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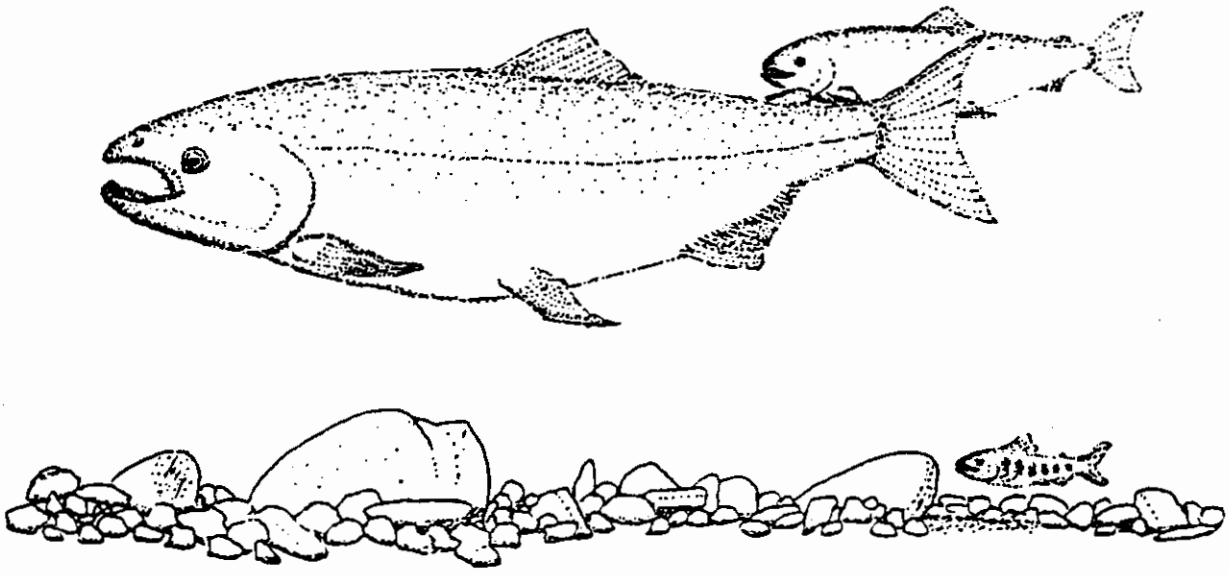
The Effect of Beach Nourishment on Salmonid Prey Resources of Lincoln Park Beach, Seattle, Washington: Pre-Project Conditions



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THE EFFECT OF BEACH NOURISHMENT ON SALMONID PREY RESOURCES OF LINCOLN PARK BEACH, SEATTLE, WASHINGTON: PRE-PROJECT CONDITIONS

Prepared for the U.S. Army Corps of Engineers, Seattle District

by

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DISCLAIMER

Ths opinions and recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the U.S. Army Corps of Engineers.

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INTRODUCTION

The Seattle District of the U.S. Army Corps of Engineers is planning to conduct beach nourishment at Lincoln Park in west Seattle in the summer of 1988. This consists of placing up to five feet of gravelly fill in about three acres of the high intertidal zone of the beach, that is, the area between five and twelve feet above mean lower low water. Beach nourishment is expected to protect the existing seawall and park facilities from erosion for five to ten years. The Corps has described the timing, composition, and extent of filling in their Final Environmental Assessment (U.S. Army Corps of Engineers 1986).

The primary federal resource issue is the project's effect on the salmon that use the area, since restoring Pacific salmon and steelhead is one of the Fish and Wildlife Service's principal goals. Our agency expressed this concern in the Fish and Wildlife Coordination Report (Cooper 1986). We explained that juvenile salmon migrating seaward from their rivers of origin during the spring and early summer feed in the nearshore areas of Puget Sound. Much of the nearshore prey for some species of salmon comes from the epibenthic zooplankton, which is the assemblage of crustacea produced on the surface of the bottom or within several centimeters above it. The specific issue is whether placement of the fill will change the stability and texture of the bottom in a way that reduces the density of those types of epibenthic zooplankton upon which juvenile salmon are known to feed.

