

## **3.0 NATURAL RESOURCES OF COMMENCEMENT BAY**

This section identifies the natural (abiotic and biological) resources present in Commencement Bay that have been exposed to, and could have been injured by, releases of hazardous substances. DOI regulations (43 CFR Part 11) provide definitions for natural resources to be considered when determining natural resource damages and during restoration planning. Five natural resource categories are defined in § 11.62 of the regulation as follows:

- Surface water, including both fresh water and marine waters, in addition to sediments that are in contact with surface waters
- Groundwater
- Air
- Geological resources
- Biological resources

Only injuries to surface water and biological resources are being pursued in Commencement Bay by the natural resource Trustees at the present time. Therefore, injuries to groundwater, air, and geological resources will not be discussed in this section.

### **3.1 ABIOTIC RESOURCES**

#### **3.1.1 Surface Water**

The surface water resources provide habitat and essential support for a host of biological resources discussed in Section 3.2, as well as aesthetic, recreational, and commercial services to humans.

The surface waters of the Injury Study Area consist of marine and estuarine water as defined in Section 1.2. This area extends from the high tide line along the shoreline from Pt. Defiance to Browns Point offshore to a depth of 20 m and includes: the surface waters extending offshore along the Ruston-Pt. Defiance Shoreline; all water in the waterways, and the surface water in the Puyallup River and Hylebos and Wapato Creeks from their mouths upstream to the Interstate 5 bridges.

### 3.1.2 Sediment

The surface water resources also include all of the subtidal and intertidal sediments contiguous with the surface waters. Sediment types (e.g., silt, sand, clay, gravel, cobble) in the Injury Study Area vary by location. Anthropogenic influences have dramatically altered the sediment characteristics, particularly through enrichment with organic matter, in many areas.

## 3.2 BIOLOGICAL RESOURCES

### 3.2.1 Aquatic Resources

The Injury Study Area of Commencement Bay provides habitat for freshwater, estuarine, and marine plants, invertebrates, and fish. Aquatic species in Commencement Bay occupy a variety of ecological niches and the resultant ecological relationships are complex. Species that use Commencement Bay include resident as well as migratory species. For the most part, species can be categorized ecologically into four general groups: 1) plants; 2) benthic and epibenthic invertebrates that live in association with the sediments; 3) demersal and pelagic fish that use the Injury Study Area as long-term nursery and adult habitat; and 4) anadromous salmonids (Salmonidae) that use the area for a relatively short, but critically important, time period in their lives.

#### 3.2.1.1 Aquatic Plants

Benthic macrophytes in Commencement Bay are divided into the seagrasses, primarily eelgrass (*Zostera marina*), and the macroalgae, including green, red, and brown algae. Kelp (*Nereocystis luetkeana*) is a common and important brown alga. Other common macroalgae reported in Puget Sound include *Enteromorpha intestinalis*, *Spongomorpha saxitilis*, *Ulva* sp., *Fucus gardneri*, *Laminaria saccharina*, *Nereocystis luetkeana*, *Petalonia fascia*, *Sargassum muticum*, *Gigartina exasperata*, and *Iridaea cordata*. Seagrasses and macroalgae function to stabilize bottom sediments, increase deposition, enhance nutrient transfer, provide substrate for epiphytic species, supply detritus for invertebrate fauna, and provide cover and protection for numerous fauna (Dexter et al., 1981). Large numbers of invertebrate species live in the organic-rich sediments trapped by eelgrass beds or eelgrass blades.

Juvenile salmonids and flatfish forage in eelgrass beds, while Pacific herring (*Clupea pallasii*) spawn directly on eelgrass blades. Eelgrass beds are considered important to the survival of many bird species, including black brant (*Branta bernicla*), which graze on eelgrass (Evans Hamilton and D.R. Systems, 1987).

Eelgrass, kelp, and other macroalgae beds are present, but are reportedly scarce in Commencement Bay. Although historical industrial development may have played a role in the scarcity of macrophytes, other factors, such as the high volumes of sediment currently deposited by the Puyallup River, do not provide optimal habitat for their colonization (DEA, 1991). Eelgrass beds are reported in the Injury Study Area within shallow subtidal habitats along the Ruston Shoreline. Intermittent beds are present in a nearshore reach that lies approximately 1.5 km south of the ASARCO facility. Eelgrass beds are also reported immediately outside of the Injury Study Area at Pt. Defiance and north of Browns Point. Kelp beds have been reported only in a small area of the Ruston Shoreline immediately below the ASARCO facility (Evans Hamilton and D.R. Systems, 1987).

### **3.2.1.2 Benthic and Epibenthic Invertebrates**

Benthic infauna (i.e., invertebrates that live either partially or completely buried in the sediment) are an integral part of the Commencement Bay estuarine ecosystem and are one of the primary links between biotic and abiotic systems. Benthic communities consume organic materials deposited on and in the sediment, cause bioturbation of the sediments (i.e., a redistribution of sediment particles through biological activity), promote nutrient regeneration from sediment, and serve as prey for higher-trophic-level organisms.

Several fairly comprehensive and other smaller, less comprehensive benthic and epibenthic studies have been conducted in the Commencement Bay Injury Study Area. Tetra Tech (1985), Becker et al. (1990), Dames & Moore (1981b), and Chapman et al. (1984) conducted assessments of the benthic community in multiple waterways as well as along the Ruston-Pt. Defiance Shoreline. Salo and McComas (1980), Parametrix (1991a), and Johnstone (1985) conducted smaller studies in individual waterways or along portions of the Ruston Shoreline. Parametrix (1989a,c; 1990a; 1991c; 1993) conducted extensive benthic surveys in the vicinity of the ASARCO smelter site, located along the Ruston-Pt. Defiance Shoreline.

