UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
ALASKA FISHERIES SCIENCE CENTER
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September 22, 1997

Mr. Stanley E. Senner
Science Coordinator
Exxon Valdez Oil Spill Trustee Council
645 G Street, Suite 401
Anchorage, Alaska 99501

Dear Mr. Senner:

At your request, I have perused the hydrocarbon results for two *Exxon Valdez* Natural Resource Damage Assessment projects that were never completed. These two projects concerned injuries to oysters and to scallops and were designated as projects "Fish/Shellfish 16" and "Fish/Shellfish 25", respectively. Following is my summary and interpretation of the hydrocarbon results for these projects. These results are currently available in the "*Exxon Valdez* Oil Spill of 1989: State/Federal Trustee Council Hydrocarbon Database 1989-1995" (EVTHD) that has been released to the public under project Subtidal 8.

Fish/Shellfish 16

A total of 38 samples of oysters were collected and analyzed for hydrocarbons under project Fish/Shellfish 16. These samples were collected from four stations in Prince William Sound (PWS) in 1989 and 1990. Two of the stations were at oyster farms at Deep Bay and Salmo Point on the eastern end of Hawkins Island just northwest of Cordova, while the remaining two stations were at oyster farms on Fairmont and Perry islands in the north and northwest parts of PWS, respectively. In 1989, samples were collected monthly from April through September (except for August) at the two stations near Cordova, while at the remaining two stations, samples were collected in April, May and September. In 1990, samples were collected once in either April or May.

Some of the samples collected from the Fairmont and Perry island stations were probably contaminated by oil spilled from the *Exxon Valdez*. The total PAH (TPAH) concentration ranged from 690 to 4,780 ng TPAH/g dry wt. in four of the eleven samples collected in 1989 from these stations, and the pattern of relative PAH abundances was generally consistent with weathered oil spilled

from the *Exxon Valdez* (EVO). Three of these samples were collected in April-May and contained the highest TPAH concentrations, but the other sample was collected in September and TPAH concentrations were less than 200 ng TPAH/g dry wt. in the two companion replicate samples. Similarly low TPAH concentrations were present in four samples collected in 1990, and individual PAH concentrations were too often below method detection limits (MDL) to indicate potential hydrocarbon sources for these samples.

Concentrations of TPAH were occasionally quite high in samples collected from the two stations near Cordova, and were probably derived from multiple sources. At the Deep Bay station, TPAH concentrations ranged from 56 to 8,670 ng TPAH/g dry wt. in the nine samples collected during 1989. The pattern of relative PAH abundances was consistent with diesel oil in two of the more contaminated samples, and was consistent with mixtures that may have included EVO in others. At the Salmo Point station, TPAH concentrations ranged from 35 to 732 ng TPAH/g dry wt. in the nine samples collected during 1989, and the pattern of relative PAH abundances was not consistent with any single known hydrocarbon source. The proximity of these stations to Cordova suggests that hydrocarbons may have derived from boat traffic and from the boat de-contamination facility that removed EVO attached to boat hulls at Cordova in 1989. However, the variability of hydrocarbon concentrations among replicated samples from these stations suggests that spurious contamination introduced during collection or initial storage cannot be dismissed.

Fish/Shellfish 25

A total of 21 samples of scallops were collected and analyzed for hydrocarbons under project Fish/Shellfish 25. These samples were collected from three stations around Kodiak Island during Fall 1989. At the Near Island station, six samples were collected mid-October and another six were collected mid-December, from a depth of 10 m. The mean TPAH concentration of samples collected mid-October was 1,700 ± 242 ng TPAH/g dry wt. (± 95% CI), which increased to 4,410 ± 635 ng TPAH/g dry wt. by mid-December. The pattern of relative PAH abundance was consistent with weathered oil spilled from the *Exxon Valdez* in all 12 samples, although an additional combustion source is indicated as a minor source as well. Abundant normal alkanes, together with pristane and especially phytane, corroborate a crude oil source for most of these PAH. However, I am hesitant to conclude that oil from the *Exxon Valdez* is the source of the detected PAH, for two reasons: First, I am not aware of any corroborating evidence of *Exxon Valdez* oil elsewhere in the vicinity of the sampled station. Second, the collection station is near a charted shipwreck, which might sporadically release a bunker oil that mimics analysis results for crude oil.