The best way to answer this question is to assess the density of epibenthic zooplankton before and after beach nourishment. Toward this goal we reviewed the literature on feeding ecology of juvenile salmon and conducted a pilot study to determine feasibility of plankton sampling at the site and to set appropriate sample sizes (Hiss and Boomer 1985). That study allowed us to design and propose a baseline evaluation (Hiss and Boomer 1987), which the Corps contracted with us to conduct during the spring of 1988. This report summarizes the baseline results and fulfills the contract. A separate study of post-project conditions in 1990 will be necessary to complete the evaluation of whether beach nourishment has any effects on salmonid prey densities or species composition.

METHODS

Our procedure generally followed the plan specified in our proposal (Hiss and Boomer 1987). The variables studied were the densities (number per square meter) of selected potential prey categories in the pre-project season, that is, spring of 1988.

Experimental Design

We established two treatment plots. One was to assess the effect of beach fill on the intertidal elevations to receive fill, that is, from +8 to +5 feet above mean lower low water. The other plot was established seaward to assess the effect of downslope movement of fill material on the intertidal area seaward of the fill, that is, tidal elevations +5 to -2. Each of the two treatment plots had two corresponding control plots within the same tidal elevations. Two control plots were chosen because neither plot contained enough area representative of Lincoln Beach to serve as a single control. One control plot was established just north of Loman Park, approximately 3/4 mile north of the north end of the beach nourishment site. The other was established just south of Brace Point, approximately 1/2 mile to the south of the south end of Lincoln Park.

Size and Location of Plots. The size and location of the fill treatment plot corresponded with the area to be filled, which is the southwest-facing segment of Lincoln Park Beach from the existing seawall down to an elevation of +5 feet. This covers approximately three acres.

The second, or seaward treatment plot was adjacent to the planned fill and extended from the edge of the fill at +5 feet down to the lower limit of the intertidal zone, which was about -2 feet.

The locations of the control plots were selected for similarity of substrate type, similar occurrence of freshwater seeps, similar exposure to prevailing winds, absence of obvious pollution sources, and presence of seawalls. The control plots had the same distribution of elevations and approximately the same spacing of transects as the treatment plots. Photographs typical of the substrate at each plot are on file at this office.

Replication. Eight replicate samples were taken from each of the two treatment plots on each sampling trip. This number was one more than the minimum needed to fulfill our required sample replication, as determined from our pilot study (Hiss and Boomer 1985). In all plots, approximate locations of replicates remained the same each month.

The locations of replicate samples in the treatment plots were selected systematically from the grid system used by Thom and Hampel (1985) in their baseline study of algae and infauna. In that study, replicates were taken along eight evenly-spaced transects perpendicular to the shore at elevations of +8 and +6 for the fill treatment plot and at +4, +2, 0, and -2 in the intertidal treatment plot seaward of the fill. We sampled every other location in the area to be filled and every fourth location in the plot seaward of the planned fill area (Figure 1).

Four replicate samples were taken from each control plot so that data from the two control plots could be combined and treated statistically as eight replicates from a single plot. In each actual control plot, we sampled at one elevation from each transect. We chose the transect location and elevation to physically match the conditions at the treatment plot, with the constraint that both the +8 and +6 elevations would be represented by four samples as was done in the fill area, and that the +4, +2, 0, and -2 elevations were each represented by two samples as was done in the seaward treatment plot.

Sampling Schedule

The seasonal time interval for sampling corresponded to the expected entry of juvenile salmonids and ended when these fish were expected to have either left the area or to have shifted to primarily neritic prey. Our literature review (Hiss and Boomer 1985) suggested this interval usually begins in late February and extends to mid-June. We sampled each plot four times over the season, from March through June. Sampling dates were March 4, 7, and 9; April 5 and 6; May 2 and 3; and June 13 and 14. Bad weather forced a two-week delay of the June sampling.

Sample Collection and Analysis

We anchored our boat at each location according to transect and elevation. Transects were defined by points on shore. At Lincoln Park we marked the transect heads used by Thom and Hampel (1985) by painting their numbers on the seawall, and positioned our boat on an imaginary line extending out perpendicular to the seawall. At the control plots we defined the transects as

