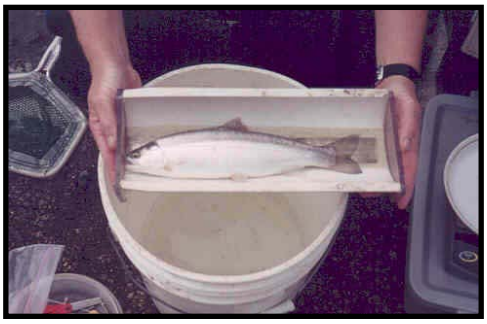
Russian River Estuary Flow-Related Habitat Project, Survey Methods Report 2003



Sonoma County Water Agency
2150 West College Avenue
Santa Rosa, California 95401

Prepared by
David Cook – Senior Environmental Specialist

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RUSSIAN RIVER ESTUARY FLOW-RELATED HABITAT PROJECT, SURVEY METHODS REPORT 2003

INTRODUCTION

The Sonoma County Water Agency (Agency), along with other government entities, is currently undertaking a Section 7 consultation to evaluate the potential effects of proposed water-related operation and maintenance activities in the Russian River watershed on threatened fish species and their habitat. Section 7 consultation under the Endangered Species Act, administered by National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries), is required for federal projects that may impact listed anadromous fish species. The Russian River watershed supports threatened stocks of steelhead, Chinook salmon, and coho salmon. During the Section 7 consultation process with NOAA Fisheries, the proposed Russian River Estuary Flow-Related Habitat Project, also referred to as the Flow Proposal, was developed. This proposed project includes an Estuary Management Plan that would change the current summer management of the Russian River Estuary (Estuary) from a tidally influenced open-mouth system to a closed-mouth lagoon with predominantly freshwater to improve rearing habitat for salmonids (Entrix 2004).

Under the proposed Russian River Estuary Flow-Related Habitat Project, releases from Warm Springs Dam at Lake Sonoma and Coyote Valley Dam at Lake Mendocino would be modified to improve rearing and migration conditions for salmonids in the Russian River, Dry Creek, and Estuary. The proposed project would also provide sufficient water to satisfy existing water demand in the Russian River and Dry Creek, and meet future demands for the Agency's Water Supply and Transmission System Project. The most substantial changes under the proposed project would be a reduction in downstream flow from Coyote Valley Dam and Warm Springs Dam between June and October and summer management of the Estuary as a lagoon. These changes must still undergo review and approval by NOAA Fisheries, as well as review under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA).

This report evaluates the feasibility and effectiveness of using several field survey techniques for sampling fish and macro-invertebrates in the Estuary, summarizes preliminary results, and discusses additional study needs. Future studies will be used in the preparation of CEQA/NEPA-related documents for the proposed Russian River Estuary Flow-Related Habitat Project.

Background

Current Estuary Management

The Estuary periodically closes throughout the year as a result of a sandbar forming at the mouth of the Russian River. Closures are most frequent in the late-spring through fall. Currently, when the Estuary is closed, increasing water levels eventually flood adjacent lands. Historically, local or government entities artificially breached the sandbar to lower water levels and prevent property damage. During 1992 and 1993, a study evaluated the impacts of artificially breaching the Russian River mouth and developed a management plan (Heckel 1994). The study recommended maintaining the Estuary as an open-mouth system using mechanical breaching to reduce adverse environmental effects and protect private property from flooding. However, this recommendation was based on existing summer flows of the Russian River required under the

State Water Resources Control Board's Decision 1610 (D1610) that, in part, specifies minimum in-stream summer flows for the Russian River. The Estuary management plan was adopted by the Sonoma County Board of Supervisors in 1995 and the Agency assumed responsibility for its implementation. Currently, the sandbar is mechanically breached using a bulldozer, on average, 5 to 7 times per year when water levels in the Estuary are between 4.5 ft and 7.0 ft (as read at the Jenner gage located at the Jenner visitor's center).

Proposed Estuary Management

The proposed Estuary Management Plan is described in detail in the Draft Biological Assessment (Entrix 2004) and is summarized below.

> "The objective of the Estuary management proposal is to improve habitat for listed salmonid species while preventing flooding of local properties. To improve summer rearing habitat in the Estuary, the proposed project would eliminate artificial breaching of the sandbar during the summer months. Artificial breaching may be required in the spring or fall, and in some dry winters, to manage storm flow inflows to the Estuary to prevent flooding of local property.
>
> Estuaries and lagoons in the Central California Coast and Northern California Steelhead Evolutionary Significant Units (ESUs) provide important summer rearing habitat for steelhead and Chinook salmon. Summertime breaching of sandbars has been found to severely alter steelhead habitat conditions in lagoons, and summertime breaching can negatively affect salmonids. Infrequent artificial breaching, especially during low-flow summer months, impairs water quality because salinity stratification repeatedly results in periods of higher water temperatures and low dissolved oxygen (DO) levels. Fluctuations in temperature, DO, and salinity affect salmonid habitat, primary production, and the abundance of aquatic invertebrates upon which young salmonids feed. Smith (1990) found that when a sandbar is left closed over the summer months, good water quality develops when the system is converted to freshwater and stable habitat conditions form. [In addition, Cannata (2004) studied two rivers in Mendocino County and found a higher abundance of steelhead in the Navarro estuary that converts to a freshwater lagoon during summer, while the tidal Albion estuary had a lower abundance of steelhead.] Habitat conditions for salmonids in the Estuary would be improved by eliminating artificial breaching in the summer.
>
> Under the proposed action, there would be two management scenarios, one for Low-flow Estuary Management and one for Storm-flow Estuary Management. The Estuary would be managed with the goal of maintaining a closed system (lagoon) with freshwater habitat during the low-flow (summer) season. This action is expected to improve summer rearing habitat by allowing the lagoon to freshen and by stabilizing salinity and DO conditions, which would also increase and stabilize the invertebrate food base for salmonids. The frequency of breaching and the amount of freshwater inflow are two major factors that influence water quality in a lagoon or estuary system. Under the Flow Proposal [Entrix 2004], flow to the Estuary would be low enough to avoid artificial breaching in the

summer, but high to freshen the lagoon after the sandbar first closes. Under Storm-flow Estuary Management, artificial breaching would be conducted to manage the Estuary as an open system during the wet season to minimize flooding of local property.

Under D1610, the Estuary cannot be managed as a closed system during *normal* water supply conditions because required minimum flows at Hacienda [near Guerneville] provide inflow rates to the Estuary that are too high to avoid flooding if the sandbar is not breached. Therefore, the proposed Estuary management action could only be implemented in concert with reduced flows such as those in the Flow Proposal. Implementation of the Flow Proposal allows dry season inflow to the Estuary to be substantially lower than permitted under D1610."

