Exxon Valdez Oil Spill
State/Federal Natural Resource Damage Assessment Final Report

Assessment of Oil Spill Impacts on Fishery Resources: Measurement of Hydrocarbons and Their Metabolites, and Their Effects, in Important Species

NRDA Project Subtidal 7
Final Report

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Study History: Natural Resources Damage Assessment Study Subtidal 7 was initiated in 1989 as part of the State/Federal Natural Resource Damage Assessment Plan for the *Exxon Valdez* oil spill. Originally titled Fish/Shellfish Study 24, Part B (Exposure To Oil And Its Effects), the project continued in 1990 and 1991 as Fish/Shellfish Study 24 (Assessment Of Oil Spill Impacts On Fishery Resources: Measurement Of Hydrocarbons And Their Metabolites, And Their Effects, In Important Species). Draft Oil Spill Progress Reports describing the ongoing progress of the studies were submitted in 1989, 1990 and 1991 and contributed to this final report. Several articles containing data from these studies have been published or are in press--

•Collier, T.K., M.M. Krahn, C.A. Krone, L.L. Johnson, M.S. Myers, S-L. Chan And U. Varanasi. 1993. Survey of oil exposure and effects in subtidal fish following the *Exxon Valdez* oil spill: 1989-1991. In: *Proceedings Exxon Valdez Oil Spill Symposium*, pp. 235-238

•Collier, T.K., M.M. Krahn, C.A. Krone, L.L. Johnson, M.S. Myers, S-L. Chan And U. Varanasi. 1993. Oil exposure and effects in subtidal fish following the *Exxon Valdez* oil spill. In: *Proceedings 1993 International Oil Spill Conference*. USCG, API, EPA, Tampa, FL, pp. 301-305

•Collier, T.K., C.A. Krone, M.M. Krahn, J.E. Stein, S.-L. Chan, and U. Varanasi. 1995. Petroleum exposure and associated biochemical effects in fish following the *EXXON Valdez* oil spill.*Exxon Valdez Oil Spill Symposium.* (in press)

•Krahn, M.M., D.G. Burrows, G.M. Ylitalo, D.W. Brown, C.A. Wigren, T.K. Collier, S.-L. Chan, and U. Varanasi. 1992. Mass spectrometric analysis for aromatic compounds in bile of fish sampled after the *EXXON Valdez* oil spill. *Environ. Sci. Technol.* 26:116-126.

•Krahn, M.M., G. Ylitalo, J. Buzitis, S-L. Chan And U. Varanasi. 1993. Comparison of high-performance liquid chromatography/fluorescence screening and GC/MS analysis for aromatic compounds in sediments sampled after the *Exxon Valdez* oil spill. *Environ. Sci. & Techn.* 27:699-708)

Abstract: Studies were conducted from 1989 to 1991 to assess injury to fisheries resources related to the *Exxon Valdez* oil spill. These studies were designed to determine exposure of fish to petroleum-derived compounds, specifically aromatic hydrocarbons, and assess possible effects. Over 4000 fish were collected from >50 sites in Prince William Sound, Lower Cook Inlet, and embayments along the Kenai and Alaska Peninsulas. Biliary fluorescent aromatic compounds (FACs) and hepatic aryl hydrocarbon hydroxylase (AHH) activities were measured, and used to determine degree of exposure of fish to aromatic compounds. The results showed continuing exposure through 1991 of several benthic fish species, which suggested persistent petroleum contamination of subtidal sediments. Pollock were found to

have increased exposure to petroleum hydrocarbons at sites up to 400 miles from the spill origin, more than one year after the spill, suggesting that the spilled oil affected either the water column or food supply of these fish at great distances from the spill, and for some time after the spill. While major histopathological and reproductive effects were not documented, the potential impact on fishery resources of long-term exposure to petroleum, albeit at moderate to low levels, could not be determined from these studies.

Key Words: bile, cytochrome P450, Dolly Varden char, flathead sole, histopathology, Pacific halibut, petroleum, pollock, Prince William Sound, reproduction, rock sole, yellowfin sole.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

Studies were conducted to assess injury to fisheries resources related to the *EXXON VALDEZ* oil spill. These studies were designed to determine the degree of exposure of fish to petroleum derived compounds, specifically aromatic hydrocarbons, and assess possible effects on various species resulting from such exposure. From 1989 to 1991, over 4000 fish of several species were collected from over 50 sites in Prince William Sound, Lower Cook Inlet, and embayments along the Kenai Peninsula and the Alaska Peninsula. Over 1600 bile samples have been analyzed for the presence of fluorescent aromatic compounds (FACs), and 595 liver samples have been analyzed for aryl hydrocarbon hydroxylase (AHH) activity, which is known to be increased after exposure of fish to chemical contaminants. These assays (biliary FACs and hepatic AHH) were used to assess exposure of fish to aromatic compounds.

Our results from measurements of levels of FACs in bile and analyses of AHH activity in liver show a continuing exposure of several nearshore benthic fish species, including flathead sole (*Hippoglossoides elassodon*), yellowfin sole (*Limanda aspera*), and rock sole (*Lepidopsetta bilineata*), which suggests continuing petroleum contamination of nearshore subtidal sediments, at some sites for more than two years following the spill. In contrast, the littoral zone appeared to be heavily impacted in the months immediately following the spill, but a year later, after a winter storm cycle, exposure of fish inhabiting this zone [i.e., Dolly Varden (*Salvelinus malma*)] was substantially decreased. Farther offshore, the benthic species, Pacific halibut (*Hippoglossus stenolepis*), did not show evidence of appreciable exposure to spilled oil. Pollock, a bathypelagic species, were found to have increased exposure to petroleum hydrocarbons at sites up to 400 miles from the spill origin, more than one year after the spill. These results suggest that the spilled oil affected either the water column or food supply of these fish at great distances from the spill, and for some time after the spill. The results of these analyses of oil exposure in several species of subtidal fish following the spill definitively show the necessity of monitoring the subtidal environment following major oil spills.

We also assessed reproductive function in nearly 900 adult female fish collected in 1990 and 1991, and examined over 400 fish collected in 1990 for histopathological alterations. While major effects were not documented, there was some suggestion of histopathological alterations of gill in one species of benthic fish, rock sole. In Dolly varden char and yellowfin sole, weak relationships were also noted between increased levels of petroleum metabolites in bile and lowered plasma levels of estradiol, a reproductive hormone involved in regulation of gonadal development and spawning. What cannot be determined from these studies are the potential impacts on fishery resources of long-term exposure to petroleum, albeit at moderate to low levels.

INTRODUCTION

Petroleum and its components have the potential to damage fishery resources (National Research Council, 1985). Of special concern in Prince William Sound and areas in the Gulf of Alaska impacted by the *EXXON Valdez* oil spill are species such as Dolly Varden char, which inhabit the littoral zones, adult salmon, which pass through littoral and subtidal waters, and benthic fish species which live in subtidal areas in close association with bottom sediments. Numerous laboratory studies have demonstrated that exposure of fish to petroleum hydrocarbons can result in a variety of adverse effects. However, because of the high rate of metabolism and depuration of petroleum hydrocarbons by many species of fish (Varanasi et al., 1989), direct measurement of tissue concentrations of parent compounds does not generally provide a useful indicator of exposure of fish to petroleum hydrocarbons. Therefore, it has been difficult to document exposure of fish to petroleum following oil spills. In recent years, however, methods have been developed for determining such exposure, based on our knowledge that many of the metabolites of aromatic petroleum hydrocarbons are fluorescent, and a primary route of excretion of these metabolites is through the bile. Thus we have demonstrated that the measurement of fluorescent aromatic compounds (FACs) in fish bile serves as a useful indicator of petroleum exposure in field-sampled animals (Krahn et al., 1986a; Krahn et al., 1992). Such measurements are now a mainstay of many monitoring programs, including those following the spill. Additionally, it is known that certain forms of cytochrome P450, a large family of enzymes found in various proportions in virtually all organisms, can increase dramatically following exposure to a variety of exogenous compounds. Of most interest for aquatic monitoring programs is the finding that an increase in hepatic cytochrome P4501A (P4501A) appears to be a useful indicator of exposure of fish species to a wide variety of organic contaminants, including many compounds contained in petroleum (Payne et al., 1986; Collier and Varanasi, 1991). Accordingly, the measurement in fish of reactions catalyzed by P4501A is proving to be very useful in monitoring oil spills in aquatic environments. One of the major reactions catalyzed by P4501A is aryl hydrocarbon hydroxylase (AHH) activity, and measurement of AHH activity constituted the primary method used in these studies for determining P4501A.

In this report we present our assessments of exposure of several species of fish for three years following the spill, using these two methods (biliary FACs and hepatic AHH activity). Data are presented for Dolly Varden char (*Salvelinus malma*), yellowfin sole (*Limanda aspera*), rock sole (*Lepidopsetta bilineata*), flathead sole (*Hippoglossoides elassodon*), Pacific halibut (*Hippoglossus stenolepis*), and pollock (*Theragra chalcogramma*). Our studies of exposure of adult Pacific salmon species have been presented in other forums associated with extensive samplings of subsistence fisheries (Varanasi et al., 1990). In addition to assessing petroleum exposure, samples were also taken for examination of histological alterations and assessment of reproductive function in two species, Dolly Varden and yellowfin sole, because of the potential for petroleum and related compounds to adversely affect tissue structure and reproduction (National Research Council, 1985).

This final report is primarily intended to present the results of our studies in a format which will be useful to the many agencies and individuals concerned with the impacts of the spill. Many portions of this report are taken from a recent manuscript which is currently in press (Collier et al., 1995a). However, we have also appended substantial additional information to this report. Appendix 1 contains a listing of exposure data obtained for all fish analyzed, on an individual sample basis. In addition to the exposure data, which are comprised of levels of biliary FACs and hepatic AHH activities, we have included in Appendix 1 the date and site of capture, specimen identification number, length and weight, and a notation whether any reproductive measurements were made or histopathological examination was done. Appendix 2 contains a listing of the results of histopathological analyses for individual fish, and Appendix 3 similarly lists the results of assessment of reproductive parameters in individual fish. Appendix 4 is comprised of a summary table for mean levels of biliary FACs, separated by species, site, and year of sampling. Appendix 5 is comprised of a summary table for mean activities of hepatic AHH, separated by species, site, and year of sampling. Finally, Appendix 6 contains copies of the previous progress reports submitted for these studies, in which additional detailed data presentations and statistical analyses for each year can be found.

OBJECTIVES

A. To sample selected fish species (Dolly Varden char, yellowfin sole, flathead sole, rock sole, pollock, Pacific halibut) from sites inside and outside Prince William Sound, with emphasis on sites inside Prince William Sound.

B. To estimate the exposure to petroleum hydrocarbons by measuring levels of hydrocarbon metabolites in bile of the above species from oiled and nonoiled habitats such to detect significant differences in bile concentrations with $\alpha=0.05$.

C. To estimate the induction of hepatic aryl hydrocarbon hydroxylase activity or increased levels of cytochrome P450IA in certain of the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha=0.05$.

D. To estimate the prevalence of pathological conditions in the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha=0.05$.

E. To assess reproductive function (e.g. levels of plasma estradiol, and the degree of ovarian maturation) in adult females of three of the above species (Dolly Varden char, yellowfin sole and pollock) from oiled and nonoiled habitats such to detect statistically significant differences with $\alpha=0.05$.

F. To estimate temporal changes in the parameters described in Objectives B&C, by comparing data obtained in 1991 to data obtained in 1989 and 1990. In order to assess either recovery or increased damage of habitats from the oil spill, trends in these parameters must be statistically significant at $\alpha = 0.05$.

METHODS

A. General Strategy

Samples of biota were collected primarily from sites located in potentially oil-impacted and unimpacted areas in Prince William Sound, in Cook Inlet, and along the Kenai Peninsula, Alaska Peninsula, and Kodiak Island (Table 1). Sampling generally was done from mid-May to mid-June, although some limited collections were also made in July and September of 1989, February, July and August of 1990 and February 1991. Specific dates of fish capture (month, day, and year) are given in Appendix 1.

Petroleum exposure of fish was primarily assessed by measuring (a) concentrations of metabolites of aromatic petroleum compounds in bile, and (b) AHH activities in liver. These types of measurements are necessary because petroleum hydrocarbons in fish are rapidly metabolized to compounds that are not detectable by routine chemical analyses. AHH activity in fish is due primarily to a single cytochrome P450, cytochrome P4501A (Varanasi et al., 1986, Buhler and Williams 1989). Measurement of hepatic AHH activity provides a sensitive indicator of contaminant exposure of sampled animals (Collier and Varanasi, 1991). Moreover, the induction of AHH activity indicates not only that contaminant exposure has occurred, but also that biological changes have occurred as a result of the exposure.

Other biological effects in fish were estimated by examining selected species for pathological conditions and by assessing reproductive impairment in suitably mature female fish. Pathological conditions included primarily lesions diagnosed by histological procedures (e.g., gill necrosis, liver cell necrosis). Reproductive capacity was estimated by examining the developmental stages of ovaries and by measuring plasma levels of certain reproductive hormones (Johnson et al., 1988). The two primary species for assessing reproductive impairment were Dolly Varden char and yellowfin sole, because during the primary sampling period (May/June), these two species are at the appropriate stage in their reproductive cycle for such assessments to be done.

B. Sampling Methods

Sampling activities were conducted at numerous sites in Prince William Sound and along the Alaska and Kenai Peninsulas. Coordinates of sites for which data are reported here in Figures 1-10 are listed in Table 1. Additional sites were also sampled, and maps of their locations and descriptions of samples collected are contained in the previous progress reports (Appendix 6). Sample collections were performed from the NOAA vessels FAIRWEATHER and DAVIDSON (and their launches), and the charter vessel BIG VALLEY, at water depths from 0 to 120 meters. At most sites, sediment samples were collected with a box corer, VanVeen grab, or Smith-McIntyre grab. Sediments were stored at - 20° C. The coordinates and depths of each station were recorded.

Fish were captured by either bottom trawl (yellowfin sole, flathead sole, rock sole), longline (Pacific halibut), midwater trawls (pollock), or gillnet/beach seine (Dolly Varden char). Bottom trawls were performed with an otter trawl (7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the liner of the cod end). Tows were of 5 to 15 minutes duration. In order to reduce contamination of the catch by free oil, trawling avoided areas of surface films or slicks. If a net was fouled by subsurface or bottom oil, it was replaced (or cleaned, if possible) and a new area for trawling was selected. Fish were kept alive in running seawater from the time of capture until necropsy, generally less than 2 hours. Individuals of selected target fish species were sorted and examined for externally visible lesions; up to 45 fish of selected species were measured, weighed, and necropsied at each site; and tissue samples were excised. Samples of bile, liver, kidney, and gonad were taken and stored appropriately (i.e. samples for P4501A analyses were kept at -80° or colder, samples for chemical analyses were kept at -20° or colder, tissues for histological examination were preserved and stored in appropriate fixatives).

C. Laboratory Analyses

1. Fluorescent Aromatic Compounds (FACs) in bile (analyses done under Technical Services-1)

Samples of bile were injected directly into a liquid chromatograph and a gradient elution was conducted using a Perkin-Elmer HC-ODS reverse-phase column with a gradient of 100% water (containing 5μL acetic acid/L) to 100% methanol (Krahn et al., 1984, 1986a, b). Two fluorescence detectors were used in series. The excitation/ emission wavelengths of one detector were set to 290/335 nm, where metabolites of naphthalene (NPH) fluoresce. Excitation/emission wavelengths of the other detector were set to 260/380 nm, where metabolites of phenanthrene (PHN) fluoresce. The total integrated area for each detector was converted (normalized) to units of either NPH or PHN that would be necessary to give that integrated area. These aromatic hydrocarbons (and especially their alkylated derivatives) are predominant components of the aromatic fraction of crude oil. In addition, bile samples were also analyzed for total biliary protein by the method of Lowry et al. (1951), and levels of FACs were normalized against the total biliary protein, as this type of normalization (within a single species) can account for some physiological variability in bile concentration, as described in Collier and Varanasi (1991).

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Activity

Hepatic microsomes were prepared essentially as described by Collier et al. (1986) and microsomal protein was measured by the method of Lowry et al. (1951), using bovine serum albumin as the standard. AHH activity was assayed by a modification of the method of Van Cantfort et al. (1977) as described by Collier et al. (1986), using ^{14}C-labeled benzo[a]pyrene as the primary substrate. As described in Collier et al. (1995b), microsomes were resuspended in 0.25M sucrose made up in 80:20 (v/v) water:glycerol, and all suspensions were frozen at -80°C until AHH assays were performed. All samples were treated similarly to minimize any effects of freezing and thawing procedures. All enzyme assays were run under conditions in which the reaction rates are in the linear range for both time and protein.

3. Histopathology

Histopathological procedures followed are described in the report from the Histopathology Technical Group for Oil Spill Assessment Studies in Prince William Sound, Alaska. Briefly, the procedures involved the following: (a) tissues preserved in the field were routinely embedded in paraffin and sectioned at five microns (Preece, 1972); and (b) paraffin sections were routinely stained with Mayer's hematoxylin and eosin, and for further characterization of specific lesions, additional sections were stained using standard special staining methods (Thompson, 1966; Preece, 1972; and Armed Forces Institute of Pathology, 1968). All slides were examined microscopically without knowledge of where the fish were captured. Hepatic lesions were classified according to the previously described diagnostic criteria of Myers et al. (1987). Ovarian lesions were classified as described in Johnson et al. (1988) and Johnson et al. (1991).

4. Reproductive Indicators

Reproductive activity was assessed by examining the ovaries of the sampled fish histologically to determine their developmental stage, and also for the presence of ovarian lesions that would be indicative of oocyte resorption (Johnson et al., 1988, 1991). Other parameters associated with reproductive activity were also measured, including estradiol (Sower and Schreck, 1982) levels, gonadotropins (GTH) in Dolly Varden (Swanson et al., 1987; Suzuki et al., 1988) and gonadosomatic index (ovary wt/gutted body wt x 100). Fish which were used for determinations of estradiol or GTH were always necropsied within one hour of capture, to minimize fluctuations in these indices which could be related to sampling stress. Relationships between indicators of reproductive function and petroleum hydrocarbon exposure were then evaluated.

D. Quality Assurance and Control Plans

1. Biliary FACs

Quality assurance procedures for bile analyses included NPH and PHN calibration standards and the calibration standard was analyzed after every 6 samples to determine a relative standard deviation. In addition, one blank sample and one reference material (control material) was analyzed daily. The concentrations of analytes should be within 2 standard deviations of the established concentrations in the control material. Replicate analyses were performed on 10% of the samples, if a sufficient amount of bile existed.

2. Hepatic AHH Activity

Quality assurance procedures for AHH measurements included duplicate zero-time and boiled enzyme blanks for each set of assays. Each sample was run in duplicate and those samples showing > 20% absolute difference between duplicates and >10 units (pmoles benzo[a]pyrene metabolized/mg microsomal protein/minute) difference between duplicates were reanalyzed.

3. Histopathology

Pathologists on this project used consistent, standard diagnostic criteria which were strictly adhered to by those who examined slides in this project. These criteria were established using color photographs of external lesions and standard reference slides containing tissues with the major lesion types expected in the study. Unusual or atypical lesions were referred to specialists for confirmation.

4. Reproductive Indicators

Quality assurance for the measurement of plasma estradiol and GTH included analysis of standards to confirm linearity and calibrate the assays. Blank analyses were conducted to eliminate matrix effects. Analyses of pooled plasma from vitellogenic female English sole and winter flounder containing known levels of estradiol and GTH were also done. Duplicate analyses of each sample to evaluate performance of the assays were conducted. These quality checks were run daily with each set of samples. Fecundity measurements were done in triplicate on each individual.

E. Statistical Tests

The FAC and AHH data showed departures both from normality and from homoscedasticity, which necessitated log-transformation of the FAC and AHH data prior to using ANOVA techniques, followed by Fisher's protected least significant difference test of the log-transformed data to assess differences between sites, at $\alpha=0.05$. To determine whether the prevalence of histopathological effects noted in each of the fish species was statistically uniform among the sites, the G test for heterogeneity (Sokal and Rohlf, 1981) was performed.

RESULTS

SUMMARIES OF FINDINGS BY SPECIES

Dolly Varden char

Dolly Varden, sampled in the littoral zone by either beach seines or gill nets run perpendicular to the shore, showed some of the highest levels of exposure to oil (as measured by levels of FACs in bile) of any fish sampled in 1989. However, by 1990, these levels had dropped markedly at heavily oiled sites (Table 1) such as Tonsina Bay and Snug Harbor (Figure 1). Hepatic AHH activities were also elevated in Dolly Varden at these oiled sites in 1989, and had dropped by 1990 (Figure 2). These results suggest that the heavy oiling of the intertidal area seen in 1989 affected fish in the very nearshore subtidal area, such as Dolly Varden char, and by 1990 the levels of petroleum hydrocarbon contamination of these areas were substantially reduced. In 1990, Dolly Varden tissues were also analyzed histologically, but no increases in prevalences of histopathological conditions of liver, kidney, gonad, or gill were seen in conjunction with apparent oil exposure as determined by levels of FACs in bile. Additionally in 1990, plasma estradiol and GTH concentrations were determined in 194 female Dolly Varden, and ovarian maturation was determined histologically in 154 fish captured at 12 sites. The results of these analyses showed little evidence of reproductive impairment in this species, although plasma estradiol levels tended to be lower in the animals most heavily exposed to petroleum (data given in Appendix 3 and Appendix 6, Progress Report for 1990). The inability to document this relationship at the $p<0.05$ level appears to be due to the small number of heavily exposed animals captured in 1990. Reproductive parameters were not measured in Dolly Varden in 1989, thus it is not known whether the comparatively higher levels of petroleum exposure at that time may have been associated with impaired reproduction. Because there was a substantial decrease in petroleum exposure between 1989 and 1990, Dolly Varden were not sampled in 1991.

Yellowfin sole

Exposure to petroleum was readily discernible in the benthic flatfish species, yellowfin sole, though the levels of FACs in bile were less than for Dolly Varden, suggesting less exposure to oil. However, levels did not drop markedly between 1989 and 1990 at oiled sites. By 1991, however, substantially decreased exposure was evident at Snug Harbor (Figure 3). In both 1990 and 1991 there was evidence of increased hepatic AHH activities in yellowfin sole at oiled sites (Figure 4). This induction of AHH activity was especially evident in males, because female yellowfin sole at the time of sampling (May and June) are undergoing ovarian recrudescence, which in flatfish is shown to markedly depress P4501A activities (Johnson et al., 1988; Johnson et al., 1993; Gray et al., 1991). Similar to Dolly Varden, there was little evidence of reproductive dysfunction in the female yellowfin sole from the oiled sites in 1990, although there was again a trend toward lower levels of plasma estradiol in the most heavily exposed fish, with exposure determined by levels of biliary FACs (data given in Appendix 3 and Appendix 6, Progress Report for 1990).

Table 1. Names, longitudes and latitudes for sites where samples were collected.

Site Name	Latitude	Longitude
Afognak	58°20'N	152°23'W
Balboa Bay	55°34'N	160°36'W
*Bay of Isles	60°24'N	147°30'W
Black Bay	59°32'N	150°13'W
Cape Kekurnoi	57°42'N	155°02'W
Cape Ugat	57°57'N	153°48'W
Cape Uyak	57°43'N	154°34'W
Cape Paramanof	58°21'N	153°08'W
Chignik Bay	56°19'N	158°23'W
Chirikof Island	55°07'N	156°42'W
Discoverer Bay	58°23'N	152°23'W
Eastend Transect	55°54'N	165°59'W
Fox Farm Bay	59°58'N	148°10'W
Goose Island	60°46'N	146°55'W
Hallo Bay	58°27'N	154°02'W
Hogan Bay	60°10'N	147°43'W
Kachemak Bay	59°34'N	151°16'W
Kamishak Bay	59°15'N	153°40'W
Katmai Bay	57°56'N	155°04'W
Kinak Bay	58°01'N	154°15'W
Kodiak Island	57°44'N	152°25'W
Kukak Bay	58°17'N	154°18'W
Malina Point	58°04'N	153°36'W
*Mummy Bay/Island	60°18'N	147°58'W
*Naked Island	60°38'N	147°26'W
Olsen Bay/Port Gravina	60°44'N	146°14'W
*Point Bazil	59°59'N	147°47'W
Portage Bay	56°55'N	155°47'W
Port Fidalgo	60°44'N	146°48'W
Resurrection Bay	59°55'N	149°20'W
Rocky Bay	60°21'N	147°06'W
Sanak Island	54°05'N	162°33'W
Seymour Canal	57°32'N	133°50'W
*Sleepy Bay	60°04'N	147°50'W
*Snug Harbor	60°14'N	147°43'W
Squirrel Bay	60°00'N	148°04'W
Sunny Cove	59°55'N	149°21'W
*Tonsina Bay	59°14'N	150°58'W
Tugidak Island	56°17'N	156°25'W
Valdez	61°07'N	146°21'W
Windy Bay	59°14'N	151°32'W

*--sites generally acknowledged to have been heavily oiled following the spill

Rock sole

Levels of biliary FACs and hepatic P4501A activities were determined in rock sole from several sites in 1989, 1990, and 1991, and rock sole were also examined for the presence of histopathological lesions in 1990. Similar to yellowfin sole, there was evidence of exposure to petroleum in rock sole sampled near oiled sites in 1989 and 1990. Decreased exposure was observed at oiled sites in the limited sampling done in 1991 as measured by levels of FACs in bile (Figure 5). There were also increases in hepatic AHH activities in rock sole at oiled sites in 1989, 1990, and 1991 (Figure 6). The results of histological analyses of tissues collected from this benthic species in 1990 showed no alterations in liver, kidney, or gonad histology (data presented in Appendix 3). However, there was a significantly ($p<0.005$) increased prevalence of respiratory epithelial hyperplasia (REH) of the gill at three sites where the biliary FAC data suggested that increased oil exposure was occurring (Tonsina Bay, Snug Harbor, and Sleepy Bay; see Figure 5) as compared to the prevalences in fish collected from Olsen Bay and Rocky Bay. Total numbers of fish affected with gill REH were 56 out of 73 (77%) at the more oil-impacted sites and 20 out of 41 (49%) at Rocky Bay and Olsen Bay. Additionally, the severity of gill REH was significantly greater ($p<0.05$) at the three more impacted sites.

Flathead sole

Increased levels of biliary FACs and induced hepatic AHH activities were measured in flathead sole from heavily oiled sites in 1989 (FACs only) and 1990 (FACs and AHH). In 1991 these same measures were slightly elevated in sole from Snug Harbor compared to a less impacted site, Olsen Bay (Figures 7 and 8 for FACs and P4501A, respectively). These results are similar to what was found for yellowfin sole and rock sole, which is consistent with all three of these flatfish species being captured from similar habitats. No histological analyses of tissues from flathead sole were done.

Pacific halibut

Pacific halibut, captured generally at depths of >30 m, showed some evidence of increased oil exposure in 1989, as determined by levels of FACs in bile, but levels were substantially less than for other flatfish species captured at shallower depths. By 1990 these levels of FACs had dropped considerably at Tonsina Bay and Snug Harbor (Figure 9).

Pollock

Pollock were not sampled until the late winter of 1990, and then were only sampled for levels of biliary FACs. At that time increased biliary levels of FACs were evident, especially in pollock from inside Prince William Sound, and by 1991 these levels had dropped quite substantially, though it was still possible to detect increased levels at some sites inside PWS, compared to animals collected from unimpacted or distant sites (Figure 10). Mass spectrometric analysis has confirmed the presence of metabolites of petroleum hydrocarbons in the bile of four of these pollock (Krahn et al., 1992). Assessment of reproductive function in female pollock collected in 1991 did not show any substantial effects that could be positively ascribed to increased oil exposure (data given in Appendix 3).

Figure 11 shows mean levels of FACs in bile from yellowfin sole sampled from Alaskan waters prior to the spill, and in addition includes results from analyses of bile from salmon and halibut collected after the spill, but from an area (Angoon) believed to be unaffected by the spill. Figure 11 was taken from the 1989 Progress Report for this Project, which is contained in Appendix 6. As stated in that report, the data presented in Figure 11 are only intended for use as general reference values.

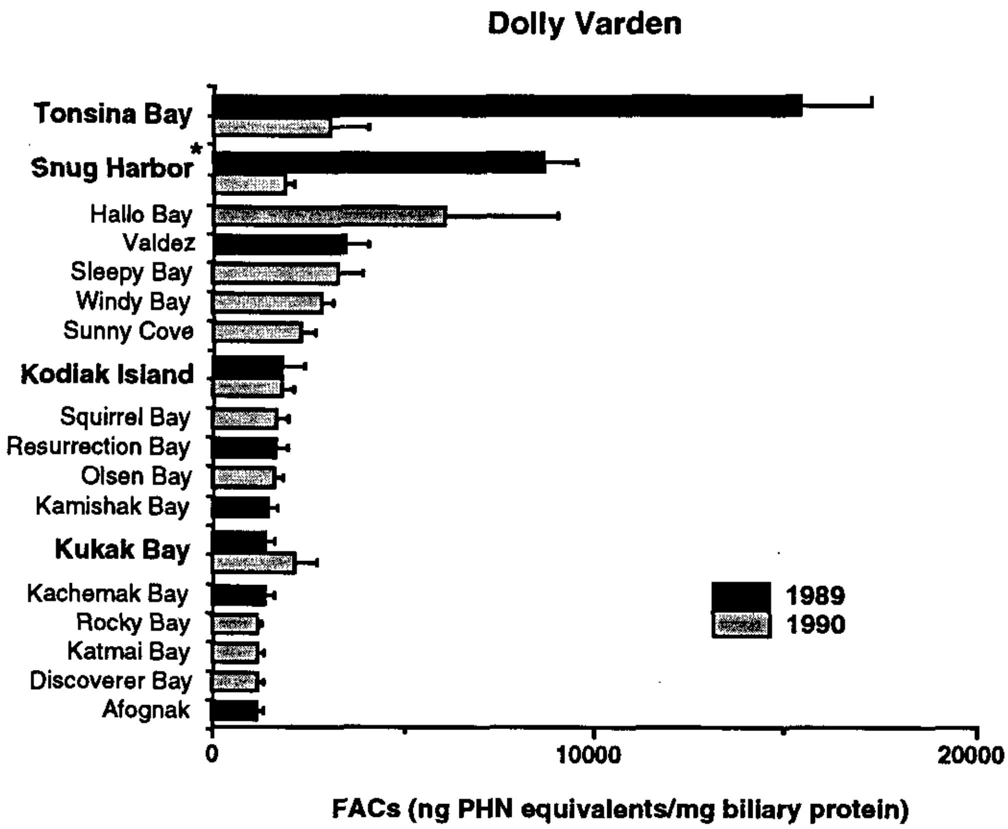

Figure 1. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in Dolly varden char, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6. *--data for Dolly Varden char for Snug Harbor in 1989 used an average protein content value of 6.75 mg/ml bile for protein correction, as no protein values were obtained in these individual samples.

Dolly Varden

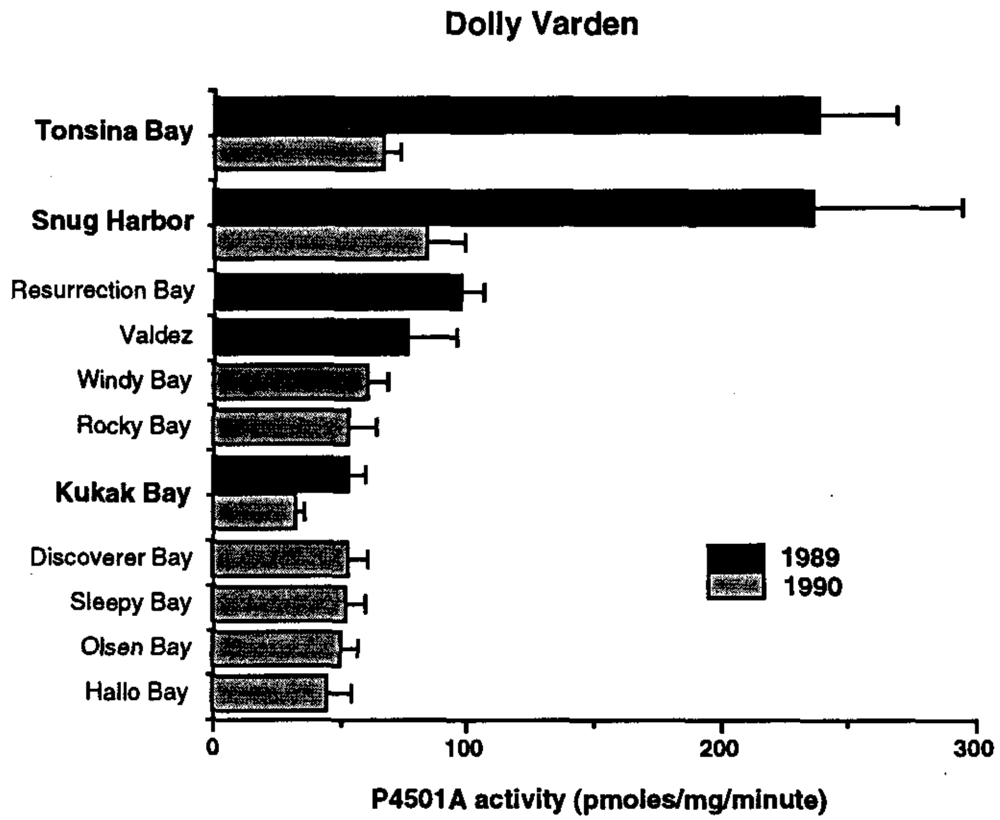

Figure 2. Average activities (± SE) of hepatic aryl hydrocarbon hydroxylase, a measure of cytochrome P4501A, in Dolly varden char. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

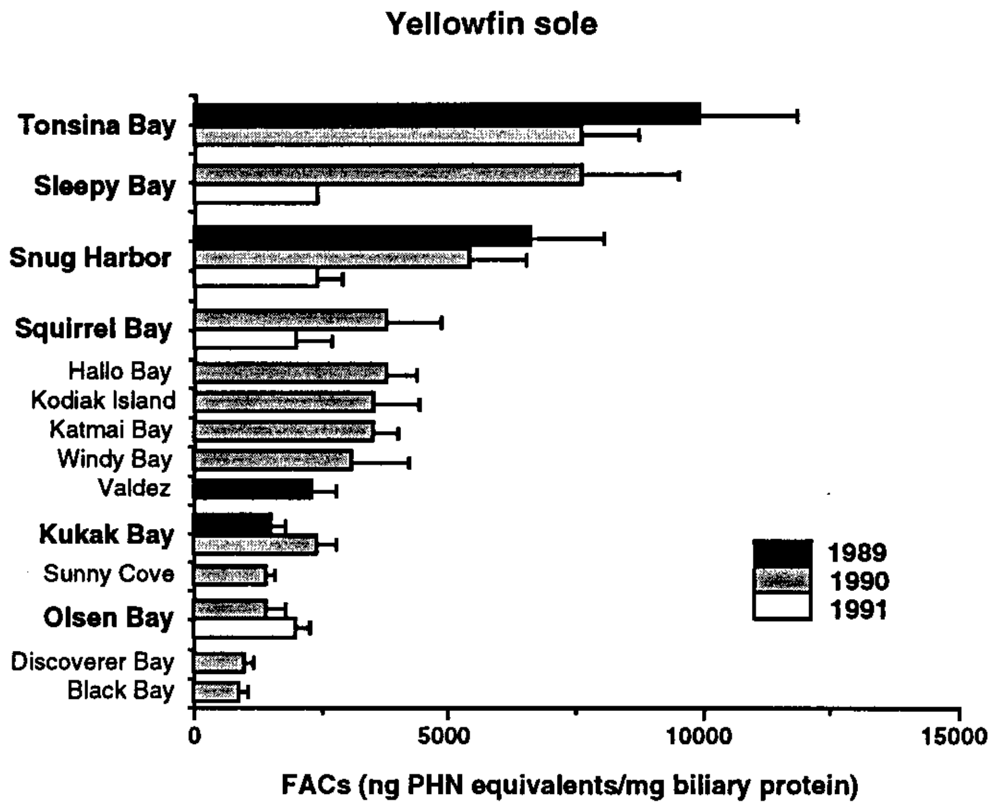

Figure 3. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in yellowfin sole, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

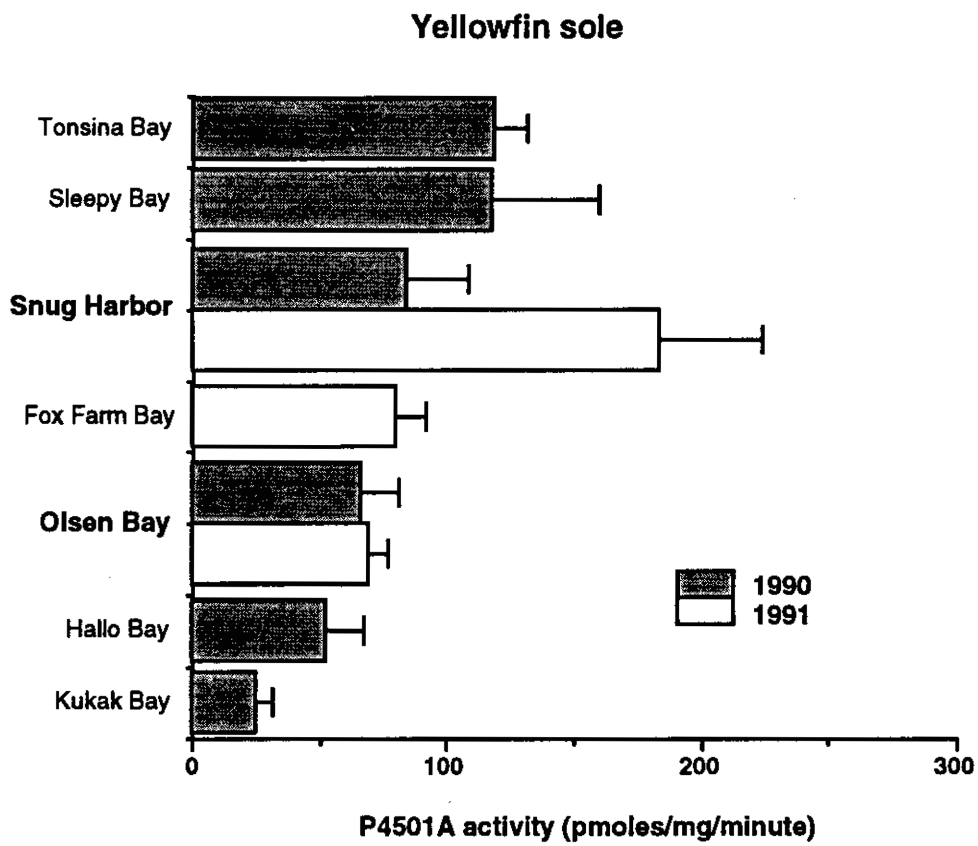

Figure 4. Average activities (± SE) of hepatic aryl hydrocarbon hydroxylase, a measure of cytochrome P4501A, in yellowfin sole. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

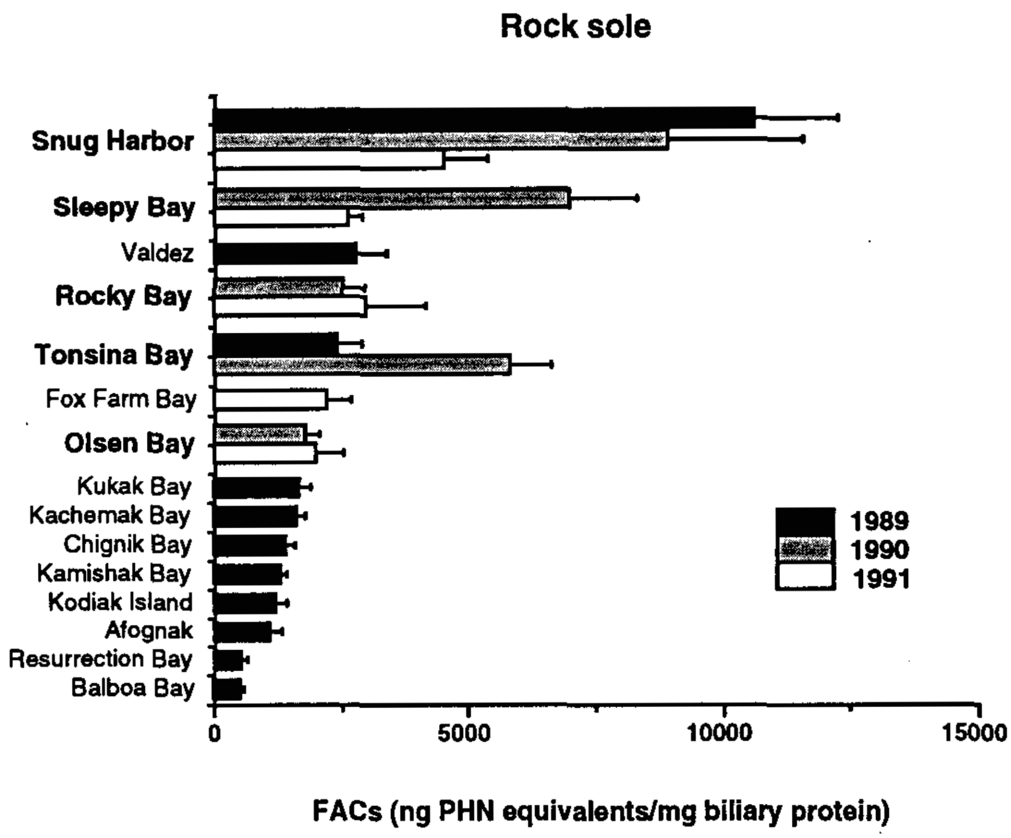

Figure 5. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in rock sole, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

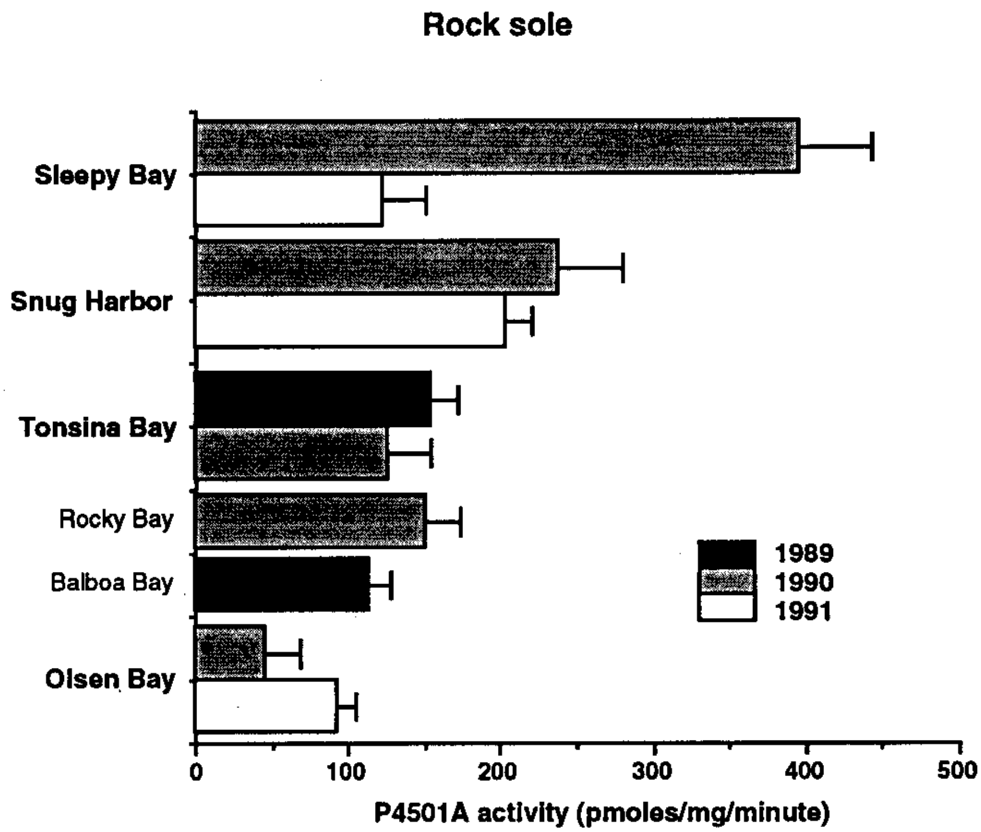

Figure 6. Average activities (± SE) of hepatic aryl hydrocarbon hydroxylase, a measure of cytochrome P4501A, in rock sole. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

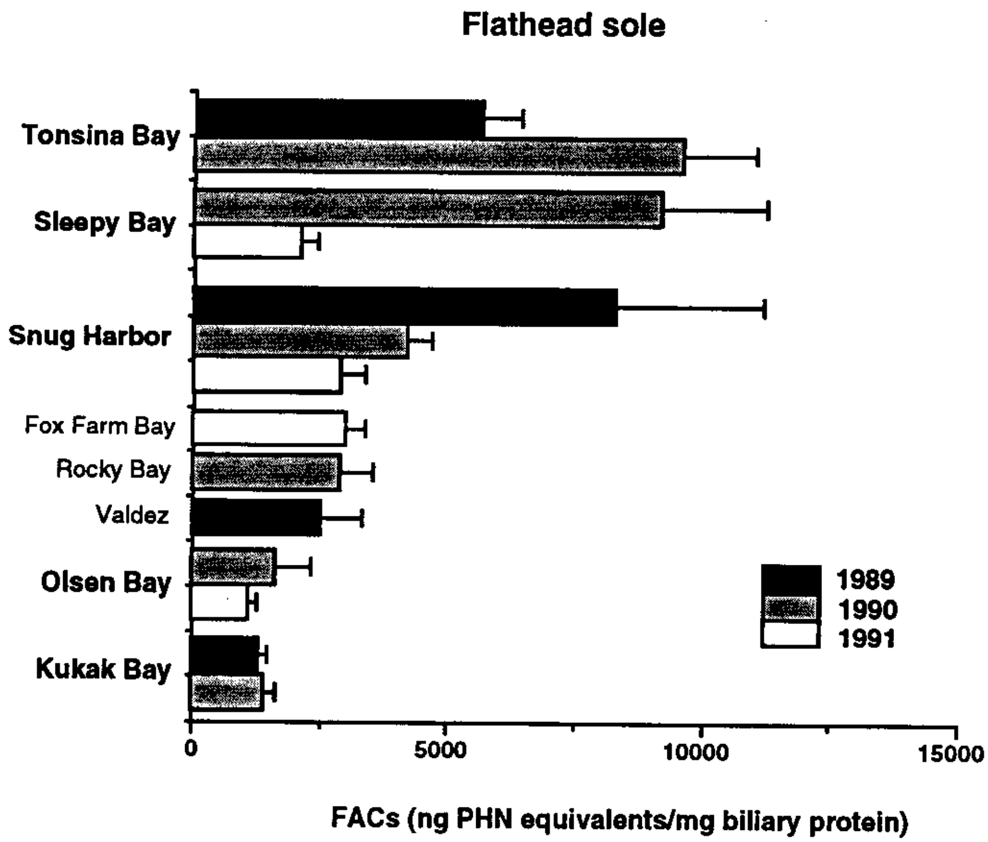

Figure 7. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in flathead sole, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

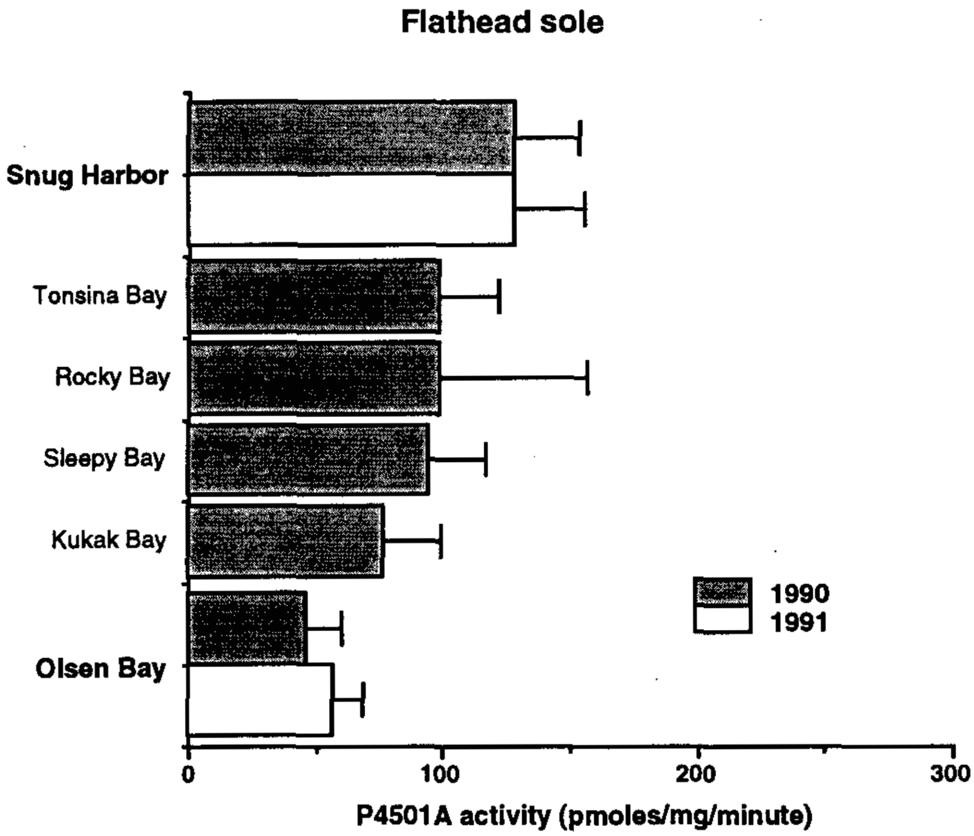

Figure 8. Average activities (± SE) of hepatic aryl hydrocarbon hydroxylase, a measure of cytochrome P4501A, in flathead sole. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

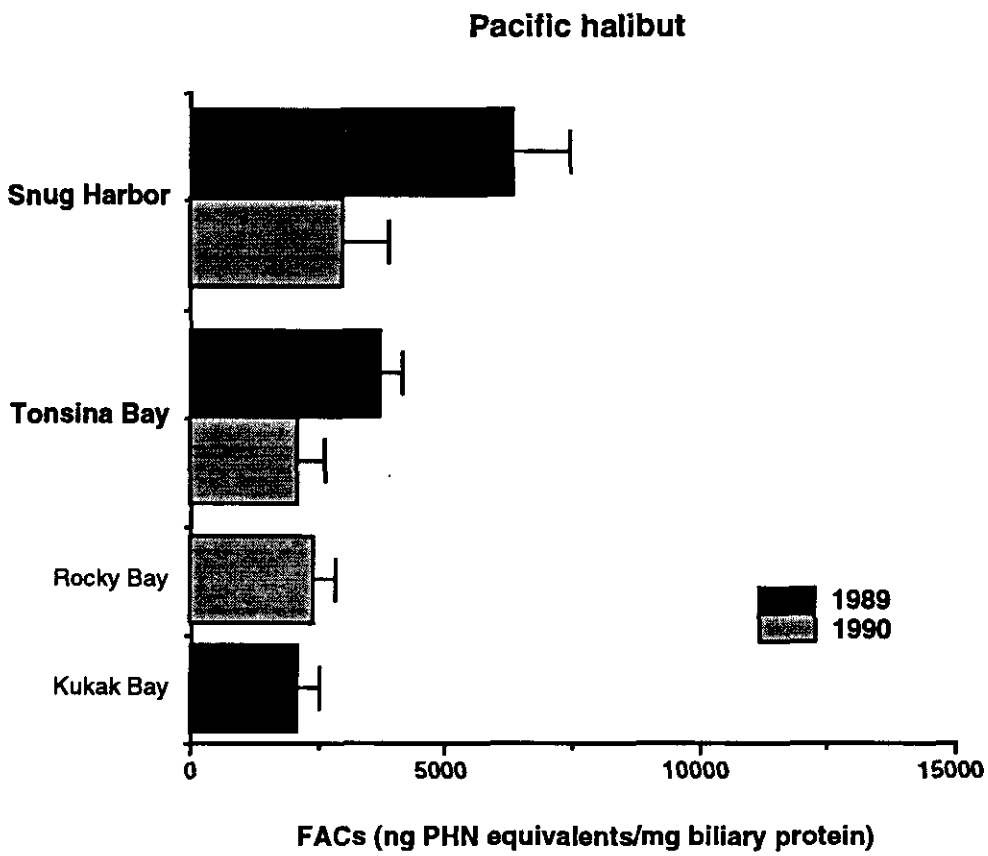

Figure 9. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in Pacific halibut, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

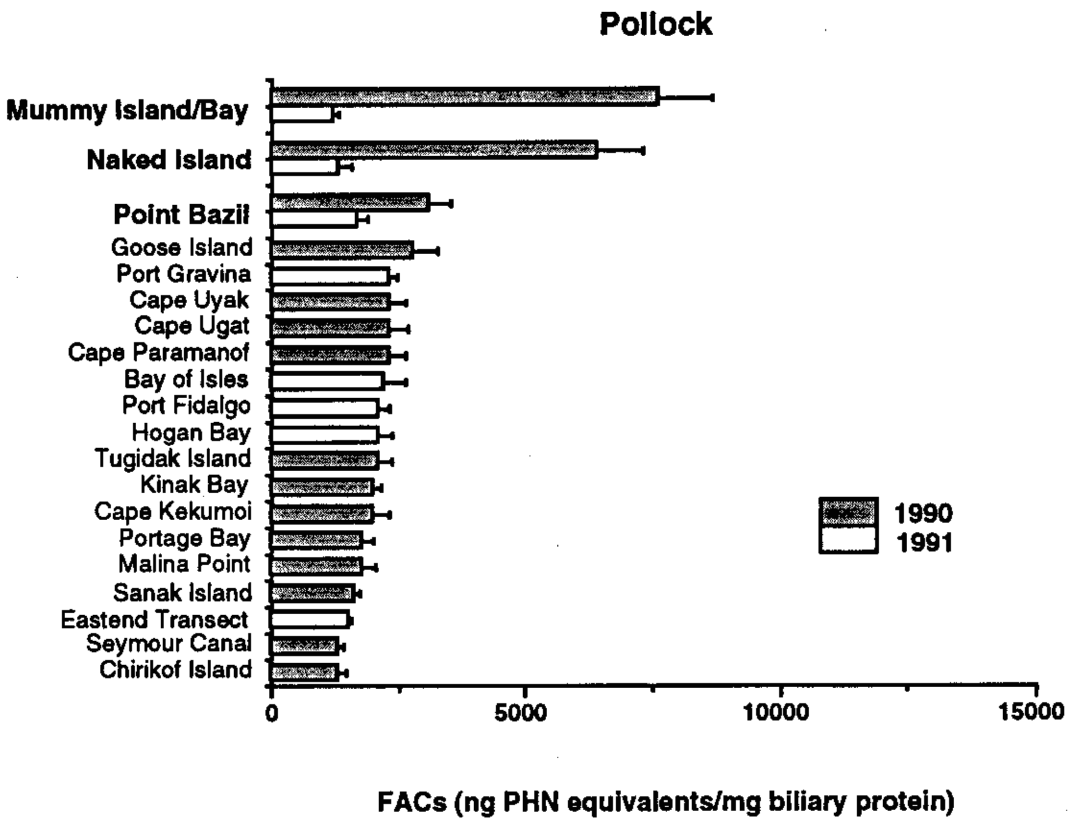

Figure 10. Average biliary levels (± SE) of fluorescent aromatic compounds (FACs) in pollock, determined at phenanthrene wavelengths and corrected for biliary protein content. Sites listed in bold type are those for which more than one year's data are presented. Numbers of analyses per site varied, but generally ranged between five and twenty. Numbers of individual samples comprising each mean value, together with results of statistical analyses of site and year differences, can be found in Appendix 6.

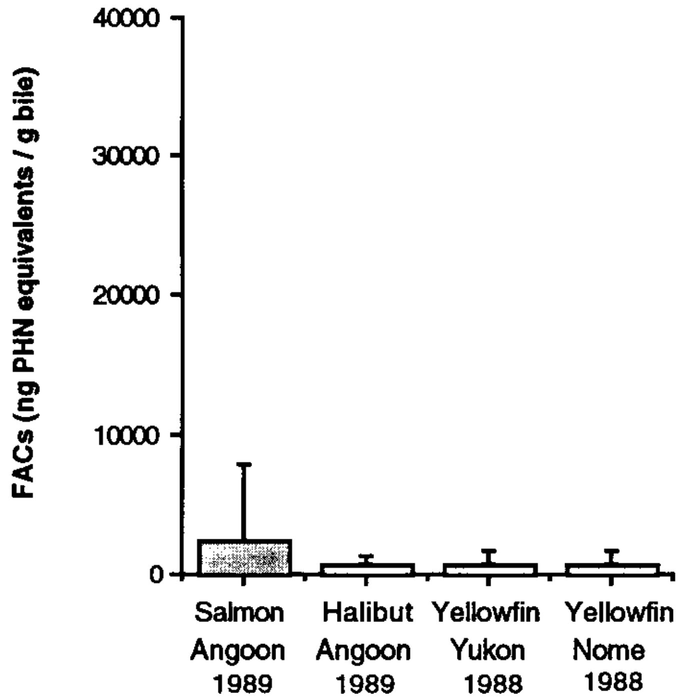

Figure 11. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths in bile of three species of fish collected from locations not affected by the *EXXON Valdez* oil spill.

DISCUSSION AND CONCLUSIONS

The results of analyses of oil exposure in several species of subtidal fish following the spill definitively point to the necessity of monitoring the subtidal environment following major oil spills. The littoral zone appeared to be heavily impacted in the months immediately following the spill, but a year later, after a winter storm cycle, exposure of fish inhabiting this zone (i.e. Dolly Varden) was substantially decreased. In contrast, nearshore benthic fish species (up to ~30m depth; species sampled were rock sole, yellowfin sole, and flathead sole) showed continuing exposure through the first two field seasons following the spill, and even after more than two years there was still some evidence of increased exposure of fish from these habitats. Beyond this depth (>30m), the degree of exposure of Pacific halibut appeared to be less than in benthic fish residing at shallower depths. A surprising finding was the evidence of exposure of pollock to petroleum approximately one year after the spill, at a site (e.g. Tugidak Island) more than 400 miles from the grounding site. Pollock, a major fisheries resource in Alaskan waters, are bathypelagic fish which feed in the water column. Thus these results suggest that the spilled oil affected either the water column or food supply of these fish at great distances from the spill, and for some time after the spill.

These findings of widespread and continuing exposure of subtidal fish following the spill raise several concerns. Perhaps foremost to many is the question of whether oil-exposed fish are safe for human consumption. Although this issue was not the subject of the NRDA process following the spill, there was a substantial effort put forth to answer this question in association with the subsistence fisheries, following the spill. The findings from this work (Varanasi et al., 1990) suggested that there was little risk involved in consumption of the flesh from oil-exposed fish species, due to the extensive metabolism and excretion of petroleum compounds by fish, although there was accumulation of hydrocarbons in various invertebrate species that do not posess substantial ability to metabolize these compounds. This finding of minimal risk from consumption of oil-exposed fish was supported by an advisory position of the Food and Drug Administration.

What remains to be determined are the potential impacts on fishery resources of long-term exposure to petroleum, albeit at moderate to low levels. To date, our studies have not shown any profound effects in the species studied following the spill, but this finding is tempered by the delayed start of assessment of serious effects such as reproductive function, and the relatively short time over which such analyses have been conducted. Although it will always be difficult to sample subtidal fishery resources comprehensively and rapidly following an oil spill, a better understanding of the potential impacts of petroleum exposure on fishery resources can be obtained through careful and realistic laboratory exposure of fish to petroleum. Such studies will need to go beyond the relatively straightforward short-term exposure studies which have been commonly done in the past. However, recent advances in methodology for assessing oil exposure in fish, together with current knowledge of the processes involved in reproduction, immune function, and growth and survival of fish species (Casillas et al., 1991; Johnson et al., 1993; Arkoosh et al., 1992; Collier et al., 1992), make this an appropriate course of action.

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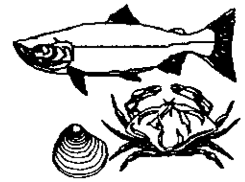
APPENDIX 1



APPENDIX 1. SUBTIDAL 7 FINAL REPORT

Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.0972	Dolly Varden	Valdez	140000	21000	-			51	423	675	F		5/20/89
89.0977	Dolly Varden	Valdez	84000	13000	6.07	13839	2142	66	380	486	F		5/20/89
89.0981	Dolly Varden	Valdez	53000	7700	-			44	360	403	M		5/20/89
89.0982	Dolly Varden	Valdez	110000	15000	-			-	385	537	M		5/20/89
89.0983	Dolly Varden	Valdez	150000	21000	-			59	408	577	M		5/20/89
89.0990	Dolly Varden	Valdez	160000	26000	-			90	394	578	F		5/20/89
89.0992	Flathead sole	Valdez	42000	16000	1.72	24419	9302	-	301	216	M		5/20/89
89.0994	Flathead sole	Valdez	11000	2100	3.36	3274	625	-	273	159	M		5/20/89
89.0995	Flathead sole	Valdez	21000	5900	2.40	8750	2458	-	275	186	F		5/20/89
89.0998	Yellowfin sole	Valdez	15000	2800	1.12	13393	2500	-	223	123	F		5/20/89
89.1000	Yellowfin sole	Valdez	32000	5400	1.70	18824	3176	-	260	206	M		5/20/89
89.1005	Yellowfin sole	Valdez	42000	7800	1.74	24138	4483	-	230	143	F		5/20/89
89.1007	Yellowfin sole	Valdez	31000	6500	2.80	11071	2321	-	239	149	M		5/20/89
89.1010	Rock sole	Valdez	42000	7000	-			-	257	195	F		5/20/89
89.1013	Rock sole	Valdez	32000	5300	0.80	40000	6625	107	200	89	F		5/20/89
89.1018	Flathead sole	Valdez	19000	4100	3.02	6291	1358	-	320	270	F		5/20/89
89.1023	Rock sole	Valdez	62000	8100	3.52	17614	2301	16	320	388	F		5/20/89
89.1024	Rock sole	Valdez	30000	4300	3.34	8982	1287	7	354	594	F		5/20/89
89.1026	Rock sole	Valdez	35000	4400	2.48	14113	1774	-	296	345	F		5/20/89
89.1027	Rock sole	Valdez	34000	4000	2.36	14407	1695	-	252	194	F		5/20/89
89.1028	Rock sole	Valdez	22000	3100	0.88	25000	3523	5	296	300	F		5/20/89
89.1029	Rock sole	Valdez	45000	5900	2.20	20455	2682	4	254	177	F		5/20/89

1. Fluorescent aromatic compounds (FAC) measured at naphthalene (NPH) and phenanthrene (PHN) wavelength pairs.
2. FAC (NPH) or FAC (PHN) expressed on a per gram of bile protein basis.
3. Aryl hydrocarbon hydroxylase (AHH) activity measured using 14-C-benzo[a]pyrene as the primary substrate.
4. Histopathological (H) or reproductive success (R) analyses performed. See Appendices 2 and 3 for data.

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1030	Yellowfin sole	Valdez	13000	2000	1.50	8667	1333	-	250	182	M		5/20/89
89.1036	Rock sole	Valdez	20000	2000	1.26	15873	1587	-	272	201	F		5/20/89
89.1037	Rock sole	Valdez	49000	6400	1.76	27841	3636	5	258	194	F		5/20/89
89.1040	Yellowfin sole	Valdez	61000	9900	-			-	272	257	M		5/20/89
89.1044	Yellowfin sole	Valdez	27000	4300	2.42	11157	1777	-	265	197	F		5/20/89
89.1046	Yellowfin sole	Valdez	25000	5000	6.50	3846	769	-	296	269	M		5/20/89
89.1047	Yellowfin sole	Valdez	50000	9800	3.04	16447	3224	-	291	304	M		5/20/89
89.1052	Yellowfin sole	Valdez	17000	3300	3.42	4971	965	-	234	148	F		5/20/89
89.1056	Flathead sole	Valdez	12000	2000	2.98	4027	671	-	250	120	F		5/21/89
89.1058	Flathead sole	Valdez	14000	2800	0.94	14894	2979	-	211	76	F		5/21/89
89.1063	Flathead sole	Valdez	16000	3600	1.90	8421	1895	-	338	373	F		5/21/89
89.1066	Flathead sole	Valdez	12000	2500	2.28	5263	1096	-	228	99	F		5/21/89
89.1069	Flathead sole	Valdez	20000	4400	2.32	8621	1897	-	228	97	M		5/21/89
89.1076	Flathead sole	Valdez	26000	5500	1.76	14773	3125	-	228	100	M		5/21/89
89.1090	Dolly Varden	Valdez	230000	31000	-			116	282	155	F		5/21/89
89.1091	Dolly Varden	Valdez	140000	21000	-			-	302	212	F		5/21/89
89.1094	Dolly Varden	Valdez	360000	110000	19.04	18908	5777	-	279	144	F		5/21/89
89.1096	Dolly Varden	Valdez	130000	17000	7.54	17241	2255	-	288	189	F		5/21/89
89.1097	Dolly Varden	Valdez	-	-	-			197	292	183	F		5/21/89
89.1098	Dolly Varden	Valdez	-	-	-			30	260	117	F		5/21/89
89.1224	Chum salmon	Naked Island	30000	5500	3.40	8824	1618	-	724	-	F		5/24/89
89.1225	Chum salmon	Naked Island	18000	3800	3.80	4737	1000	-	712	-	F		5/24/89
89.1229	Chum salmon	Naked Island	30000	5700	2.12	14151	2689	-	724	-	F		5/24/89
89.1230	Chum salmon	Naked Island	35000	7000	3.32	10542	2108	-	699	-	F		5/24/89
89.1231	Chum salmon	Naked Island	46000	10000	5.50	8364	1818	-	686	-	F		5/24/89
89.1232	Chum salmon	Naked Island	60000	10000	2.98	20134	3356	-	712	-	M		5/24/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein [2]	ug PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1238	Chum salmon	Naked Island	24000	3900	2.60	9231	1500	-	762	-	F		5/24/89
89.1239	Chum salmon	Naked Island	24000	4200	4.32	5556	972	-	781	-	F		5/24/89
89.1240	Chum salmon	Naked Island	28000	6600	3.04	9211	2171	-	750	-	M		5/24/89
89.1290	Flathead sole	Snug Harbor	42000	14000	2.90	14483	4828	-	305	308	F		5/30/89
89.1291	Yellowfin sole	Snug Harbor	22000	8100	2.10	10476	3857	-	269	224	M		5/30/89
89.1292	Yellowfin sole	Snug Harbor	62000	17000	3.02	20530	5629	-	323	372	F		5/30/89
89.1293	Yellowfin sole	Snug Harbor	22000	5700	1.54	14286	3701	-	255	206	F		5/30/89
89.1295	Yellowfin sole	Snug Harbor	56000	16000	1.10	50909	14545	-	290	233	F		5/30/89
89.1298	Yellowfin sole	Snug Harbor	45000	9800	0.92	48913	10652	-	253	190	F		5/30/89
89.1299	Yellowfin sole	Snug Harbor	45000	7700	2.24	20089	3438	-	280	291	F		5/30/89
89.1300	Yellowfin sole	Snug Harbor	61000	15000	1.46	41781	10274	-	270	247	M		5/30/89
89.1301	Yellowfin sole	Snug Harbor	37000	9500	2.56	14453	3711	-	281	291	M		5/30/89
89.1304	Yellowfin sole	Snug Harbor	45000	13000	2.20	20455	5909	-	227	138	M		5/30/89
89.1306	Yellowfin sole	Snug Harbor	28000	9500	2.44	11475	3893	-	225	126	M		5/30/89
89.1311	Chum salmon	Snug Harbor	50000	13000	13.08	3823	994	-	680	3180	M		5/30/89
89.1312	Chum salmon	Snug Harbor	95000	24000	4.14	22947	5797	-	750	5450	F		5/30/89
89.1315	Rock sole	Snug Harbor	89000	22000	1.24	71774	17742	-	205	107	F		5/30/89
89.1317	Rock sole	Snug Harbor	49000	15000	0.94	52128	15957	-	256	170	F		5/30/89
89.1318	Rock sole	Snug Harbor	140000	47000	2.52	55556	18651	40	325	374	F		5/30/89
89.1321	Rock sole	Snug Harbor	86000	24000	0.76	113158	31579	1	265	195	F		5/30/89
89.1323	Rock sole	Snug Harbor	52000	15000	1.72	30233	8721	-	230	131	F		5/30/89
89.1325	Rock sole	Snug Harbor	42000	10000	0.50	84000	20000	-	230	140	F		5/30/89
89.1334	Halibut	Snug Harbor	7000	1100	1.20	5833	917	-	1070	-	M		5/30/89
89.1335	Halibut	Snug Harbor	16000	5900	1.04	15385	5673	-	1060	-	M		5/30/89
89.1336	Halibut	Snug Harbor	19000	4900	3.16	6013	1551	-	680	-	F		5/30/89
89.1338	Halibut	Snug Harbor	27000	7400	1.48	18243	5000	-	700	-	M		5/30/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1339	Halibut	Snug Harbor	28000	6100	1.06	26415	5755	-	840	-	F		5/30/89
89.1340	Halibut	Snug Harbor	37000	10000	1.64	22561	6098	-	740	-	F		5/30/89
89.1341	Halibut	Snug Harbor	41000	12000	1.04	39423	11538	-	860	-	M		5/30/89
89.1342	Halibut	Snug Harbor	22000	7700	0.80	27500	9625	-	1780	-	M		5/30/89
89.1357	Rock sole	Snug Harbor	77000	22000	1.92	40104	11458	504	274	251	F		5/31/89
89.1359	Rock sole	Snug Harbor	81000	24000	2.18	37156	11009	428	298	286	F		5/31/89
89.1363	Rock sole	Snug Harbor	26000	7500	1.04	25000	7212	214	411	930	F		5/31/89
89.1364	Rock sole	Snug Harbor	39000	11000	1.60	24375	6875	224	342	470	F		5/31/89
89.1365	Chum salmon	Snug Harbor	80000	13000	3.58	22346	3631	-	645	2720	F		5/31/89
89.1369	Chum salmon	Snug Harbor	53000	14000	2.54	20866	5512	-	700	4990	M		5/31/89
89.1370	Chum salmon	Snug Harbor	-	-	3.40	0	0	-	-	-	F		5/31/89
89.1380	Rock sole	Snug Harbor	-	-	-			83	380	453	F		5/31/89
89.1381	Rock sole	Snug Harbor	-	-	-			116	344	333	M		5/31/89
89.1381	Dolly Varden	Snug Harbor	-	-	-			116	344	333	M		5/31/89
89.1382	Rock sole	Snug Harbor	-	-	-			413	490	1186	M		5/31/89
89.1382	Dolly Varden	Snug Harbor	-	-	-			413	490	1186	M		5/31/89
89.1383	Dolly Varden	Snug Harbor	300000	64000	-			221	295	203	M		5/31/89
89.1385	Dolly Varden	Snug Harbor	-	-	-			133	350	339	F		5/31/89
89.1386	Dolly Varden	Snug Harbor	210000	53000	-			124	315	248	F		5/31/89
89.1394	Flathead sole	Snug Harbor	7700	2000	1.06	7264	1887	-	335	311	M		5/31/89
89.1396	Flathead sole	Snug Harbor	20000	3700	0.90	22222	4111	-	291	202	F		5/31/89
89.1398	Flathead sole	Snug Harbor	91000	21000	2.30	39565	9130	-	329	359	F		5/31/89
89.1403	Flathead sole	Snug Harbor	55000	11000	1.84	29891	5978	-	387	528	F		5/31/89
89.1404	Flathead sole	Snug Harbor	43000	10000	1.18	36441	8475	-	257	102	F		5/31/89
89.1412	Flathead sole	Snug Harbor	55000	17000	3.28	16768	5183	-	265	131	M		5/31/89
89.1413	Flathead sole	Snug Harbor	320000	100000	1.66	192771	60241	-	315	274	M		5/31/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1416	Flathead sole	Snug Harbor	150000	45000	-			-	236	107	M		5/31/89
89.1417	Flathead sole	Snug Harbor	39000	12000	2.28	17105	5263	-	244	118	M		5/31/89
89.1421	Halibut	Snug Harbor	56000	15000	2.12	26415	7075	-	622	3180	F		5/31/89
89.1425	Halibut	Snug Harbor	44000	13000	1.32	33333	9848	-	690	3630	F		5/31/89
89.1432	Chum salmon	Snug Harbor	76000	14000	3.38	22485	4142	-	700	4090	F		6/1/89
89.1433	Chum salmon	Snug Harbor	82000	20000	5.16	15891	3876	-	750	3860	F		6/1/89
89.1434	Chum salmon	Snug Harbor	55000	12000	4.42	12443	2715	-	800	4990	M		6/1/89
89.1438	Chum salmon	Snug Harbor	52000	11000	3.90	13333	2821	-	700	4090	M		6/1/89
89.1439	Chum salmon	Snug Harbor	55000	11000	1.76	31250	6250	-	695	4540	M		6/1/89
89.1446	Dolly Varden	Snug Harbor	-	-	-			411	303	260	F		
89.1491	Chum salmon	Evans Island	42000	7900	1.70	24706	4647	-	680	3630	F		6/3/89
89.1492	Chum salmon	Evans Island	65000	16000	2.66	24436	6015	-	660	3180	M		6/3/89
89.1493	Chum salmon	Evans Island	53000	10000	1.96	27041	5102	-	690	4540	F		6/3/89
89.1494	Chum salmon	Evans Island	29000	6000	5.16	5620	1163	-	640	3180	F		6/3/89
89.1495	Chum salmon	Evans Island	23000	4700	3.96	5808	1187	-	690	4540	F		6/3/89
89.1497	Chum salmon	Evans Island	26000	5600	2.02	12871	2772	-	710	4990	M		6/3/89
89.1499	Chum salmon	Evans Island	29000	5800	3.36	8631	1726	-	670	3630	M		6/3/89
89.1558	Chum salmon	Evans Island	42000	9800	2.90	14483	3379	-	710	4540	M		6/4/89
89.1559	Chum salmon	Evans Island	57000	15000	4.34	13134	3456	-	700	3630	F		6/4/89
89.1565	Chum salmon	Evans Island	53000	12000	5.34	9925	2247	-	820	7490	M		6/4/89
89.1589	Chum salmon	Resurrection Bay	24000	3900	3.14	7643	1242	-	710	4090	F		6/5/89
89.1590	Chum salmon	Resurrection Bay	39000	7800	3.16	12342	2468	-	740	4990	M		6/5/89
89.1591	Chum salmon	Resurrection Bay	25000	4300	9.28	2694	463	-	570	2270	M		6/5/89
89.1594	Chum salmon	Resurrection Bay	35000	7300	2.84	12324	2570	-	690	3630	F		6/5/89
89.1608	Chum salmon	Resurrection Bay	-	-	6.06	0	0	-	380	3400	F		6/5/89
89.1641	Chum salmon	Resurrection Bay	25000	4400	4.60	5435	957	-	710	4990	M		6/5/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1642	Chum salmon	Resurrection Bay	19000	3800	9.45	2011	402	-	670	3630	F		6/5/89
89.1659	Rock sole	Resurrection Bay	30000	4300	3.14	9554	1369	-	380	798	F		6/5/89
89.1662	Rock sole	Resurrection Bay	5000	410	1.20	4167	342	-	248	193	F		6/5/89
89.1663	Rock sole	Resurrection Bay	5700	660	5.14	1109	128	-	224	135	F		6/5/89
89.1664	Rock sole	Resurrection Bay	8700	1300	2.28	3816	570	-	235	186	J		6/5/89
89.1666	Rock sole	Resurrection Bay	7500	670	2.04	3676	328	-	232	199	F		6/5/89
89.1667	Rock sole	Resurrection Bay	8100	1100	6.38	1270	172	-	201	102	M		6/5/89
89.1668	Rock sole	Resurrection Bay	4000	360	1.38	2899	261	-	234	139	M		6/5/89
89.1683	Dolly Varden	Resurrection Bay	52000	11000	6.50	8000	1692	79.8	445	884	F		6/6/89
89.1684	Dolly Varden	Resurrection Bay	68000	15000	5.76	11806	2604	81.6	410	679	F		6/6/89
89.1685	Dolly Varden	Resurrection Bay	45000	5100	6.61	6808	772	68.2	-	-	F		6/6/89
89.1687	Dolly Varden	Resurrection Bay	52000	7100	6.43	8087	1104	130.9	-	-	F		6/6/89
89.1688	Dolly Varden	Resurrection Bay	89000	13000	9.19	9684	1415	119.5	-	-	F		6/6/89
89.1696	Chum salmon	Resurrection Bay	81000	13000	4.82	16805	2697	-	690	4540	F		6/6/89
89.1697	Chum salmon	Resurrection Bay	48000	10000	5.33	9006	1876	-	680	3630	M		6/6/89
89.1701	Chum salmon	Resurrection Bay	39000	9400	5.80	6724	1621	-	622	3860	F		6/6/89
89.1709	Dolly Varden	Resurrection Bay	70000	13000	4.00	17500	3250	82.1	324	336	F		6/6/89
89.1710	Dolly Varden	Resurrection Bay	79000	12000	5.11	15460	2348	98.8	422	834	F		6/6/89
89.1712	Dolly Varden	Resurrection Bay	110000	14000	8.11	13564	1726	124.5	457	924	F		6/6/89
89.1715	Dolly Varden	Resurrection Bay	54000	8200	5.14	10506	1595	128.9	313	326	F		6/6/89
89.1716	Dolly Varden	Resurrection Bay	31000	5000	8.60	3605	581	48	392	759	F		6/6/89
89.1730	Rock sole	Tonsina Bay	24000	4500	0.94	25532	4787	98.4	362	478	M		6/7/89
89.1731	Rock sole	Tonsina Bay	31000	3200	2.54	12205	1260	226	375	789	M		6/7/89
89.1732	Rock sole	Tonsina Bay	15000	1800	2.44	6148	738	265.5	360	521	M		6/7/89
89.1733	Rock sole	Tonsina Bay	120000	25000	5.24	22901	4771	103.1	350	494	M		6/7/89
89.1740	Rock sole	Tonsina Bay	34000	9800	3.98	8543	2462	153.2	319	430	M		6/7/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1742	Rock sole	Tonsina Bay	14000	2400	1.86	7527	1290	175	333	488	M		6/7/89
89.1744	Rock sole	Tonsina Bay	27000	6600	6.62	4079	997	139.8	383	723	M		6/7/89
89.1746	Rock sole	Tonsina Bay	43000	9200	2.26	19027	4071	97.6	328	441	M		6/7/89
89.1747	Rock sole	Tonsina Bay	36000	6500	1.90	18947	3421	139.2	345	468	M		6/7/89
89.1752	Rock sole	Tonsina Bay	47000	8700	4.28	10981	2033	75.7	281	279	M		6/7/89
89.1755	Rock sole	Tonsina Bay	29000	5900	8.48	3420	696	208.4	255	197	M		6/7/89
89.1756	Dolly Varden	Tonsina Bay	150000	41000	1.66	90361	24699	247.4	298	245	F		6/7/89
89.1757	Dolly Varden	Tonsina Bay	210000	47000	5.38	39033	8736	139.1	326	352	F		6/7/89
89.1759	Dolly Varden	Tonsina Bay	330000	77000	5.48	60219	14051	308.7	321	290	M		6/7/89
89.1760	Dolly Varden	Tonsina Bay	210000	41000	5.84	35959	7021	208.3	385	480	F		6/7/89
89.1761	Dolly Varden	Tonsina Bay	590000	140000	5.51	107078	25408	-	242	125	M		6/7/89
89.1764	Dolly Varden	Tonsina Bay	170000	36000	5.52	30797	6522	179.7	378	420	F		6/7/89
89.1765	Dolly Varden	Tonsina Bay	340000	73000	4.98	68273	14659	119.3	418	738	F		6/7/89
89.1766	Dolly Varden	Tonsina Bay	240000	46000	4.72	50847	9746	129.3	395	624	F		6/7/89
89.1767	Dolly Varden	Tonsina Bay	220000	56000	3.04	72368	18421	494.4	279	189	M		6/7/89
89.1770	Dolly varden	Tonsina Bay	280000	71000	6.48	43210	10957	313.7	299	226	M		6/7/89
89.1771	Dolly Varden	Tonsina Bay	330000	79000	4.26	77465	18545	134.5	247	135	F		6/7/89
89.1773	Dolly Varden	Tonsina Bay	280000	64000	7.00	40000	9143	165.6	408	650	F		6/7/89
89.1775	Dolly varden	Tonsina Bay	880000	220000	6.78	129794	32448	574.3	236	99	M		6/7/89
89.1778	Dolly varden	Tonsina Bay	620000	140000	6.39	97027	21909	224.5	290	193	M		6/7/89
89.1779	Dolly Varden	Tonsina Bay	290000	74000	3.06	94771	24183	278.7	232	98	F		6/7/89
89.1781	Dolly Varden	Tonsina Bay	540000	140000	10.80	50000	12963	110.4	473	1012	M		6/7/89
89.1782	Dolly Varden	Tonsina Bay	500000	130000	10.27	48685	12658	200.4	426	632	F		6/7/89
89.1784	Dolly Varden	Tonsina Bay	340000	70000	13.66	24890	5124	206.3	461	903	F		6/7/89
89.1788	Flathead sole	Tonsina Bay	66000	18000	3.08	21429	5844	-	331	341	F		6/7/89
89.1789	Flathead sole	Tonsina Bay	75000	21000	-			-	285	206	M		6/7/89

