

Tillamook Bay Basin National Estuary

GIS Spatial Analysis to aid Salmon Restoration Programs in the

Tillamook Bay Basin

1. Introduction:

This document is a final report of Salmon Restoration Programs in parts of the Tillamook Bay Basin in Oregon State. It consists of 14 sections describing the project's purpose, objective, background, data sets, methods, results and discussion. GIS capabilities are investigated, experimented and tested by exploring its various functions and are applied therefore, in spatial analysis such as buffering, clipping analysis, symbology creation, geodatabase creation, statistical calculation, table, graph, and map making.

The coastal temperate rain forest of North America epitomizes the concept ecologists known as terrestrial/marine ecotone, a zone that possesses "a set of characteristics uniquely defined ... by the strength of the interactions between the adjacent ecological systems" (Simenstad, 1997).

This project uses spatial analysis to identify areas within selected Tillamook watershed that would be suitable for designation as salmon anchor habitats. The primary benefits of anchor habitats are the increased protection of riparian areas as well as steep slopes.

2. Objective:

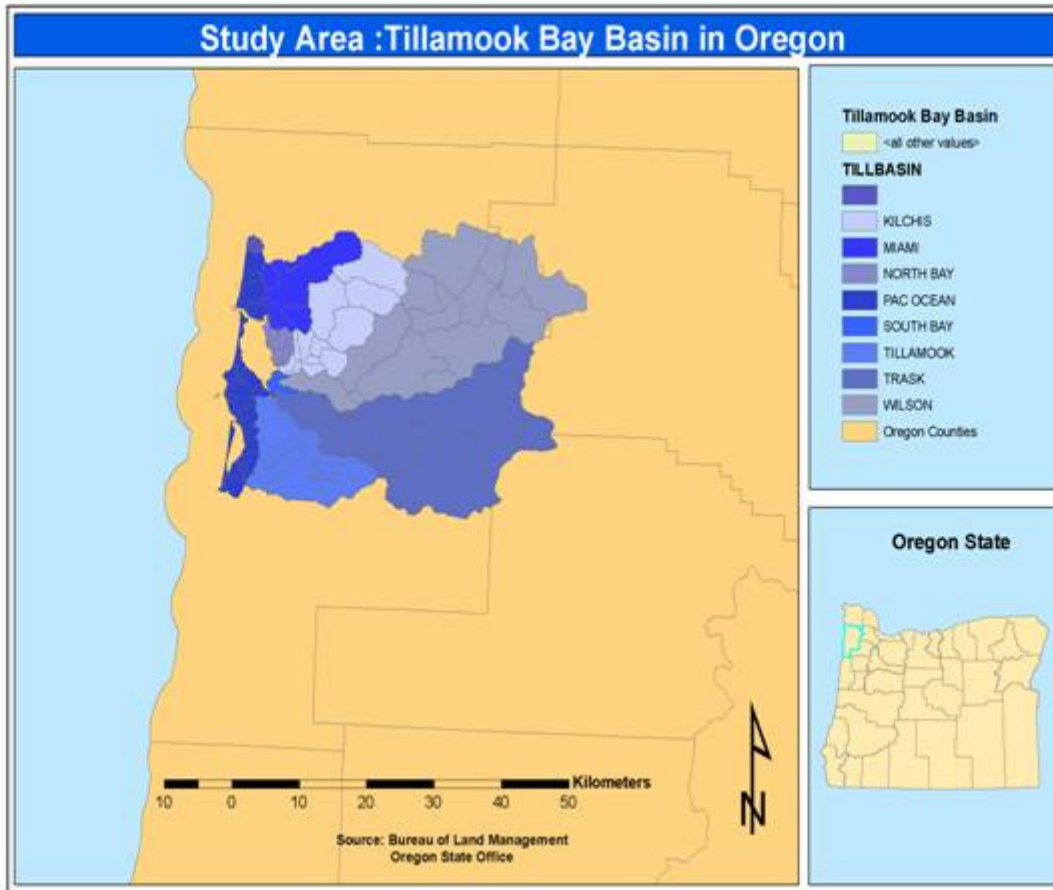
Objectives of this project are two fold:

- I. To answer the questions asked by resource managers, fishermen, farmers, and people living throughout Northwest through several types of simple spatial analyses.
- II. To focus on analysis on the identification of areas within watersheds that would be suitable for designation as salmon anchor habitats.

