

Environment of the Western Hemlock Ecoregion

Coastal environment: wet & fairly mild temperatures

Ecoregion	Elevation Range (ft.)	Avg. Annual Temp (°F)	Avg annual precip (cm)
(Seattle) for reference	0	53	86
Sitka Spruce	0 – 500	52	200 – 300
Western Hemlock	0 – 2500	47	150 – 300
Silver Fir	1900 – 4200	42	220 – 280
Mountain Hemlock	4200 – 5900	39	160 – 280
Subalpine Fir	4200 – 5800	39	100 – 150
Alpine	>5000 - >7000	37.5*	46*



Mature WH Forest Ecosystem Productivity

WA WH Forests are **HIGHLY** productive:

g C / m² / yr
Lassoie et al. 1985

WHY?

Annual Net Primary Productivity of Ecosystems

Ecosystem Type	Mean NPP g C / m ² / yr	Range of NPP g C / m ² / yr
Terrestrial Uplands		
Tropical rain forest	2,200	1,000 - 3,500
Temperate evergreen forest	1,320	600 - 2,500
Temperate deciduous forest	1,200	600 - 2,500
Boreal forest	800	400 - 2,000
Woodland & shrubland	700	250 - 1,200
Temperate grassland	600	200 - 1,500
Tundra and alpine	140	10 - 400
Desert & semidesert scrub	90	10 - 250
Freshwater Wetlands		
Swamp & marsh	2,000	800 - 6,000
Lake and stream	250	100 - 1,500
Marine		
Algal beds and reefs	2,500	500 - 4,000
Estuaries	1,800	500 - 4,000
Open Ocean	125	2 - 400

