# Natural Resources of Umpqua Estuary

**ESTUARY INVENTORY REPORT**

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Prepared by: Frank Ratti

Oregon Department of Fish and Wildlife
506 S. W. Mill Street
P. O. Box 3503
Portland, Oregon 97208

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# PREFACE

This report is one of a series prepared by the Oregon Department of Fish and Wildlife (ODFW) which summarizes the physical and biological data for selected Oregon estuaries. The reports are intended to assist coastal planners and resource managers in Oregon in fulfilling the inventory and comprehensive plan requirements of the Land Conservation and Development Commission's Estuarine Resources Goal (LCDC 1977).

A focal point of these reports is a habitat classification system for Oregon estuaries. The organization and terminology of this system are explained in volume 1 of the report series entitled "Habitat Classification and Inventory Methods for the Management of Oregon Estuaries."

Each estuary report includes some general management and research recommendations. In many cases ODFW has emphasized particular estuarine habitats or features that should be protected in local comprehensive plans. Such protection could be achieved by appropriate management unit designations or by specific restrictions placed on activities within a given management unit. In some instances ODFW has identified those tideflats or vegetated habitats in the estuary that should be considered "major tracts", which must be included in a natural management unit as required by the Estuarine Resources Goal (LCDC 1977). However, the reports have not suggested specific boundaries for the management units in the estuary. Instead, they provide planners and resource managers with available physical and biological information which can be combined with social and economic data to make specific planning and management decisions.

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# UMPQUA ESTUARINE SYSTEM

## Introduction

The Umpqua estuary (Fig. 1) is the fourth largest estuary in Oregon. Its parent stream, the Umpqua River, is one of the largest coastal rivers in Oregon, draining nearly all of Douglas County. The wide, relatively deep river channel results in a high percentage of subtidal land, compared with many other larger estuaries.

The Umpqua provides some of the state's largest fisheries for shad, striped bass, herring, and softshell clams. Large numbers of salmon and trout migrate through and feed in the estuary and river.

The City of Reedsport and communities of Gardiner and Winchester Bay are located on the shores of this estuary. Historic developments which have included diking, dredging, filling, and jetty construction have caused major habitat changes, including significant losses of large tidal marshes and flats.

The Oregon Land Conservation and Development Commission classified the Umpqua as a shallow draft development estuary (LCDC 1977a). The classification encourages certain water-dependent development but also requires protection of water quality and unique and biological important areas. A comprehensive plan was completed for the Umpqua estuary (Umpqua Study Group 1975) before LCDC established statewide planning goals for coastal resources (LCDC 1977b). The previous planning will simplify the tasks now required to meet state goals.

## Historical Changes

Major habitat changes in the Umpqua estuary have resulted from diking of tidal marshes to create farmland and develop Reedsport and Winchester Bay and from navigational development, which has included channgel dredging, jetty and marina construction, and filling. Industrial development has resulted in additional filling.

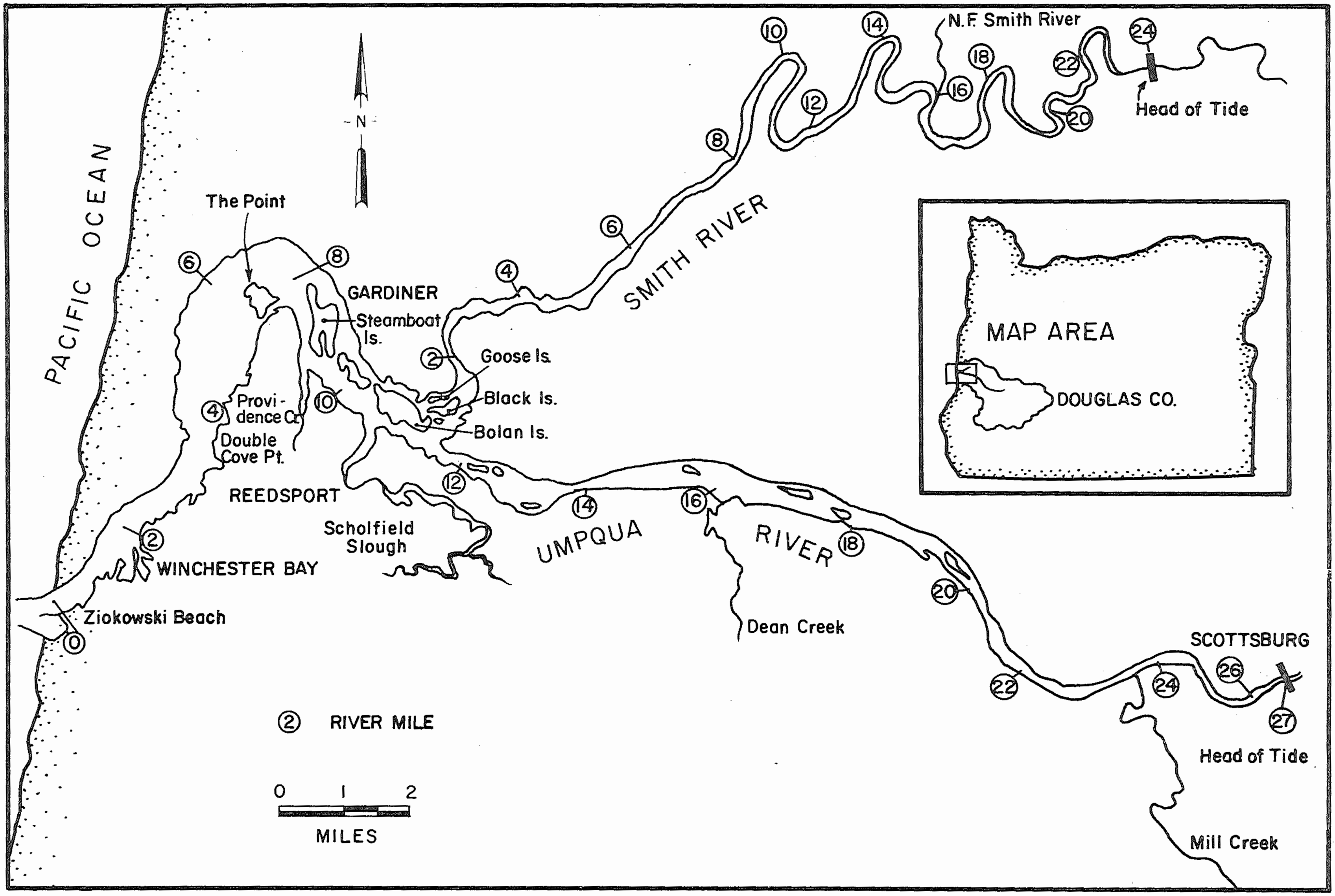


Fig. 1. Umpqua estuary (base map from Mullen, 1974a).

Three jetties have been built at the mouth of the Umpqua River estuary to make the entrance more navigable. The U. S. Army Corps of Engineers (USACE 1975) completed the south jetty (4,200 ft) in 1938 and the north jetty (8,000 ft) in 1940. These jetties did not eliminate shoaling problems so a 5,500 ft trainer jetty was constructed inside the entrance to the south side in 1951 to narrow the width of the mouth and increase water velocity. The shoaling problem is most severe during summer, when river flows are low and the oceans southward littoral drift and northwest wind across the spit deposit sand inside the mouth. The shoaling problem is not yet solved, and a further extension of the trainer jetty to meet the south jetty has been proposed by the USACE.

Several navigation channels in the Umpqua are maintained by the USACE. A 26-foot deep entrance channel and a 22-foot deep, 200-foot wide channel from the entrance to Reedsport were dredged in 1941 (USACE 1975). In 1970 a turning basin at Reedsport and a 12-foot deep, 100-foot wide, channel at Winchester Bay and a side channel, 22-feet deep, 200-feet wide, extending from the main channel to Gardiner were authorized. There is also a 6-foot deep, 100-foot wide dredged channel in the Smith River from its mouth to the North Fork. The 22-foot channels have been maintained at less than the authorized depth since the shipping has not required the full depth.

Major threats to the productivity of Oregon estuaries are the loss of marshes and tideflats and rapid sedimentation due to diking, logging and burning in the watershed, and other activities accompanying settlement of the area. The marshes of the Umpqua estuary were probably not as extensive as those on the other large estuaries, but most large tracts of marsh along the Smith and Umpqua rivers were diked and converted to agricultural land. Much of Reedsport is built on diked marsh, which was subsequently filled. Rainbow Slough in Reedsport was filled and converted to Rainbow Avenue. Several areas have been filled by intertidal disposal of dredged material. Marshes at Gardiner and tidelands on Bolan Island were filled for industrial development. The Oregon Division of State Lands (DSL 1972) recorded 105.85 acres of land below mean high (MHW) that had been filled in the Umpqua by 1971. Eighty acres of that area were filled to construct the Winchester Bay (Salmon Harbor) marina. Marina development also included dredging many intertidal acres to subtidal levels. Diking obstructed tidal influence on several tidal marshes. That acreage was far greater than lands actually filled, but was not included in DSL figures. Diked lands, fills, and other changes in intertidal land will be identified in each subsystem of the estuary.

## Physical Characteristics

The physical characteristics of an estuary influence plant and animal communities present and the estuary's sensitivity to development. Physical dimensions, circulation, water flow, and water chemistry data are relatively complete for the lower Umpqua estuary but not for the riverine portion of the upper estuary. Tidal information and sediment data are sketchy, and existing basemaps of the Umpqua generally do not extend to head of tide.

### Drainage basin

The extensive Umpqua drainage extends through the Coast Range to the Cascades. Only the Columbia and Rogue rivers have larger drainages (Table 1). The annual freshwater yield at the mouth of the Umpqua is slightly greater than that of the Rogue, although the Umpqua estuary is more than 10 times larger. The gentle grade of the Umpqua River channel allows tidewater to extend 27 miles upriver compared to a head of tide at river mile (RM 6) on the Rogue.

The Smith River, a moderate sized coastal tributary, which joins the Umpqua in the estuary at RM 11.5, provides a significant freshwater component to the bay. The Smith River meanders through a flat valley and tidewater extends 24 miles upstream from its junction with the Umpqua (Fig. 1).

The Umpqua drainage basin was mainly forest, much of which was heavily logged but was not reforested. Irrigation reduces the summer flows of the Umpqua. The City of Roseburg is located more than 100 miles up river from the estuary, but most communities along the river shores are rural.

Table 1. Areas, heads of tide, and drainage areas of Oregon estuaries.

| Estuary | Area (acres at MHW)[a] | Head of tide (miles from mouth)[b] | Drainage area (mile 2)[c] |
|---|---|---|---|
| Columbia | 93,782 | 144 | 258,000 |
| Necanicum | 278 | 3 | 87 |
| Nehalem | 2,309 | 13 | 847 |
| Tillamook | 8,289 | 17 | 540 |
| Netarts | 2,325 | 7 | 15 |
| Sand Lake | 528 | 4.5 | 17 |
| Nestucca | 1,000 | 8.6 | 322 |
| Salmon | 204 | 4.3 | 75 |
| Siletz | 1,187 | 24.6 | 373 |
| Yaquina | 3,910 | 24.2 | 253 |
| Alsea | 2,146 | 15 | 474 |
| Siuslaw | 2,245 | 23 | 773 |
| Umpqua | 6,830 | 27 | 4,560 |
| Smith | | 35 | 347 |
| Coos | 12,380 | 34 | 605 |
| Coquille | 771 | 41 | 1,058 |
| Sixes | *d* | 2.5 | 129 |
| Elk | *d* | 1.5 | 94 |
| Rogue | 627 | 4.5 | 5,100 |
| Pistol | *d* | 1 | 106 |
| Chetco | 102 | 3.5 | 359 |
| Winchuck | *d* | >1 | 70 |

[a]*From DSL 1973 estimates; excludes marshes and narrow riverine sections of estuaries.*
[b]*From DSL Tideland maps, USACE Environmental Impact Statements and ODFW stream surveys.*
[c]*Pacific Northwest River Basins Commission 1978.*
[d]*Not available.*

## Estuary dimensions and form

Estimates of the area of the estuary range from 5,712 acres (Marriage 1958) to 6,830 acres (DSL 1973). However, both figures are underestimates because neither include tidal marshes or the riverine portions of the estuary to the heads of tide. The total area is probably about 11,000 acres (estimating from DSL [1973] and other maps). The DSL (1973) estimate of tideland area on the Umpqua (1,531 acres) is about accurate since there is only a small amount of undiked tideland in the upper estuary which was not included. Marshes probably once covered a significant portion of the estuary, but less than 350 acres remain.

Depth to width ratios for the Umpqua estuary are high and are accentuated by dredged navigation channels (Gladwell and Tinney 1962). Variation in cross-sectional area is shown in Fig. 2. Tidal prism is the volume of the estuary between low and high tides. The tidal prism in the Umpqua is large $1.18 \times 10^9$ $ft^3$ on mean tide range and $1.66 \times 10^9$ $ft^3$ on the diurnal tide range (MLLW-MHHW) (Johnson 1972). The Umpqua River estuary has both a large freshwater discharge and a large tidal prism so that the mixing of marine and fresh water varies considerably during the year.

<u>Freshwater discharge and tides</u>

The seasonal and daily variation in freshwater flow is the most variable factor in the mixing process of the estuary. The mean daily flow on the Umpqua near Elkton ranged between 900 and 125,000 cfs from 1953-1967. Average flows for the Umpqua and Smith rivers are shown in Table 2. Extreme flood levels exceed 250,000 cfs (Percy et al. 1974). Flows have varied from 20,000 to 30,000 cfs on successive days (USACE 1975). The natural variation in streamflow combined with other physical factors influences the migrations, growth patterns, breeding, and spawning of fish, wildlife, and vegetation.