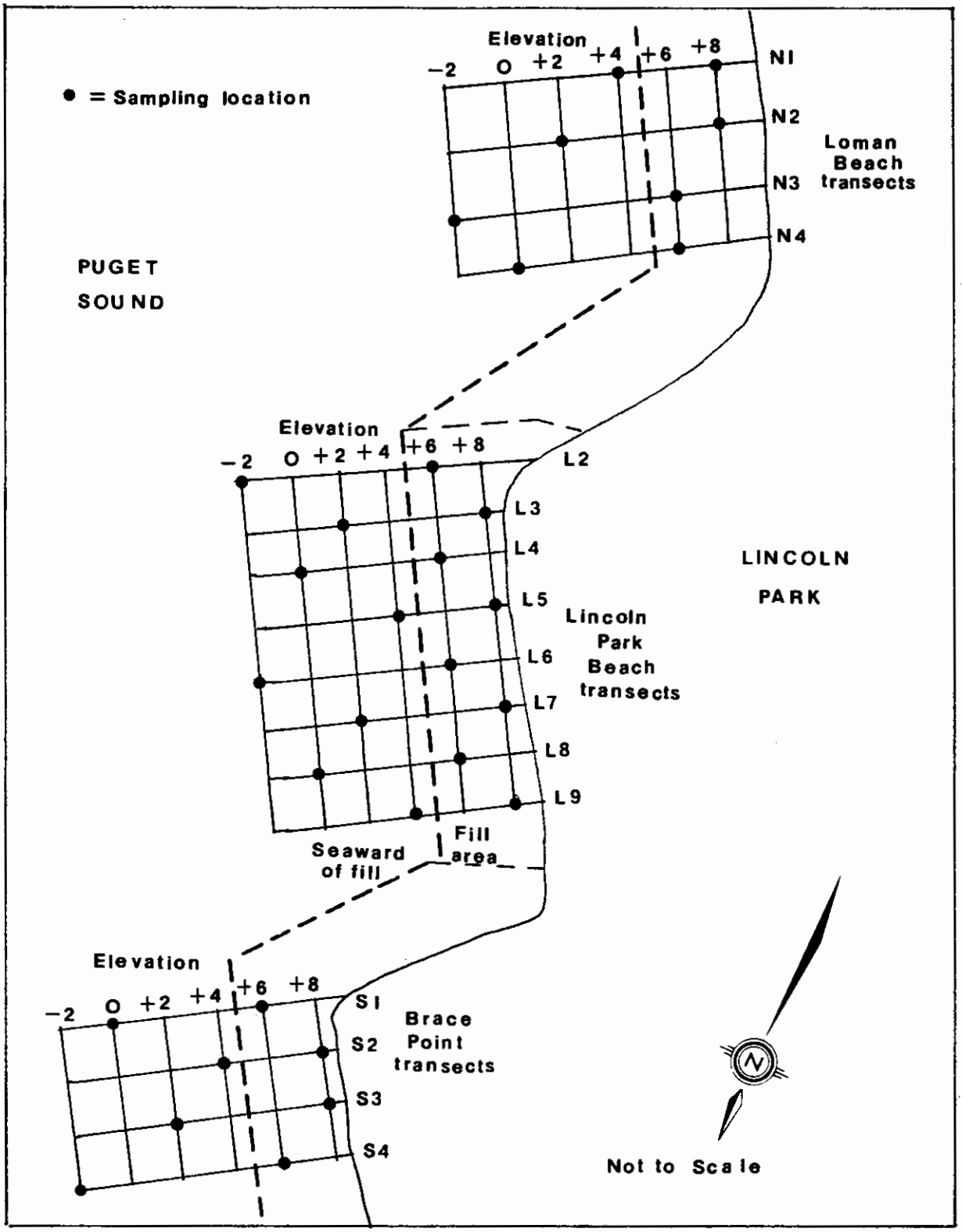

Figure 1. Map of Lincoln Beach and control plots, showing sampling locations.

imaginary lines passing through two points on shore, such as trees or antennas, and extending seaward. We positioned our boat so one point was behind the other. This method placed us within two boat lengths of the transect line. We maneuvered the boat to the appropriate bottom elevations by sounding with a pole. The boat was anchored at a depth equal to the predicted tide minus the desired elevation. This method placed us within about 0.8 foot of the desired elevation.

Epibenthic zooplankton was collected with a suction apparatus covering 0.1 square meters of the bottom, as described in the pilot study (Hiss and Boomer 1985). Water from this area was pumped through two nested sieves with opening sizes of 250 and 500 microns. Pumping continued until 500 liters had passed through the pump or until sand, algae, or debris began clogging the sieves. If the sieves clogged before 100 liters had been pumped, we discarded the sample and took another one within one meter of the original location. If the sieves clogged after 100 liters had been pumped we kept the sample. This group of samples made up 10% of the total, ranged from 200 to 480 liters, and was scattered over the various months and plots. Contents of each sieve were transferred to 15% formalin in the field and preserved in 70% ethanol in the lab.