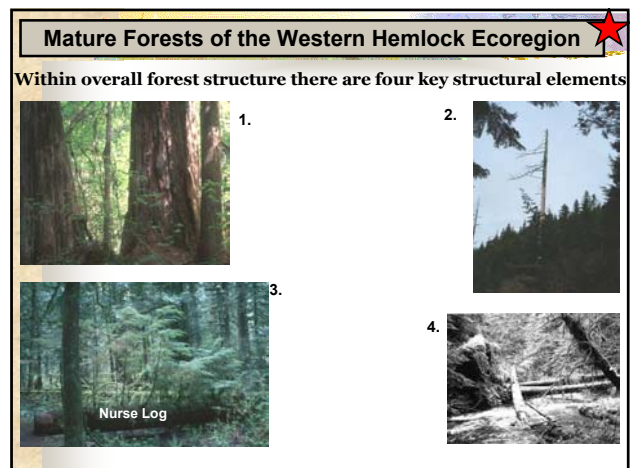
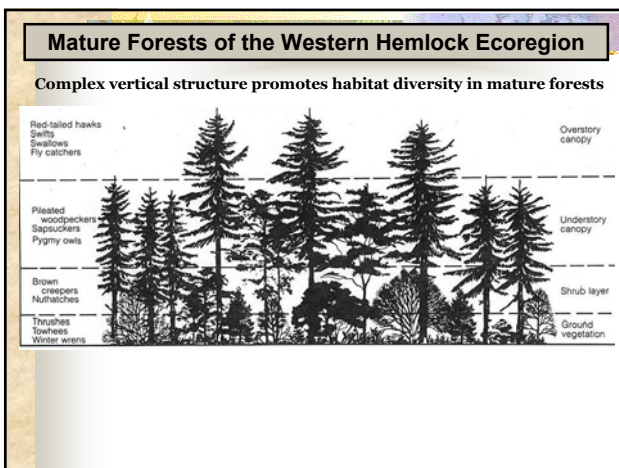
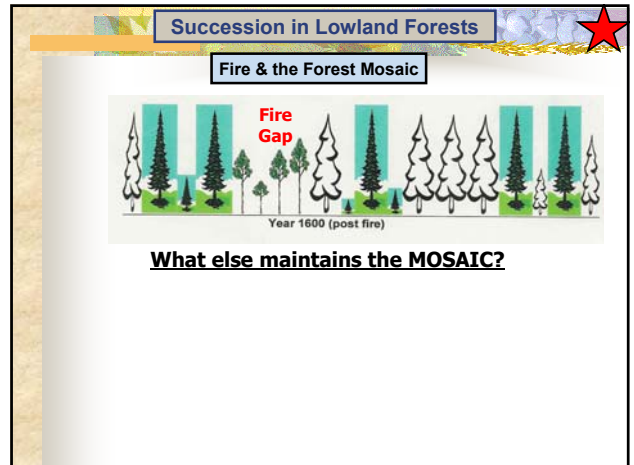
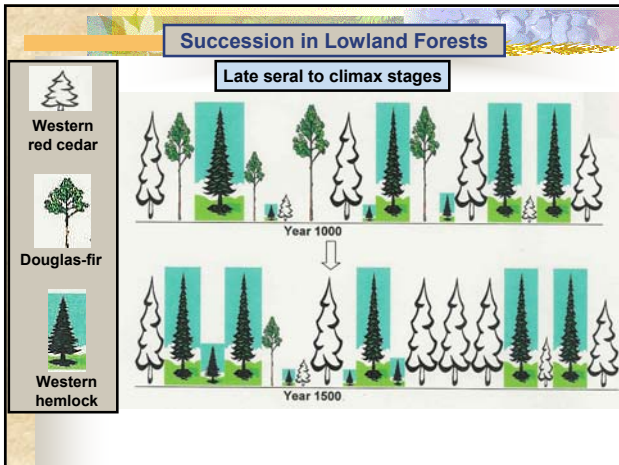
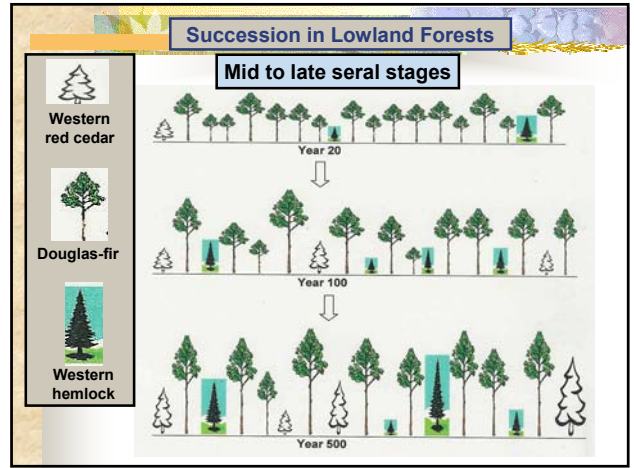
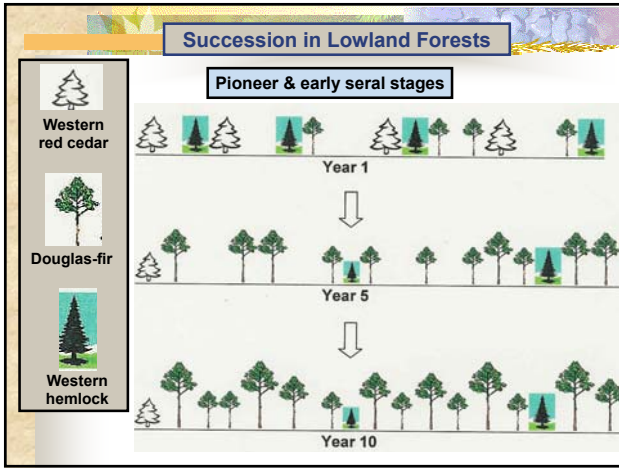
Characteristic large, old evergreens of lowland forests

	Douglas-fir	Western hemlock	Western red cedar
Height (ft)	280	200	200
Life span (yrs)	800 - 1200	500	800 – 1000
Shade tolerance			
Growth in open			
Succession			

Pseudotsuga mensezeii

Tsuga heterophylla

Thuja plicata



Mature Forests of the Western Hemlock Ecoregion

Conditions on the forest floor

- Chronic shade
- Cool
- Moist / humid
- Little wind



Understory plants adapted to stressful conditions



Mature Forests of the Western Hemlock Ecoregion

Animal Species

Nearly as diverse as coastal Sitka Spruce forests

~ 210 native vertebrates

Animals strongly tied to mature forest conditions – overall structure & habitat elements

- 56 vertebrate species use cavities of large trees
- 42 vertebrate species use woody debris