Monthly variations in freshwater discharge (Fig. 3) follow the patterns of precipitation and melting snow in the drainage. Spring flow is generally higher than fall flow partly due to te influence of snow melt in the Cascades.

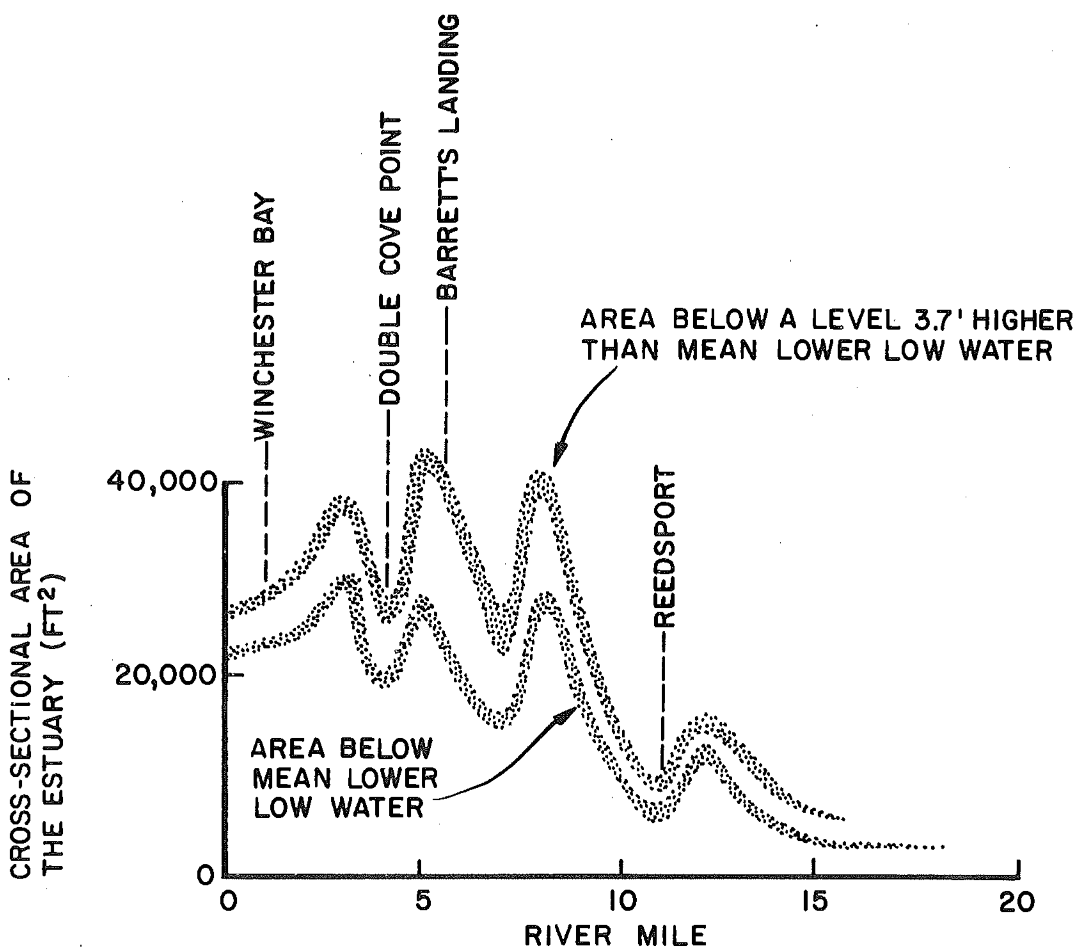


Fig. 2. Cross-sectional area of the Umpqua River (USACE 1975).

Table 2. Average monthly flows (cfs) of the Umpqua and Smith rivers (Oregon Water Resources Board 1974; USGS 1965-1973).

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Umpqua River (at Elkton, RM 56.8, 1906-1968) | 15,778 | 15,702 | 12,270 | 9,648 | 6,623 | 3,892 | 1,790 | 1,177 | 1,174 | 1,962 | 6,834 | 12,723 |
| Smith River (at RM 28.5, 1965-1973) | 2,416 | 1,243 | 1,172 | 576 | 205 | 93 | 38 | 27 | 34 | 126 | 646 | 1,984 |

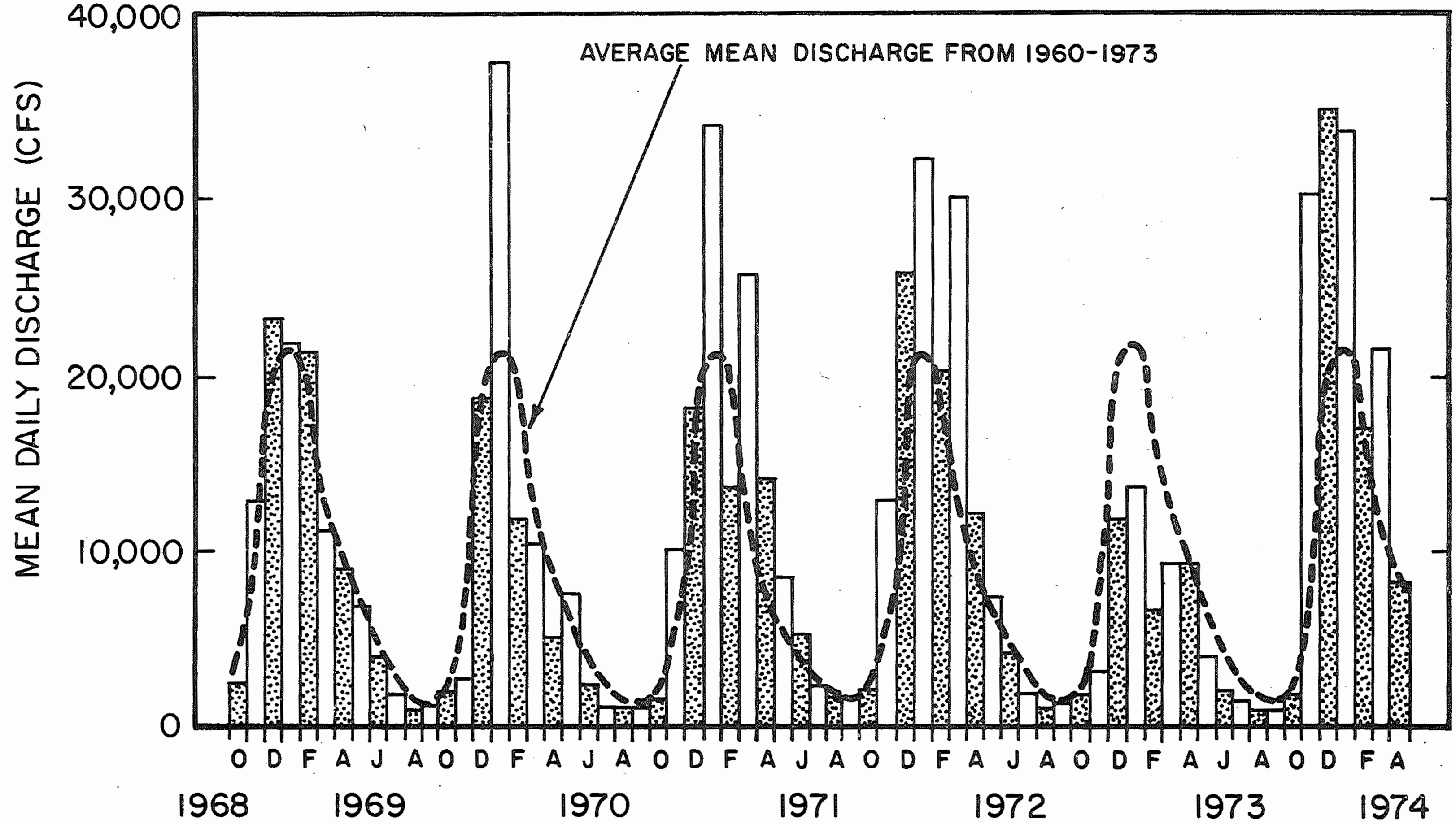


Fig. 3. Total mean monthly streamflow of the Umpqua River, Smith River and Mill Creek (USACE 1975).

The only tidal information for the Umpqua is the predicted tides at the mouth, Gardiner, and Reedsport. Few actual measurements have been made. The tidal range and delay time of tides in the upper estuary have not been studied. Mean tidal elevations are shown in Table 3.

Table 3. Mean tidal elevations (ft) at the mouth of the Umpqua and at Gardiner (relative to mean lower low water) (National Ocean Survey 1976).

| | MHHW | MHW | MTL | MLLW | ELW |
|---|---|---|---|---|---|
| Entrance | 6.9 | 6.3 | 3.7 | 0.0 | -3.0 |
| Gardiner | 6.7 | 6.1 | 3.5 | 0.0 | -3.0 |

Mixing and salinity

The mixing characteristics of the Umpqua estuary have been well defined (Burt 1956; Burt and McAlister 1958, 1959; Mullen 1973). The mixing of ocean and river water was traced by measuring the difference between surface and bottom salinities along the channel. The Umpqua was classified as two-layered during high flow, partially-mixed during moderate flow, and completely mixed during low flow (Burt and McAlister 1959).

When the freshwater discharge was high, Burt and McAlister (1959) found a layer of fresh water overlying a wedge of highly saline water (Fig. 4). During this condition the net current at the surface over a tidal cycle was downstream, while at the bottom there was a slower net current upstream (Fig. 5). Thus, the material at the bottom was transported upstream as far as the saline wedge penetrated, and materials at the surface were flushed out of the estuary. The penetration of the salt water (in the two-layered system) varied according to flow but extended as far as 6 miles upstream.

During partially-mixed conditions, which were measured by Burt and McAlister (1959) in March, May, and October, the surface and bottom layers exhibited less of a difference in salinities. They found salt water up to 8 miles from the

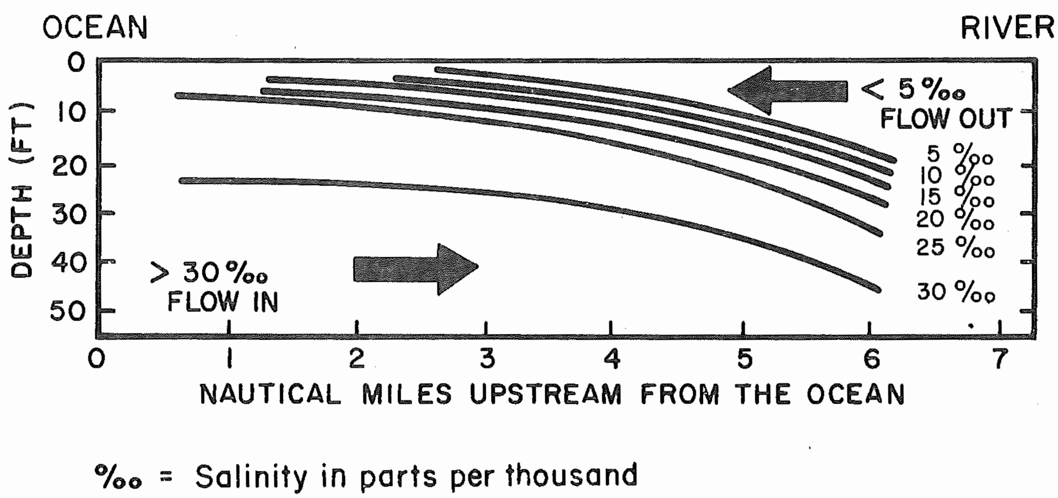


Fig. 4. Vertical distribution of salinity in the Umpqua River during high river flow and high tide (Burt and McAllister 1959).

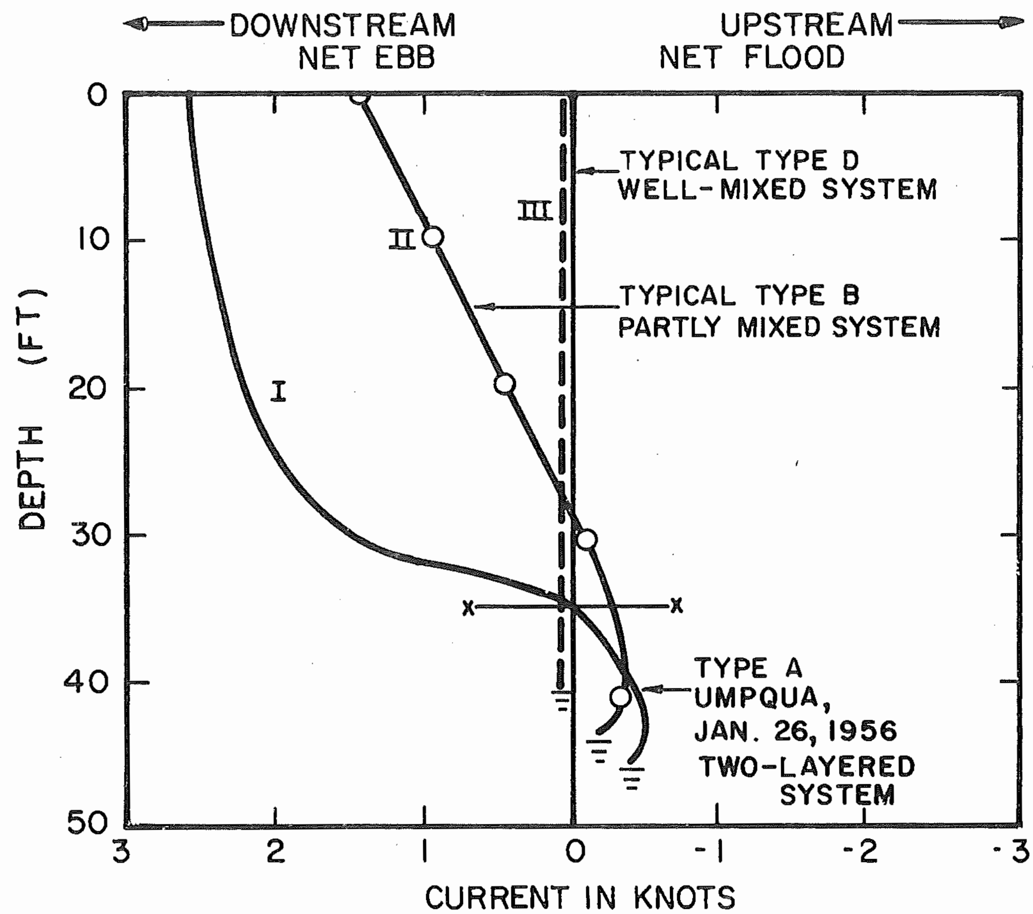


Fig. 5. Net current averaged during a tidal cycle for three classes of estuaries (Line X - X shows depth of no net motion where average current is zero over a tidal cycle for line 1) (Burt and McAllister 1959).

mouth. This condition also resulted in opposite net currents on the surface and bottom, but the velocities were slower (Fig. 5).