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89.1792	Flathead sole	Tonsina Bay	24000	7300	1.68	14286	4345	-	239	335	F		6/7/89
89.1793	Flathead sole	Tonsina Bay	26000	9000	0.92	28261	9783	-	271	175	F		6/7/89
89.1795	Flathead sole	Tonsina Bay	14000	4300	1.76	7955	2443	-	345	328	F		6/7/89
89.1796	Flathead sole	Tonsina Bay	14000	4200	0.84	16667	5000	-	300	195	M		6/7/89
89.1797	Flathead sole	Tonsina Bay	19000	6100	0.78	24359	7821	-	310	299	F		6/7/89
89.1798	Flathead sole	Tonsina Bay	24000	6900	1.46	16438	4726	-	278	214	M		6/7/89
89.1801	Flathead sole	Tonsina Bay	22000	8800	2.66	8271	3308	-	364	513	F		6/7/89
89.1807	Flathead sole	Tonsina Bay	31000	9100	1.24	25000	7339	-	230	108	M		6/7/89
89.1817	Halibut	Tonsina Bay	27000	5800	3.10	8710	1871	17.5	780	5450	F		6/7/89
89.1819	Halibut	Tonsina Bay	17000	4000	1.30	13077	3077	29.8	1140	16800	F		6/7/89
89.1821	Halibut	Tonsina Bay	24000	5100	0.92	26087	5543	70.7	900	8170	F		6/7/89
89.1822	Halibut	Tonsina Bay	10000	2400	0.66	15152	3636	51.8	1210	21800	F		6/7/89
89.1824	Halibut	Tonsina Bay	21000	4300	1.06	19811	4057	-	560	2950	F		6/7/89
89.1825	Halibut	Tonsina Bay	39000	10000	1.44	27083	6944	-	980	10670	F		6/7/89
89.1826	Halibut	Tonsina Bay	12000	2800	0.94	12766	2979	-	485	1280	M		6/7/89
89.1828	Halibut	Tonsina Bay	15000	3600	1.30	11538	2769	-	700	3860	F		6/7/89
89.1830	Halibut	Tonsina Bay	19000	3500	1.01	18812	3465	-	650	3630	F		6/7/89
89.1832	Halibut	Tonsina Bay	22000	3700	1.36	16176	2721	-	910	8630	F		6/7/89
89.1833	Yellowfin sole	Tonsina Bay	45000	9100	1.00	45000	9100	-	300	307	M		6/8/89
89.1834	Yellowfin sole	Tonsina Bay	64000	17000	-			-	305	406	M		6/8/89
89.1836	Yellowfin sole	Tonsina Bay	48000	9700	1.42	33803	6831	-	290	298	M		6/8/89
89.1837	Yellowfin sole	Tonsina Bay	11000	2400	0.64	17188	3750	-	273	276	M		6/8/89
89.1838	Yellowfin sole	Tonsina Bay	90000	23000	1.12	80357	20536	-	282	333	M		6/8/89
89.1839	Yellowfin sole	Tonsina Bay	57000	17000	0.76	75000	22368	-	267	217	M		6/8/89
89.1841	Yellowfin sole	Tonsina Bay	28000	7500	2.88	9722	2604	-	282	303	M		6/8/89
89.1842	Yellowfin sole	Tonsina Bay	44000	15000	1.08	40741	13889	-	280	242	M		6/8/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.1846	Yellowfin sole	Tonsina Bay	63000	17000	2.70	23333	6296	-	240	170	F		6/8/89
89.1856	Yellowfin sole	Tonsina Bay	76000	19000	5.44	13971	3493	-	280	282	F		6/8/89
89.1867	Dolly Varden	Kachemak Bay	39000	6000	2.60	15000	2308	-	423	853	M		6/9/89
89.1868	Dolly Varden	Kachemak Bay	30000	4600	3.48	8621	1322	-	357	437	M		6/9/89
89.1870	Dolly Varden	Kachemak Bay	24000	3700	3.88	6186	954	-	388	635	F		6/9/89
89.1873	Dolly Varden	Kachemak Bay	26000	4000	4.08	6373	980	-	342	434	F		6/9/89
89.1874	Dolly Varden	Kachemak Bay	22000	2500	1.82	12088	1374	-	270	177	M		6/9/89
89.1877	Dolly Varden	Kachemak Bay	19000	2700	1.72	11047	1570	-	272	196	F		6/9/89
89.1885	Dolly Varden	Kachemak Bay	29000	3100	4.40	6591	705	-	290	240	F		6/9/89
89.1886	Dolly Varden	Kachemak Bay	46000	6100	2.44	18852	2500	-	251	129	M		6/9/89
89.1888	Dolly Varden	Kachemak Bay	43000	7100	10.60	4057	670	-	296	268	F		6/9/89
89.1896	Dolly Varden	Kachemak Bay	35000	5000	3.40	10294	1471	-	275	189	M		6/9/89
89.1926	Rock sole	Kachemak Bay	24000	3300	1.32	18182	2500	-	371	582	F		6/9/89
89.1928	Rock sole	Kachemak Bay	16000	1800	1.14	14035	1579	-	320	473	M		6/9/89
89.1929	Rock sole	Kachemak Bay	24000	4300	1.48	16216	2905	-	263	274	F		6/9/89
89.1989	Rock sole	Kachemak Bay	29000	4100	6.10	4754	672	-	355	625	J		6/12/89
89.1991	Rock sole	Kachemak Bay	27000	4500	1.96	13776	2296	-	315	430	F		6/12/89
89.1992	Rock sole	Kachemak Bay	19000	3100	3.14	6051	987	-	253	208	M		6/12/89
89.1993	Rock sole	Kachemak Bay	19000	2900	1.70	11176	1706	-	319	380	F		6/12/89
89.1994	Rock sole	Kachemak Bay	11000	2100	0.82	13415	2561	-	281	255	F		6/12/89
89.1996	Rock sole	Kachemak Bay	17000	2000	0.98	17347	2041	-	305	350	F		6/12/89
89.1997	Rock sole	Kachemak Bay	18000	2800	1.38	13043	2029	-	240	149	F		6/12/89
89.2097	Dolly Varden	Kamishak Bay	28000	5100	3.00	9333	1700	-	425	828	F		6/13/89
89.2098	Dolly Varden	Kamishak Bay	40000	6900	4.16	9615	1659	-	370	475	F		6/13/89
89.2100	Dolly Varden	Kamishak Bay	30000	4500	-			-	450	738	F		6/13/89
89.2101	Dolly Varden	Kamishak Bay	49000	8500	5.80	8448	1466	-	495	997	M		6/13/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2102	Dolly Varden	Kamishak Bay	63000	8800	9.95	6332	884	-	460	884	F		6/13/89
89.2103	Dolly Varden	Kamishak Bay	64000	9000	10.76	5948	836	-	483	1045	M		6/13/89
89.2108	Rock sole	Kamishak Bay	15000	2700	2.34	6410	1154	-	252	184	M		6/13/89
89.2109	Rock sole	Kamishak Bay	6200	820	0.68	9118	1206	-	305	307	F		6/13/89
89.2110	Rock sole	Kamishak Bay	14000	2400	2.58	5426	930	-	355	490	F		6/13/89
89.2112	Rock sole	Kamishak Bay	6800	1100	0.90	7556	1222	-	252	175	M		6/13/89
89.2113	Rock sole	Kamishak Bay	10000	1600	1.42	7042	1127	-	230	138	M		6/13/89
89.2115	Rock sole	Kamishak Bay	8800	2800	1.94	4536	1443	-	212	122	F		6/13/89
89.2116	Rock sole	Kamishak Bay	8900	1100	1.06	8396	1038	-	329	440	F		6/13/89
89.2145	Rock sole	Kamishak Bay	11000	1900	1.44	7639	1319	-	293	325	M		6/14/89
89.2148	Rock sole	Kamishak Bay	8100	2300	2.12	3821	1085	-	292	330	F		6/14/89
89.2150	Rock sole	Kamishak Bay	9400	2500	1.24	7581	2016	-	263	190	M		6/14/89
89.2154	Dolly Varden	Kamishak Bay	63000	8500	3.82	16492	2225	-	283	250	F		6/14/89
89.2224	Rock sole	Afognak/Shuyak	19000	3100	1.40	13571	2214	-	372	607	F		6/15/89
89.2225	Rock sole	Afognak/Shuyak	10000	1400	0.92	10870	1522	-	253	550	F		6/15/89
89.2226	Rock sole	Afognak/Shuyak	7900	1100	2.94	2687	374	-	371	647	F		6/15/89
89.2227	Rock sole	Afognak/Shuyak	14000	2200	1.16	12069	1897	-	341	460	F		6/15/89
89.2229	Rock sole	Afognak/Shuyak	5000	500	1.04	4808	481	-	335	492	F		6/15/89
89.2230	Rock sole	Afognak/Shuyak	7700	1200	1.06	7264	1132	-	355	558	F		6/15/89
89.2231	Dolly Varden	Afognak/Shuyak	33000	5700	4.98	6627	1145	-	333	394	F		6/15/89
89.2233	Dolly Varden	Afognak/Shuyak	37000	6600	5.38	6877	1227	-	351	365	F		6/15/89
89.2234	Dolly Varden	Afognak/Shuyak	42000	6900	5.94	7071	1162	-	342	431	M		6/15/89
89.2244	Dolly Varden	Afognak/Shuyak	33000	5600	4.24	7783	1321	-	300	260	F		6/15/89
89.2245	Dolly Varden	Afognak/Shuyak	45000	9400	4.34	10369	2166	-	375	547	F		6/15/89
89.2249	Dolly Varden	Afognak/Shuyak	33000	6600	6.60	5000	1000	-	395	602	F		6/15/89
89.2251	Dolly Varden	Afognak/Shuyak	63000	11000	25.11	2509	438	-	383	552	F		6/15/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein [2]	µg PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2254	Dolly Varden	Afognak/Shuyak	41000	7600	5.26	7795	1445	-	320	329	F		6/15/89
89.2256	Dolly Varden	Afognak/Shuyak	37000	6700	6.38	5799	1050	-	397	620	F		6/15/89
89.2257	Dolly Varden	Afognak/Shuyak	62000	12000	8.56	7243	1402	-	332	428	M		6/15/89
89.2316	Rock sole	Afognak/Shuyak	9600	1700	1.42	6761	1197	-	328	-	M		6/16/89
89.2318	Rock sole	Afognak/Shuyak	11000	1500	2.48	4435	605	-	360	-	F		6/16/89
89.2319	Rock sole	Afognak/Shuyak	8500	1400	2.26	3761	619	-	168	-	F		6/16/89
89.2320	Rock sole	Afognak/Shuyak	7400	1900	3.76	1968	505	-	228	-	M		6/16/89
89.2335	Yellowfin sole	Kukak Bay	15000	2000	4.14	3623	483	-	250	165	M		6/17/89
89.2337	Yellowfin sole	Kukak Bay	24000	4800	3.68	6522	1304	-	340	498	F		6/17/89
89.2340	Yellowfin sole	Kukak Bay	19000	3300	1.88	10106	1755	-	225	125	M		6/17/89
89.2343	Yellowfin sole	Kukak Bay	20000	6700	3.66	5464	1831	-	248	169	F		6/17/89
89.2344	Yellowfin sole	Kukak Bay	20000	5600	1.80	11111	3111	-	235	146	M		6/17/89
89.2345	Yellowfin sole	Kukak Bay	8700	1100	2.46	3537	447	-	234	142	M		6/17/89
89.2346	Yellowfin sole	Kukak Bay	9000	1400	1.52	5921	921	-	274	240	M		6/17/89
89.2354	Yellowfin sole	Kukak Bay	28000	5200	3.06	9150	1699	-	235	155	M		6/17/89
89.2355	Yellowfin sole	Kukak Bay	11000	2400	1.40	7857	1714	-	267	237	M		6/17/89
89.2356	Yellowfin sole	Kukak Bay	23000	4000	1.92	11979	2083	-	256	196	M		6/17/89
89.2365	Dolly Varden	Kukak Bay	-	-	-			31	368	502	F		6/17/89
89.2367	Dolly Varden	Kukak Bay	64000	12000	7.60	8421	1579	44	280	269	F		6/17/89
89.2368	Dolly Varden	Kukak Bay	62000	10000	2.90	21379	3448	88	250	143	M		6/17/89
89.2369	Dolly Varden	Kukak Bay	65000	11000	4.18	15550	2632	99	358	430	M		6/17/89
89.2370	Dolly Varden	Kukak Bay	31000	3000	2.80	11071	1071	-	332	393	M		6/17/89
89.2371	Dolly Varden	Kukak Bay	82000	16000	-			-	400	657	M		6/17/89
89.2372	Dolly Varden	Kukak Bay	23000	5400	-			41	367	488	F		6/17/89
89.2374	Dolly Varden	Kukak Bay	37000	6000	3.34	11078	1796	78	318	309	F		6/17/89
89.2375	Dolly Varden	Kukak Bay	12000	2700	2.34	5128	1154	45	329	353	M		6/17/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2377	Flathead sole	Kukak Bay	12000	2800	4.18	2871	670	-	358	389	F		6/17/89
89.2380	Flathead sole	Kukak Bay	16000	3000	3.06	5229	980	-	363	400	F		6/17/89
89.2381	Flathead sole	Kukak Bay	13000	2800	2.76	4710	1014	-	235	183	F		6/17/89
89.2382	Flathead sole	Kukak Bay	8100	1600	4.00	2025	400	-	402	631	F		6/17/89
89.2383	Flathead sole	Kukak Bay	7600	1300	3.06	2484	425	-	255	439	F		6/17/89
89.2387	Flathead sole	Kukak Bay	14000	2700	1.84	7609	1467	-	371	494	F		6/17/89
89.2390	Flathead sole	Kukak Bay	9700	1400	2.49	3896	562	-	273	202	M		6/17/89
89.2391	Flathead sole	Kukak Bay	13000	3000	-			-	247	122	M		6/17/89
89.2394	Flathead sole	Kukak Bay	14000	2700	-			-	252	148	M		6/17/89
89.2403	Flathead sole	Kukak Bay	22000	7300	4.44	4955	1644	-	248	132	M		6/17/89
89.2416	Halibut	Kukak Bay	7400	2600	2.26	3274	1150	-	680	2770	J		6/17/89
89.2417	Halibut	Kukak Bay	6400	660	1.52	4211	434	-	1170	15890	J		6/17/89
89.2418	Halibut	Kukak Bay	8600	3200	1.62	5309	1975	-	740	5450	J		6/17/89
89.2419	Halibut	Kukak Bay	9400	3300	1.14	8246	2895	-	650	2270	J		6/17/89
89.2421	Halibut	Kukak Bay	16000	6800	1.96	8163	3469	-	760	4540	F		6/17/89
89.2422	Halibut	Kukak Bay	10000	3300	1.18	8475	2797	-	1020	12710	F		6/17/89
89.2423	Halibut	Kukak Bay	9000	1500	2.96	3041	507	-	510	1417	F		6/17/89
89.2426	Dolly Varden	Kukak Bay	29000	3900	6.28	4618	621	52	243	152	M		6/18/89
89.2427	Dolly Varden	Kukak Bay	28000	5200	3.72	7527	1398	65	240	152	M		6/18/89
89.2428	Dolly Varden	Kukak Bay	28000	3900	3.34	8383	1168	52	277	226	M		6/18/89
89.2429	Dolly Varden	Kukak Bay	-	-	-			63	250	160	F		6/18/89
89.2431	Dolly Varden	Kukak Bay	-	-	-			55	298	253	F		6/18/89
89.2434	Dolly Varden	Kukak Bay	33000	3700	3.64	9066	1016	38	237	131	M		6/18/89
89.2435	Dolly Varden	Kukak Bay	27000	3100	5.18	5212	598	-	270	167	F		6/18/89
89.2438	Dolly Varden	Kukak Bay	22000	4000	3.63	6061	1102	29	224	112	F		6/18/89
89.2439	Rock sole	Kukak Bay	23000	4200	2.12	10849	1981	409	265	250	F		6/18/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2440	Rock sole	Kukak Bay	24000	3300	1.00	24000	3300	262	233	152	F		6/18/89
89.2441	Rock sole	Kukak Bay	9600	1800	-			131	375	690	F		6/18/89
89.2442	Rock sole	Kukak Bay	23000	3900	1.60	14375	2438	256	292	365	F		6/18/89
89.2443	Rock sole	Kukak Bay	13000	1800	1.38	9420	1304	-	375	609	F		6/18/89
89.2444	Rock sole	Kukak Bay	26000	4700	1.62	16049	2901	152	235	161	F		6/18/89
89.2445	Rock sole	Kukak Bay	15000	3100	1.52	9868	2039	207	265	239	F		6/18/89
89.2446	Rock sole	Kukak Bay	6100	1200	1.98	3081	606	105	339	460	F		6/18/89
89.2447	Rock sole	Kukak Bay	12000	1600	2.02	5941	792	263	201	110	M		6/18/89
89.2448	Rock sole	Kukak Bay	15000	2600	2.62	5725	992	204	385	786	F		6/18/89
89.2450	Rock sole	Kukak Bay	17000	2600	1.40	12143	1857	96	241	173	F		6/18/89
89.2452	Rock sole	Kukak Bay	16000	3300	1.94	8247	1701	173	200	105	M		6/18/89
89.2453	Rock sole	Kukak Bay	20000	4700	2.08	9615	2260	282	205	108	M		6/18/89
89.2456	Rock sole	Kukak Bay	15000	2700	1.34	11194	2015	-	225	148	M		6/18/89
89.2458	Rock sole	Kukak Bay	8100	2200	3.28	2470	671	-	199	103	M		6/18/89
89.2461	Rock sole	Kukak Bay	23000	3800	2.58	8915	1473	-	254	219	M		6/18/89
89.2463	Rock sole	Kukak Bay	23000	6400	3.44	6686	1860	-	220	130	M		6/18/89
89.2467	Rock sole	Kukak Bay	20000	3400	2.44	8197	1393	-	210	121	M		6/18/89
89.2473	Dolly Varden	Kukak Bay	50000	6300	5.64	8865	1117	34	497	-	M		6/18/89
89.2474	Halibut	Kukak Bay	5900	580	0.54	10926	1074	-	822	3990	F		6/18/89
89.2475	Halibut	Kukak Bay	14000	3900	1.20	11667	3250	-	800	5630	F		6/18/89
89.2476	Halibut	Kukak Bay	14000	4600	1.32	10606	3485	-	914	7150	F		6/18/89
89.2567	Rock sole	Chignik Bay	14000	3700	1.82	7692	2033	-	380	657	F		6/19/89
89.2568	Rock sole	Chignik Bay	15000	3000	2.16	6944	1389	-	380	732	F		6/19/89
89.2569	Rock sole	Chignik Bay	12000	3200	2.02	5941	1584	-	265	203	M		6/19/89
89.2570	Rock sole	Chignik Bay	13000	2900	3.16	4114	918	-	402	750	F		6/19/89
89.2571	Rock sole	Chignik Bay	6100	1100	0.76	8026	1447	-	225	126	F		6/19/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2572	Rock sole	Chignik Bay	14000	3500	2.92	4795	1199	-	358	547	F		6/19/89
89.2574	Rock sole	Chignik Bay	11000	1900	1.64	6707	1159	-	378	692	F		6/19/89
89.2575	Rock sole	Chignik Bay	18000	5400	2.20	8182	2455	-	387	746	F		6/19/89
89.2576	Rock sole	Chignik Bay	3900	600	1.14	3421	526	-	350	498	M		6/19/89
89.2577	Rock sole	Chignik Bay	6300	900	0.82	7683	1098	-	227	143	M		6/19/89
89.2624	Rock sole	Balboa Bay	10000	1300	1.86	5376	699	58.1	314	380	M		6/21/89
89.2625	Rock sole	Balboa Bay	9500	1300	1.70	5588	765	322.9	340	547	F		6/21/89
89.2626	Rock sole	Balboa Bay	6100	580	1.50	4067	387	90.2	293	285	M		6/21/89
89.2627	Rock sole	Balboa Bay	8300	1300	0.78	10641	1667	109.6	295	292	M		6/21/89
89.2628	Rock sole	Balboa Bay	7400	1000	3.53	2096	283	93.8	260	203	M		6/21/89
89.2629	Rock sole	Balboa Bay	9700	1200	5.70	1702	211	113.8	326	411	M		6/21/89
89.2630	Rock sole	Balboa Bay	8200	670	4.02	2040	167	119.3	319	410	M		6/21/89
89.2632	Rock sole	Balboa Bay	7700	1100	1.86	4140	591	75	235	143	F		6/21/89
89.2633	Rock sole	Balboa Bay	7700	990	1.96	3929	505	89.6	225	440	M		6/21/89
89.2634	Rock sole	Balboa Bay	10000	470	1.26	7937	373	107.1	275	197	M		6/21/89
89.2636	Rock sole	Balboa Bay	940	280	1.88	500	149	122	310	358	F		6/21/89
89.2637	Rock sole	Balboa Bay	6100	590	1.06	5755	557	120.4	400	715	F		6/21/89
89.2640	Rock sole	Balboa Bay	6500	520	2.56	2539	203	76.1	410	888	M		6/21/89
89.2642	Rock sole	Balboa Bay	6600	970	1.19	5546	815	102	381	647	F		6/21/89
89.2645	Rock sole	Balboa Bay	5100	570	1.22	4180	467	114.8	274	234	M		6/21/89
89.2646	Rock sole	Balboa Bay	5300	1100	1.90	2789	579	-	355	304	M		6/21/89
89.2647	Rock sole	Balboa Bay	6400	970	1.11	5766	874	97.8	257	193	M		6/21/89
89.2651	Rock sole	Balboa Bay	4200	400	0.75	5600	533	132.7	283	272	F		6/21/89
89.2673	Rock sole	Kodiak	35000	6100	4.54	7709	1344	-	415	978	F		6/23/89
89.2675	Rock sole	Kodiak	41000	6400	6.3	6508	1016	-	355	501	F		6/23/89
89.2676	Rock sole	Kodiak	18000	3400	1.21	14876	2810	-	275	211	F		6/23/89

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	μg NPH equiv / g bile protein[2]	μg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.2677	Rock sole	Kodiak	31000	5000	3.96	7828	1263	-	310	352	F		6/23/89
89.2678	Rock sole	Kodiak	18000	1400	2.22	8108	631	-	350	501	F		6/23/89
89.2682	Rock sole	Kodiak	13000	1600	1.83	7104	874	-	299	330	M		6/23/89
89.2684	Rock sole	Kodiak	11000	1400	1.35	8148	1037	-	265	209	M		6/23/89
89.2691	Rock sole	Kodiak	17000	2400	1.71	9942	1404	-	310	337	M		6/23/89
89.2693	Rock sole	Kodiak	56000	7600	9.8	5714	776	-	279	233	M		6/23/89
89.2700	Rock sole	Kodiak	14000	1500	1.35	10370	1111	-	280	276	M		6/23/89
89.2714	Dolly Varden	Kodiak	87000	19000	10.9	7982	1743	-	505	1168	M		6/23/89
89.2715	Dolly Varden	Kodiak	54000	8700	3.07	17590	2834	-	437	717	F		6/23/89
89.2716	Dolly Varden	Kodiak	53000	9700	11.6	4569	836	-	580	2000	F		6/23/89
89.8610	Coho salmon	Kukak Bay	21000	4300	4.8	4375	896	-	655	-	F		8/30/89
89.8611	Coho salmon	Kukak Bay	28000	11000	11.25	2489	978	-	675	-	F		8/30/89
89.8612	Coho salmon	Kukak Bay	35000	11000	7.88	4442	1396	-	670	-	M		8/30/89
89.8613	Coho salmon	Kukak Bay	54000	20000	11.33	4766	1765	-	570	-	M		8/30/89
89.8614	Coho salmon	Kukak Bay	54000	12000	10.45	5167	1148	-	700	-	F		8/30/89
89.8615	Coho salmon	Kukak Bay	38000	9100	7.44	5108	1223	-	670	-	M		8/30/89
89.8616	Coho salmon	Kukak Bay	30000	8100	7.44	4032	1089	-	580	-	M		8/30/89
89.8631	Flathead sole	Kukak Bay	22000	3400	2.78	7914	1223	-	365	485	F		8/30/89
89.8632	Flathead sole	Kukak Bay	17000	2500	0.80	21250	3125	-	301	296	M		8/30/89
89.8633	Flathead sole	Kukak Bay	19000	3300	2.32	8190	1422	-	347	380	F		8/30/89
89.8634	Flathead sole	Kukak Bay	21000	2800	2.52	8333	1111	-	282	191	-		8/30/89
89.8636	Flathead sole	Kukak Bay	19000	2000	3.02	6291	662	-	250	126	M		8/30/89
89.8637	Flathead sole	Kukak Bay	16000	1700	1.48	10811	1149	-	315	284	F		8/30/89
89.8638	Flathead sole	Kukak Bay	18000	2600	1.24	14516	2097	-	220	86	M		8/30/89
89.8639	Flathead sole	Kukak Bay	26000	2700	1.20	21667	2250	-	385	515	-		8/30/89
89.8640	Flathead sole	Kukak Bay	20000	2500	1.66	12048	1506	-	250	131	-		8/30/89

APPENDIX 1. SUBTIDAL 7 REPORT–Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.8641	Flathead sole	Kukak Bay	12000	2600	3.24	3704	802	-	270	160	-		8/30/89
89.8669	Coho salmon	Afognak/Shuyak	22000	3200	4.06	5419	788	-	670	2721	M		8/31/89
89.8670	Coho salmon	Afognak/Shuyak	58000	10000	3.66	15847	2732	-	640	4082	F		8/31/89
89.8671	Coho salmon	Afognak/Shuyak	32000	5700	5.86	5461	973	-	640	4308	M		8/31/89
89.8672	Coho salmon	Afognak/Shuyak	-	-	2.44	0	0	-	664	4989	F		8/31/89
89.8673	Coho salmon	Afognak/Shuyak	15000	2100	2.26	6637	929	-	710	4989	F		8/31/89
89.8674	Coho salmon	Afognak/Shuyak	30000	5400	9.7	3093	557	-	675	4989	F		8/31/89
89.8675	Coho salmon	Afognak/Shuyak	57000	10000	13.3	4286	752	-	710	4989	F		8/31/89
89.8676	Coho salmon	Afognak/Shuyak	19000	2500	6.8	2794	368	-	690	4989	M		8/31/89
89.8677	Coho salmon	Afognak/Shuyak	27000	3900	3.98	6784	980	-	625	3175	F		8/31/89
89.8678	Coho salmon	Afognak/Shuyak	54000	10000	7.53	7171	1328	-	665	4762	F		8/31/89
89.8690	Coho salmon	Kachemak Bay	26000	5000	10.54	2467	474	-	663	4490	F		9/2/89
89.8692	Coho salmon	Kachemak Bay	20000	2500	18.51	1080	135	-	589	3583	F		9/2/89
89.8693	Coho salmon	Kachemak Bay	24000	3200	16.74	1434	191	-	633	4082	F		9/2/89
89.8694	Coho salmon	Kachemak Bay	38000	4500	26.58	1430	169	-	745	5850	M		9/2/89
89.8696	Coho salmon	Kachemak Bay	36000	3900	17.62	2043	221	-	600	3628	F		9/2/89
89.8697	Coho salmon	Kachemak Bay	26000	3800	20.99	1239	181	-	675	4762	F		9/2/89
89.8698	Coho salmon	Kachemak Bay	14000	1200	4.10	3415	293	-	690	5578	F		9/2/89
89.8699	Coho salmon	Kachemak Bay	21000	2400	6.16	3409	390	-	630	4082	M		9/2/89
89.8700	Coho salmon	Kachemak Bay	29000	4100	5.82	4983	704	-	690	4989	F		9/2/89
89.8701	Rock sole	Kachemak Bay	34000	3900	5.62	6050	694	-	280	263	M		9/2/89
89.8702	Rock sole	Kachemak Bay	6200	870	3.98	1558	219	-	305	359	F		9/2/89
89.8704	Rock sole	Kachemak Bay	24000	2400	1.36	17647	1765	-	253	180	F		9/2/89
89.8705	Rock sole	Kachemak Bay	26000	2600	1.64	15854	1585	-	306	406	F		9/2/89
89.8706	Rock sole	Kachemak Bay	21000	1600	1.62	12963	988	-	290	290	F		9/2/89
89.8707	Rock sole	Kachemak Bay	23000	3800	1.66	13855	2289	-	253	193	F		9/2/89

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv[2] / g bile protein	µg PHN equiv[2] / g bile protein	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
89.8708	Rock sole	Kachemak Bay	21000	2800	1.82	11538	1538	-	319	426	F		9/2/89
89.8709	Rock sole	Kachemak Bay	33000	3800	1.94	17010	1959	-	260	212	F		9/2/89
89.8710	Rock sole	Kachemak Bay	56000	9700	5.10	10980	1902	-	356	650	F		9/2/89
89.8711	Rock sole	Kachemak Bay	22000	1500	3.38	6509	444	-	290	320	F		9/2/89
89.8814	Coho salmon	Kamishak Bay	46000	10000	8.59	5355	1164	-	720	4989	F		9/6/89
89.8815	Coho salmon	Kamishak Bay	42000	6700	7.1	5915	944	-	664	4036	F		9/6/89
89.8816	Coho salmon	Kamishak Bay	44000	8600	8.7	5057	989	-	680	3855	F		9/6/89
89.8817	Coho salmon	Kamishak Bay	68000	13000	16.2	4198	802	-	655	3175	F		9/6/89
89.8818	Coho salmon	Kamishak Bay	25000	4900	6.66	3754	736	-	625	3764	F		9/6/89
89.8819	Coho salmon	Kamishak Bay	36000	5600	6.40	5625	875	-	670	4626	M		9/6/89
89.8820	Coho salmon	Kamishak Bay	36000	6500	4.24	8491	1533	-	562	2948	F		9/6/89
89.8821	Coho salmon	Kamishak Bay	26000	4900	4.00	6500	1225	-	670	4536	F		9/6/89
89.8822	Coho salmon	Kamishak Bay	36000	5300	6.16	5844	860	-	700	5896	M		9/6/89
89.8823	Coho salmon	Kamishak Bay	62000	11000	8.4	7381	1310	-	665	4082	F		9/6/89
89.8884	Rock sole	Resurrection Bay	12000	1500	2.66	4511	564	-	245	177	F		9/8/89
89.8885	Rock sole	Resurrection Bay	12000	990	4.44	2703	223	-	285	250	F		9/8/89
89.8886	Rock sole	Resurrection Bay	35000	4400	4.22	8294	1043	-	235	165	F		9/8/89
89.8888	Rock sole	Resurrection Bay	26000	1600	2.26	11504	708	-	250	167	F		9/8/89
89.9066	Flathead sole	Snug Harbor	63000	13000	4.18	15072	3110	-	352	418	F		9/14/89
89.9067	Flathead sole	Snug Harbor	42000	6300	2.34	17949	2692	-	257	131	M		9/14/89
89.9069	Flathead sole	Snug Harbor	53000	8800	2.12	25000	4151	-	366	536	F		9/14/89
89.9070	Flathead sole	Snug Harbor	62000	17000	2.48	25000	6855	-	337	312	F		9/14/89
89.9071	Flathead sole	Snug Harbor	80000	16000	2.88	27778	5556	-	370	469	F		9/14/89
89.9072	Flathead sole	Snug Harbor	96000	25000	2.26	42478	11062	-	345	388	M		9/14/89
89.9073	Flathead sole	Snug Harbor	26000	5500	3.08	8442	1786	-	305	299	M		9/14/89
89.9074	Flathead sole	Snug Harbor	75000	16000	4.42	16968	3620	-	342	412	F		9/14/89

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89.9080	Flathead sole	Snug Harbor	130000	33000	3.92	33163	8418	-	330	230	M		9/14/89
89.9081	Flathead sole	Snug Harbor	49000	12000	2.28	21491	5263	-	260	179	M		9/14/89
89.9135	Rock sole	Snug Harbor	45000	7600	1.80	25000	4222	-	283	314	M		9/14/89
89.9136	Rock sole	Snug Harbor	110000	22000	2.18	50459	10092	-	370	700	F		9/14/89
89.9137	Rock sole	Snug Harbor	55000	9700	1.88	29255	5160	-	360	721	F		9/14/89
89.9138	Rock sole	Snug Harbor	56000	14000	4.26	13146	3286	-	241	160	F		9/14/89
89.9139	Rock sole	Snug Harbor	160000	32000	2.50	64000	12800	-	265	237	F		9/14/89
89.9140	Rock sole	Snug Harbor	97000	20000	2.66	36466	7519	-	235	175	M		9/14/89
89.9141	Rock sole	Snug Harbor	110000	29000	3.40	32353	8529	-	264	213	F		9/14/89
89.9142	Rock sole	Snug Harbor	66000	11000	3.34	19760	3293	-	262	236	F		9/14/89
89.9144	Rock sole	Snug Harbor	88000	19000	4.94	17814	3846	-	280	235	M		9/14/89
89.9159	Rock sole	Snug Harbor	38000	8800	1.80	21111	4889	-	212	124	M		9/14/89
89.9283	Coho salmon	Valdez	83000	10000	6.06	13696	1650	-	720	5909	F		9/19/89
89.9284	Coho salmon	Valdez	120000	18000	10.4	11538	1731	-	710	5000	F		9/19/89
89.9285	Coho salmon	Valdez	86000	13000	6.14	14007	2117	-	670	2272	F		9/19/89
89.9286	Coho salmon	Valdez	81000	12000	41.92	1932	286	-	680	4313	F		9/19/89
89.9287	Coho salmon	Valdez	190000	24000	28.9	6574	830	-	720	5454	F		9/19/89
89.9288	Coho salmon	Valdez	140000	30000	2.46	56911	12195	-	664	4090	F		9/19/89
89.9289	Coho salmon	Valdez	110000	18000	8.6	12791	2093	-	578	2727	F		9/19/89
89.9290	Coho salmon	Valdez	65000	6700	21.00	3095	319	-	586	3410	M		9/19/89
89.9291	Coho salmon	Valdez	160000	48000	63.4	2524	757	-	573	2272	M		9/19/89
89.9292	Coho salmon	Valdez	170000	38000	31.6	5380	1203	-	584	2500	M		9/19/89
90.6101	Dolly Varden	Yakutat Bay	-	-	-			97	340	288	F	H and R	5/22/90
90.6102	Dolly Varden	Yakutat Bay	-	-	-			59	305	302	F	H and R	5/22/90
90.6105	Dolly Varden	Yakutat Bay	-	-	-			27	284	220	F	H and R	5/22/90
90.6106	Dolly Varden	Yakutat Bay	110000	29000	4.7	23404	6170	80	295	230	F	H and R	5/22/90

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90.6107	Dolly Varden	Yakutat Bay	66000	14000	2.7	24444	5185	55	282	228	F	H and R	5/22/90
90.6108	Dolly Varden	Yakutat Bay	130000	34000	4.7	27660	7234	112	280	250	F	H and R	5/22/90
90.6109	Dolly Varden	Yakutat Bay	-	-	-			56	280	215	F	H and R	5/22/90
90.6112	Dolly Varden	Yakutat Bay	160000	86000	22.9	6987	3755	32	519	986	F	H and R	5/23/90
90.6113	Dolly Varden	Yakutat Bay	-	-	-			94	325	270	F	H and R	5/23/90
90.6115	Dolly Varden	Yakutat Bay	27000	3000	2.2	12273	1364	-	301	235	M	H	5/23/90
90.6116	Dolly Varden	Yakutat Bay	62000	14000	6.1	10164	2295	39	395	520	F	H and R	5/23/90
90.6117	Halibut	Yakutat Bay	12000	2500	0.9	13333	2778	47	1130	-	F		5/23/90
90.6118	Halibut	Yakutat Bay	12000	1300	1.2	10000	1083	16	790	-	M		5/23/90
90.6119	Halibut	Yakutat Bay	13000	1200	1.5	8667	800	27	830	-	F		5/23/90
90.6120	Halibut	Yakutat Bay	7100	1400	0.8	8875	1750	45	810	-	F		5/23/90
90.6121	Halibut	Yakutat Bay	13000	1300	1.1	11818	1182	12	725	-	F		5/23/90
90.6122	Halibut	Yakutat Bay	9600	1800	1.1	8727	1636	47	860	-	M		5/23/90
90.6123	Halibut	Yakutat Bay	11000	1600	1.8	6111	889	29	260	-	M		5/23/90
90.6124	Halibut	Yakutat Bay	9400	1900	0.7	13429	2714	18	930	-	F		5/23/90
90.6125	Halibut	Yakutat Bay	15000	2800	1.5	10000	1867	45	640	-	F		5/23/90
90.6126	Halibut	Yakutat Bay	11000	1500	1.4	7857	1071	48	850	-	F		5/23/90
90.6127	Yellowfin Sole	Yakutat Bay	25000	5400	1.5	16667	3600	11	317	460	F	R	5/23/90
90.6128	Yellowfin Sole	Yakutat Bay	-	-	-			18	197	100	F	R	5/23/90
90.6129	Yellowfin Sole	Yakutat Bay	29000	5700	1.7	17059	3353	-	199	85	F	R	5/23/90
90.6130	Yellowfin Sole	Yakutat Bay	32000	7000	1.8	17778	3889	19	223	147	F	R	5/23/90
90.6131	Yellowfin Sole	Yakutat Bay	17000	3300	1.5	11333	2200	-	290	305	M		5/23/90
90.6132	Yellowfin Sole	Yakutat Bay	9200	1800	1.9	4842	947	-	263	258	M		5/23/90
90.6133	Yellowfin Sole	Yakutat Bay	15000	3400	2.7	5556	1259	-	295	308	M		5/23/90
90.6136	Yellowfin Sole	Yakutat Bay	19000	5500	-			-	229	145	M		5/23/90
90.6138	Yellowfin Sole	Yakutat Bay	26000	5700	1.7	15294	3353	-	264	237	M		5/23/90

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90.6143	Yellowfin Sole	Yakutat Bay	20000	4700	2.4	8333	1958	-	253	183	M		5/23/90
90.6145	Yellowfin Sole	Yakutat Bay	26000	3200	1.0	26000	3200	-	247	170	M		5/23/90
90.6149	Dolly Varden	Yakutat Bay	22000	2500	10.2	2157	245	-	508	1585	M		5/25/90
90.6150	Dolly Varden	Yakutat Bay	26000	30000	6.4	4063	4688	-	450	1097	F		5/25/90
90.6151	Dolly Varden	Yakutat Bay	57000	5500	2.9	19655	1897	-	471	1336	F		5/25/90
90.6152	Dolly Varden	Yakutat Bay	30000	4000	4.0	7500	1000	-	428	894	M		5/25/90
90.6158	Dolly Varden	Yakutat Bay	-	-	-			21	415	847	F		5/25/90
90.6159	Dolly Varden	Yakutat Bay	-	-	-			17	395	585	F		5/25/90
90.6160	Dolly Varden	Yakutat Bay	-	-	-			24	405	620	F		5/25/90
90.6161	Dolly Varden	Yakutat Bay	-	-	-			27	378	446	F		5/25/90
90.6162	Dolly Varden	Yakutat Bay	-	-	-			827	368	503	F		5/25/90
90.6163	Dolly Varden	Yakutat Bay	-	-	-			497	427	782	F		5/25/90
90.6164	Dolly Varden	Olsen Bay	26000	4300	2.3	11304	1870	-	398	705	M		5/28/90
90.6166	Flathead Sole	Olsen Bay	14000	2100	2.5	5600	840	19	271	177	M		5/28/90
90.6167	Flathead Sole	Olsen Bay	22000	2800	5.3	4151	528	12	321	269	F		5/28/90
90.6168	Flathead Sole	Olsen Bay	13000	2000	2.6	5000	769	61	283	195	F		5/28/90
90.6169	Flathead Sole	Olsen Bay	13000	3400	0.8	16250	4250	53	281	180	F		5/28/90
90.6172	Flathead Sole	Olsen Bay	9500	1600	1.0	9500	1600	84	256	154	F		5/28/90
90.6175	Rock Sole	Olsen Bay	31000	2100	1.3	23846	1615	110	386	683	F	H	5/28/90
90.6176	Rock Sole	Olsen Bay	23000	3600	2.1	10952	1714	6	253	195	M	H	5/28/90
90.6177	Rock Sole	Olsen Bay	16000	4800	2.2	7273	2182	-1	240	157	M	H	5/28/90
90.6178	Rock Sole	Olsen Bay	15000	3000	-			12	206	95	F	H	5/28/90
90.6180	Rock Sole	Olsen Bay	6700	700	0.8	8375	875	1	340	511	F	H	5/28/90
90.6182	Rock sole	Olsen Bay	22000	4000	1.6	13750	2500	95	262	215	M	H	5/29/90
90.6183	Yellowfin Sole	Olsen Bay	23000	4900	2.3	10000	2130	117	277	264	F	R	5/29/90
90.6184	Yellowfin Sole	Olsen Bay	30000	3000	3.2	9375	938	86	318	458	F	R	5/29/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6185	Yellowfin Sole	Olsen Bay	10000	1300	0.80	12500	1625	36	295	351	F	R	5/28/90
90.6186	Yellowfin Sole	Olsen Bay	19000	2700	3.3	5758	818	46	308	367	F	R	5/28/90
90.6187	Yellowfin Sole	Olsen Bay	18000	3600	2.9	6207	1241	193	311	365	F	R	5/28/90
90.6188	Yellowfin Sole	Olsen Bay	-	-	-			37	230	144	F	R	5/28/90
90.6195	Dolly Varden	Olsen Bay	-	-	-			51	425	715	M	H	5/28/90
90.6196	Dolly Varden	Olsen Bay	59000	13000	6.7	8806	1940	36	390	520	F	H and R	5/28/90
90.6197	Dolly Varden	Olsen Bay	47000	7100	5.1	9216	1392	87	405	640	F	H and R	5/28/90
90.6198	Dolly Varden	Olsen Bay	-	-	-			62	338	324	F	H and R	5/28/90
90.6199	Dolly Varden	Olsen Bay	-	-	-			32	383	560	F	H and R	5/28/90
90.6200	Dolly Varden	Olsen Bay	26000	4700	8.7	2989	540	-	420	815	M	H	5/28/90
90.6201	Dolly Varden	Olsen Bay	43000	6600	4.0	10750	1650	53	385	520	F	H and R	5/28/90
90.6206	Yellowfin Sole	Olsen Bay	9500	1900	1.8	5278	1056	36	340	529	F	R	5/29/90
90.6207	Yellowfin Sole	Olsen Bay	13000	2500	0.80	16250	3125	5	286	325	F	R	5/29/90
90.6208	Yellowfin Sole	Olsen Bay	-	-	-			53	270	237	F	R	5/29/90
90.6209	Yellowfin Sole	Olsen Bay	21000	4100	0.80	26250	5125	98	298	348	F	R	5/29/90
90.6210	Yellowfin Sole	Olsen Bay	14000	2600	1.5	9333	1733	39	253	186	F	R	5/29/90
90.6212	Yellowfin Sole	Olsen Bay	12000	1600	5.0	2400	320	51	345	559	F	R	5/29/90
90.6214	Yellowfin Sole	Olsen Bay	12000	2600	3.2	3750	813	-	261	207	F	R	5/29/90
90.6215	Yellowfin Sole	Olsen Bay	11000	1800	1.4	7857	1286	-	237	158	F	R	5/29/90
90.6221	Yellowfin Sole	Olsen Bay	7000	1300	2.4	2917	542	-	396	310	F	R	5/29/90
90.6222	Yellowfin Sole	Olsen Bay	14000	1500	1.2	11667	1250	-	347	547	F	R	5/29/90
90.6223	Yellowfin Sole	Olsen Bay	25000	2000	1.2	20833	1667	-	291	280	F	R	5/29/90
90.6224	Yellowfin Sole	Olsen Bay	19000	1700	4.9	3878	347	-	280	312	F	R	5/29/90
90.6225	Yellowfin Sole	Olsen Bay	17000	1800	1.5	11333	1200	-	246	206	F	R	5/29/90
90.6226	Yellowfin Sole	Olsen Bay	36000	5500	-			-	240	151	F	R	5/29/90
90.6227	Yellowfin Sole	Olsen Bay	14000	710	0.96	14583	740	-	238	140	F	R	5/29/90

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90.6228	Yellowfin Sole	Olsen Bay	28000	4400	2.8	10000	1571	-	228	131	F	R	5/29/90
90.6230	Dolly Varden	Olsen Bay	60000	9700	7.5	8000	1293	-	323	289	M	H	5/29/90
90.6231	Dolly Varden	Olsen Bay	53000	11000	5.4	9815	2037	56	442	882	F	H and R	5/29/90
90.6232	Dolly Varden	Olsen Bay	45000	9000	5.2	8654	1731	63	360	395	F	H and R	5/29/90
90.6233	Dolly Varden	Olsen Bay	-	-	-			14	239	86	F	H and R	5/29/90
90.6234	Flathead sole	Rocky Bay	17000	2300	2.4	7083	958	73	355	371	F		5/30/90
90.6235	Flathead sole	Rocky Bay	14000	980	1.2	11667	817	18	338	305	F		5/30/90
90.6236	Flathead sole	Rocky Bay	20000	3500	1.4	14286	2500	25	333	355	M		5/30/90
90.6237	Flathead sole	Rocky Bay	14000	2100	0.5	28000	4200	21	396	577	F		5/30/90
90.6238	Flathead sole	Rocky Bay	20000	3500	1.7	11765	2059	31	378	529	F		5/30/90
90.6239	Flathead sole	Rocky Bay	23000	4600	0.7	32857	6571	58	325	300	F		5/30/90
90.6240	Flathead sole	Rocky Bay	13000	2100	2.6	5000	808	37	347	343	F		5/30/90
90.6241	Flathead sole	Rocky Bay	18000	2400	0.9	20000	2667	609	258	111	M		5/30/90
90.6242	Flathead sole	Rocky Bay	10000	1600	0.4	25000	4000	36	350	390	F		5/30/90
90.6243	Flathead sole	Rocky Bay	29000	6000	1.5	19333	4000	78	301	247	F		5/30/90
90.6246	Dolly Varden	Rocky Bay	120000	27000	20.1	5970	1343	20	388	470	F	H and R	5/30/90
90.6247	Dolly Varden	Rocky Bay	41000	4500	3.2	12813	1406	79	354	375	F	H and R	5/30/90
90.6248	Dolly Varden	Rocky Bay	44000	4200	3.7	11892	1135	39	430	782	F	H and R	5/30/90
90.6249	Dolly Varden	Rocky Bay	100000	14000	13.6	7353	1029	38	376	670	M	H	5/30/90
90.6250	Dolly Varden	Rocky Bay	-	-	-			35	392	670	F	H and R	5/30/90
90.6251	Dolly Varden	Rocky Bay	-	-	-			115	360	338	F	H and R	5/30/90
90.6252	Dolly Varden	Rocky Bay	-	-	-			27	461	1045	F	H and R	5/30/90
90.6254	Dolly Varden	Rocky Bay	37000	6500	5.2	7115	1250	-	411	713	M	H	5/30/90
90.6255	Dolly Varden	Rocky Bay	-	-	-			84	442	767	F	H and R	5/30/90
90.6256	Dolly Varden	Rocky Bay	62000	6700	5.8	10690	1155	36	426	660	F	H and R	5/30/90
90.6257	Dolly Varden	Rocky Bay	51000	5800	6.2	8226	935	91	378	425	F	H and R	5/30/90

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90.6258	Dolly Varden	Rocky Bay	160000	33000	20.8	7692	1587	25	356	334	F	H and R	5/30/90
90.6259	Halibut	Rocky Bay	15000	1500	1.0	15000	1500	39	660	3000	F		5/30/90
90.6260	Halibut	Rocky Bay	8000	1000	0.5	16000	2000	53	710	4000	M		5/30/90
90.6261	Halibut	Rocky Bay	11000	2800	1.1	10000	2545	76	760	5000	F		5/30/90
90.6263	Halibut	Rocky Bay	12000	2300	1.7	7059	1353	49	680	3000	F		5/30/90
90.6264	Halibut	Rocky Bay	24000	4600	1.3	18462	3538	34	665	2500	M		5/30/90
90.6265	Halibut	Rocky Bay	65000	8500	4.2	15476	2024	59	660	4000	F		5/30/90
90.6266	Halibut	Rocky Bay	20000	3300	0.6	33333	5500	60	640	2500	M		5/30/90
90.6267	Halibut	Rocky Bay	7300	1300	0.8	9125	1625	98	610	3000	F		5/30/90
90.6268	Halibut	Rocky Bay	5500	770	0.4	13750	1925	85	610	2000	M		5/30/90
90.6269	Rock Sole	Rocky Bay	16000	2700	1.1	14545	2455	57	284	308	F	H	5/30/90
90.6270	Rock Sole	Rocky Bay	19000	2400	1.1	17273	2182	197	270	222	F	H	5/30/90
90.6271	Rock Sole	Rocky Bay	12000	2000	0.8	15000	2500	179	352	559	F	H	5/30/90
90.6272	Rock Sole	Rocky Bay	7000	860	1.2	5833	717	136	385	706	F	H	5/30/90
90.6273	Rock Sole	Rocky Bay	26000	3800	1.2	21667	3167	210	248	177	F	H	5/30/90
90.6274	Rock Sole	Rocky Bay	17000	3200	0.8	21250	4000	121	236	157	F	H	5/30/90
90.6276	Flathead Sole	Snug Harbor	34000	5700	1.7	20000	3353	235	365	396	F		5/31/90
90.6278	Flathead Sole	Snug Harbor	64000	12000	2.1	30476	5714	138	285	236	F		5/31/90
90.6279	Flathead Sole	Snug Harbor	29000	5900	1.0	29000	5900	21	290	235	F		5/31/90
90.6280	Flathead Sole	Snug Harbor	50000	9800	2.2	22727	4455	73	282	200	M		5/31/90
90.6281	Flathead Sole	Snug Harbor	34000	7300	1.8	18889	4056	133	284	187	F		5/31/90
90.6282	Flathead Sole	Snug Harbor	29000	5200	2.7	10741	1926	159	275	186	M		5/31/90
90.6284	Flathead Sole	Snug Harbor	32000	5800	1.1	29091	5273	70	276	166	M		5/31/90
90.6285	Flathead Sole	Snug Harbor	53000	11000	3.6	14722	3056	198	276	178	M		5/31/90
90.6286	Rock Sole	Snug Harbor	73000	13000	2.6	28077	5000	216	374	657	F	H	5/31/90
90.6287	Rock Sole	Snug Harbor	110000	24000	1.5	73333	16000	367	351	522	F	H	5/31/90

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90.6288	Rock Sole	Snug Harbor	78000	18000	1.0	78000	18000	490	327	403	F	H	5/31/90
90.6289	Rock Sole	Snug Harbor	-	-	-			119	221	121	M	H	5/31/90
90.6290	Rock Sole	Snug Harbor	44000	11000	3.7	11892	2973	298	350	461	F	H	5/31/90
90.6292	Rock Sole	Snug Harbor	89000	17000	3.4	26176	5000	200	331	491	F	H	5/31/90
90.6293	Rock Sole	Snug Harbor	33000	6200	1.0	33000	6200	144	352	479	F	H	5/31/90
90.6294	Rock Sole	Snug Harbor	-	-	-			104	290	305	F	H	5/31/90
90.6295	Rock Sole	Snug Harbor	-	-	-			200	250	169	M	H	5/31/90
90.6297	Dolly Varden	Snug Harbor	45000	5000	2.6	17308	1923	72	344	358	F	H and R	5/31/90
90.6298	Yellowfin Sole	Snug Harbor	38000	5000	2.7	14074	1852	120	293	356	F	R	5/31/90
90.6301	Yellowfin Sole	Snug Harbor	52000	9400	2.2	23636	4273	11	293	299	F	R	5/31/90
90.6303	Yellowfin Sole	Snug Harbor	26000	4300	2.7	9630	1593	12	253	186	F	R	5/31/90
90.6305	Yellowfin Sole	Snug Harbor	36000	6400	1.7	21176	3765	118	260	239	F	R	5/31/90
90.6306	Yellowfin Sole	Snug Harbor	46000	7900	2.0	23000	3950	32	332	522	F	R	5/31/90
90.6307	Yellowfin Sole	Snug Harbor	45000	9400	-			235	285	266	F	R	5/31/90
90.6308	Dolly Varden	Snug Harbor	46000	4800	2.9	15862	1655	63	303	282	F	H and R	5/31/90
90.6309	Dolly Varden	Snug Harbor	27000	2300	7.3	3699	315	236	310	301	F	H and R	5/31/90
90.6310	Yellowfin Sole	Snug Harbor	18000	3000	1.5	12000	2000	21	322	451	F	R	5/31/90
90.6311	Yellowfin Sole	Snug Harbor	77000	15000	1.5	51333	10000	61	350	644	F	R	5/31/90
90.6312	Yellowfin Sole	Snug Harbor	48000	7900	1.9	25263	4158	170	257	198	F	R	5/31/90
90.6314	Yellowfin Sole	Snug Harbor	30000	4500	1.0	30000	4500	60	341	525	F	R	5/31/90
90.6315	Yellowfin Sole	Snug Harbor	65000	10000	-			-	250	210	F	R	5/31/90
90.6316	Yellowfin Sole	Snug Harbor	310000	61000	8.8	35227	6932	-	252	198	F	R	5/31/90
90.6318	Yellowfin Sole	Snug Harbor	74000	11000	1.5	49333	7333	-	257	210	F	R	5/31/90
90.6319	Yellowfin Sole	Snug Harbor	53000	7600	-			-	233	144	F	R	5/31/90
90.6321	Yellowfin Sole	Snug Harbor	84000	14000	3.0	28000	4667	-	249	198	F	R	5/31/90
90.6322	Yellowfin Sole	Snug Harbor	93000	13000	-			-	235	146	F	R	5/31/90

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90.6323	Yellowfin Sole	Snug Harbor	68000	11000	1.7	40000	6471	-	262	210	F	R	5/31/90
90.6325	Yellowfin Sole	Snug Harbor	150000	24000	2.6	57692	9231	-	260	210	F	R	5/31/90
90.6326	Yellowfin Sole	Snug Harbor	73000	11000	1.1	66364	10000	-	253	232	F	R	5/31/90
90.6327	Yellowfin Sole	Snug Harbor	140000	24000	3.2	43750	7500	-	252	153	F	R	5/31/90
90.6328	Yellowfin Sole	Snug Harbor	59000	11000	1.4	42143	7857	-	243	157	F	R	5/31/90
90.6329	Yellowfin Sole	Snug Harbor	80000	7100	8.1	9877	877	-	390	819	F	R	5/31/90
90.6331	Dolly Varden	Snug Harbor	26000	2100	1.8	14444	1167	78	333	379	F	H and R	6/1/90
90.6332	Dolly Varden	Snug Harbor	-	-	-			88	322	290	F	H and R	6/1/90
90.6333	Dolly Varden	Snug Harbor	-	-	-			59	410	631	F	H and R	6/1/90
90.6336	Dolly Varden	Snug Harbor	20000	3200	4.1	4878	780	103	368	475	F	H and R	6/1/90
90.6338	Dolly Varden	Snug Harbor	-	-	-			46	358	455	F	H and R	6/1/90
90.6339	Dolly Varden	Snug Harbor	51000	6600	3.5	14571	1886	81	362	466	F	H and R	6/1/90
90.6340	Dolly Varden	Snug Harbor	41000	4200	2.3	17826	1826	54	309	285	F	H and R	6/1/90
90.6342	Dolly Varden	Snug Harbor	25000	2600	1.2	20833	2167	-	354	438	F	H and R	6/1/90
90.6343	Dolly Varden	Snug Harbor	62000	6200	2.2	28182	2818	-	378	568	F	H and R	6/1/90
90.6348	Dolly Varden	Snug Harbor	51000	4900	2.4	21250	2042	-	362	418	F	H and R	6/1/90
90.6349	Dolly Varden	Snug Harbor	100000	12000	4.6	21739	2609	-	435	732	F	H and R	6/1/90
90.6352	Dolly Varden	Snug Harbor	50000	9700	2.6	19231	3731	-	362	440	F	H and R	6/1/90
90.6361	Halibut	Snug Harbor	7500	1200	0.8	9375	1500	51	570	2000	F		6/1/90
90.6362	Halibut	Snug Harbor	8000	1600	0.4	20000	4000	68	560	2000	F		6/1/90
90.6363	Halibut	Snug Harbor	7500	1300	0.4	18750	3250	123	580	3000	F		6/1/90
90.6364	Halibut	Snug Harbor	18000	2400	5.2	3462	462	152	920	12000	F		6/1/90
90.6365	Halibut	Snug Harbor	16000	2700	1.0	16000	2700	69	710	4000	F		6/1/90
90.6366	Halibut	Snug Harbor	230000	36000	3.8	60526	9474	-	600	4000	F		6/1/90
90.6368	Halibut	Snug Harbor	14000	2300	0.9	15556	2556	-	660	4000	F		6/1/90
90.6369	Halibut	Snug Harbor	14000	2400	1.9	7368	1263	69	920	9500	M		6/1/90

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90.6370	Halibut	Snug Harbor	13000	2700	1.9	6842	1421	-	1060	15000	F		6/1/90
90.6371	Halibut	Rocky Bay	-	-	-			11	600	2560	M		
90.6372	Halibut	Rocky Bay	-	-	-			59	640	2860	M		
90.6373	Halibut	Rocky Bay	-	-	-			86	590	2390	F		
90.6374	Halibut	Rocky Bay	-	-	-			31	630	2692	M		
90.6376	Halibut	Rocky Bay	-	-	-			241	580	2206	M		
90.6379	Dolly Varden	Sleepy Bay	58000	9100	1.8	32222	5056	38	438	937	F	H and R	6/2/90
90.6381	Dolly Varden	Sleepy Bay	98000	11000	3.6	27222	3056	89	369	461	F	H and R	6/2/90
90.6383	Dolly Varden	Sleepy Bay	51000	5800	2.4	21250	2417	85	337	390	F	H and R	6/2/90
90.6384	Dolly Varden	Sleepy Bay	-	-	-			94	348	365	F	H and R	6/2/90
90.6386	Dolly Varden	Sleepy Bay	33000	3500	2.7	12222	1296	93	341	455	F	H and R	6/2/90
90.6388	Dolly Varden	Sleepy Bay	-	-	-			23	418	846	F	H and R	6/2/90
90.6393	Dolly Varden	Sleepy Bay	34000	3300	1.9	17895	1737	64	388	598	F	H and R	6/2/90
90.6394	Dolly Varden	Sleepy Bay	-	-	-			67	426	798	F	H and R	6/2/90
90.6395	Dolly Varden	Sleepy Bay	31000	2900	2.1	14762	1381	57	442	840	F	H and R	6/2/90
90.6397	Dolly Varden	Sleepy Bay	58000	4700	2.2	26364	2136	99	353	388	F	H and R	6/2/90
90.6401	Dolly Varden	Sleepy Bay	58000	5300	2.3	25217	2304	-	415	710	F	H and R	6/2/90
90.6404	Yellowfin Sole	Sleepy Bay	69000	14000	6.5	10615	2154	62	312	443	F	R	6/2/90
90.6406	Yellowfin Sole	Sleepy Bay	31000	5500	2.6	11923	2115	27	319	345	F	R	6/2/90
90.6411	Yellowfin Sole	Sleepy Bay	56000	10000	-			64	304	394	F	R	6/2/90
90.6413	Yellowfin Sole	Sleepy Bay	38000	6900	1.5	25333	4600	30	337	502	F	R	6/2/90
90.6417	Flathead Sole	Sleepy Bay	44000	7600	1.3	33846	5846	13	345	321	F		6/2/90
90.6418	Flathead Sole	Sleepy Bay	30000	9600	1.1	27273	8727	65	386	637	F		6/2/90
90.6419	Flathead Sole	Sleepy Bay	37000	9500	0.7	52857	13571	134	365	482	F		6/2/90
90.6420	Flathead sole	Sleepy Bay	-	-	-			153	384	569	F		6/2/90
90.6421	Flathead Sole	Sleepy Bay	19000	5900	0.6	31667	9833	54	350	415	F		6/2/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein [2]	µg PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6422	Rock Sole	Sleepy Bay	52000	12000	2.2	23636	5455	348	283	286	M	H	6/3/90
90.6423	Rock Sole	Sleepy Bay	42000	8700	1.0	42000	8700	337	312	395	F	H	6/3/90
90.6424	Rock Sole	Sleepy Bay	70000	14000	0.8	87500	17500	342	293	295	F	H	6/3/90
90.6425	Rock Sole	Sleepy Bay	50000	8900	1.8	27778	4944	294	294	311	F	H	6/3/90
90.6426	Rock Sole	Sleepy Bay	47000	8100	1.8	26111	4500	261	247	188	F	H	6/3/90
90.6427	Rock Sole	Sleepy Bay	44000	9800	2.5	17600	3920	628	303	337	F	H	6/3/90
90.6428	Rock Sole	Sleepy Bay	43000	7500	1.1	39091	6818	385	241	154	M	H	6/3/90
90.6429	Rock Sole	Sleepy Bay	45000	7500	1.7	26471	4412	602	243	171	F	H	6/3/90
90.6430	Rock Sole	Sleepy Bay	100000	23000	3.5	28571	6571	566	376	681	F	H	6/3/90
90.6431	Rock Sole	Sleepy Bay	41000	7200	1.0	41000	7200	184	245	152	F	H	6/3/90
90.6436	Yellowfin Sole	Sleepy Bay	-	-	-			45	292	300	F	R	6/3/90
90.6438	Yellowfin Sole	Sleepy Bay	38000	7400	5.4	7037	1370	63	308	419	F	R	6/3/90
90.6439	Yellowfin Sole	Sleepy Bay	190000	39000	2.2	86364	17727	98	237	142	F	R	6/3/90
90.6440	Yellowfin Sole	Sleepy Bay	71000	15000	4.0	17750	3750	82	270	253	F	R	6/3/90
90.6441	Yellowfin Sole	Sleepy Bay	130000	26000	1.3	100000	20000	520	225	143	F	R	6/3/90
90.6442	Yellowfin Sole	Sleepy Bay	67000	13000	1.5	44667	8667	136	271	231	F	R	6/3/90
90.6443	Yellowfin Sole	Sleepy Bay	87000	21000	1.7	51176	12353	157	319	432	F	R	6/3/90
90.6444	Yellowfin Sole	Sleepy Bay	33000	5700	1.6	20625	3563	-	257	240	F	R	6/3/90
90.6445	Flathead Sole	Sleepy Bay	55000	13000	0.8	68750	16250	22	346	321	F		6/3/90
90.6446	Flathead Sole	Sleepy Bay	21000	4600	5.9	3559	780	206	336	376	F		6/3/90
90.6447	Flathead Sole	Sleepy Bay	54000	13000	-			53	218	94	F		6/3/90
90.6448	Flathead sole	Sleepy Bay	-	-	-			147	224	101	F		6/3/90
90.6450	Dolly Varden	Sleepy Bay	70000	8200	3.5	20000	2343	-	295	235	F	H and R	6/3/90
90.6451	Dolly Varden	Sleepy Bay	79000	9900	3.6	21944	2750	-	311	321	F	H and R	6/3/90
90.6482	Yellowfin Sole	Squirrel Bay	21000	3400	0.90	23333	3778	-	263	237	F	R	6/4/90
90.6483	Yellowfin Sole	Squirrel Bay	13000	2100	0.74	17568	2838	-	292	281	M		6/4/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6492	Yellowfin Sole	Squirrel Bay	81000	14000	-			-	255	213	F	R	6/4/90
90.6493	Yellowfin Sole	Squirrel Bay	84000	15000	1.5	56000	10000	-	246	203	F	R	6/4/90
90.6495	Dolly Varden	Squirrel Bay	71000	5800	2.5	28400	2320	-	367	441	F	R	6/4/90
90.6496	Dolly Varden	Squirrel Bay	64000	6600	3.6	17778	1833	-	410	620	F	R	6/4/90
90.6497	Dolly Varden	Squirrel Bay	32000	5100	5.5	5818	927	-	348	410	M		6/4/90
90.6498	Dolly Varden	Squirrel Bay	48000	5000	4.2	11429	1190	-	450	720	F		6/4/90
90.6499	Dolly Varden	Squirrel Bay	38000	5200	3.1	12258	1677	-	391	575	M		6/4/90
90.6501	Dolly Varden	Squirrel Bay	59000	6100	2.7	21852	2259	-	460	830	F	R	6/4/90
90.6503	Dolly Varden	Squirrel Bay	81000	11000	3.1	26129	3548	-	383	608	F	R	6/4/90
90.6504	Dolly Varden	Squirrel Bay	87000	10000	9.2	9457	1087	-	415	705	F	R	6/4/90
90.6505	Dolly Varden	Squirrel Bay	110000	11000	4.1	26829	2683	-	370	488	F	R	6/4/90
90.6510	Dolly Varden	Squirrel Bay	92000	6500	2.9	31724	2241	-	305	204	F	R	6/4/90
90.6511	Dolly Varden	Squirrel Bay	29000	2900	5.3	5472	547	-	467	1140	F	R	6/4/90
90.6513	Dolly Varden	Squirrel Bay	11000	700	1.7	6471	412	-	482	1230	F	R	6/4/90
90.6517	Yellowfin Sole	Squirrel Bay	53000	8000	3.9	13590	2051	-	286	290	F	R	6/5/90
90.6519	Yellowfin Sole	Squirrel Bay	43000	6700	3.9	11026	1718	-	368	640	F	R	6/5/90
90.6520	Yellowfin Sole	Squirrel Bay	27000	3100	1.7	15882	1824	-	381	710	F	R	6/5/90
90.6521	Yellowfin Sole	Squirrel Bay	32000	3900	-			-	243	175	F	R	6/5/90
90.6523	Yellowfin Sole	Squirrel Bay	35000	3800	-			-	270	252	F	R	6/5/90
90.6524	Yellowfin Sole	Squirrel Bay	33000	3300	0.74	44595	4459	-	226	135	F	R	6/5/90
90.6538	Dolly Varden	Squirrel Bay	37000	3100	1.6	23125	1938	-	287	650	F	R	6/5/90
90.6565	Yellowfin Sole	Sunny Cove	16000	1300	2.2	7273	591	-	331	441	F	R	6/6/90
90.6568	Yellowfin Sole	Sunny Cove	35000	4000	7.9	4430	506	-	365	667	F	R	6/6/90
90.6569	Yellowfin Sole	Sunny Cove	17000	1800	1.8	9444	1000	-	256	210	F	R	6/6/90
90.6570	Yellowfin sole	Sunny Cove	54000	6600	4.3	12558	1535	-	240	199	F	R	6/6/90
90.6571	Yellowfin sole	Sunny Cove	74000	6900	5.1	14510	1353	-	310	449	F	R	6/6/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6572	Yellowfin sole	Sunny Cove	54000	4900	4.0	13500	1225	-	295	398	F	R	6/6/90
90.6573	Yellowfin sole	Sunny Cove	36000	3800	4.2	8571	905	-	320	641	F	R	6/6/90
90.6574	Yellowfin sole	Sunny Cove	46000	6000	10.8	4259	556	-	311	468	F	R	6/6/90
90.6575	Yellowfin sole	Sunny Cove	48000	5300	4.8	10000	1104	-	287	283	F		6/6/90
90.6576	Yellowfin sole	Sunny Cove	46000	5300	6.9	6667	768	-	330	550	F	R	6/6/90
90.6577	Yellowfin sole	Sunny Cove	39000	3200	3.9	10000	821	-	310	396	F	R	6/6/90
90.6579	Yellowfin sole	Sunny Cove	39000	3100	0.98	39796	3163	-	255	217	F	R	6/6/90
90.6580	Yellowfin sole	Sunny Cove	48000	5000	7.1	6761	704	-	290	287	F	R	6/6/90
90.6581	Yellowfin sole	Sunny Cove	30000	4900	1.4	21429	3500	-	261	241	F	R	6/6/90
90.6583	Yellowfin sole	Sunny Cove	43000	6000	4.2	10238	1429	-	257	208	F	R	6/6/90
90.6584	Yellowfin sole	Sunny Cove	52000	6500	3.7	14054	1757	-	235	175	F	R	6/6/90
90.6585	Yellowfin sole	Sunny Cove	61000	9900	6.1	10000	1623	-	251	149	F	R	6/6/90
90.6586	Yellowfin sole	Sunny Cove	44000	5000	2.2	20000	2273	-	220	126	F	R	6/6/90
90.6597	Yellowfin Sole	Sunny Cove	32000	3700	-			-	288	315	F		6/6/90
90.6603	Dolly Varden	Sunny Cove	83000	6700	1.4	59286	4786	-	419	614	F	R	6/6/90
90.6604	Dolly Varden	Sunny Cove	66000	8000	2.2	30000	3636	-	368	476	F	R	6/6/90
90.6605	Dolly Varden	Sunny Cove	68000	9800	3.3	20606	2970	-	431	810	F	R	6/6/90
90.6608	Dolly Varden	Sunny Cove	72000	9900	4.8	15000	2063	-	475	1030	F	R	6/6/90
90.6609	Dolly Varden	Sunny Cove	58000	6100	4.3	13488	1419	-	387	552	F	R	6/6/90
90.6610	Dolly Varden	Sunny Cove	58000	6100	5.5	10545	1109	-	453	825	F	R	6/6/90
90.6612	Dolly Varden	Sunny Cove	49000	5600	4.5	10889	1244	-	430	774	F	R	6/6/90
90.6613	Yellowfin Sole	Sunny Cove	21000	3700	-			-	266	252	F	R	6/7/90
90.6614	Yellowfin Sole	Sunny Cove	25000	3800	4.1	6098	927	-	260	258	F	R	6/7/90
90.6615	Dolly Varden	Sunny Cove	42000	4500	1.9	22105	2368	-	418	710	F	R	6/7/90
90.6617	Dolly Varden	Sunny Cove	49000	4000	2.5	19600	1600	-	488	1328	F	R	6/7/90
90.6621	Dolly Varden	Sunny Cove	46000	4400	2.2	20909	2000	-	415	673	F	R	6/7/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6643	Yellowfin Sole	Black Bay	15000	940	3.4	4412	276	-	296	337	F	R	6/11/90
90.6644	Yellowfin Sole	Black Bay	24000	3100	4.3	5581	721	-	328	523	F	R	6/11/90
90.6645	Yellowfin Sole	Black Bay	27000	2500	1.7	15882	1471	-	302	357	F	R	6/11/90
90.6646	Yellowfin Sole	Black Bay	17000	1100	2.2	7727	500	-	248	214	F	R	6/11/90
90.6648	Yellowfin Sole	Black Bay	17000	2200	2.0	8500	1100	-	260	242	M		6/11/90
90.6649	Yellowfin Sole	Black Bay	32000	3300	6.3	5079	524	-	232	186	M		6/11/90
90.6650	Yellowfin Sole	Black Bay	11000	1900	2.7	4074	704	-	268	-	M		6/11/90
90.6652	Yellowfin Sole	Black Bay	36000	5800	3.0	12000	1933	-	211	174	M		6/11/90
90.6653	Yellowfin Sole	Black Bay	22000	3400	6.2	3548	548	-	292	310	M		6/11/90
90.6660	Halibut	Tonsina Bay	4100	600	0.3	13667	2000	45	1700	40000	F		6/12/90
90.6663	Yellowfin Sole	Tonsina Bay	62000	12000	1.8	34444	6667	-	304	305	M		6/12/90
90.6664	Yellowfin Sole	Tonsina Bay	86000	17000	1.9	45263	8947	-	288	238	M		6/12/90
90.6665	Yellowfin Sole	Tonsina Bay	56000	13000	3.9	14359	3333	-	263	232	M		6/12/90
90.6666	Yellowfin Sole	Tonsina Bay	48000	9300	1.6	30000	5813	-	260	220	M		6/12/90
90.6674	Flathead Sole	Tonsina Bay	72000	16000	1.5	48000	10667	97	331	425	F		6/12/90
90.6675	Flathead Sole	Tonsina Bay	19000	4800	1.0	19000	4800	98	377	430	F		6/12/90
90.6676	Flathead Sole	Tonsina Bay	64000	13000	2.3	27826	5652	215	344	455	F		6/12/90
90.6677	Flathead Sole	Tonsina Bay	25000	5400	0.7	35714	7714	17	324	388	F		6/12/90
90.6678	Flathead sole	Tonsina Bay	44000	7600	0.9	48889	8444	73	375	457	F		6/12/90
90.6679	Flathead sole	Tonsina Bay	44000	7700	0.8	55000	9625	168	354	360	F		6/12/90
90.6680	Flathead sole	Tonsina Bay	79000	17000	1.0	79000	17000	156	347	450	F		6/12/90
90.6681	Flathead sole	Tonsina Bay	35000	7300	1.1	31818	6636	8	322	252	F		6/12/90
90.6682	Flathead sole	Tonsina Bay	26000	5300	0.7	37143	7571	135	317	263	M		6/12/90
90.6683	Flathead sole	Tonsina Bay	67000	14000	0.8	83750	17500	21	368	435	F		6/12/90
90.6684	Dolly Varden	Tonsina Bay	96000	15000	1.3	73846	11538	39	329	320	F	R	6/12/90
90.6685	Dolly Varden	Tonsina Bay	120000	23000	8.3	14458	2771	48	498	1260	F	R	6/12/90

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90.6686	Dolly Varden	Tonsina Bay	-	-	-			74	320	278	F	R	6/12/90
90.6687	Dolly Varden	Tonsina Bay	-	-	-			78	307	270	F	R	6/12/90
90.6688	Dolly Varden	Tonsina Bay	45000	5500	4.5	10000	1222	-	475	1062	M		6/12/90
90.6689	Dolly Varden	Tonsina Bay	64000	6600	3.8	16842	1737	92	323	390	F	R	6/12/90
90.6690	Dolly Varden	Tonsina Bay	41000	8700	3.3	12424	2636	-	500	1110	M		6/12/90
90.6691	Dolly Varden	Tonsina Bay	-	-	-			78	374	430	F	R	6/12/90
90.6692	Dolly Varden	Tonsina Bay	65000	12000	3.9	16667	3077	-	551	1410	M		6/12/90
90.6693	Dolly Varden	Tonsina Bay	68000	11000	5.7	11930	1930	84	528	1320	F	R	6/12/90
90.6694	Yellowfin sole	Tonsina Bay	50000	9700	1.3	38462	7462	139	335	527	F	R	6/12/90
90.6695	Yellowfin sole	Tonsina Bay	25000	4800	0.52	48077	9231	81	310	352	F	R	6/12/90
90.6696	Yellowfin sole	Tonsina Bay	130000	24000	2.6	50000	9231	147	310	385	F	R	6/12/90
90.6697	Yellowfin sole	Tonsina Bay	57000	8100	1.0	57000	8100	87	275	285	F	R	6/12/90
90.6698	Yellowfin sole	Tonsina Bay	130000	21000	1.7	76471	12353	150	315	434	F	R	6/12/90
90.6699	Yellowfin sole	Tonsina Bay	36000	6700	1.4	25714	4786	112	315	452	F	R	6/12/90
90.6700	Rock sole	Tonsina Bay	47000	8200	1.6	29375	5125	142	388	810	M	H	6/12/90
90.6701	Rock sole	Tonsina Bay	23000	3500	1.1	20909	3182	37	324	340	M	H	6/12/90
90.6702	Rock sole	Tonsina Bay	23000	5000	0.9	25556	5556	149	330	410	F	H	6/12/90
90.6703	Rock sole	Tonsina Bay	27000	5400	1.4	19286	3857	146	314	344	F	H	6/12/90
90.6704	Rock sole	Tonsina Bay	51000	9600	1.0	51000	9600	121	323	385	M	H	6/12/90
90.6705	Rock sole	Tonsina Bay	42000	9800	1.9	22105	5158	72	273	240	M	H	6/12/90
90.6706	Rock sole	Tonsina Bay	61000	10000	1.7	35882	5882	295	322	375	M	H	6/12/90
90.6707	Halibut	Tonsina Bay	47000	9300	2.8	16786	3321	90	650	3000	F		6/12/90
90.6708	Yellowfin Sole	Tonsina Bay	-	-	-			-2	305	320	M		6/12/90
90.6709	Rock sole	Tonsina Bay	79000	14000	1.4	56429	10000	39	338	433	M	H	6/13/90
90.6710	Rock sole	Tonsina Bay	45000	14000	3.5	12857	4000	-	311	320	M	H	6/13/90
90.6711	Dolly Varden	Tonsina Bay	80000	12000	8.7	9195	1379	81	355	525	F	R	6/13/90

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90.6712	Dolly Varden	Tonsina Bay	80000	15000	6.0	13333	2500	53	470	1025	F	R	6/13/90
90.6713	Dolly Varden	Tonsina Bay	60000	13000	7.6	7895	1711	39	374	555	F	R	6/13/90
90.6716	Halibut	Tonsina Bay	16000	1900	0.9	17778	2111	-	455	980	F		6/13/90
90.6717	Halibut	Tonsina Bay	46000	7800	9.1	5055	857	20	695	3100	F		6/13/90
90.6718	Dolly Varden	Windy Bay	82000	6900	2.3	35652	3000	96	289	252	F	H and R	6/14/90
90.6720	Dolly Varden	Windy Bay	-	-	-			72	334	347	F	H and R	6/14/90
90.6721	Dolly Varden	Windy Bay	-	-	-			55	352	446	F	H and R	6/14/90
90.6722	Dolly Varden	Windy Bay	66000	8300	3.2	20625	2594	40	337	442	F	H and R	6/14/90
90.6723	Dolly Varden	Windy Bay	54000	6900	2.2	24545	3136	53	329	354	F	H and R	6/14/90
90.6725	Dolly Varden	Windy Bay	92000	12000	3.2	28750	3750	35	402	640	F	H and R	6/14/90
90.6727	Dolly Varden	Windy Bay	64000	9700	2.3	27826	4217	50	368	537	F	H and R	6/14/90
90.6728	Dolly Varden	Windy Bay	-	-	-			48	324	270	F	H and R	6/14/90
90.6729	Dolly Varden	Windy Bay	52000	8300	3.3	15758	2515	-	306	303	F	R	6/14/90
90.6735	Dolly Varden	Windy Bay	100000	13000	-			-	365	440	F	H and R	6/14/90
90.6736	Dolly Varden	Windy Bay	67000	9000	4.0	16750	2250	59	283	232	F	H and R	6/14/90
90.6740	Dolly Varden	Windy Bay	64000	11000	4.1	15610	2683	-	385	575	F	H and R	6/14/90
90.6761	Yellowfin Sole	Windy Bay	18000	3700	4.7	3830	787	-	371	730	F	R	6/14/90
90.6764	Yellowfin Sole	Windy Bay	38000	7800	1.4	27143	5571	-	287	326	M		6/14/90
90.6765	Yellowfin Sole	Windy Bay	27000	6300	0.90	30000	7000	-	267	209	M		6/14/90
90.6766	Yellowfin Sole	Windy Bay	22000	3800	2.3	9565	1652	-	310	375	M		6/14/90
90.6767	Yellowfin Sole	Windy Bay	41000	6100	2.2	18636	2773	-	277	278	M		6/14/90
90.6786	Dolly Varden	Windy Bay	55000	6200	3.4	16176	1824	-	322	342	F	H and R	6/15/90
90.6792	Dolly Varden	Windy Bay	-	-	-			104	285	240	F	H and R	6/15/90
90.6796	Yellowfin Sole	Windy Bay	35000	5700	1.7	20588	3353	-	352	638	F	R	6/15/90
90.6797	Yellowfin Sole	Windy Bay	35000	6200	5.8	6034	1069	-	357	572	F	R	6/15/90
90.6798	Yellowfin Sole	Windy Bay	52000	8800	4.4	11818	2000	-	315	467	F	R	6/15/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6799	Yellowfin Sole	Windy Bay	44000	11000	2.3	19130	4783	-	285	290	F	R	6/15/90
90.6801	Yellowfin Sole	Windy Bay	39000	6100	2.8	13929	2179	-	252	209	F	R	6/15/90
90.6813	Yellowfin Sole	Discoverer Bay	6500	770	1.6	4063	481	-	355	603	F	R	6/16/90
90.6814	Yellowfin Sole	Discoverer Bay	6400	640	1.6	4000	400	-	327	470	F	R	6/16/90
90.6815	Yellowfin Sole	Discoverer Bay	6900	1400	5.0	1380	280	-	327	490	F	R	6/16/90
90.6817	Yellowfin Sole	Discoverer Bay	6400	1600	1.3	4923	1231	-	292	302	F	R	6/16/90
90.6818	Yellowfin Sole	Discoverer Bay	8600	720	1.3	6615	554	-	342	494	F	R	6/16/90
90.6819	Yellowfin Sole	Discoverer Bay	16000	2400	1.6	10000	1500	-	352	605	F	R	6/16/90
90.6820	Yellowfin Sole	Discoverer Bay	6900	820	0.90	7667	911	-	293	279	F	R	6/16/90
90.6821	Yellowfin Sole	Discoverer Bay	19000	2200	5.9	3220	373	-	307	370	F	R	6/16/90
90.6823	Yellowfin Sole	Discoverer Bay	18000	2300	1.3	13846	1769	-	316	340	F	R	6/16/90
90.6824	Yellowfin Sole	Discoverer Bay	14000	2900	1.8	7778	1611	-	296	336	F	R	6/16/90
90.6825	Yellowfin Sole	Discoverer Bay	10000	1500	1.3	7692	1154	-	295	324	F	R	6/16/90
90.6829	Yellowfin Sole	Discoverer Bay	14000	2300	1.9	7368	1211	-	272	222	F	R	6/16/90
90.6830	Yellowfin Sole	Discoverer Bay	16000	3000	1.8	8889	1667	-	315	358	F	R	6/16/90
90.6831	Yellowfin Sole	Discoverer Bay	20000	4900	1.6	12500	3063	-	284	296	F	R	6/16/90
90.6832	Yellowfin Sole	Discoverer Bay	24000	3600	-			-	263	206	F	R	6/16/90
90.6833	Yellowfin Sole	Discoverer Bay	12000	1400	-			-	290	327	F	R	6/17/90
90.6834	Yellowfin Sole	Discoverer Bay	10000	1500	2.0	5000	750	-	330	458	F	R	6/17/90
90.6835	Yellowfin Sole	Discoverer Bay	49000	8400	-			-	296	307	F	R	6/17/90
90.6836	Yellowfin Sole	Discoverer Bay	15000	2500	3.7	4054	676	-	300	352	F	R	6/17/90
90.6837	Yellowfin Sole	Discoverer Bay	21000	4200	-			-	282	284	F	R	6/17/90
90.6838	Yellowfin Sole	Discoverer Bay	8800	870	9.2	957	95	-	287	268	F	R	6/17/90
90.6839	Yellowfin Sole	Discoverer Bay	18000	3200	2.6	6923	1231	-	274	238	F	R	6/17/90
90.6842	Yellowfin Sole	Discoverer Bay	18000	1900	2.7	6667	704	-	275	235	F	R	6/17/90
90.6858	Dolly Varden	Discoverer Bay	-	-	-			66	311	282	F	H and R	6/16/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6860	Dolly Varden	Discoverer Bay	54000	5200	6.7	8060	776	82	450	904	F	H and R	6/16/90
90.6861	Dolly Varden	Discoverer Bay	55000	4200	2.2	25000	1909	26	410	711	F	H and R	6/16/90
90.6862	Dolly Varden	Discoverer Bay	11000	5700	-			43	410	713	F	H and R	6/16/90
90.6863	Dolly Varden	Discoverer Bay	-	-	-			44	334	312	F	H and R	6/16/90
90.6865	Dolly Varden	Discoverer Bay	39000	2800	2.9	13448	966	45	326	313	F	H and R	6/16/90
90.6867	Dolly Varden	Discoverer Bay	-	-	-			44	318	285	F	H and R	6/17/90
90.6868	Dolly Varden	Discoverer Bay	50000	4500	4.6	10870	978	103	410	630	F	H and R	6/17/90
90.6869	Dolly Varden	Discoverer Bay	25000	2200	1.4	17857	1571	25	328	332	F	H and R	6/17/90
90.6870	Dolly Varden	Discoverer Bay	-	-	-			54	298	280	F	H and R	6/17/90
90.6871	Dolly Varden	Discoverer Bay	28000	2900	5.1	5490	569	-	312	364	F	H and R	6/17/90
90.6872	Dolly Varden	Discoverer Bay	47000	5200	3.5	13429	1486	-	380	560	F	H and R	6/17/90
90.6873	Dolly Varden	Discoverer Bay	34000	3000	1.8	18889	1667	-	411	660	F	H and R	6/17/90
90.6874	Dolly Varden	Discoverer Bay	41000	4700	4.2	9762	1119	-	455	1038	F	H and R	6/17/90
90.6875	Dolly Varden	Discoverer Bay	53000	6700	-			-	331	406	F	H and R	6/17/90
90.6911	Dolly Varden	Hallo Bay	270000	39000	2.8	96429	13929	15	359	389	F	H and R	6/18/90
90.6915	Dolly Varden	Hallo Bay	57000	5400	1.9	30000	2842	23	453	754	F	H and R	6/18/90
90.6916	Dolly Varden	Hallo Bay	66000	11000	2.5	26400	4400	60	392	550	F	H and R	6/18/90
90.6917	Dolly Varden	Hallo Bay	270000	75000	2.5	108000	30000	17	478	812	F	H and R	6/18/90
90.6918	Dolly Varden	Hallo Bay	44000	4600	3.1	14194	1484	35	318	278	F	H and R	6/18/90
90.6919	Dolly Varden	Hallo Bay	40000	4000	1.8	22222	2222	23	418	728	F	H and R	6/18/90
90.6921	Dolly Varden	Hallo Bay	75000	7700	3.6	20833	2139	45	344	463	F	H and R	6/18/90
90.6923	Dolly Varden	Hallo Bay	35000	3400	2.3	15217	1478	36	396	643	F	H and R	6/18/90
90.6924	Dolly Varden	Hallo Bay	-	-	-			95	438	949	F	H and R	6/18/90
90.6926	Dolly Varden	Hallo Bay	57000	6000	3.5	16286	1714	98	343	870	F	H and R	6/18/90
90.6929	Dolly Varden	Hallo Bay	48000	5200	4.7	10213	1106	-	305	300	F	H and R	6/18/90
90.6963	Yellowfin Sole	Hallo Bay	41000	9200	4.8	8542	1917	4	322	393	F	R	6/18/90

APPENDIX 1. SUBTIDAL 7 REPORT—Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.6964	Yellowfin Sole	Hallo Bay	24000	4900	1.5	16000	3267	136	320	394	F	R	6/18/90
90.6965	Yellowfin Sole	Hallo Bay	36000	7400	2.5	14400	2960	95	323	352	F	R	6/18/90
90.6966	Yellowfin Sole	Hallo Bay	49000	13000	1.4	35000	9286	121	303	320	F	R	6/18/90
90.6967	Yellowfin Sole	Hallo Bay	72000	19000	2.6	27692	7308	42	321	408	F	R	6/18/90
90.6968	Yellowfin Sole	Hallo Bay	19000	2300	1.4	13571	1643	12	375	732	F	R	6/18/90
90.6969	Yellowfin Sole	Hallo Bay	46000	10000	1.7	27059	5882	30	357	435	F	R	6/18/90
90.6970	Yellowfin Sole	Hallo Bay	65000	13000	2.8	23214	4643	9	359	610	F	R	6/18/90
90.6971	Yellowfin Sole	Hallo Bay	28000	5800	1.1	25455	5273	23	350	373	F	R	6/18/90
90.6972	Yellowfin Sole	Hallo Bay	36000	7200	2.6	13846	2769	46	364	544	F	R	6/18/90
90.6973	Yellowfin Sole	Hallo Bay	28000	3600	1.9	14737	1895	-	335	514	F	R	6/18/90
90.6975	Yellowfin Sole	Hallo Bay	34000	4900	2.3	14783	2130	-	300	294	F	R	6/18/90
90.6978	Yellowfin Sole	Hallo Bay	38000	7100	1.0	38000	7100	-	284	305	F	R	6/18/90
90.6979	Yellowfin Sole	Hallo Bay	11000	1200	1.2	9167	1000	-	276	306	F	R	6/18/90
90.6980	Yellowfin Sole	Hallo Bay	51000	8600	2.4	21250	3583	-	275	268	F	R	6/18/90
90.6981	Yellowfin Sole	Hallo Bay	26000	5200	1.2	21667	4333	-	270	244	F	R	6/18/90
90.6982	Yellowfin Sole	Hallo Bay	39000	11000	3.4	11471	3235	-	287	260	F	R	6/18/90
90.6983	Yellowfin Sole	Hallo Bay	67000	16000	1.4	47857	11429	-	342	654	F	R	6/19/90
90.6984	Yellowfin Sole	Hallo Bay	27000	6700	3.4	7941	1971	-	338	496	F	R	6/19/90
90.6985	Yellowfin Sole	Hallo Bay	27000	6100	2.1	12857	2905	-	363	709	F	R	6/19/90
90.6986	Yellowfin Sole	Hallo Bay	13000	1300	-			-	329	534	F	R	6/19/90
90.6987	Yellowfin Sole	Hallo Bay	9700	2400	2.2	4409	1091	-	309	312	F	R	6/19/90
90.6988	Yellowfin Sole	Hallo Bay	22000	4400	2.9	7586	1517	-	375	648	F	R	6/19/90
90.6989	Yellowfin Sole	Hallo Bay	56000	9100	1.7	32941	5353	-	325	441	F	R	6/19/90
90.6990	Yellowfin Sole	Hallo Bay	29000	5800	5.5	5273	1055	-	324	495	F	R	6/19/90
90.6991	Yellowfin Sole	Hallo Bay	10000	2000	2.2	4545	909	-	378	730	F	R	6/19/90
90.7003	Flathead sole	Kukak Bay	8800	1400	0.8	11000	1750	65	383	508	F		6/20/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.7004	Flathead sole	Kukak Bay	3500	450	0.8	4375	563	237	332	362	F		6/20/90
90.7005	Flathead sole	Kukak Bay	5300	1000	0.6	8833	1667	150	305	225	F		6/20/90
90.7006	Flathead sole	Kukak Bay	4900	1200	0.9	5444	1333	76	310	272	M		6/20/90
90.7007	Flathead sole	Kukak Bay	-	-	-			25	285	230	M		6/20/90
90.7008	Flathead sole	Kukak Bay	9300	860	0.9	10333	956	85	335	347	F		6/20/90
90.7009	Flathead Sole	Kukak Bay	11000	2200	0.8	13750	2750	21	304	249	F		6/20/90
90.7010	Flathead Sole	Kukak Bay	15000	1800	1.3	11538	1385	73	360	366	F		6/20/90
90.7011	Flathead Sole	Kukak Bay	13000	2400	1.5	8667	1600	27	370	441	F		6/20/90
90.7012	Flathead Sole	Kukak Bay	12000	1800	2.6	4615	692	10	302	233	F		6/20/90
90.7014	Dolly Varden	Kukak Bay	50000	5000	2.3	21739	2174	50	345	375	F	H and R	6/20/90
90.7015	Dolly Varden	Kukak Bay	35000	3900	2.1	16667	1857	51	325	288	F	H and R	6/20/90
90.7016	Dolly Varden	Kukak Bay	36000	4200	2.2	16364	1909	14	345	436	F	H and R	6/20/90
90.7018	Dolly Varden	Kukak Bay	42000	6700	5.8	7241	1155	23	409	591	F	H and R	6/20/90
90.7019	Dolly Varden	Kukak Bay	-	-	-			39	342	396	F	H and R	6/20/90
90.7020	Dolly Varden	Kukak Bay	-	-	-			32	315	282	F	H and R	6/20/90
90.7021	Dolly Varden	Kukak Bay	-	-	-			38	315	297	F	H and R	6/20/90
90.7022	Dolly Varden	Kukak Bay	30000	4900	3.3	9091	1485	33	326	330	F	H and R	6/20/90
90.7023	Dolly Varden	Kukak Bay	31000	4700	3.6	8611	1306	-	409	690	F	H and R	6/20/90
90.7024	Dolly Varden	Kukak Bay	28000	4900	3.8	7368	1289	-	315	278	F	H and R	6/20/90
90.7027	Dolly Varden	Kukak Bay	22000	3800	1.6	13750	2375	-	320	301	F	H and R	6/20/90
90.7028	Dolly Varden	Kukak Bay	26000	4500	0.7	37143	6429	-	325	335	F	H and R	6/20/90
90.7030	Dolly Varden	Kukak Bay	29000	6400	2.6	11154	2462	-	345	475	F	H and R	6/20/90
90.7032	Dolly Varden	Kukak Bay	-	-	-			26	420	972	F	H and R	6/20/90
90.7040	Dolly Varden	Kukak Bay	-	-	-			16	428	895	F	H and R	6/20/90
90.7047	Yellowfin Sole	Kukak Bay	33000	5000	1.7	19412	2941	-	260	202	M		6/20/90
90.7062	Yellowfin sole	Kukak Bay	40000	5200	1.8	22222	2889	7	367	625	F	R	6/20/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein [2]	µg PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.7063	Yellowfin sole	Kukak Bay	16000	1400	1.1	14545	1273	14	342	575	F	R	6/20/90
90.7064	Yellowfin sole	Kukak Bay	18000	3000	1.0	18000	3000	14	360	578	F	R	6/20/90
90.7065	Yellowfin sole	Kukak Bay	12000	1900	1.1	10909	1727	6	354	568	F	R	6/20/90
90.7066	Yellowfin sole	Kukak Bay	29000	4800	2.1	13810	2286	6	336	458	F	R	6/20/90
90.7067	Yellowfin sole	Kukak Bay	44000	6100	1.3	33846	4692	53	287	320	F	R	6/20/90
90.7068	Yellowfin sole	Kukak Bay	27000	3300	1.4	19286	2357	13	309	414	F	R	6/20/90
90.7069	Yellowfin Sole	Kukak Bay	-	-	-			49	304	366	F	R	6/20/90
90.7070	Yellowfin sole	Kukak Bay	35000	5400	2.9	12069	1862	60	315	308	F	R	6/20/90
90.7071	Yellowfin sole	Kukak Bay	16000	2400	1.9	8421	1263	24	306	332	F	R	6/20/90
90.7072	Yellowfin Sole	Kukak Bay	-	-	-			27	324	447	F	R	6/20/90
90.7102	Yellowfin Sole	Katmai Bay	20000	4200	1.1	18182	3818	-	272	226	M		6/21/90
90.7103	Yellowfin Sole	Katmai Bay	34000	3200	1.4	24286	2286	-	313	408	M		6/21/90
90.7114	Yellowfin Sole	Katmai Bay	34000	6100	1.1	30909	5545	-	235	163	F	R	6/21/90
90.7117	Dolly Varden	Katmai Bay	29000	3900	2.0	14500	1950	-	565	1320	M		6/21/90
90.7118	Dolly Varden	Katmai Bay	17000	3300	2.3	7391	1435	-	465	1165	F	R	6/21/90
90.7119	Dolly Varden	Katmai Bay	35000	3900	4.2	8333	929	-	445	979	M		6/21/90
90.7120	Dolly Varden	Katmai Bay	20000	3600	4.0	5000	900	-	364	588	F	R	6/21/90
90.7121	Dolly Varden	Katmai Bay	15000	3000	2.6	5769	1154	-	347	413	F	R	6/21/90
90.7123	Dolly Varden	Katmai Bay	22000	3800	4.3	5116	884	-	417	848	F	R	6/21/90
90.7124	Dolly Varden	Katmai Bay	29000	4800	3.6	8056	1333	-	370	642	F	R	6/21/90
90.7125	Dolly Varden	Katmai Bay	36000	5200	4.4	8182	1182	-	490	1263	F	R	6/21/90
90.7127	Yellowfin Sole	Katmai Bay	16000	2700	1.1	14545	2455	-	375	814	F	R	6/21/90
90.7129	Yellowfin Sole	Katmai Bay	21000	3300	0.84	25000	3929	-	395	1114	F	R	6/21/90
90.7130	Yellowfin Sole	Katmai Bay	23000	3400	1.7	13529	2000	-	344	599	F	R	6/21/90
90.7131	Yellowfin Sole	Katmai Bay	23000	2900	1.1	20909	2636	-	346	665	F	R	6/21/90
90.7134	Yellowfin Sole	Katmai Bay	28000	4400	1.1	25455	4000	-	315	360	F	R	6/21/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	μg NPH equiv[2] g bile protein	μg PHN equiv[2] g bile protein	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.7135	Yellowfin Sole	Katmai Bay	32000	4300	1.4	22857	3071	-	318	344	F	R	6/21/90
90.7136	Yellowfin Sole	Katmai Bay	56000	12000	2.3	24348	5217	-	279	377	F	R	6/21/90
90.7138	Yellowfin Sole	Kodiak Island	43000	7500	2.5	17200	3000	-	323	419	F	R	6/22/90
90.7139	Yellowfin Sole	Kodiak Island	42000	5200	1.0	42000	5200	-	298	336	F	R	6/22/90
90.7145	Dolly Varden	Kodiak Island	37000	6000	3.8	9737	1579	-	446	1067	F	R	6/23/90
90.7146	Dolly Varden	Kodiak Island	42000	6400	3.7	11351	1730	-	443	870	F	R	6/23/90
90.7147	Dolly Varden	Kodiak Island	20000	3900	6.0	3333	650	-	300	269	F	R	6/23/90
90.7149	Dolly Varden	Kodiak Island	27000	5000	3.4	7941	1471	-	341	413	F	R	6/23/90
90.7150	Dolly Varden	Kodiak Island	43000	5900	4.5	9556	1311	-	423	748	F	R	6/23/90
90.7152	Dolly Varden	Kodiak Island	29000	4500	3.7	7838	1216	-	329	355	F	R	6/23/90
90.7153	Dolly Varden	Kodiak Island	50000	8100	2.5	20000	3240	-	372	432	F	R	6/23/90
90.7154	Dolly Varden	Kodiak Island	31000	5400	5.7	5439	947	-	342	429	F	R	6/23/90
90.7161	Dolly Varden	Kodiak Island	48000	7600	2.4	20000	3167	-	435	693	F	R	6/23/90
90.7164	Dolly Varden	Kodiak Island	53000	7600	3.0	17667	2533	-	407	635	F	R	6/23/90
90.7184	Yellowfin Sole	Kodiak Island	51000	7200	3.2	15938	2250	-	323	437	F	R	6/23/90
90.7185	Yellowfin Sole	Kodiak Island	42000	4800	1.2	35000	4000	-	322	426	F	R	6/23/90
90.7186	Yellowfin Sole	Kodiak Island	29000	4100	1.4	20714	2929	-	316	396	F	R	6/23/90
90.7187	Yellowfin Sole	Kodiak Island	18000	3200	2.0	9000	1600	-	270	287	F	R	6/23/90
90.7188	Yellowfin Sole	Kodiak Island	68000	7800	0.70	97143	11143	-	306	362	F	R	6/23/90
90.7189	Yellowfin Sole	Kodiak Island	25000	3900	2.6	9615	1500	-	300	332	F	R	6/23/90
90.7191	Yellowfin Sole	Kodiak Island	33000	4200	5.0	6600	840	-	312	411	F	R	6/23/90
90.7192	Yellowfin Sole	Kodiak Island	46000	6600	1.7	27059	3882	-	308	366	F	R	6/23/90
90.7193	Yellowfin Sole	Kodiak Island	34000	5900	2.7	12593	2185	-	282	292	F	R	6/23/90
90.7194	Yellowfin Sole	Kodiak Island	36000	5800	1.6	22500	3625	-	258	219	F	R	6/23/90
90.7202	Dolly Varden	MacLeod Harbor	-	-	-			757	283	238	F	R	7/16/90
90.7203	Dolly Varden	MacLeod Harbor	-	-	-			29	356	518	F	R	7/16/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv[2] / g bile protein	µg PHN equiv[2] / g bile protein	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
90.7204	Dolly Varden	MacLeod Harbor	-	-	-			29	362	530	F	R	7/16/90
90.7205	Dolly Varden	MacLeod Harbor	-	-	-			24	381	645	F	R	7/16/90
90.7206	Dolly Varden	MacLeod Harbor	13000	2100	2.1	6190	1000	45	277	310	F	R	7/16/90
90.7207	Dolly Varden	MacLeod Harbor	34000	5700	3.6	9444	1583	45	338	360	F	R	7/16/90
90.7208	Dolly Varden	MacLeod Harbor	-	-	-			50	280	310	F	R	7/16/90
90.7209	Dolly Varden	MacLeod Harbor	-	-	-			52	310	380	F	R	7/16/90
90.7210	Dolly Varden	MacLeod Harbor	-	-	-			16	282	261	F	R	7/16/90
90.7211	Dolly Varden	MacLeod Harbor	-	-	-			1	312	390	F	R	7/16/90
90.7212	Dolly Varden	MacLeod Harbor	25000	3600	4.2	5952	857	8	344	470	F	R	7/16/90
90.7213	Dolly Varden	MacLeod Harbor	23000	5300	7.9	2911	671	3	349	464	F	R	7/16/90
90.7215	Dolly Varden	MacLeod Harbor	35000	5200	5.9	5932	881	1	290	301	F	R	7/16/90
90.7216	Dolly Varden	MacLeod Harbor	24000	4700	6.4	3750	734	3	300	320	F	R	7/16/90
90.7217	Dolly Varden	MacLeod Harbor	27000	2900	5.0	5400	580	8	290	323	F	R	7/16/90
90.7218	Dolly Varden	MacLeod Harbor	18000	2500	3.9	4615	641	17	293	295	F	R	7/16/90
90.7219	Dolly Varden	MacLeod Harbor	28000	3800	-			30	293	310	F	R	7/16/90
90.7220	Dolly Varden	Moose Lips Bay	-	-	-			18	297	276	F	R	7/16/90
90.7221	Dolly Varden	Moose Lips Bay	-	-	-			13	403	825	F	R	7/16/90
90.7222	Dolly Varden	Moose Lips Bay	-	-	-			3	375	672	F	R	7/16/90
90.7223	Dolly Varden	Moose Lips Bay	-	-	-			16	412	830	F	R	7/16/90
90.7224	Dolly Varden	Moose Lips Bay	30000	4400	4.6	6522	957	54	302	311	F	R	7/16/90
90.7225	Dolly Varden	Moose Lips Bay	25000	3100	3.5	7143	886	43	308	312	F	R	7/16/90
90.7226	Dolly Varden	Moose Lips Bay	-	-	-			27	398	790	F	R	7/16/90
90.7227	Dolly Varden	Moose Lips Bay	15000	2300	7.2	2083	319	62	318	340	F	R	7/16/90
90.7228	Dolly Varden	Moose Lips Bay	20000	2800	8.4	2381	333	-	379	720	F	R	7/16/90
90.7229	Dolly Varden	Moose Lips Bay	-	-	-			-	299	315	F	R	7/16/90
90.7230	Dolly Varden	Moose Lips Bay	36000	5800	9.1	3956	637	-	375	643	F	R	7/16/90

