AN INVESTIGATION OF SOCKEYE EGG SURVIVAL IN BABINE LAKE

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1.0 INTRODUCTION

Babine Lake, located in west central British Columbia (Figure 1), is the largest lake flowing into the Skeena River. Annual returns of sockeye salmon (*Oncorhynchus nerka*) to the Skeena system have averaged 2.5 million fish annually from 1973 -1986. Babine Lake stocks account for 95% of the sockeye in the Skeena system (West and Mason, 1987). Enhancement efforts for sockeye in Babine Lake have focused on increasing suitable spawning habitat. To this end two spawning channels were constructed at Fulton River (Figure 1); the first completed in 1965 and the second in 1971. Another spawning channel was constructed in 1968 at Pinkut Creek, southeast of the Fulton River. The Fulton and Pinkut channels now account for about 50% of sockeye spawners returning to the Skeena River (West and Mason, 1987). The number of spawners in these channels is controlled by a counting fence which is closed when optimal spawner density is achieved. In recent years the number of returning sockeye has been greater than the capacity of the spawning channels and "surplus" fish are forced to spawn below the counting fence and along the nearshore of Babine Lake at the mouth of the Fulton River.

The egg-to-alevin survival of these "surplus" sockeye is not known. This information is important in order to make decisions regarding the potential for harvesting "surplus" sockeye. In addition anecdotal records of sockeye salmon spawning in Babine Lake exist from the mid-1960's, prior to the completion of the Pinkut and Fulton spawning channels. These records consist mostly of gill net catches of ripe sockeye in shallow, nearshore waters of the lake during late fall, after most spawners had moved into the lake tributaries. H.D. Smith's journal entries for 1962 indicate that divers observed redds at Red Bluff Point (C. Wood, pers. comm.). These redds

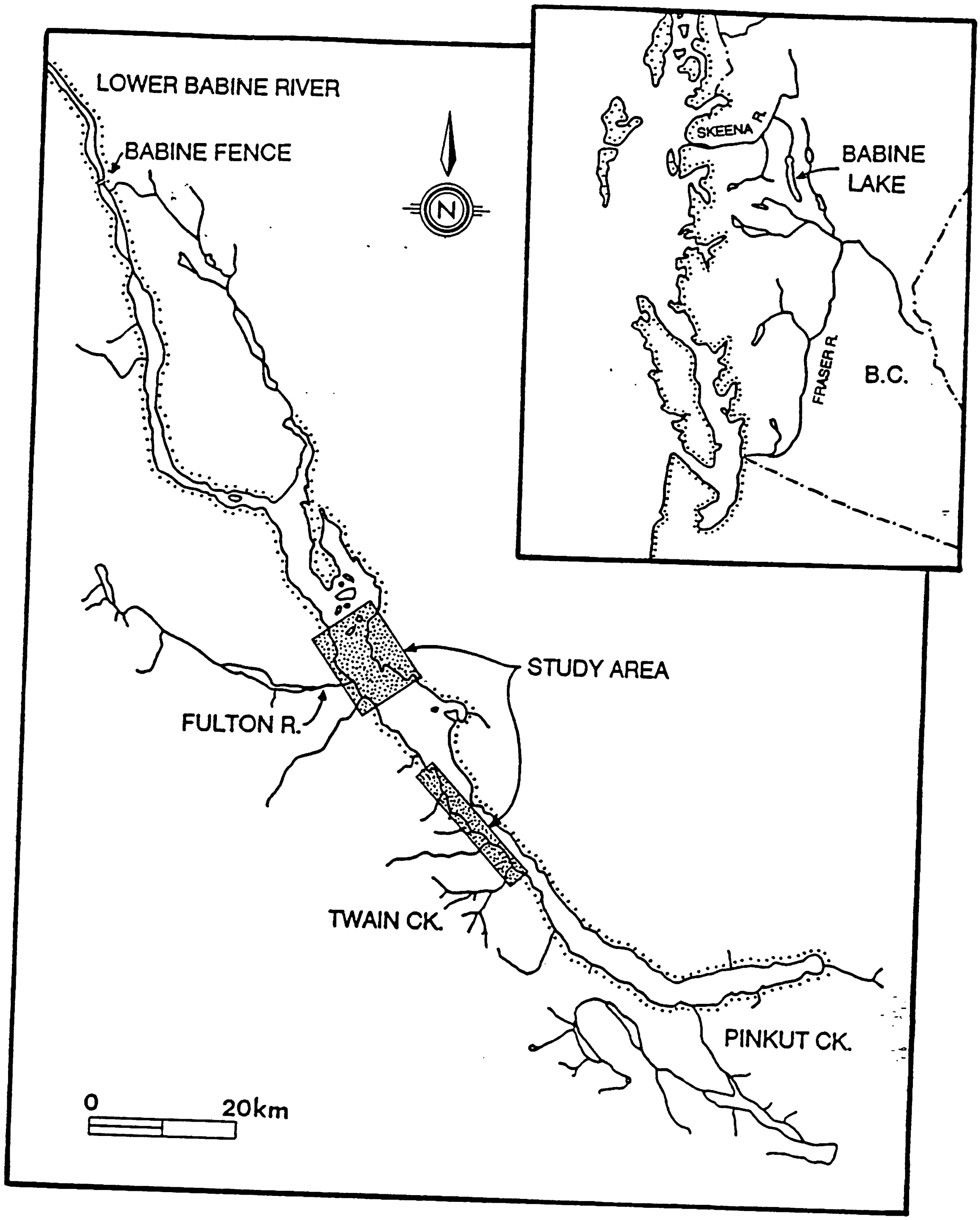


Figure 1. Location of the study area for the Babine Lake sockeye program.

were presumed to be sockeye redds as sockeye were observed, but many lake char (*Salvelinus namaycush*) were also seen in the area. Apparently no eggs could be collected from these redds.

In the fall of 1990 a possible sockeye spawning site in Babine Lake was identified near Wilkinson Bay, directly across from the Fulton River (Wood, pers. comm.). Gill nets placed at Wilkinson Bay in late October, 1990, caught both ripe and spawned out sockeye as well as lake char. The clean gravel/cobble substrate appeared suitable for spawning and egg incubation. Field investigations at a number of sites in Babine Lake were planned for the winter of 1991/92 to investigate egg-to-alevin survival of Fulton river sockeye, "surplus" sockeye from the Fulton River and lake spawning sockeye. In addition, surplus sockeye spawners from the Fulton River were to be tagged for subsequent identification by divers at lake spawning sites. The location and characteristics of the lake spawning habitat were to be described and the spawning sites marked so that eggs could be sampled in spring to assess overwintering survival.

In 1991 the number of sockeye returning to the Fulton River did not exceed the capacity of the spawning channels and, thus, a "surplus" sockeye population was not generated (S. Barnetson, pers. comm.). In addition, preliminary observations by divers at Wilkinson Bay did not confirm the presence of spawning sockeye, even though ripe sockeye were caught in gill nets. As a consequence of these observations the general objectives of the 1991/92 field program were revised as follows:

1. Characterize and map the shallow water nearshore habitat of Babine Lake in the vicinity of Fulton River and assess the value of this habitat for spawning sockeye, particularly with respect to egg survival.

2. Assess egg-to-alevin survival of eyed sockeye eggs from fish taken from the Fulton River when incubated in a range of substrates at two sites in Babine Lake. To compare these survival rates with those of eyed eggs incubated in the Fulton River spawning channels.

3. Identify important physicochemical parameters (eg. substrate composition and dissolved oxygen levels within substrate) which could affect egg to alevin survival.

4. Monitor water temperature on a continuous basis over the winter at the sites of egg incubation.

2.0 STUDY AREA & METHODS

2.1 General Study Area

The study area encompassed the eastern and western shorelines of Babine Lake in the vicinity of Fulton River as well as an 18 km section of the western shoreline of the lake 15 km south of the Fulton River (Figure 1). Nearshore habitat surveys were carried out from Red Bluff to Tachek Island (Figure 2), and from Long Island to Char Point (Figure 3). South of Fulton River, habitat surveys were carried out from Sandspit to Twain Creek (Figure 4).

On the basis of these habitat surveys and previous observations, two sites (Wilkinson Beach and Long Island; Figure 3) were selected for outplanting sockeye eggs. These two sites showed the widest range of substrate habitat, including the best egg incubation habitat observed in Babine Lake (Section 3.2).

2.2 Habitat Surveys

The purpose of the habitat surveys was to assess the suitability of the nearshore substrate as spawning and egg incubation habitat for sockeye. Divers swam transects perpendicular to shore recording habitat zones based on the following classification criteria:

Habitat A. Several layers of gravel or cobble substrate over sand or silt substrate. Very little sand or silt within the interstitial spaces of the cobble or gravel.

Habitat B. Gravel and/or cobble substrate mixed with sand or silt. Most interstitial space between the larger substrate filled with sand or silt.

Habitat C. Sand or silt with little, if any, larger substrate.

The divers recorded dominant substrate, width and depth for each habitat zone.

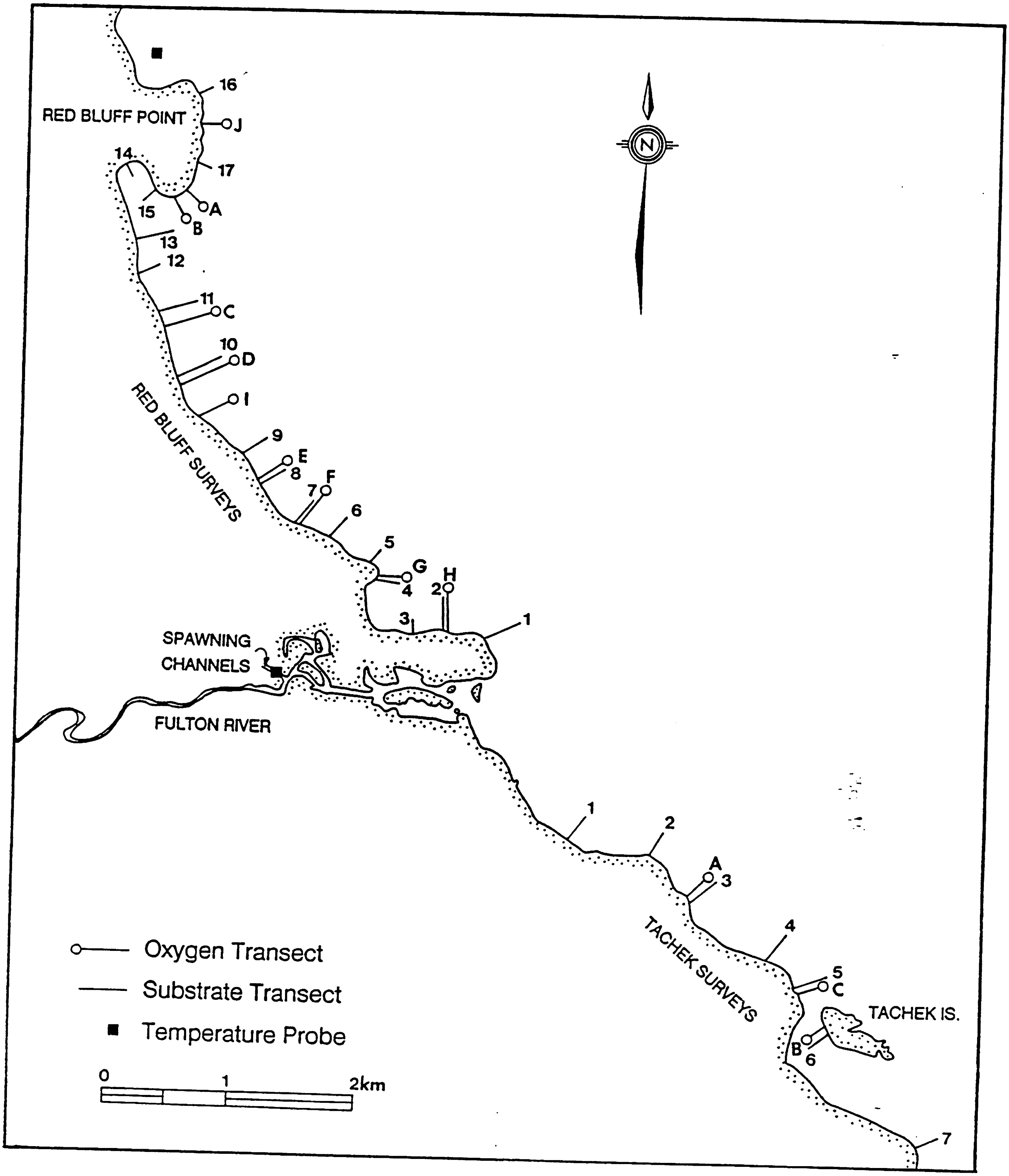


Figure 2. Location of nearshore habitat surveys from Red Bluff to Tachek

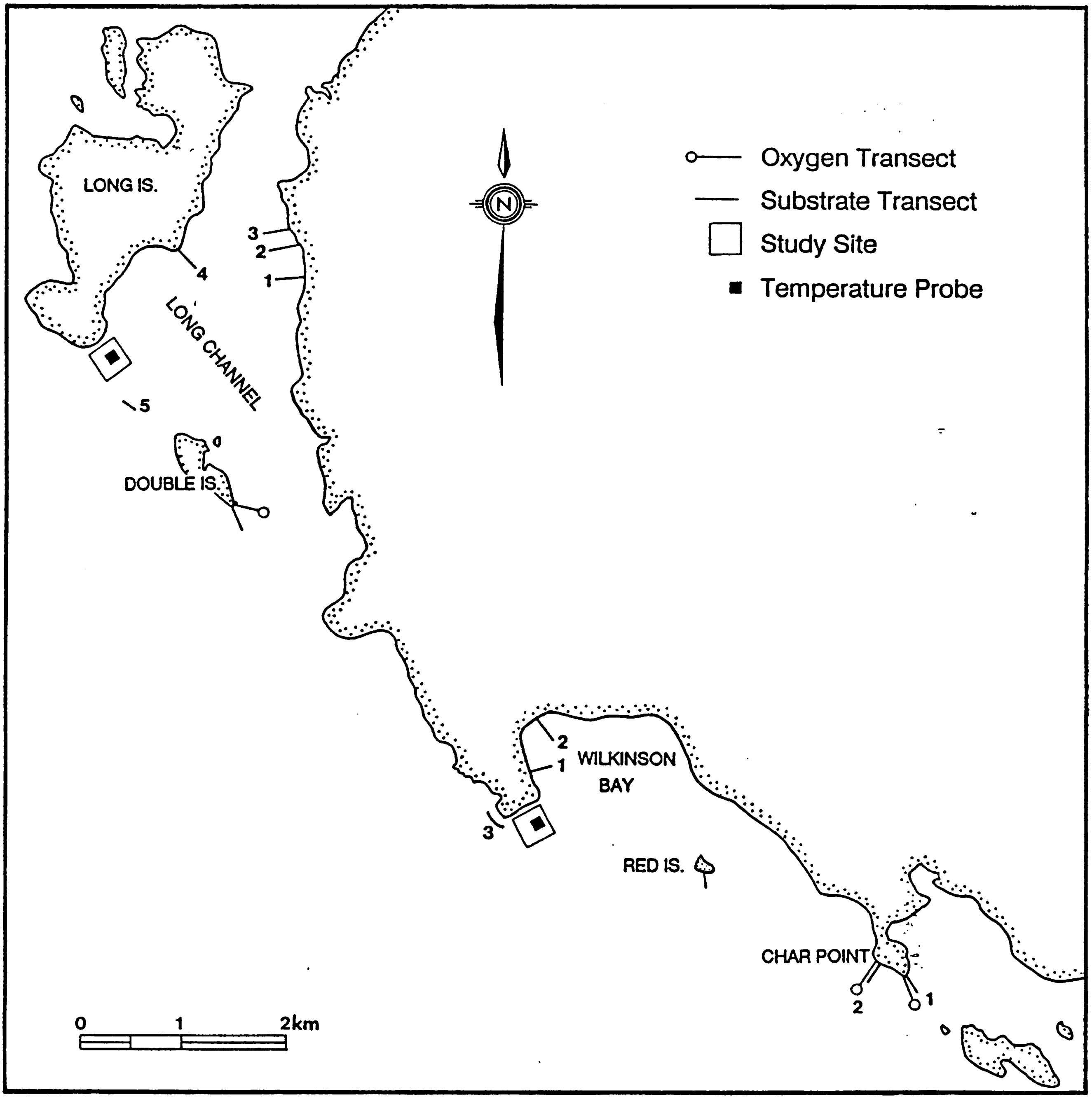


Figure 3. Location of nearshore habitat surveys from Long Island to Char Point.

