A Comparative Evaluation of Biomarker Methods Using Fish Captured from the Los Angeles Harbor Area

(Goby Biomarker Study)

Final Report

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by

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This study was conducted through a contract from the California Department of Fish and Game, with funding from the California State Water Resources Control Board (Bay Protection and Toxic Cleanup Program) and the National Oceanic and Atmospheric Administration (National Status and Trends Program and Coastal Ocean Program).

Executive Summary

The Goby Biomarker Study was conducted as part of the Bay Protection and Toxic Cleanup Program (mandated by the California State Legislature in 1989). The project was designed to assess the impact of sediment contaminants on fish, with special emphasis on evaluation of bay gobies (*Lepidoglobius lepidus*) as a potential indicator species for the California coast. The study area included nine sites in the Los Angeles Harbor area. Sediments were analyzed by the California Department of Fish and Game for metals, pesticides, polyaromatic hydrocarbons, and polychlorinated biphenyls. In addition, pore water was tested for metals and sediments assayed for toxicity to amphipods. Analysis revealed that six sites were moderately to severely contaminated and designated as impacted. The remaining three were substantially less contaminated and were designated as reference sites.

A total of 127 fish were collected in October 1993. None of the sampled fish were bay gobies. Instead, four different teleost species (yellowfin gobies, white croakers, tonguefish, and basketweave cusk-eels) and one elasmobranch (round stingrays) were caught. Contaminant exposure was assessed: 1) grossly via determination of hepatosomatic index (HSI), gonadosomatic index (GSI), and condition index (CI); 2) biochemically via evaluation of cytochrome P4501A (CYP1A) induction with the ethoxyresorufin O-deethylase (EROD) assay; and 3) histologically via examination of liver and spleen. In addition, to augment the EROD assay, P450 immunohistochemistry was used to localize CYP1A induction in tissue sections. All organ and tissue samples were assayed blind and site codes revealed only when analyses were finished.

The most striking lesions were splenic lymphoid and myeloid necrosis. Lesions were observed in all five species and average scores were consistently higher in fish from contaminated sites. Since both cell lines are major components of the immune system, their loss probably results in significant immunosuppression and increased susceptibility to infections. Hepatic lesions were not as severe, but three (eosinophilic cytoplasmic inclusions, megalocytes, and hyalinization of vessel walls) were consistently associated with impact sites. Both splenic and hepatic lesions were taken as direct evidence of deleterious effect.

Of the two methods used to evaluate CYP1A activity, P450 immunohistochemistry proved more valuable and revealed clear differences between impact and reference sites. CYP1A was induced in all (gill, spleen, gonad, liver, kidney, and intestine) organs examined and scores were consistently and sometimes significantly higher in fish from impact sites. In contrast, EROD activity was often erratic and only when activity was evaluated based on the predominant species collected did differences emerge between reference and impact sites.

Of the three indices examined, only HSI distinguished between impact and reference sites. HSI was consistently higher in croakers from impact sites. GSI is a valuable biomarker, but was not useful in this study because fish were often so small that obtaining accurate gonad weights was difficult or impossible.

Overall, the biomarker approach was effective in separating reference from impact sites and enabled us to assess both contaminant exposure (CYP1A induction) and effect (splenic and hepatic lesions). Although we were unable to identify a single "indicator" species which could be used throughout California coastal waters, all five species examined did have lesions consistent with contaminant exposure. Recommendations for future studies include: 1) development of species priority lists based on habitat, availability, and responsiveness; 2) increasing sample size to allow for valid comparisons when multiple species are used; 3) aging fish to exclude age-related lesions; and 4) expanding organ sampling to thoroughly assess damage to the immune system.

Goby Biomarker Study

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Introduction

The Bay Protection and Toxic Cleanup Program (BPTCP) was mandated by the California State Legislature in 1989. The BPTCP is administered by the California State Water Resources Control Board, in cooperation with the state's Regional Water Quality Control Boards, California Department of Fish and Game, and Office of Environmental Health and Hazard Assessment. This study ("Goby Biomarker Study") was one of several special studies conducted as part of the BPTCP, but was also planned and conducted in cooperation and partial funding from two National Oceanic and Atmospheric Administration's (NOAA's) programs: National Status and Trends Program; and the Coastal Ocean Program.

Hundreds of samples (primarily sediment) from California's coastal bays and estuaries have been collected and analyzed since the BPTCP began its field sampling effort in 1992, with most of the assessment effort focused on toxic "hot spot" screening. Results have identified numerous coastal locations, throughout the state, which were termed impacted, as demonstrated by sediment contaminants, benthic community data, and laboratory toxicity bioassays.

Included in the field studies were about 100 sampling stations, nine of which were selected for this study with fish. All nine sites were in the Los Angeles Harbor area (see Map 1). Sediments were analyzed for metals (appendix 1), pesticides (appendix 3), polyaromatic hydrocarbons (appendix 4), and polychlorinated biphenyls (appendix 5). In addition, pore water was tested for metals (appendix 2) and sediments assayed for toxicity to amphipods (appendix 6). Analysis of the data revealed that six sites were moderately to severely contaminated and designated as impacted (appendices 6-10). The remaining three were substantially less contaminated and were designated as reference sites.

In order to assess the impact of sediment contaminants on fish, it was proposed that bay gobies (*Lepidoglobius lepidus*) be collected, at all nine Los Angeles sites, and evaluated by a variety of biomarker assays. Although several species of marine fish were considered, bay gobies were selected as the target species of choice because their habitat (burrows in the mud), habits (territorial), distribution (throughout the California coast), relative abundance, and ease of capture (by bottom trawls). Contaminant exposure was assessed grossly via evaluation of condition and gonado-somatic indices, biochemically via analysis of cytochrome P4501A induction, and histologically via examination of liver and spleen. The ultimate goal of the study was to evaluate bay gobies as a potential "indicator species" for contaminated marine ecosystems along the California coast.

Objectives

Objective 1: To determine the type and frequency of histopathological disorders, enzyme levels, and contaminant levels at reference and study sites.

Approach:

1) To determine type and frequency of histopathological disorders; fish were necropsied, samples of liver and spleen fixed and paraffin processed, sections histologically evaluated for the presence of lesions, and lesions scored semi-quantitatively.

2) To determine enzyme levels; liver samples were homogenized and an EROD assay run to determine level of P450 induction. In addition, step-sections of paraffin blocks were cut and immunohistochemistry run using a monoclonal antibody specific for P450.

3) To determine contaminant exposure; fish carcasses, following organ removal, were frozen and assayed.

Objective 2: To determine the appropriateness of goby biomarkers for use as indicators of bay and estuarine pollution.

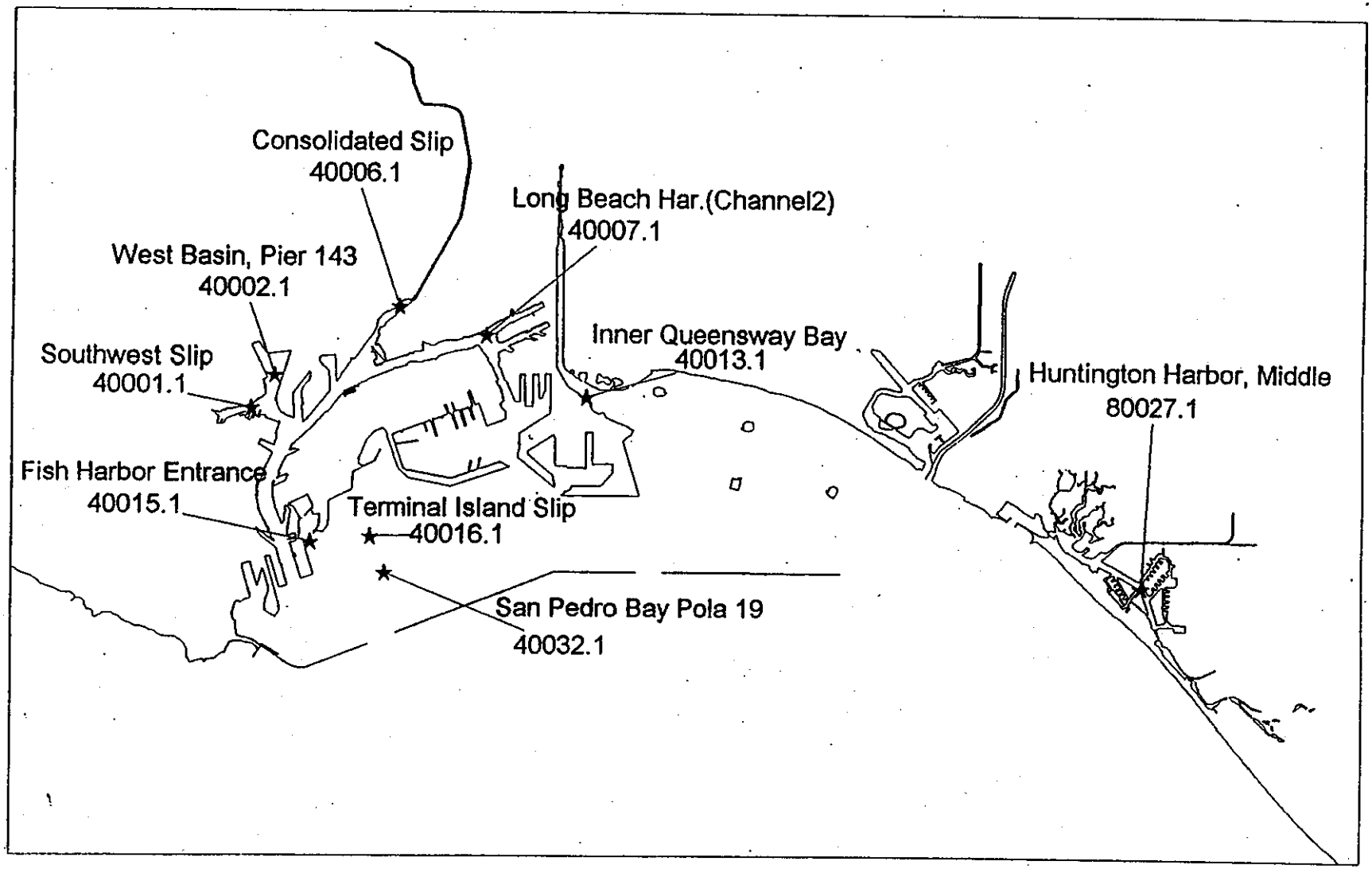
Approach: Evaluate the various gross (HSI, GSI, and CI), biochemical (EROD), histologic (liver and spleen histopathology), and immunohistochemical (P450) assays used in this study to determine if they can differentiate impact from reference sites, and if those differences are relevant (ie. consistent with contaminant exposure) and statistically significant.

Specific Data Evaluation Includes Determination of:

1. the relative bioaccumulation of sediment-associated toxicants in the tissues of sampled fish
2. the relative performance of each of the biomarkers
3. the presence/absence of statistically significant results
4. the relative degree of severity of effects observed at each site
5. the relationships between the sediment, chemistry, and biological data

MAP 1

Fish Sampling Locations



Materials and Methods

Fish Collection: Fish collection was done by California Department of Fish and Game from a 19 ft Boston Whaler and sampling was conducted over a period of five days in October 1993. Initial collections were made using a fine mesh net (eye size approximately 1 cm) and beam trawls. A larger mesh net (approximately 2 cm eye) was also tried with both beam and otter trawls. Following capture, fish were held on the boat and maintained with frequent water changes. When sampling was complete, fish were transferred to the Southern California Coastal Waters Research Project (SCCWRP) laboratory where they were held in flow-through fiberglass tanks.

Necropsy and Tissue Sampling: Although provided with a NOAA protocol regarding a "clean technique" for necropsies, some equipment and supplies (ie. teflon cutting boards and 10% HCl) were not available and some procedures proved impractical. As such, NOAA protocols were modified and streamlined. A large plastic cutting board was used to perform the initial dissection. A second smaller polyethylene board was used to separate individual organs for formalin fixation. Between fish, cutting boards were wiped clean with paper towels. Occasionally, the smaller board was briefly scrubbed and rinsed in tap water. Between sites, the smaller cutting board was wiped clean, rinsed in tap water, and dried with a paper towel. The larger board was scrubbed clean, then rinsed with tap water, distilled (DI) water, 10% nitric acid, methanol, and milli-Q (MQ) water between sites. Two sets of instruments were used, one for the initial dissection (opening the abdomen), and a second set for the final dissection (separating organs). Between fish, the first set was wiped clean and rinsed in tap, DI, and MQ water. The second set was wiped clean between fish. Between sites, both sets were wiped clean, rinsed with tap and DI water, rinsed with 10% nitric acid and methanol, and then rinsed with MQ water.

Fish were killed with an overdose of ticaine methanesulfonate (MS222), rinsed in tap, DI, and MQ water, then transferred to a clean paper towel covering the larger cutting board. Dissections were made using two sets of gloves, an inner latex set and an outer polyethylene set. With each fish, a new pair of polyethylene gloves was used. Following the initial dissection, polyethylene gloves were discarded and the final dissection made with the latex set. Latex gloves were used until torn or extremely soiled.

Euthanized fish were weighed ("total weight"), measured for standard length (SL), and placed in right lateral recumbency on the larger board. The left abdominal wall was opened and left operculum removed to expose the gills. Internal organs were briefly examined for gross lesions. Gastrointestinal (GI) tract, liver, and spleen were removed together by severing rectum and esophagus, and then transferred to the smaller cutting board. The heart and gills were then excised. Finally, gonads were excised, weighed, and transferred to the second cutting board. Although initially targeted for histologic analysis, kidneys were not routinely sampled. That decision was based on the small size of many fish and concern that renal excision would result in excessive loss of tissue from the carcass (slated for chemical residue analysis). A few kidney samples were taken if fish were large enough and if kidneys were readily accessible. Following organ removal, the carcass was weighed ("chemistry weight"), placed in a glass jar, and frozen at -20°C.

The final dissection was made on the smaller cutting board. In teleost fish, gall bladders were dissected free of the liver, placed in amber vials, and frozen on dry ice. Bile samples from stingrays were taken by aspirating with needle and syringe. Following bile

sampling, the liver was weighed ("total liver weight") and a piece cut free with razor blade. The smaller section of liver was then weighed ("P450 liver weight") and homogenized (using a hand tissue grinder) with a volume of phosphate buffered saline (PBS) approximately three times the weight of the liver sample. The homogenate was centrifuged for 10 minutes at 11,000 x g and 2°C. The supernatant was decanted into a cryotube and frozen on dry ice.

After the first day, it was apparent that many fish were too small for both liver EROD and histologic analyses. To augment biochemical EROD analysis, it was decided to take samples for P450 immunohistochemistry. The two organs selected for P450 immunohistochemistry were liver and gill. Liver histopathology samples were fixed in formalin, along with spleen, heart, and gill in one 20 ml glass scintillation vial (vial "A"). Gonad, GI tract, and any skin or kidney samples were fixed in a second vial ("B").

Histopathology: Histology samples were fixed in 10% formalin for 14 to 17 days. Prior to cassetting, a list of random numbers was generated and one assigned to each fish (Appendix 11). Each cassette was labelled with a processing number (93H63), a random number (from 1-127), and a letter ("A" = liver, spleen, and gonad; "B" = gill; and "C" = skin). All tissues, except skin, were routinely paraffin processed. Skin samples were decalcified in dilute hydrochloric acid for 24 hours, rinsed in tap water for 24 hours, and then paraffin processed. Paraffin blocks were sectioned at 4 µm and stained with hematoxylin and eosin (HE). All slides were read blind.

An initial screen of 50 slides was used to identify the range of lesions present and to determine which were included in the final score sheet. The initial screen was also used to identify "type lesions" in both liver and spleen. "Type lesions" were specific examples of lesions with emphasis on separating lesion types based on severity. Severity scores were semiquantitative and based on a scale of 0 to 3 (0 = not present, 1 = mild, 2 = moderate, and 3 = severe). Once "type lesions" were identified, specific criteria (size, number, composition) for severity scores were generated and the slides read. Two organs, liver and spleen, were scored for lesions. Four other other organs (skin, kidney, gill, and gonad) were screened for lesions, but were not scored.

P450 Immunohistochemistry: Sections for P450 immunohistochemistry were taken from the same paraffin blocks used for routine histopathology. There were two blocks for each fish and both blocks were cut at 4 µm and mounted on a single "Superfrost" (Fisher Scientific) electrically charged glass slide. Slides were air dried and shipped to Dr. John Stegeman in Woods Hole, Massachusettes. Immunohistochemistry was performed with a monoclonal antibody (MAb 1-12-3p5) developed against scup (*Stenotomus versicolor*) cytochrome P4501A. All slides were stained using a standard ABC (avidin-biotin complex) technique. Slides were read and scored blind. P450 score was reported as a staining index by multiplying the "occurrence" by the "intensity" (O x I) of the stain.

EROD: Frozen liver samples (homogenate supernatant) were shipped to Dr. John Stegeman in Woods Hole, Massachusettes on dry ice. 7-ethoxyresorufin O-deethylase (EROD) activity was evaluated either spectrophotometrically, according to the method of Klotz *et al.* (1984), or flurometrically, by modifications of the method of Eggens and Galgani (1992) using Millipore Cytofluor fluorescent plate reader. Hepatic EROD activity was reported as pmol/min-mg.

Indices: Gross measurements included standard length (SL in millimeters), body weight (BW in grams), liver weight (LW), and gonad weight (GW). Gross measurements were used to

determine three indices; hepatosomatic index (HSI), gonadosomatic index (GSI), and condition index (CI). HSI was determined by taking LW/BW and multiplying by 100. GSI was determined by taking GW/BW and multiplying by 100. CI was determined by taking BW/SL^3 and multiplying by 100,000.

Statistical Analysis: Dr. Neil Willits (Senior Statistician, UCD) was the statistical consultant for this study. Two types of data were generated, non-continuous and continuous. Non-continuous data included semi-quantitative scores used with both the histopathology lesions in spleen and liver (range = 0-3), and similar semi-quantitative P450 immunohistochemistry scores (range = 0-15). Continuous data included EROD activity, gross measurements, and indices.

Non-continuous data was analyzed using Principal Components Analysis (PCA), followed by analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA) of the scale values derived from PCA. This type of analysis has several advantages including: 1) accounting for the presence and severity of lesions; 2) identifying the source of variability; 3) identifying the most significant lesions; and 4) determining the significance of "impact" versus reference site differences with a single P value. PCA was run separately on the lesion (spleen and liver) data and on the P450 immunohistochemistry data. Four principal components were used with the lesion data and only one for the P450 analysis (only one component accounted for appreciable variability). Two types of post hoc comparisons among sites were used following PCA and MANOVA; Tukey's and Least Square Means. The disadvantage to the Tukey comparisons are they do not adjust for possible impact of gender and species. The Least Square Means comparisons do adjust for gender and species, and were considered the more relevant of the two.

Continuous data was analyzed using MANOVA, and site to site comparisons made using Least Square Means.

Results

Fish Collection: Initial collection attempts were made at night on 10-4-93 at sites 40015 and site 40006. Trawling speed and time were varied. Through trial and error, a 15 minute trawl at a speed just above idle provided the best results. Faster speeds tended to "fly" the sled above the bottom, and longer trawls resulted in excessive mud in the "caught end" of the net. Longer trawls also resulted in higher morbidity and mortality.

10 hours of sampling yielded no Bay gobies and only 13 yellowfin gobies. Following a meeting between UCD, AMS, and CADFG personnel, and a subsequent conference call on 10-5-93 with NOAA, the decision was made to go with multiple species. The four species selected were: 1) yellowfin goby (*Acanthogobus flavimanus*); 2) basketweave cusk-eel (*Ophidion scrippsae*); 3) California tonguefish (*Symphurus atricauda*); and 4) white croaker (*Genyonemus lineatus*). Selection was based on; relative abundance and availability at the initial reference site (site 40015), habits and habitat, size, and distribution. In addition, a fifth species - round stingrays (*Urolopus halleri*) - was added because it was the predominant species at site 80027 and no croakers, cusk-eels, or tonguefish were caught. Although the stingrays were relatively large (they could not be weighed on the balance used), rays did fit some selection criteria being bottom dwellers and relatively abundant.

The final collection total of 127 fish included; 31 yellowfin gobies, 49 white croakers, 7 basketweave cusk-eels, 30 tonguefish, and 10 round stingrays (Table 1). Fish were collected from nine different sites over a period of four days, from 10-4-93 to 10-7-93. Sorting the data by site (Appendix 12) revealed that the distribution of species was highly variable. Two examples are site 40013, where only white croakers were caught, and site 80027 where 10 of 12 fish were stingrays.

Necropsy and Tissue Sampling: Histopathology samples included; 127 liver, 127 spleen, 127 heart, 127 gill, 127 gonad, 127 GI tract, 14 skin, and a small (<20) number of kidney samples (Appendix 13). 85 liver samples were collected for EROD analysis and 212 (106 liver and 106 gill) samples taken for P450 immunohistochemistry. The total number of liver and gill samples for P450 immunohistochemistry was less than the histopathology totals (127) because 21 fish died prior to necropsy and tissues were mildly to severely autolyzed. 99 gall bladder/bile samples were taken, frozen, and archived at -80°C.

Table 1. Goby Biomarker Study. Sample Number and Species of Teleost Fish Collected from Nine Sites in the Los Angeles Harbor area.

			Fish Species (N)					
#	Site #	Site Name	Goby	Croaker	Cusk-eel	Tonguefish	Stingray	total
1	40001	Southwest Slip	3	2	0	0	0	5
2	40002	West Basin Pier 143	4	5	0	6	0	15
3	40006	Consolidated Slip	7	11	0	0	0	18
4	40007	Long Beach Harbor, channel 2	2	5	5	3	0	15
5	40013	Inner Queensway Bay	0	15	0	0	0	15
6	40015	Entrance to Fish Harbor	12	3	0	0	0	15
7	40016	Term Island Stop	1	3	1	17	0	22
8	40032	Pola 19	0	5	1	4	0	10
9	80027	Huntington Harbor, middle	2	0	0	0	10	12
		total	31	49	7	30	10	127

Histopathology - Results:

Definitions

Basophilic: Blue to purple color when sections are stained with hematoxylin and eosin (HE).

Congestion: Stasis of blood in a blood vessel (usually a vein).

Diffuse: Spread out.

Eosinophilic: Red to orange color when sections are stained with HE.

Focus: A small area.

Granuloma / granulomatous: Granuloma refers to a mass lesion centered around either a foreign body (ie. a parasite) or cluster of bacteria (ie. tuberculosis tubercles). The wall of a granuloma is composed of a mixture of macrophages, giant cells (fused macrophages), and a peripheral rim of connective tissue. Granulomatous refers to a more diffuse inflammatory reaction composed of primarily macrophages, but mixed with some giant cells and lymphocytes.

Hyalinization: Hyalinization refers to thickening or infiltration of a tissue or organ by an acellular, hyaline (glassy) material which can be composed of a variety of materials (ie. immune complexes or amyloid).

Hyperplasia: Hyperplasia is an increase in the number of cells of a particular organ or tissue. Hyperplasia is differentiated from neoplasia (cancer) in that it is usually a reversible condition.

Inflammation: Inflammation refers to the influx, into an organ or tissue, of inflammatory cells. Inflammatory cells can be broadly classified as mononuclear (macrophages, lymphocytes) and polymorphonuclear (PMN) cells (neutrophils, eosinophils, basophils), which have "segmented" nuclei (pinched in multiple places).

Karyomegaly: Enlarged nucleus.

Karyorrhexis: Karyorrhexis is the fragmentation of a pyknotic nucleus in a dead cell.

Lymphocyte: Lymphocytes are mononuclear inflammatory cells which specifically target foreign antigens. They can be divided into B-cells which produce antibody and T-cells which do not produce antibody, but are responsible for cell-mediated immunity.

Macrophage: Macrophages are mononuclear inflammatory cells which have the capability of phagocytizing foreign material or micro-organisms.

Necrosis: Cell death.

Definitions continued:

Nematode: Round worm.

Neoplasia / neoplasms: Neoplasms are tumors and can be divided into benign and malignant. Cancer usually refers to malignant neoplasms.

Megalocyte: Megalocytes are excessively large cells which often have large (karyomegalic) nuclei.

Phagocytosis: Phagocytosis is the process whereby by a cell (usually an inflammatory cell) surrounds, engulfs, and digests a small fragment of foreign material or a micro-organism (ie. bacteria).

Pyknosis: Pyknosis is one of the initial changes the nucleus of a dying cell undergoes. Pyknosis involves nuclear shrinkage with condensation of chromatin and hyperpigmentation (usually dark blue-black with HE stain).

Tinctorially Altered Foci: Tinctorially Altered Foci (TAF) are small focal preneoplastic lesions in the liver which are primarily distinguished by color (ie. basophilic foci = blue; eosinophilic foci = red).

Histopathology - Results:

I. Splenic Lesions:

A. Splenic Necrosis

1. **Lymphoid Necrosis (LN):** Lymphoid necrosis was a surprisingly common lesions. The necrosis involved individual lymphocytes in the white pulp and was characterized by cellular shrinkage, nuclear pyknosis, and karyorrhexis (Figures 1 & 2). Necrotic lymphocytes were often phagocytized by macrophages and macrophage aggregates were often centered within the white pulp.

   Type lesions for LN:

   a. Score = 0; no necrosis (type specimens = 57*)
   b. Score = 1; 1-4 necrotic lymphocytes per 150 micron diameter field in a lymphoid follicle (type specimen = 76)
   c. Score = 2; 5-10 necrotic lymphocytes per 150 micron diameter field (type specimen = 1)
   d. Score = 3; >10 necrotic lymphocytes per 150 follicle diameter field (type specimen = 69)

   * "Type specimen" numbers refer to UCD random ID numbers; ie. 57 = 93H63-57.

2. **Red Pulp Necrosis (RPN):** The red pulp of the spleen is composed of hematopoietic cells, including both red and white blood cells in various stages of maturation from stem cells through well-differentiated blood cells. Careful examination revealed that many fish had necrosis of individual cells in the red pulp, similar to that observed in the lymphoid follicles. Necrotic hematopoietic cells were characterized by nuclear pyknosis and karyorrhexis, and phagocytosis by individual macrophages (Figures 3 & 4).

   Type lesions for RPN:

   a. Score = 0; no necrosis (type specimen = 18)
   b. Score = 1; 1-4 necrotic cells per 150 micron diameter field of hematopoietic tissue (type specimen = 23)
   c. Score = 2; 5-10 necrotic cells per 150 micron diameter field (type specimen = 9)
   d. Score = 3; >10 necrotic cells per 150 micron diameter field (type specimen = 73)

B. **Splenic Hyperplasia:**

1. **Periarteriolar macrophage sheath hyperplasia (PSH):** The periarteriolar macrophages are generally considered antigen presenting cells, in mammalian spleens, and are believed to process antigen and present it to T-cells. The lesions which occurs in some fish appears to be an increase in the thickness of the sheath surrounding small arterioles in the spleen (Figure 5). The increased sheath thickness is the result of increased numbers of macrophages forming multiple concentric layers around the arteriole.

   Type lesions for PSH:

   a. Score = 0; 0-2 layers of APC per arteriole (type specimen = 18)
   b. Score = 1; 3-4 layers of APC per arteriole (type specimen = 4)
   c. Score = 2; 5-6 layers of APC per arteriole (type specimen = 6)
   d. Score = 3; >6 layers of APC per arteriole (type specimen = 3)

2. **Lymphoid hyperplasia (LH):** Lymphoid hyperplasia can be characterized by increase in the number and size of the lymphoid aggregates in the spleen. Although lymphoid hyperplasia was left on the final score sheet, none of the spleens examined had any significant hyperplasia and there are no "type specimens."

C. **Vascular Lesions**

1. **Splenic Congestion (SC):** Splenic congestion was a relatively common finding and characterized by dilation of splenic blood vessels, and stasis and pooling of blood in the red pulp (Figures 6 and 7). The white pulp was often obscured with severe congestion, making it difficult to evaluate.

   Type lesions for SC:

   a. Score = 0; no congestion (type specimen = 18)
   b. Score = 1; mild red pulp congestion, but no expansion or compression of white pulp (type specimen = 10)
   c. Score = 2; moderate congestion resulting in partial to complete obscuring of interstitial connective tissue and white pulp (type specimen = 44)
   d. Score = 3; severe expansion of the red pulp with complete loss of interstitium and white pulp, often with bulging capsule (type specimen = 90)

2. **Splenic hemorrhage and necrosis (SHN):** One fish (109) had a large focus of hemorrhage and necrosis in the spleen. The lesion was characterized by an irregular necrotic central mass of pale eosinophilic proteinaceous material and fibrin, surrounded by extravasated red blood cells (figures 8 & 9). This lesion was not included in the final score sheet and there are no "type specimens."

D. **Splenic macrophage aggregates (SMA):** Macrophage aggregates were a common finding in the spleen and were characterized by accumulations of large macrophages packed with granular green-brown pigment (Figures 10 & 11). Macrophage aggregates were often located within the white pulp, amongst lymphocytes.

Type lesions for SMA:

1. Score = 0; none present (type specimen = 5)
2. Score = 1; 1-5 macrophage aggregates per 50X field, macrophage aggregates are $\geq$ 50 microns diameter (type specimen = 18)
3. Score = 2; 5-10 aggregates per 50X field (type specimen = 27)
4. Score = 3; >10 aggregates per 50X field (type specimen = 4)

E. **Lymphoid depletion (LD):** Lymphoid depletion was another relatively common lesion characterized by decreased number and size of lymphoid follicles in the spleen (Figures 12 and 13).

Type lesions for LD:

1. Score = 0; $\geq$ 5 follicles per 50X field with a follicle defined as a cluster of lymphocytes 150 microns in diameter (type specimen = 18)
b. Score = 1; 3-4 follicles per 50X field (type specimen = 23)
c. Score = 2; 1-2 follicles per 50X field (type specimen = 8)
d. Score = 3; $\leq$ 1 follicle per 50X field (type specimen = 10)

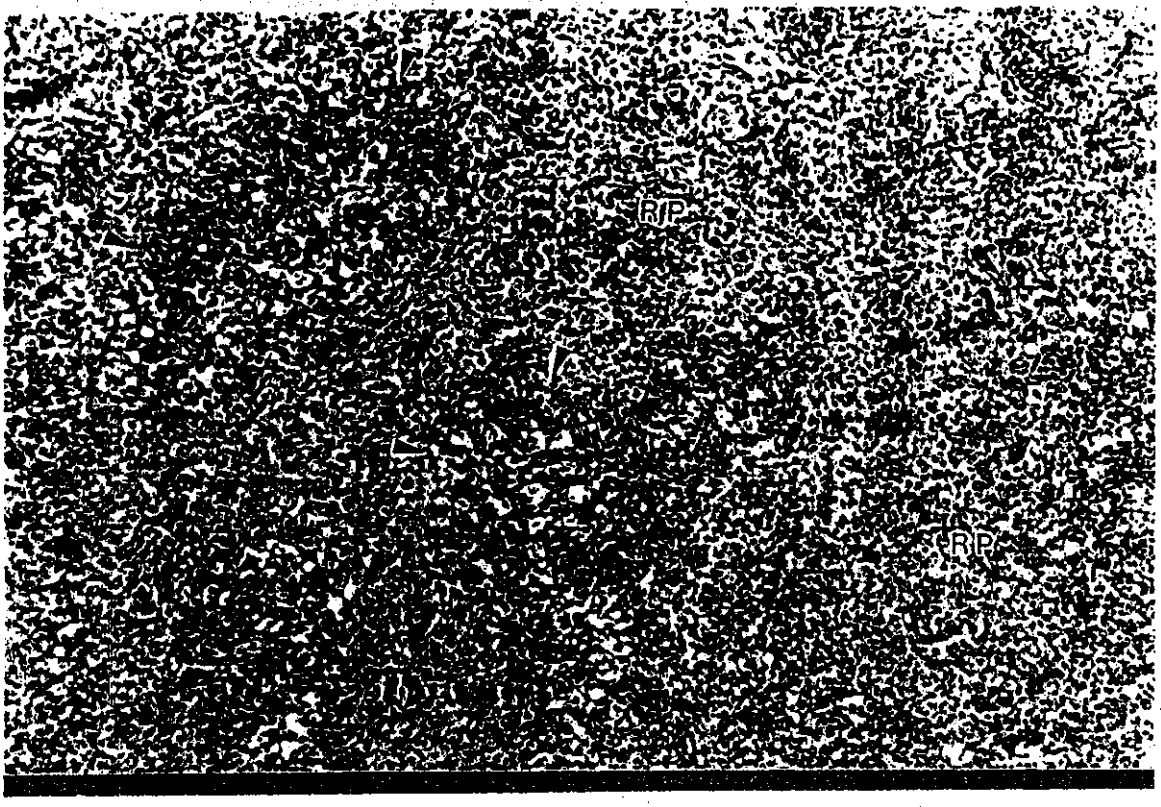


Figure 1. Spleen of fish 93H63-69 (white croaker from site 40013) with severe lymphoid necrosis (arrowheads). The necrosis is confined to the lymphoid follicles (white pulp) and does not involve the hematopoietic tissue of the red pulp (RP). HE 50X.

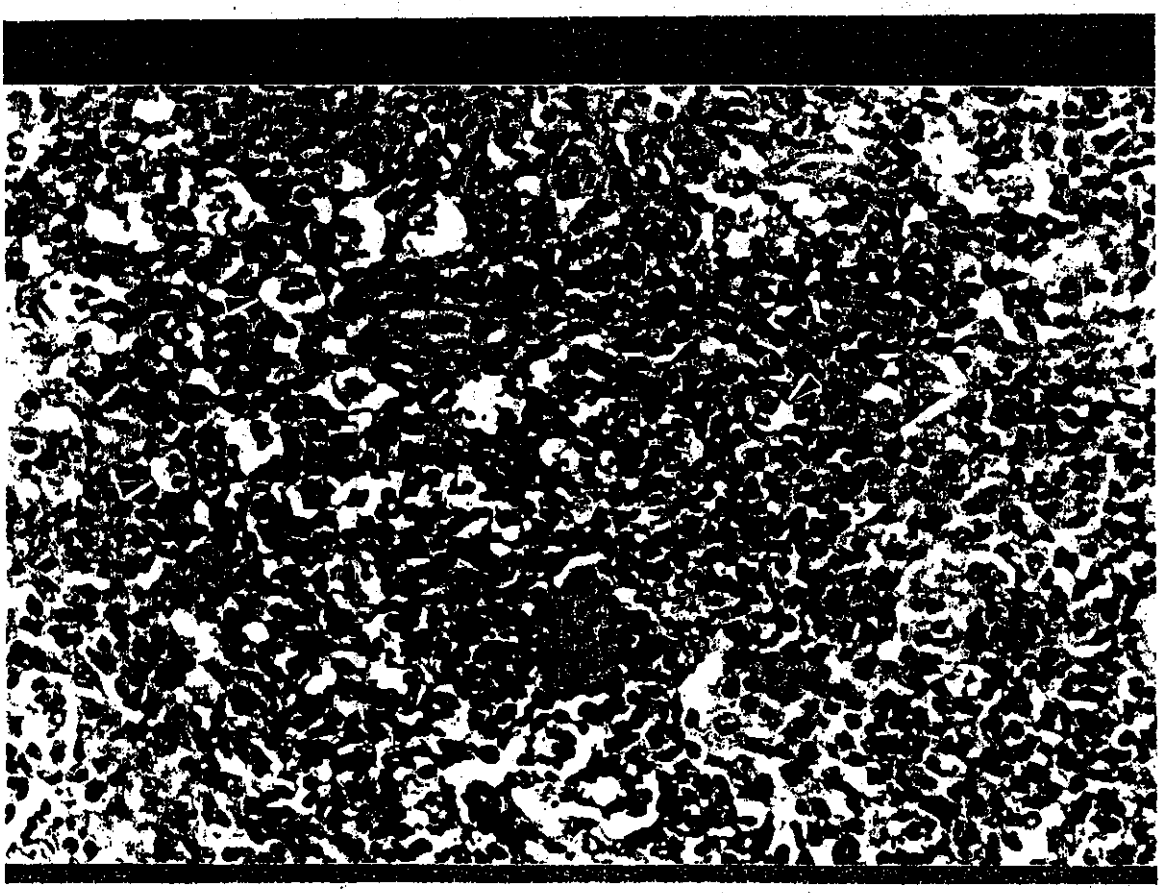


Figure 2. Higher magnification of figure 1. Note the large numbers of

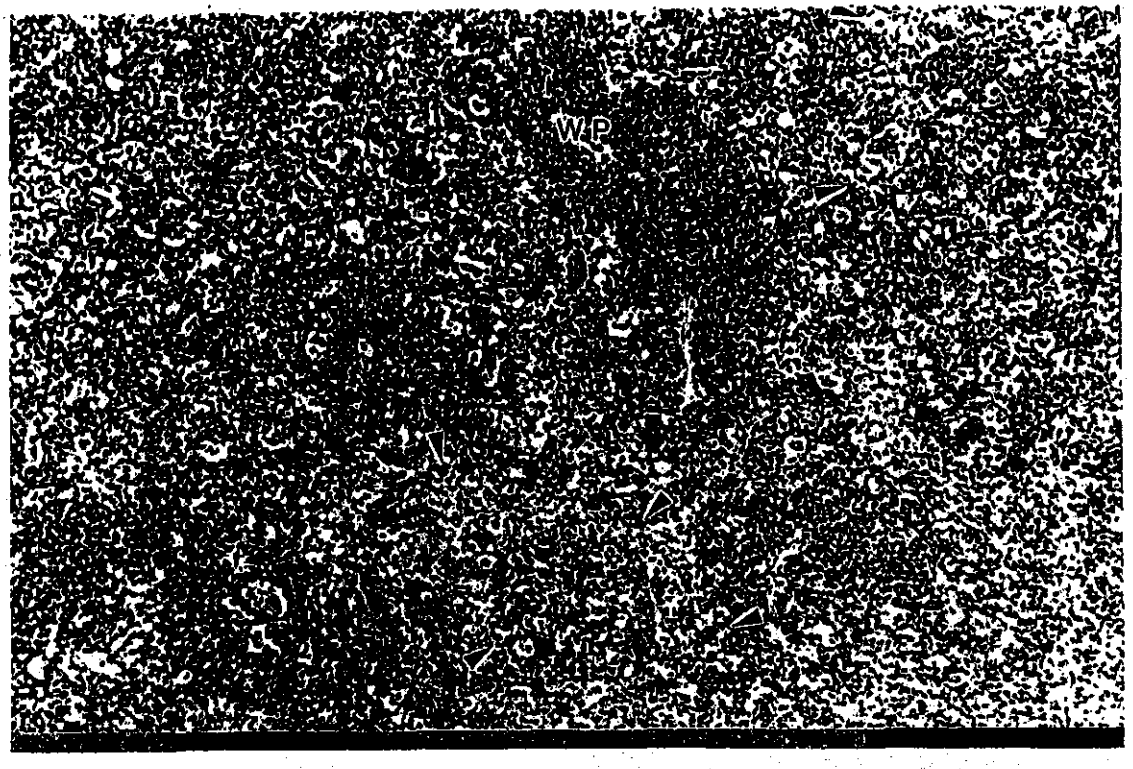


Figure 3. Spleen of fish 93H63-83 (white croaker from site 40002) with severe red pulp necrosis (arrowheads). Note that the lymphoid follicles (white pulp; WP) is only mildly affected with scattered individually necrotic lymphocytes (arrow). HE 50X.

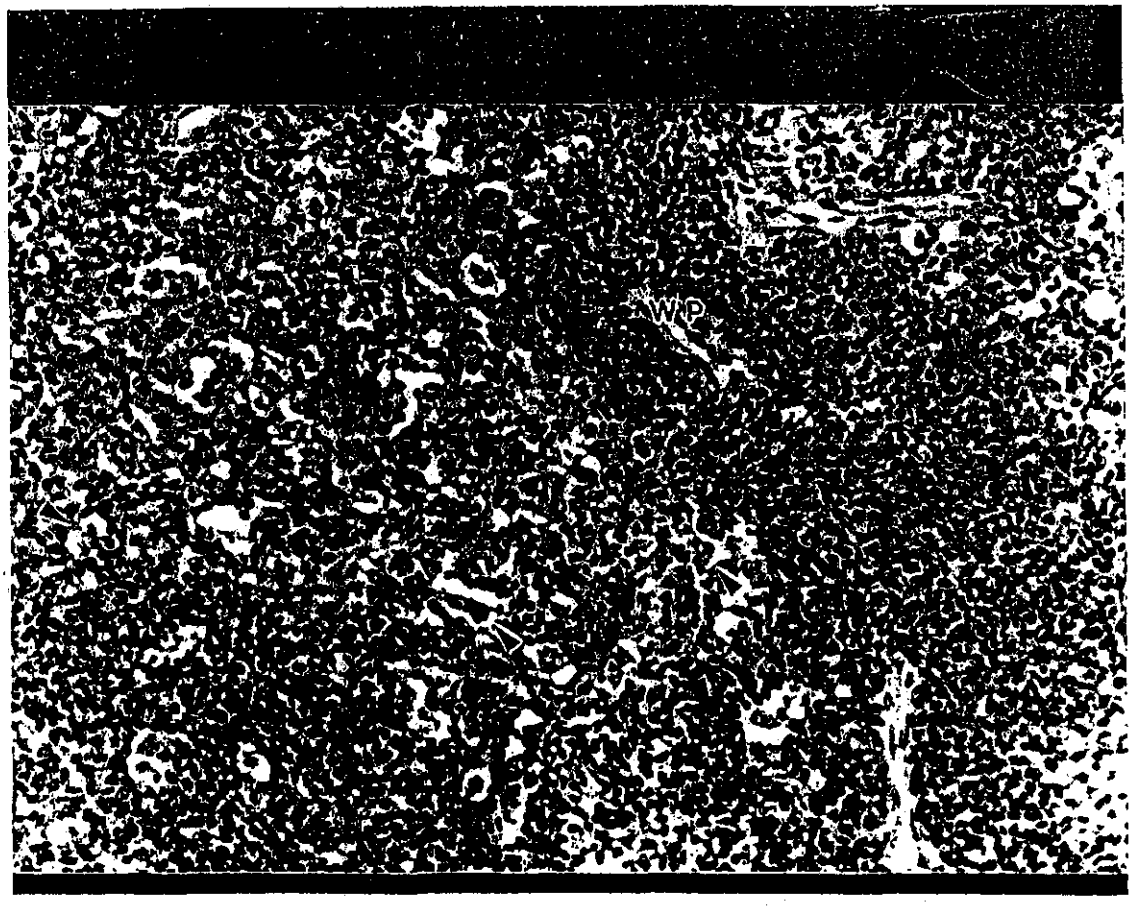


Figure 4. Higher magnification of figure 3. Note the large number of individually necrotic cells (arrowheads) in the red pulp. The

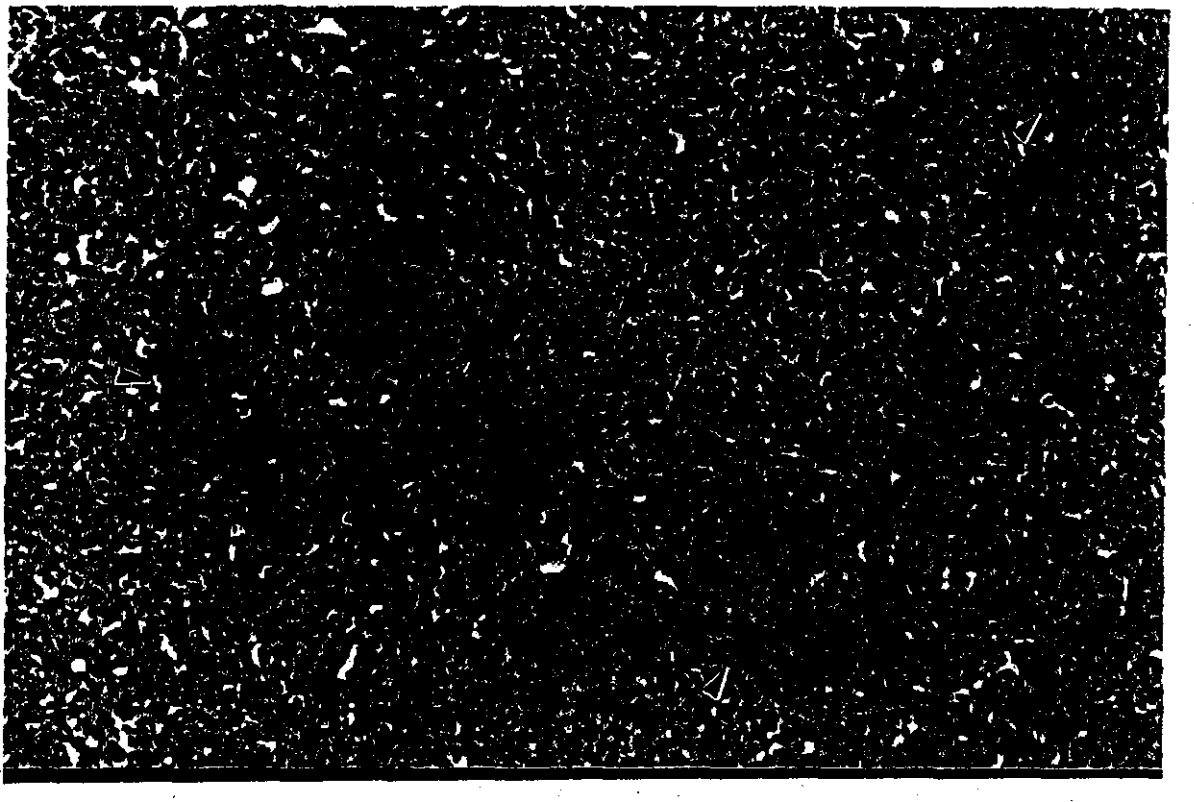


Figure 5. Spleen of fish 93H63-88 (yellowfin goby from site 40015) with moderate periarteriolar sheath hyperplasia. The arteriole in the center (arrow) has only two layers, but several others (arrowheads) have three to six layers of antigen presenting cells. HE 100X.

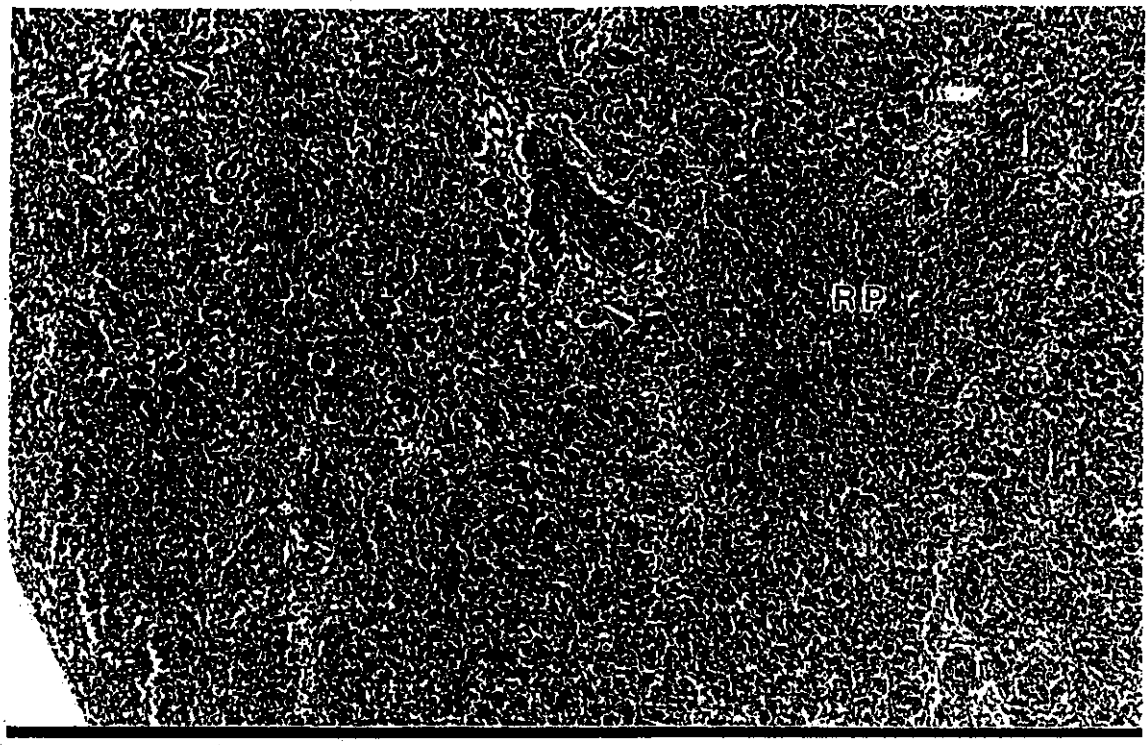


Figure 6. Spleen of fish 93H63-44 (yellowfin goby from site 40015) with severe congestion. The vasculature of the red pulp (RP) is markedly expanded and congested with blood. Lymphoid follicles (arrowheads) are small and often partially obscured by the dilated, congested blood vessels. HE 25X.

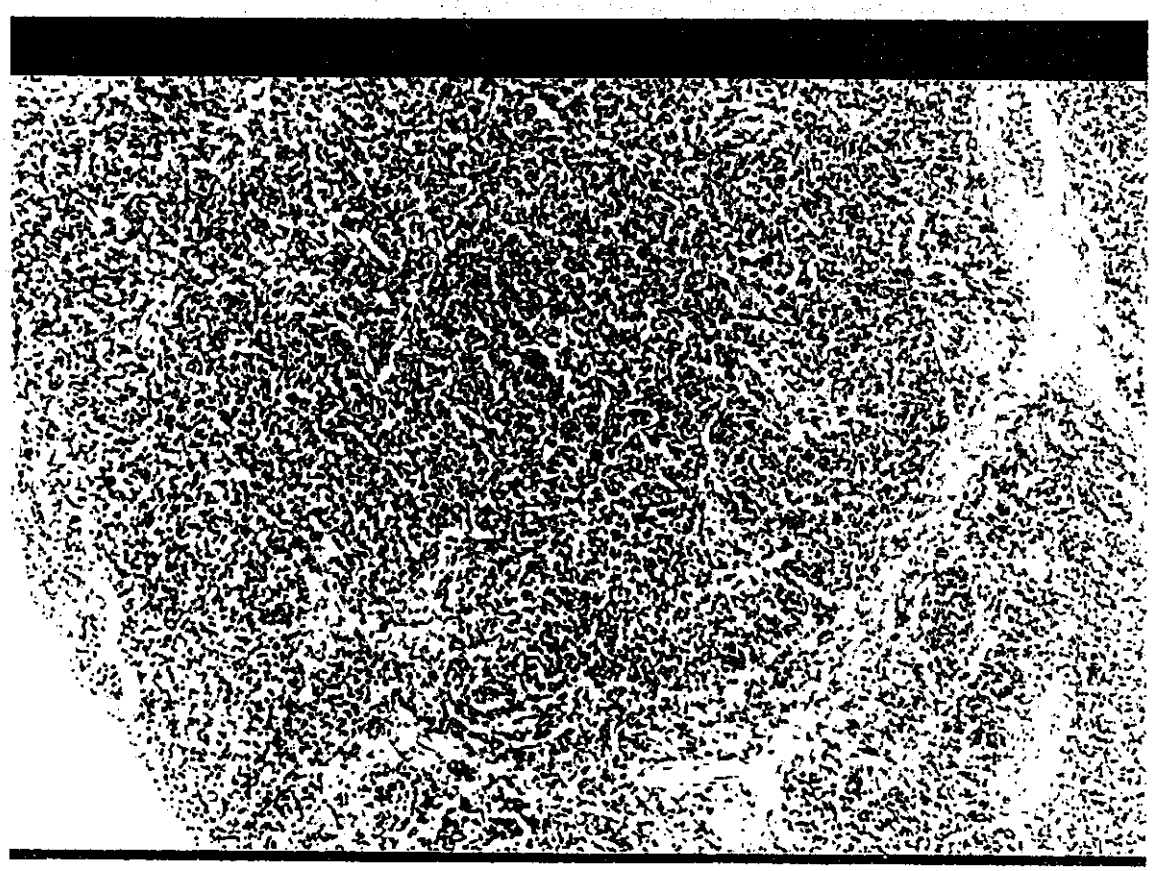


Figure 7. Higher magnification of figure 6. The hematopoietic cells of the red pulp are very difficult to identify because of the severe

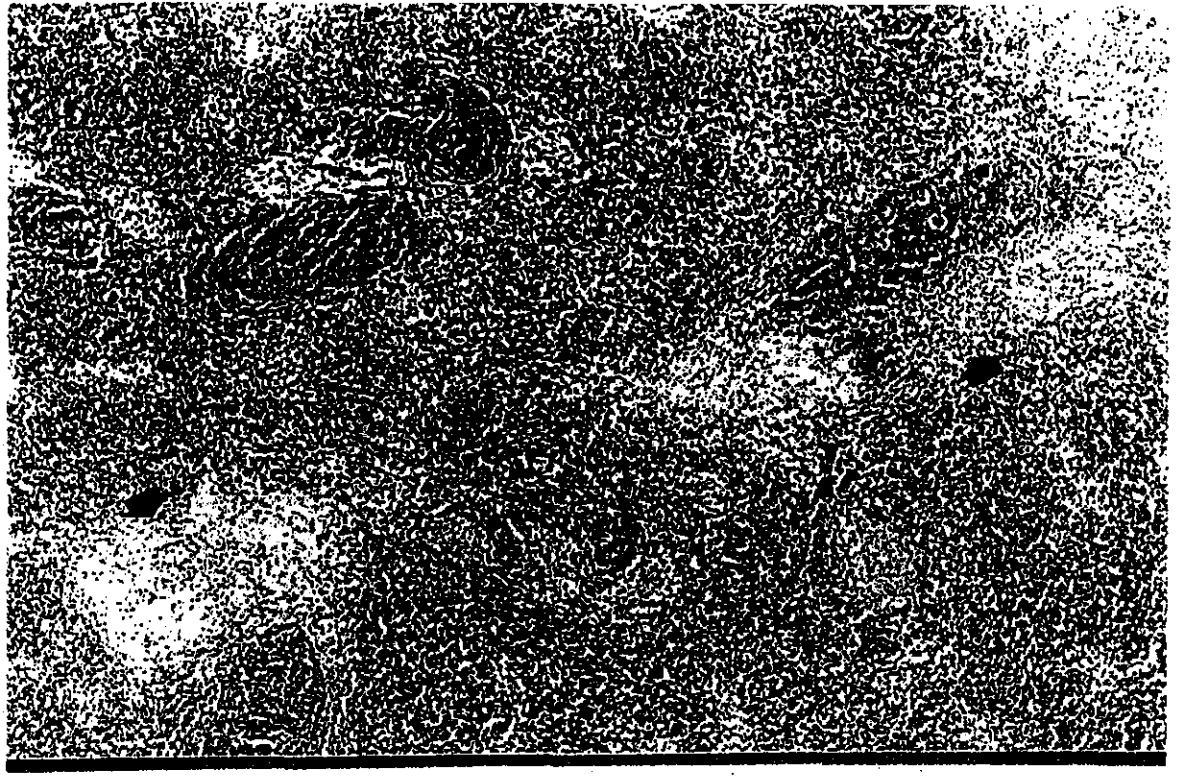


Figure 8. Spleen of fish 93H63-109 (yellowfin goby from site 40002) with two large foci of hemorrhage and coagulation necrosis (arrows). HE 25X.

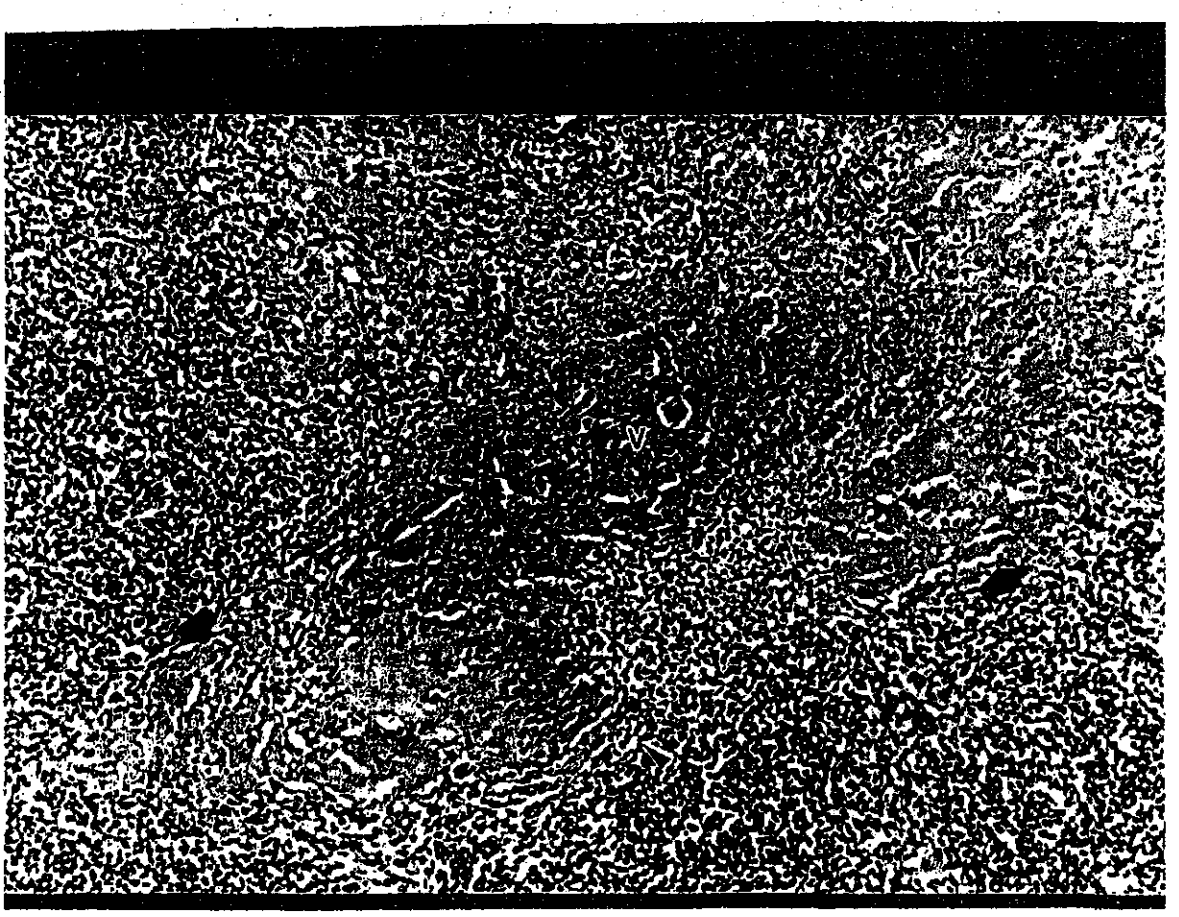


Figure 9. Higher magnification of figure 9. The splenic vein (V) is hemorrhaging (arrowheads) into the parenchyma and there are multiple foci of pale eosinophilic acellular material (arrows) which may represent

Figure 10. Spleen of fish 93H63-88 (yellowfin goby from site 40015) with large numbers of macrophage aggregates (arrowheads). HE 50X.

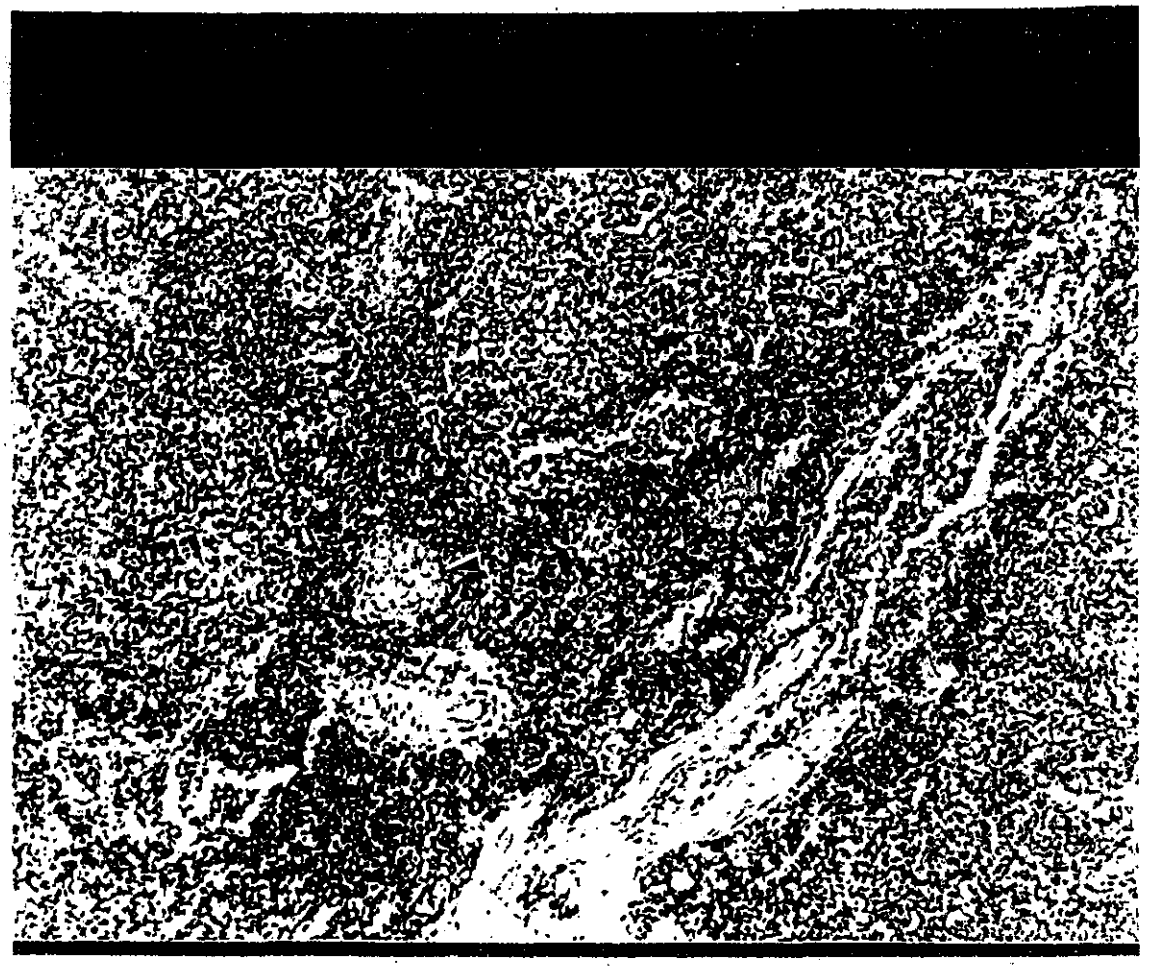


Figure 11. Spleen of fish 93H63-66 (yellowfin goby from site 40006)

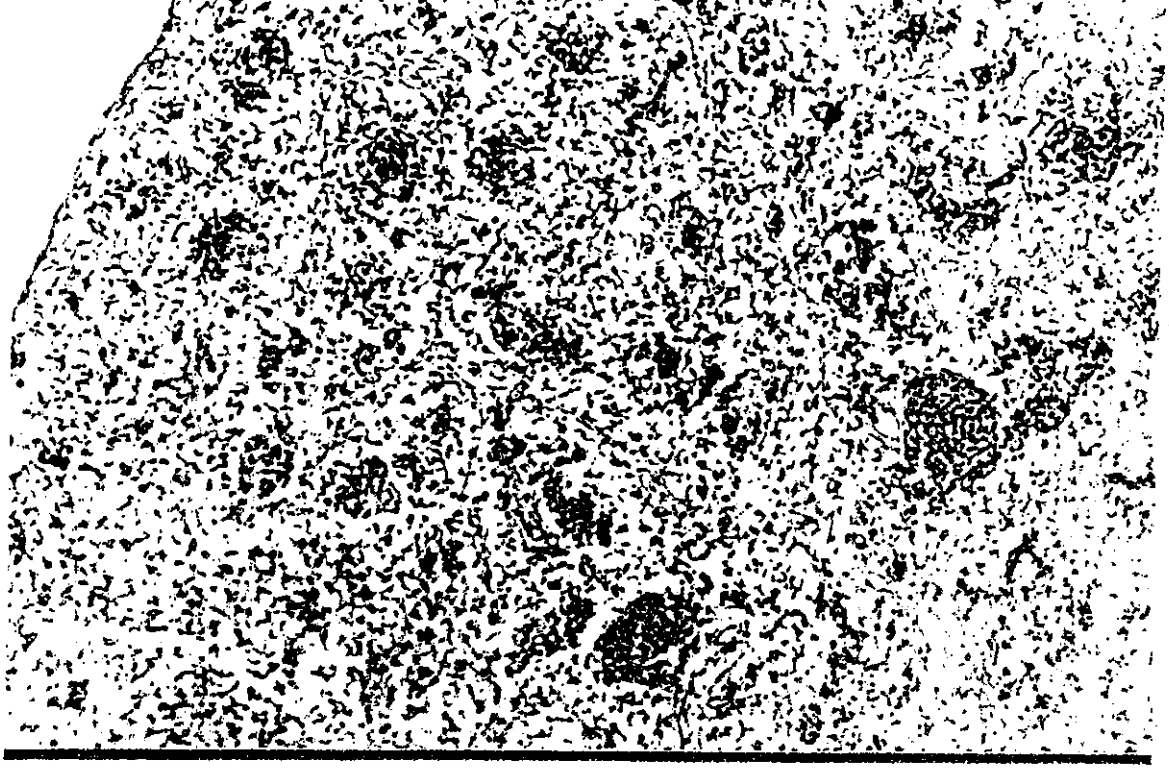


Figure 12. Spleen of fish 93H63-70 (basketweave cusk-eel from site 40007) with severe lymphoid depletion. Note that there are no lymphoid follicles present. HE 50X.

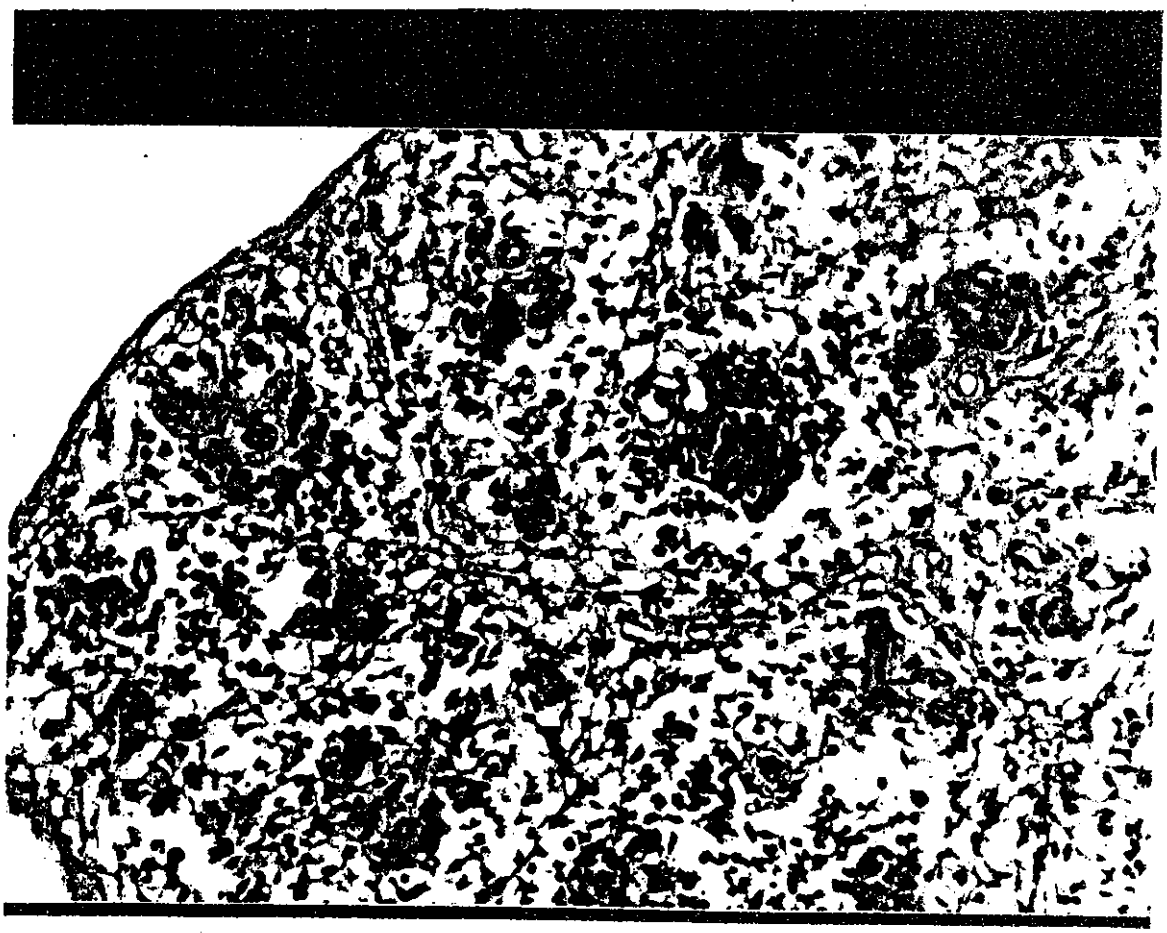


Figure 13. Higher magnification of figure 12. Organized lymphoid follicles are absent and even the red pulp appears depleted of

Histopathology - Results:

Splenic Histopathology Summary: Splenic lesion scores are given in appendix 14. Appendices 14a-14c include scores for all fish sorted on the basis of site. Scores in appendices 14d-14h are sorted on the basis of both species and site.