Dames & Moore (1981b), Meyer and Vogel (1978), Parametrix (1989b, 1991b), Jones and Stokes (1989a,b), Johnstone (1986), and Simenstad and Cordell (1980) conducted epibenthic investigations within the study area. Simenstad et al. (1993) examined multiple benthic and epibenthic studies and data sets to evaluate potential changes in the benthic and epibenthic communities in the bay over time. A complete list of the taxa of benthic and epibenthic invertebrates observed by investigators in the Commencement Bay Injury Study Area is included in Appendix B.

In the most comprehensive benthic study conducted in the Commencement Bay Injury Study Area, Tetra Tech (1985) found the benthic community to be principally composed of two benthic species: the polychaete *Tharyx multifilis* and the pelecypod (bivalve) *Axinopsida serricata*, which together accounted for 59 percent of benthic organisms collected when data from all areas were combined. Nematodes were ranked among the most abundant, not because they were widespread, but because densities were extremely high at a few stations. Of the crustaceans, the ostracods *Euphilomedes producta* and *E. carcharodonta* and the tanaid *Leptocheilia dubia* were the dominant species. Echinoderms and oligochaetes were not very abundant. Chapman et al. (1984) and Dames & Moore (1981a) found a similar community structure, numerically dominated by four or five species with *T. multifilis*, *A. serricata*, *Lumbrineris* sp., and *Euphilomedes* sp. as the dominant species in most areas of the waterways. Table 3-1 summarizes the 10 numerically dominant benthic taxa observed by Tetra Tech (1985).

Tetra Tech (1985), Dames & Moore (1981a), and Chapman et al. (1984) found that the mean numbers of species and mean numbers of individuals per grab sample varied considerably among the waterways and nearshore area. Generally, however, the highest numbers of species were observed along the Ruston-Pt. Defiance Shoreline, except for the area immediately adjacent to the ASARCO facility. Tetra Tech (1985) reported that the mean number of species in the Hylebos, Blair, Sitcum, Milwaukee, St. Paul, Middle, and Thea Foss Waterways was about 35-50 percent lower than that at reference locations. Statistical analyses also indicated that the number of taxa was generally depressed within the waterways compared to the number at reference stations in Carr Inlet.

**Table 3-1. Abundances and Ranking of the Ten Numerically Dominant Benthic Taxa Collected in Commencement Bay**

TAXON <sup>a</sup>	TOTAL ABUNDANCE (number/m <sup>2</sup> )	RANK	PROPORTION OF TOTAL INDIVIDUALS (%)	CUMULATIVE PROPORTION (%)
<i>Tharyx multifilis</i> (Po)	42,106	1	35.4	35
<i>Axinopsida serricata</i> (Pe)	27,978	2	23.5	59
Nematoda	9,784	3	8.2	67
<i>Macoma carlottinsis</i> (Pe)	4,351	4	3.7	71
<i>Lumbrineris</i> sp. (Po)	4,081	5	3.4	74
<i>Capitella capitata</i> (Po)	2,771	6	2.3	76
<i>Euphilomedes producta</i> (Os)	2,289	7	1.9	78
<i>Euphilomedes carcharodonta</i> (Os)	1,836	8	1.5	80
<i>Leptochelia dubia</i> (Ta)	1,242	9	1.0	81
<i>Prionospio steenstrupi</i> (Po)	1,148	10	1.0	82

**Source:** Tetra Tech (1985).

- <sup>a</sup> Po = Polychaeta  
 Pe = Pelecypoda (bivalve)  
 Os = Ostracoda  
 Ta = Tanaidacea

Tetra Tech (1985) and Becker et al. (1990) observed two distinct benthic community structures along the Ruston-Pt. Defiance Shoreline. The structure of one community was dominated by several species of polychaetes, molluscs, and crustaceans. Taxa were evenly distributed, with no species accounting for more than 15 percent of the individuals in the area. The structure of the other community, observed at two stations adjacent to the ASARCO smelter, was highly dominated by five species constituting 62-100 percent of the total abundance. Parametrix (1989a,c; 1990a; 1991c) found benthic assemblages near the smelter dominated by polychaetes (i.e., 24 of 38 dominant species were polychaete worms). Because of the type of substrate found in the area (e.g., coarse-grained sand and slag material), other dominant taxa included sea cucumbers (e.g., *Pentamera populifera* and *Cucmaria piperata*), barnacles (e.g., *Balanus crenatus*), and bivalves (e.g., *Mya arenaria*, *Macoma* sp., and *A. serricata*).

In a reconnaissance study of the Tacoma Yacht Basin, Parametrix (1993) observed a gradient in the benthic community based on abundances and number of taxa. The sampling station farthest from the boat basin was dominated by non-deposit feeding polychaetes (e.g., *Platynereis bicamaliculata*, *Phyllochaetopterus prolifica*, *Pholoides aspera*). The stations located within the boat basin were dominated by deposit feeding polychaetes (e.g., *T. mutifilis*, *Cirratulus cirratus*), which are characteristically found at sites with organic-enriched sediment. Thus, the observed gradient may be due in part to conventional sediment characteristics, such as organic carbon content.

Studies of epibenthic invertebrates have been less comprehensive than those for the infaunal benthos; investigations were rarely comparable and no single investigation described communities in all of the waterways. Studies have been conducted principally in the spring, with an emphasis on organisms that provide food for juvenile salmon during their out-migration (Simenstad et al., 1993). Most of the studies found a dominance of harpacticoid copepods and gammarid amphipods in the epibenthic assemblages in the waterways of Commencement Bay. Dames & Moore (1981a), who sampled three times between April and November, found that the harpacticoid genera of *Harpacticus*, *Zaos*, and *Tisbe* dominated up to 80 percent of community densities in most waterways. Studies conducted by Parametrix (1989b, 1991b) and Jones and Stokes (1988; 1989b; 1991a,b) near pier aprons and slips found similar communities.

