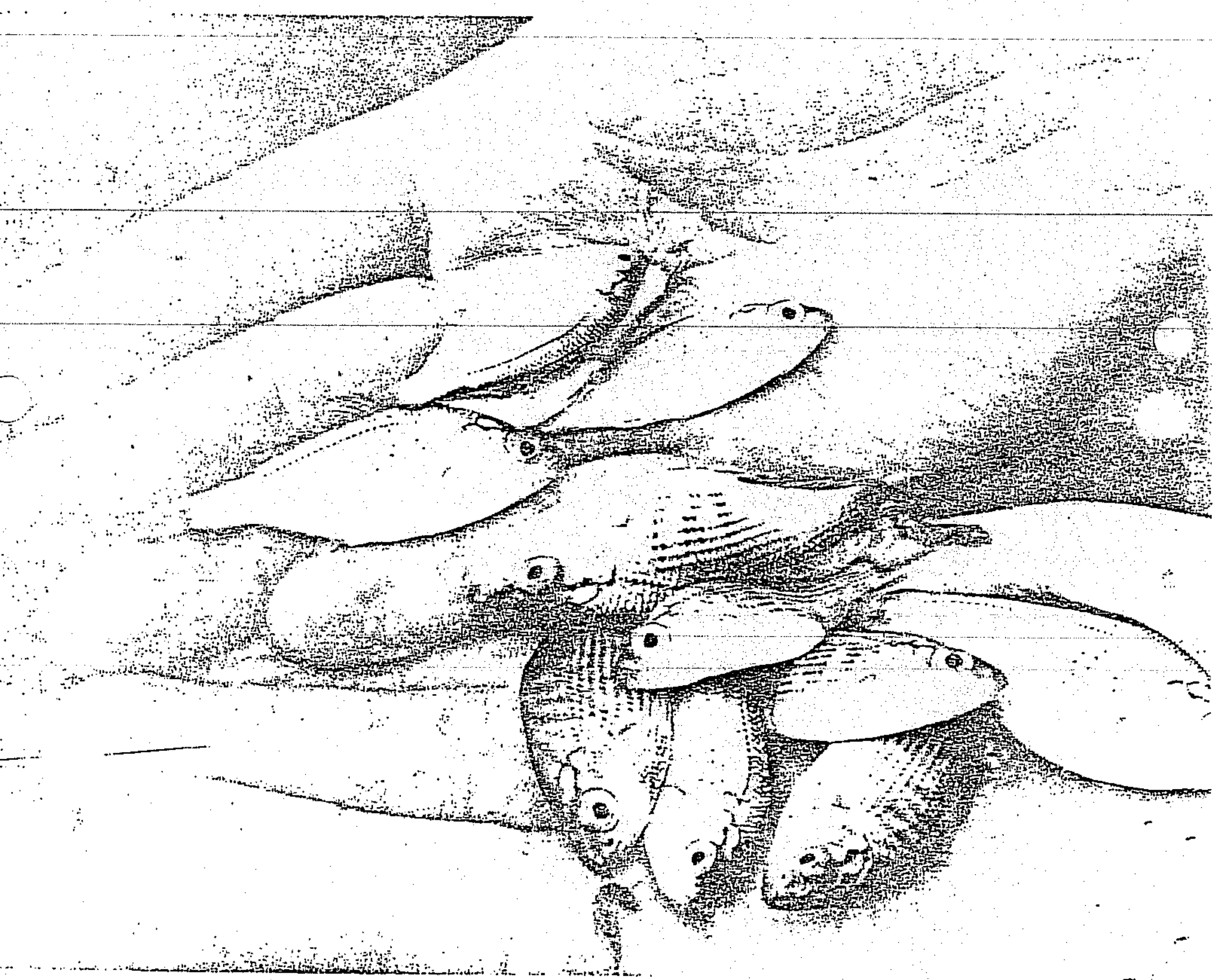
NECANICUM ESTUARY



INVENTORY

NECANICUM ESTUARY

INVENTORY

NEAL MAINE
E-3 AWARENESS

CLATSOP COUNTY, OREGON

JUNE 1979

Fish Drawings by Ron Pittard-Searep Studio
Line Drawings by Walt Linstrom, Clatsop County Planning Dept.
Photography by Neal Maine

Preperation of this report was financially aided through grants from Land Conservation and Development Commission, with funds obtained from NOAA, and appropriated from section 305, 306 of the Coastal Zone Management Act of 1972.

Special thanks to the following people for their help;
- Ed Johnson-field work and write-up on sediments section
- Norm Kujala-identification of plankton(Oregon Ocean Services)
- Harry Nehls-review of section on birds
- Warren Knispel-field work and review of fish section(Dept. of Fish & Wildlife
- Bob Emmitt-identification of benthic animals(National Marine Fisheries)

No. 23

NECANICUM RIVER ESTUARY

INVENTORY

This Necanicum River Estuary Inventory is the first attempt to compile and research information on the estuary system, and is not intended to fill all the voids of knowledge. It will provide some basic biological and physical information for use in the local planning process. Although there are still some blank spots in the study it is adequate to move into the planning process which will help delineate the next step in the information gathering. This initial document will be the tool which illustrates and stimulates the further need of study in the future.

Up to the initiation of the LCDC grant sponsored study of the Necanicum Estuary there was very little information to use for effective planning. Because of the size of the Necanicum Estuary along with other smaller estuaries in Oregon, little attention was paid to them. A new awareness is being generated about the small ocean contact units because of the key role they play in coastal ecology and their link with Coast Range watersheds. It is hoped that this study will help amplify that awareness in Clatsop County and serve as the springboard to a comprehensive plan for the Necanicum Estuary system.

TABLE OF CONTENTS

SECTION A

(Physical)

DRAINAGE BASIN

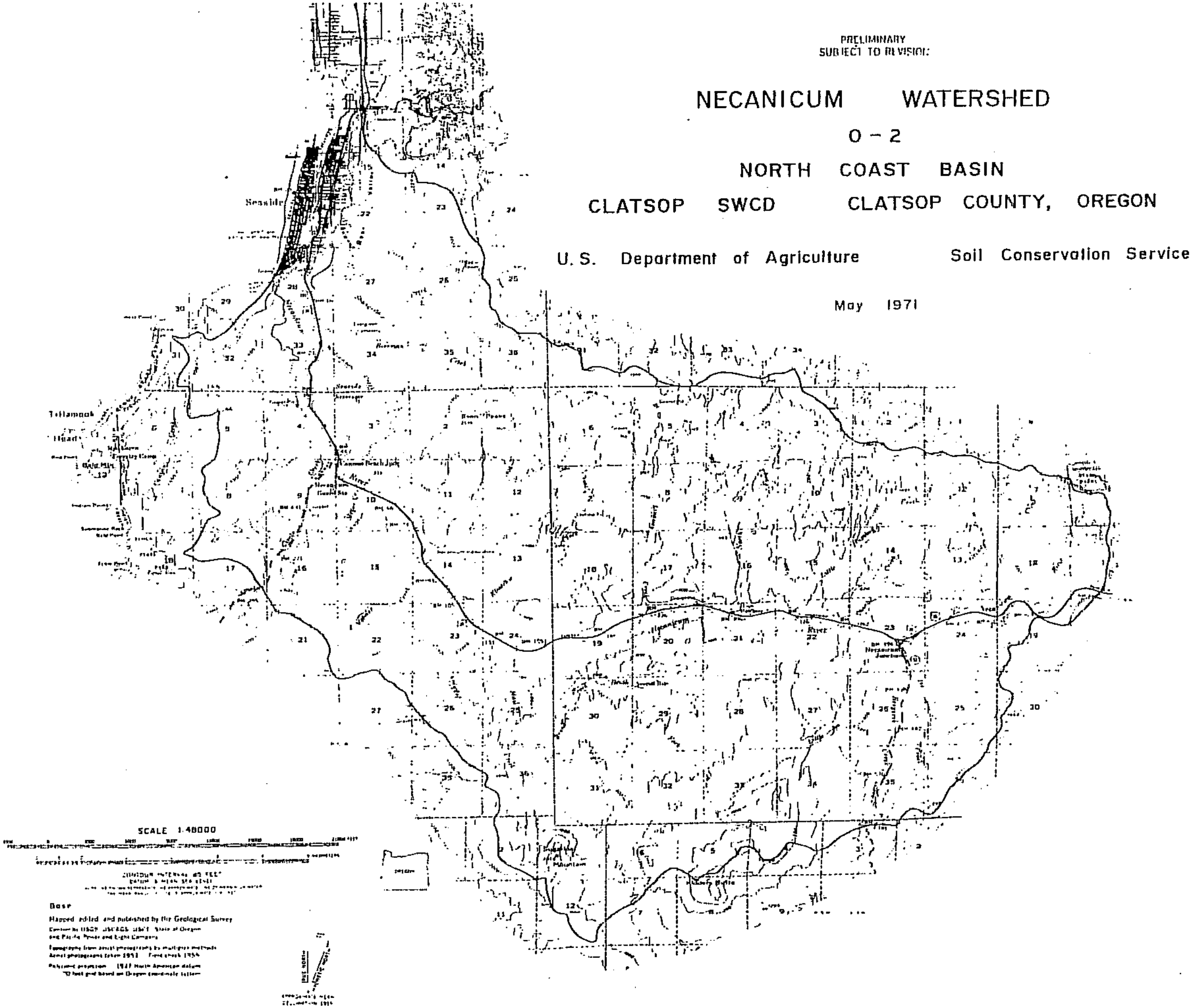
The Necanicum River-Neawanna Creek-Neacoxie system drains a total of 87 sq. miles. The average yearly freshwater yield of the system is 220,200 ac-ft. with an average annual precipitation of 100 inches. The basin consists primarily of forests (93.6% 40,500 acres), cropland (1.2% 500 acres), and rangeland (1.2% 500 acres).

The Necanicum Estuary measures less than 2000 feet at its mouth and covers about 278 acres. Maximum depth varies from 9-15 feet becoming very shallow at the mouth.

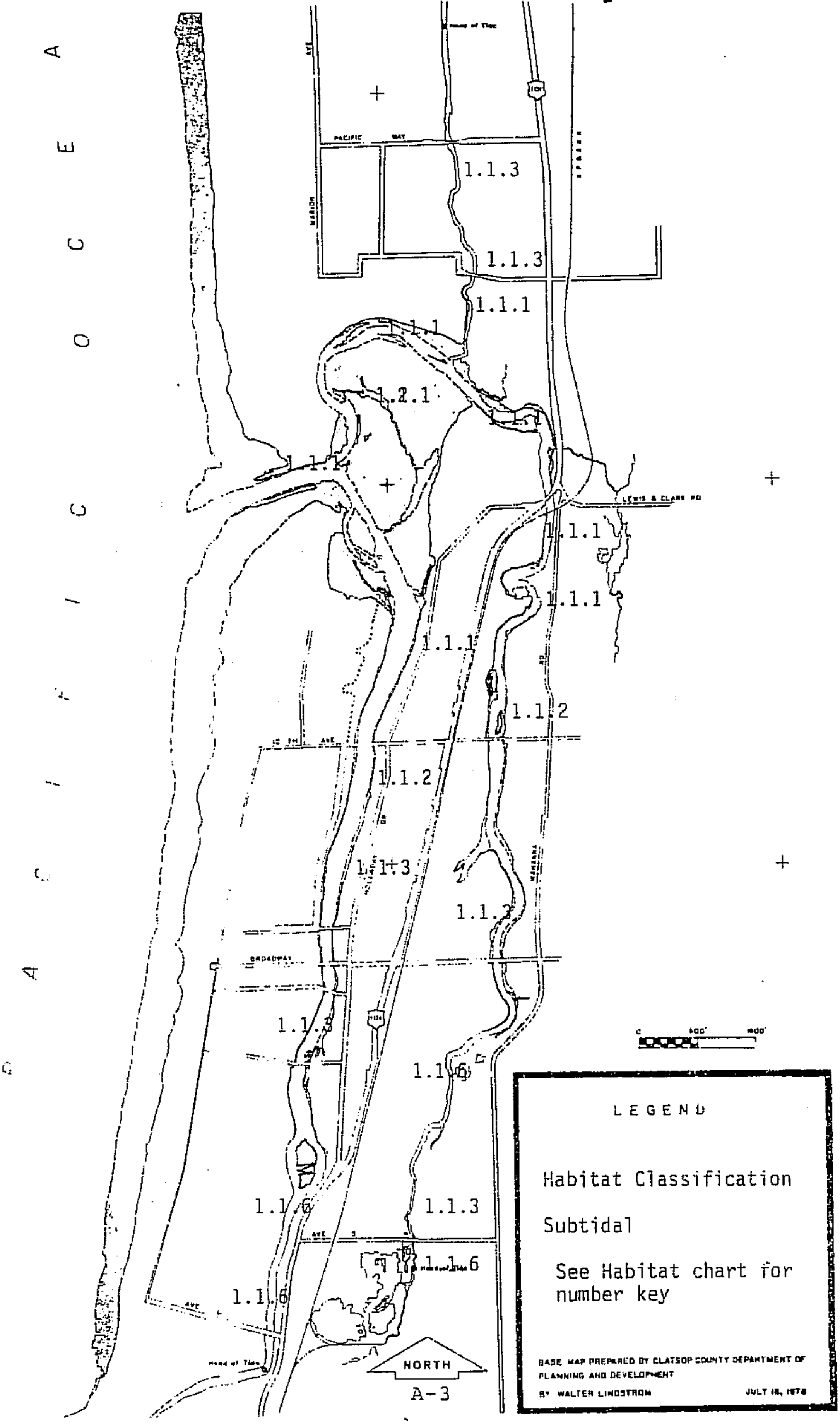
The estuary consists of the Necanicum River, Neawanna Creek, Mill Creek, and Neacoxie Creek. The Necanicum-Neawanna system drains an area of 87 sq. miles with the source of the Necanicum at river mile 21.2, elevation 1360 feet.

The mouth of Neawanna Creek enters the estuary from the North bank at river mile 1.2. Neawanna Creek is approximately 7 miles in length with its source at an elevation of 880 feet. Mill Creek, which enters the Neawanna at 1.5 miles and drains Stanley Lake, is a short 400 yd. from the lake system. At the present time Mill Creek tidal water is controlled by tide gates at its mouth.

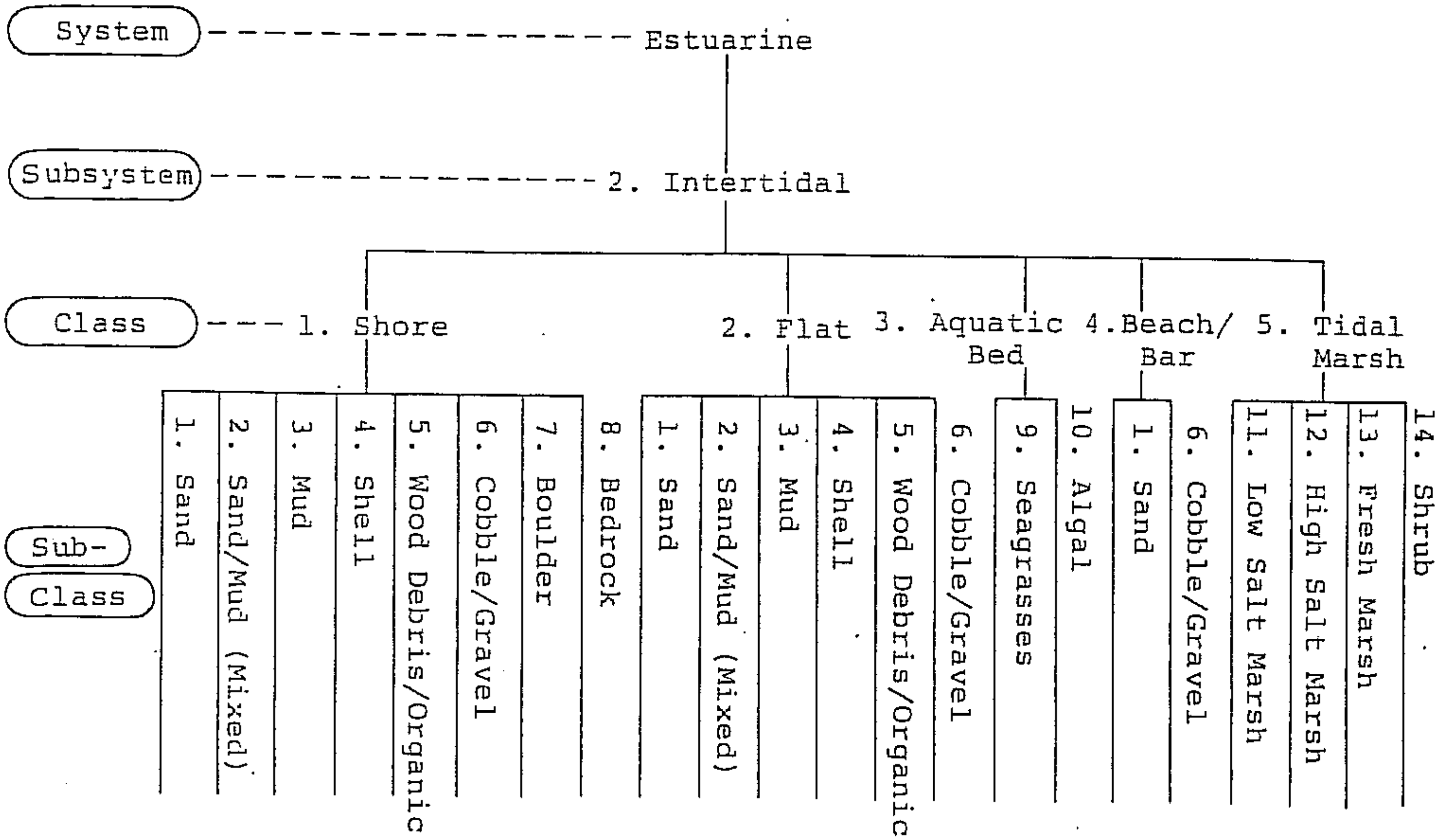
The mouth of Neacoxie Creek enters the estuary from the North bank of river mile 0.2. The Neacoxie is less than 4 miles in length with its source at Sunset Lake, elevation approximately 25 feet.

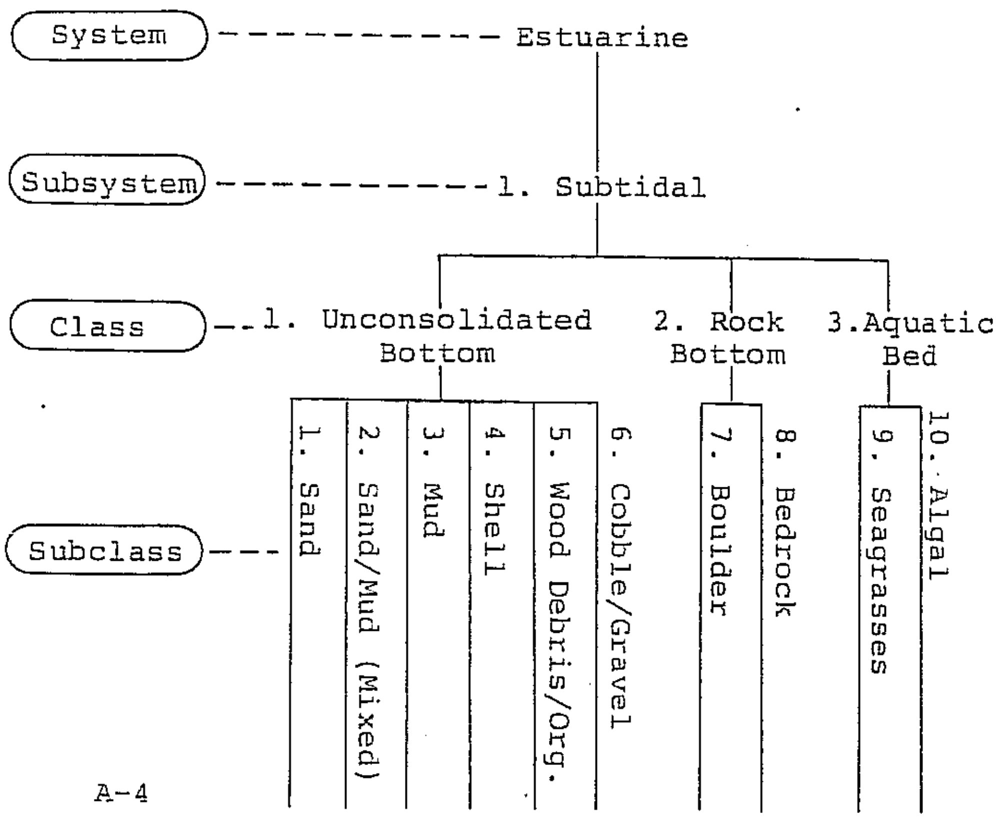

PRELIMINARY
SUBJECT TO REVISION
NECANICUM WATERSHED
O - 2
NORTH COAST BASIN
CLATSOP SWCD CLATSOP COUNTY, OREGON
U.S. Department of Agriculture Soil Conservation Service
May 1971
Seaside
Tillamook Head
SCALE 1:48000
Base
Mapped, edited, and published by the Geological Survey

Necanicum River Estuary



ESTUARINE HABITAT CLASSIFICATION SYSTEM





Modified from "Classification of Wetlands and Deep-Water Habitats of the United States", Fish and Wildlife Service, U.S. Department of Interior, October 1977.

SEDIMENTS OF THE NECANICUM ESTUARY

The intent of this portion of the report is to determine the major distribution pattern for the various size sediments in the estuary. All the data were collected during the week of August 28, 1978, and any conclusions must be limited to the conditions prevalent at that time.

The techniques employed were recommended and explained by Gary Muhlberg[1]. The results should be considered as starting points for future studies as the data are presented as general information. However, the expenditures required to obtain precise assessment were far beyond the nature and scope of this study.

Technique and Sampling Method

Sediments were collected by boat for most of the stations with a grabbing device. Each productive grab produced approximately 100 milliliters of sediments which were placed in plastic bags. Using the following sieves: 1 millimeter (very coarse sand); .5 millimeter (coarse sand); .25 millimeter (medium sand); .125 millimeter (fine sand); and .063 millimeter (very fine sand); plus a collecting basin for the sediments smaller than .063 (silt and clay fraction) the sediments were separated. The actual technique involved measuring a sample which varied between 6 and 10 milliliters wet volume then washing it through the piled sieves with the aid of a spray bottle. Once completely sieved, the sediments were washed into a 10 milliliter graduated cylinder, one screen at a time, with data being recorded as the volume accumulated from each screen. The Wentworth scale[2] (Strahler, pg. 374)* was used to classify the sediments into various sand and silt-clay categories. In all, twenty samples were collected and sieved (see map for locations), ten from the Necanicum, seven from the Neawanna Creek and three from Neacoxie Creek.

*picture of scale included

[1]Muhlberg, Gary, Instructor of Oceanography, Clatsop Community College. Personal conversation, August 14, 1978.

[2]Strahler, Arthur, The Earth Sciences, New York, Harper & Row, 1971. pg. 374 (1967)

Realm of Deposition

In surveying the literature, it does not appear to me that an absolute or uniform method of naming and defining various portions of the river exists. However, Kulm & Byrne[3] have used a system in an estuarine environment which I consider somewhat similar to the Necanicum to define components. Basically, three units -- marine, marine fluviatile and fluviatile were identified. In their work, grain size and mineral content were used to make the separation; lacking the mineral assessment makes our boundary more arbitrary.

