# STATE OF
# COLUMBIA RIVER ESTUARY
# ECOLOGICAL CONDITIONS

**PRESENTATION FOR**

**THE PROJECT SPONSOR PORTS**

**SEI WORKSHOP 1**

**SEATTLE, WA**

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## HISTORICAL PERSPECTIVE

**Considerable amount of literature available from last 30 years**

**Little information on historic conditions prior to physical modification of the estuary**

**Physical modification of the estuary began in 1800's with diking and filling of shallow portions**

**Major biological modification began 1866 with commercial harvest of salmon, 55 canneries by 1883, some runs decimated by 1890**

**1895 first jetty at mouth of the Columbia**

**Highly modified by watershed development: forest harvest, mining, irrigation, dams, urban, etc**

**Hydrographic conditions (salinity, current speed and direction) within estuary are dynamic over a considerable length**

# AREA OF CONCERN

**COLUMBIA RIVER: RM 3 to 106.5 (192 km)**

# HABITAT TYPES

**High Marsh & Swamp** (Upland, not inundated)

**Low Marsh** (Upper intertidal to +1 m MLLW)

**Tide Flats** (+1 to –1 m MLLW)

**Water Column** (Water surface to 1 m > bottom)

**Demersal Slope** (-1 to -6 m MLLW)

**Channel Bottom** (>-6 m MLLW)

**TIDAL RANGE** ~3.6 m in lower estuary

**SALMONID SPECIES**

(14 ESUs listed or candidates)

**Chinook**

**Chum**

**Pink**

**Coho**

**Sockeye**

**Steelhead**

**Coastal Cutthroat**

**Bull Trout**

Variety of life cycle types with different size juveniles in estuary that have substantially different habitat requirements, two basic types:

**Ocean type**

**Stream type**

**JUVENILE SALMON PREY SPECIES**

## EPIBENTHIC PREY

***Corophium salmonis*** Tube-building amphipod, deposit feeder, silty sand substrate, moderate salinities

***Eogammarus confervicolus*** Amphipod that crawls on sediment surface, tolerates wide range of salinities, prefers sandy substrate

## PLANKTONIC PREY

**Insects** (dipterans, variety of others)

**Cladocerans** (*Daphnia*)

**Calanoid copepods**

**Mysids**

No historic information on prey consumed by juveniles

## JUVENILE SALMON PREY SPECIES

### ZOOPLANKTON

***Daphnia pulex*** Riverine cladoceran

***Bosmina longirotris*** Riverine cladoceran

***Cyclops vernalis*** Riverine copepod

***Eurytemora affinis*** Estuarine copepod

***Neomysis mercedis*** Estuarine-freshwater mysid

***Acartia clausi*** Marine copepod sensitive to chemical contaminants

***Archeomysis grebnitzkii*** Marine mysid

***Oithona similis*** Marine copepod

## NON-SALMONID FISHES

**Sturgeon** *Acipenser transmontanus*

**American Shad** *Alosa sapidissima*

**River Lamprey** *Lampetra ayresi*

**Pacific lamprey** *Lampetra tridentata*

**Surf Smelt** *Hypomesus pretiosus*

Numerous other marine & freshwater species

## BENTHIC INVERTEBRATES

***Cancer magister*** Dungeness crab

***Macoma baltica*** Small thin-shelled clam

***Neanthes limnicola*** Polychaete worm

***Pseudopolydora kempi*** Polychaete worm

Numerous other species, considerable sampling, interpretation of data limited

## AVIAN SPECIES

**Caspian Tern**

Population explosion last 10 years
Nest on man-made island
Major salmon predator (10-20,000,000 fish/year)
Control measures underway

**Double Crested Cormorant**

**Pelagic Cormorant**

Many other avian species

## EXOTIC SPECIES

***Corbicula fluminea manilensis*** Asian clam

***Peudodiaptomus inopinus*** Calanoid copepod

***Alosa sapidissima*** American shad

15 other fish species

## ORGANIC PRODUCTION

**Wetland production** decrease estimated ~80%, macroalgae ~15%

**Wetland and phytoplankton production** primarily upstream in fluvial environment

**Benthic production primarily** lower estuary in saline environment

Macrophytes

***Zostera marina*** Eelgrass

***Enteromorpha intestinalis*** Green algae

**Diatoms**

## PHYSICAL CHARACTERISTICS

## BATHYMETERY

Considerable changes from diking and filling.
Lost >12,000 hectares (20,000 acres) tidal marshes and swamps

~40% of original estuarine area lost, most shallow water habitat (Thomas 1983).
Also modified by channel dredging

## SEDIMENT CHARACTERISTICS

**Transport quantity** ~1,000,000 metric tons/year
Most **coarse silt to sand** (0.0039 – 1 mm), with some larger material.
**Fill rate** of ~0.5 cm/y

**Substrate**:

Channels: medium to coarse sand
Shallows: medium sand to very fine sand with silt and clay

**Bedform**:

Waves, 6-8 m wavelength, high 40 cm lower estuary; to 100 m wavelength, 3 m high upper estuary.
Demonstrates active characteristic of channel bottom, not a stable substrate

## SUSPENDED SOLIDS & TURBIDITY

May be long-term changes in ambient suspended solids due to watershed changes

**Turbidity Range:**

Varies with season, distance within the estuary

**Upriver**: 40-100 mg/l, coarse clay to fine silt, organic content 1-12 ppt,

**Lower estuary**; 5-40 mg/l,

**Turbidity Maximum:**

Area of high, but varying suspended solids concentrations, tends to trap organic matter

Maintained by a trapping mechanism associated with estuarine circulation and settling

Location varies over >20 km within mid-estuary

Complex mechanism not fully understood
Influences deposition of fine sediment

# SALINITIES

Concern for alterations due to changes in estuary physical characteristics.

Salinity only a factor in the lowest portion of estuary

Salinity highly variable within the estuary

Regulated by river discharge + tide stage

Maximum salinity intrusion:
Cathlamet Bay and Gray's Bay essentially fresh  Channels saline at bottom some distance upstream.

Minimum salinity intrusion: East Sand Island downstream.

## CURRENT VELOCITIES

Highly variable with time and location

Vertical Distribution of Mean Current driven by:
- ebb-flood asymmetry in time-dependent flow,
- vertical mixing,
- baroclinic pressure gradient, and
- interaction of flow with topography.

Upstream flow occurs to approximately 150 km upstream during lower river discharges and major flood tides

Altered from historical conditions by changes in estuarine physical characteristics

Current speed important to salmon habitat
- <0.3 m/s for ocean-type juvenile salmon

# SUMMARY

**1. Available pertinent information is substantial for most topics**

**2. Estuary is a physically and biologically dynamic ecosystem**

**3. Columbia River Estuary is substantially different than most estuaries we are familiar with**

**4. Considerable information will be provided through following workshops**