Northern spotted owl



Douglas squirrel (*Tamiasciurus douglasii*)

Other species similar to Sitka Spruce forests



Marbled Murrelet



Photos from Mathews (1988)

Data: NAS (2000); Bunnell & Chan-McLeod (1997); Johnson & O'Neill (2001)

Mature Forests of the Western Hemlock Ecoregion

Animal Species

Forests support very high animal diversity for nation

WA + OR

- % US Conifer Forest Lands: 6.8
- % US Breeding Birds: 37
- % US Cavity Nesters: 58
- % US Mammals: 42
- % US Mammals (> 1 kg): 56



Data: NAS (2000); Bunnell & Chan-McLeod (1997); Johnson & O'Neill (2001)

Disturbance in Mature Western Hemlock Forest Ecosystems

Fires return interval of ~ _____ years is much more frequent than Sitka Spruce forests (1,146 years)

- Data possibly inflated by Native American burning

Fire consequences severe

- High fuel loads – stand destroying crown fires usual with fire
- Many species fire avoiders



Wind disturbance significant but not nearly as often or intense as Sitka Spruce forests

Western Hemlock Forests: Human Impacts & Management

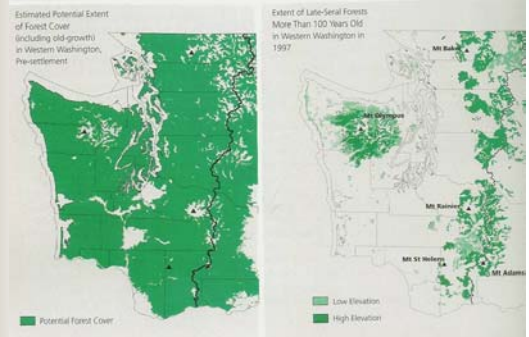
Most of our lowland forests are heavily managed for production



Forest harvest Wishkah Valley

Western Hemlock Forests: Human Impacts & Management

Less than 10% of original forests remain at low elevations in western WA



WA DNR 1998

Western Hemlock Forests: Human Impacts & Management

The landscape patterns of harvest are critical for understanding ecological impacts

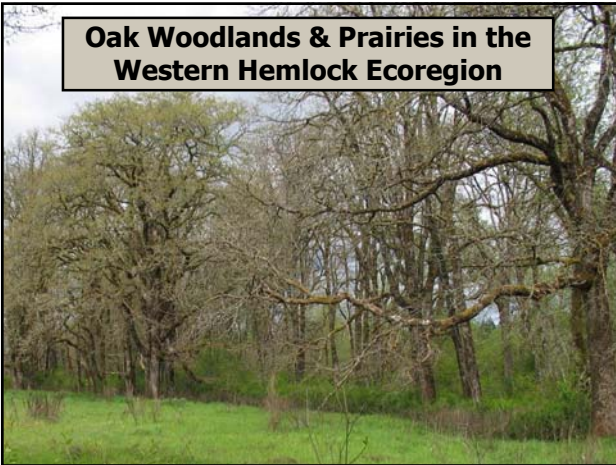


Western Hemlock Forests: Human Impacts & Management

Plantation forests are not the same ecologically

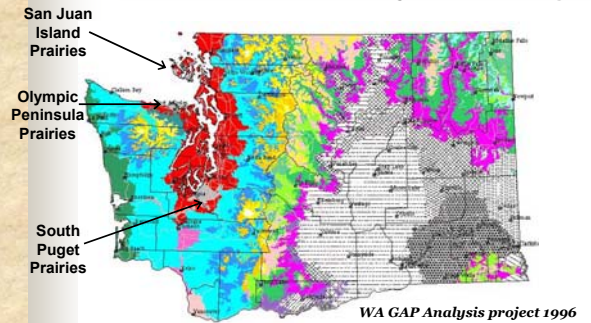


Oak Woodlands & Prairies in the Western Hemlock Ecoregion



Oak Woodland & Prairie Ecosystems

Oak Woodland & Prairie Ecosystems in Grey



Oak Woodland & Prairie Ecosystems

Evergreen forests don't cover everything – why?
Prairies & oak woodlands of South Puget Sound