3. Study area:

Wilson Basin within Tillamook Bay:

Tillamook Bay, our study area is a large, shallow estuary along the north coast of Oregon State (Figure1). The watershed draining into the bay is over 629 square miles in size. Land use is dominated by forestry covering 89 percent in the upper watersheds and agriculture mainly major dairy industry occupying in the low lands. The Bay itself is home to extensive shellfish beds, making the area the most productive commercial and recreational shellfish area in the state.



Tillamook Basin

Source: Oregon Geospatial Data Clearinghouse
Tillamook County GIS Website

4. Background:

Salmon, a powerful image of the Pacific Northwest are considered as either threatened or endangered under the federal Endangered Species Act (Figure 3). Salmon habitat is influenced by landscape processes governing the supply and movement of water, sediment, and wood to and through their rivers and streams (Montgomery, 2004). Salmon

runs rely on rivers to provide particular kinds of habitat suitable for spawning, to promote the development of their eggs while buried in streambed gravel, and to shelter their young while they grow up, forage, and hide from predators as they run down to the sea (Bjornn and Reiser, 1991; Montgomery, 2004). On their way back upriver, returning adults also need deep, sheltered pools in which to rest and clean gravel in which to spawn. A general understanding of salmon ecology therefore rests on understanding the watershed and fluvial processes that create, sustain, and destroy salmon habitat (Swanston, 1991).

Tillamook Bay and its watershed have encountered habitat loss, degradation, and simplification threatening anadromous salmonid populations. In past times, Tillamook Bay and the five rivers of its watershed supported large runs of salmon and steelhead trout. Anadromous salmonids are fish, typically born in freshwater streams, mature in the sea, and return to streams to spawn. Out of the five species of anadromous fish in the Tillamook watershed: coho, chinook, and chum salmon; and steelhead and sea-run cutthroat trout only fall chinook salmon populations are considered to be healthy and steady today (TBNEP 1998). Steelhead trout, sea-run cutthroat trout, coho salmon, and chum salmon have decreased dramatically since the turn of the century (TBNEP 2000).



Plate 1. Salmon: A Powerful Image of the Pacific Northwest

Source: <http://www.wildsalmoncenter.org/anchor-habitat.php>

Healthy freshwater habitats for salmon are characterized by cool, clean well-oxygenated water; unobstructed access to spawning grounds; clean, stable spawning gravel; complex stream channels with riffles, glides, and deep pools; adequate large woody debris; abundant food supply; and diverse well-established riparian communities. Riparian trees provide large woody debris in order to improve stream complexity as well as moderate water temperatures.

4.1. Factors responsible for Tillamook's degraded salmonid habitats:

Human intervention with natural system in the bay and watershed over period have altered, degraded, or converted the riparian, instream, wetland, estuary, and tidal habitats that are ideal for salmonid species.



Plate 2. These watersheds will be managed in accordance with a strategy that prioritizes salmonid recovery while balancing multiple purposes of state forests