The TPAH concentrations in the remaining nine samples were too low to identify potential sources reliably. Six of these samples were collected from Uyak Bay and these had TPAH concentrations that ranged from below the MDL to 283 ng TPAH/g dry wt. The three samples collected from Cape Chiniak had TPAH concentrations that were less than 26 ng TPAH/g dry wt.

I hope these remarks satisfy your requirement for closure regarding these two projects. If not, please contact me at your convenience (907-789-6065; jeff.short@noaa.gov) to determine how we should proceed.

Sincerely,

Jeff Short

Jeffrey W. Short
Supervisory Research Chemist

PACE

CONFIDENTIAL

LITIGATION SENSITIVE

DRAFT

Natural Resource Damage Assessment (NRDA) Plan

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Fish/Shellfish Study Number 25

Injury to Scallop Resources in Kodiak Waters

DRAFT PRELIMINARY STATUS REPORT

1. EXECUTIVE SUMMARY

Sampling of Weathervane scallops (Patinopecten caurinus) obtained from the commercial fishery for hydrocarbon uptake has tentatively been completed, pending return of results from the Analytical Chemistry group. Sampling of Weathervane shells for archival storage and future growth analysis is continuing. Routine sampling of operational pink scallop (Chylamys rubidial farms for hydrocarbon uptake is still in progress. Initial project staging work, preparatory to deployment of test nets for the long-term growth and survival portion of the study, will begin in spring 1990. This staging will result in the stocking of 13,500 pink scallops in oiled and non-oiled test locations for observation of hydrocarbon uptake, depuration, growth, and survival rates.

2. OBJECTIVES

The basic objectives of this project are to assemble historic information on growth and survival of important scallop species near Kodiak Island prior to the oil spill, to measure the rate of aromatic hydrocarbon contaminant uptake and depuration in scallops presently growing near Kodiak Island, and to measure the effects of oil contamination on the growth and survival of cultured scallops.

3. DISCUSSION

The basis for these objectives arises from the assumption that a future production potential for both wild scallops and shellfish mariculture was in existence in Kodiak area waters prior to March 24, 1989. This potential is dependent on the highest possible

standards of water quality, and may exceed the degree of quality required for other possible uses such as recreation, anchorages, log storage, or fishing grounds for certain fisheries. This project will use scallops as a sentinel organism to measure the long-term effects of recurring oil contamination to organisms exposed to the water column and sub-tidal sediments.

Similarly, shellfish mariculture, as a generalized activity, may serve as a form of "sentinel organism" for future resource consumption of tidelands and waters that may have been preempted through chronic degradation of water quality and marine sediments from episodic oil pollution.

Demand for these resource qualities was in existence prior to the Exxon Valdez oil spill. For instance, a cooperative effort by the State of Alaska, the Japanese Government, the local municipal governments, and the Kodiak Area Native Association has resulted in the investment of $2 million towards realization of the scallop and shellfish mariculture potential of Kodiak Island's waters. Additionally, an important commercial fishery for Weathervane scallops has been in operation since 1967. Information regarding the recent performance of the commercial fishery for Weathervane scallops is not available for this study due to an administrative policy governing fish ticket confidentiality issued by the Attorney General for the State of Alaska. However, an independent estimate of the historic production potential for Weathervane scallops prior to the oil spill indicated a reasonable expectation of future sustainable annual harvests of around 4 million animals, with an estimated annual ex-vessel value on the order of $1 million.

Does this potential for scallop production in Kodiak waters continue to exist to the same extent in the aftermath of eleven million gallons of crude oil? Part of this study is designed to provide some critical information about long-term growth and survival that will be incorporated into bio-economic models that may be employed in making that determination. Previous modeling efforts used for aquaculture policy formulation have demonstrated the sensitivity of outcomes to the parameters of long-term growth and survival rate.

Other studies, such as Air/Water studies numbers 1 and 3, could be useful in documenting the amount of coastal habitat suitable for shellfish mariculture that may have been impacted through oil contact. This study will document the species specific effects on growth, survival, and product quality that might be experienced by future scallop mariculture operations at both oiled and non-oiled locations in the Kodiak area. The results might also be used to update production forecast models of future Weathervane harvests that may become impacted to some degree by the EVOS. Finally, the results may shed some light on potential alternative methods and strategies for restoration of lost use, populations, or habitat

that may have been injured by the oil spill.