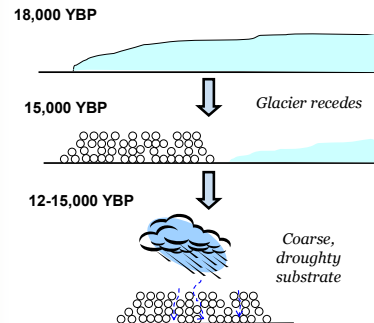
Mima Mounds Prairie Natural Area Preserve

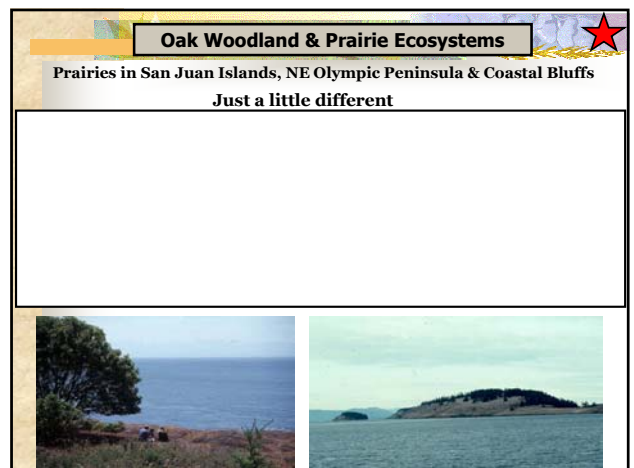
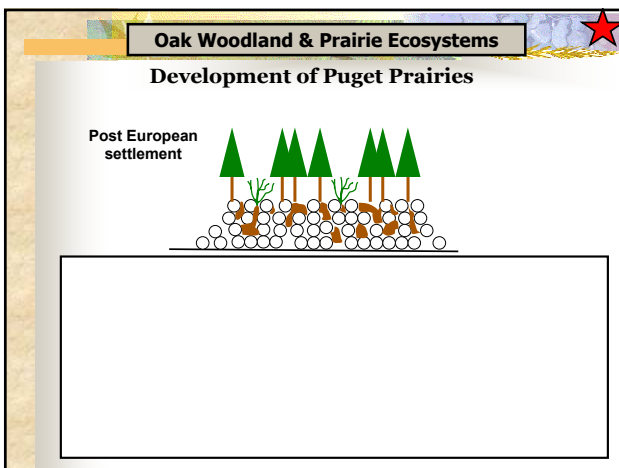
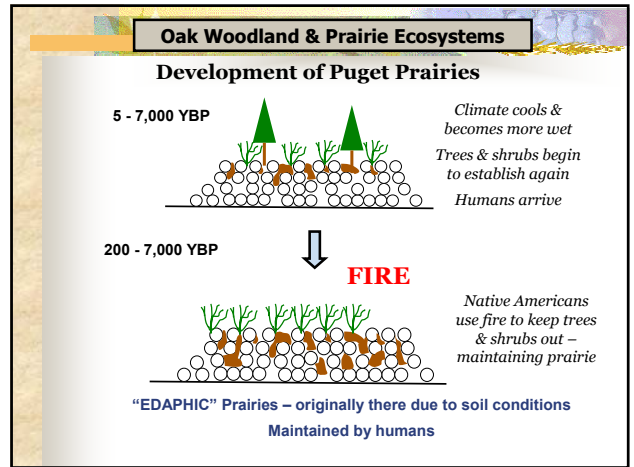
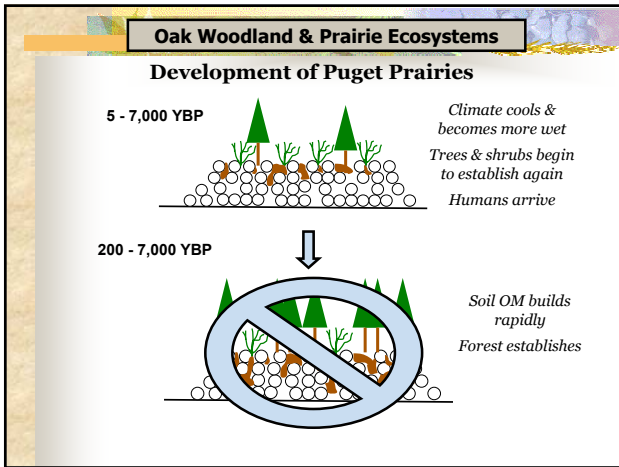
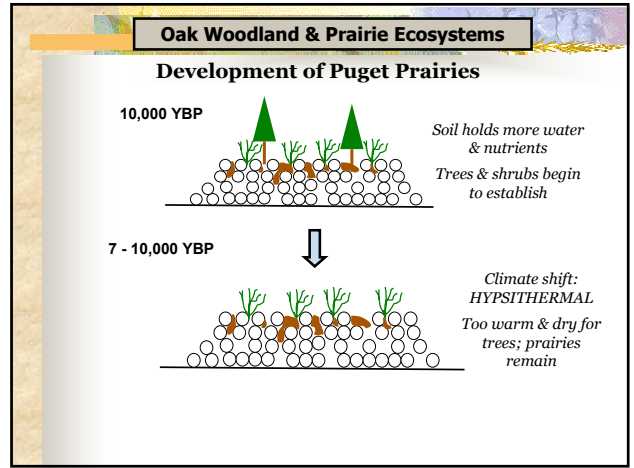
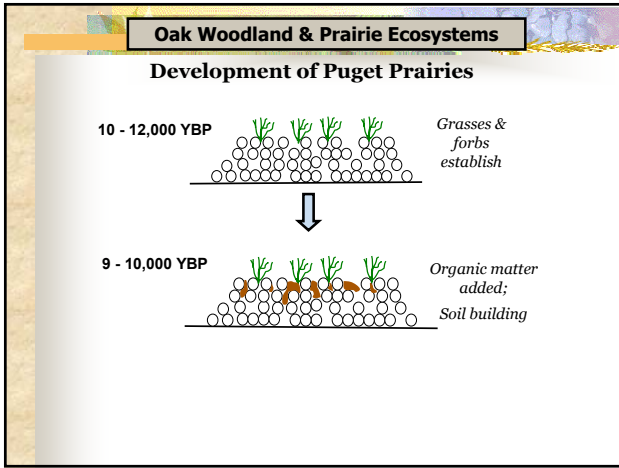