Identification and sorting of organisms was based on a protocol developed with the assistance of a subcontractor to emphasize taxa of epibenthic zooplankton of potential prey value to juvenile salmon in estuaries and nearshore marine areas of the Northwest (Table 1). Taxa considered to be of secondary prey value were grouped in categories designated "other genera" or "other families." The subcontractor provided a special key to facilitate sorting the zooplankton into these categories (Cordell 1988), trained our technicians, and verified identifications as needed. The final taxonomic level of identification of each organism depended on the condition of the invertebrates and their life history stage. All samples were separately archived after analysis.

RESULTS

The following is a list of the organisms which we consider will be the most useful, because of their abundance, in evaluating the impact of beach nourishment.

Intertidal Zone Scheduled to Receive Beach Nourishment

March. Sphaeromatid isopods and Calliopiid Gammarideans predominated in the Lincoln Beach samples (Table 2). These taxa were also relatively abundant in the control plots.

April. Sphaeromatids and Calliopiids again predominated at Lincoln Beach, but Tisbe species, miscellaneous Harpacticoid copepods, and the Hyalid Gammaridean Allorchestes angusta were also common (Table 3). These taxa were also well-represented in the control plots except for the Sphaeromatids.

May. The Lincoln Beach samples were dominated by Tisbe, Sphaeromatids, and Calliopiids (Table 4). Of secondary importance were miscellaneous Harpacticoid genera, Paramoera species, and A. angusta. The control plots had sizeable populations of all but the last two taxa.

June. The Lincoln Beach samples were clearly dominated by Sphaeromatids (Table 5). Miscellaneous Harpacticoids were second in abundance. In contrast, Sphaeromatids were not very abundant in the comparison plots. However, Harpacticoids in the control plots were about as numerous as at Lincoln Beach.

Intertidal Zone Seaward of Beach Nourishment Sites

March. Tisbe clearly predominated at Lincoln Beach, with miscellaneous Harpacticoids occupying a secondary position (Table 6). Sphaeromatids and A. angusta were the principal larger epibenthic zooplankters. The control plots also contained high densities of Tisbe and other Harpacticoids but had fewer Sphaeromatids and A. angusta than Lincoln Beach.

April. Tisbe and other Harpacticoids were again the most abundant taxa among the Lincoln Park Harpacticoids (Table 7). Calliopiids and Sphaeromatids were the most abundant larger epibenthos, while Cumella vulgaris and miscellaneous Gammaridean

families occupied a secondary position in abundance. The control plots also had large proportions of these organisms, with the exception of miscellaneous Gammaridean families.

May. Tisbe and other Harpacticoids again dominated the Lincoln Park Harpacticoid samples but members of the Harpacticus uniremis group, unidentifiable Harpacticoids, and Zaus species became more abundant than before (Table 8). Calliopiids and Sphaeromatids were again the most abundant larger epibenthos, while C. vulgaris and A. angusta were also common. All taxonomic groups with the exception of A. angusta had correspondingly heavy representation in the control plots.

June. Miscellaneous genera were the most abundant Harpacticoid category at Lincoln Beach with Zaus and Tisbe in an important, but secondary position (Table 9). Calliopiids and Sphaeromatids were again the most abundant larger epibenthos, while C. vulgaris and A. angusta occupied a secondary position. All these taxa had ample representation in the control plots.

DISCUSSION

The data we collected appear adequate as a baseline for evaluating the impact of beach nourishment on potential feeding grounds of juvenile salmon. A minor deficiency in the data stemmed from our inability to identify to lower taxonomic levels many of the Harpacticoids from the lower intertidal at Lincoln Beach in May. This was probably due to crushing or breakage of some individuals due to the very large number of organisms in some of the samples.

We have expressed our results as total count of each taxon found in the eight samples taken from each plot each month. For comparison to post-project conditions we have suggested (Hiss and Boomer 1987) using the densities of epibenthos from each sample, transforming to normalize the distribution, and statistically comparing baseline and post-project years. The data needed to accomplish this are on computer file at this office.