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90.7231	Dolly Varden	Moose Lips Bay	37000	5800	6.6	5606	879	66	374	675	F	R	7/16/90
90.7232	Dolly Varden	Moose Lips Bay	51000	10000	10.5	4857	952	61	343	515	F	R	7/16/90
90.7233	Dolly Varden	Moose Lips Bay	29000	4700	5.4	5370	870	33	392	710	F	R	7/16/90
90.7234	Dolly Varden	Moose Lips Bay	51000	6800	8.1	6296	840	22	392	725	F	R	7/16/90
90.7235	Dolly Varden	Snug Harbor	-	-	-			79	290	245	F	R	7/18/90
90.7236	Dolly Varden	Snug Harbor	88000	15000	8.8	10000	1705	43	344	435	F	R	7/18/90
90.7237	Dolly Varden	Drier Bay	75000	11000	7.9	9494	1392	47	348	592	F		7/20/90
90.7238	Dolly Varden	Sleepy Bay	70000	14000	3.8	18421	3684	28	355	530	F	R	7/21/90
90.7239	Dolly Varden	Sleepy Bay	66000	10000	4.3	15349	2326	23	312	325	F	R	7/21/90
90.7240	Dolly Varden	Sleepy Bay	87000	14000	13.6	6397	1029	21	308	322	F	R	7/21/90
90.7241	Dolly Varden	Sleepy Bay	220000	27000	3.2	68750	8438	17	348	436	F	R	7/21/90
90.7242	Dolly Varden	Sleepy Bay	-	-	-			23	307	336	F	R	7/21/90
90.7243	Dolly Varden	Sleepy Bay	48000	9300	1.0	48000	9300	12	287	270	F	R	7/21/90
91.4000	Pollock	Trinity Islands	42000	8300	5.1	8235	1627	-	490	1061	F	R	2/12/91
91.4001	Pollock	Trinity Islands	62000	8600	6.7	9254	1284	-	520	1255	F	R	2/12/91
91.4002	Pollock	Trinity Islands	46000	7800	5.1	9020	1529	-	540	1586	F	R	2/12/91
91.4003	Pollock	Trinity Islands	38000	7200	6.2	6129	1161	-	550	1347	F	R	2/12/91
91.4004	Pollock	Trinity Islands	54000	12000	9.4	5745	1277	-	560	1543	F	R	2/12/91
91.4005	Pollock	Trinity Islands	55000	8300	5.8	9483	1431	-	540	1318	F	R	2/12/91
91.4006	Pollock	Trinity Islands	70000	10000	19.3	3627	518	-	570	1504	F	R	2/12/91
91.4007	Pollock	Trinity Islands	57000	8800	6.3	9048	1397	-	560	1670	F	R	2/12/91
91.4008	Pollock	Trinity Islands	61000	9500	7.5	8133	1267	-	550	1497	F	R	2/12/91
91.4009	Pollock	Trinity Islands	65000	12000	7.8	8333	1538	-	490	1003	F	R	2/12/91
91.4016	Pollock	Eastend Transect	68000	11000	8.2	8293	1341	-	520	1184	F	R	2/28/91
91.4017	Pollock	Eastend Transect	45000	8300	4.8	9375	1729	-	430	536	F	R	2/28/91
91.4018	Pollock	Eastend Transect	18000	2900	2.0	9000	1450	-	470	729	F	R	2/28/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein [2]	µg PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.4019	Pollock	Eastend Transect	70000	11000	7.1	9859	1549	-	450	707	F	R	2/28/91
91.4020	Pollock	Eastend Transect	78000	10000	7.5	10400	1333	-	470	697	F	R	2/28/91
91.4021	Pollock	Eastend Transect	110000	19000	9.6	11458	1979	-	500	858	F	R	2/28/91
91.4022	Pollock	Eastend Transect	73000	13000	8.5	8588	1529	-	530	1145	F	R	2/28/91
91.4023	Pollock	Eastend Transect	56000	9900	5.7	9825	1737	-	490	954	F	R	2/28/91
91.4024	Pollock	Eastend Transect	85000	13000	8.2	10366	1585	-	480	698	F	R	2/28/91
91.4025	Pollock	Eastend Transect	65000	9900	6.2	10484	1597	-	510	980	F	R	2/28/91
91.4027	Pollock	Eastend Transect	35000	6300	3.5	10000	1800	-	470	765	F	R	2/28/91
91.4028	Pollock	Eastend Transect	88000	9300	8.8	10000	1057	-	420	477	F	R	2/28/91
91.4029	Pollock	Eastend Transect	130000	15000	12.3	10569	1220	-	450	587	F	R	2/28/91
91.4031	Pollock	Bogoslof	65000	11000	9.2	7065	1196	-	510	1176	F	R	2/25/91
91.4032	Pollock	Bogoslof	76000	12000	8.8	8636	1364	-	510	983	F	R	2/25/91
91.4033	Pollock	Bogoslof	68000	16000	11.2	6071	1429	-	500	1084	F	R	2/25/91
91.4035	Pollock	Bogoslof	67000	13000	8.5	7882	1529	-	540	1337	F	R	2/25/91
91.4038	Pollock	Bogoslof	53000	9700	7.4	7162	1311	-	520	1097	F	R	2/25/91
91.4040	Pollock	Bogoslof	75000	14000	13.0	5769	1077	-	500	910	F	R	2/25/91
91.4041	Pollock	Bogoslof	71000	12000	9.4	7553	1277	-	530	1137	F	R	2/25/91
91.4042	Pollock	Bogoslof	45000	7400	5.3	8491	1396	-	500	1055	F	R	2/25/91
91.4043	Pollock	Bogoslof	61000	12000	7.5	8133	1600	-	500	1052	F	R	2/25/91
91.4044	Pollock	Bogoslof	70000	13000	9.6	7292	1354	-	540	1460	F	R	2/25/91
91.4045	Pollock	Sanak Island	88000	16000	13.5	6519	1185	-	520	1246	F	R	3/16/91
91.4046	Pollock	Sanak Island	65000	12000	13.2	4924	909	-	570	1414	F	R	3/16/91
91.4047	Pollock	Sanak Island	76000	16000	12.4	6129	1290	-	550	1420	F	R	3/16/91
91.4048	Pollock	Sanak Island	27000	5700	3.9	6923	1462	-	530	1287	F	R	3/16/91
91.4049	Pollock	Sanak Island	71000	13000	7.7	9221	1688	-	550	1257	F	R	3/16/91
91.4050	Pollock	Sanak Island	120000	27000	11.2	10714	2411	-	510	903	F	R	3/16/91

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91.4052	Pollock	Sanak Island	69000	15000	9.7	7113	1546	-	550	1670	F	R	3/16/91
91.4053	Pollock	Sanak Island	22000	4100	3.4	6471	1206	-	560	1556	F	R	3/16/91
91.4054	Pollock	Sanak Island	68000	12000	11.6	5862	1034	-	570	1434	F	R	3/16/91
91.4055	Pollock	Sanak Island	68000	16000	11.2	6071	1429	-	560	1345	F	R	3/16/91
91.4060	Pollock	Sutwik Island	70000	6700	5.4	12963	1241	-	570	1327	F	R	3/20/91
91.4061	Pollock	Sutwik Island	57000	7100	15.5	3677	458	-	610	1376	F	R	3/20/91
91.4063	Pollock	Sutwik Island	46000	5600	5.0	9200	1120	-	540	1019	F	R	3/20/91
91.4064	Pollock	Sutwik Island	66000	13000	3.8	17368	3421	-	560	1521	F	R	3/20/91
91.4065	Pollock	Sutwik Island	59000	10000	9.6	6146	1042	-	590	1512	F	R	3/20/91
91.4067	Pollock	Sutwik Island	18000	2400	1.1	16364	2182	-	580	1563	F	R	3/20/91
91.4068	Pollock	Sutwik Island	50000	5200	7.3	6849	712	-	530	1171	F	R	3/20/91
91.4069	Pollock	Sutwik Island	50000	6200	8.6	5814	721	-	640	1593	F	R	3/20/91
91.4070	Pollock	Sutwik Island	38000	4900	4.0	9500	1225	-	540	1125	F	R	3/20/91
91.4071	Pollock	Sutwik Island	35000	4100	4.5	7778	911	-	640	2482	F	R	3/20/91
91.4074	Pollock	Sutwik Island	81000	13000	9.6	8438	1354	-	600	1726	F	R	3/20/91
91.4075	Pollock	Portage Bay	69000	9400	7.4	9324	1270	-	520	1193	F	R	3/20/91
91.4077	Pollock	Portage Bay	51000	7000	5.1	10000	1373	-	610	1800	F	R	3/20/91
91.4079	Pollock	Portage Bay	92000	10000	8.8	10455	1136	-	550	1385	F	R	3/20/91
91.4080	Pollock	Portage Bay	73000	10000	8.2	8902	1220	-	510	950	F	R	3/20/91
91.4082	Pollock	Portage Bay	65000	10000	6.6	9848	1515	-	560	1444	F	R	3/20/91
91.4084	Pollock	Portage Bay	35000	4600	3.3	10606	1394	-	580	1543	F	R	3/20/91
91.4085	Pollock	Portage Bay	75000	9100	12.3	6098	740	-	510	948	F	R	3/20/91
91.4086	Pollock	Portage Bay	76000	12000	5.7	13333	2105	-	610	1727	F	R	3/20/91
91.4087	Pollock	Portage Bay	71000	8700	8.4	8452	1036	-	580	1982	F	R	3/20/91
91.4088	Pollock	Portage Bay	48000	6600	12.3	3902	537	-	620	1937	F	R	3/20/91
91.4090	Pollock	Cape Ikolik	44000	5600	5.8	7586	966	-	510	1125	F	R	3/21/91

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91.4091	Pollock	Cape Ikolik	17000	5500	5.3	3208	1038	-	620	2140	F	R	3/21/91
91.4092	Pollock	Cape Ikolik	47000	7000	7.6	6184	921	-	490	906	F	R	3/21/91
91.4093	Pollock	Cape Ikolik	66000	9800	8.2	8049	1195	-	500	963	F	R	3/21/91
91.4094	Pollock	Cape Ikolik	91000	13000	9.5	9579	1368	-	550	1363	F	R	3/21/91
91.4095	Pollock	Cape Ikolik	69000	17000	9.3	7419	1828	-	590	1770	F	R	3/21/91
91.4096	Pollock	Cape Ikolik	110000	13000	12.7	8661	1024	-	520	1157	F	R	3/21/91
91.4097	Pollock	Cape Ikolik	33000	4600	2.9	11379	1586	-	490	889	F	R	3/21/91
91.4098	Pollock	Cape Ikolik	57000	7600	6.6	8636	1152	-	520	1116	F	R	3/21/91
91.4099	Pollock	Cape Ikolik	100000	17000	10.5	9524	1619	-	550	1314	F	R	3/21/91
91.4101	Pollock	Cape Ikolik	96000	20000	21.7	4424	922	-	530	1328	F	R	3/21/91
91.4105	Pollock	Sturgeon Head	110000	20000	14.2	7746	1408	-	410	510	F	R	3/22/91
91.4106	Pollock	Sturgeon Head	53000	7700	6.8	7794	1132	-	490	891	F	R	3/22/91
91.4107	Pollock	Sturgeon Head	63000	8500	9.5	6632	895	-	480	688	F	R	3/22/91
91.4109	Pollock	Sturgeon Head	54000	7200	8.5	6353	847	-	510	1076	F	R	3/22/91
91.4110	Pollock	Sturgeon Head	82000	12000	8.1	10123	1481	-	530	1416	F	R	3/22/91
91.4111	Pollock	Sturgeon Head	89000	12000	10.9	8165	1101	-	510	1156	F	R	3/22/91
91.4112	Pollock	Sturgeon Head	77000	9500	11.3	6814	841	-	520	1143	F	R	3/22/91
91.4116	Pollock	Sturgeon Head	79000	13000	9.2	8587	1413	-	530	1351	F	R	3/22/91
91.4117	Pollock	Sturgeon Head	82000	10000	10.9	7523	917	-	540	1418	F	R	3/22/91
91.4118	Pollock	Sturgeon Head	86000	13000	15.3	5621	850	-	500	1010	F	R	3/22/91
91.4119	Pollock	Sturgeon Head	76000	12000	7.2	10556	1667	-	480	981	F	R	3/22/91
91.4120	Pollock	Katmai Bay	59000	9700	6.2	9516	1565	-	560	1401	F	R	3/23/91
91.4121	Pollock	Katmai Bay	56000	7100	9.6	5833	740	-	470	738	F	R	3/23/91
91.4122	Pollock	Katmai Bay	69000	11000	9.6	7188	1146	-	570	1610	F	R	3/23/91
91.4124	Pollock	Katmai Bay	66000	13000	9.5	6947	1368	-	530	1303	M	R	3/23/91
91.4125	Pollock	Katmai Bay	99000	15000	18.2	5440	824	-	530	1288	F	R	3/23/91

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CK-HBT-039	Halibut	Albatross Bank	12000	1400	2.7	4444	519	-	410	800	-		4/10/90
CK-HBT-040	Halibut	Albatross Bank	22000	2000	5.7	3860	351	-	-	-	-		4/10/90
CK-HBT-042	Halibut	Albatross Bank	14000	870	2.3	6087	378	-	390	600	-		4/10/90
CK-HBT-043	Halibut	Albatross Bank	9100	68	1.6	5688	43	-	-	-	-		4/10/90
CK-HBT-044	Halibut	Cape Ikolik	10000	830	0.7	14286	1186	-	600	2600	M		4/11/90
CK-HBT-045	Halibut	Cape Ikolik	16000	1400	2.0	8000	700	-	470	1100	M		4/11/90
CK-HBT-047	Halibut	Cape Ikolik	4500	290	0.7	6429	414	-	690	3900	M		4/11/90
CK-HBT-048	Halibut	Cape Ikolik	18000	3400	1.9	9474	1789	-	540	1800	M		4/11/90
CK-HBT-050	Halibut	Cape Ikolik	46000	6500	20.1	2289	323	-	580	2400	M		4/11/90
CK-HBT-051	Halibut	Cape Ikolik	44000	4900	5.3	8302	925	-	600	2400	M		4/11/90
CK-HBT-053	Halibut	Cape Ikolik	31000	4100	3.4	9118	1206	-	660	3400	M		4/11/90
CK-HBT-054	Halibut	Cape Ikolik	32000	3500	5.9	5424	593	-	630	2800	M		4/11/90
CK-HBT-055	Halibut	Cape Ikolik	46000	5400	4.7	9787	1149	-	540	1800	M		4/11/90
CK-HBT-056	Halibut	Cape Ikolik	12000	430	1.6	7500	269	-	620	2800	M		4/11/90
CS-HBT-001	Halibut	Portlock Bank	5500	820	2.1	2619	390	-	450	1000	M		4/8/90
CS-HBT-002	Halibut	Portlock Bank	6500	460	7.5	867	61	-	550	1700	M		4/8/90
CS-HBT-003	Halibut	Portlock Bank	11000	1200	3.9	2821	308	-	600	2300	M		4/8/90
CS-SAB-00	Sablefish	E of Kodiak Island	13000	1500	3.1	4194	484	-	610	2100	F		4/9/90
CS-SAB-00	Sablefish	E of Kodiak Island	11000	1600	1.9	5789	842	-	530	1200	F		4/9/90
CS-SAB-00	Sablefish	E of Kodiak Island	9400	430	3.7	2541	116	-	510	1100	F		4/9/90
CS-SAB-00	Sablefish	E of Kodiak Island	5800	860	2.2	2636	391	-	610	2200	M		4/9/90
CS-SAB-00	Sablefish	E of Kodiak Island	6200	460	3.8	1632	121	-	510	1400	M		4/10/90
CS-SAB-00	Sablefish	E of Kodiak Island	5900	1000	3.9	1513	256	-	520	1400	F		4/10/90
CS-SAB-00	Sablefish	E of Kodiak Island	8200	490	3.8	2158	129	-	580	1500	F		4/10/90
CS-SAB-00	Sablefish	E of Kodiak Island	4600	210	2.3	2000	91	-	630	2400	F		4/10/90
CS-SAB-00	Sablefish	E of Kodiak Island	10000	2100	2.2	4545	955	-	610	2300	M		4/10/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5401	Flathead sole	Snug Harbor	42000	7700	2.0	21000	3850	324	267	165	F		5/30/91
91.5402	Yellowfin Sole	Snug Harbor	-	-	-			489	235	152	M		5/30/91
91.5403	Yellowfin Sole	Snug Harbor	-	-	-			233	276	260	M		5/30/91
91.5404	Yellowfin Sole	Snug Harbor	-	-	-			201	352	602	M		5/30/91
91.5405	Yellowfin Sole	Snug Harbor	-	-	-			169	251	219	M		5/30/91
91.5406	Yellowfin Sole	Snug Harbor	-	-	-			178	335	499	M		5/30/91
91.5407	Yellowfin Sole	Snug Harbor	-	-	-			420	257	212	M		5/30/91
91.5408	Yellowfin Sole	Snug Harbor	-	-	-			177	283	274	M		5/30/91
91.5409	Yellowfin Sole	Snug Harbor	-	-	-			85	333	453	M		5/30/91
91.5410	Yellowfin Sole	Snug Harbor	-	-	-			105	353	502	M		5/30/91
91.5411	Yellowfin Sole	Snug Harbor	-	-	-			354	315	381	M		5/30/91
91.5412	Yellowfin Sole	Snug Harbor	-	-	-			211	285	314	M		5/30/91
91.5413	Yellowfin Sole	Snug Harbor	-	-	-			822	284	278	M		5/30/91
91.5414	Yellowfin Sole	Snug Harbor	-	-	-			500	346	592	M		5/30/91
91.5415	Yellowfin Sole	Snug Harbor	-	-	-			205	272	272	M		5/30/91
91.5416	Yellowfin Sole	Snug Harbor	-	-	-			81	380	828	M		5/30/91
91.5417	Yellowfin sole	Snug Harbor	19000	2700	1.1	17273	2455	-	288	288	F	R	5/30/91
91.5418	Yellowfin sole	Snug Harbor	15000	2100	1.3	11538	1615	63	322	455	F	R	5/30/91
91.5419	Yellowfin sole	Snug Harbor	19000	2300	4.2	4524	548	26	373	736	F	R	5/30/91
91.5420	Yellowfin Sole	Snug Harbor	-	-	-			11	371	702	F	R	5/30/91
91.5421	Yellowfin sole	Snug Harbor	19000	1900	4.9	3878	388	30	379	805	F	R	5/30/91
91.5423	Yellowfin Sole	Snug Harbor	-	-	-			28	382	724	F	R	5/30/91
91.5424	Yellowfin sole	Snug Harbor	27000	4100	1.5	18000	2733	-	268	218	F	R	5/30/91
91.5425	Yellowfin Sole	Snug Harbor	-	-	-			31	385	767	F	R	5/30/91
91.5426	Yellowfin sole	Snug Harbor	27000	4300	1.5	18000	2867	-	283	301	F	R	5/30/91
91.5427	Yellowfin sole	Snug Harbor	28000	3900	1.5	18667	2600	92	322	404	F	R	5/30/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.4126	Pollock	Katmai Bay	72000	12000	13.8	5217	870	-	510	912	M	R	3/23/91
91.4127	Pollock	Katmai Bay	110000	25000	19.1	5759	1309	-	550	1310	F	R	3/23/91
91.4128	Pollock	Katmai Bay	70000	11000	13.2	5303	833	-	570	1399	M	R	3/23/91
91.4129	Pollock	Katmai Bay	55000	9700	8.4	6548	1155	-	480	950	M	R	3/23/91
91.4130	Pollock	Katmai Bay	90000	13000	9.9	9091	1313	-	510	1112	F	R	3/23/91
91.4139	Pollock	Uganik Island	71000	9000	7.3	9726	1233	-	370	-	M	R	3/23/91
91.4141	Pollock	Uganik Island	93000	13000	10.1	9208	1287	-	410	366	F	R	3/23/91
91.4143	Pollock	Uganik Island	19000	2700	1.7	11176	1588	-	380	385	F	R	3/23/91
91.4145	Pollock	Uganik Island	61000	9400	7.9	7722	1190	-	370	326	F	R	3/23/91
91.4147	Pollock	Uganik Island	39000	5200	4.9	7959	1061	-	350	299	F	R	3/23/91
91.4150	Pollock	Kuliak Bay	62000	8700	9.0	6889	967	-	530	1076	F	R	3/24/91
91.4152	Pollock	Kuliak Bay	120000	15000	26.6	4511	564	-	480	965	F	R	3/24/91
91.4157	Pollock	Kuliak Bay	48000	6900	6.0	8000	1150	-	520	1287	F	R	3/24/91
91.4160	Pollock	Kuliak Bay	100000	12000	12.7	7874	945	-	490	798	F	R	3/24/91
91.4166	Pollock	Uganik Island	12000	2500	3.9	3077	641	-	560	1040	F	R	3/24/91
91.4167	Pollock	Uganik Island	50000	6400	8.9	5618	719	-	470	838	F	R	3/24/91
91.4167	Pollock	Uganik Island	52000	6600	8.9	5843	742	-	470	838	F	R	3/24/91
91.4168	Pollock	Uganik Island	58000	7300	7.0	8286	1043	-	400	448	F	R	3/24/91
91.4174	Pollock	Uganik Island	73000	9400	11.8	6186	797	-	420	557	F	R	3/24/91
91.4180	Pollock	Kuliak Bay	91000	15000	19.7	4619	761	-	490	1209	F	R	3/25/91
91.4181	Pollock	Kuliak Bay	61000	17000	6.6	9242	2576	-	530	1064	F	R	3/25/91
91.4182	Pollock	Kuliak Bay	77000	11000	10.9	7064	1009	-	490	991	F	R	3/25/91
91.4187	Pollock	Kuliak Bay	54000	8800	7.6	7105	1158	-	480	901	F	R	3/25/91
91.4188	Pollock	Kuliak Bay	69000	9600	11.6	5948	828	-	500	1080	F	R	3/25/91
91.4201	Pollock	Kuliak Bay	93000	13000	10.7	8692	1215	-	430	992	F	R	3/25/91
91.4207	Pollock	Kuliak Bay	80000	12000	11.1	7207	1081	-	530	1142	F	R	3/25/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.4209	Pollock	Kuliak Bay	100000	17000	8.1	12346	2099	-	460	752	F	R	3/25/91
91.4401	Pollock	Port Gravina	51000	8100	4.4	11591	1841	-	650	2750	F	R	3/17/91
91.4402	Pollock	Port Gravina	76000	12000	4.8	15833	2500	-	500	1630	F	R	3/17/91
91.4403	Pollock	Port Gravina	110000	20000	7.5	14667	2667	-	630	2150	F	R	3/17/91
91.4404	Pollock	Port Gravina	52000	9300	3.9	13333	2385	-	640	2105	F	R	3/17/91
91.4405	Pollock	Port Gravina	72000	6100	8.5	8471	718	-	510	1160	F	R	3/17/91
91.4406	Pollock	Port Gravina	60000	11000	3.5	17143	3143	-	590	1760	F	R	3/17/91
91.4407	Pollock	Port Gravina	70000	9600	6.5	10769	1477	-	620	2115	F	R	3/17/91
91.4408	Pollock	Port Gravina	51000	7600	4.8	10625	1583	-	590	2010	F	R	3/17/91
91.4409	Pollock	Port Gravina	30000	5900	2.1	14286	2810	-	630	2273	F	R	3/17/91
91.4410	Pollock	Port Gravina	78000	17000	6.8	11471	2500	-	750	3605	F	R	3/17/91
91.4411	Pollock	Port Gravina	34000	5800	2.7	12593	2148	-	570	1552	F	R	3/17/91
91.4412	Pollock	Port Gravina	100000	20000	7.7	12987	2597	-	540	1425	F	R	3/17/91
91.4413	Pollock	Port Gravina	44000	6900	4.1	10732	1683	-	580	1723	F	R	3/17/91
91.4414	Pollock	Port Gravina	45000	7500	2.6	17308	2885	-	610	1935	F	R	3/17/91
91.4415	Pollock	Port Gravina	45000	9500	3.0	15000	3167	-	670	3004	F	R	3/17/91
91.4416	Pollock	Port Fidalgo	35000	6600	2.9	12069	2276	-	650	2540	F	R	3/18/91
91.4417	Pollock	Port Fidalgo	27000	8100	2.7	10000	3000	-	760	3113	F	R	3/18/91
91.4418	Pollock	Port Fidalgo	55000	8400	8.4	6548	1000	-	620	1960	F	R	3/18/91
91.4419	Pollock	Port Fidalgo	43000	7200	2.9	14828	2483	-	560	1290	F	R	3/18/91
91.4420	Pollock	Port Fidalgo	52000	9400	3.6	14444	2611	-	600	1529	F	R	3/18/91
91.4421	Pollock	Port Fidalgo	26000	3800	3.2	8125	1188	-	590	1520	F	R	3/18/91
91.4422	Pollock	Port Fidalgo	84000	13000	5.1	16471	2549	-	560	1440	F	R	3/18/91
91.4423	Pollock	Port Fidalgo	62000	10000	3.5	17714	2857	-	490	754	F	R	3/18/91
91.4424	Pollock	Port Fidalgo	52000	8000	4.6	11304	1739	-	520	1085	F	R	3/18/91
91.4425	Pollock	Port Fidalgo	31000	4900	5.0	6200	980	-	500	1059	F	R	3/18/91

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91.4426	Pollock	Bay of Isles	87000	14000	7.6	11447	1842	-	610	2035	F	R	3/19/91
91.4427	Pollock	Bay of Isles	110000	17000	8.9	12360	1910	-	620	2180	F	R	3/19/91
91.4428	Pollock	Bay of Isles	100000	17000	8.7	11494	1954	-	460	775	F	R	3/19/91
91.4429	Pollock	Bay of Isles	52000	8800	2.7	19259	3259	-	450	704	F	R	3/19/91
91.4430	Pollock	Bay of Isles	45000	7300	5.5	8182	1327	-	550	1114	F	R	3/19/91
91.4431	Pollock	Bay of Isles	110000	17000	3.9	28205	4359	-	510	1059	F	R	3/19/91
91.4433	Pollock	Hogan Bay	77000	9900	4.3	17907	2302	-	500	1014	F	R	3/21/91
91.4434	Pollock	Hogan Bay	58000	14000	6.7	8657	2090	-	620	1428	F	R	3/21/91
91.4435	Pollock	Hogan Bay	67000	11000	3.7	18108	2973	-	610	1745	F	R	3/21/91
91.4437	Pollock	Hogan Bay	190000	29000	11.5	16522	2522	-	490	755	F	R	3/21/91
91.4438	Pollock	Hogan Bay	74000	11000	8.9	8315	1236	-	530	1004	F	R	3/21/91
91.4439	Pollock	Hogan Bay	41000	6600	3.2	12813	2063	-	510	1150	F	R	3/21/91
91.4440	Pollock	Hogan Bay	94000	19000	18.2	5165	1044	-	650	1802	F	R	3/21/91
91.4441	Pollock	Hogan Bay	31000	5000	2.9	10690	1724	-	540	1172	F	R	3/21/91
91.4442	Pollock	Hogan Bay	78000	13000	10.4	7500	1250	-	520	1066	F	R	3/21/91
91.4443	Pollock	Hogan Bay	85000	11000	6.3	13492	1746	-	500	1021	F	R	3/21/91
91.4444	Pollock	Hogan Bay	87000	14000	10.7	8131	1308	-	610	1166	F	R	3/21/91
91.4445	Pollock	Hogan Bay	74000	13000	2.6	28462	5000	-	600	2165	F	R	3/21/91
91.4446	Pollock	Hogan Bay	56000	9500	3.4	16471	2794	-	540	1137	F	R	3/21/91
91.4447	Pollock	Hogan Bay	79000	11000	6.6	11970	1667	-	540	1273	F	R	3/21/91
91.4448	Pollock	Point Bazil	65000	10000	3.9	16667	2564	-	680	2455	F	R	3/22/91
91.4449	Pollock	Point Bazil	77000	12000	10.0	7700	1200	-	590	2013	F	R	3/22/91
91.4450	Pollock	Point Bazil	120000	14000	5.8	20690	2414	-	700	1960	F	R	3/22/91
91.4451	Pollock	Point Bazil	85000	12000	14.4	5903	833	-	640	1302	F	R	3/22/91
91.4452	Pollock	Point Bazil	150000	23000	24.0	6250	958	-	670	2350	F	R	3/22/91
91.4453	Pollock	Point Bazil	95000	19000	10.1	9406	1881	-	560	1125	F	R	3/22/91

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91.4454	Pollock	Point Bazil	100000	16000	8.9	11236	1798	-	620	1392	F	R	3/22/91
91.4455	Pollock	Point Bazil	36000	5400	2.8	12857	1929	-	570	1165	F	R	3/22/91
91.4456	Pollock	Point Bazil	86000	16000	6.5	13231	2462	-	730	2663	F	R	3/22/91
91.4456	Pollock	Point Bazil	80000	15000	6.5	12308	2308	-	730	2663	F	R	3/22/91
91.4459	Pollock	Point Bazil	76000	11000	11.6	6552	948	-	640	1606	F	R	3/22/91
91.4460	Pollock	Point Bazil	87000	12000	12.1	7190	992	-	590	1296	F	R	3/22/91
91.4461	Pollock	Point Bazil	70000	11000	6.5	10769	1692	-	550	1123	F	R	3/22/91
91.4462	Pollock	Point Bazil	120000	17000	12.9	9302	1318	-	600	1296	F	R	3/22/91
91.4465	Pollock	Mummy Bay	100000	15000	12.3	8130	1220	-	460	920	F	R	3/24/91
91.4466	Pollock	Mummy Bay	70000	13000	10.5	6667	1238	-	500	895	F	R	3/24/91
91.4467	Pollock	Mummy Bay	74000	14000	8.2	9024	1707	-	540	986	F	R	3/24/91
91.4468	Pollock	Mummy Bay	86000	14000	12.2	7049	1148	-	620	1982	F	R	3/24/91
91.4469	Pollock	Mummy Bay	46000	7900	6.8	6765	1162	-	590	1196	F	R	3/24/91
91.4470	Pollock	Mummy Bay	110000	15000	10.7	10280	1402	-	500	825	F	R	3/24/91
91.4471	Pollock	Mummy Bay	150000	23000	11.1	13514	2072	-	530	938	F	R	3/24/91
91.4472	Pollock	Mummy Bay	91000	13000	15.8	5759	823	-	560	1216	F	R	3/24/91
91.4473	Pollock	Mummy Bay	110000	17000	14.0	7857	1214	-	540	1064	F	R	3/24/91
91.4474	Pollock	Mummy Bay	72000	11000	12.5	5760	880	-	630	1386	F	R	3/24/91
91.4475	Pollock	Mummy Bay	75000	12000	9.2	8152	1304	-	550	1174	F	R	3/24/91
91.4476	Pollock	Mummy Bay	58000	8800	7.9	7342	1114	-	540	1084	F	R	3/24/91
91.4477	Pollock	Mummy Bay	70000	9000	13.0	5385	692	-	540	984	F	R	3/24/91
91.4478	Pollock	Bay of Isles	59000	9400	13.7	4307	686	-	560	1105	F	R	3/24/91
91.4479	Pollock	Bay of Isles	120000	16000	6.1	19672	2623	-	600	2005	F	R	3/24/91
91.4480	Pollock	Naked Island -	76000	16000	8.6	8837	1860	-	500	775	F	R	3/25/91
91.4481	Pollock	Naked Island -	69000	9200	14.6	4726	630	-	510	815	F	R	3/25/91
91.4482	Pollock	Naked Island -	73000	14000	6.4	11406	2188	-	520	771	F	R	3/25/91

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91.4483	Pollock	Naked Island -	34000	7100	9.2	3696	772	-	500	803	F	R	3/25/91
91.4484	Pollock	Naked Island -	53000	8500	17.4	3046	489	-	660	2106	F	R	3/25/91
91.4485	Pollock	Naked Island -	110000	16000	10.9	10092	1468	-	620	1330	F	R	3/26/91
91.4486	Pollock	Naked Island -	120000	17000	23.5	5106	723	-	490	725	F	R	3/26/91
91.4487	Pollock	Naked Island -	120000	16000	5.4	22222	2963	-	560	989	F	R	3/26/91
91.4488	Pollock	Naked Island -	74000	12000	10.0	7400	1200	-	560	1095	F	R	3/26/91
91.4489	Pollock	Naked Island -	85000	14000	19.6	4337	714	-	510	814	F	R	3/26/91
91.4490	Pollock	Naked Island -	70000	12000	11.3	6195	1062	-	530	884	F	R	3/26/91
91.5300	Flathead sole	Olsen Bay	16000	2000	0.98	16327	2041	83	250	144	M		5/27/91
91.5301	Flathead sole	Olsen Bay	29000	3300	4.7	6170	702	4	314	345	F		5/27/91
91.5302	Flathead sole	Olsen Bay	18000	2500	1.3	13846	1923	57	291	251	F		5/27/91
91.5303	Flathead sole	Olsen Bay	12000	1800	2.2	5455	818	34	231	125	M		5/27/91
91.5304	Flathead sole	Olsen Bay	16000	2200	2.1	7619	1048	84	243	155	M		5/27/91
91.5305	Flathead sole	Olsen Bay	14000	1900	18.3	765	104	6	315	230	M		5/27/91
91.5306	Flathead sole	Olsen Bay	18000	2800	1.8	10000	1556	120	256	150	F		5/27/91
91.5307	Flathead sole	Olsen Bay	-	-	-			85	240	126	M		5/27/91
91.5308	Flathead sole	Olsen Bay	33000	3500	12.1	2727	289	39	238	112	M		5/27/91
91.5309	Flathead sole	Olsen Bay	-	-	-			61	246	126	F		5/27/91
91.5310	Flathead sole	Olsen Bay	27000	3000	1.6	16875	1875	-	395	653	F		5/27/91
91.5312	Flathead sole	Olsen Bay	14000	2300	1.9	7368	1211	-	220	88	M		5/27/91
91.5313	Flathead sole	Olsen Bay	20000	2400	3.8	5263	632	-	246	115	M		5/27/91
91.5314	Flathead sole	Olsen Bay	18000	2600	2.3	7826	1130	-	217	81	M		5/27/91
91.5315	Rock sole	Olsen Bay	11000	1600	0.40	27500	4000	79	368	709	F		5/27/91
91.5316	Rock sole	Olsen Bay	25000	3200	3.9	6410	821	80	352	527	F		5/27/91
91.5317	Rock sole	Olsen Bay	20000	2000	0.98	20408	2041	45	250	175	F		5/27/91
91.5318	Rock sole	Olsen Bay	24000	3300	3.7	6486	892	122	292	298	F		5/27/91

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5319	Rock sole	Olsen Bay	17000	1900	1.1	15455	1727	140	360	633	F		5/27/91
91.5320	Rock sole	Olsen Bay	21000	3200	0.78	26923	4103	81	333	475	F		5/27/91
91.5321	Yellowfin Sole	Olsen Bay	-	-	-			63	298	366	M		5/27/91
91.5322	Yellowfin Sole	Olsen Bay	-	-	-			99	282	256	M		5/27/91
91.5323	Yellowfin Sole	Olsen Bay	-	-	-			29	261	201	M		5/27/91
91.5324	Yellowfin Sole	Olsen Bay	-	-	-			149	239	173	M		5/27/91
91.5325	Yellowfin Sole	Olsen Bay	-	-	-			20	287	300	M		5/27/91
91.5326	Yellowfin Sole	Olsen Bay	-	-	-			51	275	268	M		5/27/91
91.5327	Yellowfin Sole	Olsen Bay	-	-	-			87	275	248	M		5/27/91
91.5328	Yellowfin Sole	Olsen Bay	-	-	-			74	253	183	M		5/27/91
91.5329	Yellowfin Sole	Olsen Bay	-	-	-			79	281	255	M		5/27/91
91.5330	Yellowfin Sole	Olsen Bay	-	-	-			124	266	266	M		5/27/91
91.5331	Yellowfin Sole	Olsen Bay	-	-	-			99	264	218	M		5/27/91
91.5332	Yellowfin Sole	Olsen Bay	-	-	-			157	303	350	M		5/27/91
91.5333	Yellowfin Sole	Olsen Bay	-	-	-			69	259	224	M		5/27/91
91.5334	Yellowfin Sole	Olsen Bay	-	-	-			86	234	136	M		5/27/91
91.5335	Yellowfin Sole	Olsen Bay	-	-	-			70	245	185	M		5/27/91
91.5336	Yellowfin sole	Olsen Bay	27000	4800	1.6	16875	3000	-	263	221	F	R	5/27/91
91.5337	Yellowfin sole	Olsen Bay	16000	3100	1.4	11429	2214	-	251	214	F	R	5/27/91
91.5338	Yellowfin sole	Olsen Bay	53000	8000	-			46	302	363	F	R	5/27/91
91.5339	Yellowfin sole	Olsen Bay	16000	2000	0.54	29630	3704	98	300	330	F	R	5/27/91
91.5340	Yellowfin sole	Olsen Bay	35000	5200	3.1	11290	1677	39	295	317	F	R	5/27/91
91.5341	Yellowfin sole	Olsen Bay	10000	1600	0.80	12500	2000	-	290	279	F	R	5/27/91
91.5342	Yellowfin sole	Olsen Bay	29000	4700	3.8	7632	1237	80	271	296	F	R	5/27/91
91.5343	Yellowfin sole	Olsen Bay	26000	3900	1.5	17333	2600	-	238	148	F	R	5/27/91
91.5344	Yellowfin sole	Olsen Bay	29000	4000	3.7	7838	1081	-	254	195	F	R	5/27/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5345	Yellowfin sole	Olsen Bay	20000	3100	1.8	11111	1722	-	267	240	F	R	5/27/91
91.5346	Yellowfin sole	Olsen Bay	10000	1300	0.38	26316	3421	-	251	205	F	R	5/28/91
91.5347	Yellowfin sole	Olsen Bay	24000	3300	-			-	240	173	F	R	5/28/91
91.5348	Yellowfin sole	Olsen Bay	8300	450	1.3	6385	346	7	385	689	F	R	5/28/91
91.5349	Yellowfin sole	Olsen Bay	18000	2500	1.2	15000	2083	14	316	445	F	R	5/28/91
91.5350	Yellowfin sole	Olsen Bay	8700	1100	0.66	13182	1667	-	243	185	F	R	5/28/91
91.5351	Yellowfin sole	Olsen Bay	8800	1300	1.1	8000	1182	13	315	477	F	R	5/28/91
91.5352	Yellowfin sole	Olsen Bay	11000	1900	1.3	8462	1462	-	221	152	F	R	5/28/91
91.5353	Yellowfin sole	Olsen Bay	9000	1400	0.56	16071	2500	-	232	171	F	R	5/28/91
91.5355	Yellowfin sole	Olsen Bay	8300	1200	1.0	8300	1200	-	275	273	F	R	5/28/91
91.5356	Yellowfin sole	Olsen Bay	7500	1100	0.60	12500	1833	-	260	216	F	R	5/28/91
91.5357	Yellowfin sole	Olsen Bay	17000	2900	-			-	242	158	F	R	5/28/91
91.5358	Yellowfin sole	Olsen Bay	21000	3300	-			43	281	319	F	R	5/28/91
91.5359	Yellowfin sole	Olsen Bay	28000	4400	3.3	8485	1333	-	286	293	F	R	5/28/91
91.536	Yellowfin Sole	Olsen Bay	-	-	-			27	320	440	F	R	5/28/91
91.5360	Yellowfin sole	Olsen Bay	39000	5000	4.2	9286	1190	27	320	440	F	R	5/28/91
91.5361	Yellowfin sole	Olsen Bay	28000	4000	1.2	23333	3333	-	253	223	F	R	5/28/91
91.5362	Yellowfin sole	Olsen Bay	28000	4300	2.1	13333	2048	74	280	295	F	R	5/28/91
91.5363	Yellowfin sole	Olsen Bay	45000	5700	3.8	11842	1500	131	255	195	F	R	5/28/91
91.5364	Yellowfin sole	Olsen Bay	26000	3400	0.88	29545	3864	-	264	237	F	R	5/28/91
91.5365	Yellowfin sole	Olsen Bay	31000	4600	-			-	232	139	F	R	5/28/91
91.5366	Pacific cod	Olsen Bay	48000	6200	8.4	5714	738	30	590	-	F		5/28/91
91.5367	Pacific cod	Olsen Bay	28000	4200	3.8	7368	1105	13	790	-	F		5/28/91
91.5368	Pacific cod	Olsen Bay	20000	3100	2.5	8000	1240	8	660	-	F		5/28/91
91.5369	Pacific cod	Olsen Bay	23000	3900	2.3	10000	1696	-	780	-	M		5/28/91
91.5370	Pacific cod	Olsen Bay	24000	3600	3.9	6154	923	17	770	-	F		5/28/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5371	Pacific cod	Olsen Bay	37000	4900	4.3	8605	1140	16	640	-	M		5/28/91
91.5372	Pacific cod	Olsen Bay	20000	2900	2.7	7407	1074	35	610	-	F		5/28/91
91.5373	Pacific cod	Olsen Bay	33000	5000	4.2	7857	1190	25	555	-	F		5/28/91
91.5374	Rock sole	Olsen Bay	14000	1800	2.1	6667	857	-1	280	225	M		5/28/91
91.5375	Rock sole	Olsen Bay	22000	3000	1.9	11579	1579	104	333	490	F		5/29/91
91.5377	Rock sole	Rocky Bay	79000	11000	2.1	37619	5238	-	348	495	M		5/29/91
91.5378	Yellowfin Sole	Rocky Bay	-	-	-			217	288	301	M		5/29/91
91.5379	Rock sole	Rocky Bay	34000	5100	3.0	11333	1700	-	346	590	F		5/29/91
91.5380	Yellowfin sole	Rocky Bay	27000	2700	11.4	2368	237	-	343	630	F	R	5/29/91
91.5381	Rock sole	Rocky Bay	78000	11000	5.5	14182	2000	-	312	420	M		5/29/91
91.5382	Yellowfin Sole	Rocky Bay	-	-	-			236	296	350	M		5/29/91
91.5384	Flathead sole	Rocky Bay	26000	2800	2.1	12381	1333	-	325	295	M		5/29/91
91.5387	Flathead sole	Snug Harbor	-	-	-			245	325	314	F		5/30/91
91.5388	Flathead sole	Snug Harbor	18000	1800	0.98	18367	1837	17	461	1310	F		5/30/91
91.5389	Flathead sole	Snug Harbor	12000	1300	1.4	8571	929	50	343	349	F		5/30/91
91.5390	Flathead sole	Snug Harbor	15000	2300	1.7	8824	1353	57	280	183	M		5/30/91
91.5391	Flathead sole	Snug Harbor	-	-	-			79	323	300	F		5/30/91
91.5392	Flathead sole	Snug Harbor	17000	2400	1.0	17000	2400	71	225	105	M		5/30/91
91.5393	Flathead sole	Snug Harbor	34000	6600	1.4	24286	4714	327	251	138	M		5/30/91
91.5394	Flathead sole	Snug Harbor	20000	2300	6.6	3030	348	49	392	594	F		5/30/91
91.5395	Flathead sole	Snug Harbor	-	-	-			77	265	168	F		5/30/91
91.5396	Flathead sole	Snug Harbor	34000	5800	1.5	22667	3867	192	262	119	M		5/30/91
91.5397	Flathead sole	Snug Harbor	31000	6300	1.3	23846	4846	222	250	136	F		5/30/91
91.5398	Flathead sole	Snug Harbor	-	-	-			112	311	261	F		5/30/91
91.5399	Flathead sole	Snug Harbor	42000	7500	1.8	23333	4167	33	287	280	F		5/30/91
91.5400	Flathead sole	Snug Harbor	31000	4900	1.3	23846	3769	70	360	421	F		5/30/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein [2]	µg PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5428	Yellowfin sole	Snug Harbor	20000	2600	3.1	6452	839	31	408	923	F	R	5/30/91
91.5429	Yellowfin sole	Snug Harbor	30000	4400	1.1	27273	4000	-	300	312	F	R	5/30/91
91.5430	Yellowfin sole	Snug Harbor	42000	6100	2.6	16154	2346	-	318	384	F	R	5/30/91
91.5431	Yellowfin sole	Snug Harbor	33000	5500	1.6	20625	3438	-	305	385	F	R	5/30/91
91.5432	Yellowfin sole	Snug Harbor	21000	2800	1.5	14000	1867	28	350	663	F	R	5/30/91
91.5433	Yellowfin sole	Snug Harbor	15000	2300	1.7	8824	1353	32	391	771	F	R	5/30/91
91.5434	Yellowfin sole	Snug Harbor	13000	1700	1.8	7222	944	-	401	888	F	R	5/30/91
91.5435	Yellowfin sole	Snug Harbor	17000	2800	1.2	14167	2333	-	299	311	F	R	5/30/91
91.5436	Yellowfin sole	Snug Harbor	31000	4500	0.98	31633	4592	-	298	360	F	R	5/30/91
91.5438	Yellowfin sole	Snug Harbor	33000	5000	1.3	25385	3846	-	235	136	F	R	5/30/91
91.5439	Yellowfin sole	Snug Harbor	21000	3300	2.7	7778	1222	-	374	699	F	R	5/30/91
91.5440	Yellowfin sole	Snug Harbor	38000	6100	6.9	5507	884	-	365	713	F	R	5/30/91
91.5441	Yellowfin sole	Snug Harbor	38000	5900	2.4	15833	2458	-	298	329	F	R	5/30/91
91.5443	Yellowfin sole	Snug Harbor	20000	2900	0.90	22222	3222	-	250	216	F	R	5/30/91
91.5444	Yellowfin sole	Snug Harbor	27000	4400	1.0	27000	4400	-	240	171	F	R	5/30/91
91.5445	Yellowfin sole	Snug Harbor	30000	4500	1.2	25000	3750	-	244	160	F	R	5/30/91
91.5446	Yellowfin sole	Snug Harbor	24000	3400	1.4	17143	2429	-	-	-	F	R	5/30/91
91.5447	Rock sole	Snug Harbor	37000	5500	5.5	6727	1000	185	365	690	F		5/30/91
91.5448	Rock sole	Snug Harbor	67000	12000	1.3	51538	9231	235	333	488	F		5/30/91
91.5449	Rock sole	Snug Harbor	31000	7000	2.1	14762	3333	265	308	345	F		5/30/91
91.5450	Rock sole	Snug Harbor	72000	15000	2.5	28800	6000	299	286	283	F		5/30/91
91.5451	Rock sole	Snug Harbor	45000	7700	2.7	16667	2852	141	362	645	F		5/30/91
91.5452	Rock Sole	Snug Harbor	-	-	-			209	243	170	M		5/30/91
91.5453	Rock sole	Snug Harbor	42000	7400	-			147	357	490	F		5/30/91
91.5454	Rock sole	Snug Harbor	47000	9100	1.2	39167	7583	135	380	584	F		5/30/91
91.5455	Rock sole	Snug Harbor	28000	5600	0.76	36842	7368	156	378	653	F		5/30/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5456	Rock sole	Snug Harbor	54000	11000	1.4	38571	7857	142	356	563	F		5/30/91
91.5457	Rock sole	Snug Harbor	8300	950	1.2	6917	792	110	365	560	F		5/30/91
91.5458	Rock sole	Snug Harbor	31000	6400	1.5	20667	4267	340	258	201	F		5/30/91
91.5459	Rock sole	Snug Harbor	13000	1100	1.3	10000	846	241	356	478	F		5/30/91
91.5460	Rock sole	Snug Harbor	27000	5400	1.8	15000	3000	124	344	491	F		5/30/91
91.5461	Rock Sole	Snug Harbor	-	-	-			299	312	362	F		5/30/91
91.5462	Pacific cod	Snug Harbor	22000	4300	4.9	4490	878	12	840	-	M		5/30/91
91.5463	Pacific cod	Snug Harbor	23000	3500	2.7	8519	1296	18	760	-	F		5/30/91
91.5464	Pacific cod	Snug Harbor	-	-	-			17	620	-	F		5/30/91
91.5465	Pacific cod	Snug Harbor	-	-	-			40	570	-	F		5/30/91
91.5466	Pacific cod	Snug Harbor	19000	3200	2.7	7037	1185	32	495	-	F		5/30/91
91.5467	Pacific cod	Snug Harbor	17000	2900	3.6	4722	806	56	660	-	F		5/30/91
91.5468	Pacific cod	Snug Harbor	26000	4200	4.2	6190	1000	25	790	-	F		5/30/91
91.5469	Pacific cod	Snug Harbor	40000	7500	8.9	4494	843	40	820	-	F		5/30/91
91.5470	Pacific cod	Snug Harbor	33000	6300	5.9	5593	1068	262	575	-	F		5/30/91
91.5471	Yellowfin sole	Sleepy Bay	23000	3800	1.6	14375	2375	-	310	475	F	R	5/31/91
91.5472	Rock sole	Sleepy Bay	42000	8100	3.6	11667	2250	189	326	435	F		5/31/91
91.5473	Rock sole	Sleepy Bay	14000	2200	2.8	5000	786	34	352	600	F		5/31/91
91.5474	Rock sole	Sleepy Bay	20000	4000	0.98	20408	4082	168	381	720	F		5/31/91
91.5475	Rock sole	Sleepy Bay	23000	4100	1.8	12778	2278	212	254	201	M		5/31/91
91.5476	Rock sole	Sleepy Bay	34000	7100	2.3	14783	3087	384	240	164	M		5/31/91
91.5477	Rock sole	Sleepy Bay	46000	9900	2.2	20909	4500	148	216	103	F		5/31/91
91.5478	Rock sole	Sleepy Bay	40000	5900	1.8	22222	3278	8	369	656	F		6/1/91
91.5479	Rock sole	Sleepy Bay	29000	4700	1.9	15263	2474	51	353	584	F		6/1/91
91.5480	Rock sole	Sleepy Bay	18000	3300	1.8	10000	1833	229	331	435	F		6/1/91
91.5481	Rock sole	Sleepy Bay	22000	3300	1.1	20000	3000	109	370	670	F		6/1/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein [2]	ug PHN equiv / g bile protein [2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5482	Rock sole	Sleepy Bay	26000	4200	1.5	17333	2800	23	381	714	F		6/1/91
91.5483	Rock sole	Sleepy Bay	37000	7200	1.9	19474	3789	-	333	423	F		6/1/91
91.5484	Rock sole	Sleepy Bay	16000	2400	1.7	9412	1412	118	288	306	M		6/1/91
91.5485	Rock sole	Sleepy Bay	31000	5100	3.9	7949	1308	9	358	535	F		6/1/91
91.5486	Rock sole	Sleepy Bay	13000	2000	-			24	326	508	F		6/1/91
91.5487	Pacific cod	Sleepy Bay	50000	8000	6.8	7353	1176	50	590	-	F		6/1/91
91.5488	Pacific cod	Sleepy Bay	39000	6400	8.1	4815	790	32	533	-	F		6/1/91
91.5489	Pacific cod	Sleepy Bay	35000	6200	3.7	9459	1676	28	575	-	F		6/1/91
91.5490	Pacific cod	Sleepy Bay	38000	5800	4.8	7917	1208	29	620	-	M		6/1/91
91.5491	Pacific cod	Sleepy Bay	21000	3400	2.8	7500	1214	10	537	-	M		6/1/91
91.5492	Pacific cod	Sleepy Bay	19000	2600	3.7	5135	703	33	541	-	M		6/1/91
91.5493	Pacific cod	Sleepy Bay	18000	3300	3.9	4615	846	39	510	-	M		6/1/91
91.5494	Flathead sole	Sleepy Bay	26000	4200	1.8	14444	2333	-	385	642	F		6/1/91
91.5495	Flathead sole	Sleepy Bay	26000	3600	2.0	13000	1800	-	369	560	F		6/1/91
91.5497	Halibut	Sleepy Bay	19000	2200	0.94	20213	2340	77	685	-	M		6/1/91
91.5498	Halibut	Sleepy Bay	24000	2700	1.1	21818	2455	115	690	-	M		6/1/91
91.5499	Halibut	Sleepy Bay	10000	1500	1.1	9091	1364	57	750	-	F		6/1/91
91.5500	Halibut	Sleepy Bay	50000	7800	2.1	23810	3714	46	680	-	M		6/1/91
91.5501	Halibut	Sleepy Bay	15000	1500	2.2	6818	682	59	710	-	F		6/1/91
91.5502	Halibut	Sleepy Bay	26000	2900	1.9	13684	1526	81	710	-	M		6/1/91
91.5505	Rock sole	Squirrel Bay	12000	1700	0.60	20000	2833	-	406	936	F		6/2/91
91.5506	Rock sole	Squirrel Bay	28000	5300	1.8	15556	2944	-	241	170	F		6/2/91
91.5507	Rock sole	Squirrel Bay	19000	2600	4.5	4222	578	-	271	228	F		6/2/91
91.5508	Rock sole	Squirrel Bay	24000	4600	1.2	20000	3833	-	240	161	F		6/2/91
91.5509	Rock sole	Squirrel Bay	21000	3000	1.5	14000	2000	-	287	284	F		6/2/91
91.5511	Rock sole	Squirrel Bay	940000	360000	2.1	447619	171429	-	296	343	F		6/2/91

APPENDIX 1. SUBTIDAL 7 REPORT–Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5512	Rock sole	Squirrel Bay	24000	5700	2.9	8276	1966	-	268	234	M		6/2/91
91.5513	Rock sole	Squirrel Bay	21000	3800	2.6	8077	1462	-	225	132	M		6/2/91
91.5514	Rock sole	Squirrel Bay	12000	2200	1.3	9231	1692	-	241	158	F		6/2/91
91.5515	Rock Sole	Squirrel Bay	-	-	-			76	223	122	F		6/2/91
91.5516	Rock sole	Squirrel Bay	12000	1800	1.5	8000	1200	99	204	92	F		6/2/91
91.5517	Rock Sole	Squirrel Bay	-	-	-			46	211	108	F		6/2/91
91.5518	Yellowfin Sole	Squirrel Bay	-	-	-			100	294	345	M		6/2/91
91.5519	Yellowfin Sole	Squirrel Bay	-	-	-			180	285	302	M		6/2/91
91.5520	Yellowfin sole	Squirrel Bay	35000	5600	2.0	17500	2800	-	278	320	F	R	6/2/91
91.5521	Yellowfin sole	Squirrel Bay	42000	5700	8.7	4828	655	-	285	341	F	R	6/2/91
91.5522	Yellowfin sole	Squirrel Bay	28000	4200	1.7	16471	2471	-	243	199	F	R	6/2/91
91.5523	Flathead sole	Fox Farm	25000	5400	3.5	7143	1543	-	323	315	M		6/3/91
91.5524	Flathead sole	Fox Farm	25000	4400	1.2	20833	3667	-	370	622	F		6/3/91
91.5525	Flathead sole	Fox Farm	36000	6600	1.6	22500	4125	-	220	87	J		6/3/91
91.5526	Flathead sole	Fox Farm	26000	5300	2.3	11304	2304	-	280	210	F		6/3/91
91.5527	Flathead sole	Fox Farm	16000	2600	1.6	10000	1625	-	252	156	F		6/3/91
91.5528	Flathead sole	Fox Farm	40000	8100	1.5	26667	5400	-	285	235	F		6/3/91
91.5529	Flathead sole	Fox Farm	30000	6700	5.0	6000	1340	-	351	360	F		6/3/91
91.5530	Flathead sole	Fox Farm	15000	2600	1.5	10000	1733	-	223	105	M		6/3/91
91.5531	Flathead sole	Fox Farm	31000	8800	2.5	12400	3520	-	335	395	F		6/3/91
91.5532	Flathead sole	Fox Farm	22000	4300	1.5	14667	2867	-	318	330	F		6/3/91
91.5533	Flathead sole	Fox Farm	16000	3000	1.0	16000	3000	-	225	95	J		6/3/91
91.5534	Flathead sole	Fox Farm	39000	12000	2.6	15000	4615	-	272	181	F		6/3/91
91.5535	Flathead sole	Fox Farm	32000	5400	1.5	21333	3600	-	382	580	F		6/3/91
91.5536	Flathead sole	Fox Farm	21000	3400	2.4	8750	1417	-	362	544	F		6/3/91
91.5537	Flathead sole	Fox Farm	31000	7000	1.5	20667	4667	-	325	369	F		6/3/91

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv[2] g bile protein	ug PHN equiv[2] g bile protein	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
91.5538	Rock sole	Fox Farm	25000	4300	1.2	20833	3583	-	331	499	F		6/3/91
91.5539	Rock sole	Fox Farm	9900	1100	0.98	10102	1122	-	428	1086	F		6/3/91
91.5540	Rock sole	Fox Farm	22000	3000	1.1	20000	2727	-	351	574	F		6/3/91
91.5541	Rock sole	Fox Farm	18000	3400	1.8	10000	1889	-	355	590	F		6/3/91
91.5542	Rock sole	Fox Farm	14000	2000	1.2	11667	1667	-	319	412	F		6/3/91
91.5543	Yellowfin Sole	Fox Farm Bay	-	-	-			154	271	212	M		6/3/91
91.5544	Yellowfin Sole	Fox Farm Bay	-	-	-			89	291	322	M		6/3/91
91.5545	Yellowfin Sole	Fox Farm Bay	-	-	-			108	329	516	M		6/3/91
91.5546	Yellowfin Sole	Fox Farm Bay	-	-	-			169	245	181	M		6/3/91
91.5547	Yellowfin Sole	Fox Farm Bay	-	-	-			41	270	278	M		6/3/91
91.5548	Yellowfin Sole	Fox Farm Bay	-	-	-			116	253	210	M		6/3/91
91.5549	Yellowfin Sole	Fox Farm Bay	-	-	-			49	281	299	M		6/3/91
91.5550	Yellowfin Sole	Fox Farm Bay	-	-	-			26	327	410	M		6/3/91
91.5551	Yellowfin Sole	Fox Farm Bay	-	-	-			32	235	146	M		6/3/91
91.5552	Yellowfin Sole	Fox Farm Bay	-	-	-			57	276	286	M		6/3/91
91.5553	Yellowfin Sole	Fox Farm Bay	-	-	-			106	275	251	M		6/3/91
91.5554	Yellowfin Sole	Fox Farm Bay	-	-	-			100	232	156	M		6/3/91
91.5555	Yellowfin Sole	Fox Farm Bay	-	-	-			50	305	368	M		6/3/91
91.5556	Yellowfin Sole	Fox Farm Bay	-	-	-			59	280	307	M		6/3/91
91.5557	Yellowfin Sole	Fox Farm Bay	-	-	-			40	309	382	M		6/3/91
91.5558	Yellowfin sole	Fox Farm	17000	2800	2.1	8095	1333	-	297	329	F	R	6/3/91
91.5559	Yellowfin sole	Fox Farm	25000	3000	-			-	331	526	F	R	6/3/91
91.5560	Yellowfin sole	Fox Farm	18000	2500	0.98	18367	2551	-	314	405	F	R	6/3/91
91.5561	Yellowfin sole	Fox Farm	26000	5000	2.3	11304	2174	-	361	670	F	R	6/3/91
91.5562	Yellowfin sole	Fox Farm	19000	3100	2.2	8636	1409	-	378	850	F	R	6/3/91
91.5563	Yellowfin sole	Fox Farm	46000	9600	2.1	21905	4571	-	363	635	F	R	6/3/91

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91.5564	Yellowfin sole	Fox Farm	33000	6100	4.3	7674	1419	-	345	627	F	R	6/3/91
91.5565	Yellowfin sole	Fox Farm	30000	5700	1.3	23077	4385	-	312	465	F	R	6/3/91
91.5567	Yellowfin sole	Fox Farm	22000	3700	1.4	15714	2643	-	342	590	F	R	6/3/91
91.5568	Yellowfin sole	Fox Farm	30000	4900	2.4	12500	2042	-	347	630	F	R	6/3/91
91.5569	Yellowfin sole	Fox Farm	32000	4700	2.4	13333	1958	-	304	420	F	R	6/3/91
91.5570	Yellowfin sole	Fox Farm	23000	3600	3.6	6389	1000	-	325	546	F	R	6/3/91
91.5571	Yellowfin sole	Fox Farm	29000	4100	1.7	17059	2412	-	295	348	F	R	6/3/91
91.5572	Yellowfin sole	Fox Farm	19000	2800	3.6	5278	778	-	251	266	F	R	6/3/91
91.5573	Yellowfin sole	Fox Farm	10000	2200	1.9	5263	1158	-	342	601	F	R	6/3/91
91.5575	Yellowfin sole	Fox Farm	22000	4400	2.7	8148	1630	-	381	779	F	R	6/3/91
91.5576	Yellowfin sole	Fox Farm	14000	1800	2.1	6667	857	-	320	437	F	R	6/3/91
91.5577	Yellowfin sole	Fox Farm	20000	3600	3.2	6250	1125	-	260	228	F	R	6/3/91
91.5578	Yellowfin sole	Fox Farm	10000	1300	1.2	8333	1083	-	335	488	F	R	6/3/91
91.5581	Yellowfin sole	Fox Farm	12000	1700	5.2	2308	327	-	330	509	F	R	6/3/91
91.5582	Yellowfin sole	Fox Farm	19000	2900	1.8	10556	1611	-	291	324	F	R	6/3/91
91.5583	Yellowfin sole	Fox Farm	17000	2400	2.6	6538	923	-	336	572	F	R	6/3/91
91.5584	Yellowfin sole	Fox Farm	31000	2700	1.5	20667	1800	-	313	442	F	R	6/3/91
91.5585	Yellowfin sole	Fox Farm	27000	4400	2.7	10000	1630	-	334	486	F	R	6/3/91
91.5586	Yellowfin sole	Fox Farm	16000	2700	1.8	8889	1500	-	315	396	F	R	6/3/91
CK-HBT-001	Halibut	Portlock Bank	28000	1500	16.9	1657	89	-	630	2900	M		4/7/90
CK-HBT-002	Halibut	Portlock Bank	25000	5100	8.4	2976	607	-	630	2700	M		4/7/90
CK-HBT-003	Halibut	Portlock Bank	21000	1900	5.8	3621	328	-	720	3900	M		4/7/90
CK-HBT-004	Halibut	Portlock Bank	110000	16000	18.5	5946	865	-	780	6000	M		4/7/90
CK-HBT-005	Halibut	Portlock Bank	15000	1400	6.4	2344	219	-	520	1600	M		4/7/90
CK-HBT-006	Halibut	Portlock Bank	7600	1400	2.2	3455	636	-	490	1400	M		4/7/90
CK-HBT-007	Halibut	Portlock Bank	14000	1200	10.8	1296	111	-	480	1200	M		4/7/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	ug NPH equiv / g bile protein[2]	ug PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
CK-HBT-008	Halibut	Portlock Bank	12000	990	1.6	7500	619	-	480	1200	M		4/7/90
CK-HBT-010	Halibut	Portlock Bank	11000	810	4.1	2683	198	-	470	1100	M		4/7/90
CK-HBT-011	Halibut	Portlock Bank	10000	1000	3.9	2564	256	-	470	1100	M		4/7/90
CK-HBT-012	Halibut	Portlock Bank	26000	2000	12.5	2080	160	-	420	800	M		4/7/90
CK-HBT-013	Halibut	Portlock Bank	23000	2100	9.1	2527	231	-	650	3200	M		4/7/90
CK-HBT-014	Halibut	Portlock Bank	92000	13000	6.7	13731	1940	-	740	5000	M		4/8/90
CK-HBT-015	Halibut	Portlock Bank	11000	1100	1.4	7857	786	-	500	1400	M		4/8/90
CK-HBT-016	Halibut	Portlock Bank	22000	1700	10.3	2136	165	-	590	2100	M		4/8/90
CK-HBT-017	Halibut	Portlock Bank	41000	6900	4.9	8367	1408	-	610	2500	M		4/8/90
CK-HBT-018	Halibut	Portlock Bank	18000	1600	5.1	3529	314	-	590	2300	M		4/8/90
CK-HBT-019	Halibut	Portlock Bank	15000	1300	5.2	2885	250	-	530	1700	M		4/8/90
CK-HBT-020	Halibut	Chiniak Bay	83000	14000	10.9	7615	1284	-	630	3100	M		4/9/90
CK-HBT-021	Halibut	Chiniak Bay	24000	1700	2.4	10000	708	-	740	4800	M		4/9/90
CK-HBT-022	Halibut	Chiniak Bay	23000	1600	2.1	10952	762	-	580	2200	M		4/9/90
CK-HBT-023	Halibut	Chiniak Bay	18000	930	1.7	10588	547	-	540	1900	M		4/9/90
CK-HBT-024	Halibut	Chiniak Bay	18000	1400	1.4	12857	1000	-	440	900	M		4/9/90
CK-HBT-025	Halibut	Chiniak Bay	20000	2100	3.6	5556	583	-	510	1400	M		4/9/90
CK-HBT-026	Halibut	Chiniak Bay	24000	3000	5.6	4286	536	-	450	900	M		4/9/90
CK-HBT-027	Halibut	Chiniak Bay	14000	1000	5.5	2545	182	-	470	1100	M		4/9/90
CK-HBT-028	Halibut	Chiniak Bay	26000	1700	8.9	2921	191	-	390	700	M		4/9/90
CK-HBT-030	Halibut	Albatross Bank	71000	8500	11.2	6339	759	-	530	1600	M		4/10/90
CK-HBT-032	Halibut	Albatross Bank	37000	4300	3.8	9737	1132	-	-	-	M		4/10/90
CK-HBT-033	Halibut	Albatross Bank	15000	1700	9.7	1546	175	-	410	700	-		4/10/90
CK-HBT-034	Halibut	Albatross Bank	63000	7700	22.2	2838	347	-	510	1400	M		4/10/90
CK-HBT-035	Halibut	Albatross Bank	19000	1800	3.9	4872	462	-	-	-	-		4/10/90
CK-HBT-037	Halibut	Albatross Bank	16000	1600	7.2	2222	222	-	590	2200	M		4/10/90

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CS-SAB-01	Sablefish	E of Kodiak Island	14000	2600	2.1	6667	1238	-	590	1700	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	11000	1800	4.0	2750	450	-	530	1200	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	4700	190	1.9	2474	100	-	490	1000	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	8600	2400	1.5	5733	1600	-	570	1550	F		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	10000	960	1.9	5263	505	-	650	2500	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	11000	2600	3.7	2973	703	-	520	1600	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	7000	910	2.3	3043	396	-	500	1200	M		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	12000	350	6.5	1846	54	-	490	1000	F		4/19/90
CS-SAB-01	Sablefish	E of Kodiak Island	21000	3200	3.1	6774	1032	-	460	950	M		4/19/90
CS-SAB-02	Sablefish	E of Kodiak Island	13000	230	5.6	2321	41	-	540	1450	U		4/19/90
CS-SAB-02	Sablefish	E of Kodiak Island	22000	3700	1.9	11579	1947	-	630	2300	U		4/19/90
P-001	Pollock	W of Goose Is.; H2	100000	14000	9.8	10204	1429	-	490	960	M		2/15/90
P-002	Pollock	W of Goose Is.; H2	130000	26000	9.1	14286	2857	-	470	877	F		2/15/90
P-003	Pollock	W of Goose Is.; H2	61000	12000	7.7	7922	1558	-	410	581	M		2/15/90
P-004	Pollock	W of Goose Is.; H2	180000	47000	5.6	32143	8393	-	520	1078	F		2/15/90
P-005	Pollock	W of Goose Is.; H2	61000	9500	9.1	6703	1044	-	450	740	F		2/15/90
P-006	Pollock	W of Goose Is.; H2	88000	15000	13.5	6519	1111	-	440	774	M		2/15/90
P-007	Pollock	W of Goose Is.; H2	110000	27000	16.1	6832	1677	-	470	876	F		2/15/90
P-008	Pollock	W of Goose Is.; H2	110000	25000	9.0	12222	2778	-	500	1085	F		2/15/90
P-009	Pollock	W of Goose Is.; H2	170000	31000	10.7	15888	2897	-	470	850	F		2/15/90
P-010	Pollock	W of Goose Is.; H2	130000	22000	18.2	7143	1209	-	500	971	F		2/15/90
P-011	Pollock	W of Goose Is.; H2	98000	17000	9.3	10538	1828	-	600	1919	F		2/15/90
P-012	Pollock	W of Goose Is.; H2	77000	15000	9.5	8105	1579	-	470	816	M		2/15/90
P-013	Pollock	W of Goose Is.; H2	270000	48000	18.1	14917	2652	-	440	627	M		2/15/90
P-014	Pollock	W of Goose Is.; H2	100000	22000	4.0	25000	5500	-	360	372	M		2/15/90
P-015	Pollock	W of Goose Is.; H2	150000	27000	20.0	7500	1350	-	470	846	F		2/15/90

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P-016	Pollock	W of Goose Is.; H2	150000	45000	7.4	20270	6081	-	420	589	F		2/15/90
P-017	Pollock	W of Goose Is.; H2	130000	29000	6.2	20968	4677	-	400	542	M		2/15/90
P-018	Pollock	W of Goose Is.; H2	99000	19000	8.5	11647	2235	-	440	659	M		2/15/90
P-019	Pollock	W of Goose Is.; H2	120000	22000	6.5	18462	3385	-	360	352	M		2/15/90
P-020	Pollock	W of Goose Is.; H2	170000	35000	13.9	12230	2518	-	410	523	M		2/15/90
P-021	Pollock	NW of Naked Is.;	90000	20000	8.6	10465	2326	-	420	560	F		2/15/90
P-022	Pollock	NW of Naked Is.;	120000	25000	2.8	42857	8929	-	450	769	F		2/15/90
P-023	Pollock	NW of Naked Is.;	140000	25000	6.8	20588	3676	-	560	1344	F		2/15/90
P-025	Pollock	NW of Naked Is.;	150000	31000	5.1	29412	6078	-	460	653	F		2/15/90
P-026	Pollock	NW of Naked Is.;	90000	19000	2.5	36000	7600	-	450	731	F		2/15/90
P-027	Pollock	NW of Naked Is.;	76000	14000	7.3	10411	1918	-	450	834	M		2/15/90
P-028	Pollock	NW of Naked Is.;	210000	45000	7.5	28000	6000	-	450	711	F		2/15/90
P-029	Pollock	NW of Naked Is.;	270000	55000	7.6	35526	7237	-	570	1542	F		2/15/90
P-031	Pollock	NW of Naked Is.;	130000	25000	5.8	22414	4310	-	480	900	F		2/15/90
P-032	Pollock	NW of Naked Is.;	250000	53000	13.4	18657	3955	-	400	517	M		2/15/90
P-033	Pollock	NW of Naked Is.;	110000	20000	2.8	39286	7143	-	520	1003	M		2/15/90
P-034	Pollock	NW of Naked Is.;	120000	30000	6.8	17647	4412	-	460	778	M		2/15/90
P-036	Pollock	NW of Naked Is.;	190000	43000	3.6	52778	11944	-	460	795	M		2/15/90
P-037	Pollock	NW of Naked Is.;	91000	17000	1.0	91000	17000	-	400	550	M		2/15/90
P-038	Pollock	NW of Naked Is.;	120000	27000	4.1	29268	6585	-	470	825	F		2/15/90
P-039	Pollock	NW of Naked Is.;	150000	39000	8.1	18519	4815	-	510	1009	M		2/15/90
P-040	Pollock	NW of Naked Is.;	220000	55000	10.0	22000	5500	-	410	565	M		2/15/90
P-041	Pollock	W of Mummy Is.;	94000	23000	3.0	31333	7667	-	420	576	F		2/16/90
P-042	Pollock	W of Mummy Is.;	230000	56000	3.8	60526	14737	-	450	725	M		2/16/90
P-043	Pollock	W of Mummy Is.;	340000	90000	10.8	31481	8333	-	430	661	M		2/16/90
P-044	Pollock	W of Mummy Is.;	95000	16000	6.8	13971	2353	-	470	841	M		2/16/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-045	Pollock	W of Mummy Is.;	280000	68000	5.8	48276	11724	-	400	502	M		2/16/90
P-046	Pollock	W of Mummy Is.;	200000	45000	10.8	18519	4167	-	410	503	M		2/16/90
P-047	Pollock	W of Mummy Is.;	130000	30000	6.2	20968	4839	-	460	948	M		2/16/90
P-048	Pollock	W of Mummy Is.;	290000	74000	11.9	24370	6218	-	420	547	M		2/16/90
P-049	Pollock	W of Mummy Is.;	110000	27000	2.1	52381	12857	-	430	604	M		2/16/90
P-050	Pollock	W of Mummy Is.;	170000	38000	11.1	15315	3423	-	470	821	M		2/16/90
P-051	Pollock	W of Mummy Is.;	190000	37000	15.4	12338	2403	-	480	768	M		2/16/90
P-052	Pollock	W of Mummy Is.;	220000	52000	10.3	21359	5049	-	460	735	F		2/16/90
P-053	Pollock	W of Mummy Is.;	200000	44000	7.4	27027	5946	-	470	807	F		2/16/90
P-054	Pollock	W of Mummy Is.;	130000	27000	9.4	13830	2872	-	450	706	F		2/16/90
P-055	Pollock	W of Mummy Is.;	220000	56000	4.6	47826	12174	-	450	656	F		2/16/90
P-056	Pollock	W of Mummy Is.;	290000	65000	6.5	44615	10000	-	480	851	F		2/16/90
P-057	Pollock	W of Mummy Is.;	380000	94000	4.5	84444	20889	-	470	757	F		2/16/90
P-058	Pollock	W of Mummy Is.;	180000	37000	5.9	30508	6271	-	420	623	F		2/16/90
P-059	Pollock	W of Mummy Is.;	190000	40000	10.2	18627	3922	-	530	1120	F		2/16/90
P-060	Pollock	W of Mummy Is.;	170000	41000	7.6	22368	5395	-	410	533	F		2/16/90
P-061	Pollock	W of Point Bazil;	62000	8200	2.6	23846	3154	-	450	741	F		2/16/90
P-062	Pollock	W of Point Bazil;	150000	32000	4.7	31915	6809	-	440	747	M		2/16/90
P-063	Pollock	W of Point Bazil;	110000	20000	7.6	14474	2632	-	470	870	M		2/16/90
P-064	Pollock	W of Point Bazil;	58000	11000	4.7	12340	2340	-	450	670	F		2/16/90
P-065	Pollock	W of Point Bazil;	49000	9500	6.7	7313	1418	-	480	943	F		2/16/90
P-066	Pollock	W of Point Bazil;	76000	15000	7.0	10857	2143	-	370	372	M		2/16/90
P-067	Pollock	W of Point Bazil;	58000	13000	5.6	10357	2321	-	500	1092	M		2/16/90
P-068	Pollock	W of Point Bazil;	190000	39000	7.8	24359	5000	-	400	483	M		2/16/90
P-069	Pollock	W of Point Bazil;	100000	18000	5.6	17857	3214	-	460	834	F		2/16/90
P-070	Pollock	W of Point Bazil;	49000	8100	4.0	12250	2025	-	400	512	M		2/16/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-071	Pollock	W of Point Bazil;	56000	7000	2.7	20741	2593	-	450	663	F		2/16/90
P-072	Pollock	W of Point Bazil;	15000	2000	7.2	2083	278	-	420	542	M		2/16/90
P-073	Pollock	W of Point Bazil;	54000	11000	4.8	11250	2292	-	440	704	F		2/16/90
P-074	Pollock	W of Point Bazil;	140000	22000	3.3	42424	6667	-	420	523	M		2/16/90
P-075	Pollock	W of Point Bazil;	120000	25000	5.3	22642	4717	-	420	560	M		2/16/90
P-076	Pollock	W of Point Bazil;	230000	48000	7.6	30263	6316	-	440	580	M		2/16/90
P-077	Pollock	W of Point Bazil;	170000	24000	8.1	20988	2963	-	470	748	F		2/16/90
P-078	Pollock	W of Point Bazil;	100000	13000	6.6	15152	1970	-	480	895	F		2/16/90
P-079	Pollock	W of Point Bazil;	49000	4200	3.2	15313	1313	-	620	1956	F		2/16/90
P-080	Pollock	W of Point Bazil;	150000	24000	11.5	13043	2087	-	540	1288	F		2/16/90
P-081	Pollock	Sanak Island; H15	66000	14000	10.2	6471	1373	-	490	1054	M		3/1/90
P-082	Pollock	Sanak Island; H15	58000	12000	6.3	9206	1905	-	490	821	M		3/1/90
P-083	Pollock	Sanak Island; H15	95000	20000	11.3	8407	1770	-	540	1294	F		3/1/90
P-084	Pollock	Sanak Island; H15	65000	11000	6.7	9701	1642	-	530	987	F		3/1/90
P-085	Pollock	Sanak Island; H15	94000	16000	9.5	9895	1684	-	500	973	F		3/1/90
P-086	Pollock	Sanak Island; H15	68000	19000	10.6	6415	1792	-	500	1146	F		3/1/90
P-087	Pollock	Sanak Island; H15	70000	19000	6.9	10145	2754	-	520	910	M		3/1/90
P-088	Pollock	Sanak Island; H15	73000	18000	14.0	5214	1286	-	530	1381	M		3/1/90
P-089	Pollock	Sanak Island; H15	83000	16000	8.7	9540	1839	-	530	1061	F		3/1/90
P-090	Pollock	Sanak Island; H15	74000	18000	12.2	6066	1475	-	550	1421	F		3/1/90
P-091	Pollock	Sanak Island; H15	130000	28000	7.9	16456	3544	-	550	1210	F		3/1/90
P-092	Pollock	Sanak Island; H15	54000	13000	9.6	5625	1354	-	530	1011	M		3/1/90
P-093	Pollock	Sanak Island; H15	52000	14000	7.8	6667	1795	-	600	1614	F		3/1/90
P-094	Pollock	Sanak Island; H15	33000	7900	8.5	3882	929	-	520	1177	M		3/1/90
P-095	Pollock	Sanak Island; H15	120000	23000	24.0	5000	958	-	50	985	M		3/1/90
P-096	Pollock	Sanak Island; H15	67000	16000	15.4	4351	1039	-	53	1164	M		3/1/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-097	Pollock	Sanak Island; H15	78000	15000	13.5	5778	1111	-	520	1053	F		3/1/90
P-098	Pollock	Sanak Island; H15	67000	13000	6.0	11167	2167	-	580	1373	F		3/1/90
P-099	Pollock	Sanak Island; H15	32000	6300	4.8	6667	1313	-	510	1141	M		3/1/90
P-100	Pollock	Sanak Island; H15	40000	5500	5.4	7407	1019	-	500	1008	M		3/1/90
P-101	Pollock	SW of Chirikof Is;	85000	27000	10.7	7944	2523	-	520	1030	F		3/15/90
P-102	Pollock	SW of Chirikof Is;	94000	32000	18.6	5054	1720	-	510	915	F		3/15/90
P-104	Pollock	SW of Chirikof Is;	98000	28000	17.5	5600	1600	-	510	1176	M		3/15/90
P-107	Pollock	SW of Chirikof Is;	110000	26000	20.4	5392	1275	-	490	680	M		3/15/90
P-108	Pollock	SW of Chirikof Is;	130000	29000	18.0	7222	1611	-	550	1429	F		3/15/90
P-109	Pollock	SW of Chirikof Is;	83000	17000	13.3	6241	1278	-	490	845	M		3/15/90
P-113	Pollock	SW of Chirikof Is;	58000	11000	12.9	4496	853	-	510	1087	M		3/15/90
P-115	Pollock	SW of Chirikof Is;	110000	21000	26.5	4151	792	-	510	1042	M		3/15/90
P-116	Pollock	SW of Chirikof Is;	37000	7600	8.7	4253	874	-	580	1597	F		3/15/90
P-118101	Halibut	Clarence Strait	12000	1400	1.1	10909	1273	-	1200	-	F		5/3/90
P-118104	Halibut	Clarence Strait	15000	1400	2.9	5172	483	-	780	-	M		5/3/90
P-118107	Halibut	Clarence Strait	15000	1500	2.6	5769	577	-	830	-	F		5/3/90
P-118110	Halibut	Clarence Strait	80000	9500	9.6	8333	990	-	900	-	M		5/3/90
P-118113	Halibut	Clarence Strait	28000	2600	2.0	14000	1300	-	740	-	F		5/3/90
P-118201	Halibut	Clarence Strait	24000	1600	3.0	8000	533	-	-	-	U		4/28/90
P-118205	Halibut	Clarence Strait	12000	1300	1.2	10000	1083	-	990	-	M		4/30/90
P-118208	Halibut	Clarence Strait	20000	2000	6.8	2941	294	-	900	-	F		4/30/90
P-118211	Halibut	Clarence Strait	160000	27000	17.6	9091	1534	-	1010	-	M		4/30/90
P-118217	Sablefish	Clarence Strait	9500	540	1.6	5938	338	-	850	-	F		5/2/90
P-118220	Sablefish	Clarence Strait	21000	970	2.6	8077	373	-	580	-	M		5/2/90
P-118223	Sablefish	Clarence Strait	15000	1200	4.3	3488	279	-	650	-	M		5/2/90
P-118226	Sablefish	Clarence Strait	7000	360	2.5	2800	144	-	690	-	M		5/2/90

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SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-118229	Sablefish	Clarence Strait	9300	370	3.9	2385	95	-	590	-	M		5/2/90
P-118232	Sablefish	Clarence Strait	8600	910	3.6	2389	253	-	590	-	M		5/2/90
P-118235	Sablefish	Clarence Strait	13000	1500	2.5	5200	600	-	640	-	M		5/2/90
P-118238	Sablefish	Clarence Strait	9700	400	5.8	1672	69	-	620	-	M		5/2/90
P-118241	Sablefish	Clarence Strait	12000	560	4.5	2667	124	-	650	-	M		5/2/90
P-118244	Sablefish	Clarence Strait	12000	460	4.2	2857	110	-	640	-	M		5/2/90
P-119	Pollock	SW of Chirikof Is;	58000	12000	16.2	3580	741	-	520	1080	F		3/15/90
P-120201	Pollock	Seymour Canal	40000	15000	7.6	5263	1974	-	668	2043	U		5/2/90
P-120202	Pollock	Seymour Canal	68000	8600	4.7	14468	1830	-	697	3175	U		5/2/90
P-120203	Pollock	Seymour Canal	25000	3000	2.2	11364	1364	-	614	1995	U		5/2/90
P-120204	Pollock	Seymour Canal	56000	6600	4.6	12174	1435	-	637	1611	F		5/2/90
P-120205	Pollock	Seymour Canal	87000	12000	7.6	11447	1579	-	642	2043	F		5/2/90
P-120206	Pollock	Seymour Canal	72000	10000	6.0	12000	1667	-	602	1950	F		5/2/90
P-120207	Pollock	Seymour Canal	57000	8300	8.8	6477	943	-	634	1560	F		5/2/90
P-120208	Pollock	Seymour Canal	43000	5800	15.6	2756	372	-	615	1815	F		5/2/90
P-120209	Pollock	Seymour Canal	-	-	-			-	510	1040	F		5/2/90
P-120210	Pollock	Seymour Canal	-	-	-			-	609	2040	F		5/2/90
P-120211	Pollock	Seymour Canal	58000	5100	5.3	10943	962	-	640	1930	F		5/2/90
P-120212	Pollock	Seymour Canal	45000	6500	5.9	7627	1102	-	628	2156	F		5/2/90
P-120213	Pollock	Seymour Canal	52000	4300	6.3	8254	683	-	600	1800	F		5/2/90
P-120214	Pollock	Seymour Canal	63000	9000	9.1	6923	989	-	621	2380	F		5/2/90
P-120215	Pollock	Seymour Canal	34000	4800	4.1	8293	1171	-	608	1910	F		5/2/90
P-120216	Pollock	Seymour Canal	53000	11000	4.3	12326	2558	-	615	2300	F		5/2/90
P-120217	Pollock	Seymour Canal	-	-	-			-	690	3060	F		5/2/90
P-120218	Pollock	Seymour Canal	-	-	-			-	555	1490	M		5/2/90
P-120219	Pollock	Seymour Canal	-	-	-			-	616	1490	F		5/2/90

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P-122	Pollock	SW of Tugidak Is;	69000	14000	10.6	6509	1321	-	200	470	M		3/16/90
P-123	Pollock	SW of Tugidak Is;	93000	22000	7.8	11923	2821	-	230	780	F		3/16/90
P-124	Pollock	SW of Tugidak Is;	110000	21000	11.2	9821	1875	-	210	560	M		3/16/90
P-130	Pollock	SW of Tugidak Is;	76000	15000	9.4	8085	1596	-	200	510	M		3/16/90
P-132	Pollock	SW of Tugidak Is;	79000	16000	5.1	15490	3137	-	210	540	M		3/16/90
P-133	Pollock	SW of Tugidak Is;	76000	13000	-			-	210	570	M		3/16/90
P-134	Pollock	SW of Tugidak Is;	97000	15000	4.6	21087	3261	-	220	630	F		3/16/90
P-136	Pollock	SW of Tugidak Is;	85000	15000	12.0	7083	1250	-	220	680	F		3/16/90
P-137	Pollock	SW of Tugidak Is;	95000	16000	-			-	200	490	F		3/16/90
P-138	Pollock	SW of Tugidak Is;	110000	17000	9.3	11828	1828	-	210	590	F		3/16/90
P-141	Pollock	S of Portage Bay;	59000	14000	6.0	9833	2333	-	480	875	F		3/17/90
P-148	Pollock	S of Portage Bay;	90000	12000	5.7	15789	2105	-	420	557	M		3/17/90
P-152	Pollock	S of Portage Bay;	93000	14000	11.0	8455	1273	-	390	404	M		3/17/90
P-153	Pollock	S of Portage Bay;	61000	10000	14.1	4326	709	-	450	695	M		3/17/90
P-160	Pollock	S of Portage Bay;	78000	13000	6.0	13000	2167	-	570	1224	F		3/17/90
P-165	Pollock	E of Cape	34000	4000	4.1	8293	976	-	400	449	M		3/18/90
P-172	Pollock	E of Cape	90000	15000	20.0	4500	750	-	530	1068	M		3/18/90
P-174	Pollock	E of Cape	65000	8500	5.6	11607	1518	-	440	612	F		3/18/90
P-176	Pollock	E of Cape	81000	18000	7.9	10253	2278	-	510	1147	F		3/18/90
P-182	Pollock	S of Kinak Bay;	100000	18000	13.4	7463	1343	-	450	753	M		3/19/90
P-184	Pollock	S of Kinak Bay;	140000	24000	12.0	11667	2000	-	420	527	M		3/19/90
P-194	Pollock	S of Kinak Bay;	98000	28000	11.3	8673	2478	-	560	1378	F		3/19/90
P-197	Pollock	S of Kinak Bay;	100000	16000	7.4	13514	2162	-	400	502	F		3/19/90
P-199	Pollock	S of Kinak Bay;	120000	16000	12.3	9756	1301	-	570	1572	F		3/19/90
P-201	Pollock	SW of Malina Pt;	20000	3300	1.5	13333	2200	-	470	757	M		3/20/90
P-202	Pollock	SW of Malina Pt;	99000	14000	11.0	9000	1273	-	500	1163	F		3/20/90

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P-203	Pollock	SW of Malina Pt;	98000	27000	8.3	11807	3253	-	500	1126	F		3/20/90
P-204	Pollock	SW of Malina Pt;	78000	11000	5.2	15000	2115	-	520	1180	F		3/20/90
P-208	Pollock	SW of Malina Pt;	57000	6800	5.3	10755	1283	-	470	789	F		3/20/90
P-209	Pollock	SW of Malina Pt;	50000	4200	4.3	11628	977	-	530	1360	F		3/20/90
P-212	Pollock	SW of Malina Pt;	80000	10000	9.9	8081	1010	-	490	908	F		3/20/90
P-213	Pollock	SW of Malina Pt;	63000	11000	3.8	16579	2895	-	410	517	F		3/20/90
P-214	Pollock	SW of Malina Pt;	65000	9900	7.9	8228	1253	-	370	406	M		3/20/90
P-215	Pollock	SW of Malina Pt;	54000	9000	4.4	12273	2045	-	400	460	M		3/20/90
P-216	Pollock	SW of Malina Pt;	140000	17000	18.3	7650	929	-	420	527	M		3/20/90
P-217	Pollock	SW of Malina Pt;	51000	4000	4.9	10408	816	-	400	450	M		3/20/90
P-218	Pollock	SW of Malina Pt;	29000	4000	1.3	22308	3077	-	410	512	M		3/20/90
P-219	Pollock	SW of Malina Pt;	44000	3500	2.5	17600	1400	-	440	663	M		3/20/90
P-222	Pollock	S of Portage Bay;	85000	13000	6.9	12319	1884	-	470	855	M		3/26/90
P-225	Pollock	S of Portage Bay;	41000	7900	3.1	13226	2548	-	350	328	M		3/26/90
P-233	Pollock	S of Portage Bay;	120000	22000	16.1	7453	1366	-	420	551	F		3/26/90
P-238	Pollock	S of Portage Bay;	53000	9600	7.4	7162	1297	-	420	504	F		3/26/90
P-240	Pollock	S of Portage Bay;	60000	12000	5.8	10345	2069	-	500	863	F		3/26/90
P-245	Pollock	E of Cape	130000	30000	10.5	12381	2857	-	450	786	F		3/27/90
P-249	Pollock	E of Cape	150000	35000	11.3	13274	3097	-	410	546	M		3/27/90
P-251	Pollock	E of Cape	37000	9400	3.7	10000	2541	-	430	656	F		3/27/90
P-254	Pollock	E of Cape	140000	27000	14.0	10000	1929	-	400	515	M		3/27/90
P-257	Pollock	E of Cape	48000	5800	3.6	13333	1611	-	450	645	M		3/27/90
P-262	Pollock	N of Cape Uyak;	130000	24000	26.4	4924	909	-	420	534	M		3/28/90
P-267	Pollock	N of Cape Uyak;	74000	11000	3.8	19474	2895	-	320	233	F		3/28/90
P-272	Pollock	N of Cape Uyak;	79000	12000	4.9	16122	2449	-	440	612	F		3/28/90
P-275	Pollock	N of Cape Uyak;	33000	4300	2.4	13750	1792	-	400	439	M		3/28/90