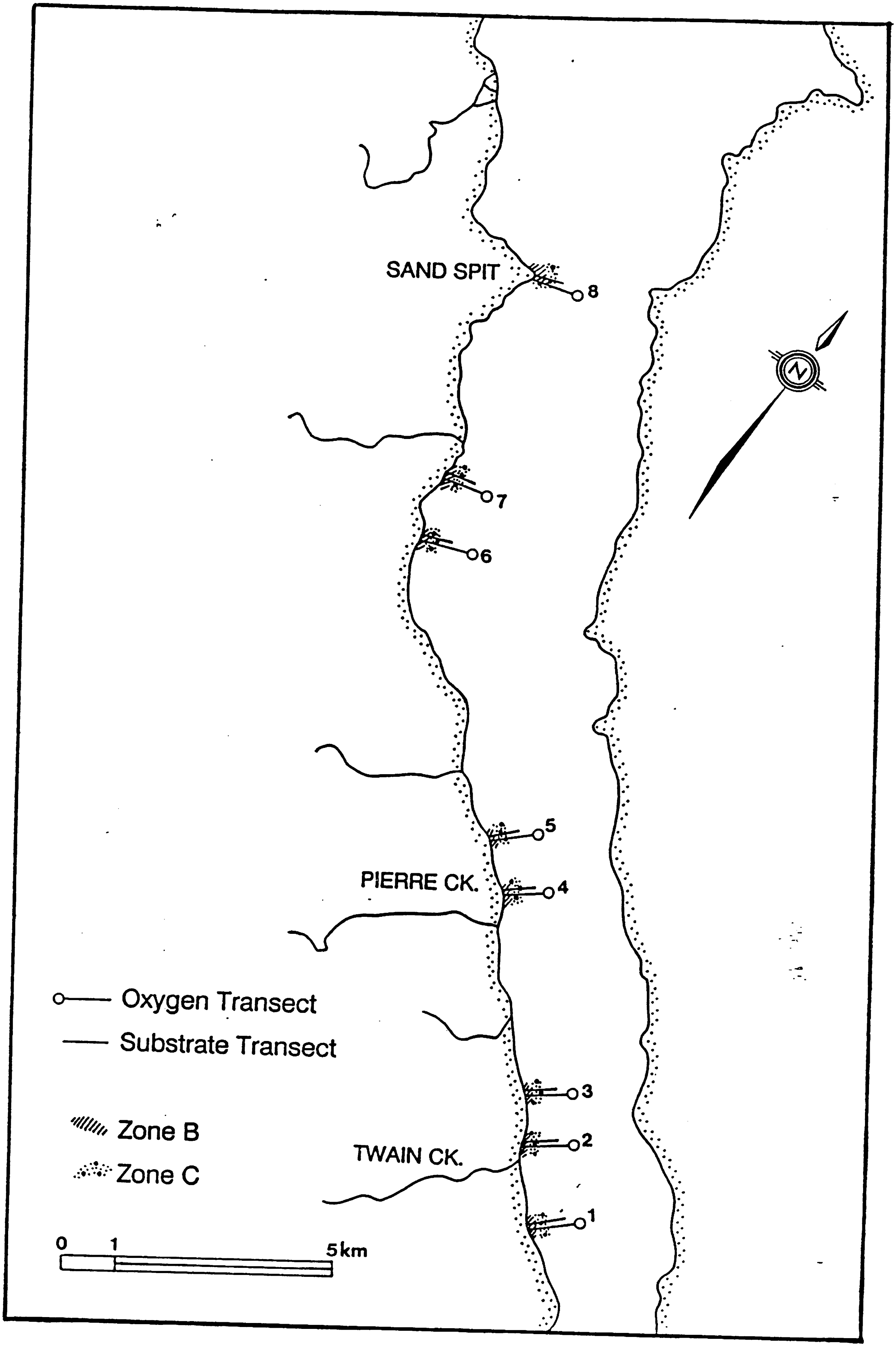


Figure 4. Location of nearshore habitat surveys from Sandspit to Twain Creek.

2.3 Site Surveys

At Long Island and Wilkinson Beach detailed underwater surveys were carried out to map the bottom substrate. Transects were laid perpendicular to shore by divers swimming a compass bearing. The transects were placed 50m apart at Wilkinson Beach and 20m apart at Long Island. At Long Island these transects were run from a baseline laid along the 2m depth contour. The divers swam each transect and recorded habitat type (A, B or C), dominant substrate, and depth within a $1m^2$ quadrat placed at 5m intervals along the transect line. The area of each habitat was determined by divers measuring the lateral distance from the transect to breaks in habitat type. From these observations a habitat map for each site was constructed.

2.4 Sampling Dissolved Oxygen from Bottom Substrate

Interstitial water from the bottom substrate was sampled using a 60 cc syringe coupled to tygon tubing and an 8" spike (Figure 5). The tygon tubing was closed at the bottom but perforated with several holes (1-2 mm) approximately 3 cm above the end of the spike. The syringe/tubing couple was sealed with silicone stopcock grease. The spike was driven 5 to 15 cm into the substrate by the diver and the sample drawn slowly into the syringe. To avoid sample contamination with lake water the first 10 cc of sample was flushed from the syringe by disconnecting the coupling at the tygon tubing. The syringe was then recoupled and a full sample drawn. Using several syringes, five to six samples could be taken before surfacing to measure oxygen content. Concurrent water temperature readings ($\pm$ 0.5°C) were taken with a hand-held thermometer placed in the substrate adjacent to the site of the oxygen sample.

Oxygen was measured by placing a probe (Oxyguard Handy Oxygen Probe, Point Four Systems Inc. Accuracy ±2% at 0-50 ppm) into the syringe casing after the plunger was removed.

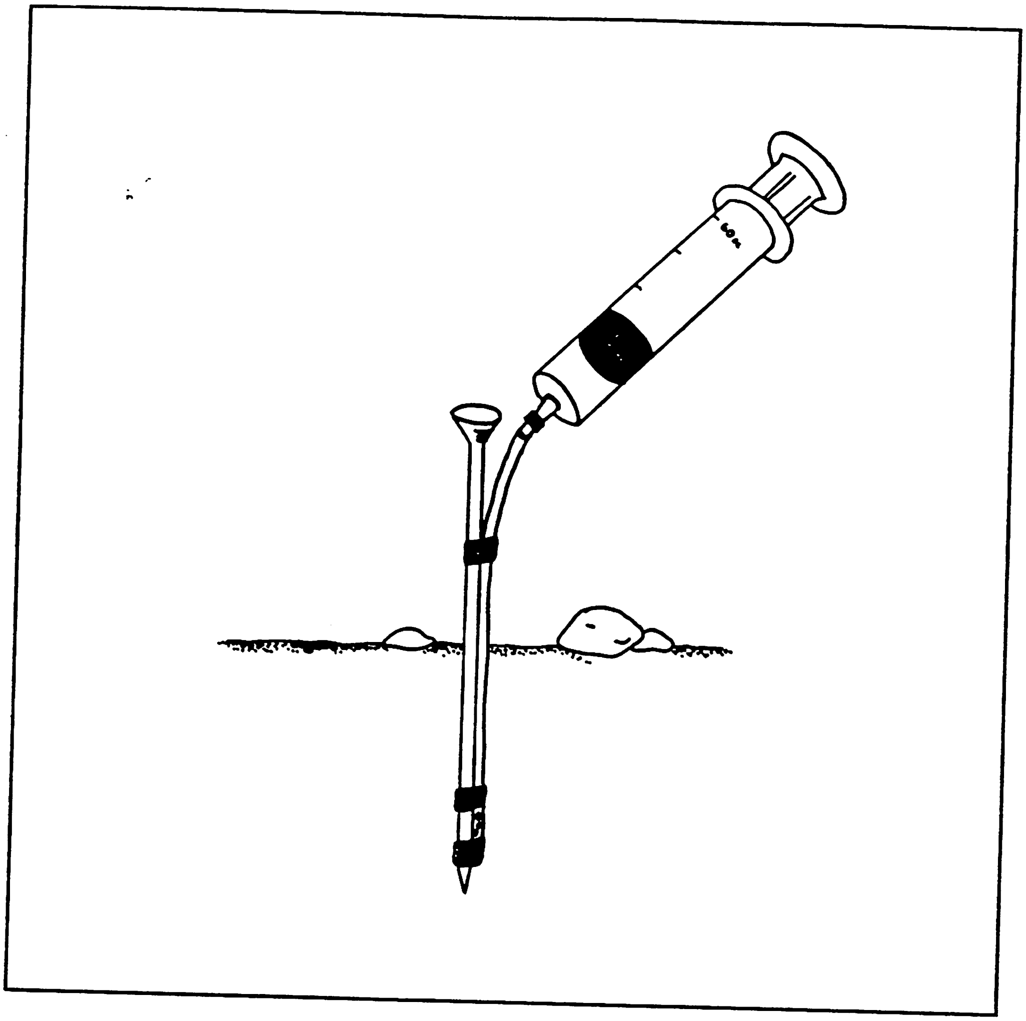


Figure 5. Method used for sampling water from the bottom substrate.

2.5 Egg Crosses & Egg Incubation

On October 4 1991, 12 male/female pairs (families) of sockeye were taken from the Fulton River spawning channel. Eggs & sperm were stripped from each pair and the fertilized eggs reared to the eyed stage (October 28) at the Fulton River hatchery. The eggs were then mechanically shocked and dead eggs removed. The eyed eggs were transported to the two incubation sites (Long Island & Wilkinson Beach) and groups of 100 eggs placed in the top chamber of Vibert boxes. The bottom chamber was filled with clean gravel from Wilkinson Beach. Each Vibert box was lined with 1 mm plastic screening to prevent the escape of hatched alevins.

The Vibert boxes were placed in all three habitat types at Wilkinson Beach & Long Island as well as in spawning channel #2 at Fulton River. The outplanting design is given in Table 1. Each Vibert box was labelled to indicate family group & habitat type. The boxes were buried into the substrate so that the top of the box (the egg incubation chamber) was just covered by a thin layer of substrate. At the lake sites each box was attached to groundline to facilitate recovery. In the spawning channel the boxes were marked with survey tape. On October 23 four families of freshly fertilized eggs from sockeye taken from the Fulton River spawning channels were also outplanted in Vibert boxes at Wilkinson Beach (Table 1). For these families only 50 freshly fertilized eggs were placed in each box.

In March the boxes were recovered by divers. At this time dissolved oxygen and substrate samples were taken from many of the incubation sites. For each box the number of hatched alevins, viable and dead eggs were counted.

Table 1. Schedule of fertilized egg outplanting and recovery. A, B, and C refer to the habitat types described in Section 2.2.

Site	Date Outplanted	Date Recovered	# of Families	# of Vibert Boxes A	B	C	Total # of Boxes
Wilkinson							
eyed eggs	October 29 1991	March 5-7 1992	12	24	24	12	60
fresh eggs	October 23 1991	March 5-7 1992	4	16	16	16	48
Long Island							
eyed eggs	October 30 1991	March 9-10 1992	12	24	24	24	60
Fulton Channel							
eyed eggs	November 1 1991	March 8 1992	12	24	N/A	N/A	24

2.6 Substrate Sampling

In March, substrate samples were taken from a number of egg incubation sites. The divers first removed the Vibert box and then collected approximately 5 litres of substrate from the incubation site. The samples were dried at 110°C overnight and then screened through a sieve series (100, 50, 25.4, 12.7, 9.5, 4.8 and 3.4 mm). The fractions were then weighed ($\pm$0.1 g).

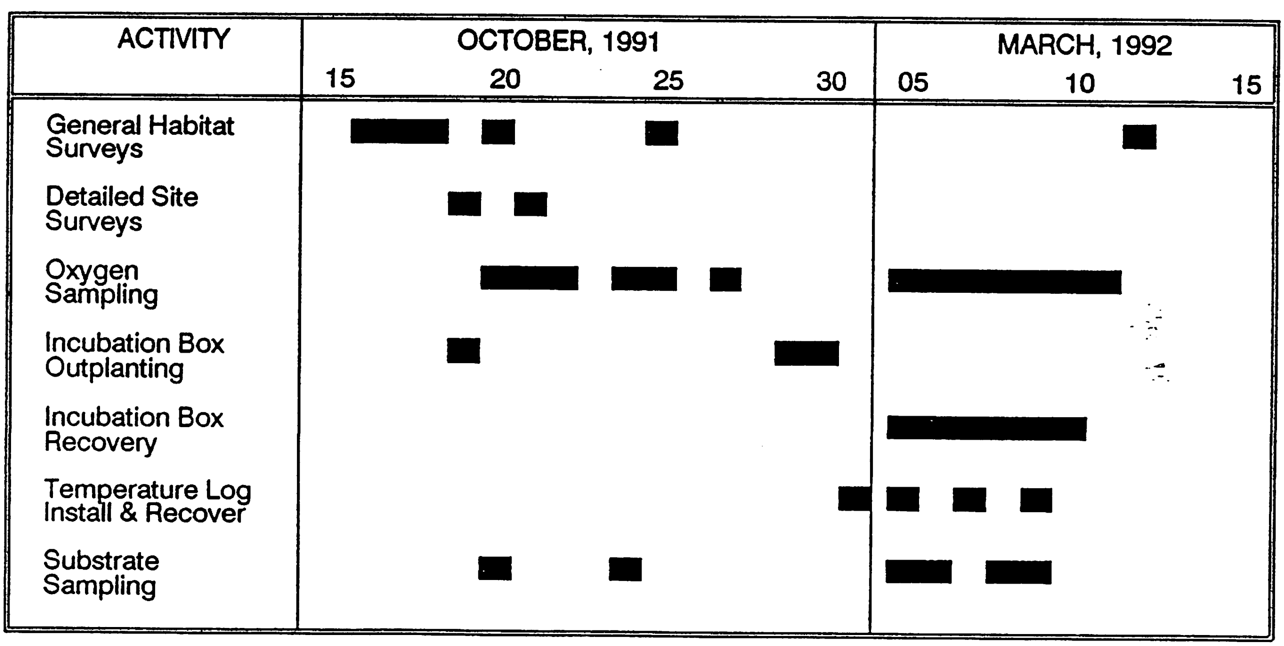
2.7 Water Temperature Monitoring

Temperature data loggers (Starlog model 6003B) were installed at both lake sites as well as at Red Bluff (Figures 2 & 3). The data loggers monitored water temperature at five second intervals and recorded the average temperature at 12 hour intervals. Each logger was housed in a laminated plastic waterproof housing with a watertight fitting for the thermistor probes ($\pm$0.5°C). The data loggers were placed on the lake bottom (2-5m depth) to avoid ice damage. The thermistor probes were placed in the substrate at the egg incubation sites. Water temperature for the spawning channel was monitored using a continuous strip recorder installed in the channel by the Fulton River facility.

2.8 Video Recording

Selected habitat survey transects and the detailed survey transects at Long Island and Wilkinson Beach were recorded using a Sony 8 mm Video recorder placed in an underwater housing. In addition video recordings were made of the oxygen sampling method, outplanting and recovery of the Vibert boxes and diving methods. An index of these videos is given in Appendix 2.

Table 2. Summary of field activities for Babine Lake sockeye program.



3.0 RESULTS

3.1 Review of Field Activities

This project was carried out in our two field periods; October 16 - 31, 1991 and March 05 - 12, 1992. Table 2 summarizes the timing of the various activities over the two field periods. During the October field trip the weather was unseasonably cold, with several nights of temperatures to -18°C. During the latter half of the fall field trip the temperature rarely rose above 0°C. At times strong winds hampered field activities. All habitat surveys (except Char Point), the detailed site surveys at Long Island and Wilkinson Beach, and egg outplanting were conducted during the fall.

Despite the unseasonably cold weather in October, the winter season was mild with heavy snowfall accumulation. In the vicinity of Fulton River no ice formed on Babine Lake until mid-February. At that time ice formed on the northern part of the lake but the area south of a line between Fulton River and Double Island (Figure 1) remained ice free all year long.

In March the weather was generally mild, with day time highs of +5°C to +10°C and night time lows to -5°C to 0°C. During the March trip the ice receded northward to a line between Red Bluff and Long Island. Wilkinson Beach was essentially ice free, although there was thin ice cover in Wilkinson Bay. The Long Island site was covered by a solid ice layer, 10-15 cm thick.

3.2 Habitat Surveys

A total of 24 habitat assessment transects were completed in the area from Red Bluff to Tachek Island (Figure 2). Thirteen of these transects had corresponding substrate oxygen samples taken from each habitat type. Twelve habitat assessment transects, three with substrate oxygen samples, were conducted on the east side of the lake (Long Island to Char Point, Figure 3.) Eight habitat assessment transects, each with corresponding substrate oxygen samples, were carried out from Sandspit to Twain Creek (Figure 4). These bottom habitats are summarized in a nearshore habitat map (Figure 6) for the Fulton River area and in Figure 4 for the area south of Fulton River.