The marine zone is described as one having vigorous tidal action, normal marine salinity, fine to medium sand grain size and sediments similar to that of the adjacent beaches and dunes.

The fluviatile zone is that area which lies between the freshwater head of estuary and a point where sediment intrusion are last felt, brackish water conditions prevail, and poorly sorted sediments ranging from silt to coarse sand in grain size are found.

The marine fluviatile comprises that which lies between the marine and fluviatile zones. Normal marine to brackish water conditions are found, a wide scope of sediments are found ranging from well to poorly sorted which vary from silt to medium size sand grains.

By referring to the Necanicum Estuary map and the percent of sand charts, one can see that boundaries have been established which roughly delineate each of the three environments. Using a study done by Twenhofel[4] (pgs. 42, 43) the arbitrary boundary that I have drawn between marine and marine fluviatile zones on the Necanicum corresponds very well with that defined by Kulm & Byrne[5].

[3] Kulm, L.D. & John V. Byrne, Estuaries (Sediments) of Yaquina Bay, Oregon, Washington D.C., American Association for the Advancement of Science, Publication #83.

[4] Twenhofel, W.H., Mineralogical & Physical Composition of the Sands Oregon Coast from Coos Bay to Mouth of Columbia River, Department of Geology & Mineral Industries, State of Oregon, Bulletin No. 30.

[5] Kulm, Estuaries (Sediments) of Yaquina Bay, Oregon.

It is important to point out that the present Seaside Sewer System outfall appears to lie within the marine zone. In my estimation, affluent particulate matter from the overloaded system pumped into the marine zone under low tide, low river runoff conditions coupled with the principle of flocculation could have a devastating effect on the overall stable productive capacity of the entire estuary.

The principle of flocculation is explained by Barnes[6] as follows and applies primarily to fresh water entering an estuarine environment: silt particles (less than .063 millimeters in size) are transported in suspension in the lower reaches of most rivers and are discharged into adjacent estuaries. On contact with a medium containing high concentrations of cation (sodium from the salt, sodium chloride) these silt particles tend to flocculate -- clump together and sink more speedily. Flocculation and fall velocities of the particles are affected by temperature and the amount of organic and inorganic matter in suspension in addition to salinity.

Although the floccules tend to sink they may be carried into outflowing fresh water by the circulation system upon which they will deflocculate and a flocculation/deflocculation cycle can result. Some will reach and adhere to the substratum; however, many will be resuspended by current action at ebb tide and if the concentration of sinking floccules is very high (10 grams silt per .1 liter of water) liquid mud may form which will flow as a layer near the bottom. Although the rate of sediment deposition has not been established for the Necanicum system, in most estuaries net deposition exceeds erosion so that there is an overall accumulation of mud. Generally, some 2 millimeters of mud accumulate per year[7].

It appears to me that such factors as temperature of the streams, marine and sewer effluent, as well as suspended silt load of the river system, amount of organic sewage discharge, accumulation rate of mud in the marine fluviatile, and salinity cycles need further study. I have been prompted to mention this because of the very noxious smelling sediments taken from Station 6 on the Necanicum.

[6] Barnes, R.S.K., Estuarine Biology, London, Edward Arnold Limited, 1974.

[7] Twenhofel, Mineralogical & Physical Composition of the Sands. pg. 7

In establishing the three zones on the Neawanna River system it becomes more apparent why this method of classification must be flexible and arbitrary rather than precise. The marine zone on the Neawanna extends much further inland than on the Necanicum. Although it hasn't been factually documented in this paper, the tidal velocity during the ebb and flood are much higher on the Neawanna than on the Necanicum or Neacoxie.

The factors which influence this are (1) the angle of entry from sea to estuary; (2) the constriction on the Neawanna versus the widening on the Necanicum as one proceeds upriver; and (3) underlying erosional resistive rock structure.

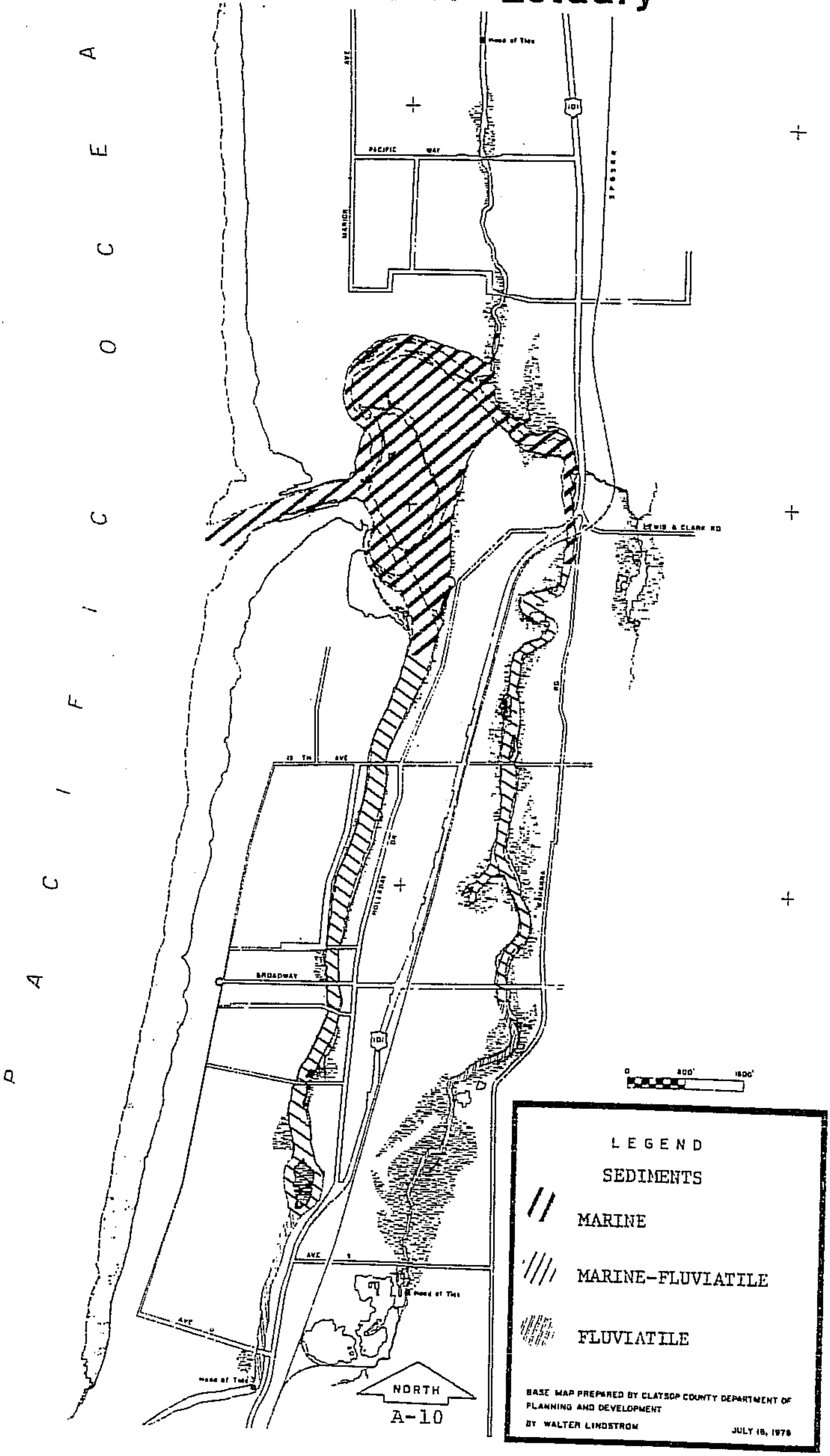
Referring to the Tideland Map of the Necanicum River, you will note that the Necanicum widens at a point which corresponds with the point where the marine zone ends and the marine fluviatile zone begins. Specimen indicators further establish this as the transition area. Viewing the Neawanna one finds a very much different situation. Here the waterway becomes smaller thus confining the volume and thereby increasing the velocity.

Based on the angle of entry it appears that the Neawanna system at its mouth would receive its water at a slightly higher initial velocity than the Necanicum. Proceeding upstream on the Neawanna, this water is further funnelled, allowing the velocity to be maintained. Near the 101 Bridge a large boulder outcropping reduces the scouring action, enabling the stream to maintain a shallow depth. This boulder outcropping apparently runs underneath the railroad tracks through Seaside and crosses under the Necanicum just above Station 10. In fact, this boulder structure separates the marine fluviatile from the fluviatile on the Necanicum. I am somewhat amazed to find this marine environment extending beyond a point somewhere between the school district bus barn and the 12th Avenue Bridge. However, this contention is supported by specimen indicators and sediment sampling.

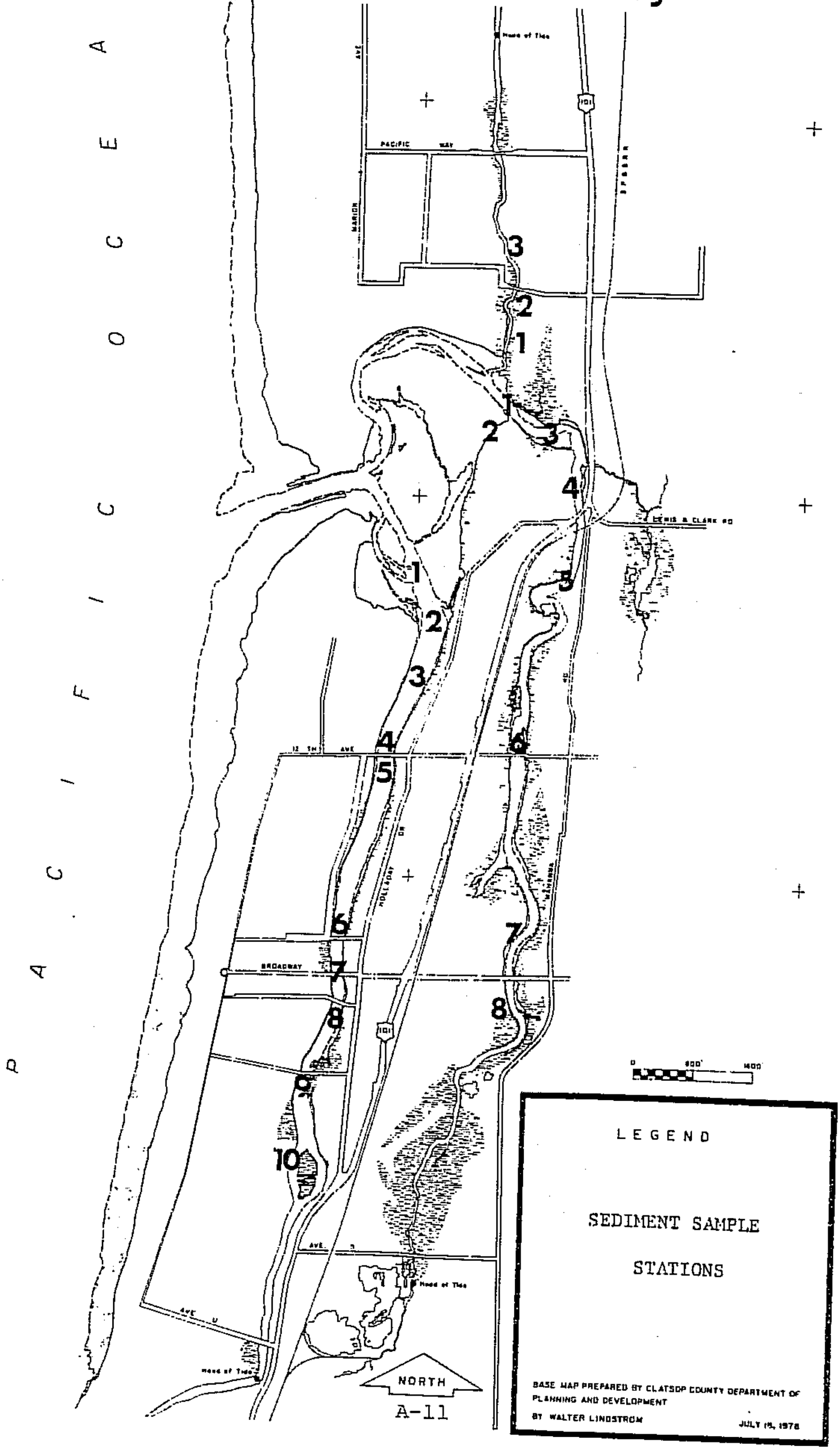
Station 7 located off the Broadway Park dock provided the highest percent of very coarse sediment for any point in the estuary. It would be of interest if this source could be more clearly identified. Certainly, the erosion rates have been greatly accelerated in recent years due to intensified building projects primarily east of the river. The effect this has on biomass capacity of this system should be monitored.

The third and final tributary, Neacoxie Creek, is an excellent example of what happens in a system when man-made constrictions are imposed. Initially, this creek must be considered a marine fluviatile which makes it the only water source in the estuary that lacks a marine zone. This projection is based on particle size of the sediments; however, a marine algae has been identified which would make this marine fluviatile assessment questionable. Finally, the culvert located at the north end of Gearhart certainly has inhibited normal marine intrusion. When one views the sediment analysis from the south as compared with the north side of the culvert, it becomes obvious what this constriction has done. Minimally, the silt-clay component has doubled over that found to the south. Potentially, this drastic change has and will continue to have an adverse effect on this system.

Necanicum River Estuary



Necanicum River Estuary



CLIMATE

The climate of the Seaside-Necanicum Estuary is strongly related to a number of aspects of the local wind patterns, latitude, and ocean shore conditions. Not only is the weather pattern related to the activities of the residents but also has a significant effect on the salinity of the estuary from freshwater runoff during winter storms, the effect of tidal influences during storms, the movement of fish upstream during fall rains, the local ocean temperature, and the amount of local fog that will be hanging over the area.

Atmospheric Conditions

The correlation between the atmospheric circulation and ocean circulation is high and operates to a degree as a single unit. The pattern in the winter would see persistent winds from the southwest bringing with it a substantial amount of rain. The winter weather pattern often originates in the Gulf of Alaska with a counter-clockwise direction and determines the basic weather pattern during the winter months. The summer weather pattern is characterized by clockwise circulation around a high pressure center that brings winds from the north and the west, moderate temperatures, little rain and much fog. These conditions are variable and can change, bringing atypical weather during anytime of the year.

Davidson and California Currents, Coastal Upwelling

Although the relationship to the major currents, winds, and upwelling are not well understood at this time, they will be described briefly here.

Davidson Current:

In winter and early spring the cold waters near the coast are shifted north as a warmer northward current develops near shore. This is a fairly strong current of up to one half mile per hour.

California Current:

This generally only applies to principal southward surface current that occurs in the summer months, although it does extend to great depths in some areas off shore.

Coastal Upwelling:

Because the surface water of the ocean does not move directly before the wind, but slips off at an angle of as much as 45° to the right, thus the prevailing northwest winds that blow parallel to our coast push the surface waters away from the land. To replace the water that is shifting seaward, cold nutrient laden water moves to the surface (Chart 1 and 2). This upwelling process is very important to the productivity of the nearshore areas as biological cycles begin with the utilization of the nutrients. This process can also provide cold nutrient water to become available to move into the estuary.

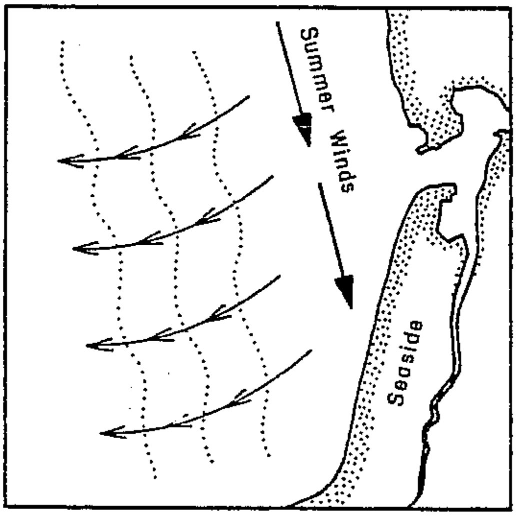


Chart 1. Upswelling-Surface View

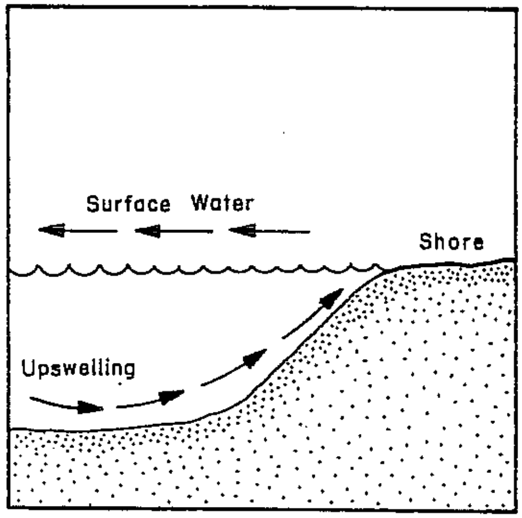


Chart 2. Upswelling in Crossection

Weather Related Hazards

An in-depth study of flood condition and tidal correlation has been done by Soil Conservation Service, Flood Hazard Analysis, March 1976 and the U.S. Department of Housing and Urban Development, Flood Insurance Study, January 1978. These materials should be referred to for information flood hazard conditions in the Necanicum Estuary and related tributaries.

Monthly Climatic Data

From 1953 to Date
For Seaside Area

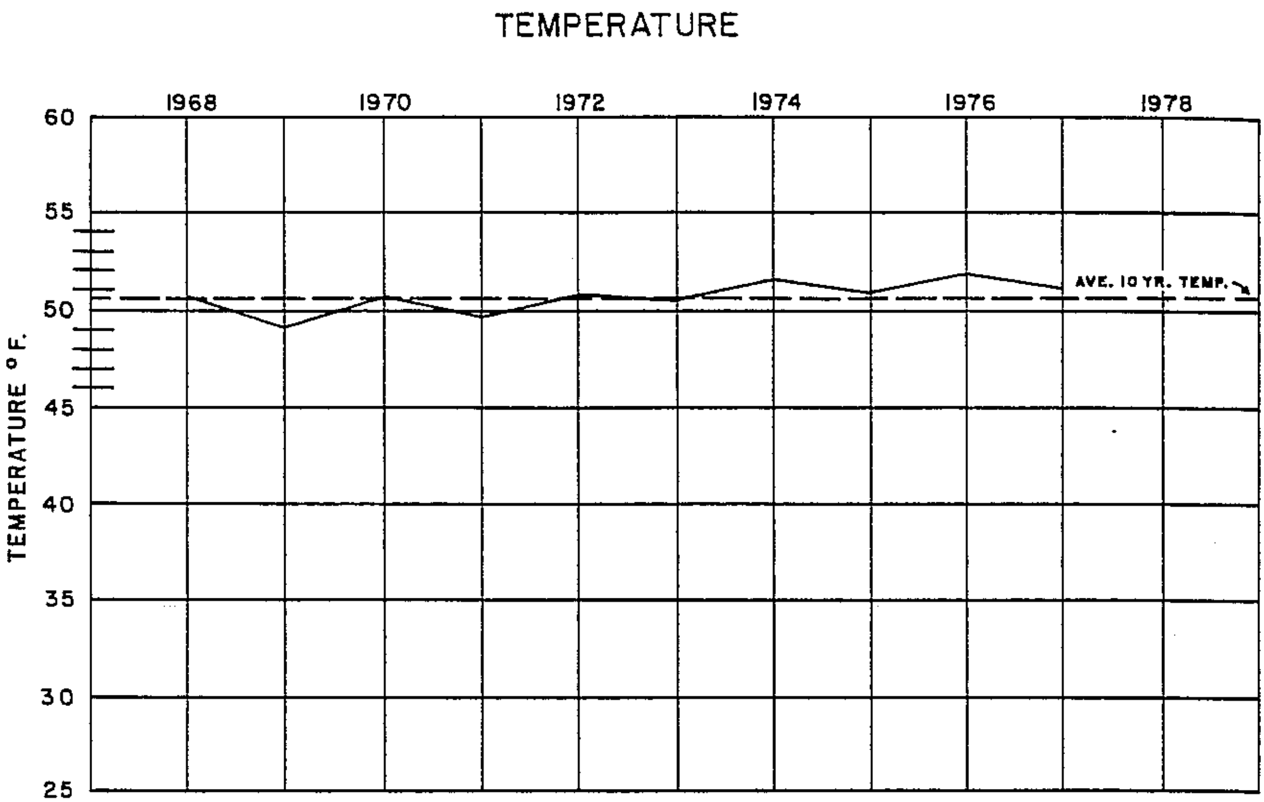
Month	Mean Precipitation Inches	Mean Temperature	Wind Speed mph	Wind Direction
Jan	11.26	41.3	9.3	E
Feb	7.66	43.9	8.9	ESE
Mar	7.51	44.4	9.0	SE
Apr	4.77	47.4	8.6	WNW
May	2.76	52.1	8.4	NW
Jun	2.53	56.6	8.3	NW
Jul	1.13	59.9	8.3	NW
Aug	1.54	60.6	7.8	NW
Sep	2.96	58.3	7.3	SE
Oct	6.56	52.5	7.4	SE
Nov	10.11	46.7	8.4	SE
Dec	11.74	43.0	9.2	ESE
Mean	70.73	50.6	8.4	

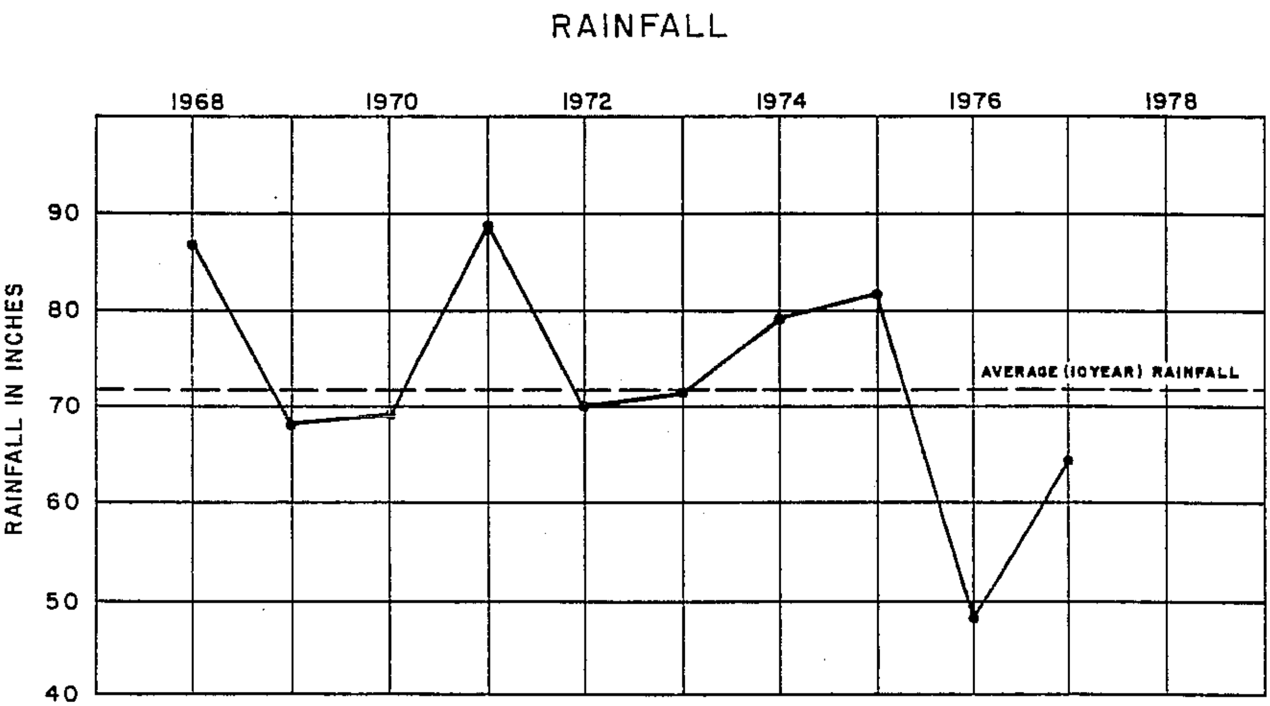
Extremes

Temperature High 101 F., July 1942
Rainfall 36.07 inches, December 1933
Rainfall 24 hour 6.98 inches, January 1919
Low Temperature 6 F., December 1972
Snow Fall 26.3 inches, January 1969
Snow Fall 24 hour 10.8 inches, January 1971