Feeding habit studies by Wingert et al. (1979), Meyer et al. (1981a,b), Pearce et al. (1982), and Simenstad and Salo (1980) can also be used to identify members of the epibenthic and benthic communities, particularly as they are important to the fish community. These studies have found that juvenile salmonids, small-mouth flatfish species (e.g., English, rock [*Pleuronectes bilineatus*], and Dover [*Microstomus pacificus*] sole), and rockfish rely on epibenthic prey for substantial portions of their diet (Table 3-2).

Surveys of larger invertebrates within the Injury Study Area have not been extensive, but creel, diving, and trawl surveys indicate that a number of larger invertebrates, primarily shrimp and crab species, inhabit Commencement Bay. Surveys of macroinvertebrates have been conducted by Eaton and Dinnel (1993), Dinnel et al. (1986), Malins et al. (1981), Noviello (1981), Salo and McComas (1980), Salo et al. (1980), and Nakatani et al. (1973) that concentrate primarily on species of economic importance. Surveys have been generally qualitative, although Dinnel et al. (1986) conducted quantitative surveys where catch-per-unit

Table 3-2. Predominant Feeding Habits of Three Species Groups Present in Commencement Bay

SPECIES	PERCENT TOTAL INDEX OF RELATIVE IMPORTANCE OF PREY TAXA <sup>a</sup>									
	EPIBENTHIC PREY					BENTHIC PREY			OTHER OR UNIDENTIFIED	
	GAMMARID AMPHIPODS	TANAIDS	OSTRACODS	DECAPODS	POLYCHAETES	BIVALVES				
SMALL-MOUTH SOLE										
English sole	23.02	7.61	2.6	0	48.57	11.35			6.85	
Rock sole	27.75	3.29	0	0	52.88	10.56			5.52	
Dover sole	12.57	0	0	0	74.83	1.75			10.85	
ROCKFISH										
Brown rockfish	8.41	0	0	51.31	0	0			40.28	
Quillback rockfish	0	0	0	54.24	1.42	0			44.1	
PACIFIC SALMONIDS										
Chinook salmon	40.22	0	0	0.95	0	0			58.83	
Coho salmon	51.93	0	0	1.16	0	0			46.91	
Chum salmon	17.3	0	0	0.33	0	0			82.37	
Steelhead salmon	5.07	0	0	66.46	0	0			28.47	

Source: Wingert et al. (1979), Meyer et al. (1981a).

<sup>a</sup> Index of relative importance = frequency of occurrence (numerical composition + gravimetric composition).

effort was calculated. The principal species observed in the above surveys were dock shrimp (*Pandalus danae*), red rock crab (*Cancer productus*), and Dungeness crab.

Eaton and Dinnel (1993) conducted a trawl survey of demersal fauna within the Hylebos and Blair Waterways. They reported 26 invertebrate species, of which the most common were crabs (especially the graceful rock or purple crab, *C. gracilis*) and shrimps (the most common being the dock shrimp *Pandalus danae* and sand shrimps *Crangon* spp.). The crabs and dock shrimp were the most common in Hylebos Waterway, and the sand shrimps were the most common in Blair Waterway.

Dinnel et al. (1986) reported dock shrimp to range from plentiful to abundant off Browns Point. This species was observed at densities of 502 to 1,067 shrimp/ha at trawl stations located at depths of 10 and 80 m off Browns Point. Pink (*Penaeus duorarum*) and sidestripe shrimps were also observed but at lower densities. In qualitative diving surveys, Nakatani et al. (1973), Salo and McComas (1980), and Salo et al. (1980) reported large numbers of dock shrimp near the ASARCO facility, other areas along the Ruston Shoreline, and in the Milwaukee Waterway. Shrimps were usually associated with submerged logs and debris. Malins et al. (1981) observed dock and pink shrimp in the Hylebos Waterway. The species *Crangon alaskensis* was also observed in lower numbers.

Creel surveys by Noviello (1981) reported the recreational harvest of Dungeness and red rock crab on the Ruston Shoreline, near Browns Point to the Hylebos Waterway, and in the Blair and Thea Foss Waterways. In trawl surveys, Dinnel et al. (1986) did not observe Dungeness crab, but did report red rock crab near Browns Point, while Malins et al. (1981) observed Dungeness crab in Hylebos Waterway, but no red rock crab. Nakatani et al. (1973) observed Dungeness crab near the ASARCO facility along the Ruston Shoreline and Salo and McComas (1980) observed crabs in the Milwaukee Waterway.

### **3.2.1.3 Resident Demersal Fish Community**

Comprehensive demersal fish surveys have been conducted by Tetra Tech (1985) and Dames & Moore (1981b). These surveys consisted of bottom trawls; no mid-water trawl data were found. Fish surveys in the Injury Study Area have shown that the demersal fish assemblage

is dominated by flatfish of the families Pleuronectidae (right eye flounders) and Bothidae (left eye flounders), particularly English sole and rock sole. Tetra Tech (1985) identified 40 species of demersal fish in Commencement Bay; English and rock soles were the most abundant and widely distributed species, accounting for nearly 70 percent of all fish collected. Flatfish species of the two families accounted for more than 85 percent of all fish collected (Table 3-3). Similar results were obtained by Dames & Moore in a travel survey in 1980 (1981b). Both juvenile and adult flatfishes were obtained in trawls conducted in spring, summer, fall, and winter, indicating that the estuary is used year-round by flatfish and other species. The only non-flatfish species observed by Tetra Tech (1985) with more than 1 percent relative abundance were Pacific herring (2.1 percent), Pacific tomcod (*Microgadus proximus*; 4.3 percent), blackbelly eelpout (*Lycodopsis pacifica*; 1.5 percent), spotted ratfish (2.3 percent), and Pacific staghorn sculpin (*Leptocottus armatus*; 1.1 percent) (Table 3-3).

