erosion (Ternyik pers. com. October 2001). However, within a designated "Natural Estuary District", riprapping can only be done "...to protect unique natural resources..." and then only if other measures have been considered and found by the County not to be feasible. Riprapping is allowed in areas zoned "Conservation Estuary District" such as Area B just northwest of Area C (Figure 1).

A possible solution to the zoning restriction on riprapping, would be partial rezoning of area C. The area between the eroding banks and the inner jetty (Figure 1, Sub-Area C1) is the area most directly affected by bank erosion. Our initial inspection of this area in October 2000, indicated that the natural designation for this portion of Area C might not accurately reflect existing resource values.

To provide a more definitive evaluation of the biological conditions in Sub-Area C1, we conducted a quantitative benthic macroinvertebrate survey of the area in May 2001 and compared the results with benthic samples collected concurrently from nearby areas. This report presents results of the benthic survey as well as a qualitative assessment of the existing habitat conditions and natural resource attributes in Sub-Area C1 and Area C.

HISTORICAL BACKGROUND

Much of the following description of historic changes to the river channel are based on a report prepared by Ogden Beeman and Associates, Inc (1990), a firm that specializes in coastal and riverine sediment transport modeling. Wilbur Ternyik provided photographic documentation. According to the Ogden Beeman and Associates, Inc. report, the bank erosion adjacent to the Shelter Cove subdivision is largely a result of changes that have been made to the Siuslaw River channel to facilitate navigation. Historically, the river channel entered the ocean to the north of its present entrance. A sand spit between the ocean and the river channel prevented most of the ocean wave energy from directly impacting the sand slope at the Shelter Cove site. The river channel was altered when the north jetty was initially constructed in the 1890s under authorization of September 19, 1890. Further jetty extensions were made after the turn of century and the project was listed as completed in 1930. The completed north jetty was 7,790 feet long and extended from the ocean inland to approximately RM 1 +00 at Cannery Hill, which is the easterly boundary of the Shelter Cove subdivision.

The original North Jetty was constructed from Cannery Hill and ran due north for about 2,000 feet until it turned west, cutting off the channel to the north and directing the river into the ocean. The inner end of the jetty acted as a training structure to turn the river. At the same time, it protected the north bank from erosion from the river as well as wave energy through the newly stabilized and deepened entrance. Prior to the extension of the jetty into the ocean, the entrance channel was shoaled to 6 to 10 feet. The jetty extension opened the entrance channel allowing increased penetration of ocean wave energy.

The original jetty was apparently built from sandstone available from local quarries. The deterioration of this rock and the jetty section lead to the rehabilitation of 1,700 feet of the outer North Jetty in 1958. The inner end of the jetty was left to deteriorate under the forces of nature and the constant impact of ocean wave forces. Presently, the inner portion of the jetty that extends in front of the Shelter Cove development has deteriorated to the extent that essentially none of it is visible at high tide. Much of the rock has deteriorated in size and sunk into the surrounding sand. As a result of the deteriorated jetty section, waves from the ocean, which penetrates into the estuary, either are refracted or are reflected directly onto the Shelter Cove site. At high tide and high wave conditions, the toe of the slope reportedly takes a direct wave attack from the ocean waves. The result of this has been the creation of two large "cusps" in the landform of the north bank.

According to the Ogden Beeman & Associates, Inc. report, it is probable that the erosion of the north bank started even when the jetty was in good condition due to wave energy penetration into the estuary through the rubble mound jetty. An U.S. Army Corps of Engineers photo taken in 1939 (Photo 1) shows the inner jetty and the early stages of the bank erosion. As the jetty deteriorated over time, the wave energy was able to pass through the jetty without reduction. An aerial photo from the 1980s (Photo 2) shows the development of the "cusps" in the bank as discussed previously. Figure 2 shows the progression of the erosion on the larger cusp from 1992 through 1998. In the present situation, the waves can attack the toe of the slope directly, particularly at high tide (Photo 3).

The fate of the material eroded from the sand slope at the Shelter Cove site was examined in the Ogden Beeman & Associates Inc. (1990) report. They reviewed Corps of Engineers surveys plotted on aerial mosaics of the outer estuary. At the time of their study (i.e., 1990), the entire area riverward of the jetty section in front of the eroding bluffs was shoaled to around MLLW (Photo 4). This shoaling of sand covered most of the outcrop of siltstone, which was described in the 1980 zoning designation as a unique attribute in this reach of the estuary. Ogden Beeman & Associates concluded that the eroding slope was contributing to this shoal. The waves and currents sweeping over this shoal place material in motion, which is carried both up and downstream of the eroded area. The shoal persisted through the 1990s. As will be discussed in more detail below, a substantial portion of the sand shoal washed off the siltstone underlayment during 2001 when a combination of mild winter conditions and unusually low winter and spring river flows resulted in a large reduction in the rate of bank erosion.

STUDY AREA AND SAMPLING DESIGN

The quantitative benthic macroinvertebrate survey was designed to compare the taxonomic composition and abundance of benthic organisms in Sub-Area C1 with other nearby areas having similar sandy substrate conditions. Four sampling areas were established (Figure 3). Photographs of each sampling area were taken at the time of sampling (Appendix A). Sampling Area 1 was located on the south side of the estuary across from the eroding bank. This area is zoned "natural." The predominant components of the substrate were medium and fine sand mixed with silt. Holes made by

Photo 1. Lower Siuslaw River Estuary in 1939 (U.S. Army Corps of Engineers). Red lines indicate area of eroding bluffs.

Photo 2. Lower Siuslaw River Estuary mid 1980s (Photo provided by W. Ternyik). Red lines indicate same area of eroding bluffs as shown in Photo 1.

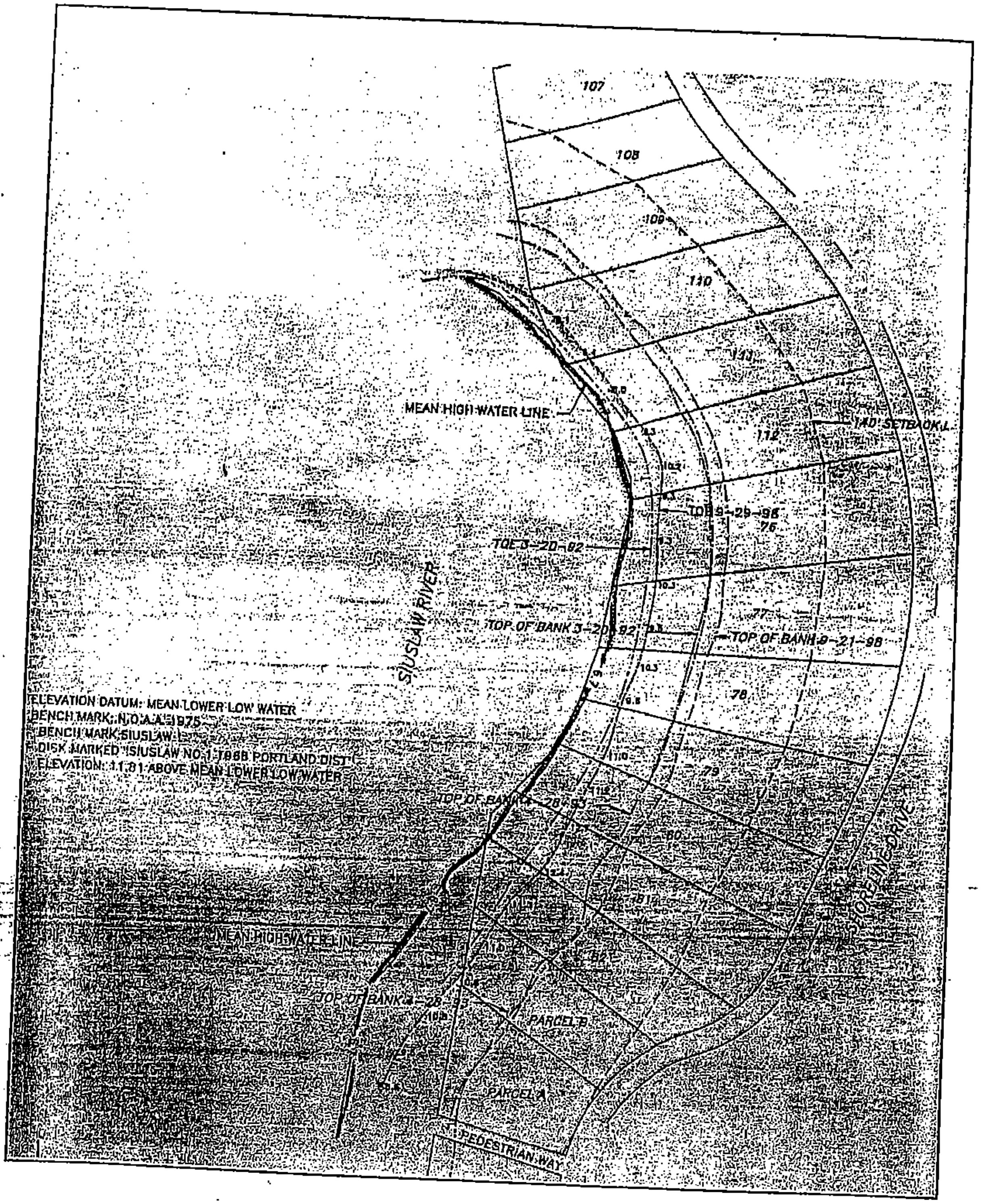

Figure 2. Progression of bank erosion between 1992 and 1998 at Shelter Cove bluff based on surveys conducted in 1992 and 1998 (Schematic diagram provided by Hurst Companies of Oregon).

Photo 3. Waves and logs washing directly against toe of Shelter Cove sand bluff in December 1999 (Photo provided by W. Ternyik).

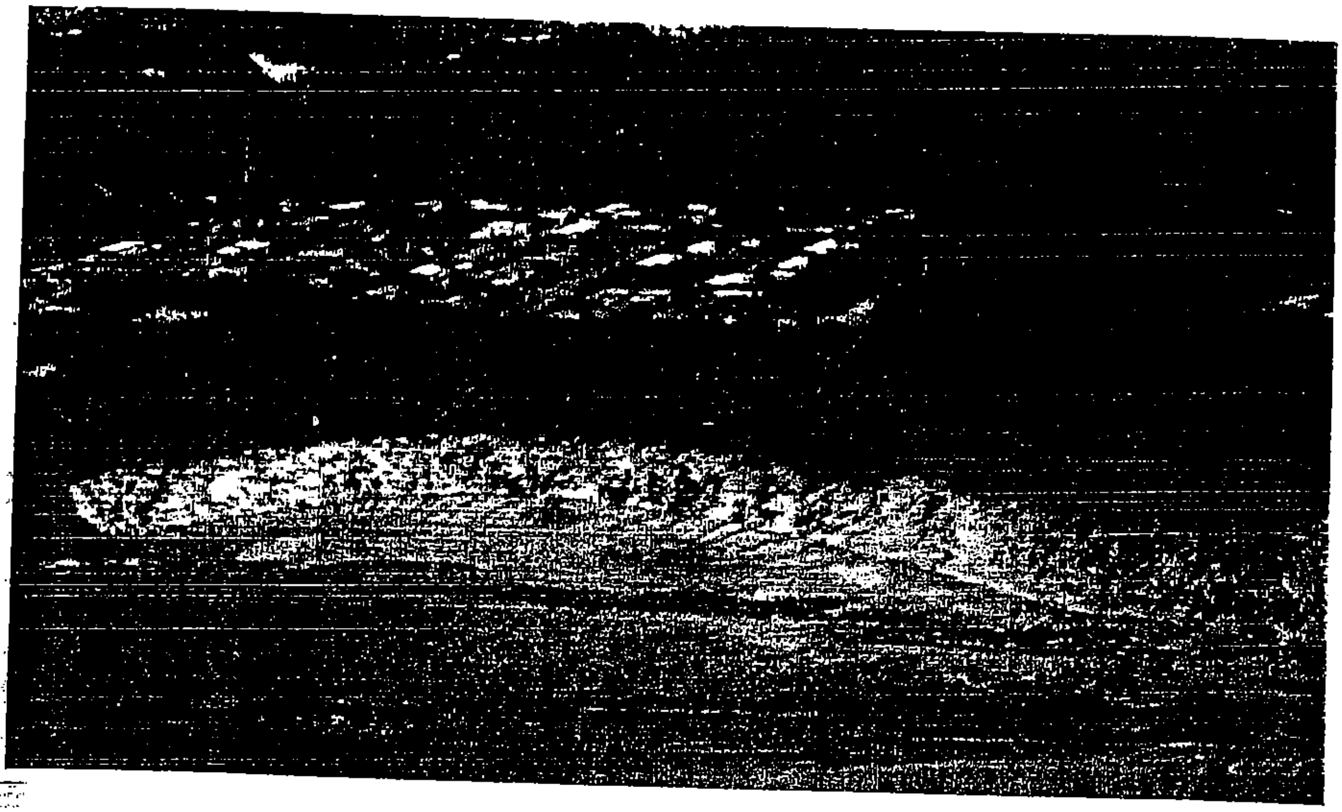

Photo 4. Shelter Cove bluffs and massive area of sand infill in front of bluffs. Aerial photo taken in late 1980s (Photo provided by W. Ternyik).