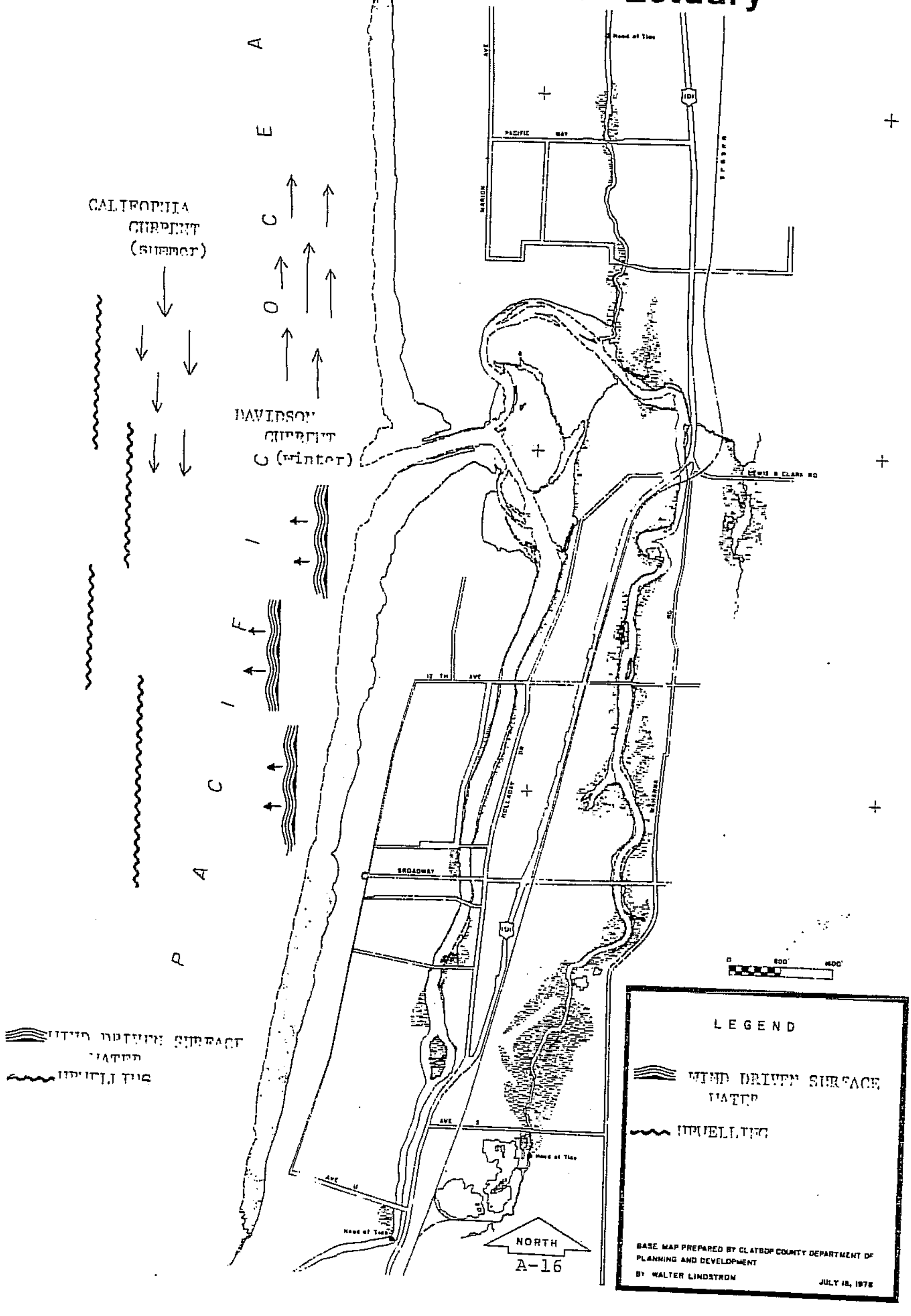
From: U.S. Department of Commerce, Local Climatological Data 1977.

TEMPERATURE AND RAINFALL—SEASIDE AREA





Necanicum River Estuary



Tidal Action (Necanicum Estuary)

One of the most obvious physical phenomenon in the estuary is the daily cycles of tidal action. Each lunar day generates two high waters and two low waters, one of the high waters being higher than the other (HHW) and one of the low waters being lower than the other (LLW).

This action produces the unique conditions of bringing ocean water into the estuary and significantly changing the water level in the environment every 6 hours and 12 minutes as the tide cycles from low to high water. This particular event causes a series of sequential events that are significant to the condition of the estuary. In addition to bringing about a daily environment that allows a unique group of organisms to survive, it also brings about a predictable series of physical events. These are best described in an engineering report by John Locket on the Necanicum estuary.

> "The significant point to recognize in the tidal pattern is the characteristic of the falling tide between the times of higher high water and lower low water which creates the maximum range of ebb flow conditions during the tidal cycle. The entire tidal prism, defined in the following paragraph, is discharged from the estuary in this long ebb run-out period. This results in the maximum velocities in the estuary which may be attributed to the tidal exchange phenomenon.
>
> Flow Attributable to the Tidal Phenomenon--The tidal prism of an estuary is defined as the net volume of water which would flow into the estuary from the ocean during an average floodtide period with no upland inflow. The Necanicum River, as it emerges into the open estuary opposite the Seaside High School, has an average width of about 700 feet. Considering that the mean range of tide at this point in the river is about eight feet and that the lower four miles of the river are subject to tidal influence, the tidal prism of the Necanicum River may be visualized as a wedge of water having average dimensions of 700 feet (average) in width and eight feet in height at its base (opposite the Seaside High School), which dimensions gradually decrease in height to zero at a point four miles upstream. Reducing this to mathematics, the tidal prism of the Necanicum River (P_t), may be expressed as follows:

$$P_t = \frac{w\, r_t\, l}{2}$$, where:

w = average width opposite Seaside High School (700 feet)

r_t = mean range of tide (8 feet)

l = length of tidal influence (4 miles)

or,

$$P_t = \frac{700 \times 8 \times 4 \times 5{,}280}{2} = 59{,}136{,}000 \text{ Cubic Feet}$$

Dividing this number by the number of cubic feet in an acre-foot (43,560), P_t becomes

$$P_t = \frac{59{,}136{,}000}{43{,}560} = 1{,}350 \text{ AF}$$ (acre-feet), which closely checks the volume of the tidal prism reported above.

As this average volume of water is discharged from the Necanicum River opposite the Seaside High School during the period of 6.21 hours in which the tide recedes from the higher high to the lower low levels, the average flow attributable to the tidal phenomenon, Q_t, becomes:

$$Q_t = \frac{59{,}136{,}000}{6.21 \times 3600} = 2{,}650 \text{ CFS (Cubic Feet per Second)}$$

River Flow--Although, as indicated above, there are no field measurements of the fresh water discharge of the Necanicum River, it is possible, knowing the mean annual precipitation over the river basin, to arrive at a reasonable estimate of the magnitude of peak river discharges. The Portland District, Corps of Engineers, reports that the mean annual precipitation over the Necanicum River basin amounts to about 100 inches of rainfall annually. Applying this, the total river length of 21 miles, together with average stream surface slope of 65 feet per mile, the Portland District, by use of the regional frequency approach, has estimated peak flows of the Necanicum River as follows:

FLOOD	PEAK DISCHARGE
2-year Frequency	6,000 C.F.S.
5-year Frequency	7,900 C.F.S.
10-year Frequency	9,000 C.F.S.
25-year Frequency	10,300 C.F.S.
50-year Frequency	11,200 C.F.S.
100-year Frequency	12,000 C.F.S.

Tidal Datum Plane

Because of the legal and planning significance based on the tidal datum (sea level datum) it is important that it be understood in relationship to the effect it has on the Necanicum Estuary.

Of the two daily high waters, one is a higher high water and the average height of higher high water over a considerable period of time in any locality is designated as mean higher high water (MHHW). Likewise, the lowest of the low waters is considered the sea level datum plane for the Pacific coast of the United States. Based on this data the National Ocean Survey of the National Oceanic and Atmospheric Administration has made approximate determinations of the elevation of MHHW, with respect to MLLW at several selected localities along the northern Oregon coast which range from +7.5 feet at the Columbia River entrance, +8.3 feet at Point Adams, +7.8 feet at Nehalem, and +7.5 feet at Barview.

In an effort to determine the precise elevation of MHW in the Necanicum Estuary, the Portland District Corps of Engineers, with assistance of the National Ocean Survey, in the fall of 1971 installed two temporary tide gauging stations in the Necanicum River at Seaside.

Data Collected 1971

Datum Plane	Elevation of Datum Plane (feet)		
	Seaside[1]		Indian Beach[2]
	Sewage Plant	12th St.Bridge	
MHHW	4.9	5.3	4.1
MHW	4.2	4.6	3.4
SLD	0.0	0.0	0.0
MLW			-2.6
MLLW			-3.9

MHHW = Mean Higher High Water
MHW = Mean High Water
SLD = Sea Level Datum
MLW = Mean Low Water
MLLW = Mean Lower Low Water

[1] Two months of observation, November and December 1971.
[2] 31 high and low waters, observed from 27 January to 14 February, 1972.

As the data indicates, it can be seen what the choking effect caused by the mouth of the river has on the full impact of the tidal fluctuations in the near ocean and the estuary. This is of extreme importance when MHHW is used to set boundaries and determine planning procedures for the estuary.

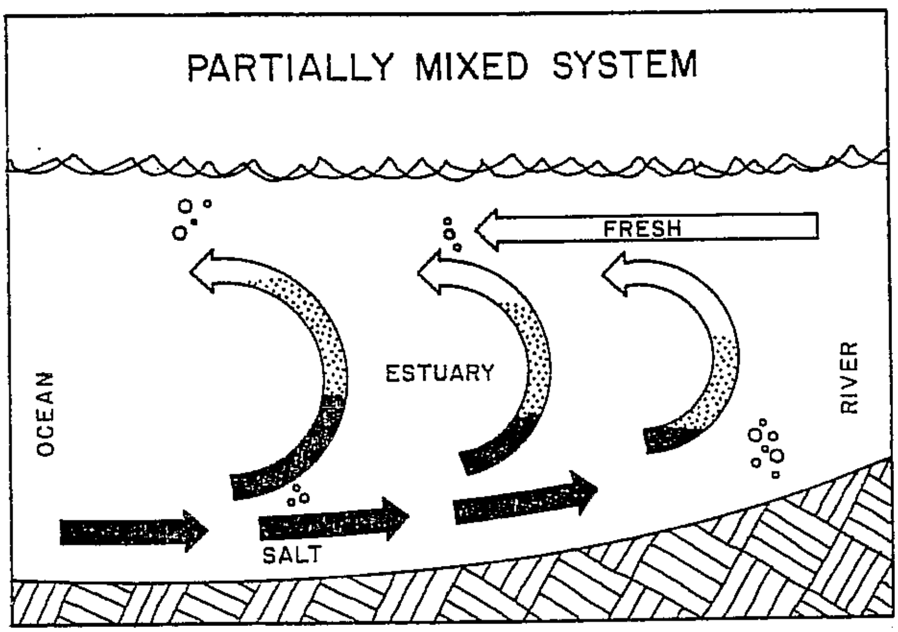
SALINITY

Mixing Classification: Mixing refers to the dilution of salt water and fresh water in the estuary. Salt water is brought in by the tides and fresh water flows in from the rivers and streams. Because of a number of physical factors, such as magnitude of fresh water inflows and the shape of the estuary, the proportions of fresh to salt water can vary widely. (Estuarine Resources OCCDC)

The Necanicum Estuary appears to fall into OCCDC classification of a partially mixed system which they have described in the following way.

The partially mixed system has a difference between the salinity of surface and bottom waters, but without a sharp interface. Relatively moderate to strong tides contribute the energy required to bring about moderate mixing between the surface fresh water and the bottom salt water. Moderate runoff also leads to greater mixing as a sharp interface is not maintained. The estuary has a moderate depth to width ratio which enhances mixing. The difference between the surface salinity and the bottom salinity is 4 percent to 19 percent.

This classification is based on the mixing type with predominates the estuary circulation through the year. Additional data collected during the balance of the year will provide background information for final classification of the Necanicum Estuary.



Salinity Factors

The nature of the salinity intrusion into the estuary is significant beyond the effect of influencing the water level. Because of the nature of marine water and its saline condition, the way that it interacts with the freshwater and its eventual release for the estuary entrapment, it should be well understood before any modification of influence is brought to bear upon this delicate system.

Because of the increased density of the marine water it can be visualized as a wedge of water moving in under the freshwater system of the estuary and under low flow conditions spending a significant amount of time in the estuary (in some cases beyond the complete tide cycle). This intruded water lays on the bottom and carries with it any material that has been added (such as effluent from sewage outfalls) and in addition provides habitat for marine organisms in top layer freshwater environment.

This condition is particularly true in the Necanicum estuary. (See page A-18) Data collected demonstrates that even on extreme low water cycles it was common to find almost marine conditions in the bottom water at sampling stations up to station No. 4 with a 1/3 meter layer of Necanicum River water running over the top of the dense marine water.

Sampling of this water demonstrated the presence of marine plankton and marine fishes on a continuous basis during low flow conditions.

In contrast, during high flow conditions resulting from heavy rainfall periods, there were more homogenous conditions with freshwater being the dominant condition. Heavy rainfall caused a great deal of mixing in the estuary, making short term barriers of freshwater conditions common.

Saline Conditions of Tributaries

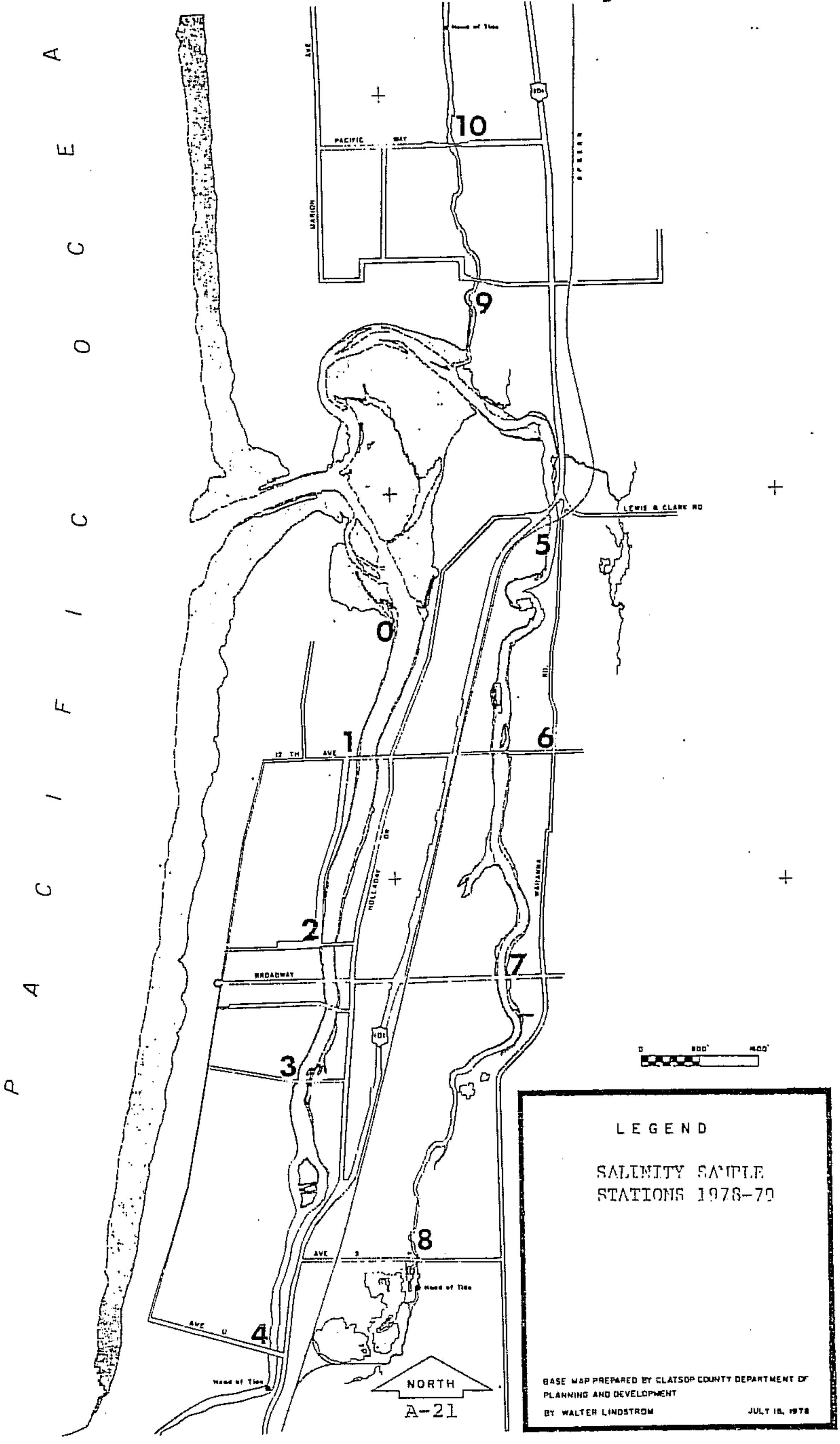
Necanicum--Because of the degree of freshwater contributed by the Necanicum, the overall salinity is somewhat reduced with most of the estuarine organisms being found only in the very lowest part of the river.

Neawanna--The angle of entry of marine water and low flow conditions allow the overall salinity to be somewhat higher than the Necanicum with a good population of saline demanding organisms in this part of the estuary. (significant eelgrass beds, ghost shrimp, obelia, fucus)

Neacoxie--Because of the presence of marine (estuary adapted) organisms up to the first culvert, the saline conditions demonstrate that they are adequate to support these organisms. Culverts on this tributary reduce the marine intrusion into the upper estuary.

SALINITY PATTERNS
NECANICUM ESTUARY

DATE	RUN OFF	STATION NO.	SAMPLING TIME	TIDE & TIME	SALINITY ‰		WATER TEMP.
Aug 21	Low	#1 Necanicum	9:35 a.m.	9:31 a.m. -0.6 (LW)	TOP BOT.	17.1 29.5	15.6 15.3
Aug 21	Low	#2 Necanicum	9:45 a.m.	9:31 a.m. -0.6 (LW)	TOP BOT.	25.5 30.2	15.5 14.8
Aug 21	Low	#3 Necanicum	9:55 a.m.	9:31 a.m. -0.6 (LW)	TOP BOT.	4.3 30.2	15.4 14.8
Aug 21	Low	#4 Necanicum	10:05 a.m.	9:31 a.m. -0.6 (LW)	TOP BOT.	0.4 24.5	15.3 15.6
Aug 21	Low	#1 Necanicum	4:45 p.m.	3:41 p.m. 8.4 (HW)	TOP BOT.	9.7 30.6	17.3 15.5
Aug 21	Low	#2 Necanicum	4:30 p.m.	3.41 p.m. 8.4 (HW)	TOP BOT.	5.0 30.0	16.9 15.5
Aug 21	Low	#3 Necanicum	4:15 p.m.	3:41 p.m. 8.4 (HW)	TOP BOT.	3.2 29.4	16.5 15.5
Aug 21	Low	#4 Necanicum	4:11 p.m.	3:41 p.m. 8.4 (HW)	TOP BOT.	0.7 23.8	16.1 16.9
Nov 19	High	#5 Neawanna Railroad Tr.	3:30 p.m.	2:46 p.m. 7.8 (HW)	TOP BOT.	1.4 1.7	7.0 6.9
Nov 19	High	#1	3:15 p.m.	2:46 p.m. 7.8 (HW)	TOP BOT.	0.4 0.4	6.6 7.0
Nov 19	High	#3	3:00 p.m.	2:46 p.m. 7.8 (HW)	TOP BOT.	0.3 0.3	-- 6.5
Jan 14	Low	#0 Necanicum Sewage Plant	2:45 p.m.	1:24 p.m. 7.5 (HW)	TOP BOT.	21.2 30.0	6.6 7.0
Jan 14	Low	#3 Necanicum	3:15 p.m.	1:24 p.m. 7.5 (HW)	TOP BOT.	2.2 26.9	6.6 6.8
Aug 25	Low	#10	3:10 p.m.	(LW)		6.1	18.6


PACIFIC OCEAN
Head of Tide
PACIFIC WAY
MARION AVE
101
10
9
LEWIS & CLARK RD
5
0
1
12 TH AVE
6
HOLLADAY DR
WAHANNA RD
2
BROADWAY
7
3
0 800' 1600'
8
AVE S
Head of Tide
4
AVE U
Head of Tide
NORTH
LEGEND
SALINITY SAMPLE STATIONS 1978-79
BASE MAP PREPARED BY CLATSOP COUNTY DEPARTMENT OF PLANNING AND DEVELOPMENT
BY WALTER LINDSTROM
JULY 18, 1978

Temperature

Temperature variation in the Necanicum system covers a wide range and needs to be considered in reference to the effect on plant and animal populations and the eventual effect on dissolved oxygen (D.O.).

Temperature ranged from a high of 21.3 c. down to a low of 4.8 c. The variation conformed to seasonal patterns, to terrestrial temperatures, the temperature of the watershed runoff and ocean water intrusion temperature. Because of the shallow depth of the Necanicum estuary and its contained state, a great amount of energy is absorbed and stored in these waters, allowing for extreme temperatures in the summer during maximum solar radiation. This is important because of the lost oxygen holding capacity during high temperatures. Variations exist in temperature from top to bottom waters with temperature difference of from 1 to 3 c. between water (see chart).

Crisis conditions could occur during summer periods when maximum amounts of effluent are being processed (as populations peak in summer months) and released in the estuary. Temperatures climb to above 20 c. and D.O. levels dip dangerously low. This combination of events could produce lethal conditions for estuary organisms and planning should be done with these maximums in mind.

Sample Temperatures (c.)

