



TETRA TECH, INC.  
630 NORTH ROSEMEAD BLVD.  
PASADENA, CALIFORNIA 91107  
TELEPHONE (213) 449-6400  
TELEX NO. 67-5345  
TETRATECH PSD

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24 August 1978

Mr. Mark Hutton  
Assistant Executive Director  
North Pacific Fishery Management Council  
P.O. Box 3136DT  
Anchorage, AK 99510

Dear Mark:

This letter is a cruise report describing the activities and accomplishments of Tetra Tech personnel aboard the vessels R.V. *Oregon* and M.V. *Sea Hawk* during July and August 1978. All operations were in the Bering Sea (between 158° and 161°, W. Long. and 56° and 58°, N. Lat.) and in conjunction with Tetra Tech's participation (pursuant to your contract number 78-10) in the experimental clam harvesting being conducted by the National Marine Fisheries Service.

In general, I feel the field effort went smoothly and as successfully as could be expected under the sometimes adverse conditions described below.

No major damage to, loss of, or breakdown of equipment occurred on either vessel, and importantly, no serious injuries were sustained by crew or scientific party. Although usually overcast, sea conditions were generally quite adequate for sampling by grab, underwater television, and otter trawl. Sampling was by-and-large accomplished according to schedule.

4 July to 10 July 1978. Dr. Gerald J. Bakus and Fred Stern of Tetra Tech were aboard the M.V. *Sea Hawk*; owner John Roberts served as Master and Steve Hughes (NMFS) as Party Chief. The original plans called for 2 to 4 days at the end of this segment for Bakus and Stern to conduct pre-harvest grab sampling in at least 2 of the 4 study plots in Block 60. This goal was not attained for one or some combinations of reasons:

- (1) The *Sea Hawk* departed Seattle 5 days late and arrived at Peterson Pt. 2 days later than schedule;
- (2) PSP harvesting took a little longer than originally planned and had priority over the benthic sampling;



- (3) A day or so of bad weather around July 9 hampered all collecting efforts somewhat;
- (4) Block 60 was found to support a relatively sparse number of clams and time was spent searching (with the harvester) for a suitable replacement.

During this period of time Jerry and Fred did participate in the harvesting operation and documented the kinds and relative abundance of epifauna which was collected incidentally by the harvester. A voucher collection of representative specimens was made.

10 July to 26 July 1978. Tom Kawling and Tom Grieb joined Fred Stern as Tetra Tech personnel aboard the R.V. *Oregon* while G. Bakus disembarked. Wendell Schneider served as Master of the *Oregon* and Fred Wathney (NMFS) as Party Chief.

#### Grab Sampling

The first several days aboard the *Oregon* were spent in collecting pre-harvest samples from the PC and 80 percent plots established by S. Hughes on the *Sea Hawk*. Upon collection, 10 infaunal sub-cores were taken from each grab and washed through nested 2.0 and 1.0 mm screens. The organisms retained were sorted from remaining sediment, sorted to taxa, and counted. The data from two grabs, one each--PC and 80 percent plots--were used to generate species area curves, the original figures of which are included on the following page. As can be seen, no clear asymptote resulted from either data base, although the accumulation of species appears to have stopped in the control grab. In order to be conservative we elected therefore to take 15 infaunal sub-cores from all subsequent grabs. Because we also observed very low species diversity and abundance we decided to dispense with the 2.0 mm screen and wash all cores on the 1.0 mm screen only.

Finally, because the shipboard sorting and identifying proved very time consuming, we decided to take a conservatively large number (6) of replicate grabs at each station, even though 4 might well serve to adequately describe the benthos at each site. That is, species/area curves for number of grabs were not generated. During these and all subsequent "random" grab sampling operations, we experienced no real difficulties whatsoever. The frame mounted van Veen grab functioned flawlessly, penetrating about 24 cm on most occasions, seldom less than 20 cm (in which case the sample was discarded), and often 27 or more cm. The only "water samples"

obtained or misfires experienced were attributed to human error or high seas. Very occasionally the sample washed out if a rock caught between the jars; if the disturbance was great, the sample was discarded. Sediments collected throughout the study area were very coarse; shipboard estimates indicated a 50/50 gravel/sand mix with almost no silt, clay, or organic material.