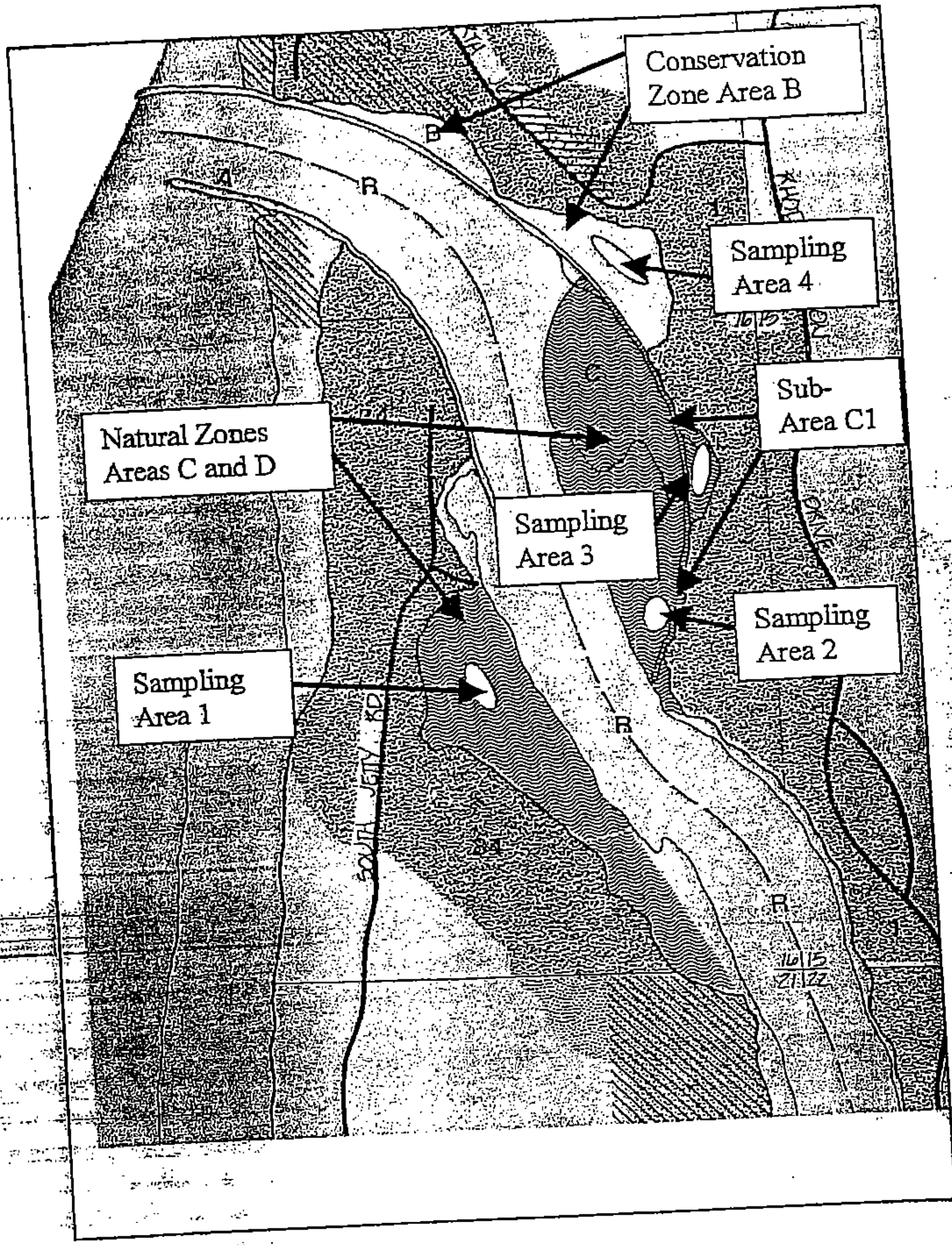

Figure 3. Map of lower Siuslaw River Estuary showing the location of sampling areas 1 through 4, Natural Zones C and D and Conservation Zone B.

the ghost shrimp, *Neotrypaea* sp., were moderately abundant throughout this area. Sampling Area 2 was located outside the jetty at approximately RM 0.0 + 4800 feet. The substrate at this location was predominately medium to fine sand mixed with silt. Ghost shrimp holes were abundant throughout sampling Area 2. Sampling Area 3 was within Sub-Area C1 between the jetty and the eroding bank. The substrate sampled at this site was predominately medium to fine sand. A few ghost shrimp holes were observed in this area but density was much lower than in sampling Areas 1 and 2. Sampling Area 4 was located within Area B (Figure 3), which is zoned as a "conservation district." The substrate at this site was predominately medium to fine sand mixed with silt. Lenses of organic detritus and shell fragments were apparent in some of the sediment samples from Area B. A small stream bisects the area sampled in Area B and numerous freshwater seeps were observed along the eastern edge of the site. No sampling was conducted adjacent to the stream. Ghost shrimp were present in parts of Area B, but the areas sampled did not include the ghost shrimp beds.

Sampling Areas 1, 3 and 4 were established at approximately the same tidal elevation within the intertidal zone. Sampling Area 2 was located at a slightly lower elevation in the intertidal zone than the other three sites to allow a comparison of conditions on the outside of the jetty in Area C. Fifteen randomly placed samples were collected from each area.

In addition to the quantitative benthic sampling, the exposed siltstone within Sub-Area C1 was visually examined for the presence of piddock clams and other benthic organisms. Approximately 75 percent of the exposed siltstone was visually inspected at low tide.

METHODS

Fifteen random benthic samples were collected at each of the four sampling areas. The samples were collected using a 3-in (7.6-cm) diameter PVC corer and a 0.1 m^2 quadrat made from 0.5 in (1.3-cm) diameter PVC pipe. After walking into the sampling area while the tide was out, the first sampling site in each area was selected by randomly selecting a number between 0 and 60. A wristwatch was then used to select a random direction in which to walk. Zero seconds was used to equal north, 15 seconds equal to east, 30 seconds to equal south and 45 seconds to equal west. A distance of 40 paces was then paced off in the direction of the randomly selected number. We selected 40 paces as an appropriate distance between sampling sites because the areas sampled were large and relatively uniform. A numbered flag was placed at the end of the 40 paces. This process was repeated until all 15 sampling sites had been established. If the investigator reached the edge of the habitat being sampled before completing 40 paces, additional bearings were randomly selected until one led back into the sampling area.

Near each flag, the 0.1 m^2 quadrat was tossed over the investigator's shoulder to establish the sampling site. If burrowing shrimp holes were present, the number of holes was counted before core sampling was initiated. Only holes greater than 3 mm were counted. Two core samples were taken to 5-cm depth within the 0.1 m^2 quadrat. The corer was forced into the sediment then tilted slightly until the bottom could be covered. The core and its contents were then carefully lifted and placed into a wide mouth jar. The two core samples were composited in the same-labeled sample jar. The samples were preserved with a 10 percent formalin solution.

In the laboratory, the samples were rinsed through a 0.5-mm sieve screen to remove most of the sediment in the samples. Retained organisms and remaining sediment were placed in sample jars and preserved in 90 percent ethanol. Later the organisms were separated from the remaining debris under a dissection microscope and placed in labeled vials containing 90 percent ethanol. The organisms were then identified to the lowest practical taxon using keys in Kozloff (1999), Smith and Carlton (1989) and Harbo (1997). Numbers of each taxon were recorded on laboratory data forms.

One-way analysis of variance (ANOVA) was used to test for significant differences between sampling areas. Total numbers of organisms, total taxa and fish prey abundance were compared. A square root transformation was used on the total numbers of organisms and prey abundance numbers to meet normality and homoscedasticity requirements of ANOVA. Differences between means were compared using the Tukey (HSD) comparisons test.

RESULTS

Quantitative Benthic Samples

The taxonomic composition and mean number of benthic organisms per sample are summarized by sampling area in Table 1 (see Appendix B for individual sample data). One-way ANOVA tests confirmed that the mean number of taxa and the mean number of organisms per sample in sampling Areas 1 and 2 were significantly larger ($P < 0.05$) than those in sampling Areas 3 and 4. Sampling Area 3 is located near the eroding sand bank and sampling Area 4 is within a cove zoned conservation to the west of sampling Area 3. The other two sampling areas were within natural zones D and C, respectively.

The most abundant organisms in samples from sampling Areas 1, 2 and 3 were the polychaete *Paraonella platybranchi* and amphipod crustaceans of the Families Gammaridae and/or Haustoridae. *Paraonella platybranchia* is a thin, very small polychaete worm that probably contributes little to the food of juvenile salmonids or other fish species. Amphipod crustaceans are common food organisms for juvenile salmonids and other estuarine fish species. Note that the densities of both *P. platybranchia* and Gammaridae in sampling Area 3, which is adjacent to the eroding sand bank, was very low with less than one individual from each group per sample. The only relatively abundant organism present in samples from sampling Area 4 was the amphipod *Eohaustorius spp.*

Table 1. Mean number of benthic macroinvertebrates per sample.

Taxa	Area 1	Area 2	Area 3	Area 4
Phylum Nemertea	0.73	0.47	0.13	0.47
Phylum Annelida				
Class Polychaeta				
Paraonidae				
Paraonella platybranchia	9.60	7.87	0.80	
Phyllodocidae				
Eteone tuberculata	1.00	0.87	0.20	
Spionidae				
Polydora sp.		0.07		
Neridae		0.07		0.13
Neanthes sp.		1.00		
Unidentified Polychaeta	0.07		0.07	
Class Oligochaeta		3.53		0.07
Phylum Arthropoda				
Class Crustacea				
Gammaridae	1.67	0.20	0.67	
Haustoriidae				
Eohaustorius spp.	0.07	7.13		5.07
Corophidae				
Corophium spp.		0.27		
Order Cumacea		0.60		
Order Euphausiacea			0.13	
Class Insecta			0.13	
Chironomidae	0.07	0.07		
Phylum Mollusca				
Class Bivalvia				
Tellinidae				
Macoma balthica	5.00	2.13		
Macoma sp.	0.13			
Myidae				
Sphenia ovoidea	0.34	0.07		
TOTAL TAXA	10	14	7	4

Salmonid food organism abundance was compared for the four sampling areas, using mean numbers of crustaceans and insects combined (Table 2). Due to high variability in

Table 2. Mean number of salmonid food organisms per sample.

Sampling Area	Mean No. of Salmonid Food Organisms
Area 1	1.7
Area 2	8.3
Area 3	0.9
Area 4	5.1

the numbers of food organisms between observations within a given sample area, no significant differences were found between treatment means when tested by ANOVA. However, it is noteworthy that of the four areas, the mean number of organisms was lowest in sampling Area 3 adjacent to the eroding sandbank.