During summer low flows, there was almost complete vertical homogeneity of salinity measurements. The net downstream current during a well-mixed condition was close to zero (Fig. 5), which slowed the flushing rate in the estuary considerably. Salinity was measureable almost to the head of tide at low flow (Mullen 1973).

Seasonal changes in mixing type are characteristic of all Oregon estuaries to some degree because of the great seasonal differences in precipitation. They are more pronounced in estuaries with large drainage areas, such as the Umpqua. Salinity and temperature ranges for the lower estuary are shown in Fig. 6.

### Flushing and water quality

Gladwell and Tinney (1962) constructed a hydraulic model of the Umpqua to study mixing, flushing, and pollution potential during different flow conditions. Their model was not capable of reproducing the high flow condition, but since the pollution potential is least during high flow, the objective of the study was met by examining moderate and low flows. The physical model included the area of the estuary from the mouth to a short distance above Reedsport below the head of tide on both the Smith and Umpqua rivers. Because higher flows diluted their model ocean, it was limited to river discharge of less than 2400 cfs, typical of June to October. Gladwell and Tinney verified the model's mixing behavior with Umpqua estuary data from Burt (1956) and Calloway (1961).

Pollution potentials and flushing times were determined from outfall locations at RMs 6.5, 7, and 9.5. The model simulated a partially mixed condition, so net currents on a tidal cycle were not the same speed or direction at the surface and bottom. A discontinuous source of pollution

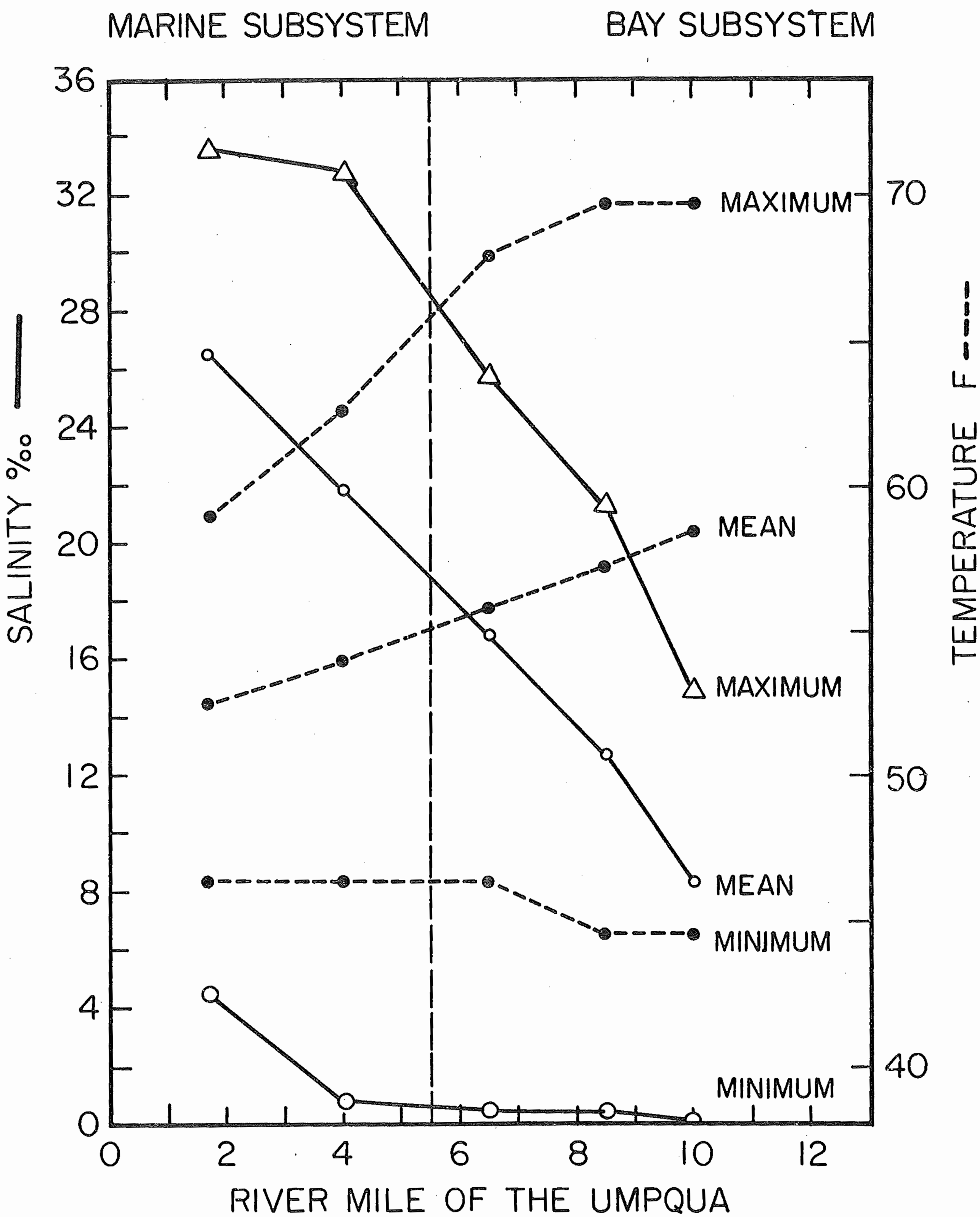


Fig. 6. Salinity and temperature ranges in the Umpqua estuary [Oregon Department of Environmental Quality (DEQ) 1978].

entering at RM 6.5 at either surface or bottom showed a pollution potential decreasing in concentration upbay to RM 13 and down bay to the mouth. At stations at RM 7.5 and RM 9.5, a continuous pollution condition resulted in significant concentrations well beyond RM 13, and it appeared that bottom and surface concentrations remained stratified upbay, while mixing downbay. There were two deep holes in the Umpqua channel near Reedsport at RM 10.5 and RM 11.5 and several eddies which tended to store large concentrations of pollutant and resist flushing in the model (Fig. 7). Incoming freshwater at the confluence of the Umpqua and Smith rivers, however, tended to mix the vertical distribution of pollutants (Gladwell and Tinney 1962).

With streamflow at 1,500 cfs flushing times equaled three tidal cycles for floating pollutants introduced at lower high water slack at RM 11, compared to 10 tidal cycles for introductions on lower low water slack at RM 7. This example led to the conclusion that flushing time was greatly reduced by introducing pollutants on an ebb tide. The model study also concluded that outfall locations in the upper estuary caused higher contamination throughout the estuary than from locations below.

Water quality measurements in the Umpqua have generally been within the standards set for marine and estuarine waters by the DEQ. Occasionally temperature, turbidity, and fecal coliform bacteria counts were excessive in the upper estuary. The temperature range increases upstream (Fig. 6). The river temperatures are colder than the ocean in winter and warmer during the summer. The river influences upbay temperatures more strongly than downbay. Temperature and salinity affect species distribution and abundance. Clam populations, eelgrass, and even mobile species may be stressed by the combination of warm summer water temperatures and brackish water.

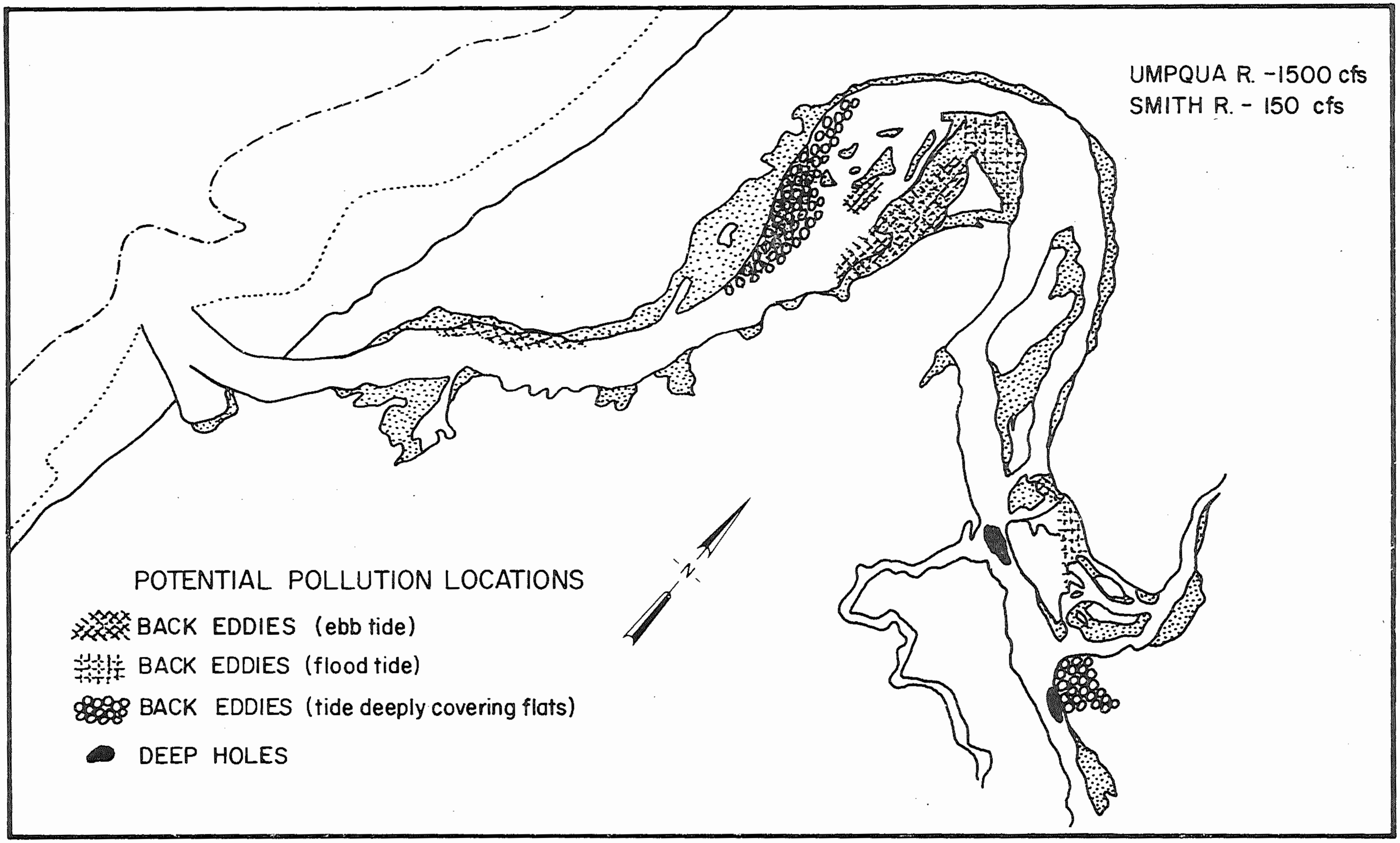


Fig. 7. Back eddies and potential pollution locations (Gladwell and Tinney 1962).

Sediments

Most of the information pertaining to sediments of the Umpqua is based on general observations and USACE dredging records. The distribution of sediments is determined by the origin of the bottom material and the velocity and direction of water currents. The salt wedge, which only forms during a high river flow, can deposit marine sediment upstream as far as Double Cove Point (Fig. 1). Another source of marine sands is the north wind, which prevails during the spring and summer. It transports sand from the dunes into the channel. In summer shoals form at the entrance from the deposition of marine sands inside the jetties, caused by a southerly wave action and littoral drift. This condition is characteristic of all Oregon estuaries which have large seasonal fluctuations in river flow. During the summer the current of the Umpqua is not sufficient to scour the entrance.

At the upper extent of marine sand, the substrate is probably mixed with material carried downstream by the river. Winter floods can deposit sediments and gravel as far as the mouth of the estuary forming winter shoals (USACE 1975), but the high flows tend to scour the channel.

The sediment above Double Cove Point was mainly material transported by the Umpqua and Smith rivers (USACE 1975). Most intertidal sediments in the upper estuary are fine grained silt and clay from terrestrial sources. In the past 80 years, increased deposition of fine sediments mainly derived from human activities have altered the intertidal sediments and depths. There are also flats and shores with high organic content of bark and wood chips from long term storage of log rafts over the intertidal areas.

The channel of the Umpqua River near the head of tide contains deposits of gravel mixed with the sand. Gravel has been removed commercially from the Umpqua River upstream of Brandy Bar (RM 20) since 1916. From 1949-70 over 4 million $yd^3$ of river-run gravel were removed. The sites that have been dredged constantly have rough bottom topographies. Sediments at these sites are fine-grained sands, which suggests the river does not adequately replenish gravel to sustain dredging in one area (Cornell, Howeland, Hayes, and Merryfield, Inc. [CH2M] 1971). The undredged river bottom in that area has smooth topography with large gravel pebbles and cobbles.

Biological Characteristics

Plant groups in the estuary include phytoplankton, macroalgae, eelgrass, and marsh species. In addition, dead organic material and nutrients are contributed from terrestrial and ocean sources.