This project is similar in many respects to Fish/Shellfish study number 16, "Prince William Sound Oysters". Both projects are utilizing the same basic mariculture technique of lantern net culture of sentinel species in oiled test areas and non-oiled control areas. The scallop project differs in that many of the samples will be obtained from the common property fishery, whereas Pacific oysters (Crassostrea gigas) do not occur naturally as a wild stock in Alaska. Coastal Alaska's cold waters and dark winters prevent oysters from reproducing naturally, and instead result in a channeling of metabolic resources, assimilated from the water column, into seasonally accelerated growth. Therefore, experimental oysters spat must be purchased from hatcheries located outside of Alaska, rather than obtained from local common property resources, as is the case with commercially harvested Weathervane scallops or pink scallop spat collected for commercial mariculture development.

The commercial fishery has focused exclusively on large Weathervane scallops captured from the common property resource. Conversely, the developing mariculture industry seems to be tending towards commercial grow out of pink scallop spat that are collected seasonally from wild scallop spawn drifting in the common property water column. Both of these production decisions regarding species selection are based on a criteria of maximization of output value per unit effort. For instance, wild pink scallops are often found close to shore and at the head of narrow bays that are comparatively difficult to fish with scallop dredge gear. Additionally, pink scallops provide a low production yield of shucked meats when compared to Weathervanes. Consequently pink scallops are not targeted by the commercial scallop dredge fishery. On the other hand, Weathervane spat has so far proven difficult to obtain from the water column in sufficient quantity that would permit mariculture operations above a certain profitability threshold, while pink scallop spat is readily available in Kodiak waters. This has tended to channel mariculture development activity in favor of pink scallops cultures.

4. METHODOLOGY

Based on the recommendation of the project peer review committee meeting of November 28, 1989, an additional activity, not described in the detailed study plan, has been initiated by this project. Weathervane scallop shells are being obtained from the commercial fishery occurring at Kiukpalik Island and Hallo Bay, on the mainland shore of Shelikof Strait (Figure 1). The top valve (Figure 2) from 100 consecutive scallops taken on a random tow by an individual boat in the commercial fishery comprises a sample for