Additional records of occurrence can be taken from fishing data. Tribal commercial fishing for species other than salmonids is not conducted in the Injury Study Area; however, several fish are recreationally harvested within the bay. Catch statistics are not maintained for recreational fisheries other than salmonids, but available creel survey data provide some information on the types of species harvested recreationally. Landolt et al. (1985) conducted a creel survey at several locations on the Ruston Shoreline and found that English sole, rock sole, Pacific sanddab (*Citharichthys sordidus*), Pacific tomcod, and squid (*Loligo opalescens*) were the most common non-salmon recreational species. Creel surveys conducted by Noviello (1981) found that Dungeness and red rock crabs were harvested between Browns Point and the Hylebos Waterway.

Eaton and Dinnel (1993) conducted a trawl survey of demersal fauna within Hylebos and Blair Waterways. They reported 40 fish species, of which the most common were bay gobies, snake pricklebacks (*Lumpenus sagitta*), staghorn sculpins, pygmy poachers (*Onodopyxis trispinosa*), English sole, and tomcod. A comparison between the two waterways showed higher abundances of staghorn sculpin and snake pricklebacks in Hylebos Waterway and bay gobies, rock sole, flathead sole (*Hippoglossoides elassadon*), and eelpouts in Blair Waterway.

Other species potentially harvested recreationally within the Injury Study Area include those within the families *Gadidae* (Pacific hake, walleye pollock, Pacific cod), *Hexagrammidae*

**Table 3-3. Relative Abundances of Fishes  
Captured by Bottom Trawl in Commencement Bay**

FAMILY	SPECIES	COMMON NAME	RELATIVE ABUNDANCE IN COMMENCEMENT BAY (PERCENT)
Squalidae	<i>Squalus acanthias</i>	Spiny dogfish	0.1
Rajidae	<i>Raja rhina</i>	Longnose skate	— <sup>a</sup>
Chimaeridae	<i>Hydrolagus coliei</i>	Spotted ratfish	2.3
Clupeidae	<i>Clupea harengus pallasii</i>	Pacific herring	2.1
Engraulidae	<i>Engraulis mordax</i>	Northern anchovy	— <sup>a</sup>
Batrachoididae	<i>Porichthys notatus</i>	Plainfin midshipman	0.1
Gadidae	<i>Gadus macrocephalus</i>	Pacific cod	— <sup>a</sup>
	<i>Merluccius productus</i>	Pacific hake	0.1
	<i>Microgadus proximus</i>	Pacific tomcod	4.3
Zoarcidae	<i>Lycodopsis pacifica</i>	Blackbelly eelpout	1.5
Embiotocidae	<i>Cymatogaster aggregata</i>	Shiner perch	0.6
	<i>Embiotoca lateralis</i>	Striped seaperch	0.1
	<i>Rhacochilus vacca</i>	Pile perch	0.1
Bathymasteridae	<i>Ronquilus jordani</i>	Northern ronquil	0.3
Stichaeidae	<i>Lumpenus sagitta</i>	Snake prickleback	0.3
Scorpaenidae	<i>Sebastes auriculatus</i>	Brown rockfish	0.1
	<i>Sebastes caurinus</i>	Copper rockfish	— <sup>a</sup>
	<i>Sebastes maliger</i>	Quillback rockfish	0.6
	<i>Sebastes melanops</i>	Black rockfish	— <sup>a</sup>
Hexagrammidae	<i>Hexagrammos stelleri</i>	Whitespotted greenling	0.2
	<i>Ophiodon elongatus</i>	Lingcod	0.1
Cottidae	<i>Chitonotus pugetensis</i>	Roughback sculpin	0.6
	<i>Enophrys bison</i>	Buffalo sculpin	0.1
	<i>Leptocottus armatus</i>	Pacific staghorn sculpin	1.1
	<i>Scorpaenichthys marmoratus</i>	Cabezon	— <sup>a</sup>
Agonidae	<i>Agonopsis emmelane</i>	Northern spearnose	— <sup>a</sup>
	<i>Agonus acipenserinus</i>	Poacher	
		Sturgeon poacher	
Bothidae	<i>Citharichthys sordidus</i>	Pacific sanddab	2.7
	<i>Citharichthys stigmaeus</i>	Speckled sanddab	0.4
Pleuronectidae	<i>Eopsetta jordani</i>	Petrale sole	— <sup>a</sup>
	<i>Errex zachirus</i>	Rex sole	— <sup>a</sup>
	<i>Hippoglossoides elassodon</i>	Flathead sole	3.9
	<i>Inopsetta ischyra</i>	Hybrid sole	— <sup>a</sup>
	<i>Pleuronectes bilineatus</i>	Rock sole	13.8
	<i>Lyopsetta exilis</i>	Slender sole	0.2
	<i>Microstomus pacificus</i>	Dover sole	7.6
	<i>Pleuronectes vetulus</i>	English sole	55.6
	<i>Platichthys stellatus</i>	Starry flounder	0.4
	<i>Pleuronichthys coenosus</i>	C-O sole	0.1
	<i>Psettichthys melanostictus</i>	Sand sole	0.4

Source: Tetra Tech (1985).