August		November		January		June	
Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
20.6	16.7	7.0	6.9	6.6	7.0	20.2	18.8
15.6	15.3	6.1	7.2	4.8	6.6	21.9	18.9
21.3	18.0	6.6	7.4			17.8	16.0

SECTION B

(Biological)

PLANKTON

This group of organisms includes those that are weak swimmers and are at the mercy of the water movement (other than vertical movement), floating organisms, and drifting life. This group would include the bacterioplankton (bacteria), phytoplankton (plants), and zooplankton (animals).

Plankton plays an important role in the food web of the Necanicum estuary and during specific times of the year marine plankton becomes the major component of the estuary plankton. This section will deal with only the zooplankton and phytoplankton. The variables that effect the growth and reproduction are extensive and are beyond the scope of this inventory. It can be pointed out that physical and biological factors are vital to the success of these organisms in maintaining a viable ecological setting for maintenance of estuary life. Alterations of any of the physical and biological constituents should be given major consideration in developing an estuary management policy.

Phytoplankton

Phytoplankton is that part of the planktoners represented by diatoms (single celled plants), dinoplagellates, and planktonic algae. Phytoplankton represents what some call the "hidden flora" because it is so inconspicuous in our environment. In the Necanicum estuary this is particularly true. In fact, without the aid of the microscope this important plant group would go totally unnoticed. Yet it makes up one of the most significant parts of the energy conversion units of the estuary. It is almost impossible to collect either a sand, mud, or water sample and not find hundreds of diatoms after the sample is prepared for microscopic observation.

Phytoplankton in its production of stored chemical energy, utilizes nitrogen, phosphate, and carbon dioxide. In addition, the diatoms population needs silicate to be used in the formation of a glass-like cast that surrounds its cell structure. Because of the plant qualities of these organisms they need light to carry on the life process and, therefore, are confined to the surface waters and water that will allow light transmission (water with low turbidity).

Factors Affecting Phytoplankton Growth:

Light, as has been mentioned, becomes a limiting factor and should be considered with the following aspects in mind. The means by which phytoplankton cells use the radiant energy; the intensity of the incident light, the way it is affected as it passes through the water. The availability of base nutrients is another important factor. These factors are of particular importance when you consider our latitude in Clatsop County, the amount of cloud cover we have during the year and the amount of silt that moves into our river from the terrestrial environment. One of the most obvious reactions to the light intensity change is the tremendous phytoplankton blooms that occur in the early spring along the coast. Great brownish masses, appearing somewhat like an oil spill are blown on the local shores and are obvious in the surf line. Examination shows that they are blooms of phytoplankton by the millions that are responding, by reproducing, to the increased light duration and intensity.

Because of the low flow conditions and relative high saline conditions of the Necanicum estuary during July, August and September (see Chart S1) a nearly marine condition exists on a continuous basis, which allows for many marine species to maintain a healthy population in the estuary. Plankton tows in late July and early August were producing almost totally marine populations of diatoms.

The filamentous diatom Melosira is dominant enough in the estuary to identify it within a community structure. One of the obvious communities in the Neawanna is the zoestra-melosira community. Melosira is also dominant in the substrate sample and algae mats. A number of the diatoms that normally grow as a part of the benthic community become dislodged from tidal action and become a part of the planktonic group. As a result these organisms contribute to the available food supply for zooplankton and filter feeders.

Note: For some reasons not yet determined the Neawanna tributary demonstrates a tremendous diatom bloom in the spring not observed in the Necanicum and Neacoxie tributaries.

Partial Species Lists of Phytoplankton in the Necanicum Estuary:

Bacillaria sp.

Rhizosolenia sp.

Coscinodiscus centralis

Chaetoceros sp.

Thalassionema nitzchiodes

Asterionella japonica

Chaetoceros debilis

Thalassiosira decipiens

Ditylum sp.

Skeletonema sp.

Biddulphia longicruris

Nitzschia closterium

Melosira moniliformis

DINOPLAGELLATES

Noctiluca sp.

Peridinium sp.

Net tows were made at high and low water cycles for comparison of populations present. (see Chart P1 for tow stations)

Chart Explanation:

The density of phytoplankton to the water volume will be rated only as high, medium, and low relative to the water sampled. Sample density is related to the relative density of the individuals within the sample.

(D) Dominant -- organism makes up the major portions of the sample (there may be more than one species in this category).

(M) Many -- a number of individual organisms, but not the dominant organism.

(I) Individuals -- isolated species present in the sample.

PHYTOPLANKTON INVENTORY

	July	August	January	March
Plankton Density	High	Medium	Low	Very High
SPECIES				
Bacillaria sp.	I	I	-	-
Rhizosolenia sp.	I	I	-	I
Chaetoceros sp.	D	M	-	D
Thalassionema nitzchiodes	I	I	I	M
Asterionella japonica	M	M	-	M
Chaetoceros debilis	M	M	M	M
Thalassisira decipiens	D	M	I	I
Ditylum sp.	I	-	-	I
Skeletonema sp.	I	I	-	-
Biddulphia sp.	M	I	I	M
Nitzschia closterium	I	-	-	I
Melosira moniliformis	D	D	-	I
Coscinodiscus centralis	I	I	I	I
Dinoflagellates				
Noctiluca sp.	I	-	-	-
Peridinium sp.	-	I	-	I

Macro Algae:

In general the macro-algae population of the Necanicum estuary is low and includes few species. One of the most conspicuous limiting factors is the lack of substrate for holdfast attachment of the larger algae. In those areas where there is adequate substrate (rocks, logs, and rip-rap) a good population of algae takes hold. There are only a few rock outcroppings with the rest of the substrate being sand and mud in the lower estuary.

The algae populations for the most part are confined to the Neawanna and Neacoxie.

Species List for the Necanicum Estuary

Ulva lactuca

Fucus distichus

Enteromorpha sp. (2)

Cladophora gracilis

Polysiphonia pacifica

Eel Grass:

Shallow water eel grass small populations in the Neawanna tributary of the Necanicum estuary. The total area is less than one acre and confined to the 1 to 2 ft. shore areas. The eel grass population is quite variable as to success from year to year.

Zostra marine, which is one of the rare members of the spermatophyte plants that grows in aquatic saline conditions, is normally submerged by water on a continuous basis. Because of its tolerance for saline waters and the need to be protected from wave shock it is normally found in estuarine waters.

Eel grass is an important part of the estuarine ecosystem because it provides large amounts of detritus. It provides a hiding and breeding place for many fishes and invertebrates. And a large number of polycheate worms and crustaceans are found among its rhizomes. It also provides substrate and habitat for diatoms, algae, and crustaceans.

REFERENCES

Boney, A.D., Phytoplankton. Edward Arnold Publishers, London, 1975. 116 pp.

Cupp, E.E., Marine Plankton Diatoms of the West Coast of North America. University of California Press, Berkeley and Los Angeles, California, 1946. 237 pp.

Haertel, L., "Estuarine Nutrients and Plankton." Ecology, 1969. Vol. 50, No. 6.

Lyford, J.H., H.K. Phinney, "Primary Productivity and Community Structure of an Estuarine Impoundment." Ecology, 1968. Vol. 49, No. 5.

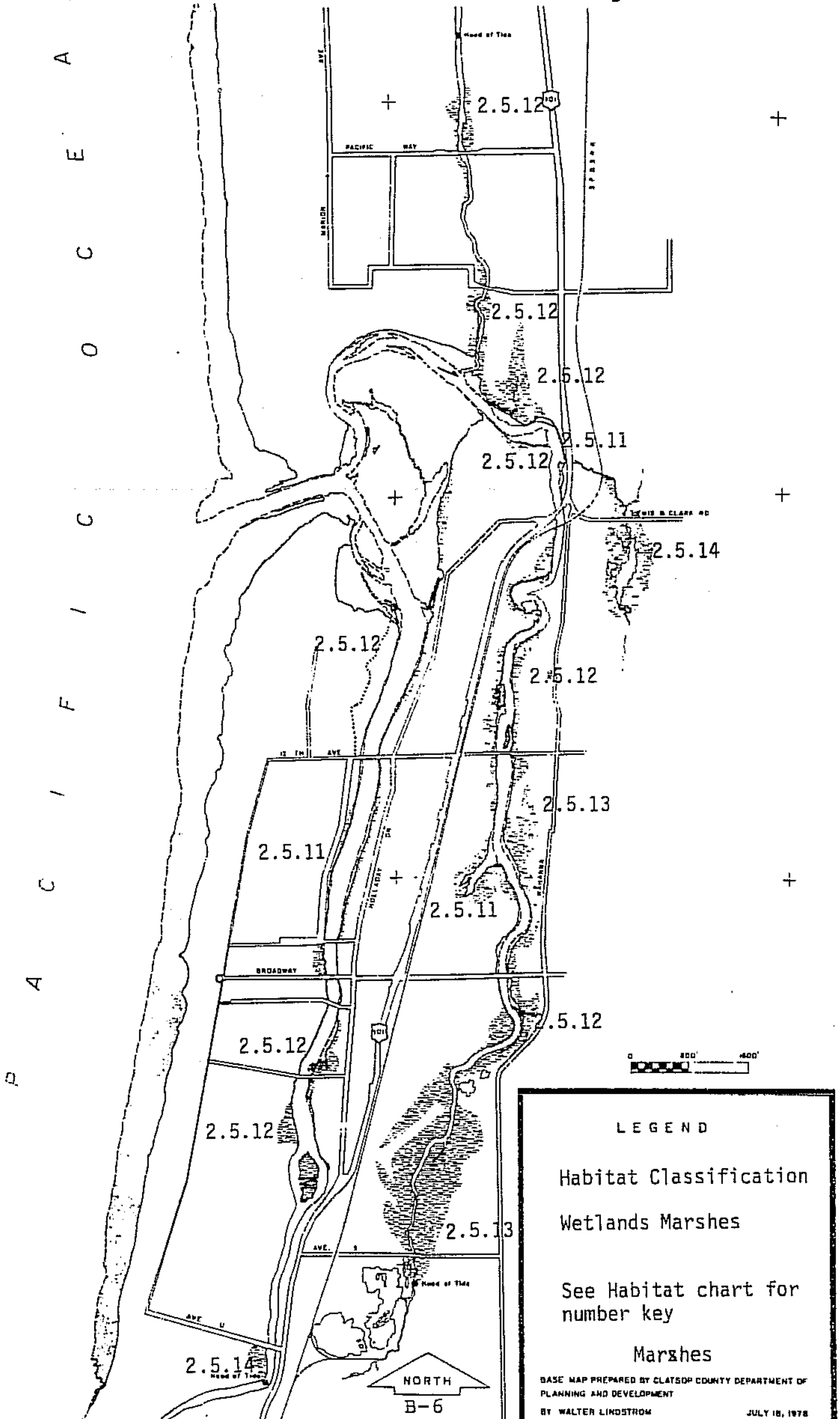
Markham, J.W., J.L. Celestino, "Intertidal Marine Plants of Clatsop County, Oregon." Syesis, 1976. Vol. 9. 14 pp.

Newell, G.E. and R.C., Marine Plankton. Hutchingson Educational LTD., London. 215 pp.

Smith, G.M., Marine Algae of the Monterey Peninsula, California. Stanford University Press, Stanford, California, 1944. 622 pp.

Stout, H., ed., The Natural Resources and Human Utilization of Netarts Bay, Oregon. N.S.F. Interdisciplinary Study, Oregon State University, 1976.

Necanicum River Estuary



LEGEND

Habitat Classification

Wetlands Marshes

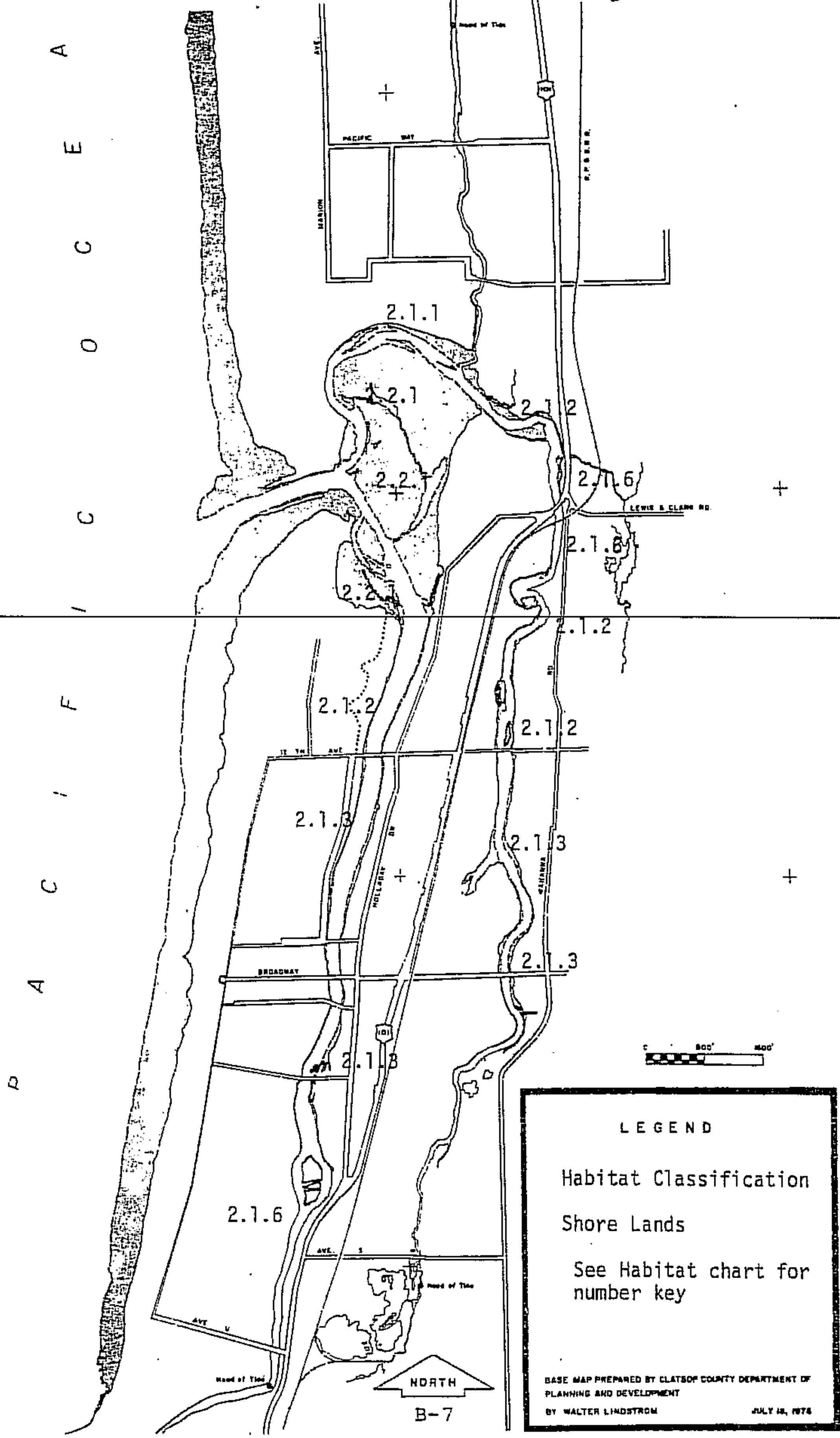
See Habitat chart for number key

Marshes

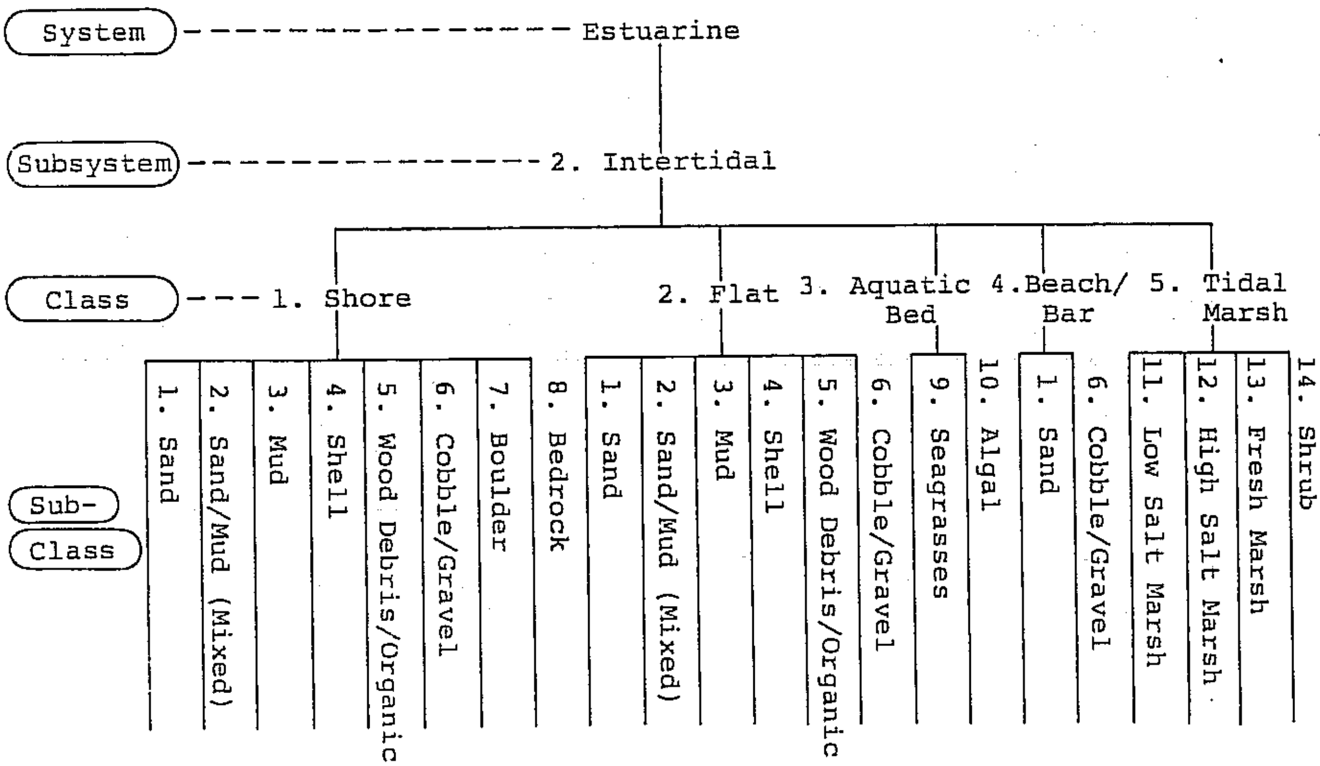
BASE MAP PREPARED BY CLATSOP COUNTY DEPARTMENT OF PLANNING AND DEVELOPMENT

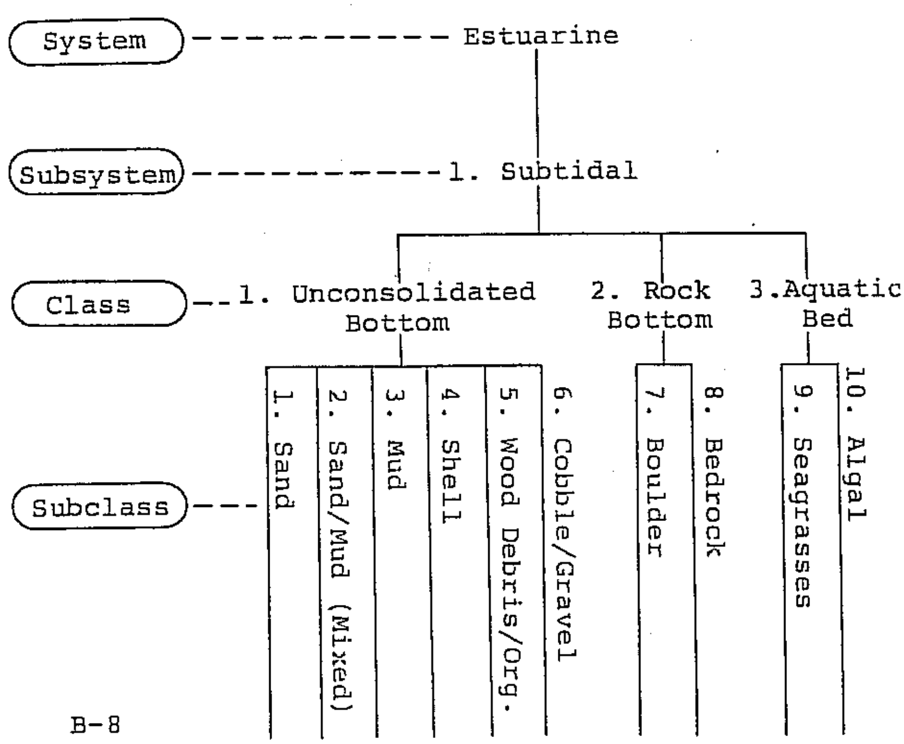
BY WALTER LINDSTROM JULY 18, 1978

Necanicum River Estuary



ESTUARINE HABITAT CLASSIFICATION SYSTEM





Modified from "Classification of Wetlands and Deep-Water Habitats of the United States", Fish and Wildlife Service, U.S. Department of Interior, October 1977.

ESTUARINE MARSHES

The marshes of the Necanicum River Estuary include those marshes, tidelands and shallow waters associated with tidal influence that produce a unique habitat that can be identified by the invasions of particular kinds of marsh plants. In the Necanicum River Estuary, of the 278 acres of estuary, approximately 150 acres fall into this description. Although there are no vast expanses of marshes, there are still enough small isolated units to possibly maintain the vitality of the estuary. The marshes of the Necanicum Estuary run 4.5 kl in the Necanicum system, 6 kl in the Neawanna, and 2 kl in the Neacoxie system.

Using the following definition (O.C.C. & D.C. 1974) for tidal marsh wetlands, "The tidal marsh wetland type is composed of those communities of vascular aquatic and semi-aquatic vegetation rooted in poorly-drained, poorly aerated soil, which may contain varying concentrations of salt occurring from lower high water inland to the line of non-aquatic vegetation." The following topics will be considered in this section: (1) Role of Tidal Marshes in Estuary Dynamics, (2) Biological Systems, (3) Formation of Marshes and Their Succession, and (4) Marsh Inventory of the Necanicum Estuary.

The vital role that estuary wetlands play in the natural cycle of the estuary has only been recently realized to the degree that management programs have been instituted to protect this resource. With estuaries being far more productive than most other types of habitats (Chart M1) and that productivity being of direct benefit to man, serious consideration should be given to their protection. Confirming studies are just now being done on the west coast, as they have on the east coast a number of years ago, to demonstrate the specifics of that productivity and its benefit.

TABLE M1

General Orders of Magnitude of Gross Primary Productivity In Terms of Dry Weight of Organic Matter Fixed Annually

Ecosystem	gms/M^2/year (grams/square meters/year)	lbs/acre/year
Land deserts, deep oceans	Tens	Hundreds
Grasslands, forests, eutrophic lakes, ordinary agriculture	Hundreds	Thousands
Estuaries, deltas, coral reefs, intensive agriculture (sugar cane, rice)	Thousands	Ten-Thousands

(From: The Conservationist 1971, The Role of Tidal Marshes, Dr. Eugene Odum)

BIOLOGICAL SYSTEMS

The most vital link in the food chain in this aquatic environment is the marsh plants as they process solar energy in the presence of chlorophyll, carbon dioxide and water to produce carbon compounds. In this process the marsh plants assimilate and convert phosphorous and nitrogen into compounds that are necessary for many of the estuary organisms. The success of these photosynthetic plants in converting sunlight into stored chemical energy will determine the productivity of the estuary marshes and the eventual productivity of the whole estuary.