Figure 4 compares the four sampling areas with respect to mean number of taxa, mean number of organisms, and mean number of salmonid food organisms. Sampling Area 3 near the eroding bank had relatively low values for all three parameters.

Mean numbers of ghost shrimp holes per $0.1m^2$ are compared for the four sampling areas in Table 3. Sampling Areas 1 and 2 were located in extensive ghost shrimp beds as indicated by the counts. Very few ghost shrimp holes were present in the area sampled at sampling Area 3 and none were found in the areas sampled at sampling Area 4.

Qualitative Site Survey

During the May 19-20 sampling period, a visual inspection was conducted of the siltstone that was exposed in Sub-Area C1 between the eroding bank and the inner jetty. A substantial amount of siltstone had recently been exposed. The mild winter and spring coupled with unusually low winter and spring flows in the Siuslaw River resulted in minimal bank erosion at the Shelter Cove bluffs. Wave action on the intertidal area in front of the sand bank was apparently sufficient to wash away much of the sand which had previously covered the siltstone to a depth of 12 inches or more (Ternyik pers com. August 2001). With the exception of a few snails and hermit crabs, the siltstone was essentially devoid of macroinvertebrates (Photo 5). Historic use of the siltstone by burrowing clams was apparent, as there were many abandoned holes in the siltstone.

Further out in Area C, beyond the jetty, a small outcropping of siltstone that has remained exposed during the past ten years or more was inspected by Wilbur Ternyik on July 22, 2001 during a minus tide. Two species of piddock clams were found in this area—the Rough Piddock (*Zirphaea pilsbryi*) and the Flat-tip Piddock (*Penitella penita*). Clam diggers were digging Rough Piddock from the exposed area during Mr. Ternyik's visit (Photo 6). Photo 7 illustrates the large size of the Rough Piddocks found at this site.

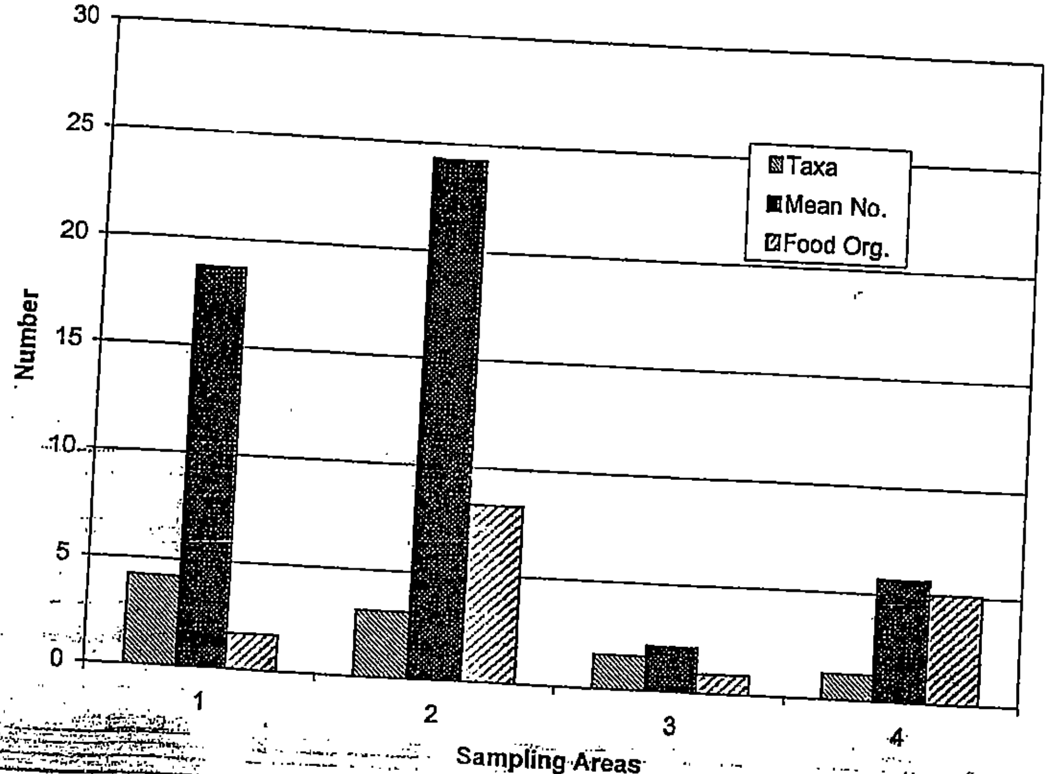

Figure 4. Mean numbers of benthic macroinvertebrate taxa, mean numbers of organisms, and mean numbers of salmonid food organisms by sampling area.

Table 3. Mean number ghost shrimp (*Neotrypaea californiensis*) holes per 0.1 m^2 in each sampling area.

Sampling Area	**Mean Number of Holes**	**Range**
Area 1	4.1	2-7
Area 2	8.5	0-25
Area 3	0.3	0-3
Area 4	0.0	NA

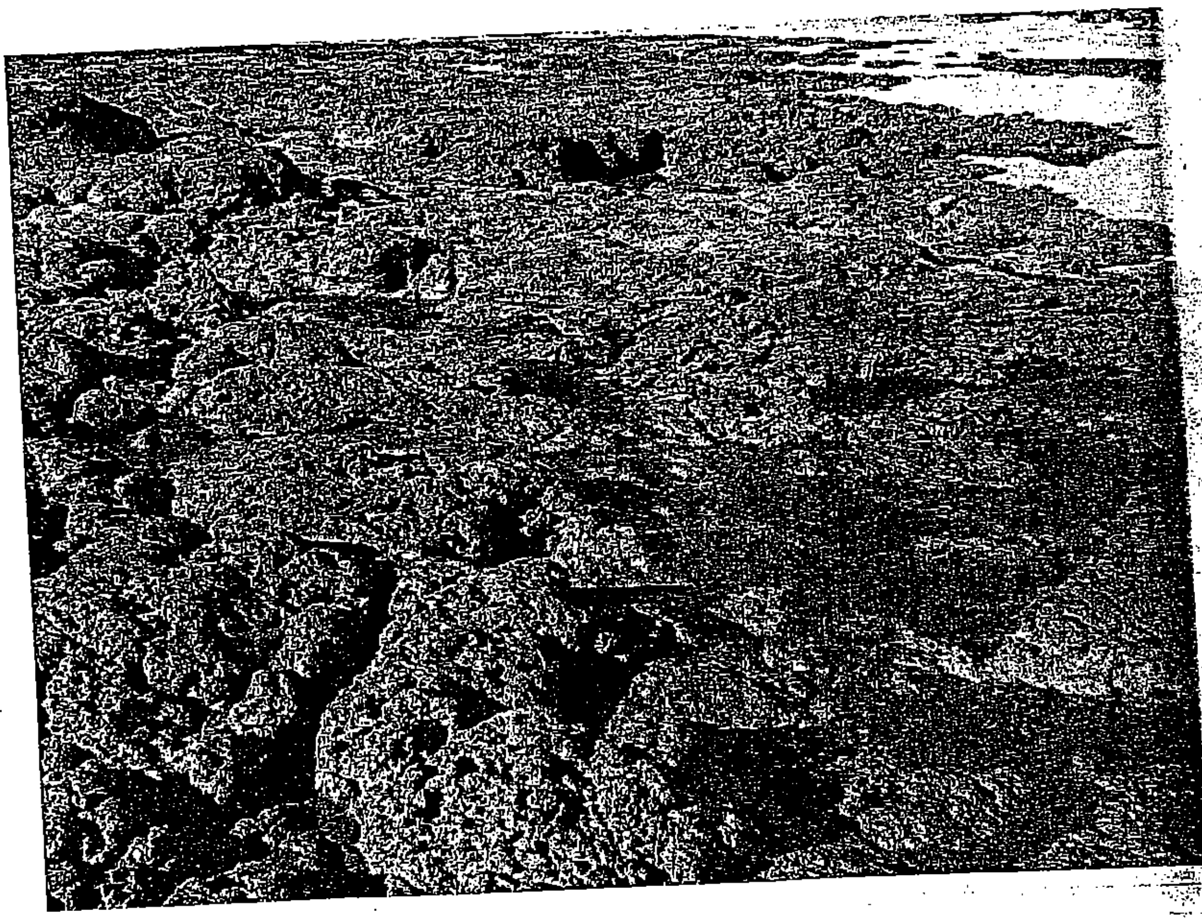

Photo 5. Recently exposed siltstone outcroping within Sub-Area C1.

Photo 6. Area C on outside of jetty in July 2001. Clam diggers were digging piddock clams on an area of the siltstone that has been exposed for ten years or more. Most of the siltstone in the foreground was covered with sand until the spring and summer of 2001 (Photo provided by W. Ternyik).

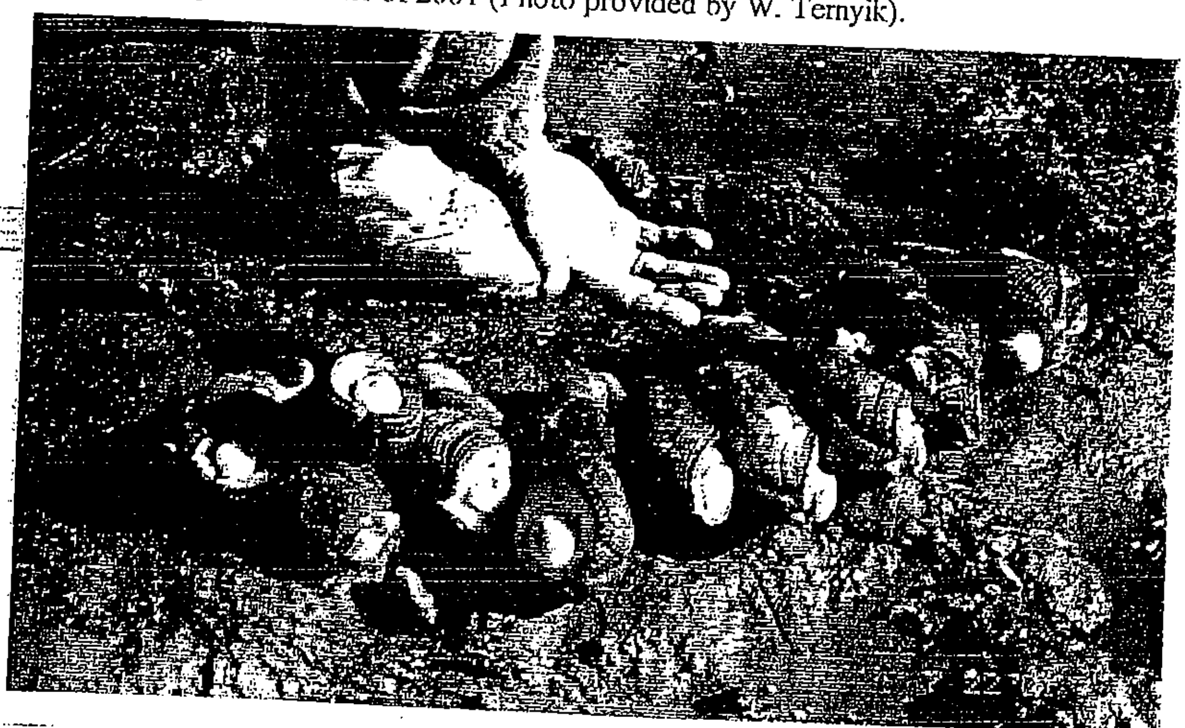

Photo 7. Large Rough Piddock clams collected by clam diggers from Area C during a minus tide in July 2001(Photo provided by W. Ternyik). These clams were buried about two feet in the siltstone substrate.

These clams were at a depth of about two feet in the soft siltstone. According to Mr. Ternyik, other nearby areas of siltstone that had been covered by sand until recently, were devoid of clams. These areas had supported piddock clams prior to being covered by sand from the eroding Shelter Cove bluffs. Note that the sandy area riverward from the exposed siltstone (Photo 8) also is underlain by siltstone and was exposed before the bank erosion began to accelerate (Ternyik pers. com. August 2001).