Garry Oak woodland
Glacial Heritage Park

Oak Woodland & Prairie Ecosystems

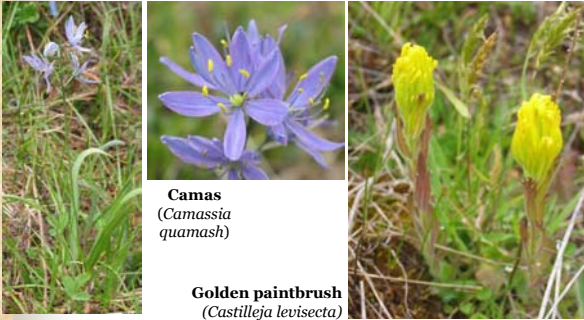
Development of Puget Prairies





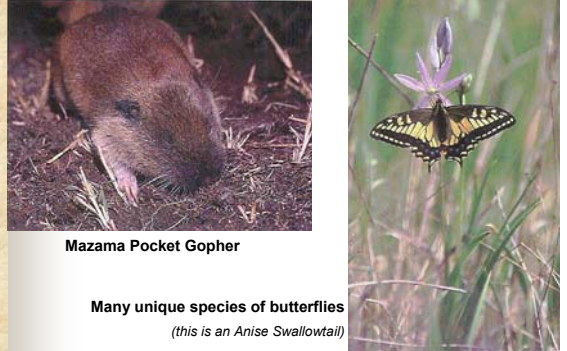
Oak Woodland & Prairie Ecosystems

As unique ecosystems they provide habitat for unique plants



Oak Woodland & Prairie Ecosystems

As unique ecosystems they provide habitat for unique critters



Photos from Dunn & Ewing (1997)

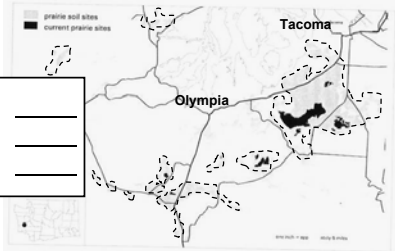
Oak Woodland & Prairie Ecosystems: Human Impacts