SURVEY METHODS

Study Area

The Estuary study area consists of the tidally influenced portion of the lower Russian River from the sandbar mouth at the Pacific Ocean to the confluence with Austin Creek, located 11.7 km (7.3 mile) upstream from the coast (Figure 1). However, tidal action has occurred as far as Monte Rio located an additional 16 km (9.9 miles) upstream (Heckel 1994). The Estuary is as narrow as 23 m (75 feet) near the upstream end and gradually widens to over 76 m (249 feet) near the mouth. Water depths vary in the Estuary but generally increase closer to the mouth; however, deep pools, greater than 10 m, occur throughout the Estuary. The study area was sectioned into 5 reaches based on habitat and topographic features, including:

- River Mouth reach – sandbar mouth to lower Penny Island
- Penny Island reach – lower Penny Island to upper Penny Island
- Bridgehaven reach - upper Penny Island to Sheephouse Creek confluence
- Duncans Mills reach - Sheephouse Creek confluence to below Moscow Road Bridge (Duncans Mills)
- Casini reach – below Moscow Road Bridge to Austin Creek confluence

Estuarine environments typically have salinity levels that range from seawater (>28 ppt) found near the ocean to freshwater (<1 ppt) found at stream inflows. Brackish waters occur in the middle were seawater and freshwater mix. Also, a common characteristic of some estuarine systems is the periodic stratification of water where the heavier seawater occurs at the bottom and the lighter freshwater or brackish water occurs at the surface. Currents, tidal/wave action, stream flows, and wind contribute to water layers mixing.

Salinity in the Estuary changes under a variety of conditions, including season, tidal cycle, river mouth (open or closed), and proximity to the coast. During the spring, summer, and early fall a broad gradient of salinities occur. Typically, salinity levels decrease with distance upstream from the Russian River mouth. The River Mouth and Penny Island reaches are composed of seawater on the bottom and brackish water near the surface. In the middle reaches of Bridgehaven and Duncans Mills there is a mix of freshwater, brackish, and seawater layers. The upper reach of the Estuary, Casini reach, is strongly influenced by freshwater flows of the Russian River.

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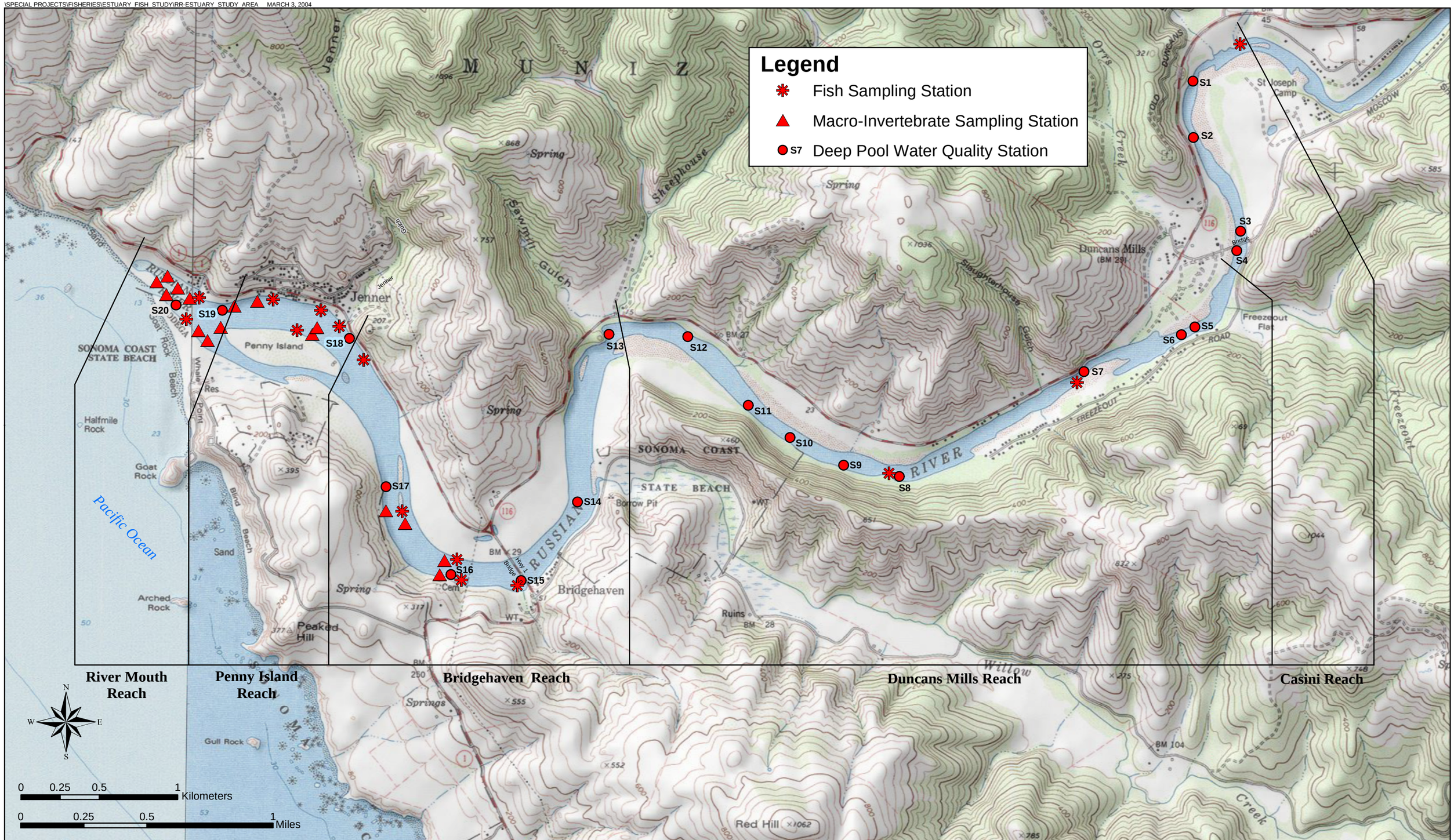

SONOMA COUNTY WATER AGENCY

Russian River Estuary
Study Area and Survey Sites

This Map is for general reference only.

Figure 1

Fish Surveys
A beach deployed purse seine was used to sample fish species and determine their relative abundances and distributions, especially for salmonids. Seining is effective in collecting fish throughout the water column that occur near shore. A purse seine 30-m-long (100-foot-long) and 3-m-deep (10-feet-deep) with pull ropes attached to both ends was used to sample fish. The seine was composed of nylon knotless netting. Floats on the top and metal rings on the bottom of the net positioned the seine vertical in the water. A rope through the metal rings when drawn closed or "pursed" the seine and prevented fish from escaping underneath the net. The purse seine was deployed with a crew of three or four using a boat to pull one end offshore and then around in a half-circle while the other end was held onshore. Once the ends of the seine were brought together at the shore the purse line was pulled and the net was hauled onshore by hand. Captured fish were placed in an aerated bucket for sorting, identifying, and counting prior to release. A few voucher specimens (non-salmonids) were preserved in ethanol for later identification. Captured steelhead were anesthetized with Alka-seltzer tablets and then measured, weighed, and examined for general condition, including life stage (i.e., parr, smolt), wild or hatchery stock indicated by a clipped adipose fin, and presence of sea lice. Also, tissue and scale samples were collected on some steelhead. Fish were allowed to recover in aerated buckets prior to release.