The habitat assessment data are given in Table I of Appendix 1. In all three survey areas habitat B substrate (cobble and/or gravel mixed with sand) was most commonly found in the shallow nearshore zone to maximum depths of 5m. At depths greater than 5m the bottom substrate was usually type C habitat, a mixture of sand and silt. In many areas hard clay was observed under the bottom substrate. The habitat C substrate observed from Sandspit to Twain Creek was particularly soft, being formed of plumose silt with little or no sand. Only two sites contained appreciable amounts of habitat A, the beach west of Wilkinson Bay and a shallow area about 150m off the south end of Long Island (Figure 3). These two areas were selected as study

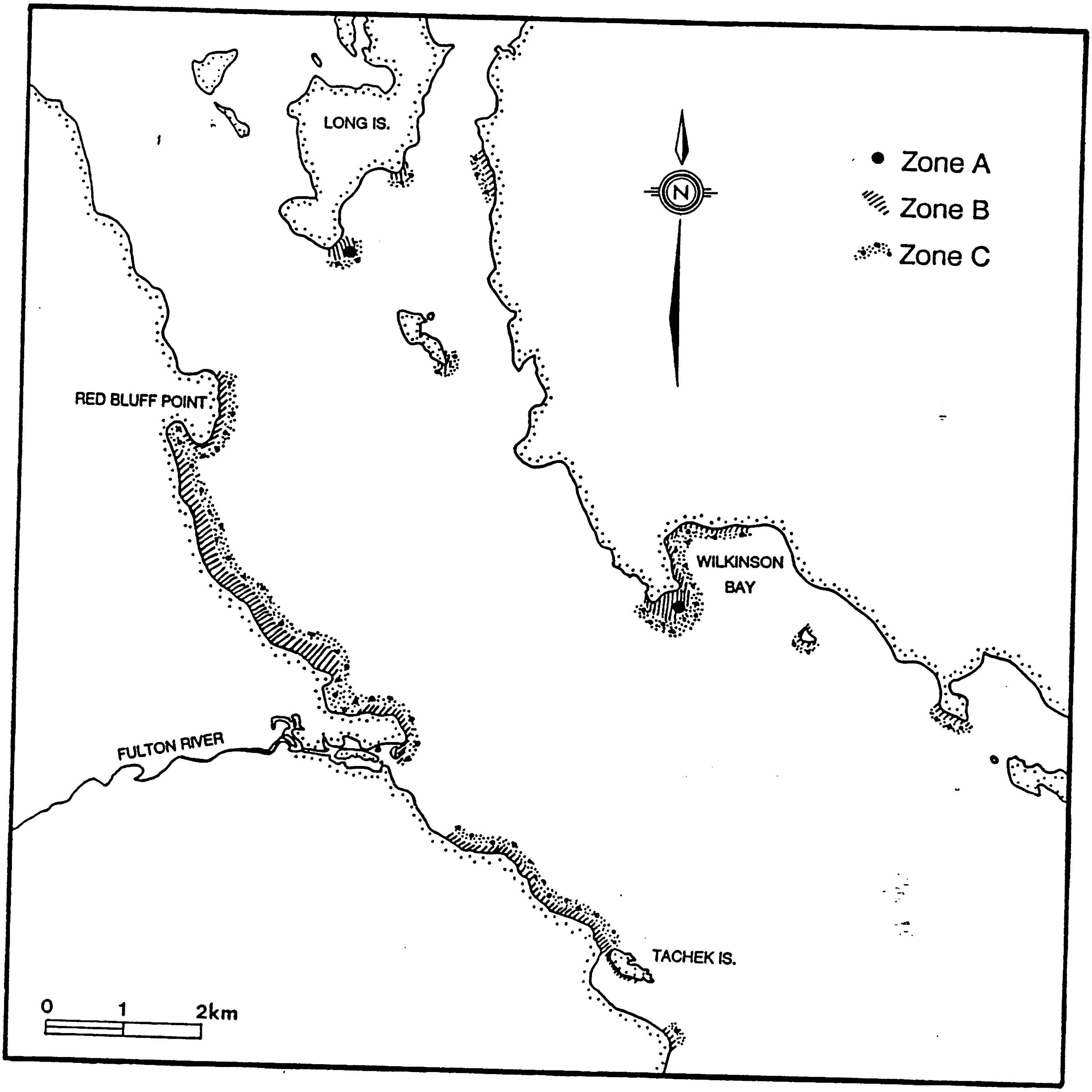


Figure 6. Summary of nearshore bottom habitat in the Fulton River area.

sites for the egg incubation studies (Section 3.2). The only other site classified as habitat A was a small area of rock fragments at the base of a slope on Tachek Island (Figure 2). The area classified as habitat B at Red Bluff was generally less silty than most other areas of type B habitat.

Data from substrate oxygen sampling of the habitat assessment transects is given in Table II of Appendix 1 and summarized in Figure 7 (samples taken at Long Island and Wilkinson Beach are summarized separately in Section 3.3). In Figure 7 substrate oxygen in the Fulton River area is summarized separately from samples collected from Sandspit to Twain Creek. The level of dissolved oxygen in lake water at the depths where samples were taken ranged from 10.0 to 11.0 ppm (Table II, Appendix 1). Tachek Island (a site classified as habitat A) had a substrate oxygen level of 11.2 ppm, essentially equal to the surrounding water column. Dissolved oxygen in habitat B substrate ranged between 2.1 and 11.3 ppm in the Fulton River area and between 0.8 and 10 ppm in the Sandspit to Twain Creek area. Overall 21 of 31 habitat B oxygen samples were less than 9 ppm. In habitat C substrate dissolved oxygen ranged from 1.0 - 9.3 ppm in the Fulton River area and between 0.8 and 6.3 ppm in the Sandspit to Twain Creek area. Overall, 23 of 24 samples from habitat C were below 9 ppm.

3.3 Site Surveys

3.3.1 Wilkinson Beach

The Wilkinson Beach site was situated along a stretch of gravel beach on the point forming the western side of Wilkinson Bay. The beach is exposed to southerly winds. The habitat map resulting from the dive survey is shown in Figure 8 and detailed observations from each transect quadrat are given in Table III, Appendix 1.

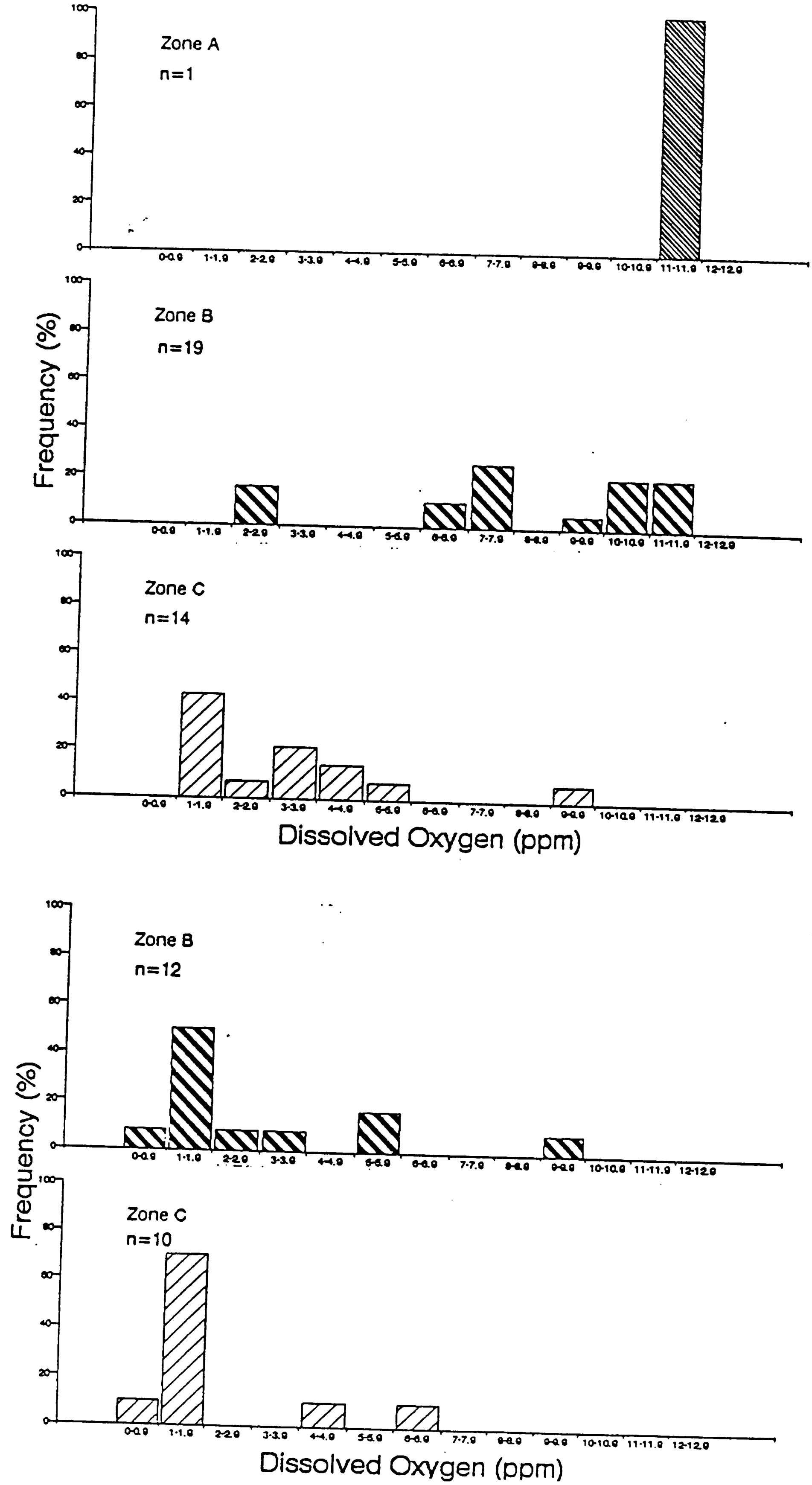


Figure 7. Substrate dissolved oxygen levels (ppm) by habitat type for the Fulton River area (top) and the Sandspit to Twain Creek area (bottom) in October, 1991.

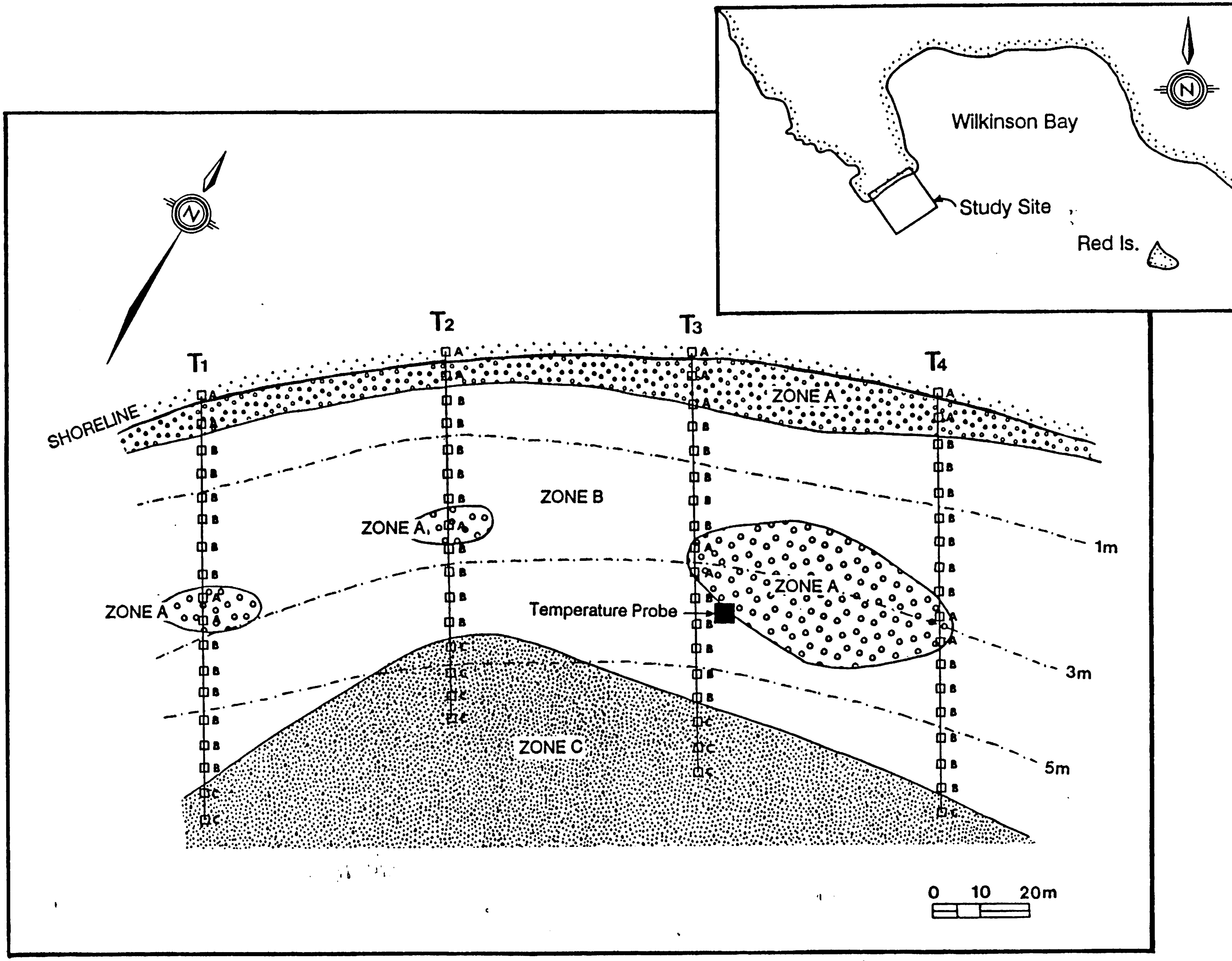


Figure 8. Habitat map of the Wilkinson Beach site. Habitat types for each quadrat along the dive survey transects (T1-T4) are shown.

The nearshore beach, classified as habitat A, was formed of clean gravel. At depths of 0.5 to 5m the bottom substrate was predominantly a mixture of cobble, gravel and sand classified as habitat B. Patches of multilayered cobble, classified as habitat A, were also found between 0.5 and 5m depth, particularly at the northeastern side of the site between transects 3 and 4. In this area the cobble was piled into shallow redds measuring approximately 1 m x 3 m. These were assumed to be lake char redds as lake char eggs were collected by suction dredge from the cobble substrate. In addition, lake char were observed by divers at this site on October 16, and ripe and spawned out lake char were caught in gill nets on the same date. The egg incubation boxes and the temperature probe were placed in this area of the study site. At depths greater than 5m the bottom substrate was primarily a mixture of sand and silt (habitat C).

Figure 9 summarizes substrate dissolved oxygen levels in October by habitat type at Wilkinson Beach; detailed data summaries are given in Table IV, Appendix 1. Oxygen in habitat A ranged between 11.0 and 11.1 ppm, essentially the same as the oxygen level in water above the substrate. In habitat B, oxygen ranged between 3.2 and 10.1 ppm with 9 of 10 samples being less than 9 ppm. In habitat C oxygen ranged between 1.2 and 8.5 ppm.

3.3.2 Long Island

The study site was located 100 to 140m off the southeastern shoreline of Long Island. Bottom habitat was mapped between the 2 and 5m depth contour (Figure 10). An area of multilayered cobble (habitat A) was found in the middle of the site at depths of 2 to 4m. The cobble was uniformly distributed over the bottom and no redds, as had been seen at Wilkinson Beach, were observed. Habitat B consisted of cobble and gravel mixed with sand and silt. At depths greater than 5m the substrate was predominately sand/silt with occasional pieces of cobble

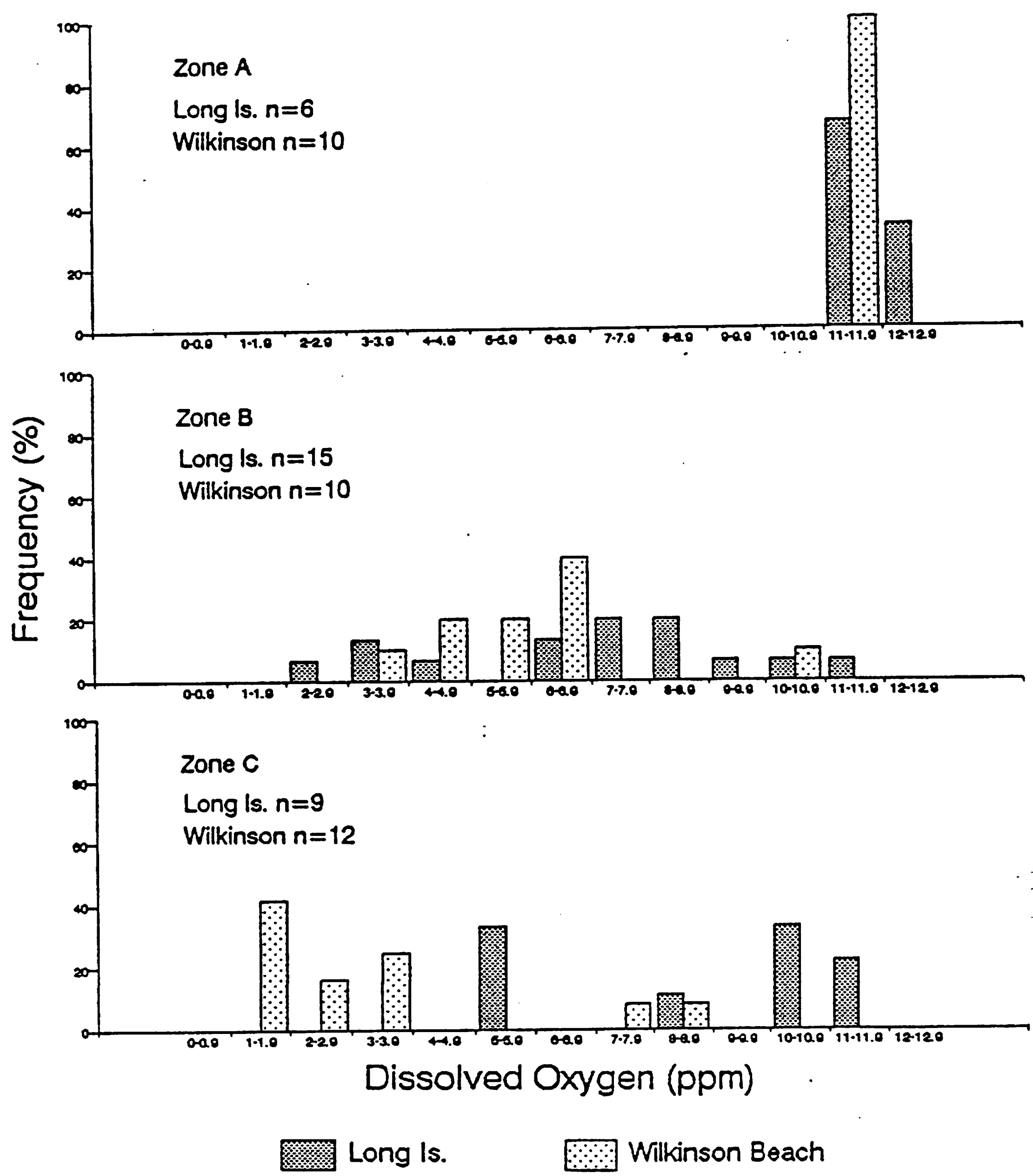


Figure 9. Substrate dissolved oxygen levels (ppm) by habitat type for Wilkinson Beach and Long Island in October, 1991.