Average lesion scores are depicted in graphs 1-3. Graph 1a shows average lesion scores for lymphoid necrosis (LN) and red pulp necrosis (RPN) in all fish from all sites. Average scores for both LN and RPN are in general markedly lower in the three reference sites (40015, 40016, and 40032) when compared to the six "impact" sites. The only exception was impact site 40007 which had a lower average LN score than two reference sites (40015 and 40032). Of the three reference sites, site 40015 had the highest LN and RPN scores.

When splenic lesion scores are examined on the basis of both site and species, the same general trend holds, with the majority of impact sites having higher average LN and RPN scores than the three reference sites. Average LN and RPN scores for gobies (graph 1b) at the two impact sites, with sample sizes greater than three (40002 and 40006), were higher than those in the only reference site (40015) with an "N" over three. In croakers (graph 1c), average LN scores were only markedly higher at impact site 1 when compared to the three reference sites, but RPN scores were consistently higher in four of five impact sites where croakers were collected. Tonguefish (graph 1d) were collected from four sites and average LN and RPN scores at the two impact sites (40002 and 40007) were elevated above scores from two reference sites (40016 and 40032).

Graph 2a depicts average lesion scores for splenic macrophage aggregates (SMA) and splenic lymphoid depletion (LD). There were no consistent trends with either lesion. Average LD scores were high at two reference sites (40016 and 40032) and one impact site (40007). SMA scores were highest at reference site 40032. Impact site 80027 (primarily composed of stingrays) had the lowest SMA and LD scores.

Additional analysis of SMA and LD scores, with respect to species, uncovered trends in croakers (graph 2c) and tonguefish (graph 2d). In croakers, there were no consistent findings with regard to SMA, but croakers from the impact sites tended to have more LD than those from the reference sites. LD scores in croakers from four impact sites were slightly higher than scores from reference site 40016, and the other two reference sites had no LD. Average SMA scores in Tonguefish were highest in fish from reference site 40032, second highest in reference site 40016, and lowest at the two impact sites. Interestingly, the same pattern with respect to size (both standard length and body weight) also occurs in Tonguefish, with the largest (and presumably oldest) fish coming from reference site 40032, second largest from reference site 40016, and smallest from the two impact sites (Graph 17c). LD scores were slightly lower in tonguefish from the two impact sites.

Graph 3a shows average lesion scores for periarteriolar sheath hyperplasia (PSH) and splenic congestion (SC). There were no consistent trends with respect to these two lesions. Sorting of the data, based on species, did not reveal any trends in gobies (graph 3b). Analysis of average scores in croakers (graph 3c) and tonguefish (graph 3d) reveals that fish from reference sites tend to have higher SC scores than fish from impact sites. The only exception was impact site 40013 which had the highest average SC score in croakers.

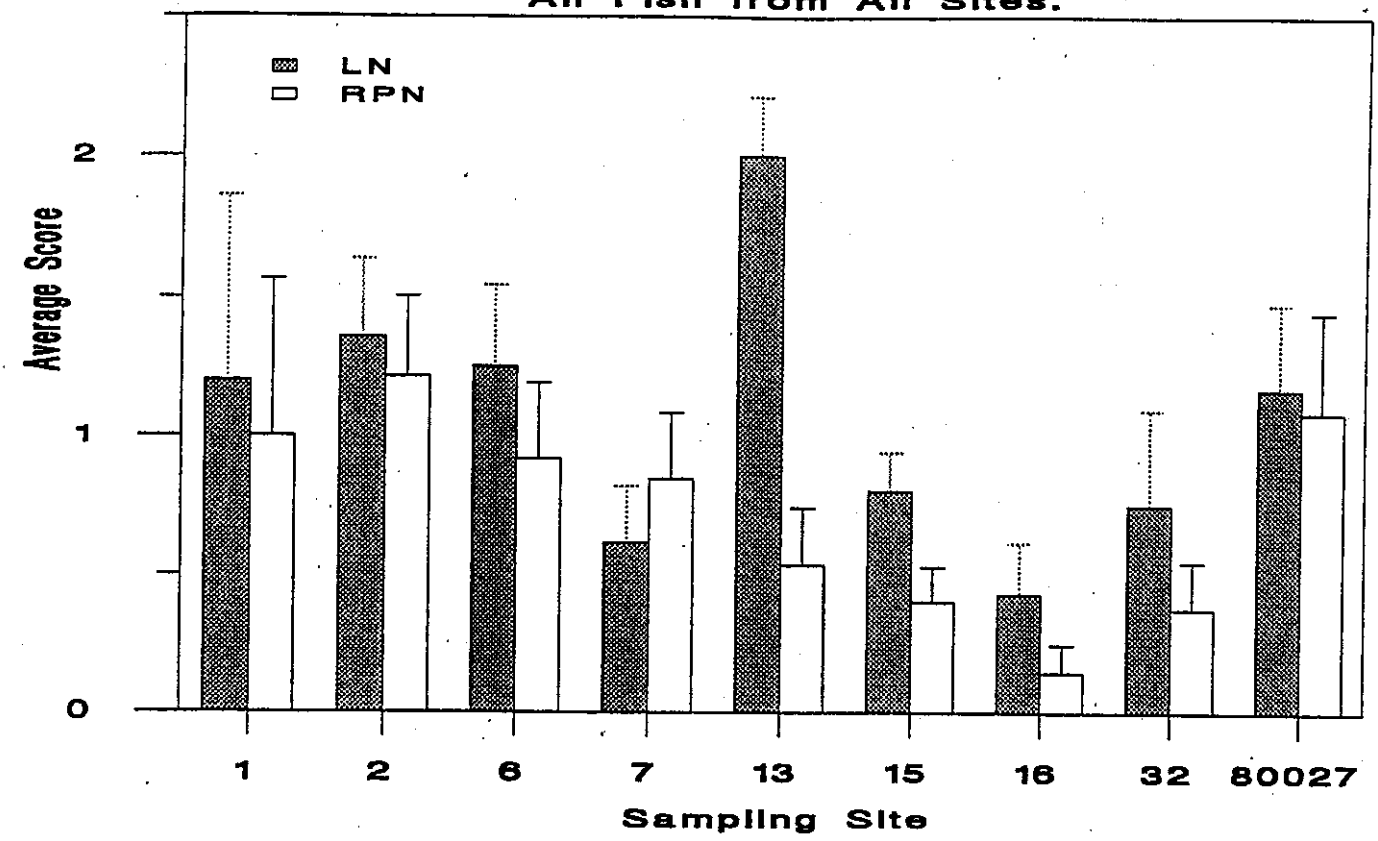
Histopathology - Results:

Splenic Histopathology - Statistics: The SAS statistical program was used to analyze for differences in individual scale values with MANOVA, nested for site effect and blocked for species. Due to missing values only 115 of 127 fish were used in the analysis. With principal components analysis (PCA), a correlation matrix, eigenvalues of the correlation matrix, and eigenvectors were calculated. From the proportion part of the "eigenvalues of the correlation matrix," the first principal component accounted for 11.8% of the variability; the second principal component, 10%; the third principal component, 8.9%; and the fourth, 7.7%.

From individual scale values for the first principal component, splenic lymphoid necrosis (LN) and red pulp necrosis (RPN) were most important (eigenvectors with the greatest absolute values contribute most to variability). With the second principal component, hepatic glycogen depletion (GD) and lipidosis (LIP) were most important. With the third principal component, hepatic melanomacrophage aggregates (MM) and splenic periarteriolar sheath hyperplasia (PSH) were most important. With the fourth principal component, hepatic macrophage aggregates (HMA) and splenic macrophage aggregates (SMA) contributed most to variability.

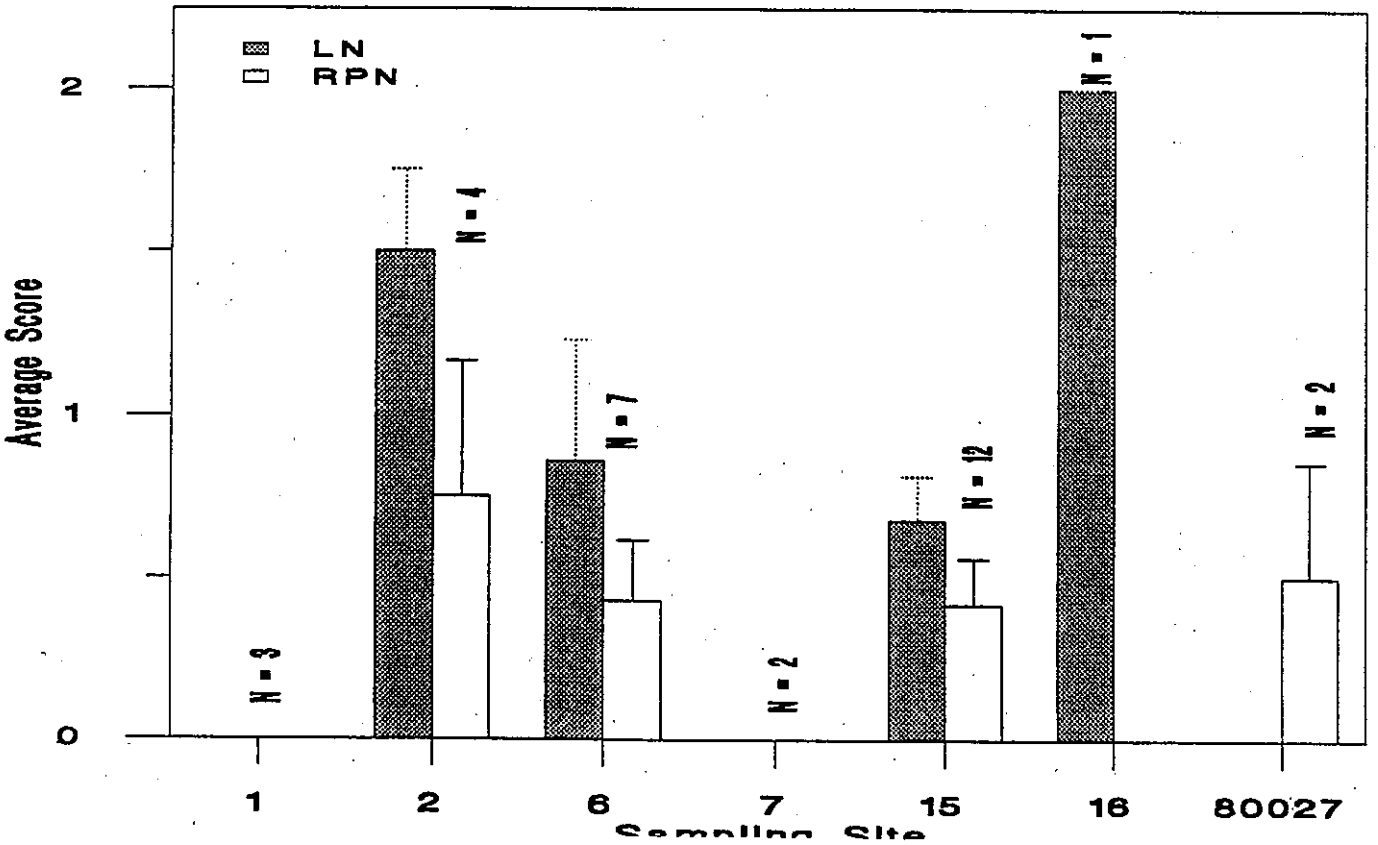
MANOVA, using all four principal components, showed that there were significant ($P < 0.05$) differences among the nine (six impact and three reference) sites, but not any overall species effect. Comparisons among sites, with respect to the first principal component, using Least Square Means revealed that impact site 40002 was highly significantly ($P \leq 0.01$) different from all three reference sites. The fact that the two lesions contributing most to variability in the first principal component were LN and RPN indicates that these two splenic lesions are important markers differentiating impact from reference sites.

Graph 1a. Average Scores for Lymphold Necrosis (LN) and Red Pulp Necrosis (RPN) for All Fish from All Sites.

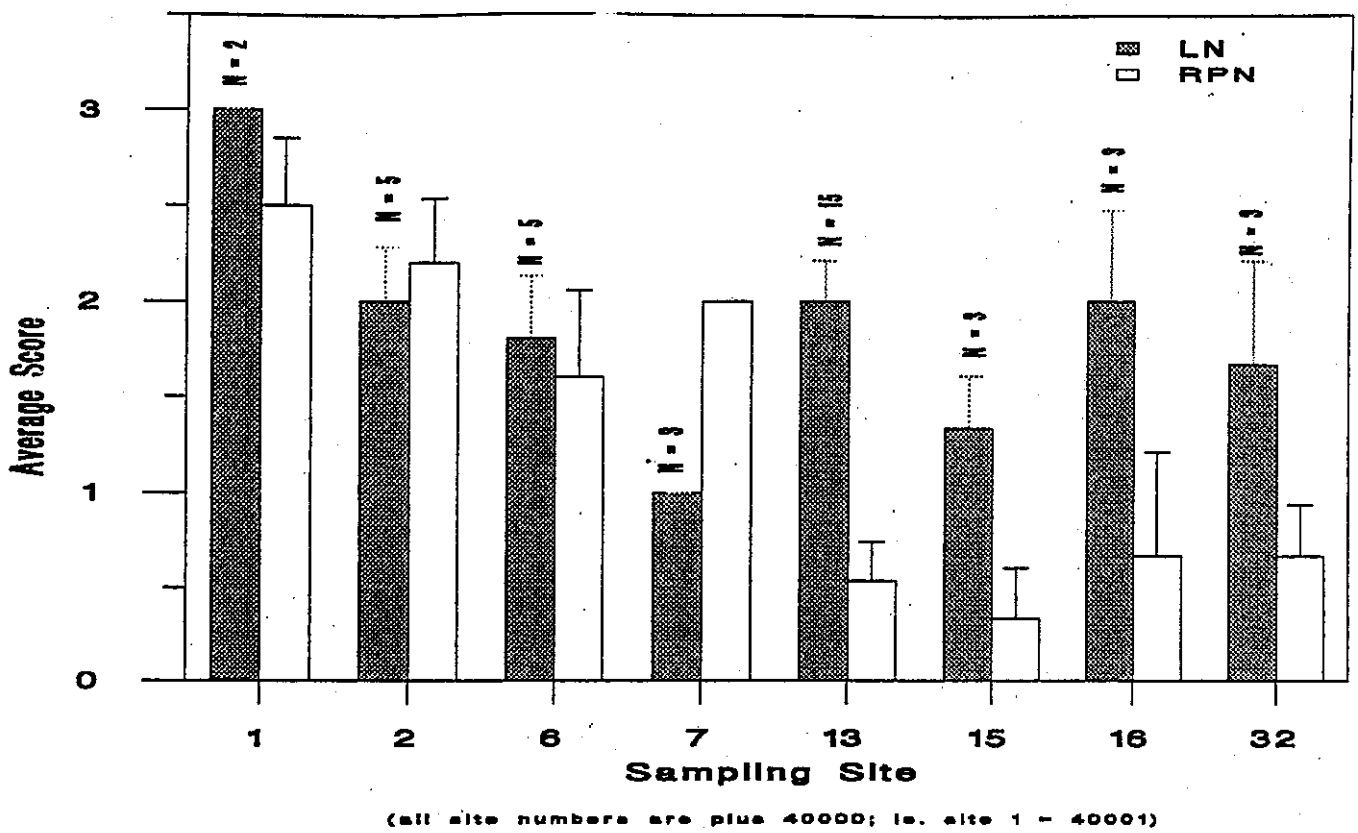


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 1b. Average Scores for Splenic Lymphold Necrosis (LN) and Red Pulp Necrosis (RPN) in Yellowfin Gobies.

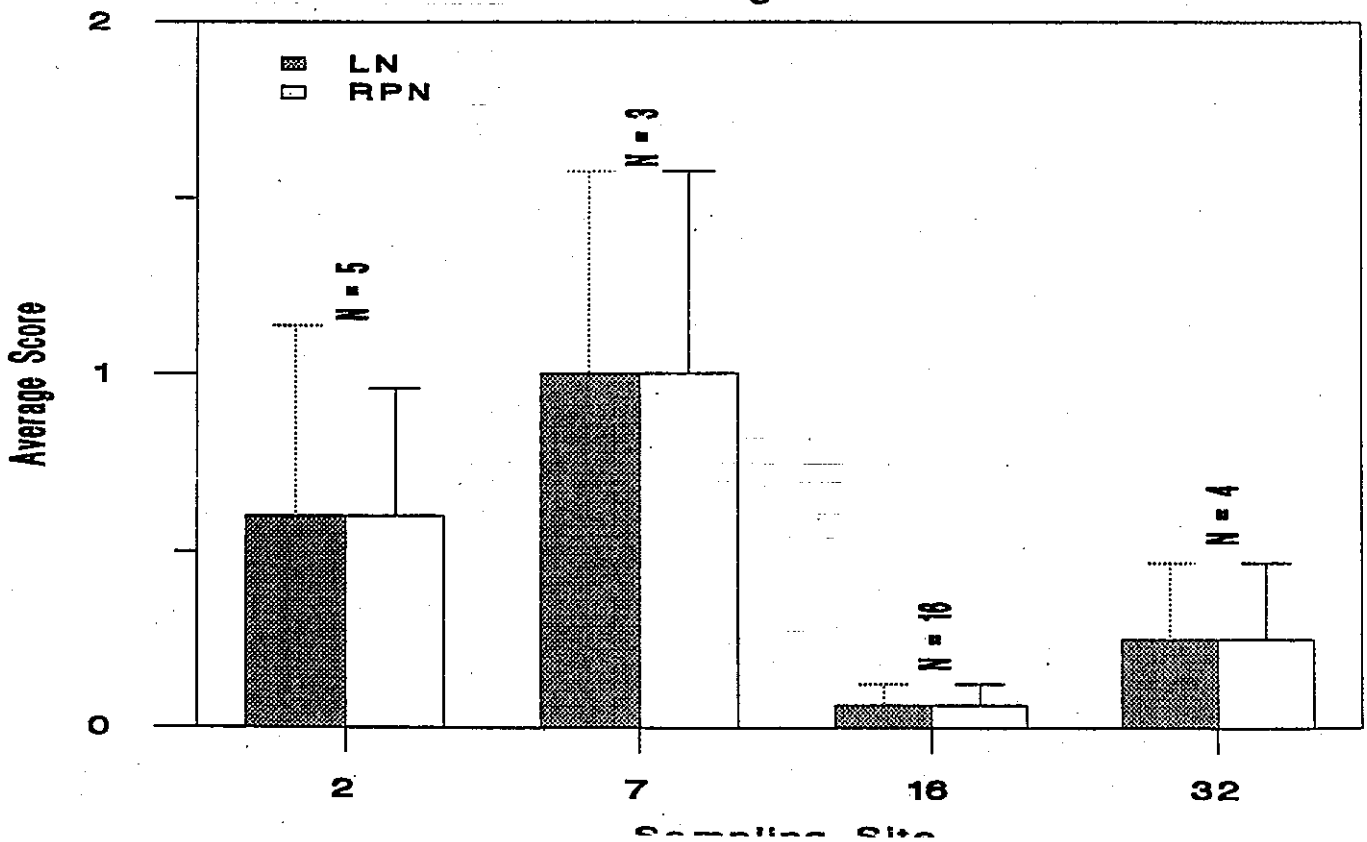


Graph 1c. Average Scores for Splenic Lymphoid Necrosis (LN) and Red Pulp Necrosis (RPN) In White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 1d. Average Scores for Splenic Lymphoid Necrosis (LN) and Red Pulp Necrosis (RPN) In Tonguefish.



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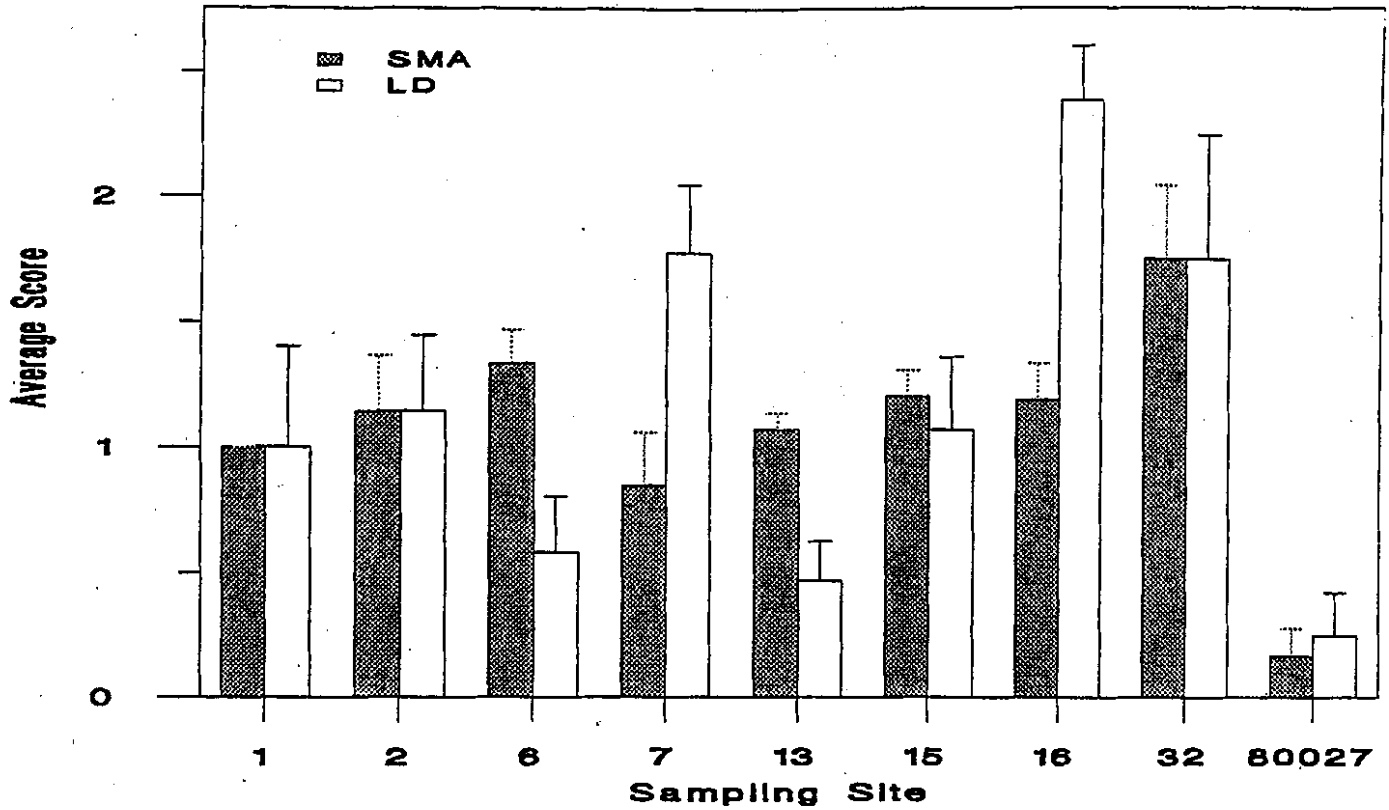
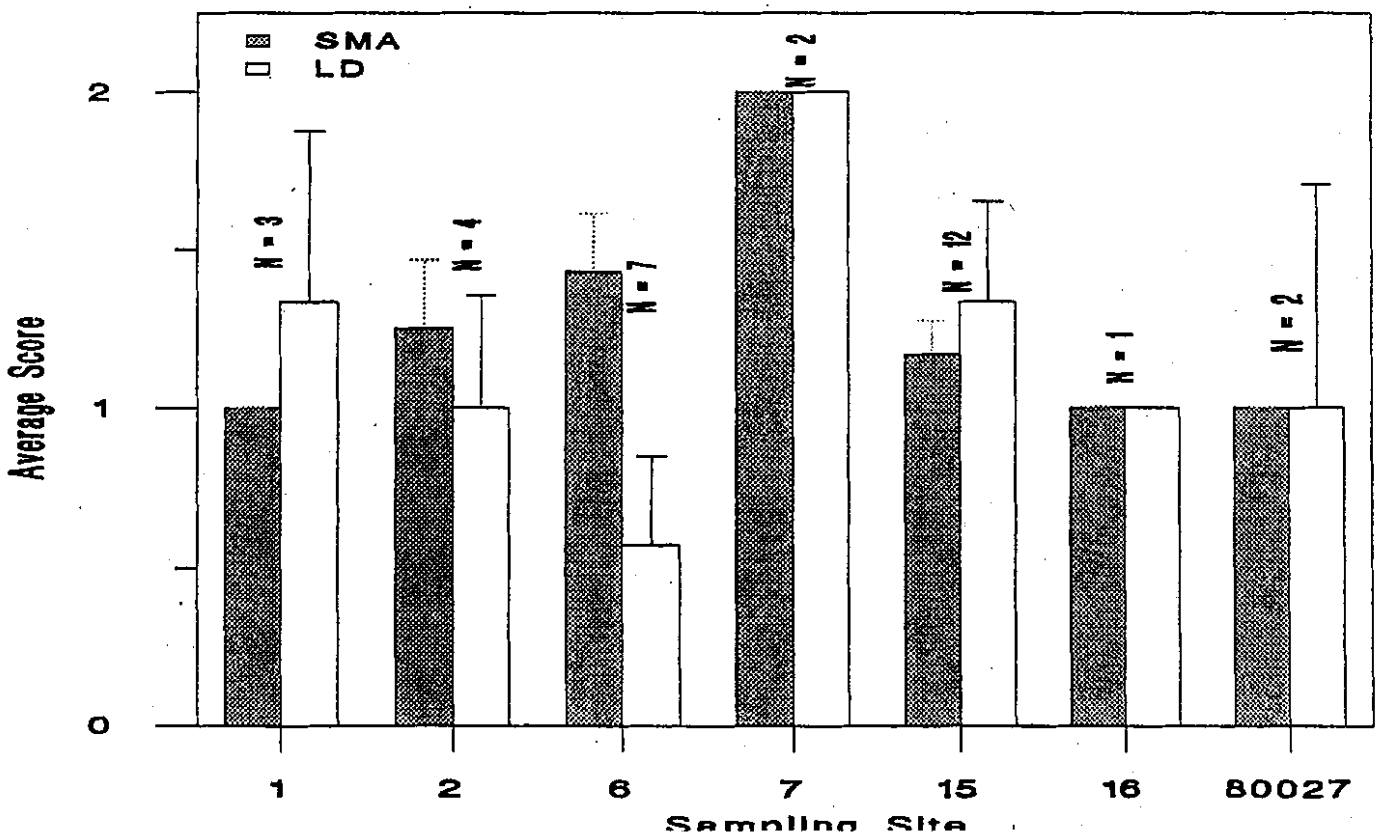
Graph 2a. Average Scores for Splenic Macrophage Aggregates (SMA) and Lymphoid Depletion (LD) in All Fish from All Sites.

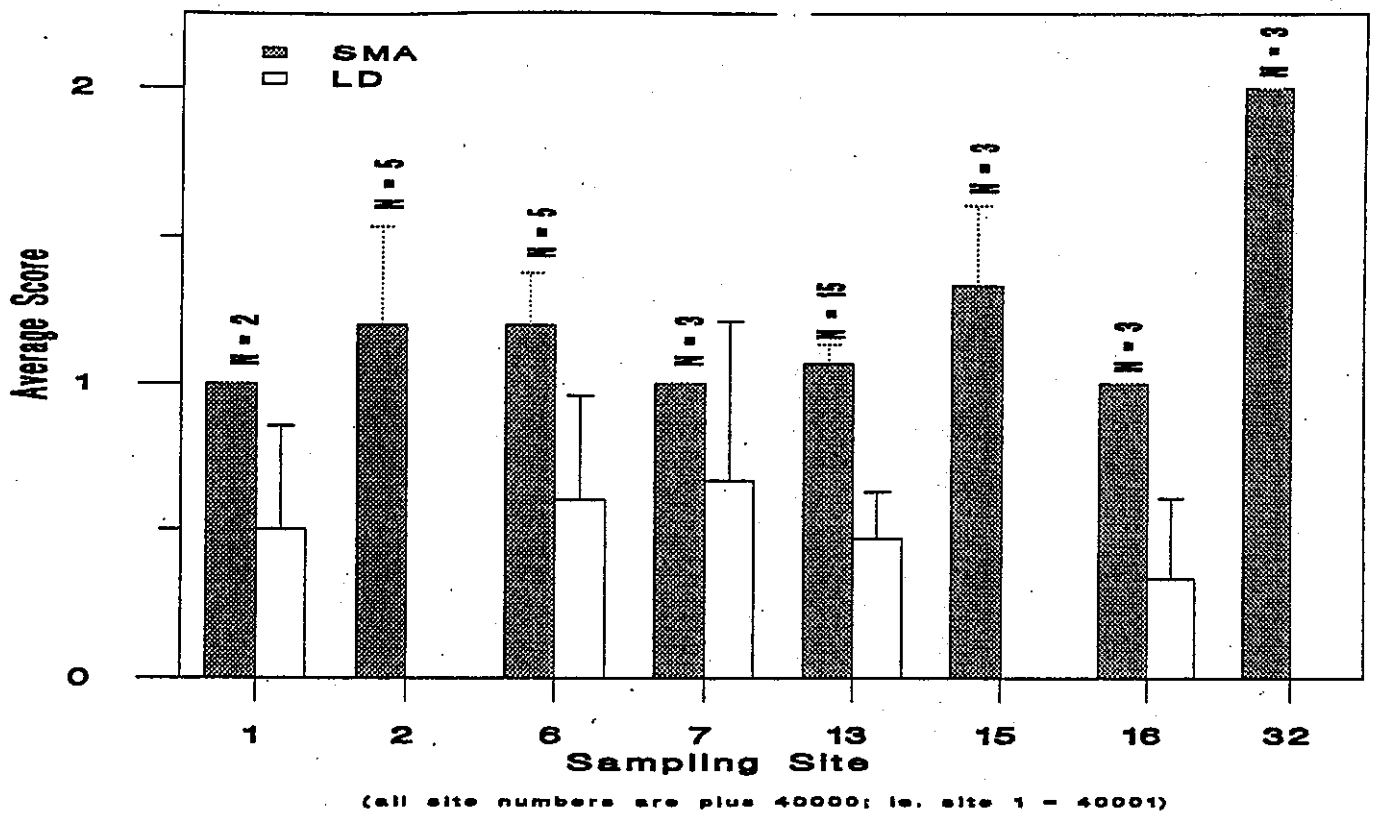


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

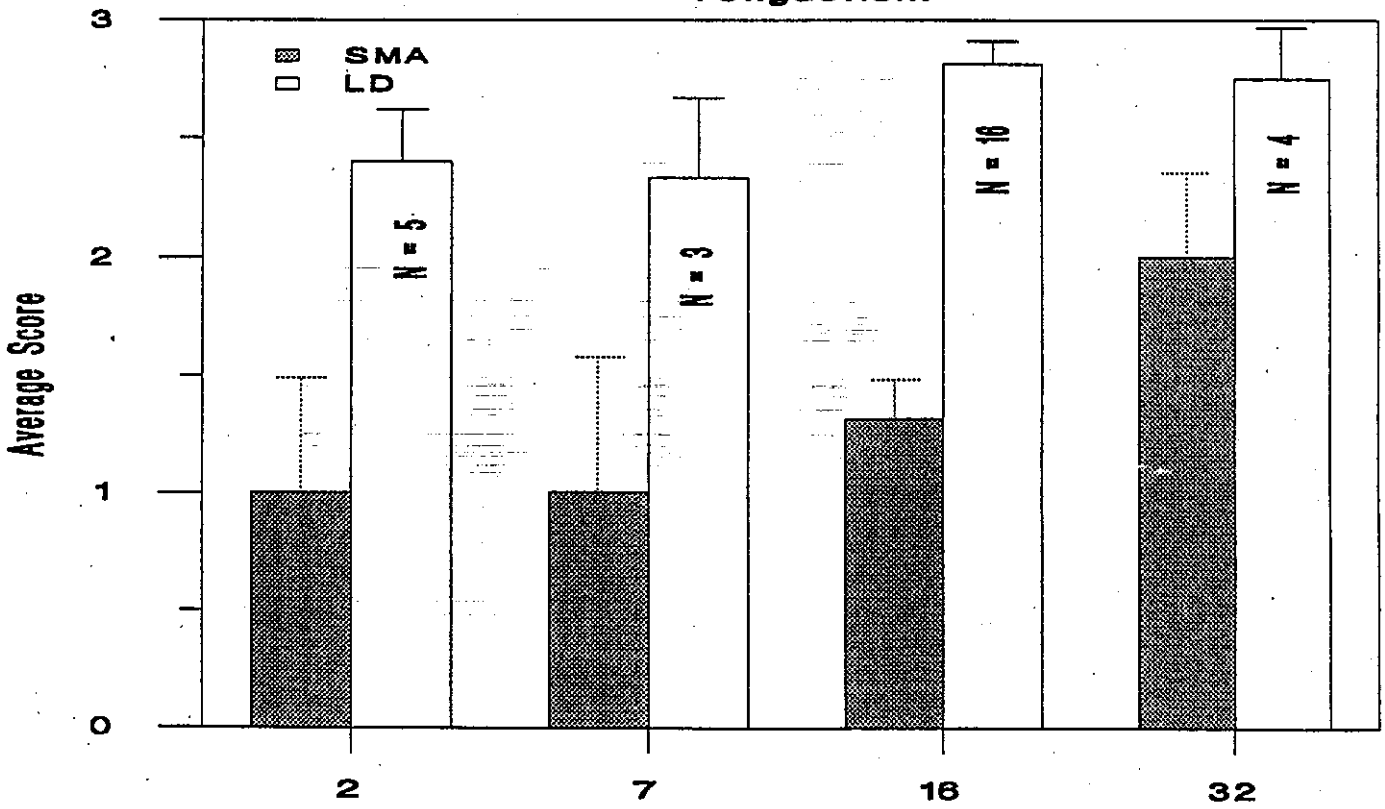
Graph 2b. Average Score for Splenic Macrophage Aggregates (SMA) and Lymphoid Depletion (LD) in Yellowfin Gobies.



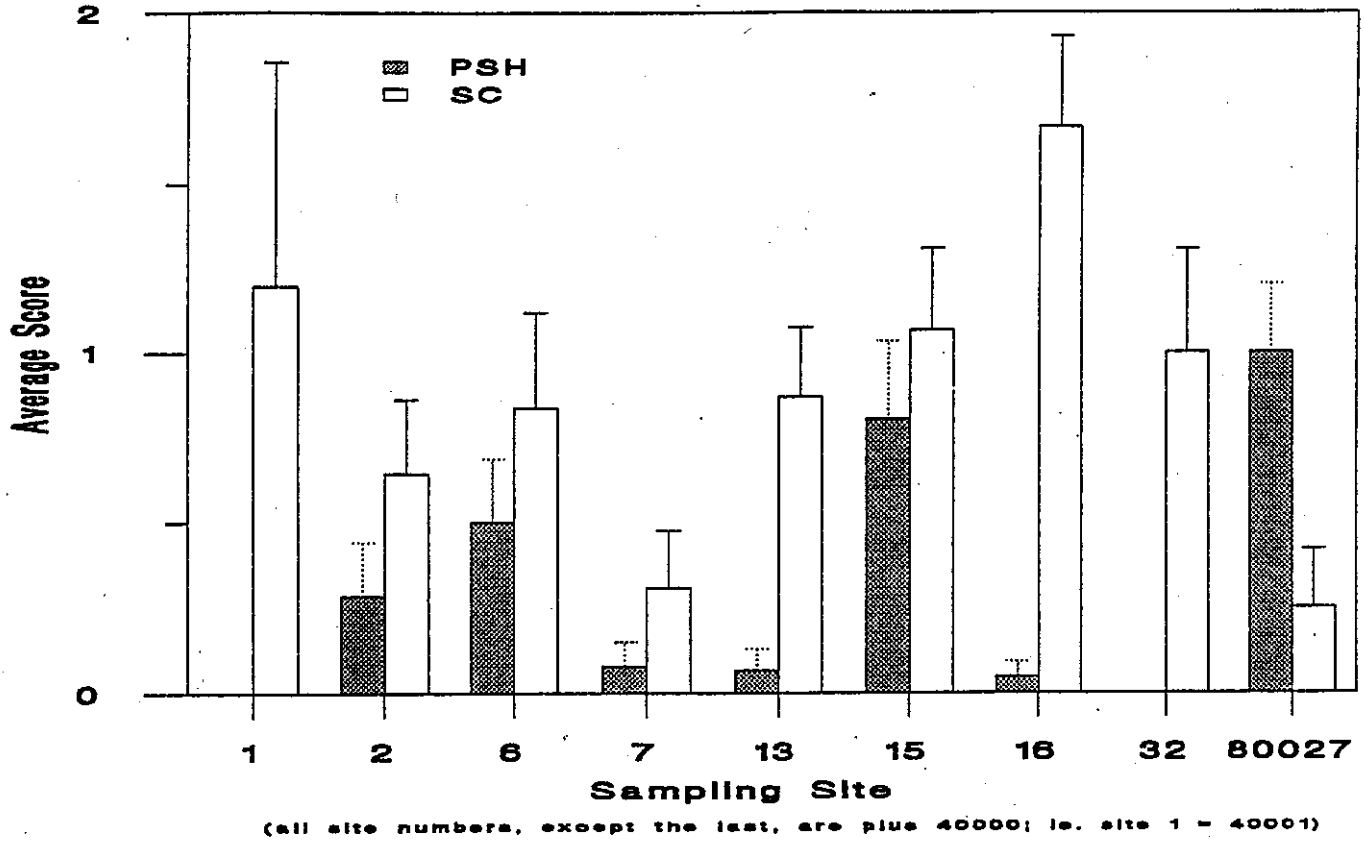
Graph 2c. Average Scores for Splenic Macrophage Aggregates (SMA) and Lymphoid Depletion (LD) in White Croakers.



Graph 2d. Average Scores for Splenic Macrophage Aggregates (SMA) and Lymphoid Depletion (LD) in Tonguefish.

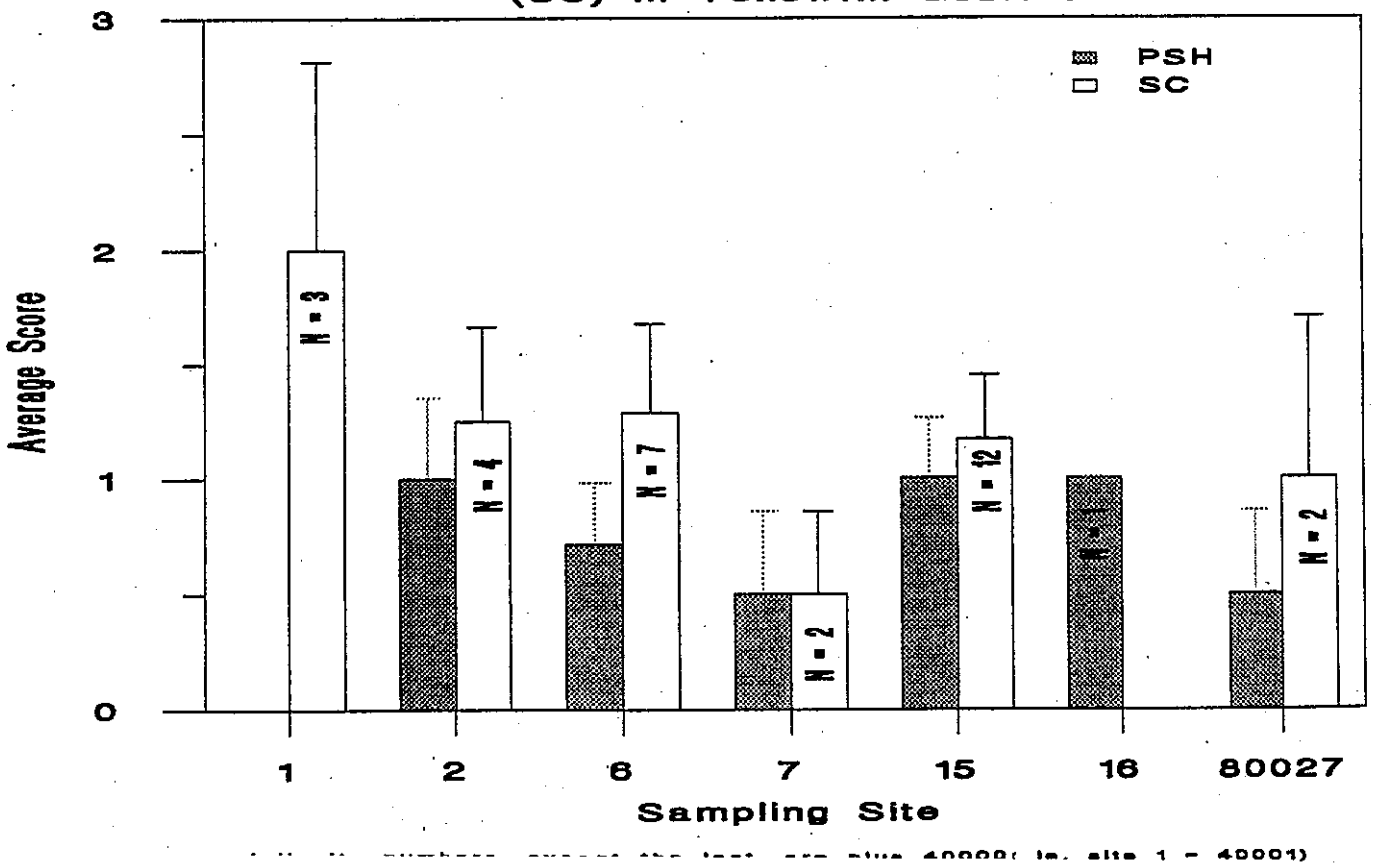


Graph 3a. Average Scores for Periarteriolar Sheath Hyperplasia (PSH) and Splenic Congestion (SC) in All Fish from All Sites.



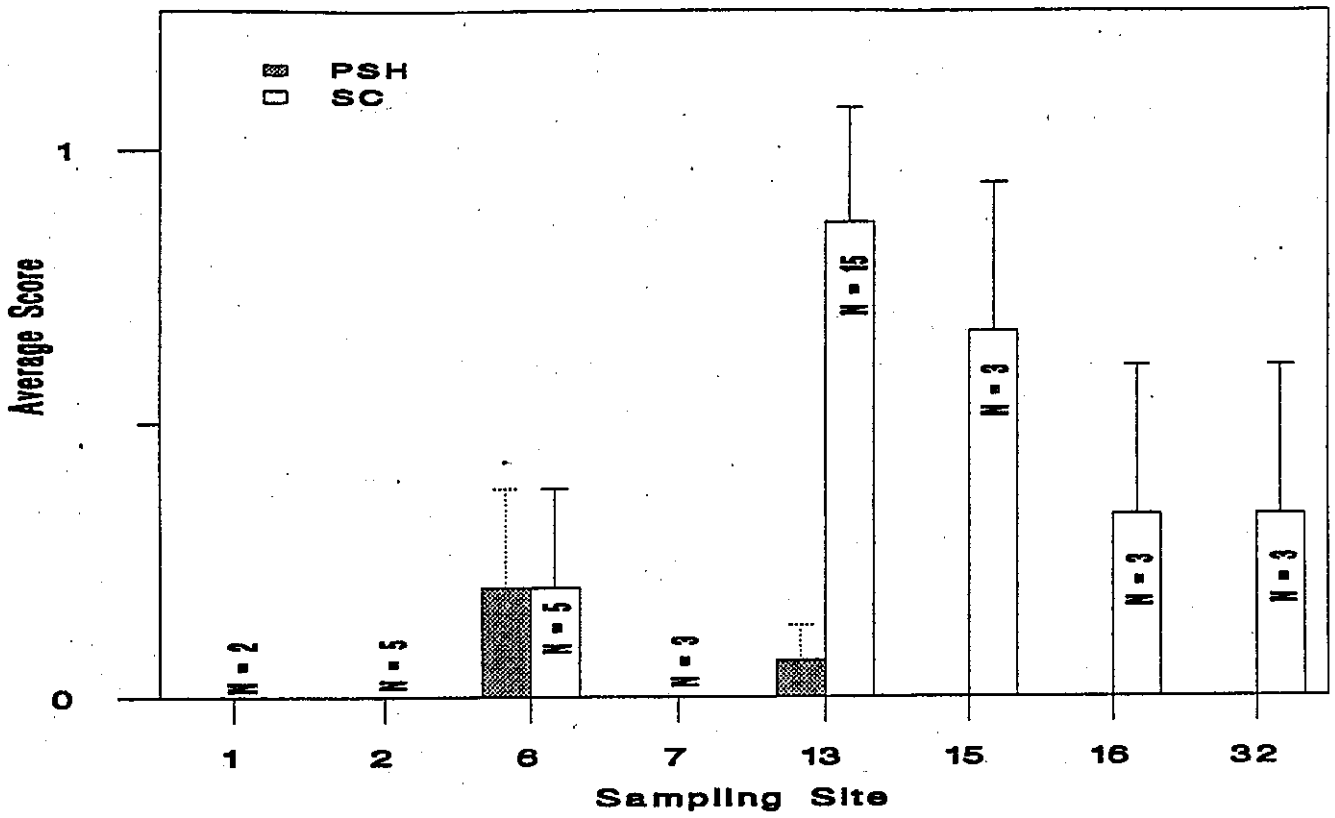
(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 3b. Average Scores for Periarteriolar Sheath Hyperplasia (PSH) and Splenic Congestion (SC) in Yellowfin Gobies.



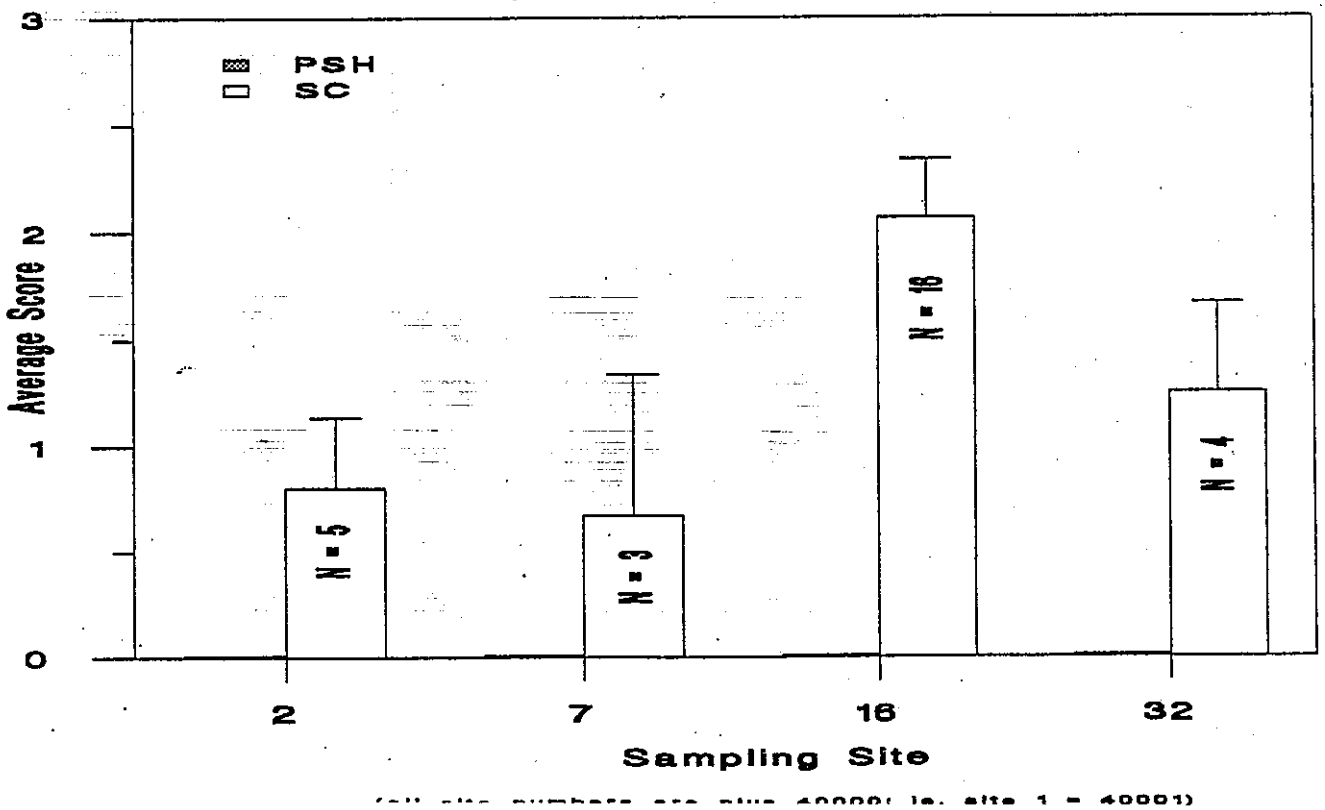
11907

Graph 3c. Average Scores for Periarteriolar Sheath Hyperplasia (PSH) and Splenic Congestion (SC) in White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 3d. Average Scores for Periarteriolar Sheath Hyperplasia (PSH) and Splenic Congestion (SC) in Tonguefish.



(all site numbers are plus 40000; ie. site 1 = 40001)

Histopathology - Results:

II. **Liver Lesions:**

A. **Hepatocyte Storage Defects:**

1. **Glycogen depletion (GD):** Hepatic glycogen depletion was a common finding. In contrast to "normal" liver with abundant glycogen stores (Figures 14 & 15), glycogen depleted livers were characterized by; decreased size of individual hepatocytes, loss of the "lacy" cytoplasmic vacuolation typical of glycogen, and increased cytoplasmic basophilia (Figure 16).

Type lesions for GD:

a. Score = 0; no glycogen depletion (type specimen = 8)
b. Score = 1; mild, glycogen vacuoles are present, vacuoles are smaller than normal, but larger than hepatocyte nuclei, hepatocytes are slightly smaller in size due to loss of glycogen (type specimen = 34)
c. Score = 2; moderate, glycogen vacuoles are present and the aggregate of vacuoles are smaller than hepatocyte nuclei, hepatocytes are moderately smaller than normal; or there is patchy loss of glycogen with some areas of mild glycogen depletion and other foci of complete glycogen depletion (type specimen = 16)
d. Score = 3; severe, glycogen vacuoles are absent from the majority of hepatocytes, hepatocytes may be significantly smaller than normal and are often markedly basophilic, glycogen vacuoles may be replaced by lipid vacuoles (type specimen = 21)

2. **Lipidosis (LIP):** Hepatic lipidosis was another common finding and was characterized by the presence of discrete, round, clear, cytoplasmic vacuoles. Hepatocytes were often enlarged and nuclei displaced to the periphery (Figure 17).

Type lesions for LIP:

a. Score = 0; no lipidosis (type specimen = 8)
b. Score = 1; mild, diffuse lipidosis with hepatocytes with small lipid vacuoles (vacuoles smaller than hepatocyte nuclei) or patchy lipidosis with scattered small foci of hepatocytes with large vacuoles (vacuoles larger than hepatocyte nuclei)(type specimen = 56)
c. Score = 2; moderate, diffuse lipidosis with 50-80% of hepatocytes with large vacuoles (type specimen = 11)
d. Score = 3; severe, diffuse lipidosis with 80-100% of hepatocytes with large lipid vacuoles, hepatocyte nuclei displaced to the periphery of the cell (type specimen = 15)

3. **Eosinophilic cytoplasmic inclusions (ECI):** Hepatocytes in a few livers had distinct, round, refractile, eosinophilic cytoplasmic inclusions (Figure 18).

Type lesions for ECI:

a. Score = 0; no inclusions (type specimen = 8)
b. Score = 1; <50% of hepatocytes have inclusions (type specimen = 56)
c. Score = 2; 50-80% of hepatocytes have inclusions (type specimen = 105)
d. Score = 3; 80-100% of hepatocytes have inclusions (type specimen = 67)

B. **Hepatic Inflammation (Hepatitis):**

1. **Macrophages:**

a. **Macrophage Aggregates (HMA):** The majority of macrophage aggregates were clusters of mature macrophages packed with coarsely granular yellow-brown pigment (Figure 19). Occasionally, an aggregate would be composed of activated macrophages with little or no pigment.

Type lesions for HMA:

1) Score = 0; no MA (type specimen = 8)
2) Score = 1; <1 MA per 50X field (type specimen = 16)
3) Score = 2; 1-3 per 50X field (type specimen = 15)
4) Score = 3; >3 MA per 50X field (type specimen = 88)

b. **Melanomacrophages (MM):** Melanomacrophages were individual macrophages packed with dark brown-black melanin pigment and were characteristic of stingray livers (Figure 20).

Type lesions for MM:

1) Score = 0; none present (type specimen = 5)
2) Score = 1; <10 per 100X field (type specimen = 33)
3) Score = 2; 10-20 per 100X field (type specimen = 40)
4) Score = 3; >20 per 100X field (type specimen = 72)

c. **Granulomatous inflammation (HGI):** Granulomatous inflammation was a rare finding and not scored for. The lesion was characterized by infiltration of the hepatic parenchyma with a mixed population of mononuclear inflammatory cells; macrophages, lymphocytes, and multinucleated giant cells (Figure 21).

d. **Foreign body granulomas (FBG):** Foreign body granulomas were focal accumulations of macrophages, lymphocytes, and occasionally multinucleated giant cells, clustered around a foreign body (Figures 21 & 22). The foreign body could often be identified as a nematode larva.

Type lesions for FBG:

1) Score = 0; none present (type specimen = 8)
2) Score = 1; mild, <1 per 25X field (type specimen = 13)
3) Score = 2; moderate, 1-3 per 25X field (type specimen = none)
4) Score = 3; severe, >3 per 25X field or fewer large granulomas (type specimen = none)

2. **Lymphocytic inflammation (LYM):** Lymphocytic inflammation in the liver was an uncommon finding, except in stingrays. Lymphocytes were usually perivascular in location, but could occasionally be found within the parenchyma (Figure 23).

Type lesions for LYM:

a. Score = 0; no inflammation (type specimen = 8)
b. Score = 1; <1 per 50X field (type specimen = 32)
c. Score = 2; 1-3 per 50X field (type specimen = 33)
d. Score = 3; >3 per 50X field (type specimen = none)

C. **Hepatic Necrosis:**

1. **Focal necrosis (FN):** Focal necrosis was not observed.

2. **Individual hepatocyte necrosis (IHN):** Individual hepatocyte necrosis was occasionally seen and characterized by shrinkage, rounding up, cytoplasmic eosinophilia, and nuclear pyknosis (Figures 24 & 25). Necrotic hepatocytes were often phagocytized by macrophages.

Type lesions for IHN:

a. Score = 0; no necrosis (type specimen = 8)
b. Score = 1; <1 per 100X field (type specimen = 56)
c. Score = 2; 1-3 per 100X field (type specimen = 110)
d. Score = 3; >3 per 100X field (type specimen = 88)

D. **Hepatic Preneoplasia and Neoplasia:**

1. **Tinctorially Altered Foci (TAF):** TAF were a rare occurrence and characterized by small clusters of hepatocytes distinguished from the adjacent parenchyma by altered staining. Types of TAF include basophilic, eosinophilic, amphophilic, and clear cell. TAF were not scored on the basis of severity, but were simply counted and described. There were only four fish with TAF; two with basophilic foci (1 & 42), one with an amphophilic focus (95), and one with a clear cell focus (118).

2. **Liver neoplasms:** Neoplasms were not observed.

E. **Other liver lesions:**

1. **Megalocytosis (MEG):** Hepatocyte megalocytosis was characterized primarily by nuclear enlargement or karyomegaly (Figures 26 & 27). Hepatocytes were not considered megalocytes unless nuclei were at least twice the average size in the section. There was usually little or no cellular enlargement associated with karyomegalic nuclei.

   Type lesions for MEG:
   a. Score = 0; none present (type specimen = 8)
   b. Score = 1; <1 per 100X field (type specimen = 109)
   c. Score = 2; 1-3 per 100X field (type specimen = none)
   d. Score = 3; >3 per 100X field (type specimen = none)

2. **Fibrin whorls (FW):** Fibrin whorls were an unusual lesion and were seen only in stingray livers. Fibrin whorls were characterized by nodular accumulation of pale eosinophilic, acellular material which was fibrinous and laminated in irregular, concentric, laminated whorls (Figures 28 & 29). Small numbers of spindle cells mixed in with the fibrinous material.

   Type lesions for FW:
   a. Score = 0; none present (type specimen = 8)
   b. Score = 1; <1 per 25X field (type specimen = 5)
   c. Score = 2; 1-3 per 25X field (type specimen = none)
   d. Score = 3; >3 per 25X field (type specimen = none)

3. **Exocrine Pancreas (EP):** Exocrine pancreas was not a lesion, but was assessed on the basis of presence (1) or absence (0).

4. **Nematodes (NEM):** A few fish had small numbers of nematode larvae either in the capsule of the liver or hepatic parenchyma (Figure 22). The nematodes were usually associated with small granulomas.

Type lesions for NEM:

a. Score = 0; none present (type specimen = 8)
b. Score = 1; <1 per 25X field (type specimen = 13)
c. Score = 2; 1-3 per 25X field (type specimen = none)
d. Score = 3; >3 per 25X field (type specimen = none)

5. **Hyalinization of Vessel Walls (HVW):** A few fish had mild to moderate intimal and medial thickening of hepatic blood vessels (both arteries and veins). The thickening was often irregular and composed of pale eosinophilic to eosinophilic, acellular, amorphous, acellular material. In some vessels, this hyalin thickening was associated with mixed mononuclear and EGL inflammation.

Type lesions for HVW:

a. Score = 0; none present (type specimen = 8)
b. Score = 1; <3 vessels per 25X field (type specimen = 1)
c. Score = 2; 3-5 vessels per 25X field (type specimen = none)
d. Score = 3; >5 vessels per 25X field (type specimen = none)

Figure 14. Liver of fish 93H63-8 (white croaker from site 40013) with no lesions. Hepatocytes are laden with glycogen and exocrine pancreatic cells (arrow) have abundant zymogen granules. HE 25X.

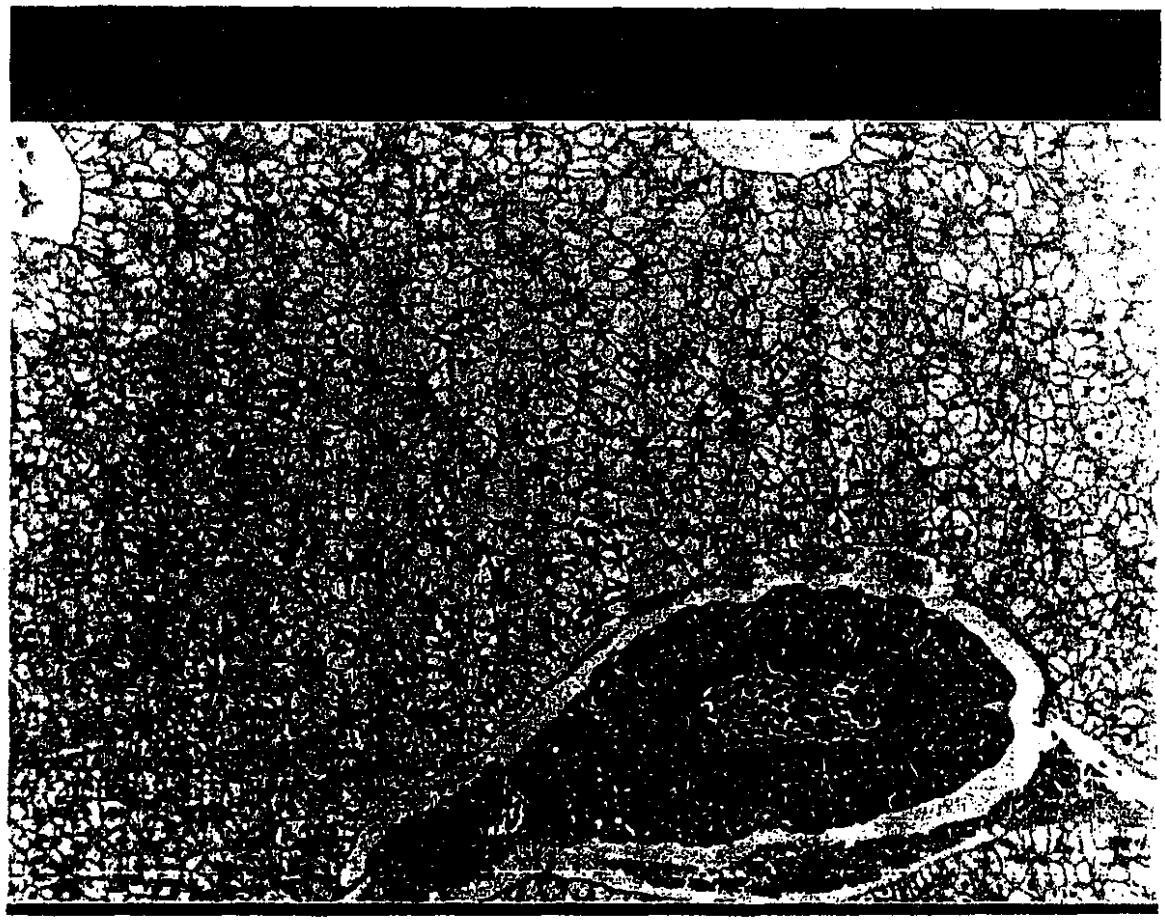


Figure 15. Higher magnification of figure 14. Note the normal

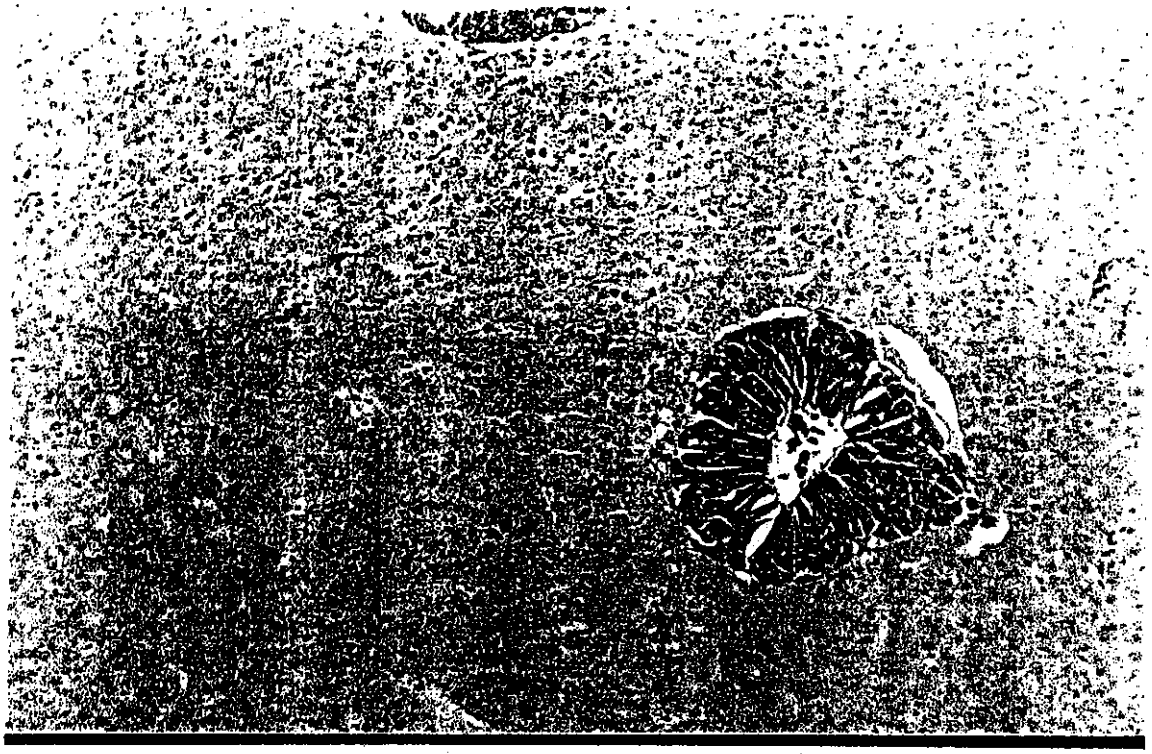
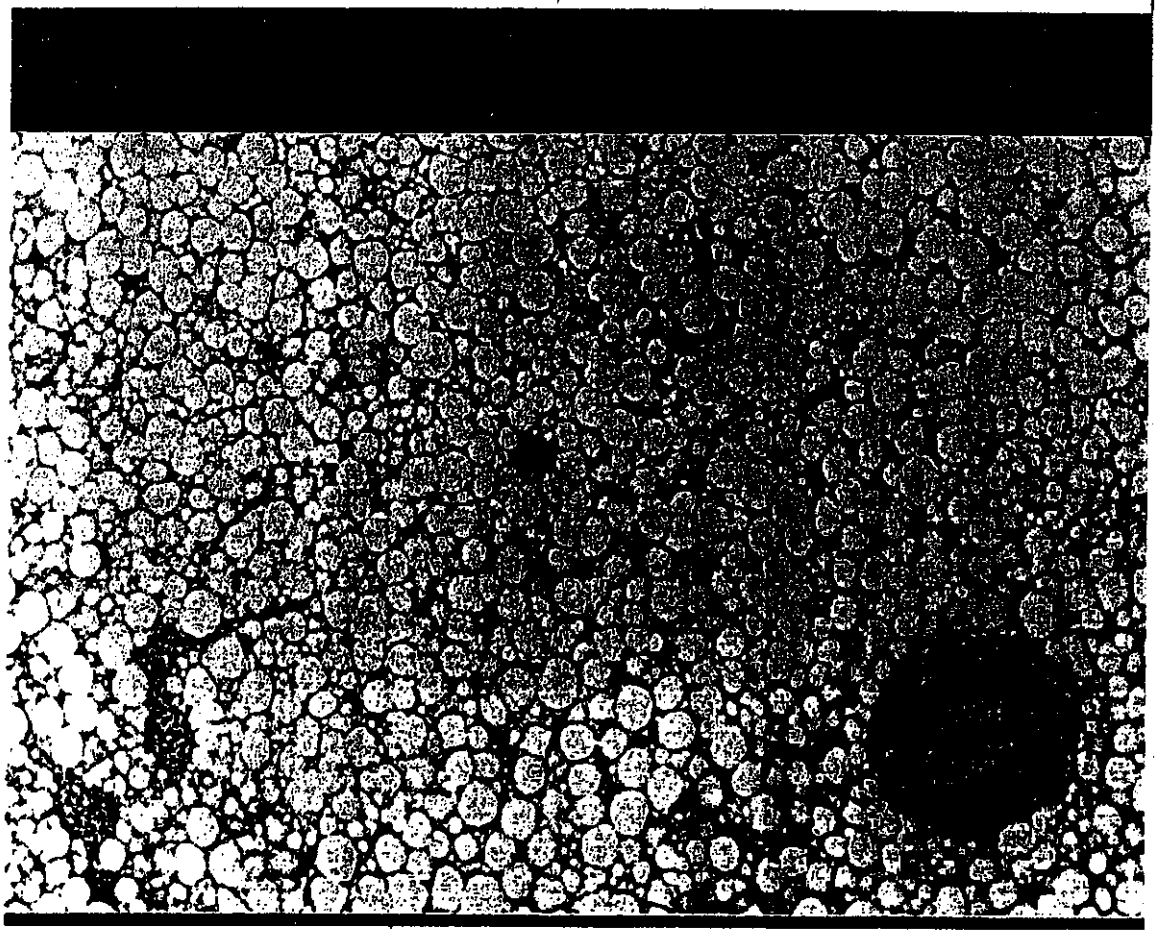


Figure 16. Liver of fish 93H63-21 (white croaker from site 40032) with severe glycogen depletion. Note hepatocytes are devoid of cytoplasmic vacuoles indicative of glycogen. HE 50X.