APPENDIX 1. SUBTIDAL 7 REPORT—Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-276	Pollock	N of Cape Uyak;	45000	11000	4.6	9783	2391	-	540	1601	F		3/28/90
P-284	Pollock	N of Cape Uyak;	220000	45000	29.6	7432	1520	-	620	2252	F		3/28/90
P-287	Pollock	N of Cape Uyak;	170000	31000	23.3	7296	1330	-	470	820	M		3/28/90
P-290	Pollock	N of Cape Uyak;	86000	24000	5.8	14828	4138	-	420	553	M		3/28/90
P-295	Pollock	N of Cape Uyak;	140000	28000	12.0	11667	2333	-	440	758	F		3/28/90
P-296	Pollock	N of Cape Uyak;	110000	26000	7.9	13924	3291	-	410	450	M		3/28/90
P-298	Pollock	N of Cape	77000	12000	3.3	23333	3636	-	460	767	F		3/29/90
P-299	Pollock	N of Cape	41000	7600	2.5	16400	3040	-	460	747	F		3/29/90
P-300	Pollock	N of Cape	70000	9700	5.5	12727	1764	-	500	1290	M		3/29/90
P-304	Pollock	N of Cape	67000	11000	4.1	16341	2683	-	460	838	M		3/29/90
P-305	Pollock	N of Cape	100000	14000	12.9	7752	1085	-	500	1080	F		3/29/90
P-310	Pollock	N of Cape	97000	13000	9.3	10430	1398	-	450	732	F		3/29/90
P-312	Pollock	N of Cape	75000	9000	3.9	19231	2308	-	490	797	F		3/29/90
P-313	Pollock	N of Cape	100000	13000	4.1	24390	3171	-	470	659	M		3/29/90
P-315	Pollock	N of Cape	54000	8200	3.0	18000	2733	-	420	570	M		3/29/90
P-317	Pollock	N of Cape	18000	1800	1.7	10588	1059	-	350	306	M		3/29/90
P-319	Pollock	NW of Cape Ugat;	40000	4700	2.6	15385	1808	-	430	569	M		3/29/90
P-320	Pollock	NW of Cape Ugat;	33000	4000	3.1	10645	1290	-	460	708	F		3/29/90
P-321	Pollock	NW of Cape Ugat;	140000	24000	20.7	6763	1159	-	500	905	F		3/29/90
P-324	Pollock	NW of Cape Ugat;	89000	13000	4.0	22250	3250	-	450	606	M		3/29/90
P-326	Pollock	NW of Cape Ugat;	35000	6500	2.4	14583	2708	-	490	924	F		3/29/90
P-330	Pollock	NW of Cape Ugat;	86000	22000	10.7	8037	2056	-	490	855	M		3/29/90
P-333	Pollock	NW of Cape Ugat;	130000	19000	27.0	4815	704	-	440	662	F		3/29/90
P-334	Pollock	NW of Cape Ugat;	61000	9700	3.3	18485	2939	-	450	697	F		3/29/90
P-335	Pollock	NW of Cape Ugat;	79000	12000	2.4	32917	5000	-	370	361	M		3/29/90
P-336	Pollock	NW of Cape Ugat;	110000	18000	7.5	14667	2400	-	360	302	M		3/29/90

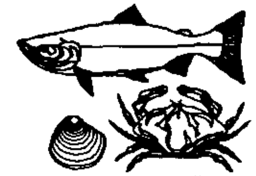
APPENDIX 1. SUBTIDAL 7 REPORT–Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
P-340	Pollock	S of Kinak Bay;	97000	20000	14.7	6599	1361	-	470	657	F		3/30/90
P-342	Pollock	S of Kinak Bay;	110000	24000	14.4	7639	1667	-	480	791	M		3/30/90
P-351	Pollock	S of Kinak Bay;	94000	14000	9.0	10444	1556	-	560	1353	F		3/30/90
P-355	Pollock	S of Kinak Bay;	74000	23000	8.8	8409	2614	-	470	778	M		3/30/90
P-358	Pollock	S of Kinak Bay;	88000	17000	6.0	14667	2833	-	570	1565	F		3/30/90
P-361	Pollock	S of Kinak Bay;	67000	16000	10.3	6505	1553	-	450	694	M		3/30/90
P-369	Pollock	S of Kinak Bay;	130000	25000	7.7	16883	3247	-	390	373	M		3/30/90
P-373	Pollock	S of Kinak Bay;	110000	16000	7.4	14865	2162	-	440	797	F		3/30/90
PP-HBT-001	Halibut	Goose Island	26000	5300	0.9	28889	5889	-	830	-	F		4/21/90
PP-HBT-002	Halibut	Goose Island	10000	1200	1.1	9091	1091	-	1080	-	F		4/21/90
PP-HBT-003	Halibut	Goose Island	30000	3300	1.6	18750	2063	-	1210	-	F		4/21/90
PP-HBT-004	Halibut	Goose Island	16000	2300	1.3	12308	1769	-	686	-	F		4/21/90
PP-HBT-005	Halibut	Goose Island	14000	2400	1.6	8750	1500	-	584	-	-		4/21/90
PP-HBT-006	Halibut	Goose Island	14000	2300	1.4	10000	1643	-	566	-	-		4/21/90
PP-HBT-007	Halibut	Goose Island	12000	680	4.1	2927	166	-	1080	-	F		4/21/90
PP-HBT-008	Halibut	Goose Island	20000	2100	1.6	12500	1313	-	864	-	F		4/21/90
PP-HBT-009	Halibut	Goose Island	25000	4400	1.4	17857	3143	-	782	-	M		4/21/90
PP-HBT-010	Halibut	Goose Island	250000	45000	16.2	15432	2778	-	711	-	M		4/21/90
PP-HBT-016	Halibut	Naked Island	30000	4300	0.8	37500	5375	-	850	-	M		4/23/90
PP-HBT-017	Halibut	Naked Island	35000	4000	1.2	29167	3333	-	864	-	M		4/23/90
PP-HBT-018	Halibut	Naked Island	29000	2900	0.9	32222	3222	-	1105	-	M		4/23/90
PP-HBT-019	Halibut	Naked Island	21000	2500	2.4	8750	1042	-	1181	-	M		4/23/90
PP-HBT-020	Halibut	Chenega Island	23000	2500	2.5	9200	1000	-	1067	-	F		4/23/90
PP-HBT-021	Halibut	Chenega Island	10000	1000	0.9	11111	1111	-	1295	-	F		4/23/90
PP-HBT-022	Halibut	Chenega Island	33000	4100	2.1	15714	1952	-	775	-	F		4/23/90
PP-HBT-023	Halibut	Chenega Island	11000	1300	0.9	12222	1444	-	800	-	F		4/23/90

APPENDIX 1. SUBTIDAL 7 REPORT--Levels of Fluorescent Aromatic Compounds (FACs) in Bile and Activities of Aryl Hydrocarbon Hydroxylase (AHH) in Liver

SPECIMEN#	SPECIES	SITE	FAC (NPH)[1] ng NPH equiv/g bile	FAC (PHN)[1] ng PHN equiv/g bile	BILE PROTEIN mg/g bile	µg NPH equiv / g bile protein[2]	µg PHN equiv / g bile protein[2]	AHH[3] pmole/mg/min	LENGTH (mm)	WEIGHT (gm)	SEX	Histopath/Repro[4]	Date of Capture
PP-HBT-024	Halibut	Chenega Island	33000	5000	2.5	13200	2000	-	838	-	F		4/23/90
PP-HBT-025	Halibut	Chenega Island	69000	9700	3.1	22258	3129	-	838	-	F		4/23/90
PP-HBT-026	Halibut	Chenega Island	9400	670	1.2	7833	558	-	787	-	M		4/23/90
PP-HBT-027	Halibut	Chenega Island	10000	850	1.7	5882	500	-	838	-	F		4/23/90
PP-HBT-028	Halibut	Chenega Island	16000	2100	3.0	5333	700	-	793	-	F		4/23/90
PP-HBT-029	Halibut	Chenega Island	11000	2500	1.2	9167	2083	-	787	-	F		4/23/90
PP-HBT-030	Halibut	Green Island	7000	2000	1.3	5385	1538	-	693	-	M		4/24/90
PP-HBT-031	Halibut	Green Island	9000	1400	1.2	7500	1167	-	597	-	M		4/24/90
PP-HBT-032	Halibut	Green Island	26000	3700	2.8	9286	1321	-	648	-	M		4/24/90
PP-HBT-033	Halibut	Green Island	22000	2200	2.6	8462	846	-	584	-	M		4/24/90
PP-HBT-034	Halibut	Green Island	12000	1400	1.4	8571	1000	-	1283	-	F		4/24/90
PP-HBT-035	Halibut	Green Island	27000	2000	2.5	10800	800	-	965	-	F		4/24/90
PP-HBT-036	Halibut	Green Island	7500	950	1.4	5357	679	-	902	-	M		4/24/90
PP-HBT-037	Halibut	Green Island	23000	2600	2.7	8519	963	-	838	-	F		4/24/90
PP-HBT-038	Halibut	Green Island	60000	10000	2.7	22222	3704	-	775	-	F		4/24/90
PP-HBT-039	Halibut	Green Island	7200	460	2.2	3273	209	-	806	-	F		4/24/90
SH-HBT-001	Halibut	Portlock Bank	12000	?	10.7	1121	89	-	540	1070	U		4/7/90
SH-HBT-002	Halibut	Portlock Bank	7500	620	4.7	1596	132	-	520	1070	U		4/7/90
SH-HBT-003	Halibut	Portlock Bank	9300	790	1.8	5167	439	-	450	1000	U		4/7/90
SH-HBT-004	Halibut	Portlock Bank	7000	610	5.8	1207	105	-	400	650	U		4/7/90
SH-HBT-005	Halibut	Portlock Bank	11000	1100	2.7	4074	407	-	440	900	U		4/7/90
SH-HBT-006	Halibut	Portlock Bank	11000	860	11.8	932	73	-	620	2700	U		4/8/90
SH-HBT-007	Halibut	Portlock Bank	15000	940	23.6	636	40	-	510	1600	U		4/8/90
SH-HBT-008	Halibut	Portlock Bank	32000	3100	5.0	6400	620	-	500	1300	U		4/8/90
SH-HBT-009	Halibut	Portlock Bank	26000	1600	4.0	6500	400	-	560	1900	U		4/8/90
SH-HBT-010	Halibut	Portlock Bank	19000	1800	2.2	8636	818	-	540	1900	U		4/8/90

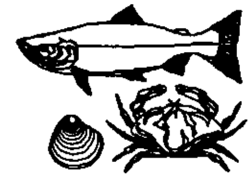
APPENDIX 2



APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
906101	YAKUTAT	340	288	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906102	YAKUTAT	305	302	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	0	0
906103	YAKUTAT	340	405	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906104	YAKUTAT	378	430	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	0
906105	YAKUTAT	284	220	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	0	0
906106	YAKUTAT	295	230	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906107	YAKUTAT	282	228	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906108	YAKUTAT	280	250	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	0	0
906109	YAKUTAT	280	215	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906110	YAKUTAT	283	206	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906112	YAKUTAT	519	986	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906113	YAKUTAT	325	270	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906114	YAKUTAT	435	781	DOLLY VARDEN	M	0	1	0	0	0	0	0	1	0	0
906115	YAKUTAT	301	235	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906116	YAKUTAT	395	520	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906175	OLSEN BAY	386	683	ROCK SOLE	F	1	0	0	0	0	0	0	1	0	0
906176	OLSEN BAY	253	195	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
906177	OLSEN BAY	240	157	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
906178	OLSEN BAY	206	95	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906179	OLSEN BAY	236	150	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906180	OLSEN BAY	340	511	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
906181	OLSEN BAY	225	128	ROCK SOLE	J	0	0	0	0	0	0	0	0	0	1
906182	OLSEN BAY	262	215	ROCK SOLE	M	0	1	0	0	0	0	0	0	0	0
906195	OLSEN BAY	425	715	DOLLY VARDEN	M	0	1	0	0	0	0	0	0	0	0
906196	OLSEN BAY	390	520	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906197	OLSEN BAY	405	640	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906198	OLSEN BAY	338	324	DOLLY VARDEN	F	0	0	1	0	0	0	0	0	0	0
906199	OLSEN BAY	383	560	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906200	OLSEN BAY	420	815	DOLLY VARDEN	M	0	0	0	1	0	0	0	0	0	0
906201	OLSEN BAY	385	520	DOLLY VARDEN	F	1	0	0	0	0	0	0	0	0	0

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information



APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangelctasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906101	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906102	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906103	0	0	0	1	0	0	1	0	0	0	0	0	0	•
906104	0	0	0	0	1	0	0	0	1	0	0	0	0	•
906105	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906106	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906107	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906108	0	0	0	1	0	0	1	0	0	0	0	0	0	R
906109	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906110	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906112	0	0	0	1	0	0	0	0	0	0	0	0	0	R
906113	0	0	0	0	0	0	0	0	0	1	0	0	0	R
906114	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906115	0	0	0	0	0	0	0	0	1	0	0	0	0	•
906116	0	0	1	0	0	0	1	0	0	0	0	0	0	R
906175	1	0	0	0	0	1	0	0	0	0	0	0	0	R
906176	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906177	1	0	0	0	1	0	0	0	0	0	0	0	0	•
906178	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906179	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906180	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906181	0	0	0	0	0	0	0	0	0	0	0	0	0	•
906182	0	0	0	0	0	0	0	0	0	1	0	0	0	•
906195	0	0	0	0	0	0	0	0	0	0	0	0	0	•
906196	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906197	0	0	0	0	0	0	0	0	0	0	0	0	0	R
906198	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906199	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906200	0	0	0	0	1	0	0	0	1	0	0	0	0	•
906201	0	0	0	0	0	0	0	0	0	0	0	0	1	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site_name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
906230	OLSEN BAY	323	289	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906231	OLSEN BAY	442	882	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906232	OLSEN BAY	360	395	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906233	OLSEN BAY	239	86	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906245	ROCKY BAY	369	530	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	0	0
906246	ROCKY BAY	388	470	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906247	ROCKY BAY	354	375	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906248	ROCKY BAY	430	782	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906249	ROCKY BAY	376	670	DOLLY VARDEN	M	0	1	0	0	0	0	0	0	0	0
906250	ROCKY BAY	392	670	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906251	ROCKY BAY	360	338	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906252	ROCKY BAY	461	1045	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	1	0
906253	ROCKY BAY	426	851	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906254	ROCKY BAY	411	713	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906255	ROCKY BAY	442	767	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906256	ROCKY BAY	426	660	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906257	ROCKY BAY	378	425	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906258	ROCKY BAY	356	334	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906269	ROCKY BAY	284	308	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906270	ROCKY BAY	270	222	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
906271	ROCKY BAY	352	559	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906272	ROCKY BAY	385	706	ROCK SOLE	F	1	0	0	0	0	0	0	0	1	0
906273	ROCKY BAY	248	177	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
906274	ROCKY BAY	236	157	ROCK SOLE	F	0	0	0	0	0	1	0	0	0	0
906275	ROCKY BAY	233	153	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
906286	SNUG HBR	374	657	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906287	SNUG HBR	351	522	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
906288	SNUG HBR	327	403	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906289	SNUG HBR	221	121	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
906290	SNUG HBR	350	461	ROCK SOLE	F	0	0	0	0	0	0	0	0	1	0
906291	SNUG HBR	375	655	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906292	SNUG HBR	331	491	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906293	SNUG HBR	352	479	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill Ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906230	1	0	0	0	1	0	0	0	0	0	0	0	0	*
906231	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906232	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906233	0	0	0	0	0	0	0	0	0	0	0	1	0	*
906245	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906246	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906247	0	0	1	0	0	0	0	0	0	0	1	0	0	R
906248	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906249	1	0	1	0	1	0	0	0	0	0	0	0	0	*
906250	0	1	1	0	0	0	0	0	0	0	0	0	0	R
906251	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906252	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906253	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906254	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906255	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906256	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906257	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906258	1	1	0	0	1	0	0	0	0	0	0	0	0	R
906269	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906270	1	0	0	0	0	1	0	0	1	0	0	0	0	R
906271	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906272	0	1	1	0	0	0	0	0	0	0	1	0	0	R
906273	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906274	1	0	0	0	0	0	0	0	1	0	0	0	0	R
906275	0	1	0	0	0	0	0	0	0	0	0	0	0	*
906286	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906287	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906288	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906289	0	0	0	0	0	0	0	0	0	0	0	0	1	*
906290	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906291	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906292	1	1	1	0	0	0	0	0	0	0	0	0	0	R
906293	0	0	0	0	0	0	0	0	0	0	0	0	1	R

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
906294	SNUG HBR	290	305	ROCK SOLE	F	0	0	0	1	0	0	0	1	0	0
906295	SNUG HBR	250	169	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
906296	SNUG HBR	488	1235	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906297	SNUG HBR	344	358	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906308	SNUG HBR	303	282	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906309	SNUG HBR	310	301	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906330	SNUG HBR	360	359	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906331	SNUG HBR	333	379	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906332	SNUG HBR	322	290	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906333	SNUG HBR	410	631	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906335	SNUG HBR	407	564	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
906336	SNUG HBR	368	475	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906337	SNUG HBR	460	1080	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906338	SNUG HBR	358	455	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906339	SNUG HBR	362	466	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906340	SNUG HBR	309	285	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906341	SNUG HBR	330	329	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906342	SNUG HBR	354	438	DOLLY VARDEN	F	0	0	1	0	0	0	0	0	0	0
906343	SNUG HBR	378	568	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906347	SNUG HBR	325	463	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
906348	SNUG HBR	362	418	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906349	SNUG HBR	435	732	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906350	SNUG HBR	332	354	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906351	SNUG HBR	325	290	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906352	SNUG HBR	362	440	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906353	SNUG HBR	361	500	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906379	SLEEPY BAY	438	937	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906380	SLEEPY BAY	476	1047	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906381	SLEEPY BAY	369	461	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906382	SLEEPY BAY	311	262	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906383	SLEEPY BAY	337	390	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906384	SLEEPY BAY	348	365	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906385	SLEEPY BAY	399	684	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

APPENDIX 2. SUBTIDAL 7 FINAL REPORT - HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucous cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill Ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906294	1	0	1	0	0	0	0	0	1	0	0	0	0	•
906295	0	0	0	0	0	0	0	0	0	0	0	0	0	•
906296	1	0	1	0	0	0	0	0	0	1	0	0	0	•
906297	0	0	0	0	0	0	0	0	0	0	0	0	0	R
906308	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906309	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906330	0	0	0	0	0	0	0	1	0	0	0	0	0	•
906331	0	0	1	0	0	1	0	0	0	0	0	0	0	R
906332	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906333	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906335	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906336	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906337	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906338	1	0	0	0	0	1	0	0	0	0	0	0	0	R
906339	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906340	0	1	0	1	1	0	0	0	0	0	0	0	0	R
906341	0	0	0	1	1	0	0	1	0	0	0	0	0	•
906342	1	1	0	0	1	0	0	0	0	0	0	0	0	•
906343	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906347	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906348	0	0	1	0	1	0	0	0	0	0	0	0	0	R
906349	0	1	1	0	0	0	0	0	0	0	0	0	0	R
906350	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906351	1	0	1	0	1	0	0	0	0	0	0	0	0	R
906352	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906353	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906379	1	1	1	0	0	0	0	0	0	0	0	0	0	R
906380	0	0	0	0	1	0	0	0	0	0	0	1	0	•
906381	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906382	0	0	0	0	1	0	0	0	0	0	1	0	0	•
906383	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906384	0	0	1	0	0	0	0	0	0	0	0	0	0	R
906385	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
906386	SLEEPY BAY	341	455	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906387	SLEEPY BAY	430	835	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906388	SLEEPY BAY	418	846	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906389	SLEEPY BAY	525	1820	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906390	SLEEPY BAY	348	420	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906391	SLEEPY BAY	400	591	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	0	0
906392	SLEEPY BAY	490	1027	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906393	SLEEPY BAY	388	598	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906394	SLEEPY BAY	426	798	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906395	SLEEPY BAY	442	840	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906396	SLEEPY BAY	395	628	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906397	SLEEPY BAY	353	388	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906398	SLEEPY BAY	555	1960	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906399	SLEEPY BAY	335	396	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906400	SLEEPY BAY	374	443	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906401	SLEEPY BAY	415	710	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906422	SLEEPY BAY	283	286	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
906423	SLEEPY BAY	312	395	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906424	SLEEPY BAY	293	295	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906425	SLEEPY BAY	294	311	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906426	SLEEPY BAY	247	188	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906427	SLEEPY BAY	303	337	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906428	SLEEPY BAY	241	154	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
906429	SLEEPY BAY	243	171	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906430	SLEEPY BAY	376	681	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906431	SLEEPY BAY	245	152	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
906450	SLEEPY BAY	295	235	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906451	SLEEPY BAY	311	321	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906452	SLEEPY BAY	350	361	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906453	SLEEPY BAY	262	177	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906454	SLEEPY BAY	336	304	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
906455	SLEEPY BAY	330	328	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906456	SLEEPY BAY	312	310	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*

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APPENDIX 2. SUBTIDAL 7 FINAL REPORT - HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906386	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906387	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906388	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906389	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906390	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906391	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906392	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906393	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906394	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906395	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906396	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906397	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906398	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906399	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906400	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906401	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906422	1	•	•	•	•	•	•	•	1	0	1	0	0	R
906423	1	1	1	0	0	0	0	1	0	0	0	0	0	R
906424	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906425	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906426	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906427	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906428	1	0	0	0	0	0	0	0	1	0	0	0	0	•
906429	0	0	0	0	0	1	0	1	0	0	0	0	0	R
906430	1	1	1	1	0	0	0	1	0	0	0	0	0	R
906431	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906450	0	0	0	0	0	0	0	0	0	1	0	0	0	R
906451	1	1	0	0	1	0	0	0	0	0	0	0	0	R
906452	0	0	1	0	0	0	0	0	0	0	0	0	0	R
906453	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906454	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906455	0	0	0	0	0	0	0	0	0	0	0	0	0	R
906456	0	0	0	0	0	0	0	0	0	0	0	0	1	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
906457	SLEEPY BAY	360	397	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906458	SLEEPY BAY	351	449	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
906459	SLEEPY BAY	348	389	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
906460	SLEEPY BAY	415	662	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906461	SLEEPY BAY	318	268	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906462	SLEEPY BAY	450	840	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906463	SLEEPY BAY	465	897	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906700	TONSINA CV	388	810	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
906701	TONSINA CV	324	340	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
906702	TONSINA CV	330	410	ROCK SOLE	F	0	0	0	1	0	0	0	1	1	0
906703	TONSINA CV	314	344	ROCK SOLE	F	1	0	0	0	0	0	0	1	0	0
906704	TONSINA CV	323	385	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
906705	TONSINA CV	273	240	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
906706	TONSINA CV	322	375	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
906709	TONSINA CV	338	433	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
906710	TONSINA CV	311	320	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
906718	WINDY BAY	289	252	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906719	WINDY BAY	307	324	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906720	WINDY BAY	334	347	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906721	WINDY BAY	352	446	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906722	WINDY BAY	337	442	DOLLY VARDEN	F	0	0	0	1	0	0	0	0	0	0
906723	WINDY BAY	329	354	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906724	WINDY BAY	313	326	DOLLY VARDEN	M	0	0	0	1	0	0	0	0	0	0
906725	WINDY BAY	402	640	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906726	WINDY BAY	252	158	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906727	WINDY BAY	368	537	DOLLY VARDEN	F	1	0	0	0	0	0	0	0	0	0
906728	WINDY BAY	324	270	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906730	WINDY BAY	284	220	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906731	WINDY BAY	290	238	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906732	WINDY BAY	383	602	DOLLY VARDEN	M	0	0	0	1	0	0	0	1	0	0
906733	WINDY BAY	382	616	DOLLY VARDEN	F	0	1	0	1	0	0	0	0	0	0
906734	WINDY BAY	382	607	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906735	WINDY BAY	365	440	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

APPENDIX 2. SUBTIDAL 7 FINAL REPORT - HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangelctasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill Ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906457	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906458	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906459	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906460	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906461	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906462	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906463	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906700	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906701	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906702	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906703	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906704	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906705	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906706	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906709	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906710	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906718	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906719	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906720	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906721	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906722	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906723	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906724	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906725	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906726	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906727	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906728	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906730	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906731	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906732	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906733	1	1	0	0	1	1	0	0	0	0	0	0	0	R
906734	0	0	0	0	0	0	0	0	1	0	0	0	0	•
906735	1	1	1	0	0	0	0	0	0	0	0	1	0	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site_name	length_(mm)	weight_(gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
906736	WINDY BAY	283	232	DOLLY VARDEN	F	1	1	0	0	0	0	0	0	0	0
906737	WINDY BAY	264	184	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906738	WINDY BAY	353	482	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906739	WINDY BAY	425	854	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906740	WINDY BAY	385	575	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906741	WINDY BAY	310	294	ROCK SOLE	M	0	0	0	1	0	0	0	1	0	0
906742	WINDY BAY	332	413	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
906743	WINDY BAY	365	575	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906744	WINDY BAY	318	408	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
906745	WINDY BAY	370	540	ROCK SOLE	F	0	0	0	0	0	0	0	1	1	0
906746	WINDY BAY	315	350	ROCK SOLE	F	0	0	0	1	0	0	0	1	0	0
906747	WINDY BAY	419	807	ROCK SOLE	F	0	0	0	0	1	0	1	0	0	0
906748	WINDY BAY	325	365	ROCK SOLE	F	1	0	0	0	0	0	0	1	0	0
906749	WINDY BAY	381	601	ROCK SOLE	F	1	0	0	0	0	0	0	1	0	0
906750	WINDY BAY	374	537	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
906751	WINDY BAY	236	135	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906752	WINDY BAY	196	79	DOLLY VARDEN	J	•	•	•	•	•	•	•	•	•	•
906753	WINDY BAY	192	85	DOLLY VARDEN	J	0	0	0	0	0	0	0	0	0	1
906754	WINDY BAY	170	42	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906755	WINDY BAY	148	25	DOLLY VARDEN	J	•	•	•	•	•	•	•	•	•	•
906756	WINDY BAY	154	40	DOLLY VARDEN	J	0	0	0	0	0	0	0	0	0	1
906757	WINDY BAY	176	54	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906758	WINDY BAY	173	60	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906759	WINDY BAY	171	34	DOLLY VARDEN	J	0	0	0	0	0	0	0	0	0	1
906760	WINDY BAY	236	122	DOLLY VARDEN	F	0	1	0	0	0	0	0	1	0	0
906786	WINDY BAY	322	342	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906787	WINDY BAY	367	486	DOLLY VARDEN	M	0	0	1	0	0	0	0	0	0	0
906788	WINDY BAY	292	237	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	0	0
906789	WINDY BAY	413	602	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906790	WINDY BAY	309	289	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	0	0
906791	WINDY BAY	373	517	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	0
906792	WINDY BAY	285	240	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906802	DISCOV BAY	348	507	ROCK SOLE	F	•	•	•	•	•	•	•	•	•	•

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906736	1	1	0	0	0	0	0	0	0	0	0	1	0	R
906737	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906738	0	0	1	0	0	0	0	0	0	1	0	0	0	•
906739	0	1	0	0	0	0	0	0	0	0	0	0	0	•
906740	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906741	1	0	1	0	1	0	0	1	0	0	0	0	0	•
906742	0	0	0	0	1	0	0	1	0	0	0	0	0	•
906743	1	1	1	0	0	0	0	0	0	0	0	1	0	R
906744	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906745	1	1	1	0	0	0	0	0	0	0	0	1	0	R
906746	1	0	1	0	0	0	0	0	1	0	0	0	0	R
906747	1	0	1	0	1	0	0	0	0	0	0	0	0	R
906748	0	0	0	0	0	0	0	1	0	0	0	0	0	R
906749	1	0	0	0	0	0	0	1	0	0	0	0	0	R
906750	1	0	1	0	0	0	0	1	0	0	0	0	0	R
906751	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906752	0	1	0	0	0	0	0	0	0	0	0	0	0	•
906753	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906754	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906755	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906756	0	0	0	0	0	0	0	0	0	0	0	0	0	•
906757	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906758	0	0	1	0	0	0	0	0	0	0	0	0	0	•
906759	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906760	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906786	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906787	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906788	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906789	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906790	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906791	•	•	•	•	•	•	•	•	•	•	•	•	•	•
906792	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906802	0	0	0	0	0	0	0	2	1	0	0	0	0	•

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
906858	DISCOV BAY	311	282	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
906859	DISCOV BAY	383	550	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	0	0
906860	DISCOV BAY	450	904	DOLLY VARDEN	F	1	0	0	0	0	0	0	0	0	0
906861	DISCOV BAY	410	711	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906862	DISCOV BAY	410	713	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906863	DISCOV BAY	334	312	DOLLY VARDEN	F	0	1	0	0	0	0	0	0	0	0
906864	DISCOV BAY	300	249	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
906865	DISCOV BAY	326	313	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906866	DISCOV BAY	433	906	DOLLY VARDEN	M	0	0	0	1	0	0	0	0	0	0
906867	DISCOV BAY	318	285	DOLLY VARDEN	F	1	0	0	0	0	0	0	0	0	0
906868	DISCOV BAY	410	630	DOLLY VARDEN	F	0	0	0	1	0	0	0	1	1	0
906869	DISCOV BAY	328	332	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
906870	DISCOV BAY	298	280	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906871	DISCOV BAY	312	364	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906872	DISCOV BAY	380	560	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906873	DISCOV BAY	411	660	DOLLY VARDEN	F	0	0	0	1	0	0	0	0	0	0
906874	DISCOV BAY	455	1038	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906875	DISCOV BAY	331	406	DOLLY VARDEN	F	1	0	0	0	0	0	0	0	0	0
906887	DISCOV BAY	255	192	ROCK SOLE	J	0	0	0	1	0	0	0	1	0	0
906888	DISCOV BAY	301	364	ROCK SOLE	F	0	0	0	0	0	1	0	1	0	0
906889	DISCOV BAY	291	286	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
906890	DISCOV BAY	275	261	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
906901	HALLO BAY	365	672	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906902	HALLO BAY	350	641	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
906903	HALLO BAY	369	724	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906904	HALLO BAY	357	600	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
906905	HALLO BAY	335	523	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
906906	HALLO BAY	338	495	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
906907	HALLO BAY	407	1023	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
906908	HALLO BAY	399	872	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906909	HALLO BAY	360	660	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
906910	HALLO BAY	414	903	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
906911	HALLO BAY	359	389	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangelctasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906858	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906859	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906860	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906861	0	0	0	0	0	0	0	0	0	0	0	1	0	R
906862	1	1	0	0	1	0	0	0	0	0	0	1	0	R
906863	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906864	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906865	1	1	0	0	0	0	0	0	0	0	0	0	0	R
906866	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906867	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906868	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906869	1	0	0	0	0	0	0	0	0	0	1	0	0	R
906870	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906871	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906872	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906873	0	0	0	0	0	0	0	0	0	1	0	0	0	R
906874	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906875	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906887	1	0	0	0	0	0	0	1	0	0	0	0	0	•
906888	1	0	0	0	0	0	0	1	0	0	0	0	0	R
906889	1	0	0	0	0	0	0	1	1	0	0	0	0	•
906890	1	0	0	0	0	0	0	1	0	0	0	0	0	•
906901	1	1	1	0	0	1	0	1	1	0	0	0	0	R
906902	1	0	1	0	1	0	0	1	0	0	0	0	0	R
906903	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906904	1	0	0	0	0	0	0	1	0	0	0	0	0	R
906905	1	0	0	0	1	0	0	0	0	0	0	0	0	R
906906	1	0	1	0	0	0	0	0	0	0	0	0	0	•
906907	0	0	1	0	1	0	0	0	0	0	0	0	0	R
906908	1	1	1	0	0	1	0	1	0	0	0	0	0	R
906909	0	0	0	0	0	0	0	1	0	0	0	0	0	R
906910	1	1	0	0	0	0	0	1	0	0	0	0	0	R
906911	1	0	1	0	1	0	0	0	1	0	0	0	0	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
906912	HALLO BAY	445	1030	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	1	0
906913	HALLO BAY	340	496	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906914	HALLO BAY	374	654	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906915	HALLO BAY	453	754	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906916	HALLO BAY	392	550	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906917	HALLO BAY	478	812	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906918	HALLO BAY	318	278	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906919	HALLO BAY	418	728	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906920	HALLO BAY	363	489	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906921	HALLO BAY	344	463	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906922	HALLO BAY	304	312	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
906923	HALLO BAY	396	643	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906924	HALLO BAY	438	949	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906925	HALLO BAY	444	863	DOLLY VARDEN	M	0	0	1	0	0	0	0	0	0	0
906926	HALLO BAY	343	870	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906927	HALLO BAY	410	750	DOLLY VARDEN	M	0	0	1	0	0	0	0	0	0	0
906928	HALLO BAY	404	497	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906929	HALLO BAY	305	300	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906930	HALLO BAY	429	785	DOLLY VARDEN	M	1	0	0	0	0	0	0	0	0	0
906931	HALLO BAY	373	558	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
906932	HALLO BAY	414	802	DOLLY VARDEN	F	0	1	0	1	0	0	0	0	0	0
906933	HALLO BAY	405	610	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906934	HALLO BAY	453	921	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906935	HALLO BAY	505	1121	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906936	HALLO BAY	443	833	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
906937	HALLO BAY	343	357	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906938	HALLO BAY	415	751	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
906939	HALLO BAY	492	1270	DOLLY VARDEN	F	0	0	1	0	0	0	0	1	1	0
906940	HALLO BAY	434	780	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	1	0
906941	HALLO BAY	452	780	DOLLY VARDEN	F	0	0	1	0	0	0	0	0	0	0
906942	HALLO BAY	452	1110	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906943	HALLO BAY	430	851	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906944	HALLO BAY	430	915	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

APPENDIX 2. SUBTIDAL 7 FINAL REPORT - HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906912	1	1	0	0	1	0	0	0	0	0	0	0	0	•
906913	1	0	0	1	0	0	0	0	0	0	0	0	0	•
906914	1	0	1	0	0	0	0	0	0	0	0	0	0	•
906915	•	•	•	•	•	•	•	•	•	•	•	•	•	R
906916	0	0	0	0	1	0	0	0	1	0	0	0	0	R
906917	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906918	1	1	0	0	0	0	0	0	0	0	0	0	0	R
906919	0	0	1	0	0	0	0	0	0	0	0	0	0	R
906920	1	1	0	0	1	0	0	0	0	0	0	0	0	•
906921	0	0	1	0	1	0	0	0	0	0	0	0	0	R
906922	0	0	0	0	1	0	0	0	1	0	0	0	0	•
906923	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906924	1	1	0	0	1	0	0	0	0	0	0	0	0	R
906925	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906926	1	1	0	0	0	0	1	0	0	1	0	0	0	R
906927	0	0	0	0	1	0	0	0	0	0	1	0	0	•
906928	1	1	1	0	0	0	0	0	0	0	0	0	0	•
906929	1	0	0	0	0	0	0	0	0	0	0	0	0	R
906930	0	0	0	1	0	0	0	0	0	0	0	0	0	•
906931	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906932	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906933	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906934	1	0	0	0	0	0	0	0	1	0	0	0	0	•
906935	0	0	0	0	0	0	0	0	1	0	0	0	0	R
906936	0	0	0	0	0	0	0	0	1	0	0	0	0	R
906937	1	0	1	0	0	0	0	0	0	0	0	0	0	•
906938	0	1	0	0	0	0	0	0	0	1	0	0	0	R
906939	0	1	0	0	0	0	0	0	0	0	0	0	0	R
906940	0	0	0	0	0	0	0	0	1	0	0	0	0	•
906941	0	0	1	0	0	0	0	0	0	0	0	0	0	R
906942	1	0	1	0	0	0	0	0	0	0	0	0	0	R
906943	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906944	1	1	0	0	0	0	0	0	0	1	0	0	0	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site_name	length_(mm)	weight_(gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
906945	HALLO BAY	485	984	DOLLY VARDEN	F	0	0	0	1	0	0	0	0	0	0
906946	HALLO BAY	449	254	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906947	HALLO BAY	484	1291	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906948	HALLO BAY	498	1345	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906949	HALLO BAY	349	482	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
906950	HALLO BAY	427	922	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906951	HALLO BAY	444	850	DOLLY VARDEN	M	0	0	1	0	0	0	0	0	0	0
906952	HALLO BAY	388	430	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
906993	HALLO BAY	413	720	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
906994	HALLO BAY	454	665	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
906995	HALLO BAY	508	1477	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
907013	KUKAK BAY	290	*	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
907014	KUKAK BAY	345	375	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	0
907015	KUKAK BAY	325	288	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
907016	KUKAK BAY	345	436	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907017	KUKAK BAY	356	523	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	0
907018	KUKAK BAY	409	591	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
907019	KUKAK BAY	342	396	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907020	KUKAK BAY	315	282	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	1	0
907021	KUKAK BAY	315	297	DOLLY VARDEN	F	0	0	0	0	0	0	0	1	0	0
907022	KUKAK BAY	326	330	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907023	KUKAK BAY	409	690	DOLLY VARDEN	F	0	0	0	1	0	0	0	0	0	0
907024	KUKAK BAY	315	278	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907025	KUKAK BAY	375	598	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907026	KUKAK BAY	333	439	DOLLY VARDEN	M	0	0	0	0	0	0	0	0	0	1
907027	KUKAK BAY	320	301	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907028	KUKAK BAY	325	335	DOLLY VARDEN	F	0	0	0	0	0	0	0	0	0	1
907029	KUKAK BAY	301	271	DOLLY VARDEN	M	0	0	0	0	0	0	0	1	0	0
907030	KUKAK BAY	345	475	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
907031	KUKAK BAY	322	352	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
907032	KUKAK BAY	420	972	DOLLY VARDEN	F	*	*	*	*	*	*	*	*	*	*
907033	KUKAK BAY	455	986	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*
907034	KUKAK BAY	345	749	DOLLY VARDEN	M	*	*	*	*	*	*	*	*	*	*

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
906945	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906946	0	0	0	0	0	0	0	0	0	0	0	0	1	•
906947	1	1	0	0	1	0	0	0	0	0	0	0	1	•
906948	1	1	0	0	0	0	0	0	0	0	0	0	0	R
906949	0	0	0	0	1	0	0	0	0	0	0	0	0	R
906950	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906951	1	0	0	0	0	0	0	0	0	0	0	0	0	•
906952	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906993	0	0	0	0	0	0	0	0	0	0	0	0	1	R
906994	1	1	0	0	0	0	0	0	0	0	0	0	0	•
906995	•	•	•	•	•	•	•	•	•	•	•	•	•	R
907013	0	0	0	0	0	0	0	0	0	0	0	0	0	•
907014	1	0	0	0	1	1	0	0	0	0	0	0	0	R
907015	0	0	0	0	0	0	0	0	0	1	0	0	0	R
907016	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907017	0	0	0	0	0	1	0	0	0	0	0	0	0	•
907018	0	0	0	0	1	1	0	0	0	0	0	0	0	•
907019	0	0	0	0	1	1	0	0	0	0	0	0	0	R
907020	0	0	0	0	0	1	0	0	1	1	0	0	0	R
907021	1	1	1	0	0	1	0	0	0	0	0	0	0	R
907022	0	0	0	0	0	1	0	0	0	1	0	0	0	R
907023	1	0	1	0	1	1	0	0	0	0	0	0	0	R
907024	•	•	•	•	•	•	•	•	•	•	•	•	•	R
907025	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907026	1	0	1	0	1	0	0	0	0	0	0	0	0	•
907027	0	0	0	0	0	0	0	0	0	1	0	0	0	R
907028	1	0	0	0	0	0	0	0	1	0	0	0	0	R
907029	0	0	0	0	0	0	0	0	1	0	0	0	0	•
907030	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907031	0	0	0	0	0	1	0	0	0	0	0	0	0	•
907032	1	0	0	0	0	0	0	0	0	0	0	0	0	•
907033	0	0	0	0	0	0	0	0	1	0	0	0	0	•
907034	0	0	0	0	1	0	0	0	0	0	0	0	0	•

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
907035	KUKAK BAY	370	543	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907036	KUKAK BAY	322	358	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907037	KUKAK BAY	315	325	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907038	KUKAK BAY	290	230	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907039	KUKAK BAY	325	523	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907040	KUKAK BAY	428	895	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
907041	KUKAK BAY	315	270	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907042	KUKAK BAY	447	1223	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907043	KUKAK BAY	400	680	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
907044	KUKAK BAY	325	314	DOLLY VARDEN	F	•	•	•	•	•	•	•	•	•	•
907045	KUKAK BAY	538	437	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907046	KUKAK BAY	306	301	DOLLY VARDEN	M	•	•	•	•	•	•	•	•	•	•
907244	OLSEN BAY	306	270	ROCK SOLE	M	0	•	0	0	0	0	0	1	0	0
907245	OLSEN BAY	270	407	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907246	OLSEN BAY	362	248	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907247	OLSEN BAY	245	665	ROCK SOLE	M	1	0	0	0	0	0	0	0	0	0
907248	OLSEN BAY	330	155	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907249	OLSEN BAY	370	487	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907250	OLSEN BAY	329	692	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907251	OLSEN BAY	355	480	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907252	OLSEN BAY	409	612	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907253	OLSEN BAY	286	902	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907254	OLSEN BAY	320	353	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907255	OLSEN BAY	322	359	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907256	OLSEN BAY	337	375	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907257	OLSEN BAY	317	544	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907258	OLSEN BAY	301	417	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907259	OLSEN BAY	304	331	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907260	OLSEN BAY	259	394	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907261	OLSEN BAY	251	205	ROCK SOLE	F	0	1	0	0	0	0	0	1	0	0
907262	OLSEN BAY	362	208	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907263	OLSEN BAY	285	587	ROCK SOLE	F	0	0	0	0	0	0	0	1	1	0
907264	OLSEN BAY	293	270	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeictasia	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill Ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
907035	1	0	0	0	1	1	0	0	0	1	0	0	0	R
907036	1	0	0	0	1	0	0	0	0	0	0	0	0	*
907037	0	0	0	0	0	1	0	0	0	0	0	0	0	*
907038	0	0	0	0	0	0	0	0	0	0	0	0	1	*
907039	0	0	0	0	1	1	0	0	0	0	0	0	0	*
907040	0	0	1	1	0	1	0	0	0	0	0	0	0	R
907041	0	0	0	0	0	0	0	0	1	0	0	0	0	*
907042	0	0	0	0	0	1	0	0	0	1	0	0	0	*
907043	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907044	0	0	0	0	0	0	0	0	0	1	0	0	1	R
907045	0	0	0	0	0	1	0	0	0	1	0	1	0	*
907046	1	0	0	0	0	0	0	0	0	0	0	0	0	*
907244	1	0	1	0	0	0	0	0	1	0	0	1	0	*
907245	1	1	0	0	0	0	0	0	0	0	0	0	0	R
907246	1	0	1	0	0	0	0	0	1	0	0	0	0	R
907247	0	0	0	0	0	0	0	1	0	0	0	0	0	*
907248	1	0	0	0	0	1	0	1	0	0	0	0	0	R
907249	0	0	0	0	0	0	0	0	1	0	0	0	0	R
907250	1	0	1	0	0	0	0	0	0	0	0	1	0	*
907251	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907252	1	0	1	0	1	0	0	0	0	0	0	1	0	R
907253	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907254	1	0	0	0	0	0	0	0	1	0	0	0	0	*
907255	1	0	0	0	0	0	0	0	0	0	0	0	0	*
907256	1	0	1	0	0	0	0	0	1	0	0	0	0	R
907257	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907258	1	0	1	0	0	0	0	0	0	0	0	0	0	R
907259	1	1	1	0	1	0	0	0	1	0	0	0	0	R
907260	1	0	1	0	0	0	0	0	0	0	0	0	0	*
907261	1	1	0	0	1	0	0	1	0	0	0	0	0	R
907262	1	0	1	0	1	0	0	0	0	0	0	1	0	R
907263	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907264	0	0	0	0	0	0	0	0	0	0	0	0	1	*

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyophonus	liver no significant lesions
907265	OLSEN BAY	342	329	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907266	OLSEN BAY	341	523	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907267	OLSEN BAY	332	520	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907268	OLSEN BAY	316	480	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907269	OLSEN BAY	265	391	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907270	OLSEN BAY	287	231	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907271	OLSEN BAY	333	266	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907272	OLSEN BAY	321	470	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907273	OLSEN BAY	217	546	ROCK SOLE	M	1	0	0	0	0	0	0	0	0	0
907274	OLSEN BAY	396	129	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907275	SQUIRREL B	369	820	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907276	SQUIRREL B	315	724	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907277	SQUIRREL B	317	405	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907278	SQUIRREL B	355	484	ROCK SOLE	F	0	0	0	0	0	0	0	0	1	0
907279	SQUIRREL B	392	632	ROCK SOLE	F	1	0	0	0	0	0	0	0	1	0
907280	SQUIRREL B	383	834	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907281	SQUIRREL B	294	686	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
907282	SQUIRREL B	330	289	ROCK SOLE	F	0	0	0	0	0	0	0	1	1	0
907283	SQUIRREL B	356	425	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907284	SQUIRREL B	345	588	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907285	SQUIRREL B	400	498	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907286	SQUIRREL B	400	876	ROCK SOLE	F	0	0	0	0	0	0	0	0	1	0
907287	SQUIRREL B	350	998	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
907288	SQUIRREL B	338	546	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907289	SQUIRREL B	401	530	ROCK SOLE	F	1	0	0	0	0	0	0	1	0	0
907290	SQUIRREL B	312	935	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907291	SQUIRREL B	316	384	ROCK SOLE	F	0	0	0	0	0	0	0	0	1	0
907292	SQUIRREL B	301	444	ROCK SOLE	M	0	1	0	0	0	0	0	0	0	0
907293	SQUIRREL B	421	386	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907294	SQUIRREL B	303	873	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907295	SQUIRREL B	365	294	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907296	SQUIRREL B	366	730	ROCK SOLE	M	0	0	0	0	0	0	0	1	1	0
907297	SQUIRREL B	345	662	ROCK SOLE	F	0	0	0	0	0	0	0	1	1	0

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeiotasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
907265	0	1	1	0	1	0	0	0	0	0	0	0	0	R
907266	0	0	0	0	0	0	0	0	1	0	0	0	0	R
907267	1	1	0	0	1	0	0	0	0	0	0	0	0	R
907268	1	0	1	0	0	0	0	0	1	0	0	0	0	R
907269	0	0	0	0	1	0	0	1	0	0	0	0	0	R
907270	1	0	0	0	0	0	0	0	1	0	0	0	0	R
907271	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907272	1	0	0	0	1	0	0	0	1	0	0	0	0	R
907273	0	0	0	0	0	1	0	0	0	0	0	0	0	*
907274	1	0	1	0	1	0	0	0	0	0	0	0	0	R
907275	1	0	1	0	0	0	0	0	1	0	0	0	0	*
907276	0	0	0	0	1	0	0	0	0	0	6	0	0	*
907277	0	0	0	0	0	0	0	0	0	0	0	0	1	*
907278	1	0	1	0	0	0	0	0	1	0	0	0	0	R
907279	1	0	0	0	0	0	0	0	0	0	0	1	0	R
907280	1	0	0	0	0	0	0	0	1	0	0	0	0	*
907281	0	0	0	0	0	0	0	0	0	0	0	0	1	*
907282	1	0	1	0	0	0	0	0	1	0	1	0	0	R
907283	1	0	1	0	0	0	0	1	1	0	0	0	0	*
907284	1	0	0	0	1	0	0	1	0	0	0	0	0	R
907285	1	1	1	0	1	0	0	0	1	0	0	1	0	R
907286	1	0	0	0	0	0	0	0	1	0	1	1	0	R
907287	1	0	1	0	1	0	0	0	0	0	0	0	0	*
907288	1	0	0	0	0	0	0	0	0	0	0	0	0	*
907289	1	0	1	0	0	1	0	0	1	0	0	0	0	R
907290	0	0	1	0	0	0	0	0	0	0	0	0	0	*
907291	0	0	0	0	0	0	0	0	0	0	0	0	1	R
907292	0	0	1	0	0	0	0	1	0	0	0	1	0	*
907293	0	0	0	0	0	1	0	0	0	0	0	0	0	R
907294	1	0	0	0	0	0	0	0	1	0	0	0	0	*
907295	1	0	0	0	1	0	0	0	0	0	0	0	0	R
907296	1	0	1	0	1	0	0	0	0	0	0	0	0	R
907297	1	1	0	0	1	0	0	0	0	0	0	1	0	R

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 2. SUBTIDAL 7 FINAL REPORT--HISTOPATHOLOGICAL ANALYSES - LIVER

specimen	site name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflammation	liver ichthyophonus	liver no significant lesions
907298	SQUIRREL B	337	558	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907299	SQUIRREL B	385	535	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907300	SQUIRREL B	344	745	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907301	SQUIRREL B	272	472	ROCK SOLE	M	1	0	0	0	0	0	0	1	0	0
907302	SQUIRREL B	274	234	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907303	SQUIRREL B	315	265	ROCK SOLE	M	0	0	0	0	0	0	0	0	1	0
907304	SQUIRREL B	282	369	ROCK SOLE	M	1	1	0	0	0	0	0	0	0	0
907305	SLEEPY BAY	286	271	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907306	SLEEPY BAY	319	356	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907307	SLEEPY BAY	301	397	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907308	SLEEPY BAY	320	326	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907309	SLEEPY BAY	320	486	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907310	SLEEPY BAY	292	447	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907311	SLEEPY BAY	388	350	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907312	SLEEPY BAY	312	728	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907313	SLEEPY BAY	358	406	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907315	SLEEPY BAY	334	306	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907316	SLEEPY BAY	330	551	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907317	SLEEPY BAY	361	461	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907318	SLEEPY BAY	245	608	ROCK SOLE	J	*	*	*	*	*	*	*	*	*	*
907319	SLEEPY BAY	315	160	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907320	SLEEPY BAY	360	345	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907321	SLEEPY BAY	310	573	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907322	SLEEPY BAY	315	368	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907323	SLEEPY BAY	264	472	ROCK SOLE	J	*	*	*	*	*	*	*	*	*	*
907324	SLEEPY BAY	270	225	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907325	SLEEPY BAY	325	259	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907326	SLEEPY BAY	350	142	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907327	SLEEPY BAY	325	582	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907328	SLEEPY BAY	350	431	ROCK SOLE	0	0	0	0	0	0	1	0	0	0	0
907329	SLEEPY BAY	249	595	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*
907330	SLEEPY BAY	334	182	ROCK SOLE	M	*	*	*	*	*	*	*	*	*	*
907331	SLEEPY BAY	395	489	ROCK SOLE	F	*	*	*	*	*	*	*	*	*	*

Lesion codes: 0=condition not observed; 1=condition observed; *= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangeistasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
907298	1	0	0	0	0	0	0	0	0	0	0	0	0	R
907299	1	0	0	0	0	0	0	0	0	0	0	1	0	R
907300	1	0	0	•	0	0	0	0	1	0	0	0	0	R
907301	0	0	0	0	0	0	0	0	0	0	0	0	1	•
907302	1	0	0	0	0	1	0	0	0	0	0	1	0	•
907303	1	1	0	0	1	0	0	0	1	0	0	0	0	•
907304	1	0	0	1	0	0	0	1	1	0	0	0	0	•
907305	1	0	0	0	0	0	0	0	0	0	0	0	0	•
907306	0	1	0	0	0	0	0	1	1	0	0	0	0	•
907307	1	1	1	0	0	0	0	1	0	0	0	0	0	•
907308	1	0	0	0	0	0	0	1	1	0	0	0	0	•
907309	0	0	0	0	0	0	0	1	0	0	0	0	0	•
907310	0	0	0	0	0	0	0	1	0	0	0	0	0	•
907311	1	0	1	0	0	0	0	1	0	0	0	1	0	•
907312	1	0	0	0	0	0	0	1	0	0	0	1	0	•
907313	1	0	0	0	0	0	0	1	1	0	0	0	0	•
907315	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907316	1	0	1	0	0	0	0	0	0	0	0	0	0	•
907317	1	0	0	0	0	0	0	1	0	0	0	1	0	•
907318	1	0	1	0	1	0	0	1	0	0	0	0	0	•
907319	0	0	0	0	0	0	0	0	0	0	0	0	1	•
907320	1	0	1	0	0	0	0	1	0	0	0	0	0	•
907321	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907322	1	0	0	0	0	0	0	0	1	0	0	0	0	•
907323	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907324	0	0	1	1	0	0	0	0	1	0	0	0	0	•
907325	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907326	1	0	0	0	1	0	0	1	0	0	0	0	0	•
907327	1	0	1	0	0	0	0	0	0	0	0	0	0	•
907328	1	0	0	0	0	0	0	1	0	0	0	1	0	•
907329	1	0	0	0	0	0	0	0	0	0	0	0	0	•
907330	1	0	0	0	0	0	0	1	1	0	0	1	0	•
907331	0	0	0	0	0	0	0	0	1	0	0	0	0	•

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

specimen	site_name	length (mm)	weight (gm)	species	sex	liver necrosis	liver nuclear pleomorphism	liver congestion	liver fatty change	liver hydropic vacuolation	liver foci of cellular alteration	liver neoplasms	liver inflamation	liver ichthyphonus	liver no significant lesions
907332	SLEEPY BAY	325	963	ROCK SOLE	0	•	•	•	•	•	•	•	•	•	•
907333	SLEEPY BAY	325	419	ROCK SOLE	M	•	•	•	•	•	•	•	•	•	•
907334	SLEEPY BAY	292	435	ROCK SOLE	F	•	•	•	•	•	•	•	•	•	•
907335	SNUG HBR	275	321	ROCK SOLE	M	•	•	•	•	•	•	•	•	•	•
907336	SNUG HBR	273	244	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907337	SNUG HBR	290	251	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907338	SNUG HBR	336	311	ROCK SOLE	F	1	0	0	0	0	0	0	0	0	0
907339	SNUG HBR	332	464	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907340	SNUG HBR	264	239	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907341	SNUG HBR	333	513	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907342	SNUG HBR	281	297	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907343	SNUG HBR	280	304	ROCK SOLE	F	•	0	0	0	0	0	0	0	0	1
907344	SNUG HBR	412	856	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907345	SNUG HBR	310	411	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907346	SNUG HBR	272	276	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907347	SNUG HBR	311	401	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907348	SNUG HBR	270	222	ROCK SOLE	M	0	0	0	0	0	0	0	1	0	0
907349	SNUG HBR	328	421	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907350	SNUG HBR	280	385	ROCK SOLE	F	1	1	0	0	0	0	0	0	0	0
907351	SNUG HBR	264	244	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907352	SNUG HBR	257	219	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907353	SNUG HBR	283	272	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907354	SNUG HBR	250	194	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907355	SNUG HBR	290	320	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907356	SNUG HBR	279	323	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	0
907357	SNUG HBR	279	250	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907358	SNUG HBR	283	293	ROCK SOLE	F	0	0	0	0	0	0	0	1	0	0
907359	SNUG HBR	280	276	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907360	SNUG HBR	250	193	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907361	SNUG HBR	244	183	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	0
907362	SNUG HBR	245	210	ROCK SOLE	M	0	0	0	0	0	0	0	0	0	1
907363	SNUG HBR	250	210	ROCK SOLE	F	0	0	0	0	0	0	0	0	0	1
907364	SNUG HBR	266	279	ROCK SOLE	M	0	1	0	0	0	0	0	0	0	0

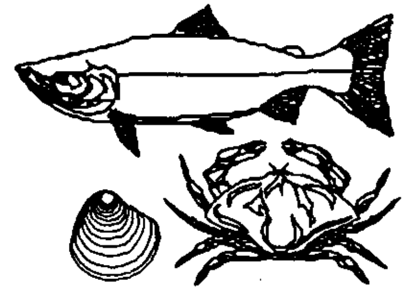
Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
Sex codes: M=Male, F=Female, J=Juvenile (too young to distinguish sex), 0=no information

APPENDIX 2. SUBTIDAL 7 FINAL REPORT - HISTOPATHOLOGICAL ANALYSES - GILL

specimen	gill respitory epithelium hyperplasia	gill clubbing	gill mucus cell hyperplasia	gill chloride cell hyperplasia	gill telangelctasis	gill Trichodina	gill respitory epithelium necrosis	gill trematode	gill inflamation	gill microsporideans	gill Ichthyophonus	gill lamellar thickness	gill no significant lesions	ovary histology
907332	1	0	0	1	0	0	0	0	1	0	0	0	0	•
907333	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907334	1	1	0	0	0	0	0	1	1	0	0	0	0	•
907335	0	0	0	0	0	0	0	1	1	0	0	0	0	•
907336	1	0	0	0	0	0	0	1	0	0	0	0	0	•
907337	1	0	1	0	0	0	0	1	1	0	0	0	0	R
907338	1	0	1	0	0	0	0	1	0	0	0	0	0	R
907339	0	0	1	0	1	0	0	0	1	0	0	1	0	•
907340	1	0	0	0	0	0	0	1	0	0	0	0	0	R
907341	1	0	1	0	0	0	0	1	1	0	0	0	0	R
907342	1	1	0	0	1	0	0	1	1	0	0	0	0	R
907343	1	0	0	0	0	0	0	1	1	0	0	0	0	R
907344	0	0	1	0	0	0	0	0	0	0	0	0	0	R
907345	1	0	1	0	0	0	0	1	0	0	0	0	0	R
907346	0	0	0	0	0	0	0	1	0	0	0	0	0	R
907347	1	0	1	0	0	0	0	1	0	0	0	1	0	R
907348	0	0	0	0	1	0	0	0	0	0	1	0	0	•
907349	1	0	0	0	0	0	0	1	0	0	0	0	0	R
907350	1	0	1	0	0	0	0	1	0	0	0	1	0	R
907351	1	1	1	0	0	0	0	1	1	0	0	1	0	R
907352	1	0	0	0	1	0	1	1	1	0	0	0	0	•
907353	1	0	0	0	0	0	0	0	1	0	0	0	0	R
907354	1	0	0	0	1	0	0	0	0	0	0	0	0	R
907355	•	•	•	•	•	•	•	•	•	•	•	•	•	R
907356	1	0	0	0	0	0	0	1	1	0	0	0	0	•
907357	0	0	0	0	0	0	0	0	0	0	0	1	0	•
907358	0	0	0	0	0	0	0	1	1	0	0	0	0	R
907359	1	0	1	0	0	0	0	1	1	0	0	1	0	R
907360	1	0	0	0	1	0	0	0	0	0	0	0	0	R
907361	1	1	1	0	0	0	0	0	0	0	0	0	0	R
907362	1	0	0	0	1	1	0	1	0	0	0	0	0	•
907363	1	0	1	0	0	0	0	0	0	0	0	0	0	R
907364	1	0	0	0	0	0	0	1	0	0	0	0	0	R

Lesion codes: 0=condition not observed; 1=condition observed; •= tissue not examined
R= ovary histology examined and reported in Appendix 3. (Reproductive studies)

APPENDIX 3



APPENDIX 3. SUBTIDAL 7 FINAL REPORT
ANALYSIS OF REPRODUCTIVE FUNCTION

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6101	dolly varden	Yakutat	1.01	5.33	1.41	2	0	early developing	regressed
90.6102	dolly varden	Yakutat	3.99	3.38	1.79	4	0	early developing	vitellogenic
90.6105	dolly varden	Yakutat	3.86	9.77	1.50	3	2	yolked	previtellogenic
90.6106	dolly varden	Yakutat	0.69	2.67	1.46	3	0	yolked	previtellogenic
90.6107	dolly varden	Yakutat	0.97	3.91	1.44	3	0	yolked	previtellogenic
90.6108	dolly varden	Yakutat	2.44	10.12	1.38	3	0	yolked	previtellogenic
90.6109	dolly varden	Yakutat	0.79	12.13	1.12	3	0	early developing	previtellogenic
90.6112	dolly varden	Yakutat	1.22	5.25	1.45	3	0	early developing	previtellogenic
90.6113	dolly varden	Yakutat	0.94	4.54	1.46	3	0	yolked	previtellogenic
90.6116	dolly varden	Yakutat	1.90	2.76	2.77	3	0	yolked	previtellogenic
90.6127	yellowfin sole	Yakutat	0.74		19.05			spawning	
90.6128	yellowfin sole	Yakutat	2.55		29.41			hydrated	
90.6129	yellowfin sole	Yakutat	2.73		1.72			early developing	
90.6130	yellowfin sole	Yakutat	6.89		0.96			hydrated	
90.6183	yellowfin sole	Olsen Bay	0.35		0.96			immature	
90.6184	yellowfin sole	Olsen Bay	5.34		13.49			hydrated	
90.6185	yellowfin sole	Olsen Bay	5.36		6.27			yolked	
90.6186	yellowfin sole	Olsen Bay	4.37		6.29			yolked	
90.6187	yellowfin sole	Olsen Bay	0.67		2.11			early developing	
90.6188	yellowfin sole	Olsen Bay	0.00		0.83			immature	
90.6196	dolly varden	Olsen Bay	0.43	5.52	1.85	3	0	early developing	previtellogenic
90.6197	dolly varden	Olsen Bay	0.70	4.95	1.56	4	0	early developing	vitellogenic

1. maturation stage determined hisologically: 1 = regressed; 2 = late regressed; 3 = pre-vitellogenic; 4 = vitellogenic; 5 = ripe (hydrated eggs visible); 6 = spawning; 7 = spawned out.
2. atresia severity: 0 = none; 1 = minimal; 2 = minimal to mild; 3 = mild; 4 = mild to moderate; 5 = moderate; 6 = moderate to severe; 7 = severe.

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat. stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6198	dolly varden	Olsen Bay	0.18	2.34	1.78	3	0	early developing	previtellogenic
90.6199	dolly varden	Olsen Bay	1.70	2.74	1.47	3	0	early developing	previtellogenic
90.6201	dolly varden	Olsen Bay	0.91	1.74	2.34	4	0	yolked	vitellogenic
90.6206	yellowfin sole	Olsen Bay	3.50		9.16			yolked	
90.6207	yellowfin sole	Olsen Bay	1.64		3.52			yolked	
90.6208	yellowfin sole	Olsen Bay	2.33		2.23			early developing	
90.6209	yellowfin sole	Olsen Bay	6.23		4.92			early developing	
90.6210	yellowfin sole	Olsen Bay	3.45		2.63			early developing	
90.6211	yellowfin sole	Olsen Bay			6.47			no information	
90.6212	yellowfin sole	Olsen Bay	4.00		1.41			yolked	
90.6213	yellowfin sole	Olsen Bay	0.34		3.70			early developing	
90.6214	yellowfin sole	Olsen Bay	0.74		0.74			yolked	
90.6215	yellowfin sole	Olsen Bay	0.06					immature	
90.6221	yellowfin sole	Olsen Bay	4.98		6.94			yolked	
90.6222	yellowfin sole	Olsen Bay	5.30		10.78			yolked	
90.6223	yellowfin sole	Olsen Bay	1.75		4.02			yolked	
90.6224	yellowfin sole	Olsen Bay	1.81		16.59			hydrated	
90.6225	yellowfin sole	Olsen Bay	0.86		3.66			yolked	
90.6226	yellowfin sole	Olsen Bay	0.15		1.67			immature	
90.6227	yellowfin sole	Olsen Bay	0.11		1.79			immature	
90.6228	yellowfin sole	Olsen Bay	0.14		0.88			immature	
90.6229	yellowfin sole	Olsen Bay	0.11		1.92			immature	
90.6231	dolly varden	Olsen Bay	3.18	4.30	1.39	4	0	yolked	vitellogenic
90.6232	dolly varden	Olsen Bay	0.88	4.72	1.72	3	0	yolked	previtellogenic
90.6233	dolly varden	Olsen Bay	0.11	0.93	2.78			early developing	
90.6246	dolly varden	Rocky Bay	0.40	3.12	1.45	3	0	yolked	previtellogenic
90.6247	dolly varden	Rocky Bay	0.19	5.88	1.63	3	0	early developing	previtellogenic
90.6248	dolly varden	Rocky Bay	1.10	4.49	0.76	3	0	yolked	previtellogenic
90.6250	dolly varden	Rocky Bay	0.50	2.10	1.22	4	0	yolked	vitellogenic
90.6251	dolly varden	Rocky Bay	0.58	2.38	1.66	4	0	yolked	vitellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6252	dolly varden	Rocky Bay	0.61	3.17	1.21	3	0	yolked	previtellogenic
90.6255	dolly varden	Rocky Bay	1.43	6.90	1.47	3	2	yolked	previtellogenic
90.6256	dolly varden	Rocky Bay	0.51	2.62	0.69			no information	
90.6257	dolly varden	Rocky Bay	0.59	2.30		4	1	yolked	vitellogenic
90.6258	dolly varden	Rocky Bay	0.36	4.16		3	0	no information	previtellogenic
90.6297	dolly varden	Snug Harbor	1.52	4.87	1.31	4	1	yolked	vitellogenic
90.6298	yellowfin sole	Snug Harbor	4.93		16.60			hydrated	
90.6299	yellowfin sole	Snug Harbor	1.32		9.50			hydrated	
90.6300	yellowfin sole	Snug Harbor	2.03		13.12			hydrated	
90.6301	yellowfin sole	Snug Harbor	3.28		7.05			yolked	
90.6302	yellowfin sole	Snug Harbor	2.48		6.90			yolked	
90.6303	yellowfin sole	Snug Harbor	1.59		2.05			yolked	
90.6304	yellowfin sole	Snug Harbor	2.74		16.92			hydrated	
90.6305	yellowfin sole	Snug Harbor	4.54		10.67			hydrated	
90.6306	yellowfin sole	Snug Harbor	2.58		13.42			hydrated	
90.6307	yellowfin sole	Snug Harbor	2.06		4.61			yolked	
90.6308	dolly varden	Snug Harbor	2.44	18.54	1.14	3	3	yolked	previtellogenic
90.6309	dolly varden	Snug Harbor	1.72	12.36	0.80	3	1	yolked	previtellogenic
90.6310	yellowfin sole	Snug Harbor	7.49		11.14			yolked	
90.6311	yellowfin sole	Snug Harbor	2.86		9.44			spawning	
90.6312	yellowfin sole	Snug Harbor	3.01		4.38			yolked	
90.6313	yellowfin sole	Snug Harbor	3.78		12.67			hydrated	
90.6314	yellowfin sole	Snug Harbor	4.50		13.73			spawning	
90.6315	yellowfin sole	Snug Harbor	10.11		7.45			yolked	
90.6316	yellowfin sole	Snug Harbor	5.43		10.07			spawning	
90.6317	yellowfin sole	Snug Harbor	0.27		1.27			early developing	
90.6318	yellowfin sole	Snug Harbor	3.33		6.33			hydrated	
90.6319	yellowfin sole	Snug Harbor	0.19		0.87			immature	
90.6320	yellowfin sole	Snug Harbor	0.14		0.95			immature	
90.6321	yellowfin sole	Snug Harbor	0.69		5.56			yolked	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6322	yellowfin sole	Snug Harbor	1.74		3.97			yolked	
90.6323	yellowfin sole	Snug Harbor	0.19		1.12			immature	
90.6324	yellowfin sole	Snug Harbor	0.07		0.76			immature	
90.6325	yellowfin sole	Snug Harbor	1.43		6.51			early developing	
90.6326	yellowfin sole	Snug Harbor	4.05		4.32			yolked	
90.6327	yellowfin sole	Snug Harbor	0.07		0.77			immature	
90.6328	yellowfin sole	Snug Harbor	2.49		3.88			yolked	
90.6329	yellowfin sole	Snug Harbor	6.69		10.33			spawning	
90.6331	dolly varden	Snug Harbor	0.89	5.46	0.91	3	0	yolked	previtellogenic
90.6332	dolly varden	Snug Harbor	0.82	3.19	1.13	3	0	yolked	previtellogenic
90.6333	dolly varden	Snug Harbor	3.30	5.14	1.01	3	1	yolked	previtellogenic
90.6336	dolly varden	Snug Harbor	1.01	3.59	0.99	3	3	yolked	previtellogenic
90.6338	dolly varden	Snug Harbor			1.02	3	5	early developing	previtellogenic
90.6339	dolly varden	Snug Harbor			0.77	3	0	yolked	previtellogenic
90.6340	dolly varden	Snug Harbor	0.67	2.64	0.84	3	2	yolked	previtellogenic
90.6342	dolly varden	Snug Harbor	0.95	7.82	0.58			yolked	
90.6343	dolly varden	Snug Harbor	0.83	2.28	0.85	4	0	yolked	vitellogenic
90.6348	dolly varden	Snug Harbor	0.78	4.90	1.37	3	2	early developing	previtellogenic
90.6349	dolly varden	Snug Harbor	1.11	3.86	0.00	3	0	yolked	previtellogenic
90.6351	dolly varden	Snug Harbor	0.58	3.07	0.00	3	2	yolked	previtellogenic
90.6352	dolly varden	Snug Harbor	1.26	2.75	1.60	3	0	yolked	previtellogenic
90.6379	dolly varden	Sleepy Bay	1.57	8.62	0.90	4	1	yolked	vitellogenic
90.6381	dolly varden	Sleepy Bay	0.94	11.36	0.93	3	0	yolked	previtellogenic
90.6383	dolly varden	Sleepy Bay	4.11	10.92	1.19	3	0	yolked	previtellogenic
90.6384	dolly varden	Sleepy Bay	0.49	2.08	0.94	3	0	yolked	previtellogenic
90.6386	dolly varden	Sleepy Bay	3.00	5.48	1.55	4	3	yolked	vitellogenic
90.6388	dolly varden	Sleepy Bay	2.20	3.40	1.19	4	1	yolked	vitellogenic
90.6393	dolly varden	Sleepy Bay	0.51	2.03	1.80	4	2	yolked	vitellogenic
90.6394	dolly varden	Sleepy Bay	1.40	4.58	1.14	4	0	yolked	vitellogenic
90.6395	dolly varden	Sleepy Bay	0.97	3.64	1.47	3	0	yolked	previtellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6397	dolly varden	Sleepy Bay	4.42	4.49	1.14	3	2	yolked	previtellogenic
90.6401	dolly varden	Sleepy Bay	3.32	6.66	1.27	3	2	yolked	previtellogenic
90.6404	yellowfin sole	Sleepy Bay	3.59		15.71			hydrated	
90.6406	yellowfin sole	Sleepy Bay	4.55		6.98			hydrated	
90.6411	yellowfin sole	Sleepy Bay	4.93		20.86			hydrated	
90.6413	yellowfin sole	Sleepy Bay	3.07		18.11			hydrated	
90.6436	yellowfin sole	Sleepy Bay	7.40		9.05			yolked	
90.6438	yellowfin sole	Sleepy Bay	4.93		11.62			hydrated	
90.6439	yellowfin sole	Sleepy Bay	2.48		3.45			yolked	
90.6440	yellowfin sole	Sleepy Bay	3.97		6.74			hydrated	
90.6441	yellowfin sole	Sleepy Bay	1.82		2.68			yolked	
90.6442	yellowfin sole	Sleepy Bay	2.34		5.21			hydrated	
90.6443	yellowfin sole	Sleepy Bay	3.45		18.39			hydrated	
90.6444	yellowfin sole	Sleepy Bay	0.99		6.67			hydrated	
90.6450	dolly varden	Sleepy Bay	0.41	4.56	0.99	3	0	yolked	previtellogenic
90.6451	dolly varden	Sleepy Bay	1.62	3.32	1.40	3	0	yolked	previtellogenic
90.6452	dolly varden	Sleepy Bay	0.47	3.13	1.25	3	0	yolked	previtellogenic
90.6453	dolly varden	Sleepy Bay	0.83	5.08	1.39	3	0	yolked	previtellogenic
90.6455	dolly varden	Sleepy Bay	0.36	4.57	1.10	3	3	no information	previtellogenic
90.6456	dolly varden	Sleepy Bay	0.91	5.40	1.24	3	0	yolked	previtellogenic
90.6457	dolly varden	Sleepy Bay	0.11	2.18	0.93	3	2	yolked	previtellogenic
90.6460	dolly varden	Sleepy Bay	0.71	1.98	1.08	4	0	yolked	vitellogenic
90.6461	dolly varden	Sleepy Bay	0.42	2.19	1.36	4	1	yolked	vitellogenic
90.6462	dolly varden	Sleepy Bay	0.79	4.10	1.10	3	2	yolked	previtellogenic
90.6463	dolly varden	Sleepy Bay	0.55	2.14	1.27	3	0	no information	previtellogenic
90.6481	yellowfin sole	Squirrel Bay	1.33		4.03			early developing	
90.6482	yellowfin sole	Squirrel Bay	7.37		15.82			hydrated	
90.6492	yellowfin sole	Squirrel Bay	0.09		1.16			early developing	
90.6493	yellowfin sole	Squirrel Bay	2.22		4.68			yolked	
90.6495	dolly varden	Squirrel Bay			1.28	2	0	yolked	regressed

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6496	dolly varden	Squirrel Bay			0.93	3	0	no information	previtellogenic
90.6501	dolly varden	Squirrel Bay			2.00			yolked	
90.6503	dolly varden	Squirrel Bay			1.12	2	0	yolked	regressed
90.6504	dolly varden	Squirrel Bay			0.80	3	0	early developing	previtellogenic
90.6505	dolly varden	Squirrel Bay			0.93	4	0	yolked	vitellogenic
90.6509	dolly varden	Squirrel Bay			1.60	4	0	yolked	vitellogenic
90.6510	dolly varden	Squirrel Bay			1.07			early developing	
90.6511	dolly varden	Squirrel Bay			1.49			yolked	
90.6513	dolly varden	Squirrel Bay			1.46			yolked	
90.6517	yellowfin sole	Squirrel Bay	5.48		10.14			yolked	
90.6518	yellowfin sole	Squirrel Bay	2.57		9.89			yolked	
90.6519	yellowfin sole	Squirrel Bay	4.40		11.06			yolked	
90.6520	yellowfin sole	Squirrel Bay	1.67		11.36			hydrated	
90.6521	yellowfin sole	Squirrel Bay	4.63		7.75			yolked	
90.6522	yellowfin sole	Squirrel Bay	0.06		6.70			yolked	
90.6523	yellowfin sole	Squirrel Bay	6.33		3.21			yolked	
90.6524	yellowfin sole	Squirrel Bay	0.15		1.82			immature	
90.6538	dolly varden	Squirrel Bay			1.76			yolked	
90.6539	dolly varden	Squirrel Bay	1.61	4.43	0.83	3	0	yolked	previtellogenic
90.6540	dolly varden	Squirrel Bay	2.38	5.63	0.59			yolked	
90.6541	dolly varden	Squirrel Bay	0.15	3.45	0.76			yolked	
90.6564	yellowfin sole	Sunny Cove	0.00		18.18			yolked	
90.6565	yellowfin sole	Sunny Cove	2.40		9.28			yolked	
90.6566	yellowfin sole	Sunny Cove	2.62		10.26			hydrated	
90.6567	yellowfin sole	Sunny Cove	1.24		8.38			hydrated	
90.6568	yellowfin sole	Sunny Cove	2.29		15.53			hydrated	
90.6569	yellowfin sole	Sunny Cove	0.61		1.90			early developing	
90.6570	yellowfin sole	Sunny Cove	0.38		1.28			early developing	
90.6571	yellowfin sole	Sunny Cove	0.70		6.71			no information	
90.6572	yellowfin sole	Sunny Cove	0.67		8.20			hydrated	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site_name	plasma_estradiol ng/ml	plasma_GTH1 ng/ml	gonadosomatic index	histological mat_stage [1]	atresia severity [2]	gross_mat stage	hist_mat
90.6573	yellowfin sole	Sunny Cove	1.61		36.91			spawning	
90.6574	yellowfin sole	Sunny Cove	0.74		13.35			hydrated	
90.6576	yellowfin sole	Sunny Cove	1.08		12.27			hydrated	
90.6577	yellowfin sole	Sunny Cove	2.29		7.49			no information	
90.6578	yellowfin sole	Sunny Cove	1.49		9.50			yolked	
90.6579	yellowfin sole	Sunny Cove	0.28		2.19			early developing	
90.6580	yellowfin sole	Sunny Cove	0.78		6.09			yolked	
90.6581	yellowfin sole	Sunny Cove	0.41		5.21			hydrated	
90.6582	yellowfin sole	Sunny Cove	1.34		6.67			yolked	
90.6583	yellowfin sole	Sunny Cove	0.73		6.88			yolked	
90.6584	yellowfin sole	Sunny Cove	1.03		10.45			yolked	
90.6585	yellowfin sole	Sunny Cove	0.16		1.59			yolked	
90.6586	yellowfin sole	Sunny Cove	0.21		3.00			early developing	
90.6603	dolly varden	Sunny Cove			1.61	3	0	yolked	previtellogenic
90.6604	dolly varden	Sunny Cove			1.22	3	0	yolked	previtellogenic
90.6605	dolly varden	Sunny Cove			0.99	4	0	yolked	vitellogenic
90.6606	dolly varden	Sunny Cove			0.93			yolked	
90.6608	dolly varden	Sunny Cove			2.01	4	0	yolked	vitellogenic
90.6609	dolly varden	Sunny Cove			1.74			yolked	
90.6610	dolly varden	Sunny Cove			1.27			yolked	
90.6612	dolly varden	Sunny Cove			1.40			yolked	
90.6613	yellowfin sole	Sunny Cove	0.75		3.94			yolked	
90.6614	yellowfin sole	Sunny Cove	2.00		3.92			yolked	
90.6615	dolly varden	Sunny Cove			1.92	4	0	yolked	vitellogenic
90.6616	dolly varden	Sunny Cove			0.82	4	0	yolked	vitellogenic
90.6617	dolly varden	Sunny Cove			1.36			yolked	
90.6618	dolly varden	Sunny Cove			1.36			yolked	
90.6619	dolly varden	Sunny Cove			0.48			early developing	
90.6620	dolly varden	Sunny Cove			0.99	3	0	yolked	previtellogenic
90.6621	dolly varden	Sunny Cove			1.37	4	0	yolked	vitellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6622	dolly varden	Sunny Cove			2.05			yolked	
90.6623	dolly varden	Sunny Cove			1.87			yolked	
90.6624	dolly varden	Sunny Cove			0.71			yolked	
90.6643	yellowfin sole	Black Bay	1.17		18.73			early developing	
90.6644	yellowfin sole	Black Bay	2.11		21.05			spawning	
90.6645	yellowfin sole	Black Bay	2.74		19.23			spawning	
90.6646	yellowfin sole	Black Bay	3.63		6.33			hydrated	
90.6684	dolly varden	Tonsina Cove	0.95	1.87	2.11	4	4	early developing	vitellogenic
90.6685	dolly varden	Tonsina Cove	2.64	1.97	3.21	4	0	yolked	vitellogenic
90.6686	dolly varden	Tonsina Cove	1.51	1.41	2.40	4	0	early developing	vitellogenic
90.6687	dolly varden	Tonsina Cove	1.52	3.24		3	2	yolked	previtellogenic
90.6689	dolly varden	Tonsina Cove	2.48	5.33	1.88	3	0	yolked	previtellogenic
90.6691	dolly varden	Tonsina Cove	2.46	4.98	2.33	4	3	yolked	vitellogenic
90.6693	dolly varden	Tonsina Cove	1.79	2.00	1.87	4	4	yolked	vitellogenic
90.6694	yellowfin sole	Tonsina Cove	4.30		10.24			early developing	
90.6695	yellowfin sole	Tonsina Cove	2.94		10.88			yolked	
90.6696	yellowfin sole	Tonsina Cove	2.87		10.49			hydrated	
90.6697	yellowfin sole	Tonsina Cove	1.72		9.30			spawning	
90.6698	yellowfin sole	Tonsina Cove	2.86		9.41			spawning	
90.6699	yellowfin sole	Tonsina Cove	3.88		7.34			hydrated	
90.6711	dolly varden	Tonsina Cove	3.20	4.27	0.94	4	3	yolked	vitellogenic
90.6712	dolly varden	Tonsina Cove	5.64	3.86	1.31	3	5	no information	previtellogenic
90.6713	dolly varden	Tonsina Cove	1.93	4.04	3.57	4	4	yolked	vitellogenic
90.6718	dolly varden	Windy Bay	2.44	10.61	0.92	2	4	yolked	regressed
90.6720	dolly varden	Windy Bay	1.50	6.97	0.63	3	0	yolked	previtellogenic
90.6721	dolly varden	Windy Bay	2.09	6.19	1.06	4	0	yolked	vitellogenic
90.6722	dolly varden	Windy Bay	3.59	4.68	1.18	4	0	yolked	vitellogenic
90.6723	dolly varden	Windy Bay	10.13	12.04	0.66	4	0	yolked	vitellogenic
90.6725	dolly varden	Windy Bay	6.82	4.47	1.08	4	1	yolked	vitellogenic
90.6727	dolly varden	Windy Bay	5.20	4.94	0.88	4	0	early developing	vitellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6728	dolly varden	Windy Bay	0.55	4.41	1.21	2	0	yolked	regressed
90.6729	dolly varden	Windy Bay	3.38	7.34	0.77	2	0	early developing	regressed
90.6731	dolly varden	Windy Bay	2.44	7.99	0.48	3	0	early developing	previtellogenic
90.6733	dolly varden	Windy Bay	6.80	3.31	0.76	4	0	early developing	vitellogenic
90.6735	dolly varden	Windy Bay	1.71	2.61	1.06	4	0	yolked	vitellogenic
90.6736	dolly varden	Windy Bay	2.87	16.99	0.45	3	0	immature	previtellogenic
90.6737	dolly varden	Windy Bay	2.62	10.88	0.62	3	0	yolked	previtellogenic
90.6740	dolly varden	Windy Bay	3.73	3.52	1.21	4	0	early developing	vitellogenic
90.6761	yellowfin sole	Windy Bay	10.37		17.74			hydrated	
90.6762	yellowfin sole	Windy Bay	6.29		12.28			hydrated	
90.6763	yellowfin sole	Windy Bay	0.13		0.87			immature	
90.6786	dolly varden	Windy Bay	2.81	8.01	2.80	3	0	early developing	previtellogenic
90.6789	dolly varden	Windy Bay	3.23	6.06	1.87	4	2	early developing	vitellogenic
90.6790	dolly varden	Windy Bay	5.38	7.92	1.57			early developing	
90.6792	dolly varden	Windy Bay	1.58	1.45	1.05	3	0	immature	previtellogenic
90.6796	yellowfin sole	Windy Bay	8.07		25.22			hydrated	
90.6797	yellowfin sole	Windy Bay	11.42		16.74			spawning	
90.6798	yellowfin sole	Windy Bay	3.55		19.30			spawning	
90.6799	yellowfin sole	Windy Bay	8.52		9.05			hydrated	
90.6800	yellowfin sole	Windy Bay	4.70		10.34			spawning	
90.6801	yellowfin sole	Windy Bay	14.38					yolked	
90.6813	yellowfin sole	Discoverer Bay	3.33		10.09			spawning	
90.6814	yellowfin sole	Discoverer Bay	12.57		13.91			hydrated	
90.6815	yellowfin sole	Discoverer Bay	5.47		12.57			yolked	
90.6816	yellowfin sole	Discoverer Bay	6.89		6.65			early developing	
90.6817	yellowfin sole	Discoverer Bay	2.92		6.58			yolked	
90.6818	yellowfin sole	Discoverer Bay	7.64		18.46			hydrated	
90.6819	yellowfin sole	Discoverer Bay	8.76		10.44			spawning	
90.6820	yellowfin sole	Discoverer Bay	2.59		8.60			yolked	
90.6821	yellowfin sole	Discoverer Bay	7.42		15.03			yolked	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6822	yellowfin sole	Discoverer Bay	25.57		8.78			yolked	
90.6823	yellowfin sole	Discoverer Bay	2.41		7.01			yolked	
90.6824	yellowfin sole	Discoverer Bay	2.32		5.32			spawning	
90.6825	yellowfin sole	Discoverer Bay	8.10		8.70			yolked	
90.6826	yellowfin sole	Discoverer Bay	10.10		13.31			spawning	
90.6827	yellowfin sole	Discoverer Bay	8.59		8.20			yolked	
90.6828	yellowfin sole	Discoverer Bay	2.22		5.41			yolked	
90.6829	yellowfin sole	Discoverer Bay	12.04		9.60			no information	
90.6830	yellowfin sole	Discoverer Bay	8.69		7.07			yolked	
90.6831	yellowfin sole	Discoverer Bay	4.60		6.99			yolked	
90.6832	yellowfin sole	Discoverer Bay	24.55		6.55			yolked	
90.6833	yellowfin sole	Discoverer Bay	11.47		8.00			yolked	
90.6834	yellowfin sole	Discoverer Bay	13.64		10.50			yolked	
90.6835	yellowfin sole	Discoverer Bay	1.90		10.64			yolked	
90.6836	yellowfin sole	Discoverer Bay	6.95		10.00			yolked	
90.6837	yellowfin sole	Discoverer Bay	4.85		7.24			yolked	
90.6838	yellowfin sole	Discoverer Bay	5.37		0.53			yolked	
90.6839	yellowfin sole	Discoverer Bay	7.69		11.76			yolked	
90.6840	yellowfin sole	Discoverer Bay	0.54		14.78			yolked	
90.6841	yellowfin sole	Discoverer Bay	8.18		7.69			yolked	
90.6842	yellowfin sole	Discoverer Bay			5.05			yolked	
90.6858	dolly varden	Discoverer Bay	2.27	2.63		3	4	early developing	previtellogenic
90.6860	dolly varden	Discoverer Bay	3.90	1.90		3	2	yolked	previtellogenic
90.6861	dolly varden	Discoverer Bay	4.58	2.88	0.77	4	1	yolked	vitellogenic
90.6862	dolly varden	Discoverer Bay	4.74	2.54	2.03	4	3	yolked	vitellogenic
90.6863	dolly varden	Discoverer Bay	1.47	2.69	1.77	3	0	early developing	previtellogenic
90.6865	dolly varden	Discoverer Bay	5.77	6.59	2.26	4	4	early developing	vitellogenic
90.6867	dolly varden	Discoverer Bay	4.00	2.97	8.06			yolked	
90.6868	dolly varden	Discoverer Bay	4.16	5.10	2.09	3	0	yolked	previtellogenic
90.6869	dolly varden	Discoverer Bay	1.28	3.46	0.72	3	0	yolked	previtellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT–Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6870	dolly varden	Discoverer Bay	0.85	6.61	6.13	3	0	yolked	previtellogenic
90.6871	dolly varden	Discoverer Bay	1.10	2.47	0.78	3	2	yolked	previtellogenic
90.6872	dolly varden	Discoverer Bay	4.24	2.24	1.80	3	0	yolked	previtellogenic
90.6873	dolly varden	Discoverer Bay	9.51	3.11	1.43	4	0	yolked	vitellogenic
90.6874	dolly varden	Discoverer Bay	7.71	1.84	1.98	4	3	yolked	vitellogenic
90.6875	dolly varden	Discoverer Bay	5.74	2.70	1.33	4	2	yolked	vitellogenic
90.6911	dolly varden	Hallo Bay	1.69	9.06	2.00	4	0	yolked	vitellogenic
90.6915	dolly varden	Hallo Bay	1.98	7.22	1.41	4	0	yolked	vitellogenic
90.6916	dolly varden	Hallo Bay	1.09	2.32	1.11	3	5	yolked	previtellogenic
90.6917	dolly varden	Hallo Bay	4.32	24.19	1.80	3	0	yolked	previtellogenic
90.6918	dolly varden	Hallo Bay	0.75	4.96	0.82	3	0	yolked	previtellogenic
90.6919	dolly varden	Hallo Bay	6.10	1.83	1.03	4	0	yolked	vitellogenic
90.6921	dolly varden	Hallo Bay	4.81	7.30	0.75	4	0	early developing	vitellogenic
90.6923	dolly varden	Hallo Bay	4.56	12.02	1.15	4	3	yolked	vitellogenic
90.6924	dolly varden	Hallo Bay	4.07	2.57	0.77	4	2	yolked	vitellogenic
90.6926	dolly varden	Hallo Bay	3.29	3.25	1.54	3	3	yolked	previtellogenic
90.6929	dolly varden	Hallo Bay	1.42	1.82	1.52	3	0	early developing	previtellogenic
90.6931	dolly varden	Hallo Bay	5.57	4.22	1.72	4	0	early developing	vitellogenic
90.6932	dolly varden	Hallo Bay	4.49	5.44	0.75			early developing	
90.6933	dolly varden	Hallo Bay	0.78	13.44	0.74	3	0	early developing	previtellogenic
90.6934	dolly varden	Hallo Bay	3.88	3.82	2.39			yolked	
90.6935	dolly varden	Hallo Bay	2.34	6.20	1.30	4	1	early developing	vitellogenic
90.6936	dolly varden	Hallo Bay	1.45	4.53	1.62	3	0	yolked	previtellogenic
90.6938	dolly varden	Hallo Bay	0.94	2.45		4	1	hydrated	vitellogenic
90.6939	dolly varden	Hallo Bay	4.17	5.47	1.07	4	3	hydrated	vitellogenic
90.6941	dolly varden	Hallo Bay	6.36	3.09	1.69	4	0	yolked	vitellogenic
90.6942	dolly varden	Hallo Bay	14.08	2.89	2.22	4	0	hydrated	vitellogenic
90.6943	dolly varden	Hallo Bay	2.73	1.99	1.23	4	0	yolked	vitellogenic
90.6945	dolly varden	Hallo Bay	2.40	3.77	1.44	4	0	yolked	vitellogenic
90.6948	dolly varden	Hallo Bay	8.25	7.87	1.58	4	0	hydrated	vitellogenic

