13%	255,274	52%	19,469	4%
Coos	210,141	54%	92,207	24%	42,551	11%	45,190	12%
Coquille	107,041	35%	115,649	37%	85,948	28%	1,279	19%
Totals	**1,233,591**	**37%**	**574,751***	**17%**	**868,798**	**26%**	**624,221**	**19%**

*Includes 35,179 acres of miscellaneous forest. Percentages do not add up to 100 due to rounding.

All Coastal Watersheds Are Important

Some people believe it isn't worth the effort to recover salmon in the most damaged coastal watersheds. They argue that the cost to private land owners of riparian buffers, longer rotations and protection for unstable soils is too great to save the remaining native coho. At the same time, many scientists urge the government to protect the best remaining habitat through the immediate and strict protection of select watersheds. Special watersheds that are rich in habitat and highly protected are referred to as **refugia** areas. Between the attention given to refugia protection and legitimate economic concerns of small woodlot owners, **someone unfamiliar with the overall science** might think the most troubled watersheds do not merit restoration. This isn't the case at all.

According to the National Research Council's *Upstream* report, if the salmon runs on individual rivers are lost, so too will be the larger population of salmon along the Oregon Coast: "*An adequate number of returning adults for every local breeding population is needed to ensure persistence of all the reproductive units… The result of regulating fishing on a metapopulation basis [i.e.., all coho along the Oregon Coast] and ignoring the reproductive units that make up a metapopulation [i.e., Siletz River coho] is the disappearance or extirpation of some of the local breeding populations and the eventual collapse of the metapopulation's production*" (Upstream, p. 363).

While the above *Upstream* quote is addressing fishery management, the message is clear -- long term salmon population viability needs not only a minimal level of abundance, it also needs to be well distributed between watersheds and within watersheds.

A Need to Move Toward More Natural Forest Condition

Returning the forests to more natural conditions so that salmon populations can thrive requires fundamental change to coastal forestry—**industrial and non-industrial**. Although big change is required in forest management, no one is talking about going back to an old growth forest. A private working forest that is sufficient to contribute its share to native salmon recovery will be a far cry from natural conditions. However, we must move very quickly from the current model of forestry.

Getting Perspective -- The Forestry Reform Picture:

Recommendations for changing forestry to protect and recover coastal coho fall into two main catagories:

1. Immediate measures that protect remaining coho and bring Oregon into compliance with the Endangered Species Act; and,
2. Long term measures to reform forestry in order to recover abundant coastal salmon stocks and insure their long term survival.

Our lists are based on the main recommendations of the IMST Forestry Report and our legal understanding of the requirements of the Endangered Species Act (ESA). We should note that in some coastal basins many of these recommendations will involve the inclusion of federal lands. Federal land management, however, under the Northwest Forest Plan allows for many of the proposed reforms. The main issue today lies in state and private forest management.

Immediate Measures to Protect Coastal Coho

1. *Manage forest practices for both upslope and riparian areas*

In coastal watersheds, it is necessary to eliminate the sharp distinction between riparian area and the upslope lands that feed streams. We need to move past reliance solely on large stream riparian areas (comprising a small percent of the landscape) to substitute for the actual landscape conditions under which salmon thrived. Integrating the upper slopes and the small stream network into a salmon protection strategy shifts timber management from the needs of industry to one defined by the needs of riparian biological and physical functions (IMST, pp. 19-20). "*Analysis and adjustment in management practices must occur in upslope forests throughout the watershed*" (IMST, p. 13).

2. *Protect small, high gradient streams, with or without fish*

All streams make important contributions to fish habitat — large wood, sediment, and gravel — even if they don't run throughout the year and even if they don't contain fish themselves. The IMST stresses that non-fish-bearing streams make important contributions to downstream processes (IMST, p. 31). A stream that shows no fish during modern surveys may have contained them before forestry changed the land. Protecting small intermittent streams is necessary in order to restore watershed processes (i.e. large wood recruitment, water quality, sediment, etc.) to their historic range.

3. *Protect all existing core habitats while the above changes are put in place*

Immediate protection for the most important functioning or potential habitat (refugia watersheds) is critical to prevent continued losses of salmonid genetic diversity. There is no substitute for immediate protection as a hedge against the impacts of current and future practices. This includes specific protected areas in all coastal basins.

5. *Implement a scientifically valid monitoring program*

As Jack Ward Thomas, the former head of the U.S. Forest Service once said, "*Ecosystems are not only more complex than we know, they are more complex than we can know*." The science of salmon and their ecosystems is evolving. As we reform forestry, it is extremely important to monitor the effectiveness of changes to forest practices and land management. The wise integration of scientific information with land management practices requires consistent, and scientifically sound monitoring.

6. *Require all landowners in all basins to restore fish habitat*

The cumulative effects of logging have been a major factor in the salmon's demise. Restoring each basin's Reference Condition — and each basin's salmon population — will be critical to the species' recovery. The largest private owners in most coastal basins are industrial timber companies, but all owners in all watersheds must make their fair contribution toward restoring the landscape.

Long Term Protection Measures

1. *Manage forestry at a whole basin scale and not at the scale of one activity*

Forest harvest must be planned at the basin scale through local planning, either through voluntary effort or regulatory mandate. Coordinated timber harvest accounting for cumulative effects must begin. A landscape perspective is critical for determining where and how much disturbance (i.e., clearcutting) may occur at the subwatershed and whole basin scale.

2. *Include the recovery goals of the Oregon Plan for landscape level forest management in the Oregon Forest Practices Act*

The state's rules governing forestry are primarily intended to ensure sustainable timber harvest. Oregon's forests and native salmon are so closely linked that the practice of forestry must sustain native salmon and their habitat. The needs of forestry and forest owning commercial interests must be harmonized with the needs of society for watershed values and ecosystem services.