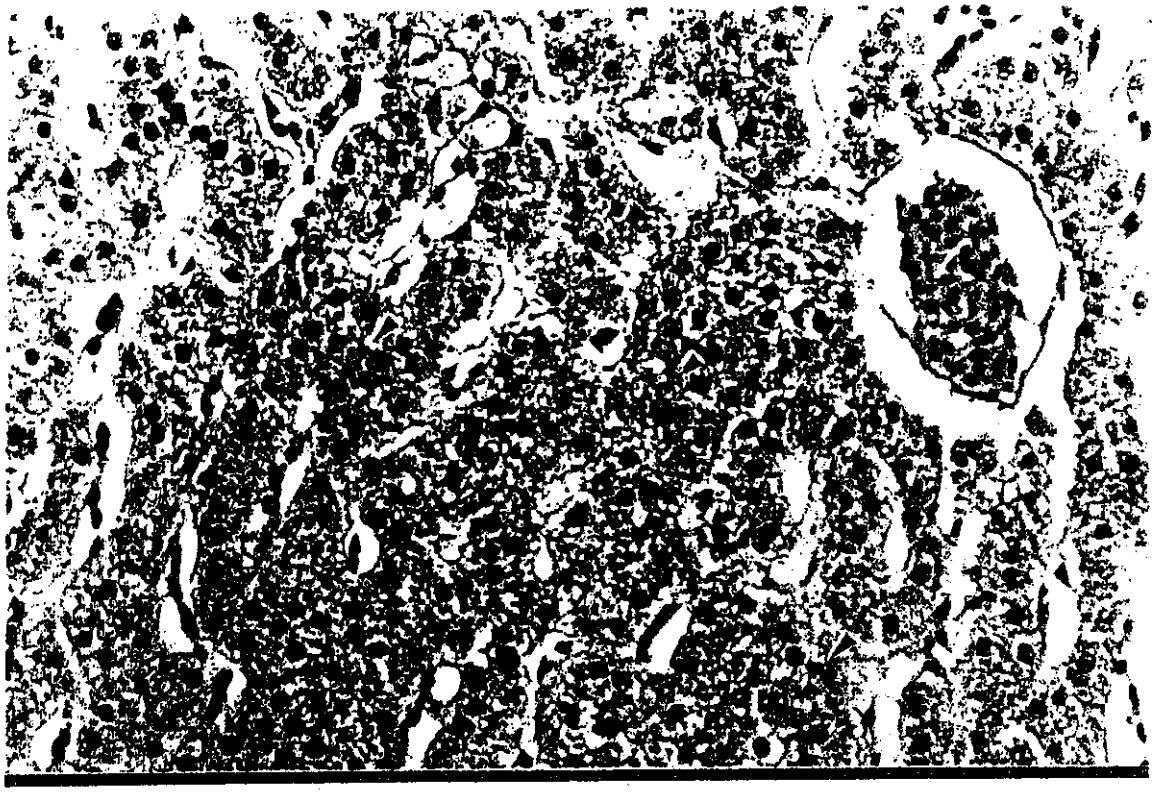


Figure 18. Liver of fish 93H63-67 (tonguefish from site 40002) with large numbers of eosinophilic cytoplasmic inclusions (arrowheads). HE 132X.

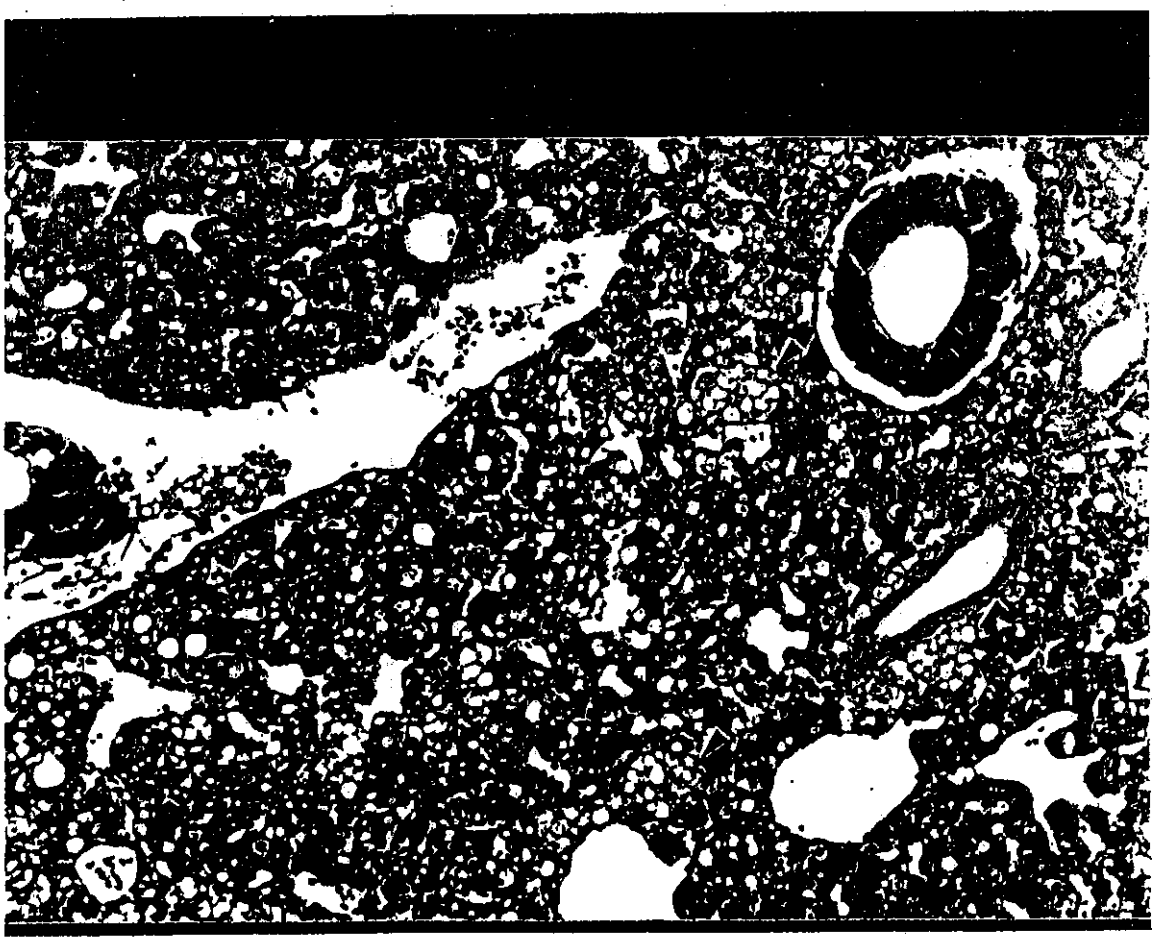


Figure 19. Liver of fish 93H63-88 (yellowfin goby from site 40015)

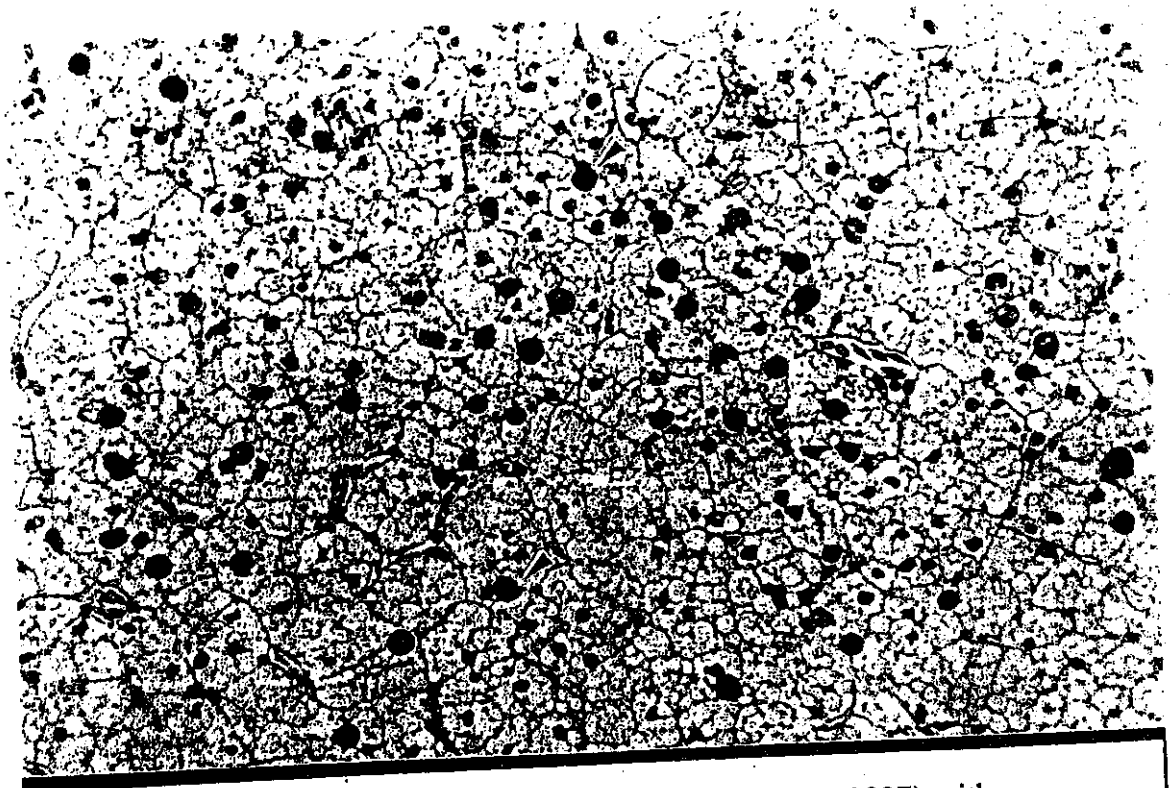


Figure 20. Liver of fish 93H63-14 (stingray from site 80027) with large numbers of melanomacrophages (arrowheads). Hepatocytes are packed with lipid. HE 50X.

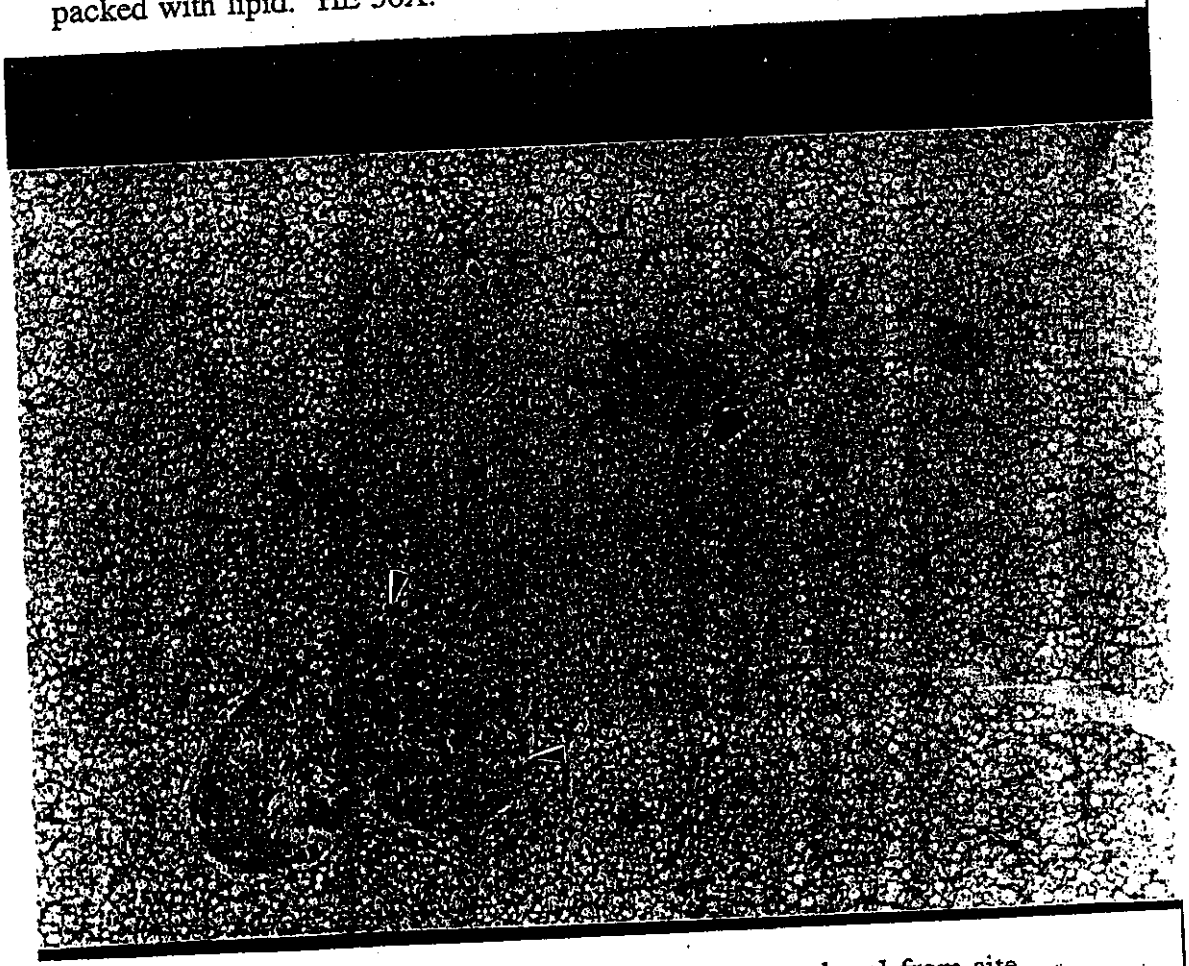
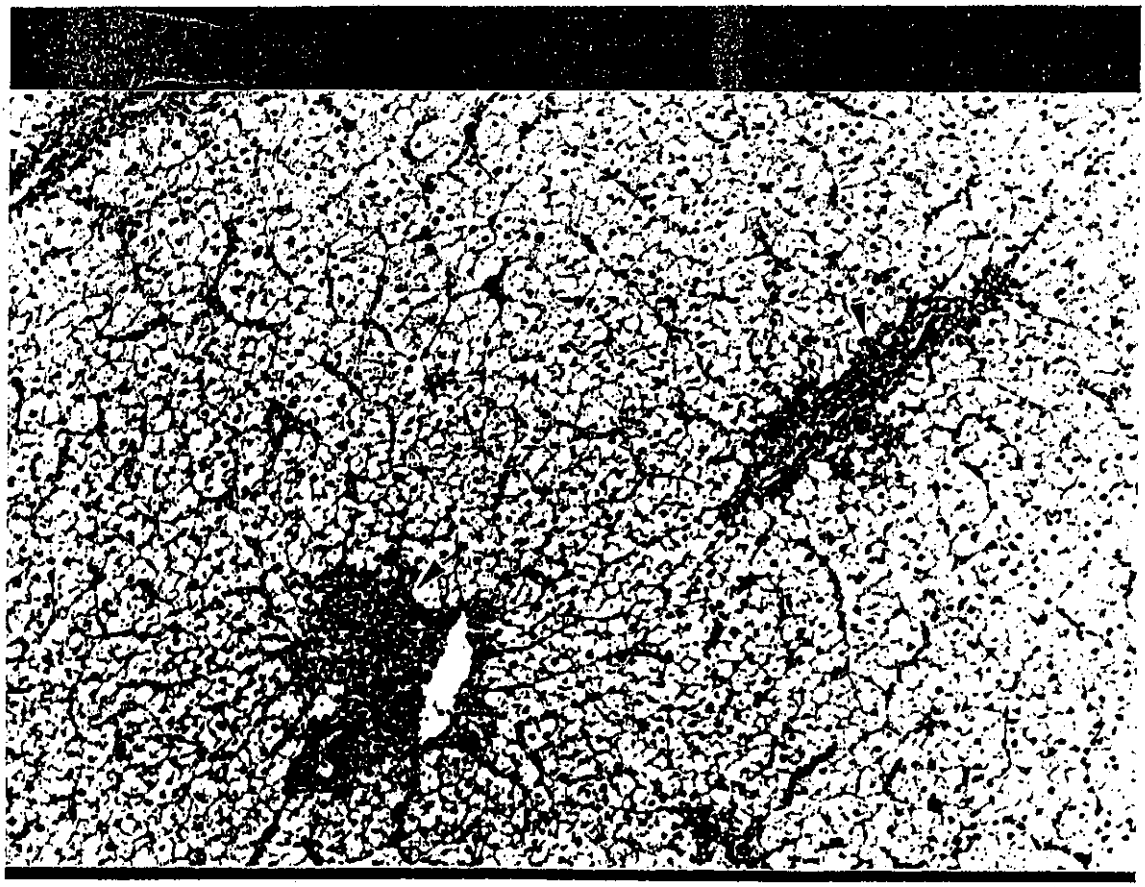


Figure 21. Liver of fish 93H63-13 (basketweave cusk-eel from site [illegible] large focus of granulomatous

Figure 22. Liver of fish 93H63-13 (basketweave cusk-eel from site 40016) with severe lipidosis. There are several granulomas on the hepatic capsule and many are centered around nematode larvae (arrowheads). HE 50X.



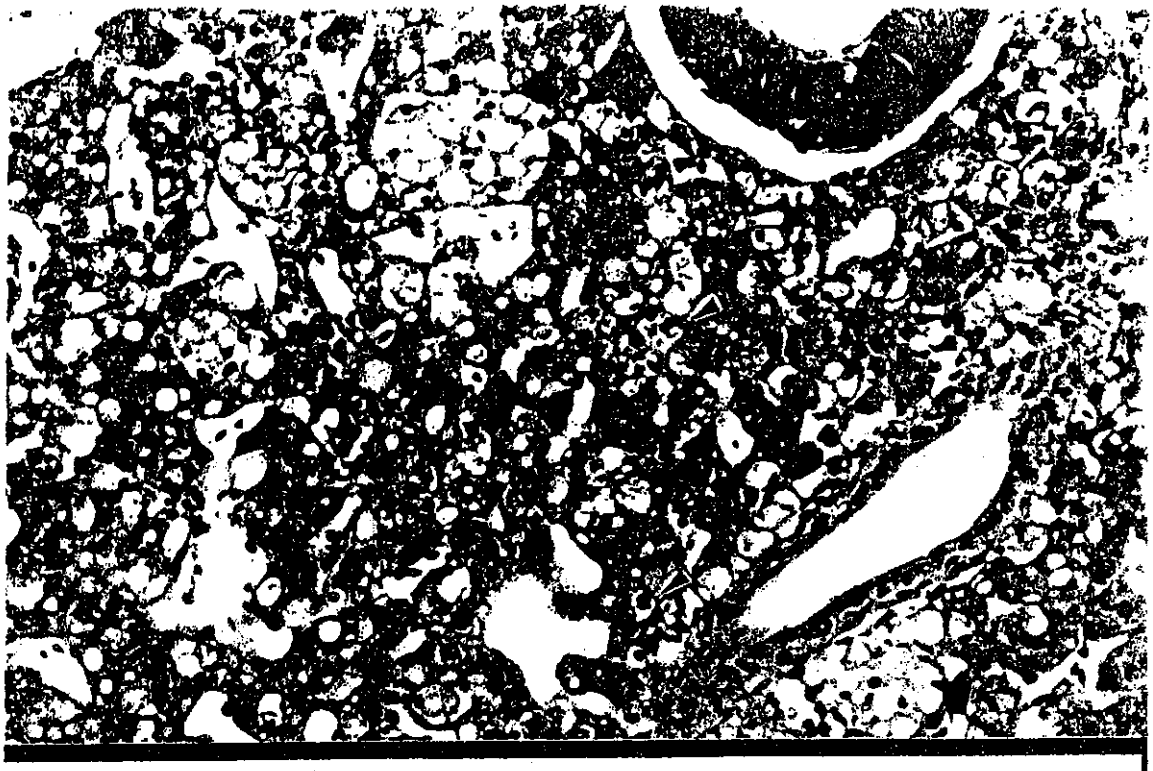


Figure 24. Liver of fish 93H63-88 (yellowfin goby from site 40015) with severe necrosis of individual hepatocytes (arrowheads) and numerous macrophage aggregates (arrows). HE 100X.

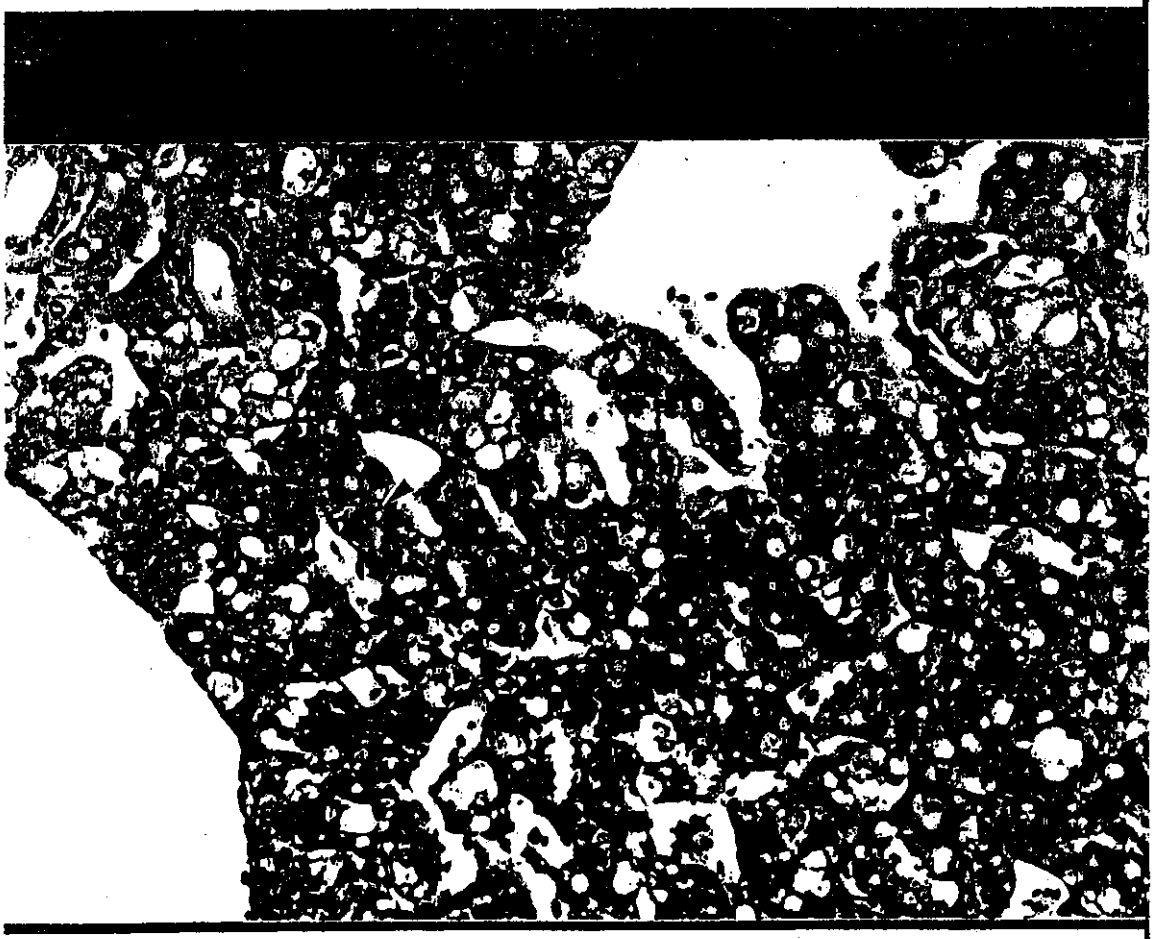


Figure 25. Liver of fish 93H63-88 (yellowfin goby from site 40015). Necrotic hepatocytes (arrowhead) are characterized by cytoplasmic

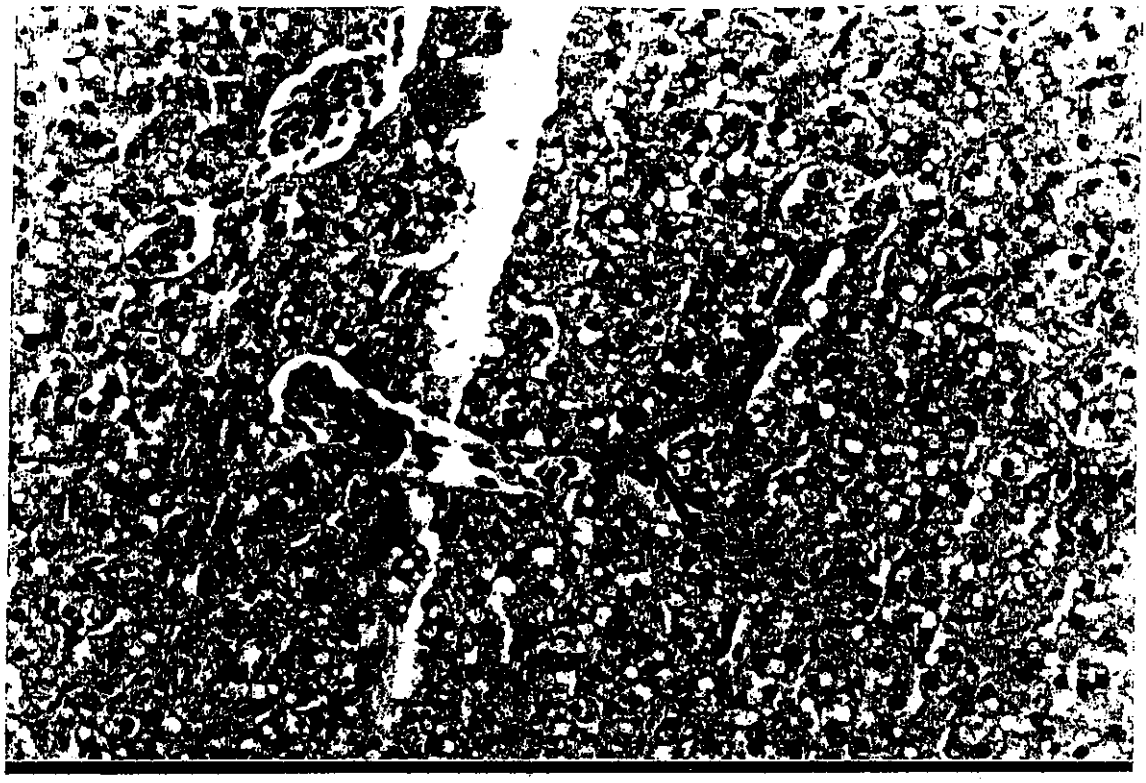


Figure 26. Liver of fish 93H63-109 (yellowfin goby from site 40002). The liver has severe glycogen depletion and mild lipidosis. There are scattered megalocytes (arrow) present. HE 100X.

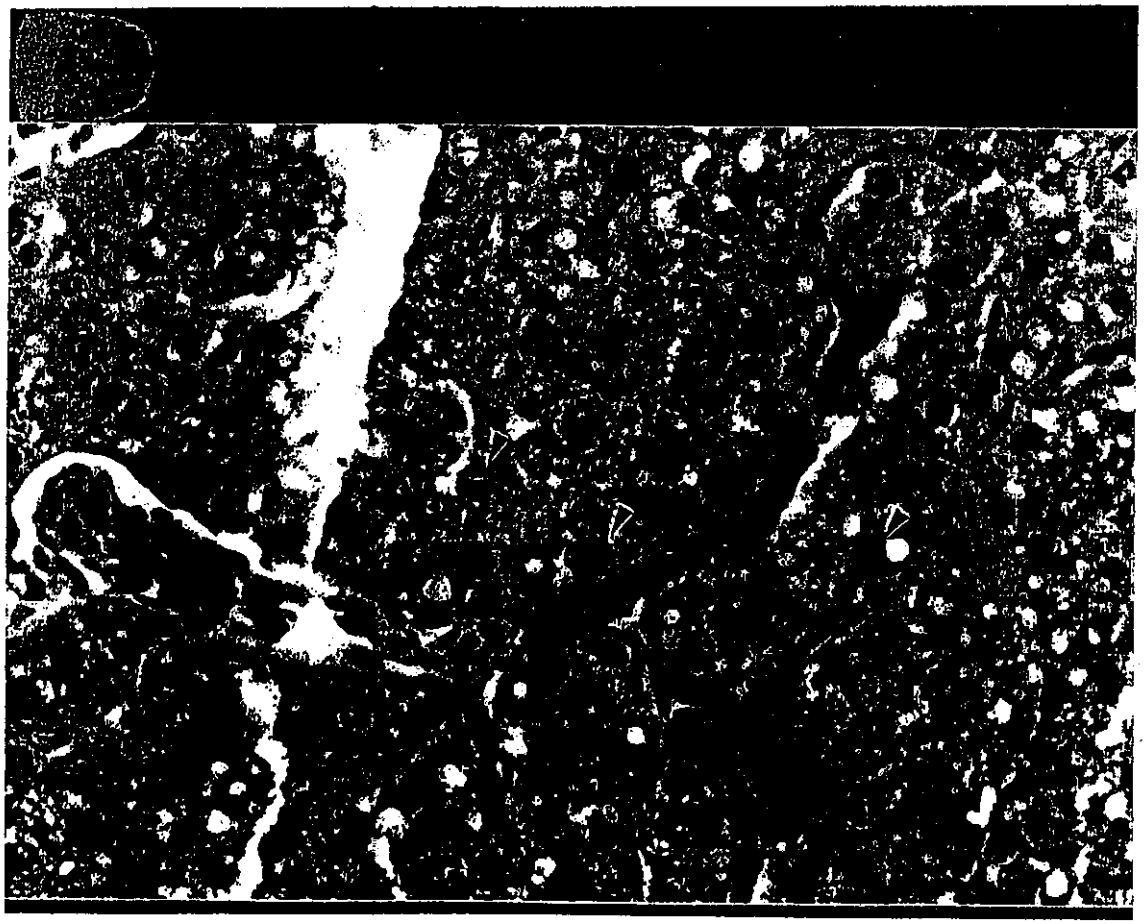


Figure 27. Higher magnification of figure 26. Megalocytes

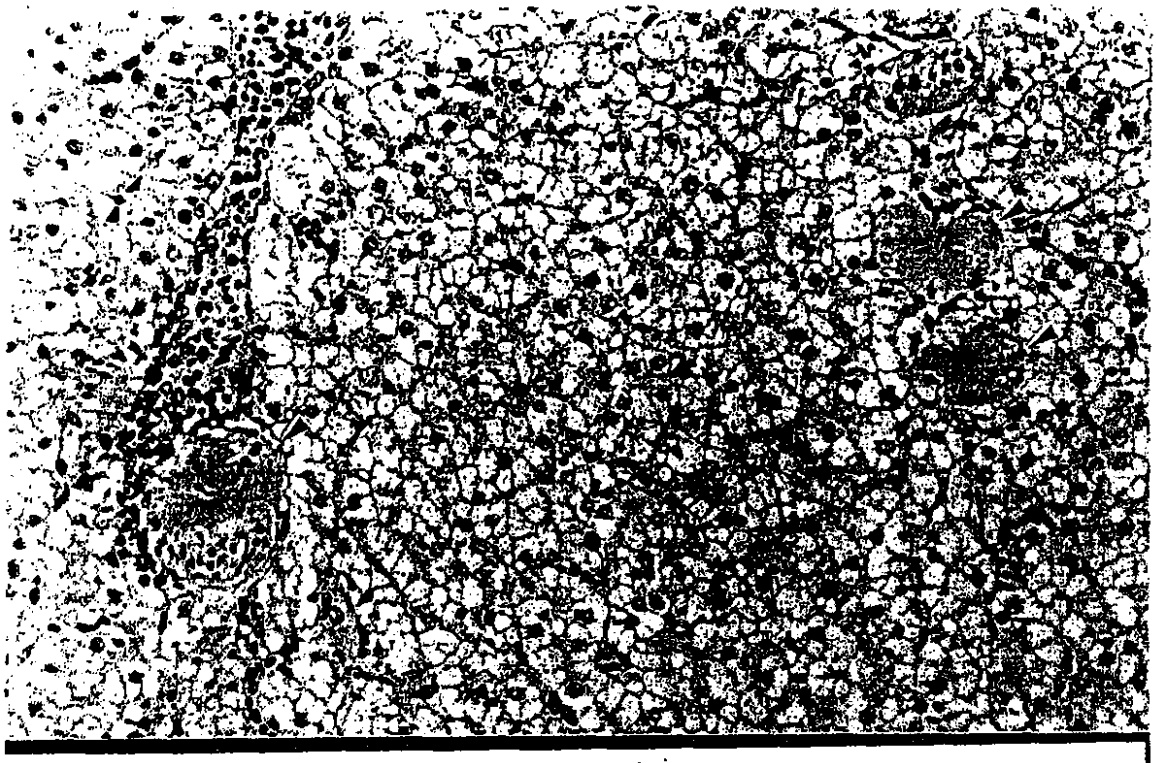


Figure 28. Liver of fish 93H63-5 (stingray from site 80027) with numerous fibrin whorls (arrowheads). HE 50X.

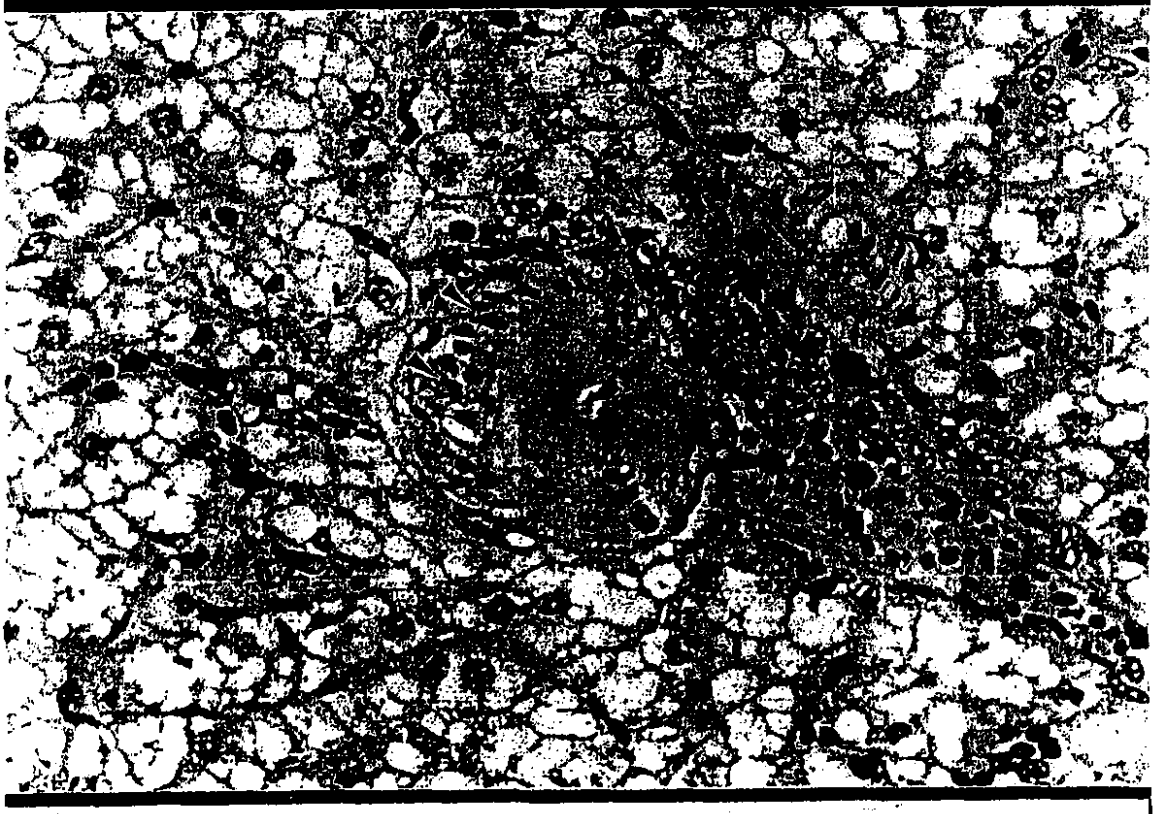


Figure 29. Higher magnification of figure 28. Note the laminated

Histopathology - Results:

Hepatic Histopathology Summary: Hepatic lesion scores are given in appendix 15. Appendices 15a-15c include scores for all fish from all sites sorted on the basis of site. Average scores and standard error were computed for each lesion. Appendices 15d-15h lesion scores sorted on the basis of both site and species.

Average lesion scores for three species (gobies, croakers, and tonguefish), which were found at more than one site, are depicted in graphs 4-6. Graph 4a shows average lesion scores for three hepatic storage defects; glycogen depletion (GD), lipidosis (LIP), and eosinophilic cytoplasmic inclusions (ECI). Average scores for GD, LIP, and ECI were consistently lower at two reference sites (40016 and 40032) when compared to five of the six impact sites. The primary exceptions to this trend were impact site 40013 which had lower average scores than all three reference sites and reference site 40015 which had the highest average scores for both GD and LIP. Site 40015 also had some ECI, whereas the other two reference sites had no ECI.

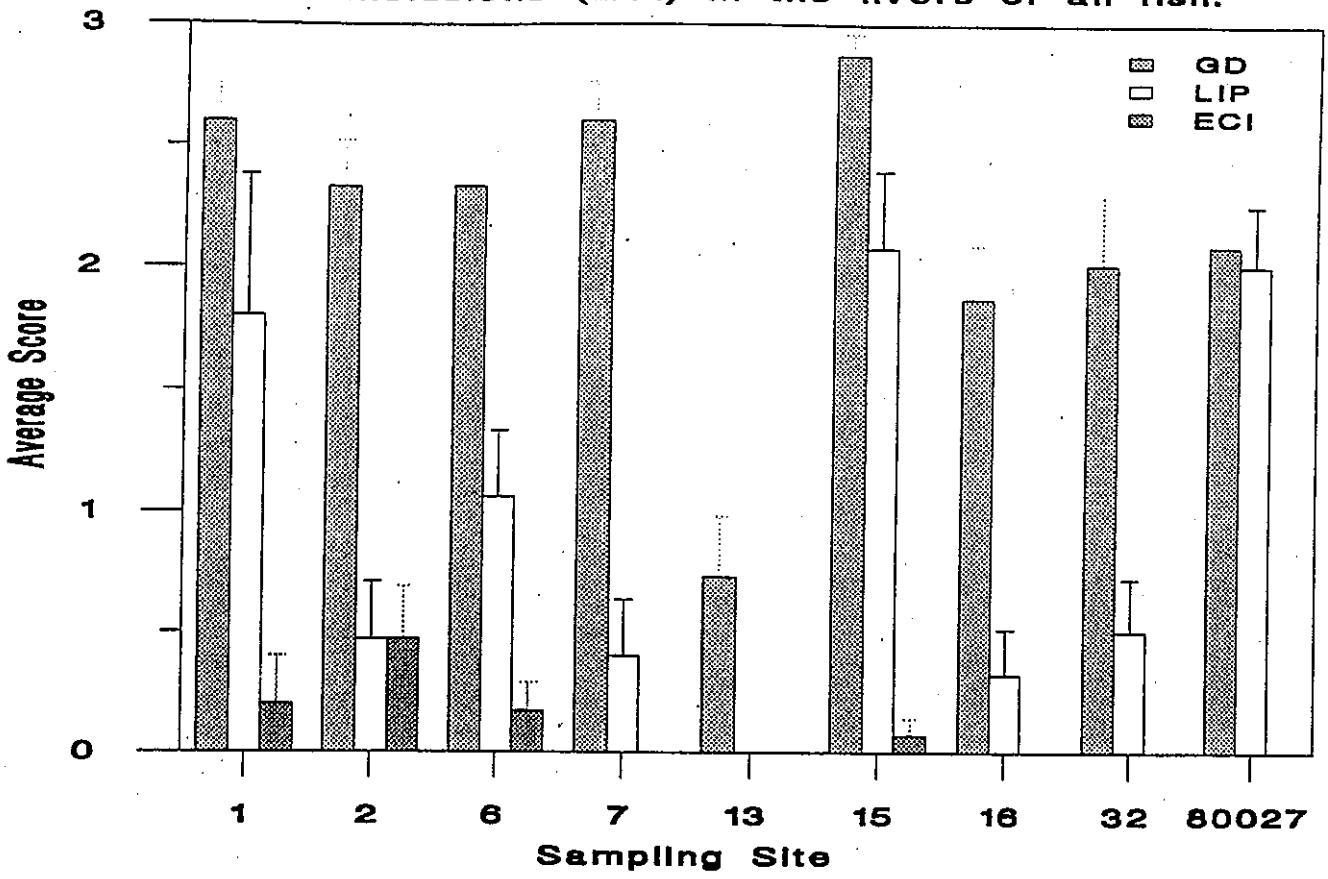
Further separation of average lesion scores on the basis of species revealed that there were some significant differences between species. With gobies (graph 4b), ECI correlated well with three of five impact sites, but there were no striking differences with respect to GD, and LIP tended to be lower at the two reference sites. With croakers, low levels of LIP were consistently found at the impact sites (versus none at the two reference sites), but there were no obvious trends with either GD or ECI. In tonguefish, GD scores were higher at the two impact sites when compared to two reference sites, and the only site with any ECI was at one of the impact sites.

Graph 5a depicts average lesion scores for hepatic macrophage aggregates (HMA), individual hepatocyte necrosis (IHN), and megalocytes (MEG). There were no obvious trends with respect to any of the three lesions. Sorting of the data on the basis of species revealed that average HMA scores for gobies (graph 5b) were highest at impact site 40001 and that gobies from impact site 40002 had an average MEG score which was markedly higher than that in the two reference sites. With croakers, there were no consistent trends with respect to HMA and IHN, but two impact sites had low levels of MEG while the three reference sites had none. In tonguefish, the only consistent finding was higher average HMA score at the two reference sites.

Graph 6a shows average lesion scores for foci of cellular alteration (FCA) and hyalinization of vessel walls (HVW) for all fish from all sites. There were no consistent trends. Additional sorting based on species revealed higher average HVW score in both gobies and croakers from impact sites when compared to the same species from reference sites. With tonguefish, the opposite trend was in effect, with the two reference sites having higher HVW scores than the two impact sites.

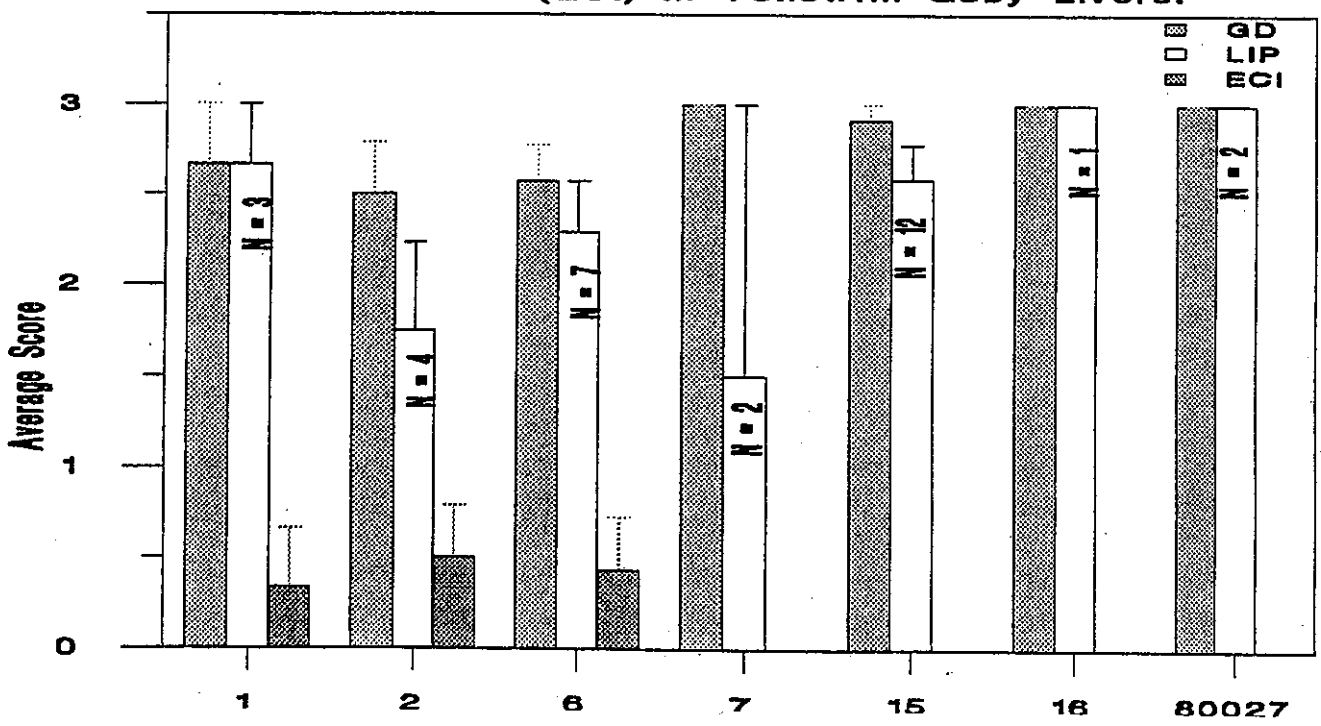
Hepatic Histopathology - Statistics: Hepatic lesion scores were statistically analyzed together with splenic lesion scores. Principal components Analysis (PCA) was covered in the splenic histopathology statistics section and in the material and methods. None of the hepatic lesions were significantly higher in the six impact sites when compared to the three reference sites. All comparisons were made between individual impact and reference sites.

Graph 4a. Average Scores for Glycogen Depletion (GD), Lipidosis (LIP), and Eosinophilic Cytoplasmic Inclusions (ECI) in the livers of all fish.

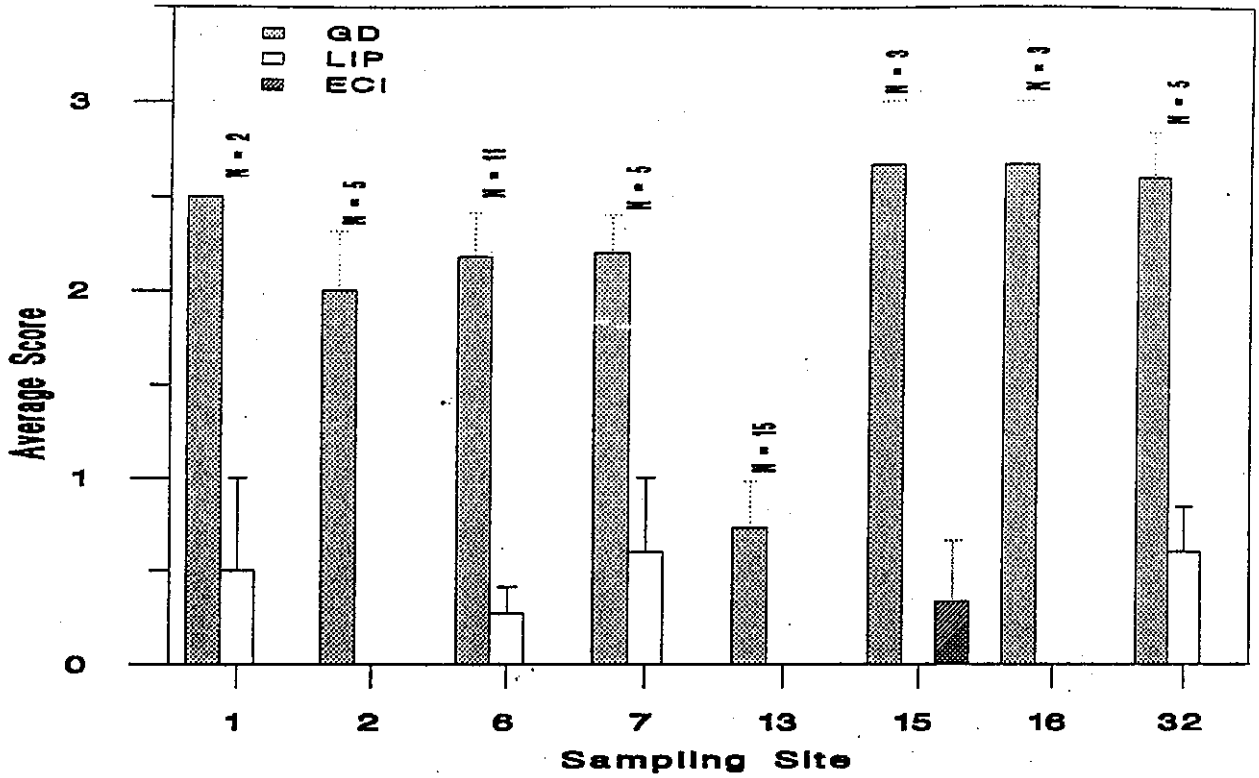


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 4b. Average Scores for Glycogen Depletion (GD), Lipidosis (LIP), and Eosinophilic Cytoplasmic Inclusions (ECI) in Yellowfin Goby Livers.

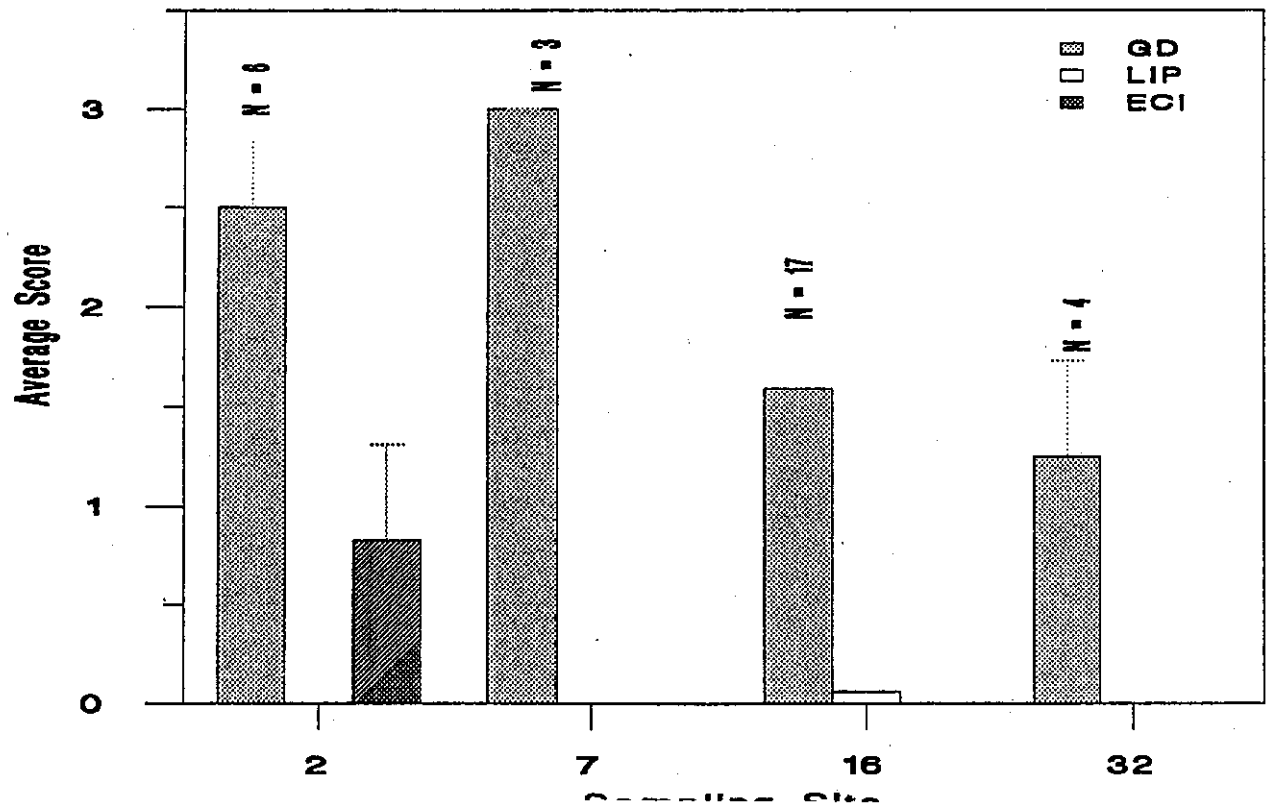


Graph 4c. Average Scores for Glycogen Depletion (GD), Lipidosis (LIP), and Eosinophilic Cytoplasmic Inclusions (ECI) in White Croaker Livers.

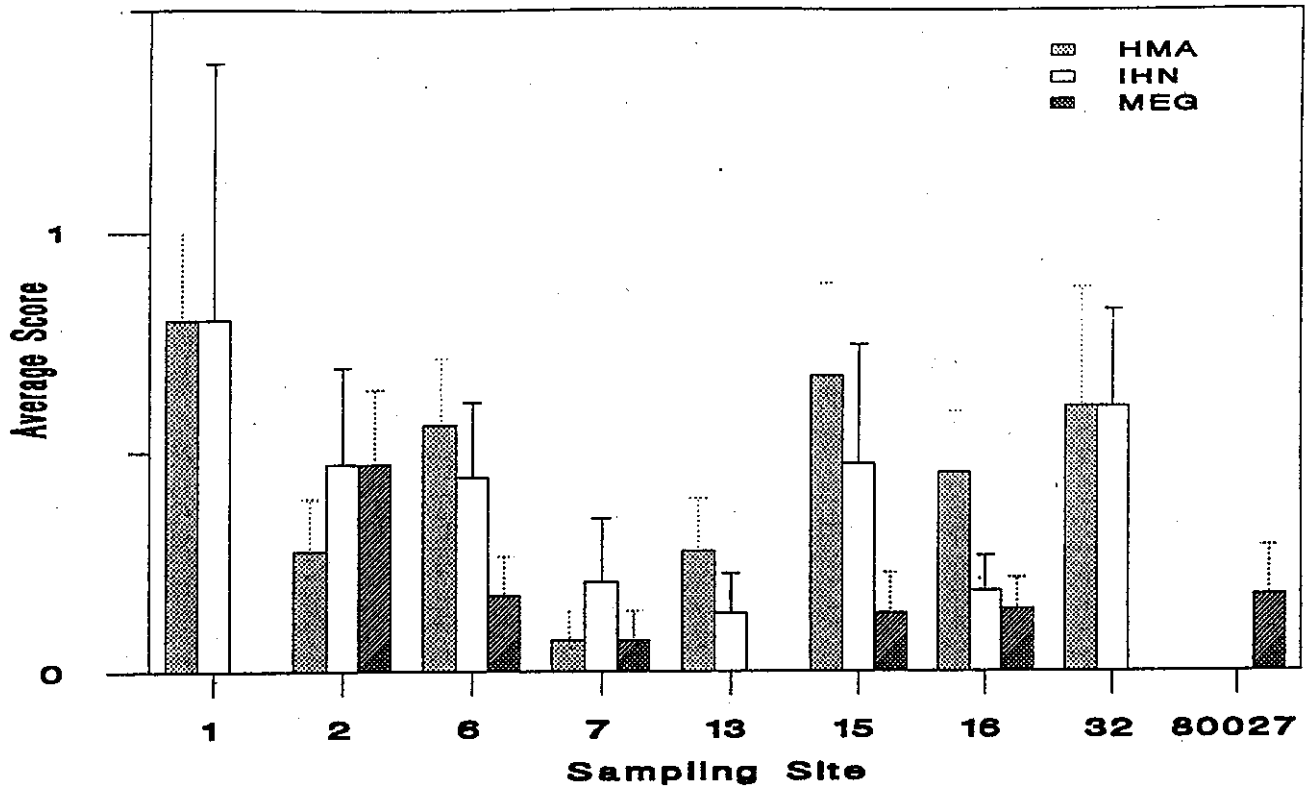


(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 4d. Average Scores for Glycogen Depletion (GD), Lipidosis (LIP), and Eosinophilic Cytoplasmic Inclusions (ECI) in Tonguefish Livers.

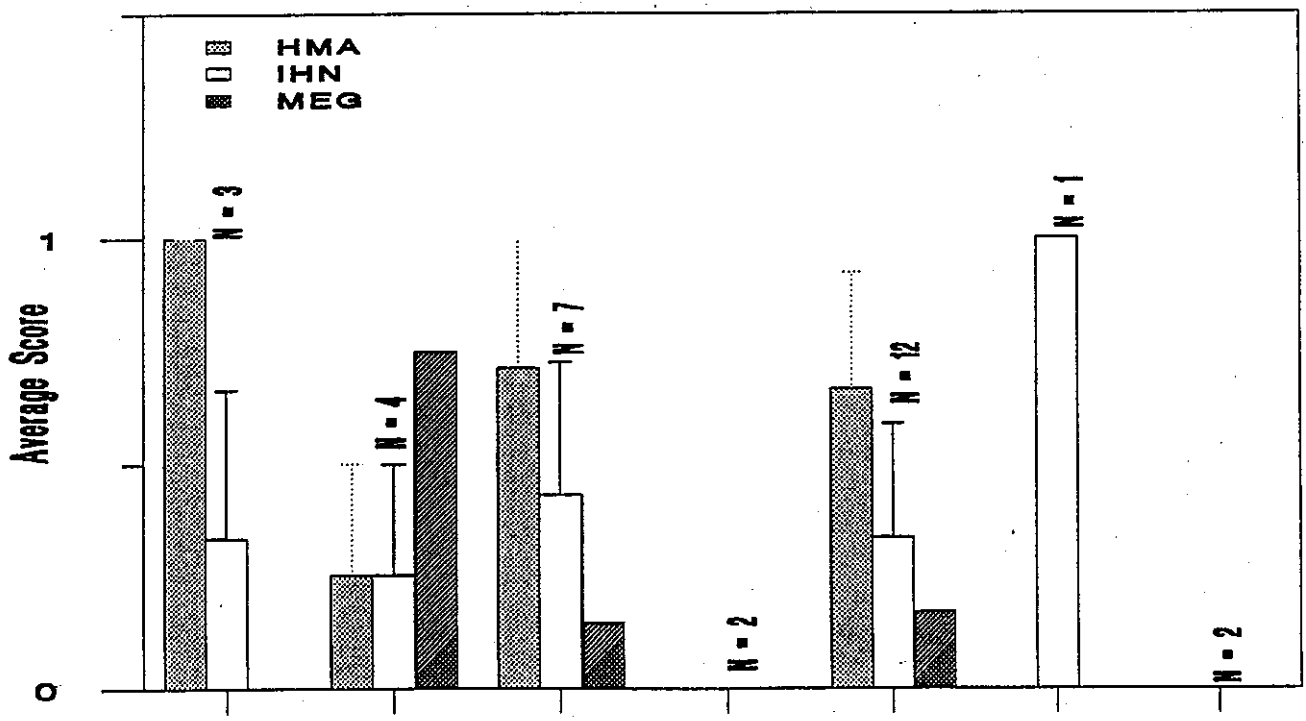


Graph 5a. Average Scores for Hepatocyte Macrophage Aggregates (HMA), Individual Hepatocyte Necrosis (IHN), and Megalocytosis in all fish.

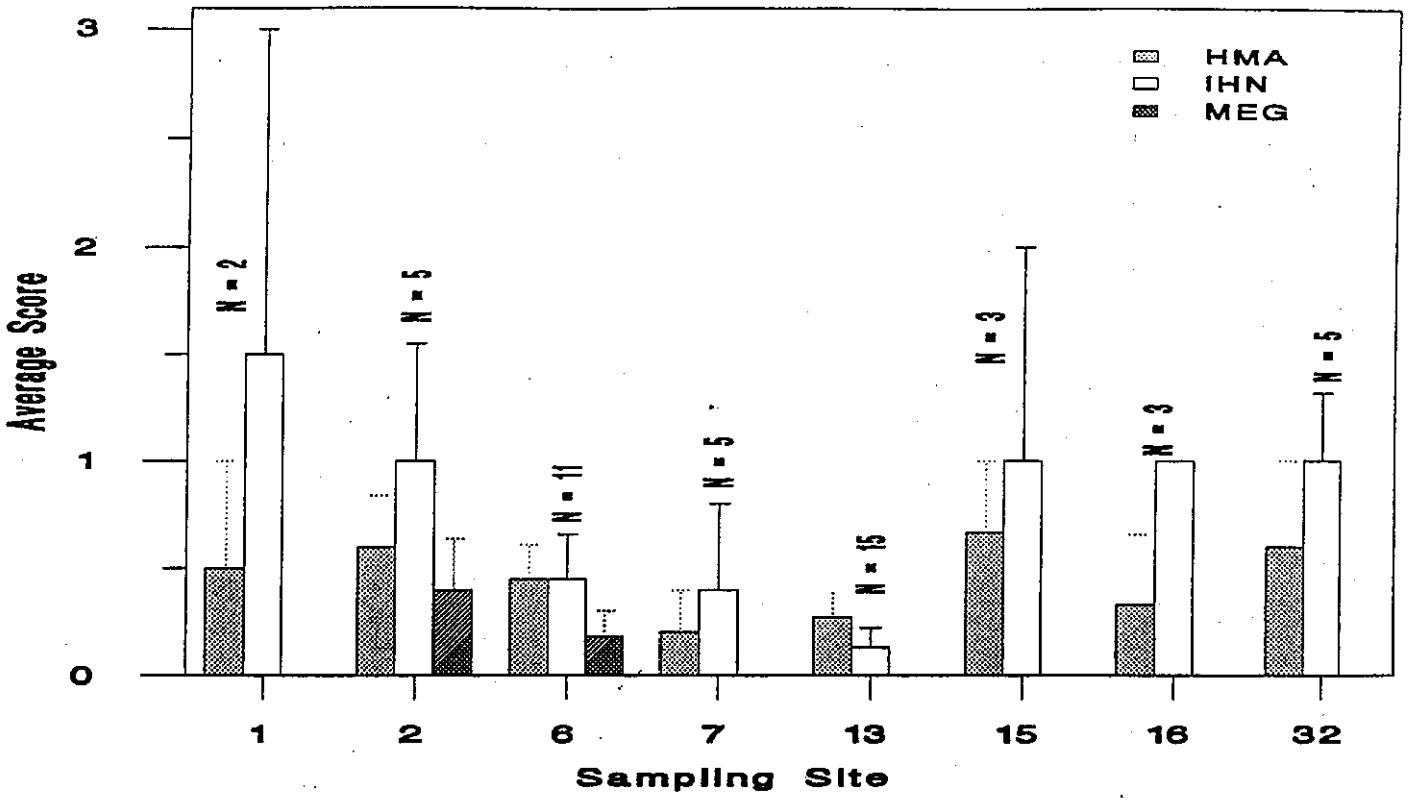


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 5b. Average Score for Hepatocyte Macrophage Aggregates (HMA), Individual Hepatocyte Necrosis (IHN), and Megalocytosis (MEG) in Yellowfin Gobies.

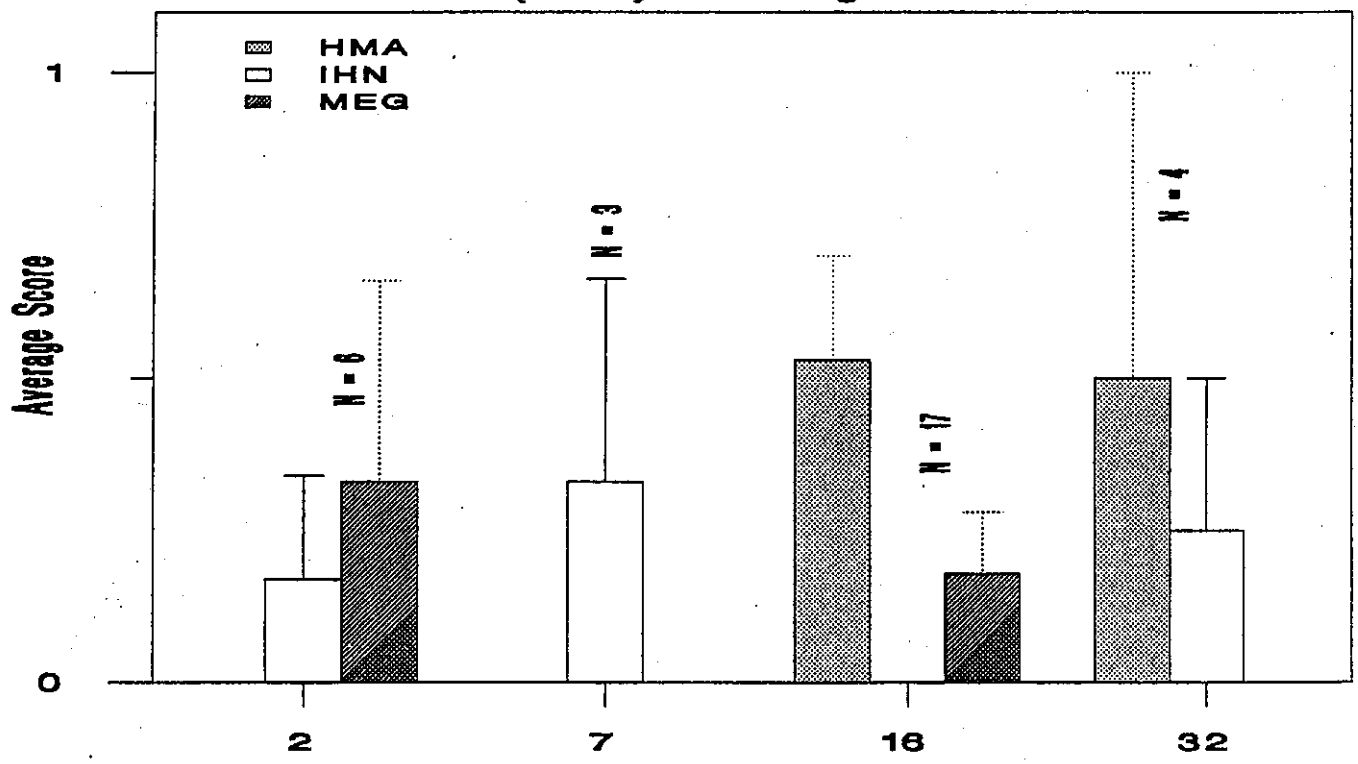


Graph 5c. Average Scores for Hepatocyte Macrophage Aggregates (HMA), Individual Hepatocyte Necrosis (IHN), and Megalocytosis (MEG) in White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 5d. Average Scores for Hepatocyte Macrophage Aggregates (HMA), Individual Hepatocyte Necrosis (IHN), and Megalocytosis (MEG) in Tonguefish.