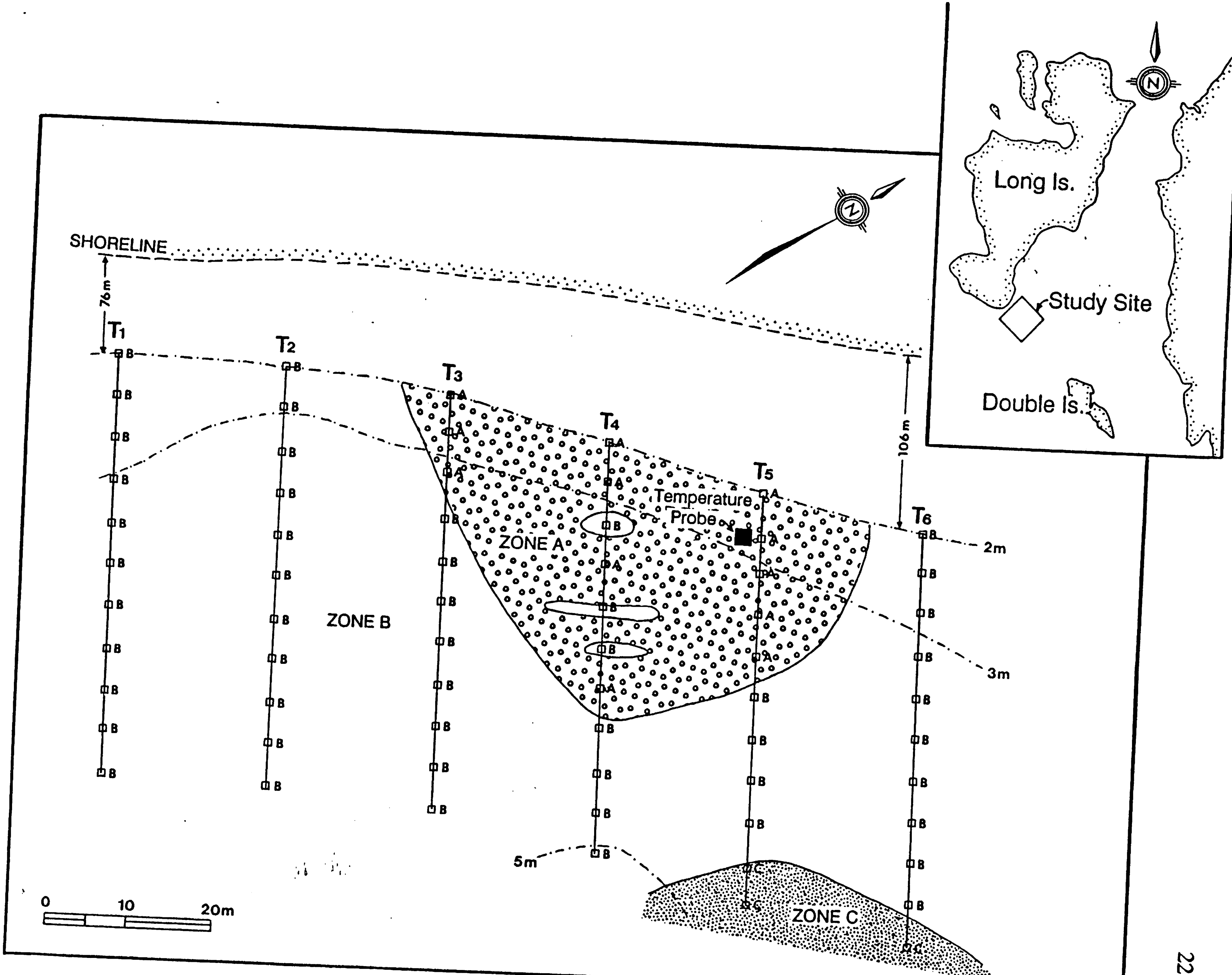


Figure 10. Habitat map of the Long Island site. Habitat types for each quadrat along the dive survey transects (T1-T6) are shown.

or gravel. The temperature probe and incubation boxes were placed in the area between transects 4 and 6. In all habitat types hard clay was found beneath the top layer of substrate.

Figure 9 summarizes dissolved oxygen levels in October from the substrates at Long Island; detailed results are given in Table IV, Appendix 1. In habitat A oxygen ranged between 11.3 and 12.1 ppm. In habitat B oxygen ranged between 3.4 and 11.0 ppm with 12 of 15 samples less than 9 ppm. In habitat C dissolved oxygen ranged between 5.2 and 11.3 ppm with 4 of 9 samples less than 9 ppm. The higher values in habitat C may be due to sample contamination from lake water, as the underlying clay layer made it difficult to place the sampling probe very deep in the substrate.

3.4 Temperature Monitoring

Figure 11 shows average daily water temperature over the winter at three sites in Babine Lake as well as the Fulton River spawning channel. The temperature probes were placed at a depth of 4m at Wilkinson Beach, 3m at Long Island, 0.5-3m at Red Bluff and 0.5m in the spawning channel. The most rapid drop in water temperature occurred during the two weeks of cold air temperatures in late October and early November. From mid-November the lake water slowly cooled to $1^{o}C$ by mid-February, when ice began to form in the northern part of the study area (Section 3.1). Around March 1 (Day 121 in Figure 11) the water began to warm at all three lake sites. In contrast, water temperature in the Fulton River spawning channel fell to approximately $1^{o}C$ by December 1st, 1992 and remained relatively constant until March. The number of degree-days between November 1, 1991 and March 1, 1992 was 314 at Wilkinson Beach, 396 at Long Island, 396 at Red Bluff and 154 at the Fulton River spawning channel.

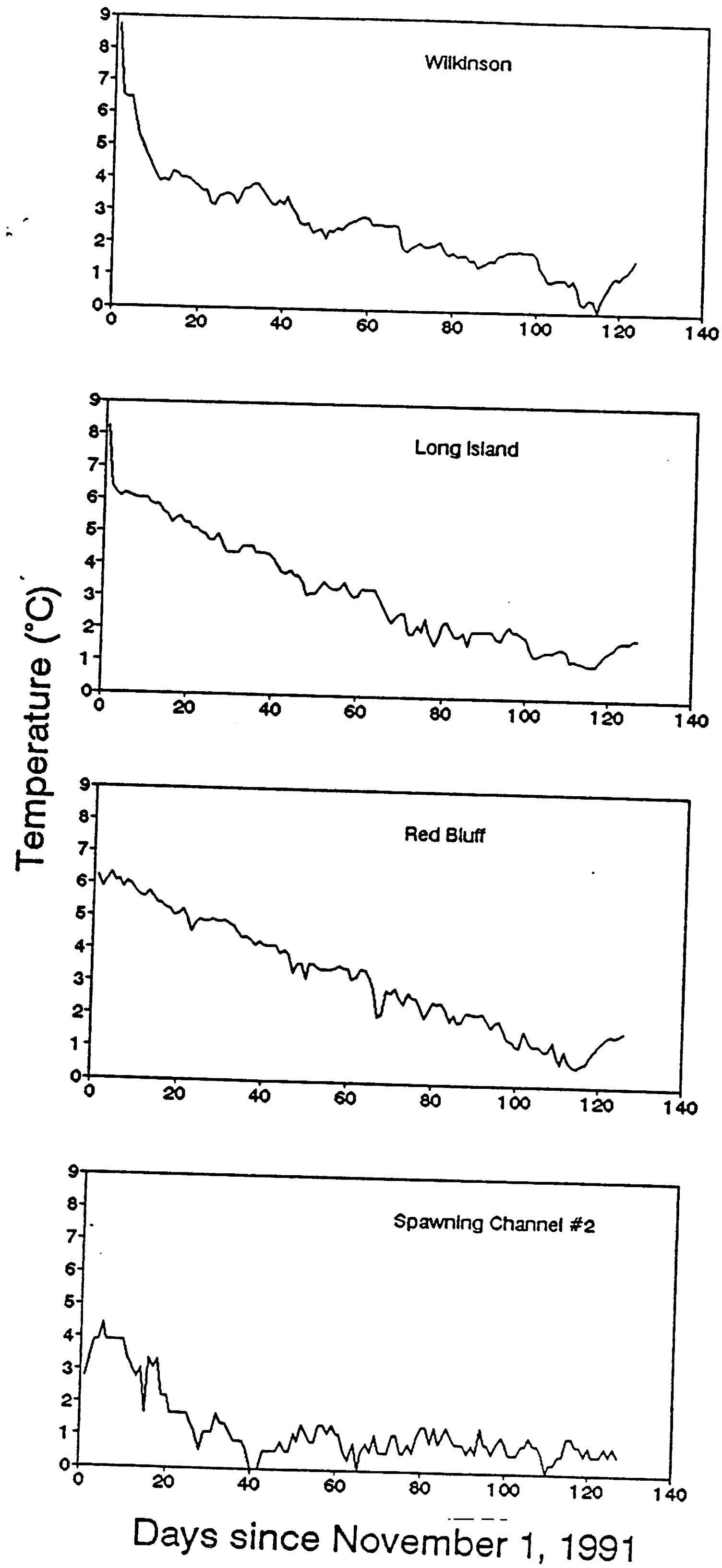


Figure 11. Average daily water temperature for Wilkinson Beach, Long Island, Red Bluff and the Fulton River spawning channel (#2) from November 1, 1991, 1 to March 9, 1992.

3.5 Egg Survival

Figures 12 and 13 summarize egg survival for eyed (Figure 12) and freshly fertilized (Figure 13) sockeye eggs planted in the three bottom habitats at Long Island and Wilkinson Beach. Survival of eyed eggs planted in the Fulton River spawning channel and eyed eggs reared in the hatchery are also summarized. By March all surviving eyed eggs, including those planted in the river, had hatched to the alevin stage. The survival data for each incubation box is given in Table V, Appendix 1.

Survival in the hatchery was greater than 90% for all 12 incubation boxes. In the spawning channel survival was greater than 90% for 23 of 24 incubation boxes. In both lake sites the survival of eyed eggs was high in habitat A and low in habitats B and C. At Wilkinson Beach survival in habitat A ranged from 63 to 100%, with 23 of 24 samples being greater than 90%. At Long Island survival ranged from 95 to 100% in the 12 boxes planted in habitat A which was similar to Wilkinson Beach.

Type A habitat typically occurred as shallow mounds or berms rising above the lake substrate. To evaluate the effects of substrate morphology 12 incubation boxes were planted in depressions dug into the underlying silt substrate at Long Island. The boxes were surrounded and covered with cobble. Survival in this experimental habitat (designated habitat AD) was lower (78 to 100%, with only 6 of 12 samples greater than 90%) than samples placed in habitat A.

No eggs survived in samples planted in habitat B at Wilkinson Beach. Survival was 0 to 61% in habitat B at Long Island but there was no survival in 12 of the 16 incubation boxes. During sample recovery the divers remarked that the egg incubation chamber of four of the 16 boxes placed in habitat B not covered with substrate. Although these four boxes were not

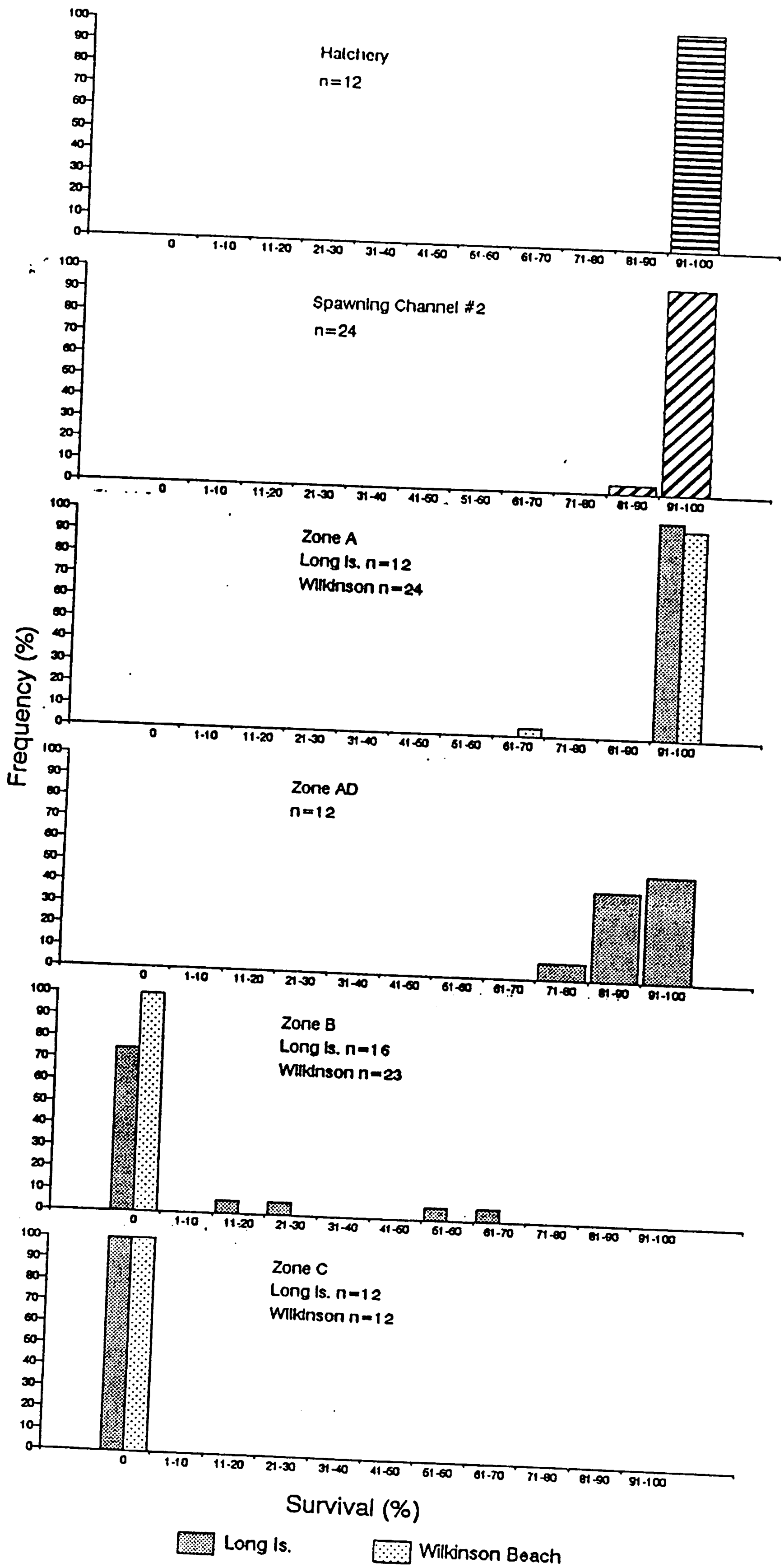


Figure 12. Survival of eggs and alevins by habitat type for eyed sockeye eggs outplanted at Wilkinson Beach and Long Island.

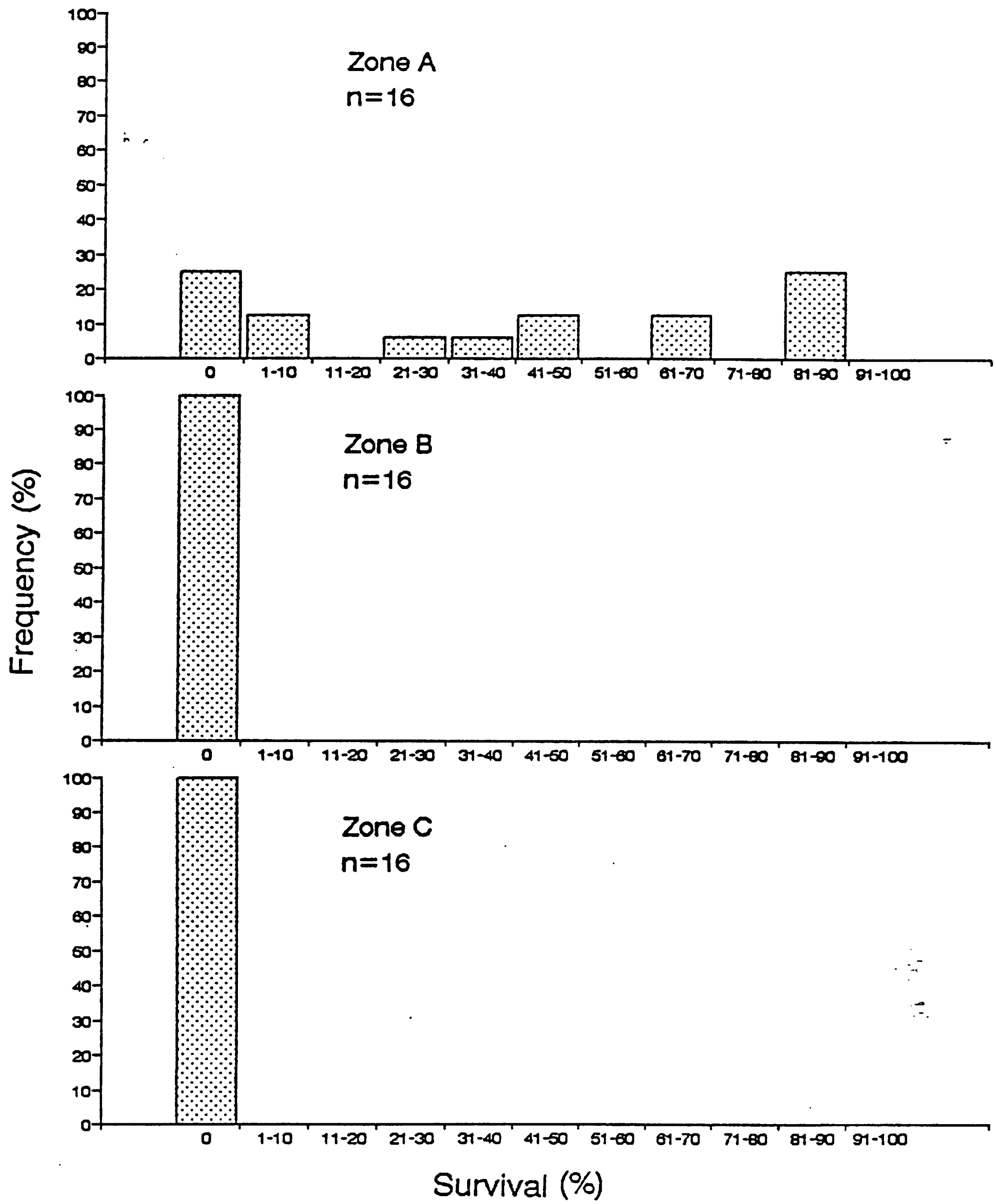


Figure 13. Survival of eggs and alevins by habitat type for freshly fertilized eggs outplanted at Wilkinson Beach.

specifically identified, they might be the samples with higher survival. In habitat C there was no survival at either study site.