Few biological surveys other than fish distribution have been conducted on the Umpqua. During the summer of 1978 some marshes and flats were qualitatively surveyed for sediment type and plant and invertebrate communities (Booth et al. 1978; Miller 1978). There have been no surveys of birds, plankton or subtidal invertebrates. Habitats in the lower Umpqua have been mapped (Fig. 8) by ODFW (1978).

Eelgrass and algae

There are several large tracts of eelgrass within the Umpqua estuary. Thompson and Snow (1974) estimated there were 100 acres of eelgrass in the Umpqua estuary, a small amount compared to other large estuaries. Eelgrass may require high salinities (23-31‰) for optimal vegetative growth, although it can tolerate low salinities (<10%) for brief periods if they are not coupled with high temperatures (>68 F) (Thayer et al. 1975). Most *Zostera* beds are found below Reedsport, where salinities are high during the summer growing season. Recent habitat mapping (Fig. 8) in the Umpqua estuary show more area of eelgrass beds than previously estimated. Specific areas will be discussed in the subsystem analysis.

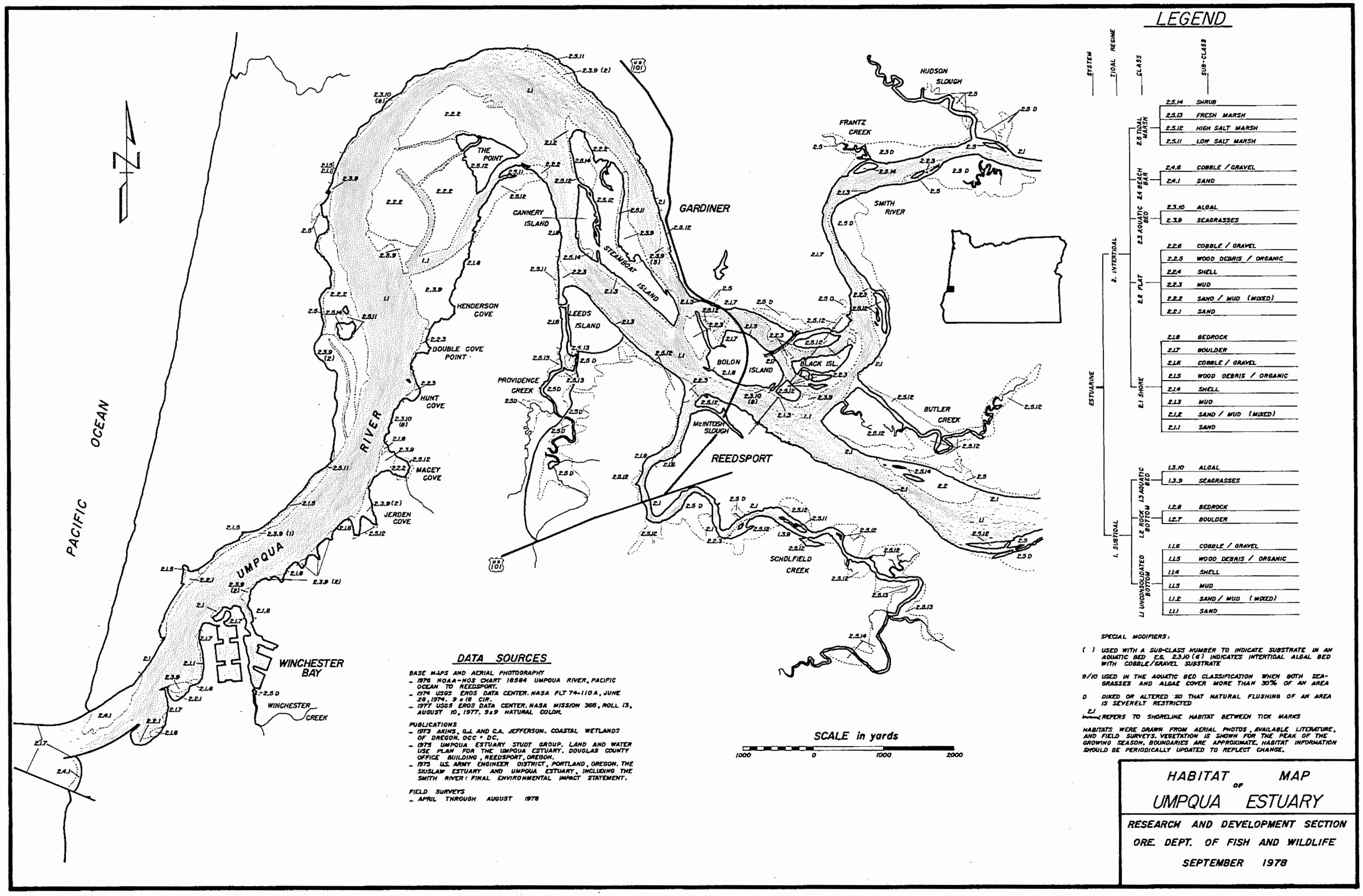


Fig. 8. Habitat map of the Umpqua estuary (ODFW 1978).

## Marshes

The tidal marshes of the Umpqua total 344 acres (Akins and Jefferson 1973), the tenth largest marsh area among Oregon estuaries. The plant composition of the tidal marshes in the upper bay near and above Reedsport are indicative of the brackish and freshwater condition throughout most of the year. Several salt marshes occur in the bay below Reedsport (Fig. 8).

The Umpqua has extensive tracts of former marsh filled for shoreland development and diked for pasture and undiked marshes used for summer pasture. An 1887 Umpqua River entrance chart (U.S. Coast and Geodetic Survey) shows several of the tidal marshes that were eliminated from major portions of Reedsport, Gardiner, and Winchester Bay. The present marsh acreage on the Umpqua is much less than previously existed. The chart also shows some areas within the bay where marsh has expanded. Individual sites will be discussed by subsystem.

## Invertebrates

The distribution of commercially and recreationally important clams has been surveyed in many of the larger Oregon bays (Marriage 1958; Gaumer et al. 1973). Although the Umpqua has been generally surveyed, no detailed clam surveys have been conducted. The Umpqua estuary supports the largest population of softshell clams (*Mya arenaria*) in any bay and the largest commercial harvest of softshells. Gapers (*Tresus capax*) occur around Winchester Bay, and butter (*Saxidomus giganteus*) and bent nose clam have also been taken in small numbers (Marriage 1958; Johnson 1978). A recent qualitative study of animal communities associated with seven intertidal areas in the Umpqua estuary (Booth et al. 1978) will be discussed by subsystems. A few other reports show harvests of invertebrate species of commercial or recreational value. Adult and juvenile Dungeness crabs are abundant in the summer and fall. The recreational catch of crabs was an important part of the sport fishery (Gaumer et al. 1973). However, the available information on the subtidal and intertidal invertebrates in the Umpqua is presently inadequate to assess the biological value of most areas.

Fish

The Umpqua, one of the largest Oregon rivers, supports one of the largest populations of naturally reproducing salmonids. Excluding the Columbia, the Umpqua system is the second largest producer of spring chinook and summer steelhead after the Rogue. It is third in production of winter steelhead and sea-run cutthroat, fourth for coho, and sixth for fall chinook (Percy et al. 1974). The estuary is a migration route for returning adults of these species, but its importance in juvenile growth and migration has not been investigated. Use the estuary by several anadromous species during different seasons of the year is shown in Fig. 9.

Shad, smelt, striped bass, white and green sturgeon, and lamprey are other anadromous fish which use the estuary during a portion of their lives. There have been commercial fisheries for most of these species, but now only shad and smelt are fished commercially in the Umpqua system. The Umpqua populations of shad and striped bass are among the largest in Oregon (Mullen 1974a, 1974b). Pacific herring, a bait fish, spawn and rear in the estuary and are another significant commercial fishery.

Other marine and freshwater fish live in different parts of the estuary. Fish species found in he Umpqua estuary and their distribution by subsystem are listed in Table 4. Many of these fish, such as rockfish, perch and sole, are also important to recreational and commercial fishermen. Some are small species that are preyed upon by other fish (eg. stickleback, sculpins, herring, smelt). These fish are further discussed in the subsystem sections. Unfortunately there is little specific information on the food habits or habitats of the fish occurring in the Umpqua.

## Birds

An estuary provides excellent habitat for birds, especially waterfowl. There is an abundance of food, including fish, clams, small invertebrates and insects, which are utilized by various species. Although there have been no direct surveys, 45 year-round resident species, which use the estuary area, jetties, and salt marshes for feeding and/or nesting, are listed by USACE (1975). Several resident birds of prey fish in the bay and hunt for small mammals in the salt marshes.

Table 4. Fish species at the Umpqua and their distribution by subsystem (Gaumer et al. 1973; Mullen 1977; Johnson 1979).

| Common Name | Genus Species | Range[1] |
|---|---|---|
| Black rockfish | *Sebastes melanops* | M |
| Copper rockfish | *S. caurinus* | M |
| Snake prickleback** | *Lumpenus sagitta* | M |
| Cabazon | *Scorpaenichthys marmoratus* | M |
| English sole* | *Parophrys vetulus* | MBR |
| Lingcod | *Ophiodon elongatus* | M |
| Night smelt** | *Spirinchus starksi* | M |
| Pacific sandlance** | *Ammodytes hexapterus* | M |
| Pacific tomcod | *Microgadus proximus* | M |
| Pile perch | *Rhacochilus vacca* | M |
| Redtail surfperch | *Amphistichus rhodoterus* | M |
| Rock greenling | *Hexagrammos lagocephalus* | M |
| White spotted** | *H. stelleri* | M |
| Kelp greenling | *H. deccagrammos* | M |
| Saddleback gunnel | *Pholis ornata* | M |
| Sand sole | *Psettichthys melanosticus* | M |
| Brown Irish lord** | *Hemilepidotns spinosus* | M |
| Sharpnose sculpin** | *Clinocottus acutuceos* | M |
| Tidepool sculpin** | *Oligocottus maculosus* | M |
| Silver-spotted sculpin** | *Blepsias cirrhosus* | M |
| Silver surfperch | *Hyperprosopon ellipticum* | M |
| Speckled sanddab | *Citharichthys stigmaeus* | M |
| Striped seaperch | *Embiotoca lateralis* | M |
| Surf smelt* | *Hypomesus pretiosus* | M |
| Longfin smelt | *Spirinchus thaleichthys* | M |
| Walleye surfperch | *Hyperprosopon argenteum* | M |
| White seaperch | *Phanerodon furcatus* | M |
| Northern anchovy | *Engraulis mordax* | MB |

Table 4. Continued

| Common Name | Genus Species | Range[1] |
|---|---|---|
| Bay pipefish | *Syngnathus griseolineatus* | MB |
| Pacific herring* | *Clupea harengus pallasi* | MB |
| American shad* | *Alosa sapidissima* | MBR |
| Penpoint gunnel** | *Apodichthys flavidus* | MBR |
| Arrow goby | *Clevelandia ios* | MBR |
| Chinook salmon | *Oncorhynchus tshawytscha* | MBR |
| Coho salmon | *O. kisutch* | MBR |
| Chum salmon** | *O. keta* | MBR |
| Cutthroat trout | *Salmo clarki* | MBR |
| Rainbow trout (steelhead) | *S. gairdneri* | MBR |
| Pacific stagnorn sculpin | *Leptocohus armatus* | MBR |
| Buffalo sculpin | *Enophrys bison* | M |
| Shiner perch* | *Cymatogaster aggregata* | MBR |
| Starry flounder* | *Platichthys stellatus* | MBR |
| Striped bass | *Morone saxitalis* | MBR |
| Threespine stickleback* | *Gasterosteus aculeatus* | MBR |
| Topsmelt | *Atherinops affinis* | MBR |
| Green sturgeon | *Acipenser medirostris* | BR |
| Prickly sculpin | *Cottus asper* | BR |
| Umpqua sqawfish* | *Ptychocheilus umpquae* | BR |
| White sturgeon | *Acipenser transmontanus* | BR |
| Redside shiner | *Richardsonius balteatus* | BR |
| Largescale sucker | *Catostomus macrocheilus* | BR |
| Yellow perch** | *Perca falvescens* | R |
| Warmouth** | *Lepomis gulosus* | R |
| Brown bullhead | *Ictalurus nebulosus* | R |
| Largemouth bass | *Micropterus salmoides* | R |
| Black crappie | *Pomoxis nigromaculatus* | R |

[1]*Marine (M), Bay (B), and Riverine (R) subsystems.*
**most abundant **least abundant.*

Regional distribution lists indicate there are at least 47 species of ducks, gulls, and shorebirds which reside in the estuary, primarily during the winter (USACE 1975). Twenty-six other species use the estuarine habitats on their migration (USACE 1975).