<sup>a</sup> Relative abundance < 0.1 percent.

(greenlings, lingcod), *Scorpaenidae* (rockfishes), and *Embiotocidae* (surf perches). These species are known to occur in Commencement Bay.

### 3.2.1.4 Anadromous Fish

Anadromous salmonids are economically important species and ecologically dependent upon Commencement Bay and the Puyallup River basin. The shallow estuarine nearshore areas of Commencement Bay are critical early nursery and foraging grounds for juveniles, and adults traverse the bay to upstream spawning grounds in the Puyallup River basin. Meyer et al. (1981a), Dames & Moore (1981a), and Duker et al. (1989) studied the presence and distribution of juvenile salmonids in Commencement Bay and found that five salmonid species predominate in the bay: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon, and steelhead trout (*O. mykiss*). Juvenile pink salmon were observed only during the spring of even-numbered years because the primary adult runs occur during the winter of odd-numbered years. Juvenile sea-run cutthroat trout (*O. clarki*) were also observed, though in small numbers compared to salmon and steelhead trout. The 1992 Washington State Salmon and Steelhead Stock Inventory identifies a total of 12 stocks in rivers that discharge into Commencement Bay (Table 3-4). The status of spring chinook is listed as critical and the Puyallup coho stock as depressed. Six stocks are listed as healthy and four are of unknown status.

**Table 3-4. Status of Salmon Stocks in the Puyallup River Basin**

SPECIES / STOCK	STATUS <sup>a</sup>
CHINOOK SALMON	
White (Puyallup) Spring	Critical
White (Puyallup) Summer/Fall	Unknown
Puyallup Fall	Unknown
CHUM SALMON	
Puyallup / Carbon	Unknown
Fennel Carbon	Healthy
Hylebos Carbon	Unknown
COHO SALMON	
Puyallup	Depressed
White (Puyallup)	Healthy
PINK SALMON	
Puyallup	Healthy

**Table 3-4. continued**

SPECIES / STOCK	STATUS <sup>a</sup>
STEELHEAD TROUT—WINTER	
Mainstem Puyallup	Healthy
White (Puyallup)	Healthy
Carbon	Healthy

**Source:** Washington Department of Fisheries et al. (1993).

<sup>a</sup> Stock status ratings:

**Healthy** – A stock of fish exhibiting production levels consistent with the available habitat and within the natural variations in survival for the stock.

**Depressed** – A stock of fish exhibiting production levels below those expected based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely.

**Critical** – A stock of fish exhibiting production levels that are so low that permanent damage to the stock is likely or has occurred.

**Unknown**– There is insufficient information to rate the stock status.

Juvenile salmonids from the Puyallup River basin are dependent upon the Injury Study Area for their early development. Both wild and hatchery-propagated juveniles are present in the Puyallup River basin and use nearshore areas of the Injury Study Area. Nearly six million salmonids in various early developmental stages of growth were planted in the Puyallup River basin in 1992 by the Washington State Department of Fisheries (WDF) and the Puyallup and Muckleshoot Tribe of Indians (Table 3-5). Hatchery plants are made in the form of eggs, unfed and fed fry, fingerlings, yearlings, and smolts.

**Table 3-5. Hatchery Releases of Juvenile Salmonids to the Puyallup River Basin in 1992**

LIFE STAGE PLANTED	SPECIES				
	CHINOOK STATE/TRIBE	CHUM STATE/TRIBE	PINK STATE/TRIBE	COHO STATE/TRIBE	STEELHEAD STATE/TRIBE
Eggs	0/0	0/0	0/0	15,000/0	0/0
Fry (850–1,700 fish/pound)	21,000/0	0/426,813	10,900/0	1,885,700/6,728	0/0
Fingerling (120–600 fish/pound)	13,591/101,5824	0/0	0/0	694,446/364,004	0/0
Yearling (16–17 fish/pound)	0/38,386	0/0	0/0	1,249,300/0	0/0
Smolts ( 5 fish/pound)	0/0	0/0	0/0	0/0	107,633/15,975

**Source:** Turcotte (personal communication 1993), Cropp (personal communication 1994).

## **3.2.2 Wildlife Resources**

### **3.2.2.1 Birds**

To date, no single detailed study of birds that use Commencement Bay has been performed. Based on the data compiled from a variety of sources (e.g., Christmas bird count data, historical records, museum holdings), a total of 203 species have been recorded in the Commencement Bay area. (See Appendix C for an annotated list of birds found in Commencement Bay). Of these species, 162 are found regularly, of which 130 species are regularly recorded in the Injury Study Area. In addition to the 162 species, 3 species occurred historically in the Injury Study Area but are no longer present. Table 3-6 summarizes the bird species regularly present in the Injury Study Area, including breeding species.

### **3.2.2.2 Mammals**

Much less information is available about the mammals in Commencement Bay, both historically as well as the present distribution and abundance. In consultation with local mammalogists, fresh water, shore, and upland mammals likely to be present were established from the distribution of mammals in south King County, north of, but near the Injury Study Area (Hunn, 1982) (Table 3-7).

Marine mammals are typically present in the deeper portions of Commencement Bay, although river otters, which can be classified as a marine mammal due to their extensive use of marine waters, are present in shallower areas. Sightings of cetaceans in Puget Sound have been recorded, but their presence is transient (Calambokidis et al., 1991). Dall's porpoise may breed in south Puget Sound, as small groups are seen year-round (Angell and Balcomb, 1982). Studies of the marine mammals in Puget Sound have focused primarily on harbor seals. The closest pupping ground is on Gertrude Island, south of the Tacoma Narrows. It is not known whether seals pupping on Gertrude Island use Commencement Bay.