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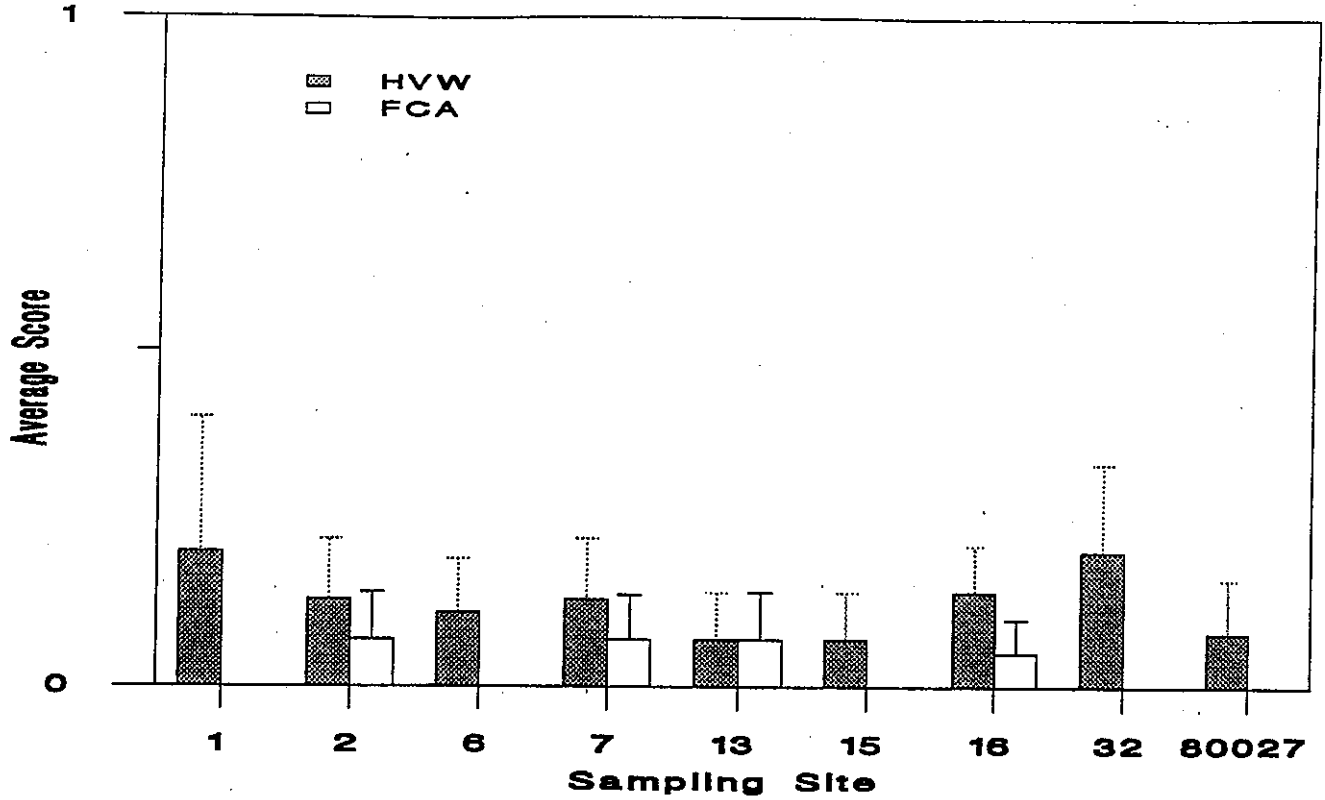
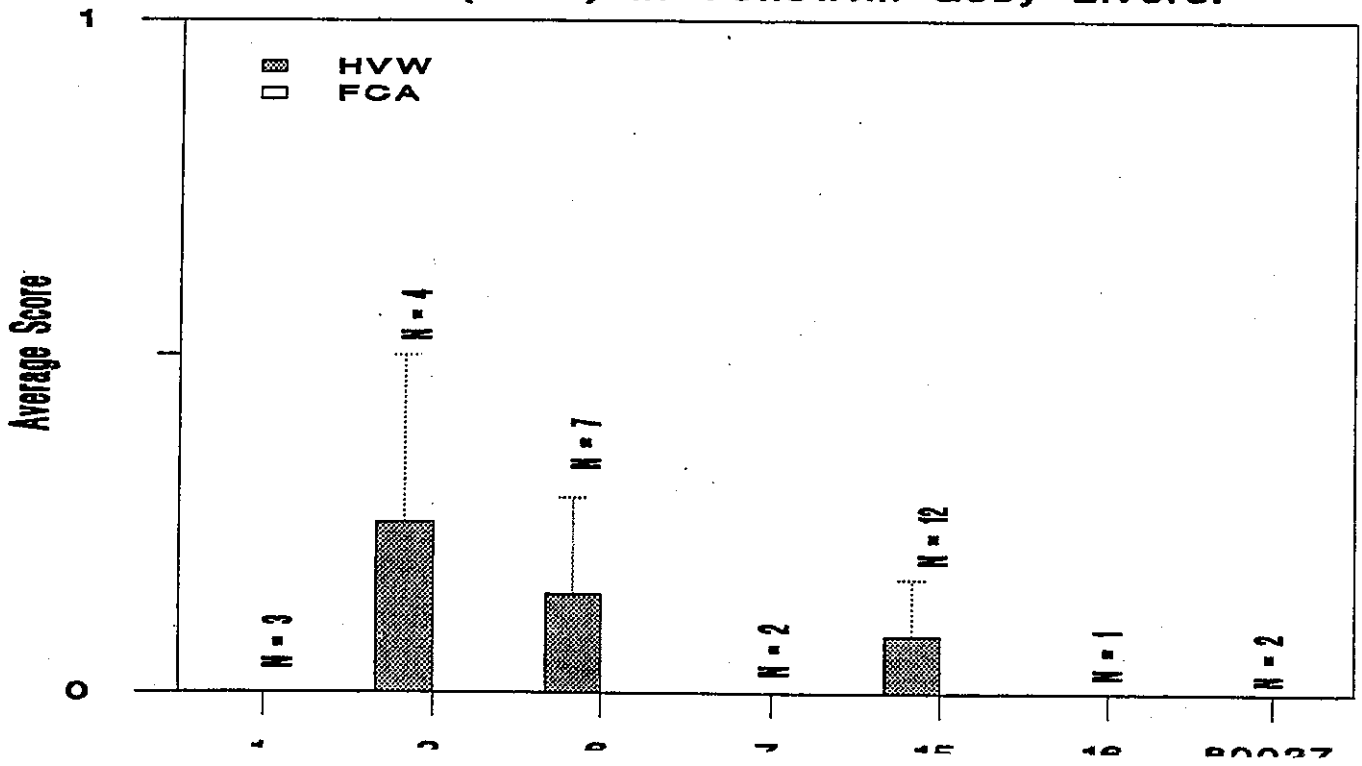
Graph 6a. Average Scores for Foci of Cellular Alteration (FCA) and Hyalinization of Vessel Walls (HVW) in all fish.

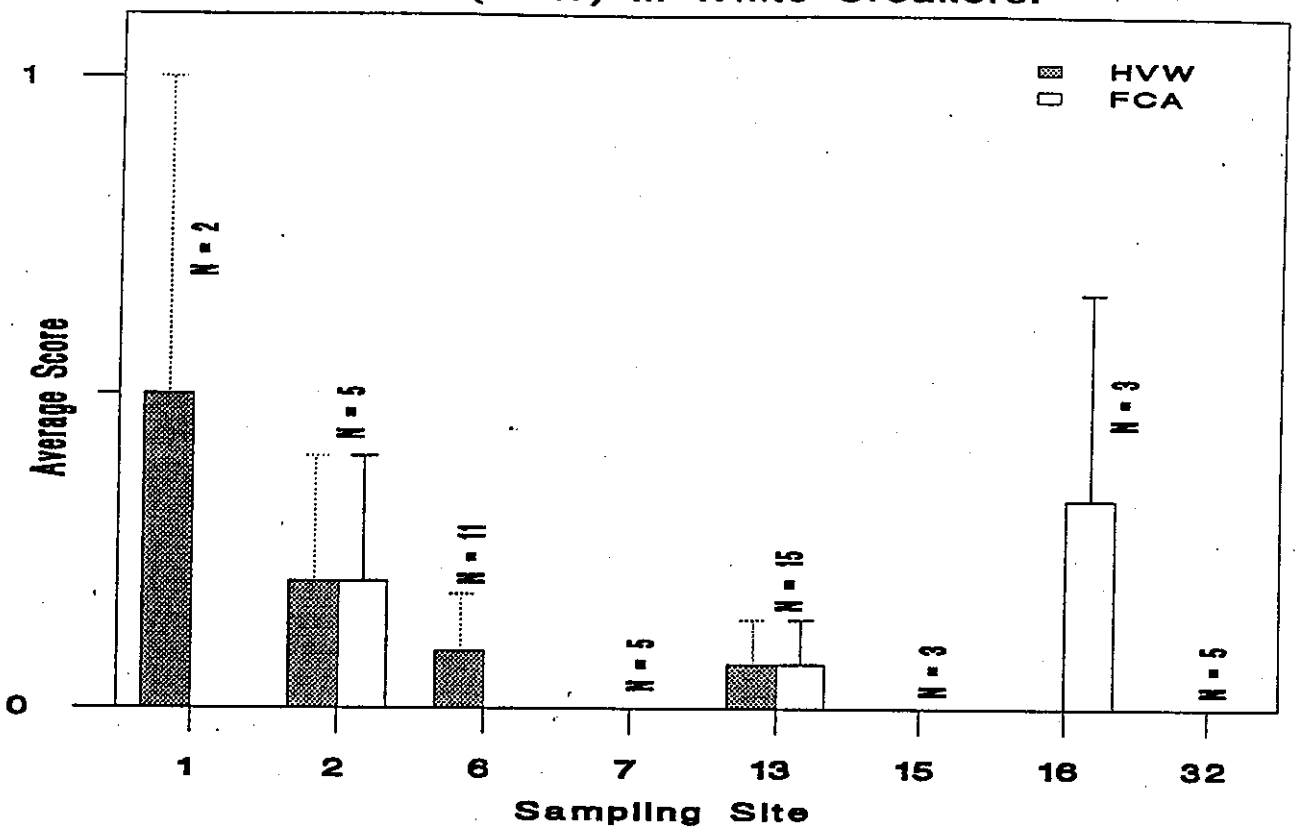


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 6b. Average Scores for Foci of Cellular Alteration (FCA) and Hyalinization of Vessel Walls (HVW) in Yellowfin Goby Livers.

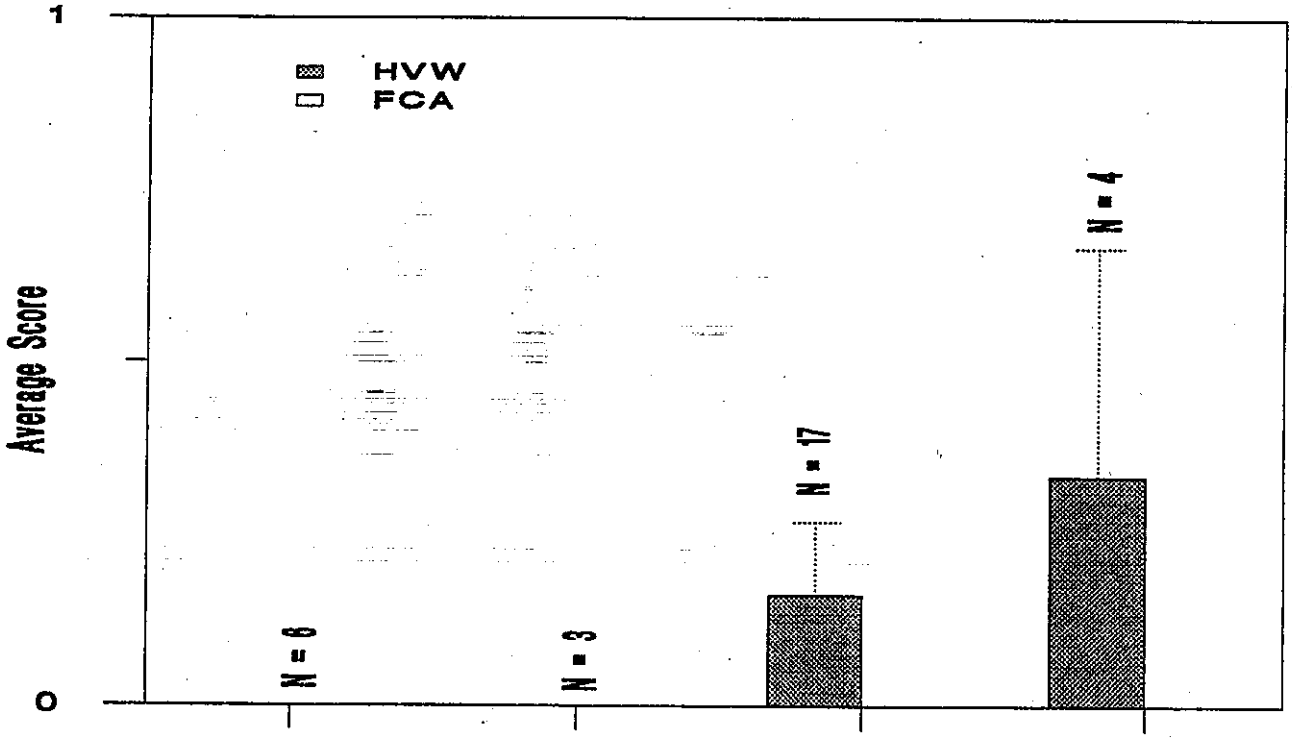


Graph 6c. Average Scores for Foci of Cellular Alteration (FCA) and Hyalinization of Vessel Walls (HVW) in White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 6d. Average Scores for Foci of Cellular Alteration (FCA) and Hyalinization of Vessel Walls (HVW) in Tonguefish.



III. Histopathology of Other Organs

A. Skin:

1. **Stingrays:** Ten stingrays were caught at site 80027. Five rays had foci of melanosis over their dorsal surface and one had a black focus on the ventral skin. Foci varied from 0.1 to 8 mm in diameter and were non-raised and grey to black. Histologically, these foci of melanosis were characterized by mild hyperplasia of melanophores in both the dermis and epidermis. In contrast to normal skin (Figures 30 & 31) with only widely scattered small melanophores in the superficial dermis, melanophores in hyperplastic foci were prominent with dark brown melanin pigment. Hyperplastic melanophores were spindle to stellate with finely tapered cell processes (Figures 32-35).

   In addition, some rays also had acanthosis (hyperplasia of squamous epithelial cells), mucous cell hyperplasia, and scattered single cell necrosis in the epidermis (Figures 34 & 35).

2. **Tonguefish:** Many tonguefish had mild to marked melanosis involving the caudal aspect of the dorsal and ventral fins, and the tail. Histologically, the melanosis was characterized by mild to moderate hyperplasia of melanophores in the superficial dermis (Figures 36 & 37). With mild melanophore hyperplasia, the melanophore layer was still intermittent. With moderate hyperplasia, the melanophore layer was continuous and in some areas, in multiple layers.

B. **Kidney:** A few stingray kidneys were examined histologically and some had marked membranous glomerulonephritis, along with a few tubular casts (Figures 38 & 39).

C. **Gills:** The gills were briefly screened, in some fish, and observed lesions included: 1) mucus cell hyperplasia (Figures 40 & 41); 2) lamellar epithelial hyperplasia; 3) interstitial fibrosis (Figures 40 & 41); and 4) inflammation (primarily with EGLs).

Histopathology - Results:

III. Histopathology of Other Organs

D. **Gonads:** Ovaries had varying degrees of oocyte atresia and mixed inflammation involving both lymphocytes and eosinophilic granular leukocytes (EGLs). Testes in some white croakers were very small (<1mm diameter) with little or no sperm production. These testes were either atrophic (testes of sexually mature males which had undergone atrophy) or were immature (testes of young sexually immature male fish). A few croakers with atrophic/immature testes also had small numbers of developing oocytes and these fish were classified as "intersex."

[Processing note: Gonads were fixed and processed together with the liver, spleen, and gonad. In retrospect, this was a mistake. Because gonads, especially testes, were often very small many were lost during routine paraffin processing. Tissues could have been lost either via passing through the slots in the cassettes or may have been inadvertently "sectioned through" when the histotech was sectioning the blocks. In the future, liver, spleen, and gonad should be fixed in separate vials and processed in separate cassettes. The addition of small sponges in the cassettes would prevent loss during proccessing. Having individual blocks for each tissue would also prevent accidental "sectioning through" when looking for other tissue.]

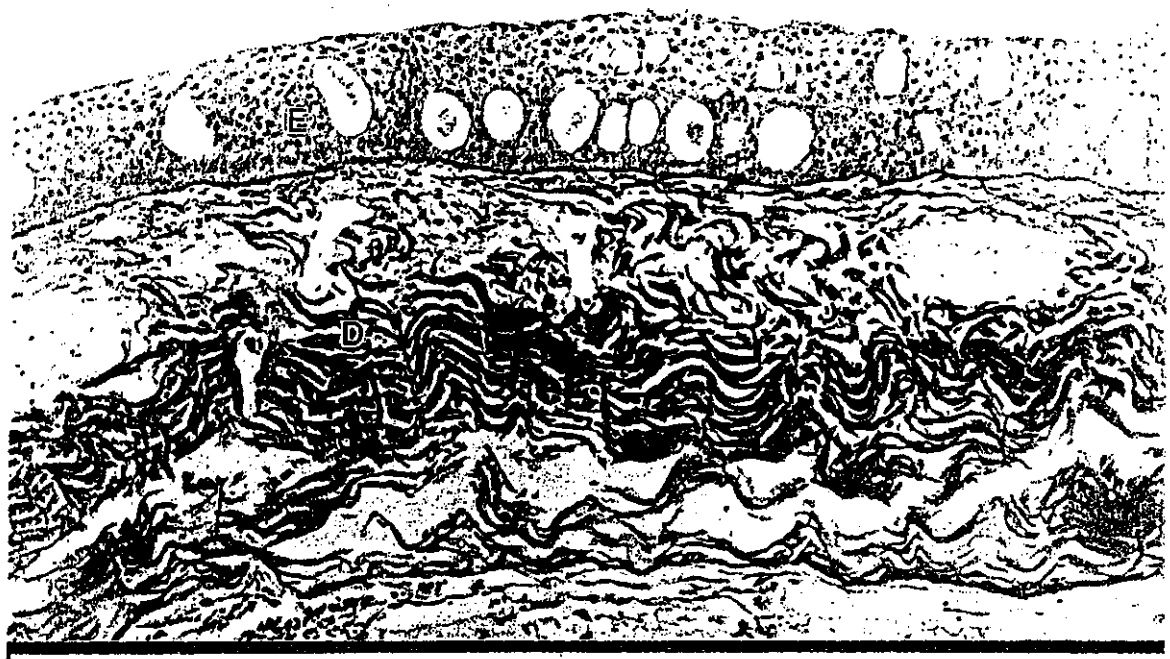
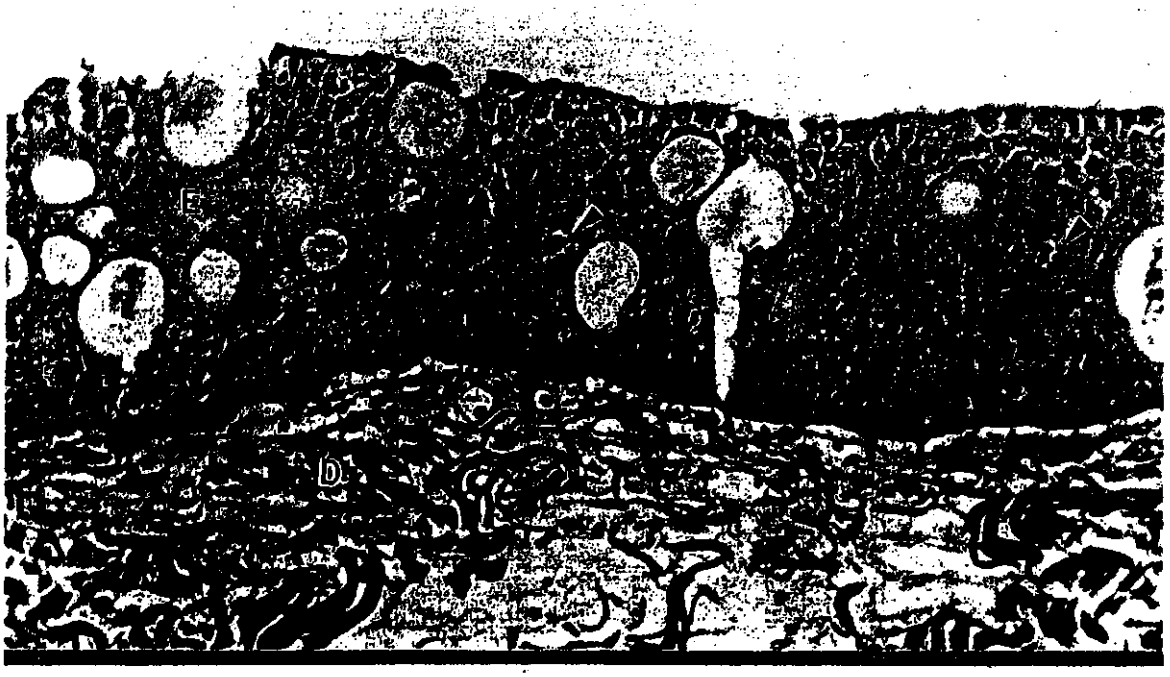


Figure 30. Normal dorsal skin from fish 93H63-40 (stingray from site 80027). Note the absence of pigmented melanophores in both the epidermis (E) and dermis (D). HE 25X.



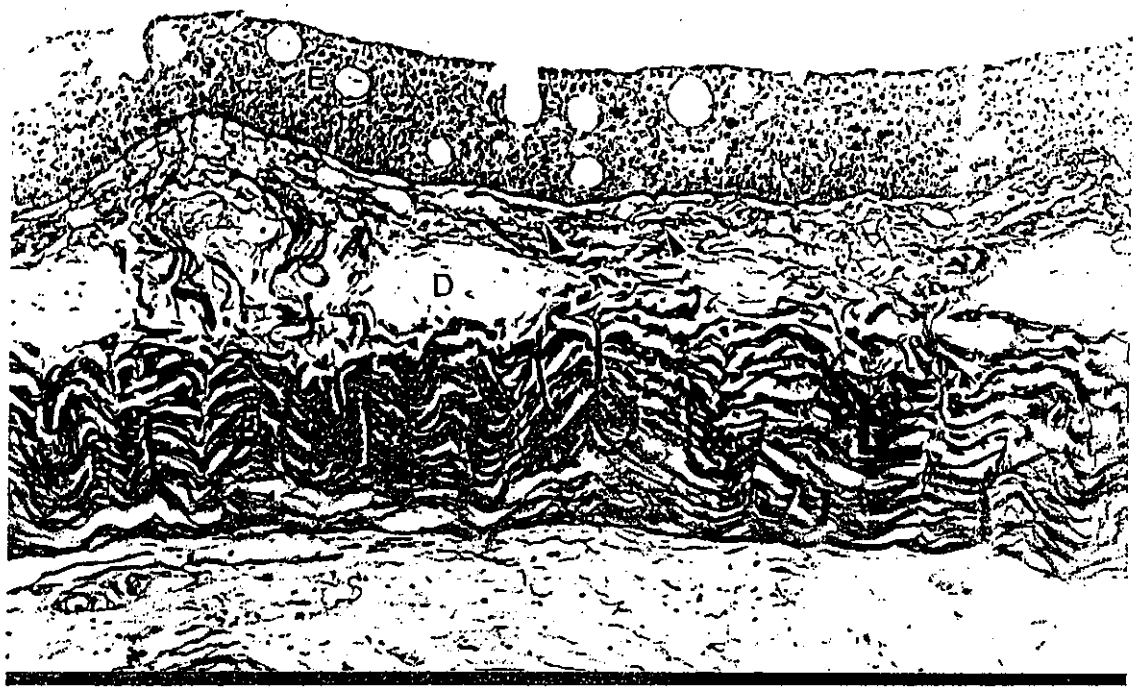
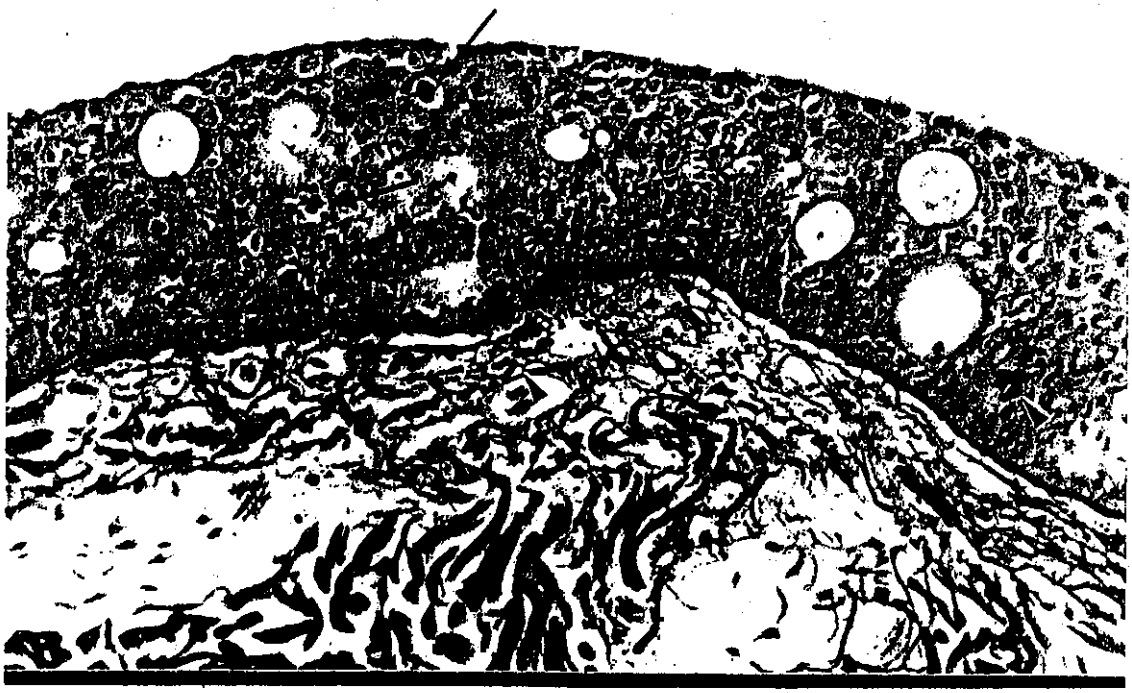


Figure 32. Dorsal skin from fish 93H63-40 (stingray from site 80027). There is mild melanophore hyperplasia in both the epidermis (E) and dermis (D). Melanophores are concentrated (arrowheads) in the dermis near the junction with the epidermis. HE 25X.



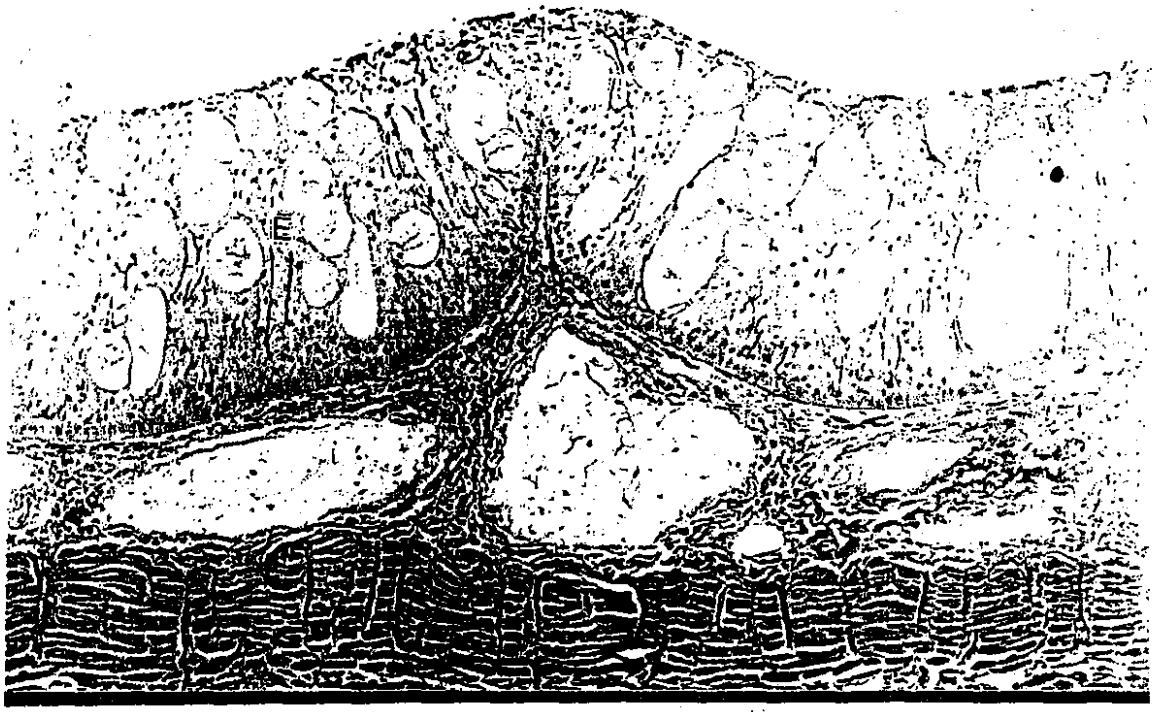
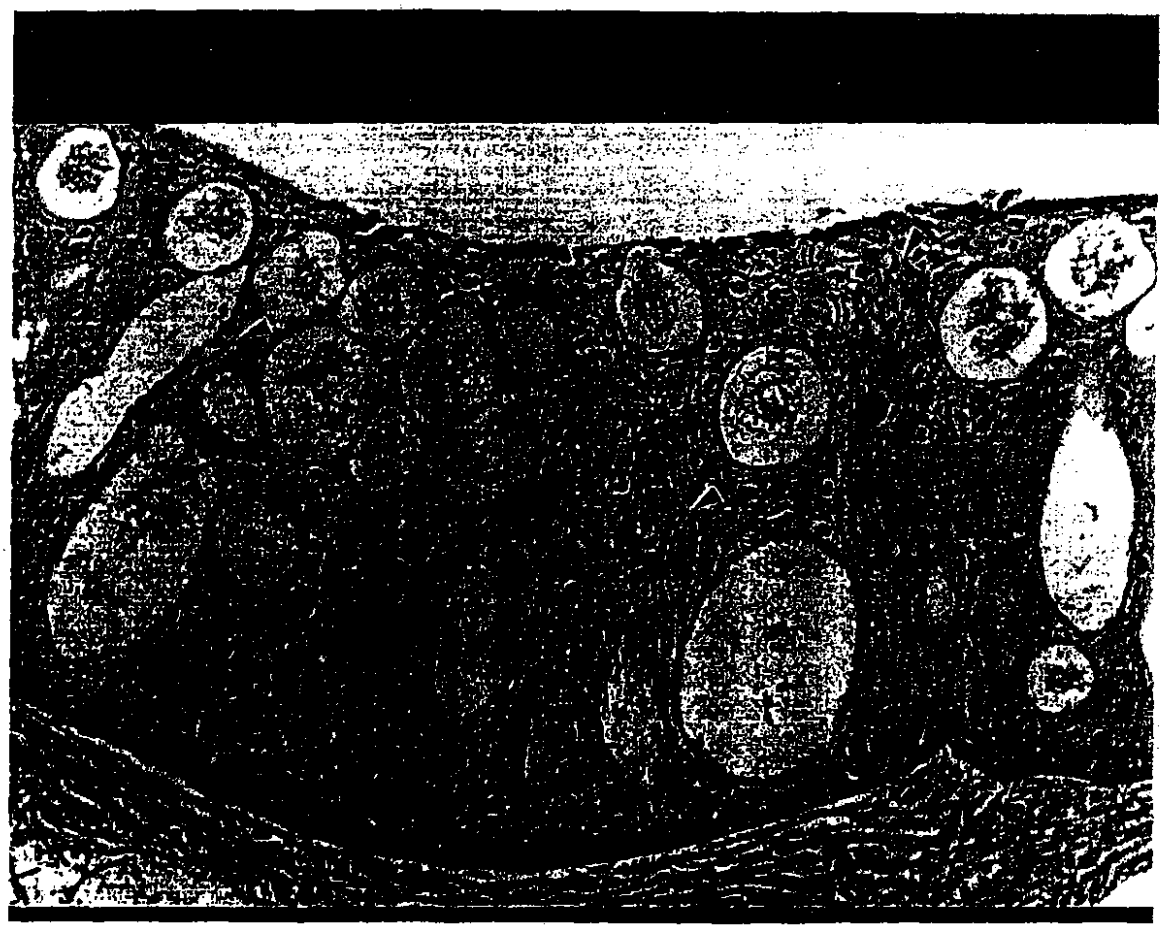


Figure 34. Dorsal skin from fish 93H63-14 (stingray from site 80027). There is marked acanthosis of the epidermis (E) and mild melanophore hyperplasia in both the epidermis and dermis. HE 25X.



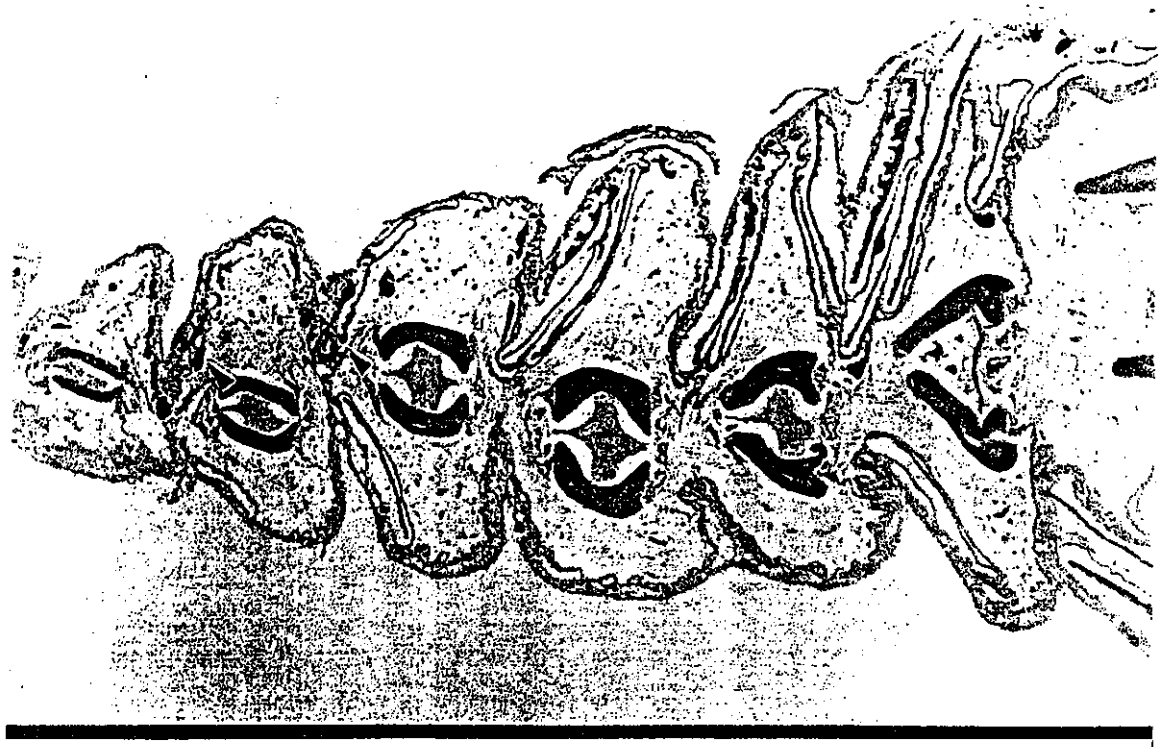
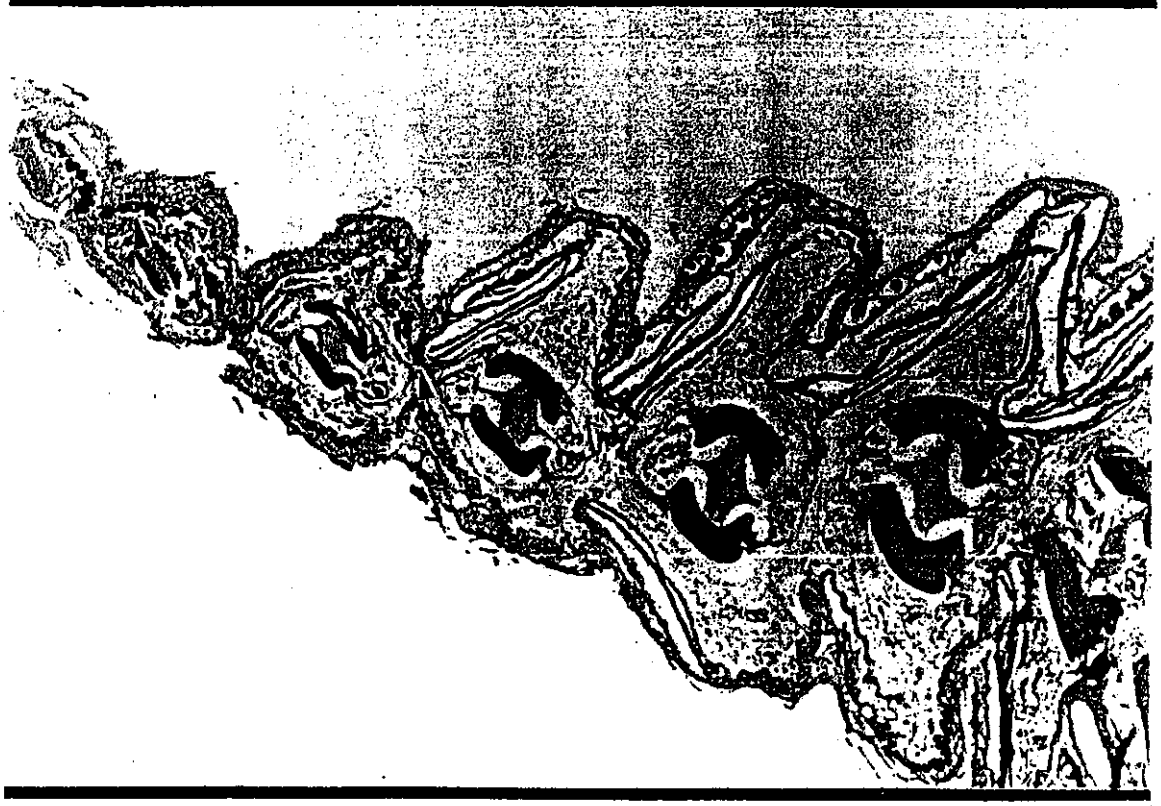


Figure 36. Dorsal and ventral skin from fish 93H63-16 (tonguefish from site 40016). There is mild melanophore hyperplasia (arrowheads) in the dermis of the dorsal skin. Note that there are still gaps in the melanophore layer where no pigment cells are visible. HE 25X.



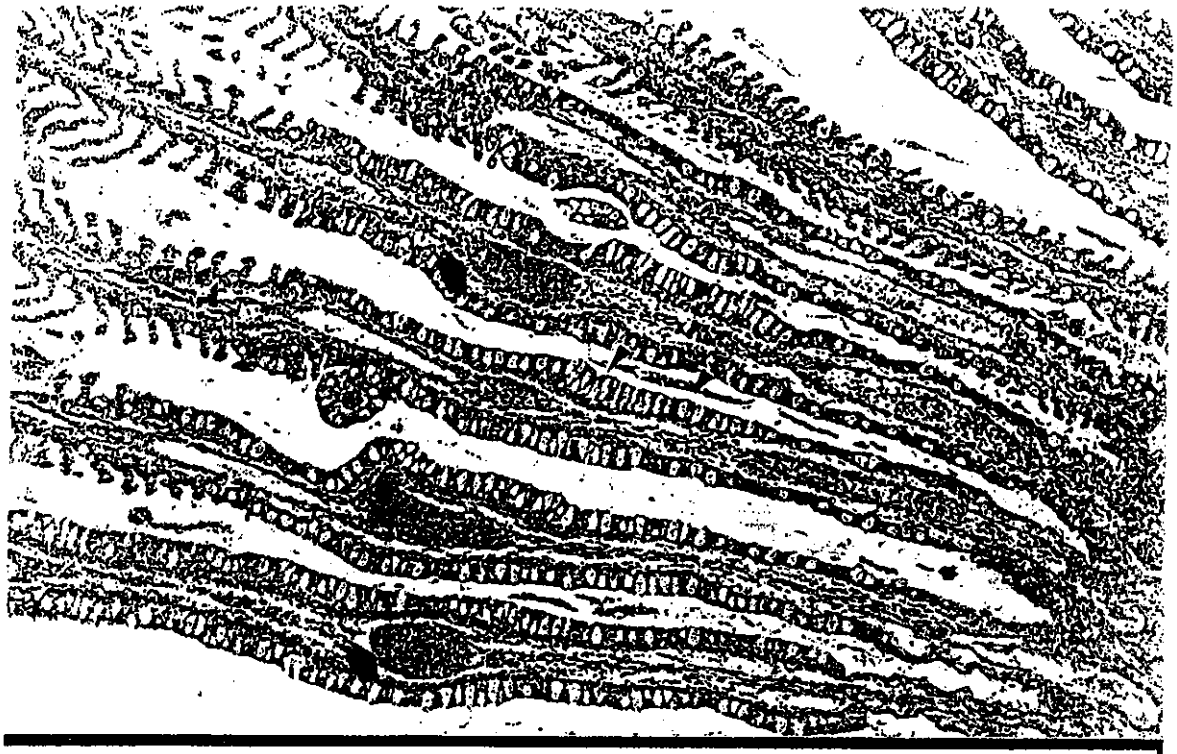
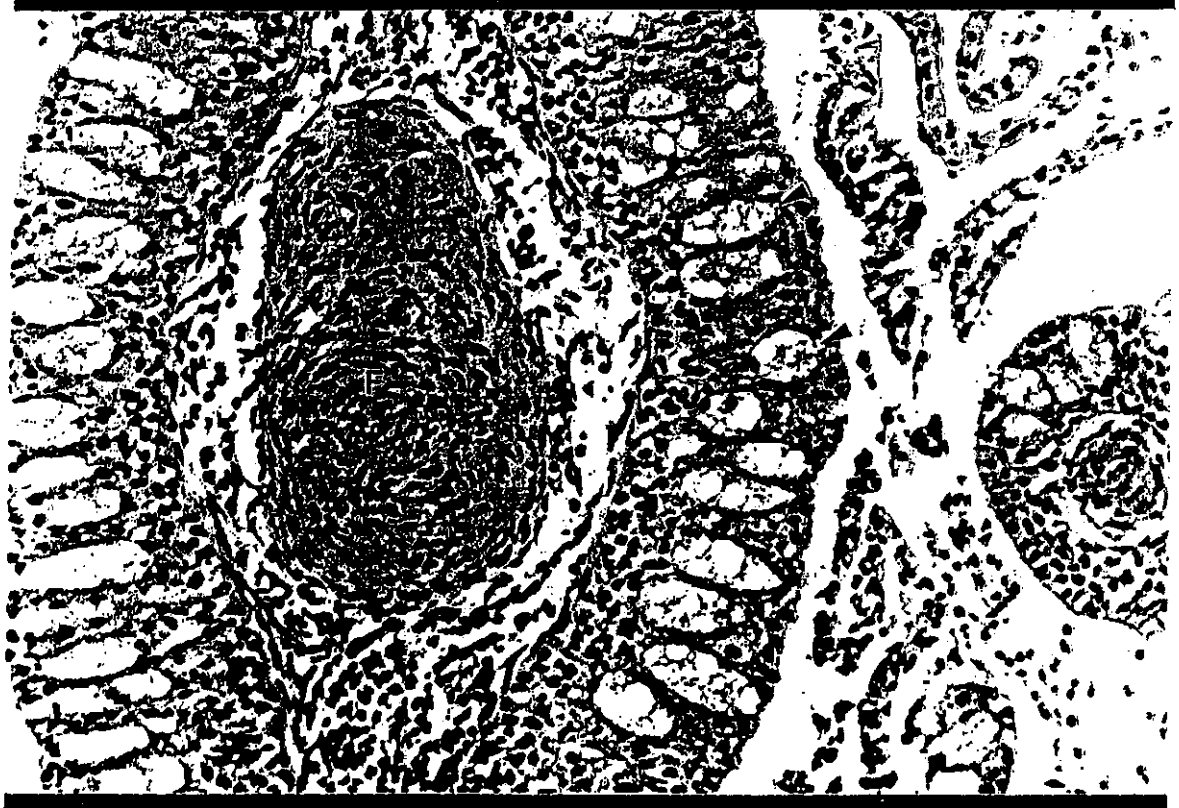


Figure 40. Gill of fish 93H63-41 (stingray from site 80027). Note the mucous cell hyperplasia (arrowheads) along the filaments and the numerous interstitial foci of fibrosis (arrows). HE 10X.



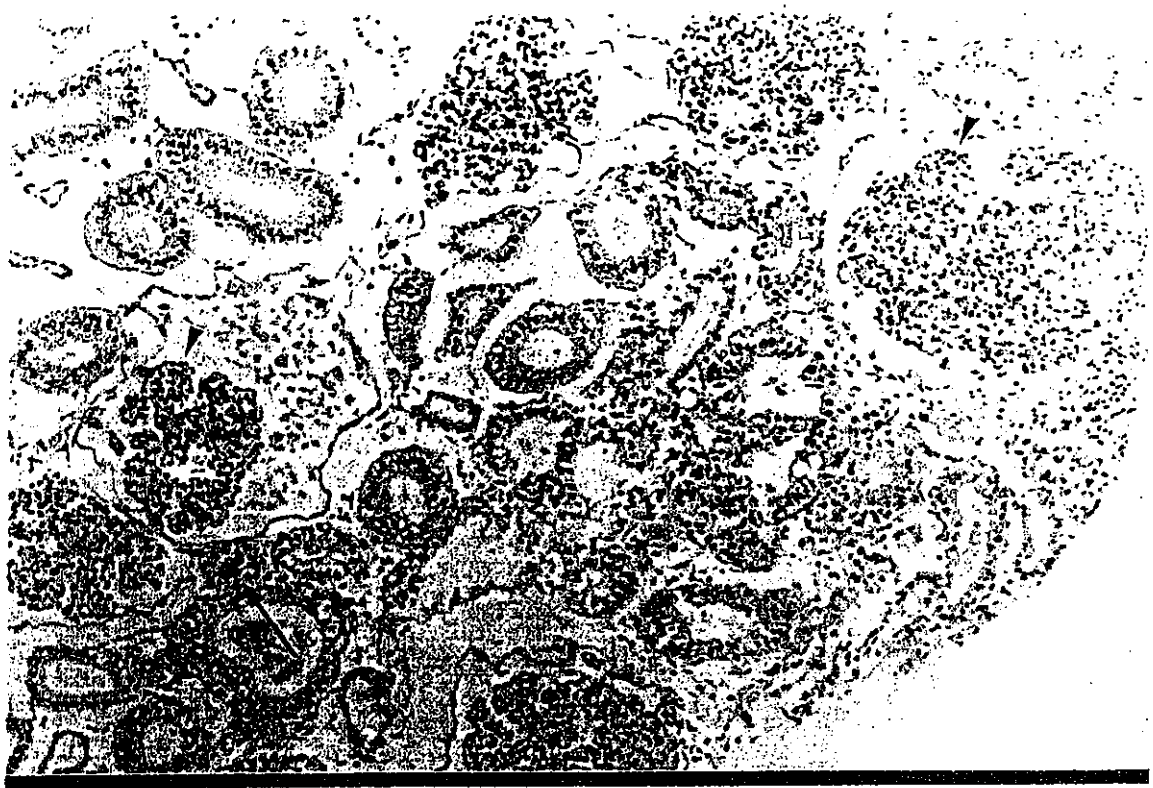


Figure 38. Kidney from fish 93H63-5 (stingray from site 80027) severe membranous glomerulonephritis. Note the thickened glomerular tufts (arrowheads) which are occasionally surrounded by a dilated Bowman's space. A few tubules have casts (arrow). HE 25X.

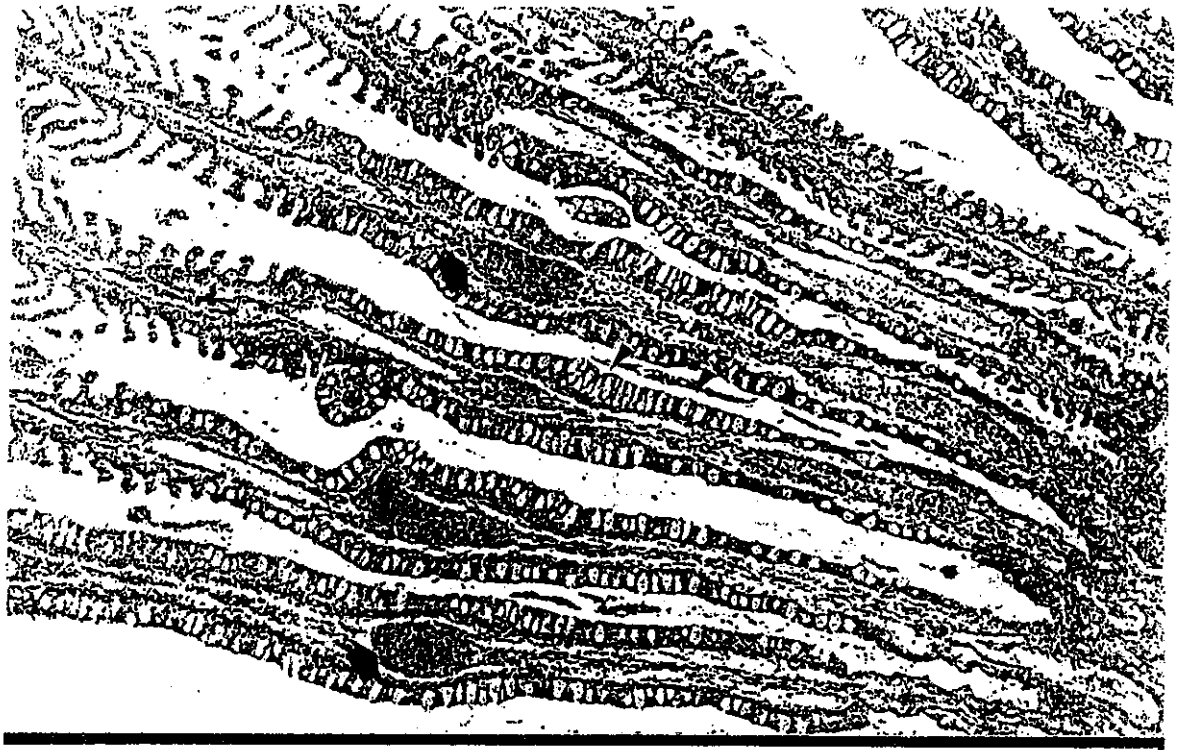
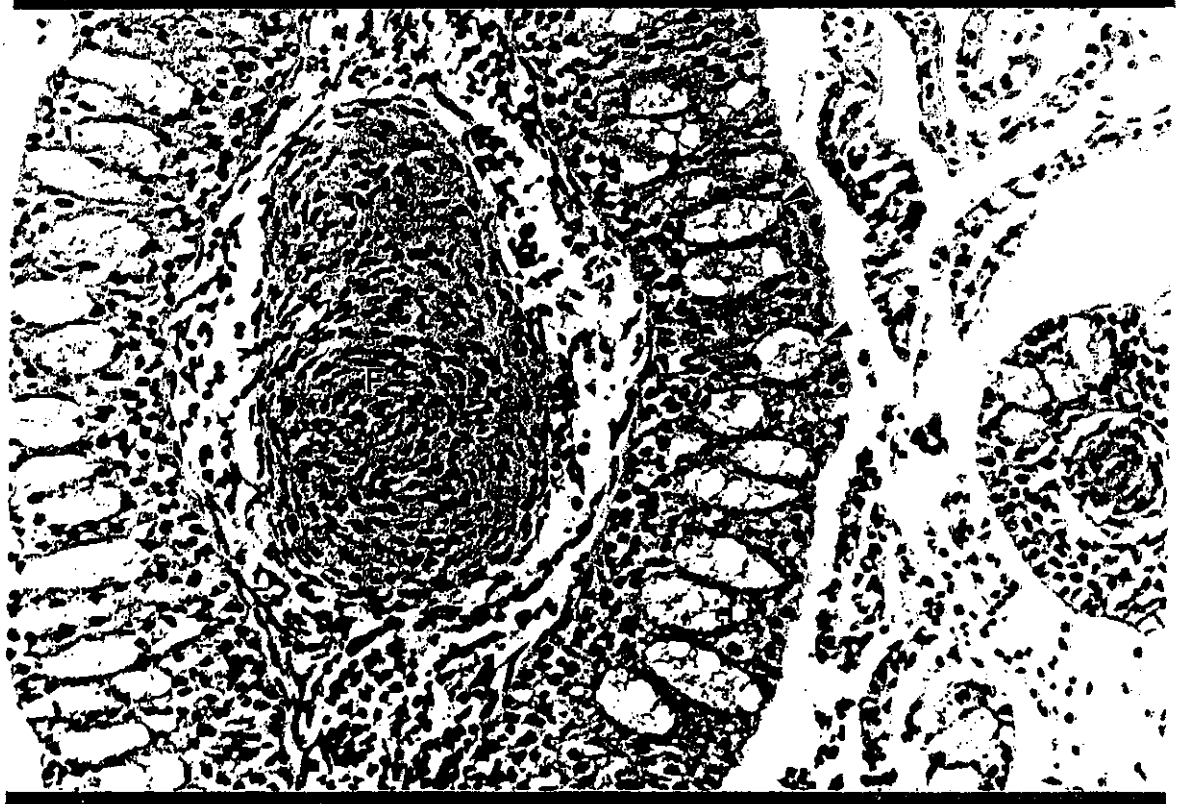


Figure 40. Gill of fish 93H63-41 (stingray from site 80027). Note the mucous cell hyperplasia (arrowheads) along the filaments and the numerous interstitial foci of fibrosis (arrows). HE 10X.



P450 Immunohistochemistry - Results: P450 activity was detected in all organs examined. In the gills, P450 was concentrated in lamellar epithelium, pillar cells, and endothelium of large blood vessels in the arch (Figures 42 & 43). In the gonad and spleen, P450 was detected in the endothelium of major blood vessels (Figures 44 & 45). In liver, P450 was induced in hepatocytes and in the endothelium of major blood vessels (Figure 46). In kidney, P450 was detected in tubular epithelium and blood vessels. In intestine, P450 was found in the lining epithelium and blood vessels.

Immunohistochemical P450 scores for gill, gonad, spleen, liver, kidney, and intestine are given in appendix 16. Apendices 16a-16c include scores for all fish from all sites sorted on the basis of site. Average P450 score and standard error were determined for each organ at each site. Appendices 16d-16g are P450 scores sorted on the basis of both site and species.

Average P450 scores of selected organs are depicted in graphs 7-9. Graph 7a shows that the three reference sites (40015, 40016, and 40032) had markedly lower P450 scores in gill epithelial cells (GEC) and endothelium of gill arch (E-GA) when compared to the five impact sites where teleost fish were caught. Impact site 80027 (where 10 of 12 fish were stingrays) had low P450 gill scores which were comparable to those in two reference sites. Of the three reference sites, site 40032 appeared to be the "cleanest" with respect to induction of gill P450. When gill P450 scores were sorted on the basis of species, the same general trend (higher scores at impact sites) was also observed in gobies (graph 7b), croakers (7c), and tonguefish (graph 7d).

Graph 8a shows average P450 scores for endothelium in gonadal blood vessels (GO-VE) and splenic blood vessels (SVE). Again, the three reference sites have markedly lower P450 scores when compared to impact sites where teleost fish were caught. In addition, impact site 80027, where stingrays were collected, also had higher vascular P450 scores. Sorting the data based on species revealed similar patterns among gobies (graph 8b), croakers (8c), and tonguefish (graph 8d) with lower P450 scores at reference sites.

Graph 9a depicts average P450 scores for hepatocytes (HEP) and major liver blood vessels (LVE). The trends were similar to P450 scores in other organs, with the three reference sites having markedly lower average P450 scores. The only exception was with the LVE P450 score at site 80027 which was the lowest amongst all nine sites. Sorting the data based on species revealed that although gobies from impact sites still had higher average liver P450 scores, when compared to reference sites, goby scores (graph 9b) were lower than those in tonguefish (graph 9d) from impact sites and markedly lower when compared to croakers from impact sites (graph 9c). Hepatic (both HEP and LVE) P450 goby scores from impact sites were even lower than scores from croakers collected from reference sites. Average HEP P450 scores in croakers from two reference sites (40015 and 16) were similar or higher than three of five impact sites where croakers were collected. LVE in contrast was consistently higher in croakers from impact sites when compared to the reference sites. Both HEP and LEV P450 scores were markedly higher in tonguefish from two impact sites when compared with those from two reference sites.

P450 Immunohistochemistry - Statistics: Due to missing values, only 82 fish were used with this analysis. Only one principal component was used as only one accounted for appreciable variability. From individual scale values, three vascular P450 categories [liver vascular endothelium (LVE), splenic blood vessels (SVE), and endothelium of gill arch blood vessels (E-GA)] were most important (eigenvectors with the greatest absolute values). Three other categories [gill pilar cells (GPC), gill epithelial cells (GEC), and hepatocytes (HEP)] also had high eigenvector values and there was strong positive correlation between almost all tissues where P450 activity was observed.

MANOVA revealed that there were significant ($P = 0.01$) differences among the nine sites, but no overall species effect. Comparisons among sites using both Tukey's and Least Square Means revealed significant differences between impact and reference sites. With Tukey's, P450 scores from impact site 40001 were significantly ($P < 0.05$) higher than scores at reference sites 40016 and 40032. P450 scores were also significantly ($P < 0.05$) higher at impact site 40002 when compared to reference site 40032.

Using Least Squares Means, three impact sites (40001, 40002, and 40006) had P450 scores which were significantly ($P < 0.01$) elevated over two reference sites (40016 and 40032). In addition, P450 scores from two impact sites (40001 and 40002) were also significantly ($P \leq 0.01$) higher that scores from the third reference site, 40015.

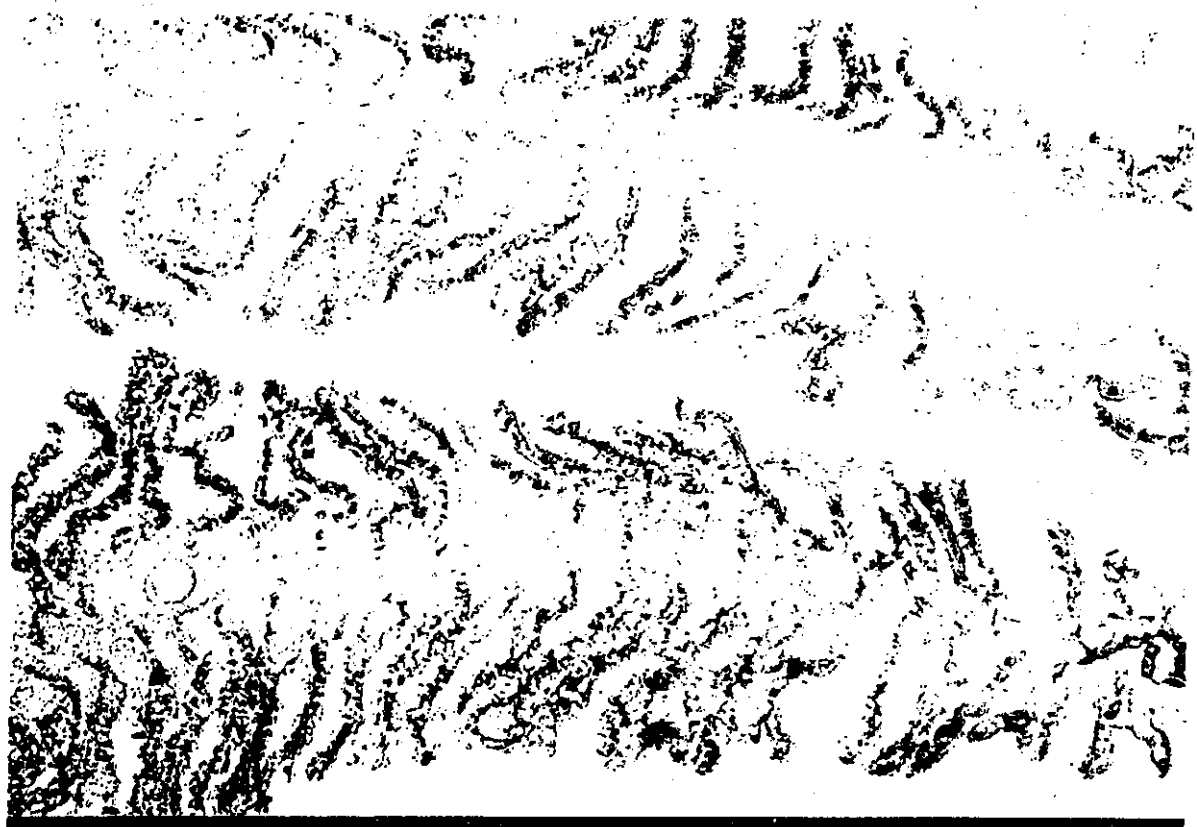


Figure 42. Gill of fish 93H63-98 (white croaker from site 40006). There is marked induction of P450 activity in both lamellar epithelium and pilar cells of gill filaments. Immunohistochemical stain with hematoxylin counterstain.

Figure 43. Gill of fish 93H63-98 (white croaker from site 40006)

Figure 44. Ovary of fish 93H63-98 (white croaker from site 40006). There is marked induction of P450 activity in the endothelium of interstitial blood vessels (arrowheads). Immunohistochemical stain with hematoxylin counterstain.

Figure 45. Spleen of fish 93H63-91 (white croaker from site 40002).

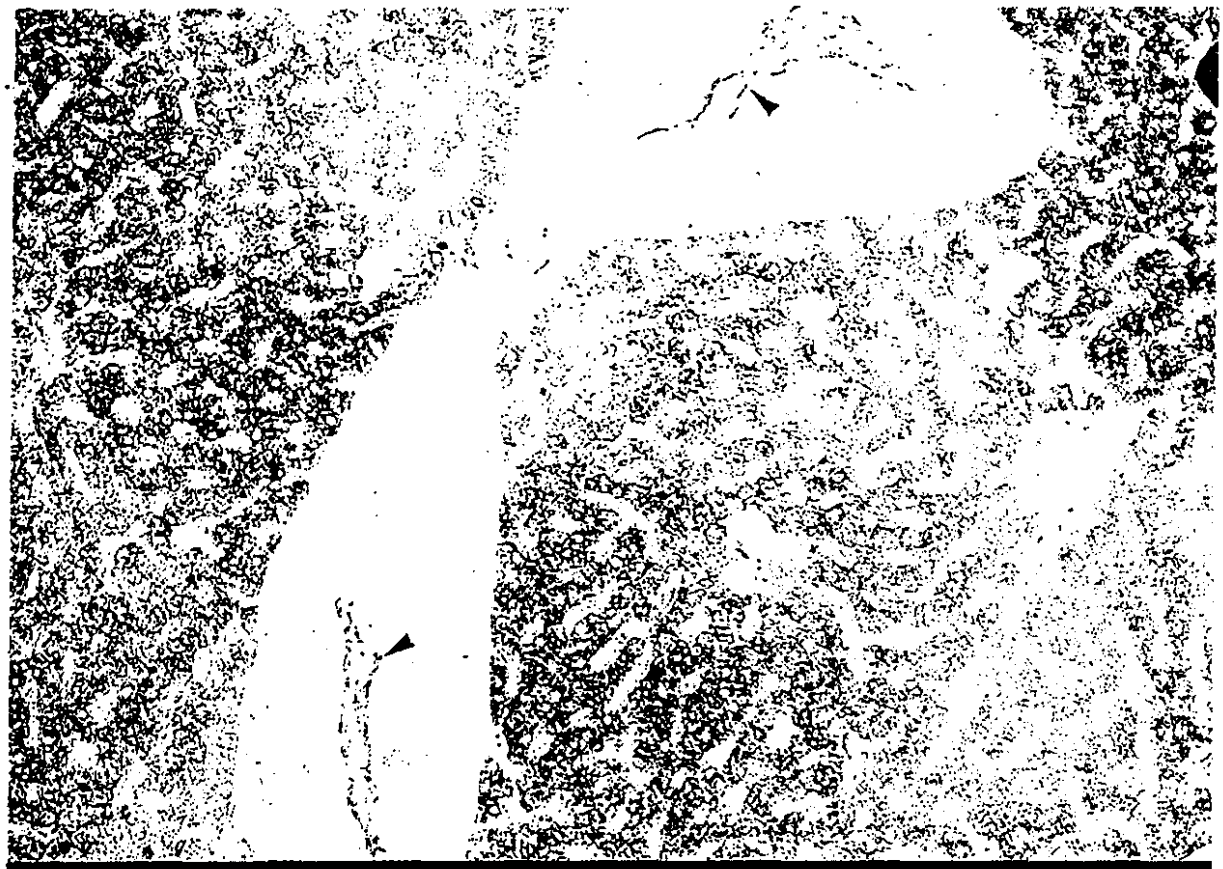
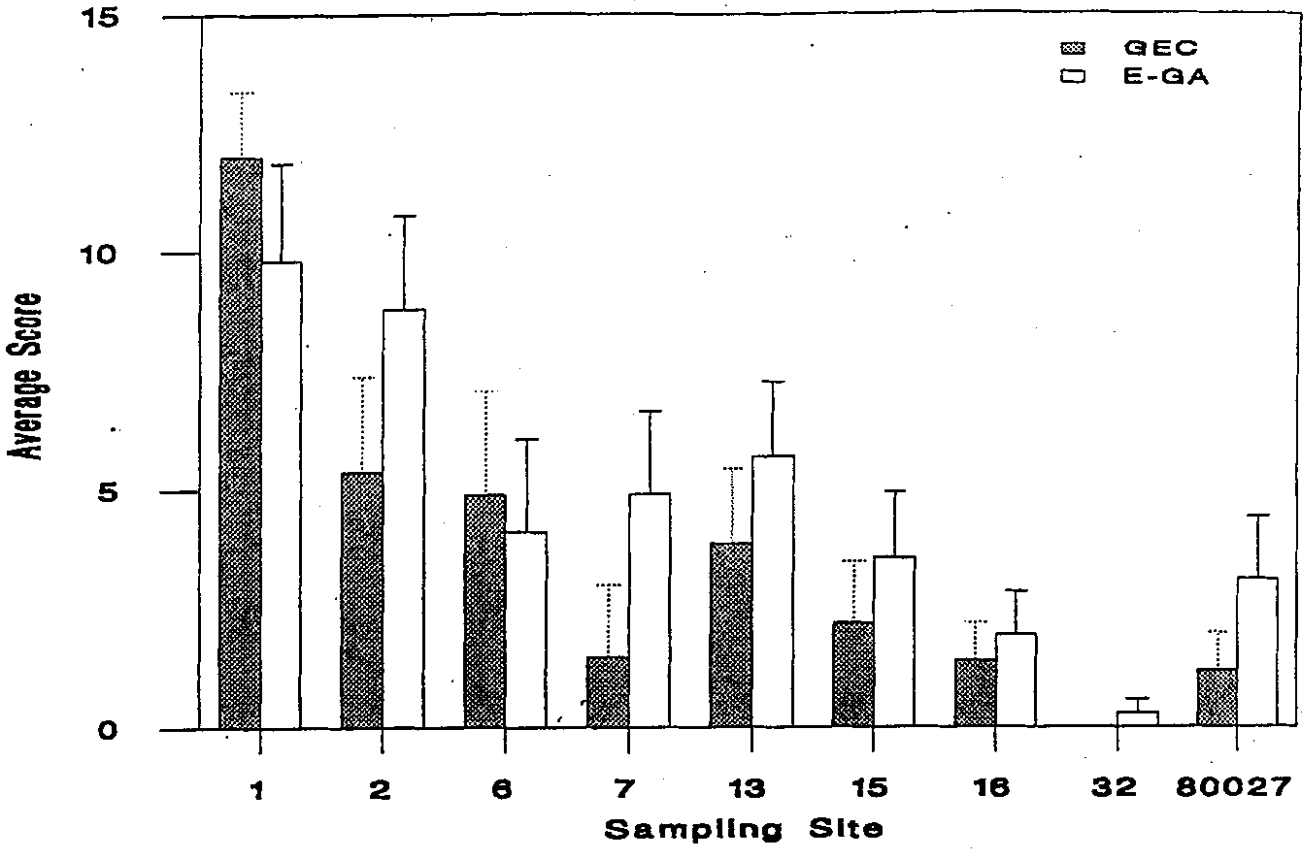


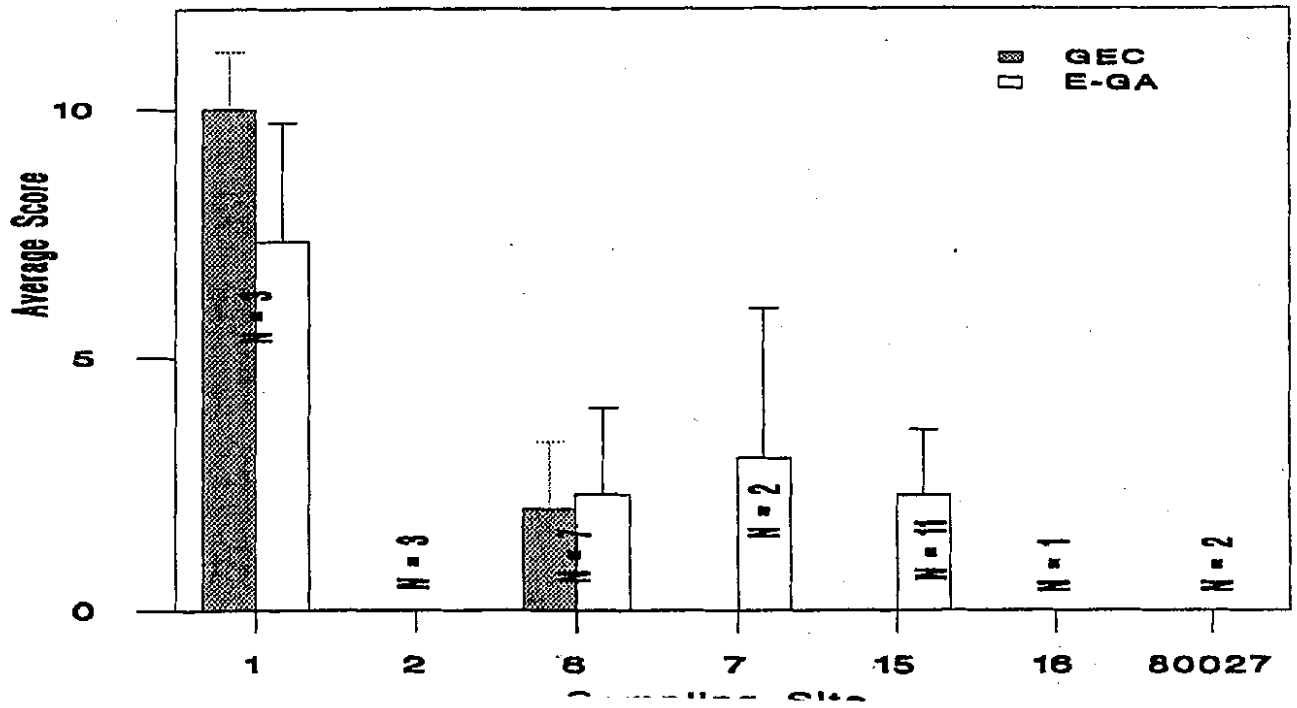
Figure 46. Liver of fish 93H63-98 (white croaker from site 40006). There is marked induction of P450 in hepatocytes throughout the liver. Blood vessels (arrowheads) centered within foci of exocrine pancreas are also positive. Immunohistochemical stain with hematoxylin counterstain.