Sample stations were located throughout the Estuary in a variety of habitat types based on substrate type (i.e., mud, sand, and gravel), pool depth, and tidal seawater and freshwater influences (Figure 1). An attempt was made to sample areas with rocky substrate and large woody debris but was abandoned due to excessive net snags. Seine stations that produced steelhead were often sampled several times during different tidal cycles. The gage at Jenner was used to determine water elevation and incoming and outgoing tides.

Macro-invertebrate Surveys
Surveys were conducted to inventory macro-invertebrate species present in the Estuary and to determine their relative abundance and distribution. Surveys focused on the lower Estuary (i.e., River Mouth, Penny Island, and lower Bridgehaven reaches) where more marine species were expected to occur. Sample stations were located between the Russian River mouth and the Highway 1 bridge at Bridgehaven in a variety of habitat types based on substrate type (e.g., mud, sand, gravel, rock), shallow and deep pool areas, and tidal influences with varying salinity levels (Figure 1). Each station included a minnow trap, shrimp trap, and crab trap. Traps were baited with fish parts and were monitored either daily or every other day. Captured invertebrates were identified to species or in a few cases to the closest taxonomic group possible and released. A few individuals were preserved in ethanol for later identification.

Bathometric Surveys
The longitudinal profile of the Estuary floor was used to determine the location and characteristics of pools that may be refuges for fish, particularly salmonids. A sonar system and global positioning system (GPS) mounted on a kayak was used to map the contours of the Estuary floor. The kayak was directed downstream and followed the thalweg of the Estuary from Austin Creek confluence to the mouth.

Water Quality
Water quality data were collected at sample stations during each sampling event, including fish seine stations, macro-invertebrate trap stations, and deep pool stations selected during bathometric surveys. A hand held YSI meter with a probe at the end of a cable was used to obtain temperature (Celsius, °C), salinity (parts per thousand, ppt), and DO (milligrams per liter, mg/l). At fish seine stations water quality was collected at the surface and bottom at the approximate center of the seine sample area. Also, a Secchi disc was used to measure water turbidity. At macro-invertebrate trap stations water quality data was collected at the bottom. During bathometric surveys water quality was collected at 20 selected deep pools during both open and closed Russian River mouth conditions. Water quality was collected at both the surface and bottom of deep pools.

PRELIMINARY RESULTS
The 2003 Estuary studies focused on evaluating the feasibility and effectiveness of using several field survey techniques in the Estuary. The following results are preliminary and are not conclusive findings. These results will be used in the development of additional studies to evaluate the proposed Russian River Estuary Flow-Related Habitat Project that would change the Estuary from an open-mouth tidal estuarine system to a closed-mouth freshwater lagoon system.

Fish Distribution and Abundance
A total of 21 fish species were caught in the Estuary from August 20 through October 9, 2003 using a purse seine and incidental captures from invertebrate traps (Table 1). This number of species is similar to the number found during surveys conducted from 1992 to 2000 that ranged from 18 to 28 species/year. A total of 49 species were detected during 7 years of study (see Martini-Lamb 2001). The 2003 study found 4 new species previously undetected.

The distribution of fish in the Estuary is, in part, based on a species preference for or tolerance to salinity (Figure 2). Most species commonly found in marine or high salinity habitats occurred in the lower Estuary. Topsmelt, anchovy, and rockfish were usually found in the seawater dominant River Mouth and Penny Island reaches. The Bridgehaven reach, with a broad range of salinities, had the highest species diversity at 13 fish species, including marine and freshwater species. Freshwater dependent species, such as the Russian River tuleperch, Sacramento sucker, and California roach were distributed in the upper Estuary in Duncans Mills and Casini reaches. Anadromous fish, such as steelhead and American shad, that are tolerant of both freshwater and seawater, occurred throughout the Estuary.

The highest abundance of fish was found at the upper and lower reaches (Figure 3), which is in contrast to fish species diversity discussed above. A possible explanation for this fish abundance pattern is that salinity levels are generally stable and unstratified at the upper and lower reaches and can support a relatively high marine or freshwater invertebrate prey base for fish. The River Mouth reach is primarily seawater from tidal action, while Casini reach is freshwater from upstream flows. Productivity is higher in estuaries with well-mixed water, which have better water quality (higher DO levels and lower temperatures) than stratified estuaries (Smith 1990). The middle reaches (Bridgehaven and Duncans Mills) are subjected to periodic fluctuations in salinity and stratification resulting in poor water quality. These variations in salinity provide a

Table 1: Fish species caught in the Russian River estuary

Family	Scientific Name	Common Name	Estuary Reach				
			River Mouth	Penny Island	Bridge-haven	Duncans Mills	Casini
Atherinidae	*Atherinops affinis*	topsmelt	X	X	X		
Atherinidae	*Atherinops californiensis*	jacksmelt	X	X			
Carangidae	*Trachurus symmetricus*	jack mackerel					
Catostomidae	*Catostomus occidentalis*	Sacramento sucker			X	X	X
Clupeidae	*Micropterus dolomieui*	Pacific herring		X			
Clupeidae	*Alosa sapidissima*	American shad	X	X	X	X	X
Clupeidae	*Etrumeus teres*	round herring	X				
Cottidae	*Cottus / Leptocottus spp*	sculpin	X	X	X	X	X
Cottidae	*Sebastes spp*	rockfish (juveniles)	X	X			
Cyprinidae	*Hesperoleucus symmetricus*	California roach				X	X
Cyprinidae	*Ptychocheilus grandis*	Sacramento pikeminnow					X
Embiotocidae	*Cymatogaster aggregata*	shiner surfperch			X		
Embiotocidae	*Hysterocarpus traskii pomo*	Russian River tuleperch					
Engraulididae	*Engraulis mordax*	northern anchovy			X		
Gasterosteidae	*Gasterosteus aculeatus*	threespine stickleback	X		X	X	X
Osmeridae	*Hypomesus pretiosus*	surf smelt		X	X		
Pleuronectidae	*Platichthys stellatus*	starry flounder	X	X	X	X	
Pholididae	*Apodichthys flavidus*	penpoint gunnel	X				
Pholididae	*Pholis ornata*	saddleback gennel	X		X		
Salmonidae	*Oncorrynchus mykiss*	steelhead		X	X		X
Syngnathidae	*Syngnathus leptorhyncus (griseolineatus)*	bay pipefish			X		