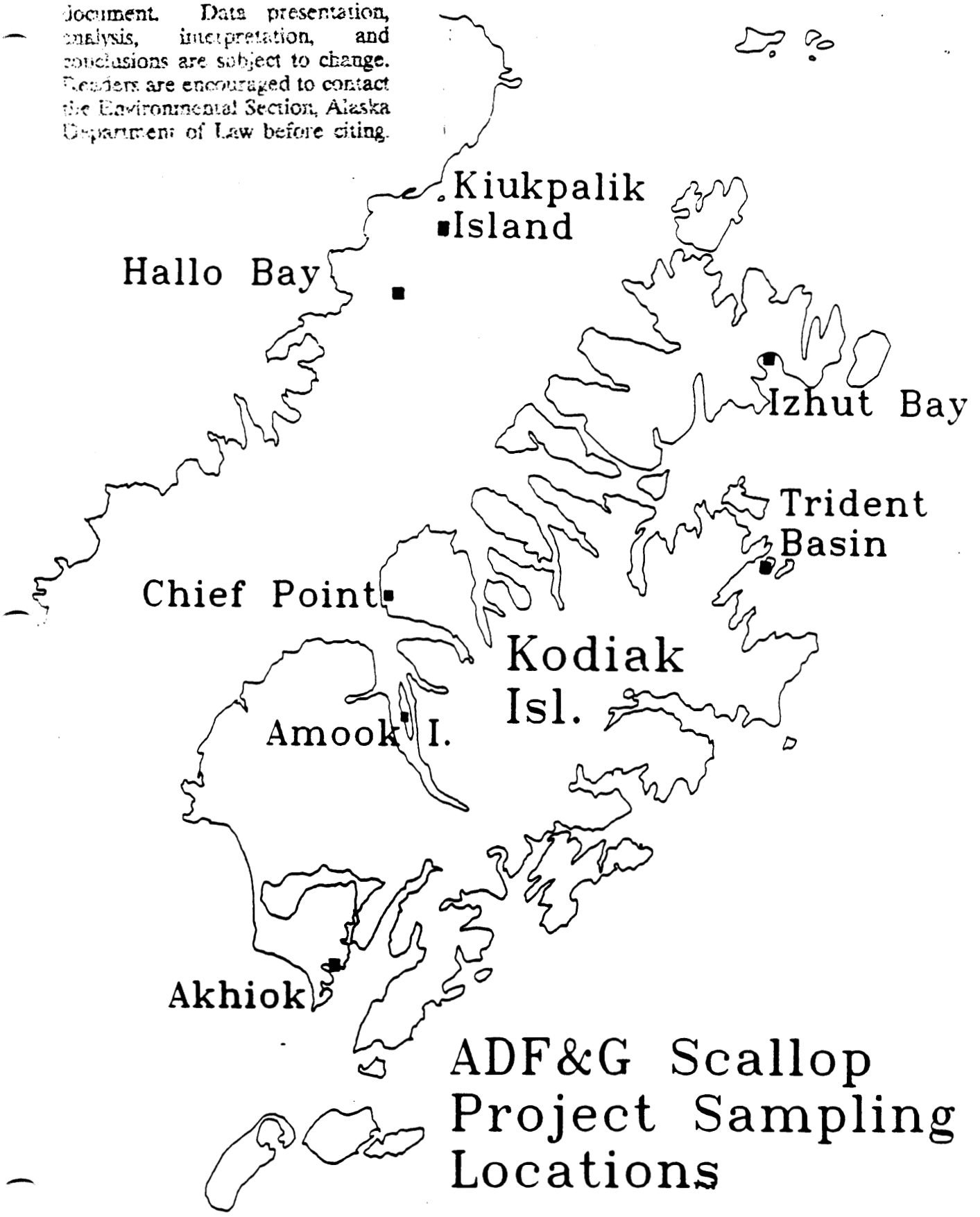

Figure 1. Map of scallop sampling locations.