## Mammals

Several mammals use the estuary and salt marshes in the Umpqua. Rodent populations in the marshes provide food for birds of prey. Raccoons and a few other species venture onto the tideflats at low tides to feed on intertidal invertebrates. Harbor seals regularly feed and rest in the estuary. A large

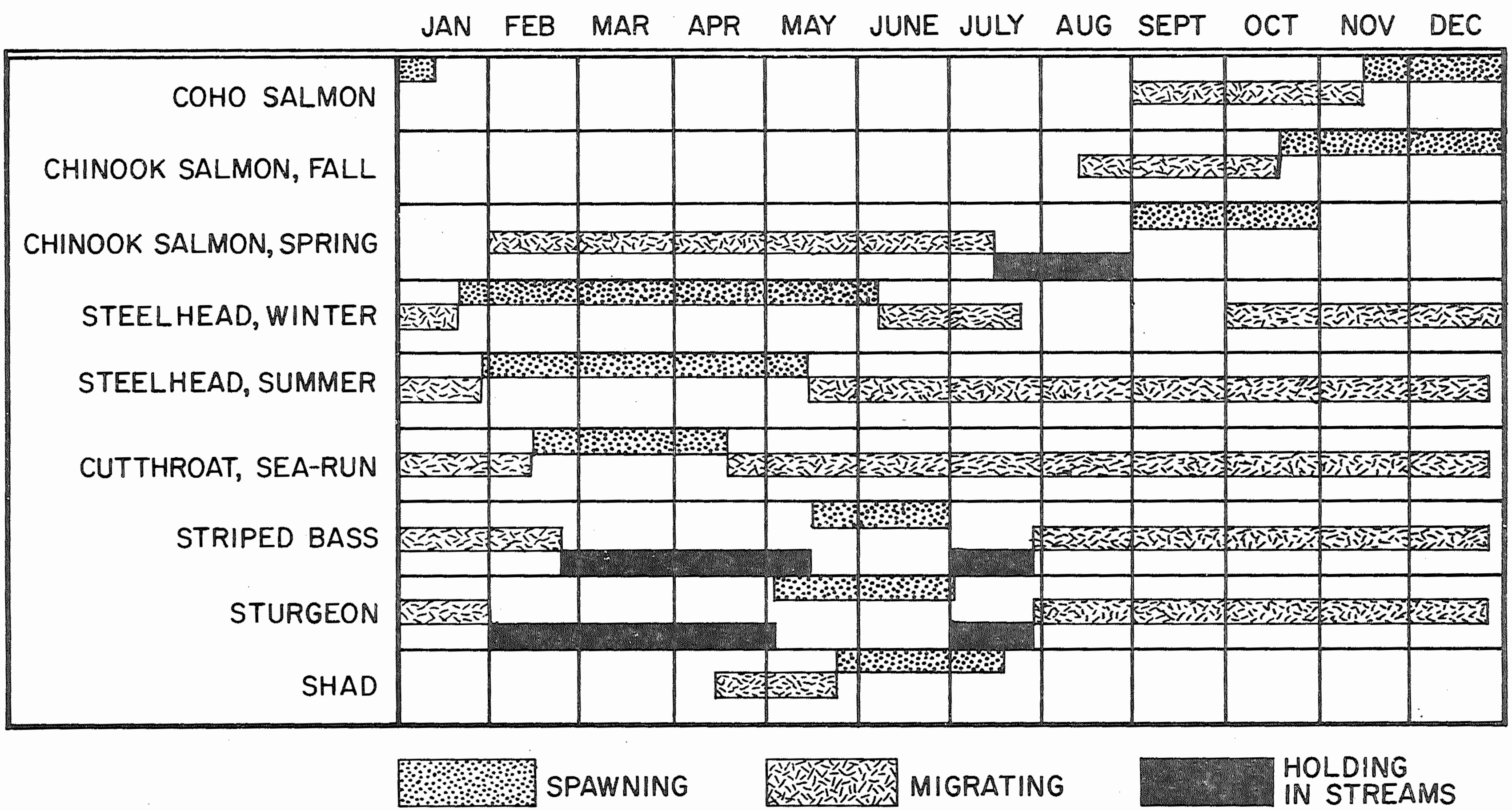


Fig. 9. Periods of fish spawning, holding, and migration, Umpqua Basin (Lauman et al. 1972).

resident population of 600-700 seals haul out on tideflats in the lower estuary below the Point (conversation July 30, 1979, with C. D. Snow, ODFW, Newport). Stellar sea lions and California sea lions are occasionally found in the estuary. They usually do not enter far beyond the mouth of the river (USACE 1975).

## UMPQUA ESTUARINE SUBSYSTEMS

A subsystem represents a group of habitats with geographical proximity and similar environmental influences. The Umpqua can be divided into four types of subsystems: a marine, a bay, two riverine, and seven slough subsystems (Fig. 10).

### Marine Subsystem

The shoreland borders of the marine subsystem estuary are the Umpqua River mouth to Double Cove Point on the south side of the river and the end of the dunes on the north side of the river (Fig. 10). A transect connecting the two shore points would follow exactly along Barrett's navigation range in the main channel. This subsystem is defined as the area of greatest marine influence, including salinity and the extent of marine sands into the estuary (USACE 1975). It covers approximately 6 river miles of the Umpqua and is predominantly subtidal.

#### Alterations

The marine subsystem has been greatly altered by the construction of jetties, breakwaters, and the navigation channel. The other major modification of the marine subsystem was the development of the Winchester Bay marina. Winchester Bay marina accounts for the largest fill on record (80 acres) in the Umpqua Bay (DSL 1972), which created several acres of subtidal habitat from intertidal and shoreland areas. The intertidal habitat was a sand-bottom

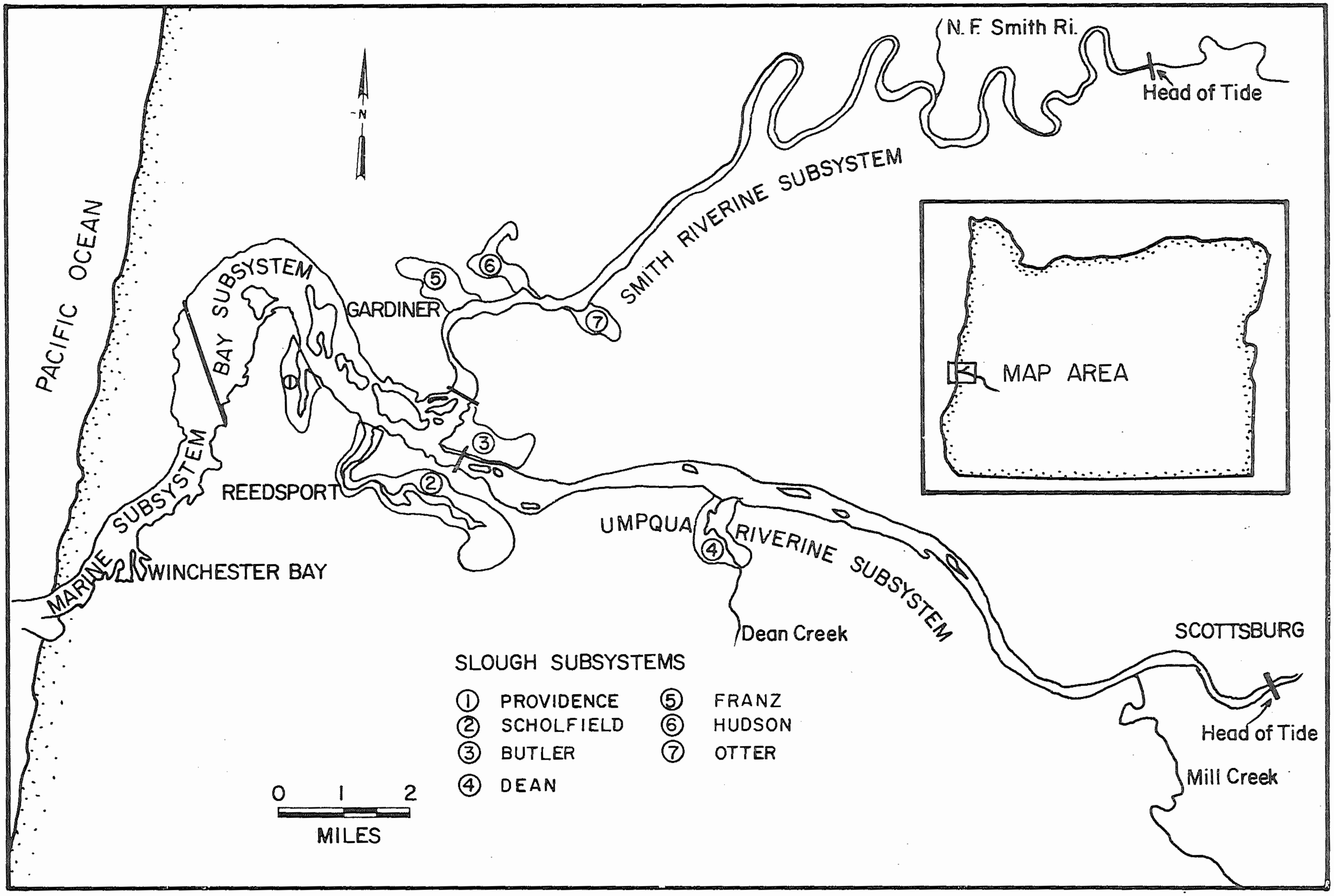


Fig. 10. Subsystems of the Umpqua estuary.

tideflat, probably similar to the present habitat of Ziokowski Beach (Fig. 1). Winchester Bay marina is the center of commercial and recreational fishing in the Umpqua River. The port accounts for $978,000 of food fish (Percy et al. 1974), which ranks fifth among Oregon estuaries. The Winchester Bay marina also is heavily used by recreational boaters and shore anglers (Gaumer et al. 1973).

Jetty development was previously discussed. Two dredge spoil islands created from channel maintenance in the marine subsystem are located on Middleground flat. The flat is a major clam bed, and the spoil probably covered other clam beds on the flat.

Physical characteristics

The marine subsystem is a relatively constricted channel between sand dunes on the north and a steep forested hill underlain with bedrock on the south. The dominant current is produced by tidal action (Gladwell and Tinney 1962). Ebb and flood velocities are also influenced by river discharge. During high river flows the salt wedge penetrates as far as Double Cove Point (USACE 1975). This subsystem is the only one which receives marine sediments. The mouth is exposed to ocean waves, which can reach beyond the throat (Johnson 1972). Summer shoals at the mouth often cause rough bar conditions. The combination of ocean energy and narrow shape makes the marine subsystem the highest energy environment in the estuary.

This subsystem experiences the widest range of salinities, from ocean strength (34.4 ppt) to nearly fresh (0.1 ppt) (Burt 1956). The highest salinities occur on flood tides during the summer and the lowest occur on ebb tides during winter. The salinity at the mouth has fluctuated as much as 29 ppt in one tidal cycle (Burt 1956). This extreme salinity range has to be tolerated by benthic and sessile organisms, while other species can migrate in and out of the subsystem according to salinity preference.

The marine subsystem has the narrowest temperature range. The extreme range of water temperatures at Double Cove Point is between 37.4 and 62.6 F from winter to summer, while the mouth has even narrower extremes (Fig. 6). The predominantly cool water temperatures enable marine and estuarine organisms to tolerate the wide fluctuations in salinity in the Umpqua River. The general water quality of the marine subsystem appears to be the best in the entire Umpqua estuary due to the rapid flushing and mixing with ocean water.

Subtidal habitats and species

Seventy-five percent of the estuarine habitat in the marine subsystem is subtidal (Table 5). The subtidal sediments in the channel are constantly in a state of flux. Tidal and river currents scour the bottom. Variations in the river flow affect the sedimentation rates, and the channel is periodically dredged. Similar unstable conditions contribute to a low benthic production in other estuaries (Schroeder et al. 1977).

The subtidal habitat may be productive for some invertebrates, however. In other Oregon estuaries, large populations of gaper and other bay clams were found in subtidal environments with lesser currents (Gaumer 1978). The Umpqua subtidal habitat is used by many dungeness crab (*Cancer magister*) during summer and fall.

Several species of fish have been caught recreationally (Gaumer et al. 1973) or seined by ODFW researchers in the marine subsystem (Mullen 1977; Johnson 1979). Low salinity probably restricts many marine fish from moving farther upbay (Table 4). Many species also leave the estuary when high river flow lowers salinity at the mouth. The highest diversity of fish species is found in the marine subsystem.

Table 5. Percentage of subtidal and intertidal habitats of selected subsystems of the Umpqua River estuary.

| Habitats | Marine Subsystem[a] | Bay Subsystem[a] | Providence Slough[a] | Schofield Slough[a] | Butler Slough[a] | Umpqua RS[b] | Smith RS[b] |
|---|---|---|---|---|---|---|---|
| SUBTIDAL | 75.0% | 54.5% | 7 | 13 | 9 | 87 | 92 |
| INTERTIDAL | 25.0 | 45.1 | 93 | 87 | 91 | 13 | 9 |
| Shore | 5.2 | 1.2 | | | | | |
| Sand | 4.1 | -- | | | | | |
| Sand/Mud (mixed) | -- | -- | | | | | |
| Mud | -- | -- | | | | | |
| Boulder | 0.6 | 0.5 | | | | | |
| Bedrock | 0.5 | 0.7 | | | | | |
| Flat | 8.3 | 20.5 | 5 | 4 | 2 | | |
| Sand/Mud (mixed) | 0.8 | 16.5 | | | | | |
| Mud | 0.3 | 4.0 | 5 | 4 | 2 | | |
| Aquatic Bed | 5.7 | 7.3 | | | | | |
| Seagrass | 5.7 | 7.3 | | | | | |
| Beach/Bar | 3.6 | -- | | | | | |
| Sand | 3.6 | -- | | | | | |
| Tidal Marsh | 2.2 | 16.5 | 88 | 83 | 89 | | |
| Low Salt Marsh | 1.0 | 1.2 | 2 | 1 | -- | | |
| High Salt Marsh | 0.4 | 15.3 | 2 | 49 | 89 | | |
| Shrub Marsh | 0.8 | -- | -- | 13 | -- | | |
| Fresh Marsh | | | 3 | 12 | -- | | |
| Diked Marsh | | | 81 | 8 | -- | | |

[a] *ODFW 1978*
[b] *DSL 1973*

Winchester Bay was one of 13 marinas in a comparative study of marina flushing and sediment quality (Slotta and Noble 1977). The Winchester Bay marina subtidal sediments were at unacceptable pollution levels for four parameters measured in the study: volatile solids, Kjeldahl nitrogen, grease and oil, and total sulfides.

Although the marina was one of the largest studied, its relatively small entrance restricted circulation and inhibited flushing. Winchester Bay is used by many fish and is a herring spawning area (Gaumer et al. 1973). Fishing from the shore is a popular activity and the marina supports a herring bait fishery (Butler 1973).