### **3.2.2.3 Reptiles and Amphibians**

A list of reptiles and amphibians that might be or have been present in the Commencement Bay area was compiled from species distribution information from King County (Hunn, 1982) (Table 3-8). As with mammals, there are no known published reports of distribution

**Table 3-6. Bird Species Regularly Found  
in the Injury Study Area Summarized by Major Group**

ORDER	COMMON NAME	SPECIES REGULARLY OCCURRING	OCCURRING SPECIES THAT BREED IN THE INJURY STUDY AREA
Gaviformes/Podicipediformes	Loons and gebes	8	1
Pelecaniformes	Cormorants	3	0
Ciconiiformes	Hérons	2	2
Anseriformes	Ducks and geese		
	Dabbling	13	2
	Diving	10	0
	Fish-eating	4	0
Falconiformes	Raptors	9	1
Galliformes	Quail	2	2
Gruiformes	Rails	3	0
Charadriiformes	Shorebirds	15	2
Charadriiformes	Gulls, terns, and alcids	14	2
Columbiformes	Pigeons	2	1
Strigiformes	Owls	2	0
Caprimulgiformes Apodiformes	Nighthawks, swifts	2	0
Covaciiformes	Kingfisher	1	1
Piciformes	Woodpecker	2	1
Passeriformes	Swallows and flycatchers	7	4
	Crows, jays, and shrikes	15	6
	Wrens, warblers, and sparrows	16	11
<b>Total Species</b>		<b>130</b>	<b>36</b>

**Table 3-7. List of Mammals Potentially Occuring in the Injury Study Area**

COMMON NAME	SPECIES	STATUS	COMMENTS
<b>ORDER MARSUPIALIA</b>			
Common Opossum	<i>Didelphis marsupialia</i>	Resident	Was introduced into northwestern Oregon in 1939 and has spread over most of western Washington.
<b>ORDER INSECTIVORA</b>			
Masked Shrew	<i>Sorex cinereus</i>	Upland Resident	Rare in humid coastal areas.
Trowbridge Shrew	<i>Sorex trowbridgei</i>	Upland Resident	Resident of Puget Sound lowlands.
Vagrant Shrew	<i>Sorex vagrans</i>	Upland Resident	Most common in western Washington.
Shrew-mole	<i>Neurotrichus gibbsii</i>	Upland Resident	Occurs in Douglas fir forests.
Townsend Mole	<i>Scapanus townsendii</i>	Upland Resident	Resident in the fields and meadows in Douglas fir areas
Pacific Mole	<i>Scapanus orarius</i>	Upland Resident	Resident in the deciduous component of Douglas fir forests, and occurs only in woodlands near Commencement Bay.
<b>ORDER CHIROPTERA</b>			
Little Brown Myotis	<i>Myotis lucifugus</i>	Migratory Visitor	Most common bat in Puget Sound lowlands, commonly seen in urban areas.
Long-eared Myotis	<i>Myotis evotis</i>	Migratory Visitor	
Long-legged Myotis	<i>Myotis volans</i>	Migratory Visitor	Also known as the hairy-winged Myotis, occurs in open forest.
Hoary Bay	<i>Lasiurus cinereus</i>	Migratory Visitor	
Big Brown Bay	<i>Eptesicus fuscus</i>	Migratory Visitor	
Western Big-eared Bat	<i>Pleucotus townsendii</i>	Migratory Visitor	Status of this rare species is not known in the Commencement Bay area.
<b>ORDER LANGOMORPHA</b>			
Eastern cottontail	<i>Sylvagus floridanus</i>	Introduced	Introduced into many counties in Washington and found in the tideflats.
<b>ORDER RODENTIA</b>			
Mountain Beaver	<i>Aplodontia rufa</i>	Upland Resident	Common in humid, coastal woods.
Townsend's Chipmunk	<i>Eutamias townsendii</i>	Upland Resident	Common coastal chipmunk.
Eastern Gray Squirrel	<i>Sciurus carolinensis</i>	Upland Resident	Introduced in urban areas.
Chickaree	<i>Tamiasciurus douglasi</i>	Upland Resident	Strictly associated with Douglas fir forests.
Beaver	<i>Castor canadensis</i>	Riparian	Status in the Puyallup River valley is dependant upon small trees for food.
Deer mouse	<i>Peromyscus maniculatus</i>	Resident	Common native mouse.
Townsend vole	<i>Microtus townsendii</i>	Resident	

Table 3-7. continued

COMMON NAME	SPECIES	STATUS	COMMENTS
Muskrat	<i>Ondatra zibethica</i>	Riparian	Status in the Puyallup River valley is dependent upon freshwater ponds with adequate food supply.
Norway Rat	<i>Rattus norvegicus</i>	Introduced	
Black Rat	<i>Rattus rattus</i>	Introduced Resident	
House mouse	<i>Mus musculus</i>	Introduced Resident	
<b>ORDER CARNIVORA</b>			
Raccoon	<i>Procyon lotor</i>	Resident	Well established in wooded areas, especially with riparian zones. Suburban pest.
Coyote	<i>Canus latrans</i>		Present in many suburban areas as well as in the tideflats open areas.
Red Fox	<i>Vulpes fulca</i>	Resident	Seen regularly at Gog-le-hi-te Marsh.
Mink	<i>Mustela vison</i>	Riparian	Status of this species of concern along the Puyallup River is dependant upon muskrat and ducks, which are principal prey items in addition to fish.
Long-tailed weasel	<i>Mustela frenata</i>		Certainly present along the Puyallup River, but its abundance is unknown.
Ermine	<i>Mustela erminea</i>	Upland Resident	Certainly present along the Puyallup River, but its status is unknown. It has been trapped in suburban Bellingham.
Striped skunk	<i>Mephitis mephitis</i>	Upland Resident	Present in many suburban areas, and in areas of the tideflats that contain enough cover.
Spotted Skunk	<i>Spilogale putorius</i>	Upland Resident	Not as well documented as the striped skunk.
Bobcat	<i>Lynx rufus</i>	Upland Resident	This species is an infrequent visitor to suburban areas in the Puget Sound lowlands.
River Otter	<i>Lutra canadensis</i>	Riparian and Marine	A resident in Commencement Bay, often seen in salt water. One was seen at Dumas Bay in 1993.
Harbor Seal	<i>Phoca vitulina</i>	Marine Resident	Nearest pupping area is Gertrude Island next to McNeil Island, south of the Narrows. The source of seals in Commencement Bay has not been validated.