Underwater Television Operations. The sampling plan called for use of underwater television in two ways:

- (1) along transects in order to document the kinds and approximate number of epifauna before, during, and after harvesting; and
- (2) as a tool to locate benthic grabs directly in a dredge track.

Initially, TV transects were attempted with a light (75 lb) towing frame. Results obtained in this manner were compromised as a result of two factors: bottom current speeds and poor visibility. The effect of the swift bottom currents (whether the vessel was anchored or drifting) was to lift and disorient the normal towing angle of the frame. Weights were added and camera/light angles changed frequently but to little avail. Eventually it was found that equally good bottom footage could be obtained using the 1,200 lb van Veen grab as the platform for the TV camera and light. However, the problem of poor visibility could not be overcome regardless of the frame used. The turbidity did not appear to be due to suspended sediments as these were very coarse but rather to enormous densities of plankton--apparently both zoo and phyto. As a consequence, back-scatter--despite the fact that various camera/light/object angles were tried--precluded a clear view of the bottom when the camera was more than 3 to 4 feet off the bottom. With the camera this close, the field of view was so small that the chance of seeing the relatively rare epifauna was slight and when seen, there was little perspective by which to judge abundance.

The problems of current speed and visibility hampered our efforts to use the TV to precisely sample dredge tracks. This procedure was complicated by two other factors--grain size and harvesting success. Reports on TV coverage during last year's (1977) sampling indicated that a deep trench and adjacent furrows were seen after dredging. Although we are confident we passed directly over many dredge tracks, within hours of the dredge, we have no clear evidence that such disturbances persist in the environments sampled. Tentatively we attribute this to a combination of coarse sediments and strong bottom currents. (With respect to the last, currents were not quantified, however, on several occasions starfish were seen tumbling along the bottom.)

It is surmised that the coarse substrate is lifted up by the dredge and falls immediately and directly back into place. There is not an appreciable fraction of fines to be carried any distance from the track and actually leave depression. The currents would however be swift enough to tumble, redistribute, and smooth out material deposited along the edge of the track in the form of a ridge or berm.

Efforts at "in-track" and "near-track" sampling were also compounded by the inability of the harvester vessel to lay down a neat series of parallel tracks as was originally envisioned. The currents made it necessary eventually for the *Sea Hawk* to harvest parallel to the current only. Yet even then, there was little assurance (in our opinion) that the dredge itself was directly behind the vessel.

Despite the abovementioned problems, we are reasonably confident that on July 21 we obtained 6 grabs from within dredge tracks in the 50 percent plot. This was accomplished by having the *Sea Hawk* conduct 12 short trawls as close together as possible, using paired buoys about 500 feet apart as reference points. Upon completion of these hauls, the *Oregon* was anchored up-current of the area of greatest concentration of tracks. The anchor warp was paid out with the TV-grab near bottom. This was repeated several times. No clear dredge tracks were seen (although they might when we review the videotapes in the laboratory) but circumstantial evidence of several kinds indicated a track. This evidence included:

- (1) an upside-down starfish;
- (2) change from ripple marks in surface to "roughened" texture;
- (3) concentrations of shell debris.

When such evidence was seen, the grab was lowered and a sample was taken.

Details of the number, kind, and times of samples which were obtained are indicated in the accompanying chart.

Otter Trawls. Trawl sampling was conducted on three occasions, a total of six trawls being made. The catch was almost exclusively yellow fin sole, with a few rock sole and many starfish being included. King crab (all undersized ♀) were collected in two hauls. The purpose of these trawls was to evaluate the feeding behavior of predators in harvested versus unharvested areas. As

such guts were removed from several hundred specimens for later laboratory analysis. No difficulties were encountered in either the collection or processing of these specimens.

Viability and Burrowing Experiments: Experiments were conducted aboard both vessels on clams collected by grab and harvester in order to assess:

- (1) mortality after collection; and
- (2) ability of organisms deposited on surface to burrow back into the sediment.

Observations on viability were made for up to 96 hours on about 80 individuals of 6 different species. Burrowing was tested in 7 species; a total of about 40 observations being made 26 July to 4 August 1978.