The rapid exposure of the siltstone outcroppings on both sides of the jetty during the spring and summer of 2001 appears to be directly related to a large reduction in the rate of erosion at the Shelter Cove bluffs. As discussed above, the winter of 2000-2001 was unusually mild and flow conditions in the river were exceptionally low. Erosion of the exposed sandbanks was much lower than it had been in the recent past. The absence of this nearby source of sand, apparently allowed tidal currents and wave action to erode away much of the sand shoal that had covered the siltstone outcrop. It is anticipated that as normal winter conditions return, the siltstone will again be covered by shoaling sand derived from the eroding bluffs. Any piddock clams or other invertebrates that have colonized the siltstone in the interim will be buried by the sand. The unusual weather conditions that prevailed during the winter of 2000-2001 clearly demonstrated how quickly the area would recover if the bank erosion could be prevented.

During the qualitative survey of the study area on May 20, we noted that harbor seals were using the sand beach at the far north end of the inner jetty as a haul out site. Both adult and juvenile seals were observed. This same site was identified as a seal haul out area in the Wilsey & Ham (1978) report.

Eelgrass beds were identified as being an important habitat component of Area C in the original planning document. However, we saw no evidence of eelgrass in either Sub-Area C1 or those portions of Area C that were exposed at low tide during the May 20 qualitative site survey.

DISCUSSION

Sandy substrates containing the ghost shrimp *Neotrypaea sp.* generally have relatively low densities of benthic organisms and relatively few species compared to more stable estuarine environments such as eelgrass beds (Jones et al 1997). This is because ghost shrimp continually rework the upper layers of the substrate, displace, and bury other benthic organisms. Sampling Areas 1 and 2 contained moderate to high densities of ghost shrimp while sampling Areas 3 and 4 contained few or no ghost shrimp. The number of taxa and the density of benthic organisms in the upper 5 cm of the substrate in sampling Areas 1 and 2 were lower than normally would be expected in similar *Neotrypaea* beds in other estuaries. Wide annual fluctuations in salinity in the Siuslaw River estuary may account for the relatively low abundance and diversity of benthic organisms in these sampling areas. Since the numbers of taxa and total numbers of organisms were significantly lower in sampling Areas 3 and 4 where *Neotrypeae* were not abundant, other factors appear to be causing stress in these areas.

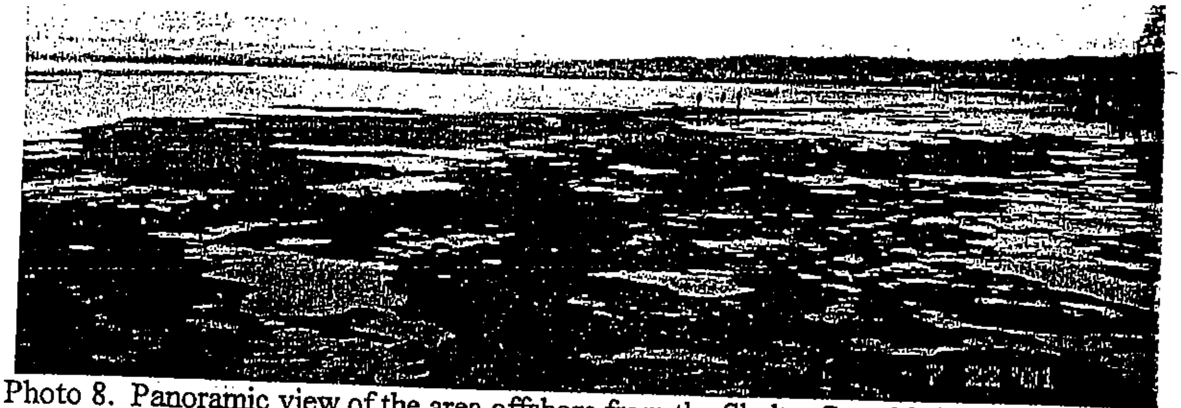

Photo 8. Panoramic view of the area offshore from the Shelter Cove bluffs (Photo provided by W. Ternyik). This entire area was historically a large expanse of exposed siltstone with estensive piddock clam beds.

The very low numerical abundance and species richness at Sub-Area C1 (Sampling Area 3) can be attributed, in part, to the highly unstable substrate conditions associated with erosion from the adjacent sand bluffs. Even though bank erosion during the previous winter and spring had been low, the sandy area between the bank and the inner jetty showed signs of recent sand input from the bank. The sandy substrate in this area also has undergone erosion due to wave action. Therefore, the combination of supplementation of sand from the bank and erosion due to wave action makes this area a very unstable substrate for benthic macroinvertebrates.

Another factor that probably contributed to the low abundance and low taxonomic diversity of Sub-Area C1 was the apparent low organic content of the sand at this site. When washing the samples through the 0.5mm mesh screen, it was apparent that there was very little organic detritus in the samples compared with the other sites. Organic detritus is an important food source for many benthic macroinvertebrates.

We also noted during collection of the samples from Sub-Area C1 that freshwater seeps were present along most of the exposed base of the sand bluffs. The freshwater seepage into the sandy substrate probably contributes additional stress on the estuarine and marine benthic organisms that potentially could colonize the area.

Area B also had very low densities of benthic macroinvertebrates and low numbers of taxa. This finding is in general agreement with previous observations made by the Aspen Group (1980) and with a benthic survey conducted by the U.S. Fish and Wildlife Service (USFWS) in 1978. Table 4 lists the benthic macroinvertebrate taxa found in the area in USFWS survey. The invertebrates collected indicated a wide range of salinities and substate types (e.g., razor clams and soft-shell clams). The Aspen Group only observed ghost shrimp and several unidentified polychaetes during his 1980 survey. They noted that "the intertidal area does not constitute a biological desert but, in my opinion, because of the diversity of substrate types and apparent salinity variation it does not constitute a major clam producing area or area of critical wildlife habitat". They concluded that the natural resource value of Area B did not warrant a natural classification and that a conservation classification was more appropriate. Area B was subsequently classified as a conservation district.

Most of the information upon which the natural classification for Area C was based was derived from a Coastal Resource Inventory for the Siuslaw River Estuary prepared by Wilsey & Ham (1978). The inventory was primarily a compilation of information existing at that time. The small scale of the mapping and limited data available for the estuary were not sufficient to separate out small areas such at Sub-Area C1 from the broad generalizations of the inventory. As described above, Sub-Area C1 has an extremely low abundance of benthic organisms, few of which could be utilized as food by juvenile salmonids. The sandy substrate in Sub-Area C1 is unstable, contains low quantities of organic detritus, and varies widely in temporal salinity conditions. The siltstone outcrop within Sub-Area C1 is frequently covered by sand eroded from the Shelter Cove bluffs. The sand smothers piddock clams and other organisms that require the stable substrate of the siltstone. No eelgrass was found in Sub-Area C1 and none is likely to colonize the area as long as bank erosion continues. Based on these results, we conclude that the criteria used to classify Area C as a natural management district are not present in Sub-Area C1 and that inclusion of Sub-Area C1 in Area B (zoned conservation) would be consistent with previous zoning of the area.

Table 4. Benthic macroinvertebrates found in Area B in 1978 by the USFWS (from Aspen Group 1980)

Common Name	Scientific Name
Molluscs	
Macoma clam	*Macoma balthica*
Macoma clam	*M. inquinata*
Razor clam	*Siliqua patula*
False mya	*Cryptomya californica*
Softshell clam	*Mya arenaria*
Worms (Annelida)	Various species of large and small unidentified worms (probably mostly polychaetes)
Crustaceans	
Mud shrimp	*Upogebia pugettensis*
Ghost shrimp	*Callianassa californiensis* (now *Neotrypaea*)
Dungeness crab	*Cancer magister*
Yellow shore crab	*Hemigrapsus oregonensis*

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APPENDIX A. PHOTO LOG

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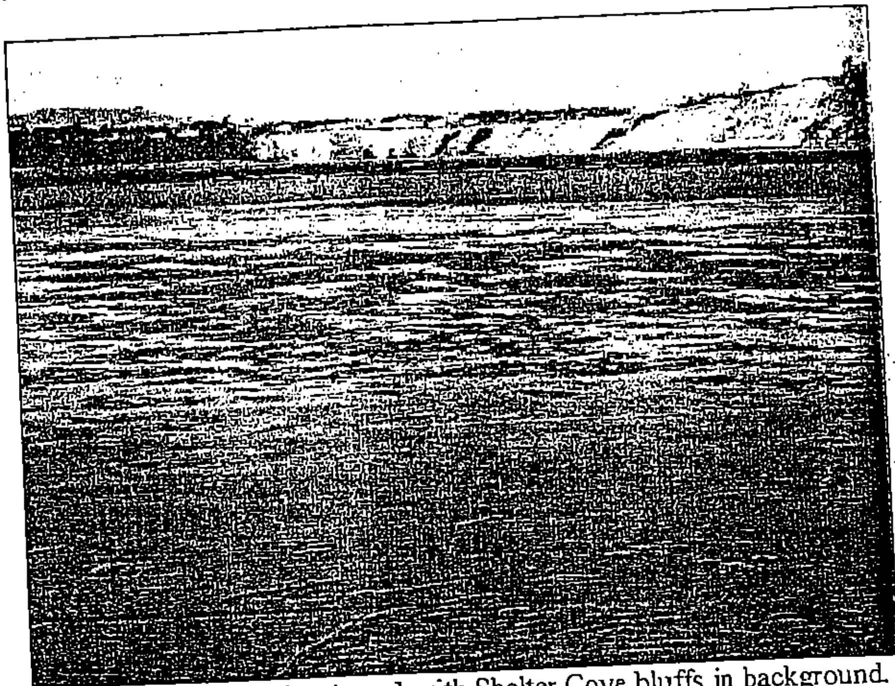
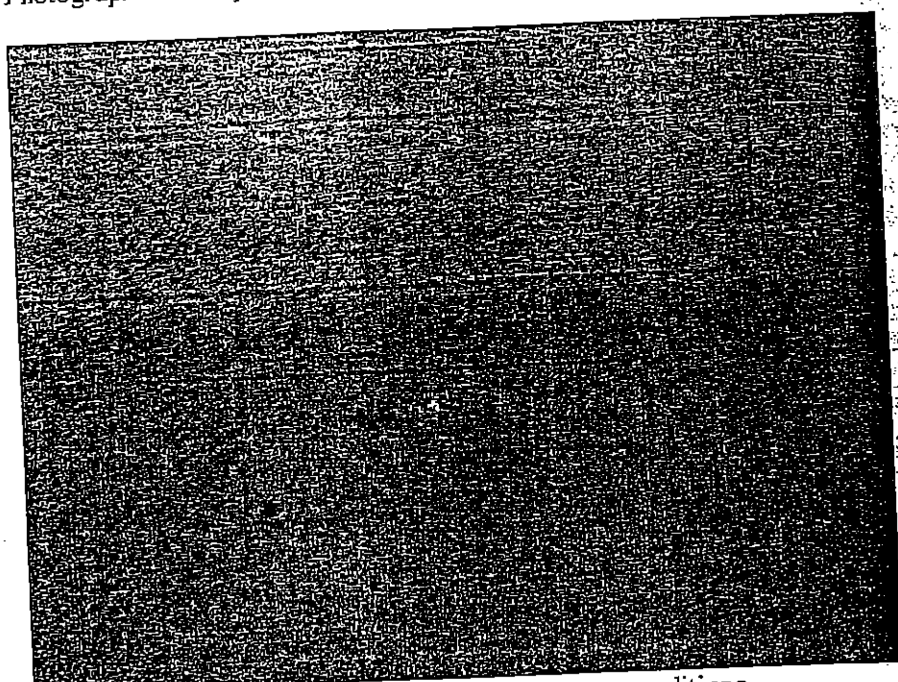
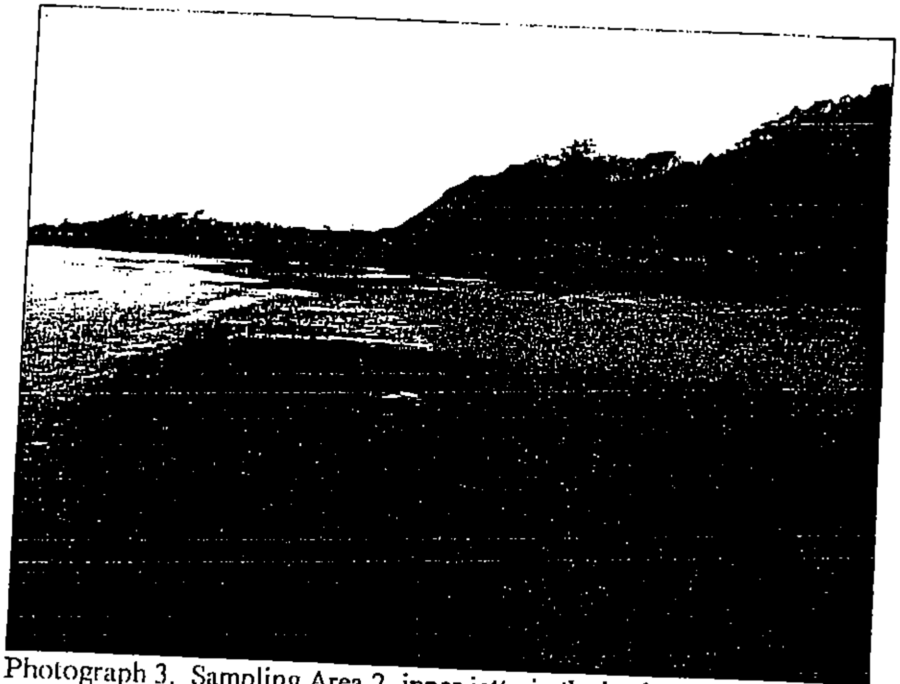
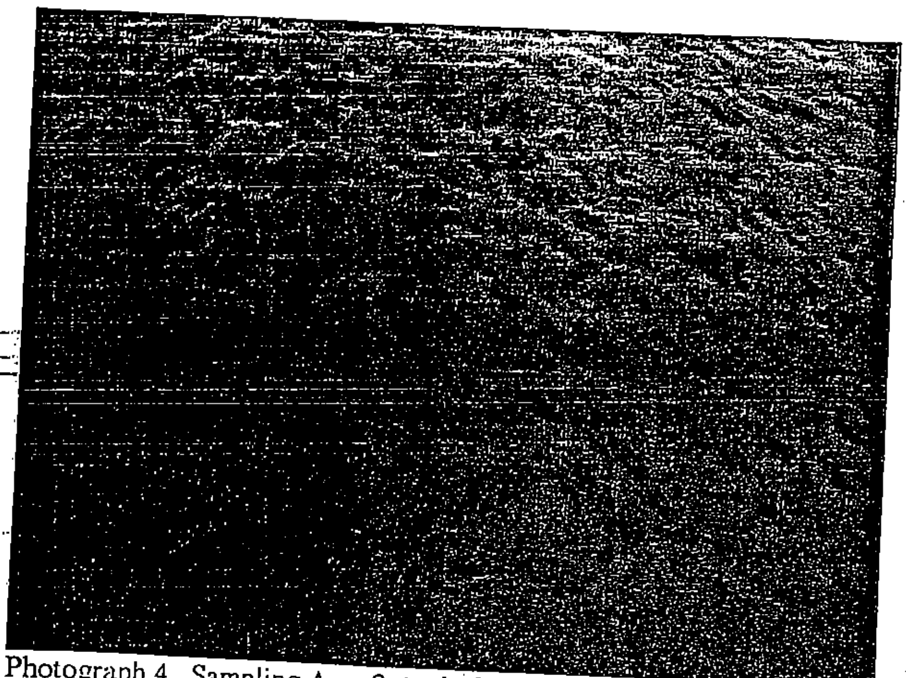