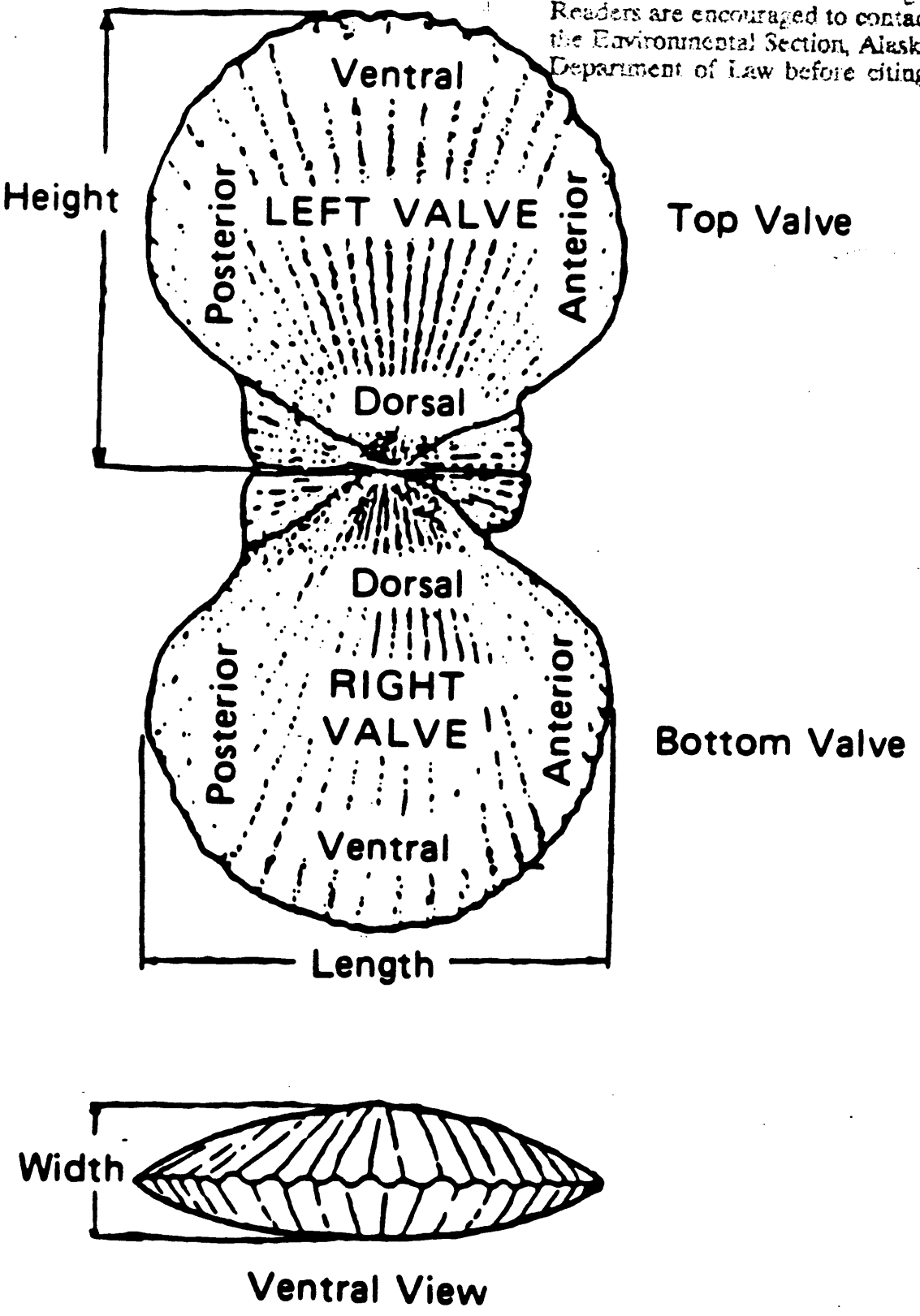

Figure 2. Scallop shell dimensions (Mottet, 1979)

the purposes of this study. These samples are being collected and archived under chain of custody procedures.

The project goal is to obtain ten samples (1000 shells) before the end of the 1989-90 fishing season. This activity will continue during the next several seasons, unless the fishery is curtailed because of deteriorating product quality or recruitment failure. If oil contamination reaches deepwater scallop beds and impacts growth, then this may become evident as induced growth checks visible on shells obtained through continued sampling.

Hydrocarbon surveys, as described in the detailed study plan, are progressing on schedule. A series of whole tissue samples from operational pink scallop mariculture projects at Trident Basin and Amook Island are being obtained and placed under chain of custody. A third site, near Akhiok village in Alitak Bay, was dropped from consideration because of cost and logistical problems. At each site six lantern nets are chosen at random and triplicate 50 gram whole animal samples, measuring between 4 and 7 cm in shell height, are selected and placed in pre-cleaned glass jars with teflon-lined lids. An additional sample blank is also taken at this time. The samples are labeled, frozen, and shipped to the NMFS Auke Bay Laboratory as per chain of custody procedures stated in the September 12, 1989, Analytical Chemistry Quality Assurance/Quality Control Plan.

Weathervane scallop whole tissue samples have been obtained from the commercial fishery on two occasions. On the first occasion, triplicate 50 gram samples were obtained and placed in baked aluminum foil containers, labeled, and frozen as per chain of custody procedures. A sample blank was not taken at this time. Because of this failure, the sample effort was repeated, this time with the inclusion of a sample blank. Additional monthly sampling will commence if testing confirms the presence of hydrocarbons.

In February, divers will begin collecting wild pink scallop whole tissue samples from three sample sites in Izhut Bay, a heavily oiled area. Triplicate 50 gram hydrocarbon samples plus a sample blank will be obtained at each site and placed into pre-cleaned sample jars, labeled, and frozen as per chain of custody procedure. Randomly selected scallops will measure between 4 and 7 cm shell height.

Growth and survival comparisons of pink scallops cultured in situ this spring will comprise the major portion of the NRDA activity in this study. The methodology will essentially duplicate that of the Oyster project with certain relevant modifications.

Pink scallop spat will be deployed in 27 test nets at oiled and non-oiled sites. Criteria for site selection will be based on mapping provided by the Department of Environmental Conservation

and by the evaluation of the principal investigator of individual site suitability for future pink scallop mariculture development. At this time, candidate sites are three heavily oiled test sites at Izhut Bay on Afognak Island, three moderately oiled test sites near Chief Point, Uyak Bay, Kodiak Island, and three non-oiled control sites at Trident Basin, near the City of Kodiak.

If resources become available, sediments at these sites will be pre-screened for confirmation of oil contamination level through the use of a portable ultra-violet fluorimeter (UVF). Discussions with NMFS concerning the feasibility of deploying a research vessel to conduct this screening are in process. Alternatively, microbiological analysis for hydrocarbon degrading activity could be used as a screening procedure, with the advantage of reducing the possibility of false positive readings that occasionally results when UVF detects animal or vegetable tissues rather than petroleum compounds.

