3.3 Summary and Current Status of Oregon's Estuarine Ecosystems

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Report Card

Available evidence on the health of Oregon's estuaries is mixed. Some estuarine indicators demonstrate the significant adverse effects of past and present human activities; conversely, others show the positive impact of recent protective measures. Other indicators suggest continued threats and risks to estuaries, or raise concerns about long-term, cumulative effects of change. Limited data availability for most indicators makes for high scientific uncertainty and underscores the need for more focused research and regular monitoring.

- Historic loss of tidal wetlands is high, but restoration of diked former wetlands is reversing loss trends, increasing habitat availability and the functionality of estuaries for juvenile salmon and other estuary-dependent species.
- Estuarine habitats are well protected from some potential disturbances like dredging, filling, and other major physical alterations.
- Aquatic nuisance species are already well established in most Oregon estuaries; new arrivals and potential introductions pose unknown threats to native species and estuarine ecosystem function generally.
- Freshwater inflow to estuaries is below historic levels, particularly during summer months, based on appropriated withdrawals. The ecological impacts of these changes are not known, but projected growth in coastal population and water use suggest the need for research to determine impacts and the need for minimum estuary inflows.
- Water quality is insufficiently monitored to draw conclusions about the condition and risks associated with increasing point source and runoff pollution introductions that can be expected as population grows.
- Principal threats to estuaries today are continued physical alterations, mostly shoreline modifications for upland development and dredging for navigation projects; invasions of aquatic nuisance species; excessive sediment and runoff pollution from local and watershed sources, and other pressures associated with population and tourism growth.

Indicators

1. Change in area of estuarine habitats (acres and percent).
   - 1a—Change in overall estuary area
   - 1b—Change in area of estuarine tidal marsh and swamp habitat.
   - 1c—Change in area of eelgrass beds.
2. Area of estuarine habitats protected (acres and percent).
3. Aquatic nuisance species (occurrence and extent).
4. Freshwater inflow (flow rate and timing).
5. Estuarine water quality trends.

Introduction

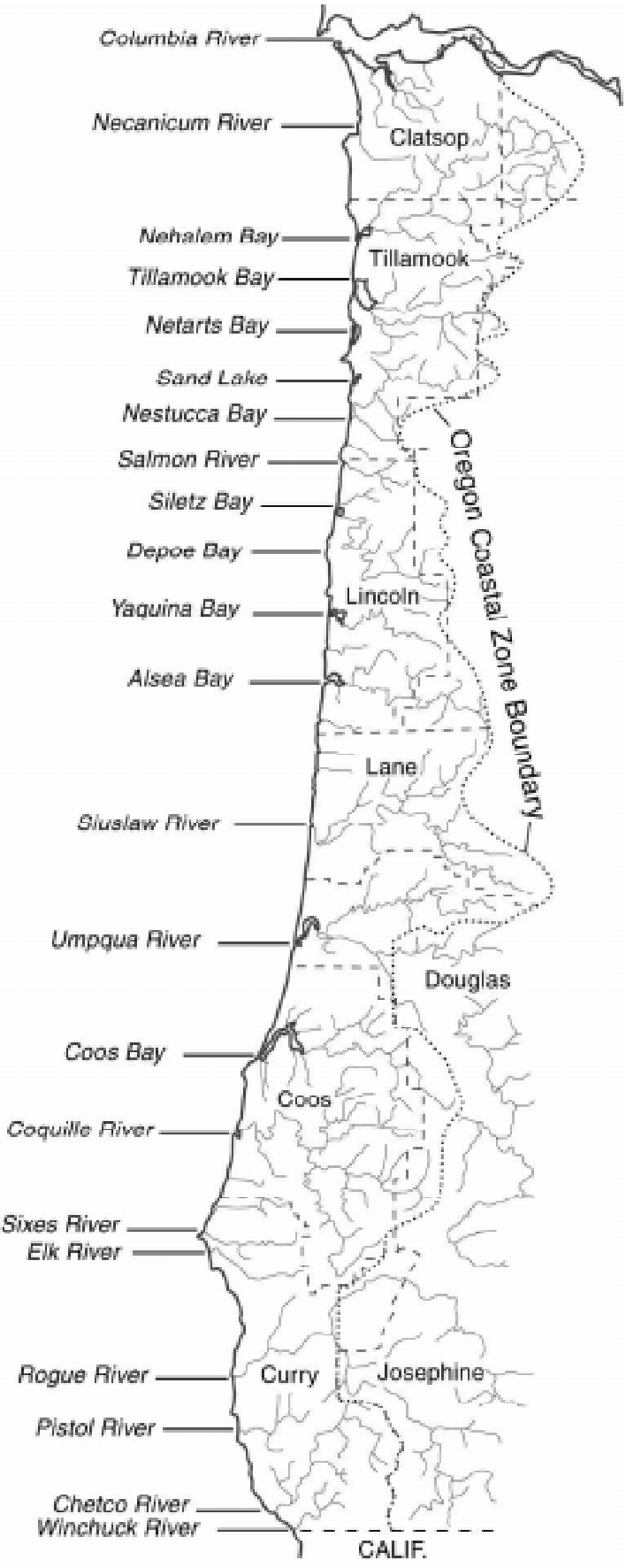
Oregon's twenty-two estuaries (**Figure 3.3-1**) are ecological transition zones, integrating features of the watersheds they drain with those of the marine environment. Physical characteristics strongly influence the structure, functions, and capacity of estuaries to provide valued ecosystem goods and services. Some of these physical characteristics are similar for most estuaries along the coast—the amount of precipitation, solar heat input, and tide levels at river mouths, for example. Other characteristics, such as the estuary size and shape, watershed area, geology, land use, and river gradient make for variety among Oregon estuaries. Regional ocean conditions also strongly influence Oregon estuaries. For example, ocean upwelling or storm events can change water properties in estuaries throughout the region within just one or two tidal cycles (Hickey, 1999).