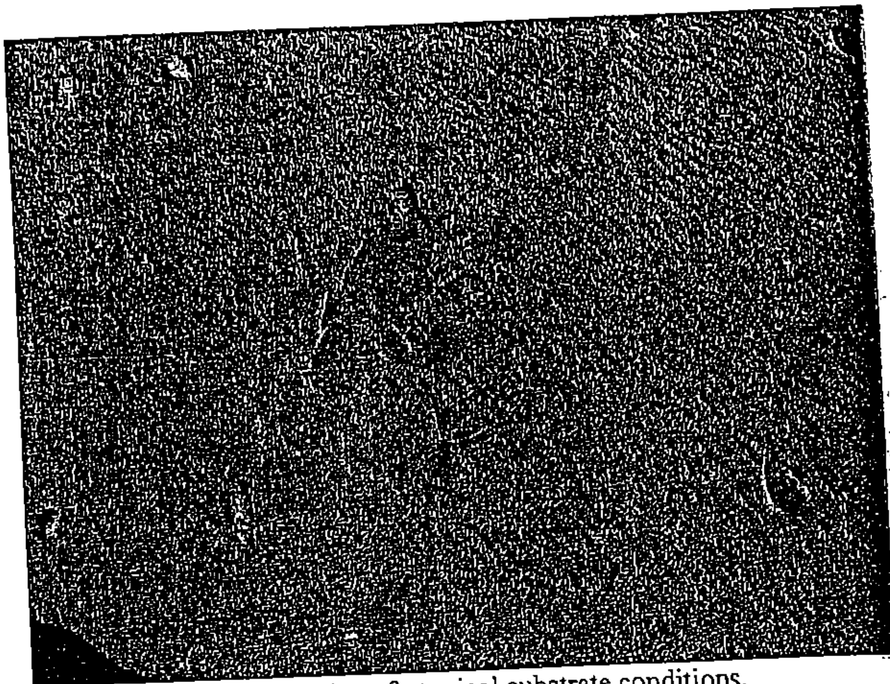
Photograph 1. Sampling Area 1 with Shelter Cove bluffs in background.



Photograph 2. Sampling Area 1, typical substrate conditions.

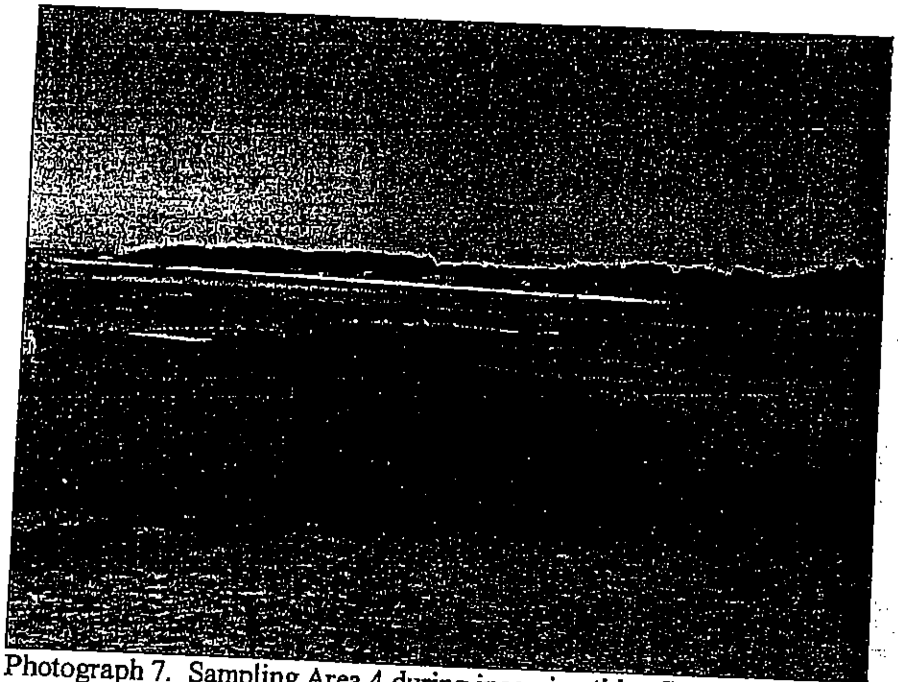

Photograph 3. Sampling Area 2, inner jetty in the background.


Photograph 4. Sampling Area 2, typical substrate conditions.



Photograph 5. Sampling Area 3, typical substrate conditions.

Photograph 6. Sampling Area 3, near base of eroding bluffs.



Photograph 7. Sampling Area 4 during incoming tide. Samples were collected beyond the log in foreground.

APPENDIX B. BENTHIC MACROINVERTEBRATE SAMPLE DATA

Table 1. Benthic macroinvertebrates collected from Area 1.

Taxa	Sample Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phylum Nemertea				1		1	2	1	1	1	1	1	1		1
Phylum Annelida															
Class Polychaeta															
Paraonidae															
Paraonella platybranchia	11	15	9	2	20	10		15	7	12	14	11	7	2	9
Phyllodocidae										1	2		1	2	2
Eteone tuberculata		2	1	3		1									
Unidentified sp.		1													
Phylum Arthropoda															
Class Crustacea											8	1		6	
Gammaridae	4				2	2		2							
Haustoriidae													1		
Eohaustorius spp.															
Class Insecta							1								
Chironomidae															
Phylum Mollusca															
Class Bivalvia															
Tellinidae								5		6	8	2	6	4	1
Macoma balthica	8	2	11	7	6	2	7	2							
Macoma sp.												2	1		
Myidae	1											2	1	1	
Spheria ovoidea	1														
Total Number	24	21	21	13	28	16	10	28	8	20	33	15	17	15	12

Table 2. Benthic macroinvertebrates collected from Area 2.

Taxa	Sample Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phylum Nemertea	1														
Phylum Annelida					2	1			1	2					
Class Polychaeta															
Paraonidae															
Paraonella platybranchia	25	71			9			1		2		10			
Phyllodocidae															
Eteone tuberculata	1		3		6	1				1		1			
Spionidae															
Polydora sp.															
Nereidae			1							1					
Neanthes sp.															
Unidentified sp.											15				
Class Oligochaeta			1		9										
Phylum Arthropoda												1	31	10	1
Class Crustacea															
Gammaridae															
Corophidae													3		
Corophium spp.															
Haustoriidae															
Eohaustorius spp.		3							1	1		2			
Order Cumacea						2	83			4		14			
Class Insecta									9						1
Chironomidae		1													
Phylum Mollusca															
Class Bivalvia															
Tellinidae															
Macoma balthica	1			3	17										
Myidae								1			1	3		1	5
Sphenia ovoidea					1										
Total Number	28	75	5	3	44	4	83	2	11	11	16	31	34	11	7

Table 3. Benthic macroinvertebrates collected from Area 3.