**Table 3-7. continued**

COMMON NAME	SPECIES	STATUS	COMMENTS
California Sea Lion	<i>Zalophus californianus</i>	Marine Visitor	Juvenile males congregate at river mouths in the Pacific Northwest, causing extensive damage to salmonid runs. The status of sea lions at the mouth of the Puyallup River is unknown.
<b>ORDER ARTIODACTYLA</b>			
Mule Deer	<i>Odocoileus hemionus</i>	Upland Resident	The status of this species along the Puyallup River is unknown. There may be a population in Federal Way.
<b>ORDER CETACEA</b>			
Killer Whale	<i>Orcinus orca</i>	Marine Visitor	There are no resident pods in central Puget Sound, however, groups of orca are frequently seen off Vashon and Maury. It has been recorded in Commencement Bay.
Harbor Porpoise	<i>Phocoena phocoena</i>	Marine Visitor	Has been recorded from Carr Inlet, had a historical presence in Puget Sound.
Dall Porpoise	<i>Phocoenoides dalli</i>	Marine Visitor	Seen regularly in central Puget Sound. It is not known if this species calves in Puget Sound.
Gray Whale	<i>Eschrichtius gibbosus</i>	Marine Visitor	Since the dramatic recovery of this species, evidence of its feeding in Puget Sound has been documented as a stopover on its way north or south along the West Coast.

**Source:** Hunn (1982).

**Table 3-8. List of Amphibians and Reptiles  
That May Occur in the Commencement Bay Area**

COMMON NAME	SPECIES	STATUS	COMMENTS
Western Garter Snake	<i>Thamnophis elegans</i>		It is not known whether the common garter snake ( <i>T. sirtalis</i> ) occurs in the tideflats.
Rubber Boa	<i>Charina bottae</i>		More likely to occur in woodlands in the area.
Alligator Fence Lizard	<i>Sceloporus occidentalis</i>		Occurs in open beach and waterfront areas that are milder in temperature than upland areas.
Red-legged Frog	<i>Rana aurora</i>	Woodlands	More likely to occur near streams in wooded areas east of the Hylebos.
Pacific Tree Frog	<i>Hyla regilla</i>	Woodlands	Widespread throughout the Puget Sound lowlands in a variety of habitats.
Bullfrog	<i>Rana catesbiana</i>	Ponds	Introduced and a real problem for the preservation of other small herps, because of its voracious appetite.
Long-toed Salamander	<i>Ambystoma macrodactylum</i>	Woodlands	Status unknown in woodlands east of the Hylebos.
Northwest Mole Salamander	<i>Ambystoma gracile</i>	Woodlands	Status unknown in woodlands east of the Hylebos.
Rough-skinned Newt	<i>Taricha granulosa</i>	Woodlands	Typically in ponds in wooded areas, which occur east of the Hylebos in Federal Way.
Western Pond Turtle	<i>Chrysemys marmorata</i>	Ponds	Rare species for which reports in Pierce County have not been substantiated.
Painted Turtle	<i>Chrysemys picta</i>	Ponds	Introduced from eastern Washington, may be present in Puyallup River.

**Source:** Hunn (1982).

and abundance of any species from Commencement Bay. Frogs and garter snakes are probably the most abundant species in the area.

### **3.3 THREATENED AND ENDANGERED SPECIES**

A number of species listed under the Endangered Species Act by the U.S. Fish and Wildlife Service occur, or are thought to occur, in the Commencement Bay Area (Table 3-9). One species listed as endangered, the peregrine falcon (*Falco peregrinus*), is a migrant and winter visitor to the tidflats where it feeds on ducks and shorebirds. Three species listed as threatened are found in the area. The bald eagle (*Haliaeetus leucocephalus*) is a resident, though scarce in the winter, that breeds in the area and feeds on salmon, other fish, and birds. The marbled murrelet (*Brachyramphus marmoratus*) is a resident of the open water of Commencement Bay.

In addition, 11 species found in the area are considered candidates by the U.S. Fish and Wildlife Service for listing as threatened or endangered, and 9 species are considered as priority species by the Washington State Department of Wildlife (Table 3-9).