3. *Approximate the size and pattern of natural disturbance regimes in logging areas*
For management to emulate natural landscape patterns, logging must shift to more closely resemble the size and **frequency** of local natural disturbance. In coastal basins, fire disturbance occurred infrequently, but often affected a large swath of land. Forestry will more closely emulate natural disturbance if timber harvest occurs less frequently and less intensively, but perhaps at larger scales.

A Win Win Solution -- Increasing Forest Harvest Rotation Time

There exists a huge opportunity to improve forest conditions supporting salmon recovery while at the same time provide for high timber output. In coastal watersheds, private rotation times are occurring long before trees reach the size that maximizes log production. Increasing rotation times is a win-win strategy that helps communities and salmon. Increasing rotation lengths moves forest management closer to natural reference conditions and helps reduce — but not eliminate — many impacts to salmon habitat associated with commercial logging. Long rotations mean fewer acres are logged each year, reducing other cumulative impacts while helping to keep habitat connected across the landscape.

A Coast Range Association report — ***Forests That Work*** — indicates that moving to 140-year rotations from 45-year rotations may increase timber inventories by more than 500 percent, reduce acres clearcut annually by 68 percent, increase the volume of timber harvested by 40 percent, and increase positive cash-flow for owners by as much as 100 percent. (See the web site www.coastrange.org/forestry/). Private timber owners will harvest more sellable logs and more valuable logs by cutting less.

Conclusion

We hope this report is read and circulated widely within coastal communities and watershed councils. Through data and the illustration of key concepts, we have argued in support of the recommendations made by Oregon's Independent Multidiciplinary Science Team (IMST). Like the IMST, our approach has focused on the **overall condition of the land** and the need for a well distributed recovery of the coastal coho population. The shift to a landscape restoration approach for salmon recovery is an acknowledgement of the complexity and uncertainty about what actually will work to recover salmon.

An important concept we touched upon is the notion of an historic range of variability (HRV) applied to the landscape condition. We cited research by Wimberly and others which demonstrates that coastal watershed forest conditions are far outside their historic range. The reform of forest practices ought to emphasize the need to shift landscape condition back toward its historic range as well as focus on specific problematic parts of the landscape (i.e. steeplands).

A main value in the report is our interpretation of large, well known data sets (forest and habitat condition, salmon population, and land ownership) so that they are more accesssible to the reader. We believe that conservation advocates and watershed council participants should have a working familiarity with their basin's key facts and data. While we in no way wish to minimize the contribution of stock mis-management and ocean conditions to the decline of coastal salmon, we believe freshwater habitat conditions are the dominant driver behind coastal salmon decline. Thus, for coastal basins, forestry reform is the most pressing issue.

Literature Cited

1. Independent Multidisciplinary Science Team. 1999. Recovery of Wild Salmonids in Western Oregon Forests: Oregon Forest Practices Act Rules and the Measures in the Oregon Plan for Salmon and Watersheds. Technical Report 1999-1 to the Oregon Plan for Salmon and Watersheds, Governor's Natural Resources Office, Salem, Oregon.
2. Micheal Wimberly, Thomas Spies, Colin Long and Cathy Whitlock. Simulating Variability in the Amount of Old Forests in the Oregon Coast Range. Conservation Biology, Pages 167 – 180, Volume 14, No. 1, February 2000.
3. Dave Egan and Evelyn Howell. The Historical Ecology Handbook, A Restorationist's Guide to Reference Ecosystems. Covalo, CA: Island Press. 2001
4. Upstream, Salmon and Society in the Pacific Northwest. Committee On Protection and Management of Pacific Northwest Andromous Salmonids. Board on Environmental Studies and Toxicology. Commission on Life Sciences. National Academy of Science. Washington, D.C.: National Academy Press. 1996.
5. Watershed Professionals Network. Oregon Watershed Assessment Manual. Salem, OR: Oregon Watershed Enhancement Board. 1998. Benchmarks are in Appendix IX-A
6. Brian Spence, Gregg Lomnicky, Robert Hughes, Richard Novitski. An Ecosystem Approach to Salmonid Conservation.. Technical Report TR-4501-96-6057. Corvallis, OR: Management Technology. 1996.
7. Coastal Landscape Analysis and Modeling Study (CLAMS) data <http://www.fsl.orst.edu/clams/>
   a. **Vegetation** -- layer developed by Janet Ohmann (USFS) for use in initializing vegetation conditions in the Coastal Landscape Analysis and Modeling Study (CLAMS).
   b. **Ownership** -- coverage is a compilation of ownership information from a number of different sources of a variety of scales and dates. Private ownership information, taken from the ACI database, represents 1990-91 ownership.
   c. **Subwatersheds** -- Nested 6th and 7th code Hydrologic Units (HU) were produced for the Coastal Landscape Analysis and Modeling Study (CLAMS). Preliminary 6th code HU were produced using the USGS GIS Weasel program with 10m Drainage Enforced-Digital Elevation Models (DE-DEM).
8. Robert Mullen. Oregon's Commercial Harvest of Coho Salmon, Oncorhynchus kisutch (Walbaum), 1892-1960. Corvallis, OR: Oregon Department of Fish and Wildlife. 1981.
9. Current Coho Population data. Oregon Department of Fish and Wildlife Research. Corvallis, OR. <http://osu.orst.edu/Dept/ODFW/spawn/coho.htm>.
10. Forests That Work, A Proposal for a New Forestry. Corvallis, OR: Coast Range Association, 1999. <http://www.coastrange.org/forestry.htm>.
11. ODFW Stream Survey Data available at: <osu.orst.edu/Dept/ODFW/freshwater/inventory/invent.html>.