As opposed to the terrestrial (dryland) environment where much of the green plant is consumed and put into the energy cycle when it is alive, the marsh plant serves the greatest importance in the system as it dies and forms the base of the food chain as decaying plant matter (detritus). Also important in this discussion is the fact that the nutrient fertilizers are cost free as products from the tidal action and freshwater runoff, as opposed to high yield agricultural crops which demand a huge investment of petroleum based nutrient fertilizers for an energy return.

The organic debris resulting from this plant decay is maintained within the estuary and becomes the foundation for the energy cycle. (i.e. In an intertidal salt marsh, less than 10 percent of living plant material is consumed by herbivores and 90 percent goes the way of the detritus-feeders and decomposers [Teal, 1962]). The decay is a result of bacteria colonization which significantly increases the protein content of the original particle. In addition the detritus may be consumed directly by a host of estuary animals such as amphipods, clams, shrimp, and worms as well as other forms. In turn these organisms become food for organisms higher in the food chain, such as fish, birds and ultimately man.

The storage aspect of the estuarine marshes are not to be overlooked in this cycle. The marshes play an important role in the storage of nutrients that become a buffer against heavy stress on seasonal shortage (e.g. winter). As described by Clark (1974): marsh grass in its entirety--roots, leaves, flowers, stems--provide storage upon which the regularity of nutrient supply to the estuarine food chain depends.

This brief description in no way describes the intricacies of food cycles in estuaries. It is used here only to demonstrate the role of the marsh plants and their significance as the base of the food pyramid as decaying organic matter.

In addition the marshes contribute to the productivity of the estuary by providing favorable conditions for the increased growth of algae by reducing the turbidity of the water and by decreasing velocity of the water during heavy runoff. Because of this unique environment, associated mud flats become biological gardens for the growth of diatoms (single-celled algae) and other algae.

Fish and Wildlife Habitat

The role of the marshes, in addition to the energy factors, is significant in providing habitat for a number of associated animals. Although the total acreage is low in the Necanicum River Estuary, it still provides important habitat for raccoons, mink, otter and a number of other small mammals. Because of the urbanization of much of the associated marshes, animal movement is restricted to the more open areas.

One of the most critical and least obvious to the layman is the role that marshes play during the high tide cycle in providing habitat for the fishes. This is especially true of the anadromous fishes, such as coho salmon and steelhead during their downstream migration. As the salmon spend a period of time in the estuary before their migration to the sea, the daily flood of large areas of low marsh is critical to their survival. The marsh fringes provide protection and an important food in the form of small aquatic animals that are plentiful in the marshes because of the detritus cycle.

Marsh habitats are important to both migrant and resident birds. Not only does the marsh provide habitat for the nesting cycle, but is important as a food supply to many local and migrant species. Census counts show particularly heavy use by migrating birds and ongoing use of the high marsh by resident birds.

Some of the uses of the marsh are very subtle and for the most part go unnoticed. An example is the role that the sedges play in the life cycle of the lady bug beetle. In July and early August the beetle larva can be seen moving up the sedge plants very near the water's edge and within a few days thousands of lady bug adults can be observed emerging from the sedge marshes. The most accessible location for observation is near the Broadway bridge on the east side of the Neawanna. The marshes as breeding and hatching habitat for insects takes on new meaning when we consider the importance of the insects in maintaining important ecological balance, as in the case of the lady bug beetle who is a predator and preys upon aphids.

Marshes-Control Erosion and Store Water

Wetland vegetation can play an important role in providing stability to shorelands by protecting them from the erosive forces of heavy winter runoff and storm driven tides. At the same time they help control the rate of runoff by reducing the velocity of the runoff. Because of the nature of the marsh substrate they are also critical in storing water during low water periods.

Water Quality Control

Within certain limits, wetlands and associated marsh plants can play an important role as natural purifying agents of water. As long as the surface area of marshes are maintained they have a tremendous potential for absorbing nitrogen and phosphorous from sewage. Each wetland has a limited capacity and to exceed that would deplete the oxygen needed for a balanced ecological system. Coastal rivers already carry a large supply of oxygen depleting nutrients; therefore, the use potential of the marshes as water purifying agents must be balanced with their ability to handle the peak loads. In the case of the Necanicum Estuary almost 50% of the marsh area has been covered over with fill, thereby reducing the potential for water quality functions.

Because the shallow estuary waters trap and hold heat which reduces the impact of cold ocean waters and mountain water this may have important impact on growth cycles and reproduction rates of marsh plants.

Recreation Value

Marshes can withstand limited impact and do not recover well from inappropriate use. They have recreational value to the hunter, the fisherman, the nature enthusiast and photographers. In considering uses of marsh area serious consideration should be given to the nature of the recreation use that it does not cause irreversible damage to the marsh and wetlands.

In addition the marsh serves an intrinsic aesthetic function as open space and as an expected associated part of an estuary system. This function is difficult to measure but should be considered in the decision making process for local planning.

FORMATION OF MARSHES AND THEIR SUCCESSION

The marshes and marsh potential area are generally going through some type of progressional change to build the site to a more complex community. In the early formation of marshes the substrate is invaded by one of the early colonizers (in the Necanicum they would normally be woody glasswort or salt grass) which acts as a substrate binder. As the colonization continues and the area traps more substrate, other talophytes begin to establish themselves. In the Necanicum we could expect seaside arrow grass, seaside plantain, and Jaumea to become part of the understory. This stabilized environment would cause a rise in elevation resulting in a vegetation pattern of Lyngbyes' sedge, tufted hairgrass, salt rush, and Pacific silverweed. There are a number of variations from this pattern but this represents a sequence that could be expected. This process may involve a period of years to occur and will be influenced by the nature of the substrate (sand or silt) and by the major water influence (salt or fresh).

Marshes appear to constantly be in a stage of advancing to the next higher form with little likelihood of regressing to a previous condition. At this time there are only a few isolated sites where marsh formation, in the earliest stages, is occurring in the Necanicum River Estuary. Most of this activity is in the lower part of the Neawanna system. In general the marshes of the Necanicum system are in the immature high marsh condition advancing to the mature high marsh environment.

Tidal Marsh Classification

Marsh Class:

Higher intertidal land forms that are predominantly covered more than 30% by erect, rooted herbaceous or woody hydrophytes. The tidal marsh generally occurs from lower high tide inland to the line of non-aquatic vegetation.

Description:

Water often moves through marshes in non-vegetated channels. The tidal marshes are a main source of primary production for the bay. Oregon tidal marsh plants are persistent, that is they are dominated by species that normally remain standing at least until the next growing season. Like flats, marshes tend to be either in equilibrium or increasing in elevation and expanding onto adjacent flats. Seldom under natural conditions would a marsh revert to a flat or a high marsh to a low marsh.

Subclasses of Tidal Marshes:

(1) Low Salt Marsh. Low Salt Marshes are entirely flooded by most high tides and, therefore, are capable of adding to the estuarine food supply on a daily basis. Tidal runoff is generally diffuse rather than contained in deep ditches. Five Oregon Low Salt Marsh categories are currently used: Low Sand Marsh, Low Silt Marsh, and Sedge Marshes in more saline areas; and Bullrush and Sedge Marshes, and Gravel Marshes in areas subject to lower salinities.

(2) High Salt Marsh. High Salt Marshes usually rise abruptly 30 cm to 1 meter above the adjacent flat, shore or low marsh. The substrate is typically high in organics -- often as an organic mat over clay. The marsh surface is just covered by most higher high tides. Tidal runoff follows well defined channels. The marsh surface is relatively level. Two main High Salt Marsh categories are currently used: Immature, being somewhat lower with less defined channels and a greater variety of plant species; and Mature, with well defined features and vegetated mainly by grasses, rushes and forbes.

(3) Fresh Marsh. Fresh Marsh occurs inland of salt marsh where the substrate is non-saline, or as the surgeplain marsh in the upstream portion of the estuary where fresh water under tidal influence periodically inundates the marsh. Vegetation is herbaceous with sedge, bullrush and cattails usually dominating.

(4) Shrub. Shrub wetlands may occur as the inland extent of the estuary. In Oregon, willow is the primary semi-aquatic woody plant that is likely to occur. Willow, however, does not tolerate salt and so is associated with estuarine Fresh Marsh rather than Salt Marsh. Some trees may be found in these areas.

MARSH INVENTORY OF THE NECANICUM ESTUARY

(1) This marsh represents one of the largest marsh areas of the Necanicum system that is still basically in its original condition. It is bordered on the river's edge by a low salt marsh that grades to a high salt marsh. The low salt marsh is characterized by woody glasswort, salt grass, Jaumea and seaside plantain.

With a change in elevation the area demonstrates plant characteristics of a high marsh with tufted hairgrass, and salt grass. Increased elevation sees the vegetation type moving to Pacific silverweed, creeping bent grass, tufted hairgrass and salt rush. The deeply carved channels are bordered with Lyngbyes' sedge.

Because of the sand dune like nature of some of the area, plants that are more representative of sand dunes can be found, such as large headed sedge beach pea and American dune grass. At the very south end of the identified marsh a sedge marsh can be found.

(2) Although most of the identified section of the estuary is filled on the west side, there are small patches of sedge marsh on the west side and a slightly large border on the east shore also of sedge marsh and tufted hairgrass.

(3) A small low salt marsh only a block long between the Oceanway Bridge and Broadway Bridge. A sedge marsh is located on both sides of the estuary and grades to a high marsh environment of Pacific silverweed, tufted hairgrass, and seaside dock on the west side.

(4) A small island that has become a high marsh environment of tufted hairgrass and Pacific silverweed. An associated sedge marsh on the east shore grading to a high marsh of tufted hairgrass, Pacific silverweed and Seaside Dock

(5) This marsh area is a portion of what is left of a large land fill. This particular site is a good example of a mature high marsh with a wide variety of marsh plants. The dominant plants being represented by tufted hairgrass, and Pacific silverweed.

(6) Two large islands located in the middle of the estuary. Bordered by sedge marsh and grading to a high marsh of tufted hairgrass, Pacific silverweed and Lyngbyes' sedge. A part of the southern island has gone through a successional process to now be supporting a small stand of willow and a few spruce.

(7) This area is high in the estuary system and is characterized by a number of freshwater plants and should be considered as a fresh marsh even though it is not above the line of salt water intrusion. The plant species are represented by freshwater sedge, cattail and Pacific silverweed.

Neawanna System

(8) A small marsh of the Neawanna that is left from a diking and filling project. A low salt marsh is just starting to build in this area and is being colonized by woody glasswort and salt grass. The shore section is a high salt marsh represented by woody glasswort, salt grass, Jaumea, fox tail grass, seaside plantain and American dune grass in the higher elevations.

(9 & 10) High salt marshes bordering the Neawanna. These marshes have similar elevations and common plant structures. They are border marshes that run parallel with the shoreline. The plant population is made up of woody glasswort, Hordium, salt grass, salt bush, Jaumea, tufted hairgrass, salt rush, Pacific silverweed, and American dune grass.

(11) This site represents the largest sedge marshes of the Necanicum Estuary. It is flooded by most high tides. The Lyngbyes' sedge surrounds a large mud flat that drains this area. A recent fill has covered some of the high marsh environment that surrounds this sedge marsh. This marsh may well represent the source for much of the organic debris that moves into this part of the estuary system.

(12) A shore border high marsh with much the same character as marsh 9 & 10 with the addition of two stands of great American bullrush and a Lyngbyes' sedge marsh on the near shore of this high marsh. Large populations of lady bugs have been observed hatching in this particular sedge area. The beetles use the sedge to move onto during their larval stage before turning into the flying adults.

(13) This marsh is high in the Neawanna estuary and is demonstrating a transition from a salt marsh environment to the fresh marsh condition. This is the single largest marsh area in the system. The plant population is represented by tufted hairgrass, Pacific silverweed, salt grass and a scirpus species found in fresh marshes.

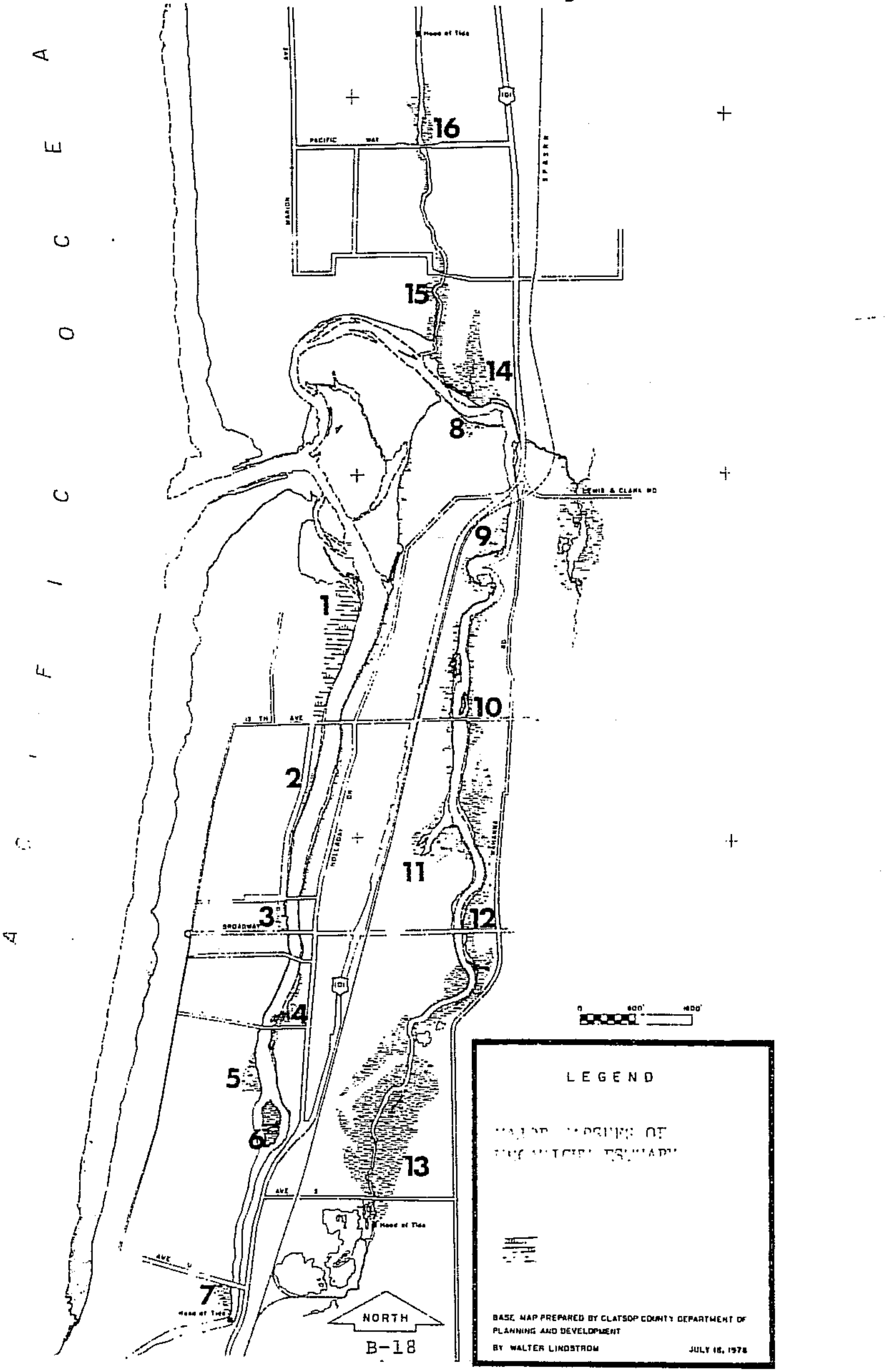
Neacoxie System

(14) A large open space marsh area at the confluence of the Neacoxie and Neawanna. A broad flat high marsh that grades into a shrub marsh on the Northern end. The shoreline plants are a typical cover of woody glasswort, Jaumea, and salt grass. The upper reaches of the marsh are dominated by American dune grass. This marsh represents the largest salt marsh in the estuary and should have specific protection.

(15) The Neacoxie tributary of the estuary has a continuous wetland along its shores to the head of tide. This is a narrow marsh and is characterized as a high marsh with near shore populations of Jaumea and salt grass. The elevated parts of the marsh consist of creeping bent grass, Pacific silverweed, salt bush, sea milkwort, salt rush and seaside arrow grass. A culvert below this marsh limits the tide movement.

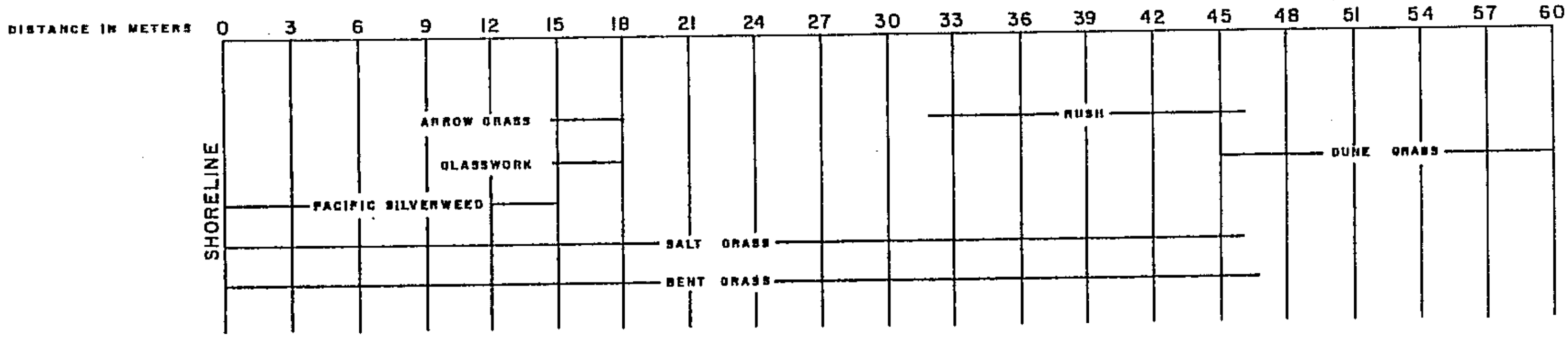
(16) This marsh environment is near the identified head of tide and is also limited by a second culvert. The marsh would fall into the high marsh class and is invaded by spike rush, triglochin, Pacific silverweed and Lyngbyes' sedge.

Necanicum River Estuary

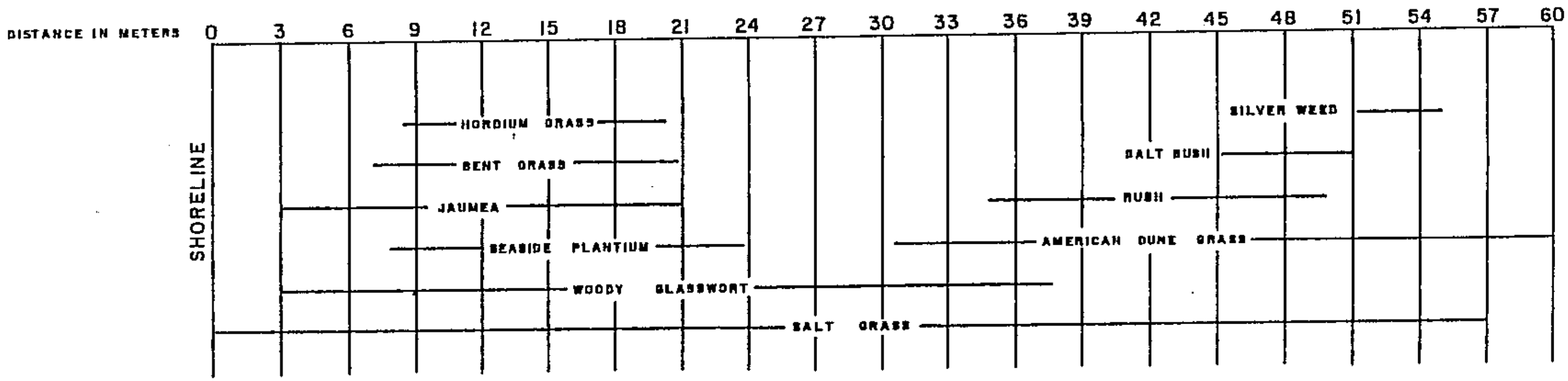


MARSH PLANT DISTRIBUTION—NECANICUM ESTUARY

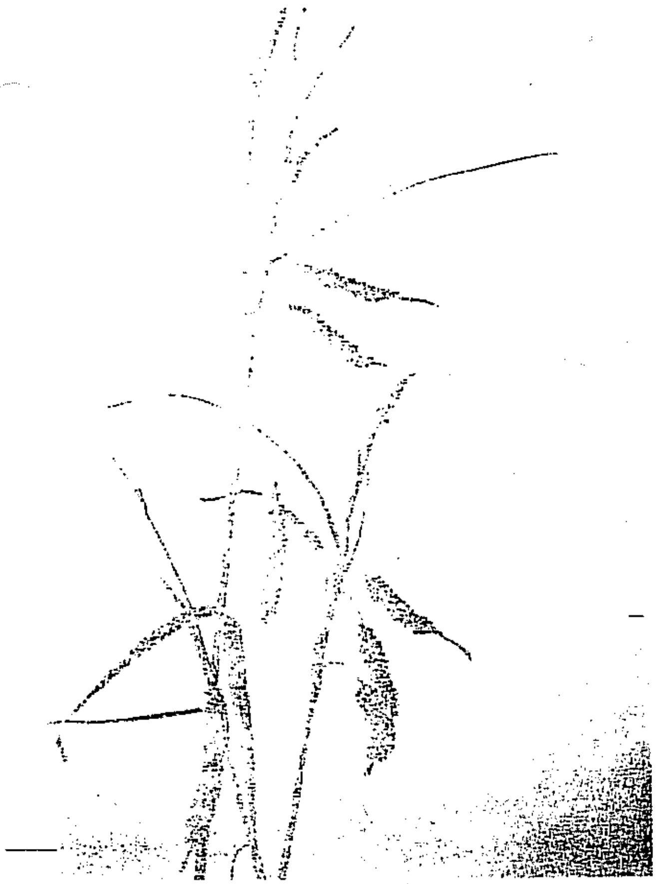
MARSH NO. 1



MARSH NO. 14



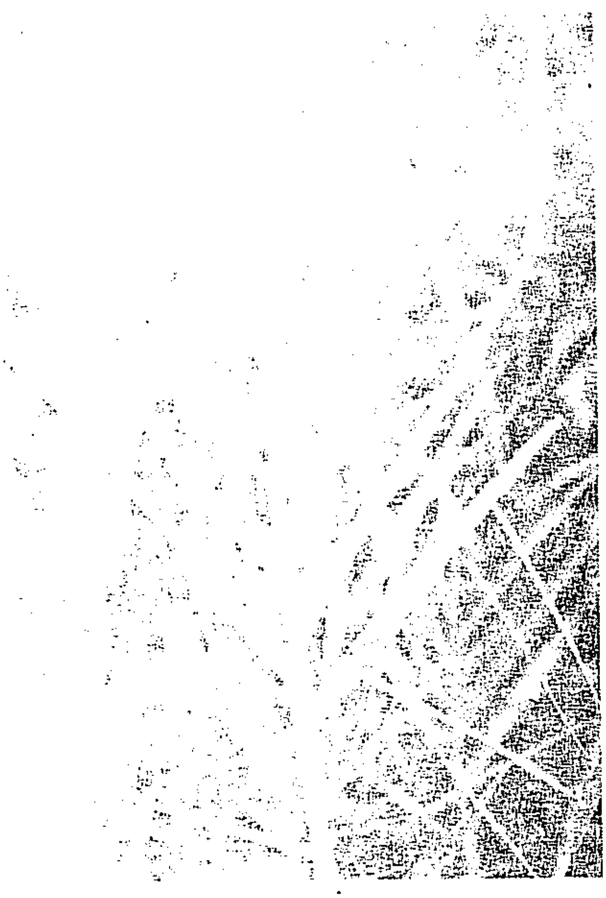
Marsh Plants



[illegible] SEDGE

GLASSWORT

[illegible] SILVER WEED



[illegible] ASS

TUFTED HAIRGRASS

Checklist of Necanicum Estuary Marsh Plants

Common Name	Scientific Name
European Beach Grass	*Ammophila arenaria*
Thrift	*Armeria maritima*
Bent Grass	*Arostis alba*
Salt Bush	*Atriplex patula*
Slough Sedge	*Carex obunupta*
Large-Headed Sedge	*Carex macrocephala*
Lyngbyes' Sedge	*Carex lyngbyei*
Salt Marsh Dodder	*Cuscuta salina*
Tufted Hairgrass	*Dischampaia caepitosa*
Salt Grass	*Distichlis spicata*
Spike Rush	*Eleocharis sp.*
American Dune Grass	*Elymus mollis*
Tall Fescue	*Festuca sp.*
Sea Milkwort	*Glaux sp.*
Fox Tail	*Hordeum sp.*
None	*Jaumea carnosa*
Baltic Rush	*Juncus balticus*
Beach Pea	*Lathyrus japonicus*
Seaside Plantain	*Plantago maritima*
Pacific Silverweed	*Potentilla pacifica*
Seaside Dock	*Rumex sp.*
Ditch-grass	*Puppia sp.*
Woody Glasswort	*Salicornia virginica*
None	*Scirpus macrocarpus* (freshwater)
Three Square Grass	*Scirpus maritimus*
Seaside Arrow Grass	*Triglochin maritima*

REFERENCES

Aikens, Glen J. and C.A. Jefferson, Coastal Wetlands of Oregon. Prepared for the Oregon Coastal Conservation and Development Commission, 1973.