Source: <http://www.ortrout.org/8success/tillamook.html>

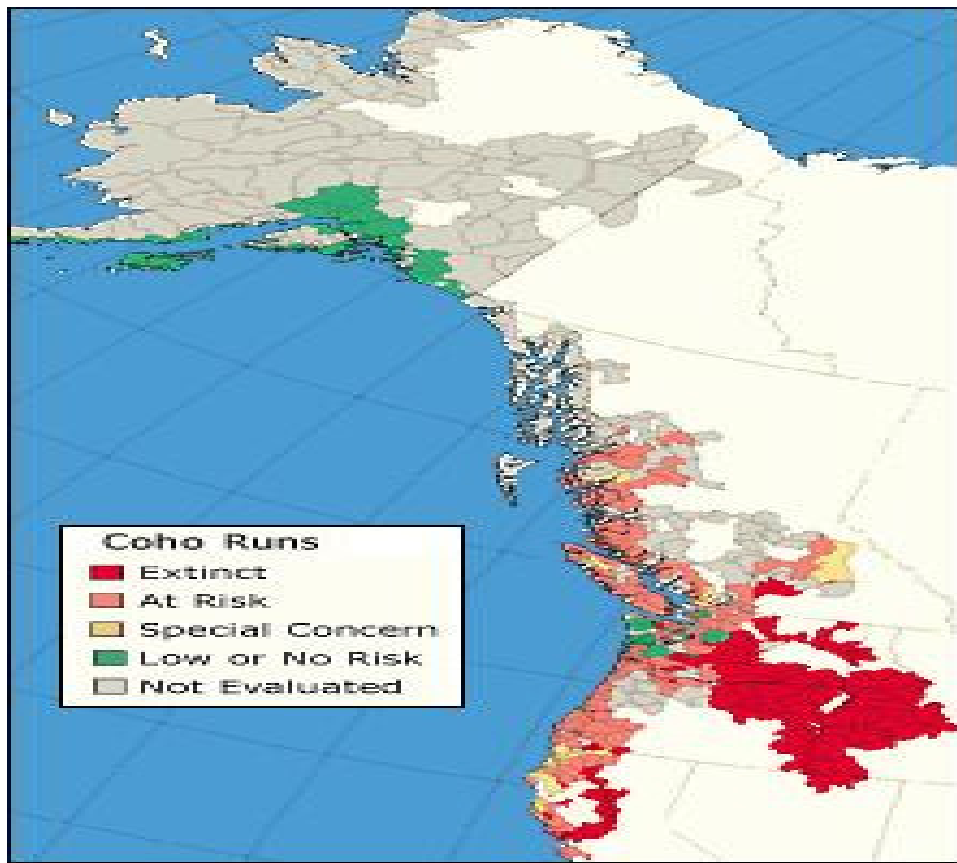
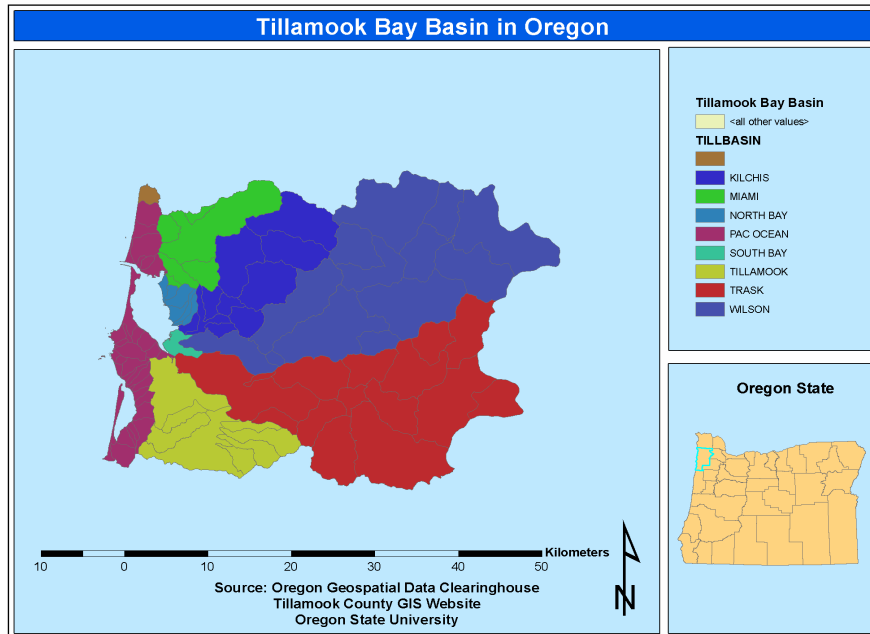


Figure 3. Salmon Stock Status Mapping (Source: <http://www.inforain.org/salmonstrategy/stockstatus.htm>)