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6949	dolly varden	Hallo Bay	4.76	4.37	1.24	4	0	yolked	vitellogenic
90.6952	dolly varden	Hallo Bay	0.47	15.82	1.29	2	0	yolked	regressed
90.6963	yellowfin sole	Hallo Bay	2.25		6.70			hydrated	
90.6964	yellowfin sole	Hallo Bay	0.07		1.75			early developing	
90.6965	yellowfin sole	Hallo Bay	0.34		2.34			spawned out	
90.6966	yellowfin sole	Hallo Bay	0.02		1.81			spawned out	
90.6967	yellowfin sole	Hallo Bay	0.67		7.83			spawning	
90.6968	yellowfin sole	Hallo Bay	0.58		7.16			spawning	
90.6969	yellowfin sole	Hallo Bay	3.29		12.32			hydrated	
90.6970	yellowfin sole	Hallo Bay	7.89		11.97			hydrated	
90.6971	yellowfin sole	Hallo Bay	3.48		7.11			spawning	
90.6972	yellowfin sole	Hallo Bay	2.75		5.36			hydrated	
90.6973	yellowfin sole	Hallo Bay	7.04		19.00			hydrated	
90.6974	yellowfin sole	Hallo Bay	3.45		12.99			hydrated	
90.6975	yellowfin sole	Hallo Bay	0.10		0.75			early developing	
90.6976	yellowfin sole	Hallo Bay	2.95		13.87			spawning	
90.6977	yellowfin sole	Hallo Bay	0.29		1.29			early developing	
90.6978	yellowfin sole	Hallo Bay	2.28		5.00			yolked	
90.6979	yellowfin sole	Hallo Bay	0.71		0.78			early developing	
90.6980	yellowfin sole	Hallo Bay	0.95		0.90			immature	
90.6981	yellowfin sole	Hallo Bay	0.23		1.43			yolked	
90.6982	yellowfin sole	Hallo Bay	0.07		0.86			early developing	
90.6983	yellowfin sole	Hallo Bay	10.26		20.26			hydrated	
90.6984	yellowfin sole	Hallo Bay	0.44		3.19			hydrated	
90.6985	yellowfin sole	Hallo Bay	12.83		24.05			spawned out	
90.6986	yellowfin sole	Hallo Bay	0.03		3.69			spawned out	
90.6987	yellowfin sole	Hallo Bay	0.06		1.87			hydrated	
90.6988	yellowfin sole	Hallo Bay	4.13		8.79			hydrated	
90.6989	yellowfin sole	Hallo Bay	0.53		1.07			early developing	
90.6990	yellowfin sole	Hallo Bay	2.01		10.91			yolked	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.6991	yellowfin sole	Hallo Bay	4.49		6.67			yolked	
90.6992	yellowfin sole	Hallo Bay	0.01		4.01			spawned out	
90.6993	dolly varden	Hallo Bay	2.36	2.15	1.87	4	0	yolked	vitellogenic
90.6995	dolly varden	Hallo Bay	13.74	4.75	0.92	4	1	yolked	vitellogenic
90.7014	dolly varden	Kukak Bay	6.49	6.15	1.53	4	0	yolked	vitellogenic
90.7015	dolly varden	Kukak Bay	1.91	3.60	1.19	3	0	yolked	previtellogenic
90.7016	dolly varden	Kukak Bay	7.40	5.66	0.83	4	0	yolked	vitellogenic
90.7018	dolly varden	Kukak Bay	19.41	6.63	1.04			yolked	
90.7019	dolly varden	Kukak Bay	4.32	9.12	0.92	4	0	yolked	vitellogenic
90.7020	dolly varden	Kukak Bay	0.70	1.01	1.21	3	0	yolked	previtellogenic
90.7021	dolly varden	Kukak Bay	1.56	3.03	0.75	3	0	yolked	previtellogenic
90.7022	dolly varden	Kukak Bay	11.11	13.06	0.64	4	0	yolked	vitellogenic
90.7023	dolly varden	Kukak Bay	5.25	4.62	1.32	4	3	yolked	vitellogenic
90.7024	dolly varden	Kukak Bay	2.59	4.79	1.26	3	0	yolked	previtellogenic
90.7025	dolly varden	Kukak Bay	15.63	15.04	1.99	4	0	yolked	vitellogenic
90.7027	dolly varden	Kukak Bay	1.14	3.42	1.51	3	0	yolked	previtellogenic
90.7028	dolly varden	Kukak Bay	1.80	3.42	1.75	4	0	yolked	vitellogenic
90.7030	dolly varden	Kukak Bay	11.25	4.63	1.21	4	3	yolked	vitellogenic
90.7032	dolly varden	Kukak Bay	17.49	5.93	2.12			hydrated	
90.7040	dolly varden	Kukak Bay	7.93	3.12	1.87	4	0	hydrated	vitellogenic
90.7043	dolly varden	Kukak Bay	7.38	5.52	1.61	4	0	yolked	vitellogenic
90.7044	dolly varden	Kukak Bay	0.97	1.08	0.73	3	0	yolked	previtellogenic
90.7062	yellowfin sole	Kukak Bay	4.75		11.79			hydrated	
90.7063	yellowfin sole	Kukak Bay	0.13		10.58			hydrated	
90.7064	yellowfin sole	Kukak Bay	0.48		13.64			hydrated	
90.7065	yellowfin sole	Kukak Bay	0.50		4.78			hydrated	
90.7066	yellowfin sole	Kukak Bay	4.70		9.63			hydrated	
90.7067	yellowfin sole	Kukak Bay	0.15		12.50			spawning	
90.7068	yellowfin sole	Kukak Bay	10.93		9.83			spawning	
90.7069	yellowfin sole	Kukak Bay	0.05		5.61			spawning	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.7070	yellowfin sole	Kukak Bay	0.05		1.51			yolked	
90.7071	yellowfin sole	Kukak Bay	1.67		10.61			hydrated	
90.7072	yellowfin sole	Kukak Bay	4.11		0.30			hydrated	
90.7112	yellowfin sole	Katmai Bay	0.31		0.68			immature	
90.7113	yellowfin sole	Katmai Bay	0.33		1.20			early developing	
90.7114	yellowfin sole	Katmai Bay	0.10		1.48			early developing	
90.7118	dolly varden	Katmai Bay			1.50			yolked	
90.7120	dolly varden	Katmai Bay			2.64			yolked	
90.7121	dolly varden	Katmai Bay			2.50			yolked	
90.7122	dolly varden	Katmai Bay			3.39			yolked	
90.7123	dolly varden	Katmai Bay			1.16			yolked	
90.7124	dolly varden	Katmai Bay			0.79			yolked	
90.7125	dolly varden	Katmai Bay			2.43			hydrated	
90.7127	yellowfin sole	Katmai Bay			16.47			hydrated	
90.7128	yellowfin sole	Katmai Bay			14.02			hydrated	
90.7129	yellowfin sole	Katmai Bay			29.29			spawning	
90.7130	yellowfin sole	Katmai Bay			20.44			spawning	
90.7131	yellowfin sole	Katmai Bay			33.11			spawning	
90.7132	yellowfin sole	Katmai Bay			1.30			spawned out	
90.7133	yellowfin sole	Katmai Bay			16.59			hydrated	
90.7134	yellowfin sole	Katmai Bay			1.82			yolked	
90.7135	yellowfin sole	Katmai Bay			11.72			spawning	
90.7136	yellowfin sole	Katmai Bay			1.71			yolked	
90.7137	yellowfin sole	Katmai Bay			1.05			immature	
90.7138	yellowfin sole	Kodiak			17.32			hydrated	
90.7139	yellowfin sole	Kodiak			15.00			hydrated	
90.7145	dolly varden	Kodiak			1.33			yolked	
90.7146	dolly varden	Kodiak			1.19			yolked	
90.7147	dolly varden	Kodiak			0.88			yolked	
90.7149	dolly varden	Kodiak			1.45			yolked	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.7150	dolly varden	Kodiak			0.98			yolked	
90.7152	dolly varden	Kodiak			0.64			yolked	
90.7153	dolly varden	Kodiak			1.25			yolked	
90.7154	dolly varden	Kodiak			0.82			yolked	
90.7157	dolly varden	Kodiak			0.87			yolked	
90.7159	dolly varden	Kodiak			1.00			yolked	
90.7161	dolly varden	Kodiak			1.45			yolked	
90.7164	dolly varden	Kodiak			0.88			yolked	
90.7166	dolly varden	Kodiak			1.40			hydrated	
90.7168	dolly varden	Kodiak			1.43			yolked	
90.7171	dolly varden	Kodiak			1.51			yolked	
90.7172	dolly varden	Kodiak			1.01			yolked	
90.7173	dolly varden	Kodiak			1.65			yolked	
90.7184	yellowfin sole	Kodiak			20.59			hydrated	
90.7185	yellowfin sole	Kodiak			12.87			hydrated	
90.7186	yellowfin sole	Kodiak			14.02			yolked	
90.7187	yellowfin sole	Kodiak			12.26			hydrated	
90.7188	yellowfin sole	Kodiak			8.14			yolked	
90.7189	yellowfin sole	Kodiak			21.76			hydrated	
90.7190	yellowfin sole	Kodiak			14.65			yolked	
90.7191	yellowfin sole	Kodiak			12.17			spawning	
90.7192	yellowfin sole	Kodiak			9.12			yolked	
90.7193	yellowfin sole	Kodiak			13.95			hydrated	
90.7194	yellowfin sole	Kodiak			2.78			yolked	
90.7195	yellowfin sole	Kodiak			1.39			immature	
90.7202	dolly varden	MacLeod Harbor	0.69	2.32	1.03			early developing	
90.7203	dolly varden	MacLeod Harbor	13.77	15.76	1.33			yolked	
90.7204	dolly varden	MacLeod Harbor	11.92	6.46	2.19			yolked	
90.7205	dolly varden	MacLeod Harbor	86.56	8.21	2.09			yolked	
90.7206	dolly varden	MacLeod Harbor	222.71	2.23	0.87			immature	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.7207	dolly varden	MacLeod Harbor	3.54	5.80	1.36			yolked	
90.7208	dolly varden	MacLeod Harbor	4.26	19.09	1.22			yolked	
90.7209	dolly varden	MacLeod Harbor	9.17	13.03	1.29			early developing	
90.7210	dolly varden	MacLeod Harbor	1.76	2.12	0.71			immature	
90.7211	dolly varden	MacLeod Harbor	10.44	9.37	1.30			yolked	
90.7212	dolly varden	MacLeod Harbor	11.07	6.62	1.10			yolked	
90.7213	dolly varden	MacLeod Harbor	8.90	33.82	1.84			yolked	
90.7214	dolly varden	MacLeod Harbor	1.73	2.22	0.41			immature	
90.7215	dolly varden	MacLeod Harbor	1.72	1.76	6.22			immature	
90.7216	dolly varden	MacLeod Harbor	2.14	2.17	0.78			early developing	
90.7217	dolly varden	MacLeod Harbor	4.11	5.94	0.39			immature	
90.7218	dolly varden	MacLeod Harbor	9.51	10.32	1.66			early developing	
90.7219	dolly varden	MacLeod Harbor	3.85	20.74	1.33			early developing	
90.7220	dolly varden	Moose Lips Bay	0.90	1.81	0.68			early developing	
90.7221	dolly varden	Moose Lips Bay	16.24	15.60	1.22			yolked	
90.7222	dolly varden	Moose Lips Bay	14.85	10.22	1.90			yolked	
90.7223	dolly varden	Moose Lips Bay	16.76	13.17	5.63			hydrated	
90.7224	dolly varden	Moose Lips Bay	8.08	10.71	0.94			early developing	
90.7225	dolly varden	Moose Lips Bay	0.53	2.65	0.59			immature	
90.7226	dolly varden	Moose Lips Bay	18.94	11.46	4.91			hydrated	
90.7227	dolly varden	Moose Lips Bay	1.86	10.15	1.05			early developing	
90.7228	dolly varden	Moose Lips Bay	14.96	12.41	1.93			yolked	
90.7229	dolly varden	Moose Lips Bay	13.39	7.93	1.42			early developing	
90.7230	dolly varden	Moose Lips Bay	17.64	12.84	1.84			yolked	
90.7231	dolly varden	Moose Lips Bay	10.27	4.46	1.48			yolked	
90.7232	dolly varden	Moose Lips Bay	8.04	4.53	2.28			yolked	
90.7233	dolly varden	Moose Lips Bay	11.04	4.82	3.34			hydrated	
90.7234	dolly varden	Moose Lips Bay	13.17	3.54	2.54			hydrated	
90.7235	dolly varden	Snug Harbor	1.68	7.83	1.01			immature	
90.7236	dolly varden	Snug Harbor	2.30	8.80	0.99			immature	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
90.7238	dolly varden	Sleepy Bay	8.90	19.09	1.13			early developing	
90.7239	dolly varden	Sleepy Bay	0.66	1.77	1.10			immature	
90.7240	dolly varden	Sleepy Bay	4.87	4.37	1.58			early developing	
90.7241	dolly varden	Sleepy Bay	2.08	2.99	1.86			early developing	
90.7242	dolly varden	Sleepy Bay	5.98	6.64	1.33			early developing	
90.7243	dolly varden	Sleepy Bay	2.43	2.86	1.26			no information	
91.4045	Pollock	Sanak Is.			30.87			early developing	
91.4046	Pollock	Sanak Is.	4.45		21.06			early developing	
91.4047	Pollock	Sanak Is.	5.67		22.52			early developing	
91.4048	Pollock	Sanak Is.	8.29		28.91			early developing	
91.4049	Pollock	Sanak Is.	16.67		25.17			early developing	
91.4050	Pollock	Sanak Is.	13.79		17.20			early developing	
91.4051	Pollock	Sanak Is.	11.24		30.59			early developing	
91.4052	Pollock	Sanak Is.	5.77		46.15			early developing	
91.4053	Pollock	Sanak Is.	10.02		23.37			early developing	
91.4054	Pollock	Sanak Is.	3.93		14.89			early developing	
91.4055	Pollock	Sanak Is.	12.60		23.63			early developing	
91.4056	Pollock	Sanak Is.	7.66		23.51			early developing	
91.4057	Pollock	Sanak Is.	3.18		23.08			early developing	
91.4058	Pollock	Sanak Is.	6.15		35.08			early developing	
91.4059	Pollock	Sanak Is.	5.01		41.90			early developing	
91.4060	Pollock	Sutwik Is.	20.17		4.89			early developing	
91.4061	Pollock	Sutwik Is.	2.21		15.85			early developing	
91.4062	Pollock	Sutwik Is.	23.73		20.30			early developing	
91.4063	Pollock	Sutwik Is.	0.72		25.81			hydrated	
91.4064	Pollock	Sutwik Is.	2.82		15.65			early developing	
91.4065	Pollock	Sutwik Is.	9.32		20.90			early developing	
91.4066	Pollock	Sutwik Is.	2.19		12.58			hydrated	
91.4067	Pollock	Sutwik Is.	4.45		11.75			early developing	
91.4068	Pollock	Sutwik Is.	9.02		11.99			early developing	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4069	Pollock	Sutwik Is.	10.64		12.04			early developing	
91.4070	Pollock	Sutwik Is.			13.00			early developing	
91.4071	Pollock	Sutwik Is.	13.85		12.65			early developing	
91.4072	Pollock	Sutwik Is.	3.48		15.38			early developing	
91.4073	Pollock	Sutwik Is.	18.92		19.70			early developing	
91.4074	Pollock	Sutwik Is.	8.60		22.85			early developing	
91.4075	Pollock	Portage Bay	21.18		24.42			early developing	
91.4076	Pollock	Portage Bay	13.70		17.13			early developing	
91.4077	Pollock	Portage Bay	20.29		13.99			early developing	
91.4078	Pollock	Portage Bay	8.13					early developing	
91.4079	Pollock	Portage Bay	13.65		18.39			early developing	
91.4080	Pollock	Portage Bay	15.04		19.76			early developing	
91.4081	Pollock	Portage Bay	10.24		16.26			early developing	
91.4082	Pollock	Portage Bay	4.55		24.88			early developing	
91.4083	Pollock	Portage Bay	13.30		18.75			early developing	
91.4084	Pollock	Portage Bay	14.52		12.06			early developing	
91.4085	Pollock	Portage Bay	43.01		16.00			early developing	
91.4086	Pollock	Portage Bay	7.15		6.83			early developing	
91.4087	Pollock	Portage Bay	28.65		19.07			early developing	
91.4088	Pollock	Portage Bay	21.73		10.29			early developing	
91.4089	Pollock	Portage Bay	5.40		14.91			early developing	
91.4090	Pollock	Cape Ikolik	26.48		19.91			early developing	
91.4091	Pollock	Cape Ikolik	6.99		23.22			early developing	
91.4092	Pollock	Cape Ikolik	23.84		20.88			early developing	
91.4093	Pollock	Cape Ikolik	12.72		17.42			early developing	
91.4094	Pollock	Cape Ikolik	11.92		24.63			early developing	
91.4095	Pollock	Cape Ikolik	10.06		26.50			early developing	
91.4096	Pollock	Cape Ikolik	11.13		23.22			early developing	
91.4097	Pollock	Cape Ikolik	9.78		15.31			early developing	
91.4098	Pollock	Cape Ikolik	17.37		17.77			early developing	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4099	Pollock	Cape Ikolik	11.39		18.00			early developing	
91.4100	Pollock	Cape Ikolik	3.46		22.91			early developing	
91.4101	Pollock	Cape Ikolik	9.99		18.22			early developing	
91.4102	Pollock	Cape Ikolik	3.80		18.60			early developing	
91.4103	Pollock	Cape Ikolik	10.56		20.02			early developing	
91.4104	Pollock	Cape Ikolik	12.61		19.68			early developing	
91.4105	Pollock	Sturgen Island	8.53		18.25			early developing	
91.4106	Pollock	Sturgen Island	26.81		13.87			early developing	
91.4107	Pollock	Sturgen Island	8.06		13.61			early developing	
91.4108	Pollock	Sturgen Island	6.04		18.29			early developing	
91.4109	Pollock	Sturgen Island	16.48		21.44			early developing	
91.4110	Pollock	Sturgen Island	13.61		18.57			early developing	
91.4111	Pollock	Sturgen Island	13.26		18.79			early developing	
91.4112	Pollock	Sturgen Island	11.69		25.24			early developing	
91.4113	Pollock	Sturgen Island	7.00		22.17			early developing	
91.4114	Pollock	Sturgen Island	4.31		29.81			early developing	
91.4115	Pollock	Sturgen Island	6.09		14.46			early developing	
91.4116	Pollock	Sturgen Island	10.45		30.02			early developing	
91.4117	Pollock	Sturgen Island	5.06		7.78			early developing	
91.4118	Pollock	Sturgen Island	8.78		18.70			early developing	
91.4119	Pollock	Sturgen Island	11.13		20.05			early developing	
91.4120	Pollock	Katmai Bay	12.98		29.88			early developing	
91.4121	Pollock	Katmai Bay	24.91		12.40			early developing	
91.4122	Pollock	Katmai Bay			25.15			early developing	
91.4123	Pollock	Katmai Bay	11.16		21.45			early developing	
91.4125	Pollock	Katmai Bay	9.75		39.79			early developing	
91.4127	Pollock	Katmai Bay	32.48		24.89			early developing	
91.4130	Pollock	Katmai Bay	16.65		28.46			early developing	
91.4133	Pollock	Katmai Bay	9.34		18.57			early developing	
91.4134	Pollock	Katmai Bay	5.75		22.61			early developing	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4141	Pollock	Uganik Is.			0.60			immature	
91.4142	Pollock	Uganik Is.	0.06		0.63			immature	
91.4143	Pollock	Uganik Is.			0.55			immature	
91.4144	Pollock	Uganik Is.			0.66			immature	
91.4145	Pollock	Uganik Is.	0.47		0.51			immature	
91.4146	Pollock	Uganik Is.			0.55			immature	
91.4147	Pollock	Uganik Is.			0.73			immature	
91.4149	Pollock	Uganik Is.			0.77			immature	
91.4150	Pollock	Kuliak Bay	10.03		13.89			early developing	
91.4151	Pollock	Kuliak Bay	21.89		29.54			early developing	
91.4152	Pollock	Kuliak Bay	9.79		23.75			early developing	
91.4153	Pollock	Kuliak Bay	2.78		34.55			early developing	
91.4154	Pollock	Kuliak Bay	8.43		17.48			early developing	
91.4155	Pollock	Kuliak Bay	14.83		20.90			early developing	
91.4156	Pollock	Kuliak Bay	7.67		21.39			early developing	
91.4157	Pollock	Kuliak Bay	10.48		25.47			early developing	
91.4158	Pollock	Kuliak Bay	15.04		21.79			early developing	
91.4159	Pollock	Kuliak Bay	3.82		18.41			early developing	
91.4160	Pollock	Kuliak Bay	3.41		24.63			early developing	
91.4162	Pollock	Kuliak Bay	5.67		23.21			early developing	
91.4163	Pollock	Kuliak Bay	8.87		19.01			early developing	
91.4164	Pollock	Kuliak Bay	3.50		25.72			early developing	
91.4165	Pollock	Uganik Is.	6.48		12.19			early developing	
91.4166	Pollock	Uganik Is.	0.31		0.73			spawning	
91.4167	Pollock	Uganik Is.	23.16		11.29			early developing	
91.4168	Pollock	Uganik Is.	0.56		0.72			immature	
91.4169	Pollock	Uganik Is.	20.04					immature	
91.4170	Pollock	Uganik Is.	10.95		0.81			immature	
91.4172	Pollock	Uganik Is.	25.21		16.94			early developing	
91.4174	Pollock	Uganik Is.	0.54		1.00			immature	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4175	Pollock	Uganik Is.	0.27		0.75			immature	
91.4176	Pollock	Uganik Is.	12.11		0.63			immature	
91.4180	Pollock	Kuliak Bay	10.39		30.63			early developing	
91.4181	Pollock	Kuliak Bay	24.12		12.49			early developing	
91.4182	Pollock	Kuliak Bay	8.59		26.11			early developing	
91.4183	Pollock	Kuliak Bay	14.23		23.93			early developing	
91.4184	Pollock	Kuliak Bay	7.93		29.79			early developing	
91.4185	Pollock	Kuliak Bay	5.24		35.34			early developing	
91.4186	Pollock	Kuliak Bay	20.28		21.40			early developing	
91.4187	Pollock	Kuliak Bay	8.24		21.56			early developing	
91.4188	Pollock	Kuliak Bay	3.14		36.52			early developing	
91.4189	Pollock	Kuliak Bay	5.77		21.63			early developing	
91.4190	Pollock	Kuliak Bay	0.37		25.63			early developing	
91.4191	Pollock	Kuliak Bay	4.15		37.93			early developing	
91.4192	Pollock	Kuliak Bay	22.04		20.85			early developing	
91.4193	Pollock	Kuliak Bay	6.44		27.24			early developing	
91.4194	Pollock	Kuliak Bay	8.50		37.50			early developing	
91.4195	Pollock	Kuliak Bay	3.47		17.76			early developing	
91.4196	Pollock	Kuliak Bay	1.75		16.36			early developing	
91.4197	Pollock	Kuliak Bay	2.62		18.65			early developing	
91.4198	Pollock	Kuliak Bay	0.65		10.84			early developing	
91.4199	Pollock	Kuliak Bay	0.85		18.63			early developing	
91.4200	Pollock	Kuliak Bay	2.69		31.39			early developing	
91.4201	Pollock	Kuliak Bay	5.37		23.58			early developing	
91.4202	Pollock	Kuliak Bay	3.61		24.42			early developing	
91.4203	Pollock	Kuliak Bay	4.50		20.34			early developing	
91.4204	Pollock	Kuliak Bay	6.11		22.31			early developing	
91.4205	Pollock	Kuliak Bay	4.54		32.29			early developing	
91.4206	Pollock	Kuliak Bay	3.51		26.76			early developing	
91.4207	Pollock	Kuliak Bay	2.19		24.07			early developing	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4208	Pollock	Kuliak Bay	5.96		22.66			early developing	
91.4209	Pollock	Kuliak Bay	3.16		19.63			early developing	
91.4401	Pollock	Port Gravina	8.35		39.28	6	0	hydrated	spawning
91.4402	Pollock	Port Gravina	4.20		18.28	6	0	no information	spawning
91.4403	Pollock	Port Gravina	0.65		25.54	6	0	spawning	spawning
91.4404	Pollock	Port Gravina	7.51		11.34	6	0	early developing	spawning
91.4405	Pollock	Port Gravina	10.28		6.04			early developing	
91.4406	Pollock	Port Gravina	10.52		12.57	6	2	yolked	spawning
91.4407	Pollock	Port Gravina	3.85		26.52	6	0	yolked	spawning
91.4408	Pollock	Port Gravina	2.26		26.76	6	0	yolked	spawning
91.4409	Pollock	Port Gravina	2.17		30.29	6	0	yolked	spawning
91.4410	Pollock	Port Gravina	5.65		17.61	6	2	yolked	spawning
91.4411	Pollock	Port Gravina	1.38		20.34	6	0	hydrated	spawning
91.4412	Pollock	Port Gravina	6.57		17.12	6	0	yolked	spawning
91.4413	Pollock	Port Gravina	1.63		17.28	6	0	hydrated	spawning
91.4414	Pollock	Port Gravina	0.45		25.78	6	1	hydrated	spawning
91.4415	Pollock	Port Gravina	4.31		29.17	5	0	yolked	hydrated
91.4416	Pollock	Goose Is./Pt. Fidalgo	11.79		18.96	6	0	early developing	spawning
91.4417	Pollock	Goose Is./Pt. Fidalgo	1.07		9.08	6	0	yolked	spawning
91.4418	Pollock	Goose Is./Pt. Fidalgo	13.32		6.40	4	0	early developing	vitellogenic
91.4419	Pollock	Goose Is./Pt. Fidalgo	0.79		1.24			immature	
91.4420	Pollock	Goose Is./Pt. Fidalgo	0.46		2.49	6	0	early developing	spawning
91.4421	Pollock	Goose Is./Pt. Fidalgo	0.83		17.04			spawning	
91.4422	Pollock	Goose Is./Pt. Fidalgo	4.23		23.13			hydrated	
91.4423	Pollock	Goose Is./Pt. Fidalgo	0.37		4.06	7	1	immature	spawned out
91.4424	Pollock	Goose Is./Pt. Fidalgo	10.59		14.20			yolked	
91.4425	Pollock	Goose Is./Pt. Fidalgo	12.14		12.22	6	2	yolked	spawning
91.4426	Pollock	Bay of Isles	0.60		8.88			spawning	
91.4427	Pollock	Bay of Isles	2.94		24.34			hydrated	
91.4428	Pollock	Bay of Isles	14.73		16.85	6	0	early developing	spawning

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4429	Pollock	Bay of Isles	5.38		13.49	4	1	early developing	vitellogenic
91.4430	Pollock	Bay of Isles	8.15		17.61	4	2	yolked	vitellogenic
91.4431	Pollock	Bay of Isles	13.97		15.18	4	0	early developing	vitellogenic
91.4432	Pollock	Bay of Isles	13.26		16.33	4	2	early developing	vitellogenic
91.4433	Pollock	Hogan Bay	6.18		18.24	6	2	yolked	spawning
91.4434	Pollock	Hogan Bay	7.05		13.68	6	1	yolked	spawning
91.4435	Pollock	Hogan Bay	14.39		7.26	4	0	early developing	vitellogenic
91.4436	Pollock	Hogan Bay	0.38		2.52	7	1	spawned out	spawned out
91.4437	Pollock	Hogan Bay	0.62		1.31			spawned out	
91.4438	Pollock	Hogan Bay	0.69		4.62	6	0	hydrated	spawning
91.4439	Pollock	Hogan Bay	5.08		16.05	6	0	early developing	spawning
91.4440	Pollock	Hogan Bay	10.28		17.59	4	0	hydrated	vitellogenic
91.4441	Pollock	Hogan Bay	7.16		19.35	6	0	yolked	spawning
91.4442	Pollock	Hogan Bay	0.66		3.24	7	2	immature	spawned out
91.4443	Pollock	Hogan Bay	15.38		2.65	6	4	immature	spawning
91.4444	Pollock	Hogan Bay	0.81		15.23	7	1	yolked	spawned out
91.4445	Pollock	Hogan Bay	4.51		15.46	4	4	yolked	vitellogenic
91.4446	Pollock	Hogan Bay	6.16		12.95	4	0	yolked	vitellogenic
91.4447	Pollock	Hogan Bay	17.73		8.40	4	3	early developing	vitellogenic
91.4448	Pollock	Pt. Bazil	30.12		10.07	6	3	yolked	spawning
91.4449	Pollock	Pt. Bazil	2.24		2.05			immature	
91.4450	Pollock	Pt. Bazil	0.74		2.43	7	2	early developing	spawned out
91.4451	Pollock	Pt. Bazil	1.20		3.78	7	4	immature	spawned out
91.4452	Pollock	Pt. Bazil	0.47		8.63	6	0	hydrated	spawning
91.4453	Pollock	Pt. Bazil	0.55		2.19	7	0	hydrated	spawned out
91.4454	Pollock	Pt. Bazil	0.49		2.11	7	5	early developing	spawned out
91.4455	Pollock	Pt. Bazil	0.44		2.16			immature	
91.4456	Pollock	Pt. Bazil	9.74		7.80	4	3	yolked	vitellogenic
91.4457	Pollock	Pt. Bazil	0.57		3.08	6	5	early developing	spawning
91.4458	Pollock	Pt. Bazil	0.59		2.28	7	3	early developing	spawned out

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4459	Pollock	Pt. Bazil	1.72		3.08	7	0	immature	spawned out
91.4460	Pollock	Pt. Bazil	0.91		2.12	7	1	immature	spawned out
91.4461	Pollock	Pt. Bazil	0.64		2.71	7	1	immature	spawned out
91.4462	Pollock	Pt. Bazil	0.82		1.84	7	2	immature	spawned out
91.4463	Pollock	Mummy Bay	1.05		2.62	7	2	immature	spawned out
91.4464	Pollock	Mummy Bay	1.37		3.59	7	3	immature	spawned out
91.4465	Pollock	Mummy Bay	1.46		26.10			hydrated	
91.4466	Pollock	Mummy Bay	0.62		1.48	5	0	spawned out	hydrated
91.4467	Pollock	Mummy Bay	1.55		9.91	6	0	yolked	spawning
91.4468	Pollock	Mummy Bay	5.07		15.62	6	0	yolked	spawning
91.4469	Pollock	Mummy Bay	0.44		7.59	6	5	spawning	spawning
91.4470	Pollock	Mummy Bay	0.81		13.48	6	0	spawning	spawning
91.4471	Pollock	Mummy Bay	0.55		2.27	6	2	immature	spawning
91.4472	Pollock	Mummy Bay	0.43		9.51	6	2	hydrated	spawning
91.4473	Pollock	Mummy Bay	0.46		8.75	6	0	hydrated	spawning
91.4474	Pollock	Mummy Bay	1.86		1.95	7	2	early developing	spawned out
91.4475	Pollock	Mummy Bay	0.84		6.49	6	1	yolked	spawning
91.4476	Pollock	Mummy Bay	0.83		1.80	7	3	immature	spawned out
91.4477	Pollock	Mummy Bay	1.19		10.36	5	1	hydrated	hydrated
91.4478	Pollock	Bay of Isles	0.60		1.96			immature	
91.4479	Pollock	Bay of Isles	4.68		12.67	6	0	yolked	spawning
91.4480	Pollock	Naked Island North	0.40		3.76	7	2	immature	spawned out
91.4481	Pollock	Naked Island North	1.79		1.88	7	0	immature	spawned out
91.4482	Pollock	Naked Island North	0.46		2.73	7	1	immature	spawned out
91.4483	Pollock	Naked Island North	0.81		12.70	6	2	spawning	spawning
91.4484	Pollock	Naked Island North	0.61		2.09			hydrated	
91.4485	Pollock	Naked Island East	1.02		2.03	7	4	immature	spawned out
91.4486	Pollock	Naked Island East	0.68		1.25	7	0	immature	spawned out
91.4487	Pollock	Naked Island East	0.60		1.61	7	4	immature	spawned out
91.4488	Pollock	Naked Island East	0.35		3.03	7	0	immature	spawned out

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.4489	Pollock	Naked Island East	0.40		1.27	7	0	immature	spawned out
91.4490	Pollock	Naked Island East	0.55		1.21	7	2	immature	spawned out
91.5336	yellowfin sole	Olsen Bay	2.47		3.09			early developing	
91.5337	yellowfin sole	Olsen Bay	0.32		1.30			immature	
91.5338	yellowfin sole	Olsen Bay	5.57		6.41			yolked	
91.5339	yellowfin sole	Olsen Bay	1.27		2.19			early developing	
91.5340	yellowfin sole	Olsen Bay	3.37		6.15			yolked	
91.5341	yellowfin sole	Olsen Bay	2.09		4.43			early developing	
91.5342	yellowfin sole	Olsen Bay	1.16		1.52			early developing	
91.5343	yellowfin sole	Olsen Bay	0.80		1.94			early developing	
91.5344	yellowfin sole	Olsen Bay	2.36		3.01			early developing	
91.5345	yellowfin sole	Olsen Bay	0.84		1.48			early developing	
91.5346	yellowfin sole	Olsen Bay	4.13		2.94			early developing	
91.5347	yellowfin sole	Olsen Bay	0.85		0.71			immature	
91.5348	yellowfin sole	Olsen Bay	9.02		6.34			hydrated	
91.5349	yellowfin sole	Olsen Bay	5.87		12.15			spawning	
91.5350	yellowfin sole	Olsen Bay	10.06		2.53			immature	
91.5351	yellowfin sole	Olsen Bay	12.34		7.58			hydrated	
91.5352	yellowfin sole	Olsen Bay	0.47		0.77			no information	
91.5353	yellowfin sole	Olsen Bay	0.09		0.69			immature	
91.5354	yellowfin sole	Olsen Bay	7.42		8.23			yolked	
91.5355	yellowfin sole	Olsen Bay	5.23		5.56			hydrated	
91.5356	yellowfin sole	Olsen Bay	9.71		5.85			yolked	
91.5357	yellowfin sole	Olsen Bay	0.13		0.85			immature	
91.5358	yellowfin sole	Olsen Bay	2.70		1.70			early developing	
91.5359	yellowfin sole	Olsen Bay	8.62		10.31			hydrated	
91.5360	yellowfin sole	Olsen Bay	3.03		15.72			spawning	
91.5361	yellowfin sole	Olsen Bay	1.71		3.65			yolked	
91.5362	yellowfin sole	Olsen Bay	1.60		6.13			early developing	
91.5363	yellowfin sole	Olsen Bay	0.54		2.58			yolked	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site_name	plasma_estradiol ng/ml	plasma_GTH1 ng/ml	gonadosomatic index	histological mat_stage [1]	atresia severity [2]	gross_mat stage	hist_mat
91.5364	yellowfin sole	Olsen Bay	1.73		6.98			yolked	
91.5365	yellowfin sole	Olsen Bay	0.49		0.83			early developing	
91.5376	yellowfin sole	Rocky Bay	8.92		20.43			hydrated	
91.5380	yellowfin sole	Rocky Bay	4.57		14.13			hydrated	
91.5417	yellowfin sole	Snug Harbor	9.89		8.82			hydrated	
91.5418	yellowfin sole	Snug Harbor	7.19		14.04			hydrated	
91.5419	yellowfin sole	Snug Harbor	8.63		13.01			hydrated	
91.5420	yellowfin sole	Snug Harbor	9.07		12.27			hydrated	
91.5421	yellowfin sole	Snug Harbor	4.89		15.78			hydrated	
91.5422	yellowfin sole	Snug Harbor	1.51		1.89			early developing	
91.5423	yellowfin sole	Snug Harbor	5.66		9.82			hydrated	
91.5424	yellowfin sole	Snug Harbor	3.11		3.72			yolked	
91.5425	yellowfin sole	Snug Harbor	10.52		10.83			hydrated	
91.5426	yellowfin sole	Snug Harbor	3.62		16.45			hydrated	
91.5427	yellowfin sole	Snug Harbor	4.42		14.24			hydrated	
91.5428	yellowfin sole	Snug Harbor	5.49		8.14			hydrated	
91.5429	yellowfin sole	Snug Harbor	5.68		3.76			no information	
91.5430	yellowfin sole	Snug Harbor	3.23		12.16			hydrated	
91.5431	yellowfin sole	Snug Harbor	6.65		13.53			hydrated	
91.5432	yellowfin sole	Snug Harbor	5.62		12.35			yolked	
91.5433	yellowfin sole	Snug Harbor	7.54		14.65			hydrated	
91.5434	yellowfin sole	Snug Harbor	4.67		16.14			hydrated	
91.5435	yellowfin sole	Snug Harbor	10.32		15.13			hydrated	
91.5436	yellowfin sole	Snug Harbor	10.60		9.83			yolked	
91.5437	yellowfin sole	Snug Harbor	5.88		5.19			hydrated	
91.5438	yellowfin sole	Snug Harbor	0.41		0.90			early developing	
91.5439	yellowfin sole	Snug Harbor	5.91		15.33			hydrated	
91.5440	yellowfin sole	Snug Harbor	13.98		16.42			hydrated	
91.5441	yellowfin sole	Snug Harbor	7.70		11.54			hydrated	
91.5442	yellowfin sole	Snug Harbor	0.72		0.72			early developing	

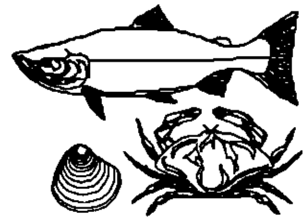
APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.5443	yellowfin sole	Snug Harbor	1.59		1.04			immature	
91.5444	yellowfin sole	Snug Harbor	0.21		1.01			early developing	
91.5445	yellowfin sole	Snug Harbor	2.47		2.04			yolked	
91.5446	yellowfin sole	Snug Harbor	0.55		1.15			early developing	
91.5471	yellowfin sole	Sleepy Bay			13.18			hydrated	
91.5520	yellowfin sole	Squirrel Bay	6.09		10.69			hydrated	
91.5521	yellowfin sole	Squirrel Bay	7.16		6.34			no information	
91.5522	yellowfin sole	Squirrel Bay	0.10		1.32			immature	
91.5558	yellowfin sole	Fox Farm Bay	15.28		14.72			spawning	
91.5559	yellowfin sole	Fox Farm Bay	7.31		11.24			hydrated	
91.5560	yellowfin sole	Fox Farm Bay	13.71		8.19			hydrated	
91.5561	yellowfin sole	Fox Farm Bay	7.54		13.74			hydrated	
91.5562	yellowfin sole	Fox Farm Bay	9.91		24.33			spawning	
91.5563	yellowfin sole	Fox Farm Bay	6.15		12.63			hydrated	
91.5564	yellowfin sole	Fox Farm Bay	11.70		10.25			hydrated	
91.5565	yellowfin sole	Fox Farm Bay	11.65		16.48			hydrated	
91.5566	yellowfin sole	Fox Farm Bay	3.20		9.98			hydrated	
91.5567	yellowfin sole	Fox Farm Bay	8.94		9.60			hydrated	
91.5568	yellowfin sole	Fox Farm Bay	9.54		12.57			hydrated	
91.5569	yellowfin sole	Fox Farm Bay	11.19		10.03			hydrated	
91.5570	yellowfin sole	Fox Farm Bay	7.32		9.82			hydrated	
91.5571	yellowfin sole	Fox Farm Bay	18.89		15.67			hydrated	
91.5572	yellowfin sole	Fox Farm Bay	7.05		8.91			yolked	
91.5573	yellowfin sole	Fox Farm Bay	6.48		15.57			hydrated	
91.5574	yellowfin sole	Fox Farm Bay	7.67		7.06			hydrated	
91.5575	yellowfin sole	Fox Farm Bay	4.97		13.36			hydrated	
91.5576	yellowfin sole	Fox Farm Bay	6.67		16.52			hydrated	
91.5577	yellowfin sole	Fox Farm Bay	7.59		4.57			yolked	
91.5578	yellowfin sole	Fox Farm Bay	7.45		12.74			hydrated	
91.5579	yellowfin sole	Fox Farm Bay	3.69		9.50			hydrated	

APPENDIX 3. SUBTIDAL 7 FINAL REPORT--Analysis of Reproductive Function

specimen#	species	site name	plasma estradiol ng/ml	plasma GTH1 ng/ml	gonadosomatic index	histological mat stage [1]	atresia severity [2]	gross mat stage	hist mat
91.5580	yellowfin sole	Fox Farm Bay	3.54		4.91			hydrated	
91.5581	yellowfin sole	Fox Farm Bay	5.05		10.20			hydrated	
91.5582	yellowfin sole	Fox Farm Bay	7.65		9.62			yolked	
91.5583	yellowfin sole	Fox Farm Bay	7.57		14.16			hydrated	
91.5584	yellowfin sole	Fox Farm Bay	4.39		13.65			hydrated	
91.5585	yellowfin sole	Fox Farm Bay	7.93		8.42			yolked	
91.5586	yellowfin sole	Fox Farm Bay	3.34		10.95			hydrated	
91.5587	yellowfin sole	Fox Farm Bay	7.42		8.70			yolked	

APPENDIX 4



APPENDIX 4. SUBTIDAL 7 FINAL REPORT
Fluorescent Aromatic Compounds (FACs) in Bile
Site Summary by Species and Year

Afognak/Shuyak

Coho salmon

YEAR 1989	n = 9	n (protein) = 9	Protein ave =	6.35 ± 3.3
AVE ± SD PHN (ng/g bile)[1]	5,900 ±3,100		AVE ± SD PHN/PROT (µg/g protein)[3]	1045 ± 650
AVE ± SD NPH (ng/g bile)[2]	35,000 ±16,000		AVE ± SD NPH/PROT (µg/g protein)[3]	6388 ± 3656

Dolly Varden

YEAR 1989	n = 10	n (protein) = 10	Protein ave =	7.68 ± 5.9
AVE ± SD PHN (ng/g bile)[1]	7,800 ±2,100		AVE ± SD PHN/PROT (µg/g protein)[3]	1235 ± 410
AVE ± SD NPH (ng/g bile)[2]	43,000 ±10,700		AVE ± SD NPH/PROT (µg/g protein)[3]	6707 ± 1938

Rock sole

YEAR 1989	n = 10	n (protein) = 10	Protein ave =	1.84 ± 0.9
AVE ± SD PHN (ng/g bile)[1]	1,600 ±700		AVE ± SD PHN/PROT (µg/g protein)[3]	1055 ± 615
AVE ± SD NPH (ng/g bile)[2]	10,000 ±3,800		AVE ± SD NPH/PROT (µg/g protein)[3]	6819 ± 3866

Albatross Bank

Halibut

YEAR 1990	n = 10	n (protein) = 10	Protein ave =	7.03 ± 5.9
AVE ± SD PHN (ng/g bile)[1]	3,000 ±2,800		AVE ± SD PHN/PROT (µg/g protein)[3]	439 ± 297
AVE ± SD NPH (ng/g bile)[2]	28,000 ±21,000		AVE ± SD NPH/PROT (µg/g protein)[3]	4763 ± 2264

Balboa Bay

Rock sole

YEAR 1989	n = 18	n (protein) = 18	Protein ave =	1.99 ± 1.2
AVE ± SD PHN (ng/g bile)[1]	900 ±300		AVE ± SD PHN/PROT (µg/g protein)[3]	546 ± 348
AVE ± SD NPH (ng/g bile)[2]	7,000 ±2,200		AVE ± SD NPH/PROT (µg/g protein)[3]	4455 ± 2358

Bay of Isles

Pollock

YEAR 1991	n = 8	n (protein) = 8	Protein ave =	7.14 ± 3.2
AVE ± SD PHN (ng/g bile)[1]	13,300 ±3,900		AVE ± SD PHN/PROT (µg/g protein)[3]	2245 ± 1077
AVE ± SD NPH (ng/g bile)[2]	85,000 ±27,500		AVE ± SD NPH/PROT (µg/g protein)[3]	14366 ± 7105

Black Bay

Yellowfin Sole

YEAR 1990	n = 9	n (protein) = 9	Protein ave =	3.53 ± 1.6
AVE ± SD PHN (ng/g bile)[1]	2,700 ±1,400		AVE ± SD PHN/PROT (µg/g protein)[3]	864 ± 506
AVE ± SD NPH (ng/g bile)[2]	22,000 ±7,800		AVE ± SD NPH/PROT (µg/g protein)[3]	7423 ± 3915

n = number of samples analyzed.
1. Fluorescent aromatic compounds (FAC) measured at phenanthrene (PHN) wavelength pairs.
2. Fluorescent aromatic compounds (FAC) measured at naphthalene (NPH) wavelength pairs.
3. FAC (NPH) or FAC (PHN) expressed on a per gram of bile protein basis.

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Bogoslof

Pollock YEAR 1991 n = 10 n (protein) = 10 Protein ave = 8.99 ± 2.0

AVE ± SD PHN (ng/g bile)[1]	12,000 ± 2,200	AVE ± SD PHN/PROT (µg/g protein)[3]	1353 ± 144
AVE ± SD NPH (ng/g bile)[2]	65,000 ± 9,200	AVE ± SD NPH/PROT (µg/g protein)[3]	7406 ± 901

Cape Ikolik

Halibut YEAR 1990 n = 10 n (protein) = 10 Protein ave = 4.63 ± 5.5

AVE ± SD PHN (ng/g bile)[1]	3,100 ± 2,100	AVE ± SD PHN/PROT (µg/g protein)[3]	855 ± 459
AVE ± SD NPH (ng/g bile)[2]	26,000 ± 15,000	AVE ± SD NPH/PROT (µg/g protein)[3]	8061 ± 2969

Pollock YEAR 1991 n = 11 n (protein) = 11 Protein ave = 9.10 ± 4.7

AVE ± SD PHN (ng/g bile)[1]	10,900 ± 5,100	AVE ± SD PHN/PROT (µg/g protein)[3]	1238 ± 302
AVE ± SD NPH (ng/g bile)[2]	66,000 ± 28,700	AVE ± SD NPH/PROT (µg/g protein)[3]	7695 ± 2249

Chenega Island

Halibut YEAR 1990 n = 10 n (protein) = 10 Protein ave = 1.91 ± 0.8

AVE ± SD PHN (ng/g bile)[1]	3,000 ± 2,600	AVE ± SD PHN/PROT (µg/g protein)[3]	1448 ± 797
AVE ± SD NPH (ng/g bile)[2]	23,000 ± 17,800	AVE ± SD NPH/PROT (µg/g protein)[3]	11192 ± 4795

Chignik Bay

Rock sole YEAR 1989 n = 10 n (protein) = 10 Protein ave = 1.86 ± 0.8

AVE ± SD PHN (ng/g bile)[1]	2,600 ± 1,400	AVE ± SD PHN/PROT (µg/g protein)[3]	1381 ± 523
AVE ± SD NPH (ng/g bile)[2]	11,000 ± 4,300	AVE ± SD NPH/PROT (µg/g protein)[3]	6351 ± 1625

Chiniak Bay

Halibut YEAR 1990 n = 9 n (protein) = 9 Protein ave = 4.68 ± 3.2

AVE ± SD PHN (ng/g bile)[1]	3,000 ± 3,900	AVE ± SD PHN/PROT (µg/g protein)[3]	644 ± 333
AVE ± SD NPH (ng/g bile)[2]	28,000 ± 19,800	AVE ± SD NPH/PROT (µg/g protein)[3]	7480 ± 3591

Clarence Strait

Halibut YEAR 1990 n = 9 n (protein) = 9 Protein ave = 5.20 ± 5.1

AVE ± SD PHN (ng/g bile)[1]	5,400 ± 8,000	AVE ± SD PHN/PROT (µg/g protein)[3]	896 ± 411
AVE ± SD NPH (ng/g bile)[2]	41,000 ± 46,700	AVE ± SD NPH/PROT (µg/g protein)[3]	8246 ± 3123

Sablefish YEAR 1990 n = 10 n (protein) = 10 Protein ave = 3.55 ± 1.2

AVE ± SD PHN (ng/g bile)[1]	700 ± 400	AVE ± SD PHN/PROT (µg/g protein)[3]	238 ± 158
AVE ± SD NPH (ng/g bile)[2]	12,000 ± 3,800	AVE ± SD NPH/PROT (µg/g protein)[3]	3747 ± 1913

Discoverer Bay

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Dolly Varden YEAR 1990 n = 11 n (protein) = 11 Protein ave = 3.60 ± 1.6

AVE ± SD PHN (ng/g bile) [1]	4,300 ± 1,300	AVE ± SD PHN/PROT (µg/g protein) [3]	1227 ± 425
AVE ± SD NPH (ng/g bile) [2]	40,000 ± 13,400	AVE ± SD NPH/PROT (µg/g protein) [3]	13645 ± 5723

Yellowfin Sole YEAR 1990 n = 23 n (protein) = 23 Protein ave = 2.58 ± 2.0

AVE ± SD PHN (ng/g bile) [1]	2,400 ± 1,700	AVE ± SD PHN/PROT (µg/g protein) [3]	1035 ± 684
AVE ± SD NPH (ng/g bile) [2]	15,000 ± 8,900	AVE ± SD NPH/PROT (µg/g protein) [3]	6502 ± 3276

Drier Bay

Dolly Varden YEAR 1990 n = 1 n (protein) = 1 Protein ave = 7.90 ± 0.0

AVE ± SD PHN (ng/g bile) [1]	11,000 ± 0	AVE ± SD PHN/PROT (µg/g protein) [3]	1392 ± 0
AVE ± SD NPH (ng/g bile) [2]	75,000 ± 0	AVE ± SD NPH/PROT (µg/g protein) [3]	9494 ± 0

E of Cape Kekurnoi; H27,

Pollock YEAR 1990 n = 9 n (protein) = 9 Protein ave = 8.97 ± 5.2

AVE ± SD PHN (ng/g bile) [1]	17,000 ± 10,700	AVE ± SD PHN/PROT (µg/g protein) [3]	1951 ± 766
AVE ± SD NPH (ng/g bile) [2]	86,000 ± 42,100	AVE ± SD NPH/PROT (µg/g protein) [3]	10405 ± 2621

E of Kodiak Island

Sablefish YEAR 1990 n = 20 n (protein) = 20 Protein ave = 3.07 ± 1.3

AVE ± SD PHN (ng/g bile) [1]	1,400 ± 1,000	AVE ± SD PHN/PROT (µg/g protein) [3]	573 ± 531
AVE ± SD NPH (ng/g bile) [2]	10,000 ± 4,600	AVE ± SD NPH/PROT (µg/g protein) [3]	3922 ± 2416

Eastend Transect

Pollock YEAR 1991 n = 13 n (protein) = 13 Protein ave = 7.11 ± 2.6

AVE ± SD PHN (ng/g bile) [1]	10,700 ± 3,800	AVE ± SD PHN/PROT (µg/g protein) [3]	1531 ± 243
AVE ± SD NPH (ng/g bile) [2]	71,000 ± 28,500	AVE ± SD NPH/PROT (µg/g protein) [3]	9863 ± 836

Evans Island

Chum salmon YEAR 1989 n = 10 n (protein) = 10 Protein ave = 3.34 ± 1.3

AVE ± SD PHN (ng/g bile) [1]	9,300 ± 3,800	AVE ± SD PHN/PROT (µg/g protein) [3]	3169 ± 1587
AVE ± SD NPH (ng/g bile) [2]	42,000 ± 14,000	AVE ± SD NPH/PROT (µg/g protein) [3]	14665 ± 7577

Fox Farm

Flathead sole YEAR 1991 n = 15 n (protein) = 15 Protein ave = 2.08 ± 1.0

AVE ± SD PHN (ng/g bile) [1]	5,700 ± 2,500	AVE ± SD PHN/PROT (µg/g protein) [3]	3028 ± 1287
AVE ± SD NPH (ng/g bile) [2]	27,000 ± 7,800	AVE ± SD NPH/PROT (µg/g protein) [3]	14884 ± 6065

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Rock sole

YEAR 1991	n = 5	n (protein) = 5	Protein ave = 1.26 ± 0.3
AVE ± SD PHN (ng/g bile)[1]	2,800 ± 1,100	AVE ± SD PHN/PROT (µg/g protein)[3]	2198 ± 864
AVE ± SD NPH (ng/g bile)[2]	18,000 ± 5,400	AVE ± SD NPH/PROT (µg/g protein)[3]	14520 ± 4858

Yellowfin sole

YEAR 1991	n = 25	n (protein) = 25	Protein ave = 2.38 ± 1.0
AVE ± SD PHN (ng/g bile)[1]	3,700 ± 1,700	AVE ± SD PHN/PROT (µg/g protein)[3]	1763 ± 996
AVE ± SD NPH (ng/g bile)[2]	23,000 ± 8,200	AVE ± SD NPH/PROT (µg/g protein)[3]	10956 ± 5586

Goose Island

Halibut

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 3.12 ± 4.4
AVE ± SD PHN (ng/g bile)[1]	6,900 ± 12,800	AVE ± SD PHN/PROT (µg/g protein)[3]	2135 ± 1482
AVE ± SD NPH (ng/g bile)[2]	42,000 ± 69,700	AVE ± SD NPH/PROT (µg/g protein)[3]	13650 ± 6748

Green Island

Halibut

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 2.08 ± 0.6
AVE ± SD PHN (ng/g bile)[1]	2,700 ± 2,600	AVE ± SD PHN/PROT (µg/g protein)[3]	1223 ± 896
AVE ± SD NPH (ng/g bile)[2]	20,000 ± 15,400	AVE ± SD NPH/PROT (µg/g protein)[3]	8937 ± 4901

Hallo Bay

Dolly Varden

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 2.87 ± 0.8
AVE ± SD PHN (ng/g bile)[1]	16,100 ± 22,100	AVE ± SD PHN/PROT (µg/g protein)[3]	6131 ± 8738
AVE ± SD NPH (ng/g bile)[2]	96,000 ± 87,600	AVE ± SD NPH/PROT (µg/g protein)[3]	35979 ± 33682

Yellowfin Sole

YEAR 1990	n = 26	n (protein) = 26	Protein ave = 2.29 ± 1.1
AVE ± SD PHN (ng/g bile)[1]	7,200 ± 4,400	AVE ± SD PHN/PROT (µg/g protein)[3]	3778 ± 2675
AVE ± SD NPH (ng/g bile)[2]	35,000 ± 17,100	AVE ± SD NPH/PROT (µg/g protein)[3]	18371 ± 11192

Hogan Bay

Pollock

YEAR 1991	n = 14	n (protein) = 14	Protein ave = 7.10 ± 4.3
AVE ± SD PHN (ng/g bile)[1]	12,600 ± 5,600	AVE ± SD PHN/PROT (µg/g protein)[3]	2123 ± 983
AVE ± SD NPH (ng/g bile)[2]	78,000 ± 35,400	AVE ± SD NPH/PROT (µg/g protein)[3]	13157 ± 5832

Kachemak Bay

Coho salmon

YEAR 1989	n = 9	n (protein) = 9	Protein ave = 14.12 ± 7.4
AVE ± SD PHN (ng/g bile)[1]	3,400 ± 1,100	AVE ± SD PHN/PROT (µg/g protein)[3]	307 ± 176
AVE ± SD NPH (ng/g bile)[2]	26,000 ± 7,200	AVE ± SD NPH/PROT (µg/g protein)[3]	2389 ± 1239

Dolly Varden

YEAR 1989	n = 10	n (protein) = 10	Protein ave = 3.84 ± 2.4
AVE ± SD PHN (ng/g bile)[1]	4,500 ± 1,500	AVE ± SD PHN/PROT (µg/g protein)[3]	1385 ± 589
AVE ± SD NPH (ng/g bile)[2]	31,000 ± 8,700	AVE ± SD NPH/PROT (µg/g protein)[3]	9911 ± 4306

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Rock sole YEAR 1989 n = 20 | n (protein) = 20 | Protein ave = 2.41 ± 1.6

AVE ± SD PHN (ng/g bile)[1]	3,200 ± 1,800	AVE ± SD PHN/PROT (µg/g protein)[3]	1633 ± 731
AVE ± SD NPH (ng/g bile)[2]	24,000 ± 9,900	AVE ± SD NPH/PROT (µg/g protein)[3]	12098 ± 4666

Kamishak Bay

Coho salmon YEAR 1989 n = 10 | n (protein) = 10 | Protein ave = 7.65 ± 3.3

AVE ± SD PHN (ng/g bile)[1]	7,700 ± 2,700	AVE ± SD PHN/PROT (µg/g protein)[3]	1044 ± 242
AVE ± SD NPH (ng/g bile)[2]	42,000 ± 13,200	AVE ± SD NPH/PROT (µg/g protein)[3]	5812 ± 1333

Dolly Varden YEAR 1989 n = 7 | n (protein) = 7 | Protein ave = 6.25 ± 3.0

AVE ± SD PHN (ng/g bile)[1]	7,300 ± 1,700	AVE ± SD PHN/PROT (µg/g protein)[3]	1462 ± 483
AVE ± SD NPH (ng/g bile)[2]	48,000 ± 14,600	AVE ± SD NPH/PROT (µg/g protein)[3]	9361 ± 3478

Rock sole YEAR 1989 n = 10 | n (protein) = 10 | Protein ave = 1.57 ± 0.6

AVE ± SD PHN (ng/g bile)[1]	1,900 ± 700	AVE ± SD PHN/PROT (µg/g protein)[3]	1254 ± 288
AVE ± SD NPH (ng/g bile)[2]	10,000 ± 2,700	AVE ± SD NPH/PROT (µg/g protein)[3]	6752 ± 1609

Katmai Bay

Dolly Varden YEAR 1990 n = 8 | n (protein) = 8 | Protein ave = 3.43 ± 0.9

AVE ± SD PHN (ng/g bile)[1]	3,900 ± 700	AVE ± SD PHN/PROT (µg/g protein)[3]	1221 ± 335
AVE ± SD NPH (ng/g bile)[2]	25,000 ± 7,500	AVE ± SD NPH/PROT (µg/g protein)[3]	7793 ± 2844

Yellowfin Sole YEAR 1990 n = 10 | n (protein) = 10 | Protein ave = 1.31 ± 0.4

AVE ± SD PHN (ng/g bile)[1]	4,700 ± 2,600	AVE ± SD PHN/PROT (µg/g protein)[3]	3496 ± 1158
AVE ± SD NPH (ng/g bile)[2]	29,000 ± 10,800	AVE ± SD NPH/PROT (µg/g protein)[3]	22002 ± 5048

Pollock YEAR 1991 n = 10 | n (protein) = 10 | Protein ave = 11.75 ± 4.0

AVE ± SD PHN (ng/g bile)[1]	12,700 ± 4,600	AVE ± SD PHN/PROT (µg/g protein)[3]	1112 ± 267
AVE ± SD NPH (ng/g bile)[2]	75,000 ± 17,900	AVE ± SD NPH/PROT (µg/g protein)[3]	6684 ± 1461

Kodiak

Dolly Varden YEAR 1989 n = 3 | n (protein) = 3 | Protein ave = 8.52 ± 3.9

AVE ± SD PHN (ng/g bile)[1]	12,500 ± 4,600	AVE ± SD PHN/PROT (µg/g protein)[3]	1804 ± 817
AVE ± SD NPH (ng/g bile)[2]	65,000 ± 15,800	AVE ± SD NPH/PROT (µg/g protein)[3]	10047 ± 5513

Rock sole YEAR 1989 n = 10 | n (protein) = 10 | Protein ave = 3.43 ± 2.7

AVE ± SD PHN (ng/g bile)[1]	3,700 ± 2,300	AVE ± SD PHN/PROT (µg/g protein)[3]	1226 ± 577
AVE ± SD NPH (ng/g bile)[2]	25,000 ± 14,100	AVE ± SD NPH/PROT (µg/g protein)[3]	8631 ± 2472

Kodiak Island

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Dolly Varden	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 3.87 ± 1.2	
AVE ± SD PHN (ng/g bile)[1]	6,000 ± 1,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1784 ± 853	
AVE ± SD NPH (ng/g bile)[2]	38,000 ± 10,400		AVE ± SD NPH/PROT (µg/g protein)[3]	11286 ± 5644	
Yellowfin Sole	YEAR 1990	n = 12	n (protein) = 12	Protein ave = 2.13 ± 1.1	
AVE ± SD PHN (ng/g bile)[1]	5,500 ± 1,500		AVE ± SD PHN/PROT (µg/g protein)[3]	3513 ± 2586	
AVE ± SD NPH (ng/g bile)[2]	39,000 ± 12,500		AVE ± SD NPH/PROT (µg/g protein)[3]	26280 ± 23684	

Kukak Bay

Coho salmon	YEAR 1989	n = 7	n (protein) = 7	Protein ave = 8.66 ± 2.3	
AVE ± SD PHN (ng/g bile)[1]	10,800 ± 4,400		AVE ± SD PHN/PROT (µg/g protein)[3]	1214 ± 271	
AVE ± SD NPH (ng/g bile)[2]	37,000 ± 11,800		AVE ± SD NPH/PROT (µg/g protein)[3]	4340 ± 844	
Dolly Varden	YEAR 1989	n = 15	n (protein) = 15	Protein ave = 4.20 ± 1.5	
AVE ± SD PHN (ng/g bile)[1]	6,400 ± 3,800		AVE ± SD PHN/PROT (µg/g protein)[3]	1439 ± 768	
AVE ± SD NPH (ng/g bile)[2]	40,000 ± 19,400		AVE ± SD NPH/PROT (µg/g protein)[3]	9412 ± 4495	
Flathead sole	YEAR 1989	n = 20	n (protein) = 20	Protein ave = 2.56 ± 1.0	
AVE ± SD PHN (ng/g bile)[1]	2,700 ± 1,200		AVE ± SD PHN/PROT (µg/g protein)[3]	1251 ± 685	
AVE ± SD NPH (ng/g bile)[2]	16,000 ± 4,800		AVE ± SD NPH/PROT (µg/g protein)[3]	8250 ± 5709	
Halibut	YEAR 1989	n = 10	n (protein) = 10	Protein ave = 1.57 ± 0.6	
AVE ± SD PHN (ng/g bile)[1]	3,000 ± 1,800		AVE ± SD PHN/PROT (µg/g protein)[3]	2104 ± 1163	
AVE ± SD NPH (ng/g bile)[2]	10,000 ± 3,300		AVE ± SD NPH/PROT (µg/g protein)[3]	7392 ± 3065	
Rock sole	YEAR 1989	n = 18	n (protein) = 18	Protein ave = 2.02 ± 0.7	
AVE ± SD PHN (ng/g bile)[1]	3,200 ± 1,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1740 ± 730	
AVE ± SD NPH (ng/g bile)[2]	17,000 ± 5,800		AVE ± SD NPH/PROT (µg/g protein)[3]	9810 ± 4948	
Yellowfin sole	YEAR 1989	n = 10	n (protein) = 10	Protein ave = 2.55 ± 1.0	
AVE ± SD PHN (ng/g bile)[1]	3,700 ± 1,800		AVE ± SD PHN/PROT (µg/g protein)[3]	1535 ± 755	
AVE ± SD NPH (ng/g bile)[2]	18,000 ± 6,300		AVE ± SD NPH/PROT (µg/g protein)[3]	7527 ± 2847	
Dolly Varden	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 2.80 ± 1.3	
AVE ± SD PHN (ng/g bile)[1]	4,900 ± 900		AVE ± SD PHN/PROT (µg/g protein)[3]	2244 ± 1463	
AVE ± SD NPH (ng/g bile)[2]	33,000 ± 7,800		AVE ± SD NPH/PROT (µg/g protein)[3]	14913 ± 8665	
Flathead Sole	YEAR 1990	n = 9	n (protein) = 9	Protein ave = 1.13 ± 0.6	
AVE ± SD PHN (ng/g bile)[1]	1,500 ± 600		AVE ± SD PHN/PROT (µg/g protein)[3]	1411 ± 620	
AVE ± SD NPH (ng/g bile)[2]	9,000 ± 3,700		AVE ± SD NPH/PROT (µg/g protein)[3]	8729 ± 3118	

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Yellowfin Sole

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 1.63 ± 0.6
AVE ± SD PHN (ng/g bile) [1]	3,900 ± 1,600	AVE ± SD PHN/PROT (µg/g protein) [3]	2429 ± 973
AVE ± SD NPH (ng/g bile) [2]	27,000 ± 10,500	AVE ± SD NPH/PROT (µg/g protein) [3]	17252 ± 6882

Kuliak Bay

Pollock

YEAR 1991	n = 12	n (protein) = 12	Protein ave = 11.72 ± 5.7
AVE ± SD PHN (ng/g bile) [1]	12,200 ± 3,200	AVE ± SD PHN/PROT (µg/g protein) [3]	1196 ± 549
AVE ± SD NPH (ng/g bile) [2]	80,000 ± 20,800	AVE ± SD NPH/PROT (µg/g protein) [3]	7458 ± 2016

MacLeod Harbor

Dolly Varden

YEAR 1990	n = 9	n (protein) = 9	Protein ave = 4.88 ± 1.7
AVE ± SD PHN (ng/g bile) [1]	4,000 ± 1,200	AVE ± SD PHN/PROT (µg/g protein) [3]	869 ± 300
AVE ± SD NPH (ng/g bile) [2]	25,000 ± 6,600	AVE ± SD NPH/PROT (µg/g protein) [3]	5525 ± 1836

Moose Lips Bay

Dolly Varden

YEAR 1990	n = 9	n (protein) = 9	Protein ave = 7.04 ± 2.1
AVE ± SD PHN (ng/g bile) [1]	5,100 ± 2,300	AVE ± SD PHN/PROT (µg/g protein) [3]	741 ± 239
AVE ± SD NPH (ng/g bile) [2]	33,000 ± 11,800	AVE ± SD NPH/PROT (µg/g protein) [3]	4913 ± 1683

Mummy Bay

Pollock

YEAR 1991	n = 13	n (protein) = 13	Protein ave = 11.09 ± 2.5
AVE ± SD PHN (ng/g bile) [1]	13,300 ± 3,800	AVE ± SD PHN/PROT (µg/g protein) [3]	1229 ± 348
AVE ± SD NPH (ng/g bile) [2]	86,000 ± 26,100	AVE ± SD NPH/PROT (µg/g protein) [3]	7822 ± 2109

N of Cape Paramanof; H57

Pollock

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 5.03 ± 3.3
AVE ± SD PHN (ng/g bile) [1]	9,900 ± 3,400	AVE ± SD PHN/PROT (µg/g protein) [3]	2288 ± 868
AVE ± SD NPH (ng/g bile) [2]	70,000 ± 25,300	AVE ± SD NPH/PROT (µg/g protein) [3]	15919 ± 5271

N of Cape Uyak; H53, H54

Pollock

YEAR 1990	n = 10	n (protein) = 10	Protein ave = 12.07 ± 9.8
AVE ± SD PHN (ng/g bile) [1]	21,600 ± 11,500	AVE ± SD PHN/PROT (µg/g protein) [3]	2305 ± 921
AVE ± SD NPH (ng/g bile) [2]	109,000 ± 54,700	AVE ± SD NPH/PROT (µg/g protein) [3]	11920 ± 4308

Naked Island

Chum salmon

YEAR 1989	n = 9	n (protein) = 9	Protein ave = 3.45 ± 0.9
AVE ± SD PHN (ng/g bile) [1]	6,300 ± 2,200	AVE ± SD PHN/PROT (µg/g protein) [3]	1915 ± 728
AVE ± SD NPH (ng/g bile) [2]	33,000 ± 12,200	AVE ± SD NPH/PROT (µg/g protein) [3]	10083 ± 4383

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Halibut

YEAR 1990	n = 4	n (protein) = 4	Protein ave =	1.33 ± 0.6
AVE ± SD PHN (ng/g bile)[1]	3,400 ±700		AVE ± SD PHN/PROT (µg/g protein)[3]	3243 ± 1533
AVE ± SD NPH (ng/g bile)[2]	29,000 ±5,000		AVE ± SD NPH/PROT (µg/g protein)[3]	26910 ± 10900

Naked Island - East

Pollock

YEAR 1991	n = 6	n (protein) = 6	Protein ave =	13.45 ± 6.1
AVE ± SD PHN (ng/g bile)[1]	14,500 ±2,000		AVE ± SD PHN/PROT (µg/g protein)[3]	1355 ± 766
AVE ± SD NPH (ng/g bile)[2]	97,000 ±20,900		AVE ± SD NPH/PROT (µg/g protein)[3]	9225 ± 6097

Naked Island - North

Pollock

YEAR 1991	n = 5	n (protein) = 5	Protein ave =	11.24 ± 4.1
AVE ± SD PHN (ng/g bile)[1]	11,000 ±3,400		AVE ± SD PHN/PROT (µg/g protein)[3]	1188 ± 696
AVE ± SD NPH (ng/g bile)[2]	61,000 ±15,700		AVE ± SD NPH/PROT (µg/g protein)[3]	6342 ± 3236

NW of Cape Ugat; H58

Pollock

YEAR 1990	n = 10	n (protein) = 10	Protein ave =	8.37 ± 8.3
AVE ± SD PHN (ng/g bile)[1]	13,300 ±6,800		AVE ± SD PHN/PROT (µg/g protein)[3]	2331 ± 1181
AVE ± SD NPH (ng/g bile)[2]	80,000 ±36,500		AVE ± SD NPH/PROT (µg/g protein)[3]	14855 ± 7905

NW of Naked Is.; H3

Pollock

YEAR 1990	n = 17	n (protein) = 17	Protein ave =	6.11 ± 3.0
AVE ± SD PHN (ng/g bile)[1]	31,900 ±13,300		AVE ± SD PHN/PROT (µg/g protein)[3]	6437 ± 3550
AVE ± SD NPH (ng/g bile)[2]	149,000 ±57,100		AVE ± SD NPH/PROT (µg/g protein)[3]	30872 ± 18690

Olsen Bay

Dolly Varden

YEAR 1990	n = 8	n (protein) = 8	Protein ave =	5.61 ± 1.9
AVE ± SD PHN (ng/g bile)[1]	8,200 ±2,900		AVE ± SD PHN/PROT (µg/g protein)[3]	1557 ± 453
AVE ± SD NPH (ng/g bile)[2]	45,000 ±12,300		AVE ± SD NPH/PROT (µg/g protein)[3]	8692 ± 2388

Flathead Sole

YEAR 1990	n = 5	n (protein) = 5	Protein ave =	2.44 ± 1.6
AVE ± SD PHN (ng/g bile)[1]	2,400 ±600		AVE ± SD PHN/PROT (µg/g protein)[3]	1598 ± 1374
AVE ± SD NPH (ng/g bile)[2]	14,000 ±4,100		AVE ± SD NPH/PROT (µg/g protein)[3]	8100 ± 4469

Rock sole

YEAR 1990	n = 6	n (protein) = 6	Protein ave =	1.60 ± 0.5
AVE ± SD PHN (ng/g bile)[1]	3,000 ±1,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1777 ± 553
AVE ± SD NPH (ng/g bile)[2]	19,000 ±7,600		AVE ± SD NPH/PROT (µg/g protein)[3]	12839 ± 5941

Yellowfin Sole

YEAR 1990	n = 20	n (protein) = 20	Protein ave =	2.21 ± 1.3
AVE ± SD PHN (ng/g bile)[1]	2,600 ±1,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1449 ± 1080
AVE ± SD NPH (ng/g bile)[2]	18,000 ±7,400		AVE ± SD NPH/PROT (µg/g protein)[3]	10009 ± 6056

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Flathead sole YEAR 1991 n = 12 n (protein) = 12 Protein ave = 4.42 ± 5.1

AVE ± SD PHN (ng/g bile)[1]	2,500 ± 500	AVE ± SD PHN/PROT (µg/g protein)[3]	1111 ± 612
AVE ± SD NPH (ng/g bile)[2]	20,000 ± 6,300	AVE ± SD NPH/PROT (µg/g protein)[3]	8353 ± 4855

Pacific cod YEAR 1991 n = 8 n (protein) = 8 Protein ave = 4.01 ± 1.8

AVE ± SD PHN (ng/g bile)[1]	4,200 ± 1,000	AVE ± SD PHN/PROT (µg/g protein)[3]	1138 ± 259
AVE ± SD NPH (ng/g bile)[2]	29,000 ± 9,100	AVE ± SD NPH/PROT (µg/g protein)[3]	7638 ± 1261

Rock sole YEAR 1991 n = 8 n (protein) = 8 Protein ave = 1.86 ± 1.2

AVE ± SD PHN (ng/g bile)[1]	2,500 ± 700	AVE ± SD PHN/PROT (µg/g protein)[3]	2002 ± 1255
AVE ± SD NPH (ng/g bile)[2]	19,000 ± 4,600	AVE ± SD NPH/PROT (µg/g protein)[3]	15179 ± 8329

Yellowfin sole YEAR 1991 n = 29 n (protein) = 29 Protein ave = 1.74 ± 1.2

AVE ± SD PHN (ng/g bile)[1]	3,200 ± 1,700	AVE ± SD PHN/PROT (µg/g protein)[3]	2008 ± 896
AVE ± SD NPH (ng/g bile)[2]	22,000 ± 11,600	AVE ± SD NPH/PROT (µg/g protein)[3]	13987 ± 6678

Point Bazil

Pollock YEAR 1991 n = 14 n (protein) = 14 Protein ave = 9.71 ± 5.2

AVE ± SD PHN (ng/g bile)[1]	13,800 ± 4,200	AVE ± SD PHN/PROT (µg/g protein)[3]	1664 ± 600
AVE ± SD NPH (ng/g bile)[2]	89,000 ± 26,700	AVE ± SD NPH/PROT (µg/g protein)[3]	10719 ± 4091

Port Fidalgo

Pollock YEAR 1991 n = 10 n (protein) = 10 Protein ave = 4.19 ± 1.6

AVE ± SD PHN (ng/g bile)[1]	7,900 ± 2,500	AVE ± SD PHN/PROT (µg/g protein)[3]	2068 ± 738
AVE ± SD NPH (ng/g bile)[2]	47,000 ± 17,200	AVE ± SD NPH/PROT (µg/g protein)[3]	11770 ± 3859

Port Gravina

Pollock YEAR 1991 n = 15 n (protein) = 15 Protein ave = 4.86 ± 2.0

AVE ± SD PHN (ng/g bile)[1]	10,400 ± 4,700	AVE ± SD PHN/PROT (µg/g protein)[3]	2273 ± 667
AVE ± SD NPH (ng/g bile)[2]	61,000 ± 22,200	AVE ± SD NPH/PROT (µg/g protein)[3]	13120 ± 2488

Portage Bay

Pollock YEAR 1991 n = 10 n (protein) = 10 Protein ave = 7.81 ± 2.7

AVE ± SD PHN (ng/g bile)[1]	8,700 ± 2,000	AVE ± SD PHN/PROT (µg/g protein)[3]	1233 ± 408
AVE ± SD NPH (ng/g bile)[2]	66,000 ± 15,600	AVE ± SD NPH/PROT (µg/g protein)[3]	9092 ± 2448

Portlock Bank

Halibut YEAR 1990 n = 31 n (protein) = 31 Protein ave = 7.08 ± 5.2

AVE ± SD PHN (ng/g bile)[1]	2,400 ± 3,400	AVE ± SD PHN/PROT (µg/g protein)[3]	421 ± 409
AVE ± SD NPH (ng/g bile)[2]	22,000 ± 22,500	AVE ± SD NPH/PROT (µg/g protein)[3]	3862 ± 2931

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Resurrection Bay

Species	YEAR	n	AVE ± SD PHN (ng/g bile)[1]	AVE ± SD NPH (ng/g bile)[2]	n (protein)	Protein ave	AVE ± SD PHN/PROT (µg/g protein)[3]	AVE ± SD NPH/PROT (µg/g protein)[3]
Chum salmon	1989	9	7,100 ±3,100	37,000 ±17,800	9	5.38 ± 2.3	1589 ± 833	8331 ± 4564
Dolly Varden	1989	10	10,300 ±3,500	65,000 ±22,000	10	6.55 ± 1.6	1709 ± 787	10502 ± 3983
Rock sole	1989	11	1,600 ±1,400	14,000 ±10,500	11	3.19 ± 1.6	519 ± 373	4864 ± 3255

Rocky Bay

Species	YEAR	n	AVE ± SD PHN (ng/g bile)[1]	AVE ± SD NPH (ng/g bile)[2]	n (protein)	Protein ave	AVE ± SD PHN/PROT (µg/g protein)[3]	AVE ± SD NPH/PROT (µg/g protein)[3]
Dolly Varden	1990	8	12,700 ±10,500	77,000 ±42,100	8	9.83 ± 6.8	1230 ± 198	8969 ± 2332
Flathead sole	1990	10	2,900 ±1,400	18,000 ±5,200	10	1.33 ± 0.7	2858 ± 1760	17499 ± 8683
Halibut	1990	9	2,900 ±2,300	19,000 ±17,400	9	1.29 ± 1.1	2446 ± 1245	15356 ± 7244
Rock Sole	1990	6	2,500 ±900	16,000 ±5,900	6	1.03 ± 0.2	2503 ± 998	15928 ± 5287
Flathead sole	1991	1	2,800 ±0	26,000 ±0	1	2.10 ± 0.0	1333 ± 0	12381 ± 0
Rock sole	1991	3	9,000 ±2,800	64,000 ±21,000	3	3.53 ± 1.4	2979 ± 1602	21045 ± 11777
Yellowfin sole	1991	1	2,700 ±0	27,000 ±0	1	11.40 ± 0.0	237 ± 0	2368 ± 0

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

S of Kinak Bay; H29, H59,

Pollock YEAR 1990 n = 13 n (protein) = 13 Protein ave = 10.36 ± 2.8

AVE ± SD PHN (ng/g bile)[1]	19,800 ± 4,300	AVE ± SD PHN/PROT (μg/g protein)[3]	2021 ± 604
AVE ± SD NPH (ng/g bile)[2]	102,000 ± 19,600	AVE ± SD NPH/PROT (μg/g protein)[3]	10545 ± 3333

S of Portage Bay; H25, H49

Pollock YEAR 1990 n = 10 n (protein) = 10 Protein ave = 8.21 ± 3.9

AVE ± SD PHN (ng/g bile)[1]	12,800 ± 3,600	AVE ± SD PHN/PROT (μg/g protein)[3]	1775 ± 553
AVE ± SD NPH (ng/g bile)[2]	74,000 ± 22,300	AVE ± SD NPH/PROT (μg/g protein)[3]	10191 ± 3274

Sanak Island

Pollock YEAR 1991 n = 10 n (protein) = 10 Protein ave = 9.78 ± 3.5

AVE ± SD PHN (ng/g bile)[1]	13,700 ± 6,000	AVE ± SD PHN/PROT (μg/g protein)[3]	1416 ± 400
AVE ± SD NPH (ng/g bile)[2]	67,000 ± 26,400	AVE ± SD NPH/PROT (μg/g protein)[3]	6995 ± 1627

Sanak Island; H15

Pollock YEAR 1990 n = 20 n (protein) = 20 Protein ave = 9.97 ± 4.3

AVE ± SD PHN (ng/g bile)[1]	15,200 ± 5,300	AVE ± SD PHN/PROT (μg/g protein)[3]	1637 ± 622
AVE ± SD NPH (ng/g bile)[2]	71,000 ± 24,500	AVE ± SD NPH/PROT (μg/g protein)[3]	7703 ± 2872

Seymour Canal

Pollock YEAR 1990 n = 14 n (protein) = 14 Protein ave = 6.58 ± 3.1

AVE ± SD PHN (ng/g bile)[1]	7,900 ± 3,200	AVE ± SD PHN/PROT (μg/g protein)[3]	1330 ± 546
AVE ± SD NPH (ng/g bile)[2]	54,000 ± 15,500	AVE ± SD NPH/PROT (μg/g protein)[3]	9308 ± 3169

Sleepy Bay

Dolly Varden YEAR 1990 n = 15 n (protein) = 15 Protein ave = 3.47 ± 2.8

AVE ± SD PHN (ng/g bile)[1]	9,200 ± 5,900	AVE ± SD PHN/PROT (μg/g protein)[3]	3283 ± 2398
AVE ± SD NPH (ng/g bile)[2]	71,000 ± 44,100	AVE ± SD NPH/PROT (μg/g protein)[3]	25068 ± 14948

Flathead Sole YEAR 1990 n = 7 n (protein) = 7 Protein ave = 1.73 ± 1.9

AVE ± SD PHN (ng/g bile)[1]	9,000 ± 3,000	AVE ± SD PHN/PROT (μg/g protein)[3]	9168 ± 5026
AVE ± SD NPH (ng/g bile)[2]	37,000 ± 13,600	AVE ± SD NPH/PROT (μg/g protein)[3]	36325 ± 20445

Rock Sole YEAR 1990 n = 10 n (protein) = 10 Protein ave = 1.74 ± 0.8

AVE ± SD PHN (ng/g bile)[1]	10,700 ± 4,600	AVE ± SD PHN/PROT (μg/g protein)[3]	7002 ± 3774
AVE ± SD NPH (ng/g bile)[2]	53,000 ± 17,500	AVE ± SD NPH/PROT (μg/g protein)[3]	35976 ± 18777

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Species	YEAR	n	AVE ± SD PHN (ng/g bile)[1]	AVE ± SD NPH (ng/g bile)[2]	n (protein)	Protein ave	AVE ± SD PHN/PROT (µg/g protein)[3]	AVE ± SD NPH/PROT (µg/g protein)[3]
Yellowfin Sole	1990	11	14,900 ± 9,800	74,000 ± 46,000	11	2.83 ± 1.7	7630 ± 6471	37549 ± 31081
Flathead sole	1991	2	3,900 ± 300	26,000 ± 0	2	1.90 ± 0.1	2067 ± 267	13722 ± 722
Halibut	1991	6	3,100 ± 2,200	24,000 ± 12,800	6	1.56 ± 0.5	2014 ± 968	15906 ± 6454
Pacific cod	1991	7	5,100 ± 1,900	31,000 ± 11,300	7	4.83 ± 1.8	1088 ± 312	6685 ± 1712
Rock sole	1991	15	4,900 ± 2,200	27,000 ± 10,300	15	2.09 ± 0.8	2634 ± 1046	14800 ± 5267
Yellowfin sole	1991	1	3,800 ± 0	23,000 ± 0	1	1.60 ± 0.0	2375 ± 0	14375 ± 0

Snug Harbor

Species	YEAR	n	AVE ± SD PHN (ng/g bile)[1]	AVE ± SD NPH (ng/g bile)[2]	n (protein)	Protein ave	AVE ± SD PHN/PROT (µg/g protein)[3]	AVE ± SD NPH/PROT (µg/g protein)[3]
Chum salmon	1989	9	14,700 ± 4,200	66,000 ± 15,800	9	4.66 ± 3.1	3971 ± 1592	18376 ± 7484
Dolly Varden	1989	2	58,500 ± 5,500	255,000 ± 45,000	2	±	±	±
Flathead sole	1989	20	19,400 ± 20,900	75,000 ± 65,600	20	2.49 ± 1.0	8295 ± 12482	32097 ± 39067
Halibut	1989	10	8,300 ± 4,000	30,000 ± 14,000	10	1.49 ± 0.7	6308 ± 3250	22112 ± 10374

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Species	Year	n	n (protein)	Protein ave	AVE ± SD PHN (ng/g bile)[1]	AVE ± SD NPH (ng/g bile)[2]	AVE ± SD PHN/PROT (µg/g protein)[3]	AVE ± SD NPH/PROT (µg/g protein)[3]
Rock sole	1989	20	20	2.16 ± 1.1	18,500 ±9,600	75,000 ±34,600	10642 ± 6989	42142 ± 24743
Yellowfin sole	1989	10	10	1.96 ± 0.6	11,100 ±3,700	42,000 ±14,200	6561 ± 3689	25337 ± 14860
Dolly Varden	1990	13	13	3.56 ± 2.1	6,000 ±3,800	49,000 ±22,900	1894 ± 841	16140 ± 6581
Flathead Sole	1990	8	8	2.03 ± 0.8	7,800 ±2,500	41,000 ±12,300	4216 ± 1305	21956 ± 6755
Halibut	1990	9	9	1.81 ± 1.6	5,800 ±10,700	36,000 ±68,500	2958 ± 2526	17542 ± 16140
Rock Sole	1990	6	6	2.20 ± 1.1	14,900 ±5,600	71,000 ±26,000	8862 ± 5860	41746 ± 24863
Yellowfin Sole	1990	22	22	2.70 ± 2.1	12,600 ±11,800	76,000 ±60,300	5386 ± 2816	32361 ± 16453
Flathead sole	1991	11	11	1.91 ± 1.5	4,400 ±2,300	27,000 ±10,400	2916 ± 1521	17706 ± 7163
Pacific cod	1991	7	7	4.70 ± 2.0	4,600 ±1,600	26,000 ±7,600	1011 ± 170	5864 ± 1397
Rock sole	1991	13	13	1.94 ± 1.2	7,200 ±3,800	39,000 ±18,000	4511 ± 2878	23805 ± 14159
Yellowfin sole	1991	24	24	2.06 ± 1.4	3,700 ±1,300	25,000 ±7,800	2380 ± 1210	16004 ± 7754

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Squirrel Bay

Dolly Varden	YEAR 1990	n = 13	n (protein) = 13	Protein ave = 3.81 ± 1.9
AVE ± SD PHN (ng/g bile)[1]	6,100 ± 3,000		AVE ± SD PHN/PROT (µg/g protein)[3]	1743 ± 861
AVE ± SD NPH (ng/g bile)[2]	58,000 ± 27,900		AVE ± SD NPH/PROT (µg/g protein)[3]	17442 ± 9051

Yellowfin Sole	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 1.91 ± 1.3
AVE ± SD PHN (ng/g bile)[1]	6,300 ± 4,400		AVE ± SD PHN/PROT (µg/g protein)[3]	3810 ± 2702
AVE ± SD NPH (ng/g bile)[2]	42,000 ± 22,700		AVE ± SD NPH/PROT (µg/g protein)[3]	25999 ± 16056

Rock sole	YEAR 1991	n = 10	n (protein) = 10	Protein ave = 2.00 ± 1.1
AVE ± SD PHN (ng/g bile)[1]	39,100 ± 107,000		AVE ± SD PHN/PROT (µg/g protein)[3]	18994 ± 50819
AVE ± SD NPH (ng/g bile)[2]	111,000 ± 276,300		AVE ± SD NPH/PROT (µg/g protein)[3]	55498 ± 130806

Yellowfin sole	YEAR 1991	n = 3	n (protein) = 3	Protein ave = 4.13 ± 3.2
AVE ± SD PHN (ng/g bile)[1]	5,200 ± 700		AVE ± SD PHN/PROT (µg/g protein)[3]	1975 ± 943
AVE ± SD NPH (ng/g bile)[2]	35,000 ± 5,700		AVE ± SD NPH/PROT (µg/g protein)[3]	12933 ± 5747

Sturgeon Head

Pollock	YEAR 1991	n = 11	n (protein) = 11	Protein ave = 10.17 ± 2.6
AVE ± SD PHN (ng/g bile)[1]	11,400 ± 3,400		AVE ± SD PHN/PROT (µg/g protein)[3]	1141 ± 288
AVE ± SD NPH (ng/g bile)[2]	77,000 ± 15,600		AVE ± SD NPH/PROT (µg/g protein)[3]	7810 ± 1446

Sunny Cove

Dolly Varden	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 3.26 ± 1.3
AVE ± SD PHN (ng/g bile)[1]	6,500 ± 2,000		AVE ± SD PHN/PROT (µg/g protein)[3]	2319 ± 1112
AVE ± SD NPH (ng/g bile)[2]	59,000 ± 12,400		AVE ± SD NPH/PROT (µg/g protein)[3]	22243 ± 13560

Yellowfin sole	YEAR 1990	n = 21	n (protein) = 21	Protein ave = 4.51 ± 2.4
AVE ± SD PHN (ng/g bile)[1]	4,800 ± 1,800		AVE ± SD PHN/PROT (µg/g protein)[3]	1355 ± 813
AVE ± SD NPH (ng/g bile)[2]	41,000 ± 14,200		AVE ± SD NPH/PROT (µg/g protein)[3]	12084 ± 7954

Sutwik Island

Pollock	YEAR 1991	n = 11	n (protein) = 11	Protein ave = 6.76 ± 3.7
AVE ± SD PHN (ng/g bile)[1]	7,100 ± 3,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1308 ± 794
AVE ± SD NPH (ng/g bile)[2]	52,000 ± 16,800		AVE ± SD NPH/PROT (µg/g protein)[3]	9463 ± 4166

SW of Chirikof Is; H22

Pollock	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 16.28 ± 4.9
AVE ± SD PHN (ng/g bile)[1]	21,100 ± 8,200		AVE ± SD PHN/PROT (µg/g protein)[3]	1327 ± 530
AVE ± SD NPH (ng/g bile)[2]	86,000 ± 27,000		AVE ± SD NPH/PROT (µg/g protein)[3]	5393 ± 1329

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

SW of Malina Pt; H31

Pollock	YEAR 1990	n = 14	n (protein) = 14	Protein ave = 6.33 ± 4.4
AVE ± SD PHN (ng/g bile)[1]	9,600 ± 6,300		AVE ± SD PHN/PROT (µg/g protein)[3]	1752 ± 813
AVE ± SD NPH (ng/g bile)[2]	66,000 ± 30,000		AVE ± SD NPH/PROT (µg/g protein)[3]	12475 ± 4036

SW of Tugidak Is; H23

Pollock	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 8.75 ± 2.6
AVE ± SD PHN (ng/g bile)[1]	16,400 ± 2,800		AVE ± SD PHN/PROT (µg/g protein)[3]	2136 ± 762
AVE ± SD NPH (ng/g bile)[2]	89,000 ± 13,600		AVE ± SD NPH/PROT (µg/g protein)[3]	11478 ± 4569

Tonsina Bay

Dolly Varden	YEAR 1989	n = 18	n (protein) = 18	Protein ave = 6.16 ± 2.8
AVE ± SD PHN (ng/g bile)[1]	85,800 ± 47,500		AVE ± SD PHN/PROT (µg/g protein)[3]	15400 ± 7533
AVE ± SD NPH (ng/g bile)[2]	362,000 ± 185,900		AVE ± SD NPH/PROT (µg/g protein)[3]	64488 ± 28723

Flathead sole	YEAR 1989	n = 10	n (protein) = 10	Protein ave = 1.60 ± 0.8
AVE ± SD PHN (ng/g bile)[1]	9,500 ± 5,300		AVE ± SD PHN/PROT (µg/g protein)[3]	5623 ± 2196
AVE ± SD NPH (ng/g bile)[2]	32,000 ± 20,200		AVE ± SD NPH/PROT (µg/g protein)[3]	18074 ± 6831

Halibut	YEAR 1989	n = 10	n (protein) = 10	Protein ave = 1.31 ± 0.6
AVE ± SD PHN (ng/g bile)[1]	4,500 ± 2,100		AVE ± SD PHN/PROT (µg/g protein)[3]	3706 ± 1421
AVE ± SD NPH (ng/g bile)[2]	21,000 ± 7,900		AVE ± SD NPH/PROT (µg/g protein)[3]	16921 ± 5756

Rock sole	YEAR 1989	n = 11	n (protein) = 11	Protein ave = 3.69 ± 2.2
AVE ± SD PHN (ng/g bile)[1]	7,600 ± 6,100		AVE ± SD PHN/PROT (µg/g protein)[3]	2411 ± 1521
AVE ± SD NPH (ng/g bile)[2]	38,000 ± 27,600		AVE ± SD NPH/PROT (µg/g protein)[3]	12664 ± 7376

Yellowfin sole	YEAR 1989	n = 10	n (protein) = 10	Protein ave = 1.89 ± 1.5
AVE ± SD PHN (ng/g bile)[1]	13,700 ± 5,900		AVE ± SD PHN/PROT (µg/g protein)[3]	9874 ± 6989
AVE ± SD NPH (ng/g bile)[2]	53,000 ± 21,700		AVE ± SD NPH/PROT (µg/g protein)[3]	37679 ± 24179

Dolly Varden	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 5.31 ± 2.3
AVE ± SD PHN (ng/g bile)[1]	12,200 ± 4,700		AVE ± SD PHN/PROT (µg/g protein)[3]	3050 ± 2890
AVE ± SD NPH (ng/g bile)[2]	72,000 ± 22,300		AVE ± SD NPH/PROT (µg/g protein)[3]	18659 ± 18610

Flathead sole	YEAR 1990	n = 10	n (protein) = 10	Protein ave = 1.08 ± 0.5
AVE ± SD PHN (ng/g bile)[1]	9,800 ± 4,500		AVE ± SD PHN/PROT (µg/g protein)[3]	9561 ± 4180
AVE ± SD NPH (ng/g bile)[2]	48,000 ± 20,500		AVE ± SD NPH/PROT (µg/g protein)[3]	46614 ± 20120

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Halibut	YEAR 1990 n = 4	n (protein) = 4	Protein ave = 3.28 ± 3.5
AVE ± SD PHN (ng/g bile)[1]	4,900 ± 3,700	AVE ± SD PHN/PROT (µg/g protein)[3]	2072 ± 872
AVE ± SD NPH (ng/g bile)[2]	28,000 ± 18,700	AVE ± SD NPH/PROT (µg/g protein)[3]	13321 ± 5008

Rock sole	YEAR 1990 n = 9	n (protein) = 9	Protein ave = 1.61 ± 0.7
AVE ± SD PHN (ng/g bile)[1]	8,800 ± 3,500	AVE ± SD PHN/PROT (µg/g protein)[3]	5818 ± 2282
AVE ± SD NPH (ng/g bile)[2]	44,000 ± 17,500	AVE ± SD NPH/PROT (µg/g protein)[3]	30378 ± 13931

Yellowfin Sole	YEAR 1990 n = 10	n (protein) = 10	Protein ave = 1.77 ± 0.9
AVE ± SD PHN (ng/g bile)[1]	12,600 ± 6,000	AVE ± SD PHN/PROT (µg/g protein)[3]	7592 ± 2453
AVE ± SD NPH (ng/g bile)[2]	68,000 ± 34,500	AVE ± SD NPH/PROT (µg/g protein)[3]	41979 ± 16636

Trinity Islands

Pollock	YEAR 1991 n = 10	n (protein) = 10	Protein ave = 7.92 ± 4.0
AVE ± SD PHN (ng/g bile)[1]	9,300 ± 1,600	AVE ± SD PHN/PROT (µg/g protein)[3]	1303 ± 296
AVE ± SD NPH (ng/g bile)[2]	55,000 ± 9,800	AVE ± SD NPH/PROT (µg/g protein)[3]	7701 ± 1814

Uganik Island

Pollock	YEAR 1991 n = 10	n (protein) = 10	Protein ave = 7.24 ± 2.9
AVE ± SD PHN (ng/g bile)[1]	7,200 ± 3,100	AVE ± SD PHN/PROT (µg/g protein)[3]	1030 ± 288
AVE ± SD NPH (ng/g bile)[2]	53,000 ± 23,400	AVE ± SD NPH/PROT (µg/g protein)[3]	7480 ± 2232

Valdez

Coho salmon	YEAR 1989 n = 10	n (protein) = 10	Protein ave = 22.05 ± 18.6
AVE ± SD PHN (ng/g bile)[1]	21,800 ± 12,600	AVE ± SD PHN/PROT (µg/g protein)[3]	2318 ± 3353
AVE ± SD NPH (ng/g bile)[2]	121,000 ± 40,700	AVE ± SD NPH/PROT (µg/g protein)[3]	12845 ± 15366

Dolly Varden	YEAR 1989 n = 10	n (protein) = 10	Protein ave = 10.88 ± 5.8
AVE ± SD PHN (ng/g bile)[1]	28,300 ± 27,900	AVE ± SD PHN/PROT (µg/g protein)[3]	3391 ± 1688
AVE ± SD NPH (ng/g bile)[2]	156,000 ± 81,400	AVE ± SD NPH/PROT (µg/g protein)[3]	16662 ± 2110

Flathead sole	YEAR 1989 n = 10	n (protein) = 10	Protein ave = 2.27 ± 0.7
AVE ± SD PHN (ng/g bile)[1]	4,900 ± 3,900	AVE ± SD PHN/PROT (µg/g protein)[3]	2541 ± 2403
AVE ± SD NPH (ng/g bile)[2]	19,000 ± 8,800	AVE ± SD NPH/PROT (µg/g protein)[3]	9873 ± 6144

Rock sole	YEAR 1989 n = 10	n (protein) = 10	Protein ave = 2.07 ± 0.9
AVE ± SD PHN (ng/g bile)[1]	5,100 ± 1,800	AVE ± SD PHN/PROT (µg/g protein)[3]	2790 ± 1569
AVE ± SD NPH (ng/g bile)[2]	37,000 ± 12,100	AVE ± SD NPH/PROT (µg/g protein)[3]	20476 ± 8786

APPENDIX 4. Fluorescent Aromatic Compounds (FAC)in Bile--Site Summary by Species and Year

Yellowfin sole — YEAR 1989, n = 10; n (protein) = 10; Protein ave = 2.69 ± 1.5

AVE ± SD PHN (ng/g bile)[1]	5,700 ± 2,600	AVE ± SD PHN/PROT (µg/g protein)[3]	2283 ± 1143
AVE ± SD NPH (ng/g bile)[2]	31,000 ± 14,900	AVE ± SD NPH/PROT (µg/g protein)[3]	12502 ± 6164

W of Goose Is.; H2

Pollock — YEAR 1990, n = 20; n (protein) = 20; Protein ave = 10.61 ± 4.4

AVE ± SD PHN (ng/g bile)[1]	25,400 ± 11,000	AVE ± SD PHN/PROT (µg/g protein)[3]	2838 ± 1888
AVE ± SD NPH (ng/g bile)[2]	125,000 ± 47,100	AVE ± SD NPH/PROT (µg/g protein)[3]	13475 ± 6770

W of Mummy Is.; H4

Pollock — YEAR 1990, n = 20; n (protein) = 20; Protein ave = 7.71 ± 3.3

AVE ± SD PHN (ng/g bile)[1]	48,000 ± 20,900	AVE ± SD PHN/PROT (µg/g protein)[3]	7562 ± 4714
AVE ± SD NPH (ng/g bile)[2]	205,000 ± 76,900	AVE ± SD NPH/PROT (µg/g protein)[3]	32004 ± 18369

W of Point Bazil; H5

Pollock — YEAR 1990, n = 20; n (protein) = 20; Protein ave = 5.83 ± 2.2

AVE ± SD PHN (ng/g bile)[1]	17,700 ± 11,500	AVE ± SD PHN/PROT (µg/g protein)[3]	3112 ± 1785
AVE ± SD NPH (ng/g bile)[2]	99,000 ± 55,500	AVE ± SD NPH/PROT (µg/g protein)[3]	17973 ± 9201

Windy Bay

Dolly Varden — YEAR 1990, n = 10; n (protein) = 10; Protein ave = 3.11 ± 0.7

AVE ± SD PHN (ng/g bile)[1]	9,100 ± 2,200	AVE ± SD PHN/PROT (µg/g protein)[3]	2885 ± 699
AVE ± SD NPH (ng/g bile)[2]	70,000 ± 15,600	AVE ± SD NPH/PROT (µg/g protein)[3]	22410 ± 6783

Yellowfin Sole — YEAR 1990, n = 10; n (protein) = 10; Protein ave = 2.85 ± 1.5

AVE ± SD PHN (ng/g bile)[1]	6,600 ± 2,100	AVE ± SD PHN/PROT (µg/g protein)[3]	3117 ± 1948
AVE ± SD NPH (ng/g bile)[2]	35,000 ± 9,800	AVE ± SD NPH/PROT (µg/g protein)[3]	16067 ± 8176

Yakutat Bay

Dolly Varden — YEAR 1990, n = 10; n (protein) = 10; Protein ave = 6.68 ± 5.8

AVE ± SD PHN (ng/g bile)[1]	22,200 ± 24,100	AVE ± SD PHN/PROT (µg/g protein)[3]	3383 ± 2251
AVE ± SD NPH (ng/g bile)[2]	69,000 ± 46,100	AVE ± SD NPH/PROT (µg/g protein)[3]	13831 ± 8740

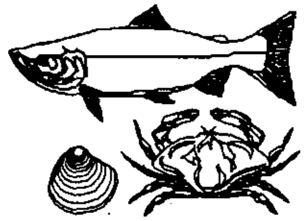
Halibut — YEAR 1990, n = 10; n (protein) = 10; Protein ave = 1.20 ± 0.3

AVE ± SD PHN (ng/g bile)[1]	1,700 ± 500	AVE ± SD PHN/PROT (µg/g protein)[3]	1577 ± 677
AVE ± SD NPH (ng/g bile)[2]	11,000 ± 2,100	AVE ± SD NPH/PROT (µg/g protein)[3]	9882 ± 2245

Yellowfin Sole — YEAR 1990, n = 10; n (protein) = 10; Protein ave = 1.80 ± 0.5

AVE ± SD PHN (ng/g bile)[1]	4,600 ± 1,500	AVE ± SD PHN/PROT (µg/g protein)[3]	2640 ± 1013
AVE ± SD NPH (ng/g bile)[2]	22,000 ± 6,600	AVE ± SD NPH/PROT (µg/g protein)[3]	13651 ± 6409

APPENDIX 5



APPENDIX 5. SUBTIDAL 7 FINAL REPORT
Hepatic Aryl Hydrocarbon Hydoxylase (AHH)
Site Summary by Species and Year

Balboa Bay

Rock sole — **YEAR 1989** — n = 17

MEAN AHH ± standard deviation[1] 114.42 ± 55.44

Discoverer Bay

Dolly Varden — **YEAR 1990** — n = 10

MEAN AHH ± standard deviation[1] 53.20 ± 23.13

Drier Bay

Dolly Varden — **YEAR 1990** — n = 1

MEAN AHH ± standard deviation[1] 47.00 ± 0.00

Fox Farm Bay

Yellowfin Sole — **YEAR 1991** — n = 15

MEAN AHH ± standard deviation[1] 79.73 ± 43.05

Hallo Bay

Dolly Varden — **YEAR 1990** — n = 10

MEAN AHH ± standard deviation[1] 44.70 ± 28.92

Yellowfin Sole — **YEAR 1990** — n = 10

MEAN AHH ± standard deviation[1] 51.80 ± 45.69

Kukak Bay

Dolly Varden — **YEAR 1989** — n = 15

MEAN AHH ± standard deviation[1] 54.27 ± 20.21

Rock sole — **YEAR 1989** — n = 12

MEAN AHH ± standard deviation[1] 211.67 ± 85.35

Dolly Varden — **YEAR 1990** — n = 10

MEAN AHH ± standard deviation[1] 32.20 ± 12.11

Flathead sole — **YEAR 1990** — n = 10

MEAN AHH ± standard deviation[1] 76.90 ± 66.32

Yellowfin sole — **YEAR 1990** — n = 11

MEAN AHH ± standard deviation[1] 24.82 ± 19.12

1. Aryl hydrocarbon hydroxylase (AHH); pmole/mg protein/min; measured using 14-C-benzo[a]pyrene as the primary substrate.