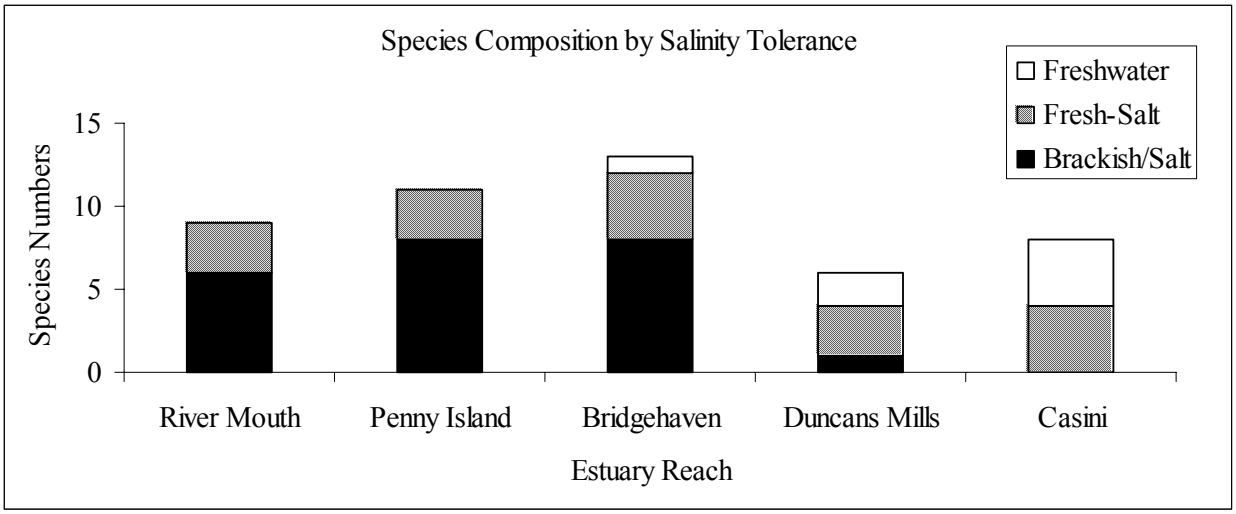

Figure 2: Fish species diversity based on salinity tolerance

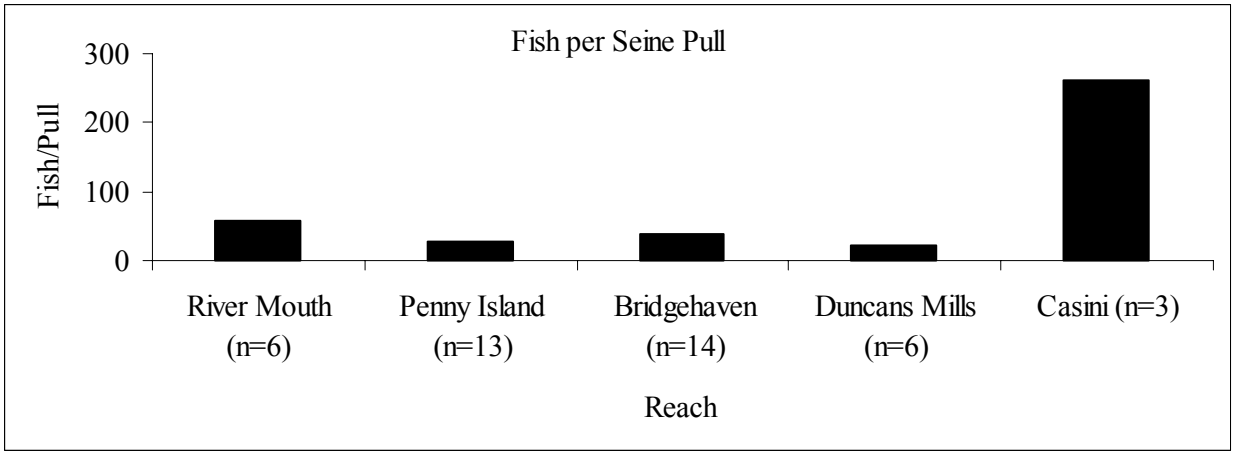

Figure 3: Number of fish caught per seine pull by reach

variety of habitats that can accommodate several fish species. However, the invertebrate prey base may be limited due to poor water quality from stratification and unstable salinities, which would reduce the numbers of fish.

A total of 65 steelhead were captured at 3 seine stations in the Estuary. These 3 stations were all located at the confluences with creeks, including Jenner Gulch, a small drainage at Bridgehaven, and Austin Creek. Also, during a reconnaissance survey at the confluence of Sheephouse Creek steelhead smolts were observed. Steelhead were parr or smolts and had an average size of 183 mm, range 105 to 310 mm (Figure 4). Most of the steelhead (n=61) were captured at Jenner Gulch, but the 3 sample stations with steelhead detected were not equally sampled. The Jenner Gulch station was sampled 8 times between August 20 and October 9, 2003 totaling 23 seine pulls and steelhead were captured on 5 dates. Species composition at the Jenner Gulch station contained common estuarine species, including 9% steelhead (Figure 5). Most steelhead (n=46)