## Intertidal habitats and species

The marine subsystem contains a high diversity of intertidal habitats (Table 5) (Fig. 8). Most are small areas located along the main channel. There are three types of intertidal areas found in the marine subsystem that are categorized by substrate (beach/bar, shore, and flat) and two types categorized by vegetation (aquatic bed and tidal marsh).

The beach/bar habitat consists of marine sands and occurs in the wave-exposed mouth (Fig. 8). Its size and shape fluctuate seasonally. It may be habitat for razor clams (*Siliqua patula*) due to its exposure to surf and high salinity.

Intertidal shore habitats occur along the length of the subsystem (Fig. 8). Frequently, the narrow width of the shore habitat indicates strong currents and an abrupt depth change at the shore edge. In the marine subsystem shores are sand on the north and bedrock on the south. The man-made jetties and riprap of the marina are boulder shore habitats. The boulders provide a substrate for algae and many sessile invertebrates. The boulders are also feeding grounds and cover for several species of fish. The lower portions of the sand shore is covered with eelgrass and the upper sand shore contains wood debris. Algae covers the bedrock along the lower tidal level. The sand is probably primarily from the dunes on the north spit, while the bedrock is at the base of a steep hill. The Umpqua estuary is frequented by several adult and juvenile bald eagles, and the hill overlooking the channel provides them with excellent roosts (personal observation, May 1978).

There are also intertidal flats in the marine subsystem. Tideflats are characterized by weaker currents, more stable sediments and higher primary productivity than shores (ODFW 1978). Two sand flats are located near the mouth behind the trainer jetty and breakwaters. The sediments at Ziokowski Beach were described as coarse and loamy sands containing a mixture of typical flat and beach invertebrates (Booth et al. 1978). This area is protected from currents and has some eelgrass and an anerobic sediment layer 3.9-7.9 in from the surface. The mid and lower intertidal zones contained abundant crab larvae, segmented worms, amphipods, arthropods, and ghost shrimp.

Several small tideflat coves occur at intervals along the south shore. Each is a small drainage from the hill. These coves, such as Hunt Cove, Macey Cove, and Jerden Cove, have finer sediments than the north shore of the bay, since they are protected from currents and have some clay and silt input from the hill. Several of the coves have eelgrass beds, which trap sediment and comprise a separate habitat. Softshell clams inhabit the coves.

The largest tideflat in the marine subsystem, called Middleground, is on the north shore (Fig. 8). Marriage (1958) defined it as the largest softshell clam area on the bay. There is also a significant area of eelgrass on the Middleground flat surrounding a small drainage channel. The eelgrass may trap the finer sediment that are mixed with the sand in this area.

There is only a small area of marsh in this subsystem of the Umpqua estuary. There are fringing marshes along the upper edge of Middleground flat and surrounding a spoils island located there. There are small marshes in Jerden and Macey coves identified by Akins and Jefferson (1973) as mature high marsh. Their presence may indicate marsh accretion in those locations. The marshes in these small coves are particularly secluded and make excellent habitat for marsh birds.

Eelgrass beds are located along much of the lower intertidal zone, except along shores near the mouth where the sediments are unstable. The eelgrass provides a protected habitat for fish such as juvenile shiner perch, the most abundant species in the Umpqua during summer (Johnson 1979). Booth et al. (1978) also found numerous benthic invertebrates among the eelgrass.

Summary and management recommendations

The marine subsystem of the Umpqua estuary is predominantly a subtidal environment. Its circulation is dominated by tidal flow, which is greatly affected by river discharge. Dredging and the construction of entrance jetties have modified the currents and extent of salinity. The shape of the lower estuary also influences the extent salinity and tidal water upstream, and the rate of discharge at the mouth. Jetty changes should accommodate both high and low freshwater flows by maintaining necessary crosssectional areas at the throat.

The tideflats of the marine subsystem contain a range of sediment types, which support a diversity of animal groups. Water quality except in Winchester Bay, is above DEQ estuarine standards and should be maintained to protect the valuable clam beds. Winchester Bay should be monitored and protected from excessive waste loads since it is important fish habitat. The marine subsystem supports the majority of sport fishing activity in the estuary, and several species of marine fish occur only within this subsystem. Tideflats and intertidal shores in the marine subsystem should be preserved since many fish feed on the benthos found in these areas. Large benthic populations may be confined to the shore due to the strong currents in the subtidal channel. Tidelands in this subsystem have already been significantly reduced by the construction of Winchester Bay marina and dredge material disposal. Future dredged material should be disposed of only at suitable upland or offshore sites.

Restoration activities should include improvement of circulation into Winchester Bay marina and the removal of spoil islands on Middleground flat. The spoils probably covered productive clam beds similar to those on the rest of the flat, and removal of the islands may permit recolonization.

Bay Subsystem

The bay subsystem begins where the marine subsystem terminates at Barrett's Navigation Range in the Umpqua channel (Fig. 10). The upbay extent of the bay subsystem is RM 12 on the Umpqua and RM 1 on the Smith. This section includes The Point, Gardiner, Steamboat Island, Bolon Island, Reedsport, and the junction of the Smith and the Umpqua rivers. It does not include Providence Creek, Scholfield Creek, or Butler Creek sloughs and marshes. It has the largest area of tidelands and undiked marsh along the Umpqua estuary subsystems. The bay subsystem is a transition zone between the marine and riverine environments of the estuary.

Alterations

The filling of tidelands and diking of a majority of tidal marsh lands were the major recent changes in the bay subsystem of the Umpqua estuary. An original navigation chart of the Umpqua River entrance shows that the International Paper plant site in Gardiner and much of downtown Reedsport were once wetlands. The DSL (1972) recorded 17.39 acres of estuarine lands filled in

Reedsport. However, filling Rainbow Slough and diking the river bank actually removed several hundred acres from tidal influence. Large wetland tracts were also removed from the estuary on Bolon Island, which were not recorded as submerged or submersible lands by DSL. Additional unrecorded fill in the bay subsystem resulted from the disposal of dredge spoils by the USACE on Steamboat Island. Recorded fills include dikes and abutments for railroad and highway bridges, which crisscross Bolon Island.

The major change in the bay subsystem of the Umpqua estuary has been expansion of tidelands and marsh islands in the river channel due to increased sedimentation following settlement of the area. Comparing the 1887 soundings chart with a recent one shows expansion of The Point Island, Stemaboat Island, and Bolon Island. Presently Steamboat Island is almost connected to Bolon Island by accreted tidelands. Some of this deposition was caused by upriver logging and farming activities, which increased sediment loads and decreased river flow (Dicken et al. 1961). Sedimentation was also encouraged in estuarine tidelands by channelizing river flow through dredged channels. Flow through the channel north of Bolon Island was constricted by logbooms, the railroad, and highway bridges and the channel has become much shallower.

Physical characteristics

The bay subsystem has diverse physical environments due to the complex mixing and circulation patterns of marine and fresh waters at the junction of the Smith and Umpqua rivers and around the islands and flats. The many paths the water travels result in different velocities, salinities, and rates of sedimentation at various sites. The channel south of Bolon and Steamboat islands carries the greater volume of water. Its capacity was increased by the dredged shipping channel, which extends to the Highway 101 bridge at Reedsport.

Salinities and temperatures in the bay subsystem vary greatly during the year. During very high flows the salt wedge did not penetrate beyond Double Cove Point, so the upper bay water was fresh from surface to bottom. During medium flows, surface and bottom salinities differed up to 16.0 ppt at RM 7.1 and up to 8.9 ppt at Reedsport (RM 10) (Burt and McAllister 1958). Mullen (1973) found salinities over 20 ppt at the surface and bottom at stations in this subsystem during low flows in August.

The salinity range is not as wide as in the marine subsystem, but the temperature range is greater. Fewer marine species are found in the bay subsystem as a result (Table 4). The maximum salinity measured in the bay subsystem decreased from RM 6.5 to RM 10 and temperature increased (Fig. 6). At the upper end of the bay subsystem, surface salinity measurements averaged less than 8 ppt.

The water quality of the bay subsystem has met DEQ water quality standards for marine and estuarine waters of Oregon, but the estuary is closed to commercial shellfish harvest upstream to The Point (Fig. 1) due to high concentrations of fecal coliform (Osis and Demory 1976). Gladwell and Tinney (1962) identified several areas of the bay subsystem which were potential areas of pollution concentration (Fig. 7). These were locations where eddies with low velocities resulted in increased sedimentation and accumulation of suspended contaminants, and where limited flushing could cause the concentration of dissolved contaminants to remain high over a long period.

The water quality of the bay subsystem is more vulnerable to water pollution than the marine subsystem because of its higher summer temperatures, the proximity of the human population, and its relatively slow flushing rate.

## Subtidal habitats and species

The subtidal habitat accounts for 54.5% of the bay subsystem (Fig. 8). Much of the subtidal habitat is dredged. The south channel is maintained to Reedsport and the north channel to the International Paper Company docks at Gardiner. Shoals have formed in the channel north of Bolon Island during the last century probably from reduced river flows due to the obstructions of fills and bridge abutments and dredging in the south channel. The depths in the north channel in 1887 ranged from 8 to 30 feet between Gardiner and the Smith River. Recent soundings (NOS 1976) show depths of less than 8 feet in that same area.

Fish species in the bay subsystem are of both ocean and river origin. Species such as the Pacific herring and northern anchovy were not found above this subsystem, and species such as the prickly sculpin and Umpqua squawfish were not found below it (Table 4). American shad rear in the bay subsystem for up to a year before they migrate to sea for the first time (Mullen 1977). Recreational anglers fish this section of the river from boats and the shore. Striped bass angling from shore is most productive in this area (Gaumer et al. 1973).

## Intertidal habitats and species

The bay subsystem contains the most extensive intertidal areas in the estuary. Flats and marshes predominate although there are also significant eelgrass beds. The tideflat habitat comprises 20.5% of the bay subsystem. The largest flats surround The Point (Fig. 8). They have mixed mud/sand sediment and contain productive beds of softshell clams (Gaumer et al. 1973), which are open to commercial harvest. Booth et al. (1978) found many amphipods (*Anisogammarus* sp., *Corophium* sp.) ghost shrimp (*Callianassa* sp.) and shrimp (*Crangon* sp.) at The Point. These crustaceans are important in the diets of larger organisms and also help form and rework the sediments. Annelid worms, nemertean worms, and small macoma clams were also abundant. The tide flats at The Point are characterized by high animal diversity and productivity and a community typical of undisturbed sediments (Booth et al. 1978).

The mud flats and shores along the channel by Gardiner and Bolon Island contrast sharply with the tide flats of The Point. Many of the same species are present in both these tidelands, but the population of the mud flats and shores are low and individuals are smaller (Booth et al. 1978). The quantity of log debris and organic material has created anerobic sediment close to the surface, which limits the number of benthic species that can survive. Macoma and softshell clams, which were abundant on The Point, were scarce on Goose Island mudflat. The reproductive capacity of populations living in anerobic sediments of the bay subsystem may be reduced as well. Higher percentages of mud and organic material in the sediments may be a more natural condition in the upper part of the bay subsystem than in the tideflats downbay, but bridge construction, filling and diking, log rafting, and saw milling have increased the proportion of that material.

Eelgrass beds are considered one of the most productive and significant habitats in estuaries. The largest eelgrass bed in the bay subsystem is south of The Point at the lower end of the subsystem. Eelgrass also grows as a narrow band at the lower intertidal edge around some of the islands and along the shores or flats (Fig. 8). The upper end of Bolan Island appears to be the uppermost limit of eelgrass growth in the estuary. Many shiner perch, bay pipefish, and three-spine stickleback would be likely to rear in these areas. Herring probably also spawn in the eelgrass but specific spawning areas above Winchester Bay have not been surveyed. The benthos associated with eelgrass beds in the bay subsystem have not been studied.

Marshes comprise 16.5% of the bay subsystem. Most are located on islands within the bay. The Point is an island of mature high marsh. It is separated from another area of high salt marsh on the mainland by the cutoff channel (Fig. 8). This marsh had several different plant communities reflecting differing elevations and salinities (Fig. 11). The dominant plant species (Table 7) are indicative of high salt marsh, but terrestrial species such as false dandelion and red clover also occur as a result of cattle grazing during the summer. Much of the marsh on The Point formed since white settlement of the area (Dicken et al. 1961) from the convergence of several small islands.