Graph 7a. Average Immunohistochemical P450 Scores for Gill Epithelial Cells (GEC) and Endothelium of Gill Arch Vessels (E-GA) for all fish from all sites.



(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 7b. Average Immunohistochemical P450 Scores for Gill Epithelial Cells (GEC) and Endothelium of Gill Arch Vessels (E-GA) in Yellowfin Gobies.



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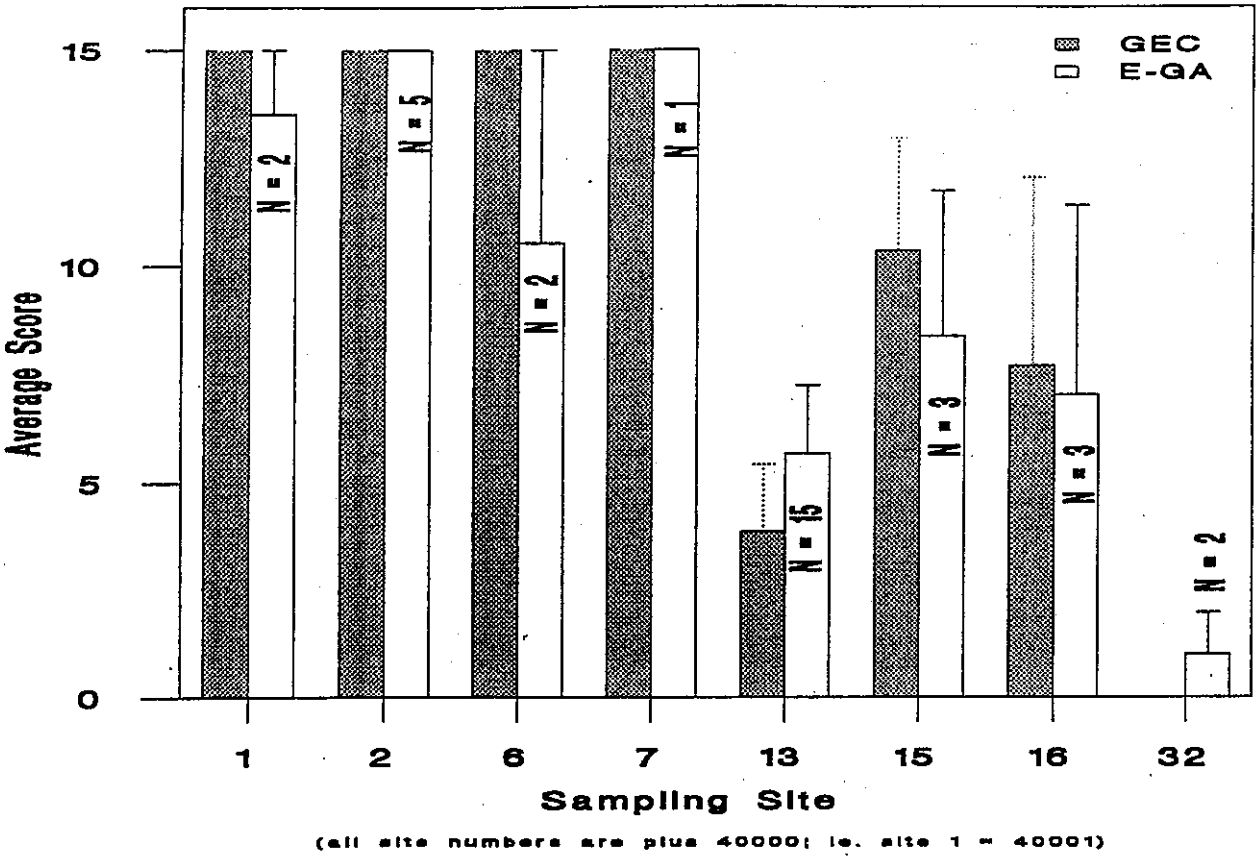
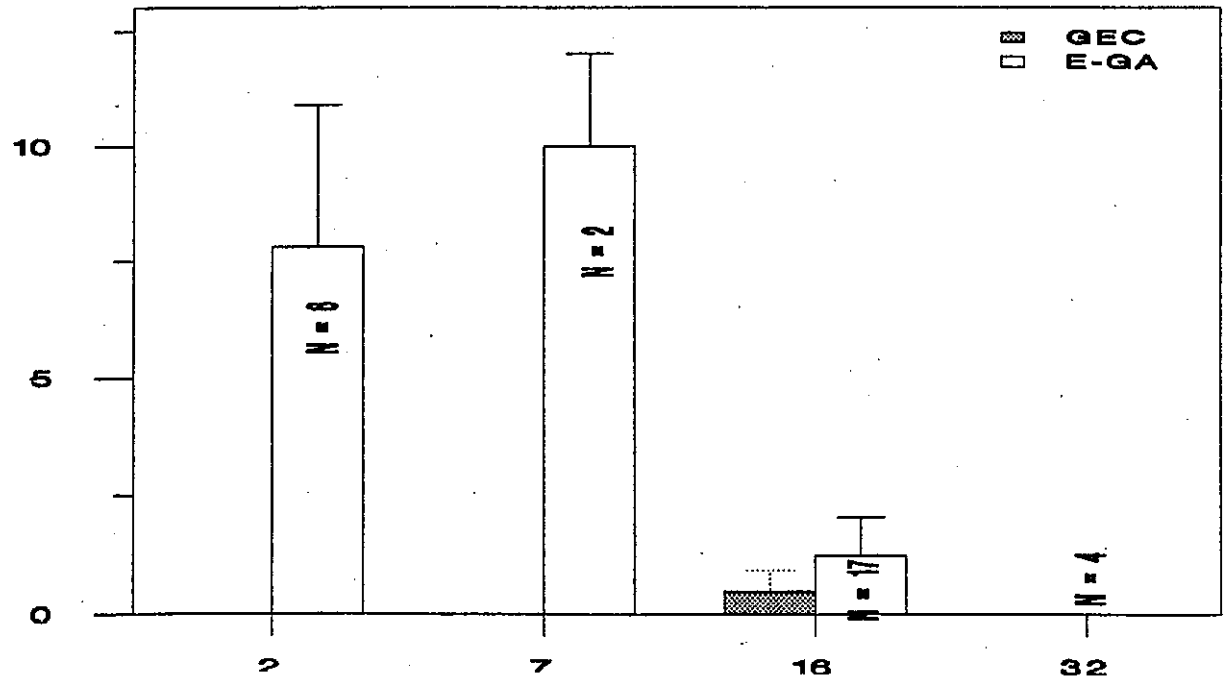
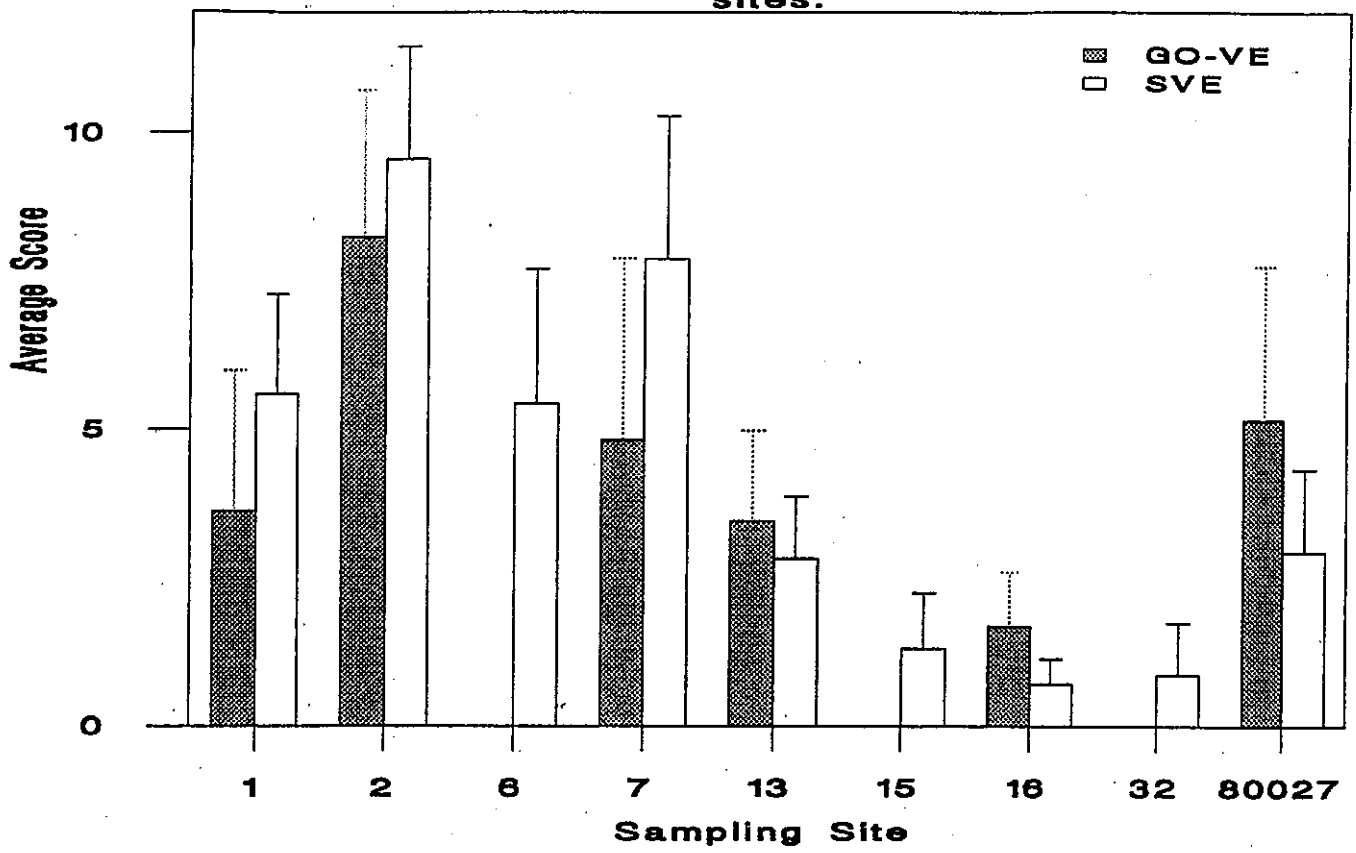
Graph 7c. Average Immunohistochemical P450 Scores for Gill Epithelial Cells (GEC) and Endothelium of Gill Arch Vessels (E-GA) in White Croakers.



Graph 7d. Average Immunohistochemical P450 Scores in Gill Epithelial Cells (GEC) and Endothelium of Gill Arch Vessels (E-GA) in Tonguefish.

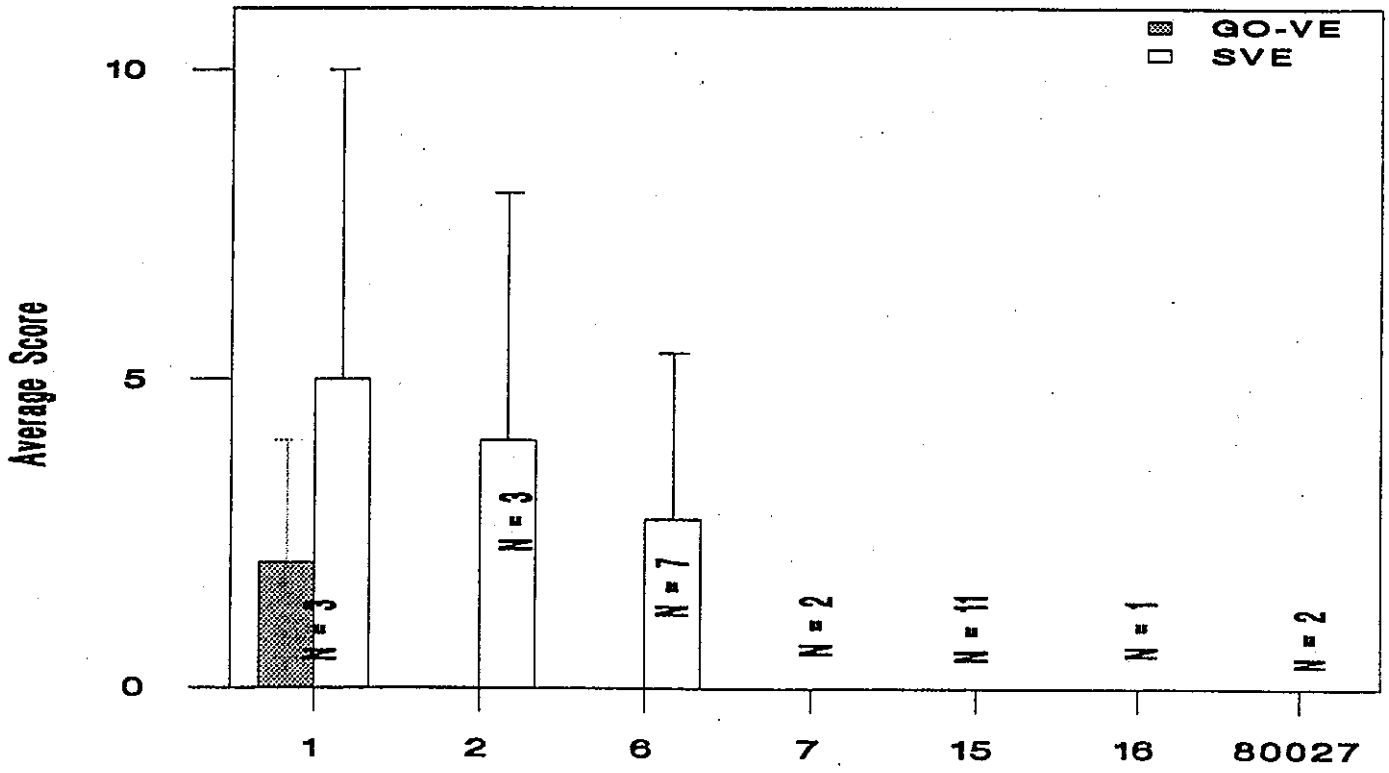


Graph 8a. Average Immunohistochemical P450 Scores for Gonadal Blood Vessels (GO-VE) and Splenic Blood Vessels (SVE) for all fish from all sites.

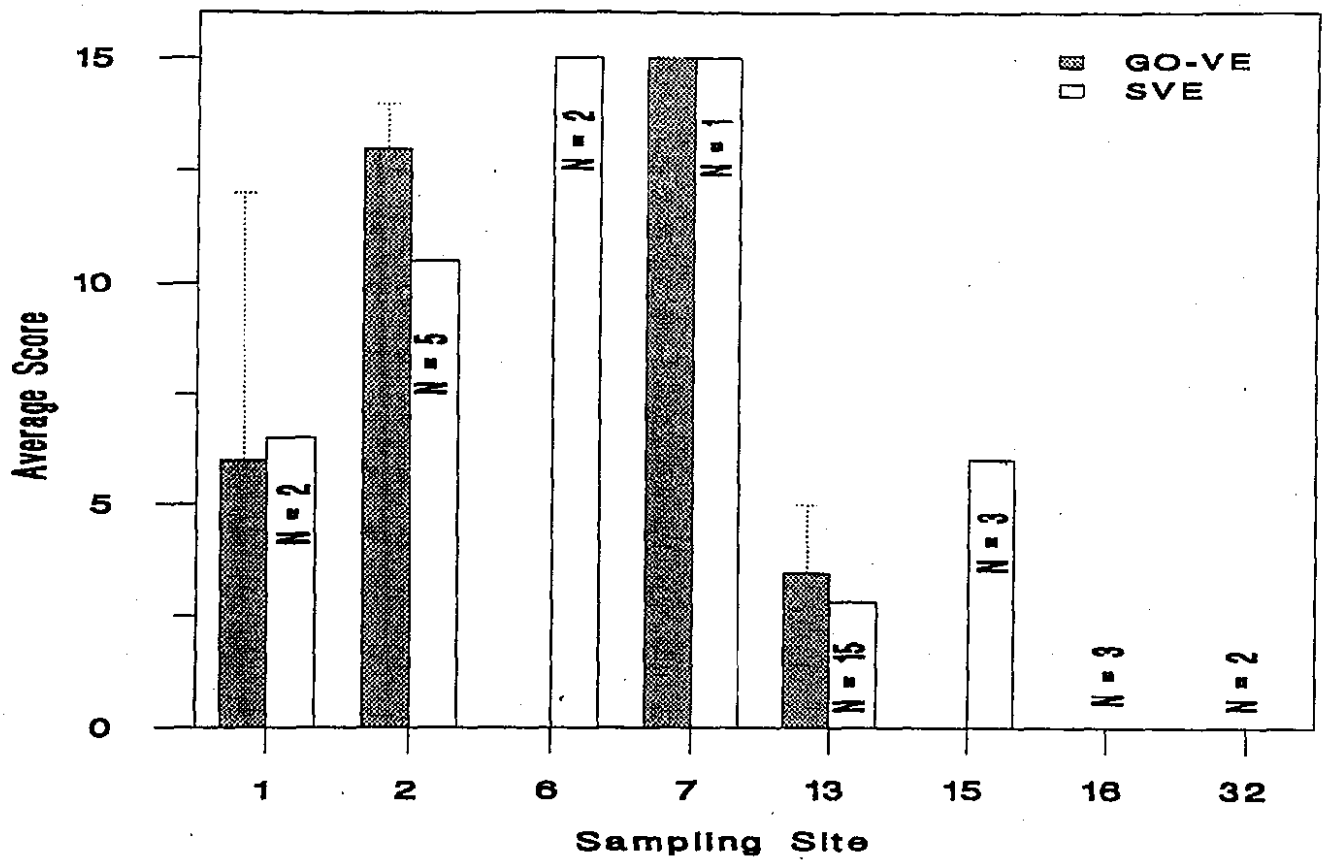


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 8b. Average Immunohistochemical P450 Scores for Gonadal Blood Vessels (GO-VE) and Splenic Blood Vessels (SVE) in Yellowfin Gobies.

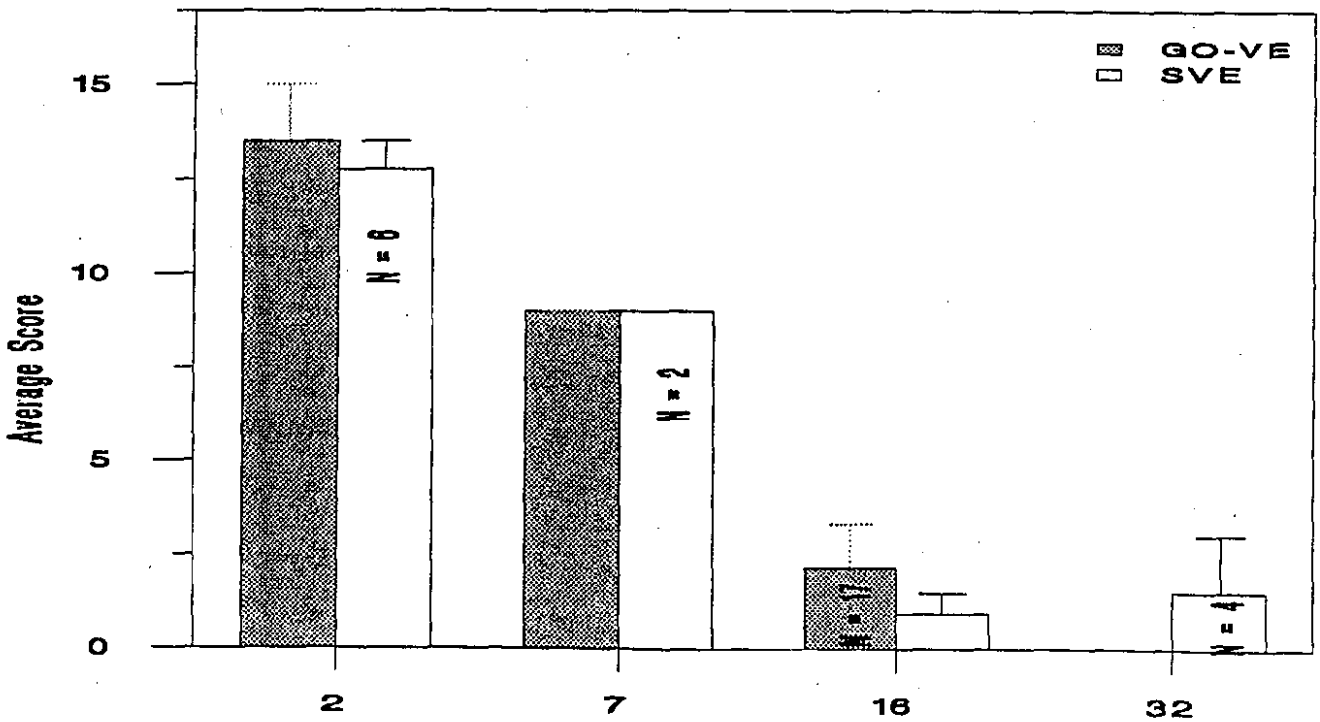


Graph 8c. Average Immunohistochemical P450 Scores for Gonadal Blood Vessels (GO-VE) and Splenic Blood Vessels (SVE) in White Croakers.

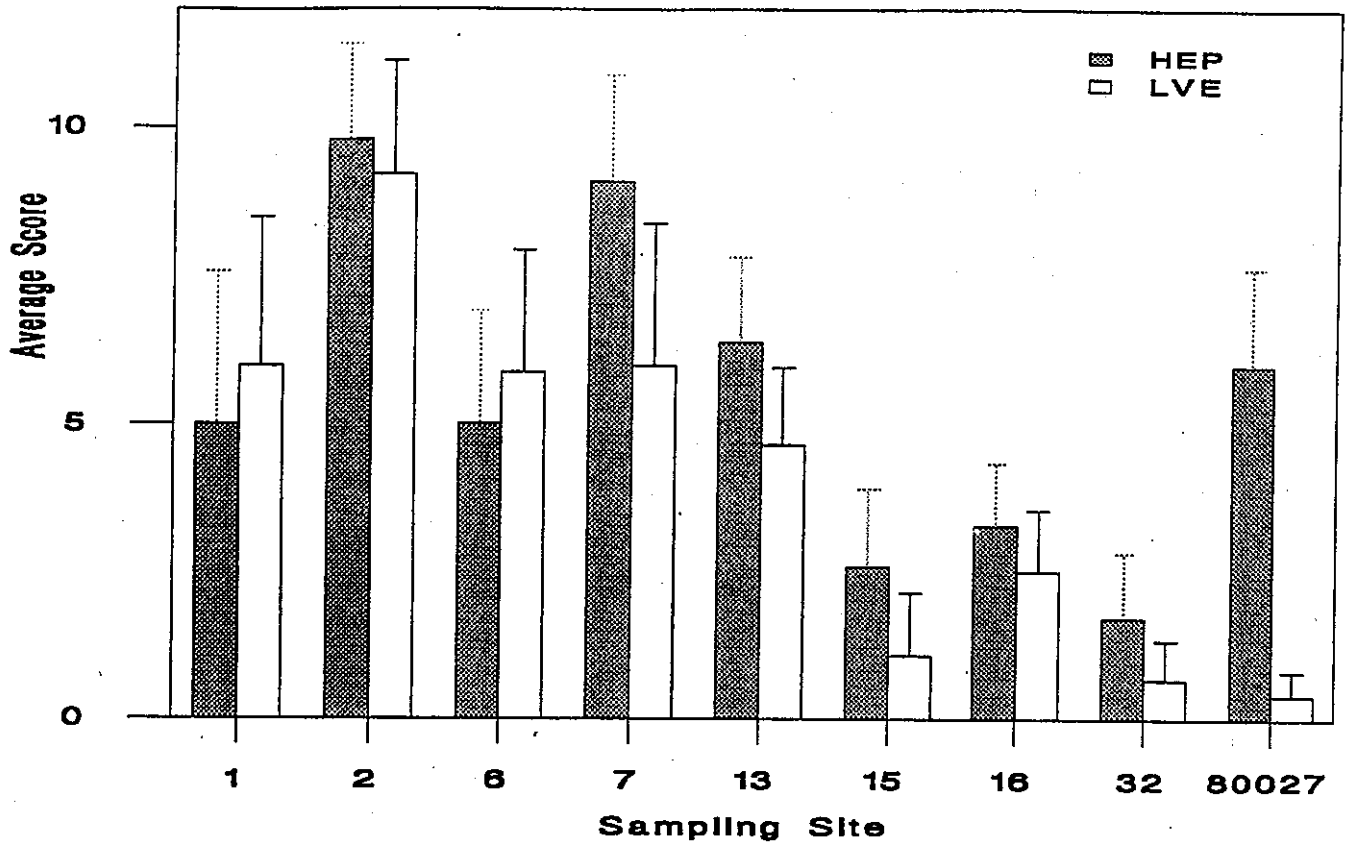


(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 8d. Average Immunohistochemical P450 Scores for Gonadal Blood Vessels (GO-VE) and Splenic Blood Vessels (SVE) in Tonguefish.

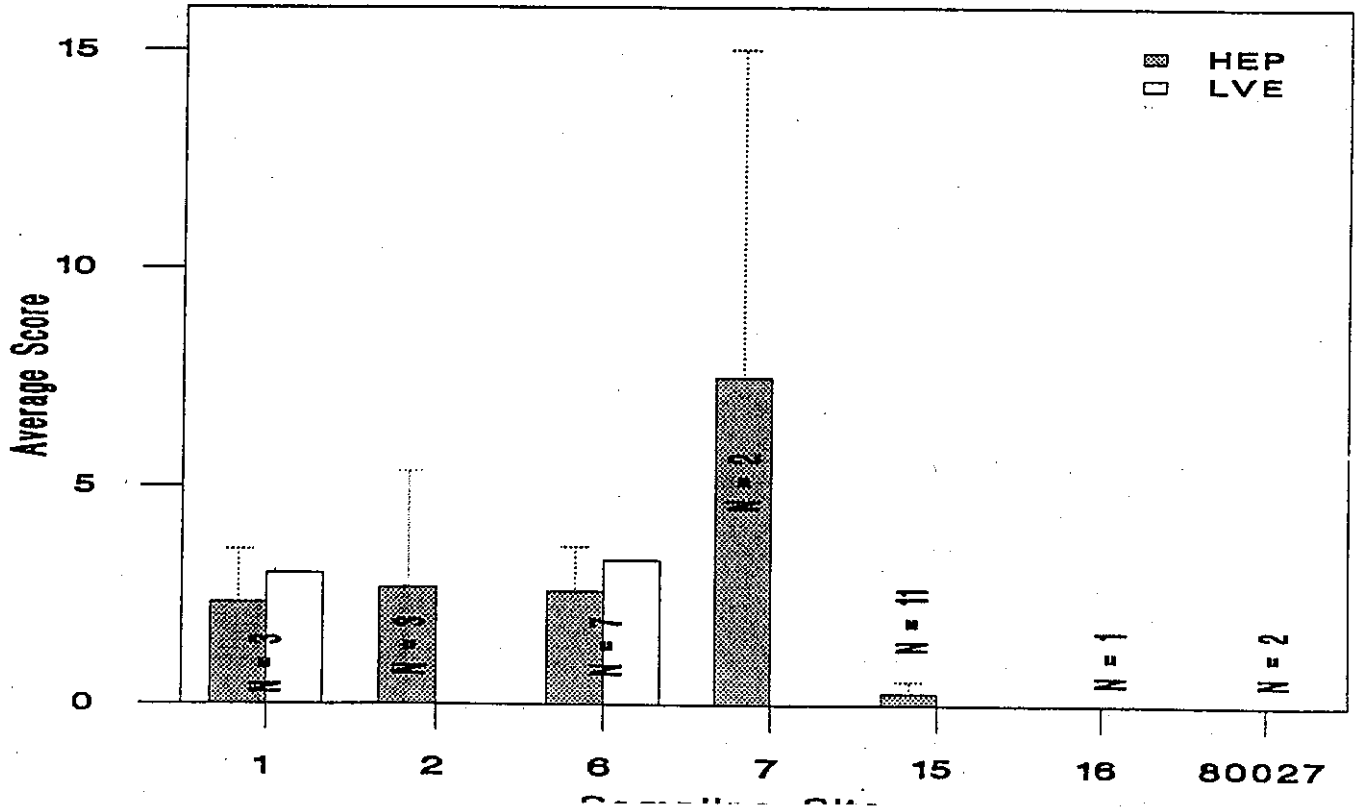


Graph 9a. Average Immunohistochemical P450 Scores for Hepatocytes (HEP) and Liver Vascular Endothelium (LVE) for all fish from all sites.

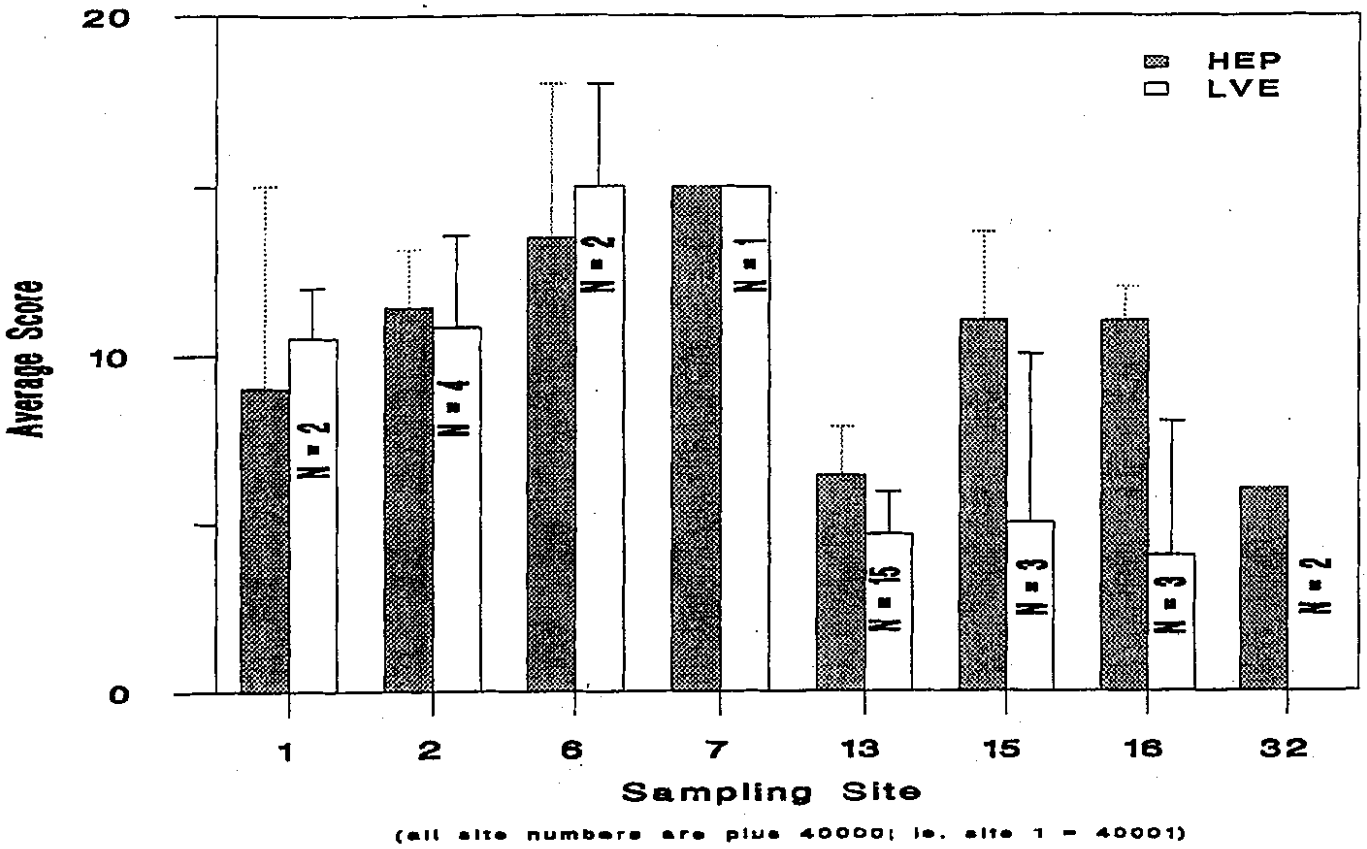


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 9b. Average Immunohistochemical P450 Scores for Hepatocytes (HEP) and Liver Vascular Endothelium (LVE) in Yellowfin Gobies.

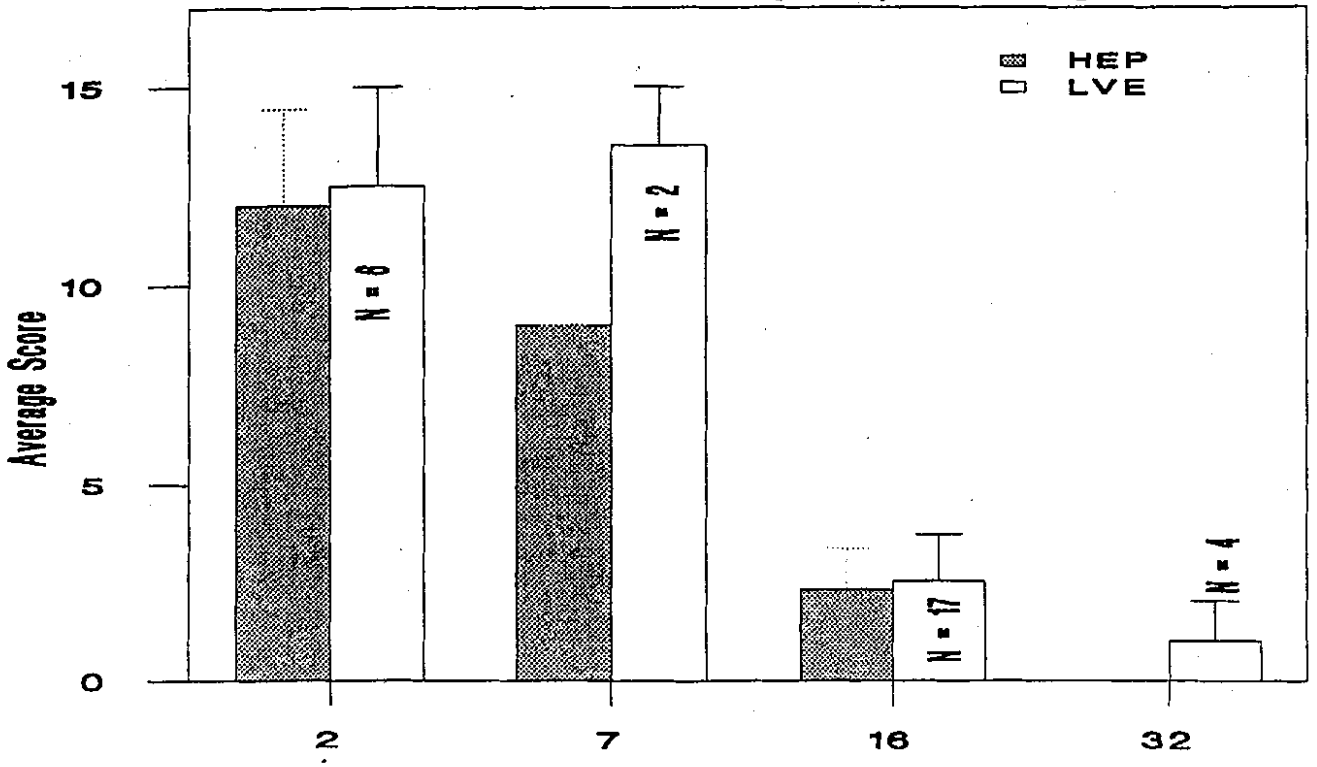


Graph 9c. Average Immunohistochemical P450 Scores for Hepatocytes (HEP) and Liver Vascular Endothelium (LVE) in White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 9d. Average Immunohistochemical P450 Scores for Hepatocytes (HEP) and Liver Vascular Endothelium (LVE) in Tonguefish.



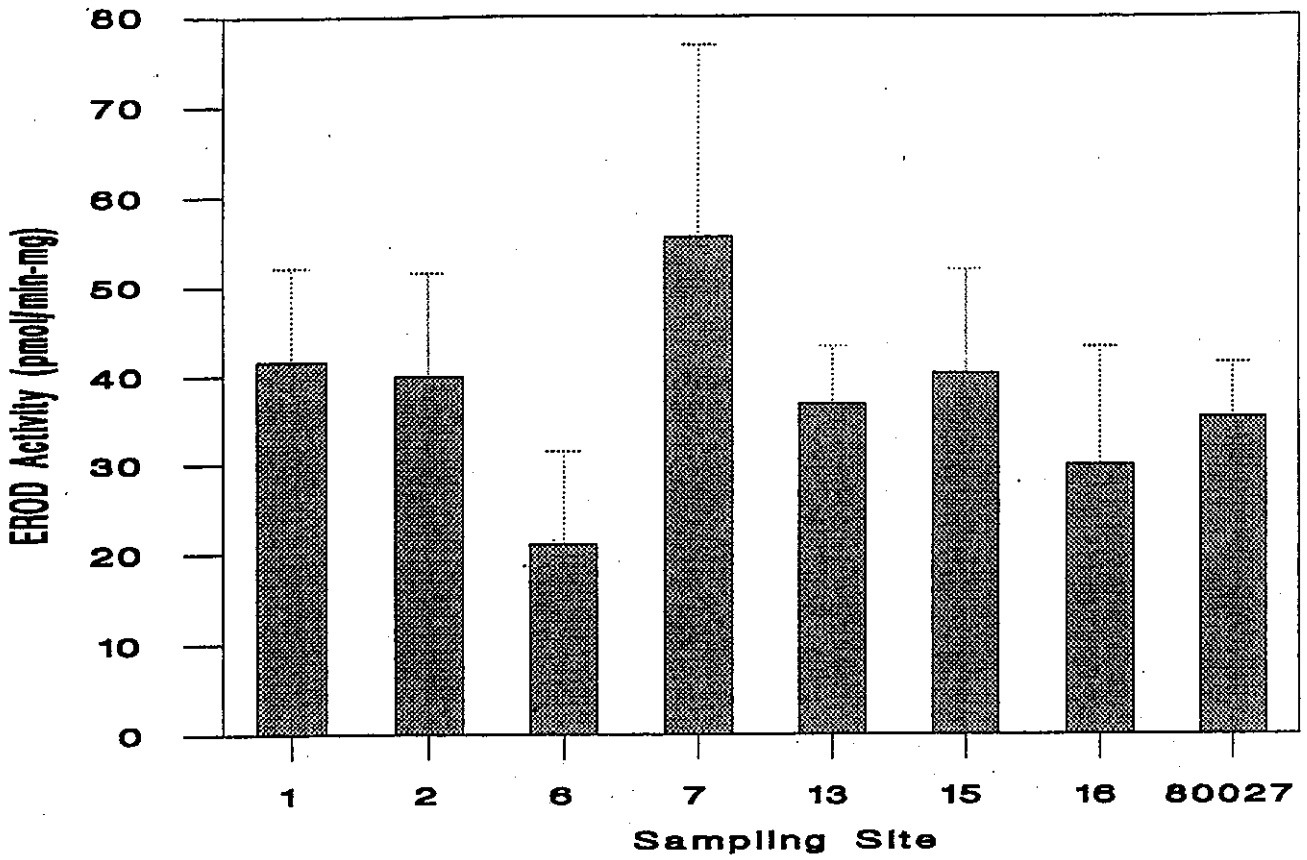
EROD - Results: Hepatic EROD activity as expressed in pmol/min-mg is given in Appendix 17. The data was sorted on the basis of site and species. Average EROD activity and standard error was determined for each site.

EROD activity for all fish from all sites is depicted on graph 10a. There are no sharp trends, but one reference site (40016) does have lower average EROD activity than five of six impact sites. The second reference site (40015) had higher EROD activity than three impact sites, but lower activity when compared to the other three impact sites. Sorting the data, with respect to species (graphs 10b-10d), did not clarify matters.

Graph 11 shows average hepatic EROD activity for the dominant species taken from each site. Although it is somewhat unconventional way of examining the data, the differences between sites does become more distinct. Reference site 40016 now has the lowest average EROD activity and the second reference site (40015) has EROD activity which is lower than five of six impact sites.

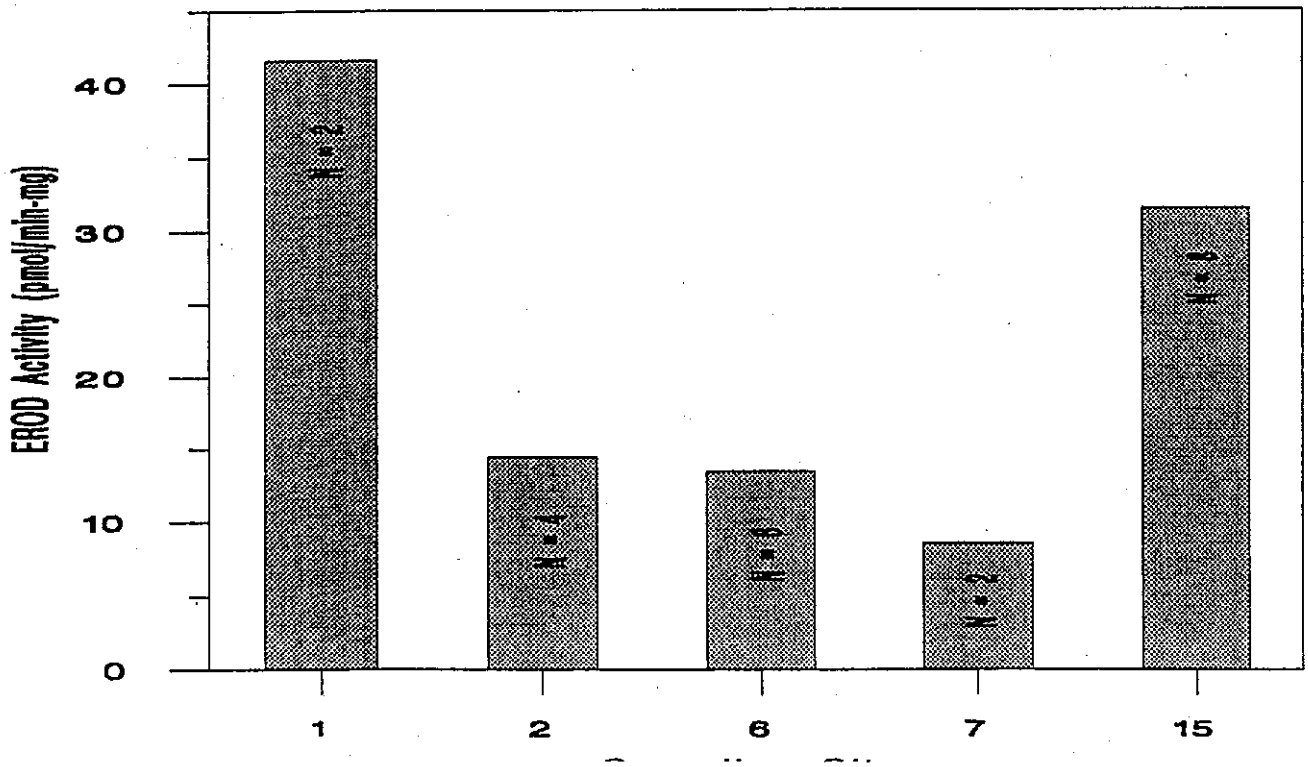
EROD - Statistics: MANOVA revealed that there were significant ($P < 0.01$) differences with respect to site and highly significant differences ($P = 0.0001$) with respect to species. Comparison between sites, using Least Squares Means, revealed that impact site 40007 (composed of primarily cusk-eels) had significantly ($P < 0.01$) higher EROD activity when compared to reference sites 40015 (gobies) and 40016 (tonguefish). Impact site 40006 (gobies) had significantly ($P < 0.05$) lower EROD activity than fish from reference site 40015 (gobies).

Graph 10a. Hepatic EROD Activity for All Fish from ALL Sites.

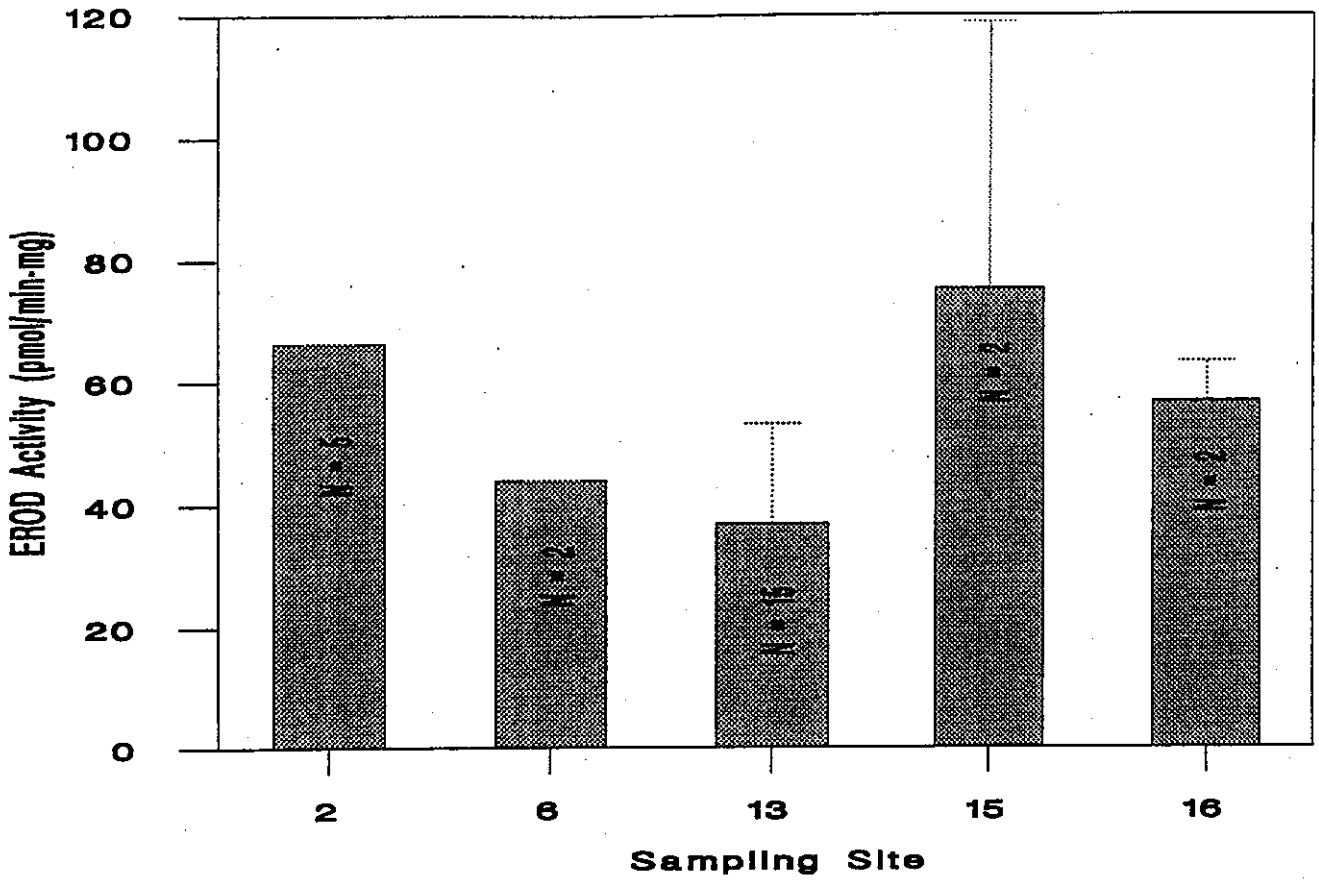


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 10b. Hepatic EROD Activity in Yellowfin Gobies.

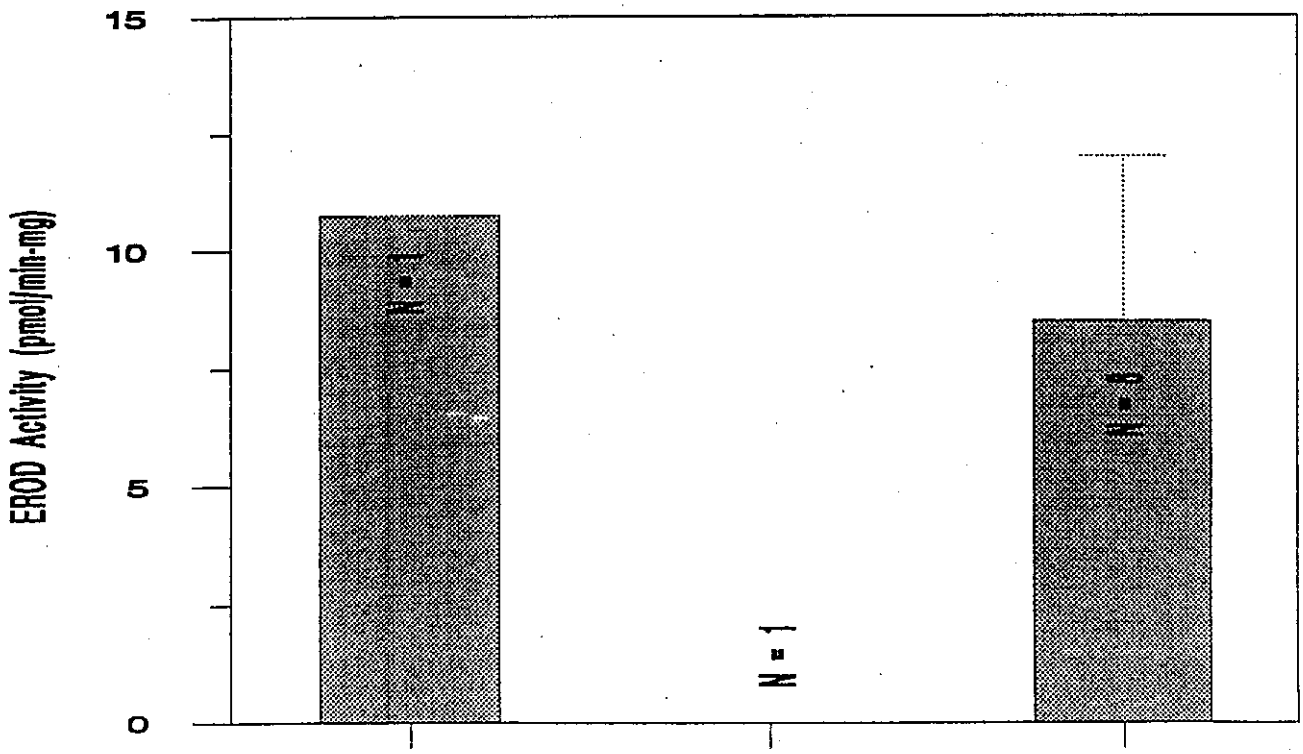


Graph 10c. Hepatic EROD Activity in White Croakers.

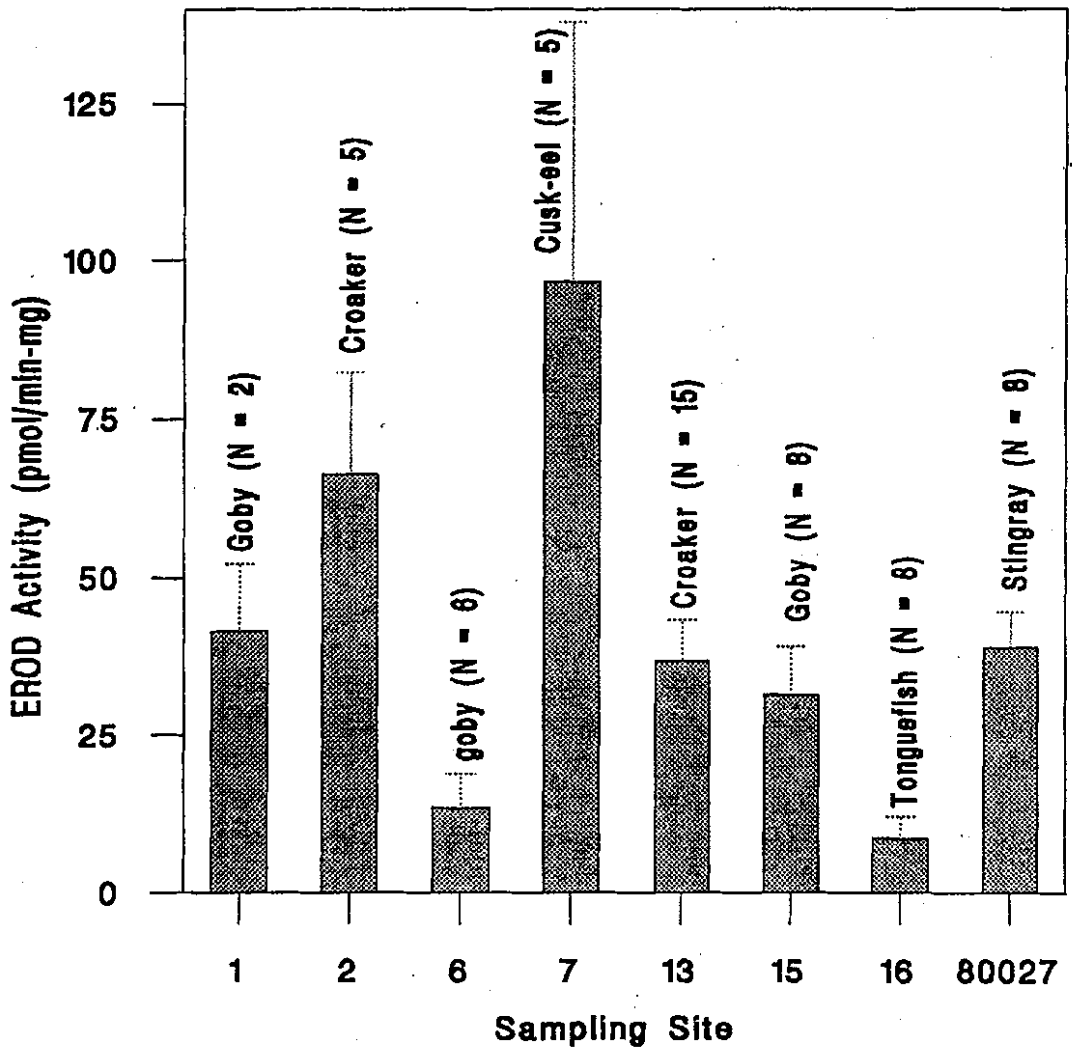


(all site numbers are plus 40000; ie. site 2 = 40002)

Graph 10d. Hepatic EROD Activity in Tonguefish.



Graph 11. Hepatic EROD Activity of Fish Species which Comprised the Majority of Fish Sampled from Each Site.



(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Indices - Results:

Hepatosomatic Index: Hepatosomatic indices (HSI), sorted on the basis of site, are given in appendices 18a-18c and depicted in graph 12a. HSI from two reference sites (40016 and 40032) are moderately to markedly lower when compared to the six impact sites. Site 80027, where 10 of 12 fish were stingrays, had the highest HSI.

HSI, sorted on the basis of site and species, are given in appendices 18d-18h and depicted in graphs 12b-12d. Average HSI in gobies (graph 12b) and tonguefish (graph 12d), from impact and reference sites, were similar. Average HSI in croakers from five impact sites was higher than HSI in croakers in all three reference sites. The highest HSI was in croakers from impact site 40013.

MANOVA revealed that there were significant ($P = 0.05$) differences in HSI with respect to site, and highly significant ($P = 0.0001$) differences with respect to species. Comparisons among sites using Least Squares Means revealed that HSI in fish from impact site 40013 was significantly ($P < 0.05$) higher than HSI in fish from all three reference sites. Average HSI was also higher in fish from site 40013 when compared to two other impact sites (40006 and 40007).

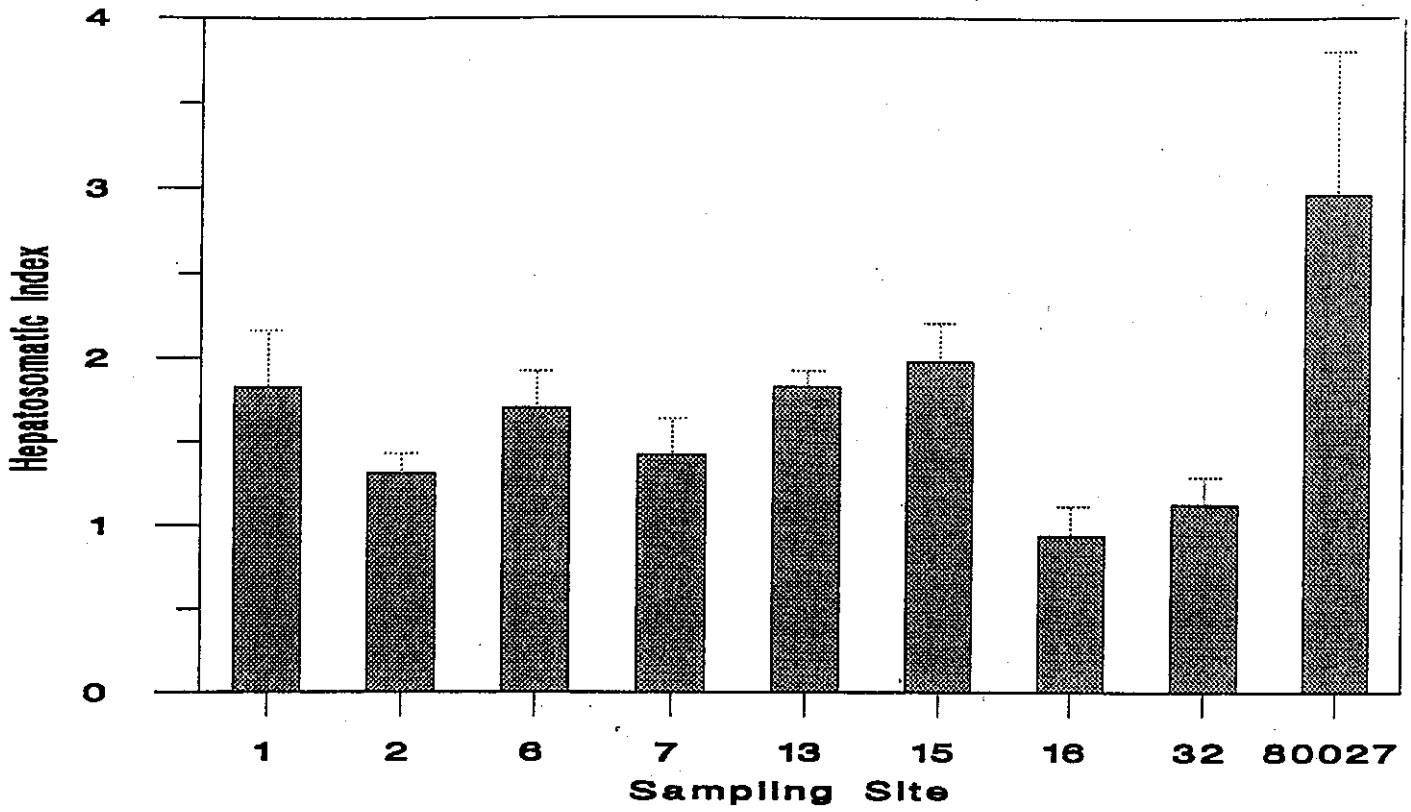
Comparisons between species, using Least Squares Means, showed that there were numerous differences with respect to HSI. HSI in cusk-eels was significantly ($P < 0.001$) different from tonguefish and croakers. HSI in stingrays was significantly ($P < 0.01$) different from tonguefish and croakers. HSI in tonguefish was significantly ($P = 0.0001$) different from croakers and gobies. HSI in croakers was significantly ($P = 0.0001$) different from gobies.

Gonadosomatic Index: Gonadosomatic indices (GSI), sorted on the basis of site, are given in appendices 18a-18c. GSI, sorted on the basis of site and species, are given in appendices 18d-18h. Although there appears to be a slight trend towards higher GSI at the three reference sites (graph 13a), separation of GSI scores on the basis of species (graph 13b-13d) did not reveal any consistent patterns. MANOVA and comparisons among sites, using Least Squares Means analysis, did not reveal any significant differences in GSI between sites or species. GSI differences between sexes were highly significant ($P < 0.001$), but this was expected.

Condition Index: Condition indices (CI), sorted on the basis of site, are given in appendices 18a-18c. CI, sorted on the basis of site and species, are given in appendices 18d-18h. Average CI for all fish from all sites is depicted in graph 14a. The highest average CI were in two impact sites (40013 and 40006), but there were no consistent trends. Additional sorting of the data based on species also did not reveal any consistent trends. Average CI, with very few exceptions was very similar in both impact and reference sites for gobies, croakers, and tonguefish. Comparisons between sites could not be made for cusk-eels and stingrays, as they were only collected in significant numbers from a single site.

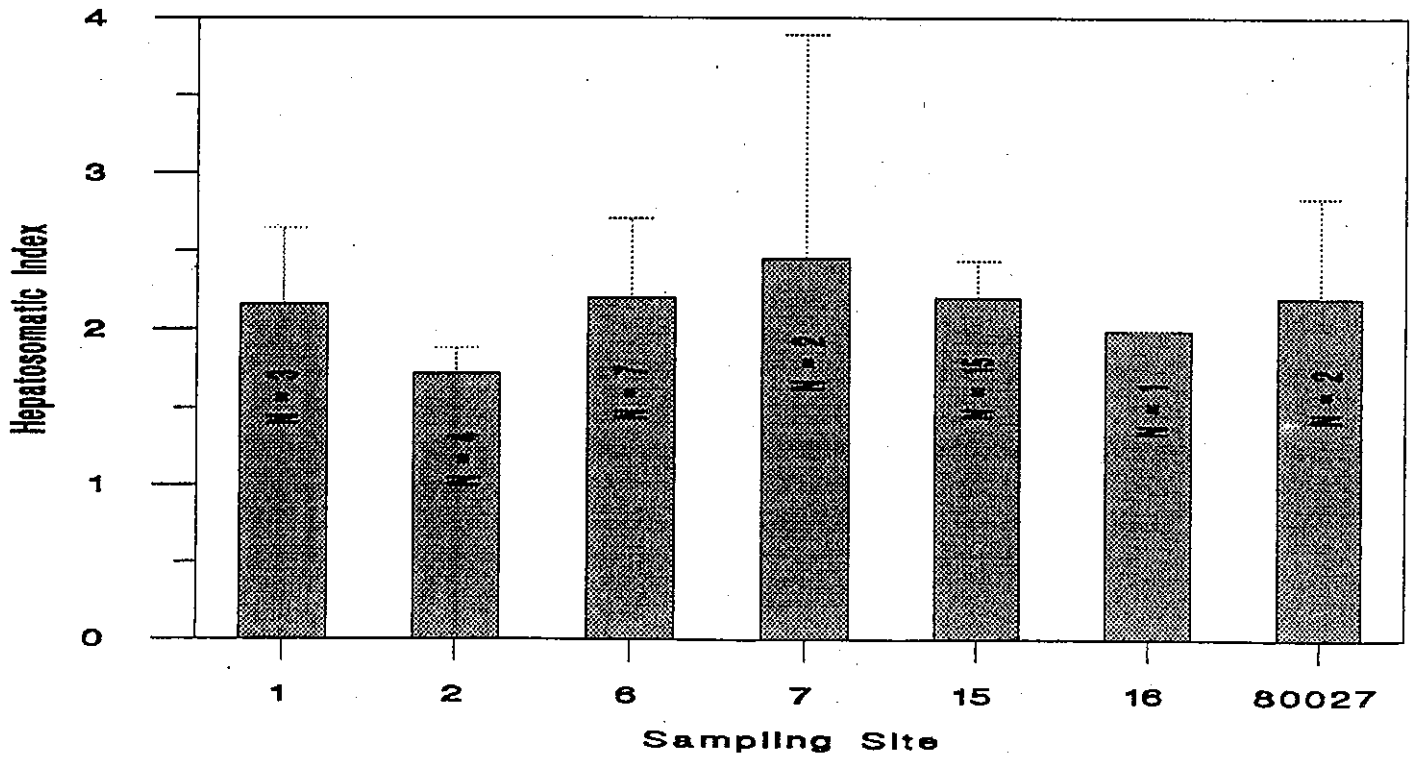
MANOVA revealed that there were significant differences in CI with respect to both site ($P < 0.01$) and species ($P = 0.0001$). Comparisons between sites, using Least Squares Means, revealed that average CI in fish from impact site 40007 was significantly ($P < 0.01$) lower than CI in all three reference sites. Average CI from impact site 40007 was also significantly ($P < 0.01$) lower than CI in fish from two other impact sites (40002 and 40006) and cusk-eels comprised 33.3% of the sample taken from site 40007. Comparisons between species, using Least Squares Means, revealed that CI in all five speces were significantly ($P \leq 0.01$) different from one another.