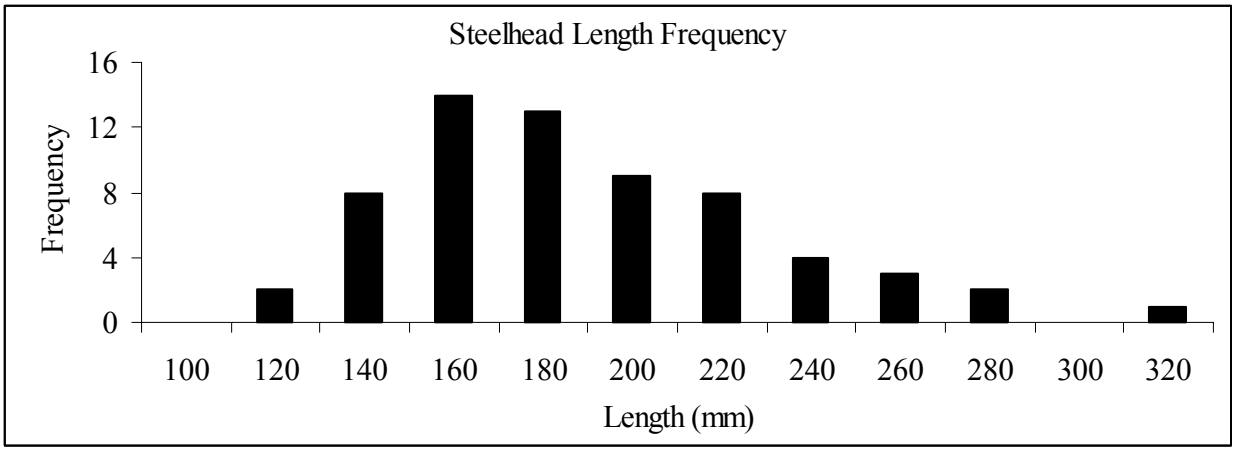

Figure 4: Histogram of steelhead length frequencies

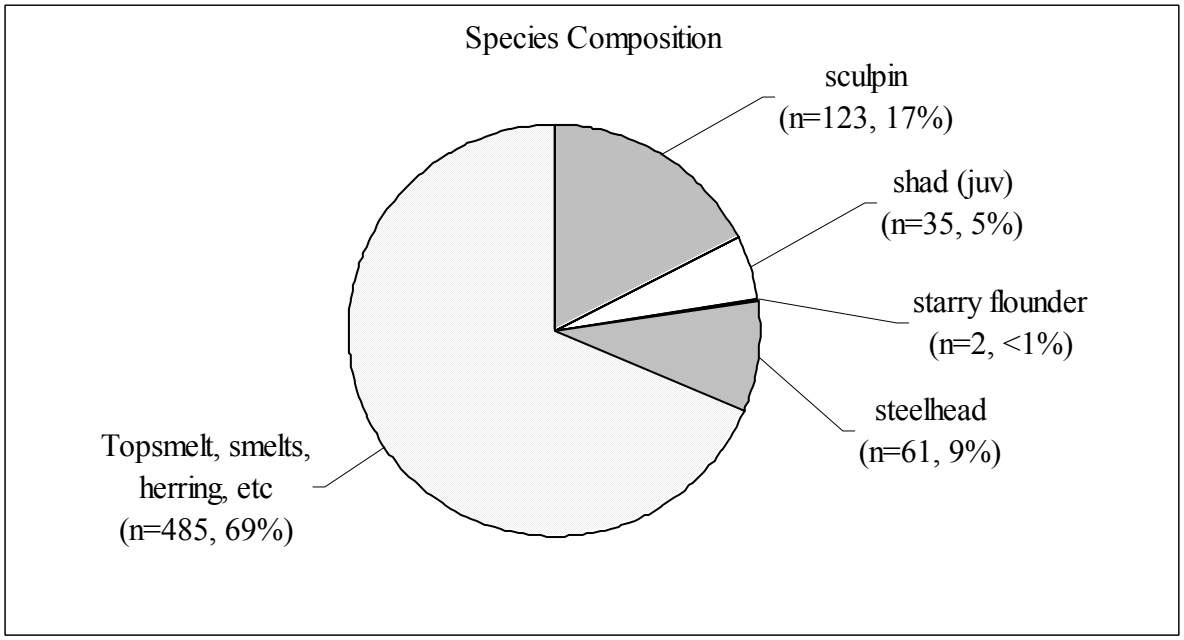

Figure 5: Fish species composition at the Jenner Gulch seine station

were seined on August 20 and accounted for 75% of all steelhead at the Jenner Gulch station. Surveys were conducted on a variety of conditions that affect water quality (i.e., incoming and outgoing current, morning and afternoon, high and low tide). Surface salinity appeared to be the only water quality factor attributable with the presence of steelhead (Figure 6). Most steelhead were captured on an incoming tide with an average salinity of 9.3 ppt, while sample events without steelhead had an average salinity of 14.6 ppt. Bottom salinities during all sample dates were around 30 ppt.

Macro-Invertebrate Distribution and Abundance

There was a low diversity and low abundance of macro-invertebrates observed in the Estuary (Table 2). However, these low counts were likely effected by the late sample season and limited

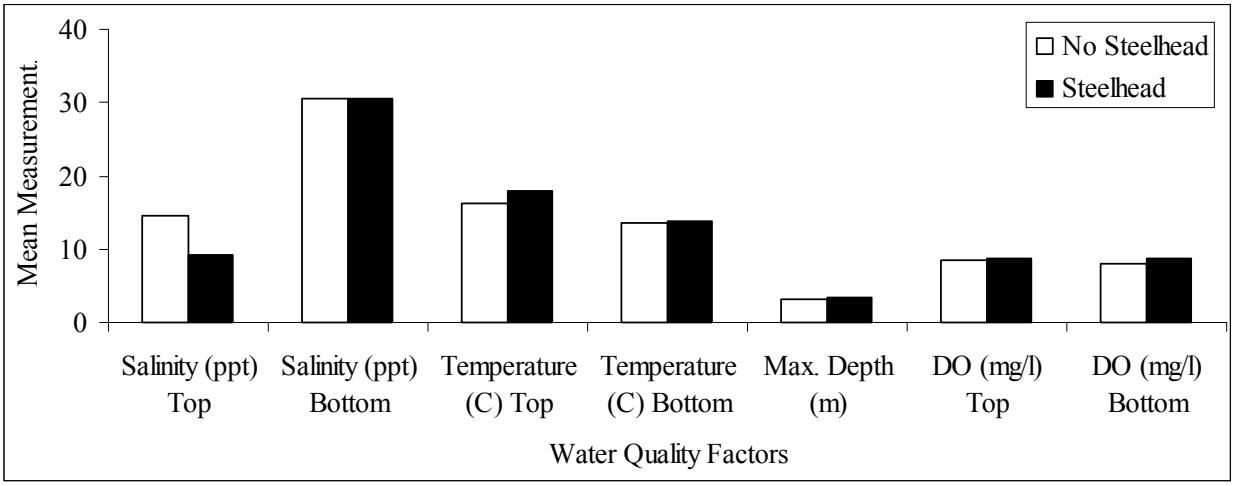

Figure 6: Water quality factors at the Jenner Gulch station during surveys with and without steelhead caught

Table 2: Macro-invertebrate species caught in the lower Estuary

Family	Scientific Name	Common Name	Estuary Reach				
			River Mouth	Penny Island	Bridge-haven	Duncans Mills	Casini
Facelinidae	*Hermissenda crassicarnis*	Nudibranch	X			Not Surveyed	Not Surveyed
Crangonidae	*Crangon* sp.	Bay shrimp	X	X	X	Not Surveyed	Not Surveyed
Cancridae	*Cancer gracilis*	Slender crab	X			Not Surveyed	Not Surveyed
Cancridae	*Cancer magister*	Dungeness crab	X	X		Not Surveyed	Not Surveyed
Cancridae	*Cancer jordani*	Hairy cancer crab	X		X	Not Surveyed	Not Surveyed

survey effort. Trapping occurred from September 11 through October 9, 2003. All species captured were marine or intertidal species including 3 crab species, 2 shrimp species, and 1 nudibranch species. Most individuals were trapped in the River Mouth reach where the seawater influence is highest. Fifteen juvenile and adult Dungeness crabs were captured in the River Mouth and Penny Island reaches. Also, approximately 50 juvenile Dungeness crabs were seined in the River Mouth reach at the sandbar during fish surveys. Slender crab and hairy cancer crab were also found at the River Mouth reach. Bay shrimp species were captured during fish seining surveys in the lower Estuary. One nudibranch species was found in abundance during 1 trap period in the River Mouth reach.