Prairie covers about 8% of historical extent in South Puget Sound

Causes of Prairie Loss

Hall (1995)

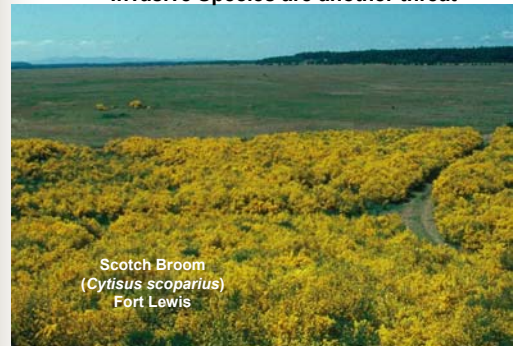
- Urban development _____
- Forest invasion _____
- Agriculture _____



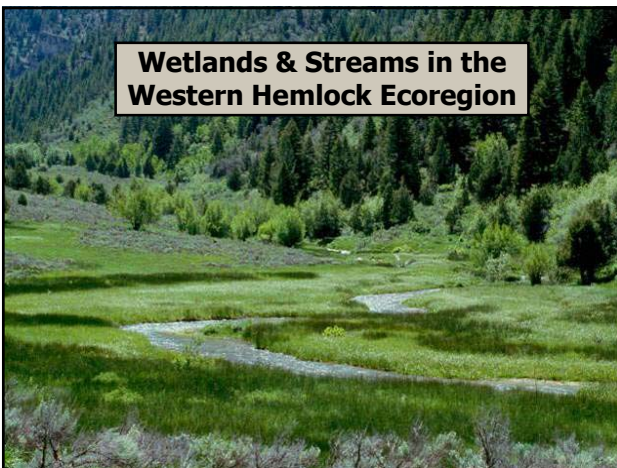
Crawford & Hall 1997

Oak Woodland & Prairie Ecosystems: Human Impacts

Invasive Species are another threat



Wetlands & Streams in the Western Hemlock Ecoregion



Freshwater Wetland Ecosystems

Diversity of wetland types

Forested



Shrub



Freshwater Wetland Ecosystems

Diversity of wetland types

Emergent



Aquatic Bed



Freshwater Wetland Ecosystems

Unique Wetland Types: Bogs



Freshwater Wetland Ecosystems

Unique, OBLIGATE wetland species



Freshwater Wetland Productivity

Freshwater wetlands are among the most productive ecosystems

Even higher than old growth forests per unit area

Annual Net Primary Productivity of Ecosystems

Ecosystem Type	Mean NPP g C / m ² / yr	Range of NPP g C / m ² / yr
Terrestrial Uplands		
Tropical rain forest	2,200	1,000 - 3,500
Temperate evergreen forest	1,320	600 - 2,500
Temperate deciduous forest	1,200	600 - 2,500
Boreal forest	800	400 - 2,000
Woodland & shrubland	700	250 - 1,200
Temperate grassland	600	200 - 1,500
Tundra and alpine	140	10 - 400
Desert & semidesert scrub	90	10 - 250
Freshwater Wetlands		
Swamp & marsh	2,000	800 - 6,000
Lake and stream	250	100 - 1,500
Marine		
Algal beds and reefs	2,500	500 - 4,000
Estuaries	1,800	500 - 4,000
Open Ocean	125	2 - 400

Freshwater Wetland Ecosystems

Why are freshwater wetlands so highly productive ?

Freshwater Wetland Ecosystems

Ecological Functions *(mostly from a human perspective)*

- A. Water filtration (pollutants, sediment; sewage treatment)
- B. Flood control (stormwater management)
- C. Dry season stream flow maintenance
- D. Groundwater recharge
- E. Erosion control (↓ peak erosive flows)
- F. Wildlife habitat (fisheries, waterfowl, etc.)
- G. Recreation, aesthetic purposes