Applications for shellfish transport permits will be submitted to the state for genetic and pathology screening. If the Commissioner of Fish and Game grants approval, then 13,500 pink and spiny scallop (C. hastata) spat, obtained last summer from wild scallop spawn collected at Trident Basin, will become available for transport this spring to designated test locations. These will be predominately pink scallop cultures, although there may be one or two percent spiny scallops incidental to the culture. At this early life stage the two species are indistinguishable. Triplicate 50 gram whole animal tissue samples plus a sample blank will be taken for a baseline hydrocarbon reference, as per the chain of custody procedures outlined previously.

The scallop spat will be transported from Trident Basin on a chartered vessel and stocked into the test nets. Three test nets will be located at each of the three test sites per oil impact level, resulting in a total of 27 nets. The nets are standard 12 mm mesh, 10 layer Japanese lantern net rearing cages (Figure 3). Each net will be stocked with 500 scallop spat, 50 animals per layer, each measuring approximately 18 to 20 mm in shell height. The top of each net will be suspended with solid trawl floats to prevent implosion and loss of floatation at depth.

The bottom of the nets will be suspended approximately one meter above the seafloor by adjusting the scope between the anchor and the net. A trailer buoy with the net number and ADF&G identification will be attached to each net in order to mark the location and permit retrieval. This differs from standard mariculture procedure whereby nets are suspended at the top of the water column in order to take advantage of surface conditions that are favorable to rapid growth and production. For this study, the nets will be moored near the bottom in order to mimic natural growing conditions of wild scallops. The nets will be assembled