Estuary Water Quality
Water quality data was collected at 20 deep pools located throughout the Estuary (Figures 1 and 7). Pool depths ranged from 3.5 m (11.5 ft) to 14 m (46 ft) (Figure 8). Data was first collected on October 23, 2003 when the Russian River mouth was closed. The mouth was artificially breached on October 27, 2003 after the mouth had been closed for approximately 9 days. The pools were sampled a second time on October 30, 2003 under open-mouth conditions.

In general, surface water quality improved after the mouth was opened, while deeper sample sites showed less improvement. This water quality pattern is affected by the existing river flows influenced by dam releases. Under closed-mouth conditions salinity was stratified with a bottom layer of seawater extending upstream to station S4 near Moscow Road Bridge, lower Casini reach (Figure 9). Surface freshwater extended as far downstream as S13 at Sheephouse Creek and slightly brackish water (<5 ppt) occurred to the Russian River mouth. Temperatures were usually warmer at the surface than at the bottom, and DO levels were lower at the bottom of pools (Figures 10 and 11). Under open-mouth conditions there was a greater mix of salinities, water temperatures were usually lower, and DO varied by location and by pool. Surface and bottom freshwater extended downstream to the upper Duncans Mills reach at station S7. There was a mix of brackish water in the central Estuary. Seawater throughout the water column occurred near the Russian River mouth. The bottoms of deeper pools (e.g., S8 at 9 m and S13 at 14 m) showed no substantial improvement in water quality under open- or closed-mouth conditions. These deep pools had relatively cool temperatures, low DO or anoxic conditions, and near seawater salinities. Under these poor water quality conditions salmonids could not utilize these pools as refuge.

DISCUSSION

Fish Species Composition
The results of previous studies (see Martini-Lamb 2001) compared to our preliminary results suggest that the Estuary has been under surveyed to determine the species composition, abundance, and distribution. Previous aquatic studies of the Estuary focused on the effects of artificial breaching conducted primarily in the spring and fall during brief sample periods. Very limited data is available from the summer season when several species may breed and/or rear in the Estuary. The proposed Estuary Management Plan will have its largest effect on flows during the summer. Our 2003 study was conducted during the fall and found 4 new fish species not detected during 7 years of field studies conducted in the 1990s. The fall is typically at the end of the breeding and rearing period for many fish that utilize estuary systems before dispersing to the ocean. To better understand the occurrence of fish the Estuary should be surveyed during the spring, summer, and fall. Permanent sample stations located in a variety of habitat types throughout the Estuary should be sampled several times a season.

Salmonid Rearing Habitat
Steelhead were the only salmonid species found during the 2003 study conducted in the fall. Chinook salmon and Coho salmon young are likely present in the Estuary during spring and early summer. Steelhead smolts were found in low and sporadic numbers throughout the Estuary, except in the River Mouth reach. The two factors that appear to influence the occurrence of, or the detection of, steelhead are surface water salinities and geographic location. Steelhead smolts

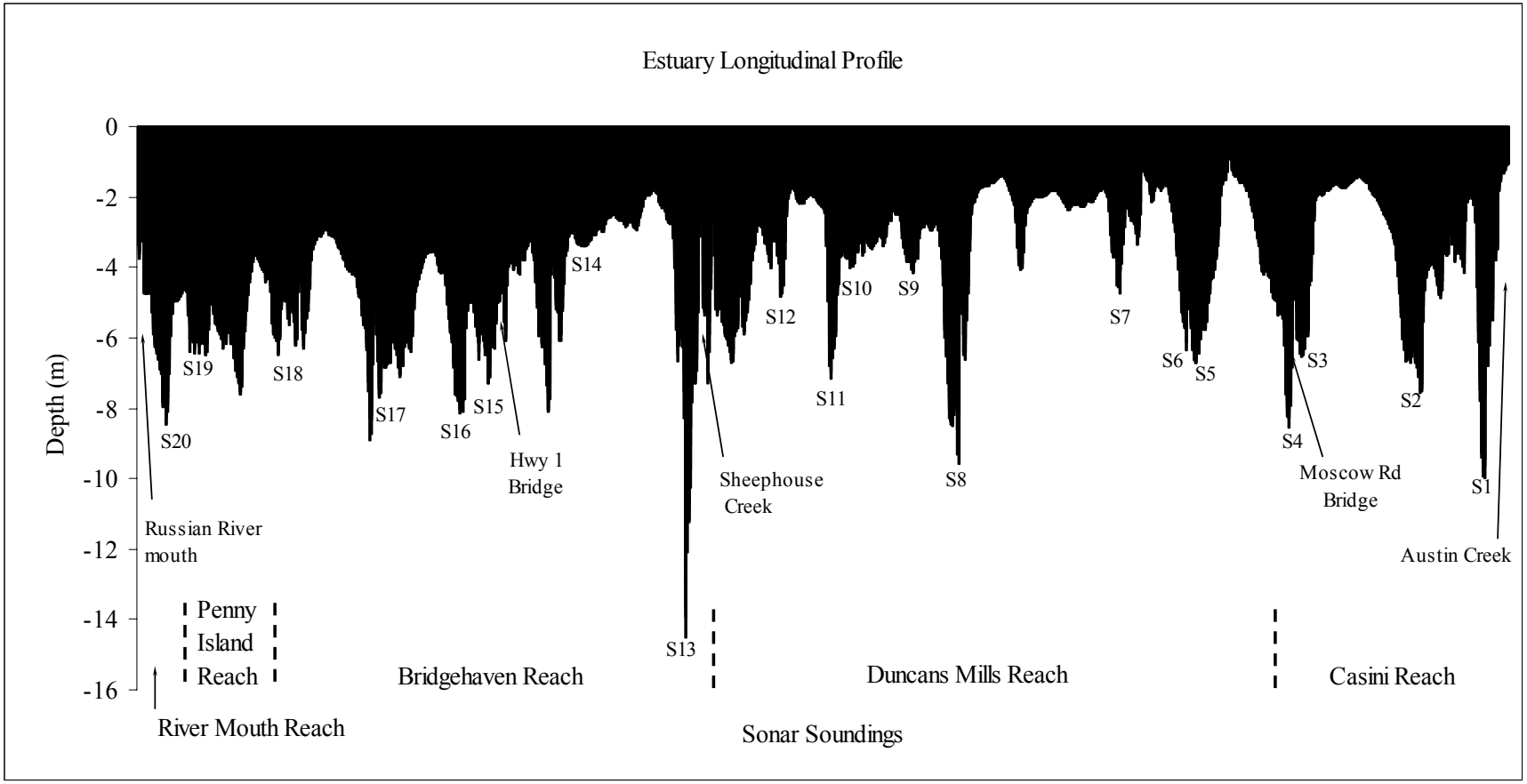

Figure 7: Longitudinal profile of the Estuary using sonar soundings. "S" numbered sites are pools selected for water quality sampling