Table 7. Marsh plants found in the Point marsh, Umpqua estuary (Booth et al. 1978; Akins and Jefferson 1973).

| | |
|---|---|
| *Carex lyngbyei* | Lynbyeis sedge |
| *Cotula coronopfolia* | Brass buttons |
| *Deschampsia caespitosa* | Tufted hair grass |
| *Distichlis spicata* | Salt grass |
| *Hypochaeris radicata* | False dandelion |
| *Juncus leseurii* | Salt rush |
| *Jaumea carnosa* | Jaumea |
| *Orthocarpus castillejoides* | Paint brush |
| *Potentilla pacifica* | Pacific silverweed |
| *Rumex occidentalis* | Dock |
| *Salicornia virginica L.* | Pickleweed |
| *Senecio jacobaea* | Tansy ragwort |
| *Scirpus americanus* | Three square rush |
| *Trifolium wormskioldii* | Cow clover |
| *Triglochin maritima* | Seaside arrowgrass |

Another tract of marsh which has undergone considerable accretion is Steamboat Island, which was formed less than 100 years ago from separate marsh islands, Steamboat and Cannary islands (Dicken et al. 1961). The accretion of these islands is directly related to dredge disposal, especially at a large site at the northwest end of the island. The intertidal area surrounding the island has spread at the northwest end of the island. The intertidal area surrounding the island has spread southward almost to Bolon Island dividing the Gardiner and Reedsport channels from RM 8.5 to RM 10. Akins and Jefferson (1973) characterized most of this island as immature high marsh, which was

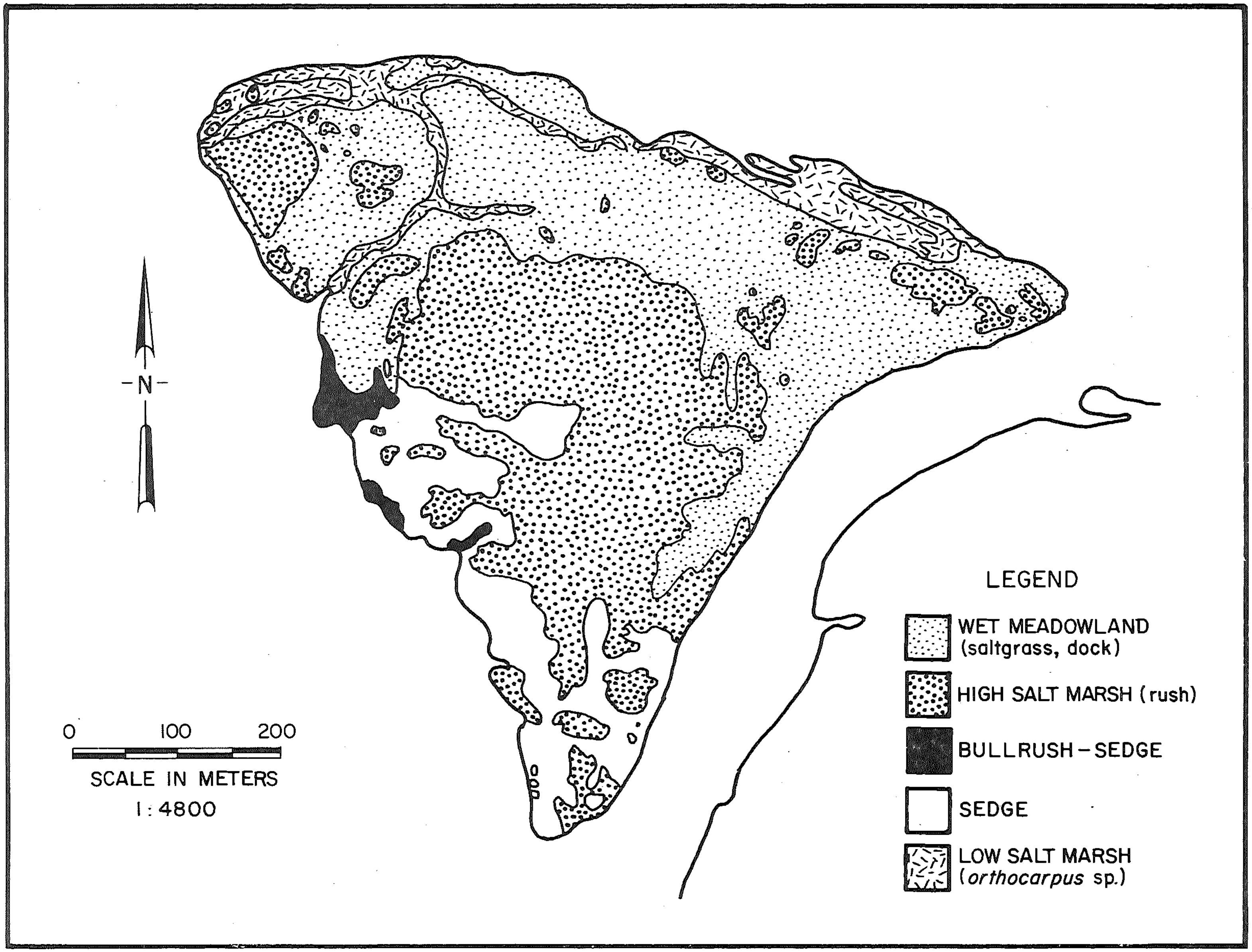


Fig. 11. Micro-habitats of The Point Island marsh (Booth et al. 1978).

inundated more frequently by high tides, since it had less defined drainage channels and was generally lower in elevation than mature high marsh. Steamboat Island's vegetation is dominated by lyngbyei's sedge, tufted hair grass, and salt grass. The vegetation has also been grazed by cattle. Recently Miller (1978) categorized more area of the island as mature high marsh than previous surveys, indicating continued acfretion.

At the junction of the Smith and Umpqua rivers are several bullrush and sedge marshes (Akins and Jefferson 1973). This marsh class is indicative of diluted salt water environments. Bullrush and sedge marshes, listed in order of size, are located at Blacks and Goose islands, the eastern tip of Bolon Island, and along the shorelines. A survey of Goose Island marsh showed that it contained several marsh communities besides bullrush and sedge (Fig. 12).

## Summary and Recommendations

The bay subsystem is a transition zone between marine and riverine habitats in the Umpqua estuary. Mobile species from adjoining subsystems occur in this subsystem at various seasons of the year, and the extreme up-or downbay distribution of some sessile species occurs in this subsystem. The bay subsystem is important because it contains the majority of tidelands in the estuary, including major tracts of tide flat, eelgrass, and marsh.

Careful management of this subsystem is critical to the overall condition of the Umpqua estuary system since it contains the largest concentration of people and industry. Decisions concerning the development of estuarine lands should consider the extent of tidelands and marshes removed from the estuary, as well as accreted wetlands. Water-dependent development should be concentrated in the areas of Reedsport and Gardiner that are adjacent to the present navigation channel. Alterations of the intertidal habitats should be minimized. The Point, Steamboat, Goose, and Blacks marsh islands and associated flats and

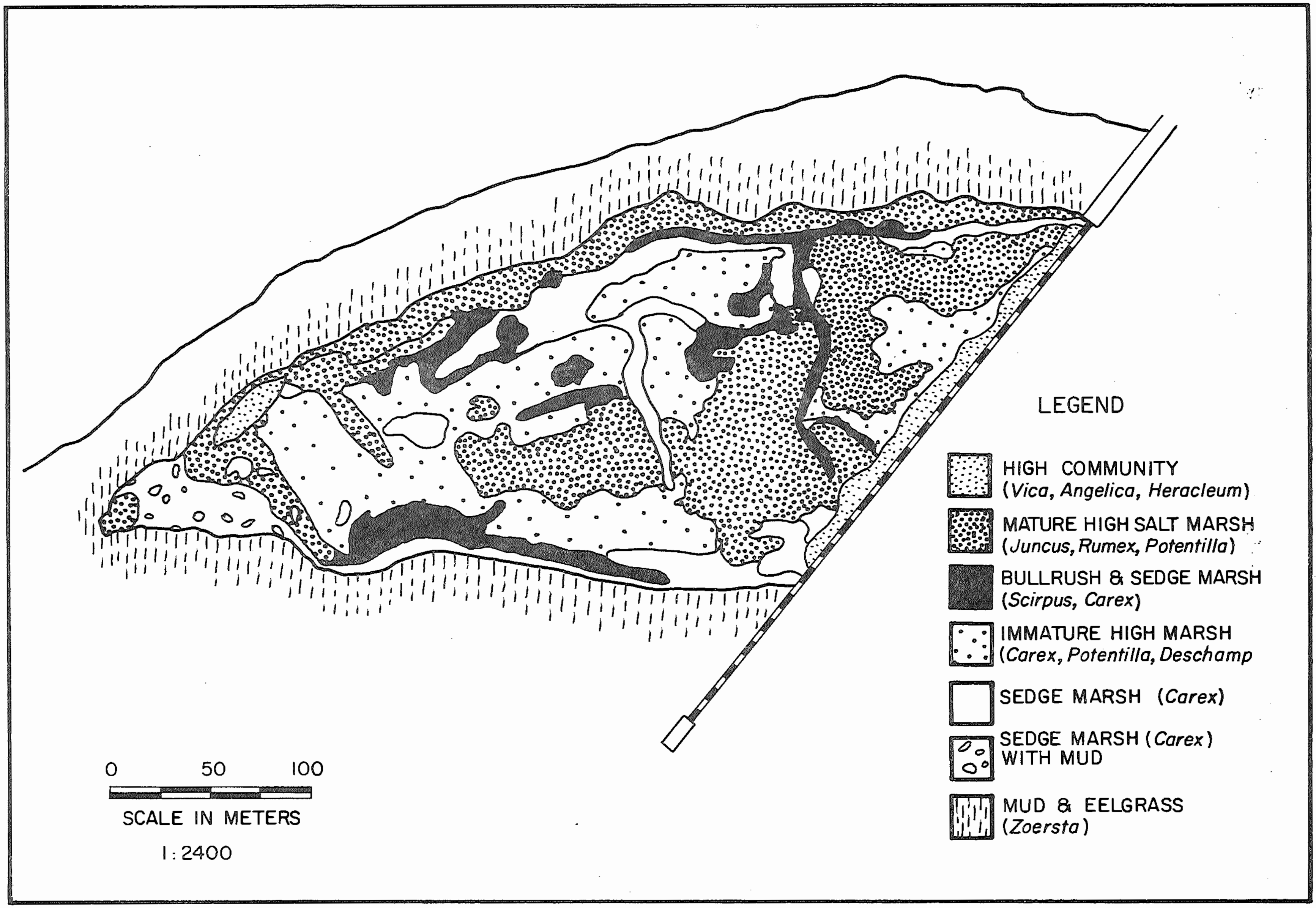


Fig. 12. Micro-habitats of Goose Island marsh (Booth et al. 1978).

eelgrass beds are major tracts in the Umpqua estuary and should be protected accordingly (LCDC 1977b). As in other estuaries the impact of cattle grazing on marsh productivity needs to be determined. Since the Umpqua has relatively few marshes, the impact of grazing could be significant.

Water quality should be maintained, since the physical environment of the bay subsystem exhibits a wide range of temperatures and salinities which can stress resident species near their tolerance limits. Outfalls should be located below RM 7 for minimum impact on the system, and contaminants should be released on ebb tides, during high river discharge. The sources of fecal coliform bacteria should be identified and reduced so that softshell clams in the area can become safe for consumption.

Circulation through the channel north of Bolon Island should be improved by removing structures which impede flow, such as log rafts, and especially the road-dikes and the railroad dike. Such restoration could increse the volume of water passing into the north channel from the Smith River. Another critical channel occurs between Bolon and Steamboat islands, which connects the flow of the south channel with the Gardiner channel. This channel should not be further obstructed in order to preserve the natural circulation of the bay subsystem. The maintenance and improvement of circulation in these areas may also enhance the shore and flat habitats which appear somewhat degraded. Channels should continue to be maintained only at depths required by present ship traffic. Considering the problems associated with dredged material disposal, USACE should reduce the authorized depth of the ship channel to coincide with actual needs. A reduction in dredging could enhance both circulation and benthic habitat. Dredged material should not be disposed of intertidally because of the limited amount of intertidal land available. Subtidal disposal is also undesirable because it can release pollutants smother benthos and reduce cross sectional area of the estuary. Suitable upland or ocean sites should be used for dredged material disposal.

Riverine Subsystems

The Umpqua estuary includes the Umpqua riverine subsystem (Umpqua RS) and the Smith riverine subsystem (Smith RS). The Umpqua RS begins at Umpqua RM 12 at the mouth of the Smith River and extends to head of tide at Scottsburg (RM 27). The Smith RS begins at the northern end of Blacks Island and extends to the head of tide (Smith RM 24) 1 mile above Spencer Creek (Fig. 10).

## Alterations

The major alterations in the riverine subsystems have been diking, dredging in the Smith River channel, and commercial gravel removal from the Umpqua RS. Construction of Highway 38 on a high dike along the south shore of the Umpqua River and Highway 48 along the north shore of the Smith River has effectively removed most of the marshland behind them from estuarine influence. Other marshes, especially in Smith RS, were diked for agricultural land reclamation. The extent of diked marsh has not been computed. A 6-foot channel from Reedsport to the North Fork of the Smith River has been dredged approximately every 10 years. The Smith River channel was dredged during 1972-3, when 170,000 $yd^3$ of material were removed (USACE 1975). Six shoreline areas on the Smith River have been used as dredge disposal areas: three diked areas of Brainard Creek and three areas at the North Fork of the Smith River.

## Physical characteristics

Little information has been collected pertaining to physical characteristics of the Umpqua RS or Smith RS. The two riverine subsystems are within narrow valleys, flanked by abruptly rising coastal mountains. Tidal information is lacking, but tidal ranges are probably smaller than in marine or bay subsystems.

The riverine subsystem is characterized by low salinities. Mullen (1973) measured salinity from July-October 1972 in the Umpqua RS. The highest measurement was about 15 ppt taken on a flood tide during September at RM 13. The salinities were never above 5 ppt above Dean Creek (RM 17) during the same study. No comparable studies have been made of the Smith RS but salinities may reach higher concentrations since the fresh water discharge in Smith River is about 10% that of the Umpqua (Gladwell and Tinney 1962). During medium to high river discharges, neither river subsystems have measureable salinities.

There are no water quality measurements, monitoring programs, or flushing studies for either Umpqua RS or Smith RS. However, Gladwell and Tinney (1962) determined that pollutants discharged at the lower end of the riverine subsystems would not adequately flush during summer flow. The flushing time increases the further upstream the discharge is located. The Umpqua RS often contains suspended sediments during high flow in excess of DEQ turbidity standards.

The water temperature in the Umpqua River is generally above 70 F during most of July, August, and early September (USGS 1970-1977). Temperatures up to 79 F have been measured at Scottsburg (DEQ 1978). Temperature data were not available for the Smith RS above Reedsport. The timing and use of riverine subsystem by fish is influenced by their tolerance of water temperatures above 68 F and low salinities.