Egg survival was lower for freshly fertilized eggs planted at Wilkinson Beach (Figure 13). In habitat A survival was 0 to 90%, and not all eggs had reached the alevin stage. No freshly fertilized eggs planted in habitats B or C survived.

Figure 14 summarizes the substrate particle size as a proportion of total sample weight for each habitat at the two study sites. Data for each sample is given in Table IV, Appendix 1. Samples were taken in March from the sites of egg incubation after the Vibert boxes were removed. Habitat A at Wilkinson Beach and Long Island was composed of gravel and cobble in similar proportions to the Fulton River spawning channel. Except for habitat AD at Long Island there were no fines in samples from A habitat. In contrast, habitat B contained a heterogeneous mixture of substrate material, ranging in size from silt to cobble. The proportion of fines was higher in habitat B samples taken at Long Island as compared to Wilkinson Beach. Samples from habitat C were taken only from Wilkinson Beach; the substrate at Long Island was similar. In habitat C over 90% of the substrate weight was fines. The Vibert box substrate was gravel sized, with over 95% of the sample weight ranging from 9.5 to 50 mm in size.

Dissolved oxygen samples were taken from the substrate at many of the Vibert box incubation sites prior to removal of the box. Figure 15 summarizes these results; the data is tabulated in Table V, Appendix 1. Dissolved oxygen in the spawning channel substrate was greater than 12 ppm for all samples. Results for habitat A, B and C at Wilkinson Beach and Long Island were similar to those obtained in October (Figure 9). Dissolved oxygen was greater than 9 ppm for all samples taken from habitat A at both sites combined and for 10 of 11 samples taken from habitat AD at Long Island. In habitat B dissolved oxygen levels ranged from 1.6 to

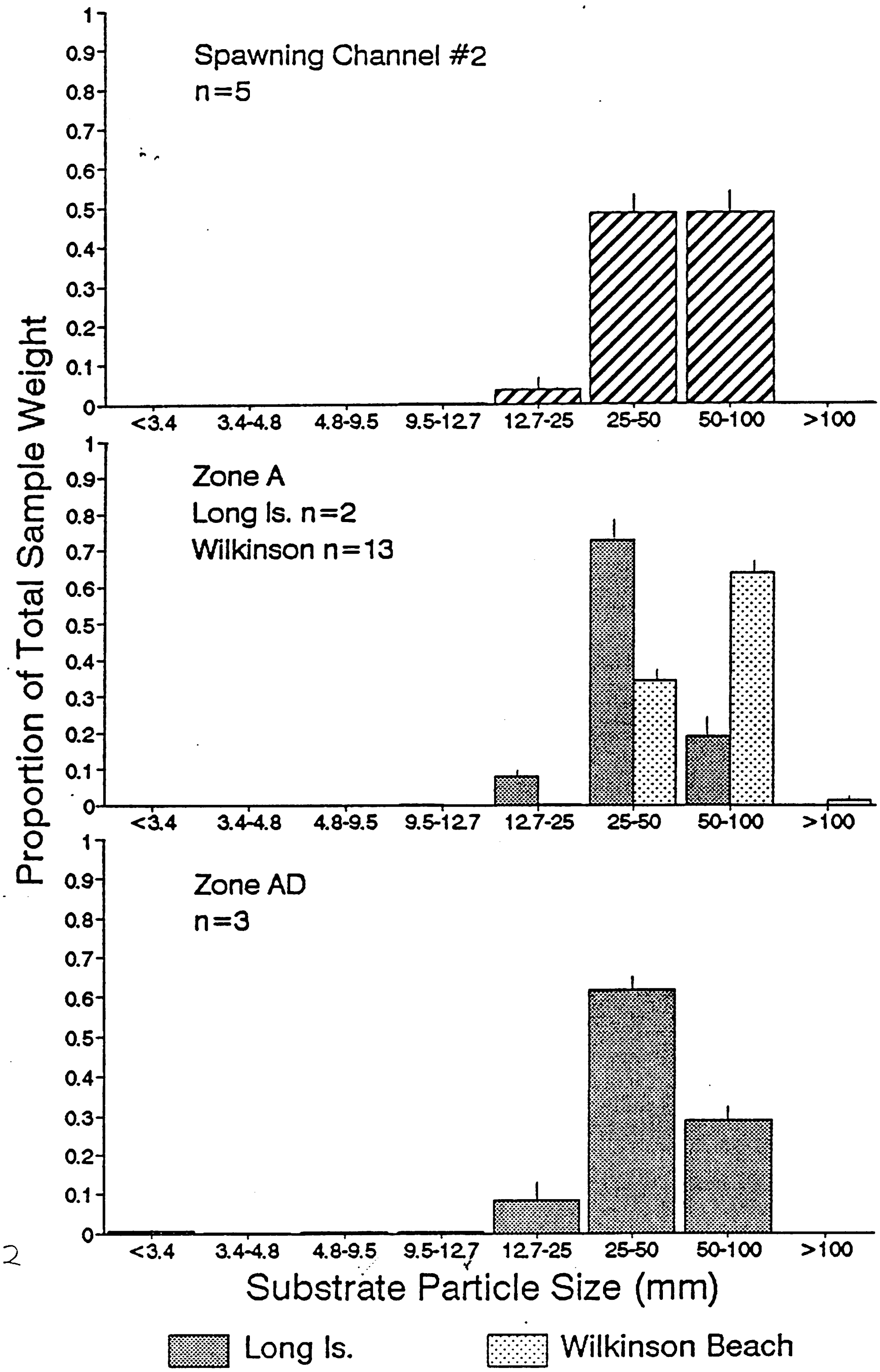


Figure 14. Substrate particle size as proportion of total sample weight for the Fulton River spawning channel, habitat A and habitat AD. Samples for Wilkinson Beach and Long Island are shown separately. Error bars indicate standard error of mean.

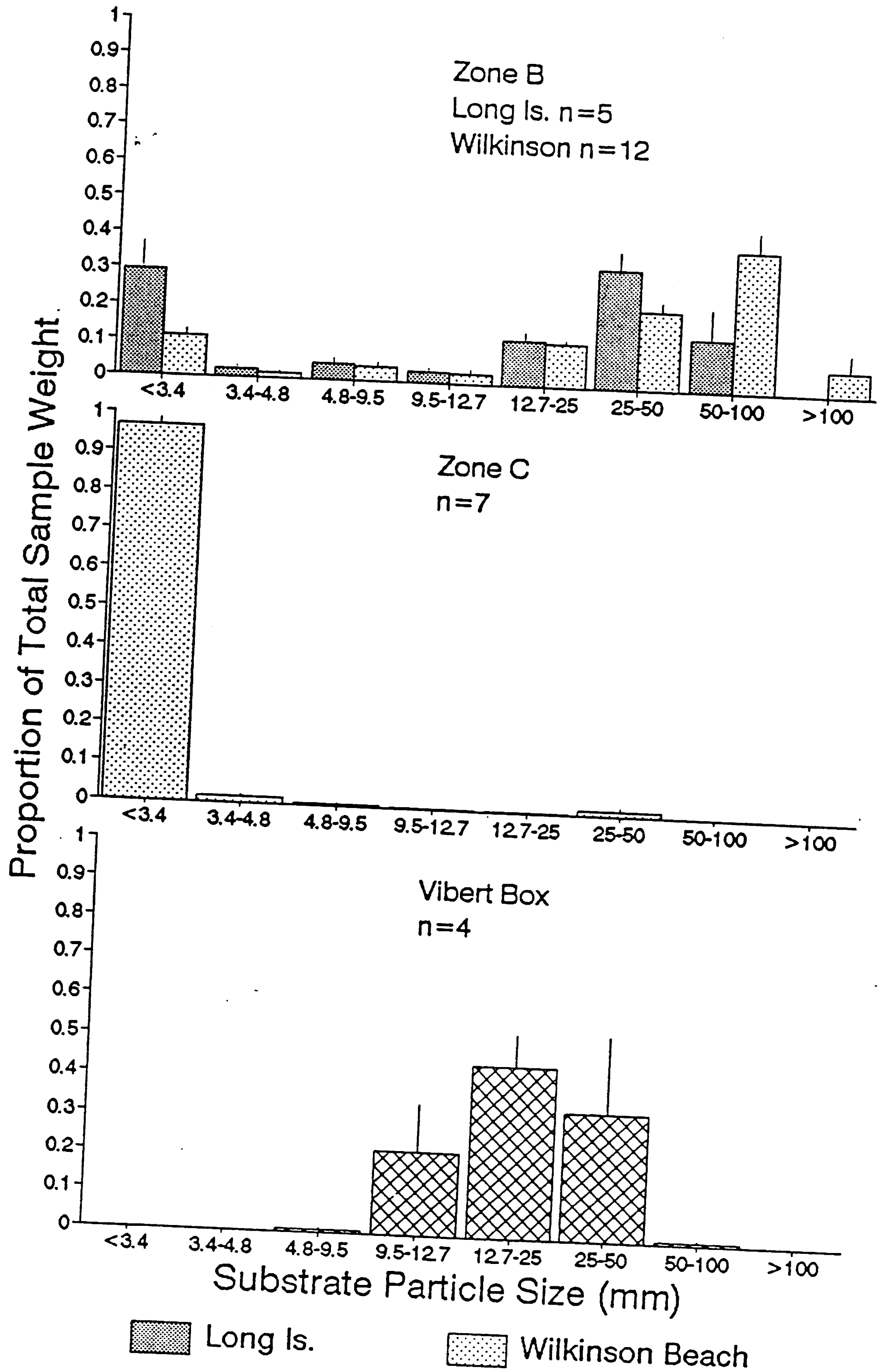


Figure 14 (cont'd.). Substrate particle size as proportion of total sample weight for habitat B, habitat C and for the Vibert boxes. Samples for Wilkinson Beach and Long Island are shown separately. Error bars indicate standard error of mean.

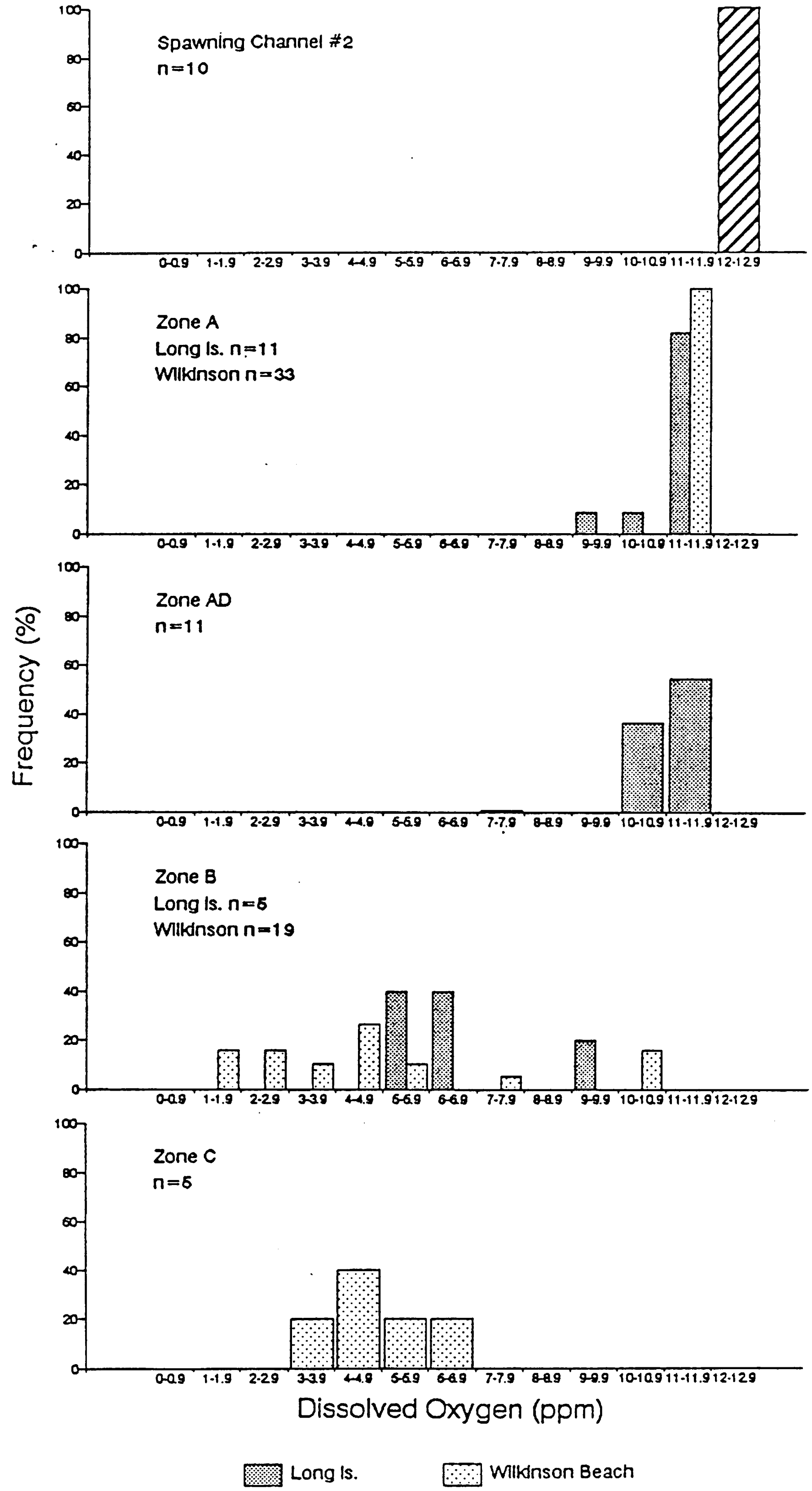


Figure 15. Substrate dissolved oxygen levels by habitat type at egg incubation sites in March. Samples for Wilkinson Beach and Long Island are shown separately.

0.7 ppm, with 20 of 24 samples below 9 ppm. In habitat C (taken at Wilkinson Beach only) all oxygen samples were less than 9 ppm.

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5.0 PERSONAL COMMUNICATIONS

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APPENDIX 1

Data Summaries

TABLE I. Data collected from nearshore habitat surveys. Depth range of each habitat zone is given in metres. Si - silt, Sa - sand, Gr - gravel, Cb - cobble, Bl - boulder.

LOCATION	DATE	DEPTH1	ZONE1	SUBSTRATE1	DEPTH2	ZONE2	SUBSTRATE2	DEPTH3	ZONE3	SUBSTRATE3	DEPTH4	ZONE4	SUBSTRATE4
CHAR PT 1	MAR 11	<6.1	B	CB/SA/BL	>6.1	C	SA						
CHAR PT 2	MAR 11	<2.7	B	CB/GR/SA	>2.7	C	SA						
DOUBLE IS	OCT 20	<4.6	B	BL/CB/SA	4.6-5.2	B	BL/SA	5.2-9.1	B	SA/BL			
LONG CH 1	OCT 20	>0	C	SI									
LONG CH 2	OCT 20	<0.6	B	CB	>0.6	C	SI						
LONG CH 3	OCT 20	<3.0	C	SI/SA	3.0-9.1	C	SI						
LONG CH 4	OCT 20	<3.0	B	CB/SA/SI	3.0-4.6	C	SA/SI	4.6-7.6	C	SI			
LONG CH 5	OCT 20	<3.0	B	CB/SA/BL	3.0-4.6	B	SA/CB/BL	6.1	B	CB/SA/BL			
LONG IS 1	OCT 20	<3.0	B	CB/BL/SA	3.0-4.6	B	BL/SA						
LONG IS 2	OCT 20	<3.0	B	CB/BL/SA	3.0-3.7	A	CB	>3.7	C	SA/CB			
RED BLUFF 1	OCT 17	<1.5	B	CB	<3.0	C	SA	3.0-7.6	C	SA			
RED BLUFF 2	OCT 17	<1.2	B	GR/CB	<2.4	B	GR/SA	2.4-9.1	C	SI			
RED BLUFF 3	OCT 17	<0.6	B	GR/SA	>0.6	C	SA/SI						
RED BLUFF 4	OCT 17	<3.0	B	CB	<4.6	B	CB/SA	>4.6	C	SA			
RED BLUFF 5	OCT 17	<2.4	B	CB	2.4-3.0	C	SA/SI	3.0-4.6	C	SI/CB/GR	4.6-9.1	C	SI/CB
RED BLUFF 6	OCT 18	<3.0	B	CB/SA/SI	3.0-4.6	C	SI/SA/CB	4.6-6.1	C	SI			
RED BLUFF 7	OCT 18	<2.4	B	CB/SI	2.4-4.6	C	SA/SI/CB	>4.6	C	SA/SI			
RED BLUFF 8	OCT 18	<3.0	B	CB/GR/SA	3.0-4.6	C	SA/SI	>4.6	C	SI/SA			
RED BLUFF 9	OCT 18	<4.6	B	CB/SA/GR	4.6-6.1	C	SA	>6.1	C	SA/SI			
RED BLUFF 10	OCT 18	<4.6	B	CB/GR	4.6-6.1	C	SA/SI						
RED BLUFF 11	OCT 18	<4.6	B	CB/SA/GR	>4.6	C	SA						
RED BLUFF 12	OCT 18	<3.0	B	CB/SA	3.0-4.6	C	SA	4.6-6.1	C	SA/SI			
RED BLUFF 13	OCT 18	<3.7	B	CB/GR/SA	3.7-6.1	C	SA	>6.1	C	SI/SA			
RED BLUFF 14	OCT 18	<0.9	B	GR	>0.9	C	SA						
RED BLUFF 15	OCT 18	<3.7	B	CB/SA	3.7-6.1	C	SA/SI						
RED BLUFF 16	OCT 18	<0.9	B	CB/GR	0.9-2.4	B	CB	2.4-3.7	B	CB/SA	>3.7	C	SA/SI
RED BLUFF 17	OCT 18	<5.5	B	CB/SA/GR	5.5-6.1	C	SA/SI	>6.1	C	SI/SA			
RED IS	OCT 20	<4.6	B	CB/SA	>4.6	C	SA/SI						
TACHEK 1	OCT 20	>0	C	SA/SI									
TACHEK 2	OCT 20	<1.8	B	GR	>1.8	C	SA/SI						
TACHEK 3	OCT 20	<1.5	B	GR/SA	>1.5	C	SA/SI						
TACHEK 4	OCT 20	<1.2	B	GR/CB	>1.2	C	SA/SI						
TACHEK 5	OCT 20	<1.8	B	SA/GR bar									
TACHEK 6	OCT 20	<1.8	A	BL/CB	steep								
TACHEK 7	OCT 20	<3.0	B	CB/SA	>3.0	C	SA/SI						
TWAINSAND 1	OCT 25	<1.5	B	CB/GR	>1.5	C	SI	>18.3	C	SI			
TWAINSAND 2	OCT 25	<1.5	B	GR/CB	1.5-5.2	C	SI/SA	>5.2	C	SI			
TWAINSAND 3	OCT 25	<1.5	B	CB/GR	>1.5	C	SI						
TWAINSAND 4	OCT 25	<1.5	B	GR/SA	>1.5	C	SI						
TWAINSAND 5	OCT 25	<0.9	B	CB/SA	0.9-2.1	C	SA/SI	2.1-4.6	C	SI/SA			
TWAINSAND 6	OCT 25	<2.1	B	CB/SA/GR	>2.1	C	SI						
TWAINSAND 7	OCT 25	<1.5	B	CB/GR	1.5-3.0	C	SI/CB	3.0-6.1	C	SI			
TWAINSAND 8	OCT 25	<0.9	B	CB/GR bar	0.9-1.8	C	SA	>1.8	C	SI			
WILK BAY 1	OCT 16	<4.6	B	CB/SA	>4.6	C	SA/SI						
WILK BAY 2	OCT 16	<3.0	B	CB/SA	>3.0	C	SA/SI						
WILK BAY 3	OCT 16	<4.6	B	BL/CB/SA	>4.6	C	SA/SI						
WILKINSON 1	OCT 16	<6.1	B	CB/SA	6.1-9.1	C	SA/SI	>9.1	C	SI/SA			
WILKINSON 2	OCT 17	<4.6	B	CB/SA	4.6-6.1	A	CB	>6.1	C	SA/SI			