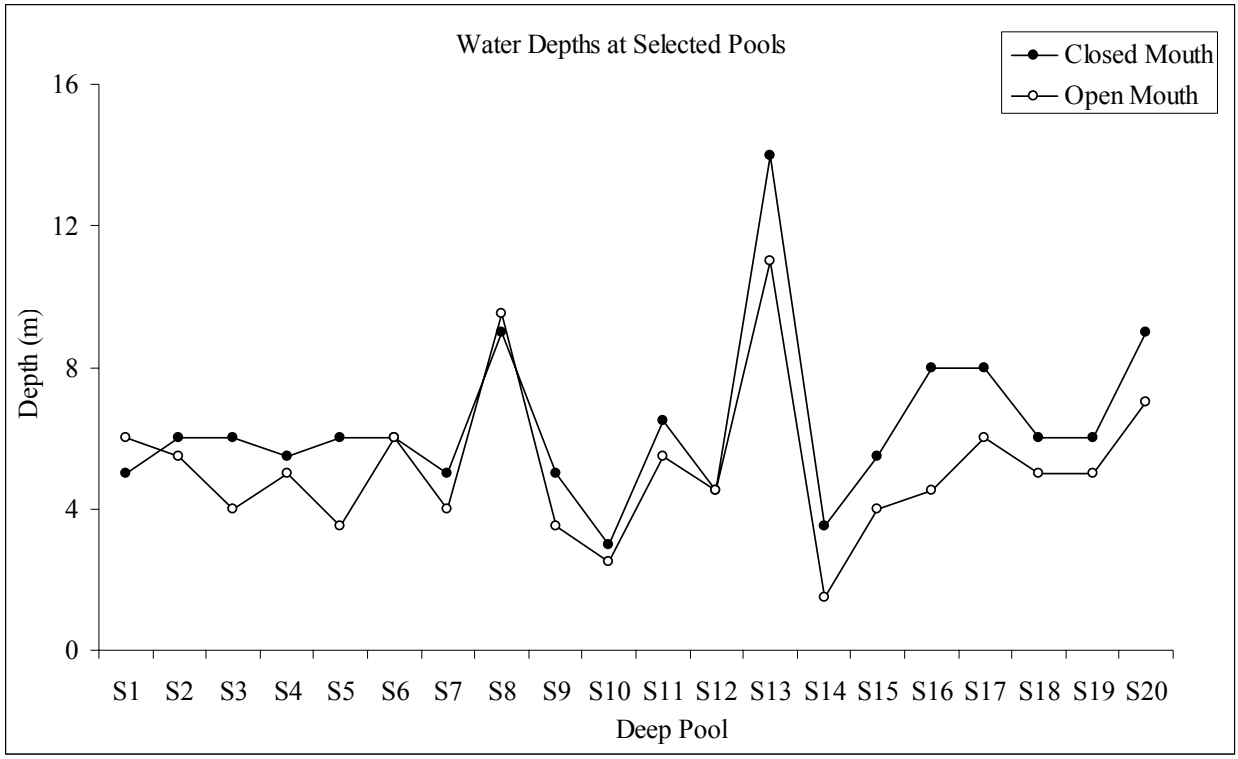

Figure 8: Depths at selected pools under open-mouth and closed-mouth conditions

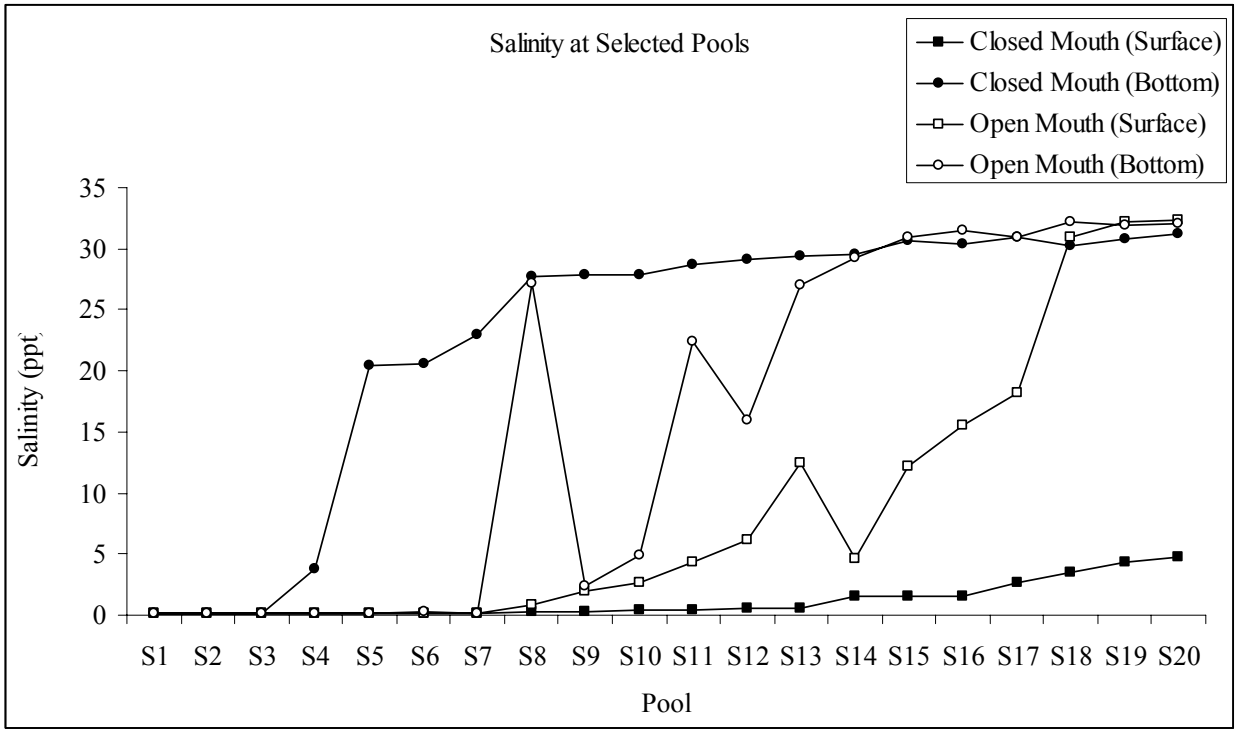

Figure 9: Salinity levels at selected pools under open-mouth and closed-mouth conditions. Water quality data was collected near the surface and at the bottom of each pool.