Final selection of taxa for determination of effects of fill on salmonid prey should be based on abundance of counts among the replicates. It may be useful to combine some taxa into the next higher level, to use as much of the data as possible. Combination of taxa will probably be especially appropriate with the Gammarideans, because only a few taxa had numerous individuals.

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Table 1. Sorting protocol for epibenthic zooplankton of potential value as juvenile salmon prey in central Puget Sound. Numbers refer to prey codes specific to this project.

1000. Adult Harpacticoids (a,b)
- 1011. *Harpacticus uniremis* group
- 1012. *Zaus* spp.
- 1021. *Tisbe* spp.
- 1090. Other Harpacticoid families, genera, or species

2000. Mysidacea

3000. Cumacea (a)
- 3010. *Cumella vulgaris*
- 3090. Other Cumacean genera

5000. Tanaidacea

6000. Isopoda (a)
- 6010. Sphaeromatidae
- 6090. Other isopod families

7000. Amphipoda: Gammaridea (a)
- 7010. Ampithoidae
- 7021. Aoridae: *Aoroides* spp.
- 7030. Calliopiidae
- 7041. Corophiidae: *Corophium* spp.
- 7050. Pontogeneiidae (a)
  - 7051. *Pontogeneia* spp.
  - 7052. *Paramoera* spp.
  - 7059. Other Pontogeneiid genera
- 7060. Anisogammaridae (a)
  - 7061. *Anisogammarus pugettensis*
  - 7062. *Eogammarus* spp.
- 7070. Hyalidae (a)
  - 7071. *Allorchestes angusta*
  - 7072. *Hyale* spp.
- 7080. Isaeidae (a)
  - 7081. *Photis* spp.
  - 7089. Other Isaeid genera
- 7090. Ischyroceridae
  - 7091. *Ischyrocerus* spp.
  - 7099. Other Ischyrocerid genera
- 7101. Phoxocephalidae
- 7110. Pleustidae (a)
  - 7111. *Parapleustes pugettensis*
  - 7119. Other Pleustid genera
- 7990. Other Gammaridean families

8000. Amphipoda: Caprellidea

9000. Saltwater life stages of insects (a)
- 9010. Diptera (a)
  - 9011. Chironomidae
  - 9012. Ephydridae
  - 9019. Other Dipteran families
- 9090. Other insect orders

(a) not further identifiable.
(b) not including copepodites since this life history stage may include substantial numbers of neritic taxa.

Table 2. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in eight 0.1 square meter samples pumped in March of 1988 from the elevations scheduled to receive beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	4	3
1012. *Zaus* spp.	0	1
1021. *Tisbe* spp.	33	11
1090. Other Harpacticoid genera	24	17
2000. Mysidacea	6	2
3000. Cumacea		
3010. *Cumella vulgaris*	2	7
5000. Tanaidacea	0	1
6000. Isopoda		
6010. Sphaeromatidae	66	108
6090. Other isopod families	0	1
7000. Amphipoda: Gammaridea		
7030. Calliopiidae	59	83
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	1	0
7052. *Paramoera* spp.	2	0
7060. Anisogammaridae (a)	0	20
7062. *Eogammarus* spp.	0	12
7070. Hyalidae		
7071. *Allorchestes angusta*	13	23
7080. Isaeidae (a)	0	2
7081. *Photis* spp.	0	14
9000. Saltwater life stages of insects (a)	0	1

(a) not further identifiable

Table 3. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in eight 0.1 square meter samples pumped in April of 1988 from the elevations scheduled to receive beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	11	20
1012. *Zaus* spp.	2	34
1021. *Tisbe* spp.	54	282
1090. Other Harpacticoid genera	49	51
2000. Mysidacea	1	0
3000. Cumacea		
3010. *Cumella vulgaris*	2	7
5000. Tanaidacea	7	1
6000. Isopoda		
6010. Sphaeromatidae	100	34
6090. Other isopod families	0	5
7000. Amphipoda: Gammaridea (a)	6	0
7030. Calliopiidae	105	312
7060. Anisogammaridae (a)	0	1
7062. *Eogammarus* spp.	1	14
7070. Hyalidae		
7071. *Allorchestes angusta*	47	3
7990. Other Gammaridean families	2	0
9000. Insects		
9010. Diptera		
9011. Chironomidae	2	0