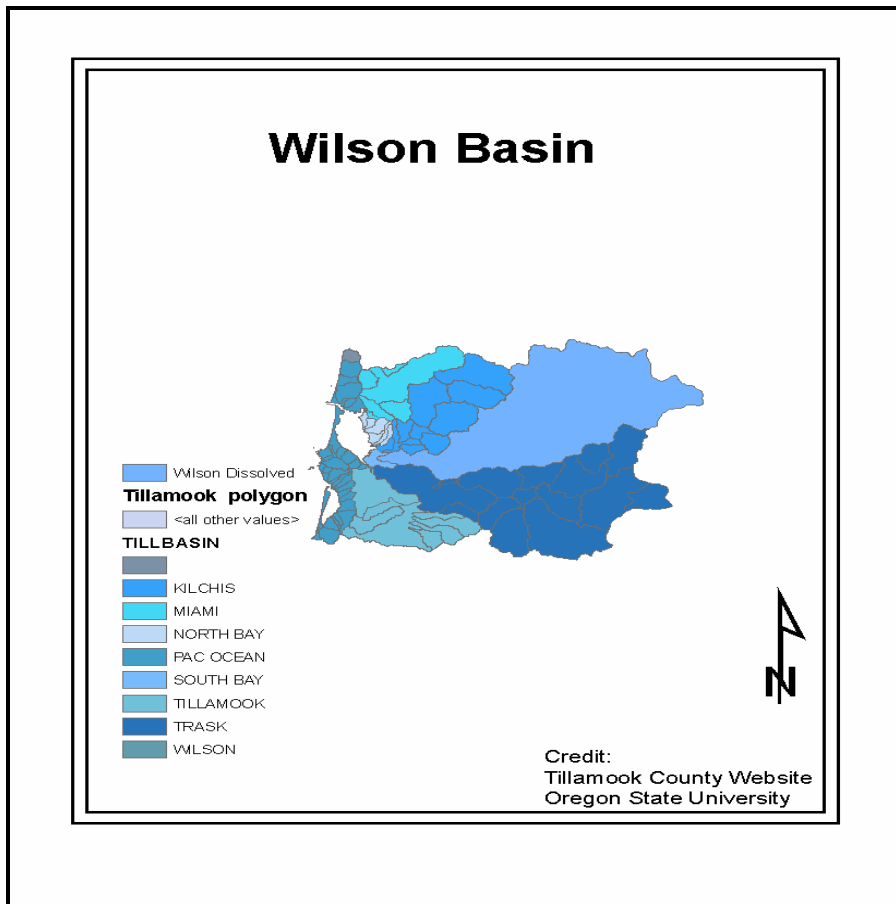
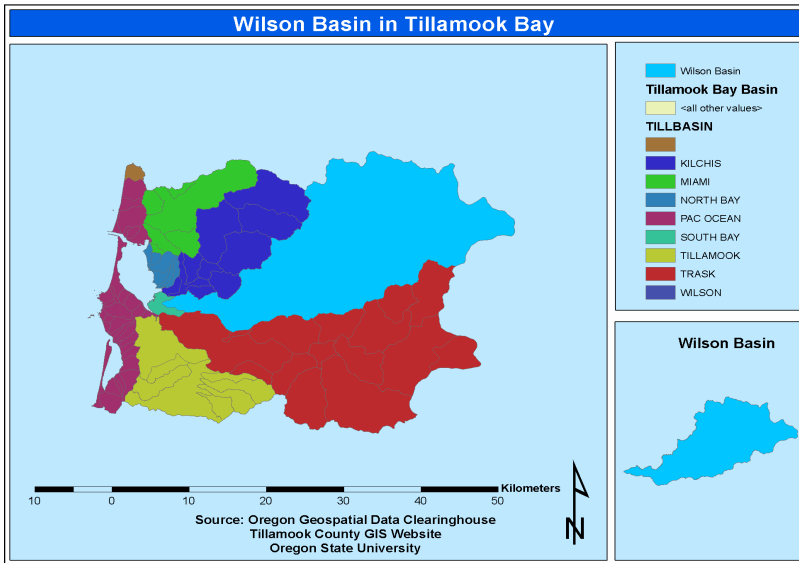
Riparian vegetation acts as a natural buffer that holds sediments in place and filters pollutants before entering stream. Loss of vegetation along the stream banks affects the water quality with increasing sediment and pollutants input as well as increasing stream temperature. Large woody debris is a vital factor for healthy salmonid habitats. Timber cutting eradicated shade and large logs that would have fallen into a stream. Poor logging, agricultural, and development practices degraded riparian areas. Without riparian vegetation, erosion is likely to be excessive, carrying bacterial or chemical