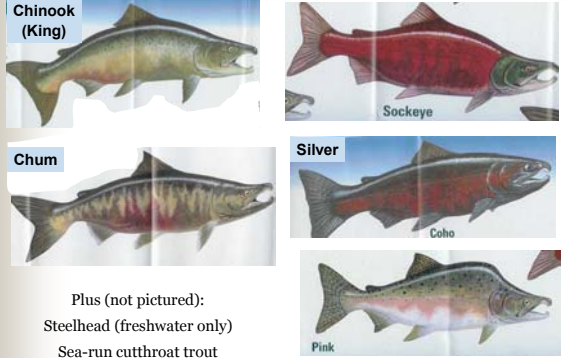
Freshwater Wetland Ecosystems

Streams & Salmon: a primer



Salmon & Streams: a primer

Five species of salmon in our region

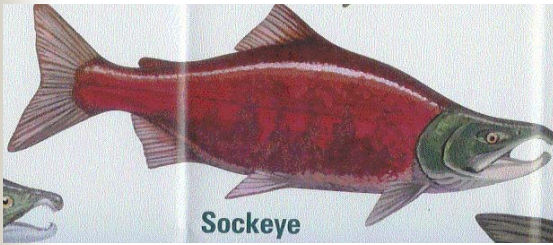


Illustrations from USFWS brochure 1998

Salmon & Streams: a primer

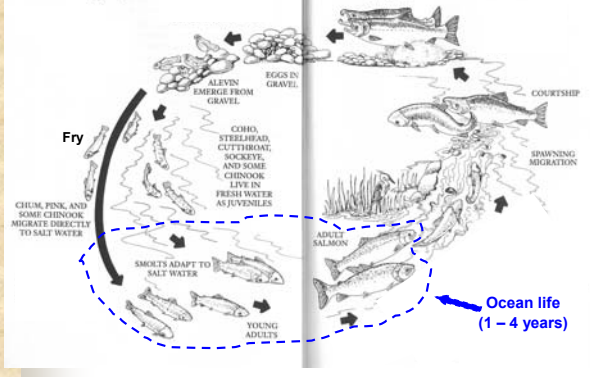
Salmon are ANADROMOUS fish

This means they use both FRESH & SALT water during their life cycle



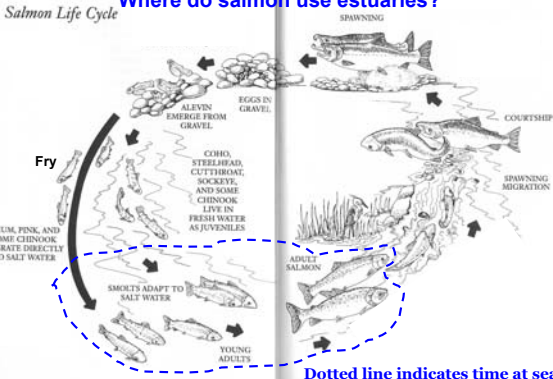
Salmon & Streams: a primer

Salmon Life Cycle



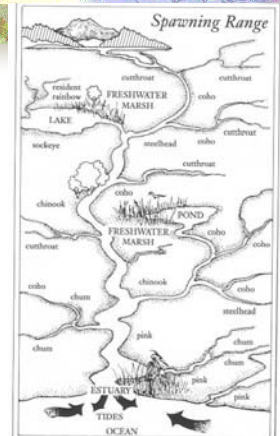
Salmon & Streams: a primer

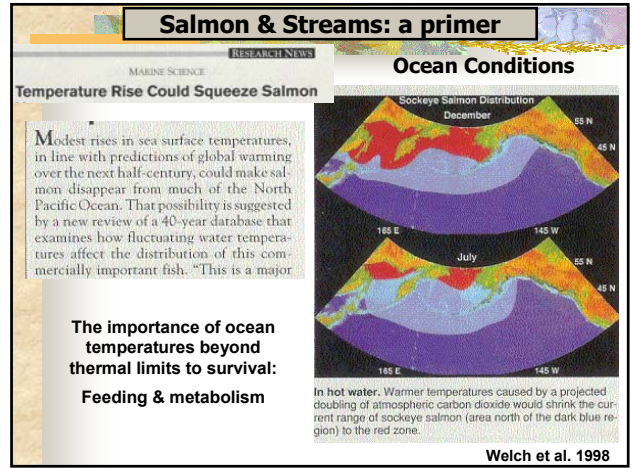
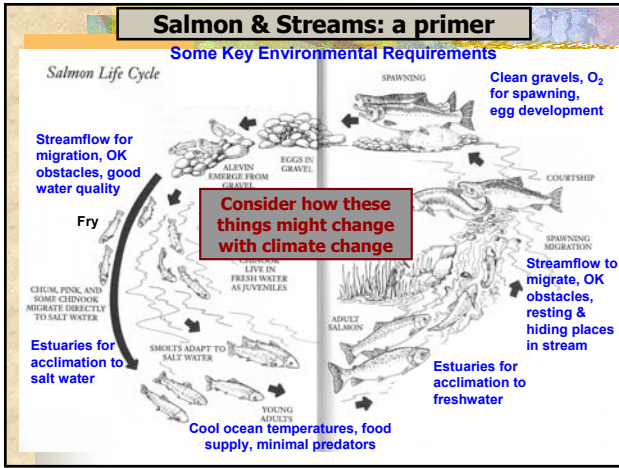
Where do salmon use estuaries?



Salmon & Streams: a primer

Different species of salmon spawn in different portions of the watershed





Salmon : current status

Endangered Species Act Status of West Coast Salmon & Steelhead
(Updated June 8, 2006)

Species ¹	Current Endangered Species Act Listing Status ²	ESA Listing Actions Under Review
Sockeye Salmon (<i>Oncorhynchus nerka</i>)	1 Snake River	Endangered
	2 Okanogan Lake	Threatened
	3 Baker River	Not Warranted
	4 Okanogan River	Not Warranted
	5 Lake Wapinitia	Not Warranted
	6 Skamish Lake	Not Warranted
	7 Lake Plummer	Not Warranted
Chinook Salmon (<i>O. tshawytscha</i>)	8 Sacramento River Watershed	Endangered
	9 Upper Columbia River Spring-run	Endangered
	10 Snake River Spring/Summer-run	Threatened
	11 Snake River Fall-run	Threatened
	12 Puget Sound	Threatened
	13 Lower Columbia River	Threatened
	14 Upper Willamette River	Threatened
	15 Central Valley Spring-run	Threatened
	16 California Coastal	Threatened