Taxa	Sample Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phylum Nemertea				1			1								
Phylum Annelida															
Class Polychaeta															
Paraonidae															
Paraonella platybranchia		3				1	1	1	1		2				3
Phyllodocidae															
Eteone tuberculata									1			1		1	
Unidentified sp.														1	
Phylum Arthropoda															
Order Euphausiacea												1	1		
Class Crustacea															
Gammaridae	1						2	4	1				1		1
Order Diptera													1	1	
Total Number	1	3	0	1	0	1	4	5	3	0	2	2	3	3	5

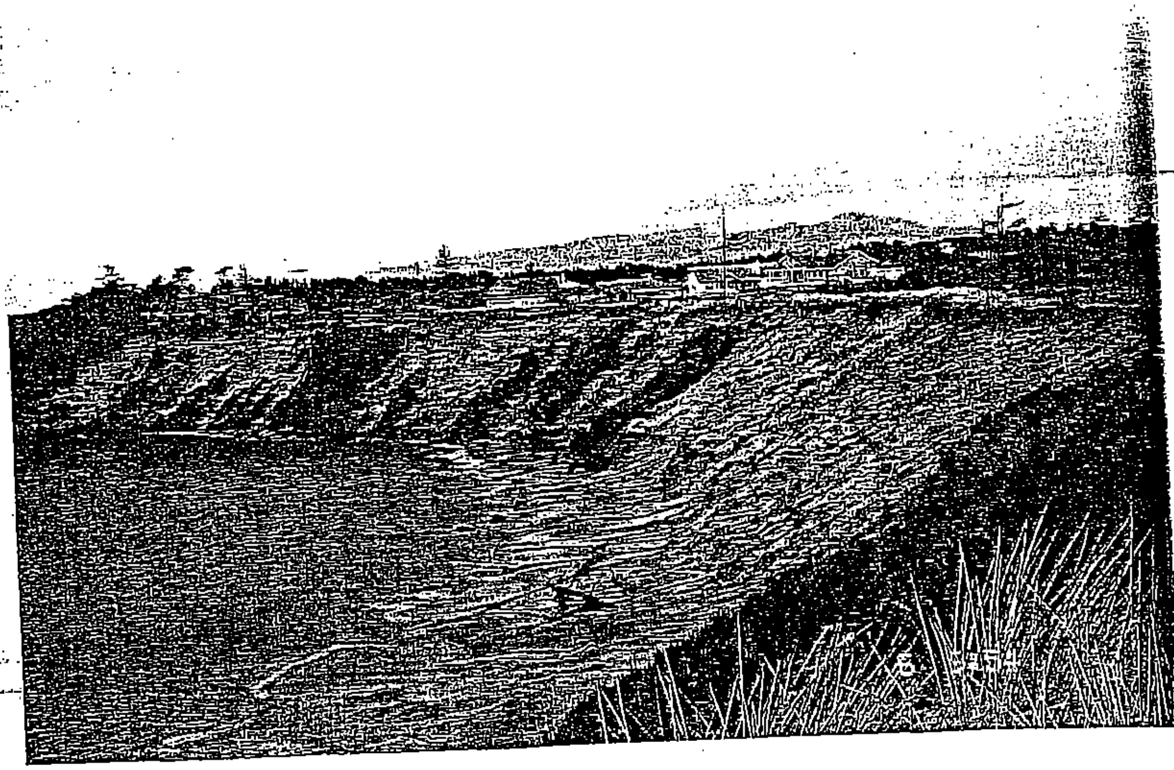
Table 4. Benthic macroinvertebrates collected from Area 4.

Taxa	Sample Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Phylum Nemertea			1				1	1	3	1					1
Phylum Annelida															
Class Polychaeta															
Neridae									2						
Class Oligochaeta													1		
Phylum Arthropoda															
Class Crustacea															
Haustoriidae															
Eohaustorius spp.	2	2		14	12		1	19	1	1		12	1	5	6
Total Number	2	2	1	14	12	0	1	20	6	2	0	12	2	5	7

SHELTER COVE SUBDIVISION - HISTORIC EROSION REPORT

LOWER SIUSLAW ESTUARY

FLORENCE, OREGON



PREPARED BY: WILBUR E. TERNYIK
WETLAND, BEACHES & DUNES CONSULTANT
P.O. BOX 1190
FLORENCE, OREGON 97439

NOVEMBER 2001

Exhibit G

INTRODUCTION

This riverfront erosion report was prepared at the request of James Hurst, the developer and owner of Shelter Cove real estate subdivision in Florence, Oregon. The purpose of the report is to provide a photo record of the ongoing and historic erosion in what is designated as the north area (Exhibit 1).

The photo record section coupled with the lower estuary biological study gives vivid illustrations of the ever increasing bank erosion and the danger it poses to the lower estuary natural values. In addition the very near future threat to homes and lives of those living north to this area of the subdivision. Both reports will be submitted to the City of Florence for their consideration as they update the City of Florence Comprehensive Land Use Plan for submittal to the Land Conservation & Development Commission (LCDC). Factual written and photographic documentation as justification for the need to change the zoning between the deteriorated jetty to the Shelter Cove bank from Natural to Conservation. This change would make the near-shore zoning consistent with both upstream and downstream adjoining riverfront areas.

Following the photographic section is a section covering historical written materials by both the owner, James Hurst, his consultant Wilbur Ternyik, Lane County, City of Florence and the Corps of Engineers (COE). The most important of which is the Corps of Engineers report of January 9, 1990. This report was in response to a request for a Section 111 Study to determine possible COE funding. Both Lane County and the City of

Florence offered to act as the required local government sponsors. There would be no cost to the sponsor.

Please note that this study report not only documents past rate of erosion and acres of land lost, but also estimates increased erosion rates and their future threats to home, life, and city infrastructures to the east. The same report as does others ask for a complete biological study of the lower estuary both inside and outside of the deteriorated jetty. The purpose being to establish the impact of the continued Shelter Cove erosion sand on the lower estuary natural values. Until this year no such comprehensive study documenting the impacts of the massive erosion sedimentation had been conducted. Mr. Hurst engaged Ellis Ecological Service to conduct the requested biological investigation report (a copy has been submittal).

By comparing the Ellis report with the COE predictions borne out by the past ten years of erosion, there is clear proof that significant loss of natural wildlife values occurs every year that the erosion problem is not corrected. It is important to note hat the COE report decision not to move forward with a Section 111 project was due to a deficit cost benefit ratio. This determination was based on a very low land value estimate before development of the subdivision and addition of homes.

Finally, we ask you to review two exhibits. The first exhibit, COE aerial map dated 1969 (Exhibit 2). Note the Authorized shipping channel location. Then look at photos #2 and #4 that shows the locations of the COE rock groins constructed on the west side of the river upstream and across from the Shelter Cove north erosion area. These groins direct the full force of the river and out going tide directly into the Shelter Cove shoreline area (North erosion area). The second review report (Exhibit 3) is from Lane County Public Works titled, "Lane County Rural Comprehensive Plan - Coastal Resources Management Plan." Page 1 illustrates mapping designation of the various elements present and zoning of various areas. Please note that the embayment below Shelter Cove has a B zoning of Conservation. In addition, the area upstream from Cannery Hill is also zoned Conservation. Our request is that the very small area to the east of the deteriorated jetty outlined in read be rezoned to Conservation, so that protective measures can be undertaken to afford permanent stoppage of the erosion problem and further estuarine natural values destruction.

We ask for serious consideration of this request be adopted into the current City of Florence Comprehensive Land Use Update. The COE made it plain that they would reconsider the Section 111 Project possibility if and when a complete lower estuary biological study was submitted and property values changed. The change of zoning will enable the process to move forward. Waiting five more years to the next update will result in five more years of massive erosion and lower estuary damage and not to mention channel-dredging costs.

Should there be any further information needed, please, contact me at (541)997-2401 or by fax (541)997-6069.

Wilbur E. Ternyik
Wetland, Beaches/Dunes Consultant

EXHIBIT 1

SHELTER COVE SUBDIVISION - HISTORIC EROSION REPORT

PHOTO SECTION

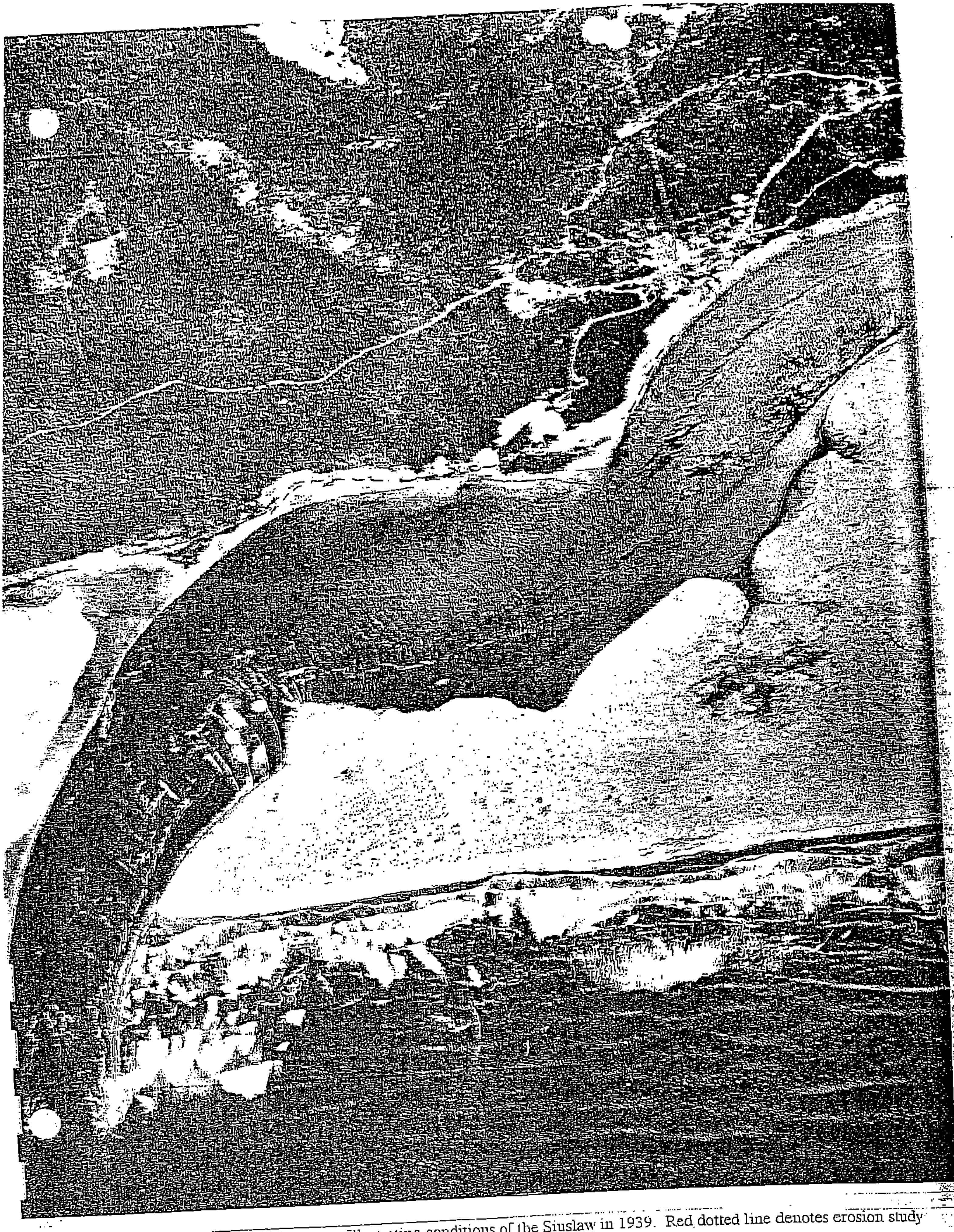


Photo 1 US Army Corps of Engineers photo - Illustrating conditions of the Siuslaw in 1939. Red dotted line denotes erosion study