### **3.4 SELECTION OF KEY RESOURCES**

Sections 3.1, 3.2, and 3.3 outlined the importance of Commencement Bay to estuarine, marine, and terrestrial species that currently use or historically used the Injury Study Area. The Trustees have determined to identify, on a preliminary basis, potentially injured biological resources that are of particular concern and designate them as key resources. While the Trustees reserve the option to examine potential injuries to other resources as evidence suggests, identifying key resources at this time will help to better focus future stages of the damage assessment. Resources of importance for the damage assessment can be grouped in the following broad categories:

- Commercially or recreationally harvested resources, including tribal harvests
- Resources that are important links in supporting the ecosystem
- Resources that are important elements of non-consumptive uses

**Table 3-9. Species Known to Occur in the Commencement Bay Area that are Listed as Endangered, Threatened, or Candidate Species by the U.S. Fish and Wildlife Service or as Washington State Priority Species by the State of Washington**

SPECIES	COMMON NAME	COMMENTS
<b>ENDANGERED (FEDERAL)</b>		
<i>Falco peregrinus</i>	Peregrine Falcon	Migrant and winter visitor to tideflats, feeds on ducks and shorebirds. Introduced birds breed in Tacoma on tall buildings.
<b>THREATENED (FEDERAL)</b>		
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Resident, though scarce in winter, breeds near Browns Point, Point Defiance Park, and Maury Island. Feeds on dead salmon, fish, and birds, including nestling great blue herons.
<i>Brachyramphus marmoratus</i>	Marbled Murrelet	Resident of open water in Commencement Bay. Must breed nearby (in mature forest) as a fledged juvenile. Was found in Federal Way.
<b>CANDIDATE SPECIES (FEDERAL)</b>		
<i>Oncorhynchus tshawytscha</i>	Spring Run Chinook Salmon	The spring run may have recently been designated a genetically distinct subspecies.
<i>Salvelinus confluentus</i>	Bull Trout	Status in Puyallup River is unknown.
<i>Histrionicus histrionicus</i>	Harlequin Duck	Breeds in mountains in Pacific Northwest, winter visitor to Browns Point.
<i>Rana aurora</i>	Northern Red-legged Frog	Occurs in Puget Sound lowlands, freshwater sites, possibly in Injury Study Area.
<i>Clemmys marmorata</i>	Northwestern Pond Turtle	Reported in Pierce County, not in Injury Study Area.
<i>Plecotus townsendii</i>	Pacific Western Big-eared Bat	Status in Pierce County unknown, resident in Puget Sound lowlands at Bellingham, has bred in caves near Mt. St. Helens. Possible feeding sites occur along the Hylebos Waterway.
<i>Rana pretiosa</i>	Spotted frog	Historical range in Pierce County. Last verified specimen from west of the Cascades was in 1968 (Vancouver, Washington).
<i>Thomomys mazama tacomensis</i>	Tacoma Western Pocket Gopher	Status in Injury Study Area highly unlikely, occurs on Fort Lewis prairies.
<i>Calamagrostis crassiglumis</i> (Poaceae)	Thurber's Reedgrass	Occurs in Puget Sound lowlands in wetlands, possibly in the Injury Study Area.
<i>Castilleja levisecta</i> (Scrophulariaceae)	Golden Paintbrush	Occurs in Puget Sound lowlands, possibly in the Injury Study Area, but there is no known documentation.
<i>Cimicifuga elata</i> (Ranunculaceae)	No common name	Occurs in the Puget Sound lowlands, possibly in the Injury Study Area, but there is no known documentation.

Table 3-9. continued

SPECIES	COMMON NAME	COMMENTS
<b>PRIORITY SPECIES (WASHINGTON STATE DEPARTMENT OF WILDLIFE)</b>		
<i>Columba fasciata</i>	Band-tailed Pigeon	Resident in open forest, particularly in Madrona ( <i>Arbutus</i> ) in winter. Probably breeds along the forested slopes east of the Hybelos Waterway.
<i>Ardea herodias</i>	Great Blue Heron	Resident in Commencement Bay. Breeds nearby at Dumas Bay County Park in Federal Way. The colony is declining in size, and has low productivity.
<i>Novumbra hubbsi</i>	Olympic Mudminnow	Status in Puyallup River drainage unknown.
<i>Pandion haliaetus</i>	Osprey	Breeds near Purday, increasing in numbers. With nesting platform, could be induced to breed. Presently a summer visitor and migrant.
<i>Progne subis</i>	Purple Martin	Breeds in the Hybelos, downtown Tacoma, Titlow Beach, and at Fort Lewis. Specific nesting boxes needed to exclude starlings.
<i>Oncorhynchus mykiss</i>	Steelhead	
<i>Capture vas</i>	Vauxes Swift	Summer and migrant visitor to tideflats. Breeds in hollow trees in open forest at Fort Lewis. Could be induced to breed in large cottonwoods planted in tideflats. Has bred in chimneys.
<i>Sialia mexicana</i>	Western Bluebird	Efforts at Fort Lewis have re-established this species back in Pierce County. Could be induced to nest with placement of boxes in appropriate open habitat.
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	Has bred as recently as 1990 in western Oregon, but disappeared in western Washington in the 1930s. Recorded in the Injury Study Area in early 1900s.

- Resources that are endangered or threatened
- Resources of cultural importance

Resources of tribal and cultural importance (except for tribal commercial harvests) have not been evaluated at this time. Table 3-10 summarizes the key resources of the Injury Study Area.

**Table 3-10. Summary of Key Resources in the Injury Study Area**

KEY RESOURCE CATEGORY	BIOLOGICAL	ABIOTIC
Economically or recreationally harvested resource including tribal harvests	Salmonids (chinook, coho, chum, and pink salmon, and steelhead trout) Flatfish (English and rock sole) Epibenthic macroinvertebrates (dock shrimp, red rock crab, and Dungeness crab)	
Important links in supporting the ecosystem	Benthic infaunal invertebrates (polychaetes and bivalves) Epibenthic invertebrates (amphipods and decapods) Benthic macroinvertebrates (decapods and echinoderms)	Surface water and sediment
Important elements of non-consumptive uses	Birds (peregrine falcon, bald eagle, and great blue heron)	
Resources that are endangered or threatened	Birds (peregrine falcon, bald eagle, and marbled murrelet) Salmonids (spring run chinook salmon)	