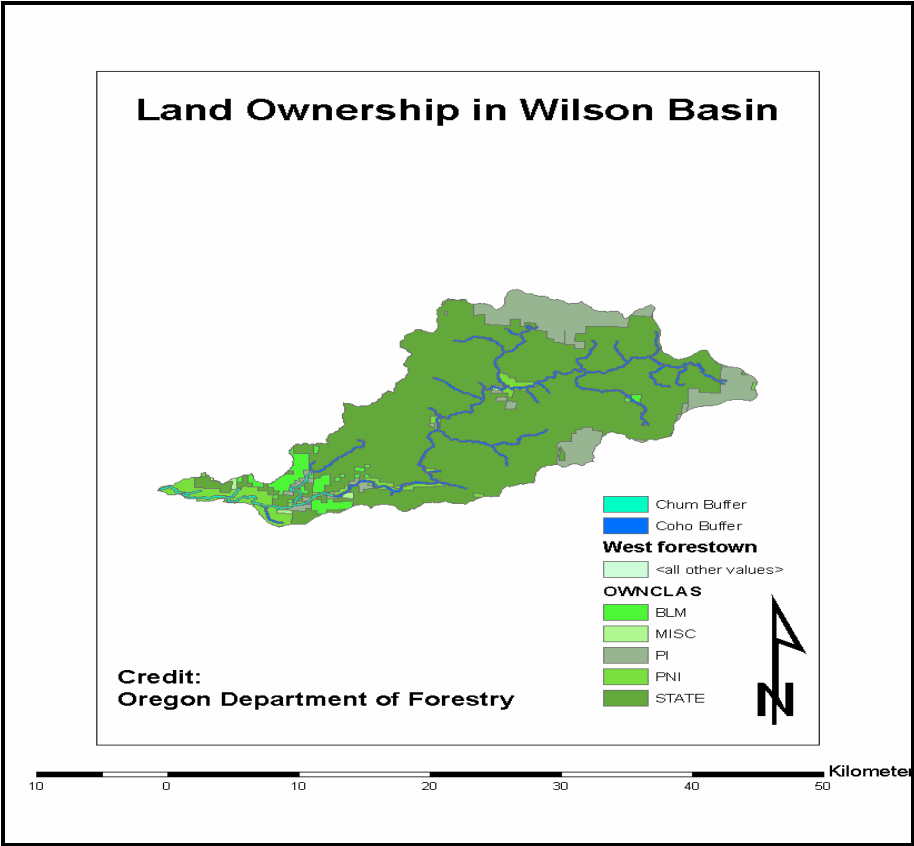
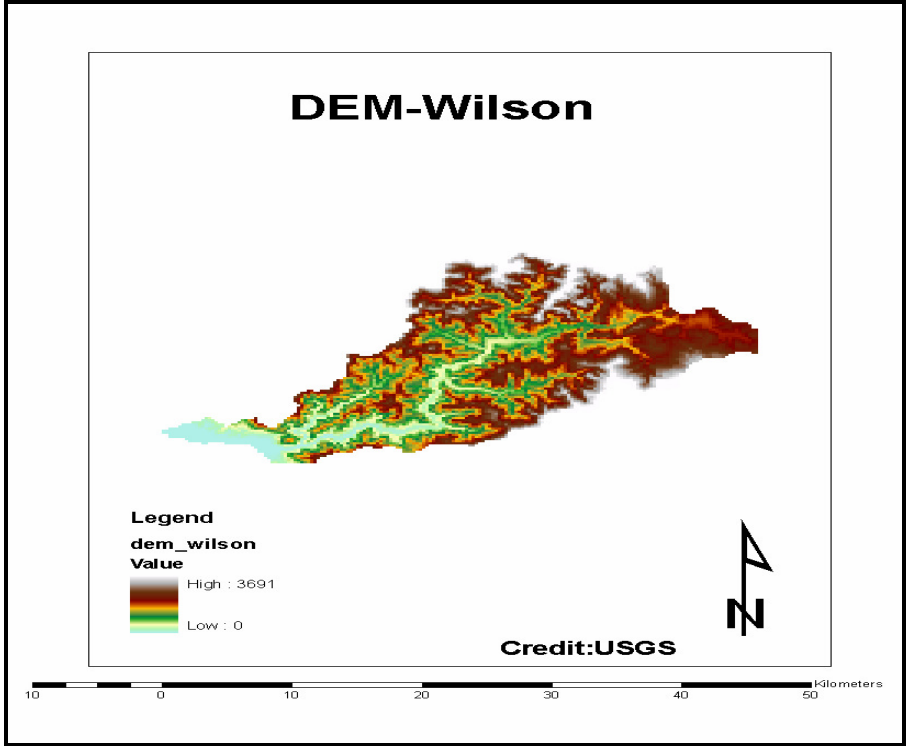
pollutants and excess sediments that clog gravel required for spawning. Reduced shade raises stream temperatures making harm to salmon population.