Estuaries are biological "hot spots" along the coast. They are permanent or temporary home to a wide variety of organisms—some of marine origin, others from upstream, and some unique to the mixing zone. Biological productivity in this mixing zone is especially high, fueled by an abundance of food and tidal energy. Estuarine habitats—marshes, eelgrass beds, mudflats and tidal channels (see: Figure 13, "Estuary Habitats" in *SOER Statewide Summary*)—serve important roles in the life cycles of marine and anadromous species like crab, salmon, herring, migratory waterfowl, shorebirds, and hundreds of less well-known species.

Because estuaries experience great variability in temperature, salinity, tides, and river flow, estuarine ecosystems and the organisms found there are highly naturally resilient to disturbance. However, the cumulative effects of human alterations such as filling, diking, dredging, and wood removal; the introduction of non-indigenous species; and excessive waste disposal have reduced the functional capacity and natural resiliency of these ecosystems.

Humans have been attracted to estuaries for millennia. Native peoples built their villages along their sheltered shores, harvested the abundant salmon, oysters, and other fish and shellfish, and used them for local transportation and trading. Early white settlement of the coast also centered on estuaries, with early cities at Astoria, Newport, Reedsport, and Coos Bay (then Marshfield). White settlers were attracted to estuaries by transportation convenience, and access to seemingly inexhaustible natural resources. Coastal rivers were used to transport logs down to estuaries for storage, processing at local mills, or shipment to distant markets. The 20th century saw growth of existing and new settlements; improvements in ports and navigation; industrial and commercial development; and commercial and recreational exploitation of salmon, oysters, and other living resources. In recent years, residential and recre-

Figure 3.3-1. Oregon's principal estuaries and coastal watersheds.



ational development have replaced industry along some estuary shorelines, bringing with it demands for more shoreline public access and amenities.

Today, a variety of local, state, and federal laws, regulations, and programs are in place to govern the actions of a diverse group of public and private estuary and shoreline users. Subtidal and intertidal lands and natural resources in estuaries are mostly state owned and managed, although there is some federal ownership of wildlife refuges and recreation areas, and concurrent federal regulatory jurisdiction over some uses and activities. A significant fraction of estuarine lands are in private ownership—mostly tidal marshes and swamps above the mean high tide level, and tidelands that were sold off by the state early in the 20th century. Land along estuary shorelines is almost exclusively in private ownership and control, although local governments are required by land use laws to give preference to water-dependent shoreline uses.

Definition and indicators of estuarine ecosystem health

From the ecological perspective, estuaries are healthy when they provide for sustained biological productivity and essential ecological processes, and the maintenance of biotic communities, native species, and genetic and demographic diversity. From a more human-centered perspective, healthy estuarine ecosystems provide sustainable yields of fish, shellfish, wildlife, and host of less visible species they depend upon. Estuaries provide sustainable flows of other valued ecosystem goods and services, such as clean water, and flood and erosion mitigation as well. Yet another way of evaluating estuarine health is to ask whether or not the public and private

Table 3.3-1. Estuarine ecosystem health indicators: type, frame of reference, significance, and principal data sources.

Indicator and Type[1]	Reference Condition	Significance	Data Sources
1 – Change in area of estuarine habitats (acres & percent) 1a—estuary-wide 1b—marsh/swamp 1c—eelgrass Type 1 & 2	Pre-Euro-American settlement area	Directly measures structural integrity and habitat diversity; indirectly measures functional integrity	Thomas, 1983 Boule and Bierly, 1987 Cortright et al., 1987 Simenstad and Feist, 1996 Hoffnagel et al., 1976 Steve Rumrill, pers. com. 1999 Kathy Taylor, pers. com. 1999 Good, 1999 ODSL, 1972 USEPA, 1998
2 – Area of estuarine habitats protected (acres & percent) Type 3	Habitat area in 1977 when estuary plans were initiated	Measures outcomes of policies to protect remaining estuarine habitat and species	Cortright et al., 1987 Fishman Environmental Associates,1987 Good et al., 1998 Good, 1999
3 - Aquatic nuisance species (occurrence & extent) Type 1 & 2	Pre-Euro-American settlement native species (none)	Measures health of estuarine biological communities	Carlton and Geller, 1993 Paul Heimowitz, pers. com. 1999 John Chapman, pers. com. 1999 Steve Rumrill, pers. com. 1999
4 – Freshwater inflow (flow rate and timing) Type 1 & 2	Estimated pre-Euro-American settlement flow	Measures the integrity of estuarine mixing processes	Bastasch, 1998 Quigley et al., 1999
5 – Estuarine water quality trends Type 2 & 3	State water quality standards	Measures physical, biological, and chemical integrity of estuarine waters	NOAA, 1998 Skelton, 1999 (DEQ data) Greg McMurray, pers. com., 1999