(a) not further identifiable

Table 4. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in eight 0.1 square meter samples pumped in May of 1988 from the elevations scheduled to receive beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	34	16
1012. *Zaus* spp.	5	3
1021. *Tisbe* spp.	308	127
1090. Other Harpacticoid genera	70	159
3000. Cumacea		
3010. *Cumella vulgaris*	2	0
5000. Tanaidacea	5	2
6000. Isopoda		
6010. Sphaeromatidae	354	73
6090. Other isopod families	4	6
7000. Amphipoda: Gammaridea (a)	3	0
7030. Calliopiidae	405	190
7041. Corophiidae: *Corophium* spp.	0	1
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	9	0
7052. *Paramoera* spp.	47	3
7060. Anisogammaridae (a)	0	1
7062. *Eogammarus* spp.	5	3
7070. Hyalidae (a)	1	0
7071. *Allorchestes angusta*	70	13
7072. *Hyale* spp.	1	0
7080. Isaeidae		
7089. Isaeid genera other than *Photis* spp.	0	2
7090. Ischyroceridae (a)	0	1
7091. *Ischyrocerus* spp.	5	0
8000. Amphipoda: Caprellidea	2	0

(a) not further identifiable

Table 5. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in eight 0.1 square meter samples pumped in June of 1988 from the elevations scheduled to receive beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	22	22
1012. *Zaus* spp.	34	20
1021. *Tisbe* spp.	59	76
1090. Other Harpacticoid genera	128	119
2000. Mysidacea	3	6
3000. Cumacea		
3010. *Cumella vulgaris*	1	3
5000. Tanaidacea	3	5
6000. Isopoda		
6010. Sphaeromatidae	408	50
6090. Other isopod families	6	3
7000. Amphipoda: Gammaridea (a)	3	7
7030. Calliopiidae	46	2
7041. Corophiidae: *Corophium* spp.	1	0
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	1	1
7052. *Paramoera* spp.	2	2
7070. Hyalidae		
7071. *Allorchestes angusta*	51	29
7072. *Hyale* spp.	0	1
7080. Isaeidae		
7081. *Photis* spp.	0	8
7089. Other Isaeid genera	3	1
7090. Ischyroceridae		
7091. *Ischyrocerus* spp.	7	5
7990. Other Gammaridean families	2	0
8000. Amphipoda: Caprellidea	22	10
9000. Saltwater life stages of insects		
9010. Diptera		
9011. Chironomidae	4	0
9019. Other Dipteran families	1	0
9090. Other insect orders	0	3

(a) not further identifiable

Table 6. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in a total of eight 0.1 square meter samples pumped in March of 1988 from intertidal elevations seaward of those scheduled for beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	49	32
1012. *Zaus* spp.	1	116
1021. *Tisbe* spp.	955	1211
1090. Other Harpacticoid genera	181	555
2000. Mysidacea	5	0
3000. Cumacea (a)	41	0
3010. *Cumella vulgaris*	0	167
3090. Other Cumacean genera	2	7
5000. Tanaidacea	4	30
6000. Isopoda		
6010. Sphaeromatidae	123	50
6090. Other isopod families	2	18
7000. Amphipoda: Gammaridea (a)	2	21
7021. Aoridae: *Aoroides* spp.	0	1
7041. Corophiidae: *Corophium* spp.	0	3
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	23	21
7060. Anisogammaridae		
7062. *Eogammarus* spp.	0	1
7070. Hyalidae		
7071. *Allorchestes angusta*	103	20
7080. Isaeidae (a)	1	11
7081. *Photis* spp.	2	16
7089. Other Isaeid genera	12	16
7090. Ischyroceridae	0	13
7101. Phoxocephalidae	1	0
7111. *Parapleustes pugettensis*	0	2
7990. Other Gammaridean families	5	96
8000. Amphipoda: Caprellidea	0	2
9000. Saltwater life stages of insects		
9090. Insect orders other than Diptera	1	0