The construction of dikes, roads, culverts, and dams can block fish passage as well as alter water flow pattern. Dams have an impact on the force of the river's flow, preventing it from cleansing sediment from its gravel beds. Human intervention has confined streams to straight channels and reclaimed wetlands but all these are harmful to salmon populations. Removal of meanders and filling of wetlands eliminates feeding and slow-water areas required by young coho and other salmon for protection from predators or swift water currents. These practices can also increase the frequency and severity of major flood occurrences, which are responsible for restructuring stream channels, damaging riparian buffers, and exporting woody debris.

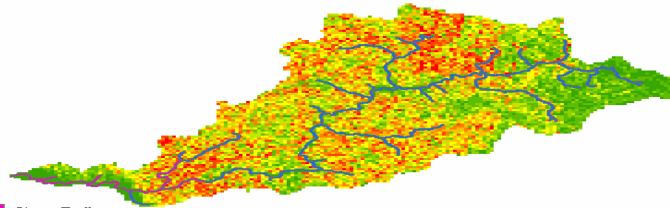


Wilson Basin in Tillamook Bay Basin





Slope-Wilson Basin



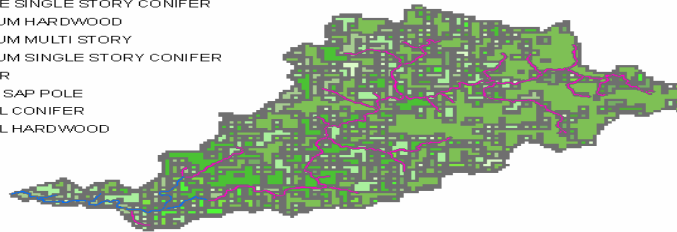
- ChumBuffer
- CohoBuffer
- 0 - 6.982271373
- 6.982271374 - 14.2438336
- 14.24383381 - 20.66752326
- 20.66752327 - 26.53263122
- 26.53263123 - 31.55986661
- 31.55986662 - 36.02852029
- 36.0285203 - 40.49717396
- 40.49717397 - 46.08299106
- 46.08299107 - 71.49845886