Appendix 5. Hepatic Aryl Hydrocarbon Hydoxylase (AHH)--Site Summary by Species and Year

MacLeod Harbor

Dolly Varden — YEAR 1990 — n = 17

MEAN AHH ± standard deviation[1] 65.76 ± 173.65

Moose Lips Bay

Dolly Varden — YEAR 1990 — n = 12

MEAN AHH ± standard deviation[1] 34.83 ± 20.79

Olsen Bay

Dolly Varden — YEAR 1990 — n = 9

MEAN AHH ± standard deviation[1] 50.44 ± 19.84

Flathead Sole — YEAR 1990 — n = 5

MEAN AHH ± standard deviation[1] 45.80 ± 26.84

Rock Sole — YEAR 1990 — n = 5

MEAN AHH ± standard deviation[1] 44.80 ± 47.48

Yellowfin Sole — YEAR 1990 — n = 12

MEAN AHH ± standard deviation[1] 66.42 ± 48.34

Flathead sole — YEAR 1991 — n = 10

MEAN AHH ± standard deviation[1] 57.30 ± 35.26

Pacific cod — YEAR 1991 — n = 7

MEAN AHH ± standard deviation[1] 20.57 ± 8.99

Rock sole — YEAR 1991 — n = 7

MEAN AHH ± standard deviation[1] 93.00 ± 29.24

Yellowfin sole — YEAR 1991 — n = 27

MEAN AHH ± standard deviation[1] 68.70 ± 40.61

Resurrection Bay

Dolly Varden — YEAR 1989 — n = 10

MEAN AHH ± standard deviation[1] 96.23 ± 27.23

Rocky Bay

Dolly Varden — YEAR 1990 — n = 11

MEAN AHH ± standard deviation[1] 53.55 ± 30.90

Flathead sole — YEAR 1990 — n = 10

MEAN AHH ± standard deviation[1] 98.60 ± 171.31

1. Aryl hydrocarbon hydroxylase (AHH); pmole/mg protein/min; measured using 14-C-benzo[a]pyrene as the primary substrate.

Appendix 5. Hepatic Aryl Hydrocarbon Hydoxylase (AHH)--Site Summary by Species and Year

Halibut	YEAR 1990	n = 14		
	MEAN AHH ± standard deviation[1]		70.07	± 52.69
Rock Sole	YEAR 1990	n = 6		
	MEAN AHH ± standard deviation[1]		150.00	± 52.18
Yellowfin Sole	YEAR 1991	n = 2		
	MEAN AHH ± standard deviation[1]		226.50	± 9.50

Sleepy Bay

Dolly Varden	YEAR 1990	n = 16		
	MEAN AHH ± standard deviation[1]		52.06	± 31.21
Flathead Sole	YEAR 1990	n = 9		
	MEAN AHH ± standard deviation[1]		94.11	± 63.51
Rock Sole	YEAR 1990	n = 10		
	MEAN AHH ± standard deviation[1]		394.70	± 144.06
Yellowfin Sole	YEAR 1990	n = 11		
	MEAN AHH ± standard deviation[1]		116.73	± 133.33
Halibut	YEAR 1991	n = 6		
	MEAN AHH ± standard deviation[1]		72.50	± 22.45
Pacific cod	YEAR 1991	n = 7		
	MEAN AHH ± standard deviation[1]		31.57	± 11.22
Rock sole	YEAR 1991	n = 14		
	MEAN AHH ± standard deviation[1]		121.86	± 104.75

Snug Harbor

Dolly Varden	YEAR 1989	n = 6		
	MEAN AHH ± standard deviation[1]		236.33	± 128.93
Rock sole	YEAR 1989	n = 9		
	MEAN AHH ± standard deviation[1]		224.78	± 173.51
Dolly Varden	YEAR 1990	n = 12		
	MEAN AHH ± standard deviation[1]		83.50	± 48.98
Flathead Sole	YEAR 1990	n = 8		
	MEAN AHH ± standard deviation[1]		128.38	± 66.40

1. Aryl hydrocarbon hydroxylase (AHH); pmole/mg protein/min; measured using 14-C-benzo[a]pyrene as the primary substrate.

Appendix 5. Hepatic Aryl Hydrocarbon Hydoxylase (AHH)--Site Summary by Species and Year

Halibut — **YEAR 1990** n = 6

MEAN AHH ± standard deviation[1] 88.67 ± 36.08

Rock Sole — **YEAR 1990** n = 9

MEAN AHH ± standard deviation[1] 237.56 ± 119.29

Yellowfin Sole — **YEAR 1990** n = 10

MEAN AHH ± standard deviation[1] 84.00 ± 71.37

Flathead sole — **YEAR 1991** n = 15

MEAN AHH ± standard deviation[1] 128.33 ± 101.72

Pacific cod — **YEAR 1991** n = 9

MEAN AHH ± standard deviation[1] 55.78 ± 74.08

Rock sole — **YEAR 1991** n = 15

MEAN AHH ± standard deviation[1] 201.87 ± 71.31

Yellowfin sole — **YEAR 1991** n = 25

MEAN AHH ± standard deviation[1] 184.08 ± 193.46

Squirrel Bay

Rock sole — **YEAR 1991** n = 3

MEAN AHH ± standard deviation[1] 73.67 ± 21.70

Yellowfin Sole — **YEAR 1991** n = 2

MEAN AHH ± standard deviation[1] 140.00 ± 40.00

Tonsina Bay

Dolly Varden — **YEAR 1989** n = 17

MEAN AHH ± standard deviation[1] 237.33 ± 125.11

Halibut — **YEAR 1989** n = 4

MEAN AHH ± standard deviation[1] 42.45 ± 20.42

Rock sole — **YEAR 1989** n = 11

MEAN AHH ± standard deviation[1] 152.90 ± 57.54

Dolly Varden — **YEAR 1990** n = 10

MEAN AHH ± standard deviation[1] 66.60 ± 18.77

Flathead Sole — **YEAR 1990** n = 10

MEAN AHH ± standard deviation[1] 98.80 ± 66.73

1. Aryl hydrocarbon hydroxylase (AHH); pmole/mg protein/min; measured using 14-C-benzo[a]pyrene as the primary substrate.

Appendix 5. Hepatic Aryl Hydrocarbon Hydoxylase (AHH)--Site Summary by Species and Year

Halibut	YEAR 1990	n = 3
	MEAN AHH ± standard deviation[1] 51.67 ± 28.96	
Rock sole	YEAR 1990	n = 8
	MEAN AHH ± standard deviation[1] 125.13 ± 77.60	
Yellowfin sole	YEAR 1990	n = 6
	MEAN AHH ± standard deviation[1] 119.33 ± 27.87	
Valdez		
Dolly Varden	YEAR 1989	n = 8
	MEAN AHH ± standard deviation[1] 81.63 ± 50.42	
Rock sole	YEAR 1989	n = 6
	MEAN AHH ± standard deviation[1] 24.00 ± 37.34	
Windy Bay		
Dolly Varden	YEAR 1990	n = 10
	MEAN AHH ± standard deviation[1] 61.20 ± 21.69	
Yakutat Bay		
Dolly Varden	YEAR 1990	n = 16
	MEAN AHH ± standard deviation[1] 129.00 ± 211.66	
Halibut	YEAR 1990	n = 10
	MEAN AHH ± standard deviation[1] 33.40 ± 13.82	
Yellowfin Sole	YEAR 1990	n = 3
	MEAN AHH ± standard deviation[1] 16.00 ± 3.56	

1. Aryl hydrocarbon hydroxylase (AHH); pmole/mg protein/min; measured using 14-C-benzo[a]pyrene as the primary substrate.

APPENDIX 6

Progress Report 24B

OIL SPILL PROGRESS REPORT

SHELLFISH AND GROUNDFISH TRAWL ASSESSMENT OUTSIDE PRINCE WILLIAM SOUND

Fish/Shellfish Study Number 24

Part B. Exposure to Oil and Its Effects

by

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EXECUTIVE SUMMARY

Studies were conducted to assess damage to fisheries resources related to the *EXXON VALDEZ* oil spill. These studies were designed to help determine the degree of exposure of biota to petroleum derived compounds, specifically aromatic hydrocarbons, and assess possible effects on various species resulting from such exposure. From May to September, 1989, samples of fish were collected from 51 sites (out of 56 sites occupied) in Prince William Sound, Lower Cook Inlet, and waters near Kenai Peninsula and the Alaskan Peninsula. Nearly 3000 bile and over 2000 liver samples were obtained from 10 species of fish from littoral, benthic and pelagic habitats. Nearly 500 of the bile samples have been analyzed for the presence of fluorescent aromatic compounds (FACs). A smaller proportion of the liver samples have been analyzed for aryl hydrocarbon hydroxylase (AHH) activity and immunochemically quantitated IA1-type cytochrome P-450 (P450), both of which are known to be increased after exposure to a variety of chemical contaminants. These assays (FACs, AHH, and P450) were used to determine degree of exposure of fish to aromatic compounds. In addition, changes in hepatic AHH activities or levels of P450 can also indicate a physiological change as a consequence of exposure. Preliminary results from measurements of levels of FACs in bile and analyses of AHH activity and levels of P450 in liver have provided evidence of exposure to petroleum-derived compounds in fish from many of the sites. The degree of exposure was highest in littoral Dolly Varden, and lowest but detectable in nearshore benthic fish, which included three species of flounder and Pacific halibut. Salmon showed evidence of moderate exposure. Analyses of samples to measure other effects including histopathological changes, reproductive disorders and levels of DNA adducts are pending.

INTRODUCTION

The section in the Study Plan (Volume 3, F24, pp. 23-24) introduces this portion of our study and is included in Appendix A.

OBJECTIVES

The general objectives of this study were outlined in the Study Plan as C and D (p. 2). The specific objectives were indicated as C1, D1 and D2 (pp. 24-25) and are included in Appendix A.

METHODOLOGY (see Appendix A)

A. *Collection areas*

Sampling activities were conducted from May 16 to September 23, 1989 at 56 sites both inside and outside of Prince William Sound (see the site maps, Appendix L, Figures 1-4 of Study Plan). At 11 of the sites, collections were made twice (May/June and September) and at two sites, collections were made three times (May/June, August and September). At five of the sites, insufficient numbers of fish were collected for analysis.

B. *Sampling procedures*

Sample collection methods were outlined in the Study Plan (pp. 26-27). Fish were collected at depths ranging from 2 to 60 meters using bottom trawls, long-line gear, gill nets, and beach seines. This equipment was deployed from launches and skiffs carried aboard the NOAA vessel *FAIRWEATHER*. Sizes, characteristics of gear, duration of sets and species collected are listed in Table 1.

All fish used for sample collections were kept alive in a flowthrough seawater system at ambient water temperature. Sampling procedures followed those outlined in the Study Plan (p. 27).

C. *Laboratory Analyses*

1. <u>Bile Metabolite Assay</u>

Assay methods were the same as outlined in the Study Plan (p. 27). Briefly, bile samples were analyzed at wavelengths appropriate for detection of naphthalene (NPH) and phenanthrene (PHN) and their metabolites. These aromatic hydrocarbons are predominant components of the aromatic fraction of crude oil. Hereafter, analyses done at these wavelengths are referred to as $FACs_{NPH}$ and $FACs_{PHN}$, respectively. The analyses of bile samples collected during July and August were performed aboard ship on pools of bile from 3-5 fish.

For some bile samples, an additional measurement of FACs was conducted at excitation/emission wavelengths of 380/430 nm where metabolites of benzo(a)pyrene (BaP) fluoresce, and these analyses are referred to as $FACs_{BaP}$. Aromatic hydrocarbons comprised of 4-5 benzenoid rings, such as BaP, are relatively minor components of petroleum. However, it is important that possible exposure to such compounds be assessed because of their known carcinogenicity in fish and rodents, together with their persistence in the marine environment.

2. <u>Liver Aryl Hydrocarbon Hydroxylase (AHH) Assay</u>

Analytical methods used for measuring hepatic AHH activity and levels of IA1-type cytochrome P450 were as outlined in the Study Plan (p.27).

D. *Quality Assurance and Control Plans*

All quality assurance and control plans for bile analytes, and AHH analysis, followed the procedures outlined in the Study Plan (p. 28).

DATA ANALYSIS

Statistical tests and analytical procedures for preliminary statistical analyses departed from those outlined in the Study Plan (p. 29) in that the data showed severe departures both from normality and from homoscedasticity, which necessitated assessing differences between sites using nonparametric statistical methods. The Kruskal-Wallis test (analysis of variance by ranks was used to test for differences among sites. If the null hypothesis of no difference among sites was rejected at $\alpha = 0.05$, a nonparametric multiple comparison test was used to determine which sites were different from each other at $\alpha = 0.05$.

RESULTS

A. *Fish and Tissue Samples Collected*

Samples were collected from 3315 individual animals representing 15 species of fish and invertebrates (Table 2). Totals of 2141 liver, 2947 bile samples and 22 composites of juvenile fish were collected at the 51 sites sampled. These totals include only those sites where a minimum of six individuals of a species were collected.

B. *Laboratory Analysis*

The samples which have been analyzed thus far were selected to represent sites with a range of potential oil exposure. In order to insure adequate numbers for statistical analyses, samples were generally analyzed only from sites where six or more individuals were collected. Two exceptions are noted in Figure 2, for Dolly Varden.

Figure 1 shows mean levels of $FACs_{PHN}$ in bile from a variety of species sampled from Alaskan waters prior to the *EXXON VALDEZ* oil spill, and in addition includes results from analyses of samples collected after the spill, but from an area believed to be unaffected by the *EXXON VALDEZ* oil spill. The Angoon site is located in Southeastern Alaska near Juneau, the Yukon Site in the northeastern Bering Sea near the mouth of the Yukon River, and the Nome site in the Norton Sound near Nome. The species at Angoon included coho, chinook and pink salmon. No suitable reference samples (i.e., liver samples from Dolly Varden collected prior to the spill) were available for measurements of hepatic AHH activity and levels of P450. We are continuing our analyses of reference samples of other species, both for bile and liver measurements, and the data presented in Figure 1 are only intended for use as general reference values.

1. Bile Analysis

To date, 448 individual bile samples, out of 2947 collected from six fish species from 13 sites, have been analyzed. Each of these samples was analyzed at both PHN and NPH wavelengths, and the data showed a very strong correlation between $FACs_{PHN}$ and $FACs_{NPH}$. Accordingly, in this preliminary report we will deal primarily with the $FACs_{PHN}$ data. At some sites (Tonsina Bay, Kukak Bay, Snug Harbor, and Valdez) up to 10 bile samples from all available fish species have been analyzed. At the other sites (Kodiak, Resurrection Bay, Afognak/Shuyak, Kamishak Bay, Kachemak Bay, Balboa Bay, Chignik Bay, Evans Island, and Naked Island) individual bile samples from rock sole, Dolly Varden, and salmon (includes chum, pink and coho salmon) were analyzed. Additionally, 238 bile composites from eight fish species collected at 44 sites were analyzed aboard the NOAA Ship *FAIRWEATHER* in July and August.

The mean $FACs_{PHN}$ values in bile of Dolly Varden, salmon and rock sole collected in May and June are shown in Figure 2. For Dolly Varden, the average value for $FACs_{PHN}$ in bile was significantly different than values for the other sites, at Tonsina Bay and Valdez. Similarly, levels of $FACs_{PHN}$ in bile of rock sole from Snug Harbor, Tonsina Bay and Valdez were significantly different than 5, 2 and 2 of the lowest sites respectively. Samples from Kukak Bay, Kodiak and Kachemak Bay had values which were significantly different than those from Balboa Bay. Levels of $FACs_{PHN}$ in salmon bile were significantly higher at Valdez and Snug Harbor than at the four lowest sites. Values for Kukak Bay salmon were significantly different than values for salmon at Kachemak Bay.

The results of bile analysis for all the species collected at Tonsina Bay, Snug Harbor, Valdez and Kukak Bay in May and June are shown in Figure 3. At all sites the levels of $FACs_{PHN}$ were consistently highest in bile collected from Dolly Varden and consistently lowest for bile from Pacific halibut. $FACs_{PHN}$ in bile of all of the species collected at Tonsina Bay and Snug Harbor were consistently higher than those from Kukak Bay.

The results of bile analysis are plotted (Figures 4A-D) for sites from Prince William Sound to the Shumagin Islands where rock sole, Dolly Varden and salmon were collected from May through August. At 29 of 35 sites (83%)

there was evidence (average bile levels of $FACs_{PHN}$ over 6500) of some exposure to aromatic compounds in Dolly Varden, however at only 18 of 29 sites (62%) is there similar evidence of exposure to rock sole. There was also evidence of exposure in salmon at 32 of 39 sites (82%). Greater exposure (average $FACs_{PHN}$ over 13,000) was found for rock sole at 24% of the sites (7 of 29), for salmon at 36% of the sites (14 of 39) and for Dolly Varden at 49% of the sites (17 of 35).

In addition, 17 bile samples from Dolly Varden sampled at Olsen Bay, Tonsina Bay and Snug Harbor were analyzed for $FACs_{BaP}$. Preliminary results show a strong correlation between levels of $FACs_{BaP}$ and both $FACs_{PHN}$ ($P<0.0001$) and $FACs_{NPH}$ ($p<0.0001$).

2. Measurement of hepatic AHH activity and IA1-type cytochrome P-450

At present, hepatic AHH activity and immunochemically-determined levels of cytochrome P-450 IA1 have been measured in only Dolly Varden trout, because this species appears, by analysis of FACs in bile, to be the most exposed of the species collected. These measurements have been completed on 57 samples from sites at Tonsina Bay, Snug Harbor, Resurrection Bay, Valdez, and Kukak Bay. Our results (Figure 5A) show that hepatic AHH activity is significantly increased in fish captured from impacted areas (Tonsina Bay and Snug Harbor) compared to fish from other areas, with the maximum difference between sites being 3-4 fold (i.e. between Kukak Bay and Tonsina Bay). Immunochemical quantitation of IA1-type cytochrome P-450 in these same samples gave similar results (Figure 5B), except that the degree of difference between highest and lowest levels was not as great, and only animals captured from Tonsina Bay showed significantly higher levels than animals from other sites. Statistical analysis of the AHH and cytochrome P-450 data did not show any sex-related differences. However, we are aware of the potential for such differences to occur in fish, and in future work we will continue to look for any sex-related effects in our data. When the AHH and P-450 data from these Dolly Varden were compared to FAC_{PHN} data on an individual fish basis (Figure 6), strong positive correlations ($p<0.0001$) were found. Overall, these findings of site differences corroborate the findings resulting from analyses of FACs in bile.

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Based on limited analyses of fish collected in Project 24B of the NRDA, it appears that several Alaskan fish species were exposed to petroleum-derived compounds at sites believed to be impacted by the *EXXON VALDEZ* oil spill. Further analyses of samples collected in 1989 is essential for a complete assessment of the extent of exposure, and for a better evaluation of possible temporal changes in exposure.

It should be noted, that whereas an elevation in levels of FACs in the bile is a direct measure of exposure to aromatic compounds, an increase in hepatic AHH activity or cytochrome P-450 is an indirect measure of such exposure, but one which also provides evidence of altered physiological processes in exposed animals. The finding that there was a strong positive correlation between levels of FACs in bile and both hepatic AHH activity and levels of IA1-type cytochrome P-450 suggest that measurement of AHH or P450 does reflect exposure of fish to petroleum-derived compounds. However, because petroleum is not a particularly strong inducer of AHH activity in fish, and because certain physiological processes (*e.g.*, spawning) can suppress AHH activity and levels of P450, caution should be used in interpreting the data. Nonetheless, these findings suggest that, in situations where bile analysis is not feasible, such as in eggs and larvae or juvenile fish, measurement of cytochrome P-450 or associated enzyme activity would be an appropriate measure. Thus, the samples of juvenile salmon already collected as part of this project should be used to test the usefulness of these measures as indicators of exposure of early-life stages to petroleum-derived compounds.

Previous laboratory studies with fish treated with aromatic compounds, extracts of urban sediment, or Prudhoe Bay crude oil show that, while levels of $FACs_{PHN}$ and AHH activity increase within hours or days of exposure, both of these measures also decline rapidly after cessation of exposure. Accordingly, these measurements are reflective of recent exposure and should be done next year, to determine whether exposure to petroleum is continuing in fish species from Prince William Sound and the Gulf of Alaska. Additionally, measurement of the binding of petroleum-derived compounds to hepatic DNA of fish is warranted. Measuring levels of contaminant metabolites bound to DNA has similarities to the measurement of FACs in bile in that it provides direct evidence of exposure to petroleum-derived contaminants. However, of added significance are the findings that DNA adducts are linked to long-term effects (e.g., neoplasia) in fish and mammalian species.

While the above tests provide immediate indications of petroleum exposure, other effects such as liver lesions and reproductive dysfunction may appear a long time after exposure of fish to contaminants. Our studies with English sole, and other laboratory studies with rodents and rainbow trout, show that liver lesions, including neoplasms, may not develop for a year or more after initial exposure to aromatic hydrocarbons. At present no data are available to show incubation periods for biological effects such as reproductive dysfunction. However, altered ovarian maturation, reduced spawning success, and altered levels of steroid hormones have been observed in fish residing in urban areas having high levels of aromatic contaminants. We have collected a limited number of samples for assessing reproductive dysfunction; however, we believe that continued sampling of certain key species at impacted sites over periods of up to three years after the spill should be done to assess whether exposed fish exhibit such long-term effects.

Relevant references to the scientific literature can be found in the Study Plan (p. 32-35).

Table 1. Gear types, sizes, deployment and species collected during Damage Assessment Study 24B aboard the NOAA Ship *FAIRWEATHER* from May to September, 1989.

Gear Type	Characteristics	Deployment
Otter Trawl	7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the cod end liner	5-15 min. tows, 10-45 m. depth, collection of rock sole, yellowfin sole, and flathead sole
Gill Net	8.9 cm stretched mesh, monofilament, 600x30 ft.	5-30 min. per set, <30 ft. depth, collection of adult salmon
Gill Net	3.8 cm stretched mesh, monofilament, 33 m x 10 m	5-30 min. per set, out from beach, collection of Dolly Varden
Beach Seine	1.9 cm stretched mesh, with .0.6 cm mesh cod end, 30 m floating type	set from beach with 200 ft. lines, collection of Dolly Varden and juvenile salmon
Long Line	150 black cod hooks, set at 3 m intervals, with bait including herring, squid, or octopus	40-60 m., 4-6 hr. sets, collection of Pacific cod and Pacific halibut

Table 2. Species and number of fish and shellfish collected for Damage Assessment Study #24B aboard the NOAA Ship *FAIRWEATHER* from May to September, 1989.

Species common name	Scientific name	# collected
flathead sole	*Hippoglossoides elasodon*	580
yellowfin sole	*Limanda aspera*	740
rock sole	*Lepidopsetta bilineata*	593
starry flounder	*Platichthys stellatus*	50
Pacific halibut	*Hippoglossus stenolepis*	167
Pacific cod	*Gadus macrocephalus*	31
Dolly Varden.	*Salvelinus malma*	460
chum salmon	*Oncorhynchus keta*	131
sockeye solmon	*Oncorhynchus nerka*	147
pink salmon	*Oncorhynchus gorbuscha*	289
coho salmon	*Oncorhynchus kisutch*	72
chinook salmon	*Oncorhynchus tshawytcha*	9
king crab	*Paralithodes camchatica*	9
tanner crab.	*Chionoectes bairdi*	15
Dunginess crab	*Cancer magister*	22
TOTAL		3315

Details of tissue samples collected from these animals are included in Appendix M of the Study Plan.

Preliminary Reference Bile Data

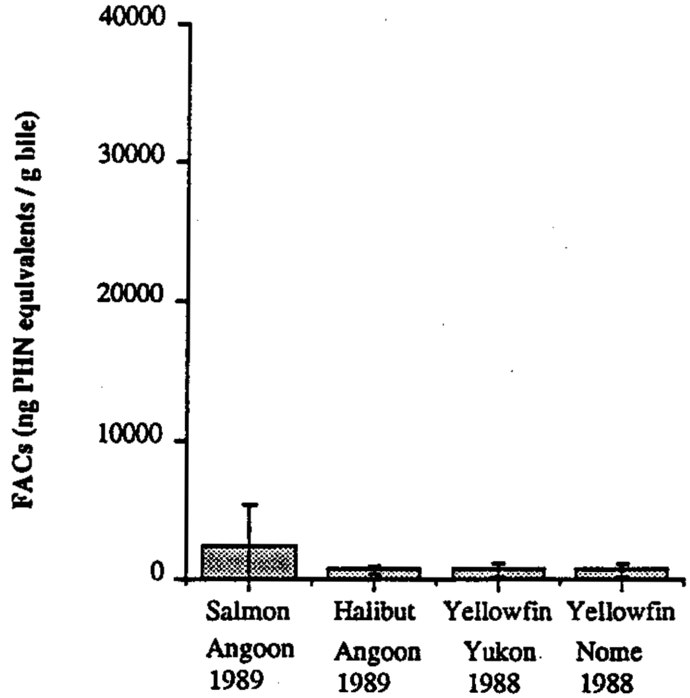


Figure 1. Average levels (± standard deviation) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of three species of fish collected from locations not effected by the EXXON VALDEZ oil spill.

ALASKA NATURAL RESOURCE DAMAGE ASSESSMENT PROGRAM

FISH AND SHELLFISH PROJECT 24b

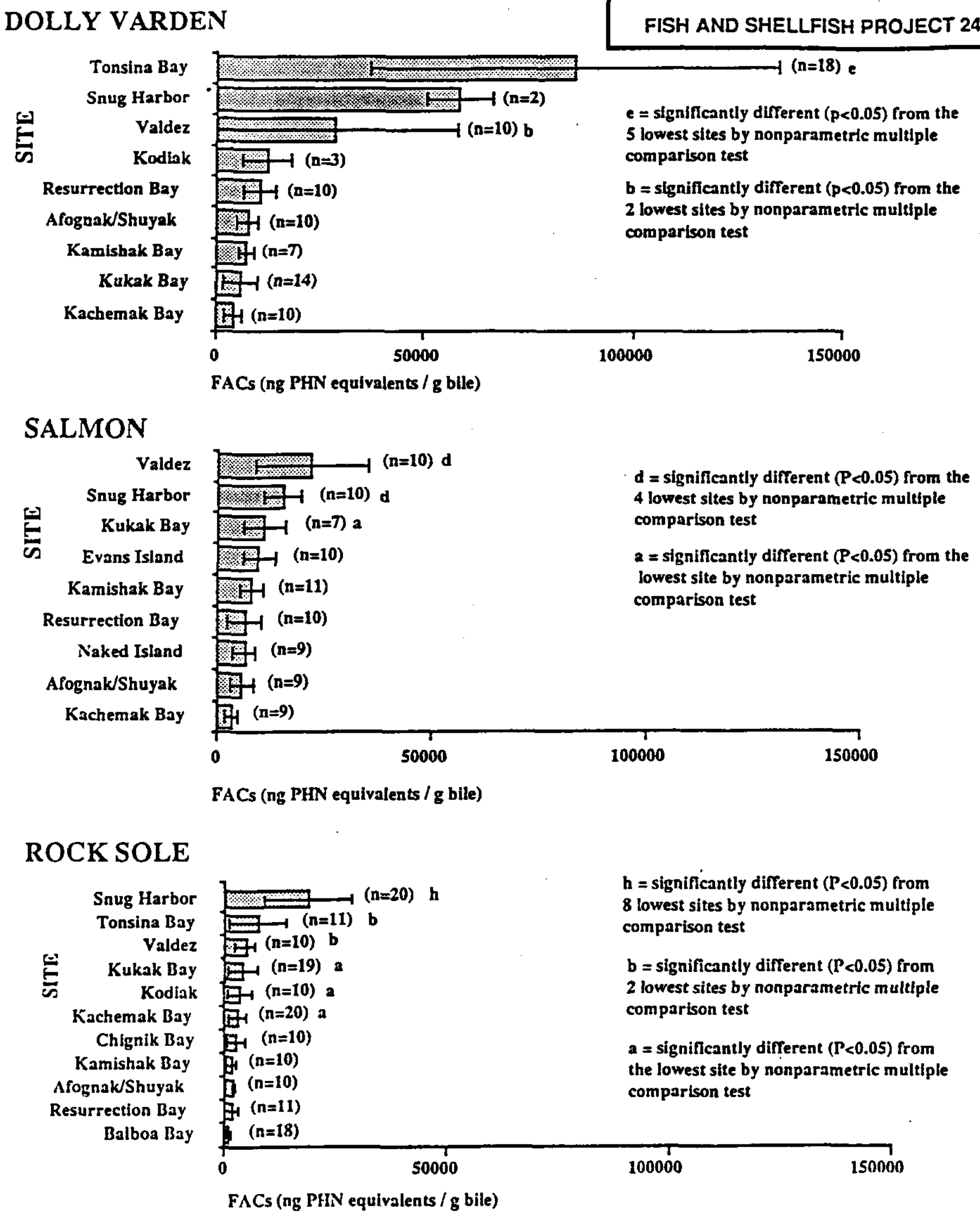


Figure 2. Average levels (± standard deviation) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of Dolly Varden, salmon (pink and chum), and rock sole collected at selected sites in the northeastern Gulf of Alaska. Parenthetical numbers indicate sample size and small letters denote results of statistical testing.

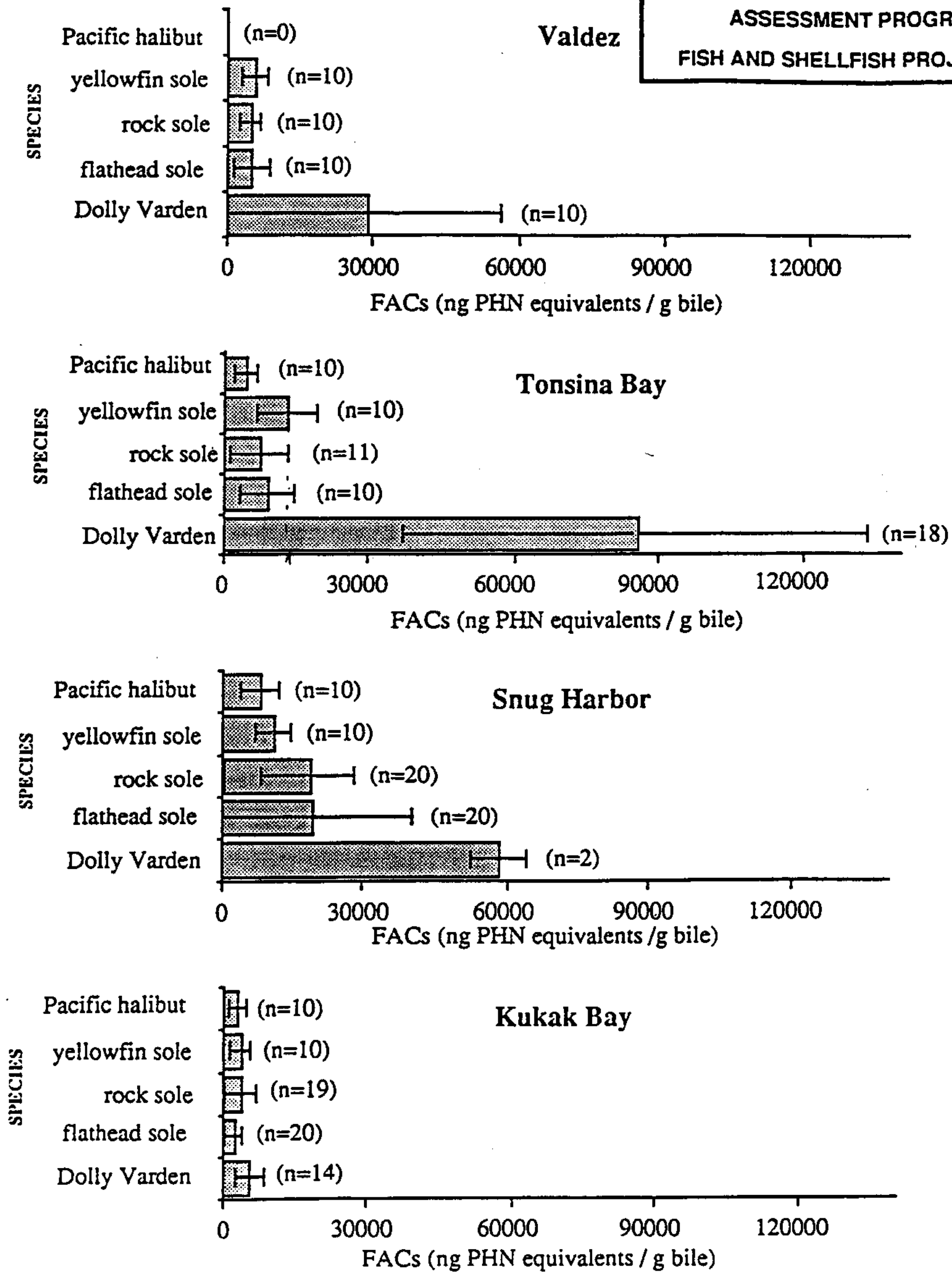


Figure 3. Average levels (± standard deviation) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of all fish species collected at Valdez, Tonsina Bay, Snug Harbor, and Kukak Bay. Parenthetical numbers indicate sample size.

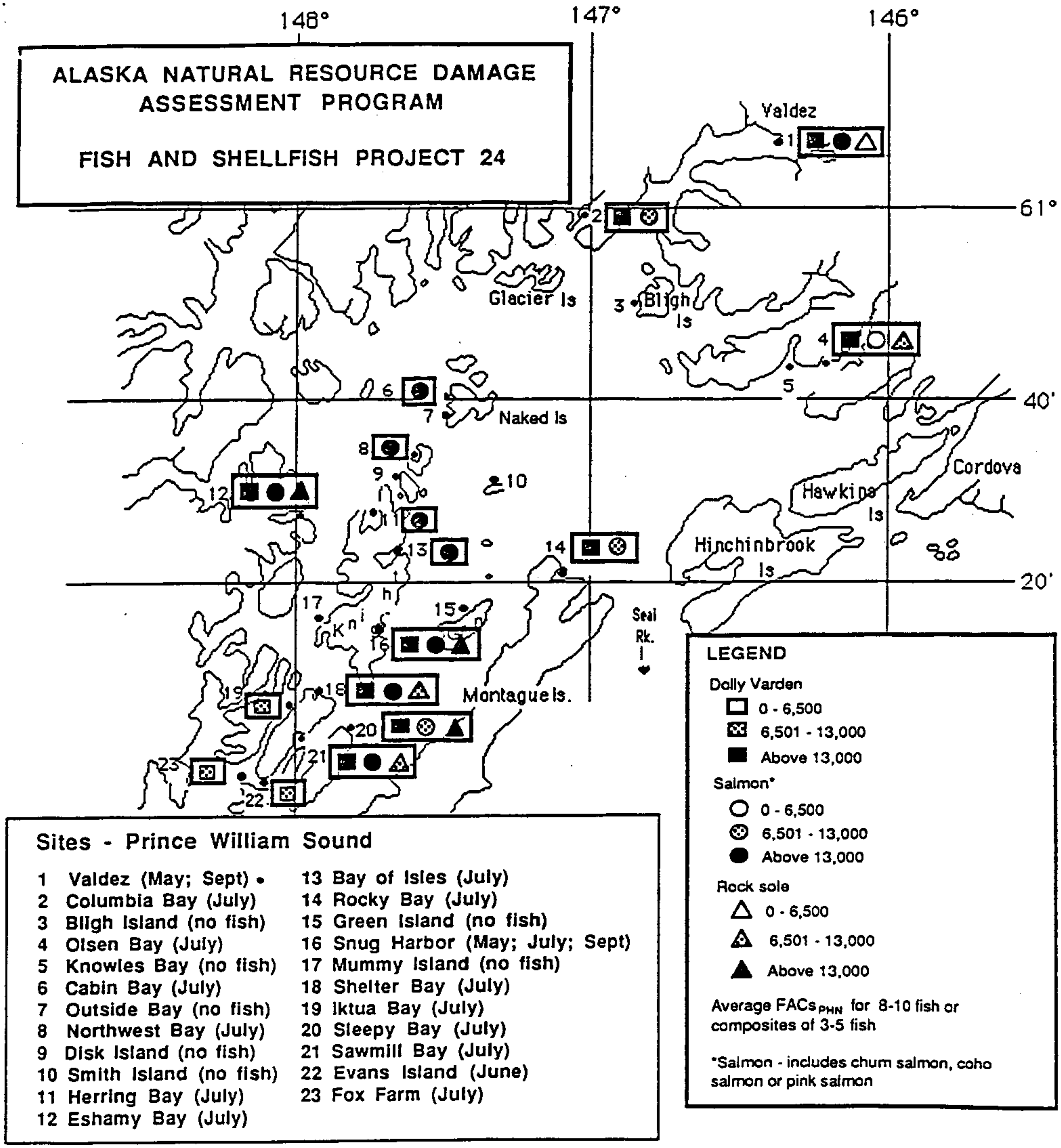


FIGURE 4A Locations of 23 sites sampled in Prince William Sound and average levels of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of Dolly Varden, salmon (includes chum, coho or pink) and rock sole collected at each site. Units are ng phenanthrene equivalents/g bile.

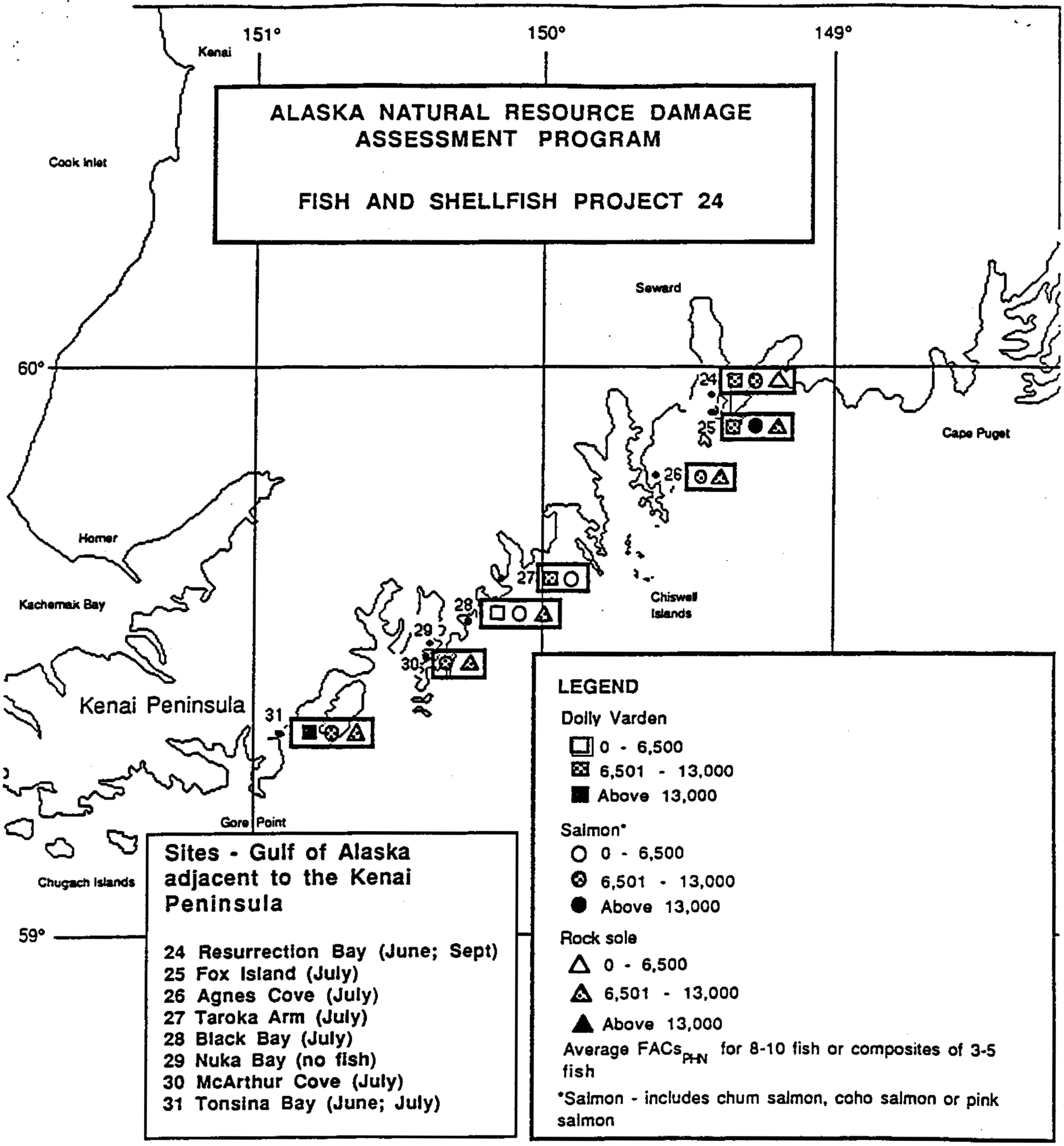


FIGURE 4B Locations of 8 sites sampled in the Gulf of Alaska adjacent to the Kenai Peninsula and average levels of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of Dolly Varden, salmon (includes chum, coho, or pink) and rock sole collected at each site. Units are ng phenanthrene equivalents/g bile.

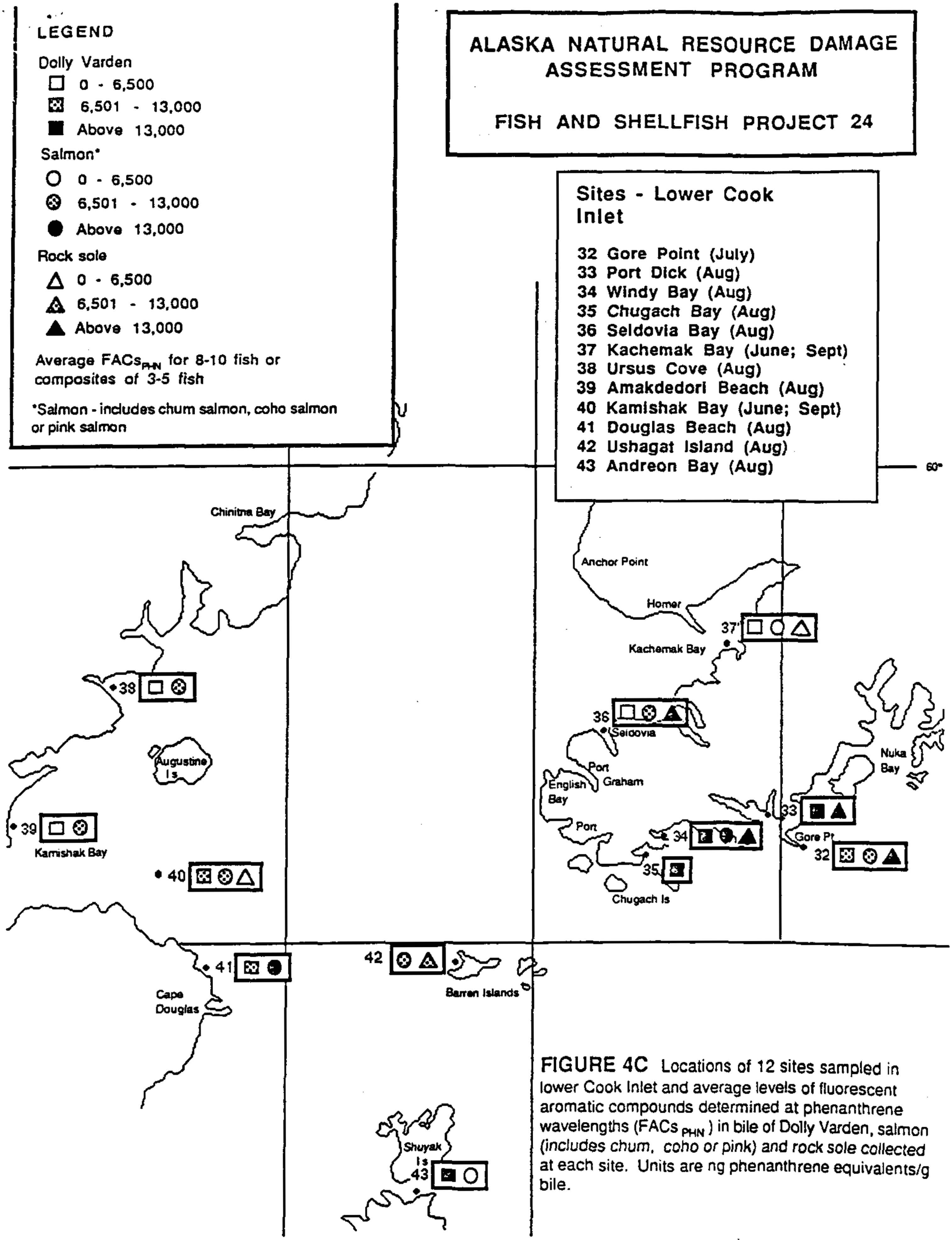


FIGURE 4C Locations of 12 sites sampled in lower Cook Inlet and average levels of fluorescent aromatic compounds determined at phenanthrene wavelengths (FACs $_{PHN}$) in bile of Dolly Varden, salmon (includes chum, coho or pink) and rock sole collected at each site. Units are ng phenanthrene equivalents/g bile.

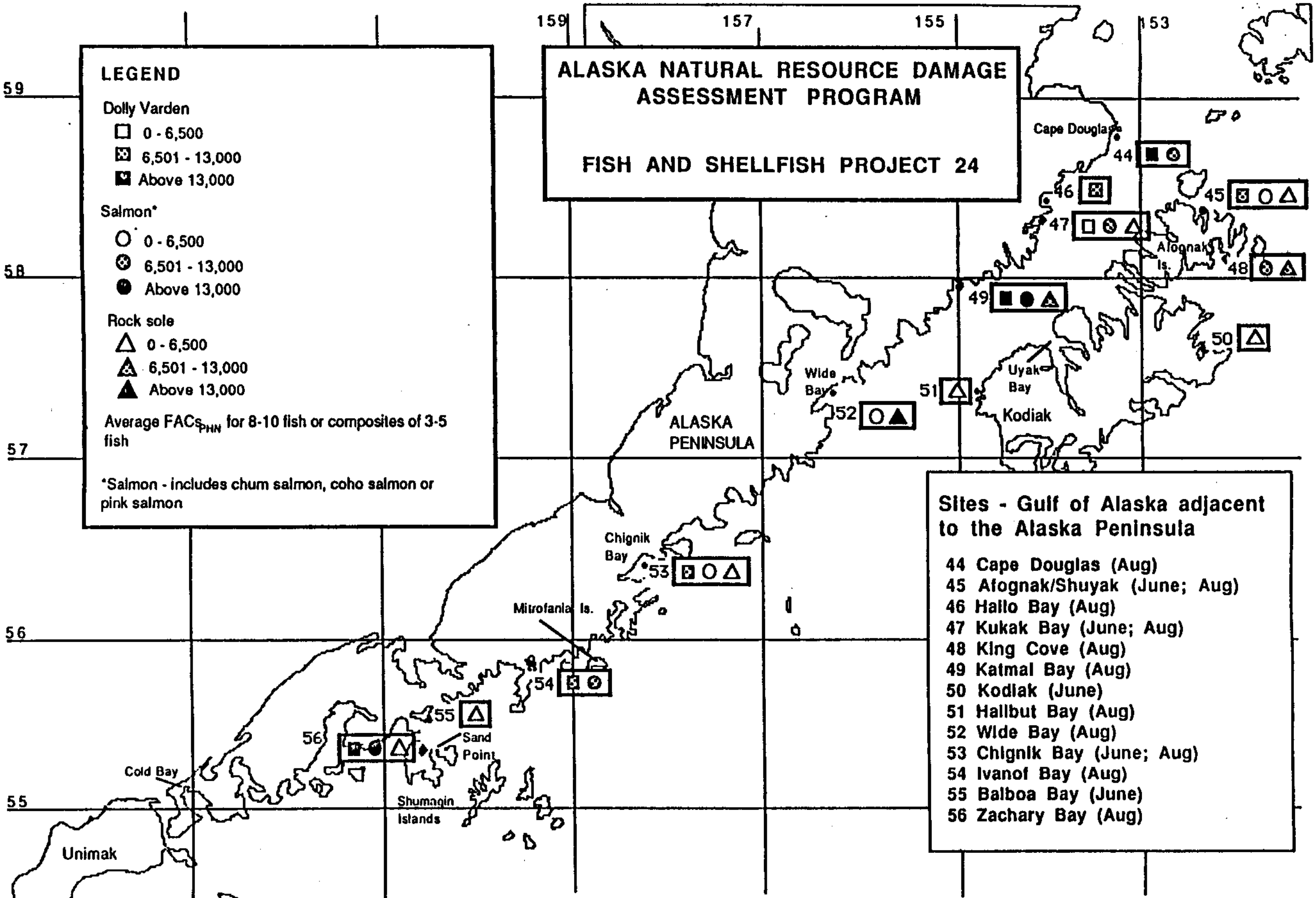


FIGURE 4D Locations of 13 sites sampled in Gulf of Alaska adjacent to the Alaska Peninsula and average levels of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of Dolly Varden, salmon (includes chum, coho or pink) and rock sole collected at each site. Units are ng phenanthrene equivalents/g bile.

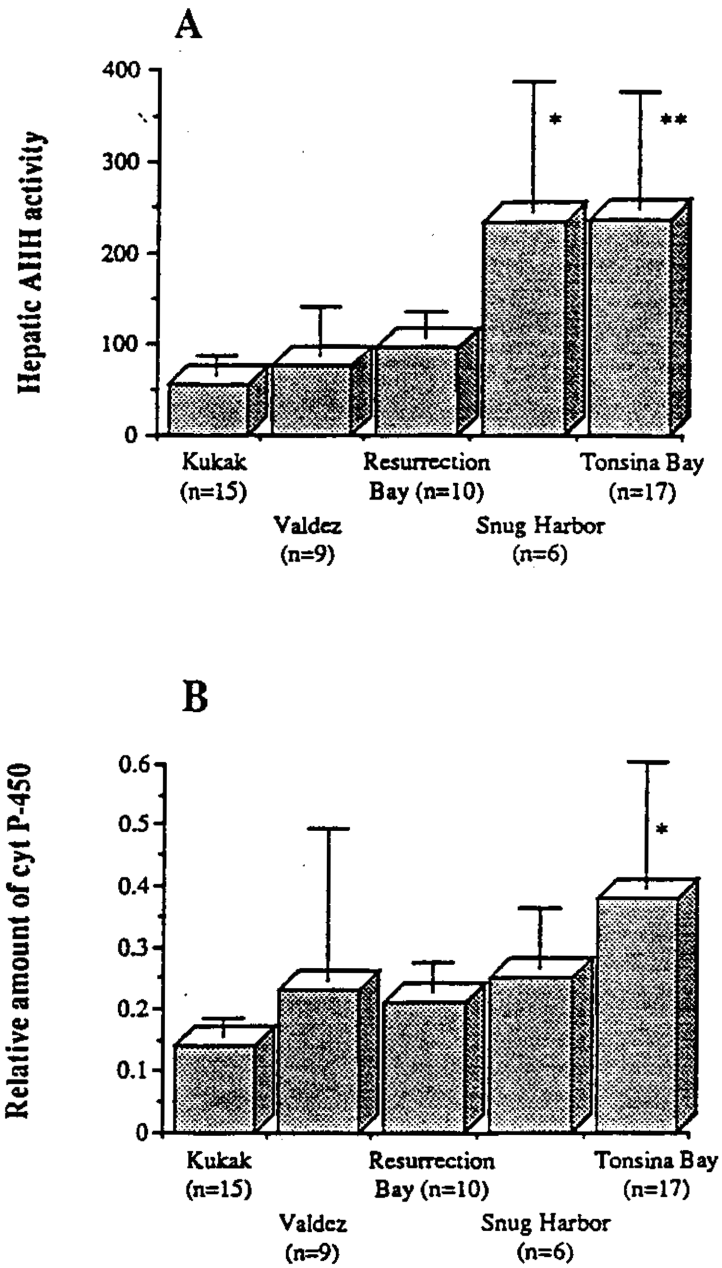
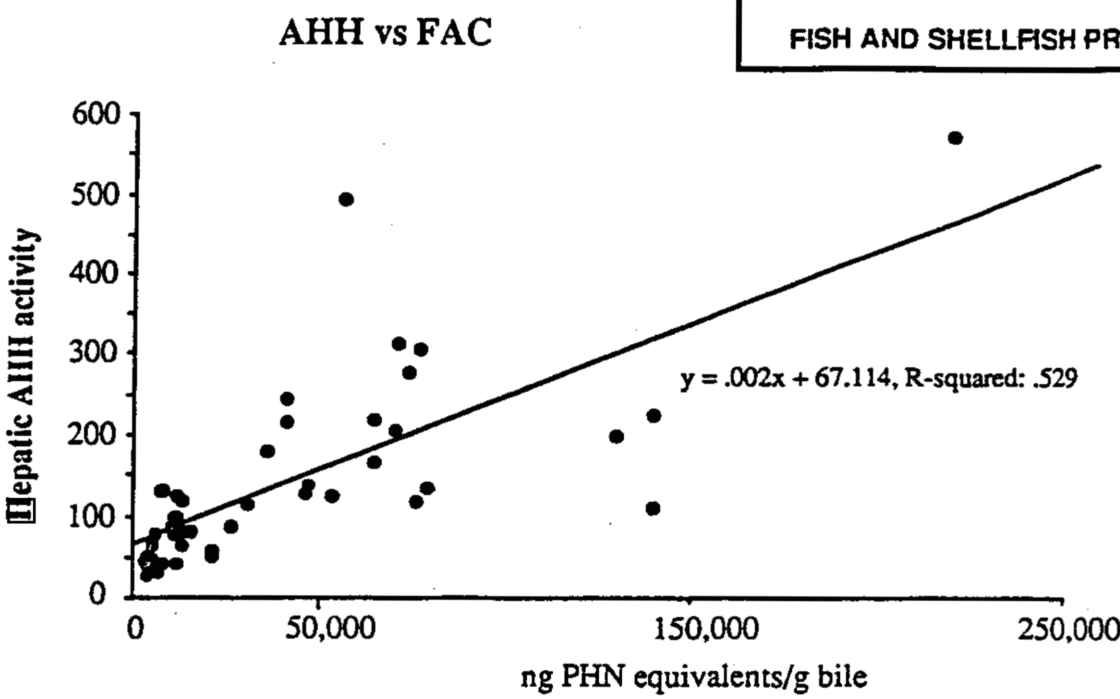


Figure 5. Hepatic aryl hydrocarbon hydroxylase (AHH) activity and levels of immunochemically-quantitated IA1-type cytochrome P-450 (P450) in Dolly Varden trout captured in May and June, 1989, from several sites in Alaskan waters. A) AHH activity, reported as pmoles benzo[a]pyrene metabolized per mg microsomal protein per minute. B) Levels of P450, reported as absorbance at 492 nm per µg microsomal protein. All values are means ± SD. **---Significantly ($p<0.05$) different from Kukak and Valdez. *---Significantly ($p<0.05$) different from Kukak.



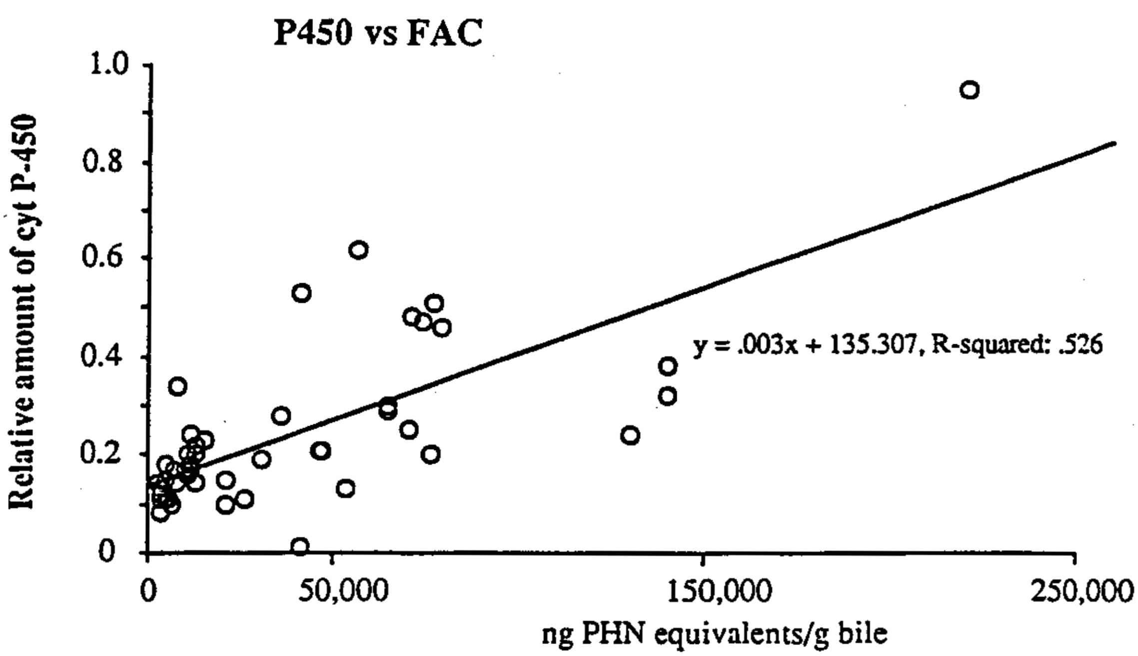


Figure 6. Relationship between levels of FACs (PHN) in bile and either hepatic AHH activity or IA1-type cytochrome P-450, in Dolly Varden trout captured in May and June, 1989, from several sites in Alaskan waters. Units for AHH activity and cytochrome P-450 as in Figure 5.

APPENDIX

Referenced Sections of Study Plan for Project 24B*

*Taken from Fish and Shellfish Study #24 Part B as presented in Volume 3 of the Detailed Operational Plans for studies in the State/Federal Natural Resource Damage Assessment Plan For The Exxon Valdez Oil Spill.

INTRODUCTION

For the initial phase of the study, this project component will focus on important species in oil-impacted near shore areas in the Gulf of Alaska. The fish and shellfish species collected off shore will be analyzed for oil exposure after the data on abundance and distribution (Component A) are evaluated. The near shore species to be studied include juvenile salmonids and Dolly Varden which inhabit many of the intertidal areas, adult salmon which pass through intertidal and subtidal waters, and bottomfish and shellfish species which live in subtidal areas in close association with bottom sediments. A comprehensive damage assessment program is needed to document the uptake of petroleum hydrocarbons by fish species from a range of habitats. Fish can take up petroleum hydrocarbons (aromatic and aliphatic) from water, food or sediment. Then, the aromatic hydrocarbons (AHs) are metabolized by the liver into derivatives that can cause a variety of adverse effects. However, because of metabolism, direct measurement of tissue concentrations of parent AHs generally does not provide a useful indicator of exposure of fish to petroleum AHs from the environment (Varanasi et al. 1989a). To estimate the exposure of fish to petroleum AHs, metabolites of these compounds can be measured in the bile (Krahn et al. 1984, 1986a, b, c). The usefulness of this method in measuring exposure of fish to spilled oil has been demonstrated by a study done during the 1984 Columbia River oil spill (Krahn et al. 1986a).

A comprehensive damage assessment program also needs to estimate any adverse effects associated with oil exposure. Changes at the tissular, cellular and subcellular levels in response to crude oil exposures are often observed (National Academy of Sciences 1985). Examples of changes after exposure of fish to oil-contaminated sediments include increases in mixed-function oxygenase enzyme activities, liver hypertrophy and fatty liver in winter flounder (*Pseudopleuronectes americanus*) (Payne et al. 1988) and the occurrence of hepatocellular lipid vacuolization in English sole (*Parophrys vetulus*) (McCain et al. 1978). Certain AHs (e.g., benzo[a]pyrene) are known carcinogens in rodents (Lutz 1979). Moreover, studies with several bottomfish species in urban estuaries show that, of the xenobiotic chemicals in sediments, AHs are most strongly associated with high prevalences of liver lesions, including neoplasms (Malins et al. 1984, Myers et al. 1987, Black et al. 1983, Varanasi et al. 1987).

AHs, especially those with 4-5 benzene rings, generally exhibit their toxicity after metabolism. Liver enzymes of fish including aryl hydrocarbon hydroxylase, (AHH) convert certain AHs into reactive intermediates (such as epoxides and diol epoxides) that bind to DNA and proteins. Additionally, modification of DNA by chemicals may result in a host of toxic effects in exposed organisms. A sensitive assay of such DNA damage has been developed recently and is known as 32P-postlabeling (PPL) assay (Reddy et al. 1984). The PPL method is currently the most sensitive technique available for directly detecting genotoxicity of environmental contaminants and has been shown to be applicable to fish species (Varanasi et al. 1989b, c). In addition to its high sensitivity, a major advantage of this method is that it directly measures metabolites of xenobiotic compounds, such as AHs, covalently bound to DNA in target tissues (e.g., liver, gonads).

In the initial phase of this study, we intend to sample in areas affected by the oil spill (see site maps) to include species included in Table 1 and to measure conversion products of petroleum hydrocarbons (e.g., metabolites, DNA adducts) in selected species. Both nearshore and offshore species will be collected; but in the initial phase, emphasis will be placed on the nearshore species because of the greater potential that these biota were affected by the oil spill. The large number of sites selected and diverse species sampled make this damage assessment project particularly comprehensive. Additionally, during this first year, we plan to measure biochemical effects such as changes in liver enzyme activities and DNA damage to provide information on early signs of hydrocarbon-induced stress in a variety of species. Only by employing a number of state-of-the art chemical and biochemical methods will analytical data be obtained to document the degree of exposure and extent of effects of petroleum hydrocarbons on economically and ecologically important fish species.

Based on the information obtained in the initial phase, in the future we plan to measure the concentrations of petroleum hydrocarbons in sediments and in certain tissues (e.g., stomach contents, liver, muscle) of biota from the spill area. In addition, liver lesions (Myers et al. 1987) and several indicators of reproductive impairment, such as inhibited ovarian maturation (Johnson et al. 1988) and failure to spawn (Casillas et al. 1989), will be measured. We will then incorporate all this information for important Alaskan fish species from Components A and B into simulation models for use in estimating oil spill impacts on fishery resources.

OBJECTIVES

(Initial phase: March 1989-February 1990. Letters below refer to the General Objectives described in the Overview Section.)

C-1. To estimate the biochemical effects (e.g., induction of hepatic AHH activity or increased binding of petroleum hydrocarbon metabolites to hepatic DNA) of petroleum hydrocarbons in a variety of species from oiled and nonoiled habitats such to detect a statistical difference in levels of effects with $a = 0.05$ and $b = 0.10$.

D-1. To sample selected economically and ecologically important fish species at a large number of sites in the Gulf of Alaska, including several in Prince William Sound, to obtain samples for a comprehensive chemical and biochemical evaluation of the effects of exposure of fish to petroleum hydrocarbons.

D-2. To determine the level of metabolites of petroleum hydrocarbons in a variety of species from oiled and nonoiled habitats such to detect a significant difference in tissue or bile concentrations with a = 0.05 and b = 0.10.

A. Study design

Samples of biota will be collected from a large number of selected sites will make this damage assessment program particularly comprehensive. Sites will be located in potentially oil-impacted areas and unimpacted sites in the the Gulf of Alaska (lower Cook Inlet, and along the Kenai Peninsula, Alaska Peninsula, and Kodiak Island) and in Prince William Sound. Juvenile and adult salmon, and Dolly Varden will be sampled in intertidal areas, whereas Pacific halibut, Pacific cod, pollock, yellowfin sole, rock sole, flathead sole, tanner crab and king crab will be sampled in subtidal areas. Salmon and halibut were selected primarily because of their economic importance, and the other species were selected because of their wide geographical distribution and year-round residency in the sampling areas. The crab species will also be sampled as an example of economically important shellfish. Surface sediment samples for establishing levels of petroleum hydrocarbon residues will be collected at all sites.

Initially, petroleum exposure by fish will primarily be assessed by measuring concentrations of metabolites of petroleum aromatic compounds in bile and activities of liver enzyme (AHH). These types of measurements are necessary because petroleum hydrocarbons in fish are rapidly metabolized to compounds that are not detectable by routine chemical analyses. AHH activity in fish is generally due to a single cytochrome P-450, apparently cytochrome P-450IA1 (Varanasi et al. 1986, Buhler and Williams 1989). Measurement of hepatic AHH activity will provide a very sensitive indicator of contaminant exposure of sampled animals (Collier and Varanasi, 1987). Moreover, the induction of AHH activity indicates not only that contaminant exposure has occurred, but also that biological changes have occurred as a result of the exposure. In addition to measuring AHH activity, cytochrome P-450IA1 will be directly quantitated in liver samples by an immunochemical method recently developed at the University of Bergen (Collier et al., 1989). Direct quantitation of the P-450IA1 has the advantage that this method can be used on archived samples and samples frozen at non-cryogenic temperatures (> -80° C), thus allowing for future comparisons to be made between data collected in this Damage Assessment Program and data from other sample collection programs, if samples from the other programs are subjected to the same immunochemical quantitation techniques.

Genetic damage will also be measured in selected liver samples by estimating levels of petroleum hydrocarbon metabolites bound to DNA using ^{32}P-postlabeling (PPL) analysis of DNA adducts. The PPL method is currently the most sensitive technique available for directly detecting genotoxicity of environmental contaminants (Varanasi et al. 1989b, c). In addition to its high sensitivity, a major advantage of this method is that it directly measures metabolites of xenobiotic compounds, such as AHs, covalently bound to DNA. Moreover, it can be applied to archived samples, with the same potential benefits as discussed above for the immunochemical quantitation of cytochrome P-450IA1.

B. Collection areas

Sampling activities for Component B will be conducted at approximately 60 sites along the path of the oil spill (see the site maps--Figs x to x). Among the sites in Prince William Sound are nonoiled sites in Port Valdez and Port Gravina and petroleum-exposed sites off Knight Island, Evans Island, and Naked Island (see site map of Prince William Sound). Sites outside Prince William Sound include: Resurrection Bay; Gore Point; Kachemak Bay; Kukak Bay; Kamishak Bay; Shuyak Island; Chignik Bay; and Balboa Bay (see the site maps of Lower Cook Inlet and the Gulf of Alaska adjacent to the Kenai and Alaska Peninsulas). Collection areas for Component A are depicted in Figs x to x. PEGGY--PLEASE ENTER FIG #s IN APPROPRIATE PLACES.

C. Sampling procedures

Sample collection for Component B will be performed from the NOAA Ship FAIRWEATHER at water depths of approximately 10 to 320 meters. The coordinates and depths of each site will be recorded. At each site, sediment samples will be collected with a box corer, VanVeen or Smith-McIntyre grab. Sediments will be stored at - 20°C.

Fish will be collected with a bottom trawl, long-line gear, gill nets, or beach seines. Bottom trawls will be performed with an otter trawl (7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the liner of the cod end). Tows will be of 5 to 15 minutes duration. In order to reduce contamination of the catch by free oil, trawling will avoid areas of surface films or slicks. If a net is fouled by subsurface or bottom oil, it will be replaced (or cleaned, if possible) and a new area for trawling will be selected. Other fish sampling gear appropriate to the species and conditions will also be deployed.

Individuals of selected target fish species will be sorted and examined for externally visible lesions; up to 30 fish of selected species will be measured, weighed, and necropsied; and selected tissue samples (including liver, stomach contents, muscle) will be excised and frozen at -20°C for future hydrocarbon analyses. Samples of liver will also be preserved in Dietrich's fixative (Gray 1954) for histopathological examination. Bile samples will be collected and stored at -20°C. Blood samples from selected sexually mature fish will be collected, centrifuged and the plasma stored at -20°C for future measurement of estradiol and vitellogenin. Ovaries were preserved in Davidsons fixative for future histological examination (Johnson et al. 1988). Portions of the liver to be used for AHH and PPL analyses will be preserved in liquid nitrogen on board the ship and then returned to the laboratory and frozen at -80°C. Table 1 contains a summary of the fish species, capture methods, and types of analyses to be conducted.

D. Laboratory Analyses

1. Bile Metabolite Assay

Samples of bile will be injected directly into a liquid chromatograph and a gradient elution conducted using a Perkin-Elmer HC-ODS with a gradient of 100% water (containing 5µL acetic acid/L) to 100% methanol (Krahn et al. 1984, 1986a, b, c). Two fluorescence detectors are used in series. The excitation/emission wavelengths of one detector are set to 290/335 nm, where metabolites of naphthalene (NPH) fluoresce. Excitation/emission wavelengths of the other detector are set to 260/380 nm, where metabolites of phenanthrene (PHN) fluoresce. The total integrated area for each detector is then converted (normalized) to units of either NPH or PHN that would be necessary to give that integrated area.

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Analysis

Hepatic microsomes are prepared essentially as described by Collier et al. (1986). AHH activity is assayed by a modification of the method of Van Cantfort et al. (1977) as described by Collier et al. (1986), using 14C-labeled benzo[a]pyrene as the primary substrate. All enzyme assays will be run under conditions in which the reaction rates are in the linear range for both time and protein.

3. DNA Damage

The ^{32}P-postlabeling assay will be conducted using a procedure described by Varanasi et al. (1989b, c). Briefly, the procedure involves digesting the DNA from liver tissue into nucleotides, labeling the nucleotides with ^{32}P, and separating the labeled nucleotides with thin-layer chromatography.

E. Quality Assurance and Control Plans

1. Bile Analytes

Quality assurance procedures for bile analyses will include NPH and PHN calibration standards and the calibration standard will be analyzed after every 6 samples and the RSD will be reported. In addition, one blank sample and two "bile pool" reference materials (control materials)--one used previously in the NS&T Program and one from a harbor seal exposed to Prudhoe Bay crude oil (a "positive control")--are analyzed daily. The concentrations of analytes should be within ±2 s.d. of the established concentrations in control material(s). Replicate analyses will be performed on 10% of the samples, if a sufficient amount exists.

2. AHH Activity

Quality assurance procedures for AHH measurements include duplicate zero-time and boiled enzyme blanks for each set of assays. Each sample will be run in duplicate and those samples showing > 10% difference between duplicates will be repeated.

3. DNA Damage

Procedures for the ^{32}P-postlabeling assay involves (1) hydrolysis of isolated DNA to normal and adducted deoxyribonucleotide monophosphates, (2) butanol extraction of the DNA hydrosylate to concentrate the adducts, (3) labeling of the adducts using ^{32}P-phosphate, (4) thin-layer chromatographic separation of the normal nucleotides from the adducts, separation of individual DNA adducts from one another, and separation of individual DNA bases from one another, and (5) determining the level of adducts present in the isolated DNA.

Quality assurance procedures for the ^{32}P-postlabeling assay include (1) the use of salmon testes DNA for measuring the efficiency of DNA hydrolysis, and as a sample blank and reference standard, (2) the use of 7R,8S,9S,10R-(N^2-deoxyguanosyl-3'-phosphate)-7,8,9,10-tetrahydrobenzo(a)pyrene (BaP-dG) as an internal standard to measure both the efficiency of the adduct enrichment and the efficiency of the enzyme-mediated transfer of the ^{32}P-phosphate from ATP to the adducts, (3) the use of the ^{32}P-labeled BaP-dG monophosphate standard will be used as a chromatography calibration standard in a separate analysis, rather than an internal standard, because of the interference of the standard with the measurement of the unknown adducts, and (4) the use of 2'-deoxyguanosine-3'-monophosphate standard to measure the efficiency of the enzyme-dependent labeling of the normal nucleotides by ^{32}P-phosphate from ^{32}P-ATP.

DATA ANALYSIS

A. Statistical Tests

The relative concentrations of contaminants (metabolites) in fish bile at the study sites will be compared statistically using "GT2 comparison intervals" (Gabriel, 1978, Sokal and Rohlf, 1981). Where significant differences among concentrations are found, the a-value will be understood to be < 0.05. To determine whether the prevalence of each type of biological effect (AHH or DNA damage) measured in each of the fish species is statistically uniform among the sites, the G test for heterogeneity (Sokal and Rohlf, 1981) will be performed.

B. Analytical Methods

Where possible, non-parametric statistical tests will be employed to avoid assumptions that the data are normally distributed. Non-parametric tests give highly reliable results. The principal non-parametric tests that will be used are Spearman rank correlation, which has about 0.91% of the power of product-moment correlation when the parametric assumptions are met (Zar, 1984), and the heterogeneity-G statistic. Spearman rank correlation will be used for estimating uptake and metabolism of petroleum hydrocarbons from oiled and non-oiled habitats when an independent measure of contamination (e.g., sediment PAH level) is available. In addition, logistic regression (appropriate where the outcome variable is binomial) will be used to model the prevalences of pathological conditions in relation to contamination.

Cohen (1977) will be used for computations of statistical power.

OIL SPILL PROGRESS REPORT

SHELLFISH AND GROUNDFISH TRAWL ASSESSMENT
OUTSIDE
PRINCE WILLIAM SOUND

Fish/Shellfish Study Number 24

Assessment of Oil Spill Impacts on Fishery Resources:

Measurement of Hydrocarbons and Their Metabolites, and Their Effects, in Important Species

by

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EXECUTIVE SUMMARY

Studies were conducted to continue to assess damage to fisheries resources related to the the *EXXON VALDEZ* oil spill (EVOS). These studies were designed to help determine the degree of exposure of biota to petroleum derived compounds, specifically aromatic hydrocarbons, and assess possible effects on various species resulting from such exposure. From June to August, 1990, samples of fish were collected from 17 sites in Prince William Sound, Yakutat Bay, Lower Cook Inlet, and waters near the Kenai Peninsula and the Alaskan Peninsula. Nearly 1100 bile and over 1200 liver samples were obtained from 5 species of fish from littoral and benthic habitats. To date, about 500 of the bile samples have been analyzed for the presence of fluorescent aromatic compounds (FACs), and about 350 of the liver samples have been analyzed for aryl hydrocarbon hydroxylase (AHH) activity, which is known to be increased after exposure of fish to chemical contaminants. These assays (biliary FACs and hepatic AHH) were used to determine degree of exposure of fish to aromatic compounds. In addition, changes in hepatic AHH activities can indicate a physiological change as a consequence of exposure. Preliminary results from measurements of levels of FACs in bile and analyses of AHH activity in liver have provided evidence of continuing exposure to petroleum-derived compounds in fish from several of the sites. The results show that in 1990, compared to 1989, the degree of exposure had decreased substantially in littoral Dolly Varden, but remained apparently constant in three other benthic species (rock sole, yellowfin sole, and flathead sole). Analyses of histopathological changes and reproductive disorders are in progress. Our data obtained thus far do not indicate a substantial impact on measured reproductive processes, but we have preliminary evidence of histopathological alteration of the gill epithelium in rock sole. This alteration is considered to be of nonspecific etiology, but increases in its prevalence in rock sole may be related to oil exposure resulting from the EVOS.

INTRODUCTION

The section in the 1990 Study Plan (Volume 1, F24, pp. 175-176) introduces this portion of our study and is included in Appendix A.

OBJECTIVES

The objectives of this study were outlined in the 1990 Study Plan (pp. 175-176) and are included in Appendix A.

METHODOLOGY (see Appendix A)

A. *Collection areas*

Sampling activities were conducted from May 22 to August 5, 1990 at 17 sites both inside and outside of Prince William Sound (see the site maps, Figure 1). At three of the sites, collections were made twice (May/June and August) and at one site, collections were made three times (May/June, July, and August).

B. *Sampling procedures*

Sample collection methods were outlined in the 1990 Study Plan (p. 179). Fish were collected at depths ranging from 2 to 60 meters using bottom trawls, long-line gear, gill nets, and beach seines. This equipment was deployed from launches and skiffs carried aboard the NOAA vessel *DAVIDSON*, and at the sites sampled in August, the NOAA vessel *JOHN N. COBB*. Sizes, characteristics of gear, duration of sets and species collected are listed in Table 1. All fish used for sample collections were kept alive in a flowthrough seawater system at ambient water temperature until necropsied.

C. *Laboratory Analyses*

1. Bile Metabolite Assay

Assay methods generally were the same as outlined in the Study Plan

(p. 179). Briefly, bile samples were analyzed at wavelengths appropriate for detection of naphthalene (NPH) and phenanthrene (PHN) and their metabolites. These aromatic hydrocarbons (and especially their alkylated derivatives) are predominant components of the aromatic fraction of crude oil. Hereafter, analyses done at these wavelengths are referred to as $FACs_{NPH}$ and $FACs_{PHN}$, respectively. In addition, bile samples this year were analyzed for total biliary protein by the method of Lowry et al. (1951), and $FACs_{NPH}$ and $FACs_{PHN}$ were normalized against the total biliary protein, as this type of normalization (within a single species) can account for some physiological variability in bile concentration, as described in Collier and Varanasi (1990).

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Assay

Analytical methods used for measuring hepatic AHH activity were as outlined in the 1990 Study Plan (pp. 179-180).

3. Histopathology

Histopathological procedures followed were as described in the 1990 Study Plan (p. 180).

4. Reproductive Indicators

Assessment of reproductive activity was done as described in the 1990 Study Plan (p. 180).

D. *Quality Assurance and Control Plans*

All quality assurance and control plans for bile analytes, and AHH analysis, followed the procedures outlined in the 1989 Study Plan (p. 28).

E. *Data Analysis*

Statistical tests and analytical procedures for preliminary statistical analyses departed from those outlined in the 1990 Study Plan (p. 180-181) in that the FAC and AHH data showed departures both from normality and from homoscedasticity, which necessitated log-transformation of the FAC and AHH data prior to using ANOVA techniques. The Fisher Partial Least Squares Difference method was used on the log-transformed data to assess differences between sites, at $\alpha=0.05$.

RESULTS

A. *Fish and Tissue Sample Collection*

Samples were collected from over 1200 individual animals representing 5 fish species (Table 2). Totals of 1233 liver samples, 1056 bile samples, 645 samples of stomach contents and 511 plasma samples were collected at the 17 sites sampled. In addition, histological samples of liver, kidney, gonad, and gill were taken from all fish, and brain samples for histological analysis were collected from 866 fish (primarily yellowfin sole and Dolly Varden).

B. *Laboratory Analysis*

The samples which have been analyzed thus far were selected to represent sites with a range of potential oil exposure. In order to insure adequate numbers for statistical analyses, samples were generally analyzed only from sites where six or more individuals were collected.

Figure 2 shows mean levels of $FACs_{PHN}$ in bile from yellowfin sole sampled from Alaskan waters prior to the EVOS, and in addition includes results from analyses of bile from salmon and halibut collected after the spill, but from an area (Angoon) believed to be unaffected by the EVOS. Figure 2 was taken from the 1989 Progress Report for this Project. As stated in that report, the data presented in Figure 2 are only intended for use as general reference values.

1. Bile Analysis

To date, 487 individual bile samples, out of 1056 collected from five fish species from 17 sites, have been analyzed. Each of these samples was analyzed at both PHN and NPH wavelengths, and, similar to what we found in 1989, there was a very strong correlation between $FACs_{PHN}$ and $FACs_{NPH}$. Accordingly, in this preliminary report we will present primarily the $FACs_{PHN}$ data. We report the bile data both per g bile ($FACs_{PHN}$) and normalized against total biliary protein ($FACs_{PHN/PROTEIN}$), as described in the methods section above. To allow comparison of the data from the two years, some of the 1989 bile $FACs_{PHN}$ values have also been normalized against total biliary protein, and are given in this progress report.