Clark, John, Coastal Ecosystems. The Conservation Foundation, Washington D.C., 1974.

Jefferson, Carol A., Plant Communities and Succession in Oregon Coast Salt Marshes. Unpublished Ph.D. Dissertation, Oregon State University, 1975.

Lyford, J.H. and H.K. Phinney, "Primary Productivity and Community Structure of an Estuarine Impoundment." Ecology, Vol. 49, No. 5, 1968.

Odum, Eugene P., Fundamentals of Ecology. 3rd edition, W.B. Sanders Co., 1971.

Odum, Eugene P., "The Role of Tidal Marshes." The Conservationist, State of New York, Conservation Department, 1961.

Steward, A.N., L.J. Dennis and H.M. Gilkey, Aquatic Plants of the Pacific Northwest. 2nd edition, Oregon State University Press, 1963.

Stout, H., ed., The Natural Resources and Human Utilization of Netarts Bay, Oregon. National Science Foundation Interdisciplinary Study, Oregon State University, 1976.

Wiedemann, A.M., L.J. Dennis and F.H. Smith, Plants of the Oregon Coastal Dunes. Oregon State Book Stores, Inc., Corvallis, Oregon, 1969. 116 pp.

Zooplankton

The zooplankton-phytoplankton interrelationship is an important factor in the dynamics of the estuary system. The phytoplankton makes up the food supply consumed by the zooplankton and it is dependent upon an ample supply. As a result the zooplankton functions as a first order consumer in the estuary food cycle. In turn the zooplankton becomes the basis of a chain of predator prey cycles in the estuary that leads to success of a major part of the food web in the estuary.

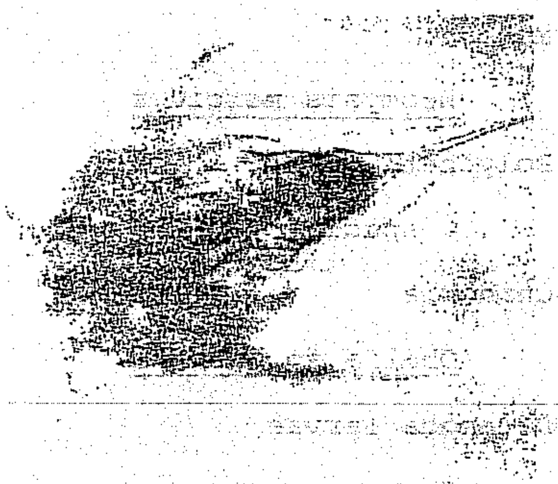
Zooplankton cycles and population changes are a characteristic factor of this group. As salinity and freshwater vary through the year, the shift in individual zooplankton and their numbers responds accordingly. Just how populations change in the Necanicum estuary will not be known until studies have been completed.

Zooplankton is not a homogenous group but is made of many individuals that are passing through a plankton stage of their life cycle (in the Necanicum estuary the nauplius stage of the barnacle is one of the most obvious parts of the plankton, page photo). Other examples would include the fish eggs and larva, benthic worm larva, and many of the crustacean and echinoderms. Other parts of the zooplankton population include forms that spend their entire life as plankton, such as the copepods and cladocerns. Most of the major phyla of organisms show up as plankton at some point in their life cycle. A number of these examples can be found on page .

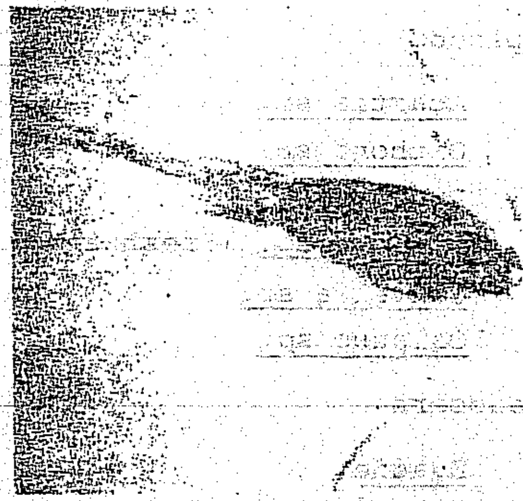
Because no definitive studies have been done on the ecological aspects of the zooplankton, the assessment must remain as a generalized view of plankton in estuaries and an inventory species list which will display the general populations during the year. Very few of the organisms are permanent residents of the estuary but are tidal in nature and come to this estuary as a part of the marine tidal population. A few individuals originate from the Neacoxie, Mill Creek, Neawanna and the Necanicum tributaries.

Inventory studies conducted during the summer of 1978 show an almost total marine condition owing to the high salinity of the estuary in the summer.

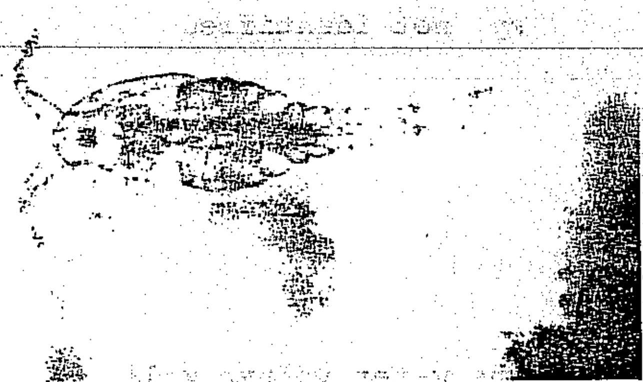
Plankton



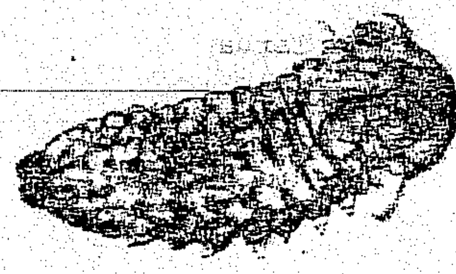
BARNACLE LARVA



COPEPOD



CYCLOPS-COPEPOD



POLYCHETA LARVA

CRAB LARVA(zoea)

MEDUSA-OBELIA

Necanicum Estuary Zooplankton

Copepoda

- Acartia sp.
- Oithona sp.
- Eurytemora sp.
- Cyclops sp. (Freshwater)
- Canvella sp.
- Calanus sp.

Cladocern

- Evadne

Ctenophores

- Pleurobrachia sp. (Spring)

Gastropoda

- Clam larva

Mysids

- Neomysis mercidis

Polycheta larvae

- 2 species

Cnidaria

- Obelia sp. medusa

Decapoda larvae

- Crab zoea

Cirripedia

- Barnacle nauplius

Fish Eggs

- sp. not identified

Chart Explanation

The density of zooplankton relative to the water volume will be rated only as high, medium and low. Sample density is related to the relative density of the individuals within the sample.

(D) Dominant--makes up the major portions of the sample (there may be more than one species in this category),

(M) Many--a number of individuals, but not the dominant organism,

(I) Individuals--isolated species present in the sample.

ZOOPLANKTON INVENTORY

	July	August	January	March
Zooplankton Density	High	Medium	Low	Low
SPECIES				
Copepod				
Acartia sp.	D	D	M	I
Oithona sp.	M	M	M	-
Eurytemora sp.	I	I	-	-
Canuella sp.	I	I	-	-
Calanus sp.	I	I	-	-
Cyclops sp.	I	I	-	-
Harpacticoid	-	-	I	M
Evadne	I	I	-	-
Ostracoda	-	I	-	M
Pleurobranchia sp.	-	-	-	I
Clam larva	I	I	-	-
Neopysis mercidis	M	M	-	-
Polycheta larva	I	I	I	M
Medusa (sp)	M	-	-	I
Crab larva	I	-	-	I
Barnacle larva	D	D	-	M
Fish Eggs	I	-	-	-

REFERENCES

Kujala, N.F., *Ocean Plankton*. Oregon Ocean Services, Warrenton, Oregon, 1977.

Lyford, J.H., H.K. Phinney, "Primary Productivity and Community Structure of an Estuarine Impoundment." *Ecology*, 1968. Vol. 49, No. 5.

Misitano, David A., *Zooplankton, Water Temperature and Salinities in the Columbia River Estuary*. December 1971 through December 1972. Data Report 92, National Marine Fisheries Service, NOAA, Seattle, Washington, 1974. 31 pp.

Smith, D.L., *A Guide To Marine Coastal Plankton*. West Coast Plankton Studies, Cambell, California, 1971. 82 pp.

NECANICUM ESTUARY
BENTHIC ANIMALS

The bottom sediments of the Necanicum Estuary system provide habitat for a large group of animals that make up the benthos. These organisms range in size from microscopic plants and animals to large animals such as clams and ghost shrimp. Much of the population found in the infauna (organisms that live within the sediments) is microscopic. The epifauna is made up of those organisms that live on or just above the sediment surface.

Organisms of the benthos may range in size from those that could be considered microscopic, such as bacteria, protozoa, fungi, algae and diatoms. Each of these organisms plays an important role in the stability of the estuary with the bacteria being of particular importance in the decomposition cycle. Nematode worms and hargacticoid copepods make up an intermediate group of organisms that are less than 1 mm in size and are normally restricted to the top few centimeters of sediment.

The larger more conspicuous organisms that can be seen with the unaided eye make up the balance of the fauna of the benthos. Crab, shrimp, clams, polychaete worms, barnacles and mussels make up the typical examples of this group.

The larger organisms can be divided into three feeding types: selective particle feeders, deposit feeders and filter feeders. Selective particle feeders may be scavengers, predators or herbivores, feeding on whole organisms they capture or fragments of plants or animals. Fishes, crabs, and some worms and other mobile species fall into this category. The food is primarily organic material and broken down by mechanical and chemical processes. Wastes are combined with mucous and often form distinctive fecal pellets which may make up a significant percentage of the bottom sediments.

Deposit feeders include worms that move through the sediment ingesting and utilizing what organic material is contained therein and discarding the remains as feces. Other deposit feeders bury themselves in the sediment. Using siphons or other extensions they suck up detritus that has recently fallen to the bottom. These animals are unselective in what they feed upon, but they often have efficient sorting mechanisms. The feces of these deposit feeders may contain a high percentage of inorganic material.

Filter feeders draw in water and particulate matter. Most clams and mussels use tiny hair-like cilia to create currents of water over a mucous network which traps particles. Others, such as tube-dwelling worms, may force water through their borrows by body movements.

The feeding habits of benthic animals can have a significant effect on the sediments and overlying waters. Deposit feeders turn over huge quantities of sediments and bring oxygen to deeper layers. Filter feeders and some deposit feeders remove detrital and particulate material from the water and sediment surface. These animals play an important role in partially breaking down organic matter for the microorganisms which complete the mineralization.

Of particular importance is the interrelationship of a number of the benthic invertebrates in being utilized as the major food supply for the estuarine fishes, in particular the downstream migrating salmon juveniles that spend an important part of their life cycles in this habitat.

ECOLOGICAL CONCERNS: that mud and sand flat areas must be maintained at all cost as habitat for benthic organisms and that release of juvenile fishes be controlled in relationship to the productive potential of the Necanicum Estuary.

Management policies should speak to this topic in relation to fish release by the state agencies and those that are released by private hatcheries.

Special consideration is given to the ghost shrimp (_Callianassa californiensis_) because of the dense population in the lower estuary and its role in the substrate.

> *_Callianassa_ is considerably elongated, which is possibly a direct response to its method of living, and is rather brightly colored, even though always hidden in the mud. Adult individuals average from two to three inches in length and vary from a whitish yellow to orange-red. Their one outstanding feature is the possession of an exceedingly large cheliped, which may be either the right or left.
>
> _Callianassa_ is found most abundantly in tidal regions of from zero to plus one foot and restricted to bottoms of mixed sand and mud of a sufficiently tenacious consistency to allow the construction of burrows of a rather permanent nature. Neither very loose sand nor very soft mud will serve.

*Description by G.E. MacGinitie from "The American Midland Naturalist".

The animal is occupied almost constantly in extending or adding new tunnels to its burrows, which often connect with those of other individuals.

Callianassa feeds by sifting the sand for its contained detritus. As in burrowing, the sand is drawn in from the face of the tunnel; but unlike the actual burrowing, the sand is sifted by the hairs on the dactyls of the second and third legs and scraped off by the hairs of the third maxillipeds. From these, by a series of movements of the mouth parts, it finds its way to the oesophagus.

A sifted load of sand for an average-sized Callianassa will approximate one-half to one cubic centimeter, the amount of material deposited around one entrance between low tides. At this rate the soil would be turned over in 240 days to a depth of thirty inches, which is the approximate limit of depth to which the animals burrow.

Egg laden females may be found at any time throughout the year but are more numerous during the latter part of June and July. The eggs are carried by the female until the embryos have reached the zoea stage, when hatching takes place. They subsequently pass through a larval stage and at the next molt become like the adult and settle to the bottom.

Dungeness crab populations reach high levels at various times during the year. During low runoff periods cancer crabs may be found in the estuary on a continuous basis because of the saline conditions of the water. As winter runoff increases they tend to move in and out with the tide cycles.

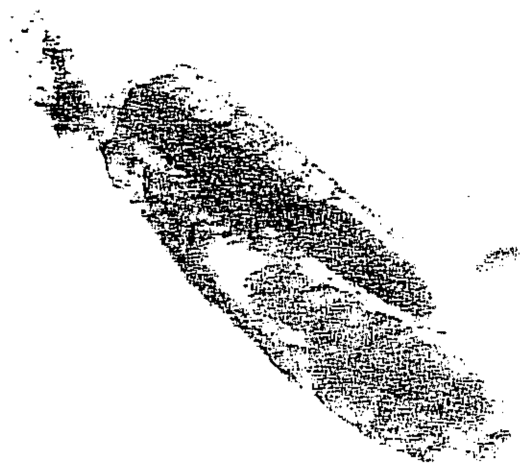
Crabs that were caught and marked by number in the Neawanna during August demonstrated that the population was generally on the move. Crabs were trapped in pots and numbered on the shell and released. Of the 75 marked only 5 were recaptured during a one week study.

Extensive crabbing by sportsmen occurs in the July and August seasons throughout the estuary. As many as 25 crab rings have been observed at 12th Avenue Bridge with additional fishermen in boats working crab rings. Success on legal adults is generally fair with hundreds of immature crabs being caught and released each day.

Crabbing would be considered the second most popular recreation use of the estuary behind fishing.

Benthic Organisms

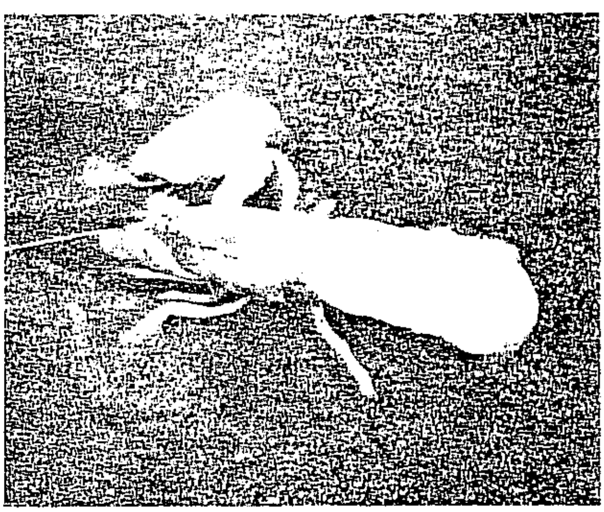
CLAM LARVA



HARPACTICOID-COPEPOD

NEMATODE WORM

DIATOMS



GHOST SHRIMP

COROPHIUM

SPECIES LIST
(incomplete)

Hydrozan

Obelia sp.

Annelida

Nemertea, 2 species
Oligochaeta
one species unidentified

Polychaeta

Hobsonia florida
Nephyts sp.
Sternaspidae (family)
Unidentified species--2

Bivalvia

Mytilus edulis (mussel)
Mya arenaria (softshell clam)
Tellina salmonea (pink clam)
Tellina sp. (white clam)

Crustacea

Corophium salmonis
Amphithoe sp.
Gammaridea
Eohaustorium estuaris
Callinassa californiensis (ghost shrimp)
Balanus glandula (barnacle)
Cancer magister (dungeness crab)

REFERENCES

Darnell, Rezneat M., Impacts of Construction Activities in Wetlands of the United States. EPA-600/3-76-045, 1976.

Lights, S.F., Intertidal Invertebrates of the Central California Coast. University of California Press, 1964.

MacGinitie, G.E., "The Natural History of Callianassa Californiensis." The American Midland Naturalist, Vol. XV, No. 2, 1934.

Marriage, Lowell D., The Bay Clams of Oregon. Fish Commission of Oregon Educational Bulletin No. 2, 1958.

Seaman, Margaret H., ed., Columbia River Estuary Inventory of Physical, Biological and Cultural Characteristics. Columbia River Estuary Study Taskforce, 1978.

Stout, H., ed., The Natural Resources and Human Utilization of Netarts Bay, Oregon. National Science Foundation Interdisciplinary Study, Oregon State University, 1976.

FISHES OF THE NECANICUM
RIVER ESTUARY

The Necanicum River Estuary provides habitat for a number of fishes of which almost all could be considered marine species. Because a number of species are migratory, the estuary is used as an intermediate transfer habitat for the anadromous fishes who move through the estuary to freshwater. Other species could be considered tidal as they move in and out with the tidal exchange or remain in the estuary during high salinity periods.

The fishes of the Necanicum system have no direct commercial value but are fishes that may spawn and spend their juvenile stages in the estuary system and become important in the off-shore ocean fishery (e.g. flounders, salmon and perch).

During the high tide cycle the estuary condition in the Necanicum system approaches the marine quality and produces no freshwater barriers to marine fish during low flow periods. The conditions that must be considered seriously are the low water cycle in which the anadromous (migrating to freshwater) fish may find barriers in water quality during low flow and low tides for adults and juveniles. Not only must the water quality in the ocean meet particular standards, but the tributary waters and the impounded estuarine water must maintain a level of quality that it provides a transfer area for these fishes.

With the exception of the Pacific Staghorn Sculpin and the Shiner Percn most of the fish species use the estuary during specific times of the year and with some relationship to their reproductive cycle. In the case of the anadromous fish, there is an upstream migration in the fall and a subsequent downstream migration of the juveniles in the spring. The adult time in the estuary is relatively short while the juveniles spend longer (weeks) periods of time in the estuary feeding before the eventual migration to the ocean.

Because some of these fish move through the estuary during the lowest flow periods and high temperature periods this has the potential for a low oxygen condition to exist in the estuary and associated water. Any significant effect on these factors would have a serious effect on these fish and their survival.

Steelhead (Salmo gairdneri gairdneri):

A small native population and a Fish and Wildlife managed stocking program makes the Necanicum system very productive for steelhead, with spawning escapement of approximately 2300 fish. In recent years the fishing pressure on this species has increased in the estuary part of the Necanicum system.

The fish has high water quality demands for its success, not only in moving through the estuary but for the downstream migrants that spend an important period of time in the estuarine water, feeding and growing before their migration to the ocean.

Tidal Fishes

This group of fish (shiner perch, striped perch, pile perch, walleye perch, starry flounder, staghorn sculpin, surf smelt, anchovy, herring, and pipe fish) for the most part move into the estuary during the tidal cycle and move out again within a fairly short period of time (from a single tidal cycle to a period of weeks). During low flow conditions in July, August, and September the estuary reaches nearly marine conditions in respect to the salinity and is not a serious limiting factor for marine fishes. The use of the estuary includes spawning, feeding, protection and as a nursery for young.

Fish Description

Coho (Silver) Salmon (Oncorhynchus kisutch):

Silver salmon runs are limited to the Necanicum, Neawanna, and Mill Creek tributaries of this system. A spawning escapement of approximately 1200 silvers has been estimated by the Fish and Wildlife Department for the Necanicum system. A small population of undetermined numbers runs in the Neawanna drainage.

Silver salmon move into the estuary in early September and move upstream into the freshwater system with the early fall rains. The spawning cycle begins in early November and continues into January. These fish are utilized by the recreation fishermen to a moderate degree in the estuary and at a low level in the river. After the spawing cycle in the upper tributaries the hatching fry spend the next year in the river feeding and growing until the spring downstream migration into the estuary for another period of feeding and growth.

Chum Salmon (Oncorhynchus keta):

There is a small run of Chum salmon that occurs sporadically and reaches a few hundred fish on peak years. This fish has no recreational fishing potential and enters the Necanicum system almost unnoticed.

Cutthroat Trout (Salmo clarki clarki):

This fish is represented by a good run in the Necanicum (approximately 5000) that enter the river from the ocean in July and run until October. This fish is eagerly sought after by the recreational fisherman in the estuary and in the Necanicum River. This fish spawns in January and February with fingerlings moving into the estuary in the spring and then moving to the open ocean.

Active management programs by the Oregon Department of Fish and Wildlife have been ongoing in the Necanicum system for sometime. Steelhead trout have been planted on a yearly basis for the last 10+ years with the average spring plant of about 50,000 fish. The utilization of the steelhead has been very extensive by the resident and out of area recreation fisherman.