Credit: USGS



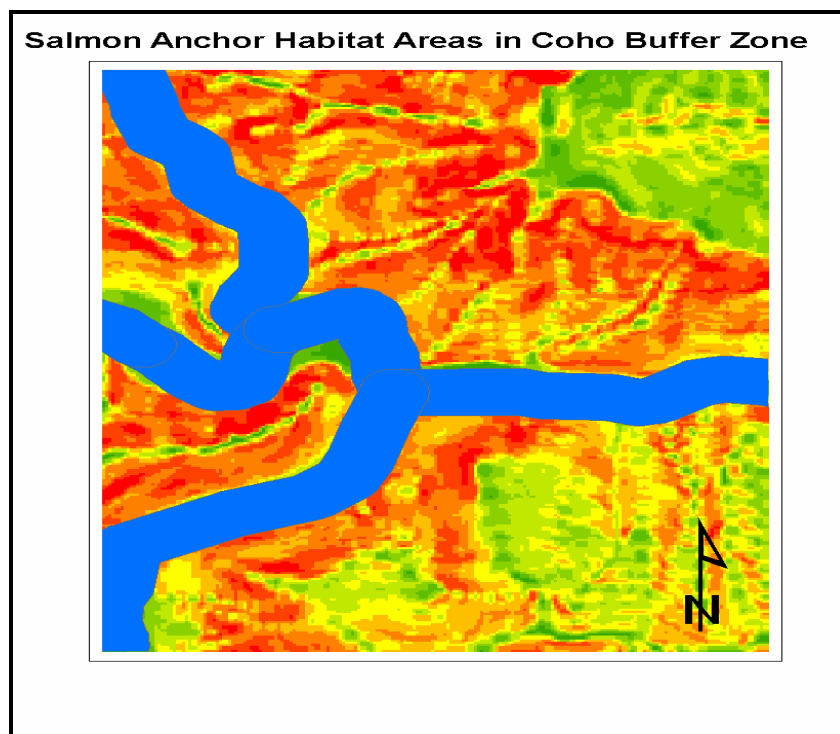
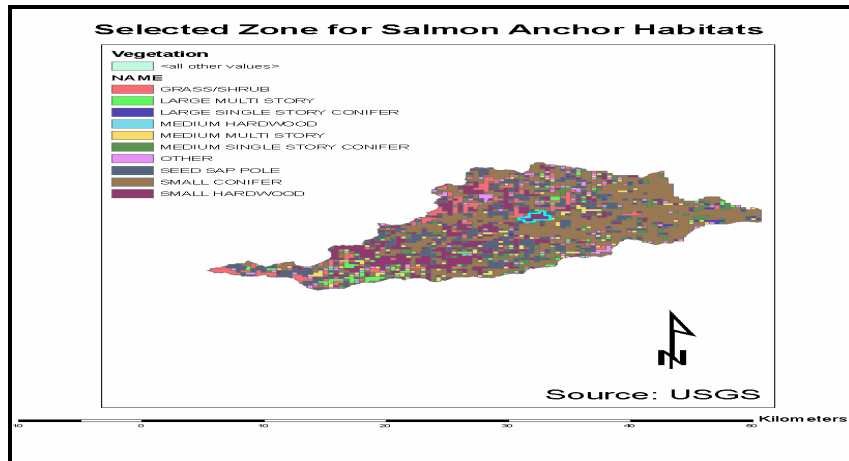
Vegetation: Seral Stage Classes

- ChumBuffer
- CohoBuffer
- Vegetation**
- <all other values>
- NAME**
- GRASS/SHRUB
- LARGE MULTI STORY
- LARGE SINGLE STORY CONIFER
- MEDIUM HARDWOOD
- MEDIUM MULTI STORY
- MEDIUM SINGLE STORY CONIFER
- OTHER
- SEED SAP POLE
- SMALL CONIFER
- SMALL HARDWOOD



Credit:
Oregon Department of Forestry





5. Discussion:

Major issues in the Tillamook Bay include degraded water quality, sedimentation, loss of habitat, and flooding. Degradation in water quality largely are due to high bacterial loads and other pollutants from various sources including livestock operations, wastewater treatment plants, on-site sewage disposal systems and urban runoff. The causes of sedimentation are mainly due to forestry, both from the actual cutting of trees and the roads built up to approach forests. Large floods result causing damage to human property, modify hydrological behavior, and impact aquatic habitats.

Riparian vegetation acts as natural buffer holding sediments in place and filtering pollutants. Application of aquatic and riparian protection should be created in the buffer zone of 150 feet along all fish bearing and large non-fish bearing stream in order to make it as non-touch zone. Maintenance of roads and proper management of unstable slopes and watershed should be given proper priority. We have created some zones where all criteria like areas are occupied by public ownership, areas mostly supporting spawning Coho Salmon, areas are mostly within the forest matrix of hardwood or conifer, and Areas having slope steeper than 65 per cent.

It is recommended that more analysis should be done to explore the topic how to create and manage salmon anchor habitat in order to save the King Salmon.