The mean $FACs_{PHN}$ and $FACs_{PHN/PROTEIN}$ values in bile of yellowfin sole, flathead sole, halibut, rock sole, and Dolly Varden collected in 1990 are shown in Figures 3-7. In general, there is excellent agreement between the protein normalized bile data and the uncorrected bile values, so we will discuss only the protein normalized results here. For yellowfin sole (Figure 3), levels of $FACs_{PHN/PROTEIN}$ in bile were significantly different at Sleepy Bay, Tonsina Bay, Snug Harbor, Hallo Bay, Squirrel Bay, Katmai Bay, Kodiak Island, Windy Bay, Yakutat Bay and Kukak Bay than at the 4 (or more) lowest sites. Similarly, levels of $FACs_{PHN/PROTEIN}$ in bile of both rock sole and flathead sole from Snug Harbor, Sleepy Bay and Tonsina Bay were significantly different from the 2 (or more) lowest sites (Figures 4 and 5). For Dolly Varden, the average value for $FACs_{PHN/PROTEIN}$ in bile at Hallo Bay, Yakutat Bay, Sleepy Bay, Tonsina Bay, Windy Bay, Sunny Cove, Kukak Bay, Snug Harbor, Kodiak Island, Squirrel Bay and Olsen Bay was significantly different from values for other sites (Figure 6). There were no significant site differences found for halibut (Figure 7).

A statistical analysis of the bile metabolite data for 1990 and 1989 was conducted and the results are shown in Figures 8-12. Again, only the $FACs_{PHN/PROTEIN}$ values are discussed. For fish collected in 1990, Dolly Varden from Tonsina Bay and halibut from both Tonsina Bay and Snug Harbor had levels of $FACs_{PHN/PROTEIN}$ in bile which were significantly different (lower) than the 1989 levels. In contrast, flathead sole and rock sole collected in 1990 from Tonsina Bay had levels of $FACs_{PHN/PROTEIN}$ in bile that were significantly different (higher) than the 1989 levels, and the levels of $FACs_{PHN/PROTEIN}$ in bile of yellowfin sole collected from Kukak Bay in 1990 were significantly different (higher) than the 1989 levels.

2. Measurement of hepatic AHH activity

Thus far, hepatic AHH activity has been measured in 337 samples (out of 1223 collected) from five species of fish collected at 12 sites. Our results are presented in Figures 13-17, and these figures should be consulted for details of the results. Briefly, in yellowfin sole, AHH activities were greatest at three sites considered to be oil-impacted (Snug Harbor, Sleepy Bay, and Tonsina Bay), with lesser activities measured at non- or less-impacted sites such as Kukak Bay and Yakutat Bay. In rock sole, hepatic AHH activities in fish from Sleepy Bay, Snug Harbor, Tonsina Bay, and Rocky Bay were significantly higher than those in rock sole from Olsen Bay. In flathead sole, AHH activities were highest at Snug Harbor, but the difference between this and other sites was not statistically significant. Halibut also showed greatest activities at Snug Harbor, but activities measured in fish from Tonsina Bay were as low or lower than activities measured at any other site. Dolly Varden was the only species in which AHH activities at Yakutat Bay were significantly elevated above other sites, and together with Snug Harbor and Tonsina Bay, these three sites were the only sites exhibiting increased activies compared to other sites. Dolly Varden from Sleepy Bay did not show any increased hepatic AHH activity.

3. Histopathology

Histopathological analyses of liver, kidney, gill and gonad have been done in a subset of the rock sole and Dolly Varden collected in 1990. No significant differences in any lesion prevalences, in relation to apparent oil exposure as determined by levels of $FACs_{PHN}$, have been found thus far in Dolly Varden. In rock sole, however, there was a significantly increased prevalence of respiratory epithelial hyperplasia (REH) in the gill at three sites where the bile metabolite data suggested that increased oil exposure was occurring (Sleepy Bay, Snug Harbor, and Tonsina Bay; see Figure 4), as compared to the prevalence in rock sole from Olsen Bay and Rocky Bay. Total numbers of fish affected by REH were 56 out of 73 (77%) at the more oil-impacted sites and 20 out of 41 (49%) at Rocky Bay and Olsen Bay. These differences were statistically significant (p=0.0025) by the Fisher's Exact Test. Additionally, the severity of gill REH was significantly greater (p=0.03) at the three more oil-impacted sites, by the Mann-Whitney U Test (nonparametric). Histopathologic examination of the remaining specimens of Dolly Varden and rock sole collected in 1990, together with selected other species, is in progress

4. Indicators of reproductive processes

Adult female Dolly Varden and yellowfin sole were examined for indicators of reproductive dysfunction, including levels of plasma estradiol and ovarian maturation stage (determined histologically in Dolly Varden and grossly in yellowfin sole). For Dolly Varden, plasma estradiol concentrations have been measured in 194 fish and ovarian maturation stage has been determined histologically in 154 fish captured at 12 sites. For yellowfin sole, plasma estradiol concentration and ovarian maturation stage have been determined in 197 yellowfin sole from 13 sites. Our initial preliminary statistical analyses of the resulting data show little evidence of severe or widespread reproductive impairment in either of these species. Neither the proportions of maturing females nor mean plasma estradiol concentrations were consistently depressed in fish from oil-exposed sites (as determined from levels of $FACs_{PHN/PROTEIN}$). However, in both Dolly Varden and yellowfin sole, plasma estradiol levels tended to be lower in sole with extremely high levels of $FACs_{PHN/PROTEIN}$ and $FACs_{NPH/PROTEIN}$ (Figures. 18 and 19). Nonetheless, relationships between plasma estradiol concentrations and bile metabolites were generally not statistically significant at the $p=0.05$ level, apparently because of the small number of heavily exposed animals. Further analyses and statistical evaluations are ongoing.

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Based on our analyses of fish collected in both 1989 and1990 for Project 24 of the NRDA, it appears that several Alaskan fish species are continuing to be exposed to petroleum-derived compounds at sites believed to be impacted by the EVOS. Further analyses of samples collected in 1990 are ongoing, and will allow a more complete assessment of the extent of exposure and a better evaluation of possible temporal changes in exposure.

It should be noted that, whereas an elevation in levels of FACs in the bile is a direct measure of exposure to aromatic compounds, an increase in hepatic AHH activity is an indirect measure of such exposure, but one which also provides evidence of altered physiological processes in exposed animals.

However, because petroleum is not a particularly strong inducer of AHH activity in fish, and because certain physiological processes (*e.g.*, spawning) can suppress AHH activity, caution should be used in interpreting the data. Nonetheless, these findings suggest that, in situations where bile analysis is not feasible, such as in eggs and larvae or juvenile fish, measurement of cytochrome P-450 or associated enzyme activity would be an appropriate measure.

Previous laboratory studies with fish treated with aromatic compounds, extracts of urban sediment, or Prudhoe Bay crude oil show that, while levels of $FACs_{PHN}$ and AHH activity increase within hours or days of exposure, both of these measures also decline rapidly after cessation of exposure. Accordingly, these measurements are reflective of recent exposure, which suggests that exposure to petroleum is continuing in fish species from Prince William Sound and the Gulf of Alaska, and that oil exposure in flathead sole, yellowfin sole, and rock sole is at least as high in 1990 as it was at a similar time of year in 1989. Accordingly, we recommend continued monitoring of exposure for at least the next year, in selected species and at selected sites. Additionally, measurement of the binding of petroleum-derived compounds to hepatic DNA of fish continues to be warranted, as this measure may indicate cumulative exposure to genotoxic compounds present in petroleum. Because these genotoxic compounds constitute only a small proportion of the compounds present in petroleum, their presence in the form of DNA adducts may be best assessed after long-term exposure, such as is apparently occurring in several species. Of added significance are the findings that DNA adducts are linked to long-term effects (e.g., neoplasia) in fish and mammalian species. We recommend that selected species be examined for modification of DNA in 1990 and 1991.

While the above tests provide immediate indications of petroleum exposure, other effects, such as lesions in liver and other organs and reproductive dysfunction, may appear at substantially longer times after exposure of fish to contaminants. Our studies with English sole, and other laboratory studies with rodents and rainbow trout, show that liver lesions, including neoplasms, may not develop for a year or more after initial exposure to aromatic hydrocarbons. At present no data are available to show latency periods for biological effects such as reproductive dysfunction. However, altered ovarian maturation, reduced spawning success, and altered levels of steroid hormones have been observed in fish residing in urban areas having high levels of aromatic contaminants, and our laboratory studies have shown that contaminant exposure, including exposure to petroleum, can reduce levels of plasma estradiol in flatfish within a few days after exposure.

The results of our histopathological analyses of rock sole, showing increased prevalence and degree of hyperplasia of the gill respiratory epithelium, suggest a potentially significant biological effect in this species due to oil exposure. Recently it has been reported that one other species of fish (an intertidal sculpin) has shown similar increased prevalences of gill hyperplasia as an apparent result of the EVOS (Khan *et al.*, 1990). However, it is important to realize that this lesion (REH) is generally interpreted as a relatively nonspecific response to injury, in that it may arise as a result of ectoparasitic agents and nutritional imbalance, in addition to resulting from xenobiotic exposure.. The substantial prevalence of this condition found in rock sole showing low levels of oil exposure emphasizes its nonspecific etiology. Nevertheless, the finding that this condition is elevated in relation to the degree of exposure is intriguing. We are continuing histopathological analyses in other species collected this year, and as warranted by the results of these analyses, histopathological evaluations of some species should continue next year in Prince William Sound.

We also collected samples for assessing reproductive dysfunction in yellowfin sole and Dolly Varden. While our initial analyses of these samples have not shown any substantial impact of oil exposure on these processes, there is some evidence of lowered levels of plasma estradiol in the most heavily exposed animals of both species. In view of our findings that exposure to petroleum products is continuing in several species,we believe that limited sampling for determination of potential impaired reproduction should continue.

Relevant references to the scientific literature can be found in the 1990 Study Plan (p. 181-186).

APPENDIX A

(excerpts from 1990 Study Plan)

II. INTRODUCTION

Analyses completed thus far under Project 24B have shown that several nearshore fish species were exposed to petroleum or petroleum derivatives in and around Prince William Sound, subsequent to the EVOS (Varanasi et al., 1990). Based on our analyses of bile for metabolites of aromatic compounds, the most heavily impacted species of those collected was the Dolly Varden char. This species was also shown to have increased hepatic activities of aryl hydrocarbon hydroxylase (AHH) as an apparent result of exposure to petroleum. Other species, including adult salmon of several species, rock sole, yellowfin sole, and flathead sole, showed evidence of lesser degrees of exposure. Because petroleum and its components can cause severe damage to fishery resources, we plan to continue monitoring of the nearshore fisheries resources of Prince William Sound and adjacent areas. Such monitoring will include measurement of petroleum exposure and short-term effects, as was done in the summer and fall of 1989, but will also encompass an assessment of long-term biological effects, including measurements of reproductive dysfunction and histopathological lesions of liver, gill, kidney, and gonad.

Certain petroleum components [e.g. aromatic hydrocarbons (AHs)] can cause reproductive toxicity and teratogenicity in rodents (Shum et al., 1979; Gulyas and Mattison 1979, Mattison and Nightingale, 1980). Similarly, reproductive impairment has been noted in benthic fish residing in contaminated areas of San Francisco Bay (Spies and Rice, 1988) and southern California (Cross and Hose, 1988). Moreover, English sole from areas of Puget Sound having high sediment concentrations of AHs showed inhibited ovarian maturation (Johnson et al., 1988), and fish from these areas that did mature often failed to spawn after hormonal treatment to induce spawning (Casillas et al., 1990). In general, reproductive impairment (including reduced plasma levels of the sex steroid, estradiol) was found in English sole which showed evidence of exposure to aromatic compounds. Moreover, our laboratory studies have shown that plasma levels of estradiol are reduced in gravid female English sole exposed to chemical contaminants extracted from urban sediments (Stein et al., 1990), and, more importantly, our preliminary studies have also shown that *exposure to Prudhoe Bay crude oil reduced plasma levels of estradiol in gravid female rock sole.* In view of our findings last year that several nearshore fish species in and around Prince William Sound have been exposed to crude oil components, including AHs, the assessment of possible reproductive dysfunction in animals from impacted areas will be very important in determining biological damage to living marine resources as a result of the oil spill. We will histologically examine ovaries of selected species, in order to determine if ovarian maturation is being affected in animals from oil-impacted areas, and will also determine fecundity and levels of plasma estradiol in these same animals. Combined with our measurements of metabolites in bile and enzyme activities in liver, these studies will enable us to estimate the degree of reproductive dysfunction which may be occurring in oil-exposed fish.

Exposure of animals to crude oil can also result in changes at the tissue and cellular levels (National Academy of Sciences, 1985). Examples of such changes after exposure of fish to oil-contaminated sediments include liver hypertrophy and fatty liver in winter flounder (Payne et al., 1988) and the occurrence of hepatocellular lipid vacuolization in English sole (McCain et al., 1978). Certain AHs (e.g., benzo[a]pyrene) are known carcinogens in rodents (Lutz, 1979), and studies with several bottomfish species show that, of the xenobiotic chemicals in sediments, AHs are most strongly associated with high prevalences of liver lesions, including neoplasms (Malins et al., 1984; Myers et al., 1987; Black et al., 1983; Varanasi et al., 1987). Generally, histopathological lesions of the types noted above do not become manifest until at least several months after exposure. However, by the summer of 1990, fish in and around oil impacted sites will have potentially been exposed to petroleum components for more than one year, and juveniles of some species of salmon will have potentially been exposed during most of their developmental period. Accordingly, assessment of histopathological effects in selected species is strongly warranted, and is included in this proposal.

Briefly, under this proposal we will continue to measure exposure to oil and oil components in the biota of Prince William Sound and other areas affected by the oil spill, by determining levels of hydrocarbon metabolites in bile and by measuring hepatic activities of AHH, as was done last year. Additionally, we plan to measure a range of biological effects, especially indicators of reproductive dysfunction and histopathological effects. Only by employing such a broad spectrum of state-of-the art chemical, biochemical and biological methods will analytical data be obtained to document the degree of exposure and resultant biological effects of petroleum hydrocarbons on economically and ecologically important fish species. We will then incorporate this information for important Alaskan fish species into models for use in estimating oil spill impacts on fishery resources.

III. OBJECTIVES

A. To sample selected nearshore fish species from 14 sites inside and outside Prince William Sound, with emphasis on sites outside Prince William Sound. Site selection is primarily based on data from last year's sampling and analyses. Representative sediment samples will also be taken from each sampling site for subsequent chemical analysis.

B. To estimate the exposure to petroleum hydrocarbons by measuring levels of hydrocarbon metabolites in bile of the above species from oiled and nonoiled habitats such to detect significant differences in bile concentrations with $\alpha = 0.05$ and $\beta = 0.10$. Additionally, stomach contents of fish showing high levels of hydrocarbon metabolites in bile will be analyzed for hydrocarbons, such to detect significant differences in concentrations with $\alpha = 0.05$ and $\beta = 0.10$

C. To estimate the induction of hepatic aryl hydrocarbon hydroxylase activity or increased levels of cytochrome P-450IA1 in the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha = 0.05$ and $\beta = 0.10$.

D. To estimate the prevalence of pathological conditions in the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha = 0.05$ and $\beta = 0.10$.

E. To estimate the levels of plasma estradiol, the degree of ovarian maturation, and fecundity in adult females of two of the above species (Dolly Varden char and yellowfin sole) from oiled and nonoiled habitats such to detect statistically significant differences with $\alpha = 0.05$ and $\beta = 0.10$.

F. To estimate temporal changes in the parameters described in Objectives B&C, by comparing data obtained in 1990 to data obtained in 1989. In order to assess either recovery or increased damage of habitats from the oil spill, trends in these parameters must be statistically significant at $\alpha = 0.05$ and $\beta = 0.10$.

G. Using the above data, construct simulation models similar to those of Schaaf et. al. (1987) for important Alaskan fish species for use in estimating oil spill impacts on fishery resources. These models will incorporate pre-spill information from the fisheries literature on mortality and fecundity together with information on reproductive impairment, pathological conditions, and biochemical effects in fish exposed to petroleum hydrocarbons as a result of the spill.

IV. <u>METHODS</u>

A. General Strategy and Approach

Samples of biota will be collected from approximately 14 sites during 1990, from mid-May to mid-June. Sites will generally be the same sites occupied last year, and will be located in potentially oil-impacted and unimpacted areas in Prince William Sound, in Cook Inlet, and in embayments on the Kenai Peninsula, Alaska Peninsula, and Kodiak Island. As feasible, the sample locations will be coordinated with Air/Water Study #2. Dolly Varden char and juvenile salmon will be sampled in intertidal areas, whereas flatfish (e.g. Pacific halibut, yellowfin sole, rock sole and flathead sole) will be sampled in subtidal areas. Salmon and halibut were selected primarily because of their economic importance, and flathead sole, yellowfin sole, rock sole, and Dolly Varden were selected because of their wide geographical distribution and year-round residency in the sampling areas. Surficial sediment samples for establishing levels of petroleum hydrocarbon residues will be collected at all sites, with analyses projected to be done under Air/Water Study 2.

Petroleum exposure of fish will primarily be assessed by measuring
(a) concentrations of metabolites of aromatic petroleum compounds in bile, and
(b) AHH activities in liver. These types of measurements are necessary because petroleum hydrocarbons in fish are rapidly metabolized to compounds that are not detectable by routine chemical analyses. AHH activity in fish is due primarily to a single cytochrome P-450, apparently cytochrome P-450IA1 (Varanasi et al., 1986, Buhler and Williams 1989). Measurement of hepatic AHH activity will provide a very sensitive indicator of contaminant exposure of sampled animals (Collier and Varanasi, 1987). Moreover, the induction of AHH activity indicates not only that contaminant exposure has occurred, but also that biological changes have occurred as a result of the exposure. In addition to measuring AHH activity, cytochrome P-450IA1 will be directly quantitated in selected liver or tissue samples by an immunochemical method recently developed at the University of Bergen (Collier et al., 1989; Goksøyr, 1990). Direct quantitation of cytochrome P-450IA1 has the advantage that this method can be used on archived samples and samples frozen at non-cryogenic temperatures (> -80° C), thus allowing for future comparisons to be made between data collected in this Damage Assessment Program and data from other sample collection programs, if samples from the other programs are subjected to the same immunochemical quantitation techniques.

Other biological effects in fish will be estimated by examining selected species for pathological conditions and by assessing reproductive impairment in suitably mature female fish. Pathological conditions will include grossly visible abnormalities (e.g., fin erosion) and other lesions diagnosed by histological procedures (e.g., gill necrosis, liver cell necrosis). Reproductive capacity will be estimated by examining the developmental stages of ovaries and by measuring plasma levels of certain reproductive hormones (Johnson et al., 1988), in addition to measuring fecundity (Cross and Hose, 1988). The two primary species for assessing reproductive impairment are Dolly Varden char and yellowfin sole. It is anticipated that, during the proposed sampling period (May/June), these two species will be at an appropriate stage in their reproductive cycle for such assessments to be done. Concurrent with these studies, we are conducting laboratory studies to determine the effects of known doses of oil and oil components on reproductive processes in these or related species.

Samples of sediment, and selected stomach contents of fish (from fish whose bile had evidence of oil exposure) will be analyzed (sediment under Air/Water Study 2) for hydrocarbons by recently developed, scientifically sound and cost-effective analytical procedures involving high-performance liquid chromatography, gas chromatography and mass spectroscopy (Krahn et al., 1988).

Environmental damage will be assessed using statistical and simulation models, which will be developed as part of these proposed studies, as well as from other investigations with related fish species. The bile and tissue chemistry data will be used to establish relationships between biological damage and estimated exposures to petroleum hydrocarbons.

B. Sampling Methods

Sampling activities will be conducted at several sites in Prince William Sound, including nonoiled sites in Rocky Bay (60°20.2'N, 147°08.1'W) and Olsen Bay (60°43.8'N, 146°13.2'W), and petroleum-exposed sites in Snug Harbor (60°14.5'N, 147°43.1'W), Sleepy Bay (60°04.1'N, 147°50.6'W), and Squirrel Bay/Fox Farm (60°00.4'N, 148°08.9'W). Among the Gulf of Alaska sites will be Yakutat Bay (59°40'N, 139°41'W), Resurrection Bay (59°54.8'N, 149°20.6'W), Tonsina Cove (59°18.7'N, 150°54.6'W), Windy (59°13.8'N, 151°31.0'W) or Chugach Bay (59°12.9'N, 151°37.8'W), Discoverer Bay (58°22.8'N, 152°22.8'W), Black Bay in Kenai National Park (59°32.1'N, 150°12.3'W), Hallo Bay (58°27.5'N, 154°00.2'W), Katmai Bay (57°58.5'N, 155°01.8'W), and Kodiak Bay (57°43.1'N, 152°26.0'W). Sample collection will be performed from a NOAA vessel (and its launches) at water depths of approximately 0 to 320 meters. At each site, sediment samples will be collected with a box corer, VanVeen or Smith-McIntyre grab. Sediments will be stored at - 20° C. The coordinates and depths of each station will be recorded.

Fish will be collected with a bottom trawl, long-line gear, gill nets, or beach seines. Bottom trawls will be performed with an otter trawl (7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the liner of the cod end). Tows will be of 5 to 15 minutes duration. In order to reduce contamination of the catch by free oil, trawling will avoid areas of surface films or slicks. If a net is fouled by subsurface or bottom oil, it will be replaced (or cleaned, if possible) and a new area for trawling will be selected. Other fish sampling gear appropriate to the species and conditions will also be deployed. Individuals of selected target fish species will be sorted and examined for externally visible lesions; up to 30 fish of selected species will be measured, weighed, and necropsied; and tissue samples will be excised and preserved in fixative for histopathological examination or frozen for chemical analyses.

C. Laboratory Analyses

1. Bile Metabolite Assay (analyses done under Technical Services-1)

Samples of bile will be injected directly into a liquid chromatograph and a gradient elution conducted using a Perkin-Elmer HC-ODS with a gradient of 100% water (containing 5μL acetic acid/L) to 100% methanol (Krahn et al., 1984, 1986a, b, c). Two fluorescence detectors are used in series. The excitation/emission wavelengths of one detector are set to 290/335 nm, where metabolites of naphthalene (NPH) fluoresce. Excitation/emission wavelengths of the other detector are set to 260/380 nm, where metabolites of phenanthrene (PHN) fluoresce. The total integrated area for each detector is then converted (normalized) to units of either NPH or PHN that would be necessary to give that integrated area.

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Activity and Cytochrome P-450IA1 Analysis

Hepatic microsomes are prepared essentially as described by Collier et al. (1986) and microsomal protein is measured by the method of Lowry et al. (1951), using bovine serum albumin as the standard. AHH activity is assayed by a modification of the method of Van Cantfort et al. (1977) as described by Collier et al. (1986), using 14C-labeled benzo[a]pyrene as the primary substrate. All enzyme assays will be run under conditions in which the reaction rates are in the linear range for both time and protein. Cytochrome P-450IA1 will be measured by an ELISA utilizing rabbit antibodies to cytochrome P-450c isolated from Atlantic cod (Goksøyr,1990).

3. Histopathology

Histopathological procedures to be followed are described in the report from the Histopathology Technical Group for Oil Spill Assessment Studies in Prince William Sound, Alaska. Briefly, the procedures will involve the following: (a) tissues preserved in the field will be routinely embedded in paraffin and sectioned at five microns (Preece, 1972); and (b) paraffin sections will be routinely stained with Mayer's hematoxylin and eosin, and for further characterization of specific lesions, additional sections will be stained using standard special staining methods (Thompson, 1966; Preece, 1972; and Armed forces Institute of Pathology, 1968). All slides will be examined microscopically without knowledge of where the fish were captured. Hepatic lesions will be classified according to the previously described diagnostic criteria of Myers et al. (1987). Ovarian lesions will be classified as described in Johnson et al. (1988).

4. Reproductive Indicators

Reproductive activity will be assessed by examining the ovaries of the sampled fish histologically to determine their developmental stage, and for the presence of ovarian lesions that would be indicative of oocyte resorption (Johnson et al., 1988). Other parameters associated with reproductive activity will also be measured, including fecundity (Bagenal and Braum, 1971), plasma vitellogenin (Gamst and Try, 1980; DeVlaming et al., 1984) and estradiol (Sower and Schreck, 1982) levels, and gonadosomatic index (ovary wt/gutted body wt x 100). Relationships between ovarian maturation, fecundity, plasma estradiol, plasma vitellogenin, and petroleum hydrocarbon exposure will then be evaluated.

D. Quality Assurance and Control Plans

1. Bile Analytes

Quality assurance procedures for bile analyses will include NPH and PHN calibration standards and the calibration standard will be analyzed after every 6 samples and the RSD will be reported. In addition, one blank sample and one reference material (control material) will be analyzed daily. The concentrations of analytes should be within 2 SD of the established concentrations in control material. Replicate analyses will be performed on 10% of the samples, if a sufficient amount exists.

2. AHH Activity and Cytochrome P-450IA1

Quality assurance procedures for AHH measurements include duplicate zero-time and boiled enzyme blanks for each set of assays. Each sample will be run in duplicate and those samples showing > 20% absolute difference between duplicates and >10 units (pmoles benzo[a]pyrene metabolized/mg microsomal protein/minute) difference between duplicates will be repeated. ELISAs for cytochrome P-450IA1 will be run in triplicate, and if the resulting coefficient of variation (CV) is > 10%, the outlying replicate will be omitted from the calculations. If the CV still exceeds 10%, the analysis of that sample will be repeated.

3. Histopathology

Pathologists on this project will use consistent, standard diagnostic criteria to be strictly adhered to by those who will also be examining slides in this project. These criteria will be established using color photographs of external lesions and standard reference slides containing tissues with the major lesion types expected in the study. Unusual or atypical lesions will be referred to specialists for confirmation. The accuracy of the histopathologic diagnosis also will be assured by consulting with and sending sections of tissues with representative lesion types to the Registry of Tumors in Lower Animals, National Museum of Natural History at the Smithsonian Institution in Washington, D.C.

4. Reproductive Indicators

Quality assurance for the measurement of plasma estradiol and vitellogenin include analysis of standards to confirm linearity and calibrate the assays. Blank analyses will be conducted to eliminate matrix effects. Analyses of pooled plasma from vitellogenic female English sole and winter flounder containing known levels of estradiol and vitellogenin will also be done. Duplicate analyses of each sample to evaluate performance of the assays will also be conducted. These quality checks are run daily with each set of samples. Fecundity measurements will be done in triplicate on each individual.

V. DATA ANALYSIS

A. Statistical Tests

The relative concentrations of contaminants in sediment and fish tissues at the study sites will be compared statistically using the Kruskal-Wallis test (ANOVA by ranks; see Sokal and Rohlf, 1981; Zar, 1984). Where significant differences among chemical concentrations are found, the α-value will be understood to be < 0.05. To determine whether the prevalence of histopathological effects noted in each of the fish species is statistically uniform among the sites, the G test for heterogeneity (Sokal and Rohlf, 1981) will be performed.

B. Analytical Methods

Where possible, non-parametric statistical tests will be employed to avoid assumptions that the data are normally distributed. Non-parametric tests give highly reliable results. The principal non-parametric tests that will be used are Spearman rank correlation, which has about 0.91% of the power of product-moment correlation when the parametric assumptions are met (Zar, 1984), and the heterogeneity-G statistic. Spearman rank correlation will be used for estimating uptake and metabolism of petroleum hydrocarbons from oiled and non-oiled habitats when an independent measure of contamination (e.g., levels of AHs in sediment) is available.

The heterogeneity-G statistic (Sokal and Rohlf, 1981) will be used to study prevalence of pathological conditions at oiled and non-oiled habitats. In addition, logistic regression (appropriate where the outcome variable is binomial) will be used to model the prevalences of pathological conditions in relation to contamination.

The Kruskal-Wallis test (a non-parametric form of ANOVA) will be used for supporting statistical analyses of variation in sediment PAH levels at sites sampled. If the null hypothesis of no differences among sites is rejected at $\alpha = 0.05$, a non-parametric multiple comparison test (Dunn, 1964; Hollander and Wolfe, 1973; Zar, 1984) will be used to determine differences between sites at $\alpha = 0.05$. Principal components analysis and LOWESS (Chambers et al., 1983) will also be employed for this purpose; both are methods of exploratory data analysis rather than inferential statistical methods.
Cohen (1977) will be used for computations of statistical power.

Table 1. Gear types, sizes, deployment and species collected during F/S 24 aboard the NOAA Ships *DAVIDSON* and *JOHN N. COBB* from May to August, 1990.

Gear Type	Characteristics	Deployment
Otter Trawl	7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the cod end liner	5-15 min. tows, 10-45 m. depth, collection of rock sole, yellowfin sole, and flathead sole
Gill Net	3.8 cm stretched mesh, monofilament, 33 m x 10 m	5-30 min. per set, out from beach, collection of Dolly Varden
Beach Seine	1.9 cm stretched mesh, with .0.6 cm mesh cod end, 30 m floating type	set from beach with 200 ft. lines, collection of Dolly Varden
Long Line	150 black cod hooks, set at 3 m intervals, with herring bait.	40-60 m., 4-6 hr. sets, collection of Pacific halibut

Table 2. Species and number of fish collected for F/S 24 aboard the NOAA Ships *DAVIDSON* and *JOHN N. COBB* from May to August, 1990.

Species common name	Scientific name	# collected
flathead sole	*Hippoglossoides elassodon*	123
yellowfin sole	*Limanda aspera*	413
rock sole	*Lepidopsetta bilineata*	225
Pacific halibut	*Hippoglossus stenolepis*	67
Dolly varden.	*Salvelinus malma*	398
TOTAL		1226

Details of tissue samples collected from these animals are included in Appendix M of the Study Plan.

ALASKA SPILL ASSESSMENT PROGRAM 1991

PRINCE WILLIAM SOUND

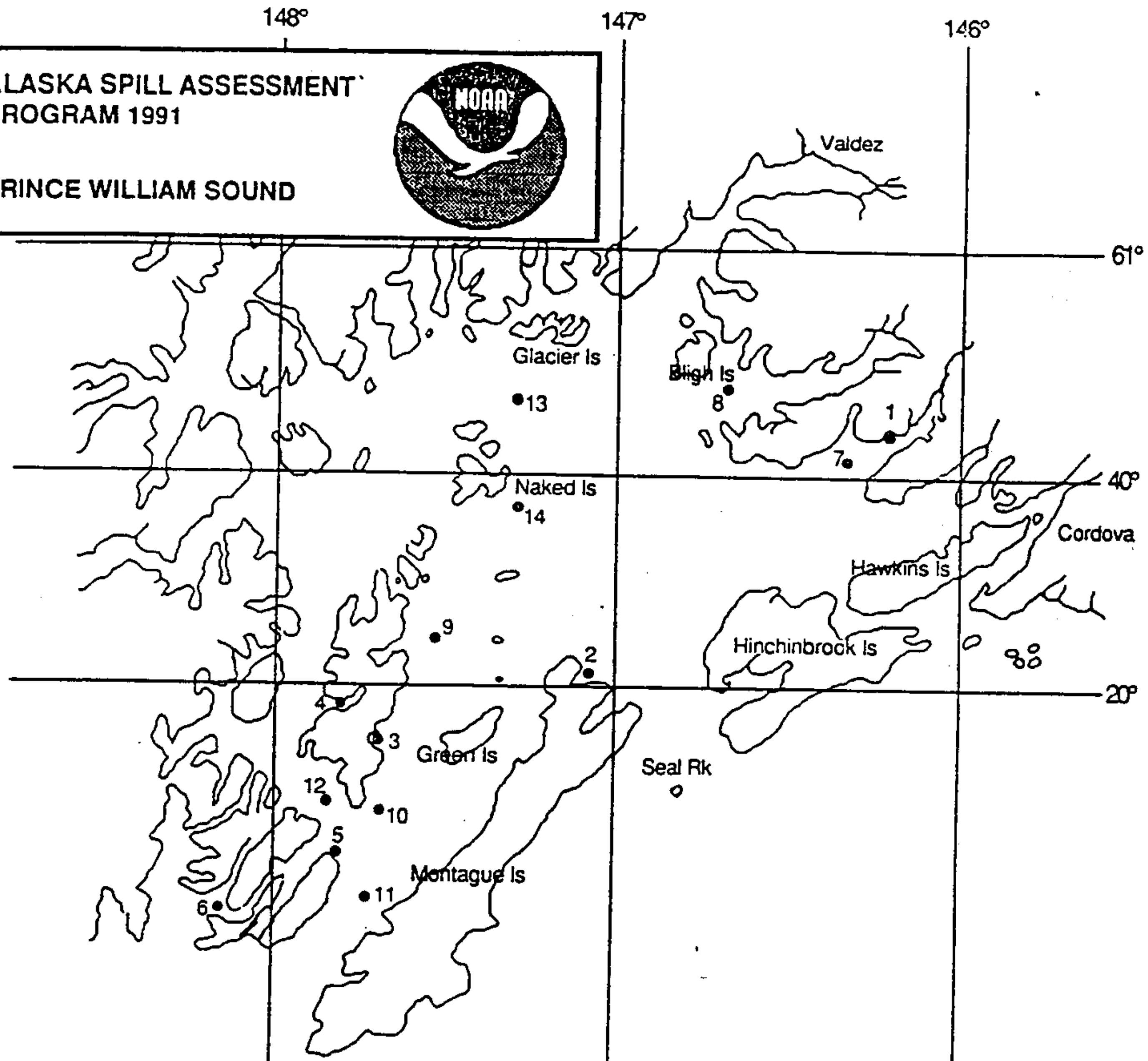


Figure 1

Sites - Prince William Sound

1 Olsen Bay	8 Port Fidalgo
2 Rocky Bay	9 Bay of Isles
3 Snug Harbor	10 Hogan Bay
4 Drier Bay	11 Point Bazil
5 Sleepy Bay	12 Mummy Bay
6 Squirrel Bay	13 Naked Island North
7 Port Gravina	14 Naked Island East

Preliminary Reference Data
(FACs and AHH)

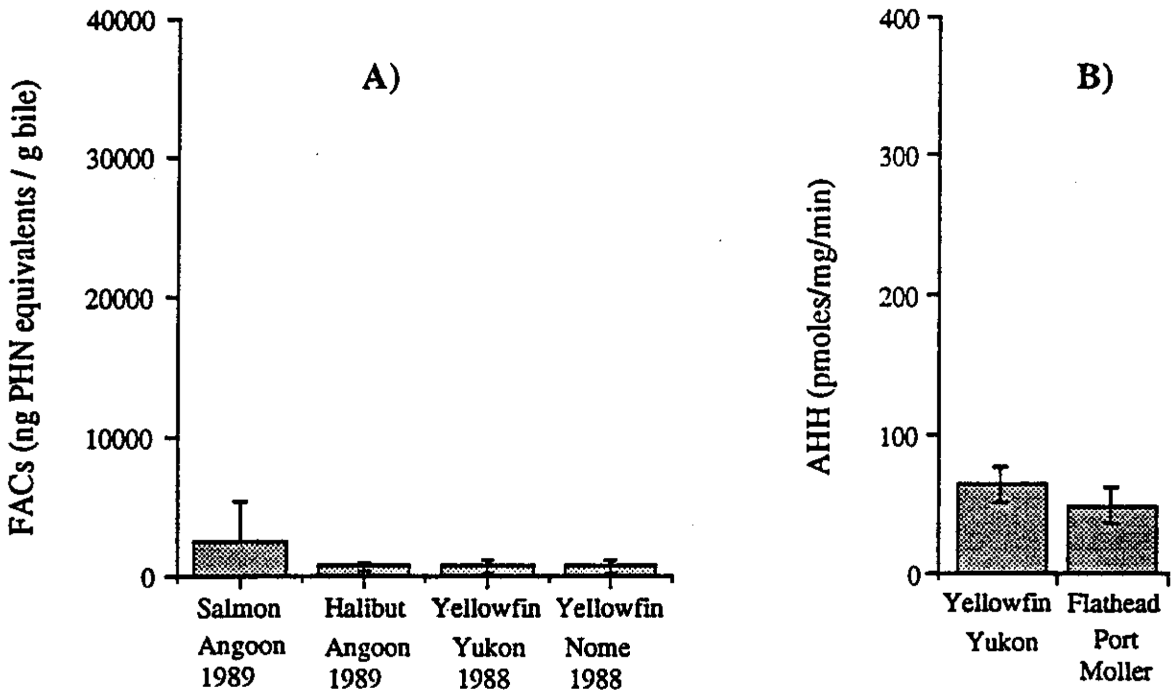
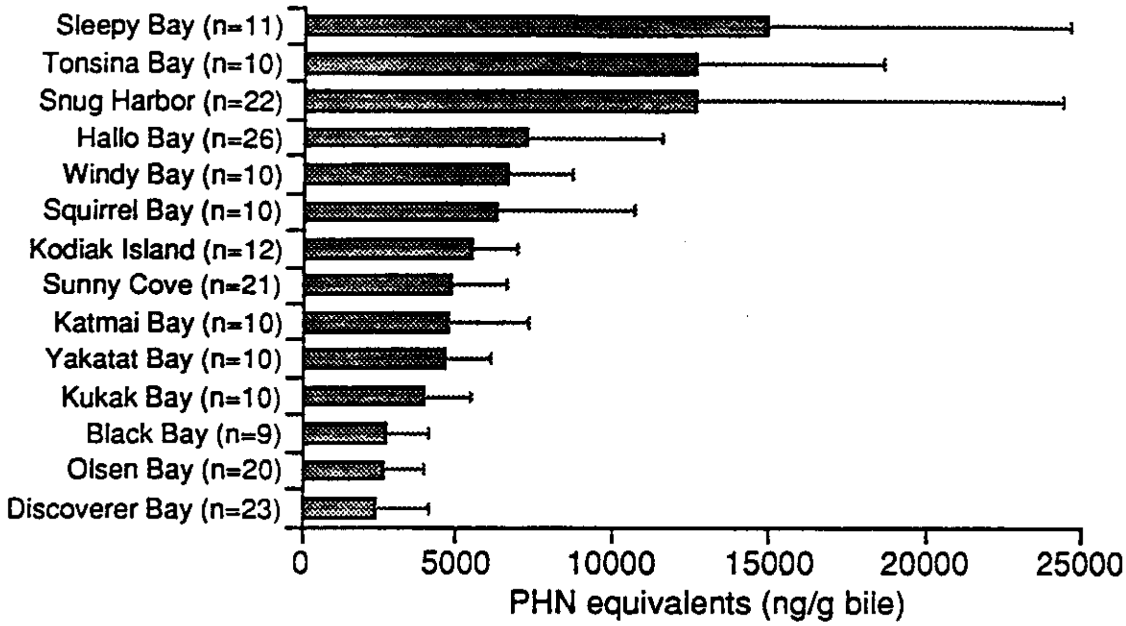


Figure 2. A) Average levels (± standard deviation) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of three species of fish collected in 1989 from locations not affected by the EXXON VALDEZ oil spill, or prior to the spill (from 1989 Progress Report for F/S 24).

B) Average hepatic AHH activities (± SE) in yellowfin sole and flathead sole collected during 1988. Data for yellowfin sole from National Benthic Surveillance Project, Cycle V; data for flathead sole from Collier and Varanasi, 1987.

YELLOWFIN SOLE



Corrected for protein

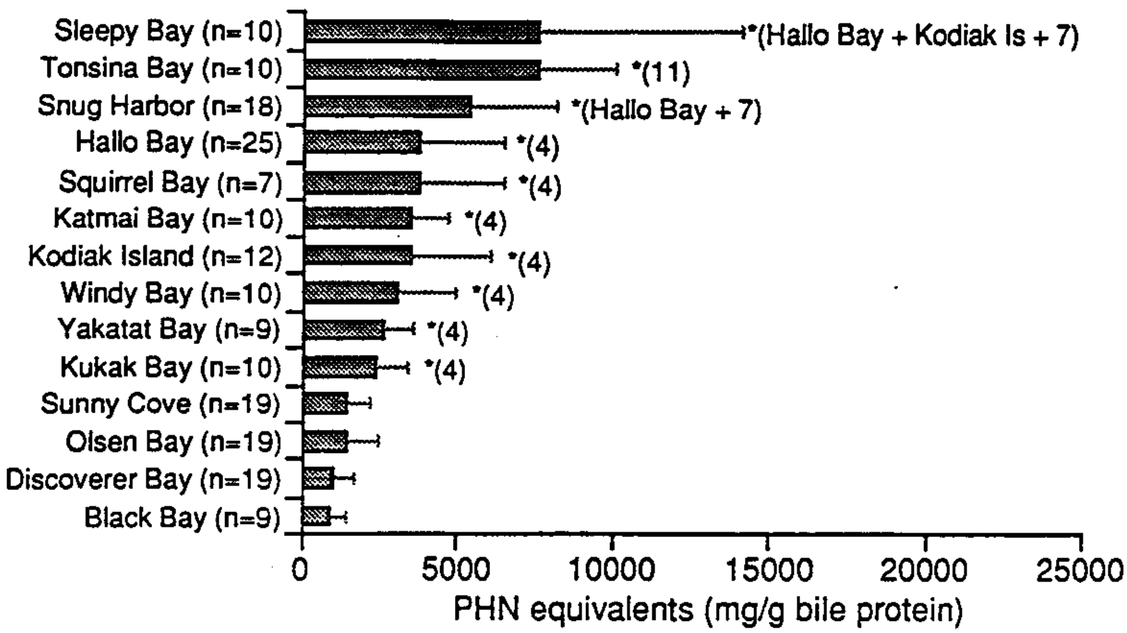
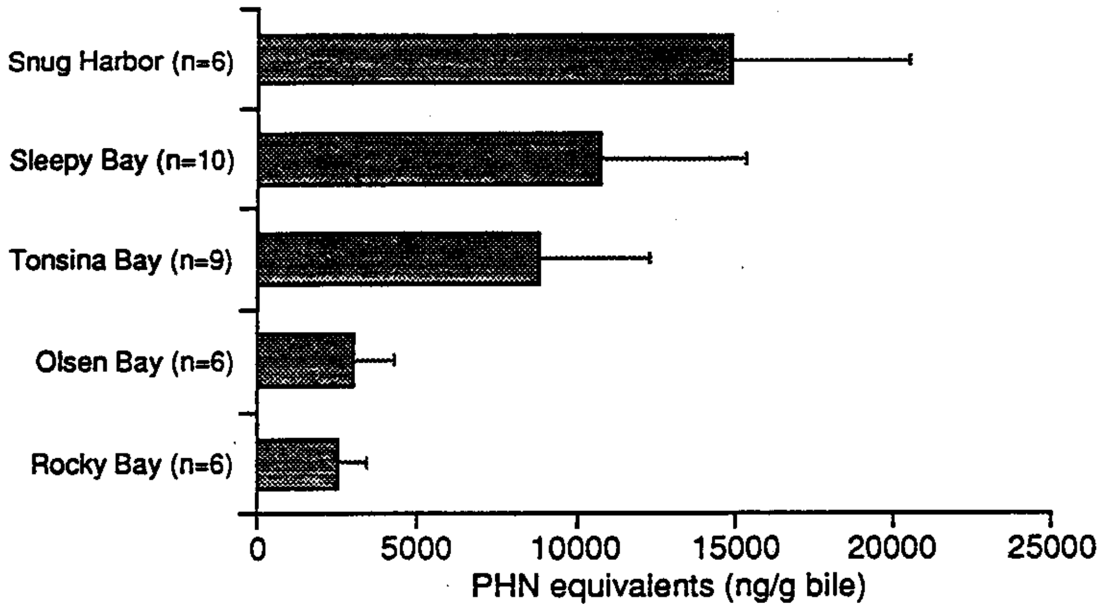


Figure 3. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths (FACsPHN) in bile of yellowfin sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (site **x** + **n**) = significantly different ($p<0.05$) from site **x** and from the **n** lowest sites, as determined by ANOVA of log-transformed data. (statistics only reported for protein normalized data)

ROCK SOLE



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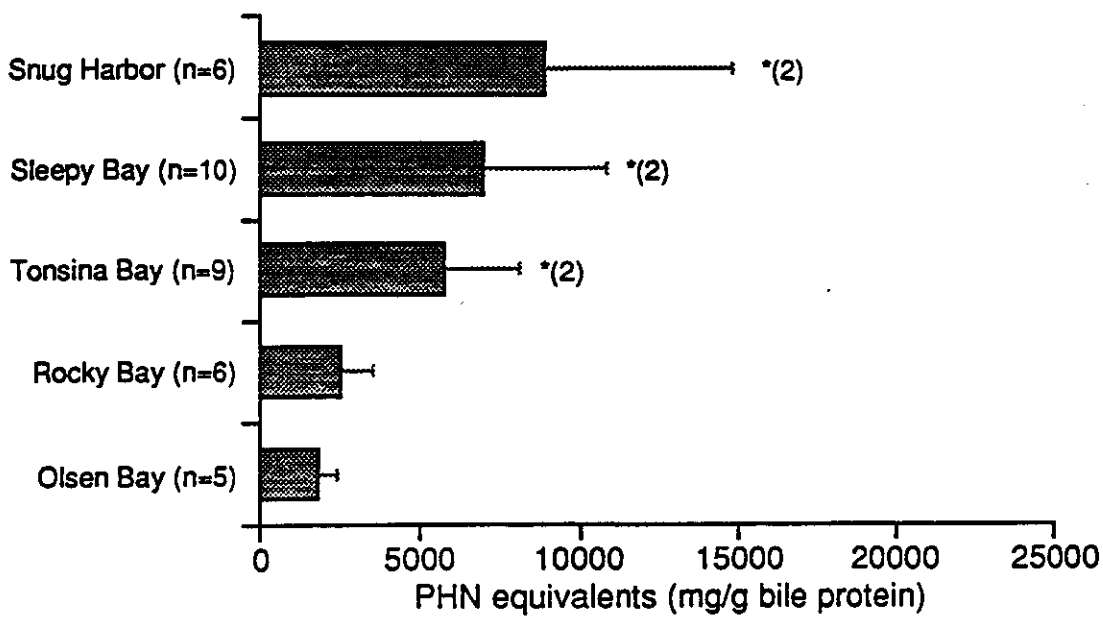
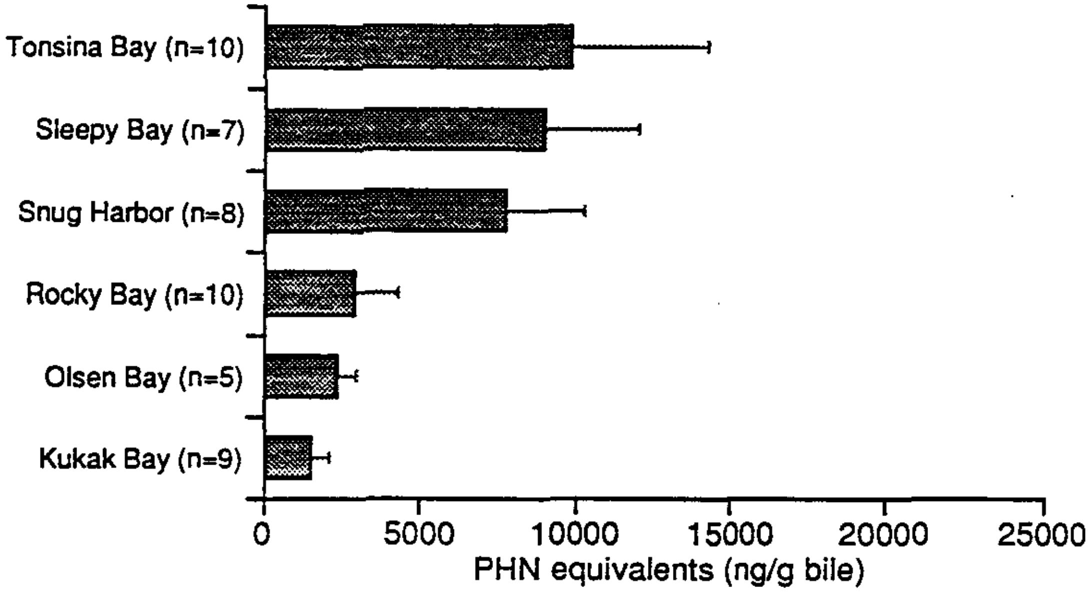


Figure 4. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of rock sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (n) = significantly different ($p<0.05$) from the n lowest sites, as determined by ANOVA of log-transformed data. (statistics only reported for protein normalized data)

FLATHEAD SOLE



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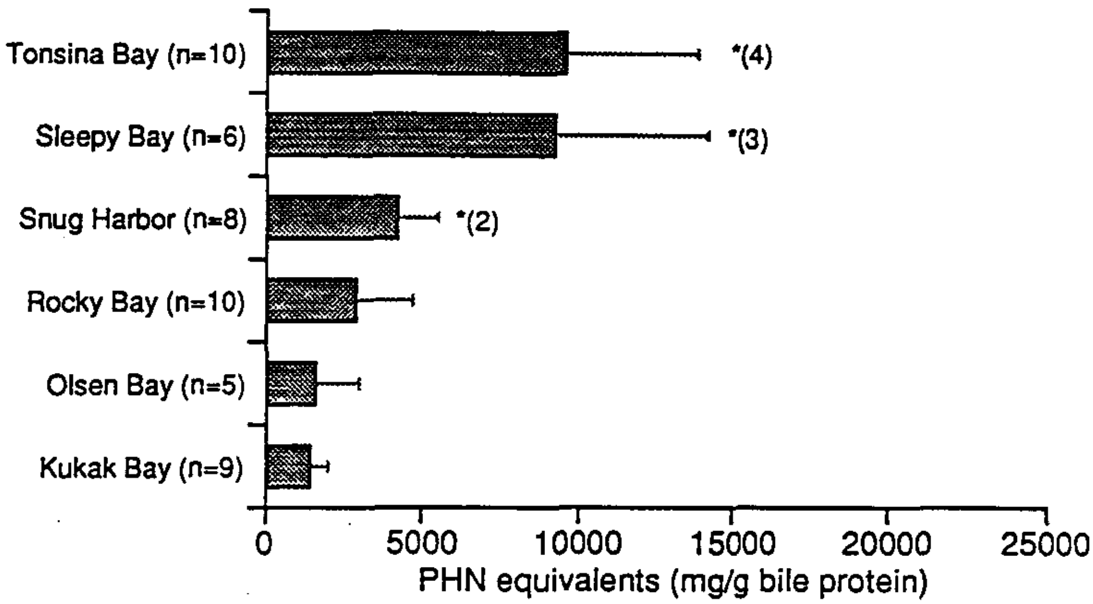
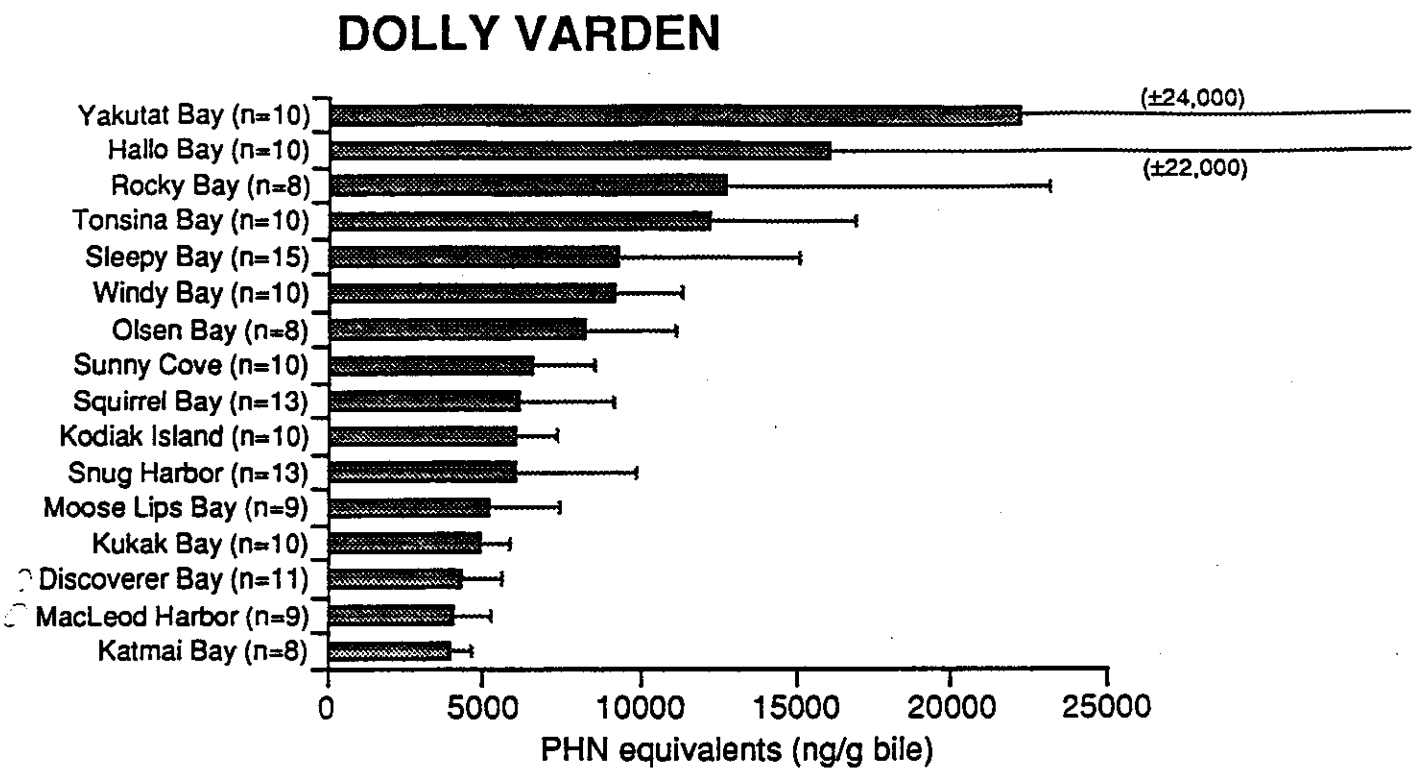


Figure 5. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths (FACsPHN) in bile of flathead sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (n) = significantly different ($p<0.05$) from the n lowest sites, as determined by ANOVA of log-transformed data. (statistics only reported for protein normalized data)



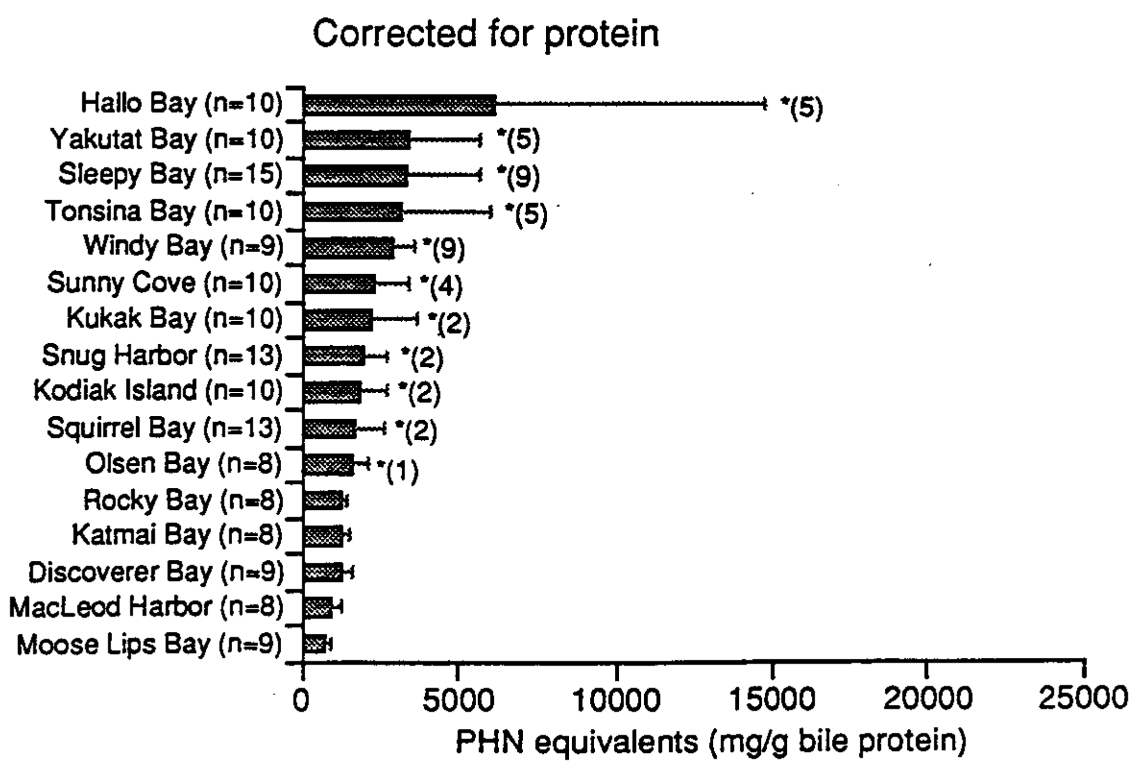


Figure 6. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths (FACsPHN) in bile of Dolly Varden collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (**n**) = significantly different ($p<0.05$) from the **n** lowest sites, as determined by ANOVA of log-transformed data. (statistics only reported for protein normalized data)

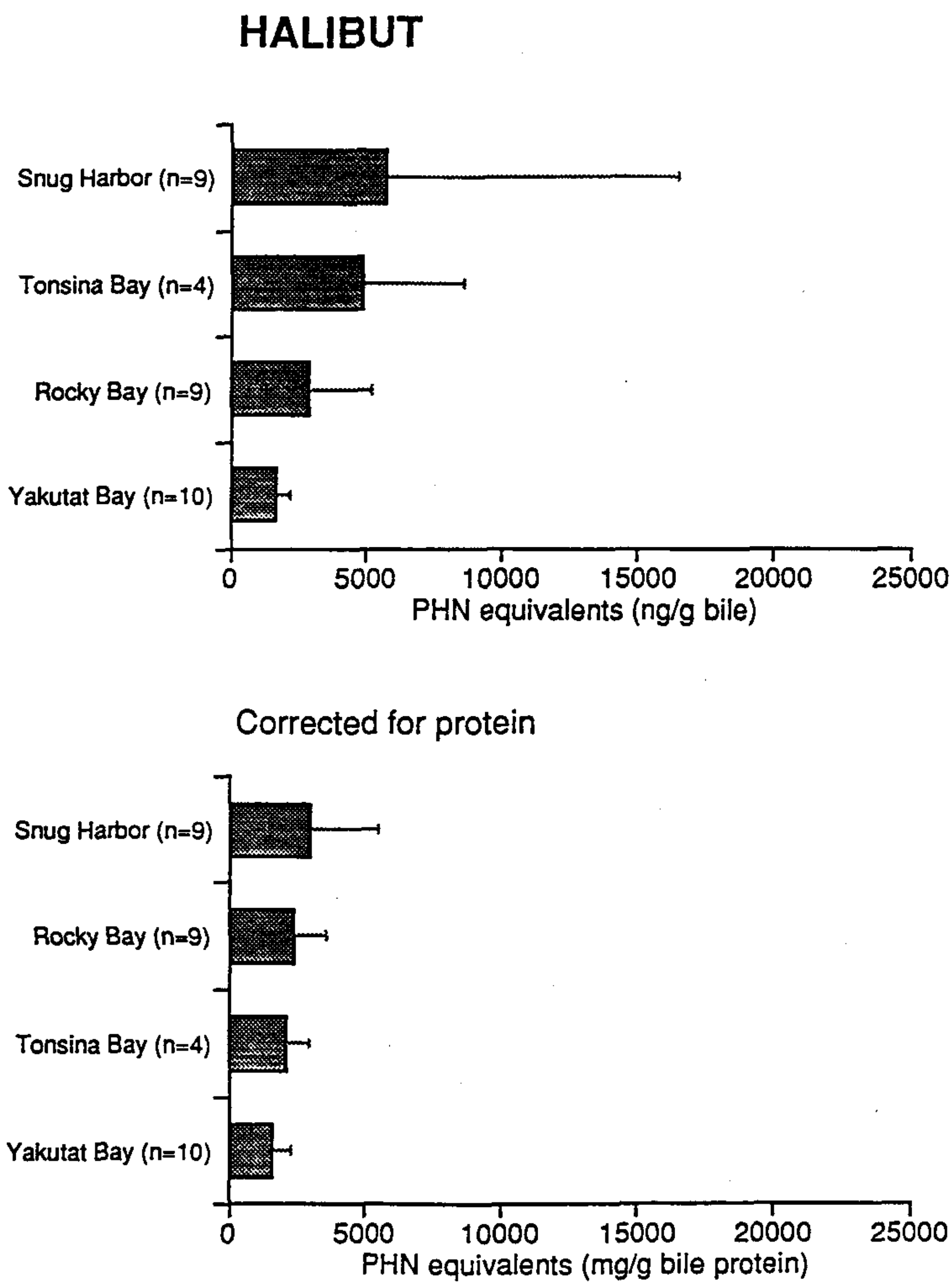


Figure 7. Average levels (± SD) of fluorescent aromatic compounds determined at phenanthrene wavelengths (FACsPHN) in bile of Pacific halibut collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. No significant site differences were found.

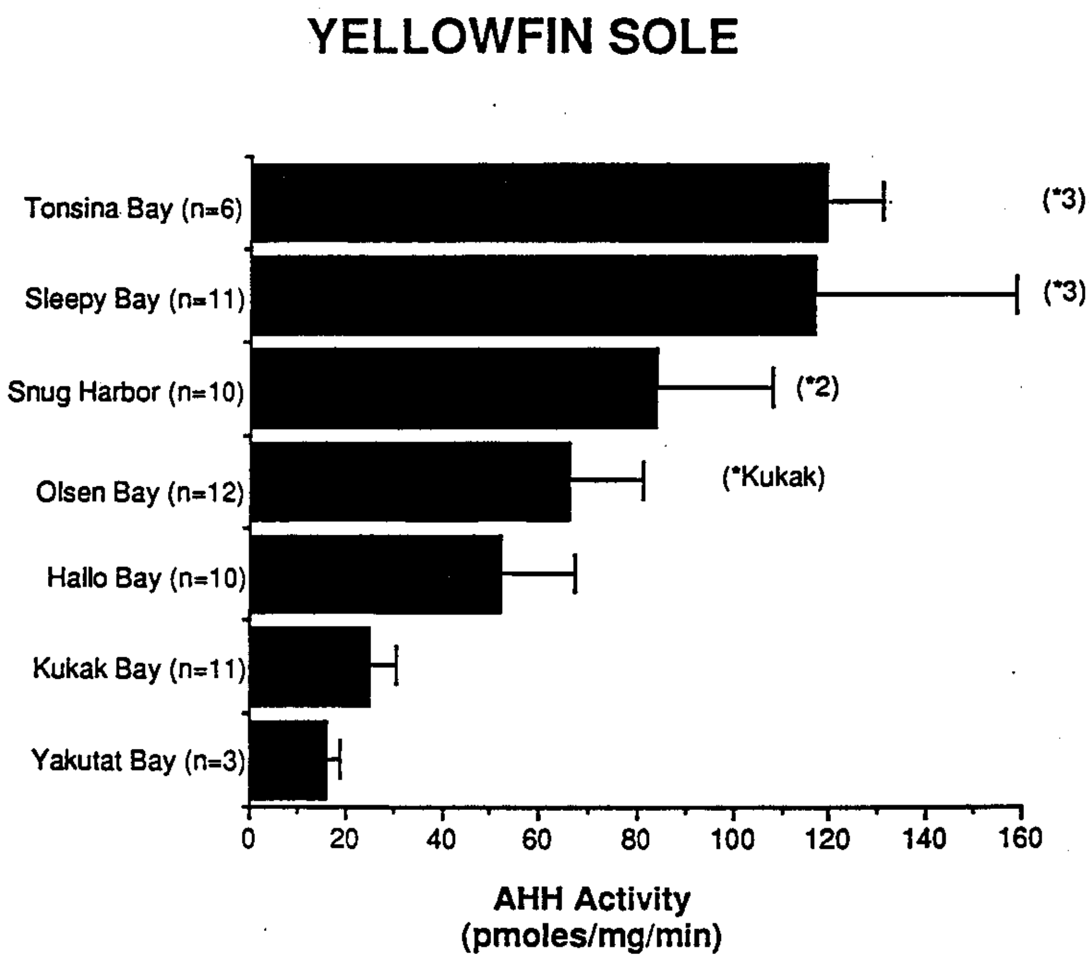


Figure 13. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of yellowfin sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (site **x** + **n**) = significantly different ($p<0.05$) from site **x** and from the **n** lowest sites, as determined by ANOVA of log-transformed data.

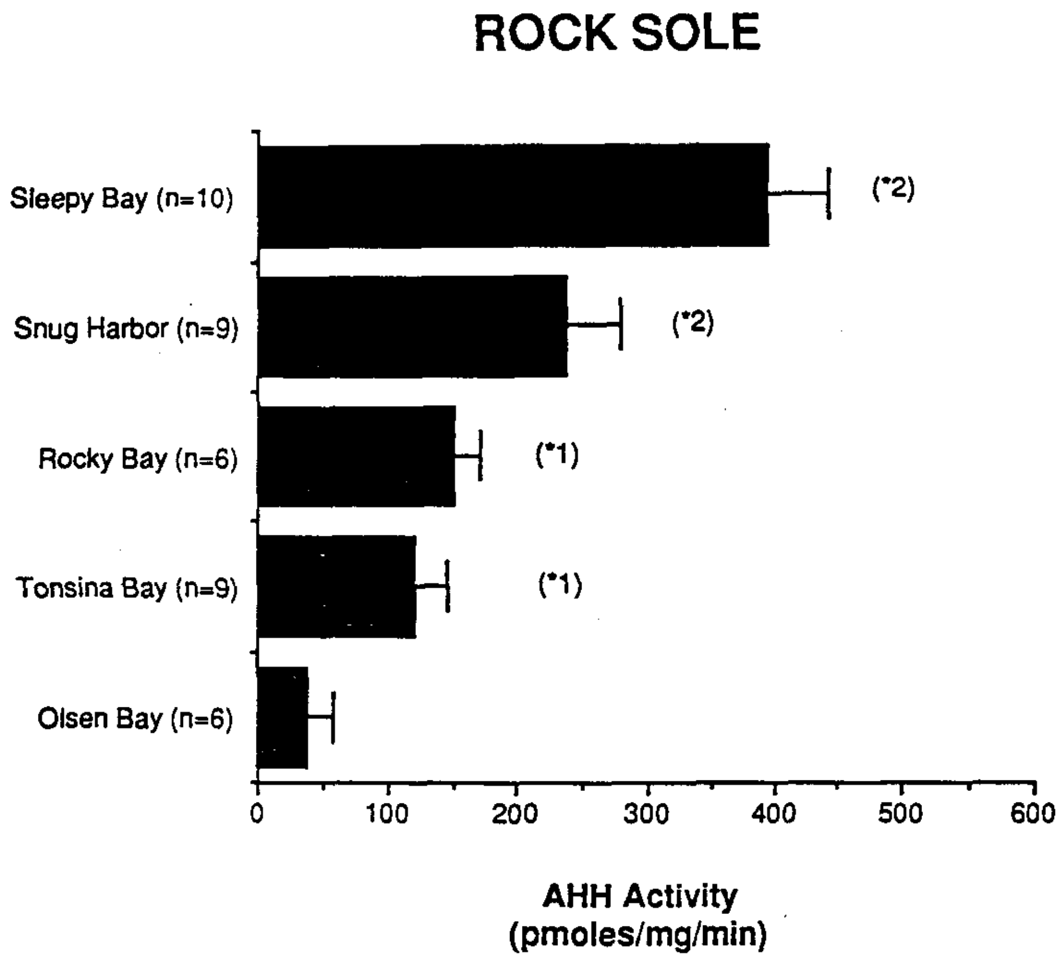


Figure 14. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of rock sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (**n**) = significantly different ($p<0.05$) from the **n** lowest sites, as determined by ANOVA of log-transformed data.

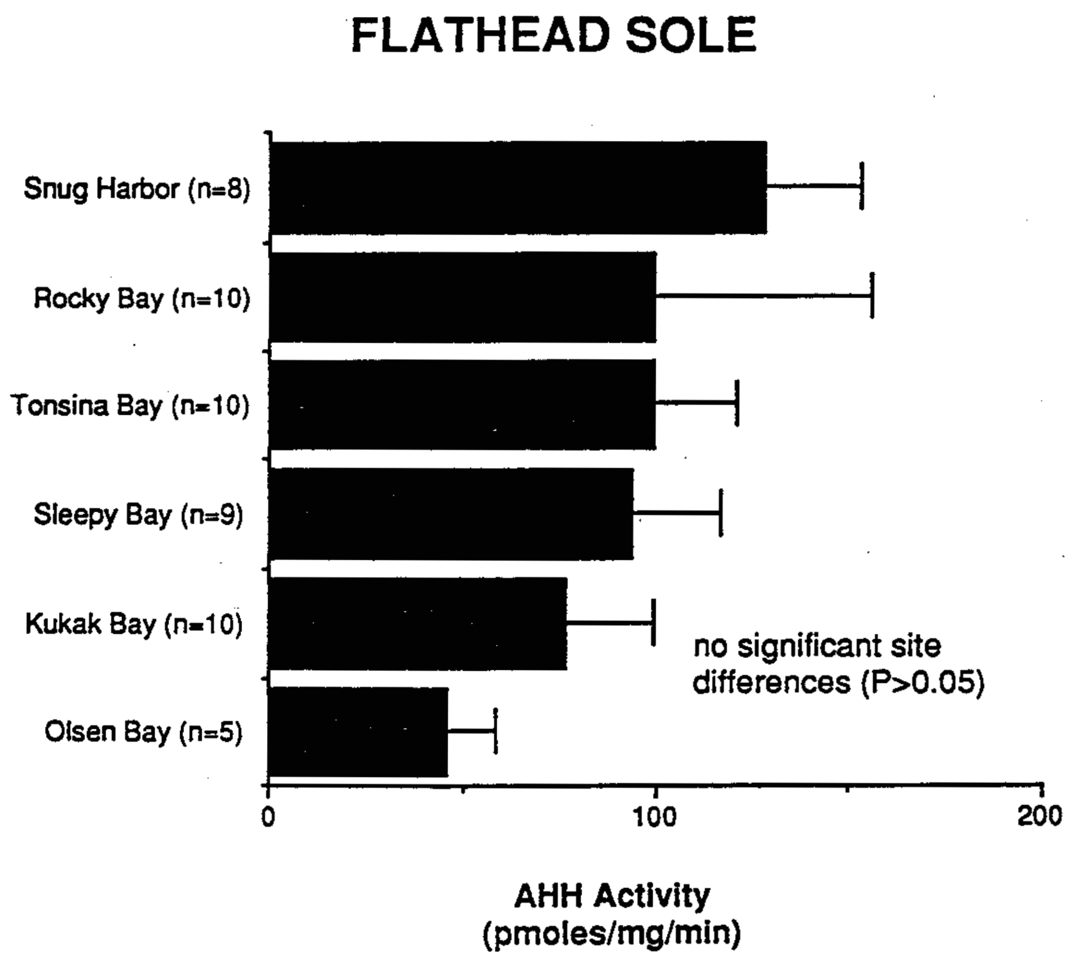


Figure 15. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of flathead sole collected under F/S 24 in 1990. Parenthetical numbers indicate sample size.

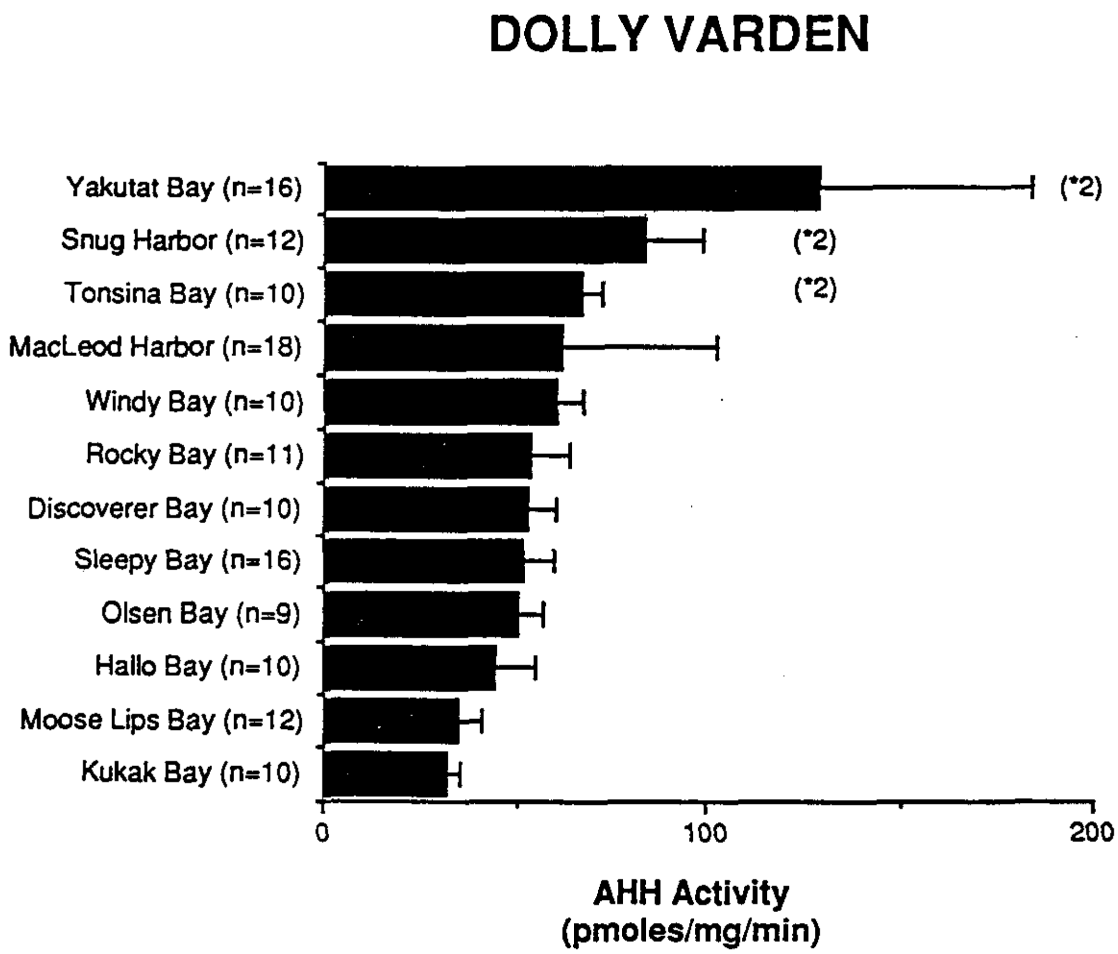


Figure 16. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of Dolly Varden collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. *(**n**) = significantly different ($p<0.05$) from the **n** lowest sites, as determined by ANOVA of log-transformed data.

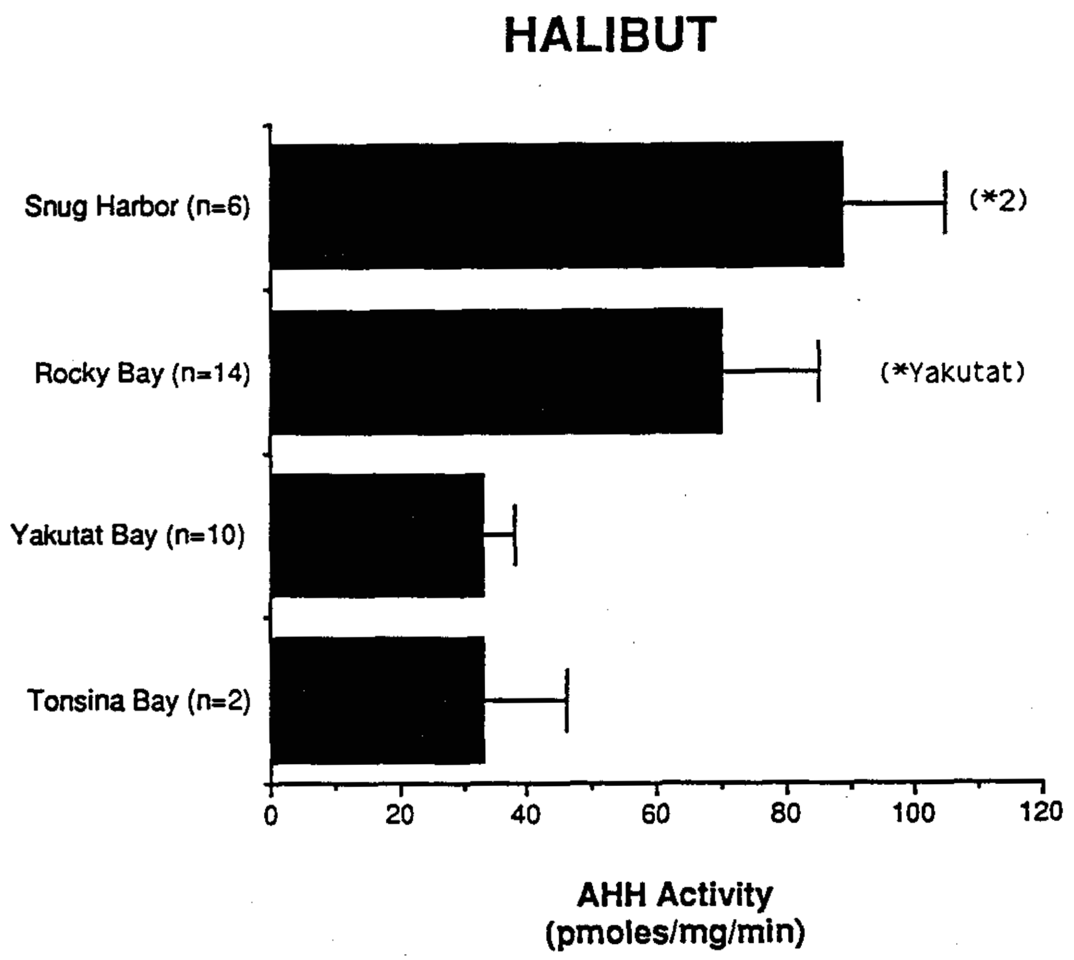


Figure 17. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of Pacific halibut collected under F/S 24 in 1990. Parenthetical numbers indicate sample size. * (**n**) = significantly different ($p<0.05$) from the **n** lowest sites, as determined by ANOVA of log-transformed data.

DRAFT

OIL SPILL PROGRESS REPORT

GROUNDFISH TRAWL ASSESSMENT INSIDE AND OUTSIDE PRINCE WILLIAM SOUND

Fish/Shellfish Study Number 24

Assessment of Oil Spill Impacts on Fishery Resources:

Measurement of Hydrocarbons and Their Metabolites, and Their Effects, in Important Species

by

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1991

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EXECUTIVE SUMMARY

Studies were conducted in 1991to continue to assess damage to fisheries resources related to the *EXXON VALDEZ* oil spill (EVOS). These studies were designed to help determine the degree of exposure of biota to petroleum derived compounds, specifically aromatic hydrocarbons, and assess possible effects on various species resulting from such exposure. From February to June, 1991, samples of fish were collected from 29 sites in Prince William Sound and the Shelikof Straits. Over 550 bile and 500 liver samples were obtained from 5 species of fish from pelagic and benthic habitats. To date, over 400 of the bile samples have been analyzed for the presence of fluorescent aromatic compounds (FACs), and about 90 of the liver samples have been analyzed for aryl hydrocarbon hydroxylase (AHH) activity, which is known to be increased after exposure of fish to chemical contaminants. These assays (biliary FACs and hepatic AHH) were used to determine degree of exposure of fish to aromatic compounds. Changes in hepatic AHH activities can also indicate a physiological change as a consequence of exposure. Results from measurements of levels of FACs in bile suggest that some fish (flathead sole and pollock) continued to be exposed to petroleum derived compounds at sites inside Prince William Sound. Generally, however, concentrations of FACs in bile of all fish species were lower in 1991 than in 1990. Based on the results of the bile FAC and hepatic AHH analyses, samples were chosen for analyses of histopathological changes and reproductive dysfunction. The histopathological analyses are in progress. Assessment of reproduction has thus far comprised analysis for plasma estradiol concentration, gonadosomatic index (GSI) and ovarian maturation stage in about 80 yellowfin sole from sites in Prince William Sound and approximately 300 pollock from 8 sites within Prince William Sound and 10 sites outside PWS. The data obtained thus far do not indicate a substantial impact on measured reproductive processes in these 2 species.

OBJECTIVES

A. To sample selected fish species (e.g. pollock, yellowfin sole, rock sole, flathead sole, Pacific cod) from several sites inside and outside Prince William Sound, with emphasis on sites inside Prince William Sound. Site selection is primarily based on data from the last two years of sampling and analyses. Representative sediment samples are also taken from each benthic sampling site for subsequent chemical analysis.

B. To estimate the exposure to petroleum hydrocarbons by measuring levels of hydrocarbon metabolites in bile of the above species from oiled and nonoiled habitats such to detect significant differences in bile concentrations with $\alpha = 0.05$. Additionally, stomach contents of fish showing high levels of hydrocarbon metabolites in bile will be analyzed for hydrocarbons, such to detect significant differences in concentrations with $\alpha = 0.05$.

C. To estimate the induction of hepatic aryl hydrocarbon hydroxylase activity or increased levels of cytochrome P-450IA in the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha = 0.05$.

D. To estimate the prevalence of pathological conditions in the above species from oiled and nonoiled habitats such to detect statistical differences in levels of effects with $\alpha = 0.05$.

E. To estimate the levels of plasma estradiol, the degree of ovarian maturation, and fecundity in adult females of two of the above species (yellowfin sole and pollock) from oiled and nonoiled habitats such to detect statistically significant differences with $\alpha = 0.05$.

F. To estimate temporal changes in the parameters described in Objectives B&C, by comparing data obtained in 1991 to data obtained in 1989 and 1990. In order to assess either recovery or increased damage of habitats from the oil spill, trends in these parameters must be statistically significant at $\alpha = 0.05$.

G. Using the above data, as appropriate, construct simulation models similar to those of Schaaf et. al. (1987) for important Alaskan fish species for use in estimating oil spill impacts on fishery resources. These models will incorporate pre-spill information from the fisheries literature on mortality and fecundity together with information on reproductive impairment, pathological conditions, and biochemical effects in fish exposed to petroleum hydrocarbons as a result of the spill.

INTRODUCTION

Because petroleum and its components can cause severe damage to fishery resources, and because our studies in 1990 showed evidence of continuing exposure to petroleum-derived compounds in fish from several sites, monitoring of the nearshore fisheries resources of Prince William Sound was carried out in 1991. The monitoring included measurement of petroleum exposure and short-term effects, as was done in the summer and fall of 1989 and the summer of 1990, and encompassed a selected assessment of long-term biological effects, including measurements of reproductive dysfunction and histopathological lesions of liver, gill,and gonad, as was done in the summer of 1990 (Varanasi et al., 1990, 1991). However, the scope of the continued studies was reduced substantially compared to studies done in 1989 and 1990, in that the primary study area was limited to Prince William Sound, and fewer species were examined. This narrowing of focus reflects our findings of the previous two years, and is aimed at continuing only those portions of the study which are most likely to assist in documentation of injury or damage. An expansion to this study included the measurement of petroleum exposure and possible effects in pollock from Prince William Sound and the Shelikof Strait. The rationale for this is described below.

Certain petroleum components [e.g. aromatic hydrocarbons (AHs)] can cause reproductive toxicity and teratogenicity in rodents (Shum et al., 1979; Gulyas and Mattison 1979, Mattison and Nightingale, 1980). Similarly, reproductive impairment has been noted in benthic fish residing in contaminated areas of San Francisco Bay (Spies and Rice, 1988) and southern California (Cross and Hose, 1988). Moreover, English sole from areas of Puget Sound having high sediment concentrations of AHs showed inhibited ovarian maturation (Johnson et al., 1988), and fish from these areas that did mature often failed to spawn after hormonal treatment to induce spawning (Casillas et al., 1991). In general, reproductive impairment (including reduced plasma levels of the sex steroid, estradiol) was found in English sole which showed evidence of exposure to aromatic compounds. Moreover, our laboratory studies have shown that plasma levels of estradiol are reduced in gravid female English sole exposed to chemical contaminants extracted from urban sediments (Stein et al., 1991), and, more importantly, our preliminary laboratory studies have also shown that exposure to Prudhoe Bay crude oil reduced plasma levels of estradiol in gravid female rock sole. In view of our findings of the last two years, the continued assessment of possible reproductive dysfunction in animals from impacted areas will be very important in determining biological damage to living marine resources as a result of the oil spill. Levels of plasma estradiol, GSI and ovarian maturation have been determined in selected species. Combined with our measurements of petroleum exposure (e.g. metabolites in bile and enzyme activities in liver), these studies enable us to estimate the degree of reproductive dysfunction which may be occurring in oil-exposed fish.

Exposure of animals to crude oil can also result in changes at the tissue and cellular levels (National Academy of Sciences, 1985). Examples of such changes after exposure of fish to oil-contaminated sediments include liver hypertrophy and fatty liver in winter flounder (Payne et al., 1988) and the occurrence of hepatocellular lipid vacuolization in English sole (McCain et al., 1978). Certain AHs (e.g., benzo[a]pyrene) are known carcinogens in rodents and fish (Lutz, 1979; Bailey et al., 1989), and studies with several bottomfish species show that, of the xenobiotic chemicals in sediments, AHs are most strongly associated with high prevalences of liver lesions, including neoplasms (Myers et al., 1987; Varanasi et al., 1987; Baumann, 1989). Generally, histopathological lesions of the types noted above do not become manifest until at least several months after exposure. However, by the summer of 1991, fish in and around oil impacted sites have potentially been exposed to petroleum components for more than two years. Moreover, there are some published data which suggest that histopathological changes have occurred in some fish species as a result of exposure to oil spilled from the EXXON Valdez (Khan et al., 1990). Accordingly, assessment of histopathological effects in selected species is strongly warranted.

Finally, preliminary studies conducted by our Division in the spring of 1990 (independent of the damage assessment process) suggested that pollock were being exposed to petroleum both inside and outside Prince William Sound. Because of the enormous commercial importance of the pollock fishery, assessment of exposure and possible associated biological effects in pollock, both inside and outside Prince William Sound was carried out.

Briefly, measurement of exposure to oil and oil components in the biota of Prince William Sound and other areas affected by the oil spill was continued, by determining levels of hydrocarbon metabolites in bile and by measuring hepatic AHH activities. Additionally, a range of biological effects, especially indicators of reproductive dysfunction and histopathological effects was evaluated. Only by employing such a broad spectrum of state-of-the art chemical, biochemical and biological methods can analytical data be obtained to document the degree of exposure and resultant biological effects of petroleum hydrocarbons on economically and ecologically important fish species.

METHODOLOGY

(see Appendix A for details)

A. *Collection areas*

Sampling activities were conducted from February 12 to June 1991 at 28 sites both inside and outside of Prince William Sound (see the site maps, Figure 1).

B. *Sampling procedures*

Sample collection methods were outlined in the 1991 Study Plan . Fish were collected at depths ranging from 2 to 60 meters using bottom trawls, long-line gear, gill nets, and beach seines. This equipment was deployed from launches and skiffs carried aboard the NOAA vessel *MILLER FREEMAN* at the sites sampled in the Bering Sea and Shelikof Strait, the Research vessel *PANDALUS* and the charter vessel *BIG VALLEY* in Prince William Sound.. All fish used for sample collections were kept alive in a flowthrough seawater system at ambient water temperature until necropsied.

C. *Laboratory Analyses*

1. Bile Metabolite Assay

Assay methods generally were the same as outlined in the Study Plan . Briefly, bile samples were analyzed at wavelengths appropriate for detection of naphthalene (NPH) and phenanthrene (PHN) and their metabolites. These aromatic hydrocarbons (and especially their alkylated derivatives) are predominant components of the aromatic fraction of crude oil. Hereafter, analyses done at these wavelengths are referred to as $FACs_{NPH}$ and $FACs_{PHN}$, respectively. In addition, bile samples this year were analyzed for total biliary protein by the method of Lowry et al. (1951), and $FACs_{NPH}$ and $FACs_{PHN}$ were normalized against the total biliary protein, as this type of normalization (within a single species) can account for some physiological variability in bile concentration, as described in Collier and Varanasi (1990).

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Assay

Analytical methods used for measuring hepatic AHH activity were as outlined in the 1991 Study Plan

3. Histopathology

Histopathological procedures followed were as described in the 1991 Study Plan .

4. Reproductive Indicators

Assessment of reproductive activity was done as described in the 1991 Study Plan .

D. *Quality Assurance and Control Plans*

All quality assurance and control plans for bile analytes, and AHH analysis, followed the procedures outlined in the 1989 Study Plan (p. 28).

E. *Data Analysis*

Statistical tests and analytical procedures for preliminary statistical analyses were as described in the 1991 Study Plan

RESULTS

A. *Fish and Tissue Sample Collection*

Samples were collected from over 550 individual animals representing 5 fish species (Table 1). Totals of 508 liver samples, 553 bile samples, 44 samples of stomach contents and 314 plasma samples were collected at the 29 sites sampled. In addition, histological samples of liver, gonad, and gill were taken from all fish.

B. *Laboratory Analysis*

The samples which have been analyzed thus far were selected to represent sites with a range of potential oil exposure. In order to insure adequate numbers for statistical analyses, samples were generally analyzed only from sites where six or more individuals were collected.

1. Bile analysis

Figure 2 shows mean levels of $FACs_{PHN}$ in bile from yellowfin sole sampled from Alaskan waters prior to the EVOS, and in addition includes results from analyses of bile from salmon and halibut collected after the spill, but from an area (Angoon) believed to be unaffected by the EVOS. Figure 2 was taken from the 1989 Progress Report for this Project. As stated in that report, the data presented in Figure 2 are only intended for use as general reference values.

This year, 409 individual bile samples, from 5 fish species from 25 sites, have been analyzed. Each of these samples was analyzed at both PHN and NPH wavelengths, and, similar to what we found in 1989 and 1990, there was a very strong correlation between $FACs_{PHN}$ and $FACs_{NPH}$. Accordingly, in this preliminary report we will present primarily the $FACs_{PHN}$ data. We report the bile data both per g bile ($FACs_{PHN}$) and normalized against total biliary protein ($FACs_{PHN/PROTEIN}$), as described in the methods section above.

The mean $FACs_{PHN/PROTEIN}$ values in bile of flathead sole, Pacific cod, rock sole, and yellowfin sole collected in 1991 are shown in Figures 3-6. In general, there is excellent agreement between the protein normalized bile data and the uncorrected bile values, so we will discuss only the protein normalized results here. Only for flathead sole (Figure 3) were levels of $FACs_{PHN/PROTEIN}$ in bile were significantly different (higher) at Fox Farm and Snug Harbor than those found for the lowest site (Olsen Bay). In contrast, there were no significant site differences found in levels of $FACs_{PHN/PROTEIN}$ in bile of yellowfin sole, Pacific cod and rock sole (Figures 4-6).

A statistical analysis was conducted of the bile metabolite data from several sites for 1990 and 1991, as well as for the one site (Snug Harbor) from which fish were collected in all three years (1989-1991), and the results are shown in Figures 7-10. For fish collected in 1991, rock sole from Snug Harbor and Sleepy Bay and yellowfin sole from Snug Harbor had levels of $FACs_{PHN/PROTEIN}$ in bile which were significantly different (lower) than the 1990 levels (Figures 8 and 9). In addition, flathead sole collected in 1991 from Snug Harbor and Sleepy Bay had levels of $FACs_{PHN}$ in bile that were significantly different (lower) than the 1990 levels (Figure 7). Levels of $FACs_{PHN/PROTEIN}$ in bile of flathead sole and rock sole collected in 1989 and yellowfin sole collected in 1989 and 1990 from Snug Harbor were significantly different (higher) than the 1991 levels (Figure 8).