Graph 12a. Hepatosomatic Indices for All Fish from All Sites.

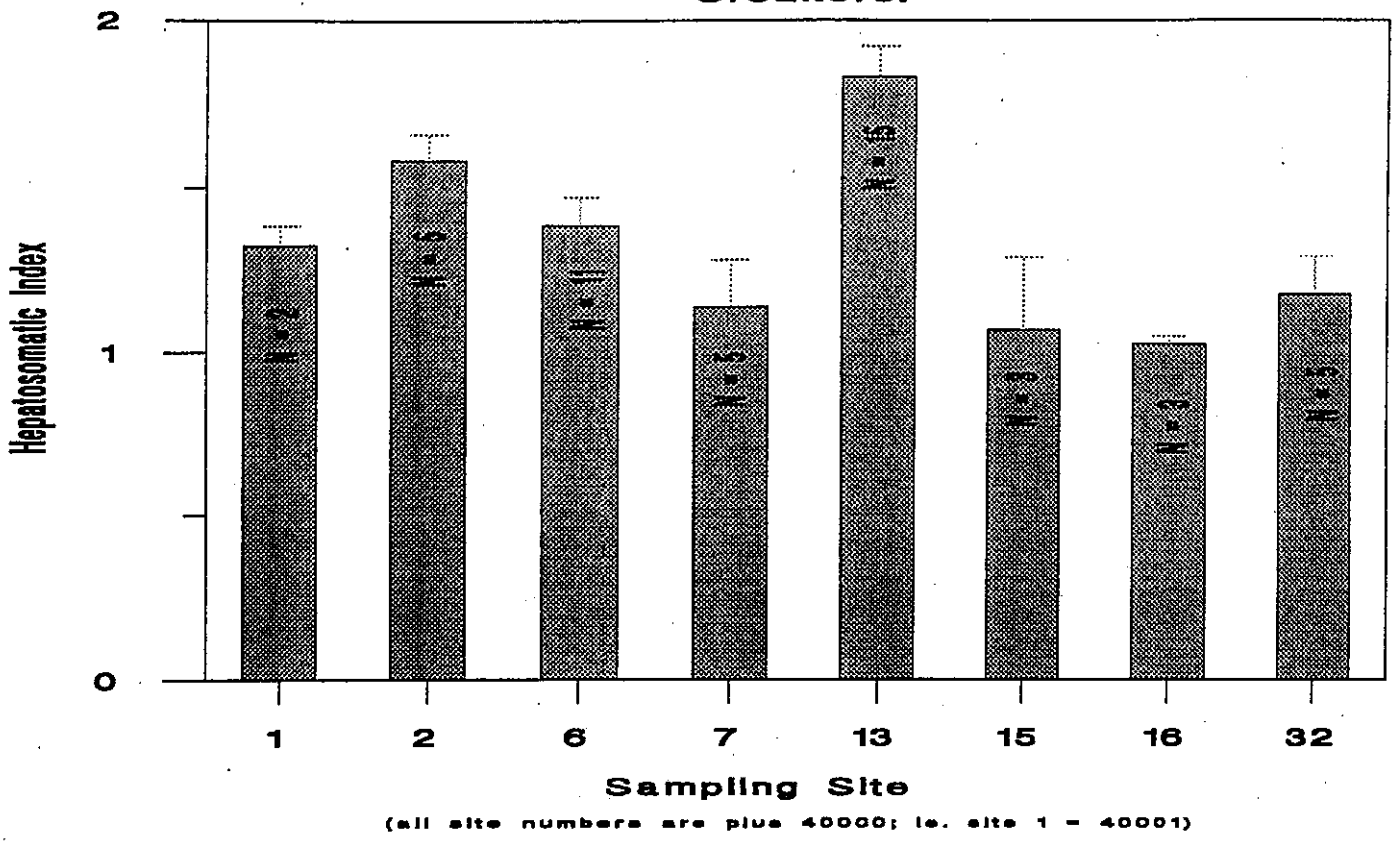


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

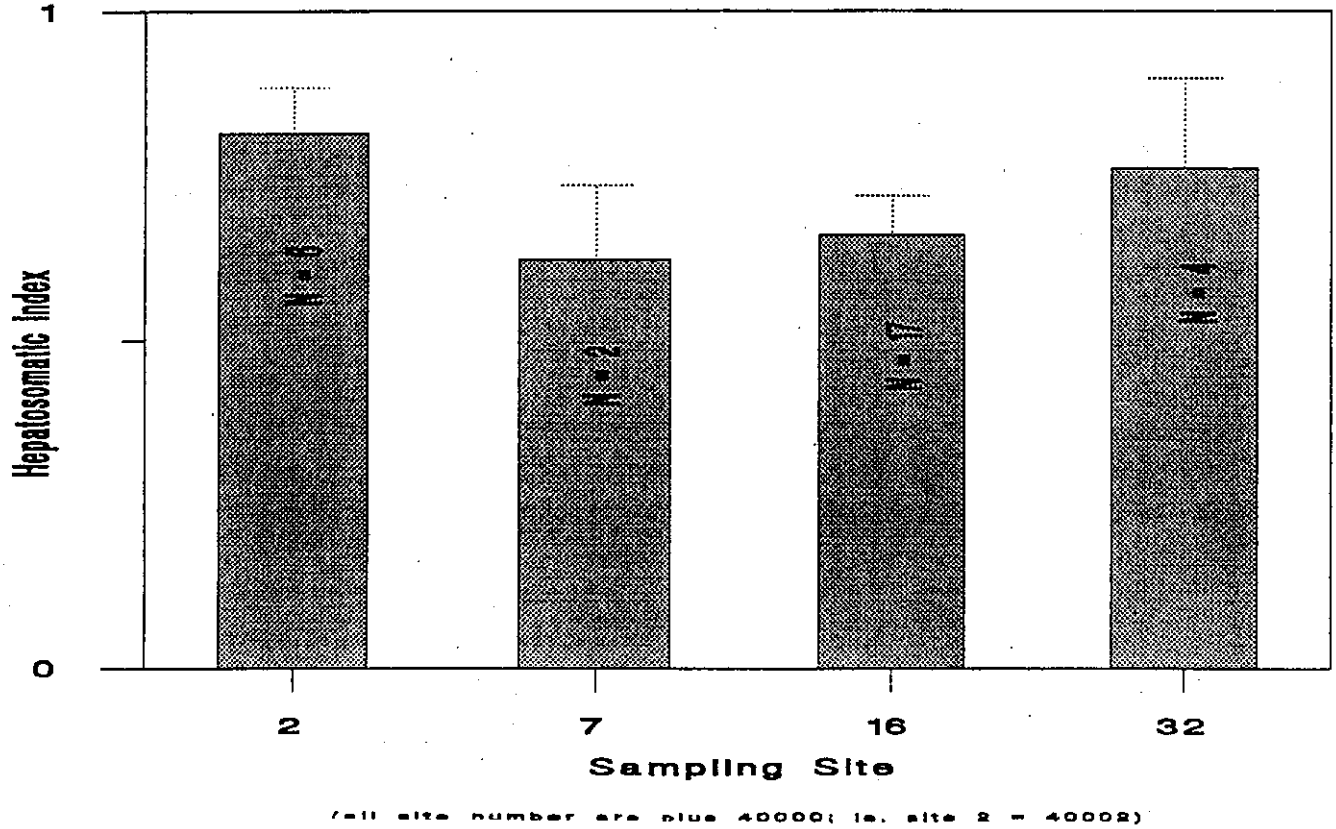
Graph 12b. Hepatosomatic Indices in Yellowfin Gobies.



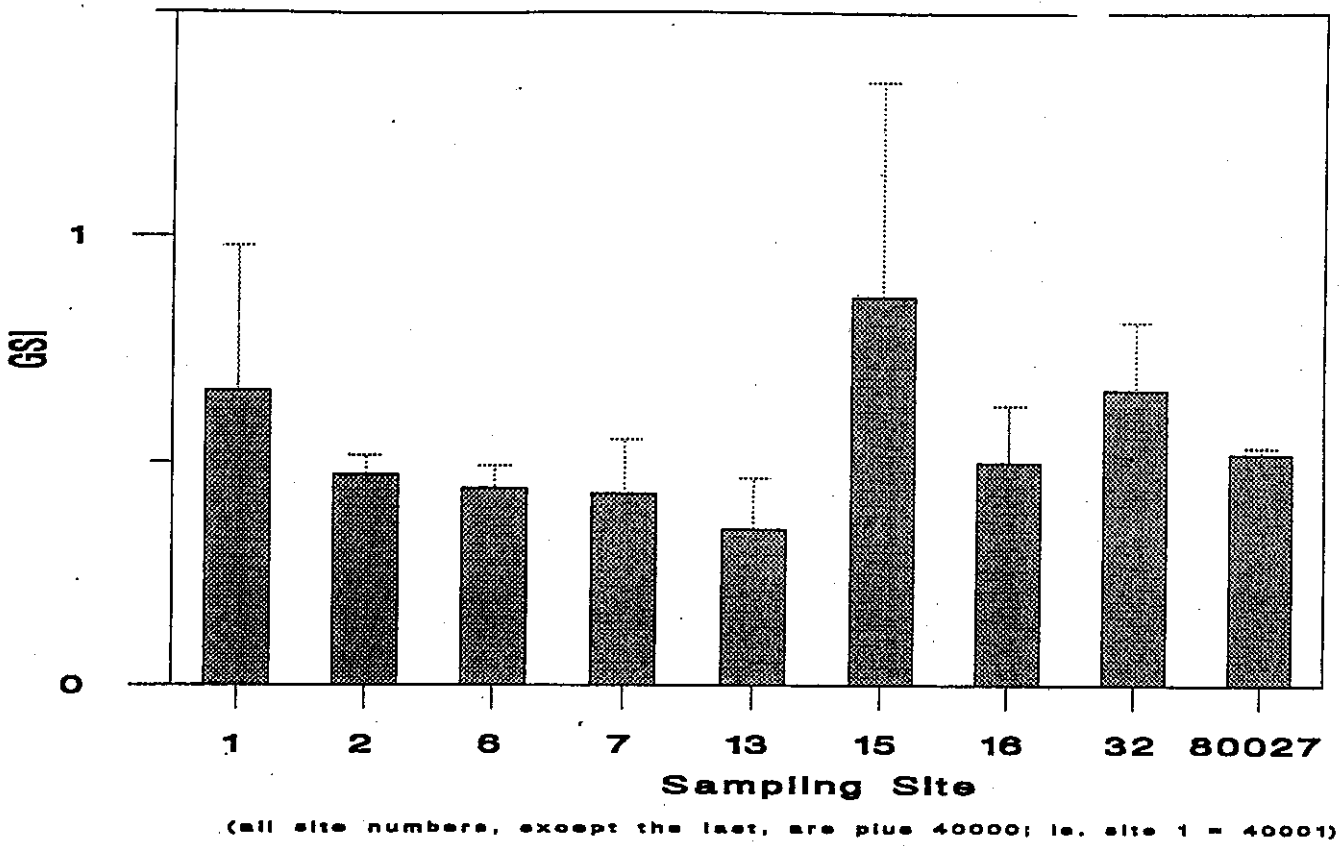
Graph 12c. Hepatosomatic Indices in White Croakers.



Graph 12d. Hepatosomatic Indices in Tonguefish.

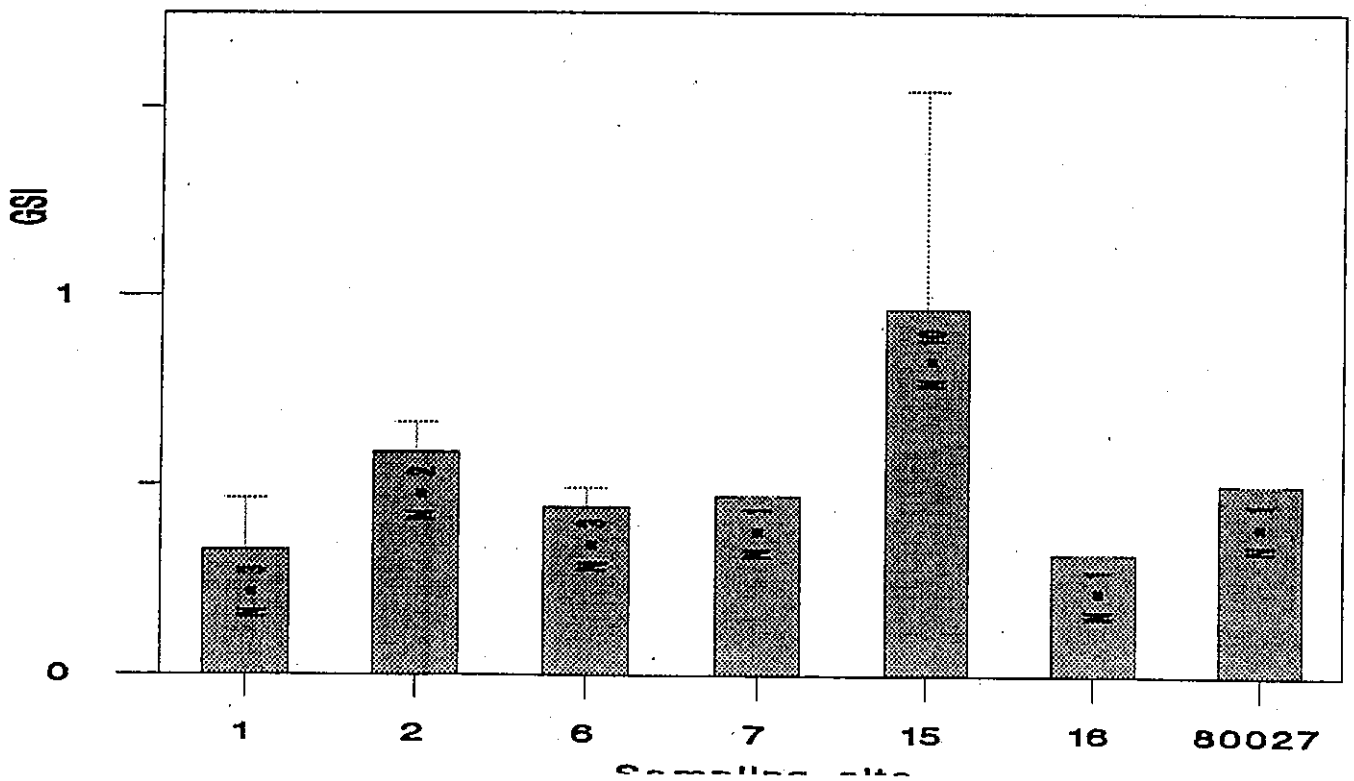


Graph 13a. Gonadosomatic indices (GSI = gonad weight/body weight X 100) for all fish from all sites.

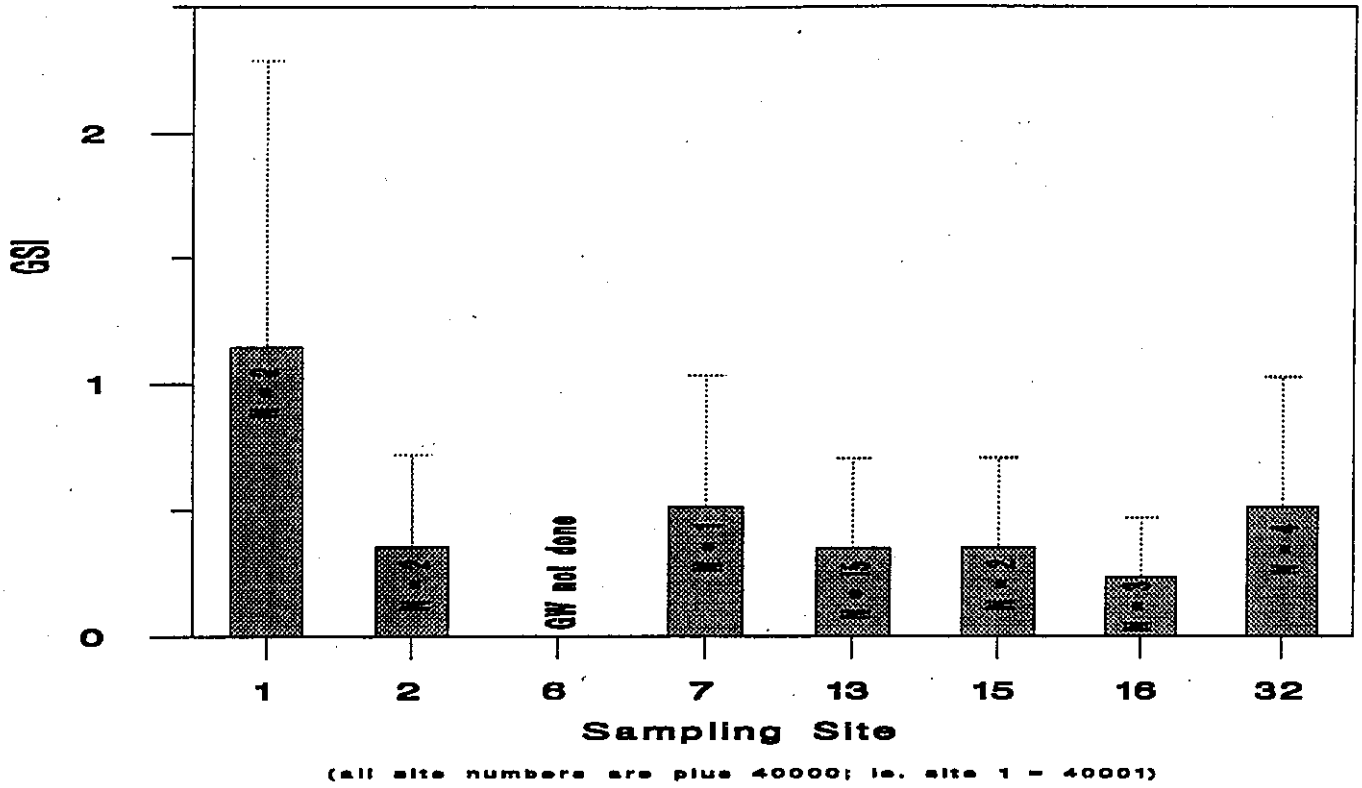


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

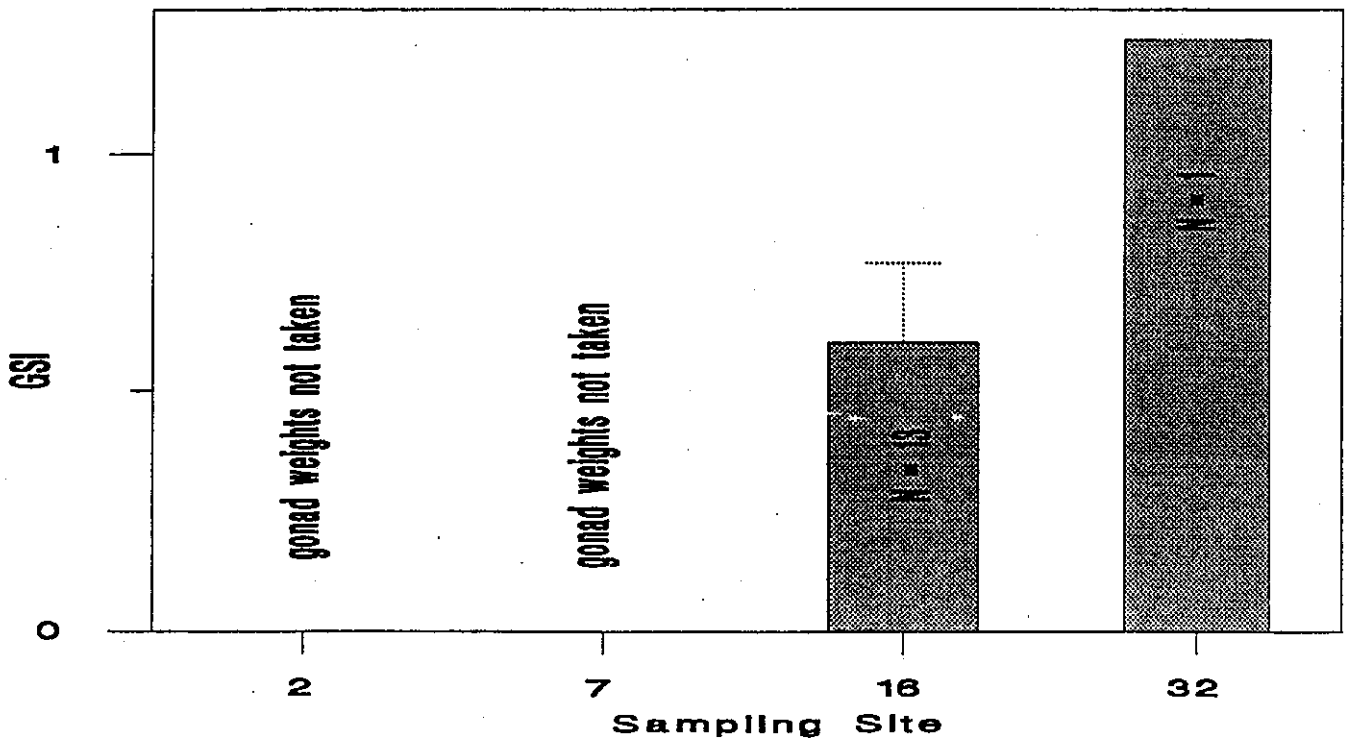
Graph 13b. Gonadosomatic indices (GSI = gonad weight/body weight X 100) for Yellowfin Gobies.



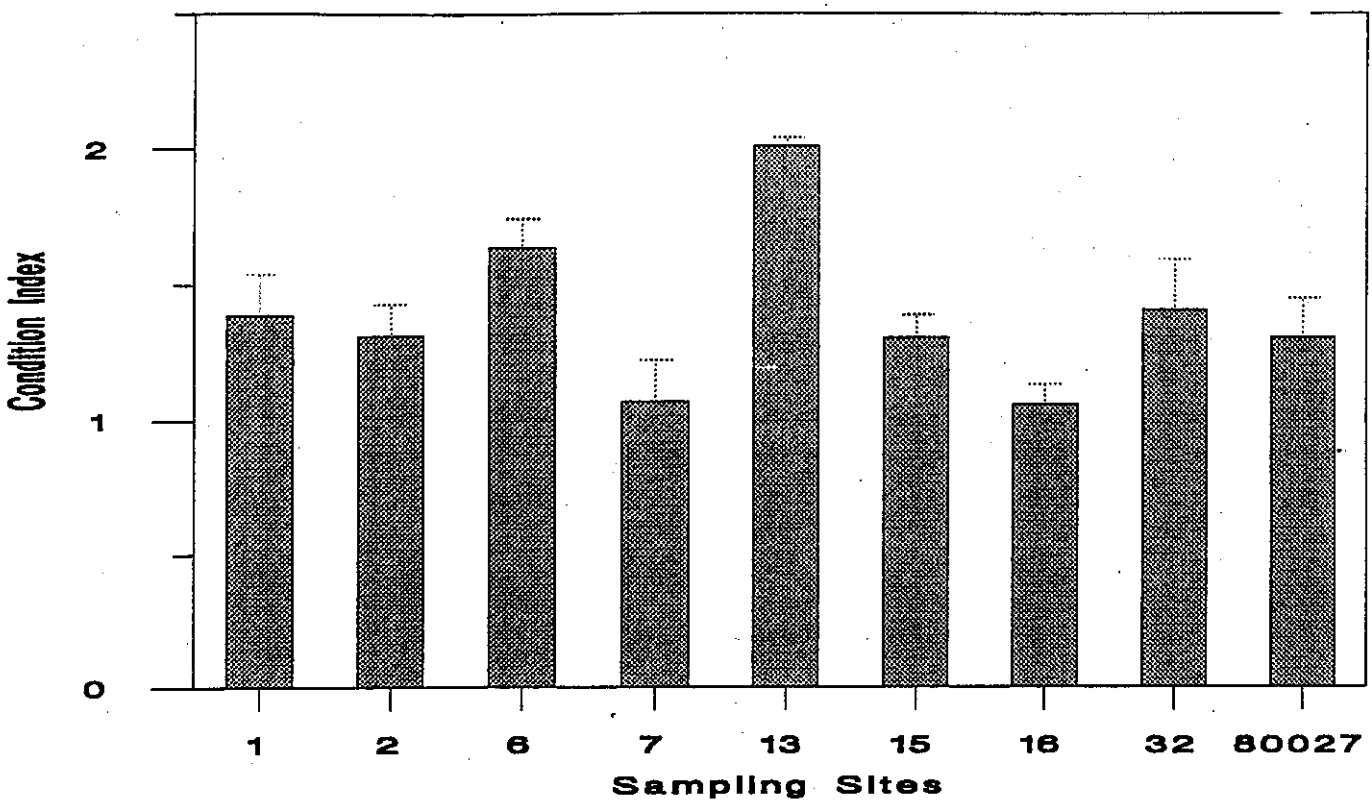
Graph 13c. Gonadosomatic Indices (GSI = gonad weight/body weight X 100) for White Croakers.



Graph 13d. Average Gonadosomatic Index (GSI = gonad weight/body weight X 100) for Tonguefish.

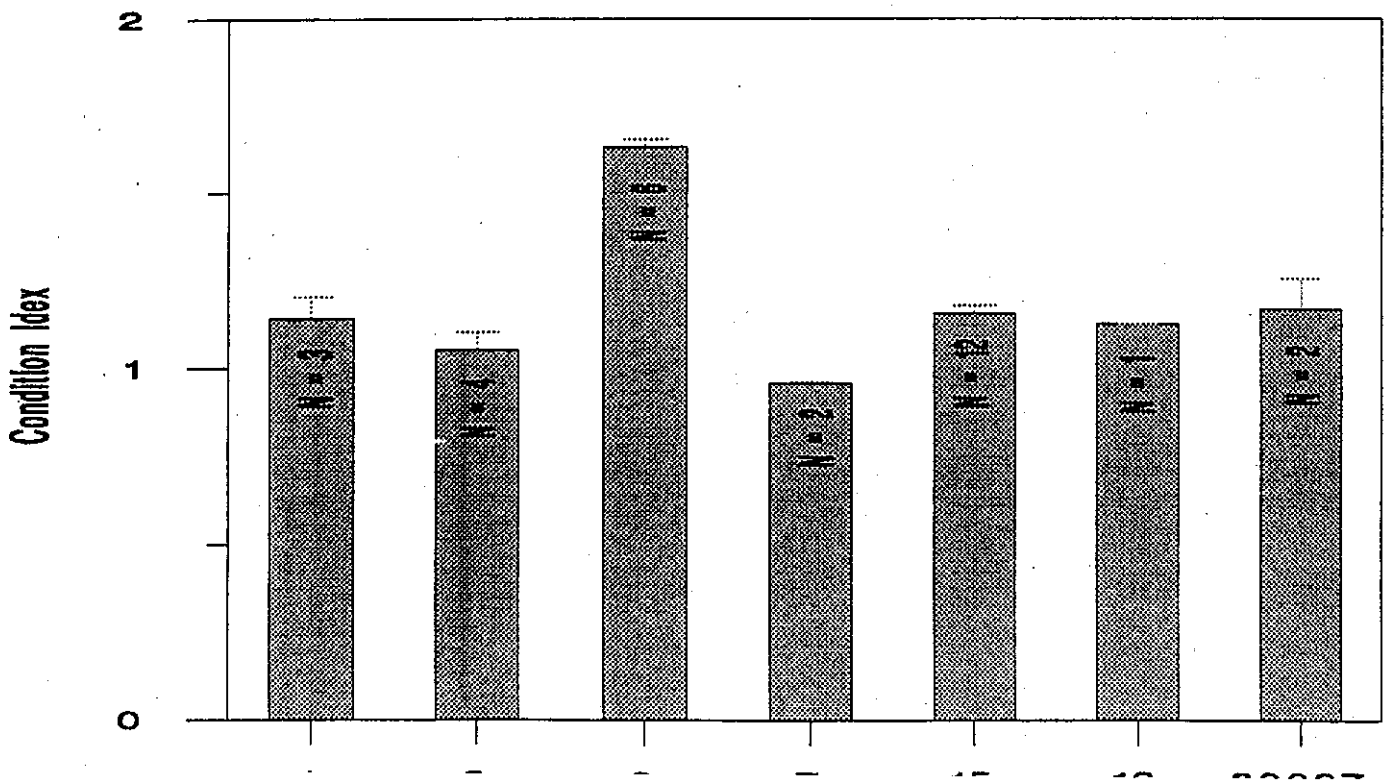


Graph 14a. Condition Index (CI = body weight/standard length^3 X100,000) of All fish from All sites.

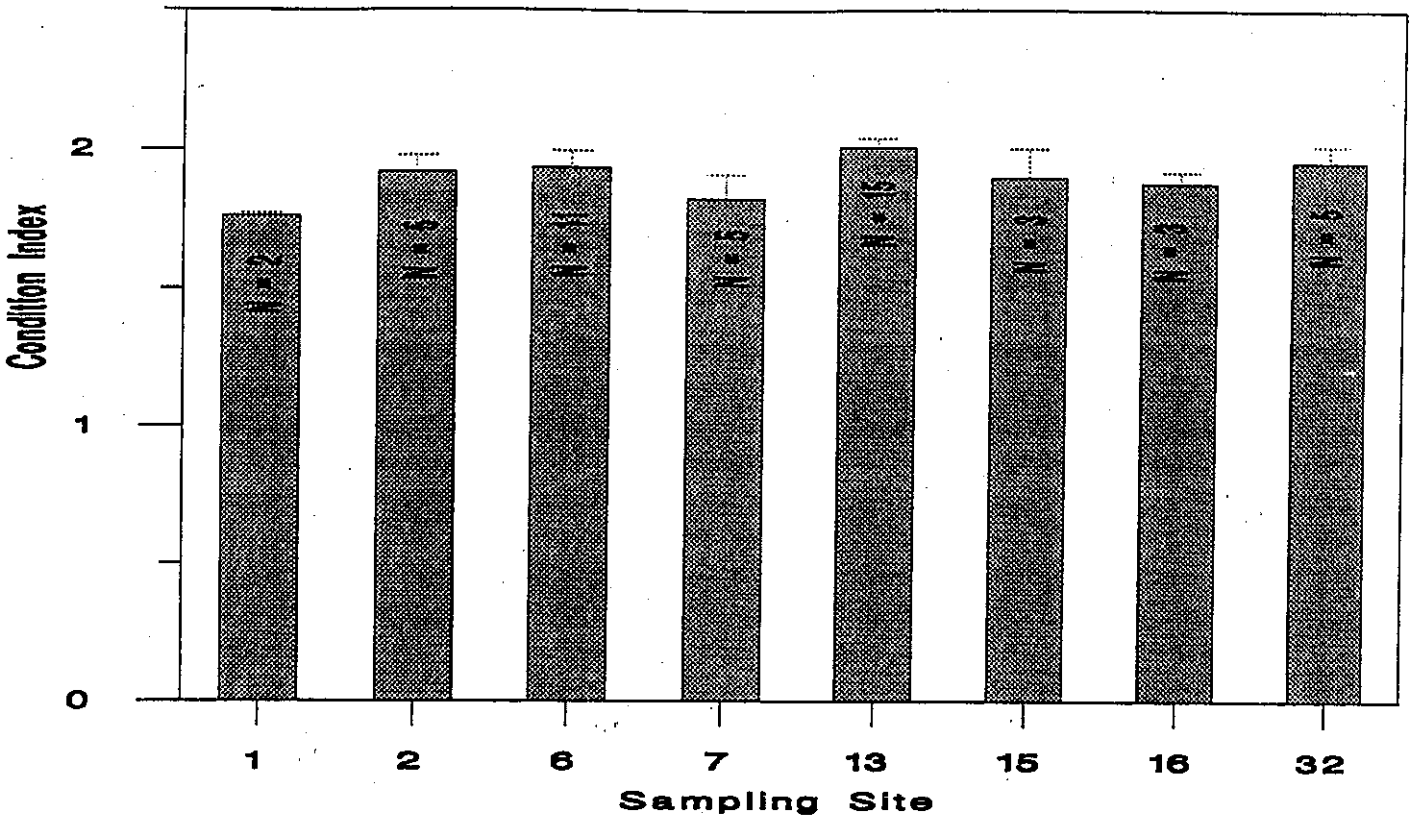


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 14b. Condition Indices (CI = body weight/standard length^3 X 100,000) for Yellowfin Gobies.

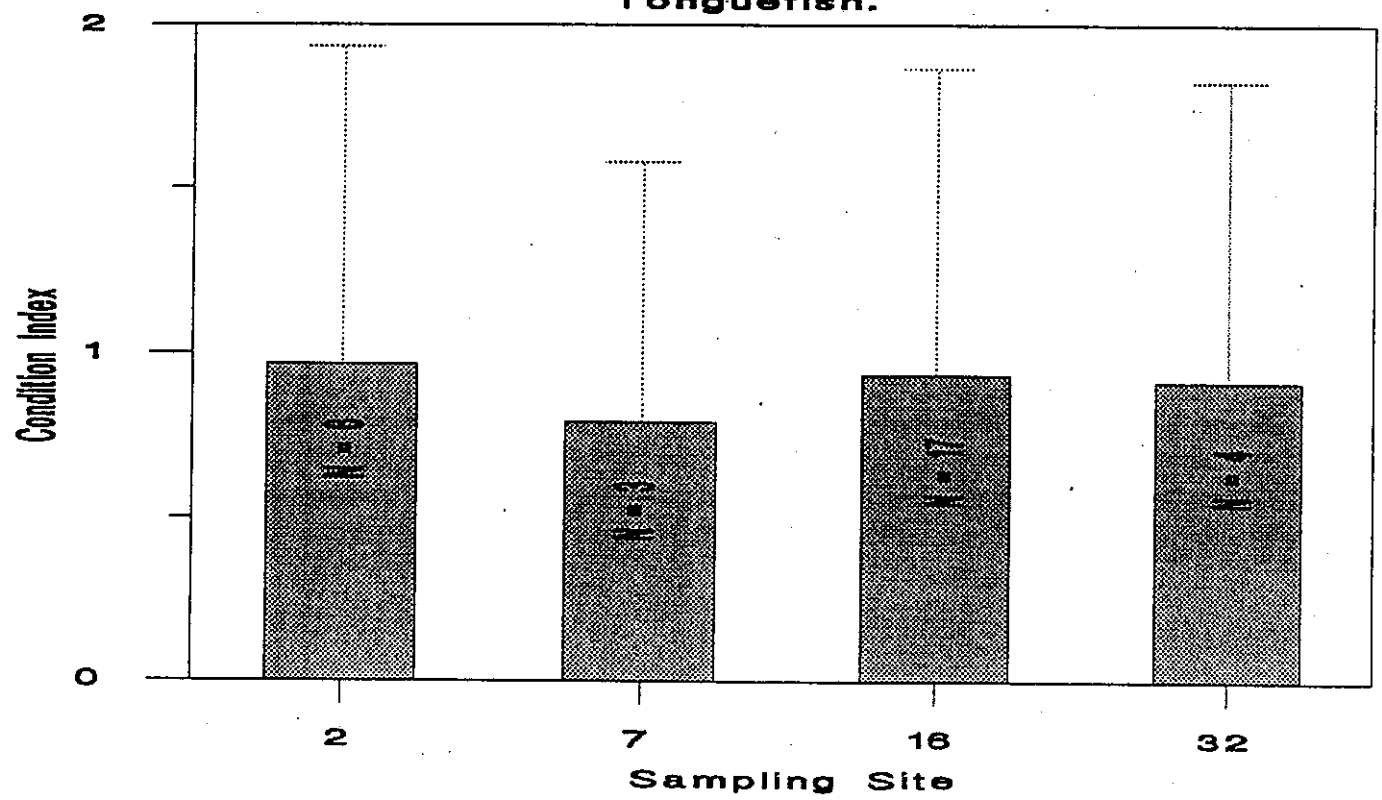


Graph 14c. Condition Indices (body weight/standard length^3 X 100,000) for White Croakers.



(all site numbers are plus 40000; ie. site 1 = 40001)

Graph 14d. Average Condition Indices (CI = body weight/standard length^3 X 100,000) for Tonguefish.



Sex Determination - Results: Determination of sex was made via gross and histologic examination of the gonads. In the majority of fish, histology was needed to determine sex. Unfortunately, 17 gonad samples were lost either during processing or sectioning. The data, sorted on the basis of site, is given in appendices 18a-18c. Additional sorting on the basis of species in shown in appendices 18d-18h and depicted in graphs 15a-15d. Graph 15a shows the distribution of mature males (testes with sperm) and females (ovaries with developing oocytes) in all fish for all sites. There were no obvious differences in between impact and reference sites.

When gobies were examined separately (graph 15b), there appear to be sharp site to site difference with respect to the sex. Two sites, impact site 40007 and reference site 40016, had samples with 100% female gobies. Sample sizes, however, were small with an "N" of two at site 40007 and only one at site 40016. Sample sizes were also small in the two other species (croakers and tonguefish) found at multiple sites, and no trends were uncovered with respect to prevalence of mature male or female fish.

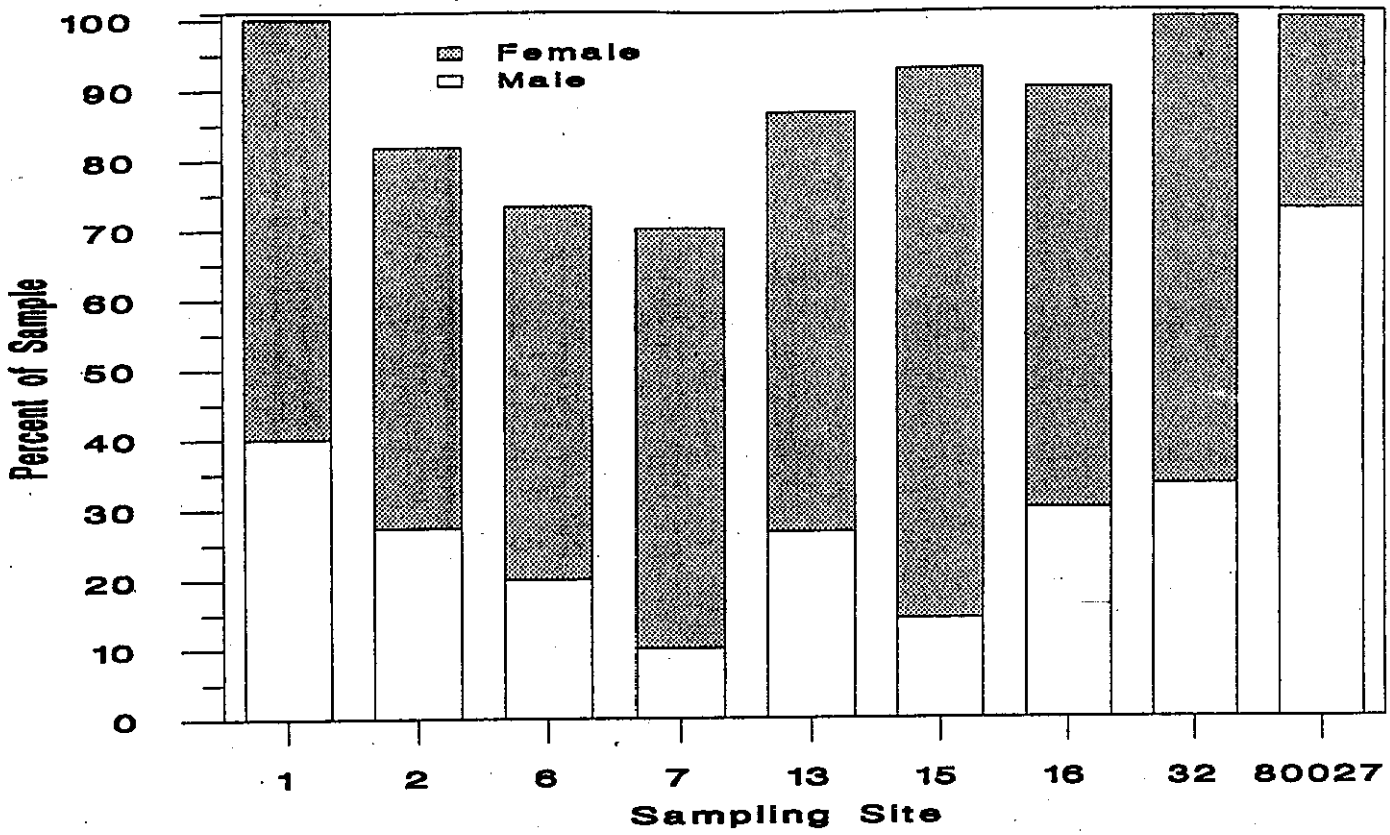
Some male fish with very small (< 1 mm diameter) testes were observed when gonads were surveyed to determine sex. These testes had minimal to no sperm production and were classified as immature and/or atrophic (Mi/a). In addition, a few male fish had immature/atrophic testes which had small numbers of immature oocytes. These fish were classified as intersex. Prevalence of intersex and Mi/a male fish for all sites is shown in graph 16a. All three intersex fish were from impact sites. Two impact sites (40006 and 40007) had markedly higher prevalences of Mi/a males when compared to the three reference sites. Reference site 40032 had no intersex fish nor any Mi/a males.

Sorting the data on the basis of sex revealed that almost all the intersex and Mi/a fish were croakers (graph 16b). Prevalence of Mi/a males among croakers was not consistent with the pattern when all five species were evaluated together. Prevalence of Mi/a croakers at reference site 40016 was higher than prevalences in all of the impact sites. In addition, the Mi/a males at reference site 40015 was higher than four of five impact sites where croakers were collected. Sample sizes at both reference and impact sites were often small (N = 2-5 at six of eight sites where croakers were collected). Average size of Mi/a croakers (mean SL = 77.9 mm) was markedly smaller than croakers with mature testes (mean SL = 118.3 mm).

No intersex or Mi/a males were observed in gobies, tonguefish, or stingrays. One intersex fish and one Mi/a male cusk-eel were found at impact site 40007.

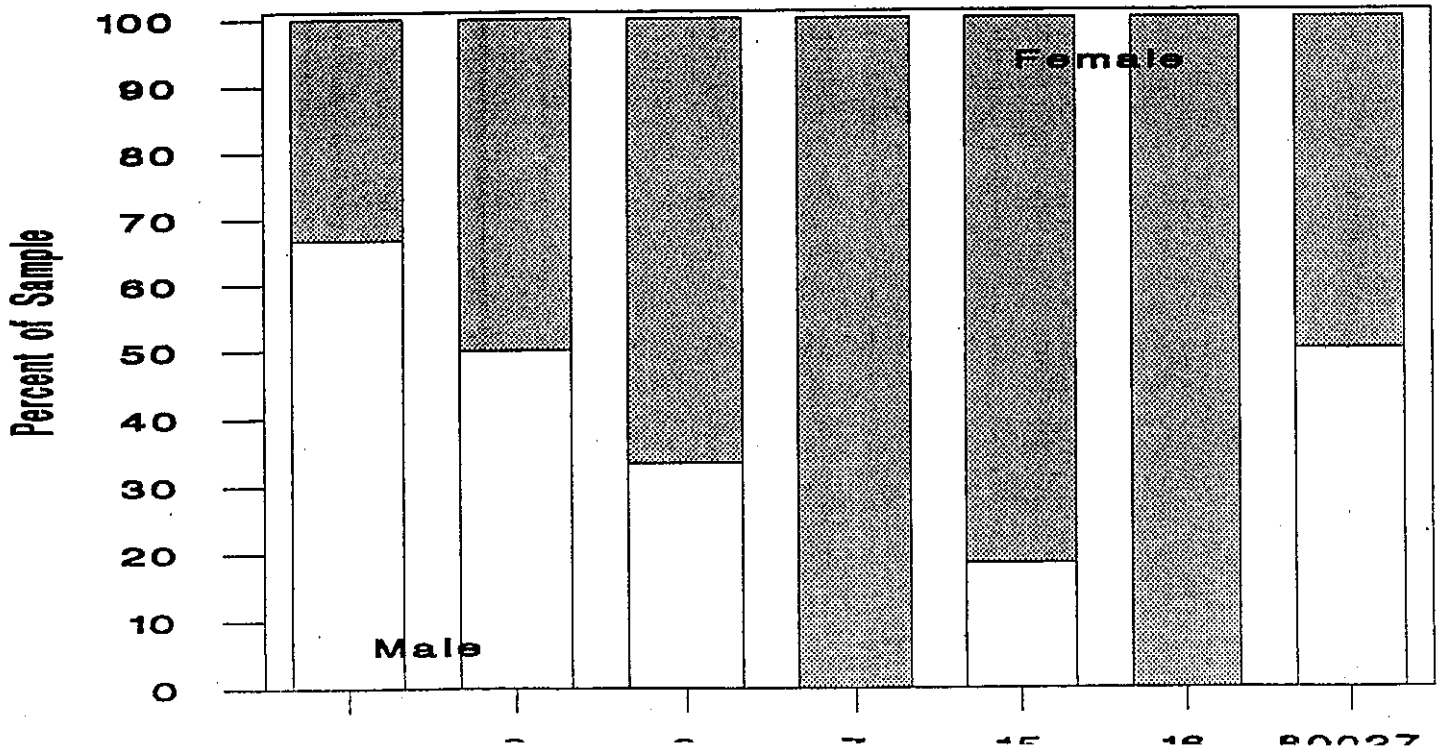
Size - Results: Although fish were not aged, both standard length (mm) and body weight (g) were determined for the majority of fish sampled (appendices 18a-18h). SL and BW data were sorted on the basis of both site and species for the three species which were collected at more than one site. Average SL and BW were similar in gobies from both impact and reference sites (graph 17a). In croakers (graph 17b), fish from four of five impact sites were consistently smaller (shorter and lighter) than croakers from the three reference sites. A similar trend was observed with tonguefish, where fish from the two impact sites (40002 and 40007) were markedly smaller than fish from two reference sites (40016 and 40032).

Graph 15a. Percent of Sample Composed of Mature Male and Female Fish.

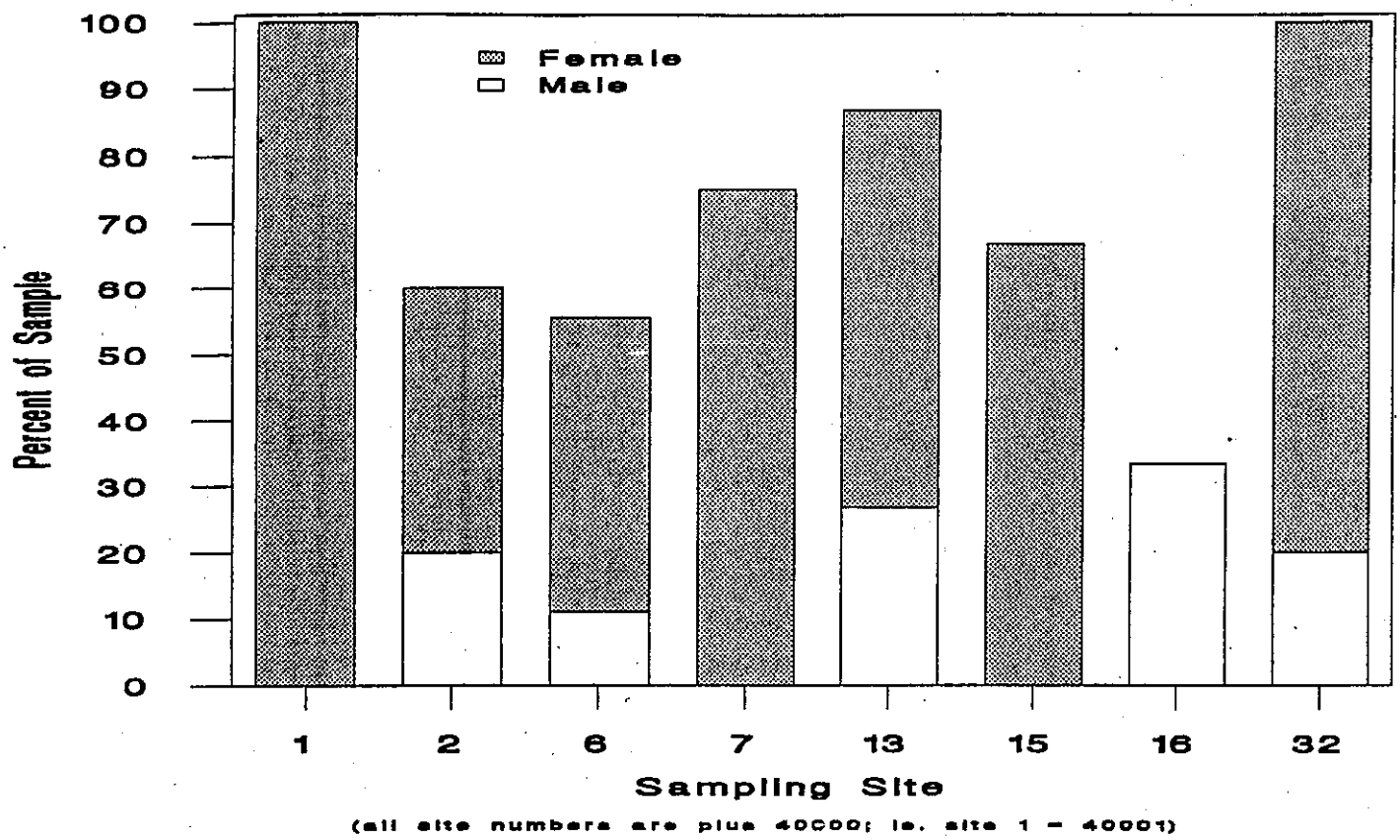


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

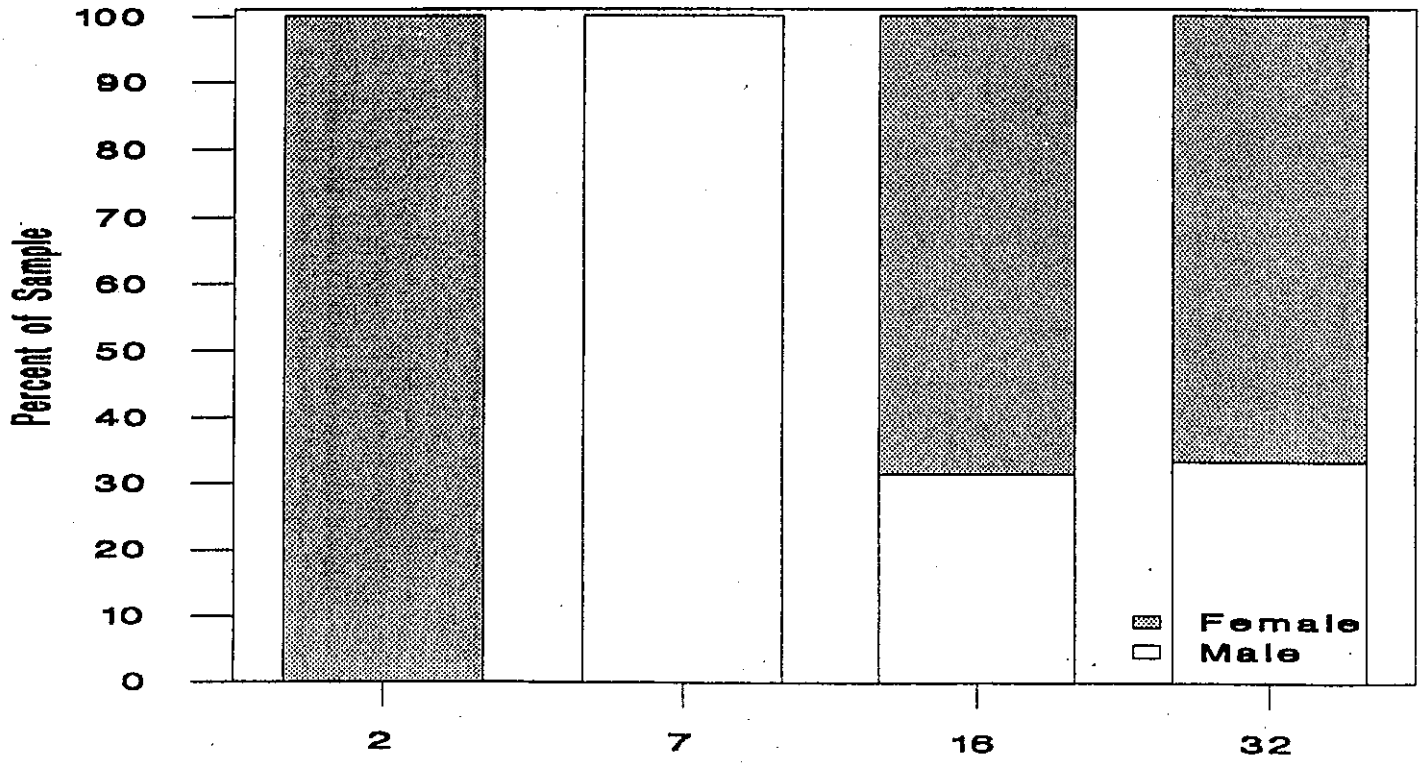
Graph 15b. Percent of Yellowfin Gobies which were Mature Males or Females.



Graph 15c. Percent of White Croakers which were Mature Males or Females.

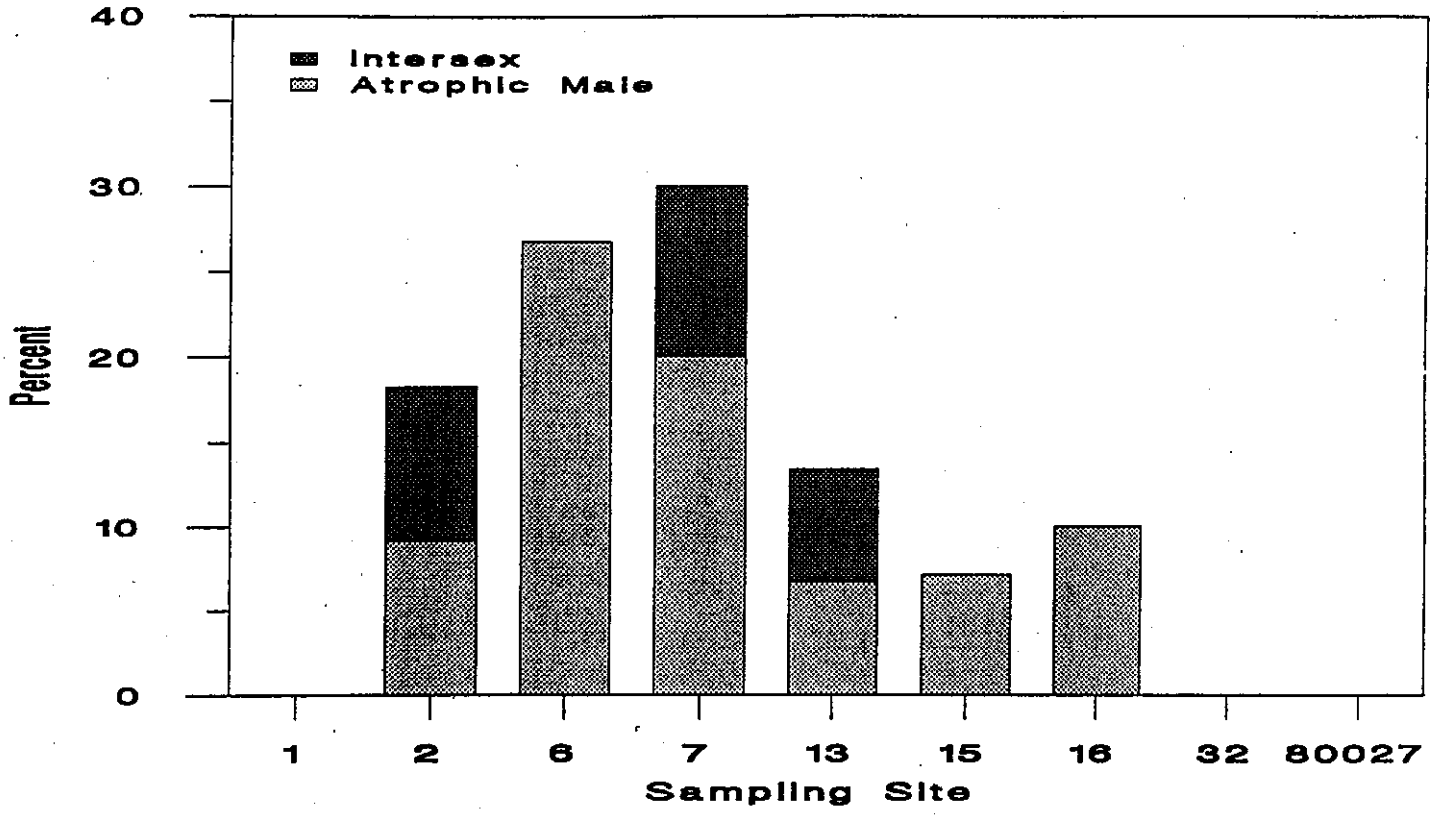


Graph 15d. Percent of Tonguefish which were Mature Males or Females.



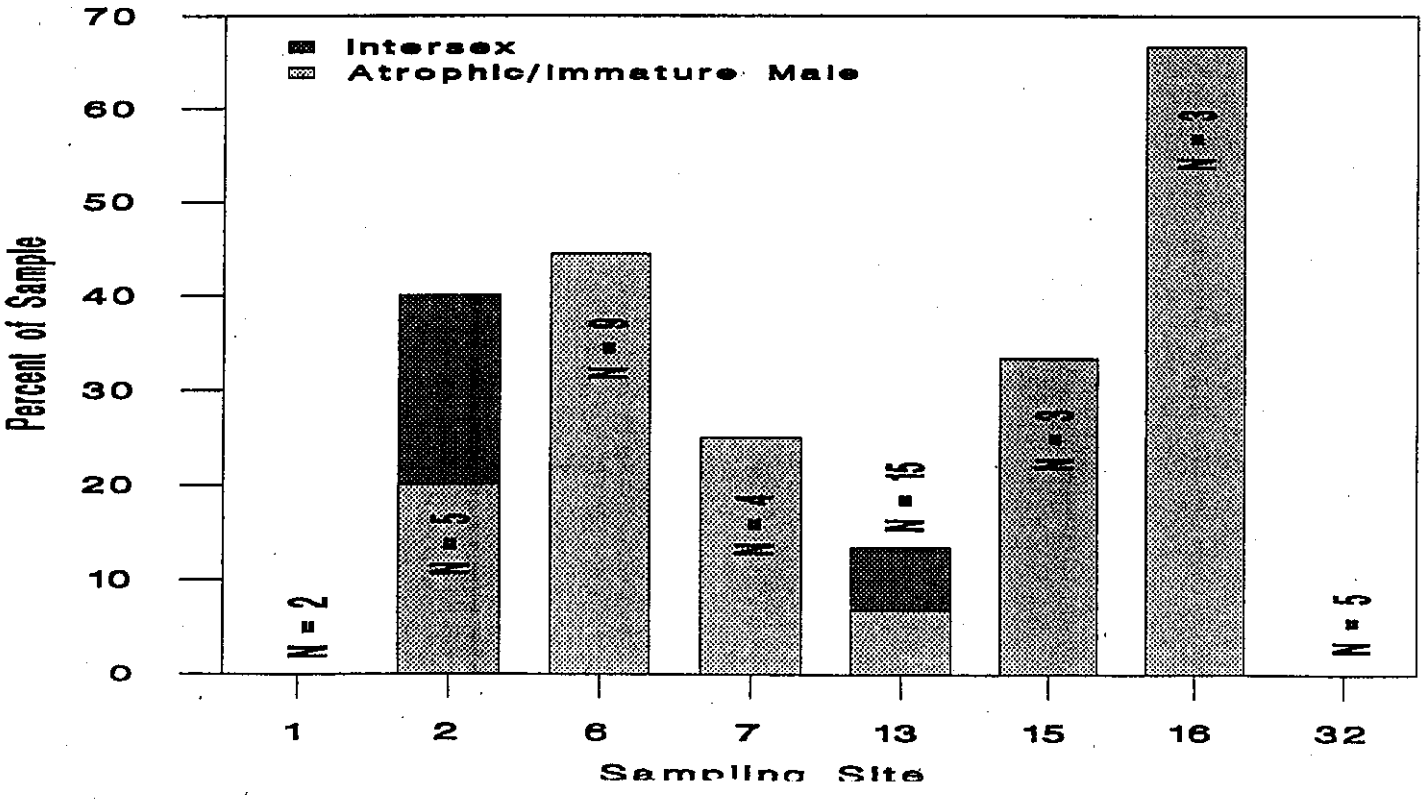
11966

Graph 16a. Percent of All Samples from All Sites Composed of Fish with Atrophic/Immature Testes or Intersex Gonads.



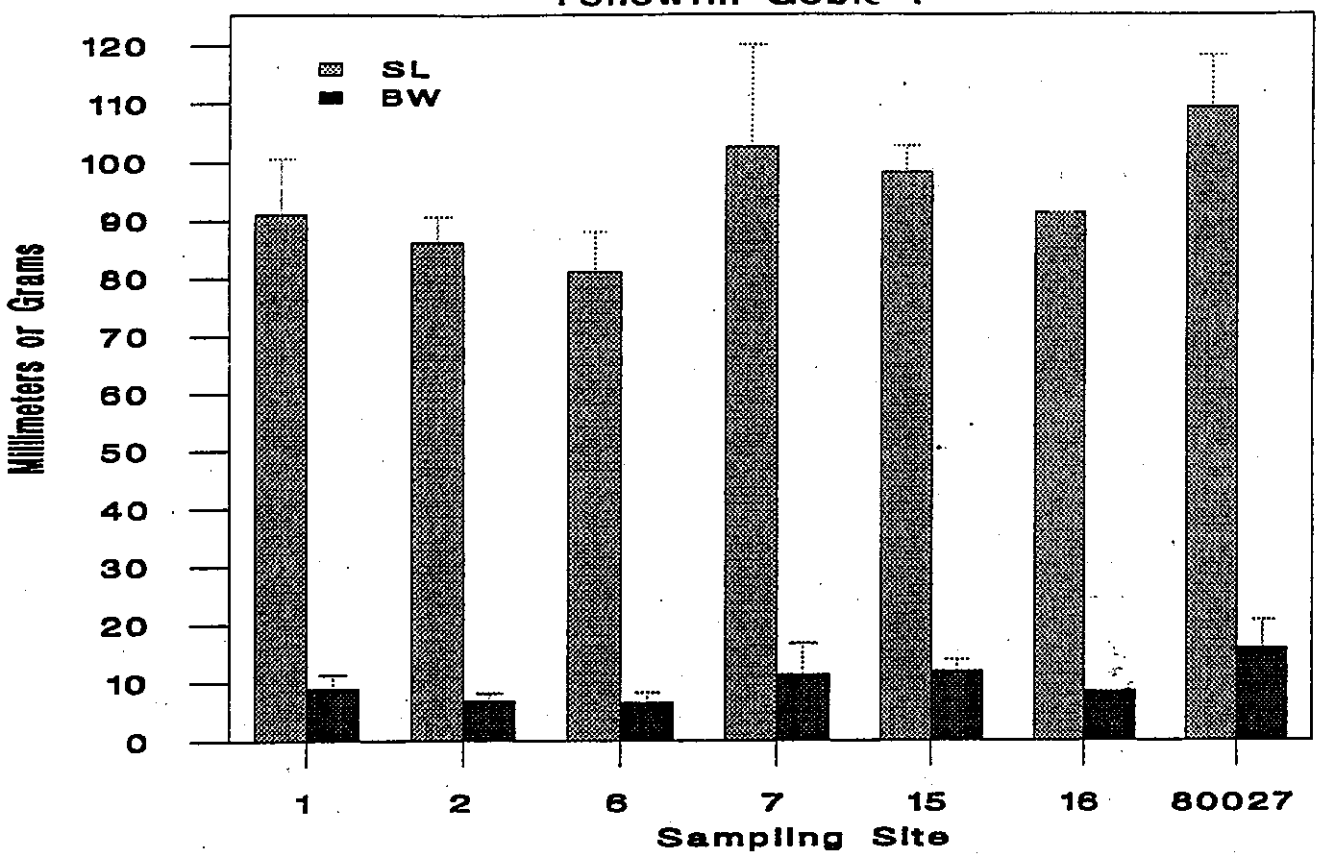
(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 16b. Percent of White Croakers which had Atrophic/Immature Testes or Intersex Gonads.



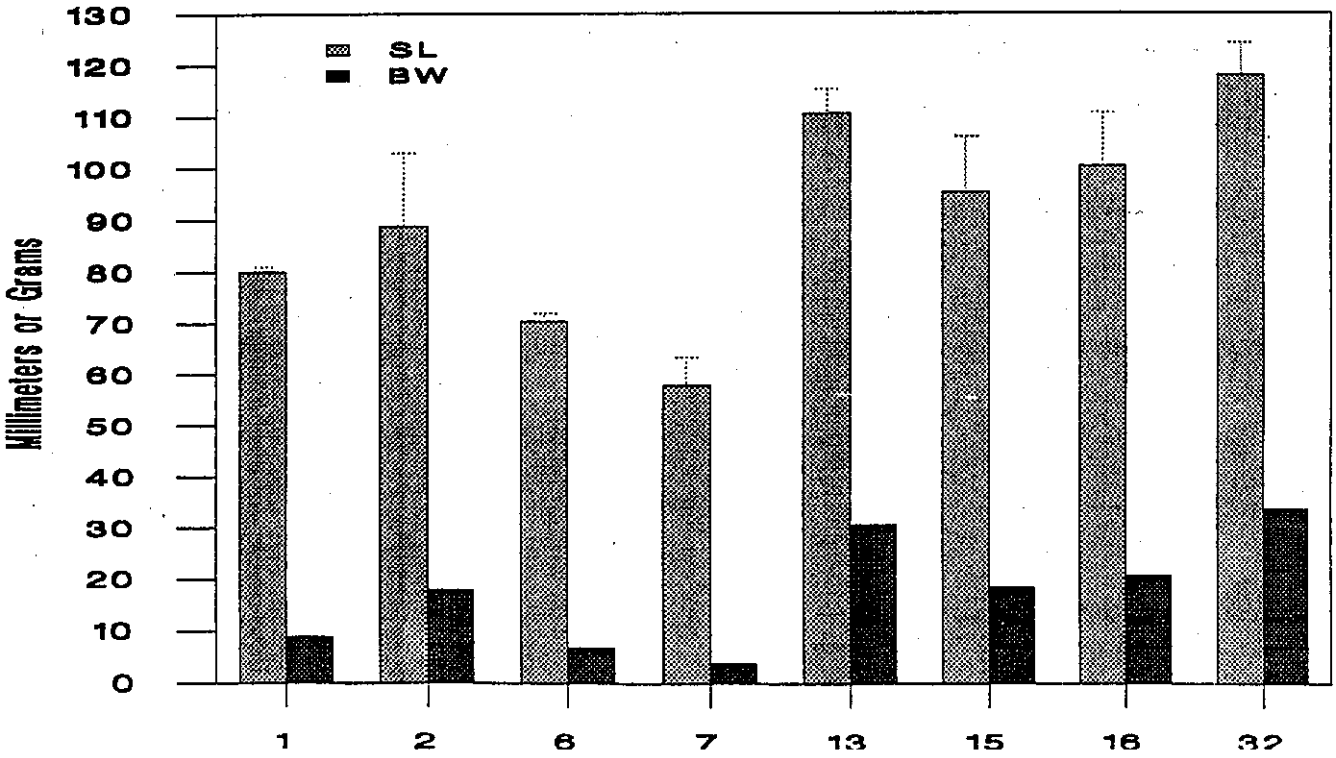
11967

Graph 17a. Average Standard length (SL in millimeters) and Body Weight (BW in grams) of Yellowfin Gobies.