The following data presents the stocking program for salmon species in the Necanicum system.

1976 - 6,000 Coho smolts
39,000 Fall Chinook smolts
630 Coho adults

1977 - 75,000 Coho smolts

1978 - 103,000 Coho smolts
98,000 Fall Chinook smolts

The full impact of this stocking program will not be known for some time. At this writing a few 3 year Fall Chinook have returned to the Necanicum.

Seining Results, August 1978

Results include numbers of fish caught with a 100' beach seine. There were 5 sets with the following total catch.

Necanicum (1 kl from mouth)
3 sets

- Shiner Perch
  - Adults 51
  - Juveniles 1,993
- Starry Flounder 19
- Staghorn Sculpin 36
- Surf Smelt 23
- Salmon
  - Juvenile Chinook 2

Neawanna (2 kl from mouth)
2 sets

- Striped Perch
  - Juveniles 16
- Shiner Perch
  - Juveniles 162
- Pile Perch
  - Juveniles 38
- Staghorn Scuplin 14
- Three Spine Stickleback 1
- Bay Pipe Fish 1

Spawning and Nursery Role of Estuary

The Necanicum River Estuary, like the rest of the estuaries on the Oregon coast, plays an important role as a nursery for many organisms. Because of the protected waters, abundant food supply and lack of ocean predators, the perch, starry flounder and salmon spend an important amount of time in this estuary system.

The feeding surface area is almost doubled each day as the tide floods across mud flats and into the marshes. Because of this factor the carrying capacity of the estuary is much greater than appears to the casual observer. In addition the tide brings with it a certain amount of usable energy from the ocean system and the offshore upwelling.

A Starry Flounder tagging program in the Necanicum has demonstrated this role to a degree with flounder tags being returned from commercial draggers as far away as Ocean Shores, Washington in 35 fathoms of water.

NECANICUM RIVER ESTUARY
FISH SPECIES LIST

Common Name	Scientific Name
Coho salmon	Oncorhynchus kisutch
Chum salmon	Oncorhynchus keta
Chinook salmon	Onchorhynchos tschawytscha
Steelhead	Salmo gairdneri gairdneri
Cutthroat trout	Salmo clarki clarki
Shinner perch	Cymatogaster aggregata
Striped perch	Embiotoca lateralis
Pile perch	Rhacochilus vacca
Walleye perch	Hyperprosopon argenteum
Redtail perch	Amphistichus rhodoterus
Starry flounder	Platichthys stellatus
Pacific staghorn sculpin	Leptocottus armatus
Surf smelt	Hypomesus pretiosus
Northern anchovy	Engraulis mordax
Pacific herring	Clupea herengus pallasi
Bay pipe fish	Syngnathus griseolineatus
Carp	Cyprinus carpio
Three spine stickleback	Gasterosteus aculeatus
Pacific lamprey	Entosphenus tridentatus
Sturgeon (green)	Acipenser medirostris

REFERENCES

Beardsley, Alan J. and Carl E. Bond, Bay Fishes of Oregon. Station Bulletin 607, Agricultural Experiment Station, Oregon State University, Corvallis, Oregon, 1970.

Knispel, Warren M., Report of the Oregon Game Commission to the Clatsop County Planning Commission. 1971.

Seaman, Margaret H., ed., Columbia River Estuary Inventory of Physical, Biological and Cultural Characteristics. Columbia River Estuary Study Taskforce, 1978.

Somerton, David and Craig Murray, Field Guide to the Fish of Puget Sound and the Northwest Coast. University of Washington Press, Seattle and London, 1976.

Stockham, John and J.R. Pease, Natural Environment--Biological Inventory of the Clatsop Plains, Oregon. Oregon State University Extension Service, Oregon State University, 1974.

WATERBIRDS OBSERVED
IN NECANICUM ESTUARY

Species	Habitat
Canada Goose	sand flats (migration)
Brant	sand flats (migration)
Snow Goose	sand flats (migration)
White Fronted Goose	
Mallard	bays and marshes
Pintail	most fresh water marshes
Cinnamon Teal	marshes
Woodduck	backwaters of rivers and streams
Canvasback	open marshes
Lesser Scaup	salt marshes, estuaries (in winter)
Greater Scaup	on the coast (in winter)
Common Goldeneye	lakes and bogs in coniferous forests
Barrow's Goldeneye	on bays along coast (in winter)
Bufflehead	forest with small ponds, open water near forest
Surf Scoter	coastal waters (during winter)
Common Merganser	open water
Red Breasted Merganser	lakes and rivers (winters on saltwater)
Hooded Merganser	on coasts (in winter)
Pelican (80 individuals 1976)	
Horned Grebe	coastal bays, oceans (in winter)
Eared Grebe	lakes and sloughs
Western Grebe	open water, bays and lakes
Pied-billed Grebe	open water of any size (in winter on migration)
American Coot	marshes and vegetated ponds
Harlequin Duck	near rushing water (nesting) rocky seashores (winter)
Greenwinged Teal	marshes and lakes
American Wigeon	open marshy areas
White Winged Scoter	seacoasts (in winter)

Species	Habitat
Common Loon	bays and coves along coast (in winter)
Arctic Loon	seacoast (in winter)
Red Throated Loon	seacoast (in winter)
Brandt's Cormorant	bays and estuaries
Pelagic Cormorant	coastal waters, bays
Double Crested Cormorant	freshwater lakes, rivers and the sea
Caspian Tern	sand flats, coastal water
Common Tern	sand flats, open water

Although the Necanicum River Estuary is not a large area it does serve as an important site for a number of waterbird species. The estuary provides feeding and resting sites for migrating birds in season, but does not provide important habitat for nesting of migratory birds.

Of particular importance are the haul out areas on the west side in the lower estuary. Many of the water associated species use this area during the fall and winter. The open sand flats are also important as rest areas and overnight stations for migrating birds. Harry Nehls, author of Shorebirds of Oregon has the following to say about the Necanicum River Estuary. "The Necanicum River Estuary has long been considered an important section of the Northern Oregon Coast for migrant birds. It is used primarily as a safety stop if sudden changes in the weather catches migrants between Tillamook Head and the mouth of the Columbia River. It is also a secondary feeding and resting area. Waterbird populations are extremely high most of the year just offshore and on the flats from Tillamook Head northward to north of Brays Harbor, so it is important to have emergency stopping places all along this area."

Species	Habitat
Long-legged Wading Birds	
Great Blue Heron	shoreline
Green Heron	shoreline
American Bittern	marsh, grassland
Snowy Egret (single sighting)	

Species	Habitat
Raptors	
Red Tailed Hawk	woodlands
Bald Eagle (rare visitor)	water edge
Marsh Hawk	marsh, grassland
Rough-legged Hawk	Open marshes
American Kestrel	open country
Shorebirds and Gulls	
Semipalmated Plover	saltwater, mudflats
Killdeer	inland beaches and coastal fields
Whimbrel	mudflats and dunes
Lesser Yellow Legs	mudflats
Northern Phalarope	open water
Spotted Sandpiper	any body of water that is surrounded by vegetation and woods
Least Sandpiper	tidal mudflats
Western Sandpiper	seacoast (in winter)
Dunlin	seacoast (in winter)
Sanderling	sandy beaches (migration and through winter)
Black-bellied Plover	seashores and mudflats (in winter)
Snowy Plover	sandy or alkaline shores
Short Billed Dowitcher	mudflats
Black Turnstone	shores of Pacific coast (in fall and winter)
Glaucous-winged Gull	bays and estuaries
Western Gull	bays, estuaries and rivers
California Gull	bays and rivers
Mew Gull	bays and estuaries
Herring Gull	coastal areas (in winter)
Thayer's Gull	among other gulls on the Pacific coast (in winter)
Ring-billed Gull	mostly on seacoast (in winter)
Bonaparte's Gull	bays and estuaries
Heerman's Gull	open water

Species	Habitat
Other Birds of the Estuary Shoreline and Forest	
Rufous Hummingbird	conifers, edges
Belted Kingfisher	rivers, streams, ponds and seashore
Red Shafted Flicker	open forest
Hairy Woodpecker	coniferous stands, deciduous trees
Downy Woodpecker	tree willow, alder
Violet-green Swallow	breeds in forests, wooded foothills
Barn Swallow	open country, near water
Steller's Jay	conifers, tree willow
Common raven	grasslands
Common Crow	tide flats, open country
Black-capped Chickadee	woodlands
Bushtit	deciduous growth, in coastal forest
Wrentit	alder stands
Bewick's Wren	tree willow
American Robin	wooded habitat, meadows
Waried Thrush	conifers and deciduous forest
Ruby-crowned Kinglet	conifers
Cedar Waxwing	conifers
Starling	urban areas
Yellow Warbler	shrub willow, scotch broom
Yellowthroat	marsh edges, tree willows
House Sparrow	urban areas, farms
Golden-crowned Sparrow	coastal brushland (winter)
Western Meadowlark	grassland, meadows
Brown-headed Cowbird	fields, willow
Brewer's Blackbird	fields
House Finch	trees, urban areas
American Goldfinch	tree willow, brushy areas

Species	Habitat
Rufous-sided Towhee	forest edges, thicks, woodlands
White-crowned Sparrow	forest edges, clearings
Fox Sparrow	thickets, edges of conifers
Western Tanager	conifers
Red Winged Blackbird	marsh, willow
Savannah Sparrow	open grassland, savannas, salt marshes
Junco	openings and edges of conifers and mixed woods
Song Sparrow	forest edges, clearings, thickets, and marshes with open grassy feeding areas
Ring Neck Pheasant	dune grass and associated scrub land

REFERENCES

Bayer, R., Birds of Lincoln County, Oregon. Sea Grant Marine Advisory Program, Oregon State University Marine Science Center, Newport, Oregon, 1977.

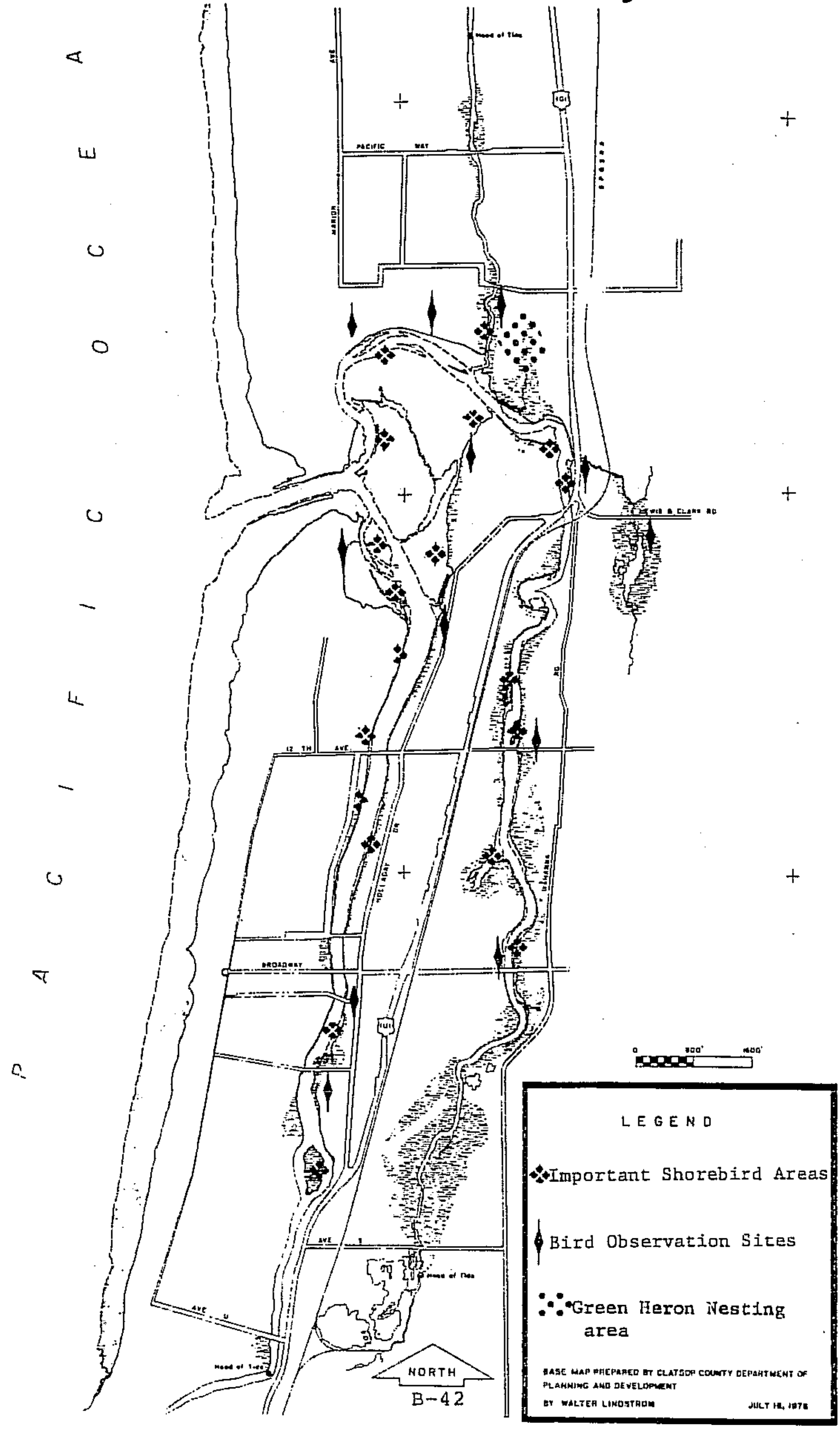
Miklos, D.F., The Audubon Society Field Guide to North American Birds. Alfred A. Knopf, Inc., New York, New York, 1977.

Nehls, H., Shorebirds of Oregon.

Robbins, C.S., B. Bruun, and H.S. Zim, Birds of North America. Western Publishing Co., Racine, Wisconsin, 1966.

Seaman, Margaret H., ed., Columbia River Estuary Inventory of Physical, Biological and Cultural Characteristics. Columbia River Estuary Study Taskforce, 1978.

Necanicum River Estuary



ANIMALS OF THE NECANICUM ESTUARY

Large Mammals

Because of the extensive development around much of the estuary, large mammals are not in great abundance. Only two species are identified for this report. The Blacktailed deer and the Roosevelt Elk find their way into the undeveloped high marshes and adjacent forest during the winter months when they move to lower areas to feed.

Small Mammals

The aquatic mammals in the estuary area include the river otter, mink, beaver, and muskrat. Although the Necanicum estuary does not provide a great deal of habitat for these furbearers there are small populations in the upper estuary. Because of the small populations these animals are not trapped extensively.

Terrestrial animals found in association with the estuary include raccoons, opossums, coyotes, striped skunk, longtailed weasel, and other less obvious species (listed in Table A1). As with many terrestrial animals the water "edge environment" from the wetlands to willow and forest areas plays an important role in the feeding and breeding cycle of these animals.

Each of the various habitats associated with the estuary contain a variety of small animals such as shrews, mice, squirrels, chipmunks, and various other small animals.

Reptiles and Amphibians

Frogs, salamanders, and snakes are most representative of this group and are found more in association with small streams and wet lands adjacent to the estuary.

Marine Mammals

On rare occasions individual Harbor Seals will migrate into the Necanicum estuary during high tidal cycles.

ANIMAL INVENTORY OF NECANICUM ESTUARY

Table A1

This inventory includes only those that have been live trapped or observed by the author.

Large Mammals

Roosevelt Elk (*Cervus canadensis*)
Black Tail Deer (*Odocoileus hemionus*)

Small Mammals

River Otter (*Lutra canadensis*)
Muskrat (*ondatra zibethica*)
Mink (*Mustela vison*)
Raccoon (*Procyon lotor*)
Beaver (*castor canadensis*)
Longtailed Weasel (*Mustela frenata*)
Striped Skunk (*Mephitis mephitis*)
Coyote (*Canis latrans*)
Norway Rat
Pacific Jumping Mouse (*Zapus princeps*)
Brush Rabbit (*Sylvilagus bachmani*)
Chickaree (*Tamiascurus douglasii*)
Townsend Chipmunk (*Eutamias townsendi*)
Western Gray Squirrel (*Sciurus grieseus*)
Vagrant Shrew (*Sorux bendirei*)
Townsend Mole (*Scapanus townsendi*)
Opossum

Marine Mammals

Harbor Seal (*Phoca vitulina*)

REFERENCES

Larrison, Earl J., Mammals of the Northwest. Seattle Audubon Society, Seattle, Washington, 1976.

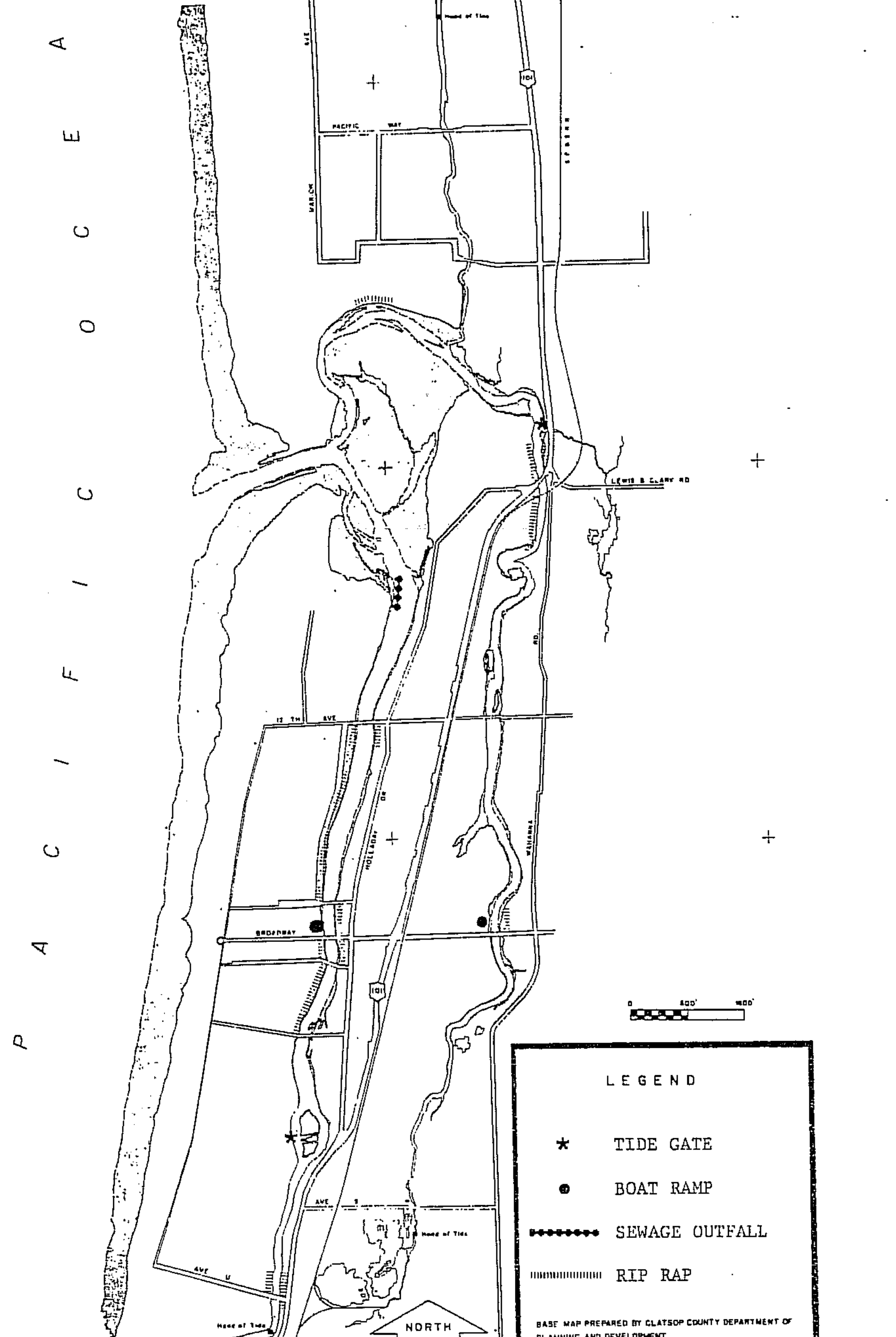
Stockham, John and J.R. Pease, Natural Environment: Biological Inventory of the Clatsop Plains. Oregon State University Extension Service, Oregon State University, 1974.

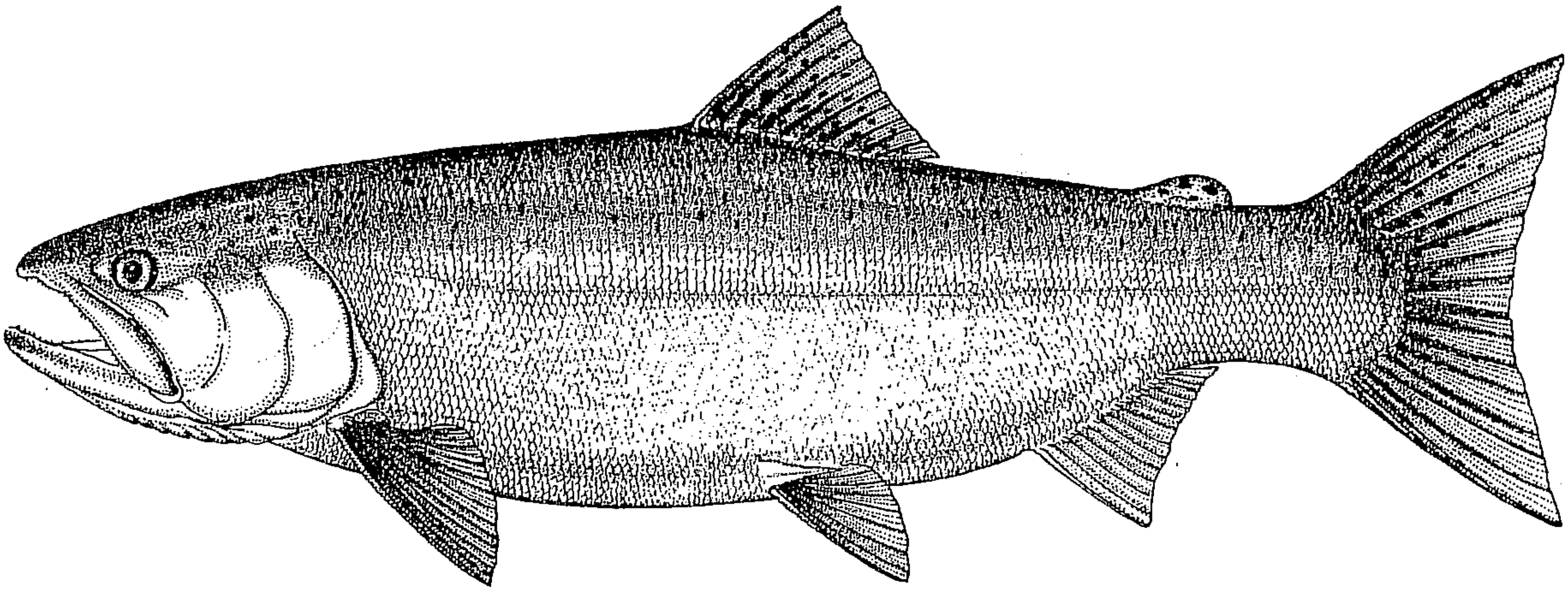
Yocom, C. and R. Dasmann, The Pacific Coastal Wildlife Region. Naturegraph Co., Healdsburg, California, 1965.