[1] Indicator Type 1: Ecosystem structure- and function-based; Type 2: Ecosystem goods- and services-based; Type 3: Environmental policy-based

decisions with potential to affect ecosystem health are consistent with local, state, and national policy and with principles of sustainability.

Each of these perspectives is useful in selecting meaningful indicators. However, choosing indicators is complicated by an incomplete knowledge of how estuaries function and what is most important. High natural variability in climatic and oceanographic conditions influencing estuaries and the lack of good baseline data and regular monitoring of estuarine conditions and changes present additional challenges. Nevertheless, much can be gained by compiling, organizing, and analyzing the data that are available.

Five indicators of estuarine ecosystem health were selected for this report (**Table 3.3-1**). The choice of indicators was based on their *significance* as measures of ecosystem health or condition, their *sensitivity* to environmental change, and the *availability of sufficient data* to draw conclusions about the direction of change. Three of the indicators are measures of physical or biological structure and function. Each of these can also be directly or indirectly related to significant attributes that the public values—clean water, and high quality habitat for fish, crab, clams, and wildlife, for example. Two indicators measure the on-the-ground outcome of environmental policies designed to protect these valuable ecosystems and resources.

Current conditions and trends

Indicator 1: Change in area of estuarine habitats (acres and percent). Most Oregon estuaries have been significantly altered historically, mostly through the diking and draining of estuarine marshes in the early to mid-1900s for pasture and other agricultural use. Filling of intertidal lands for urban and port development up through the late 1960s further reduced the area of estuaries, as ports grew and navigation channels were deepened to support that growth. At the time, these changes stimulated economic growth and there was little concern or appreciation for the ecological damage being done. Not until the 1960s did growing public concern over these practices lead to new laws that dramatically reduced filling and prohibited new diking. In recent years, preliminary evidence suggests that restoration of tidal wetlands has begun to reverse loss trends. Implementation of salmon and watershed recovery plans will likely accelerate this trend.

Current conditions and trends in habitat examined here include (a) change in overall estuary area, (b) change in tidal marsh-swamp area (the most altered of estuarine habitat types),

Table 3.3-2. Change in total area and area of tidal wetlands (tidal marshes and swamps) for Oregon's 17 largest estuaries, due to filling and diking that occurred from about 1870 to 1970.

Estuary	Actual 1970 Area (acres)[1]		Diked or Filled	Estimated 1870 Area (acres)[3]		Percent Change (1870-1970)	
	Tidal Wetland	Total Estuary	Tidal Wetland[2]	Tidal Wetland	Total Estuary	Tidal Wetland	Total Estuary
Columbia	16,150	119,220	30,050	46,200	149,270	-65%	-20%
Necanicum	132	451	15	147	466	-10%	-3%
Nehalem	524	2,749	1,571	2,095	4,320	-75%	-36%
Tillamook	884	9,216	3,274	4,158	12,490	-79%	-26%
Netarts	228	2,743	16	244	2,759	-7%	-1%
Sand Lake	462	897	9	471	906	-2%	-1%
Nestucca	205	1,176	2,160	2,365	3,336	-91%	-65%
Salmon	238	438	313	551	751	-57%	-42%
Siletz	274	1,461	401	675	1,862	-59%	-22%
Yaquina	621	4,349	1,493	2,114	5,842	-71%	-26%
Alsea	460	2,516	665	1,125	3,181	-59%	-21%
Siuslaw	746	3,060	1,256	2,002	4,316	-63%	-29%
Umpqua	1,201	6,544	1,218	2,419	7,762	-50%	-16%
Coos Bay	1,727	3,348	3,360	5,087	10,708	-66%	-20%
Coquille	276	1,082	4,600	4,876	5,682	-94%	-81%
Rogue	44	880	30	74	910	-41%	-3%
Chetco	4	171	5	9	176	-56%	-3%
TOTAL	24,176	160,301	50,436	74,612	220,737	-68%	-24%

Data Sources:
[1] Cortright et al., 1987; Thomas, 1983
[2] Filled lands (Oregon Division of State Lands, 1972); Diked lands (Thomas, 1983; Boule and Bierly, 1987; and unpublished data compiled by Cziesla, O'Keefe, Gupta, and Good, 1999).
[3] 1870 area estimates were derived by adding area of diked and filled land to 1970 area estimates.