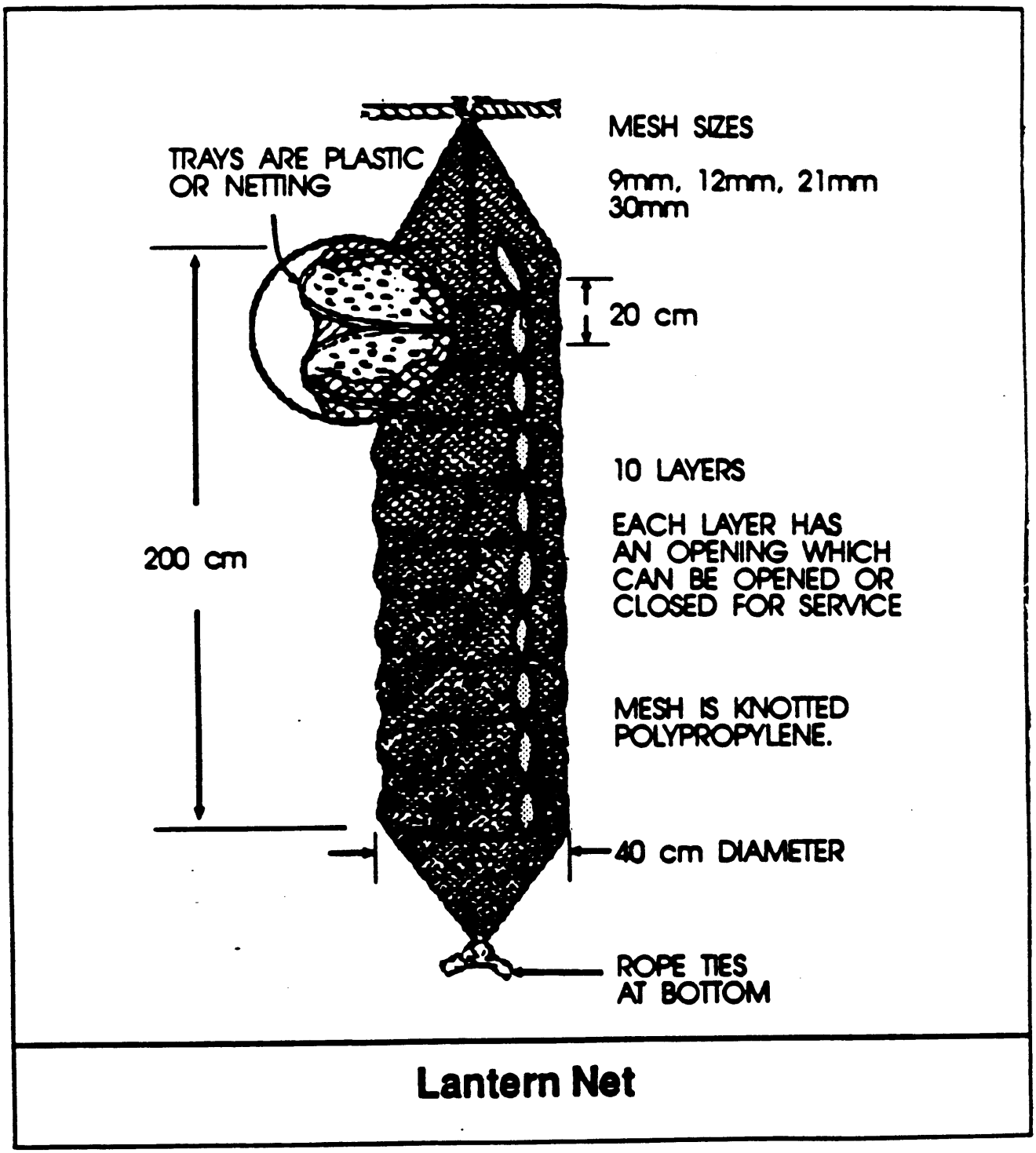

Figure 3. Lantern Net (Swann, 1989)

and the gear staged in March, prior to the active growth and nutrient assimilation season.

Following the initial deployment, samples will be obtained on a monthly basis during the active growing season, April through November. During the winter, the sampling rate will be reduced to once every three months, most likely occurring during February, weather permitting. A recording thermograph will be attached to one net at each location in order to automatically record daily water temperature fluctuations and seasonal trends. At the time of each monthly sample, measurements of temperature, salinity, and water transparency (Sechi disk) will be recorded. Scallops from even or odd numbered layers will be subsampled alternately from month to month.

The net will be hauled from its mooring onboard a vessel and up onto a 4′ by 8′ work table. The side opening will be unstiched and all scallops from the designated layer will be removed. The contents of the layer will be sorted into two groups, live and dead. A random sample of 30 live animals will be measured in order to determine growth in shell height. During this process, additional dead animals may be encountered and then separated from the total live animal group. Next, the dead shells will measured and sorted into groups according to size and then enumerated. After all the animals from one layer have been sorted and counted they will be replaced into the layer they were removed from and the next layer in the series will be sampled. After all five layers have been sampled, the aperture of the net will be sewn together and the net returned to its mooring.

5.PRELIMINARY STUDY RESULTS, TO DATE

Hydrocarbon sampling, to date, is summarized in Table 1.

Sampling of weathervane scallops from the commercial scallop dredge fishery [redacted] the presence of hydrocarbon contamination has been tentati[redacted]completed, pending return of sample results submitted to th[redacted]Chemistry group for testing. To date, seven samp[redacted] obtained with the voluntary cooperation of two commercial fishing vessels.

This season it appears that the entire scallop dredge fleet is only working in one general area on the mainland shore of Shelikof Strait, near Hallo Bay and Kiukpalik Island. It was hoped that additional samples could be obtained from traditional scallop beds off of Marmot Cape. However, the fisherman are voluntarily avoiding this area due to comparatively poor production. In addition there is always the possible risk of returning with oil contaminated scallops that might jeopardize the public's quality

Table 1.
Kodiak Scallop Project Hydrocarbon Sampling

LOCATION	TYPE	LATTITUDE	LONGITUDE	DATE	DESCRIPTION	CONTAINER	SAMPLE NUMBERS
Trident Basin	farm	57.46.8 N	152.23.6 W	11-Oct-89	triplicate 50 gm whole tissue and blank	jar	GMW 001 - GMW 006
Trident Basin	farm	57.46.8 N	152.23.6 W	22-Dec-89	triplicate 50 gm whole tissue and blank	jar	AED 018 - AED 023
Amook Island	farm	57.31.0 N	153.50.0 W	20-Nov-89	triplicate 50 gm whole tissue and blank	jar	AED 007 - AED 013
Hallo Bay	fishery	58.36.0 N	153.27.0 W	15-Nov-89	triplicate 50 gm whole tissue without blank	foil	AED 003 - AED 005
Cape Chiniak	fishery	58.31.0 N	153.53.0 W	21-Dec-89	triplicate 50 gm whole tissue and blank	foil	AED 014 - AED 017

perception of all Kodiak scallops in the marketplace.