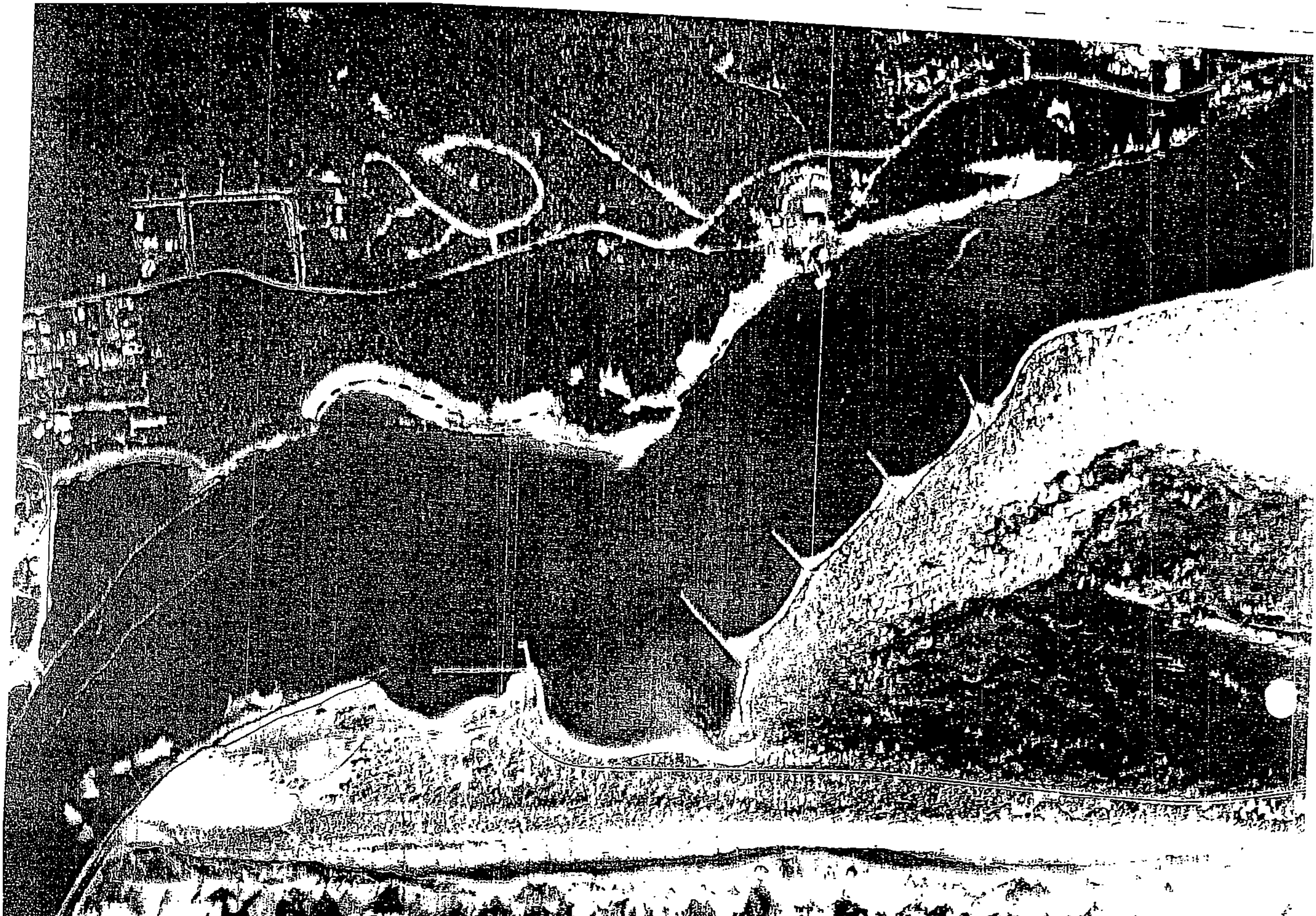


Photo 2 (Taken in 1991)

Lower Siuslaw River estuary, Lane County, Oregon. Shelter Cove sul [illegible] ision erosion areas outlined in red dotted line. Photo was taken before development. Note Corps of Engineers rock groins on wes. side of the river.

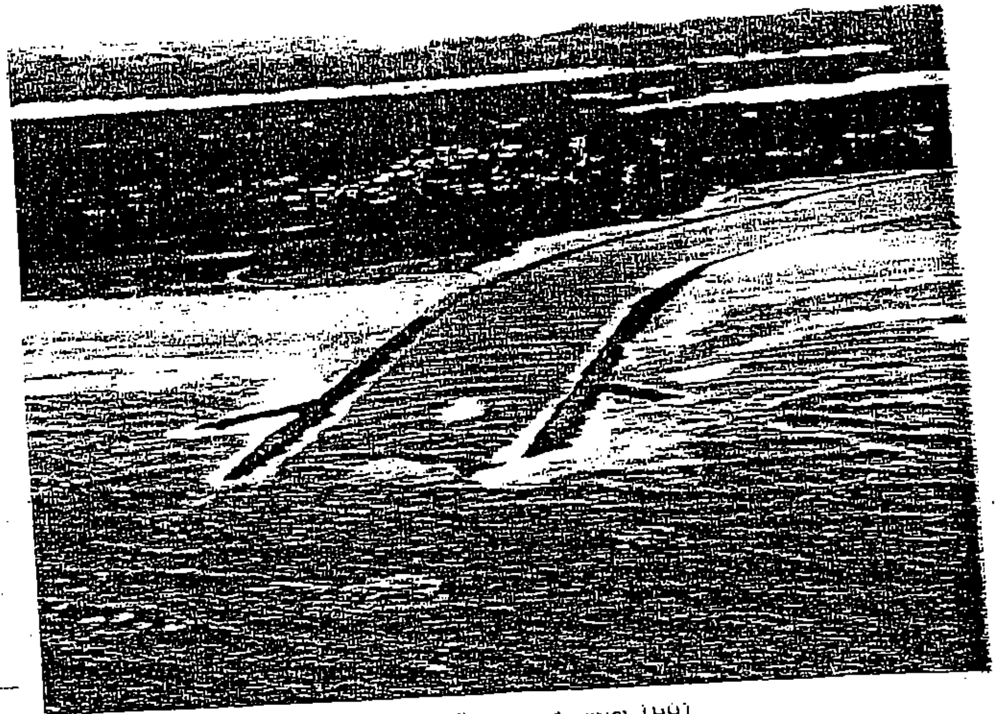


Photo 3 by Wilbur E. Ternyik August 1991

Aerial photo looking east at Siuslaw River entrance to lower bend of river. Entire lower stretch subject to off shore wave surge. Note eroded areas 1 and 2 north of deteriorated north jetty.

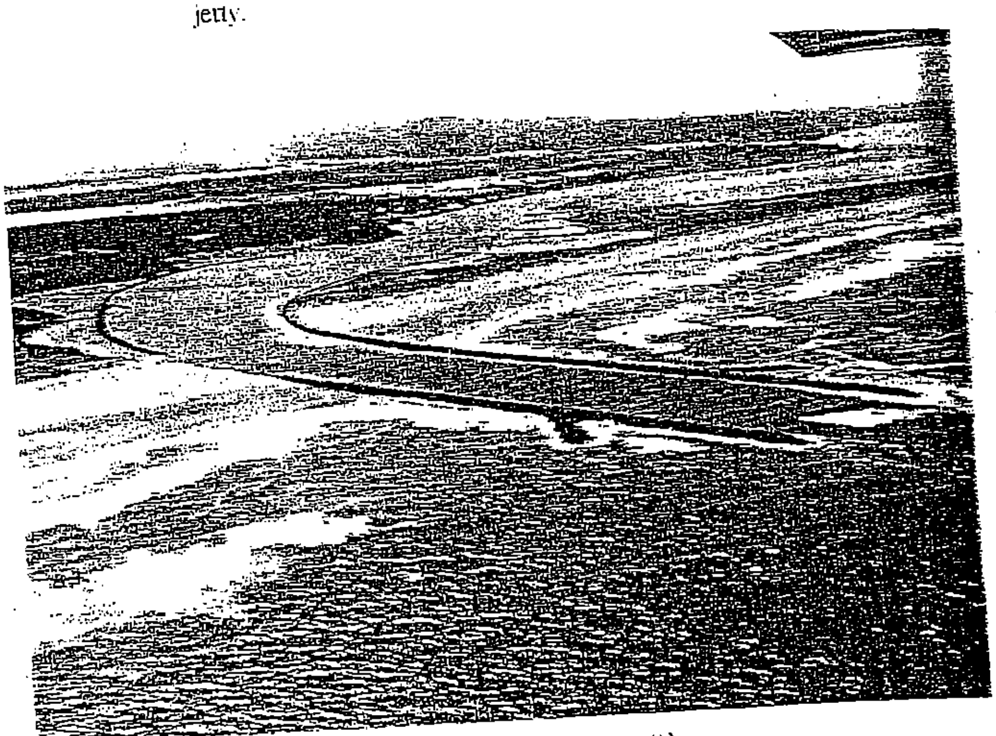


Photo 4 by Wilbur E. Ternyik August 1991

Aerial view looking southeast towards Hurst property erosion site (3). Note Corps of Engineers installed groins (4) on south side of river directing river channel flow to north bank. Erosion site subject to ocean storm wave surge and southwest winter waves over completely deteriorated jetty.

Photo 5 by Wilbur E. Ternyik August 1991

Location: North bank of the Siuslaw River looking east from deteriorated jetty. Note sand bank devoid of vegetation due to wave erosion at the base of the slope and wind erosion on the face. Planned Ammophila arenaria planting will stop the bank surface erosion.

Photo 6 by Wilbur E. Ternyik August 1991

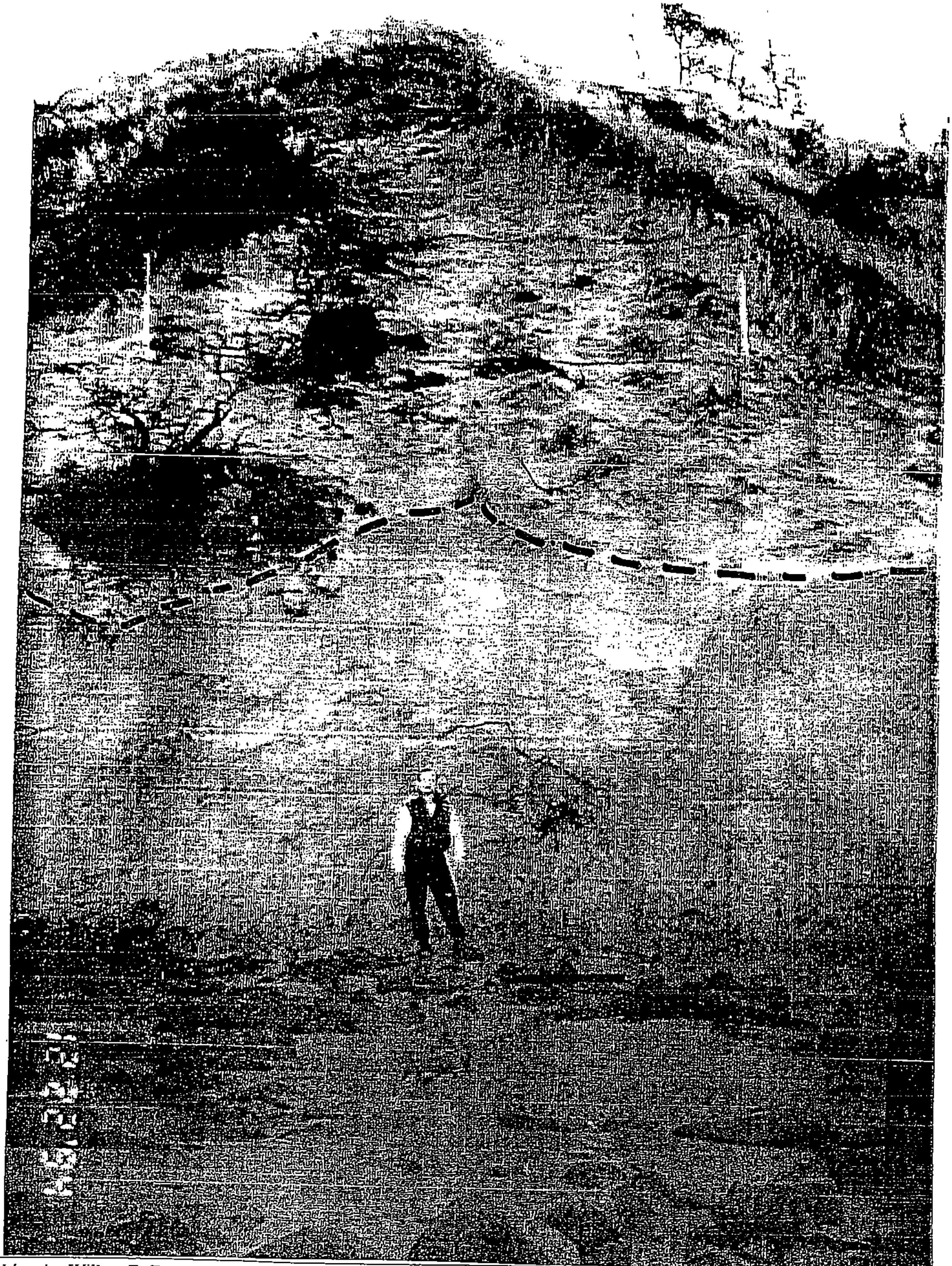
North bank of the Siuslaw River. Illustrating severe wind erosion and sloughing as a result of river erosion at the toe of the slope. Face of erosion slope is currently the Corps of Engineers property.