Fred Stern and Tom Grieb of Tetra Tech were aboard the *Sea Hawk*. They assisted in the harvesting program, collected 2 and 3 week post-harvest benthic grabs, and continued re-burrowing experiments.

At the present time, laboratory processing of benthic samples is ongoing. We anticipate no difficulties meeting the contractual dates for delivery of progress and/or final reports.

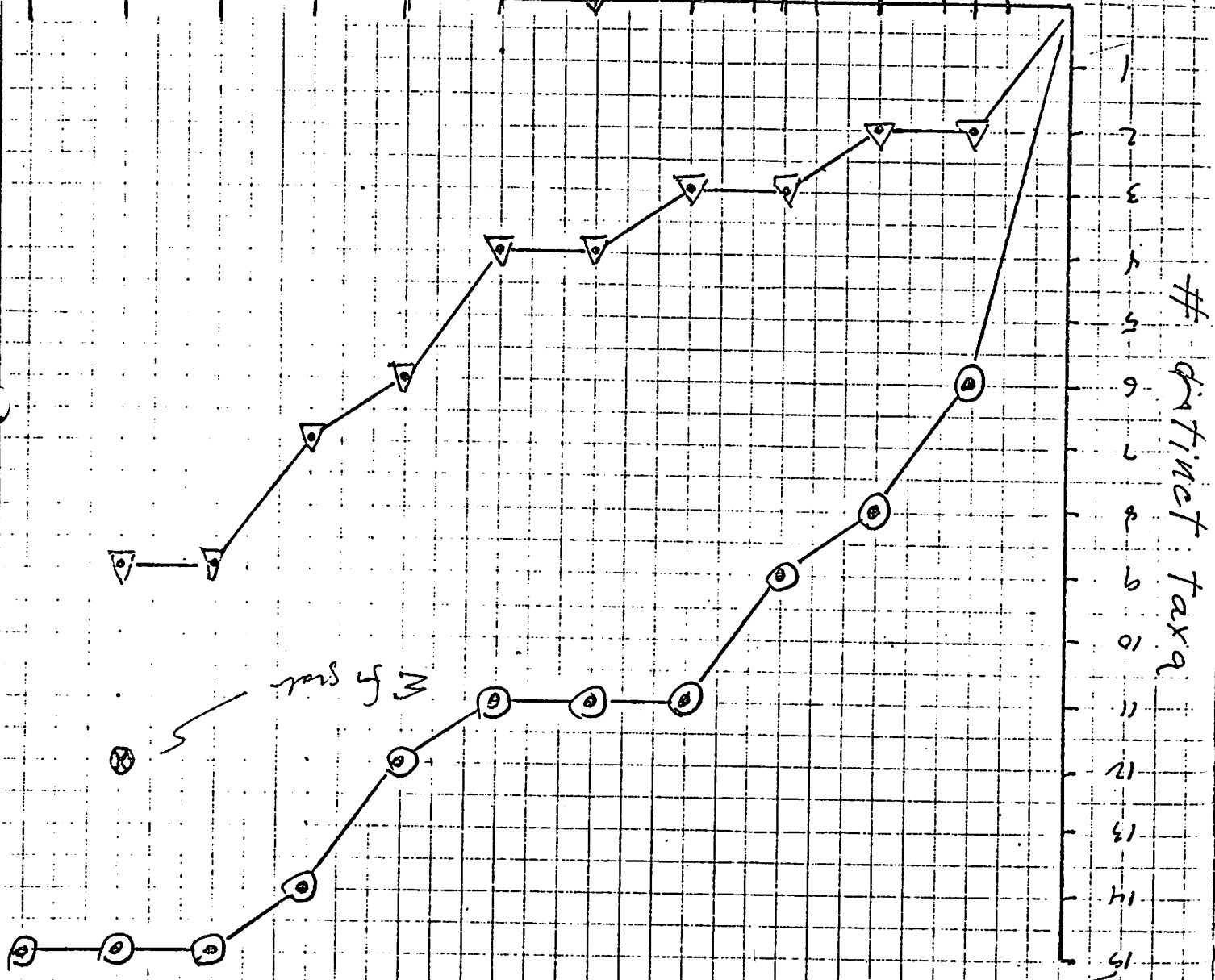
Sincerely yours,



Thomas J. Kawling  
Project Manager  
Resource Sciences Division  
Engineering Department