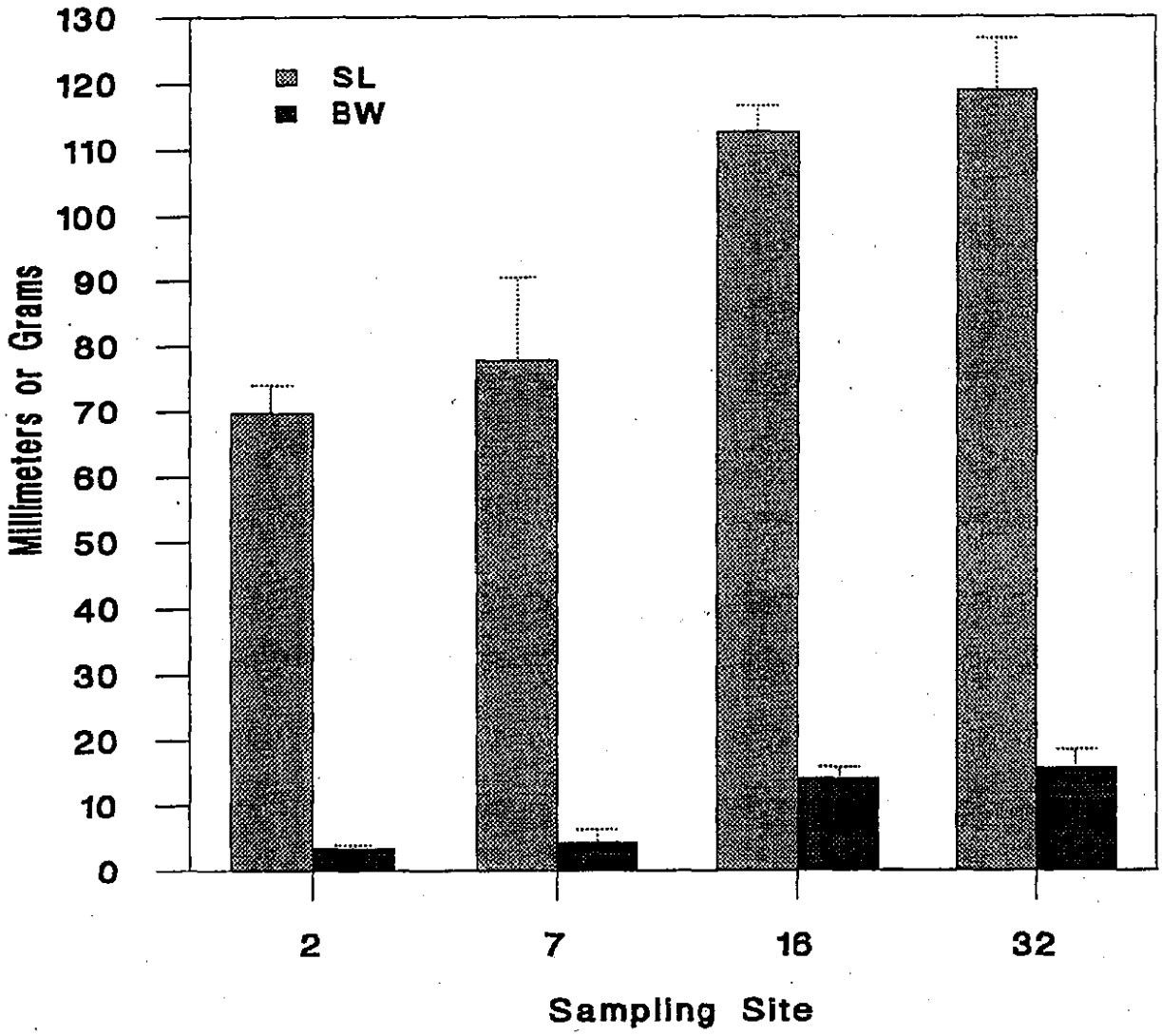


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Graph 17b. Average Standard Length (SL in millimeters) and Body Weight (BW in grams) of White Croakers.



Graph 17c. Average Standard Length (SL in millimeters) and Body Weight (BW in grams) of Tonguefish.



(all site numbers are plus 40000; ie. site 2 = 40002)

Discussion

The major goal of this study was to evaluate bay gobies (*Lepidogobius lepidus*) as a suitable indicator organism for contaminated sites along the California coast. Previous approaches by the National Oceanic and Atmospheric Administration (Myers *et al.*, 1992; 1994) to study impacted sites, on the West Coast of the United States, have used bottom dwelling fish. In those studies, contaminants in sediment were linked to body burdens and chronic histopathologic alterations in liver from older mature fish.

The present study differed in some important respects. First, gobies were specifically targeted as an optimal organism due to their burrowing nature within sediment. Secondly, a tiered approach was used, utilizing; 1) gross biomarkers of **effect** (body and organ weight indices); 2) biochemical and immunochemical biomarkers of **exposure** (P450 immunohistochemistry and EROD activity); and 3) histologic biomarkers of **effect** (splenic and hepatic histopathology). Third, in addition to assessing prevalence, severity of histologic lesions and P450 induction was also evaluated and results included in the statistical analysis. Finally, the majority of sampled fish were small and presumably young, providing us with important information on the acute effects of contaminant exposure on perhaps most vulnerable members of the population.

In one respect, the study failed miserably in that we were unable to collect sufficient numbers of bay gobies at any of the sampling sites. Instead we were forced to utilize multiple species, including a different species of goby (yellowfin) and one elasmobranch (round stingrays). Significantly, our results demonstrate a trend - across all five species examined - for the association of sediment contamination with induction of cytochrome P4501A (immunochemically and biochemically) and with formation of splenic and hepatic lesions in exposed fish.

Histopathology:

Spleen. The spleen in both bony (class Osteichthyes, order teleostei) and cartilaginous (class chondrichthyes, subclass elasmobranchii) fish is anatomically and functionally similar to mammalian spleen (Zapata, 1985; Fange, 1982; Fange and Nilsson, 1985; Ellis, 1980). The key components in the spleen of both fish and mammals are the white pulp (lymphoid tissue) and red pulp (myeloid tissue). The mammalian white pulp is further organized into periarteriolar cuffs of T-cells and discrete follicles with germinal centers (B-cells and plasma cells). While fish lack discrete periarteriolar cuffs of T-cells, many species have lymphoid aggregates which appear analogous to mammalian follicles. Lymphoid follicles are especially prominent and well-developed in elasmobranchs (Fange, 1982).

The functional importance of spleen, as a protective immunologic organ in fish, has been questioned by Ferren (1967) who observed no effect on the intensity of antibody production after splenectomy in marine elasmobranchs and teleosts. Numerous studies, however, using plaque techniques (Neale and Chavin, 1971; Ortiz-Muniz and Sigel, 1971; Sailendri and Mhukkaruppan, 1975; Smith *et al.*, 1967) have demonstrated antibody producing cells in fish spleen and the general consensus is that this organ is an important source of immunoglobulins, in both elasmobranchs and teleosts, and serves a vital role in the fish

immune system. Yu *et al.* (1970) observed that splenectomy in the blue gourami (*Trichogaster trichopterus*), immunized against infectious pancreatic necrosis virus, resulted in complete shutdown of immunoglobulin production. The importance of the fish spleen as a lymphoid organ would certainly seem to be magnified since fish (both cartilaginous and bony) lack lymph nodes. Similarly, the spleen's importance as a myeloid organ increases in fish since they also lack functional hematopoietic tissue in their bone marrow.

The most striking lesions observed in this study were in the spleen. Necrosis of lymphoid and myeloid cells were particularly impressive. The lesions, observed in all five species, were often widespread and severe, especially in fish collected from impacted sites. Targeting of these two splenic cell lines may be a result of both their function and mitotic state. Both cell types are in a constant state of turnover, with large numbers of stem cells undergoing mitotic division. This normally high level of mitotic activity may predispose them to circulating cytotoxins, as their DNA is more exposed - especially in comparison to differentiated cells.

We regard the loss of these two cell types as a direct indication of deleterious effect. Both are major components of the immune system (lymphocytes with the production of immunoglobulins, and hematopoietic cells with the production of a variety of white blood cells). The loss or derangement of one or both of these cell lines probably results in significant impairment to the immune system, with resultant increased susceptibility to a host of viral, bacterial, and protozoan infections.

The fact that fish in the three reference sites had markedly lower average lesion scores for both lymphoid and myeloid necrosis, when compared to the six impacted sites, is indicative of a relationship between sediment contaminants and splenic lesions. P450 immunohistochemical and EROD site specific trends also indicate exposure to sediment contaminants. Spazier *et al.* (1992) documented (via LM and EM) extensive splenic damage (degeneration and necrosis of hematopoietic cells and macrophages) in eels (*Anguilla anguilla*) following a mixed chemical (phosphate esters, chlorinated and heterocyclic hydrocarbons, aromatic nitro compounds, urea derivatives, and pesticides with heavy metals) spill in the Rhine river. Splenic parenchymal necrosis has also been reported in Atlantic cod (*Gadus morhua*) exposed to crude oil (Khan and Kiceniuk, 1984), bream (*Abramis brama*) exposed to phenol (Waluga 1966), rainbow trout (*Oncorhynchus mykiss*) exposed to fumagillin (Lauren *et al.*, 1989) and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD)(Spitsbergen *et al.*, 1988a), and yellow perch (*Perca flavescens*) exposed to TCDD (Spitsbergen *et al.*, 1988b). Although a viral etiology cannot be completely ruled out, it is considered much less likely in light of the unequal distribution of lesions (in impact versus reference sites), and because of the number of species involved (five including one elasmobranch).

The targeting of two different splenic cell lines and presence of similar lesions in hematopoietic tissues (epigonal organ - elasmobranchs) of stingray gonads indicates that the lesions are probably not restricted to spleen, but in all likelihood involve other lymphoid and myeloid organs. Rainbow trout exposed to TCDD develop a number of lymphomyeloid lesions including thymic lymphoid necrosis, premature thymic involution, splenic lymphoid depletion, and loss of renal hematopoietic tissue (Spitsbergen *et al.*, 1988a). Similar thymic and splenic lesions have been observed in yellow perch exposed to TCDD (Spitsbergen *et al.*, 1988b) and have been well-documented in TCDD-exposed mammals (Allen and Carstens,

1967; McConnell, 1980).

In order to properly assess damage to both the lymphoid and hematopoietic systems, both thymus and head kidney should be included, along with spleen, in any future studies of teleost fish. With elasmobranchs, the Leydig organ (lympho-myeloid aggregates associated with the esophagus), epigonal organ, and spleen all need to be examined. Spitsbergen *et al.* (1988a and 1988b) observed leukopenia and thrombocytopenia in TCDD exposed rainbow trout and yellow perch. Evaluation of peripheral blood could provide additional avenues of assessment of the immunologic and hematologic status of wild fish. A final means of assessing the status of lymphomyeloid tissue would be to simply weigh the lymphomyeloid organs of sampled fish. Although weights of lymphomyeloid organs vary between fish species (Fange, 1982), careful dissection and establishment of reference site standards could provide valuable information with respect to gross atrophy in fish from impact sites.

Splenic lymphoid depletion (LD) was an expected sequela to severe lymphoid necrosis. It was surprising, therefore, to discover that two reference sites (40016 and 40032) had higher average lymphoid depletion scores than five of six impact sites when all fish from all sites were examined together. Average LD scores for both reference sites were falsely elevated, however, because 76% (16/21) of fish from site 40016 and 50% (4/8) of fish from site 40032 were tonguefish which had markedly higher LD scores when compared to the other four species.

Sorting of lesion scores on the basis of species and site revealed that average LD scores for tonguefish from the two impact sites were only marginally lower than scores from the two reference sites. Some of that difference may also be age related, as tonguefish from the two reference sites were markedly larger (longer and heavier) and presumably older than fish from the two impact sites. Another possibility is that tonguefish may simply be a species which has a minimal complement of splenic lymphoid tissue. The quantity and proportion of lymphomyeloid tissue among fish species has been shown to vary (Fange and Nilsson, 1985). Icefish (*Chaenocephalus aceratus*), for example, have almost no myeloid tissue and their spleens are dominated by lymphoid cells and macrophages (Walvig, 1958).

Examination of sorted scores in the other two species, collected from more than one site, revealed that LD scores in croakers were higher in four of five impact sites when compared to reference site 40016, and that the other two reference sites had no LD. In gobies, scores were mixed with two impact sites having higher LD scores than reference sites, but three impact sites having similar or lower LD scores.

Splenic macrophage aggregates (SMA) are another "residual" lesion which could be expected following severe parenchymal necrosis. Examination of average SMA scores from all fish, however, revealed that in general scores were similar between impact and reference sites. The two exceptions were reference site 40032, which had the highest average SMA score, and impact site 80027 which had the lowest average score. Both deviations were probably related to species differences. Site 80027 was composed of 83% (10/12) stingrays which did not develop SMA (stingrays instead had scattered macrophages with melanin). In contrast, reference site 40032 was composed of 50% (4/8) tonguefish and 37.5% (3/8) croakers. Both tonguefish and croakers from site 40032 had the highest average SMA scores when compared to the same species collected from other sites. Tonguefish and croakers from site 40032 also happened to be the largest and presumably oldest groups of fish of their

respective species.

The distribution of larger/older fish in reference sites is important with respect to SMA because macrophage aggregates in yellow perch (*Perca flavescens*)(Brown and George, 1985) and Pacific herring (*Clupea harengus*)(Marty *et al.*, 1993) have both been found to be age-related. In both species, incidence and/or severity of macrophage aggregates (renal MA in perch; hepatic, splenic, and renal MA in herring) were found to increase with increasing age. If size is a function of age in croakers and tonguefish, macrophage scores should be evaluated with respect to the size of fish collected. For example, although croakers from impact sites 40006 and 40007 had average SMA scores which were similar to reference sites 40015 and 40016, their scores are probably more significant since fish from both impact sites were also the smallest (and presumably youngest) croakers sampled. The distribution of larger/older tonguefish at two reference sites also provides some explanation for their higher than expected SMA scores.

Another possible explanation for lower than expected SMA scores at impact sites is that xenobiotic exposure may have had a direct impact on splenic inflammatory response by killing macrophages and/or their precursors. Spazier *et al.* (1992) found markedly reduced numbers of splenic macrophages and a complete absence of SMA in eels from the Rhine river exposed to a mixed pesticide spill. Lower than expected impact site SMA scores, in this study, could represent a similar phenomenon.

In summary, moderate to severe necrosis of splenic lymphoid and myeloid tissue was associated with impact sites and could be related to xenobiotic contamination at those sites. While not immediately lethal, both lesions would severely compromise the immune system and result in increased infections, morbidity, and mortality. A more thorough assessment of the immune system, in future studies, should include histopathologic examination of all major lymphomyeloid organs including thymus and head kidney in teleosts, and Leydig and epigonal organs in elasmobranchs. Hematologic assessment of peripheral blood, gross weights and measurements of lymphomyeloid organs would be two additional means of helping to assess damage to the immune system.

Liver. Glycogen depletion (GD) was one of three lesions, observed in this study, associated with loss or accumulation of material within hepatocyte cytosol. Fish hepatocytes normally have abundant glycogen stores and loss of glycogen is a common, non-specific lesion which can be seen under a variety of stressful conditions including infection, parasitism, and exposure to xenobiotics (Meyers and Hendricks, 1985; Eurell and Haensly, 1981; Sabo *et al.*, 1975; Hawkes, 1977; Hawkes, 1980; Woodward *et al.*, 1983; Spitsbergen *et al.*, 1988b). Only in tonguefish were GD scores from impact sites markedly higher than scores in fish from reference sites. Tonguefish from impact sites, however, were also markedly smaller/younger than fish from reference sites and differences in GD may simply be an age-related phenomenon.

Lipidosis (LIP), another non-specific lesion characterized by the accumulation of excessive cytoplasmic lipid in hepatocytes, was seen in many fish, but was not consistently associated with impact sites. Gobies from three of five impact sites had lower LIP scores than gobies from reference sites. In contrast, LIP was observed in croakers from three impact sites while croakers from two of three reference sites had none. Increased hepatic lipidosis,

following xenobiotic exposure, has been documented in many studies (Eurell and Haensly, 1981; Fletcher *et al.*, 1982; Khan and Kiceniuk, 1984; McCain *et al.*, 1978; Solangi and Overstreet, 1982; Spitsbergen *et al.*, 1988b). Other studies, however, have shown decreased levels of hepatic lipid in response to xenobiotic exposure (Haensly *et al.*, 1982; Sabo *et al.*, 1975; Woodward *et al.*, 1983). The question of whether or not the accumulation or loss of lipid is species related should be addressed in any future studies. In addition, the mechanisms of fatty change in teleost liver need investigation. These may reflect transient diminution of ATP levels, presentation of excessive fatty acids to hepatocytes, diminished apoprotein synthesis, and possibly microtubule disaggregation (Hinton *et al.*, 1978).

The third hepatocyte storage defect, observed in this study, was eosinophilic cytoplasmic inclusions (ECI). Although we have not definitively identified what the lesion represents, a viral etiology seems unlikely based on the irregular nature of the inclusions and lack of distinct margins. A more likely possibility is that the inclusions represent either large lysosomes/phagolysosomes, peroxsosomes, or degenerative vacuoles. Hepatic ECI were a common finding in rainbow trout exposed to TCDD (Spitsbergen *et al.*, 1988a; Helder, 1982) and were occasionally observed in yellow perch exposed to TCDD (Spitsbergen *et al.*, 1988b). Transmission electron microscopy (TEM) studies by Helder (1982) and others studying the effects of halogenated aromatic hydrocarbons in laboratory animals (Norbeck and Allen, 1972; Turner and Collins, 1983; Zimmerman, 1978) revealed that ultrastructurally ECI were "myelin figures," a common hepatocellular response to chemical damage. ECI certainly may be associated with xenobiotic exposure, in this study, as ECI were observed in gobies from three of five impact sites, and were found in tonguefish from one of two impact sites where tonguefish were collected. In contrast, no ECI were seen in either gobies or tonguefish collected from the three reference sites. Hepatic ECI should probably be monitored in any future studies, at least in two species (gobies and tonguefish), and the use of TEM could help to definitively identify what these inclusions represent.

Hepatic macrophage aggregates (HMA) have been previously associated with xenobiotic exposure (Wolke, 1992; Wolke *et al.*, 1985; Haensly *et al.*, 1982; Marty *et al.*, 1993), but there were few differences between impact and reference sites in this study. The only exception were tonguefish which had no HMA at two impact sites, compared to low levels at two reference sites. This again is probably age-related as larger/older tonguefish were collected from reference sites.

Hepatic megalocytosis (MEG) is an interesting lesion characterized by marked karyomegaly and/or cytomegaly, and is thought to represent a form of sublethal hepatic injury which may persist for months (Groff *et al.*, 1992; Kent *et al.*, 1988). MEG has been observed in rainbow trout exposed to pyrrolizidine alkaloids (Hendricks *et al.*, 1981) and medaka (*Oryzias latipes*) exposed to diethylnitrosamine (Hinton *et al.*, 1988). "Megalocytic hepatosis" is also the most commonly encountered idiopathic lesion found in English sole (*Parophrys vetulus*) from contaminated sites within Puget Sound (Myers *et al.*, 1987) and has been seen in fish from chemically contaminated sites in the Kanawha river, West Virginia (Hinton and Lauren, unpublished observations) and in *Sebastes* rockfish from Prince William sound exposed to crude oil from the Exxon Valdez oil spill (Marty *et al.*, 1993).

MEG was observed in gobies collected from two of five impact sites. Interestingly, croakers from the same two impact sites (40002 and 40006) also had low levels of MEG, as

did tonguefish from site 40002. No MEG was found in croakers collected from the three reference sites. Although MEG was found in gobies and tonguefish from one reference site each, average scores were low and MEG may be a good hepatic biomarker of exposure and effect (Myers *et al.*, 1991).

Hyalinization of vessel walls (HVW) was a lesion targeting the major blood vessels in the liver. Although HVW has not been reported in the literature, its pathogenesis may be similar to sinusoidal fibrosis (deposition of collagen in hepatic perisinusoidal spaces) observed in rainbow trout experimentally exposed to crude oil via feeding (Hawkes, 1977) and in *Sebastes* rockfish from Prince William sound exposed to crude oil from the Exxon Valdez oil spill (Marty *et al.*, 1993). Damage to vascular endothelium, with subsequent collagen deposition and/or fibrosis, may be a common pathway for both HVW and sinusoidal fibrosis. Prevalence and severity of HVW were quite low, but the trend in both gobies and croakers was for higher average scores in impact versus reference sites, and the lesion may be associated with xenobiotic exposure. The trend was strongest in croakers, where fish from four of five sites had HVW (compared to none at reference sites). The pattern was reversed with HVW scores in tonguefish (HVW present in fish from reference sites and not at impact sites), but this again may be age-related as fish from reference sites were larger and presumably older.

Foci of cellular alteration (FCA) were only observed in four fish (three from impact sites and one from a reference site). FCA are putative preneoplastic lesions and have been associated with both contaminated marine habitats (Johnson *et al.*, 1993; Landahl *et al.*, 1990; Murchelano and Wolke, 1991; Myers *et al.*, 1987; Myers *et al.*, 1991) and fish experimentally exposed to known carcinogens (Hinton *et al.*, 1985; Hinton *et al.*, 1988; Hendricks *et al.*, 1984). Although, in this study, FCA were rare and no hepatic neoplasms were found, the vast majority of fish collected were small (and presumably young) and were not expected to present with many preneoplastic or neoplastic liver lesions. Sampling larger/older fish would certainly increase the probability of finding such lesions. Interestingly, FCA have been recently been reported (Myers *et al.*, 1994) in adult white croakers sampled from several U.S. westcoast sites including the Los Angeles area. Three of the four fish with FCA in this study were croakers.

An alternative to targeting older fish for FCA and hepatic neoplasms would be to utilize enzyme histochemistry to determine if enzyme altered foci (EAF) are present. Although tissue preparation and analysis are more involved (snap freezing followed by either freeze-drying or cryostat sectioning and enzyme histochemical assays) compared to routine paraffin processing, EAF are the earliest preneoplastic lesion observed, following carcinogen exposure, and are often present in the absence of other histologic alterations in the liver (Teh and Hinton, 1993).

In summary, although the differences in liver lesion scores between impact and reference sites were not statistically significant, several hepatic lesions (ECI, MEG, and HVW) were consistently associated with the impact sites and should be monitored in future studies. Increasing the sample size and aging the fish would help to determine if these differences are real, and expansion of sampling to include older year classes would increase the probability of detecting slow developing, chronic lesions such as hepatic neoplasms.

Skin. Cutaneous melanophore hyperplasia was observed in stingrays, from impact site 80027, and tonguefish from both reference and impact sites. Although not overt neoplasms, melanophore hyperplasia is considered a preneoplastic lesion which could progress into malignant chromatophoromas (pigment cell tumors). Melanophore hyperplasia and neoplasia (as well as other forms of chromatophore hyperplasia and neoplasia) have been associated with several species of fish from impacted aquatic environments including: 1) butterflyfish (*Chaetodon* spp.) from Hawaiian waters (Okihiro, 1988); 2) croakers (*Nibea mitsukurii*) from Pacific coast of Japan (Kimura *et al.*, 1984); 3) rockfish (*Sebastes* spp.) from Cordell bank, north of the Farallon Island Radioactive Waste Dump (FIRWD)(Okihiro *et al.*, 1993; 4) sablefish (*Anoplopoma fimbria*) from the FIRWD (Okihiro, unpublished data); and 5) freshwater drum (*Aplodinotus grunniens*) from the Great Lakes (Okihiro, unpublished data). Melanophore/chromatophore hyperplasia and neoplasia should certainly be monitored in any future studies, especially if older year classes are sampled as these lesions are likely slow to develop and progress.

Gills. Gills were collected primarily for use with P450 immunohistochemistry, but were briefly screened and did have some histologic lesions consistent with xenobiotic exposure. A more complete examination, along the lines of what was done with spleen and liver, is recommended. In addition, it would be interesting to see how well histopathology scores correlate with gill P450 immunohistochemistry.

Gonads. In this study, ovaries from several species had varying degrees of oocyte atresia and mixed inflammation. Higher prevalence of oocyte atresia has been associated with xenobiotic exposure in several fish species including eels exposed to crude oil from the Amoco Cadiz oil spill (Lopez *et al.*, 1981) and English sole from sites in Puget Sound, Washington contaminated with aromatic hydrocarbons and PCBs (Johnson *et al.*, 1988). Premature oocyte necrosis has also been observed in mammals exposed to aromatic hydrocarbons (Mattison and Nightingale, 1980; Mattison *et al.*, 1983).

Testes from some white croakers and a few cusk-eels, in this study, were very small with little or no sperm production. Although the majority of affected testes were from smaller (and presumably younger) fish, without age data we cannot be sure that the affected testes simply represent immature gonads from younger males. It is also certainly possible that the lesions represent atrophic testes from fish exposed to xenobiotics, especially since three intersex fish were also taken from impact sites (and none from reference sites). Male feminization, testicular atrophy, and intersex gonads have been documented in fish, reptiles, birds, and mammals from contaminated environments (Colborn and Clement, 1992; Fry, 1981).

Again, increasing the sample size, aging fish, and thorough evaluation of gonads for histologic lesions will help to determine if ovarian and testicular lesions are related to xenobiotic exposure.

Cytochrome P4501A: Induction of cytochrome P4501A (CYP1A) in fish is primarily associated with exposure to coplanar polyaromatic or polyhalogenated hydrocarbons (Jiminez and Stegeman, 1990; Lech *et al.*, 1982; Stegeman and Hahn 1994) and numerous field studies have documented elevated CYP1A in fish from contaminated sites (Goksoyr and Forlin, 1992; Munkittrick *et al.*, 1994; Johnson *et al.*, 1988; Stein *et al.*, 1992). Despite the long association of CYP1A induction with contaminated sites, the relationship with toxicity has historically been uncertain at best.

Recently, however, several studies have presented data suggesting that induction of CYP1A may be directly linked with adverse reproductive effects in mammals. TCDD, a halogenated aromatic hydrocarbon and established CYP1A inducer, is a known endocrine disrupter (Peterson *et al.*, 1993) with antiestrogenic effects in mammals (Safe *et al.*, 1991). The antiestrogenic effect of TCDD (and probably other CYP1A inducers) is mediated by the aryl hydrocarbon (Ah) receptor, resulting in alteration of the estrogen receptor (ER) and its ability to promote gene transcription. The exact means by which Ah receptor binding and activation accomplish these effects is still not fully understood, but potential mechanisms include: 1) decreased estrogen binding to the estrogen receptor (Wang *et al.*, 1993); 2) increased estrogen metabolism (Spink *et al.*, 1990); 3) down-regulation of estrogen receptor protein (White and Gasiewicz, 1993); and 4) blocking of estrogen responsive gene transcription (Zacharewski *et al.*, 1991; Zacharewski *et al.*, 1994).

Studies with fish have also revealed associations between CYP1A inducers and adverse reproductive effects. Zebrafish (*Brachydanio rerio*) exposed to TCDD have significantly impaired reproductive function (Wannemacher *et al.*, 1992). In addition, chronic dietary exposure of rainbow trout to another CYP1A inducer, Aroclor 1254 (Lech *et al.*, 1982), resulted in decreased responsiveness to 17*B*-estradiol as measured by plasma vitellogenin levels (Chen *et al.*, 1986). Atlantic croakers (*Micropogonias undulatus*) exposed to Aroclor 1254 and benzo[a]pyrene had depressed levels of plasma estradiol and vitellogenin, impaired steroidogenesis, and decreased ovarian growth (Thomas, 1990). Several field studies have also linked CYP1A induction with reproductive dysfunction in fish (Johnson *et al.*, 1988; Munkittrick *et al.*, 1994).

In this study, CYP1A was evaluated using two methods; immunohistochemistry and the 7-ethoxyresorufin O-deeylase (EROD) assay. The two methods are both useful, but measure different things. The immunohistochemical assay (using monoclonal antibodies specific for CYP1A in rainbow trout or scup) localizes the enzyme in tissue section. Although intensity of stain can reflect relative amount of CYP1A, immunohistochemistry does not provide any direct information on enzyme activity. The EROD assay, in contrast, while incapable of localizing enzyme activity within an organ, does provide direct information with respect to CYP1A activity (at least with respect to deethylation of synthetic ethoxyresorufin), and EROD activity is generally considered reflective of CYP1A induction (Stegeman *et al.*, 1990).

Of the two assays, P450 immunohistochemistry generated much more consistent data with respect to defining differences between impact and reference sites, and when results were compared with splenic histopathology scores. In every organ examined (gill, gonad, spleen, and liver), P450 scores from impact sites were consistently higher than those from reference sites. In many cases, differences were dramatic and statistically higher in impact sites.

In contrast, EROD activity tended to be erratic and even when the data was sorted on the basis of species, no consistent patterns developed. Only when comparisons were made based on the **dominant** species collected did some coherent patterns emerge. Average EROD activity at the two reference sites was sharply lower than that of fish from five of six impact sites, bringing them more in line with the immunohistochemical P450 and splenic lesion scores. Although we cannot in good conscience selectively ignore data, a case can be made for focusing primarily on EROD activity from the dominant species from both reference sites.

At reference site 40015, EROD samples were taken from eight gobies and two croakers. Average EROD activity for the two croakers was more than twice as high (75 pmol/min-mg) when compared to the eight gobies (31 pmol/min-mg). The argument could be made that based on numbers (8/10), habits (territoriality), and habitat (burrows in the sediment) that gobies are more representative of site 40015 than are croakers. And since gobies from impact site 40001 were induced, lower EROD values at reference site 40015 probably reflect site-specific conditions.

Similar arguments can be made for reference site 40016 where tonguefish comprised 73% (8/11) of the sample. Average EROD activity in tonguefish (8.5 pmol/min-mg) was 6.5 times lower than that in the two croakers in the sample and more than 17 times lower than EROD activity in the only cusk-eel caught at the site. It simply makes no sense to average EROD activity from all three species and designate that as representative of the site.

On the other hand, it also makes little sense to compare different sites with EROD data derived from five different species - which we were eventually forced to do. The obvious solution is to increase the sample size so that sufficient EROD samples are available from the different species to make valid site to site comparisons. Eventually, when habits and habitats of the different species are established, certain species may be selectively chosen for EROD analysis and other species avoided. If sufficient numbers can be obtained, the burrowing habits of the goby make this species a strong candidate as an indicator of site specific contamination in future studies.

Overall, P450 immunohistochemistry proved to be superior to the EROD assay in this study. The advantages with immunohistochemistry included: 1) no additional samples needed to be taken (ie. paraffin blocks used for histopathology were also used for immunohistochemistry); 2) sample preservation was the same as histopathology (10% formalin); 3) P450 could be localized within organs; 4) multiple organs could be run simultaneously; and 5) the results consistently separated impact from reference sites. Although the EROD assay is useful in determining CYP1A activity, if sample size becomes limiting (as was the case in this study), immunohistochemistry would be the assay of choice.

Indices:

Hepatosomatic Index (HSI). Hepatosomatic index (HSI) was determined for almost all fish. The only exception was stingrays, the majority of which were too large for the scale used. Average HSI was lower at two reference sites (40016 and 40032) when compared to the six impact sites. Sorting the data based on species revealed no significant differences in HSI with respect to site with gobies or tonguefish. In croakers, however, average HSI in fish from five impact sites was marginally to markedly higher than HSI from the three reference sites.

Differences in HSI, in croakers from different sites, could be the result of several factors including; age, sex, body weight, and exposure to xenobiotics. Age, sex, and body weight are critical factors influencing HSI in juvenile (personal communication, Swee Teh, VM:APC, UCD) and adult medaka (unpublished data, Mark Okihiro, VM:APC, UCD). In juvenile medaka, HSI decreases from one to six weeks post-hatch, but following week six, HSI starts to increase. The rate of HSI increase, between six and 11 weeks, is similar between male and females, but following sexual maturity (11 weeks), differences between sexes become magnified and HSI is consistently higher in female medaka. Studies with adult (> 1 year) medaka have revealed that HSI continues to increase as fish grow and increase in body weight. Again, the increase is more pronounced in female medaka.

Among croakers, there were no consistent trends with respect to sex which appear to account for HSI differences. There were, however, differences in size as fish from reference sites were consistently longer and heavier than croakers from four of five impact sites. The heavier body weight could explain the lower HSI in croakers from reference sites if the fish were in the initial stages of juvenile liver development when HSI is falling with increasing age. On the other hand, if croakers were sexually mature, then HSI differences between impact and reference sites are the opposite of what is expected (higher HSI in heavier fish) and may be due to xenobiotic exposure and subsequent liver growth by hyperplasia, hypertrophy, or both. Increased HSI (as well as increased EROD activity and decreased GSI) has been observed in male and female white suckers exposed to pulp mill effluent (Munkittrick *et al.*, 1994). It is not known whether lower HSI has been associated with contaminated marine environments. Increasing the sample size and aging fish, in future studies, will help to determine if differences in HSI are attributable to xenobiotic contamination.

Gonadosomatic Index (GSI). Gonadosomatic (GSI) was determined for the majority of fish collected, but there were few consistent differences between sites. Among gobies, fish from reference site 40015 had markedly higher GSI when compared to GSI from impact site fish. Among croakers, fish from impact site 40002 had higher average GSI when compared to croakers from the three reference sites. Comparisons among the other three species (tonguefish, cusk-eels, and stingrays) could not be made as either the fish were collected from only one site or gonad weights were not taken. In general, it was often difficult to obtain an accurate GSI because gonads were often very small and could not be reliably separated from adjacent swim bladder (which was often seen in histologic section). GSI evaluation was especially difficult in female tonguefish, as ovaries were located within deep diverticulae making a clean dissection almost impossible.

Decreased GSI has been reported in: 1) several fish species exposed to pulp mill effluent (Munkittrick *et al.*, 1992a; Munkittrick *et al.*, 1992b; Munkittrick *et al.*, 1994); 2) bream (*Abramis brama*) from sites in the Rhine river (Germany) contaminated with organochlorines and aromatic hydrocarbons (Sloof and DeZwart, 1983); and 3) English sole from sites in Puget Sound, Washington contaminated with aromatic hydrocarbons and PCBs (Johnson *et al.*, 1988). **Increased** ovary-somatic index (along with decreased reproductive success) has been reported in longhorn sculpin (*Myxocephalus octodecemspinosus*) experimentally exposed to crude oil (Khan, 1991).

Although neither decreased nor increased GSI was consistently associated with impact sites in this study, sample sizes among the five species taken were often very small and valid conclusions cannot be drawn until more data is available. Setting minimum size/age requirements for GSI assessment would markedly improve accuracy. In addition, correlation with gonadal histopathology may help determine why GSI differences exist.

Condition Index (CI). There were no significant or consistent differences in condition index (CI), between impact and reference sites, among any of the five species examined.

Fish Collection and Necropsy:

Collection Methodology. In this initial investigation, improvisation was occasionally called for. In future studies, collection methods and protocols should be standardized and contingency plans made, as much as possible, ahead of time. For this study, we utilized both beam and otter trawls. The major advantage of the otter trawl appeared to be decreasing the likelihood of collecting a large plug of mud in the "caught end." The drawback to the otter trawl was that with the larger mesh size, smaller fish could potentially be lost. Standardization of trawl type, net "eye" size, and net length should be made and alternative plans formalized.

Duration of trawl runs and total number of trawls greatly affect sampling success. In this study, 15 minute trawls were used and as many attempts as necessary were made until 15 fish were caught. Trawls of longer duration resulted in more mud in the "caught end" and increased morbidity and mortality. Longer trawls, however, also produce more fish. A 15 minute time limit should be adhered to in future studies, but with the option to increase run duration depending on catch success.

Number trawls attempted was not recorded, but should be in the future as number of attempts is indicative of fish abundance and an important endpoint. Alternatively, the same endpoint may be achieved by applying the same number of attempts at each site and then comparing numbers caught by site. With the latter, sample size between sites may vary widely.

Maintenance of fish after capture is an important consideration that also needs addressing. In this study, fish were held in buckets on board ship and then transferred to holding tanks at the SCRWWP laboratory. The on ship facilities were inadequate for large numbers of fish and resulted in increased morbidity and mortality. Holding facilities on collection vessels needs to be improved (ie. flow though tanks with aeration) and holding times, both on ship and in the laboratory, kept as short as possible to minimize potential interference with assays, and to provide uniform conditions between collections.

In this study, some fish died from injuries sustained during capture. Necropsy and histologic examination revealed moderate to severe autolysis, rendering them useless for biochemical and immunohistochemical analyses. Dead fish with moderate autolysis were still useful for routine histology and probably could be used for residue analysis. In future studies, the usefulness of dead fish (for histology and residue analysis) can be maximized if they are iced immediately and necropsied as soon as possible. Dead fish; speciated, sized, aged, and sexed could also provide additional valuable information even if no further analyses are conducted.

Species Selection. Despite initial attempts to focus on bay gobies, inadequate numbers forced us to select several alternative species. The question now is were any of these the "right" species? It is likely that there is no one ideal "indicator" species for the entire California coast, but that different species have varying responses to different classes of xenobiotics. In retrospect, it is actually fortuitous that we studied several species because we now have data on five different species, all of which appear sensitive with some respect to contaminated sediments.

For future studies, priority lists of target fish species should be generated. Selection of

preferred species should be based on availability, ease of capture, habitat, and sensitivity to xenobiotics. Our findings indicate that the four teleost species used in this study (croakers, gobies, cusk-eels, and tonguefish) satisfied the criteria for availability and ease of capture. In addition, three of the four (gobies, cusk-eels, and tonguefish) also have the "right" type of habitat in that they were in intimate contact with bottom sediments, and as such should certainly be placed higher on the priority list. The last and perhaps most important criterion, sensitivity to contaminants, has already been discussed, but all five species had relatively similar splenic and hepatic lesions, and induced CYP1A. Additional information relating to normal biology (anatomy, histology, physiology) and behavior (nocturnal versus diurnal, territoriality, migratory and feeding patterns) should be also assembled to increase the precision of future collection schema and analyses.

A major factor influencing species availability is location. The California coast varies tremendously in types of ecosystems and environments, and the present study is representative of only quiet harbors and protected inshore regions. Habitats with other characteristics (ie. sandy beaches, rocky reefs, and kelp beds) will have to be assessed separately with respect to species distribution and availability. There are dramatic changes in the spectrum of inshore fish species as one moves from the Mendecino coast south to the Baha peninsula, and future studies will have to take this into account. Finally, although priority lists are desirable, ultimately the deciding factor is simply what is available at the time of sampling. This was certainly the case with this study. We started out with a goal to sample only bay gobies, but ended up taking five different species.

Sampling Criteria. Although the current study did not have specific sampling criteria with respect to size, age, or sex these factors should be considered for any future studies. Upper and lower size limits should be set so that similar year classes are compared. Comparison of similar size fish is almost as important as comparing the same species because older fish tend to have higher prevalences of chronic lesions (including tumors). To simplify matters, size limits should be based on length rather than weight. Size limits will have to vary according to the species selected as upper size certainly varies greatly.

Age data should also be generated via analysis of either otoliths or scales. Although ideally all fish should be aged, a compromise solution would be to consult or develop (if not available) age versus length tables for all target species, from data gathered at reference sites. Age of fish from impact sites could then be estimated based on length.

Whenever possible an attempt should also be made to collect sufficient numbers of male and female fish to determine if sex-specific differences exist in lesion prevalence and severity, or in CYP1A induction. Unfortunately, this is often difficult as the majority of marine teleost species have little sexual dimorphism, especially with regard to younger/smaller fish.

Sample Size. Although 15 was selected as the sample size for this study, that decision was arbitrary and sample size should be based on statistical criteria (ie. what is needed to discriminate between sites). For the present, the 15 fish sample size can be adhered to as long as only single species are involved. As more studies of this type are done, the basis for setting sample size should become more apparent.

A more important question is what to do if (as was the case in this study) more than one species is caught? Should we attempt to look at equal numbers of each species (ie. three each of the five different species) or should the fish be sampled in the order that they are caught. The probably answer is that once priority lists are generated, the species sampled from a mixed catch should be based on that list. For example, if we know that yellowfin gobies are the best "indicator" species in muddy harbor ecosystems, then all the gobies should be sampled first, followed by the second and third best "responders" until a agreed upon limit is reached.

Determination of a final limit, when multiple species are collected, should again be based on statistical criteria. In this study, strict adherence to the 15 fish sample size resulted in major obstacles when it came time to make site to site comparisons. For example, all 15 fish collected from site 40013 were croakers, while 13 of 15 fish from site 40015 were gobies and 10 of 12 fish from site 80027 stingrays. The obvious solution, for future studies, is to increase the sample size for each species so that valid statistical comparisons are possible. A minimum sample size of 10 fish per species per site (with sampling to include the two or three top species in a given priority list) would certainly help maximize the potential for site to site comparisons. In addition, surplus samples may be formalin-fixed (for histopathology) or frozen (for chemical analysis) and archived. Analysis of archived samples, at a later date, can help form a baseline for comparisons over the temporal scale.

An alternative solution to the multiple species dilemma is to select several reference sites where baseline "control" data can be accumulated. If histopathologic, biochemical, and contaminant residue data can be gathered at a few clean sites, for all target species, then comparisons can be made between results from impact sites and previously accumulated reference data.

When to Sample. Obviously time of sampling is very important. In this study, collection was in the fall (October 1993) and large numbers of juvenile croakers and tonguefish were caught. If our intention is to catch smaller/younger fish, it may be desirable to make fall sampling a standard. Standardization of collection dates would help to minimize the possibility of seasonal catch variation. If, however, the goal is to capture other species and age groups, sampling should probably be shifted, as seasonal migration may affect relative abundance of a given species. In addition, reproductive cycles could affect whether or not juveniles or adults are caught in a given month, and may have profound effects on GSI, HSI, P450s, and other parameters.

Another consideration is whether to conduct collections during day or night. This study used both and nocturnal species certainly proved easier to collect at night. The general consensus was that night sampling was more productive and markedly increased the chances of collecting certain species like cusk-eels. Final decisions on when to sample should be based on species, but certainly more background information on basic biology, habits, and habitats of targeted species is needed in order to ensure sampling efficiency.

Catch Data. All catch data is potentially important, but how much data is sufficient? Abundance of fish and distribution of various parameters (species, age, size, and sex) could be useful, especially if collection techniques are standardized. Catch data could be used to

augment biochemical and histologic analyses and, in similar fashion, comparisons made from site to site and year to year.

Site Analyses. Additional information needs to be collected and made available concerning the sites themselves. Parameters such as sediment composition, water temperature, salinity, geographical location, local fishing pressure, and proximity to effluents all impact on fish populations and need to be taken into consideration for site selection and comparisons.

Necropsy Logistics. In this study, sufficient personnel were not always available to handle fish of this study. Speed of processing is primarily determined by the speed of the pathologist and, with the current protocol, only 4-6 fish can be processed within an hour. With this limitation, only 30-50 fish per day can be handled by a two person dissection team, with one person performing the dissection and the second person recording the data and processing the EROD biochemical liver samples. In future studies, if more fish need to be processed, additional personnel are essential to successfully perform these initial but easily overlooked steps.

We were fortunate, in this study, to have had the SCCWRP laboratory available to us. That facility was not only large, but had running water, dilute nitric acid, a cold room with flow through tanks and air lines (allowing us to keep fish live for extended periods), and abundant counter and freezer space. If possible, any future work should also be done at this facility or at a comparably equipped site.

Dissection Protocol. Dissection protocols need to be re-evaluated and streamlined in order to maximize the number of fish which can be adequately processed in a timely manner. Gonads were often difficult to identify and remove in smaller fish. Tonguefish were especially difficult as ovaries often extended far back in diverticulae running under the vertebral column. Excision of tonguefish ovaries often resulted in inclusion of fragments of skeletal muscle and inaccurate ovarian weights. Inclusion of GSI in future studies, should be based on size of targeted fish (setting a lower limit to exclude smaller fish) and species (avoiding those with inaccessible gonads). Many organs (kidney, heart, brain, swim bladder, gastrointestinal tract, and skin) were by design not routinely sampled for histopathology. Some of these may provide important additional information and should be considered for future studies.

Conclusions

It was obvious at the start of this study that our goal of sampling 15 bay gobies from nine sites over a 2-3 day period was much too simplistic. Sampling took considerably longer than expected and we were eventually forced to use multiple species. The biggest drawback to multiple species was that sample sizes were unequal and often very small. Increasing the sample size, for select species in future studies, will certainly help. Although lesions and P450 activity were detected in all five species, three (yellowfin gobies, white croakers, and tonguefish) were the most useful in that they were found in sufficient numbers to allow comparisons between impact and reference sites.

Of the histologic biomarkers examined, the most important were splenic lymphoid necrosis and necrosis of hematopoietic cells. Average scores for these two lesions were consistently higher in fish from contaminated sites and the combined effect may be varying degrees of immunosuppression, which could directly impact on the survival of fish. In contrast, site differences in liver lesion scores were often slight. Some hepatic markers, notably ECI, MEG, and HVW, however, were consistently associated with impact sites and may be useful in future studies, especially if sample size is increased and older fish examined.

Of the two methods used to assess cytochrome P4501A induction, immunohistochemistry proved most valuable, revealing clear differences between reference and impact sites (which had consistently and sometimes significantly higher P450 scores). In contrast, EROD activity was often erratic and not nearly as definitive. Only when EROD activity was averaged for the predominant species collected did differences emerge between reference and impact sites.

Of the three indices examined, surprisingly HSI was the most useful in distinguishing between impact and reference sites. Without accurate age data, however, we were unable to ascertain whether elevated HSI in croakers from impact sites was due to normal hepatic development or xenobiotic exposure. GSI is a valuable index, but did not reveal consistent differences between impact and reference sites.

Some of the reasons why GSI was not useful, in this study, were that fish were often so small that obtaining accurate gonadal weights was difficult or impossible. A more effective alternative would be to use histopathology to assess gonadal status. Ovarian follicular atresia, testicular atrophy, and intersex gonads were all observed when gonads were screened to identify sex. If gonadal histology is correlated with age data (to differentiate immature gonads from xenobiotic induced lesions), differences between impact and reference sites could emerge.

Overall, the biomarker approach (using multiple species and a few select assays) was effective in separating reference from impact sites and enabled us to assess both xenobiotic exposure (P450 induction) and deleterious effect (splenic and hepatic lesions).

Recommendations for the
Goby Biomarker Study

1. **Age Data:** Age of fish was not determined in this study. Aging fish will allow lesions which are age-related (ie. macrophage aggregates) to be differentiated from those which are truly contaminant induced. Aging fish will also help to differentiate immature gonads from gonads with contaminant induced atrophy and/or feminization. Fish carcasses have not been processed for residue analysis and it is highly recommended that otoliths or scales (whichever is appropriate) be sampled and analyzed for age.

2. **Contaminant Residues in Fish Tissue:** Fish carcasses were collected and frozen, but have not yet been run for contaminant residues. Residue analysis is also highly recommended as it would: 1) provide specific data on body burdens; 2) allow correlation of sediment contaminant data with tissue residues; and 3) permit lesion and CYP1A induction data to be correlated with body burdens. Costs can be minimized by assaying for only those chemicals already shown to be at high levels in sediment.

3. **Fluorescence absorbing compounds (FAC) Analysis:** Bile samples were taken from every fish, frozen and archived. FACs are a measure of PAH metabolites and would also be very helpful in assessing exposure. Again costs can be minimized by analyzing a subset of bile samples from fish collected at sites heavily contaminated with PAHs.

4. **Correlation of Histologic Lesion Prevalence/Severity and CYP1A induction with Sediment Contaminant Data:** This was a blind study and, as such, sediment contaminant data was not made available until the study was almost complete. Correlation of lesion and CYP1A data with current information on sediment contaminants may permit closer association of biomarkers with specific classes of xenobiotic chemicals.

5. **Analysis of Additional Histologic Tissues:** Preliminary screen of several other organs, which were not scored, did reveal lesions compatible with contaminant exposure. Of those organs, we have almost complete (samples from all 127 fish) sets of gill and gonad. Gonads were especially intriguing with the possibility of both testicular atrophy and intersex gonads being present. Complete (identification of lesions and scoring individual samples) histologic analysis of both organs (gill and gonad) is recommended.

General Recommendations

1. **Fish Collection:**
   a. Standardize collection methodology (trawl type, run duration, number of attempts, etc.), but retain flexibility to alter methods depending on habitat and circumstances.
   b. Minimize stess, morbidity, and mortality by using live-wells, on collection vessels, and maintaining fish in flow through tanks with refrigerated water prior to necropsy.
   c. Use freshly dead fish for histopathology and/or residue analysis, if there are inadequate numbers of live fish. Alternatively, speciate, measure, age, and sex dead fish for population based site to site comparisons.
   d. Create priority lists (based on criteria maximizing the probability of finding lesions in **resident** fish) for different coastal ecosystems. For example, a Southern California muddy harbor site would have a priority list of: 1) yellowfin gobies; 2) tonguefish; and 3) white croakers. In contrast, a Northern California kelp bed study site would have a priority list including: 1) striped surfperch; 2) kelp greenling; and 3) black and yellow rockfish.
   e. Use generated priority lists to include or exclude different species from the sample based on their standings.
   f. Have sample sizes set for each site, but **increase** sample size if more than one species is collected. For example, if the per site sample size is 15, increase it to 20 or 30 (10 per species) if two or three high priority species are caught.
   g. Consider setting either minimal or maximal size limits so that similar size/age classes can be compared between sites.

2. **Necropsy:**
   a. Have adequate facillities (counter space, freezers, holding tanks, etc.) available to perform necropsies, process and store tissue samples.
   b. Have adequate personel available to necropsy fish promptly, process sampled, and record data.
   c. Streamline instrument cleaning and decontamination protocols to enable necropsies to proceed at a reasonable pace.
   d. Have at least two scales available; one to accurately weigh organs (rated to 0.001 gm) and another for body weights (range dependent on upper size limit of the study).
   e. **Indices:**
      1) Use GSI only if fish are large enough for gonads to be cleanly excised and accurate weights taken.
      2) Continue to use both HSI and CI as gross biomarkers of health.
   f. Standardize necropsy protocols so that all fish are examined for gross external and internal lesions, and no organs are overlooked.

g. **Histopathology Samples:**
   1) Minimal histopathology sampling should include spleen, liver, and gonad.
   2) Consider expanding sampling so the immune status can be fully evaluated. In addition to spleen, sample head kidney and thymus in teleost fish, and epigonal and Leydig organ in elasmobranchs.
   3) Consider taking other organs (kidney, heart, GI tract, gill, brain) for at least **archival storage** (either in formalin or paraffin). Costs would be minimal and tissues could be analyzed if a more complete analysis is needed.

h. **P450 Samples:**
   1) P450 immunohistochemistry can be run on the same samples used for histopathology.
   2) Liver samples for EROD activity can be considered optional if immunohistochemistry is performed.

i. Take either otoliths or scales and age fish.

j. Take carcasses for xenobiotic residue analysis and correlate body burdens with lesion scores and P450 activity.

3. **Tissue Processing:**
   a. Minimize contact of fixed tissues with alcohol and process as soon as possible to minimize loss of P450 antigenicity during immunohistochemical assay.
   b. Cassette and paraffin process gonad separate from other organs to avoid loss during processing or accidental sectioning through of blocks.

4. **Lesion Evaluation and Scoring:**
   a. Continue to have all assays (histopathology, immunohistochemistry, EROD) read **blind** so as not to bias results.
   b. Standardize scoring criteria so that changes (in lesion and P450 scores) at specific sites can be evaluated over time, and data from different studies are comparable.
   c. Sort all lesion and P450 data on the basis of species, sex, and age so that valid site to site comparisons can be made.

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ppendix 1. Goby Biomarker Study. Heavy Metals in Sediment from Nine Sites in the Los Angeles Harbor Area.
All Data reported in Parts Per Million (ppm).

Site #	Site Name	ID ORG #	Collection Date	Aluminum	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Selenium	Tin	Zinc
0001	Southwest Slip	1	7/29/92	41000.00	2.100	14.000	0.3700	110.000	110.00	47000.0	53.000	590.00	0.6200	43.000	0.3100	0.460	6.3000	200.0000
0001	Southwest Slip	2	7/29/92	37000.00	2.400	13.000	0.4800	95.000	110.00	48000.0	49.000	550.00	0.7600	40.000	0.3000	0.470	4.5000	190.0000
0001	Southwest Slip	1062	2/1/94	43000.00	1.830	16.800	0.4180	93.300	102.00	44400.0	46.300	526.00	0.4700	42.000	0.2870	0.415	2.7700	198.0000
0001	Southwest Slip	1063	2/1/94	42800.00	1.780	15.700	0.5010	93.300	107.00	41800.0	39.700	495.00	0.5660	39.900	0.3100	0.445	2.8300	189.0000
0001	Southwest Slip	1064	2/1/94	62700.00	1.900	12.400	0.4520	77.800	75.20	39900.0	44.400	476.00	0.3260	31.700	0.1980	0.300	2.1000	160.0000
0001	Southwest Slip	3	7/29/92	34000.00	2.000	15.000	0.5700	100.000	120.00	44000.0	52.000	530.00	0.5700	43.000	0.3100	0.590	4.8000	200.0000
			Average	43416.67	2.00	14.48	0.47	94.90	104.03	44183.33	47.40	527.83	0.55	39.93	0.29	0.45	3.88	189.50
0002	West Basin - Pier 143	5	7/30/92	42000.00	1.300	9.400	0.2200	67.000	62.00	36000.0	36.000	450.00	0.2200	28.000	0.1600	0.270	4.3000	130.0000
0006	Consolidated Slip	16	7/31/92	30000.00	3.700	18.000	2.8000	140.000	190.00	43000.0	140.000	350.00	0.7300	45.000	0.8900	0.640	8.0000	540.0000
0006	Consolidated Slip	1050	2/1/94	39200.00	3.340	18.300	2.7200	149.000	215.00	46600.0	109.000	485.00	0.6040	45.800	0.9760	0.737	5.1100	463.0000
0006	Consolidated Slip	1051	2/1/94	53200.00	3.430	23.900	2.6900	139.000	210.00	47400.0	95.300	529.00	0.5610	45.300	0.9360	0.598	5.0800	606.0000
0006	Consolidated Slip	1052	2/1/94	58700.00	3.850	19.100	2.9000	146.000	222.00	52200.0	95.600	600.00	0.7370	50.600	1.0500	0.765	5.3300	616.0000
0006	Consolidated Slip	17	7/31/92	22000.00	4.400	17.000	2.9000	140.000	200.00	46000.0	170.000	420.00	0.5600	46.000	0.9200	0.530	8.7000	570.0000
			Average	40620.00	3.74	19.26	2.80	142.80	207.40	47040.00	121.98	476.80	0.64	46.54	0.95	0.65	6.44	559.00
0007	Long Beach Harbor - Ch. 2	20	9/1/92	41000.00	2.200	19.000	0.5600	110.000	160.00	48000.0	72.000	580.00	1.2000	45.000	0.6000	0.420	7.7000	330.0000
0013	Inner Queensway Bay	37	9/2/92	31000.00	1.600	8.300	1.2000	55.000	51.00	37000.0	40.000	410.00	0.2300	31.000	0.3500	0.470	3.7000	190.0000
0013	Inner Queensway Bay	1056	2/1/94	69000.00	0.835	3.960	0.9650	28.900	27.00	24700.0	72.500	359.00	0.1220	15.600	0.3810	0.216	1.4200	131.0000
0013	Inner Queensway Bay	1057	2/1/94	70400.00	1.180	4.120	1.0400	31.500	28.60	24100.0	62.000	320.00	0.1190	14.100	0.3660	0.215	2.3300	138.0000
0013	Inner Queensway Bay	1058	2/1/94	66400.00	1.550	6.430	1.5000	44.100	48.80	36700.0	65.700	493.00	0.2080	24.000	0.7620	0.416	2.8900	214.0000
0013	Inner Queensway Bay	38	9/2/92	44000.00	1.810	8.500	1.0600	61.000	43.00	37000.0	39.500	380.00	0.1590	33.000	0.3500	0.530	4.2600	180.0000
			Average	56160.00	1.36	6.26	1.15	44.10	39.68	31900.00	55.94	392.40	0.17	23.54	0.44	0.37	2.92	170.60
0015	Fish Harbor Entrance	43	8/19/92	50000.00	1.400	10.000	0.4700	67.000	50.00	31000.0	32.000	500.00	0.3400	27.000	0.2400	0.410	4.2000	120.0000
0015	Fish Harbor Entrance	44	8/19/92	60000.00	1.010	9.300	0.4000	55.000	33.00	28000.0	28.400	370.00	0.2030	24.000	0.1800	0.280	3.0200	100.0000
0015	Fish Harbor Entrance	45	8/19/92	48000.00	1.200	6.700	0.3200	43.000	40.00	29000.0	34.000	400.00	0.5400	21.000	0.1500	0.280	2.5000	110.0000
			Average	52666.67	1.20	8.67	0.40	55.00	41.00	29333.33	31.47	423.33	0.36	24.00	0.19	0.33	3.24	110.00
0016	Terminal Island Stop	46	8/18/92	42000.00	1.280	12.000	0.6200	75.000	47.00	36000.0	25.600	400.00	0.2630	38.000	0.3000	1.200	3.9600	120.0000
0016	Terminal Island Stop	47	8/18/92	47000.00	1.370	7.600	0.3600	70.000	29.00	35000.0	18.900	460.00	0.1290	35.000	0.1300	0.480	2.7800	100.0000
0016	Terminal Island Stop	48	8/18/92	36000.00	1.790	14.000	0.7600	91.000	55.00	42000.0	29.400	510.00	0.2550	47.000	0.3500	1.400	2.8100	150.0000
			Average	41666.67	1.48	11.20	0.58	78.67	43.67	37666.67	24.63	456.67	0.22	40.00	0.26	1.03	3.18	123.33
0032	Pola 19 (San Pedro Bay)	103	8/19/92	53000.00	0.400	6.000	0.2400	47.000	27.00	25000.0	24.000	430.00	0.1800	18.000	0.1400	0.200	3.6000	79.0000
0032	Pola 19 (San Pedro Bay)	104	8/19/92	72000.00	0.630	6.300	0.2400	43.000	17.00	24000.0	20.700	360.00	0.1060	16.000	0.1000	0.000	2.2200	70.0000
0032	Pola 19 (San Pedro Bay)	81	7/30/92	65000.00	0.900	5.000	0.2500	46.000	21.00	24000.0	23.000	440.00	0.1500	17.000	0.1100	0.150	3.3000	76.0000
0032	Pola 19 (San Pedro Bay)	105	8/19/92	69000.00	0.840	6.500	0.2300	41.000	19.00	26000.0	19.200	360.00	0.0840	16.000	0.1000	0.000	2.5200	77.0000
			Average	64750.00	0.69	5.95	0.24	44.25	21.00	24750.00	21.73	397.50	0.13	16.75	0.11	0.09	2.91	75.50
0027	Huntington Harbor - Middle	95	9/15/92	47000.00	0.600	6.800	0.2700	60.000	77.00	40000.0	77.000	560.00	0.1500	29.000	0.2200	0.150	4.9000	230.0000
0027	Huntington Harbor - Middle	96	9/15/92	33000.00	0.600	6.000	0.3400	57.000	68.00	39000.0	57.000	480.00	0.1600	27.000	0.2100	0.200	4.9000	210.0000
0027	Huntington Harbor - Middle	1177	3/30/94	48200.00	0.355	10.100	0.3820	61.000	64.60	39100.0	45.500	556.00	0.1400	34.500	0.1830	0.327	1.9800	214.0000
0027	Huntington Harbor - Middle	1178	3/30/94	56800.00	0.346	8.470	0.4190	59.400	63.00	38100.0	55.200	555.00	0.1310	31.600	0.1630	0.296	2.1200	215.0000
0027	Huntington Harbor - Middle	1179	3/30/94	52400.00	0.381	9.020	0.4630	59.800	63.40	38200.0	51.300	535.00	0.1350	33.300	0.2140	0.295	2.0000	213.0000
			Average	47480.00	0.46	8.04	0.37	59.44	67.20	38880.00	57.20	537.20	0.14	31.08	0.20	0.25	3.18	216.40

Appendix 2. Goby Biomarker Study. Heavy Metals in Pore Water (PW) from Nine Sites in the Los Angeles Harbor Area.
All Data in parts Per Million (ppm).

Site #	Site Name	ID ORG #	Collection Date	PW Aluminum	PW Cadmium	PW Copper	PW Iron	PW Lead	PW Manganese	PW Nickel	PW Silver	PW Zinc
40001	Southwest Slip	1	7/29/92	16	0.00001	1.50	9200	0.02	2600	2.10	0.0	4.20
40001	Southwest Slip	2	7/29/92	42	0.00580	7.70	9500	0.59	2900	2.30	0.0	9.90
40001	Southwest Slip	1062	2/1/94									
40001	Southwest Slip	1063	2/1/94									
40001	Southwest Slip	1064	2/1/94									
40001	Southwest Slip	3	7/29/92									
40002	West Basin- Pier 143	5	7/30/92	520	0.18000	7.40	8700	8.60	1900	4.60	0.0	72.00
40006	Consolidated Slip	16	7/31/92	98	0.02300	1.00	1800	1.50	390	1.20	0.0	4.60
40006	Consolidated Slip	1050	2/1/94									
40006	Consolidated Slip	1051	2/1/94									
40006	Consolidated Slip	1052	2/1/94									
40006	Consolidated Slip	17	7/31/92	55	0.01200	0.99	1100	0.66	600	2.20	0.0	3.00
40007	Long Beach Harbor- Channel 2	20	9/1/92	600	0.19000	39.00	7000	18.00	2200	4.00	0.0	98.00
40013	Inner Queensway Bay	37	9/2/92									
40013	Inner Queensway Bay	1056	2/1/94									
40013	Inner Queensway Bay	1057	2/1/94									
40013	Inner Queensway Bay	1058	2/1/94									
40013	Inner Queensway Bay	38	9/2/92									
40015	Fish Harbor Entrance	43	8/19/92	6	0.03500	0.72	7300	0.35	2000	3.50	0.0	9.20
40015	Fish Harbor Entrance	44	8/19/92									
40015	Fish Harbor Entrance	45	8/19/92									
40016	Terminal Island Stop	46	8/18/92									
40016	Terminal Island Stop	47	8/18/92									
40016	Terminal Island Stop	48	8/18/92									
40032	Pola 19 (San Pedro Bay)	103	8/19/92									
40032	Pola 19 (San Pedro Bay)	104	8/19/92									
40032	Pola 19 (San Pedro Bay)	81	7/30/92									
40032	Pola 19 (San Pedro Bay)	105	8/19/92									
80027	Huntington Harbor - Middle	95	9/15/92	76	0.01900	2.60	7500	1.30	2300	3.00	0.0	14.00
80027	Huntington Harbor - Middle	96	9/15/92									
80027	Huntington Harbor - Middle	1177	3/30/94									
80027	Huntington Harbor - Middle	1178	3/30/94									
80027	Huntington Harbor - Middle	1179	3/30/94									

oby Biomarker Study. Pesticide Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.
data reported in parts per billion (ppb).

Site Name	ID #	ORG Collection Date	ALDRIN	CCHLOR	TCHLOR	ACDEN	GCDEN	CLPYR	DACTH	OPDDD	PPDDD	OPDDE	PPDDE	PPDDMS	PPDDMU	OPDDT	PPDDT	DIELDRIN	HCB	METHOXY	CNONA	TNONA	OCDAN	TOXAPH
Southwest Slip	1	7/29/92	0.000	1.200						3.60	15.000	9.70	89.00			0.00	10.00	0.000	0.000	0.00		1.200		0.00
Southwest Slip	2	7/29/92	0.000	1.300						4.60	16.000	9.60	96.00			5.40	10.00	0.000	0.000	0.00		1.300		0.00
Southwest Slip	1062	2/1/94	0.000	0.901	1.100	0.000	0.000	0.00	0.000	3.02	10.100	8.68	61.70	3.24	2.90	0.00	1.87	0.000	0.000	0.00	1.380	0.922	0.000	0.00
Southwest Slip	1063	2/1/94	0.000	1.080	1.600	0.000	0.000	0.00	0.000	2.57	12.500	8.47	58.00	4.98	5.02	0.00	5.08	0.529	0.000	0.00	1.010	1.360	0.000	0.00
Southwest Slip	1064	2/1/94	0.000	0.531	0.706	0.000	0.000	0.00	0.000	1.80	6.610	6.65	47.50	0.00	2.71	0.00	0.00	0.000	0.000	0.00	0.646	0.527	0.000	0.00
Southwest Slip	3	7/29/92	0.000	2.200						3.80	17.000	9.30	93.00			0.00	0.00	0.000	0.000	0.00		2.400		0.00
		Average	0.000	1.202	1.135	0.000	0.000	0.000	0.000	3.232	12.868	8.733	74.200	2.740	3.543	0.900	4.492	0.088	0.000	0.000	1.012	1.285	0.000	0.000
est Basin - Pier 143	5	7/30/92	0.000	1.200						2.40	8.600	5.40	41.00			0.00	3.70	0.000	0.000	0.00		1.100		0.00
Consolidated Slip	16	7/31/92	0.000	26.000						35.00	140.000	10.00	270.00			9.70	52.00	7.100	1.600	0.00		24.000		160.00
Consolidated Slip	1050	2/1/94	0.000	29.900	36.700	2.950	2.890	9.21	1.410	35.90	164.000	7.27	360.00	0.00	40.90	2.23	34.40	1.160	1.540	6.65	10.300	34.200	1.670	0.00
Consolidated Slip	1051	2/1/94	0.000	21.300	24.600	3.270	3.000	18.90	0.983	35.40	158.000	11.40	226.00	0.00	29.10	6.45	32.40	2.470	2.190	3.96	14.000	22.200	1.480	0.00
Consolidated Slip	1052	2/1/94	0.000	13.900	19.100	3.540	1.850	1.58	1.080	27.60	98.700	10.90	212.00	8.41	14.80	6.24	21.50	5.360	1.320	0.00	8.620	15.700	0.783	0.00
Consolidated Slip	17	7/31/92	0.000	23.000						33.00	140.000	12.00	270.00			7.50	36.00	6.200	1.600	0.00		23.000		100.00
		Average	0.000	22.820	26.800	3.253	2.613	9.897	1.158	33.380	140.140	10.314	267.800	2.803	28.267	6.426	35.260	4.458	1.650	2.122	10.973	23.820	1.311	52.000
Beach Harbor - Ch. 2	20	9/1/92	0.000	2.000						3.30	11.000	9.90	88.00			0.00	0.00	0.000	0.300	0.00		2.000		0.00
ner Queensway Bay	37	9/2/92	0.000	7.400						1.60	11.000	1.40	27.00			1.20	7.30	3.700	0.400	0.00		7.400		0.00
ner Queensway Bay	1056	2/1/94	0.000	3.710	4.020	0.702	0.000	3.57	0.309	1.35	5.230	0.00	8.71	0.00	0.00	0.00	3.06	1.650	0.205	1.78	1.190	3.170	0.000	0.00
ner Queensway Bay	1057	2/1/94	0.000	4.270	4.800	0.755	0.000	3.68	0.240	1.13	5.570	0.00	7.88	0.00	0.00	0.00	0.00	0.000	0.261	0.00	1.810	3.990	0.000	0.00
ner Queensway Bay	1058	2/1/94	0.000	6.850	7.640	1.410	0.859	7.30	0.219	2.49	12.600	1.26	14.70	0.00	4.46	0.00	5.80	3.770	0.346	1.94	2.780	6.740	0.862	0.00
ner Queensway Bay	38	9/2/92	0.000	9.800		1.900				2.30	13.000	1.60	24.00			1.70	11.70	6.500	0.300	0.00		9.100		32.
		Average	0.000	6.406	5.487	1.192	0.286	4.850	0.256	1.774	9.480	0.852	16.458	0.000	1.487	0.580	5.572	3.124	0.302	0.744	1.927	6.080	0.287	6.4.
sh Harbor Entrance	43	8/19/92	0.000	0.000						0.00	2.900	8.60	70.00			0.00	0.00	0.000	0.000	0.00		0.000		0.00
sh Harbor Entrance	44	8/19/92	0.000	0.000		0.000				0.00	2.500	5.90	45.00			0.00	0.00	0.000	0.000	0.00		0.000		0.00
sh Harbor Entrance	45	8/19/92	0.000	0.000						0.00	2.200	3.70	33.00			0.00	0.00	0.000	0.000	0.00		0.000		0.00
		Average	0.000	0.000		0.000				0.000	2.533	6.067	49.333			0.000	0.000	0.000	0.000	0.000		0.000		0.000
rminal Island Stop	46	8/18/92	0.000	0.000		0.000				2.00	6.800	16.20	111.00			0.00	5.30	0.000	0.000	0.00		0.000		0.00
rminal Island Stop	47	8/18/92	0.000	0.000		0.000				0.00	2.200	4.20	23.80			0.00	3.70	0.000	0.000	0.00		0.000		0.00
rminal Island Stop	48	8/18/92	0.000	0.000		0.000				1.90	5.900	15.30	92.70			0.00	1.00	0.000	0.000	0.00		0.000		0.00
		Average	0.000	0.000		0.000				1.300	4.967	11.900	75.833			0.000	3.333	0.000	0.000	0.000		0.000		0.000
t 19 (San Pedro Bay)	103	8/19/92	0.000	0.000						1.20	3.100	8.80	75.00			0.00	0.00	0.000	0.000	0.00		0.000		0.00
t 19 (San Pedro Bay)	104	8/19/92	0.000	0.000		0.000				1.10	4.100	10.50	74.50			0.00	1.50	0.000	0.000	0.00		0.000		0.00
t 19 (San Pedro Bay)	81	7/30/92	0.000	0.000						1.90	5.500	13.00	110.00			0.00	2.50	0.000	0.000	0.00		0.000		0.00
t 19 (San Pedro Bay)	105	8/19/92	0.000	0.000		0.000				2.10	7.000	22.80	157.00			0.00	2.90	0.000	0.000	0.00		0.000		0.00
		Average	0.000	0.000		0.000				1.575	4.925	13.775	104.125			0.000	1.725	0.000	0.000	0.000		0.000		0.000
ington Harbor - Middle	95	9/15/92	0.000	4.300						3.00	11.000	2.30	76.00			0.00	3.40	0.000	0.500	0.00		4.900		0.00
ington Harbor - Middle	96	9/15/92	0.000	4.300						2.70	9.500	2.00	72.00			0.00	5.10	0.900	0.200	0.00		5.000		0.00
ington Harbor - Middle	1177	3/30/94	0.720	4.270	4.140	0.634	0.000	6.68	1.140	2.75	11.100	2.33	53.90	0.00	4.65	1.51	9.57	1.030	0.266	0.00	2.940	4.020	0.000	0.00
ington Harbor - Middle	1178	3/30/94	0.000	3.700	4.610	0.500	0.000	3.22	0.409	2.67	8.300	0.00	65.70	0.00	0.00	0.00	5.34	0.708	0.000	0.00	2.320	3.960	0.000	0.00
ington Harbor - Middle	1179	3/30/94	0.000	4.320	5.410	0.000	0.000	9.36	0.641	3.60	13.100	0.00	86.20	0.00	0.00	0.00	8.31	1.010	0.227	0.00	2.760	4.650	0.000	0.00
		Average	0.144	4.178	4.720	0.378	0.000	6.420	0.730	2.944	10.600	1.328	70.760	0.000	1.550	0.302	6.344	0.730	0.239	0.000	2.673	4.506	0.000	0.000

12001

Polyaromatic Hydrocarbon (PAH) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.
l data in parts per billion (ppb).