If aromatic hydrocarbon contaminates are detected in these samples then the project would continue to comply with the Attorney General's directive regarding confidentiality of NRDA results. Confirmation of hydrocarbon contamination would then result in initiation of additional sampling to be performed on a monthly basis until the fishery closes, in order to measure rates of hydrocarbon contaminant depuration.

Collection of Weathervane scallop top valves for long-term archival and eventual age and growth determination is proceeding as per the request of the peer review team and with the voluntary cooperation of the commercial fisherman. To date, one sample of 100 shells taken from a random tow in the fishing area has been obtained and archived under chain of custody procedures. Sampling will continue with the eventual goal of obtaining 1000 shells before the fisherman voluntarily end their season or the department closes it for them under emergency order. This season ending is anticipated sometime during April, 1990.

Ageing, growth rate determination, and analysis of this data will not begin until several years of shell samples have been obtained from a given area. This data may then be compared with scallop growth data obtained by the Department of Fish and Game during the late 1970's. In the past, ageing Weathervane scallop samples obtained from Kodiak and other Gulf of Alaska fisheries has proven to be a difficult process to properly calibrate and standardize between researchers. The annual growth checks in Weathervanes are somewhat variable in intensity or definition and are often difficult to routinely detect. In addition, induced growth checks may also arise when an immature scallop is passed through the five-inch rings of a commercial scallop dredge.

It is hoped that holding the shells obtained during NRDA studies until several years samples have been collected will permit age determinations to be carried out in a single batch for all samples by one person or facility. This should permit improved standardization of results and enhanced quality assurance.

Hydrocarbon sampling of operational pink scallop mariculture projects was started in October and is continuing on schedule. To date, twelve samples have been obtained on two occasions from the project at Trident Basin, and six samples have been obtained on one occasion from the project at Amook Island. The Amook project is scheduled to be sampled again as soon as weather permits. The next Trident sample will be collected during February. All the samples collected to date have been, or will be, relinquished to the Analytic Chemistry group according to chain of custody procedures for further processing.

Pink scallop growth data from the 1987-88 Kodiak Scallop Mariculture study has been obtained by the principal investigator in an ASCII format. Work will begin soon to standardize the data into a Lotus 1-2-3 format and to develop historic growth and survival curves for comparison with experimental data to be produced this spring from the test culture portion of this study.

6. STATUS OF INJURY ASSESSMENT

It is too early in the course of this study to make conclusions concerning oil induced long-term differential growth and survival rates, or rates of hydrocarbon uptake and depuration for scallops growing in Kodiak Island waters. Additional data, obtained from initiating the in situ growth and survival phase of this project during the coming growing season, would be sufficient to permit comparison of test results with the historic growth record and the formulation of preliminary conclusions regarding the impacts of oil contamination on long-term growth and survival rates of important scallop species near Kodiak.

Return of data from the Analytical Chemistry group describing the results of analysis of hydrocarbon [redacted] scallops with [redacted] decision point [redacted] regarding the [redacted] or cessation of [redacted] commercial dredge fishery near the Shelikof mainland.

Further oil contamination monitoring by Air/Water Study number 2 of sedimentary contaminates into deeper subtidal zones, or the indication of a diminution in the productivity of the Weathervane fishery, may provide an analogous decision point concerning the continuation of sampling the commercial Weathervane harvest for shell archival purposes.

One aspect of potential injury to scallop resources in Kodiak waters that is apparently not addressed in the study plan for this project or other NRDA projects is the potential for loss of a larval year class. **During last July, Weathervane scallops were spawning [redacted] significant [redacted] larvae [redacted] reported to be coincident with [redacted] oil masses near the Douglas-Kiukpalik Island area of the Shelikof mainland.** Reports were received of large masses of dead and dying invertebrate larvae washed up on mainland beaches with the oil. One observer reported that larvae were attracted to oil globules and that larvae may have ingested oil. The validity of these reports is unknown, and damages may be difficult to assess. With episodic re-introduction of oil into the water column from storms or tides this process may induce chronic recruitment failures into certain stocks of marine invertebrate resources. However, belated confirmation may be achieved in several years time if there is a

pronounced harvest failure among the stocks of crabs, scallops, shrimp, and clams that populate the mainland waters of Shelikof Strait.