TABLE II. Substrate dissolved oxygen data collected from nearshore habitat surveys. Depth in metres, penetration of substrate in cm. Temp1 is water temperature recorded in the substrate by diver, Temp2 is temperature of the sample at the time of oxygen measurement.

SAMPLE	SITE	ZONE	DATE	SUBSTRATE	DEPTH	PENTRATN	TEMP1	O2PPM	SATUR	TEMP2
127	CHAR PT 1	B	MAR 11	SA80 CB15 BL5	5.2	5	2.0	7.7	64	4.5
126	CHAR PT 1	C	MAR 11	SA90 BL10	4.6	5	2.0	4.2	35	3.7
125	CHAR PT 1	B	MAR 11	CB50 BL30 SA20	2.1	5	2.0	10.6	87	3.8
130	CHAR PT 2	C	MAR 11	SA100	2.7	5	2.5	1.2	11	4.2
129	CHAR PT 2	C	MAR 11	SA100	1.5	5	2.5	3.7	31	4.9
128	CHAR PT 2	B	MAR 11	CB40 GR40 SA20	0.9	5	2.5	7.8	64	3.6
114	DOUBLE IS	B	OCT 20	SA90 SI10	4.6	12	9.8	6.0	52	9.8
28	RED BLUFF A	B	OCT 24	CB40 BL40 SA20	1.5	9	8.4	11.1	0	8.3
30	RED BLUFF A	C	OCT 24	SA100	4.3	15	8.5	1.3	10	7.3
29	RED BLUFF A	B	OCT 24	SA60 BL30 CB10	2.1	13	8.4	2.1	17	7.6
32	RED BLUFF B	B	OCT 24	GR80 SA10 SI5 CB/BL5	4.3	6	8.0	10.6	88	7.6
33	RED BLUFF B	C	OCT 24	SI100	6.7	8	8.0	1.0	8	7.7
31	RED BLUFF B	B	OCT 24	CB80 GR15 SA5	2.4	2	8.5	11.1	92	7.8
34	RED BLUFF C	B	OCT 24	CB80 BL10 SA10	1.5	5	8.1	10.2	85	8.5
35	RED BLUFF C	B	OCT 24	CB50 SA50	3.7	3	8.3	2.6	22	8.6
36	RED BLUFF C	C	OCT 24	SA100	4.3	15	8.3	1.7	14	8.2
37	RED BLUFF D	B	OCT 24	GR60 SA20 CB20	2.4	3	8.0	9.8	82	8.4
38	RED BLUFF D	B	OCT 24	GR80 SA15 CB5	3.0	2	8.0	7.9	65	8.2
39	RED BLUFF D	C	OCT 24	SA60 SI40	5.8	3	8.2	5.8	50	8.2
42	RED BLUFF E	B	OCT 24	GR40 SA40 CB20	2.4	4	8.0	6.8	55	8.3
43	RED BLUFF E	B	OCT 24	CB70 SA20 SI10	4.0	2	8.5	7.4	60	7.9
44	RED BLUFF E	C	OCT 24	SA70 SI20 CB10	5.5	4	8.5	3.9	32	7.5
41	RED BLUFF F	C	OCT 24	SI90 CB10	2.4	3	8.2	9.3	77	8.7
40	RED BLUFF F	B	OCT 24	CB90 SI10	0.9	5	8.1	11.0	90	8.4
46	RED BLUFF G	B	OCT 24	CB60 GR20 SA20	1.8	5	8.1	10.4	85	8.8
45	RED BLUFF G	B	OCT 24	CB90 SI10	1.2	3	8.2	11.3	88	8.4
48	RED BLUFF H	C	OCT 24	SI100	3.0	3	8.0	1.8	13	8.1
49	RED BLUFF H	C	OCT 24	SI100	5.8	6	8.0	1.4	10	7.9
47	RED BLUFF H	C	OCT 24	SA100	0.6	5	8.0	2.0	16	8.2
112	RED BLUFF I	C	OCT 20	SA/SI100	2.4	10	9.0	3.2	0	0.0
113	RED BLUFF I	WC	OCT 20	WATER COLUMN	2.4	0	9.0	10.0	0	0.0
115	RED BLUFF J	C	OCT 21	SA100	2.4	10	0.0	4.2	0	0.0
116	RED BLUFF J	WC	OCT 21	WATER COLUMN	1.5	0	0.0	10.6	0	0.0
107	TACHEK A	B	OCT 20	SA80 GR20	1.2	14	7.0	2.2	0	0.0
108	TACHEK A	WC	OCT 20	WATER COLUMN	1.2	0	7.0	11.0	0	0.0
109	TACHEK B	A	OCT 20	CB100	0.6	15	10.0	11.2	0	0.0
111	TACHEK C	WC	OCT 20	WATER COLUMN	3.0	0	10.0	10.4	0	0.0
110	TACHEK C	B	OCT 20	CB33 GR33 SA33	3.0	13	10.0	7.2	0	0.0
51	TWAINSAND 1	C	OCT 25	SI85 SA10 CB5	5.8	15	8.3	1.0	8	7.9
50	TWAINSAND 1	C	OCT 25	SI>95 CB<5	14.6	7	8.1	1.4	12	7.7
52	TWAINSAND 1	B	OCT 25	GR80 CB20 SA10	0.9	12	8.2	1.8	14	7.8
58	TWAINSAND 2	C	OCT 25	SI100	4.0	13	8.4	1.5	12	6.8
56	TWAINSAND 2	B	OCT 25	GR80 SA20	0.3	4	7.6	3.2	25	7.2
57	TWAINSAND 2	C	OCT 25	SI100	5.2	3	7.6	4.6	36	6.9
53	TWAINSAND 3	B	OCT 25	SA/GR80 CB20	0.6	5	8.0	2.0	16	7.1
55	TWAINSAND 3	C	OCT 25	SA/SI/GR95 CB5	4.6	6	8.0	1.0	7	8.3
54	TWAINSAND 3	C	OCT 25	SA/SI/GR >95 CB<5	6.1	15	8.0	0.8	6	7.8
64	TWAINSAND 4	B	OCT 25	SA60 GR35 CB5	0.6	13	7.6	0.8	6	5.7
63	TWAINSAND 4	B	OCT 25	SI40 SA40 GR20	3.4	10	7.9	1.8	14	5.7
62	TWAINSAND 4	C	OCT 25	SI100	7.6	5	8.3	1.1	8	6.4
61	TWAINSAND 5	B	OCT 25	CB90 SA/GR10	0.9	3	8.0	5.8	46	6.4
60	TWAINSAND 5	C	OCT 25	SI100	1.5	3	7.5	6.3	51	6.9
59	TWAINSAND 5	C	OCT 25	SA/SI100	4.6	4	8.0	1.5	12	7.1
67	TWAINSAND 6	B	OCT 25	CB50 SA40 GR10	2.1	5	8.3	5.6	44	6.6
66	TWAINSAND 6	C	OCT 25	SI100	6.4	15	8.4	1.5	10	6.7
68	TWAINSAND 6	B	OCT 25	GR80 SA10 CB10	1.2	5	8.2	1.4	11	6.2
65	TWAINSAND 7	B	OCT 25	CB80 GR20 w SA	0.6	4	8.0	9.2	75	8.0
70	TWAINSAND 8	B	OCT 25	SA70 GR20 SI10	2.4	15	8.1	1.2	10	7.8
69	TWAINSAND 8	B	OCT 25	GR80 SA10 CB10	0.9	17	7.8	1.0	8	7.9
71	TWAINSAND 8	B	OCT 25	SA95 GR5 w SI	7.0	16	8.4	1.9	15	7.8

TABLE III. Quadrat data for site surveys of Long Island and Wilkinson Beach. Depth and distance in metres. Estimates of percent composition of substrate are given.

SITE	TRANSECT	DISTANCE	DEPTH	ZONE	SUBSTRATE1	SUBSTRATE2	SUBSTRATE3	SUBSTRATE4
LONG	1	0	1.8	B	GR/SA60	CB40		
LONG	1	5	2.1	B	GR60	CB40		
LONG	1	10	2.4	B	GR60	CB40		
LONG	1	15	3.0	B	GR60	CB40		
LONG	1	20	3.6	B	CB60	GR40		
LONG	1	25	3.9	B	GR60	CB40	some BL	
LONG	1	30	4.2	B	SA40	GR30	CB30	
LONG	1	35	4.2	B	SA/GR40	CB40	BL20	
LONG	1	40	4.5	B	SA/GR60	CB40	BL<5	
LONG	1	45	4.5	B	SA/GR50	CB40	BL10	
LONG	1	50	4.5	B	GR50	CB25	BL25	
LONG	2	0	1.8	B	no data			
LONG	2	5	3.0	B	GR33	SA33	CB33	
LONG	2	10	3.0	B	CB70	GR30		
LONG	2	15	3.3	B	CB60	GR/SA40		
LONG	2	20	3.6	B	CB50	GR/SA50		
LONG	2	25	3.6	B	CB50	GR/SA50		
LONG	2	30	3.6	B	GR/SA60	CB40		
LONG	2	35	3.9	B	CB50	GR50	some BL	
LONG	2	40	3.9	B	CB50	GR50	some BL	
LONG	2	45	3.9	B	CB60	GR40	some BL	
LONG	2	50	4.2	B	CB80	GR20		
LONG	3	0	1.8	A	CB100			
LONG	3	5	2.1	A	CB100			
LONG	3	10	3.0	A	CB100			
LONG	3	15	3.3	B	CB50	GR/SA50		
LONG	3	20	3.6	B	GR/SA60	CB40		
LONG	3	25	3.6	B	CB70	GR30		
LONG	3	30	3.6	B	GR/SA70	CB30		
LONG	3	35	3.9	B	CB50	GR50		
LONG	3	40	4.2	B	CB60	GR40		
LONG	3	45	4.2	B	CB50	GR50	BL<5	
LONG	3	50	4.5	B	CB60	GR40	some SA	some SI
LONG	4	0	1.5	A	GR/CB95	CB5		
LONG	4	5	2.4	A	GR/CB95	CB5		
LONG	4	10	3.0	B	GR/CB95	CB5		
LONG	4	15	3.0	A	GR/CB95	CB5		
LONG	4	20	3.3	B	GR80	CB15	SA5	
LONG	4	25	3.6	B	CB95	SA/GR5		
LONG	4	30	4.2	A	CB100			
LONG	4	35	4.5	B	GR/SA70	CB30		
LONG	4	40	4.8	B	GR/SA70	CB30		
LONG	4	45	4.8	B	GR/SA>95	CB<5		
LONG	4	50	5.2	B	GR/SA>95	CB<5		
LONG	5	0	1.8	A	CB100			
LONG	5	5	2.1	A	CB100			
LONG	5	10	3.0	A	CB100			
LONG	5	15	3.3	A	CB100			
LONG	5	20	3.6	A	CB100			
LONG	5	25	3.6	B	CB80	GR/SA20		
LONG	5	30	3.6	B	CB60	GR20	SA20	
LONG	5	35	4.2	B	SA60	CB25	GR15	
LONG	5	40	4.5	B	SA60	CB25	GR15	
LONG	5	45	4.5	C	SA>95	CB<5	GR<5	
LONG	5	50	4.5	C	SA>95	CB<5	GR<5	SI<5
LONG	6	0	1.5	B	CB95	SA/GR5		
LONG	6	5	1.5	B	CB/BL95	GR/SA5		
LONG	6	10	2.4	B	CB/BL95	GR/SA5		
LONG	6	15	3.0	B	CB/BL90	GR/SA10		
LONG	6	20	3.3	B	CB80	SA10	GR10	
LONG	6	25	3.3	B	CB80	SA10	GR10	
LONG	6	30	3.6	B	CB30	GR30	SA30	BL10
LONG	6	35	3.6	B	CB30	GR30	SA30	BL10
LONG	6	40	4.2	B	CB60	GR20	SA20	
LONG	6	45	4.5	B	SA/GR70	CB30		
LONG	6	50	4.5	C	SA95	CB5		
WILK	1	0	0.0	A	GR100	some BL		

TABLE III (cont'd.). Quadrat data for site surveys of Long Island and Wilkinson Beach. Depth and distance in metres. Estimates of percent composition of substrate are given.

SITE	TRANSECT	DISTANCE	DEPTH	ZONE	SUBSTRATE1	SUBSTRATE2	SUBSTRATE3	SUBSTRATE4
WILK	1	5	0.3	A	CB95	GR5		
WILK	1	10	0.6	B	GR33	SA33	CB33	
WILK	1	15	0.9	B	CB100			
WILK	1	20	0.9	B	GR/CB80	CB20	SA<5	
WILK	1	25	0.9	B	GR/CB50	CB50	SA<5	
WILK	1	30	1.2	B	GR/CB80	CB20	SA<5	
WILK	1	35	1.5	B	GR50	CB50	SA<5	
WILK	1	40	1.8	A	CB100			
WILK	1	45	2.1	A	CB100			
WILK	1	50	3.3	B	GR80	CB15	SA5	
WILK	1	55	4.2	B	CB85	GR10	SA5	
WILK	1	60	4.5	B	CB80	GR15	SA5	
WILK	1	65	5.2	B	CB50	SA30	GR20	
WILK	1	70	5.5	B	SA50	CB30	GR20	
WILK	1	75	6.1	B	SA50	CB45	BL5	
WILK	1	80	6.7	C	SA80	CB20		
WILK	1	85	6.7	C	SA95	BL5		
WILK	2	0	0.0	A	GR>95	BL<5		
WILK	2	5	0.3	A	GR/CB80	CB20		
WILK	2	10	0.6	B	GR/CB90	CB10		
WILK	2	15	0.9	B	CB80	GR20		
WILK	2	20	1.2	B	CB85	CB/BL15		
WILK	2	25	1.2	B	GR/CB85	CB15		
WILK	2	30	1.5	B	CB/GR70	CB30		
WILK	2	35	1.5	A	CB100			
WILK	2	40	1.8	B	CB80	GR20	GR/SA<5	
WILK	2	45	3.3	B	CB85	SA/GR15		
WILK	2	50	3.6	B	CB80	SA/GR20		
WILK	2	55	4.2	B	CB80	SA/GR20		
WILK	2	60	4.5	C	SA90	CB/BL10		
WILK	2	65	5.2	C	SA85	CB15		
WILK	2	70	5.5	C	SA>95	BL/CB<5		
WILK	2	75	5.8	C	SA100	some BL		
WILK	3	0	0.0	A	GR>95	BL<5		
WILK	3	5	0.3	A	CB50	GR50		
WILK	3	10	0.3	A	CB50	GR50		
WILK	3	15	0.6	B	CB95	GR5		
WILK	3	20	0.9	B	SA>95	CB<5		
WILK	3	25	1.2	A	CB/GR95	CB5		
WILK	3	30	1.5	B	GR60	CB40		
WILK	3	35	1.5	B	CB60	GR40		
WILK	3	40	2.7	A	CB100			
WILK	3	45	3.3	A	CB80	GR/SA20		
WILK	3	50	3.6	B	CB70	GR15	SA15	
WILK	3	55	4.2	B	GR/SA70	CB30		
WILK	3	60	4.5	B	CB60	GR/SA40		
WILK	3	65	5.2	B	GR/SA70	CB30		
WILK	3	70	5.8	B	GR/SA80	CB20		
WILK	3	75	6.1	C	SA85	CB15		
WILK	3	80	6.7	C	SA90	CB10		
WILK	3	85	7.6	C	SA95	SI5		
WILK	4	0	0.0	A	BL95	GR5		
WILK	4	5	0.3	A	GR100			
WILK	4	10	0.3	B	CB100			
WILK	4	15	0.6	B	lgCB80	CB/GR20		
WILK	4	20	0.9	B	CB95	SA5		
WILK	4	25	1.2	B	SA90	BL/CB10		
WILK	4	30	1.5	B	SA90	CB10		
WILK	4	35	1.5	B	GR80	CB20	SA<5	
WILK	4	40	1.8	B	CB50	GR25	SA25	
WILK	4	45	2.4	A	CB90	GR10		
WILK	4	50	3.6	A	CB100			
WILK	4	55	3.9	B	CB85	GR/SA15		
WILK	4	60	4.2	B	CB95	SA5		
WILK	4	65	4.5	B	CB40	GR40	SA20	
WILK	4	70	5.2	B	CB45	GR45	SA10	
WILK	4	75	5.5	B	CB40	GR40	SA20	
WILK	4	80	6.1	B	CB70	SA30		
WILK	4	85	6.1	C	SA100			

TABLE IV. Substrate dissolved oxygen data collected from Wilkinson Beach and Long Island in October, 1991. Depth in meters, penetration of substrate in cm. Temp1 is water temperature recorded in the substrate by diver. Temp2 is temperature of the sample at the time of oxygen measurement.