(a) not further identifiable

Table 7. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in a total of eight 0.1 square meter samples pumped in April of 1988 from intertidal elevations seaward of those scheduled for beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	56	138
1012. *Zaus* spp.	56	996
1021. *Tisbe* spp.	1090	2780
1090. Other Harpacticoid genera	745	1215
2000. Mysidacea	1	2
3000. Cumacea		
3010. *Cumella vulgaris*	46	101
3090. Other Cumacean genera	5	33
5000. Tanaidacea	8	25
6000. Isopoda		
6010. Sphaeromatidae	135	530
6090. Other isopod families	21	68
7000. Amphipoda: Gammaridea (a)	8	135
7030. Calliopiidae	311	893
7041. Corophiidae: *Corophium* spp.	1	7
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	21	248
7060. Anisogammaridae (a)	0	2
7061. *Anisogammarus pugettensis*	0	1
7062. *Eogammarus* spp.	0	5
7070. Hyalidae (a)	1	0
7071. *Allorchestes angusta*	33	23
7072. *Hyale* spp.	3	9
7080. Isaeidae		
7081. *Photis* spp.	0	7
7089. Other Isaeid genera	17	102
7090. Ischyroceridae (a)	3	1
7091. *Ischyrocerus* spp.	5	9
7101. Phoxocephalidae	0	2
7990. Other Gammaridean families	41	9
8000. Amphipoda: Caprellidea	3	17
9000. Saltwater life stages of insects (a)	1	0
9010. Diptera		
9011. Chironomidae	0	7
9090. Other Insect Orders	1	0

(a) not further identifiable

Table 8. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in a total of eight 0.1 square meter samples pumped in May of 1988 from intertidal elevations seaward of those scheduled for beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids (a)	553	0
1011. *Harpacticus uniremis* group	280	143
1012. *Zaus* spp.	156	1115
1021. *Tisbe* spp.	1273	522
1090. Other Harpacticoid genera	667	1222
2000. Mysidacea	0	4
3000. Cumacea		
3010. *Cumella vulgaris*	101	308
3090. Other Cumacean genera	0	3
5000. Tanaidacea	18	8
6000. Isopoda		
6010. Sphaeromatidae	424	270
6090. Other isopod families	19	13
7000. Amphipoda: Gammaridea (a)	5	2
7030. Calliopiidae	647	721
7041. Corophiidae: *Corophium* spp.	4	3
7060. Pontogeneiidae		
7051. *Pontogeneia* spp.	14	14
7052. *Paramoera* spp.	3	0
7060. Anisogammaridae (a)	1	0
7061. *Anisogammarus pugettensis*	2	0
7062. *Eogammarus* spp.	1	6
7070. Hyalidae		
7071. *Allorchestes angusta*	172	14
7072. *Hyale* spp.	18	16
7080. Isaeidae		
7081. *Photis* spp.	10	2
7089. Other Isaeid genera	3	1
7090. Ischyroceridae		
7091. *Ischyrocerus* spp.	5	4
7101. Phoxocephalidae	0	1
7990. Other Gammaridean families	7	1
8000. Amphipoda: Caprellidea	10	3
9000. Saltwater life stages of insects		
9010. Diptera		
9011. Chironomidae	2	2

(a) not further identifiable

Table 9. Total count of epibenthic zooplankton of potential value as juvenile salmon prey in a total of eight 0.1 square meter samples pumped in June of 1988 from intertidal elevations seaward of those scheduled for beach nourishment.

Prey category	Lincoln Beach	Control sites
1000. Adult Harpacticoids		
1011. *Harpacticus uniremis* group	22	77
1012. *Zaus* spp.	112	442
1021. *Tisbe* spp.	142	401
1090. Other Harpacticoid genera	887	655
2000. Mysidacea	1	8
3000. Cumacea (a)	1	0
3010. *Cumella vulgaris*	34	684
5000. Tanaidacea	7	21
6000. Isopoda		
6010. Sphaeromatidae	198	241
6090. Other isopod families	4	10
7000. Amphipoda: Gammaridea (a)	10	9
7030. Calliopiidae	203	230
7041. Corophiidae: *Corophium* spp.	0	2
7050. Pontogeneiidae		
7051. *Pontogeneia* spp.	0	4
7052. *Paramoera* spp.	1	29
7070. Hyalidae		
7071. *Allorchestes angusta*	43	68
7072. *Hyale* spp.	1	7
7080. Isaeidae, (a)	0	1
7081. *Photis* spp.	0	1
7089. Other Isaeid genera	5	10
7090. Ischyroceridae (a)	0	1
7091. *Ischyrocerus* spp.	8	3
7990. Other Gammaridean families	0	1
8000. Amphipoda: Caprellidea	15	30
9000. Saltwater life stages of insects		
9010. Diptera		
9011. Chironomidae	0	4

(a) not further identifiable