Photo 8 by Wilbur E. Ternyik 1992

Location: Shelter Cove, another illustration of the continued deterioration of the jetty.

hoto 7 by ilbur E. Ternyik 1992

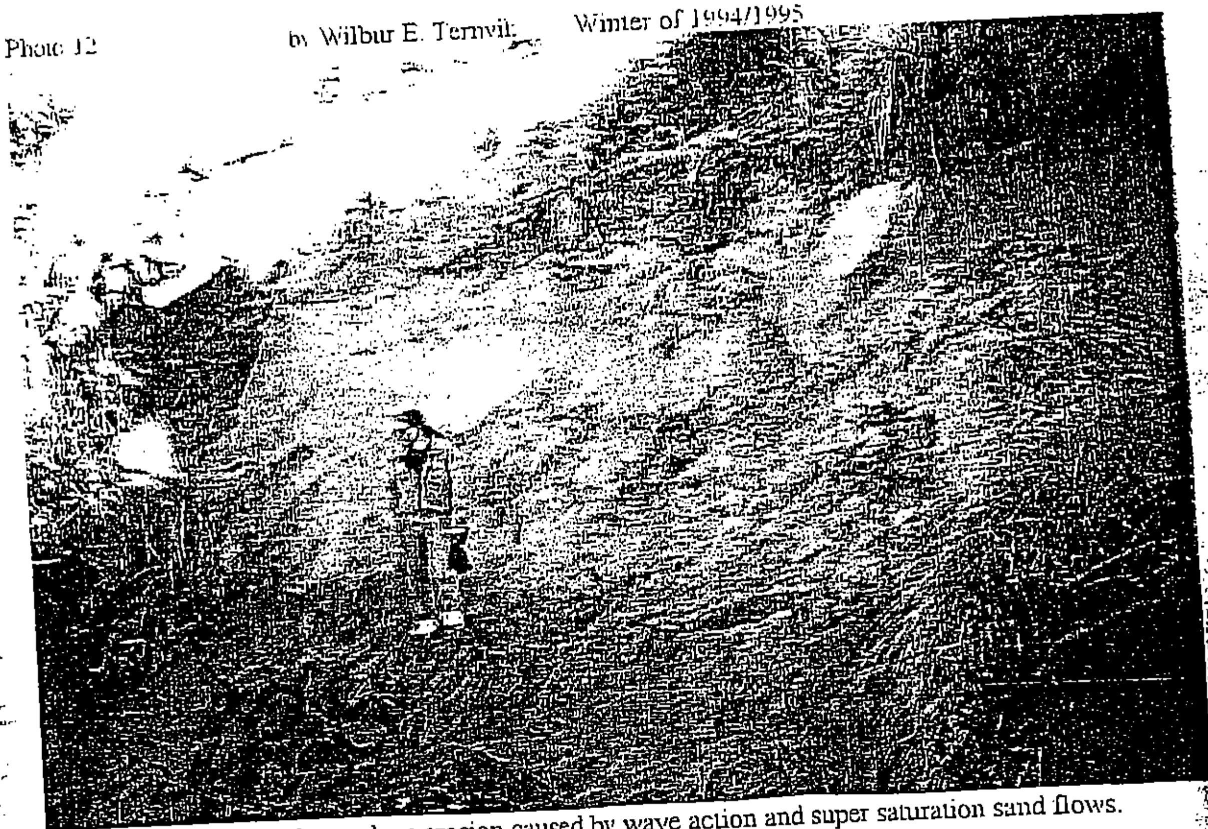
... north erosion area. Note massive erosion sand burial of tidal resources inside and outside of the deteriorated jetty.



to 14 by Wilbur E. Ternyik Winter 1994/1995

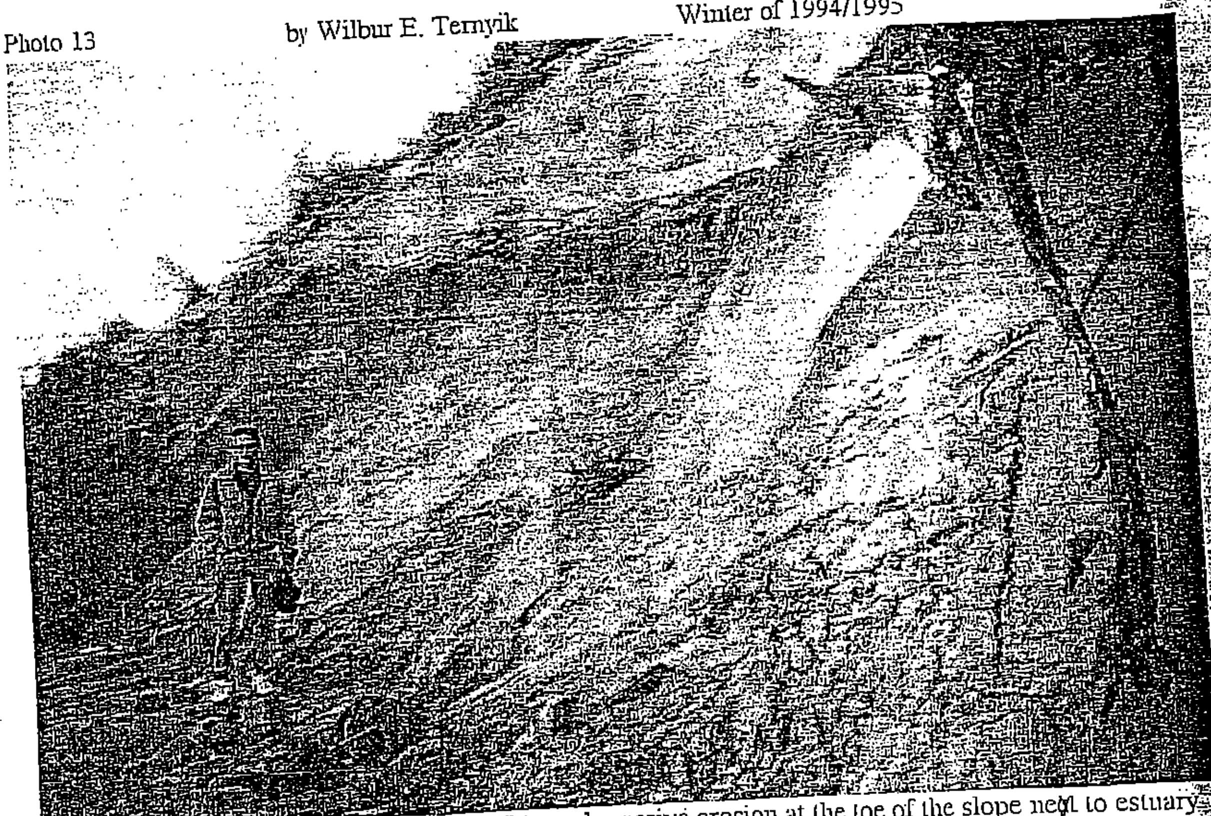
lter Cove, looking east at erosion slope fronting Lot 23. Note massive one-year erosion process caused by unprotected toe of the

Photo 12 by Wilbur E. Ternyik Winter of 1994/1995



Location: Shelter Cove lower slope erosion caused by wave action and super saturation sand flows.

Photo 13 by Wilbur E. Ternyik Winter of 1994/1995



Location: Shelter Cove, further evidence of annual massive erosion at the toe of the slope next to estuary shoreline.

Photo 16 by Wilbur E. Ternyik -Winter 1994/1995 - Shelter Cove, looking from deteriorated jetty to bank. Note loss of beachgrass planting shown by bare sand area after storm wave attack.

Photo 15 by Wilbur E. Ternyik - Winter 1994/1995 - Shelter Cove, again looking east at slope failure caused by storm wave attack to the toe of the slope.

SHELTER COVE EROSION

Winter Season - 1995/1996

SHELTER COVE EROSION

WINTER SEASON – 1998/1999

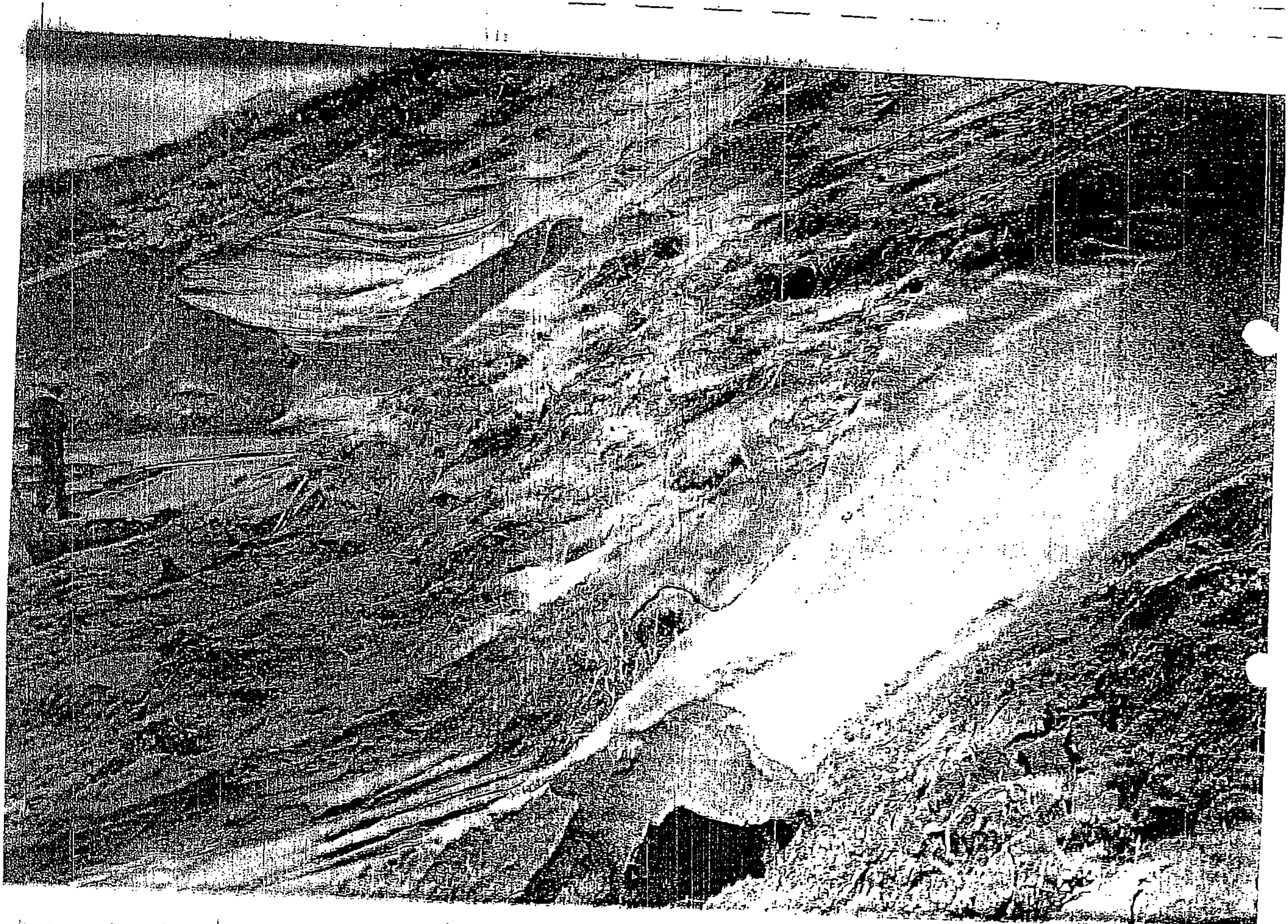


Photo 22 by Wilbur E. Ternyik Winter 1998/1999
Shelter Cove, with Matt Ternyik surveying the massive ongoing sl ailure. Caused by super saturation and wave erosion of the toe of
the slope

Photo 21 by Wilbur E. Ternyik Winter 1998/1999 … and beachgrass planting shown by bare sand area after storm waves.

Photo 21 by Wilbur E. Ternyik Winter 1998/1999 [illegible] grass planting shown by bare sand area after storm waves.

SHELTER COVE EROSION

Winter Season - 1992/1993