SAMPLE	SITE	ZONE	DATE	SUBSTRATE	DEPTH	PENTRATN	TEMP1	O2PPM	SATUR	TEMP2
4	LONG IS	A	OCT 27	CB/GR100	2.7	10	7.0	11.9	99	7.4
5	LONG IS	A	OCT 27	CB100	3.0	10	8.0	12.0	98	7.2
6	LONG IS	A	OCT 27	CB100	2.1	6	8.0	12.1	98	7.0
117	LONG IS	A	OCT 21	CB100	3.0	13	8.5	11.0	0	0.0
10	LONG IS	A	OCT 27	CB100	2.4	10	7.0	11.3	93	7.4
11	LONG IS	A	OCT 27	CB100	1.8	10	7.0	11.3	92	6.9
1	LONG IS	B	OCT 27	SA75 GR15 CB10 occBL	4.9	4	7.6	8.8	73	7.8
18	LONG IS	B	OCT 27	SA100 inCB	3.0	3	8.0	8.2	67	7.0
24	LONG IS	B	OCT 27	SA95 GR5 in CB	2.1	3	8.0	11.0	89	7.2
23	LONG IS	B	OCT 27	SA95 GR5 in CB	3.0	4	8.0	7.1	58	7.8
16	LONG IS	B	OCT 27	SA100 in CB	2.7	5	8.0	3.4	27	7.6
121	LONG IS	B	OCT 21	SA/GR100	0.0	5	0.0	7.0	0	0.0
8	LONG IS	B	OCT 27	SA45 CB40 GR15	4.0	4	7.6	9.4	77	7.5
9	LONG IS	B	OCT 27	SA75 CB10 GR10 BL5	5.2	7	7.6	2.7	22	7.4
12	LONG IS	B	OCT 27	GR50 SA50 in BL	1.8	4	8.0	6.8	55	6.8
119	LONG IS	B	OCT 21	SA100	3.0	5	9.0	3.2	0	0.0
17	LONG IS	B	OCT 27	SA95 GR5 in CB	2.7	4	8.0	4.1	33	7.4
22	LONG IS	B	OCT 27	SA95 GR5 in CB	3.0	4	8.0	7.1	58	7.8
7	LONG IS	B	OCT 27	GR40 SA40 BL20	4.9	4	7.6	10.4	87	8.3
2	LONG IS	B	OCT 27	SA70 GR15 CB10 BL5	4.3	4	7.5	8.9	73	7.4
3	LONG IS	B	OCT 27	SA80 CB20	4.9	5	7.6	6.6	54	7.4
21	LONG IS	C	OCT 27	SA90 CB5 GR5	4.6	10	7.8	8.3	69	7.9
14	LONG IS	C	OCT 27	SA80 GR10 SI10	5.2	10	7.6	5.2	43	8.0
15	LONG IS	C	OCT 27	SA80 GR15 SI5	4.9	5	7.6	10.5	86	7.5
13	LONG IS	C	OCT 27	SA90 CB5 GR5	5.2	7	7.6	5.0	41	7.9
25	LONG IS	C	OCT 27	SA90 GR5 SI5	4.9	5	7.7	10.8	88	7.8
19	LONG IS	C	OCT 27	SA90 GR5 SI5	4.6	11	7.7	5.7	46	8.0
20	LONG IS	C	OCT 27	SA90 CB5 GR5	4.3	10	7.7	10.9	90	8.0
26	LONG IS	C	OCT 27	SA95 GR5	5.2	4	7.7	11.0	90	8.1
27	LONG IS	C	OCT 27	SA/SI>95 GR/CB<5	4.6	15	8.0	11.3	92	8.0
120	LONG IS	WC	OCT 21	WATER COLUMN	3.0	0	9.0	10.9	0	0.0
122	LONG IS	WC	OCT 21	WATER COLUMN	0.0	0	0.0	10.8	0	0.0
118	LONG IS	WC	OCT 21	WATER COLUMN	3.0	0	8.5	11.1	0	0.0
80	WILKINSON	A	OCT 22	CB100	4.6	8	8.6	11.0	92	8.5
73	WILKINSON	A	OCT 22	CB100	4.6	10	8.6	11.0	91	9.0
72	WILKINSON	A	OCT 22	CB100	5.5	10	8.7	11.0	91	9.3
79	WILKINSON	A	OCT 22	CB100	5.2	8	8.7	11.0	93	8.8
74	WILKINSON	A	OCT 22	CB100	3.7	8	8.5	11.1	92	8.5
78	WILKINSON	A	OCT 22	CB100	4.6	8	8.7	11.0	93	8.8
84	WILKINSON	A	OCT 22	CB100	5.5	15	8.8	11.0	91	9.0
85	WILKINSON	A	OCT 22	CB100	5.2	15	8.7	11.0	92	8.6
99	WILKINSON	A	OCT 22	CB100	4.6	15	8.9	11.1	96	9.2
86	WILKINSON	A	OCT 22	CB100	4.6	15	8.7	11.0	92	8.7
100	WILKINSON	B	OCT 22	SA100	6.1	4	8.8	5.9	51	8.8
82	WILKINSON	B	OCT 22	SA/SI100 in CB	6.4	7	8.0	3.2	27	8.5
87	WILKINSON	B	OCT 22	SA100 in CB	5.5	6	8.0	5.4	45	9.3
81	WILKINSON	B	OCT 22	SA/SI100 in CB	5.8	7	8.0	6.1	51	8.7
77	WILKINSON	B	OCT 22	SA/SI100 in CB	6.1	8	8.0	10.1	85	8.6
88	WILKINSON	B	OCT 22	SA100 in CB	6.1	6	8.5	4.9	41	9.2
101	WILKINSON	B	OCT 22	SA100	6.4	4	8.9	6.7	57	8.4
102	WILKINSON	B	OCT 22	SA100	6.4	5	8.9	6.9	68	8.1
76	WILKINSON	B	OCT 22	SA100 in CB	5.5	6	9.0	6.5	55	8.6
75	WILKINSON	B	OCT 22	SA/GR100 in CB	4.3	5	8.5	4.9	42	7.9
106	WILKINSON	C	OCT 22	SA80 SI20	6.7	14	8.0	1.5	13	9.1
105	WILKINSON	C	OCT 22	SA80 SI20	6.7	13	8.5	1.5	12	9.1
104	WILKINSON	C	OCT 22	SA/SI100	7.6	8	8.9	3.0	25	7.9
103	WILKINSON	C	OCT 22	SA/SI100	7.6	8	8.9	8.5	72	8.2
83	WILKINSON	C	OCT 22	SA/SI100	7.0	7	9.0	2.3	19	8.4
98	WILKINSON	C	OCT 22	SA80 SI20	7.3	8	8.5	1.6	14	9.1
95	WILKINSON	C	OCT 22	SA/SI100	7.6	8	8.9	3.2	28	9.5
89	WILKINSON	C	OCT 22	SA/SI100	6.7	10	8.5	3.4	31	9.1
96	WILKINSON	C	OCT 22	SA80 SI20	7.0	15	8.5	1.4	12	9.4
97	WILKINSON	C	OCT 22	SA80 SI20	7.3	11	8.5	1.2	10	9.4
93	WILKINSON	C	OCT 22	SA/SI100	7.9	8	8.9	7.9	68	9.6
91	WILKINSON	WC	OCT 22	WATER COLUMN	5.2	0	8.7	11.1	92	9.2
90	WILKINSON	WC	OCT 22	WATER COLUMN	5.5	0	8.7	10.9	91	9.1

TABLE V. Survival and substrate dissolved oxygen data for sockeye eggs outplanted at Wilkinson Beach and Long Island. Sub? indicates if a substrate sample was taken at the egg incubation site.

SITE	DATE	ZONE	SAMPLE #	DO DATA TEMP	SUBS	SYR	TEMP	PPM	%SAT	family	group	TOTAL OUTPL	EGGS DEAD	EGGS ALIVE	ALEVINS DEAD	ALEVINS ALIVE	PROP. SURVIV
Hatchery	08-Mar-92	H	137	.	no	.	.	.	.	6	eyed	100	100	0	0	92	92.0
Hatchery	08-Mar-92	H	141	.	no	.	.	.	.	2	eyed	100	2	0	4	94	94.0
Hatchery	08-Mar-92	H	136	.	no	.	.	.	.	5	eyed	100	6	0	0	97	97.0
Hatchery	08-Mar-92	H	132	.	no	.	.	.	.	9	eyed	100	2	0	0	98	98.0
Hatchery	08-Mar-92	H	133	.	no	.	.	.	.	10	eyed	100	2	0	0	98	98.0
Hatchery	08-Mar-92	H	140	.	no	.	.	.	.	1	eyed	100	2	0	0	98	98.0
Hatchery	08-Mar-92	H	143	.	no	.	.	.	.	4	eyed	100	2	0	0	98	98.0
Hatchery	08-Mar-92	H	135	.	no	.	.	.	.	12	eyed	100	2	0	0	99	99.0
Hatchery	08-Mar-92	H	134	.	no	.	.	.	.	11	eyed	100	1	0	0	99	99.0
Hatchery	08-Mar-92	H	138	.	no	.	.	.	.	7	eyed	100	1	0	0	99	99.0
Hatchery	08-Mar-92	H	139	.	no	.	.	.	.	8	eyed	100	1	0	0	100	100.0
Hatchery	08-Mar-92	H	142	.	no	.	.	.	.	3	eyed	100	0	0	0	100	100.0
Long	09-Mar-92	A	155	2	no	9	6.2	11.7	100	8	eyed	100	1	0	4	95	95.0
Long	09-Mar-92	A	156	2	no	10	.	.	.	10	eyed	100	0	0	4	96	96.0
Long	10-Mar-92	A	168	2.2	no	10	4.1	11.5	99	9	eyed	100	2	0	2	96	96.0
Long	09-Mar-92	A	161	1.8	no	8	3.6	11	93	3	eyed	100	0	0	4	96	96.0
Long	09-Mar-92	A	157	1.8	no	1	3.5	9.3	79	11	eyed	100	0	0	3	97	97.0
Long	10-Mar-92	A	163	2.2	no	1	4.2	11.5	104	7	eyed	100	2	0	1	97	97.0
Long	09-Mar-92	A	151	2	yes	6	3.8	11.2	92	4	eyed	100	2	0	1	97	97.0
Long	09-Mar-92	A	160	2	no	5	3.5	11.5	95	12	eyed	100	2	0	0	98	98.0
Long	10-Mar-92	A	166	2	no	11	5	11.7	103	1	eyed	100	0	0	2	98	98.0
Long	10-Mar-92	A	165	2	no	8	3.8	11.3	97	2	eyed	100	1	0	1	98	98.0
Long	09-Mar-92	A	159	1.8	no	11	3.5	10	84	5	eyed	100	0	0	1	99	99.0
Long	09-Mar-92	A	152	1.8	yes	1	3.8	11	91	6	eyed	100	0	0	0	100	100.0
Long	09-Mar-92	AD	150	2	yes	4	3.2	11.3	91	11	eyed	100	1	0	21	78	78.0
Long	10-Mar-92	AD	162	2	no	12	4	10.9	94	12	eyed	100	0	0	19	81	81.0
Long	10-Mar-92	AD	171	2.5	no	7	7.8	11.5	101	4	eyed	100	4	0	12	84	84.0
Long	10-Mar-92	AD	169	2	no	11	3.2	10.8	90	1	eyed	100	0	0	16	84	84.0
Long	10-Mar-92	AD	167	2.5	no	5	3.4	10.7	93	3	eyed	100	1	0	13	86	86.0
Long	10-Mar-92	AD	172	2	no	2	3.9	11.6	100	7	eyed	100	0	0	11	89	89.0
Long	09-Mar-92	AD	149	2	yes	5	3.7	10.2	84	6	eyed	100	1	0	6	93	93.0
Long	10-Mar-92	AD	164	2.5	no	4	3.4	11.1	92	8	eyed	100	2	0	5	93	93.0
Long	09-Mar-92	AD	158	2	no	2	.	.	.	2	eyed	100	2	0	4	94	94.0
Long	10-Mar-92	AD	170	2	no	1	3.9	11.3	97	5	eyed	100	0	0	4	96	96.0
Long	09-Mar-92	AD	154	2	no	12	4.1	7.2	62	10	eyed	100	0	0	3	97	97.0
Long	09-Mar-92	AD	153	2	yes	3	3.1	11.2	91	9	eyed	100	0	0	1	99	99.0
Long	09-Mar-92	B	144	2.5	yes	10	3.7	6.4	54	12	eyed	100	.	.	.	.	.
Long	09-Mar-92	B	145	3	yes	11	4.2	5.2	44	2	eyed	100	100	0	0	0	0.0
Long	09-Mar-92	B	146	2.5	yes	12	3.7	6.2	52	8	eyed	100	100	0	0	0	0.0
Long	09-Mar-92	B	148	2	yes	9	4.6	5.8	50	10	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	203	.	no	.	.	.	.	3	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	182	.	no	.	.	.	.	6	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	179	.	no	.	.	.	.	8	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	186	.	no	.	.	.	.	5	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	180	.	no	.	.	.	.	1	eyed	100.	100	0	0	0	0.0
Long	10-Mar-92	B	188	.	no	.	.	.	.	11	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	202	.	no	.	.	.	.	12	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	173	.	no	.	.	.	.	9	eyed	100	100	0	0	0	0.0
Long	09-Mar-92	B	147	2.5	yes	8	3.5	9.8	80	3	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	B	174	.	no	.	.	.	.	11	eyed	100	1	0	83	16	16.0
Long	10-Mar-92	B	181	.	no	.	.	.	.	7	eyed	100	18	0	53	29	29.0
Long	10-Mar-92	B	189	.	no	.	.	.	.	5	eyed	100	22	0	25	53	53.0
Long	10-Mar-92	B	187	.	no	.	.	.	.	6	eyed	100	8	0	31	61	61.0
Long	10-Mar-92	C	190	.	no	.	.	.	.	4	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	198	.	no	.	.	.	.	9	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	191	.	no	.	.	.	.	5	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	199	.	no	.	.	.	.	10	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	194	.	no	.	.	.	.	6	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	193	.	no	.	.	.	.	2	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	201	.	no	.	.	.	.	8	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	200	.	no	.	.	.	.	3	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	197	.	no	.	.	.	.	11	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	196	.	no	.	.	.	.	7	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	195	.	no	.	.	.	.	12	eyed	100	100	0	0	0	0.0
Long	10-Mar-92	C	192	.	no	.	.	.	.	1	eyed	100	100	0	0	0	0.0

TABLE V. Survival and substrate dissolved oxygen data for sockeye eggs outplanted at Wilkinson Beach and Long Island. Sub? indicates if a substrate sample was taken at the egg incubation site.