TJK:st

1100 hrs - 12 Jul 78  
 ading orgs in 1+2 mm  
 curve plotted  
 furnished  
 species/over  
 = 5 gms  
 = 5 gms



○ Data from station PC, replicates one, pre-harvest, taken 11 Jul 78  
 △ Data from station 80, repl 10, pre-harvest

(No. equiv. cores)

TOTAL AREA SAMPLED

sub

SUMMARY OF TETRA TECH PARTICIPATION IN VESSEL OPERATIONS -- BERING SEA  
SUMMER 1978

DATE	MORNING	AFTERNOON	EVENING
4 July	G.Bakus & F.Stern board <i>Sea Hawk</i>	PSP sampling	PSP sampling
5 July	PSP sampling	PSP sampling	PSP sampling
6 July	PSP sampling	PSP sampling	PSP sampling
7 July	search for area to replace Block 60 for intensive sampling		weather down
8 July	weather down	weather down	transfer gear and personnel to <i>Oregon</i>
9 July	weather down	weather down	T.K. & T.G. and gear to <i>Oregon</i> via fishing boat; G.Bakus disem- barks
11 July	intransit to study area; rigging TV gear	search for buoys in 80% plot; not there so sample Primary Control (PC) plot - 3 grabs	process, sort, and identify samples collected
12 July	collect 10 benthic grabs in 80% plot	process samples	sort and identify organisms
13 July	collect 7 benthic grabs in PC plot	processing samples	processing samples
14 July	rig and test TV frame	test TV frame	rig and test TV on van Veen grab
15 July	testing TV frame poor visibility hampers arrangement of light	TV coverage in 80% plot	6 grabs collected in 50% plot
16 July	process samples/ TV in 50% plot	fouled buoy; strong tides, counter to windwaves; collect 6 grabs in 20% plot	process samples
17 July	weather down	two otter trawls at 50% plot	gutted catch from trawls

SUMMARY OF TETRA TECH PARTICIPATION IN VESSEL OPERATIONS -- BERING SEA  
SUMMER 1978

DATE	MORNING	AFTERNOON	EVENING
18 July	attempt "intrack" sampling in 50% plot	attempt "intrack" sampling in 50% plot	R & R
19 July	process backlog of samples	collected 6 grabs in 80% plot	process samples
20 July	process samples	collected 6 grabs in PC plot	process samples
21 July	process samples	collected 6 "intrack" samples in 50% plot and 6 adjacent control grabs	made two trawls (in and near tracks) and gutted sample of catch
22 July	process grab samples	collect "1-day" samples in 50% plot	R & R
23 July	process samples	collect "2-day" samples in 50% plot and adjacent control (12 grabs total); also two trawls, in and near tracks, 50% plot	gut sub-sample of fishes collected
24 July	process samples collected previous day	swell too big for safe sampling	swell too big for safe sampling
25 July	weather down - packing gear and samples	collect 6 bottom grabs in 20% plot and 6 in 80% plot	process samples
26 July	collect 6 grabs in PC plot; T.Grieb, F.Stern, and some gear to MV <i>Sea Hawk</i>	T.Kawling and F. Wahtney ashore at Port Moller	
27 July	Tt personnel aid harvesting effort all day		
28 July	Tt personnel aid harvesting effort all day		



SUMMARY OF TETRA TECH PARTICIPATION IN VESSEL OPERATIONS -- BERING SEA  
 SUMMER 1978

DATE	MORNING	AFTERNOON	EVENING
29 July	collect 6 grabs at 50% plot and 6 in 20% plot	processed samples collected in morning	processed samples collected in morning
30 July	aid harvesting and conducted burrowing exits throughout day		
31 July	aid harvesting and conducted burrowing exits throughout day		
1 Aug	aid harvesting and conducted burrowing exits throughout day		
2 Aug	collect 6 grabs in PC plot and 6 in 80% plot	process samples collected in morning	R & R
3 Aug	collect 6 grabs in 50% plot and 6 in 20% plot	process samples collected in morning	
4 Aug	F. Stern and T. Grieb disembark <i>Sea Hawk</i> at Port Moller		