Habitats and species

The riverine subsystems are almost entirely subtidal. The subtidal habitat covers 87% of the Umpqua RS and 92% of the Smith RS. Only a small section of the habitats of the riverine subsystems have been mapped (Fig. 8). The predominant substrate of the upper Umpqua RS is gravel (CH2M 1972), although layers of silt may be deposited over the gravel during low flows. Bottom types of the Smith riverine subsystem are unknown, but the sediments are probably finer since the currents are slower than in the Umpqua. No studies have been made of riverine benthos.

Twenty-six species occur in the Umpqua RS during the summer (Table 4). They are predominantly anadromous and fresh water species. Brown bullhead, largemouth bass, and black crappie are restricted to riverine subsystems.

The shad population of the Umpqua estuary is second only to the Columbia River population in size in Oregon. It was the most abundant species seined by Mullen (1977). The juvenile shad reared in the estuary for up to a year before migrating to sea. Adults returned to spawn up to seven times (Mullen 1972). A tagging study indicated individual shad do not frequently migrate between bays. It was concluded that each estuary and even the Smith and Umpqua rivers have discreet shad populations (Mullen 1974a).

Shad are commercially fished in the Umpqua riverine subsystem below Mill Creek and on the Smith below the North Fork. Umpqua fishermen are limited to drift nets to protect salmonids. Both set and drift nets are allowed on Smith River. The number of shad fishermen on the Umpqua River varied between 22 and 45 from 1950-71. After 1975 shad fishermen were prohibited from harvesting striped bass. Since that time, the number of shad fishermen in the Umpqua dwindled to 15 in 1977. The number of Smith River fishermen varied from 10 to 83. The female shad population in 1969 in the Umpqua RS was estimated at between 173,000 and 229,000 individuals, based on commercial catch figures (Mullen 1974a). The Smith RS population is probably significantly less, judging from commercial landing records.

Striped bass spend crucial portions of their lives in the riverine subsystems of the estuary. The striped bass and shad were introduced from the east coast into San Francisco Bay. Striped bass have slowly established in bays north of San Francisco. The Umpqua and Coos River systems have the largest populations in Oregon. Striped bass live and spawn many more years than shad. The population size fluctuates, and one successful year class can dominate a river system for several years.

Presently the harvest of striped bass is restricted to sport fishing, and the commercial shad gill netters use light mesh net to permit large stripers to escape. The striper is a highly prized game fish. When striped bass was part of the commercial fishery the Umpqua RS, landings increased from 1,000-9,000 pounds from 1950-60 and up to 53,000 pounds in 1971 (Mullen 1974b). Smith RS landings also reflected proportional increases. The sport fishery in 1972 was estimated at 6,036 fish of undetermined weight. This number approached the commercial catch.

Green sturgeon and white sturgeon also live and spawn in the Umpqua RS (Lauman et al. 1972). Sturgeon are occasionally caught by sport fishermen.

The remaining habitats in the Umpqua RS and Smith RS are narrow intertidal shores, gravel bars, and bullrush and sedge marsh which occurs mostly in fringes along the shore. There are major diked marshes in the riverine subsystem, mainly near Reedsport. The Hinsdale Ranch is a large diked marsh on the Umpqua RS, and the pastures below Brainard Creek on the south shore and below Noel Creek on the north shore are large diked marshes on the Smith RS. Diking has occurred to head of tide on both rivers.

## Summary and management recommendations

The riverine subsystems of the Umpqua estuary includes the Umpqua and Smith rivers above Reedsport to the heads of tide. Although the channel habitats are tidally influenced, they are predominantly fresh water.

The subsystems are important spawning and feeding grounds for shad, striped bass, and other species of fish. Therefore, efforts should be made to maintain the water quality of both rivers. Extreme temperature is the most severe condition which fish must tolerate. Upriver water use plans should include provisions for adequate summer flows to maintain temperatures below lethal limits of juvenile fishes. Turbidity levels and fecal coliform concentrations are also potential water quality problems in the summer, when flushing time is long and gravel removal disturbs the sediments.

The remaining marshes and restorable diked marshes in the Smith RS should not be used for dredge disposal sites since most of the marshes have already been tidegated or diked. Spoils from future maintenance dredging in the Smith River channel should be taken to upland or offshore disposal sites.

Studies of fish species which rear or spawn in the river subsystems of estuaries are needed. Investigations of the role of physical environmental factors in residence times and habitat utilization by shad, striped bass, cutthroat trout, and sturgeon would help determine the importance of the riverine subystem to the production of these species. Without such studies, it is difficult to make recommendations concerning the effects of expanded or reduced gravel removal, dredging, and other activities on the fish populations.

There is at least one potential marsh restoration site on the Smith RS across from Hudson Slough. The tidegate is broken, and both salt tolerant and freshwater marsh plants are present, but circulation is poor. This marsh should be preserved and circulation improved by removal of the faulty tidebox and parts of the dike. Other diked marshes in both riverine subsystems should be examined for their restoration potential.

## Slough Subsystems

The slough subsystems include several small tributaries that empty into the Umpqua estuarine system. Sloughs are predominantly intertidal, with large portions of tideflat and marsh. Slough subsystems in the Umpqua estuary have a great range of environmental factors because they empty into the bay and riverine subsystems. Each slough has a separate drainage system and tidal prism. Sloughs in the bay subsystem are Providence, Scholfield, and Butler (Fig. 10). The Umpqua RS has Dean Creek Slough, and Smith RS has three small slough subsystems: Frantz Creek, Hudson Clough, and Otter Slough (Fig. 10).

Alterations

Several of the small slough subsystems have been altered considerably. Three historic sloughs have been eliminated. Winchester Bay was developed from a small slough at Winchester Creek; Rainbow and McIntosh sloughs in Reedsport were once predominantly high marsh but were filled to create upland. Providence Slough is diked and tidegated at the mouth and thereby removed from tidal influence. Most of the marshes on the lower north shore of Scholfield Slough were diked and filled or used for pasture. Several houseboats are located in Scholfield Creek near the U. S. 101 bridge. Smith River and Umpqua River highways constrict the openings of Franz, Hudson, Otter and Dean slough subsystems.

Physical characteristics

The sloughs and creeks of the Umpqua estuary have been studied very little, even though some have been modified or removed from estuarine influence. The heads of tide have not been determined on most slough tributaries. Tidal prism data and detailed flow, salinity, and water quality measurements are not available for any of the slough subsystems. Salinities in the sloughs are probably less than or equal to salinities in adjacent bay or riverine subsystems. Lower salinities result from the added dilution of tide water by freshwater inflow. The seasonal temperature patterns of sloughs are often more extreme than adjacent water because the shallower and intertidal lands store heat and cold at low tides. Flushing is inhibited in several sloughs by constriction of the lower slough by road dikes. In diked sloughs the channels become sediment traps, which can have soft, anerobic mud bottoms. Butler Creek and Otter Slough are examples of relatively pristine slough subsystems.

Habitats and species

The small subtidal habitats of the sloughs are unlike areas in the other subsystems. The subtidal portions of Providence, Scholfield, and Butler creeks account for 7-13% of the slough areas (Table 5). The substrate probably contains more silt and clay than the riverine substrate. Above the heads of tide, the creeks contain more gravel and are spawning habitat for coho salmon and winter steelhead trout (Table 8). Other species of fish occur in the sloughs. Mullen (1977) collected the largescale sucker, striped bass, American shad, shiner perch, prickly sculpin, and Umpqua squawfish from Scholfield Slough. These species indicate a predominantly freshwater environment, although the species can withstand low salinities. In sloughs above Reedsport, such as Otter Slough (Fig. 10), Booth et al. (1978) found freshwater organisms such as water striders, caddis fly larvae, horse fly larvae, and dragon fly larvae in the channels.

Providence Creek is diked, and there is little circulation in the slough. The subtidal environment may resemble a freshwater pond, containing a variety of insects and freshwater fish. However, the pastureland surrounding such diked sloughs may contribute enough organic material and bacteria to consume the available oxygen, thus making the habitat unsuitable for most fish.

The area and types of marsh habitat (Table 5) of Providence, Scholfield and Butler creeks were compared from ODFW habitat maps (1978). The three areas have contrasting environments, mostly due to human activities rather than natural environmental gradients, since they all are located near Reedsport.

Table 8. Coho and winter steelhead spawning habitat in the Umpqua estuary slough subsystems (Lauman et al. 1972).

| Location | Spawning habitat Coho | Winter steelhead |
|---|---|---|
| <u>Bay Subsystem</u> | | |
| Providence Creek | | |
| Scholfield Creek | x | x |
| Butler Creek | x | x |
| <u>Umpqua Riverine Subsystem</u> | | |
| Dean Creek | x | x |
| <u>Smith Riverine Subsystem</u> | | |
| Frantz Creek | x | |
| Hudson Slough | x | |
| Otter Slough | x | x |

Eighty-one percent of Providence Slough (Fig. 10) contains freshwater marsh and pasture plant communities (Miller 1978). The pastureland is grazed by cattle. Several patches of ungrazed freshwater marsh occur in the pond environment of Providence Slough. The dike system of Providence Slough surrounds Leed's Island and continues along the north shore of the Umpqua estuary. The entire area was once high marsh, which probably contained bullrush and sedge until it was diked.

Scholfield Slough is intermediate among the three sloughs mentioned in terms of man-made modifications. Eight percent of its present area is diked marsh, which is used for pasture. The upper portion of Scholfield Slough has not been altered except for a railroad line along its north shore. The marsh changes from bullrush and sedge (49%) to fresh marsh (12%) and finally to shrub marsh (13%) in its upper reaches (Table 5). Bullrush and sedge marshes occur in predominantly freshwater environments but are characterized as salt marsh because they can tolerate exposure to salinity (Akins and Jefferson 1973). Fresh marsh plants cannot tolerate salt water. Fresh marsh plants include cattails (*Typha latifolia*), spike rush (*Eleocharis* sp.), and freshwater sedge (*Carex obnupta*). Bullrush and sedge marshes are dominated by *Scirpus validus* and *Carex lyngbyei* (Akins and Jefferson 1973).

The numerous other sloughs above Reedsport on the Umpqua and Smith rivers have various amounts of exposure to tidal inundation, depending on the extent of diking and tidegating. Tidal information is lacking, and the habitats have not been mapped.

The largest marsh on the Umpqua River above Reedsport is on Dean Creek Slough. Large marshes also exist on Frantz, Hudson and Otter sloughs. A study of Otter Slough described it as a tidally influenced freshwater marsh. Other sloughs in the Smith and Umpqua rivers probably have fresh marshes or grazed pastureland, depending upon the degree of tidal influence.

## Summary and management recommendations

The slough subsystems of the Umpqua estuary are small but important because they contain a large portion of the marshes in the estuary. Subtidal and other intertidal lands occupy a small percentage of the subsystems. There are a variety of marsh types present because of salinity gradients and environmental changes by man. Filling, diking, and tidegating have eliminated many marshes from estuarine influence and turned others into fresh marsh. The sloughs above Reedsport and those on Smith River contain fresh marsh under tidal influence.

The unaltered marshes are important sources of organic material and provide habitats for birds, mammals, and insects. They should be protected from further filling or diking. Butler Creek Slough is a major tract of marsh which should be preserved (LCDC 1977b). Undiked marsh areas in the slough subsystems should be protected since only a small percentage of original marshes remain. A diked marsh on the south bank of Scholfield Creek is a potential restoration area. A culvert there already permits limited exchange. The dike and tidegate on Providence Slough should be removed to help restore the slough. The slough subsystems should be surveyed for other potential restoration sites.

The water quality of each slough should be monitored. Areas of high fecal coliform bacteria or low dissolved oxygen should be determined and sources of pollutants eliminated if possible. The slough channels are important passageways for anadromous fish and habitat for other species.

## SUMMARY AND RESEARCH RECOMMENDATIONS

The Umpqua estuary is one of the largest in Oregon. The Umpqua River drains thousands of square miles extending to the Cascade Mountains. Much of the estuary is subtidal and riverine in character, in part due to early development which included extensive diking and filling of marshes and tidelands. The Umpqua estuary is renowned for its populations of striped bass, shad, steelhead and chinook salmon. Softshell clams and Dungeness crabs also provide significant fisheries. However, the total biological community is not well documented.

In order to make decisions on the suitability of sites for development, information is needed on the potential impacts of the development on the estuary so that its productivity can be adequately protected.

Most data available for the Umpqua estuary was taken in broad surveys that included all Oregon estuaries. Research which specifically deals with the Umpqua investigation is needed.

The acreage of diked marshes should be calculated from historical records. A comparison of the acreage of tidelands and marshes present now and the acreage existing before white settlement is needed. General research is also needed comparing diked and undiked, grazed and ungrazed marshes as habitats for fish and wildlife and their productive input to the estuary. An inventory and map of the present type and extent of each kind of marsh in the upper estuary and an inventory of potentially restorable tidal marshes should be made. The other habitats in the sloughs and riverine subsystems above Reedsport should also be identified and mapped at an adequate scale to delineate habitat boundaries.

Sediments are an important physical parameter which have not been surveyed. Comparisons of sediment sizes and qualities of bay habitats are needed. The origin of sediments in tidelands and channels and the rate of disposition should be investigated. Other data needs pertaining to the physical environment include seasonal salinity and water quality measurements of the Smith River and the sloughs and tidal characteristics, including lag time and upriver tidal ranges. Increased human use may warrant an examination of heavy metal concentrations in the Umpqua.

Benthic invertebrates should be surveyed and their habitat requirements determined to protect them from avoidable disturbances. A comparative study of bottom dwelling organisms and fishes and their seasonal distribution in the estuary would help assess the present condition of various habitats and subsystems.

In general, studies should seek to answer questions concerning specific habitat functions and relative habitat values in the Umpqua estuary. The studies should measure the variability of the parameters they address both in space and time. Researchers should try to incorporate a historical perspective of changes within the estuary into their conclusions.

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