SITE	DATE	ZONE	SAMPLE	DO DATA								TOTAL	EGGS		ALEVINS		PROP.
			#	TEMP1	SUBS?	SYR#	TEMP2	PPM	%SAT	family	group	OUTPL	DEAD	ALIVE	DEAD	ALIVE	SURVIV
River	08-Mar-92	R	118	.	no	.	.	.	.	9	eyed	100	15	0	0	85	85.0
River	08-Mar-92	R	110	2	yes	12	4.3	12.8	108	8	eyed	100	8	0	0	92	92.0
River	08-Mar-92	R	120	.	no	.	.	.	.	4	eyed	100	4	0	0	96	96.0
River	08-Mar-92	R	131	.	no	.	.	.	.	9	eyed	100	3	0	0	97	97.0
River	08-Mar-92	R	108	2	yes	10	4.3	12.5	109	6	eyed	100	2	0	0	98	98.0
River	08-Mar-92	R	116	2	no	2	5.1	12.9	118	2	eyed	100	1	0	0	99	99.0
River	08-Mar-92	R	129	.	no	.	.	.	.	12	eyed	100	1	0	0	99	99.0
River	08-Mar-92	R	114	2	no	3	5.1	12.8	116	2	eyed	100	1	0	0	99	99.0
River	08-Mar-92	R	125	.	no	.	.	.	.	10	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	124	.	no	.	.	.	.	7	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	121	.	no	.	.	.	.	3	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	115	2	yes	8	4.5	12.3	106	5	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	113	2	yes	1	3.7	12.5	107	11	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	128	.	no	.	.	.	.	7	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	122	.	no	.	.	.	.	10	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	130	.	no	.	.	.	.	3	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	126	.	no	.	.	.	.	8	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	127	.	no	.	.	.	.	2	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	109	2	no	7	3.7	12.6	107	5	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	111	2	no	4	3.9	12.8	111	6	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	119	.	no	.	.	.	.	11	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	112	2	no	9	5	12.7	111	1	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	123	.	no	.	.	.	.	9	eyed	100	0	0	0	100	100.0
River	08-Mar-92	R	117	2	yes	5	3.7	12.2	106	1	eyed	100	0	1	0	99	100.0
Wilkinson	06-Mar-92	A	54	2.5	no	7	3.1	11.5	98	9	eyed	100	0	0	0	100	100.0
Wilkinson	05-Mar-92	A	8	2.0	yes	9	3.3	11.4	97	7	eyed	100	37	0	0	63	63.0
Wilkinson	06-Mar-92	A	51	2.5	no	8	2.8	11.7	95	8	eyed	100	0	0	9	91	91.0
Wilkinson	05-Mar-92	A	17	2.0	no	6	3.2	11.6	93	6	eyed.	100	6	0	3	91	91.0
Wilkinson	05-Mar-92	A	3	2.0	yes	6	3.1	11.4	95	10	eyed	100	6	0	2	92	92.0
Wilkinson	05-Mar-92	A	19	3.0	no	1	3.9	11.7	99	12	eyed	100	0	0	8	93	93.0
Wilkinson	06-Mar-92	A	50	2	no	1	3.5	11.2	92	8	eyed	100	7	0	0	93	93.0
Wilkinson	06-Mar-92	A	56	2.5	no	9	3.1	11.4	92	6	eyed	100	2	0	3	95	95.0
Wilkinson	06-Mar-92	A	52	2.5	no	11	2.6	11.6	94	1	eyed	100	0	0	5	95	95.0
Wilkinson	05-Mar-92	A	16	2.0	no	4	2.8	11.4	93	2	eyed	100	0	0	4	96	96.0
Wilkinson	06-Mar-92	A	49	2	no	5	3.2	11.4	93	4	eyed	100	3	0	0	97	97.0
Wilkinson	05-Mar-92	A	4	2.0	yes	7	3.3	11.6	96	2	eyed	100	3	0	0	97	97.0
Wilkinson	05-Mar-92	A	20	2.5	no	8	2.9	11.7	93	12	eyed	100	0	0	2	98	98.0
Wilkinson	06-Mar-92	A	47	2	no	3	3.4	11.5	94	11	eyed	100	1	0	0	99	99.0
Wilkinson	06-Mar-92	A	55	2.5	no	12	3.1	11.6	96	10	eyed	100	1	0	0	99	99.0
Wilkinson	06-Mar-92	A	46	2	no	6	3.2	11.4	92	4	eyed	100	0	0	1	99	99.0
Wilkinson	05-Mar-92	A	2	2.0	yes	5	3.0	11.6	96	1	eyed	100	0	0	1	99	99.0
Wilkinson	05-Mar-92	A	7	3.0	yes	10	2.8	11.5	96	9	eyed	100	1	0	0	99	99.0
Wilkinson	06-Mar-92	A	62	2	no	8	3.4	11.3	92	3	eyed	100	1	0	0	99	99.0
Wilkinson	05-Mar-92	A	1	2.0	yes	8	2.8	11.6	97	5	eyed	100	0	0	0	100	100.0
Wilkinson	06-Mar-92	A	53	2.5	no	10	2.6	11	89	3	eyed	100	0	0	0	100	100.0
Wilkinson	06-Mar-92	A	44	2	no	2	3.1	11.3	92	7	eyed	100	0	0	0	100	100.0
Wilkinson	06-Mar-92	A	48	2.5	no	4	3.4	11.4	93	5	eyed	100	0	0	0	100	100.0
Wilkinson	05-Mar-92	A	6	2.5	yes	4	3.6	11.6	96	11	eyed	100	0	0	0	100	100.0
Wilkinson	06-Mar-92	B	78	.	no	.	.	.	.	6	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	B	11	3.0	yes	10	3.7	4.2	35	2	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	88	.	no	.	.	.	.	10	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	86	.	no	.	.	.	.	8	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	87	.	no	.	.	.	.	12	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	B	15	3.0	yes	1	4.6	3.5	30	11	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	B	14	2.8	yes	6	3.8	2.3	20	3	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	41	2	no	7	5.8	3	25	5	eyed	100	99	0	1	0	0.0
Wilkinson	06-Mar-92	B	85	.	no	.	.	.	.	7	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	37	2	yes	1	2.9	5.9	50	1	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	89	.	no	.	.	.	.	7	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	42	2	no	10	4.8	10.4	88	9	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	B	12	3.0	yes	7	4.2	2.1	18	6	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	34	2.5	yes	4	5.1	10.7	90	4	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	B	13	3.0	yes	5	3.9	4.2	36	4	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	32	2	yes	1	2.9	7.9	64	5	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	43	2	no	9	4	1.9	16	11	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	81	.	no	.	.	.	.	10	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	35	2	yes	3	2.8	10.7	86	2	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	33	2	yes	2	5	4.9	41	12	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	31	2	no	12	4.1	4.9	41	1	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	84	.	no	.	.	.	.	3	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	B	45	2	no	11	5.2	5.8	49	8	eyed	100	100	0	0	0	0.0

TABLE V. Survival and substrate dissolved oxygen data for sockeye eggs outplanted at Wilkinson Beach and Long Island. Sub? indicates if a substrate sample was taken at the egg incubation site.

SITE	DATE	ZONE	SAMPLE #	DO DATA TEMP1	SUBS?	SYR	TEMP2	PPM	%SAT	family	group	TOTAL OUTPL	EGGS DEAD	EGGS ALIVE	ALEVINS DEAD	ALEVINS ALIVE	PROP. SURVIV
Wilkinson	06-Mar-92	C	74	.	no	.	.	.	.	9	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	27	2.5	yes	8	3.2	6.7	55	4	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	83	.	no	.	.	.	.	10	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	59	.	no	.	.	.	.	11	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	28	2.5	yes	7	3	5	41	3	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	66	.	no	.	.	.	.	12	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	29	2.5	yes	5	3.1	4	33	8	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	68	.	no	.	.	.	.	6	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	60	.	no	.	.	.	.	7	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	57	.	no	.	.	.	.	5	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	36	2.5	yes	5	3.4	4.6	38	1	eyed	100	100	0	0	0	0.0
Wilkinson	06-Mar-92	C	26	2.5	yes	6	3.1	3.3	27	2	eyed	100	100	0	0	0	0.0
Wilkinson	05-Mar-92	A	21	2.5	no	9	3.7	11.6	96	2	fert	50	50	0	0	0	0.0
Wilkinson	05-Mar-92	A	9	3.0	yes	1	3.4	11.4	97	3	fert	50	50	0	0	0	0.0
Wilkinson	05-Mar-92	A	18	2.5	no	2	3.2	11.7	96	2	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	A	91	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	A	93	.	no	.	.	.	.	1	fert	50	46	3	0	1	8.0
Wilkinson	07-Mar-92	A	96	.	no	.	.	.	.	2	fert	50	45	0	0	5	10.0
Wilkinson	07-Mar-92	A	95	.	no	.	.	.	.	1	fert	50	36	10	0	4	28.0
Wilkinson	05-Mar-92	A	22	2.5	no	10	3.0	11.6	94	2	fert	50	34	16	0	0	32.0
Wilkinson	05-Mar-92	A	23	2.5	no	3	3.7	11.7	97	2	fert	50	27	23	0	0	46.0
Wilkinson	07-Mar-92	A	90	.	no	.	.	.	.	1	fert	50	26	13	0	11	48.0
Wilkinson	07-Mar-92	A	92	.	no	.	.	.	.	4	fert	50	14	36	0	0	72.0
Wilkinson	05-Mar-92	A	5	2.0	yes	3	3.2	11.5	97	3	fert	50	14	35	0	1	72.0
Wilkinson	05-Mar-92	A	25	3.0	no	5	2.6	11.7	93	3	fert	50	9	41	0	0	82.0
Wilkinson	05-Mar-92	A	24	3.0	no	7	2.8	11.8	95	3	fert	50	8	41	0	1	84.0
Wilkinson	07-Mar-92	A	94	.	no	.	.	.	.	1	fert	50	7	41	0	2	86.0
Wilkinson	05-Mar-92	A	10	2.0	yes	1	5.8	11.6	100	3	fert	50	5	45	0	0	90.0
Wilkinson	07-Mar-92	B	105	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	104	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	107	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	106	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	103	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	98	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	101	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	102	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	B	38	2	no	12	5	2.1	19	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	B	30	2	no	11	3.4	1.8	16	4	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	B	39	2	no	10	3.6	1.6	14	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	B	82	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	99	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	97	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	B	40	2	no	9	3.8	4.6	38	3	fert	50	50	0	0	0	0.0
Wilkinson	07-Mar-92	B	100	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	70	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	72	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	80	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	73	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	76	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	69	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	79	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	77	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	63	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	64	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	67	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	61	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	75	.	no	.	.	.	.	2	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	71	.	no	.	.	.	.	4	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	65	.	no	.	.	.	.	1	fert	50	50	0	0	0	0.0
Wilkinson	06-Mar-92	C	58	.	no	.	.	.	.	3	fert	50	50	0	0	0	0.0

TABLE VI. Substrate particle size from samples taken at egg incubation sites. The weight of each size fraction is given.

				WEIGHT (g)								
Site	Date	Zone	Sample#	>100mm	100-50mm	50-25mm	25-12.7mm	12.7-9.5mm	9.5-4.8mm	4.8-3.4mm	<3.4mm	TOTAL
Long	09-Mar-92	A	152	0	1047.4	5536.5	469.2	0	0	0	0	7053
Long	09-Mar-92	A	151	0	1541.0	4429.2	623.5	0.7	0	0	0	6594
Long	09-Mar-92	AD	150	0	1596.9	4211.1	1218.6	29	31.2	11.3	84	7183
Long	09-Mar-92	AD	149	0	2020.1	3539.4	419.1	8.2	2.8	0.7	25	6015
Long	09-Mar-92	AD	153	0	2246.4	4971.9	77.9	3.2	5.1	1.3	41	7347
Long	09-Mar-92	B	144	0	2126.9	1354.6	161.0	43.2	74.4	26.5	682	4469
Long	09-Mar-92	B	145	0	537.8	2218.2	406.8	144.8	266.3	121.6	1845	5540
Long	09-Mar-92	B	147	0	675.3	2225.5	673.0	23.7	54.7	17.0	599	4268
Long	09-Mar-92	B	146	0	0.0	707.4	773.7	166.2	162.0	164.7	1506	3480
Long	09-Mar-92	B	148	0	0.0	957.9	571.4	266.3	395.0	161.4	1681	4033
River	08-Mar-92	R	108	0	2955.2	3723.3	1245.5	2.1	0	0	0	7926
River	08-Mar-92	R	117	0	2955.5	5836.1	0	0	0	0	0	8792
River	08-Mar-92	R	115	0	5444.4	3843.9	68.2	0	0	0	0	9357
River	08-Mar-92	R	110	0	4196.2	2956.4	0	0	0	0	0	7153
River	08-Mar-92	R	113	0	4298.2	3575.4	71.5	0	0	0	0	7945
Vibertbox	06-Mar-92	V	991	0	0	4486	1713.3	16.9	0	0	0	6216
Vibertbox	06-Mar-92	V	994	0	0	0	5075.1	2656.3	20.3	0	0	7752
Vibertbox	06-Mar-92	V	993	0	0	0	3397.6	3632.4	161.5	0	0	7192
Vibertbox	06-Mar-92	V	992	0	112.8	3417.9	2077.4	25.1	0	0	0	5633
Wilkinson	05-Mar-92	A	10	0	5090.2	1608.9	0	0	0	0	0	6699
Wilkinson	05-Mar-92	A	7	0	3013.8	2745.9	0	0	0	0	0	5760
Wilkinson	05-Mar-92	A	2	0	4444.8	2439.8	0	0	0	0	0	6885
Wilkinson	24-Oct-91	A	803	0	6180.5	4438.5	0	0	0	0	0	10619
Wilkinson	05-Mar-92	A	1	0	5634.4	1907.5	0	0	0	0	0	7542
Wilkinson	20-Oct-91	A	801	0	4265.0	2554.0	0	0	0	0	0	6819
Wilkinson	05-Mar-92	A	9	0	6006.3	1898.8	5.7	0	0	0	0	7911
Wilkinson	05-Mar-92	A	4	0	4823.8	2084.8	0	0	0	0	0	6909
Wilkinson	05-Mar-92	A	6	0	3210.6	2878.3	133.2	0	0	0	0	6222
Wilkinson	05-Mar-92	A	3	0	3674.1	3355	0	0	0	0	0	7029
Wilkinson	05-Mar-92	A	5	1397.6	4272.9	1424.4	0	0	0	0	0	7095
Wilkinson	05-Mar-92	A	8	0	7464.6	633.1	0	0	0	0	0	8098
Wilkinson	20-Oct-91	A	802	0	3000.2	4249.0	32.6	0	0	0	0	7282
Wilkinson	24-Oct-91	B	805	0	1061.6	1121.7	453.8	309.9	656.4	238.9	1519	5362
Wilkinson	06-Mar-92	B	34	0	3527.3	1999.8	983.6	194.8	147.4	39.1	277	7169
Wilkinson	06-Mar-92	B	37	3077.3	2079.5	1424.7	1013.1	168.2	256.6	77.9	1087	9184
Wilkinson	06-Mar-92	B	32	0	3198.6	2340.4	1125.4	213.8	324.1	92.7	1061	8356
Wilkinson	06-Mar-92	B	35	0	1063.6	2017.8	1698.3	238.7	432.2	127.6	1000	6578
Wilkinson	05-Mar-92	B	15	0	4059.4	1454.1	684.8	172.6	149.7	55.2	615	7191
Wilkinson	06-Mar-92	B	33	0	3968.4	2029.4	783.4	136.5	210.3	66.3	690	7884
Wilkinson	05-Mar-92	B	12	0	5101.6	1321.8	657.3	85	101.2	28.5	475	7770
Wilkinson	05-Mar-92	B	14	1943.8	3315.5	769.4	476.4	97.1	92.2	37.5	291	7023
Wilkinson	05-Mar-92	B	11	0	1030.8	3119.4	1504.8	300.1	345.9	116.5	809	7227
Wilkinson	05-Mar-92	B	13	1920.6	4033	1533.2	527.9	108.2	123.5	34.6	407	8688
Wilkinson	24-Oct-91	B	804	0	4000.1	529.5	1162.6	530.7	757.1	251.9	1701	8933
Wilkinson	06-Mar-92	C	28	0	0	0	0	1.9	16.7	47.7	5464	5530
Wilkinson	06-Mar-92	C	27	0	0	85.6	19.5	1.4	10.1	31.6	4987	5135
Wilkinson	06-Mar-92	C	29	0	0	48.5	0	2.1	6.1	16.9	5288	5362
Wilkinson	24-Oct-91	C	806	0	0	95.8	9.8	1.9	29.8	60.5	1395	1593
Wilkinson	24-Oct-91	C	807	0	0	0	0	0	4.9	35.1	1502	1542
Wilkinson	06-Mar-92	C	26	0	0	0	0	0	7.1	16.6	4974	4998
Wilkinson	06-Mar-92	C	36	0	0	0	0	5.9	14.6	51.1	5748	5820

APPENDIX 2

Index of Video Documentation

Index of Video 1. Habitat and Site Surveys.

Time (hr:mi:sec)	Footage (ft)	Description
0:00:06	0.7	SOCKEYE EGG SURVIVAL IN BABINE LAKE
0:00:13	1.4	HABITAT SURVEYS
0:00:21	2.1	Wilkinson Bay 3
0:01:55	13.1	Red Bluff 2
0:04:02	27.5	Red Bluff 4
0:07:43	52.9	Long Channel 1
0:09:12	63.3	Long Channel 2
0:11:54	81.8	Double Island
0:14:52	102.4	Twain Creek Twainsand 1
0:18:03	123.8	Sandspit Twainsand 8
0:20:45	142.3	Char Point 2
0:23:32	160.9	SITE SURVEYS - WILKINSON BEACH
0:23:41	162.9	Transect 1
0:29:54	205.6	Transect 2
0:36:33	250.9	Transect 3
0:42:23	291.5	Transect 4
0:49:33	340.3	SITE SURVEY - LONG ISLAND
0:49:33	340.3	Transect 1
0:54:50	376.8	Transect 2
1:02:22	429.0	Transect 3
1:08:25	470.3	Transect 4
1:13:46	507.4	LAYOUT OF INCUBATION BOXES AT WILKINSON BAY
1:13:58	508.8	Habitat C
1:15:16	517.7	Habitat B
1:16:46	528.0	Habitat A
1:18:12	537.6	LAYOUT OF INCUBATION BOXES AT LONG ISLAND
1:18:17	538.3	Habitat A
1:18:53	542.4	Habitat B
1:20:25	552.8	Habitat C
1:21:46	562.4	CREDITS

TOTAL TIME OF VIDEO = 01:22:00

Index of Video 2. Methods used in Babine Lake Sockeye Survival Study.

Time (min:sec)	Footage (ft)	Description
00:07	0.7	SOCKEYE EGG SURVIVAL IN BABINE LAKE
00:25	2.8	DISSOLVED OXYGEN SAMPLING
00:34	4.1	Habitat A
02:35	17.9	Habitat B
03:55	26.8	Habitat C
05:12	35.8	OUTPLANTING OF SOCKEYE EGGS
05:52	40.6	Habitat A
07:21	50.2	Habitat B
08:28	58.4	Habitat C
09:16	63.9	Temperature Probe
10:15	70.1	RETRIEVAL AT LONG ISLAND
12:37	86.6	LAKE CHAR REDDS
13:37	93.5	COLLECTING LAKE CHAR EGGS
14:02	96.3	CREDITS

TOTAL LENGTH OF VIDEO = 14:20