	17 Central Valley Fall and Late Fall-run	Species of Concern
	18 Upper Klamath Trinity Rivers	Not Warranted
	19 Oregon Coast	Not Warranted
	20 Washington Coast	Not Warranted
	21 Middle Columbia River spring-run	Not Warranted
	22 Upper Columbia River summer fall-run	Not Warranted
	23 Southern Oregon and Northern California Coast	Not Warranted
	24 Duwamish River summer fall-run	Not Warranted

National Marine Fisheries Service, NOAA; 2006

Salmon : current status

Coho Salmon (<i>O. kisutch</i>)	25 Central California Coast	Endangered
	26 Southern Oregon/Northern California	Threatened
	27 Lower Columbia River	Threatened
	28 Oregon Coast	Not Warranted
	29 Southern Washington	Underreviewed
Chum Salmon (<i>O. keta</i>)	30 Puget Sound Strait of Georgia	Species of Concern
	31 Olympic Peninsula	Not Warranted
	32 Hood Canal/Sammamish	Threatened
	33 Columbia River	Threatened
	34 Puget Sound/Strait of Georgia	Not Warranted
	35 Pacific Coast	Not Warranted
	36 Southern California	Endangered
Steelhead (<i>O. mykiss</i>)	37 Upper Columbia River	Threatened
	38 Central California Coast	Threatened
	39 South Central California Coast	Threatened
	40 Snake River Basin	Threatened
	41 Lower Columbia River	Threatened
	42 California Central Valley	Threatened
	43 Upper Willamette River	Threatened
	44 Middle Columbia River	Threatened
	45 Northern California	Threatened
	46 Oregon Coast	Species of Concern
Pink Salmon (<i>O. gorbuscha</i>)	47 Southern Washington	Not Warranted
	48 Olympic Peninsula	Not Warranted
	49 Puget Sound ³	Proposed Threatened
	50 Elkhorn Mountains Province	Not Warranted
Oligocene	51 Estuary	Not Warranted
	52 Columbia	Not Warranted

Critical habitat
Protective Regulations