In 1991, pollock were collected from 19 sites within Prince William Sound (PWS) and from the Shelikof Strait for Fish/Shellfish Study 24; a previous collection in 1990 was conducted under the oil spill response effort. Again, we will discuss only the protein normalized results. The mean $FACs_{PHN/PROTEIN}$ values in bile of the pollock collected; both inside and outside PWS, in 1991 are shown in Figure 11. Pollock at four sites (Figure 11), all within PWS, had levels of $FACs_{PHN/PROTEIN}$ in bile that were significantly different (higher) than those found for pollock from Uganik Island (lowest site) or Eastend Transect (site from an area unimpacted by oil). A statistical analysis was conducted of the bile metabolite data for pollock collected from sites sampled in both 1990 and 1991; the results are shown in Figures 12. For pollock collected in 1991, levels of $FACs_{PHN/PROTEIN}$ in bile were significantly different (lower) than the 1990 levels at Mummy Island/Bay, Naked Island and Point Bazil.

Recent studies in our laboratory (Appendix B) carried out as a complement to our oil spill studies have provided further evidence that the FACs measured in bile of fish after the EVOS are in fact derived from petroleum compounds. This publication should be consulted for further details.

2. Measurement of hepatic AHH activity

Thus far, hepatic AHH activity has been measured in 90 samples from three species of fish collected at 3 sites. Further analyses are ongoing. The initial round of analyses emphasized comparisons between a known oil-impacted site (Snug Harbor) and a site where little or no oil impact has been noted (Olsen Bay, near Port Gravina). Analyses thus far have also emphasized flatfish species, which were shown in the previous two years of studies under F/S 24 have continuing exposure to oil at oil-impacted sites both inside and outside Prince William Sound. Our results are presented in Figures 13-15. Briefly, AHH activity continues to be induced in flatfish sampled from Snug Harbor, presumably as a result of the EVOS. Both rock sole and flathead sole had significantly increased hepatic AHH activities at Snug Harbor compared to fish captured at Olsen Bay, and compared to the previous year's data, neither species showed any decrease in AHH activity from 1990 to 1991, in fish sampled from Snug Harbor. However, there was a significant decrease in hepatic AHH activity between 1990 and 1991 in rock sole sampled from Sleepy Bay. There were not enough flathead sole collected from Sleepy Bay in 1991 to allow a reasonable statistical analysis of the results. Analyses of hepatic AHH activity are continuing in rock sole and flathead sole collected during 1991. Initial analyses of hepatic AHH activity in yellowfin sole have shown that there was an apparent depression of this enzyme in females, most probably related to their gonadal maturity, as AHH activity is generally depressed in female fish as they near spawning. Analyses of AHH activity in male yellofin sole, however, showed apparent induction of hepatic AHH activity in fish from Snug Harbor. However, analyses of AHH activities in male from Olsen Bay are not yet completed, thus a statistical comparison of 1991 data cannot be done at this time. Overall, these results suggest that induction of hepatic AHH activity is continuing in flatfish from at least one site in Prince William Sound, as an apparent result of the EVOS.

3. Indicators of reproductive success

Adult female yellowfin sole and adult female pollock were examined for evidence of petroleum-associated reproductive dysfunction. Several indicators of reproductive development were measured, including concentrations of estradiol in plasma, gonadosomatic index (GSI), and ovarian maturation stage (determined grossly). For yellowfin sole, plasma estradiol concentrations and GSI have been determined in 90 fish captured at three sites. For pollock, plasma estradiol concentrations and GSI have been measured in 227 fish from 18 sites, 10 within Prince William Sound and 8 in the Shelikof Straits.

Analysis of yellowfin sole samples indicate that neither plasma estradiol concentrations nor GSI appear to be depressed in fish from Snug Harbor, the site at which fish had highest concentrations of metabolites in bile (Fig. 16 a,b). Moreover, plasma estradiol concentrations show little relationship with levels of NPH or PHN metabolites in bile (Fig. 17 a,b). GSI is negatively correlated with concentrations of both NPH and PHN metabolites in bile, and appears to be depressed in fish with highest concentrations of metabolites in bile (i.e. > 25000 mg/g bile protein for NPH and > 3000 ng/g bile protein for PHN) (Fig. 17 c,d). However, the fish with highest concentrations of bile metabolites were somewhat smaller than other animals (278 ± 28 mm vs 311 ± 46 mm), and possibly too young to be sexually mature. Results of multiple regression analysis (Table 2) indicate that when fish size is taken into account, the relationship between GSI and bile metabolites is no longer statistically significant, suggesting that depressed GSI was not necessarily related to petroleum exposure.

Analysis of pollock samples indicates that both GSI and plasma estradiol concentrations tended to be lower in pollock sampled from within Prince William Sound than in those from the Shelikof Strait (Fig. 18 a,b). However, these differences in reproductive status did not appear to be due to current levels of oil exposure because there was no correlation between concentrations of NPH or PHN metabolites in bile and either plasma estradiol or GSI (Fig. 19 a-d). It is possible that past exposure could account for reduced plasma estradiol concentrations and GSI in fish from sites that were originally heavily oiled such as Naked Island and Mummy Bay. However, an alternative explanation for the observed differences in reproductive development between fish from inside and outside Prince William Sound is that spawning occurs slightly earlier in the Prince William Sound fish. From visual examination of ovaries it appeared that a higher proportion of females was spawning within Prince William Sound than outside (24% vs 2%). There also appeared to be a higher number of regressed females at sites within Prince William Sound (31% vs 15%), but animals judged to be immature based on visual examination of the ovaries may actually be spawned out, since the two stages can be difficult to distinguish without microscopic examination of the ovaries. Pollock ovaries are now being examined histologically for accurate assessment of their developmental stage. If histological examination confirms that a substantial proportion of pollock from within Prince William Sound had just finished spawning, this could account for low GSI and plasma estradiol concentrations in fish from these sites, rather than any effect of oil exposure.

4. Histopathology

Histopathological analyses of tissues are currently in progress.

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Table 1. Species and number of fish collected for F/S 24 aboard the NOAA Ships *MILLER FREEMAN* , the Research Vessel *PANDALUS* and the charter vessel *BIG VALLEY* from February to June, 1991.

Species common name	Scientific name	# collected
flathead sole	*Hippoglossoides elassodon*	62
yellowfin sole	*Limanda aspera*	145
rock sole	*Lepidopsetta bilineata*	61
Pacific cod	*Gadus macrocephalus*	24
pollock	*Theragra chalcogramma*	300
TOTAL		589

Table 2. Relationship between day of capture, length, condition factor, and concentrations of fluorescent aromatic compounds in bile measured at phenanthrene (PHN) and napthalene (NPH) wavelengths (mg/g bile protein) and gonadosomatic index (GSI) and plasma estradiol concentrations in female yellowfin sole from Prince William Sound.

Dependent Variable	df	Significance of Regression	RS	Independent Variable: Snug Harbor	length	Day of Capture	Condition Factor	PHN	NPH
GSI	88	p=0.0001	0.52	ns	(+) p=0.0001	(+) p=0.0003	ns	ns	ns
Estradiol	88	p=0.0001	0.29	ns	(+) p=0.0056	(+) p=0.0006	ns	ns	ns

ns = not significant

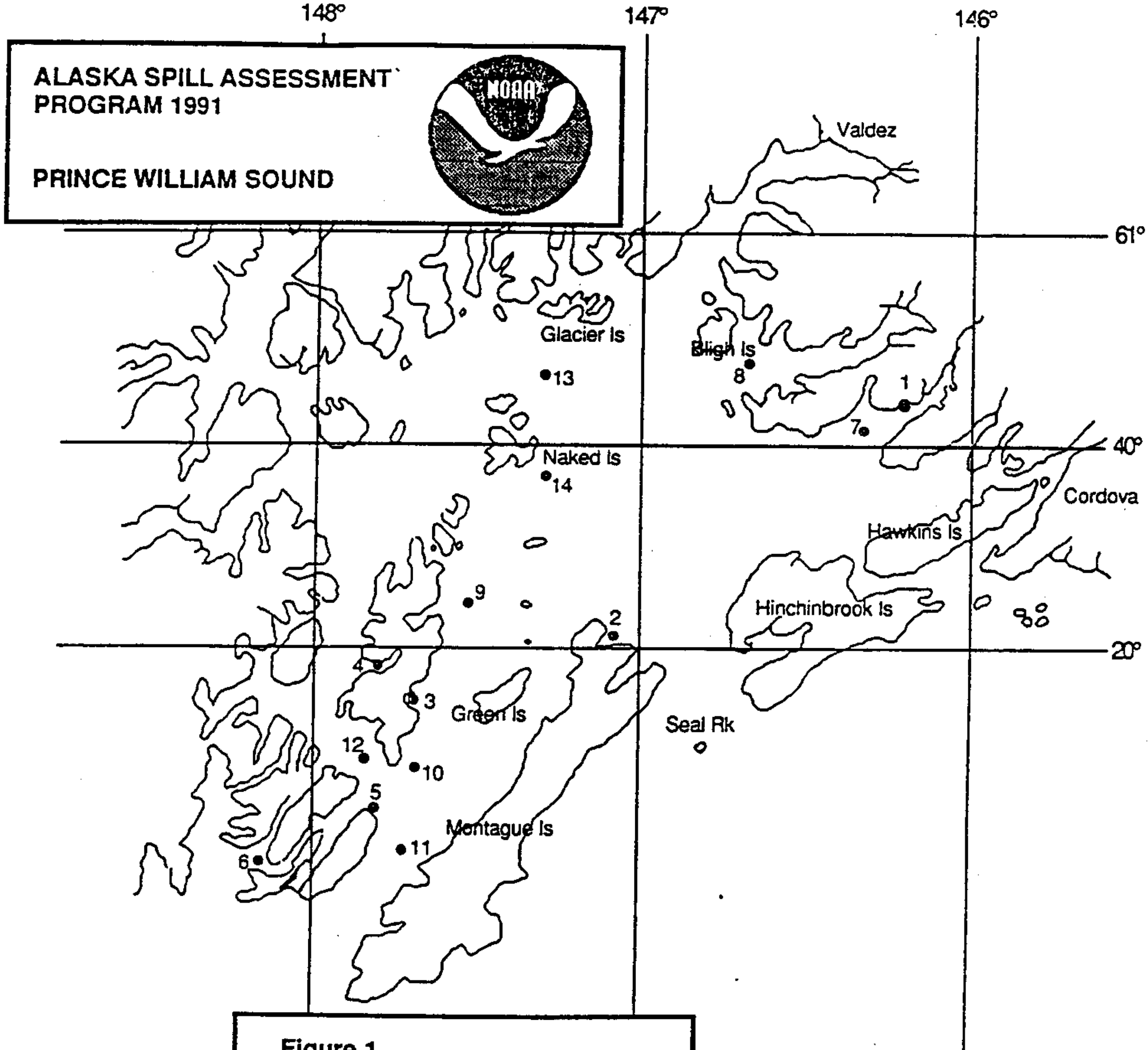


Figure 1

Sites - Prince William Sound

1 Olsen Bay
2 Rocky Bay
3 Snug Harbor
4 Drier Bay
5 Sleepy Bay
6 Squirrel Bay
7 Port Gravina
8 Port Fidalgo
9 Bay of Isles
10 Hogan Bay
11 Point Bazil
12 Mummy Bay
13 Naked Island North
14 Naked Island East

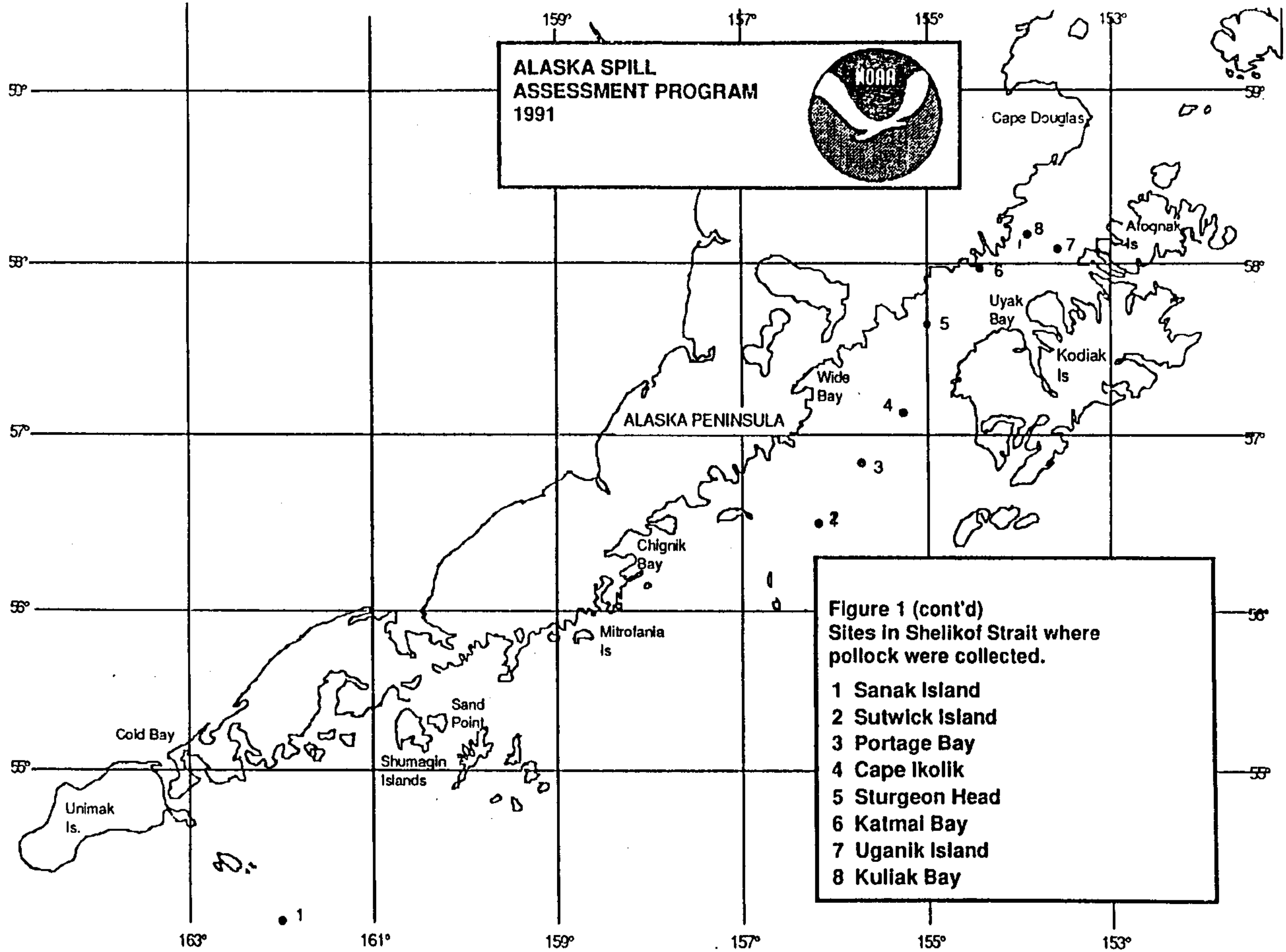


Figure 1 (cont'd)
Sites in Shelikof Strait where pollock were collected.

1 Sanak Island
2 Sutwick Island
3 Portage Bay
4 Cape Ikolik
5 Sturgeon Head
6 Katmai Bay
7 Uganik Island
8 Kuliak Bay

Preliminary Reference Data
(FACs and AHH)

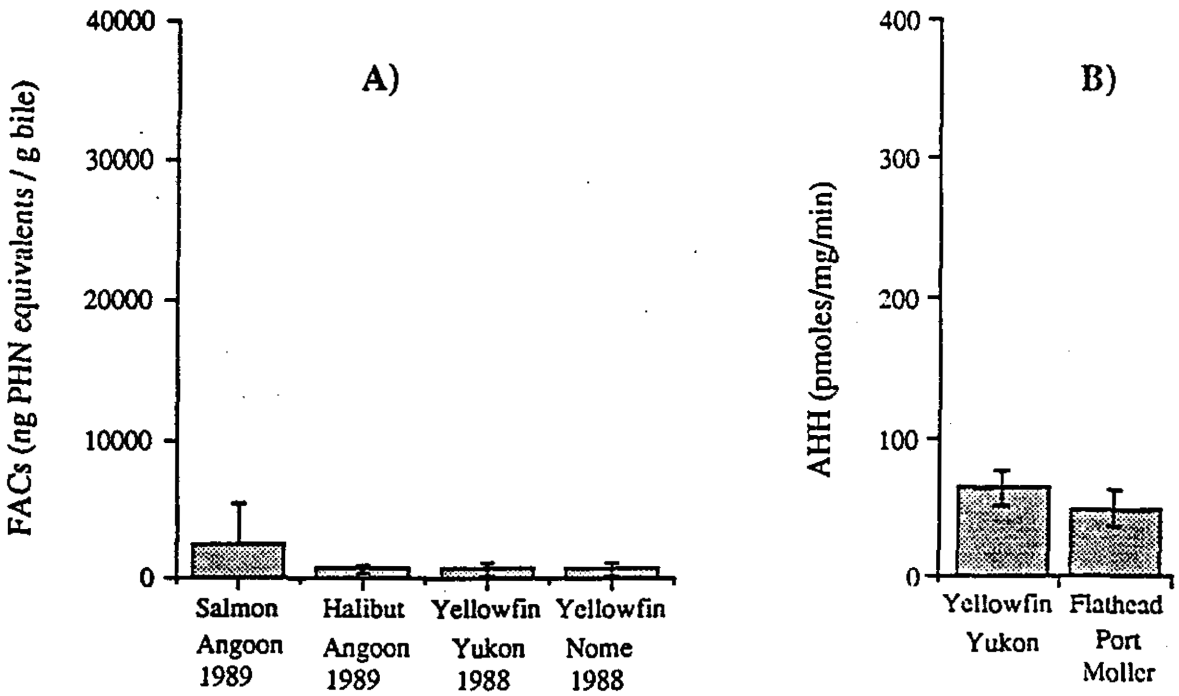
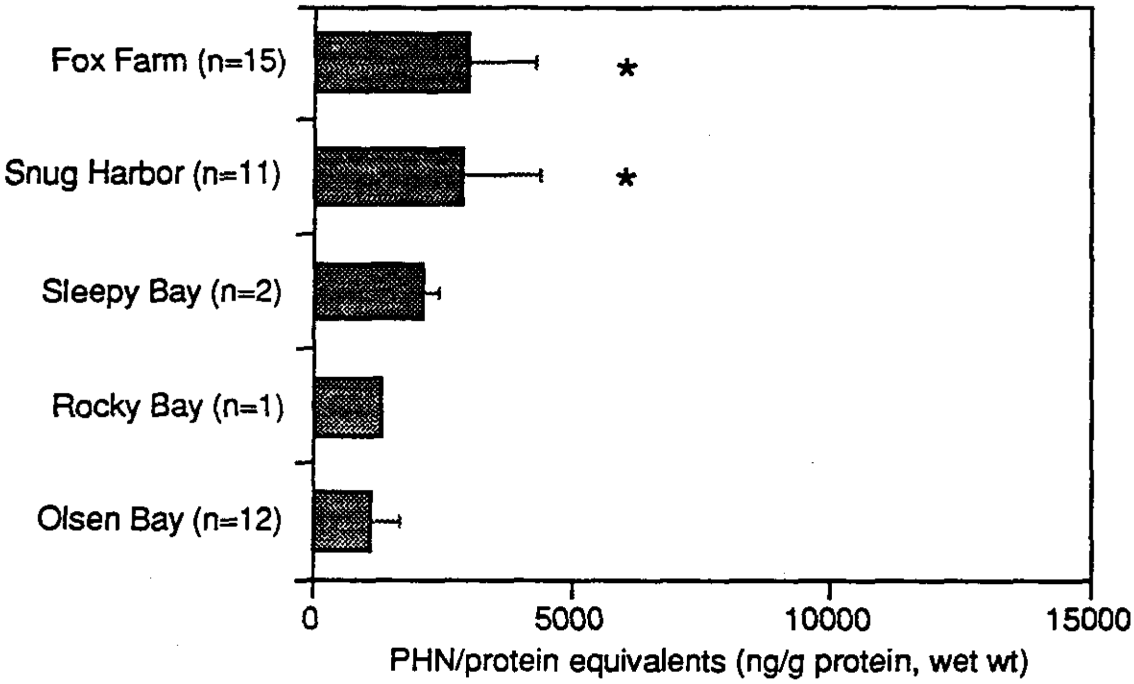


Figure 2. A) Average levels (± standard deviation) of fluorescent aromatic compounds determined at phenanthrene wavelengths ($FACs_{PHN}$) in bile of three species of fish collected in 1989 from locations not affected by the EXXON VALDEZ oil spill, or prior to the spill (from 1989 Progress Report for F/S 24).

B) Average hepatic AHH activities (± SE) in yellowfin sole and flathead sole collected during 1988. Data for yellowfin sole from National Benthic Surveillance Project, Cycle V; data for flathead sole from Collier and Varanasi, 1987.

FLATHEAD SOLE 1991



* Significantly different by log-transformed ANOVA from reference site (Olsen Bay)

Figure 3. Average levels (± SD) of FACs PHN in bile of flathead sole collected in 1991.

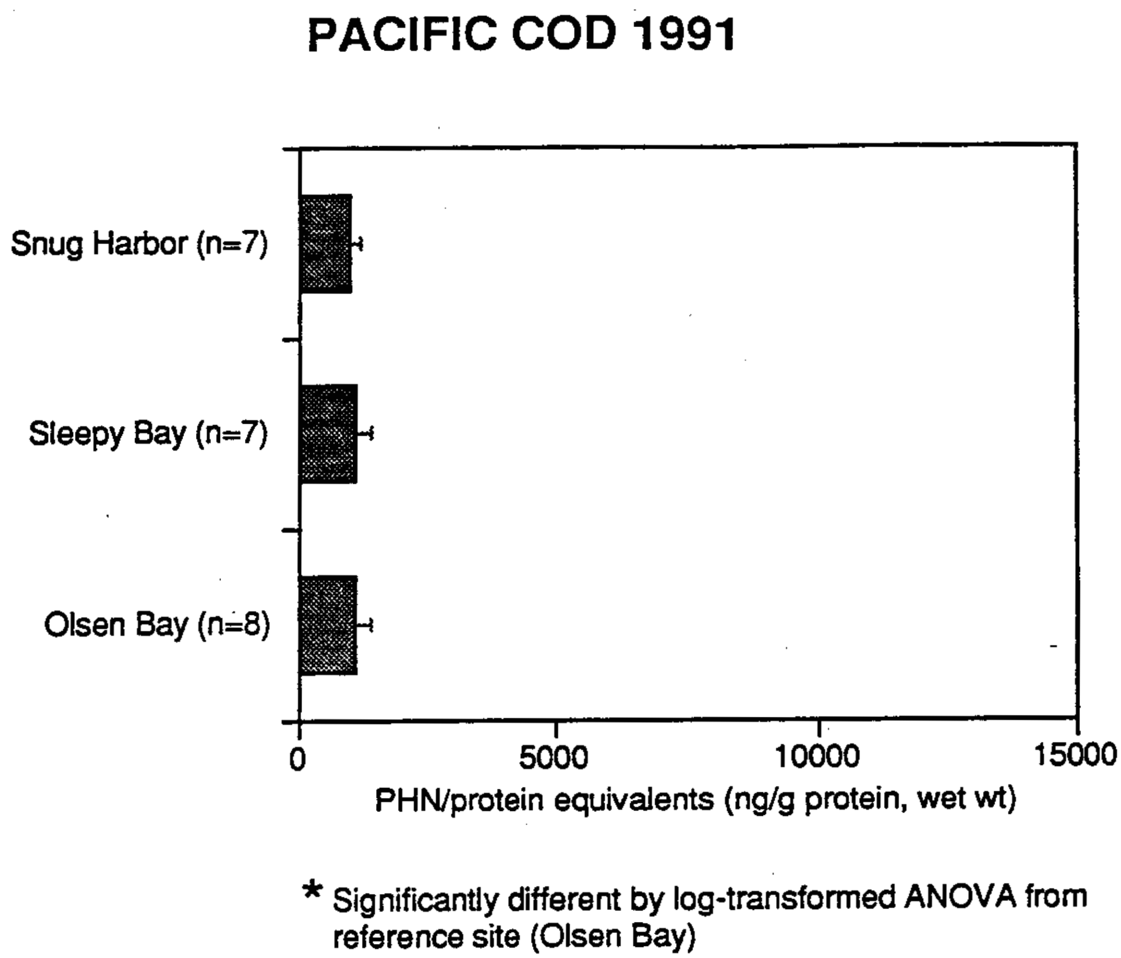
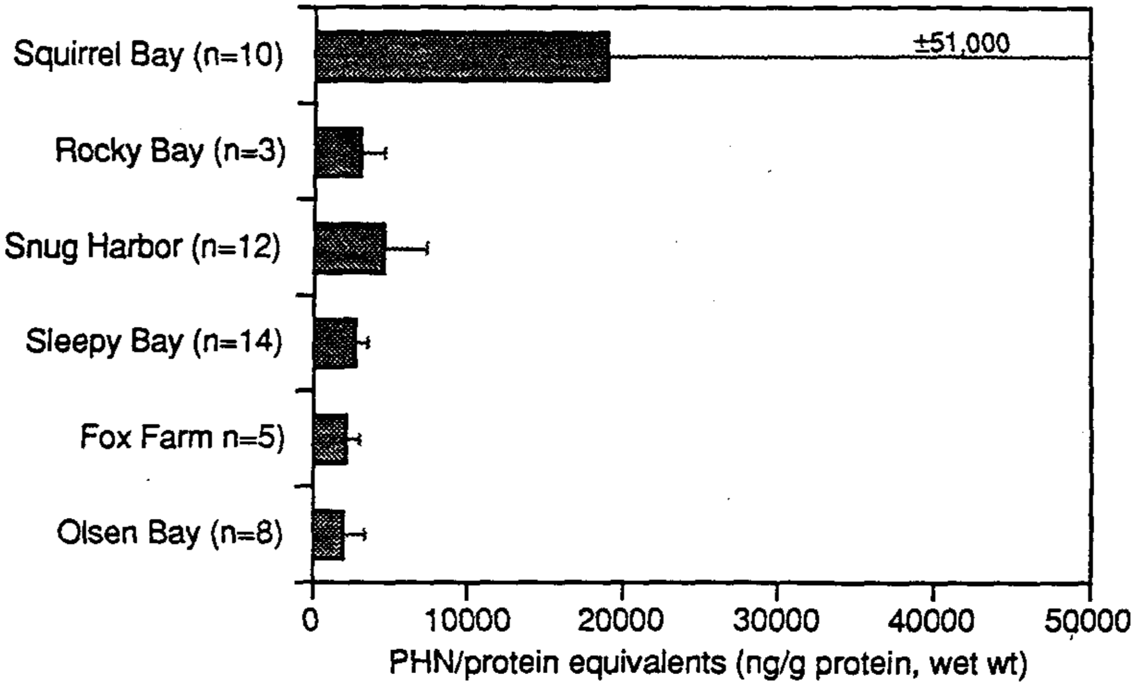


Figure 4. Average levels (± SD) of FACs PHN in bile of Pacific cod collected in 1991.

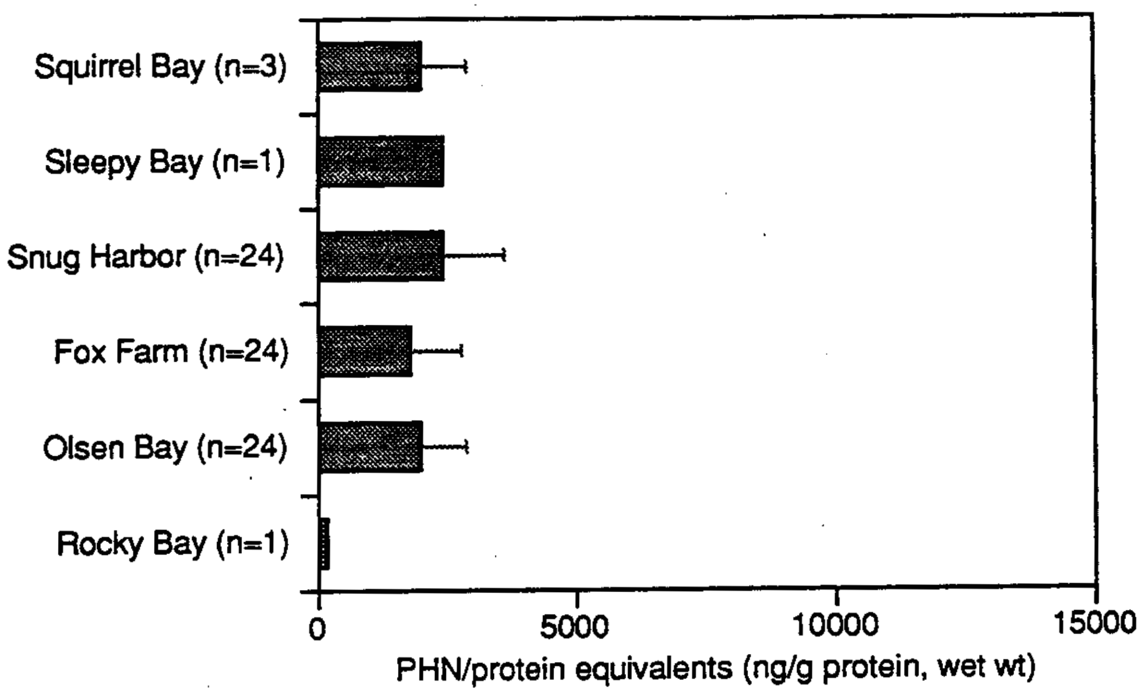
ROCK SOLE 1991



* Significantly different by log-transformed ANOVA from reference site (Olsen Bay)

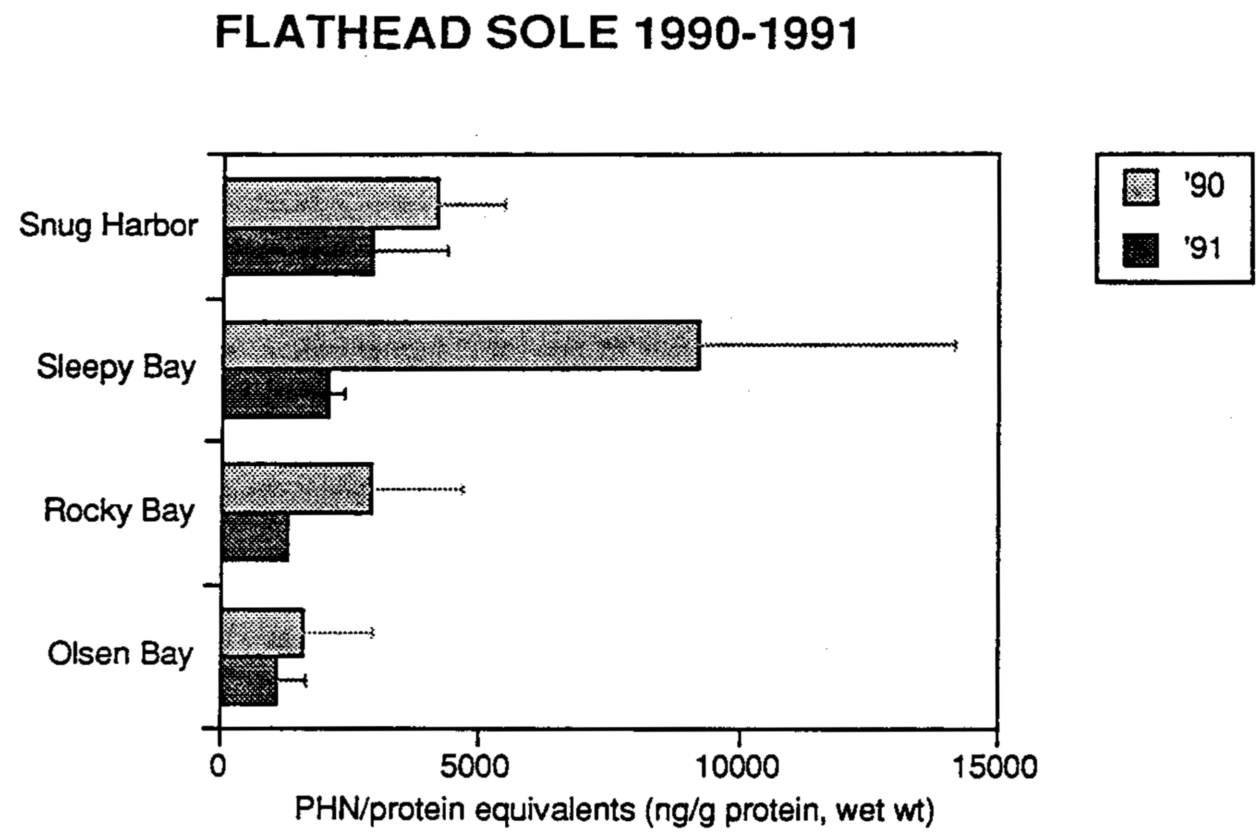
Figure 5. Average levels (± SD) of FACs PHN in bile of rock sole collected in 1991.

YELLOWFIN SOLE 1991



* Significantly different by log-transformed ANOVA from reference site (Olsen Bay)

Figure 6. Average levels (± SD) of FACs PHN in bile of yellowfin sole collected in 1991.



* Significantly different by log-transformed ANOVA ('90 vs'91)

Figure 7. Average levels (± SD) of FACs PHN in bile of flathead sole collected in 1991 compared to levels for 1990.

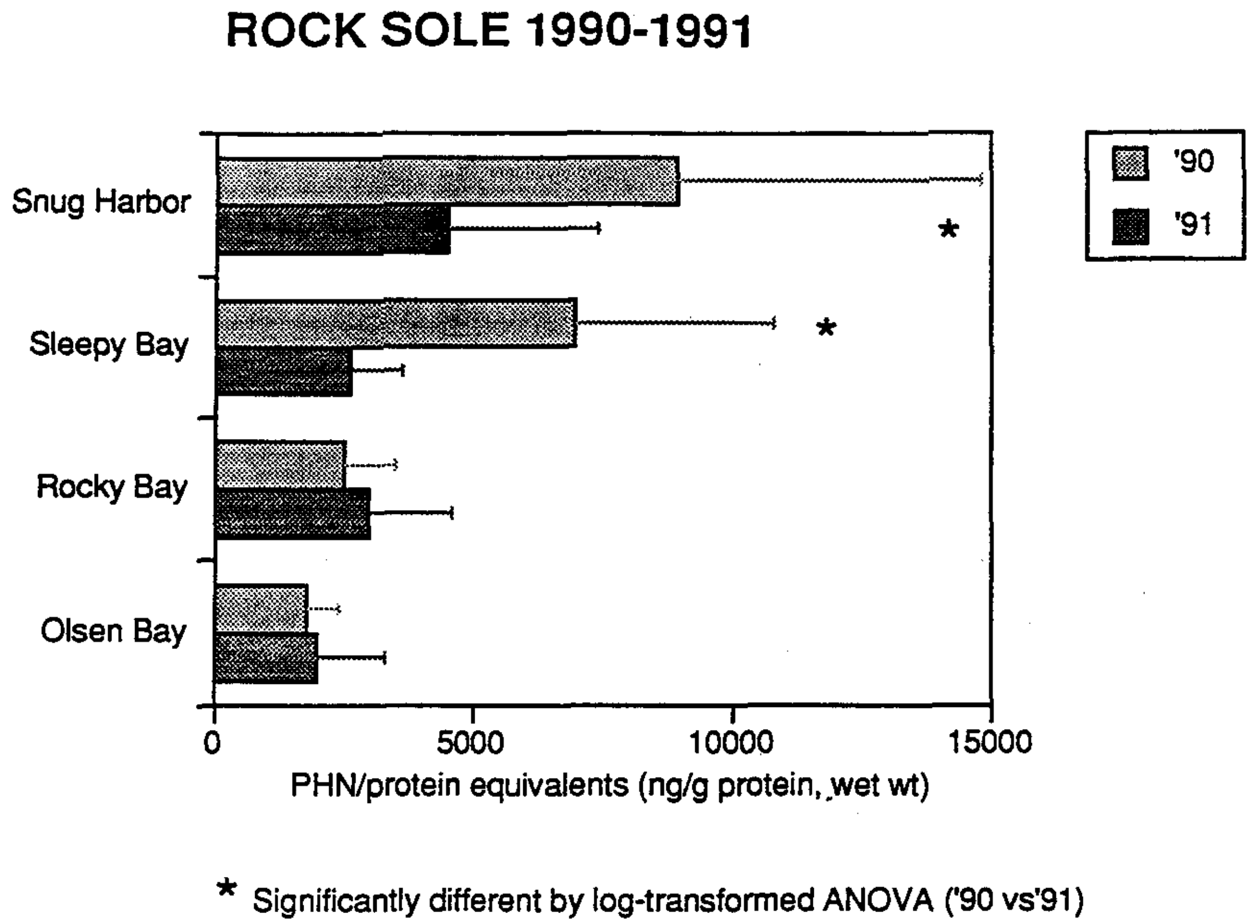
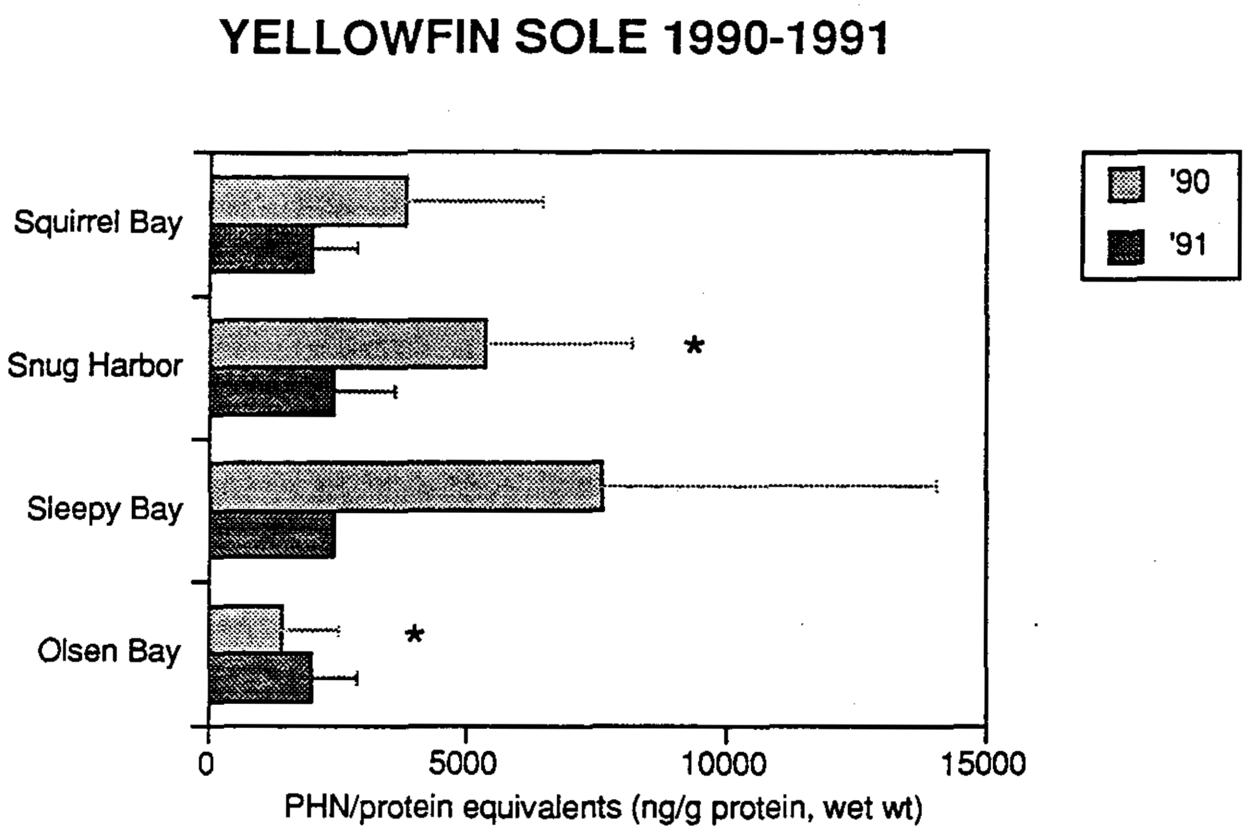
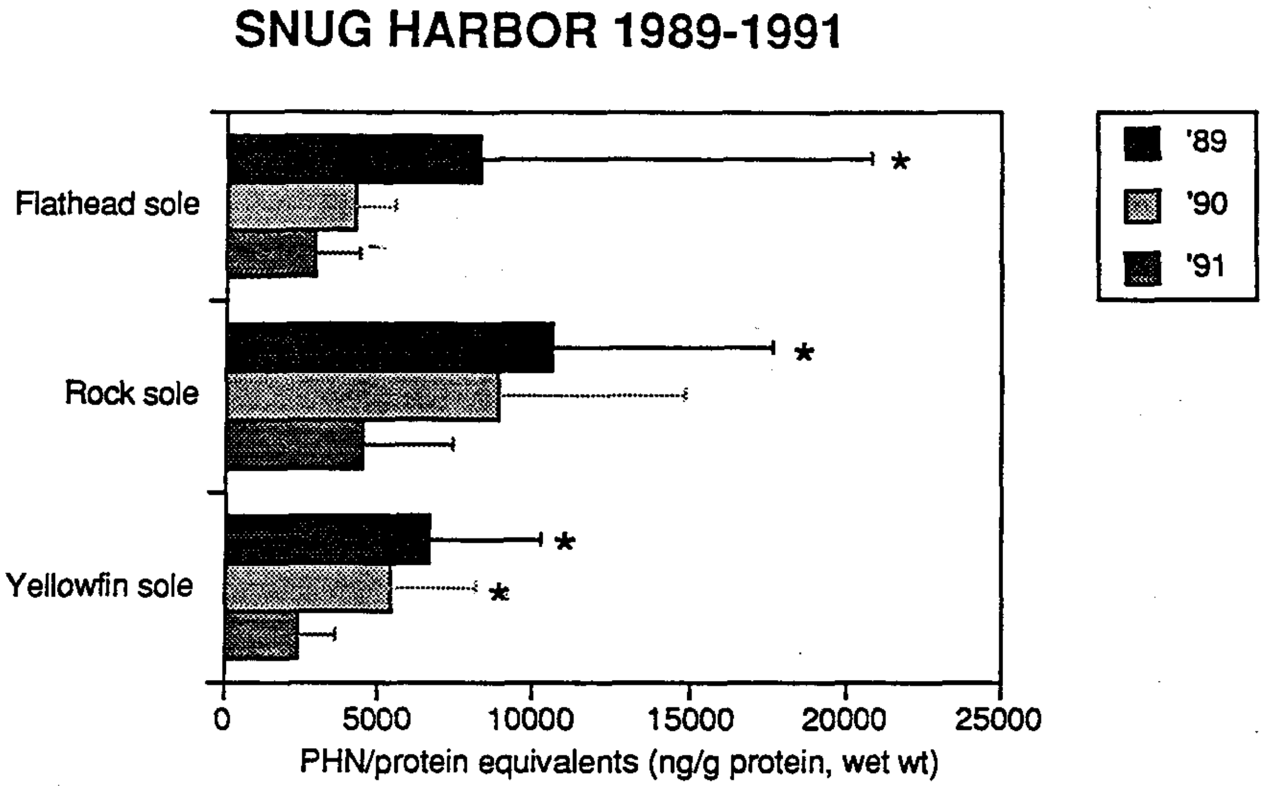


Figure 8. Average levels (± SD) of FACs PHN in bile of rock sole collected in 1991 compared to levels for 1990.



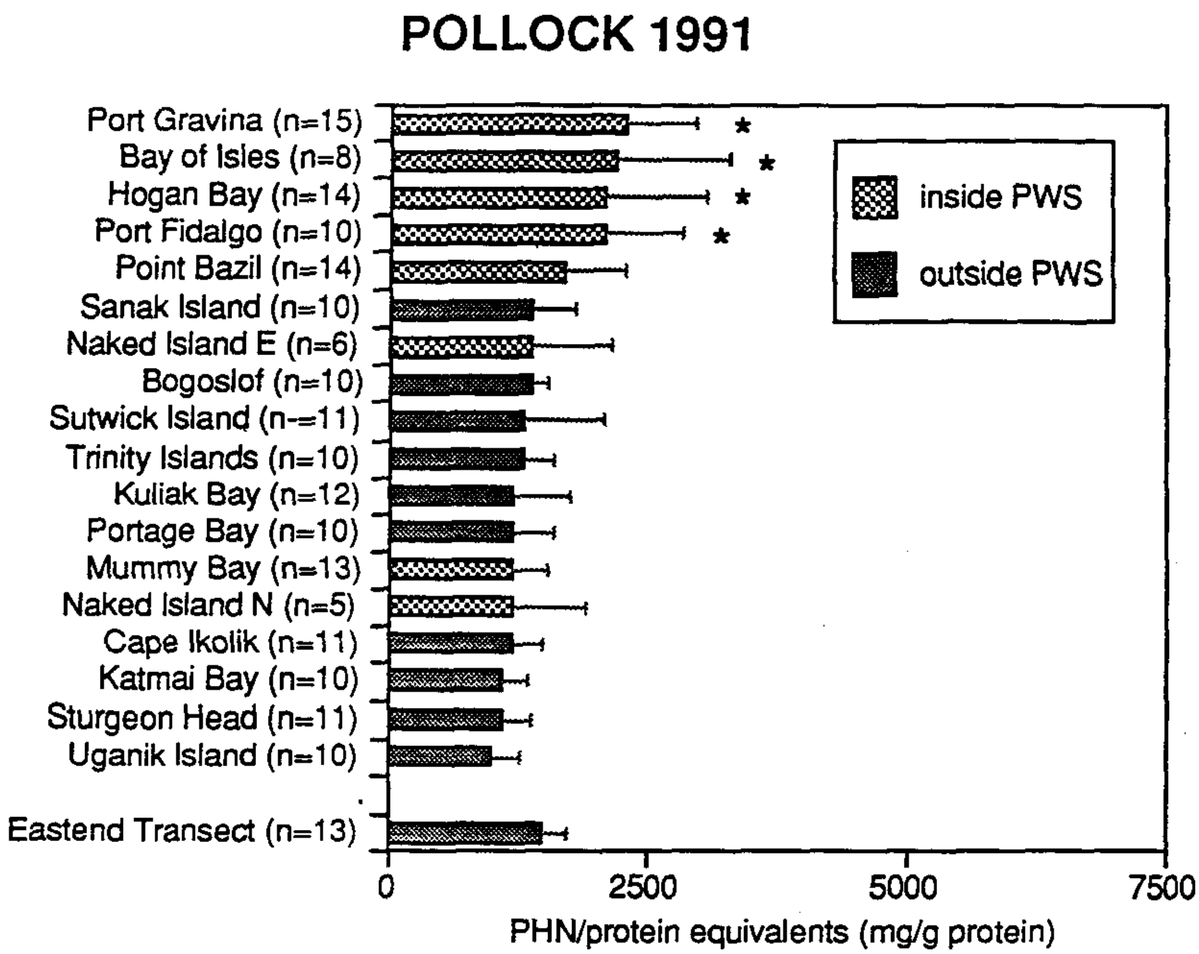
* Significantly different by log-transformed ANOVA ('90 vs'91)

Figure 9. Average levels (± SD) of FACs PHN in bile of yellowfin sole collected in 1991 compared to levels for 1990.



* Significantly different by log-transformed ANOVA from '91

Figure 10. Average levels (± SD) of FACs PHN in bile of flathead sole, rock sole and yellowfin sole collected at Snuf Harbor in 1989, 1990 and 1991.



* Significantly different by log-transformed ANOVA from Uganik Island (lowest site) or Eastend Transect (unimpacted site)

Figure 11. The mean FACsPHN values in bile of pollock collected in 1991 in Prince William Sound and the Shelikof Strait.

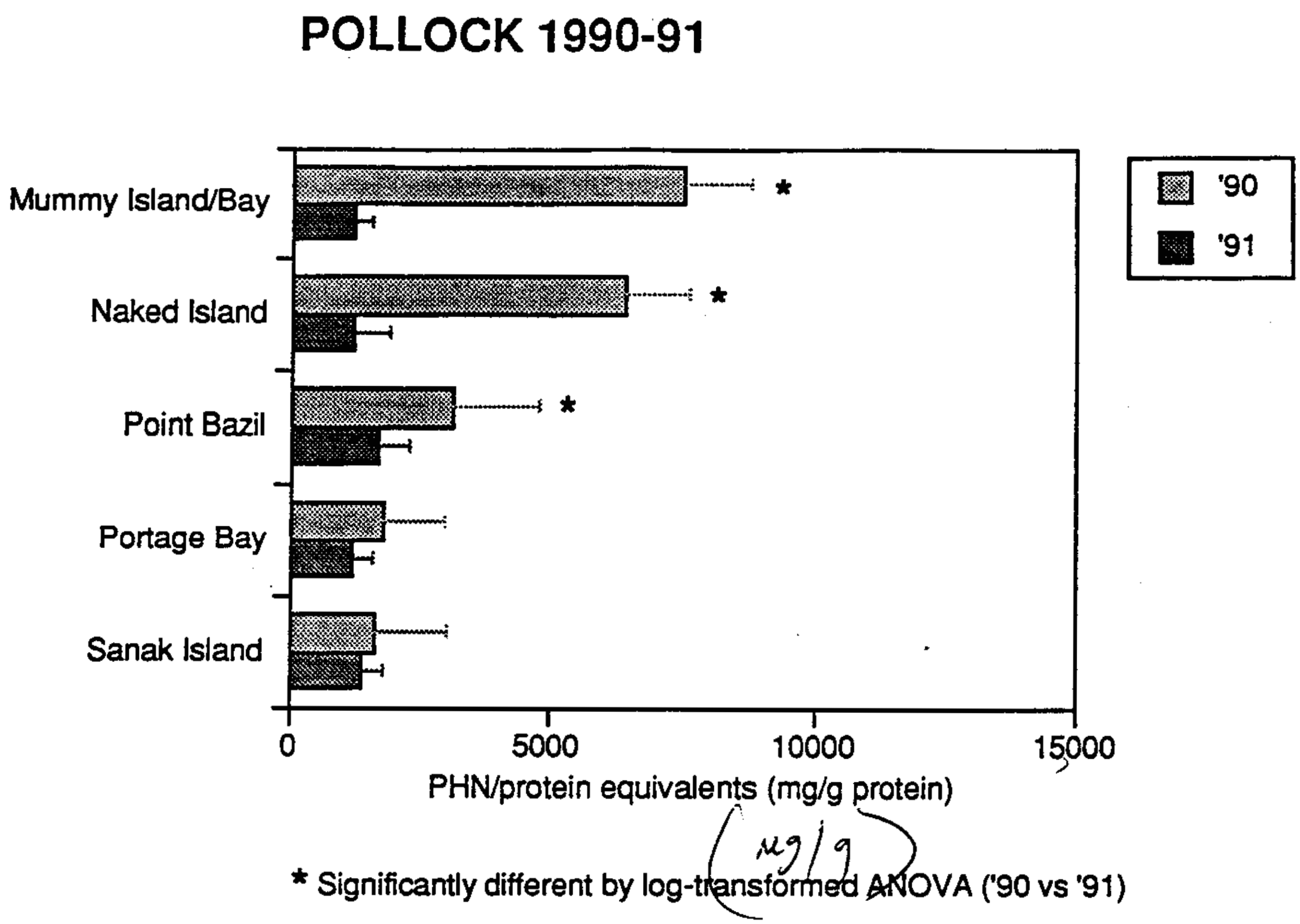


Figure 12. The mean FACsPHN values in bile of pollock collected in 1990 and 1991.

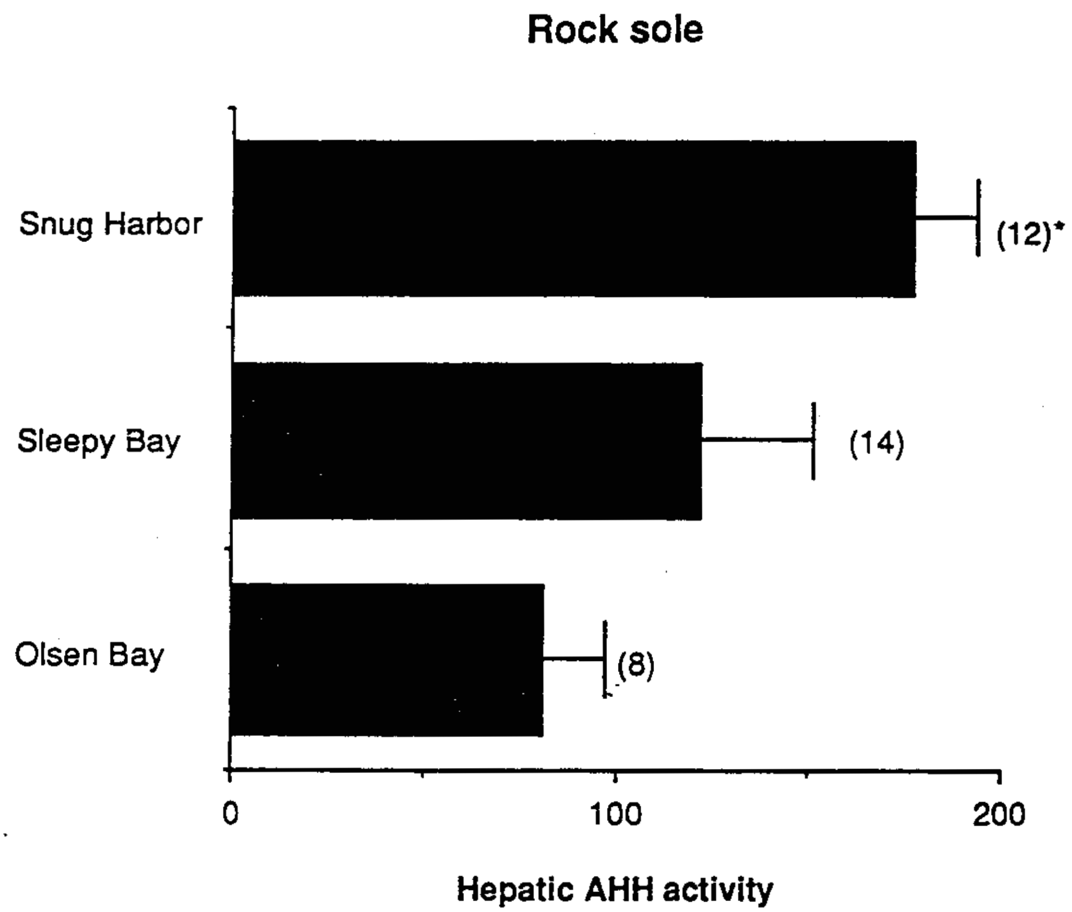


Figure 13. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of rock sole collected in 1991. Parenthetical numbers indicate sample size. * = significantly different ($p < 0.05$) from values for fish from Olsen Day, as determined by ANOVA of log transformed data.

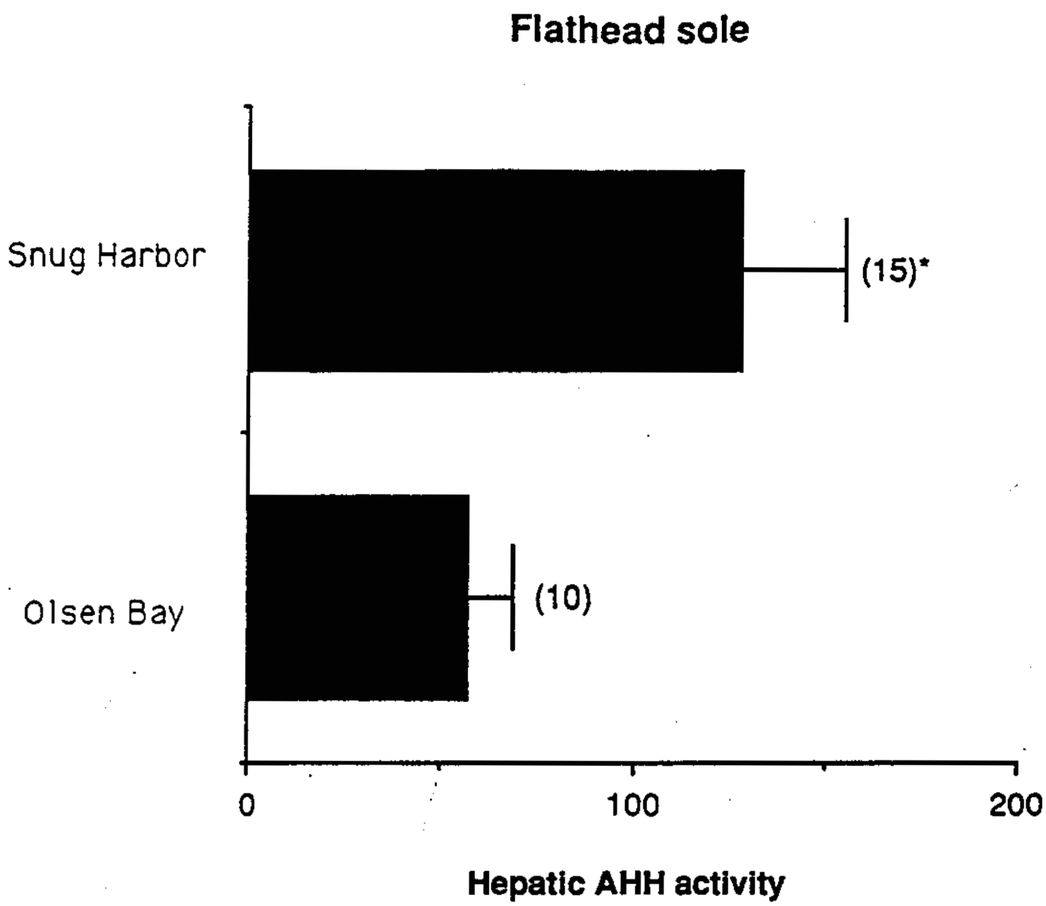


Figure 14. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of flathead sole collected in 1991. Parenthetical numbers indicate sample size. * = significantly different ($p < 0.05$) from values for fish from Olsen Day, as determined by ANOVA of log transformed data.

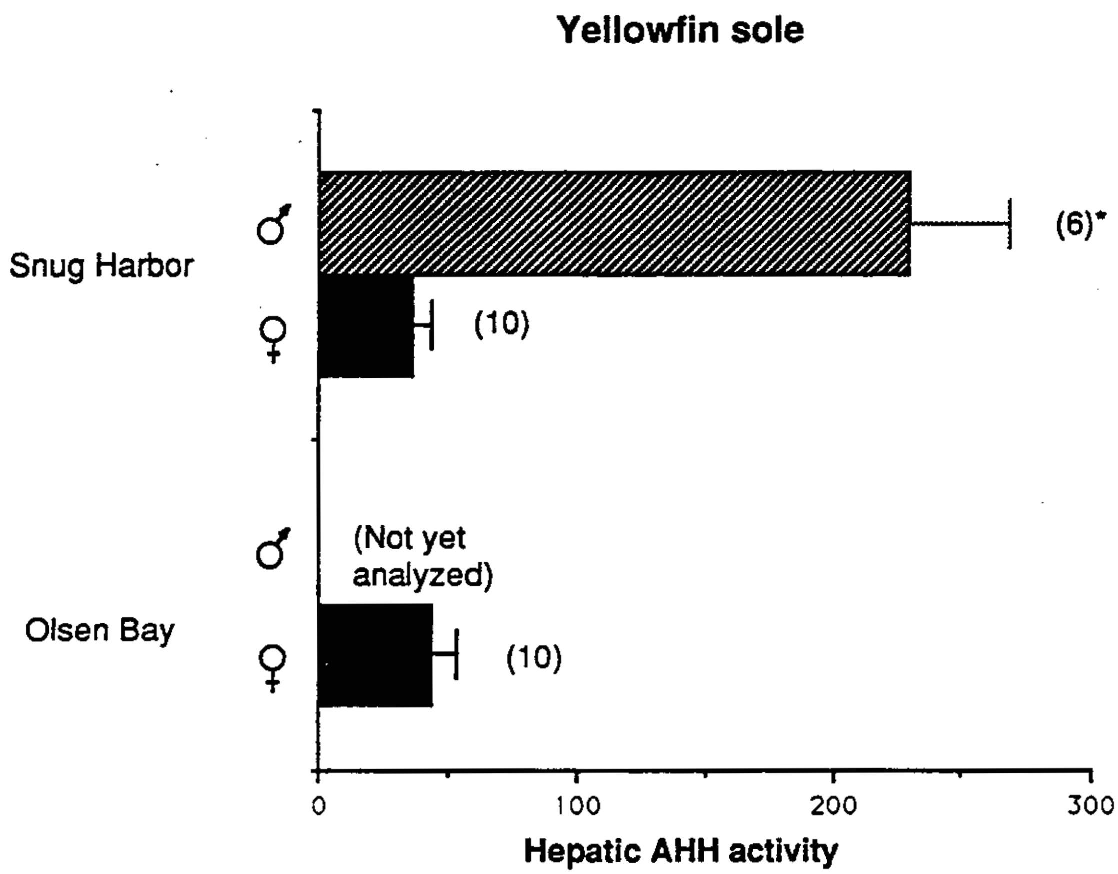


Figure 15. Average aryl hydrocarbon hydroxylase (AHH) activities (± SE) in liver of flathead sole collected in 1991. Parenthetical numbers indicate sample size. * = significantly different ($p < 0.05$) from values for female yellowfin sole from Snug Harbor, as determined by ANOVA of log transformed data.

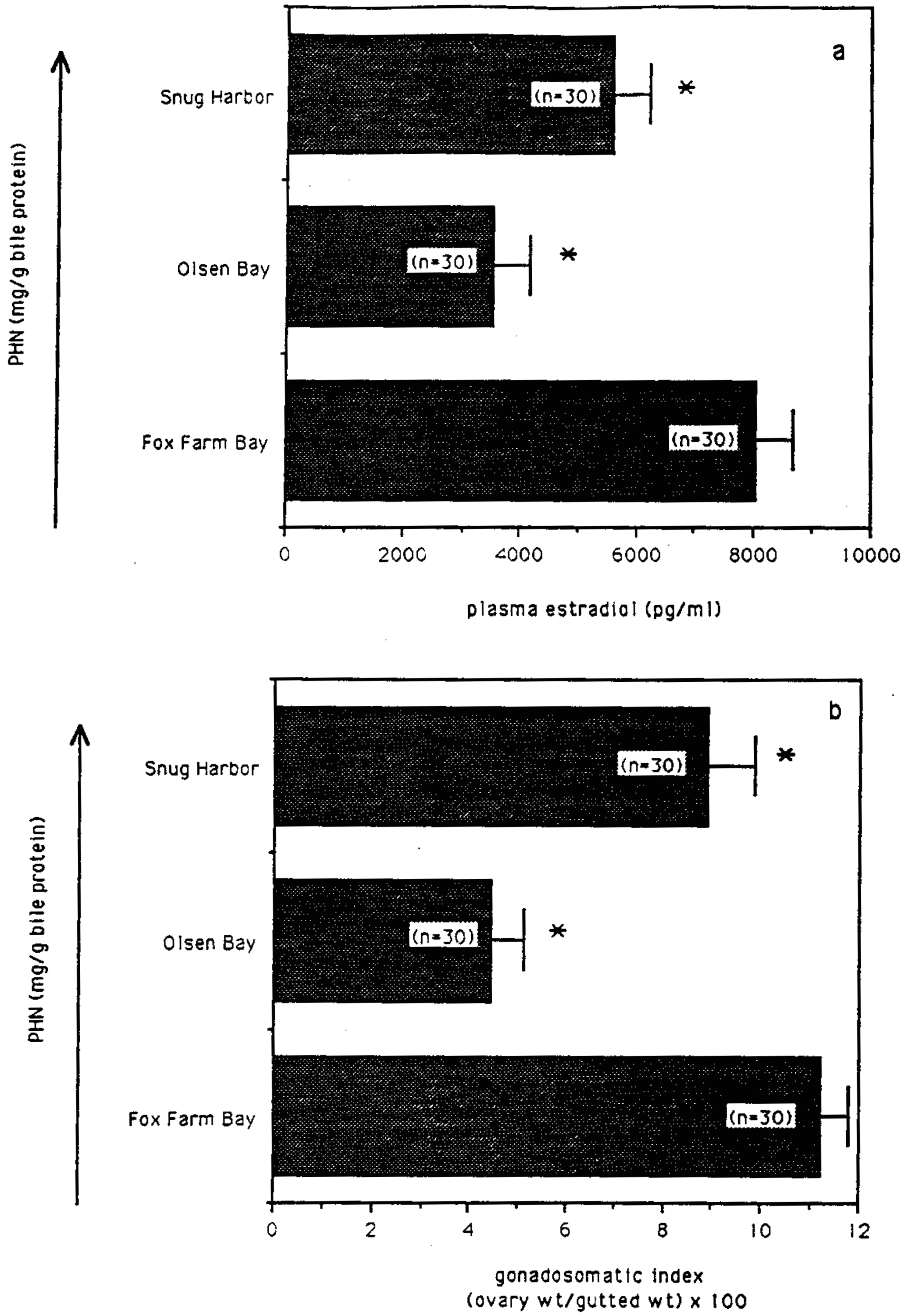


Figure 16. (a) Mean gonadosomatic indices (GSI) and (b) plasma estradiol concentrations (pg/ml) in yellowfin sole from from three sites in Prince William Sound. Snug Harbor was heavily oiled in the 1988 spill, while Olsen Bay and Fox Farm Bay were minimally impacted. Sites are arranged from in order of increasing oil exposure, as indicated by mean concentration of phenanthrene metabolites in bile. Asterisk (*) indicates site mean is significantly different from Fox Farm (ANOVA, $p < 0.05$), the site with lowest concentration of PHN metabolites in bile.

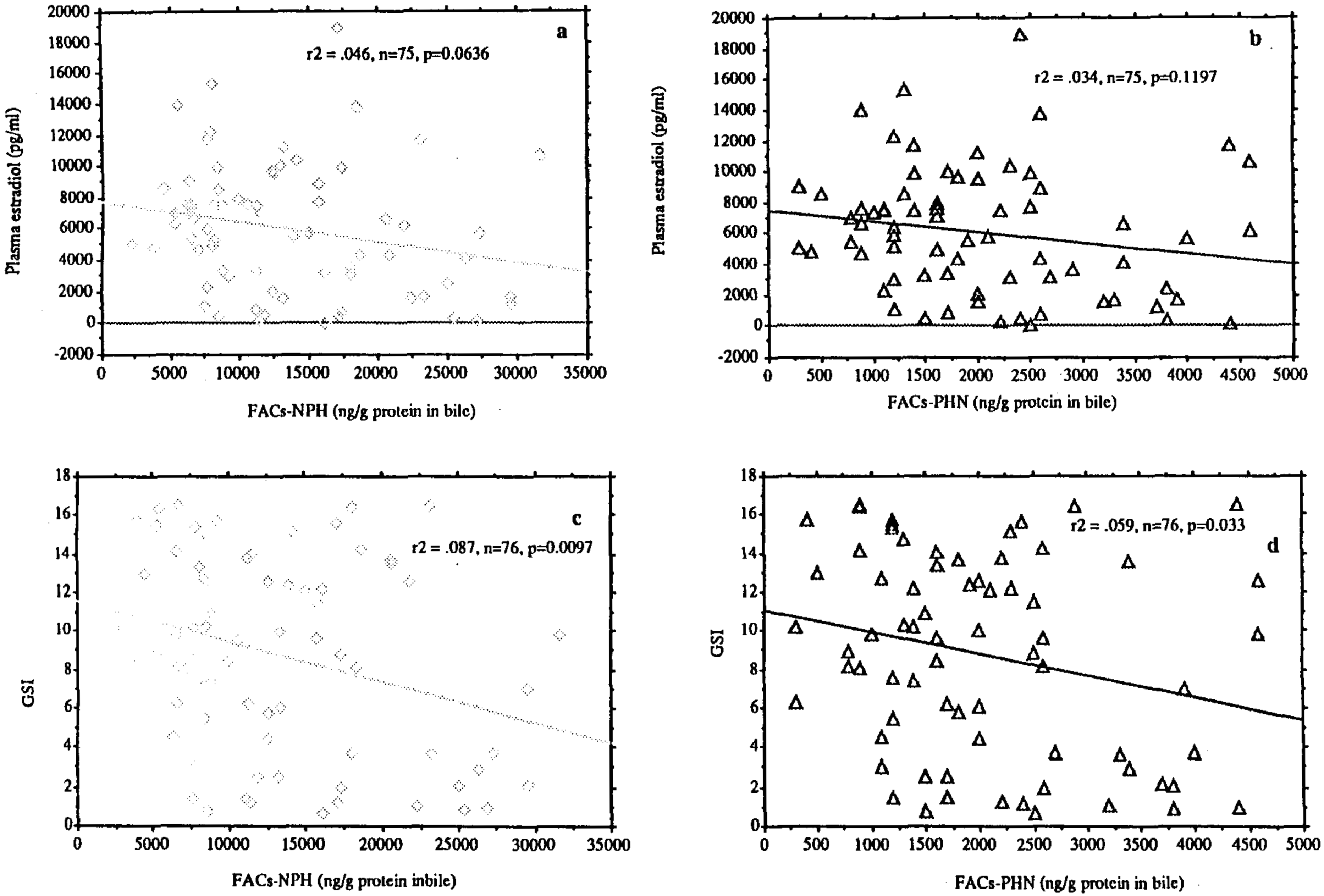


Figure 17. Relationships (linear regression $p < 0.05$) between (a) gonadosomatic index in yellowfin sole and concentration of phenanthrene (PHN) metabolites in bile (mg/g bile protein); (b) gonadosomatic index and concentration of napthalene (NPH) metabolites in bile (mg/g bile protein); (c) plasma estradiol levels (pg/ml) and concentrations of PHN metabolites in bile; and (d) plasma estradiol levels and concentrations of NPH metabolites in bile.

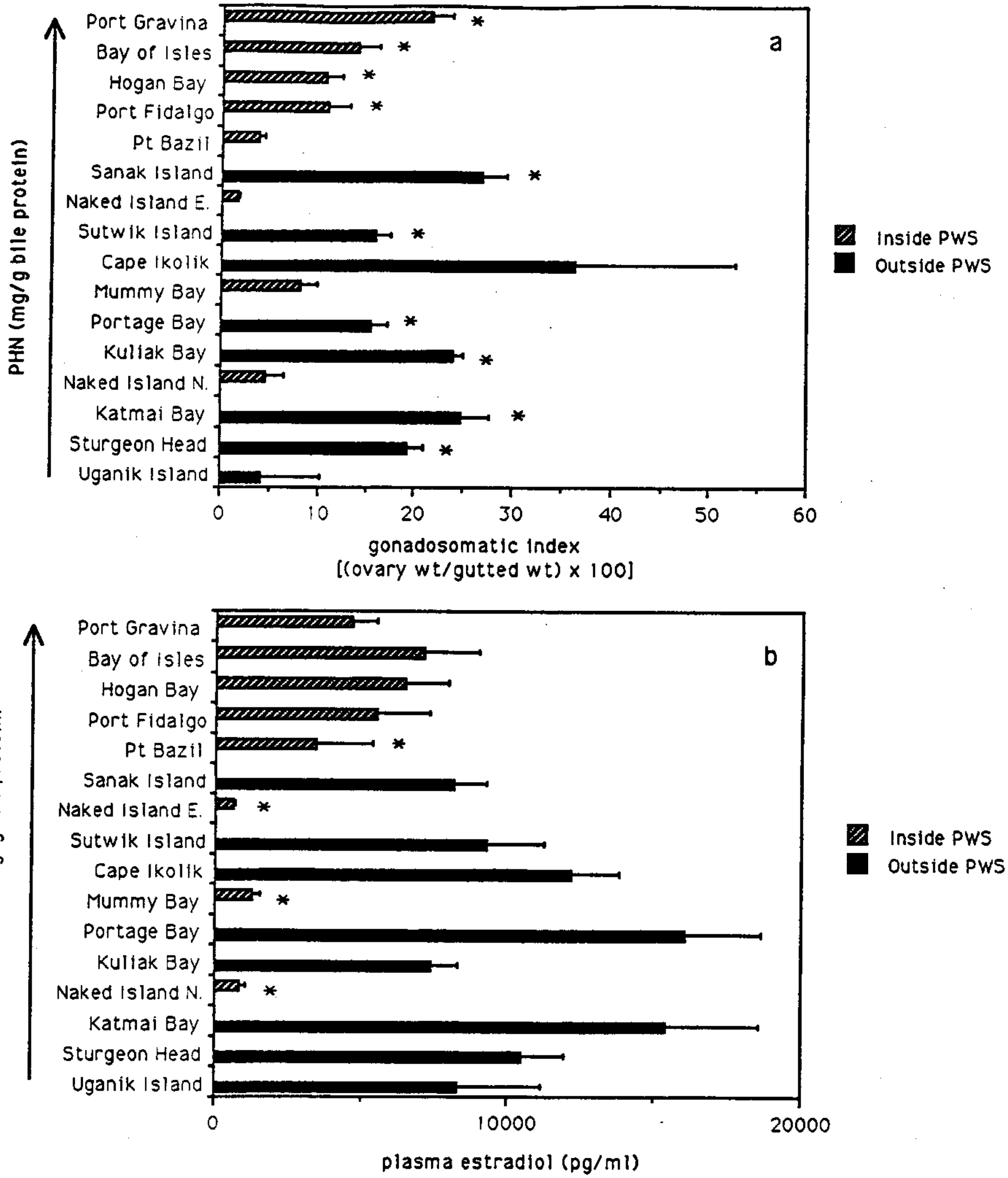


Figure 18. (a) Mean gonadosomatic indices (GSI) and (b) plasma estradiol concentrations (pg/ml) in pollock from eight sites within Prince William Sound and eight sites outside of Prince William Sound. Sites are arranged in order of increasing oil exposure, as indicated by mean concentration of PHN metabolites in bile. Mean plamsa estradiol concentration was significantly lower in pollock from four sites within Prince William Sound (Pt. Bazil, Naked Island East, Mummy Bay, and Naked Island North). GSI was not depressed at any of the sites within Prince William Sound in comparison to the Uganik reference site, and were significantly higher at four sites within Prince William Sound (Port Gravina, Bay of Isles, Hogan Bay, and Goose Island) compared to the Uganik reference site.

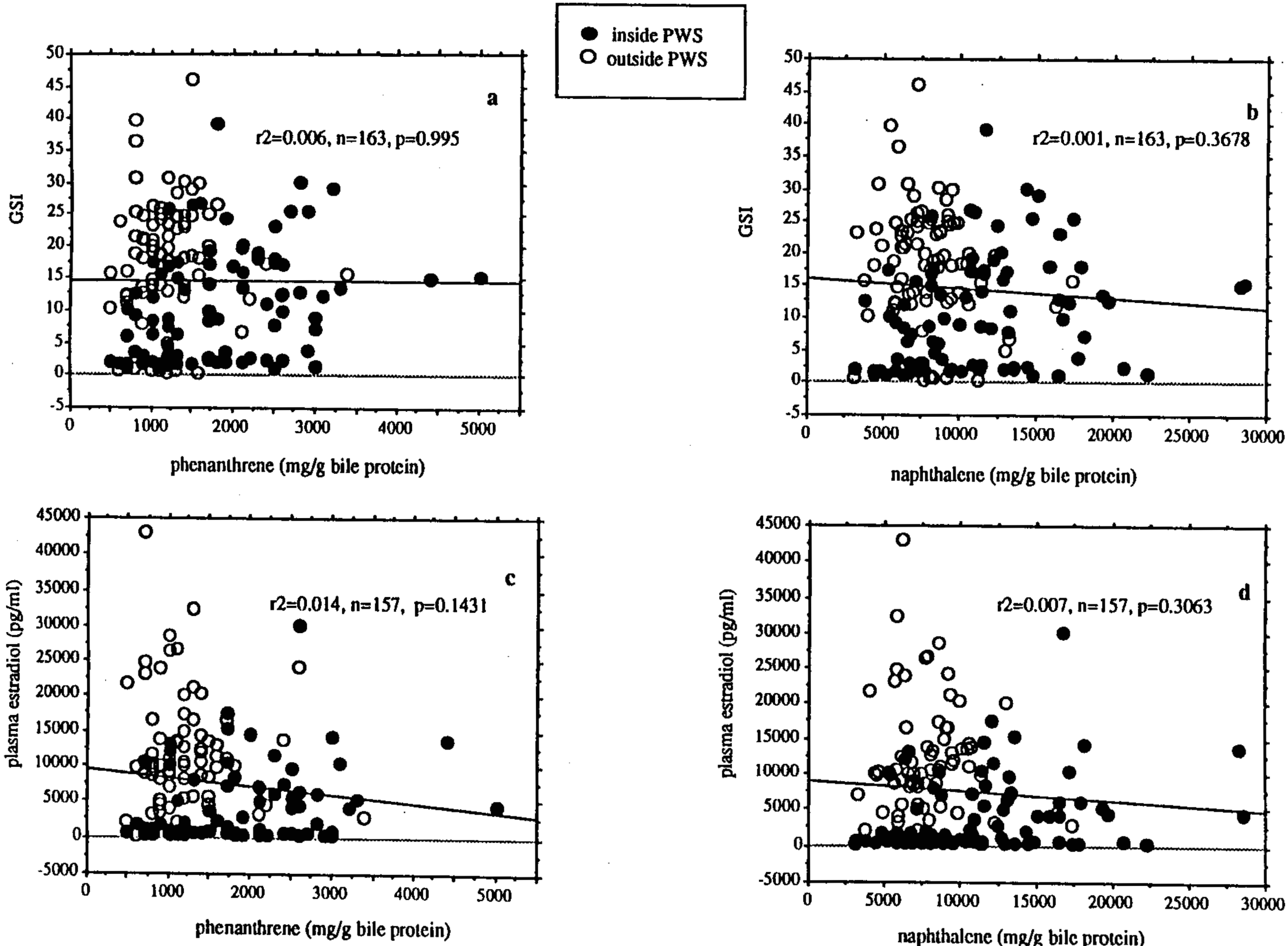


Figure 19. Relationships (linear regression $p < 0.05$) between (a) gonadosomatic indies in pollock and concentrations of PHN metabolites in bile (mg/g bile protein); (b) gonadosomatic indies and concentrations of naphthalene (NPH) metabolites in bile (mg/g bile protein); (c) plasma estradiol levels (pg/ml) and concentrations of PHN metabolites in bile; and (d) plasma estradiol levels and concentrations of NPH metabolites in bile.

APPENDIX A

(excerpts from 1991 Study Plan)

METHODS

A. General Strategy and Approach

Samples of benthic fish (yellowfin sole, rock sole, flathead sole, and to a lesser extent, Pacific cod) will be collected from five sites during 1991, from mid-May to mid-June. Sites proposed for sampling are Olsen Bay, Rocky Bay, Snug Harbor, Sleepy Bay, and Squirrel Bay. As feasible, the sample locations will be coordinated with Air/Water Study #2. The selection of species is based primarily on results obtained in 1990 and 1989 under Fish/Shellfish Study 24, and to a lesser extent, Fish/Shellfish Study 18. Surficial sediment samples for establishing levels of petroleum hydrocarbon residues will be collected at these sites, with analyses projected to be done under Air/Water Study 2. Pollock will be collected in March, 1991, at several sites inside Prince William Sound and in the Shelikof Strait. Because of the schooling nature of this species, and because we will be largely dependent on assistance from other federal and state groups for use of sampling platforms, sites cannot be predetermined, but efforts will be made to sample sites representing a spatial gradient away from the spill's occurrence and path.

Petroleum exposure of fish will primarily be assessed by measuring: (a) concentrations of metabolites of aromatic petroleum compounds in bile, and (b) AHH activities in liver. These types of measurements are necessary because petroleum hydrocarbons in fish are rapidly metabolized to compounds that are not detectable by routine chemical analyses. AHH activity in fish is due primarily to a single cytochrome P-450, apparently cytochrome P-450IA (Varanasi et al., 1986, Buhler and Williams 1989). Measurement of hepatic AHH activity will provide a very sensitive indicator of contaminant exposure of sampled animals (Collier and Varanasi, 1987; Collier and Varanasi, 1991). Moreover, the induction of AHH activity indicates not only that contaminant exposure has occurred, but also that biological changes have occurred as a result of the exposure. In addition to measuring AHH activity, cytochrome P-450IA will be directly quantified in selected liver or tissue samples by an immunochemical method recently developed at the University of Bergen (Collier et al., 1989; Goksøyr, 1991). Direct quantification of cytochrome P-450IA1 has the advantage that this method can be used on archived samples and samples frozen at non-cryogenic temperatures (> -80° C), thus allowing for future comparisons to be made between data collected in this Damage Assessment Program and data from other sample collection programs, if samples from the other programs are subjected to the same immunochemical quantification techniques.

Other biological effects in fish will be estimated by examining selected species for pathological conditions and by assessing reproductive impairment in suitably mature female fish. Pathological conditions will include grossly visible abnormalities (e.g., fin erosion) and other lesions diagnosed by histological procedures (e.g., gill necrosis, liver cell necrosis). Reproductive capacity will be estimated by examining the developmental stages of ovaries and by measuring plasma levels of certain reproductive hormones (Johnson et al., 1988), in addition to measuring fecundity (Cross and Hose, 1988). The two primary species for assessing reproductive impairment are yellowfin sole and pollock. It is anticipated that, during the respective sampling periods (May/June and March), these two species will be at an appropriate stage in their reproductive cycle for such assessments to be done. Concurrent with these studies, we are conducting laboratory studies to determine the effects of known doses of oil and oil components on reproductive processes in these or related species.

Samples of sediment, and selected stomach contents of fish (from fish whose bile had evidence of oil exposure) will be analyzed (sediment under Air/Water Study 2) for hydrocarbons by recently developed, scientifically sound and cost-effective analytical procedures involving high-performance liquid chromatography, gas chromatography and mass spectroscopy (Krahn et al., 1988).

Environmental damage will be assessed using statistical and simulation models, which will be developed as part of these proposed studies, as well as from other investigations with related fish species. The bile and tissue chemistry data will be used to establish relationships between biological damage and estimated exposures to petroleum hydrocarbons.

B. Sampling Methods

Sampling activities will be conducted at several sites in Prince William Sound, including nonoiled sites in Rocky Bay (60°20.2'N, 147°08.1'W) and Olsen Bay (60°43.8'N, 146°13.2'W), and petroleum-exposed sites in Snug Harbor (60°14.5'N, 147°43.1'W), Sleepy Bay (60°04.1'N, 147°50.6'W), and Squirrel Bay/Fox Farm (60°00.4'N, 148°08.9'W). Sample collection will be performed from a charter vessel for the three flatfish species and cod, at water depths of approximately 0 to 100 meters. At each site, sediment samples will be collected with a box corer, VanVeen or Smith-McIntyre grab. Sediments will be stored at - 20° C. The coordinates and depths of each station will be recorded. For pollock, samples will be collected from a NOAA vessel (R/V MILLER FREEMAN) at the sites outside Prince William Sound, and from an Alaska Department of Fish and Game vessel (R/V PANDALUS) at sites inside Prince William Sound.

Fish will be collected with a bottom trawl, long-line gear, or midwater trawl. Bottom trawls will be performed with an otter trawl (7.5 m opening, 10.8 m total length, 3.8 cm-mesh in the body of the net, and 0.64 cm-mesh in the liner of the cod end). Tows will be of 5 to 15 minutes duration. In order to reduce contamination of the catch by free oil, trawling will avoid areas of surface films or slicks. If a net is fouled by subsurface or bottom oil, it will be replaced (or cleaned, if possible) and a new area for trawling will be selected. Other fish sampling gear appropriate to the species and conditions will also be deployed. Individuals of selected target fish species will be sorted and examined for externally visible lesions; up to 30 fish of selected species will be measured, weighed, and necropsied; and tissue samples will be excised and preserved in fixative for histopathological examination or frozen for chemical analyses.

C. Laboratory Analyses

1. Bile Metabolite Assay (analyses done under Technical Services-1)

Samples of bile will be injected directly into a liquid chromatograph and a gradient elution conducted using a Perkin-Elmer HC-ODS with a gradient of 100% water (containing 5μL acetic acid/L) to 100% methanol (Krahn et al., 1984, 1986a, b, c). Two fluorescence detectors are used in series. The excitation/emission wavelengths of one detector are set to 290/335 nm, where metabolites of naphthalene (NPH) fluoresce. Excitation/emission wavelengths of the other detector are set to 260/380 nm, where metabolites of phenanthrene (PHN) fluoresce. The total integrated area for each detector is then converted (normalized) to units of either NPH or PHN that would be necessary to give that integrated area.

2. Liver Aryl Hydrocarbon Hydroxylase (AHH) Activity and Cytochrome P-450IA1 Analysis

Hepatic microsomes are prepared essentially as described by Collier et al. (1986) and microsomal protein is measured by the method of Lowry et al. (1951), using bovine serum albumin as the standard. AHH activity is assayed by a modification of the method of Van Cantfort et al. (1977) as described by Collier et al. (1986), using 14C-labeled benzo[a]pyrene as the primary substrate. All enzyme assays will be run under conditions in which the reaction rates are in the linear range for both time and protein. Cytochrome P-450IA1 will be measured by an ELISA utilizing rabbit antibodies to cytochrome P-450c isolated from Atlantic cod (Goksøyr,1991).

3. Histopathology

Histopathological procedures to be followed are described in the report from the Histopathology Technical Group for Oil Spill Assessment Studies in Prince William Sound, Alaska. Briefly, the procedures will involve the following: (a) tissues preserved in the field will be routinely embedded in paraffin and sectioned at five microns (Preece, 1972); and (b) paraffin sections will be routinely stained with Mayer's hematoxylin and eosin, and for further characterization of specific lesions, additional sections will be stained using standard special staining methods (Thompson, 1966; Preece, 1972; and Armed forces Institute of Pathology, 1968). All slides will be examined microscopically without knowledge of where the fish were captured. Hepatic lesions will be classified according to the previously described diagnostic criteria of Myers et al. (1987). Ovarian lesions will be classified as described in Johnson et al. (1988).

4. Reproductive Indicators

Reproductive activity will be assessed by examining the ovaries of the sampled fish histologically to determine their developmental stage, and for the presence of ovarian lesions that would be indicative of oocyte resorption (Johnson et al., 1988). Other parameters associated with reproductive activity will also be measured, including fecundity (Bagenal and Braum, 1971), plasma vitellogenin (Gamst and Try, 1980; DeVlaming et al., 1984) and estradiol (Sower and Schreck, 1982) levels, and gonadosomatic index (ovary wt/gutted body wt x 100). Relationships between ovarian maturation, fecundity, plasma estradiol, plasma vitellogenin, and petroleum hydrocarbon exposure will then be evaluated.

D. Quality Assurance and Control Plans

1. Bile Analytes

Quality assurance procedures for bile analyses will include NPH and PHN calibration standards and the calibration standard will be analyzed after every 6 samples and the RSD will be reported. In addition, one blank sample and one reference material (control material) will be analyzed daily. The concentrations of analytes should be within 2 SD of the established concentrations in control material. Replicate analyses will be performed on 10% of the samples, if a sufficient amount exists.

2. AHH Activity and Cytochrome P-450IA1

Quality assurance procedures for AHH measurements include duplicate zero-time and boiled enzyme blanks for each set of assays. Each sample will be run in duplicate and those samples showing > 20% absolute difference between duplicates and >10 units (pmoles benzo[a]pyrene metabolized/mg microsomal protein/minute) difference between duplicates will be repeated. ELISAs for cytochrome P-450IA1 will be run in triplicate, and if the resulting coefficient of variation (CV) is > 10%, the outlying replicate will be omitted from the calculations. If the CV still exceeds 10%, the analysis of that sample will be repeated.

3. Histopathology

Pathologists on this project will use consistent, standard diagnostic criteria to be strictly adhered to by those who will also be examining slides in this project. These criteria will be established using color photographs of external lesions and standard reference slides containing tissues with the major lesion types expected in the study. Unusual or atypical lesions will be referred to specialists for confirmation. The accuracy of the histopathologic diagnosis also will be assured by consulting with and sending sections of tissues with representative lesion types to the Registry of Tumors in Lower Animals, National Museum of Natural History at the Smithsonian Institution in Washington, D.C.

4. Reproductive Indicators

Quality assurance for the measurement of plasma estradiol and vitellogenin include analysis of standards to confirm linearity and calibrate the assays. Blank analyses will be conducted to eliminate matrix effects. Analyses of pooled plasma from vitellogenic female English sole and winter flounder containing known levels of estradiol and vitellogenin will also be done. Duplicate analyses of each sample to evaluate performance of the assays will also be conducted. These quality checks are run daily with each set of samples. Fecundity measurements will be done in triplicate on each individual.

DATA ANALYSIS

A. Statistical Tests

The relative concentrations of contaminants in sediment and fish tissues at the study sites will be compared statistically using the Kruskal-Wallis test (ANOVA by ranks; see Sokal and Rohlf, 1981; Zar, 1984). Where significant differences among chemical concentrations are found, the α-value will be understood to be < 0.05. To determine whether the prevalence of histopathological effects noted in each of the fish species is statistically uniform among the sites, the G test for heterogeneity (Sokal and Rohlf, 1981) will be performed.

B. Analytical Methods

Where possible, non-parametric statistical tests will be employed to avoid assumptions that the data are normally distributed. Non-parametric tests give highly reliable results. The principal non-parametric tests that will be used are Spearman rank correlation, which has about 91% of the power of product-moment correlation when the parametric assumptions are met (Zar, 1984), and the heterogeneity-G statistic. Spearman rank correlation will be used for estimating uptake and metabolism of petroleum hydrocarbons from oiled and non-oiled habitats when an independent measure of contamination (e.g., levels of AHs in sediment) is available.

The heterogeneity-G statistic (Sokal and Rohlf, 1981) will be used to study prevalence of pathological conditions at oiled and non-oiled habitats. In addition, logistic regression (appropriate where the outcome variable is binomial) will be used to model the prevalences of pathological conditions in relation to contamination.

The Kruskal-Wallis test (a non-parametric form of ANOVA) will be used for supporting statistical analyses of variation in sediment PAH levels at sites sampled. If the null hypothesis of no differences among sites is rejected at $\alpha = 0.05$, a non-parametric multiple comparison test (Dunn, 1964; Hollander and Wolfe, 1973; Zar, 1984) will be used to determine differences between sites at $\alpha = 0.05$. Principal components analysis and LOWESS (Chambers et al., 1983) will also be employed for this purpose; both are methods of exploratory data analysis rather than inferential statistical methods.

Cohen (1977) will be used for computations of statistical power.

APPENDIX B

(Preprint "Mass Spectrometric Analysis of Aromatic Compounds in Bile of Fish Sampled After *EXXON VALDEZ* Oil Spill"

by M.M. Krahn, D.G. Burrows, G.M. Ylitalo, D.W. Brown, C.A. Wigren, T.C. Collier, S.-L. Chan and U. Varanasi)