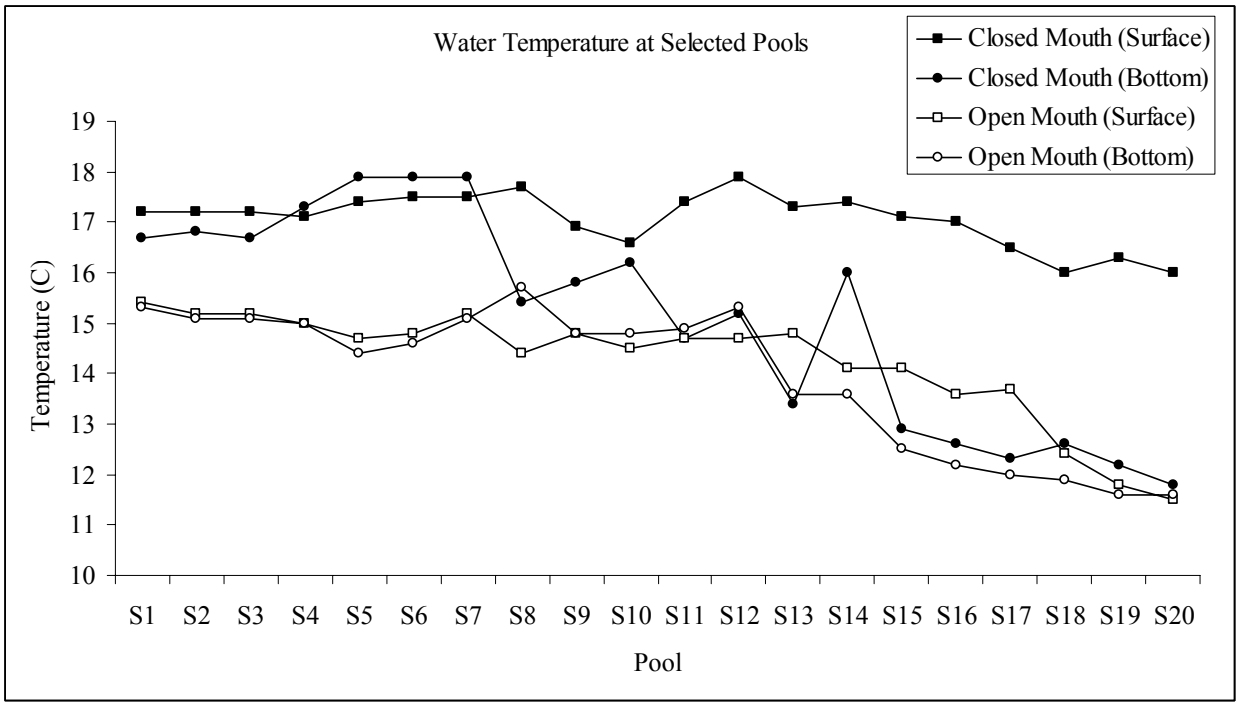

Figure 10: Temperatures at selected pools under open-mouth and closed-mouth conditions. Water quality data was collected near the surface and at the bottom of each pool.

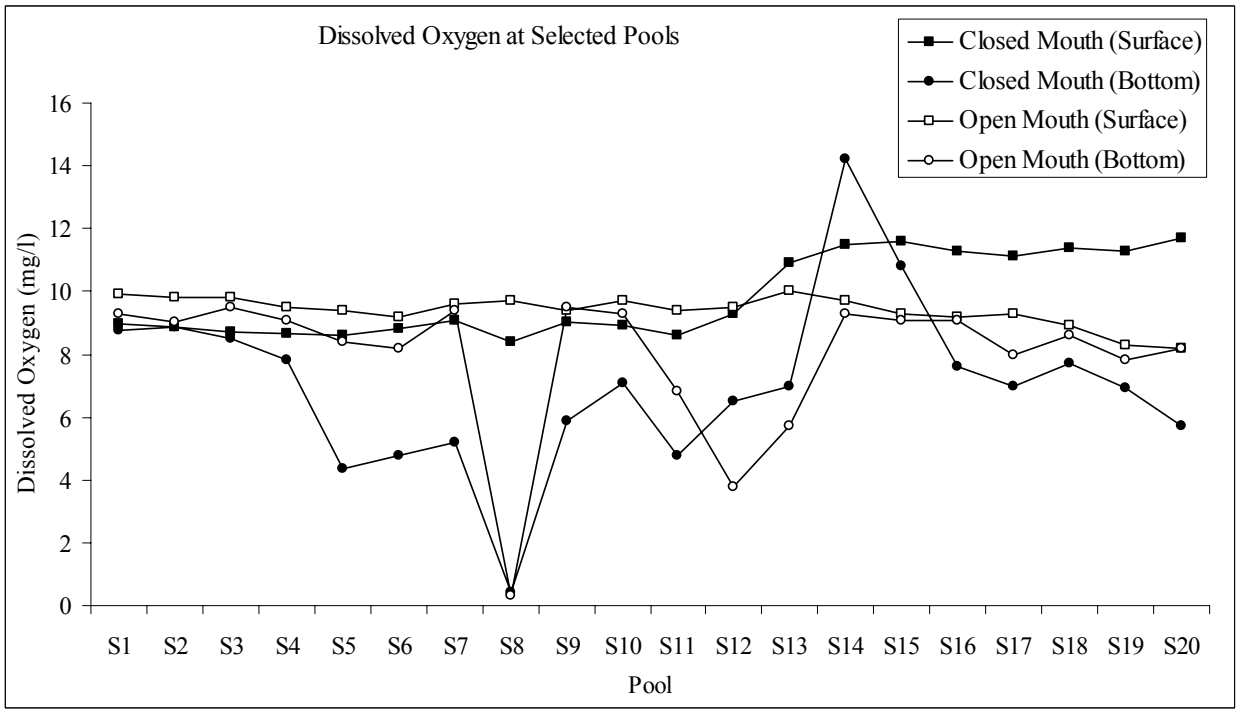

Figure 11: Dissolved oxygen at selected pools under open-mouth and closed-mouth conditions. Water quality data was collected near the surface and at the bottom of each pool.

were usually captured on an in-coming tide and always at the mouth of a creek. An explanation for the distribution of steelhead is that the creek mouths are sources of freshwater that steelhead use as refuges when water with relatively low salinity is scarce in the Estuary. Additional studies should focus on the abundance and distribution of salmonids and water quality from late spring through early fall when steelhead, Chinook salmon, and Coho salmon rearing may occur. Steelhead preference for low-salinity water in the vicinity of creek mouths should be studied to further evaluate the proposed Estuary Management Plan change from a tidal estuary to a freshwater lagoon system. Permanent seining stations should be established at creek mouths and non-creek mouths with a gradient of salinity levels throughout the Estuary.

Macro-invertebrate Habitat

Our preliminary studies found low numbers of macro-invertebrates; however, our surveys were conducted late in the season for most species. Additional studies should focus on the distribution and abundance of marine species that would be affected if the Estuary was managed as a freshwater lagoon. Because of their economic value, the importance of the Estuary for Dungeness crab spawning and rearing should be evaluated. Crab/shrimp traps should be used to sample a variety of habitat types present in the Mouth and Penny Island reaches during the spring, summer, and fall.

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