SECTION C

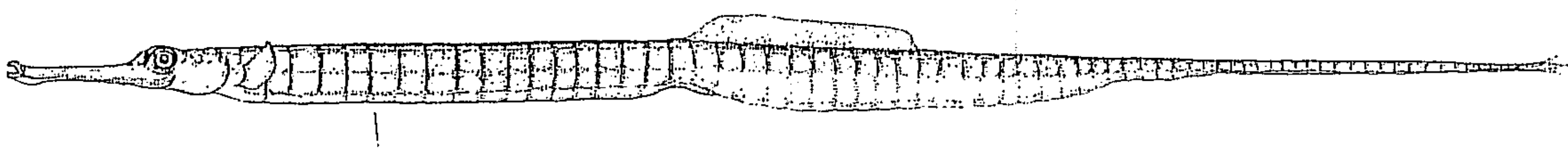
(Urban Impacts)

Existing Uses
(to be included later)

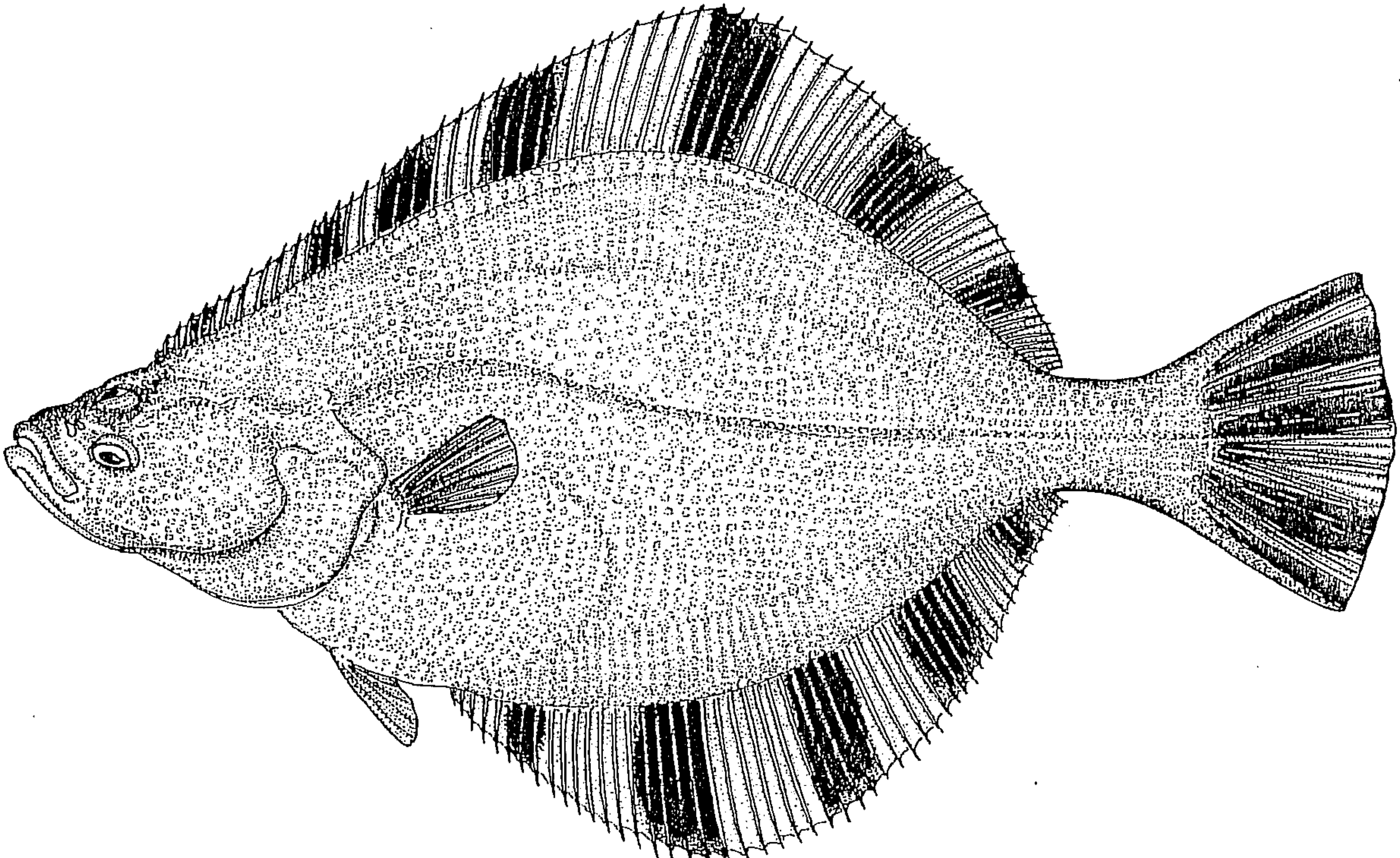

PACIFIC OCEAN
PACIFIC WAY
LEWIS & CLARK RD
12 TH AVE
BROADWAY
HOLLADAY DR
WAHANNA RD.
AVE U
Head of Tide
0 800' 1600'
NORTH
LEGEND
TIDE GATE
BOAT RAMP
SEWAGE OUTFALL
RIP RAP
BASE MAP PREPARED BY CLATSOP COUNTY DEPARTMENT OF PLANNING AND DEVELOPMENT
BY WALTER LINDSTROM
JULY 16, 1976



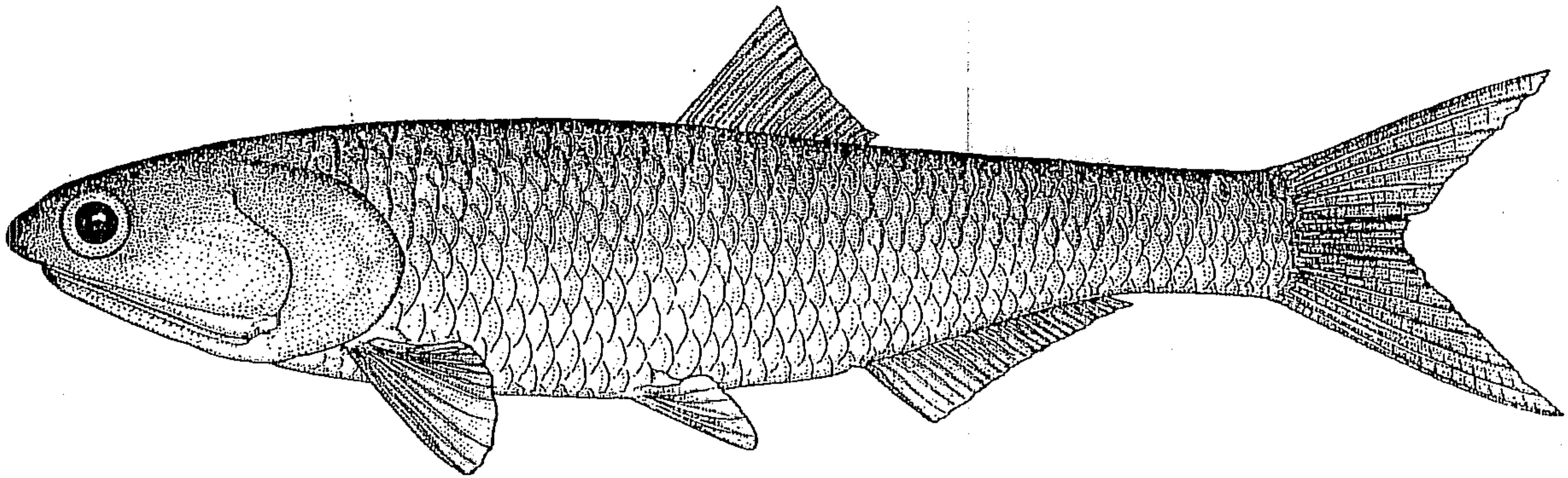
Oncorhynchus kisutch Coho Salmon



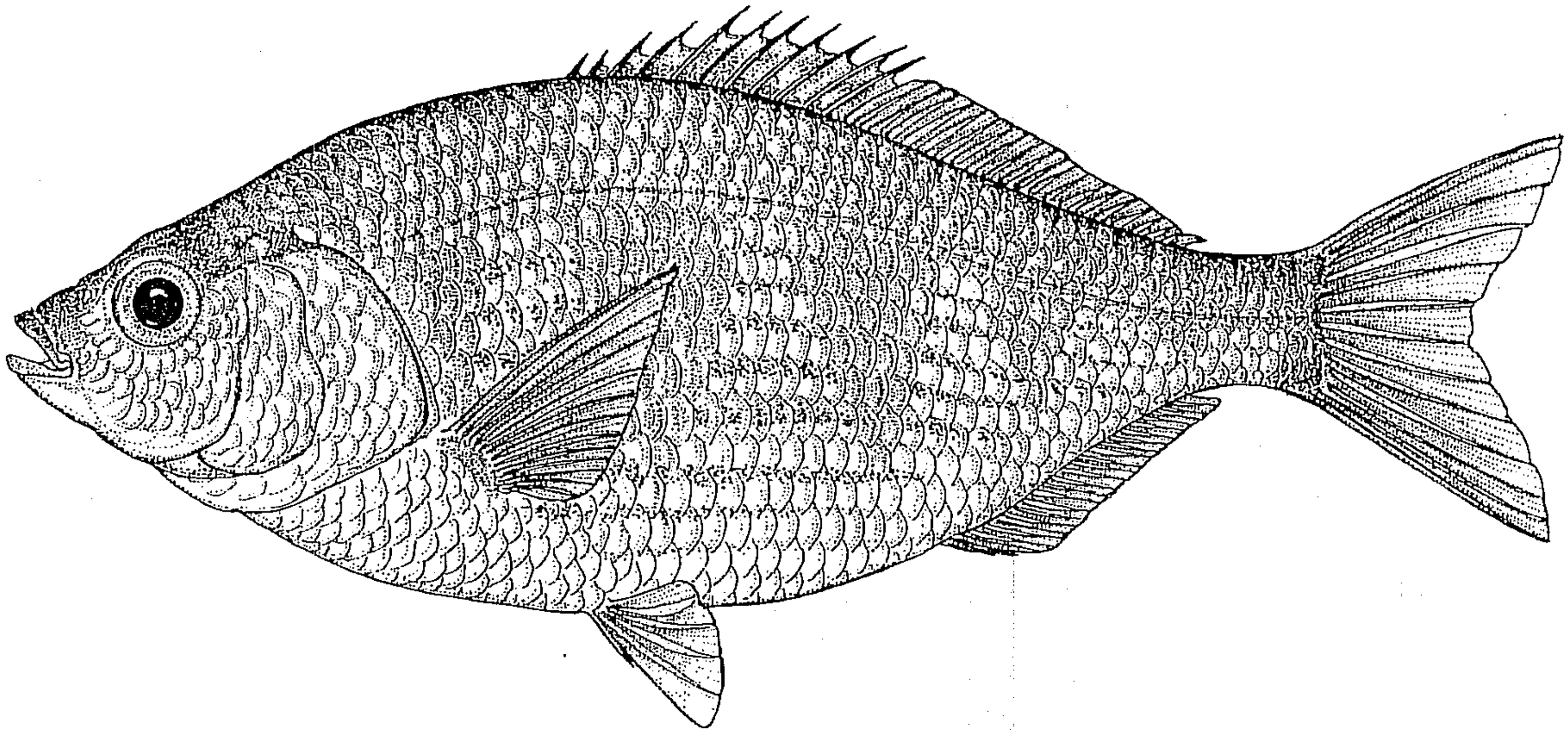
Syngnathus griseolineatus Bay Pipefish



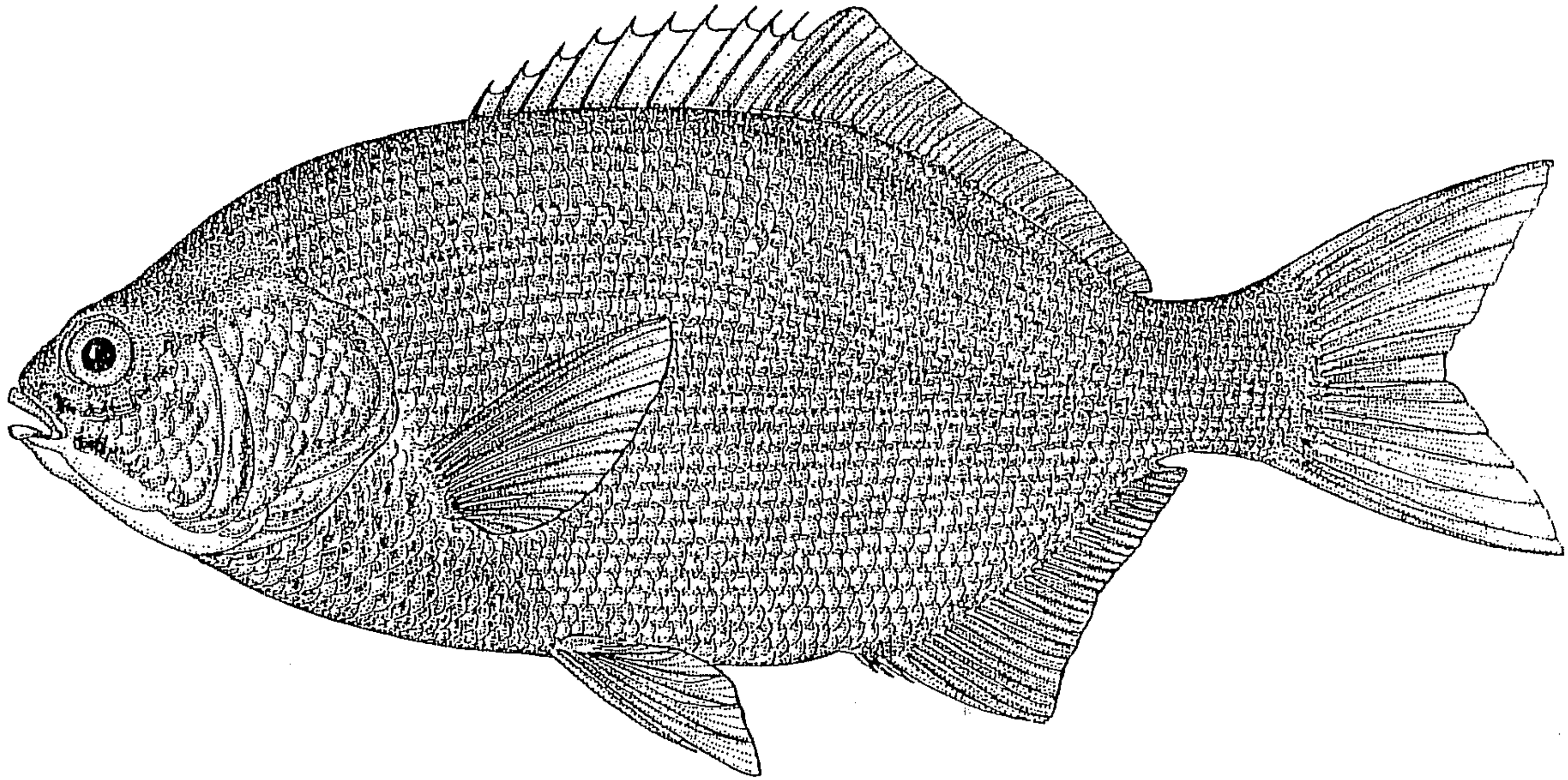
Paltichthys Stellalus Starry Flounder



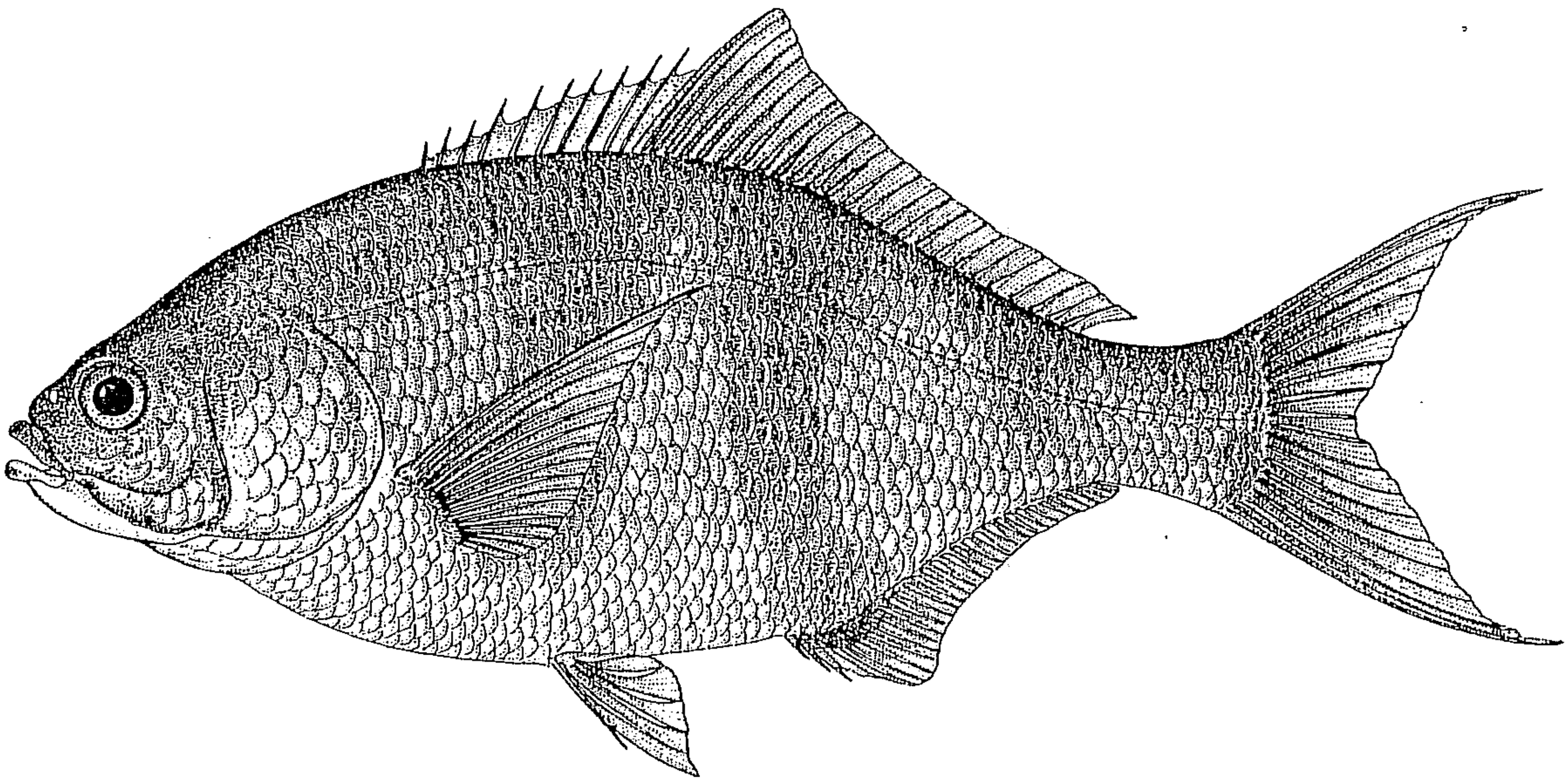
Engraulis Mordax Northern Anchovy



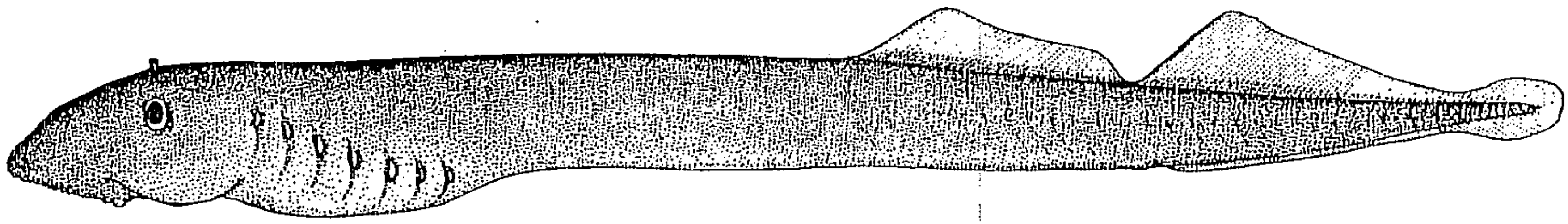
Cymatogaster aggregata Shiner Perch



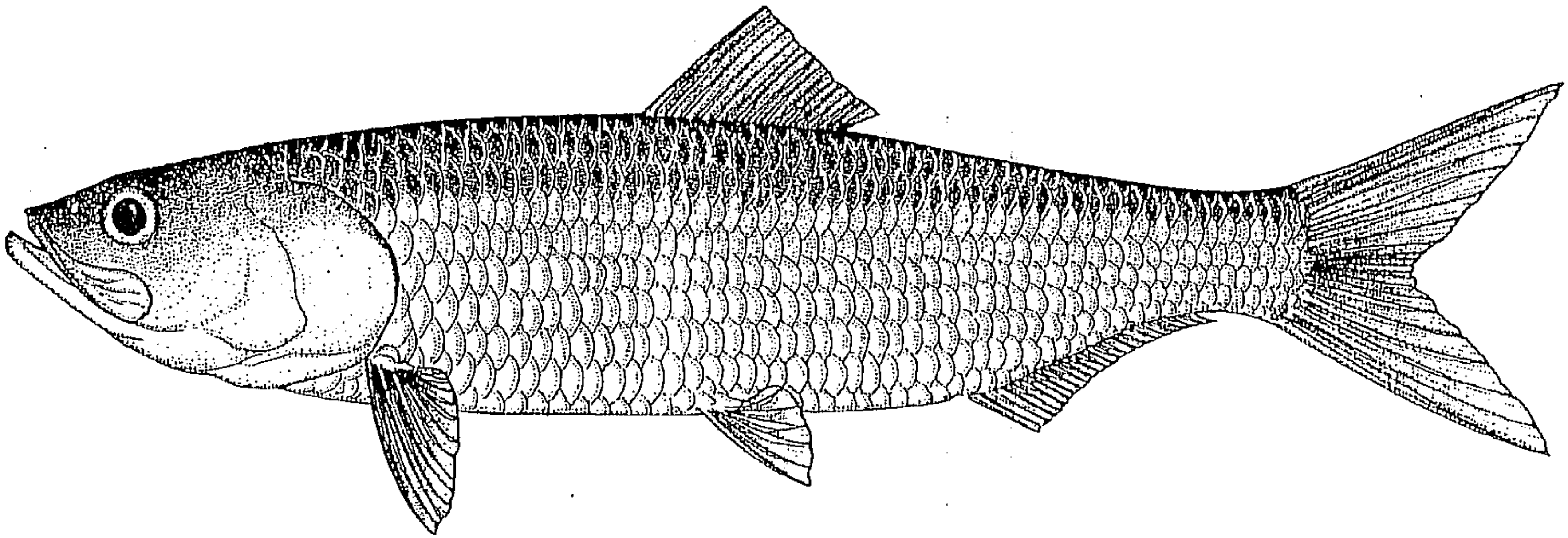
Emblotoca lateralis Striped Seaperch



Rhacochilus vacca   Pile Perch



Entosphenus tridentatus Pacific Lamprey



Clupea harengus pallasi Pacific Herring