Site Name	ID #	ORG Collection Date	ACY	ACE	ANT	BAA	BAP	BBF	BKF	BGP	BEP	BPH	CHR	DBA	DMN	FLA	FLU	IND	MNP1	MNP2	MPH1	NPH	PHN	PER	PYR	TMN
Southwest Slip	1	7/29/92		83.00	620.00	970.00	1100.00				950.00	19.00	1700.00	180.00	11.00	2000.00	150.00		23.00	60.00	60.00		660.00	370.00	1400.00	
Southwest Slip	2	7/29/92		21.00	390.00	860.00	1600.00				1400.00	7.30	1600.00	270.00	9.50	1000.00	77.00		8.50	26.00	36.00		350.00	450.00	1300.00	
Southwest Slip	1062	2/1/94	39.20	34.50	1050.00	1350.00	2190.00	3270.00	1190.00	917.00	1500.00	12.60	2040.00	366.00	9.96	2300.00	175.00	1190.00	12.60	40.60	101.00	34.50	885.00	566.00	1270.00	0.00
Southwest Slip	1063	2/1/94	63.00	30.70	911.00	1200.00	1950.00	3230.00	1150.00	830.00	1390.00	10.70	2310.00	341.00	7.27	1910.00	129.00	1010.00	9.81	30.30	83.10	25.80	642.00	545.00	1190.00	0.00
Southwest Slip	1064	2/1/94	26.00	22.40	344.00	382.00	1080.00	1670.00	601.00	450.00	754.00	7.26	677.00	187.00	0.00	571.00	54.70	621.00	8.25	19.20	39.50	19.80	381.00	285.00	581.00	0.00
Southwest Slip	3	7/29/92		130.00	1400.00	2200.00	3300.00				2500.00	23.00	4000.00	510.00	0.00	4400.00	310.00		25.00	70.00	130.00		1400.00	820.00	2900.00	
		Average	42.73	53.60	785.83	1160.33	1870.00	2723.33	980.33	732.33	1415.67	13.31	2054.50	309.00	6.29	2030.17	149.28	940.33	14.53	41.02	71.60	26.70	716.33	506.00	1440.17	0.00
'est Basin - Pier 143	5	7/30/92		6.20	97.00	210.00	400.00				370.00	0.00	370.00	70.00	5.80	280.00	21.00		5.10	13.00	12.00		84.00	140.00	370.00	
Consolidated Slip	16	7/31/92		38.00	160.00	690.00	630.00				680.00	20.00	1100.00	150.00	47.00	1300.00	76.00		74.00	230.00	130.00		480.00	190.00	1400.00	
Consolidated Slip	1050	2/1/94	34.10	55.80	210.00	743.00	1320.00	1620.00	563.00	1100.00	1150.00	27.40	993.00	378.00	81.70	1410.00	51.70	890.00	76.60	245.00	67.40	127.00	448.00	329.00	1650.00	21.80
Consolidated Slip	1051	2/1/94	36.00	60.70	286.00	696.00	1340.00	1680.00	576.00	1120.00	1140.00	30.70	849.00	329.00	74.80	1360.00	57.50	873.00	88.50	254.00	158.00	130.00	770.00	330.00	1670.00	31.00
Consolidated Slip	1052	2/1/94	37.10	66.20	325.00	706.00	1400.00	1730.00	591.00	1160.00	1180.00	31.90	918.00	337.00	93.40	1510.00	65.90	917.00	90.80	272.00	217.00	124.00	1170.00	324.00	1780.00	26.20
Consolidated Slip	17	7/31/92		52.00	220.00	1000.00	920.00				920.00	29.00	1500.00	200.00	67.00	1700.00	97.00		79.00	210.00	160.00		810.00	250.00	2200.00	
		Average	35.73	54.54	240.20	767.00	1122.00	1676.67	576.67	1126.67	1010.00	27.80	1072.00	278.80	72.78	1456.00	69.62	893.33	81.78	242.20	148.48	127.00	695.60	284.60	1740.00	26.33
g Beach Harbor Ch. 2	20	9/1/92		65.00	440.00	910.00	1600.00				1400.00	25.00	1600.00	310.00	23.00	1500.00	120.00		28.00	57.00	69.00		590.00	360.00	1600.00	
ner Queensway Bay	37	9/2/92		6.00	19.00	92.00	100.00				130.00	26.00	150.00	29.00	13.00	200.00	36.00		39.00	56.00	33.00		140.00	62.00	220.00	
ner Queensway Bay	1056	2/1/94	0.00	0.00	7.39	37.70	64.70	93.90	32.60	67.00	54.30	0.00	62.70	14.90	0.00	115.00	5.01	41.60	5.09	11.00	9.22	11.60	52.40	23.70	119.00	0.00
ner Queensway Bay	1057	2/1/94	0.00	6.53	8.85	53.00	80.70	119.00	47.80	97.70	73.80	0.00	72.50	21.40	8.07	133.00	5.48	78.90	7.78	11.40	21.00	14.10	92.40	30.80	143.00	0.00
ner Queensway Bay	1058	2/1/94	0.00	6.09	14.00	92.00	158.00	205.00	71.80	142.00	126.00	5.87	146.00	41.10	44.80	234.00	9.89	95.30	9.60	20.50	17.50	20.20	98.20	49.30	243.00	0.00
ner Queensway Bay	38	9/2/92		11.00	14.40	73.50	93.60				107.00	24.00	110.00	25.10	9.90	268.00	25.10		34.90	45.50	31.30		161.00	51.80	275.00	
		Average	0.00	5.92	12.73	89.84	99.00	139.30	50.73	102.23	98.62	11.57	108.24	26.30	15.15	190.00	16.30	71.93	19.27	28.88	22.40	15.30	108.80	43.52	200.00	0.00
ih Harbor Entrance	43	8/19/92		7.40	13.00	82.00	110.00				99.00	0.00	81.00	25.00	0.00	130.00	7.40		0.00	7.00	15.00		75.00	130.00	150.00	
ih Harbor Entrance	44	8/19/92		0.00	12.60	35.30	73.60				66.30	0.00	45.10	13.10	0.00	107.00	0.00		0.00	0.00	9.10		56.50	86.20	121.00	
ih Harbor Entrance	45	8/19/92		26.00	23.00	68.00	91.00				69.00	0.00	90.00	19.00	8.30	160.00	21.00		6.90	9.40	16.00		120.00	90.00	170.00	
		Average		11.13	16.20	54.43	91.53				78.10	0.00	72.03	19.03	2.77	132.33	9.47		2.30	5.47	13.37		83.83	102.07	147.00	
rminal Island Stop	46	8/18/92		0.00	9.10	11.50	62.20				57.30	0.00	26.50	14.60	0.00	54.10	0.00		0.00	8.80	0.00		16.40	303.00	64.60	
rminal Island Stop	47	8/18/92		0.00	6.10	14.40	39.10				35.30	0.00	18.40	6.70	0.00	44.60	0.00		0.00	0.00	0.00		14.00	123.00	63.00	
rminal Island Stop	48	8/18/92		0.00	18.70	34.90	94.50				77.30	0.00	50.80	23.90	0.00	70.90	0.00		0.00	9.80	0.00		33.10	306.00	81.40	
		Average		0.00	11.30	20.27	65.27				56.63	0.00	31.90	15.07	0.00	56.53	0.00		0.00	6.20	0.00		21.17	244.00	69.67	
19 (San Pedro Bay)	103	8/19/92		0.00	14.00	71.00	58.00				56.00	0.00	79.00	15.00	0.00	130.00	7.90		0.00	0.00	17.00		48.00	59.00	130.00	
19 (San Pedro Bay)	104	8/19/92		0.00	0.00	7.90	17.00				18.30	0.00	9.70	0.00	0.00	22.20	0.00		0.00	0.00	0.00		6.80	42.20	22.60	
19 (San Pedro Bay)	61	7/30/92		0.00	0.00	17.00	31.00				27.00	0.00	21.00	7.40	0.00	35.00	0.00		0.00	5.80	0.00		10.00	57.00	38.00	
19 (San Pedro Bay)	105	8/19/92		0.00	0.00	17.30	29.70				21.90	0.00	22.10	9.30	0.00	36.50	0.00		0.00	5.00	5.10		7.10	69.50	39.20	
		Average		0.00	3.50	28.30	33.93				30.80	0.00	32.95	7.93	0.00	55.93	1.98		0.00	2.70	5.53		17.98	56.93	57.45	
ngton Harbor - Middle	95	9/15/92		0.00	17.00	59.00	88.00				110.00	0.00	90.00	24.00	13.00	150.00	0.00		0.00	8.50	7.10		52.00	29.00	170.00	
ngton Harbor - Middle	96	9/15/92		0.00	9.90	59.00	83.00				110.00	0.00	110.00	24.00	6.90	160.00	8.20		0.00	8.50	10.00		67.00	28.00	180.00	
ngton Harbor - Middle	1177	3/30/94	0.00	0.00	0.00	37.10	91.80	132.00	49.80	93.40	72.20	0.00	59.80	21.60	0.00	115.00	0.00	86.10	0.00	7.77	6.88	10.90	38.00	25.30	116.00	0.00
ngton Harbor - Middle	1178	3/30/94	0.00	0.00	7.58	32.20	122.00	159.00	57.20	97.90	70.50	0.00	47.80	26.60	0.00	111.00	0.00	74.60	0.00	5.58	7.55	7.45	37.90	21.90	113.00	0.00
ngton Harbor - Middle	1179	3/30/94	0.00	0.00	8.57	41.00	145.00	190.00	70.30	116.00	83.70	0.00	52.10	33.10	0.00	137.00	0.00	88.90	0.00	6.35	9.78	8.55	49.50	25.30	140.00	0.00
		Average	0.00	0.00	8.61	44.46	105.96	160.33	59.10	102.43	89.28	0.00	71.94	25.86	3.98	134.60	1.64	83.20	0.00	7.34	8.28	8.97	48.48	25.90	143.80	0.00

12002

oby Biomarker Study. Polychlorinated Biphenyl (PCB) Sediment Data.
l PCB values reported in parts per billion (ppb).

Site Name	ID #	ORG Collection Date	PCB 8	PCB 18	PCB 28	PCB 44	PCB 52	PCB 66	PCB 87	PCB 101	PCB 105	PCB 118	PCB 128	PCB 138	PCB 153	PCB 170	PCB 180	PCB 187	PCB 195	PCB 206	PCB 209	ARO 5460
Southwest Slip	1	7/29/92	0.000	0.000	0.000	1.700	3.000	3.100		10.000	3.600	9.300	2.700	16.000	12.000	2.900	6.100	3.300	0.000	1.900	1.200	
Southwest Slip	2	7/29/92	0.000	0.000	0.000	2.200	4.600	3.400		12.000	4.200	11.000	3.200	19.000	14.000	4.000	8.700	3.800	0.000	1.100	0.000	
Southwest Slip	1062	2/1/94	0.000	0.000	0.663	2.540	6.720	3.700		16.400	5.990	15.500	4.400	24.700	18.800	5.230	11.100	4.810	1.160	2.210	0.955	132.000
Southwest Slip	1063	2/1/94	0.000	0.000	0.577	1.880	4.470	3.530		12.400	5.360	11.600	4.320	19.200	14.700	3.570	7.640	3.810	0.561	1.330	0.839	60.600
Southwest Slip	1064	2/1/94	0.000	0.000	0.583	1.490	3.400	2.770		9.490	3.370	8.710	2.350	13.800	10.600	2.510	5.490	2.310	0.000	0.920	0.551	40.800
Southwest Slip	3	7/29/92	0.000	0.000	0.000	2.200	4.700	3.500		14.000	3.800	13.000	3.400	21.000	13.000	3.800	7.900	3.500	0.000	1.000	0.000	
		Average	0.000	0.000	0.304	2.002	4.482	3.333		12.382	4.387	11.518	3.395	18.950	13.850	3.668	7.822	3.522	0.287	1.410	0.591	77.800
		Standard Error	0.000	0.000	0.136	0.157	0.530	0.139		1.048	0.430	1.019	0.341	1.555	1.154	0.388	0.816	0.305	0.197	0.215	0.205	27.696
West Basin - Pier 143	5	7/30/92	0.000	0.000	0.000	1.200	2.200	1.900		7.100	2.800	6.800	2.000	11.000	7.600	1.900	3.800	1.900	0.000	0.000	0.000	
Consolidated Slip	16	7/31/92	0.000	4.600	9.900	11.000	14.000	16.000		23.000	6.800	18.000	4.300	38.000	35.000	11.000	26.000	15.000	1.800	2.000	0.000	
Consolidated Slip	1050	2/1/94	0.000	1.590	0.000	7.350	13.100	10.400		24.800	1.700	19.100	2.580	44.400	43.000	15.700	41.300	20.400	2.720	4.550	3.350	49.600
Consolidated Slip	1051	2/1/94	0.000	2.030	4.770	7.540	11.700	13.700		22.600	8.050	17.100	5.970	40.300	38.000	12.900	39.900	18.100	3.020	4.690	3.610	198.000
Consolidated Slip	1052	2/1/94	0.000	1.860	4.700	6.930	10.500	13.200		22.600	9.770	17.600	4.870	44.400	48.300	16.800	54.800	22.600	4.320	5.160	2.630	198.000
Consolidated Slip	17	7/31/92	1.500	7.700	13.000	13.000	17.000	20.000		24.000	7.600	18.000	4.100	39.000	36.000	11.000	35.000	16.000	1.900	2.200	0.000	
		Average	0.300	3.556	6.474	9.164	13.260	14.660		23.400	6.784	17.960	4.364	41.220	39.660	13.480	39.400	18.020	2.752	3.720	1.918	148.533
		Standard Error	0.300	1.169	2.262	1.204	1.109	1.605		0.434	1.361	0.330	0.552	1.348	2.158	1.196	4.690	1.475	0.456	0.670	0.799	49.467
Long Beach Harbor Ch.2	20	9/1/92	1.400	5.200	11.000	11.000	14.000	19.000		14.000	6.100	14.000	2.900	19.000	15.000	5.300	11.000	5.400	0.000	2.000	1.900	
Inner Queensway Bay	37	9/2/92	0.000	1.000	1.700	2.300	2.800	2.700		3.100	1.700	3.000	1.000	4.900	3.700	1.600	3.200	1.400	0.000	0.000	0.000	
Inner Queensway Bay	1056	2/1/94	0.000	0.549	1.000	1.180	1.430	1.740		1.650	0.760	1.630	0.517	2.730	2.050	0.738	1.810	0.845	0.000	0.000	0.000	35.700
Inner Queensway Bay	1057	2/1/94	0.000	0.000	0.926	1.200	1.490	1.470		1.630	0.680	1.480	0.000	2.690	1.820	0.911	1.990	0.794	0.000	0.000	0.000	37.600
Inner Queensway Bay	1058	2/1/94	0.000	1.240	1.500	2.120	2.220	3.500		3.140	1.960	2.920	2.270	4.930	3.740	1.520	3.590	1.460	0.000	0.747	0.000	63.300
Inner Queensway Bay	38	9/2/92	0.000	1.100	1.500	2.000	2.700	3.000	1.300	2.800	0.700	2.800	0.600	4.600	3.300	1.600	3.100	1.300	0.000	0.500	0.000	
		Average	0.000	0.778	1.325	1.760	2.128	2.482	1.300	2.464	1.160	2.366	0.877	3.970	2.922	1.274	2.738	1.160	0.000	0.249	0.000	45.600
		Standard Error	0.000	0.226	0.153	0.238	0.290	0.383		0.342	0.277	0.333	0.383	0.518	0.412	0.186	0.353	0.141	0.000	0.158	0.000	8.871
Fish Harbor Entrance	43	8/19/92	0.000	0.000	0.000	1.100	2.000	2.100		4.300	1.800	4.400	1.100	5.900	4.300	1.100	2.000	1.100	0.000	0.000	0.000	
Fish Harbor Entrance	44	8/19/92	0.000	0.500	0.600	0.900	1.700	1.700	1.300	3.100	0.800	3.400	0.800	4.300	3.200	0.700	1.600	0.900	0.000	0.000	0.000	
Fish Harbor Entrance	45	8/19/92	0.000	0.000	0.000	0.000	1.200	1.400		2.800	1.000	2.700	0.000	4.500	3.000	1.100	2.100	0.000	0.000	0.000	0.000	
		Average	0.000	0.167	0.200	0.667	1.633	1.733	1.300	3.400	1.200	3.500	0.633	4.900	3.500	0.967	1.900	0.667	0.000	0.000	0.000	
		Standard Error	0.000	0.167	0.200	0.338	0.233	0.203		0.458	0.306	0.493	0.328	0.503	0.404	0.133	0.153	0.338	0.000	0.000	0.000	
Terminal Island Stop	46	8/18/92	0.000	0.700	0.900	1.500	2.500	2.800	1.800	4.300	1.000	4.500	1.100	5.800	4.400	1.100	2.000	1.100	0.000	0.000	0.900	
Terminal Island Stop	47	8/18/92	0.000	0.600	0.000	0.700	1.600	0.900	1.100	2.400	0.500	2.500	0.600	3.300	2.200	0.600	1.000	0.000	0.000	0.000	0.000	
Terminal Island Stop	48	8/18/92	0.000	0.700	0.900	1.500	2.700	2.600	1.900	4.900	1.200	5.000	1.300	6.800	4.600	1.000	2.300	1.200	0.000	0.000	0.000	
		Average	0.000	0.667	0.600	1.233	2.267	2.100	1.600	3.867	0.900	4.000	1.000	5.300	3.733	0.900	1.767	0.767	0.000	0.000	0.300	
		Standard Error	0.000	0.033	0.300	0.267	0.338	0.603	0.252	0.754	0.208	0.764	0.208	1.041	0.769	0.153	0.393	0.384	0.000	0.000	0.300	
Pola 19 (San Pedro Bay)	103	8/19/92	0.000	0.000	0.000	0.000	0.000	1.000		1.000	0.000	1.100	0.000	1.400	1.100	0.000	0.000	0.000	0.000	0.000	0.000	
Pola 19 (San Pedro Bay)	104	8/19/92	0.000	0.000	0.000	0.000	0.700	0.800	0.000	0.900	0.000	1.200	0.000	1.600	1.100	0.000	0.600	0.000	0.000	0.000	0.000	
Pola 19 (San Pedro Bay)	81	7/30/92	0.000	0.000	0.000	0.000	0.000	1.100		1.300	0.000	1.400	0.000	1.900	1.200	0.000	0.000	0.000	0.000	0.000	0.000	
Pola 19 (San Pedro Bay)	105	8/19/92	0.000	0.000	0.800	0.900	1.200	2.400	0.000	2.000	1.000	2.600	0.700	3.300	2.500	0.600	1.300	0.900	0.000	0.000	0.000	
		Average	0.000	0.000	0.200	0.225	0.475	1.325	0.000	1.300	0.250	1.575	0.175	2.050	1.475	0.150	0.475	0.225	0.000	0.000	0.000	
		Standard Error	0.000	0.000	0.200	0.225	0.293	0.364	0.000	0.248	0.250	0.347	0.175	0.429	0.342	0.150	0.309	0.225	0.000	0.000	0.000	
Huntington Harbor- Middle	95	9/15/92	0.000	0.000	1.000	0.000	0.000	1.500		3.200	0.000	3.000	1.000	7.300	5.800	1.800	4.000	2.100	0.000	0.000	0.000	
Huntington Harbor- Middle	96	9/15/92	0.000	0.000	0.000	0.000	0.000	1.400		2.800	1.200	2.700	1.000	5.800	4.900	1.500	3.200	1.900	0.000	0.000	0.000	
Huntington Harbor- Middle	1177	3/30/94	0.000	0.000	0.000	0.543	0.822	1.070		2.160	0.982	2.330	0.785	6.190	4.050	1.410	3.050	1.720	0.000	0.000	0.000	41.900
Huntington Harbor- Middle	1178	3/30/94	0.000	0.000	0.000	0.525	0.913	1.190		2.510	1.300	2.080	0.590	4.970	4.480	1.040	2.330	1.440	0.000	0.000	0.000	54.100
Huntington Harbor- Middle	1179	3/30/94	0.000	0.000	0.000	0.590	2.700	1.460		2.780	1.280	2.330	0.670	5.210	4.570	1.140	2.440	1.420	0.000	0.000	0.000	49.000
		Average	0.000	0.000	0.200	0.332	0.887	1.324		2.690	0.952	2.488	0.809	5.894	4.760	1.378	3.004	1.716	0.000	0.000	0.000	48.333
		Standard Error	0.000	0.000	0.200	0.136	0.493	0.083		0.172	0.245	0.162	0.084	0.412	0.293	0.135	0.300	0.131	0.000	0.000	0.000	3.538

12003

Appendix 6. Amphipod (Rhepoxynius abronius) Toxicity Test, Sediment Grain Size, Total Organic Carbon, and Sediment Tributylin Data from Nine Sites in the Los Angeles Harbor Area.

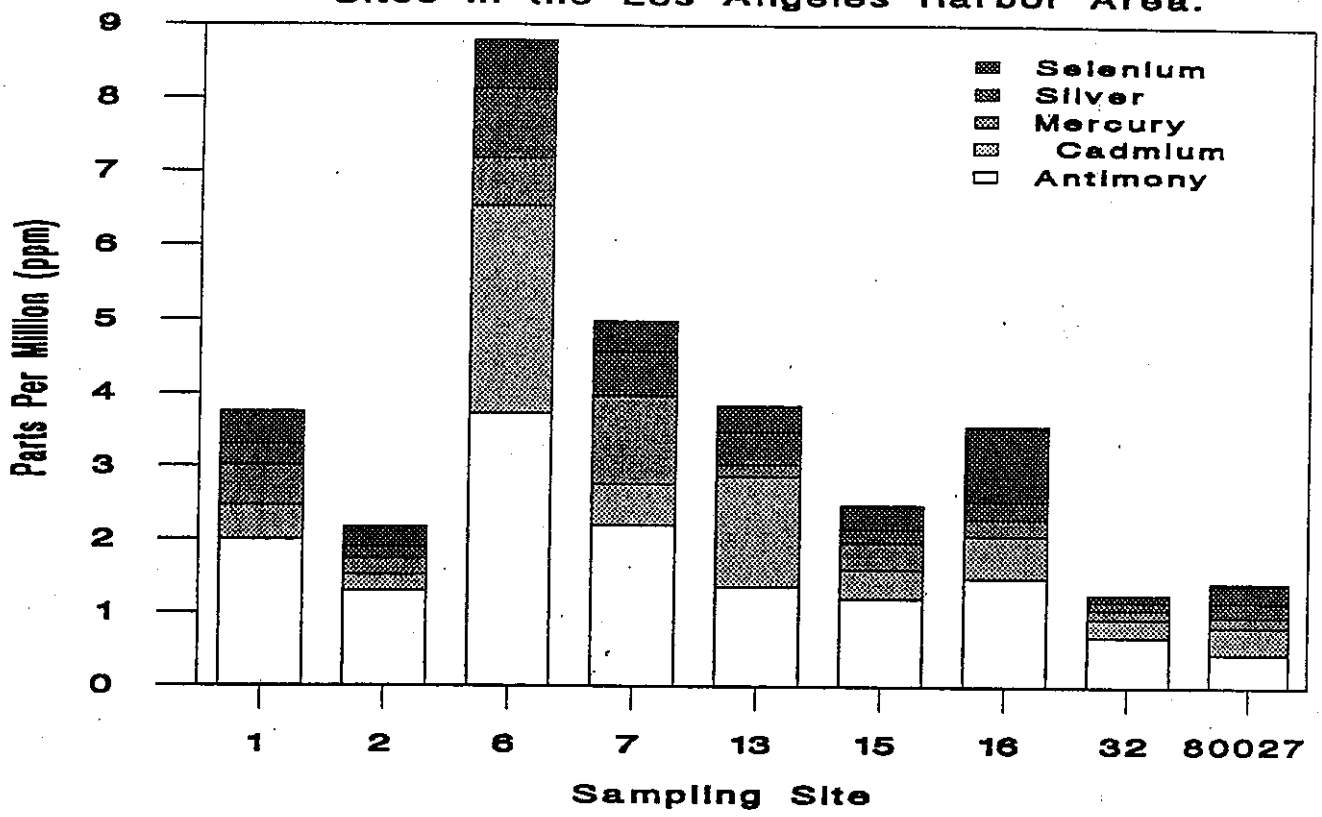
Site #	Site Name	ID ORG #	Collection Date	*Rhepoxynius abronius* Mean % Survival (Sediment)	Standard Deviation of lab replicates	Statistical Significance	Sediment Grain Size (% fines)	Total Organic Carbon (TOC)	Sediment Tributyltin (TBT) ppb
40001	Southwest Slip	1	7/29/92	65	28.90	*	70.06	1.6	0.12
40001	Southwest Slip	2	7/29/92	51	17.80	*	71.65	1.4	0.27
40001	Southwest Slip	1062	2/1/94	69	12.45	ND	62.63	1.28	0.2
40001	Southwest Slip	1063	2/1/94	72	7.58	ND	63.54	1.28	0.273
40001	Southwest Slip	1064	2/1/94	58	15.25	ND	46.4	0.81	0.15
40001	Southwest Slip	3	7/29/92	71	13.40	**	80.54	2	0.19
			Average	64			65.803	1.395	0.201
40002	West Basin - Pier 143	5	7/30/92	78.00	13.00	ns	75.47	0.9	0.13
40006	Consolidated Slip	16	7/31/92	58	17.20	**	90.9	4.6	0.38
40006	Consolidated Slip	1050	2/1/94	62	21.68	ND	93.6	4.28	0.619
40006	Consolidated Slip	1051	2/1/94	65	9.35	ND	94.03	4.27	0.496
40006	Consolidated Slip	1052	2/1/94	80	11.18	ND	94.58	4.54	0.455
40006	Consolidated Slip	17	7/31/92	59	16.40	**	92.92	4.3	5.1
			Average	64.8			93.206	4.398	1.41
40007	Long Beach Harbor - Ch. 2	20	9/1/92	88.00	11.50	ns	79.82	1.6	0.22
40013	Inner Queensway Bay	37	9/2/92	83	13.00	ns	94.6	2	0.031
40013	Inner Queensway Bay	1056	2/1/94	83	8.37	ND	20.47	0.29	0.04
40013	Inner Queensway Bay	1057	2/1/94	76	9.62	ND	21.49	1.05	0.0261
40013	Inner Queensway Bay	1058	2/1/94	71	11.40	ND	38.33	1.95	0.0461
40013	Inner Queensway Bay	38	9/2/92	84	6.50	ns	90	1.5	0.02
			Average	79.4			52.978	1.358	0.033
40015	Fish Harbor Entrance	43	8/19/92	83	5.00	*	63.11	0.9	0.027
40015	Fish Harbor Entrance	44	8/19/92	83	7.60	*	37	0.61	0.02
40015	Fish Harbor Entrance	45	8/19/92	92	7.60	ns	29.37	0.8	0.029
			Average	86			43.16	0.77	0.025
40016	Terminal Island Stop	46	8/18/92	72	5.70	**	75	0.69	0.02
40016	Terminal Island Stop	47	8/18/92	88	8.40	ns	68	0.49	0
40016	Terminal Island Stop	48	8/18/92	80	12.70	*	91	0.55	0
			Average	80			78	0.577	0.007
40032	Pola 19 (San Pedro Bay)	103	8/19/92	94	5.50	ns	26	0.4	0.015
40032	Pola 19 (San Pedro Bay)	104	8/19/92	94	5.50	ns	40	0.29	0.05
40032	Pola 19 (San Pedro Bay)	81	7/30/92	93	2.70	ns	18.06	0.5	0.028
40032	Pola 19 (San Pedro Bay)	105	8/19/92	86	15.20	ns	40	0.28	0.02
			Average	91.75			31.015	0.368	0.028
80027	Huntington Harbor - Middle	95	9/15/92	67	13.00	*	88.96	0.8	0.063
80027	Huntington Harbor - Middle	96	9/15/92	44	23.80	*	80.77	1.4	0.028
80027	Huntington Harbor - Middle	1177	3/30/94	93	5.70	ND	89.02	1.46	0.0722
80027	Huntington Harbor - Middle	1178	3/30/94	78	35.46	ND	78.49	1.34	0.0904
80027	Huntington Harbor - Middle	1179	3/30/94	89	9.62	ND	82.05	1.46	0.122
			Average	74.2			83.858	1.292	0.075

Statistical Significance: Test Sample Relative to Lab Controls

* significant at 0.05 level
** significant at 0.10 level

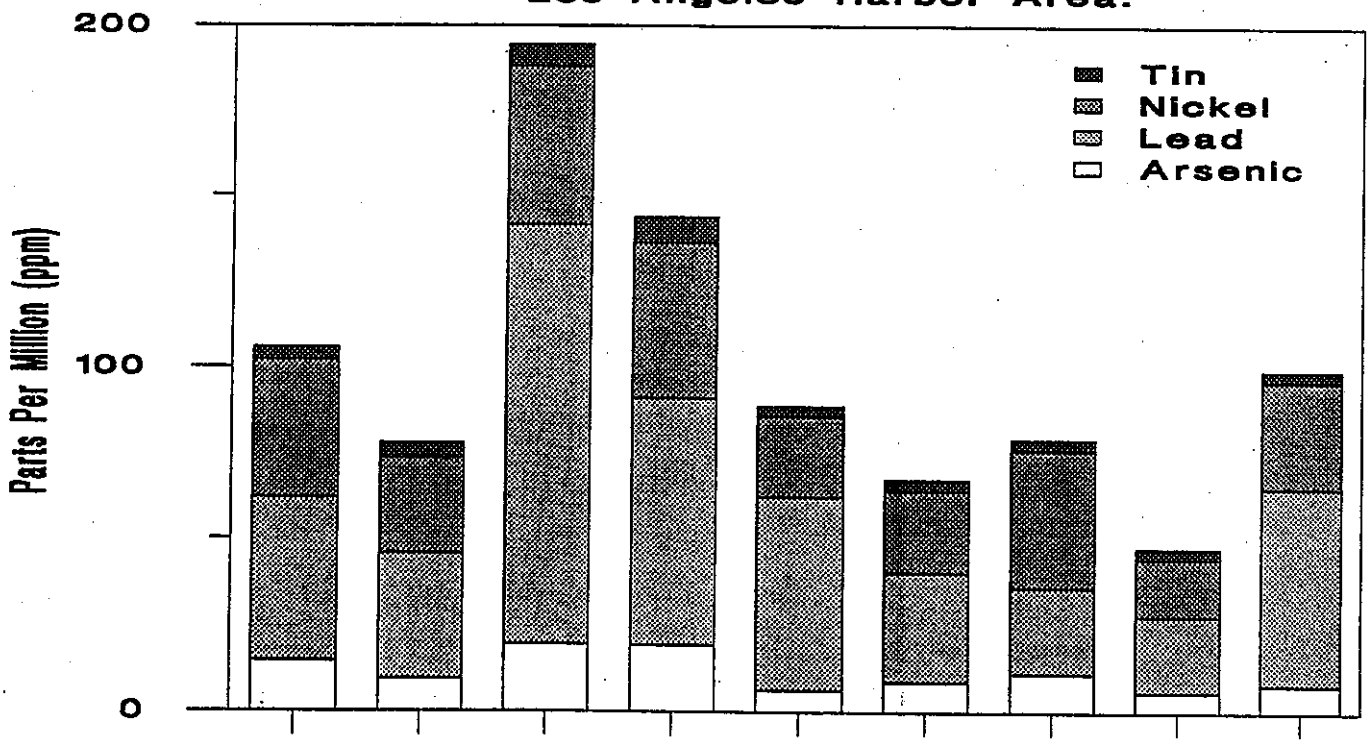
ns = not significant
ND = not done

Appendix 7a. Heavy Metals (Antimony, Cadmium, Mercury, Silver, Selinium) in Sediment from Nine Sites in the Los Angeles Harbor Area.



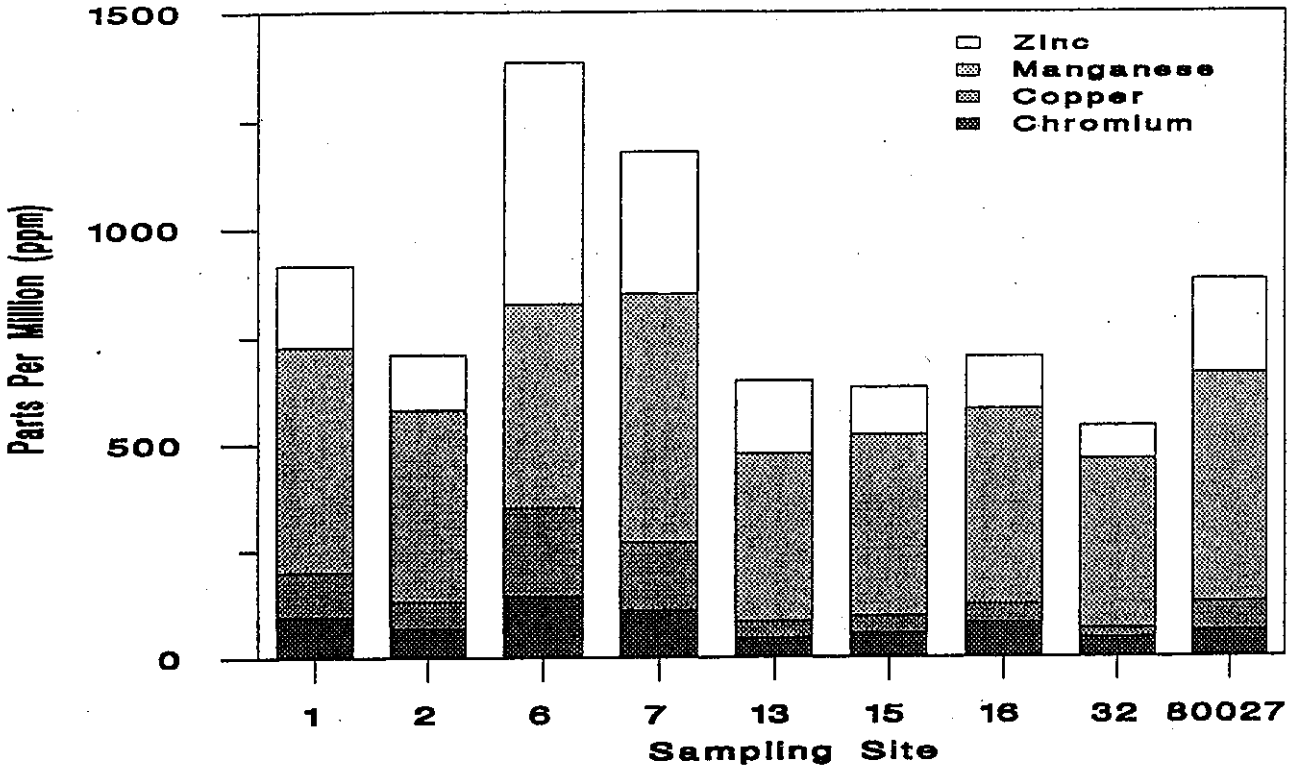
(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 7b. Heavy Metals (Arsenic, Lead, Nickel, Tin) in Sediment from Nine Sites in the Los Angeles Harbor Area.



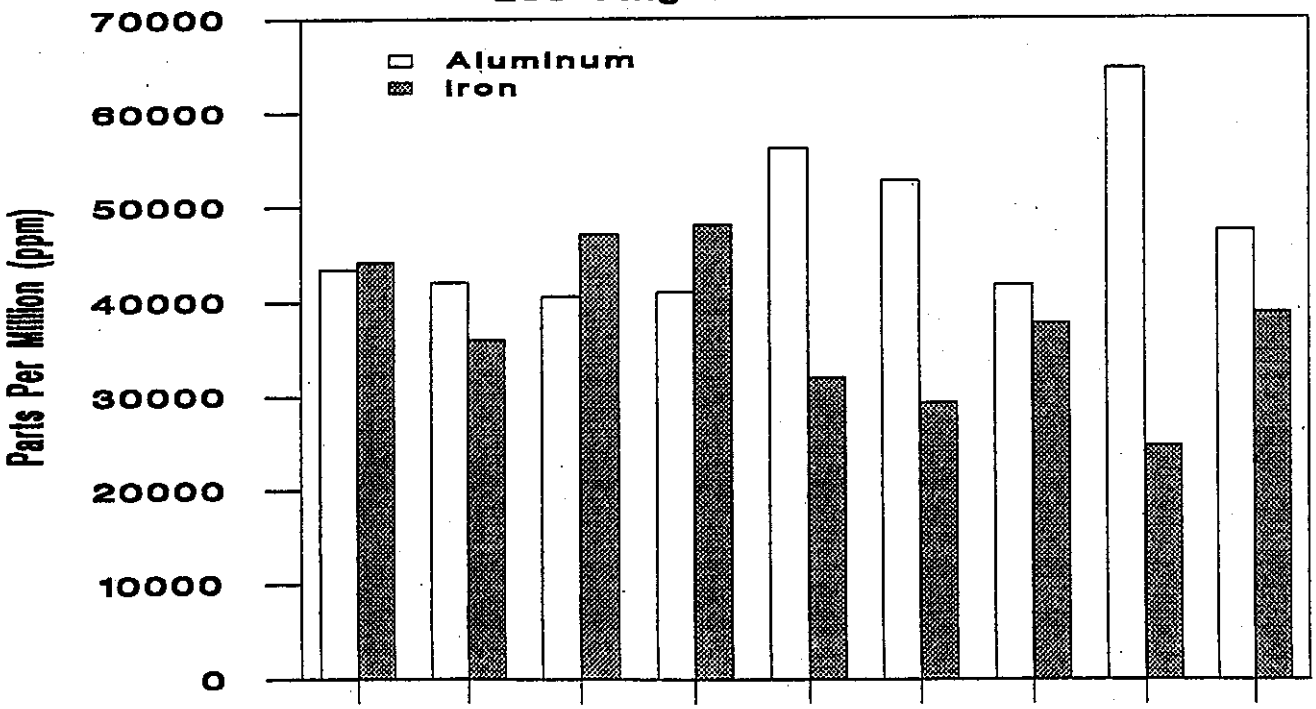
12005

Appendix 7c. Heavy Metals (Chromium, Copper, Manganese, Zinc) in Sediment from Nine Sites in the Los Angeles Harbor Area.

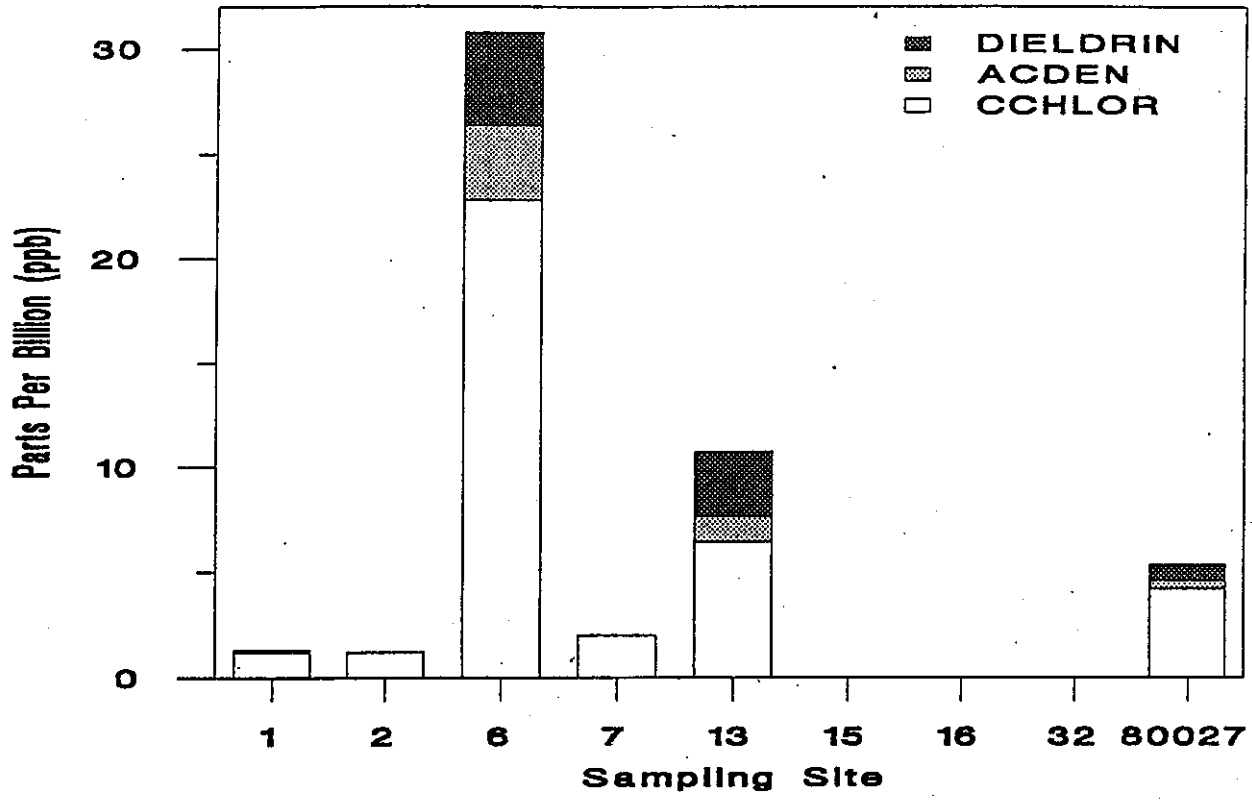


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 7d. Heavy Metals (Aluminum and Iron) in Sediment from Nine Sites in the Los Angeles Harbor Area.

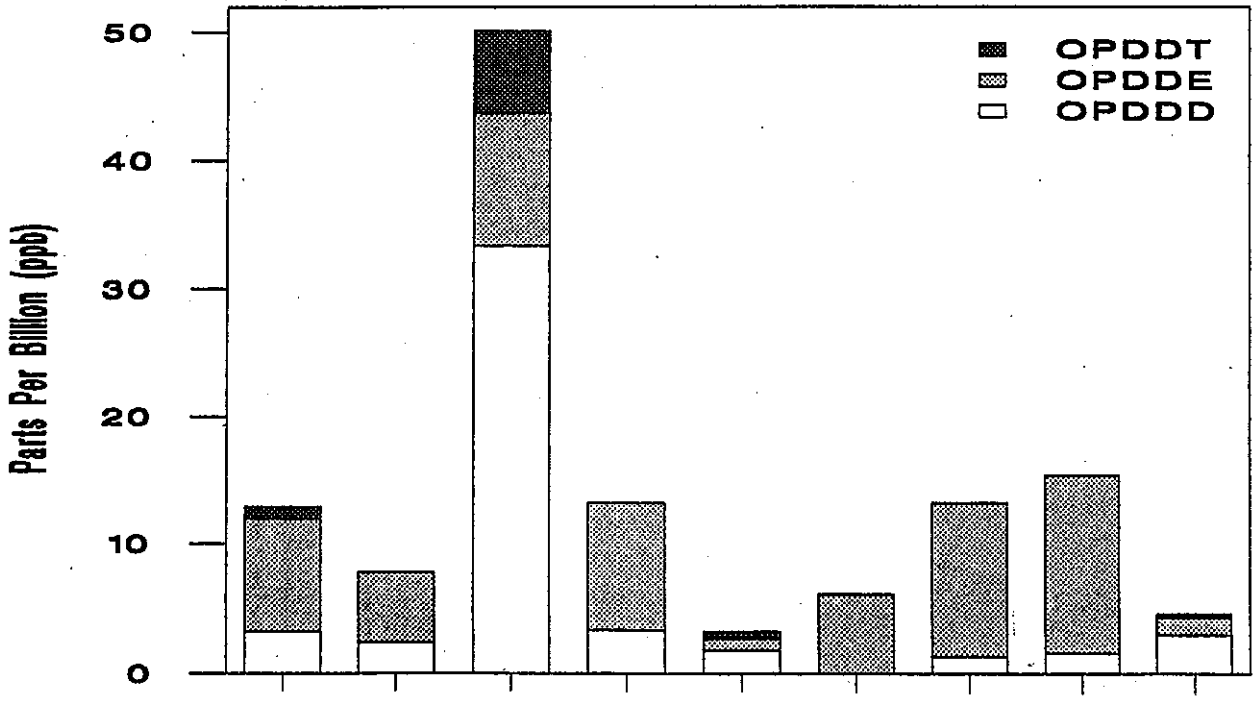


Appendix 8a. Pesticide (CCHLOR, ACDEN, DIELDRIN) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.



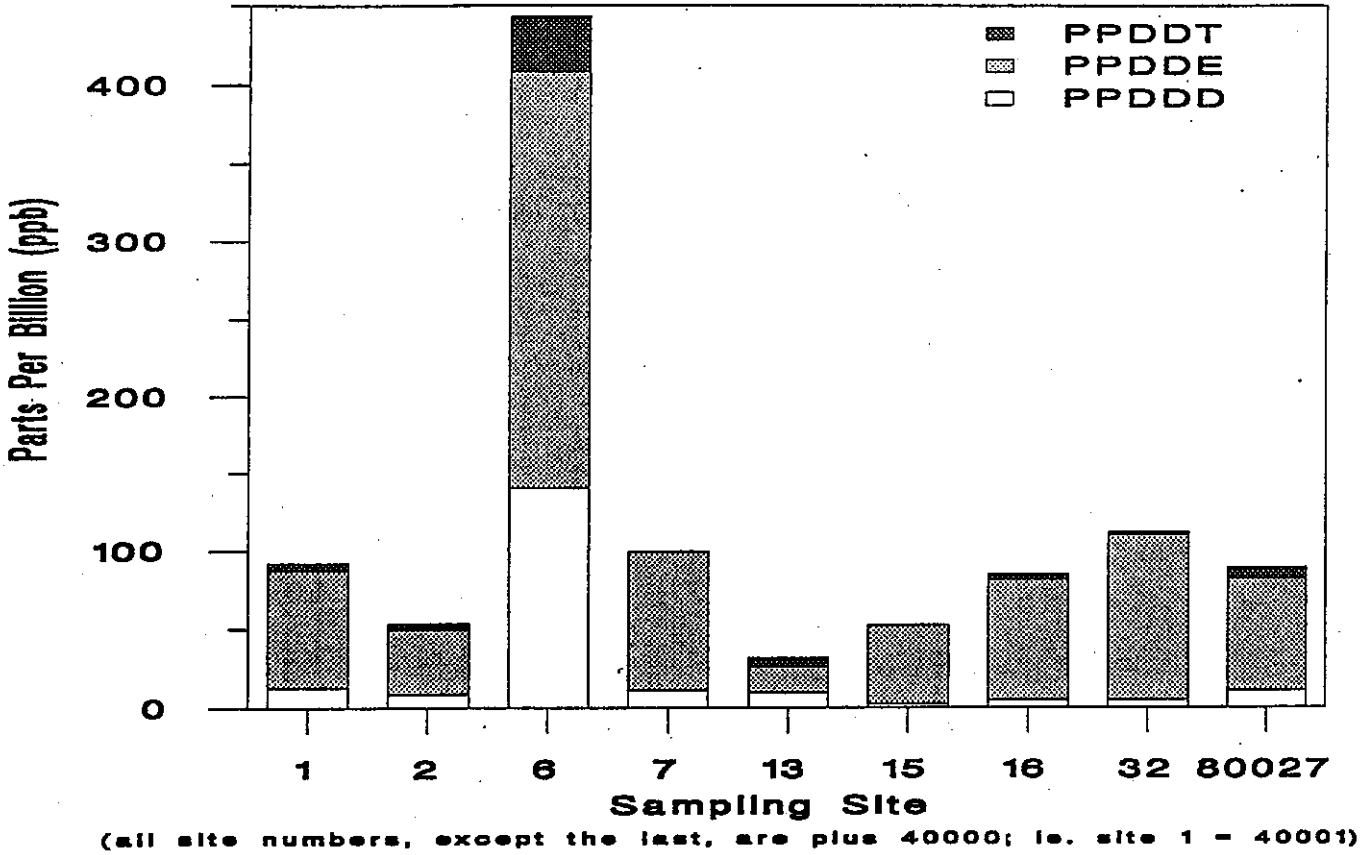
(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 8b. Pesticide (OPDDD, OPDDE, OPDDT) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.



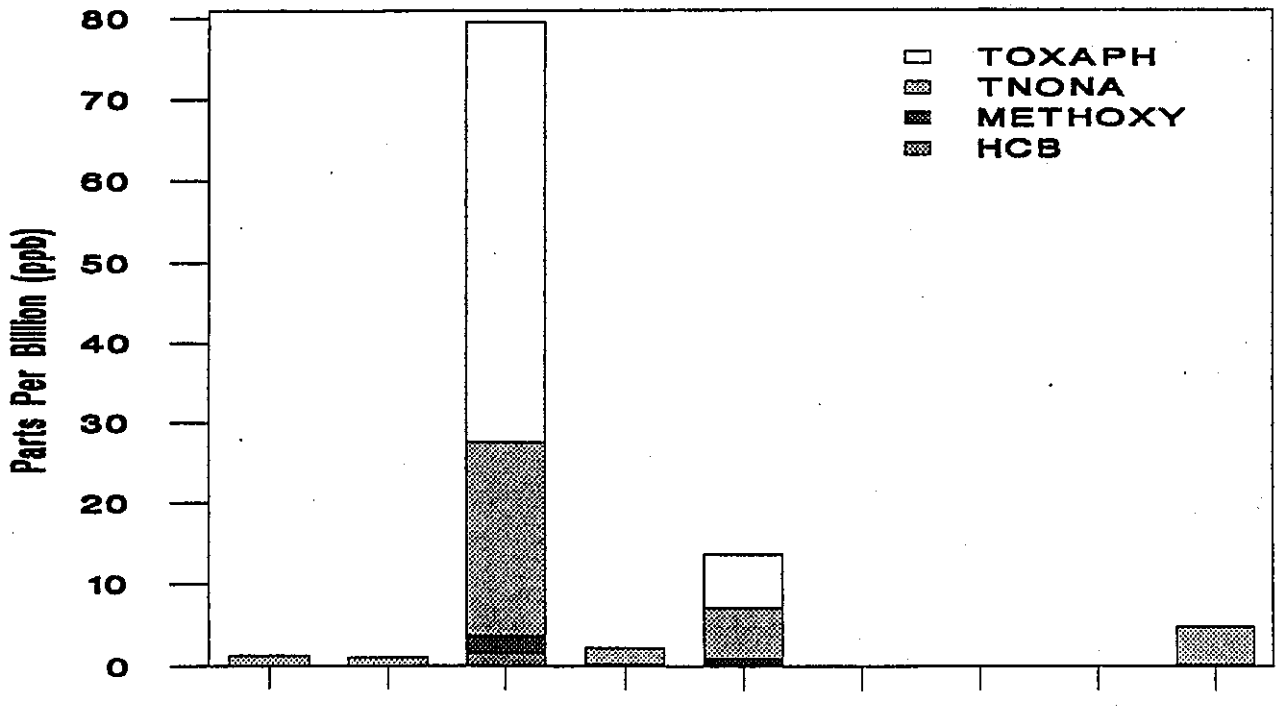
12007

Appendix 8c. Pesticide (PPDDD, PPDDE, PPDDT) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.



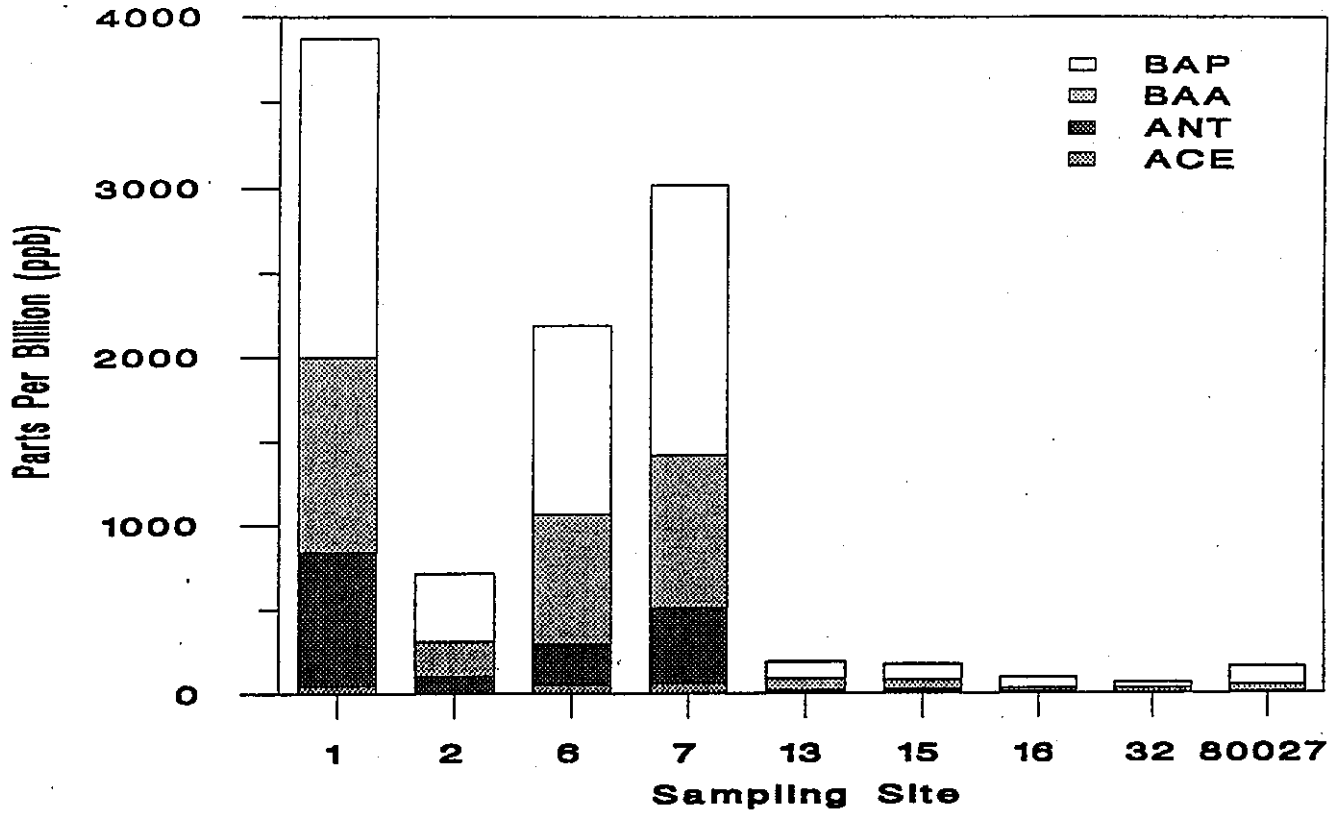
(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 8d. Pesticide (HCB, METHOXY, TNONA, TOXAPH) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.



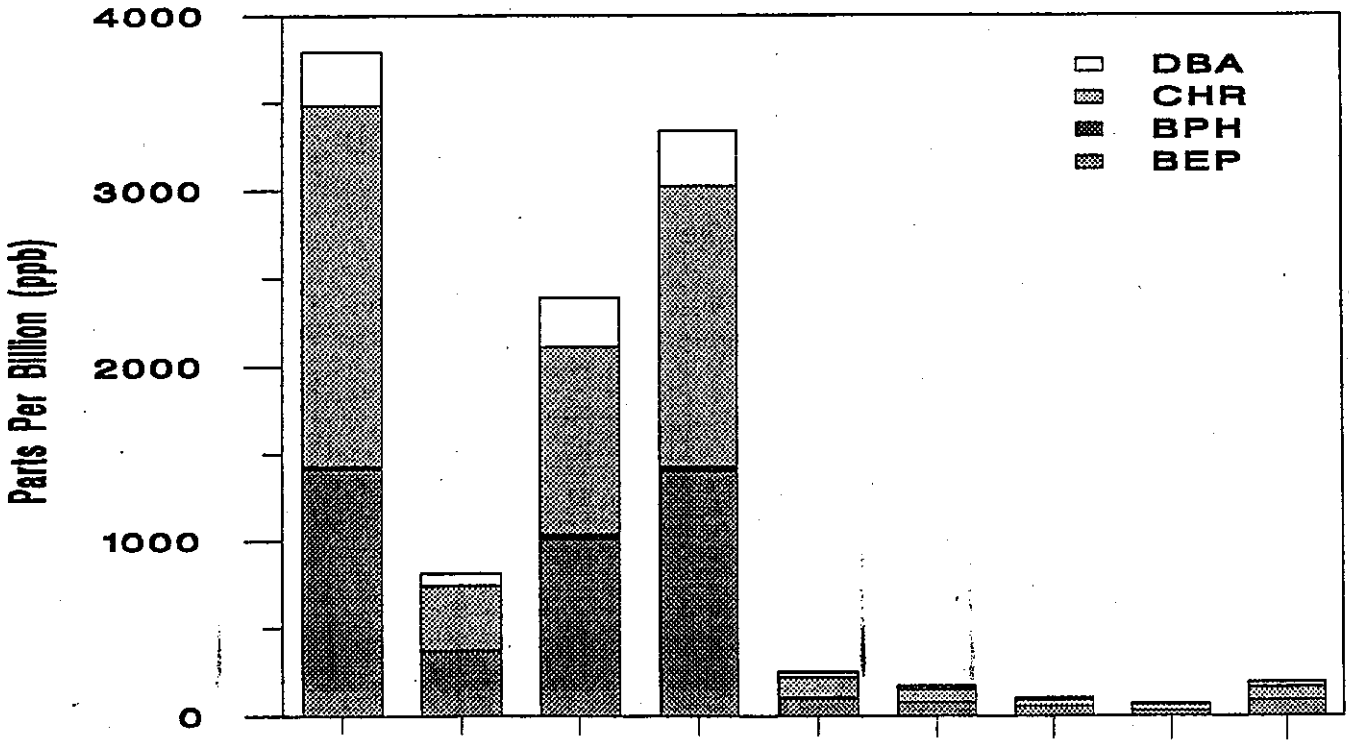
12008

Appendix 9a. Polyaromatic Hydrocarbon (BAP, BAA, ANT, ACE) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.

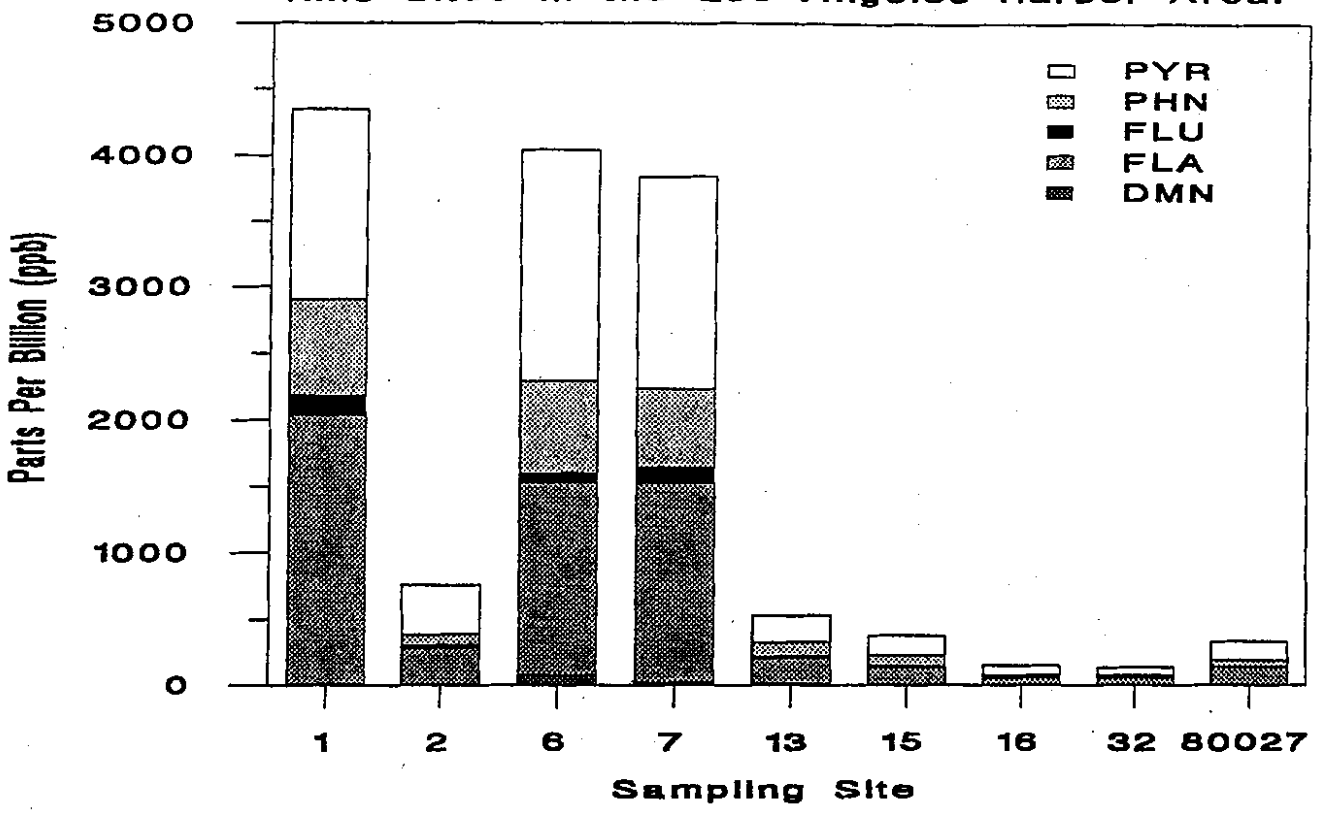


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 9b. Polyaromatic Hydrocarbon (DBA, CHR, BPH, BPE) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.

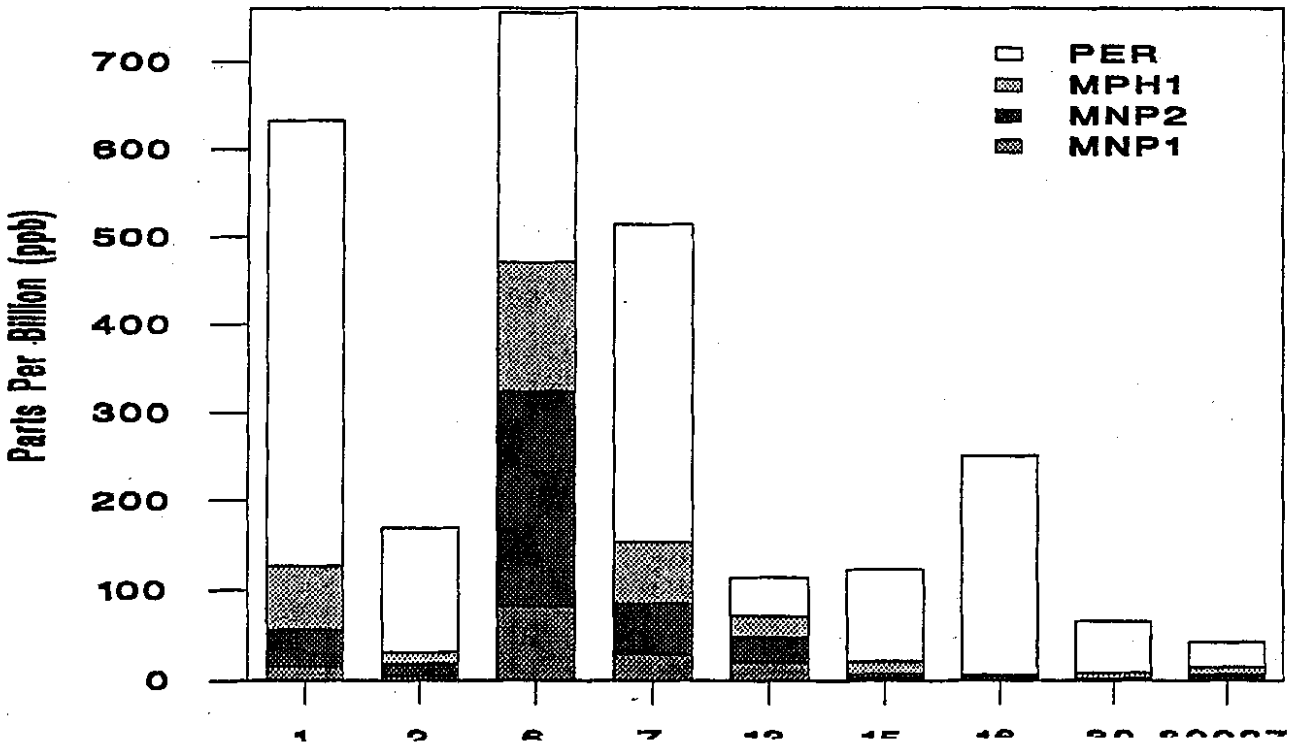


Appendix 9c. Polyaromatic Hydrocarbon (DMN, FLA, FLU, PHN, PYR) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.

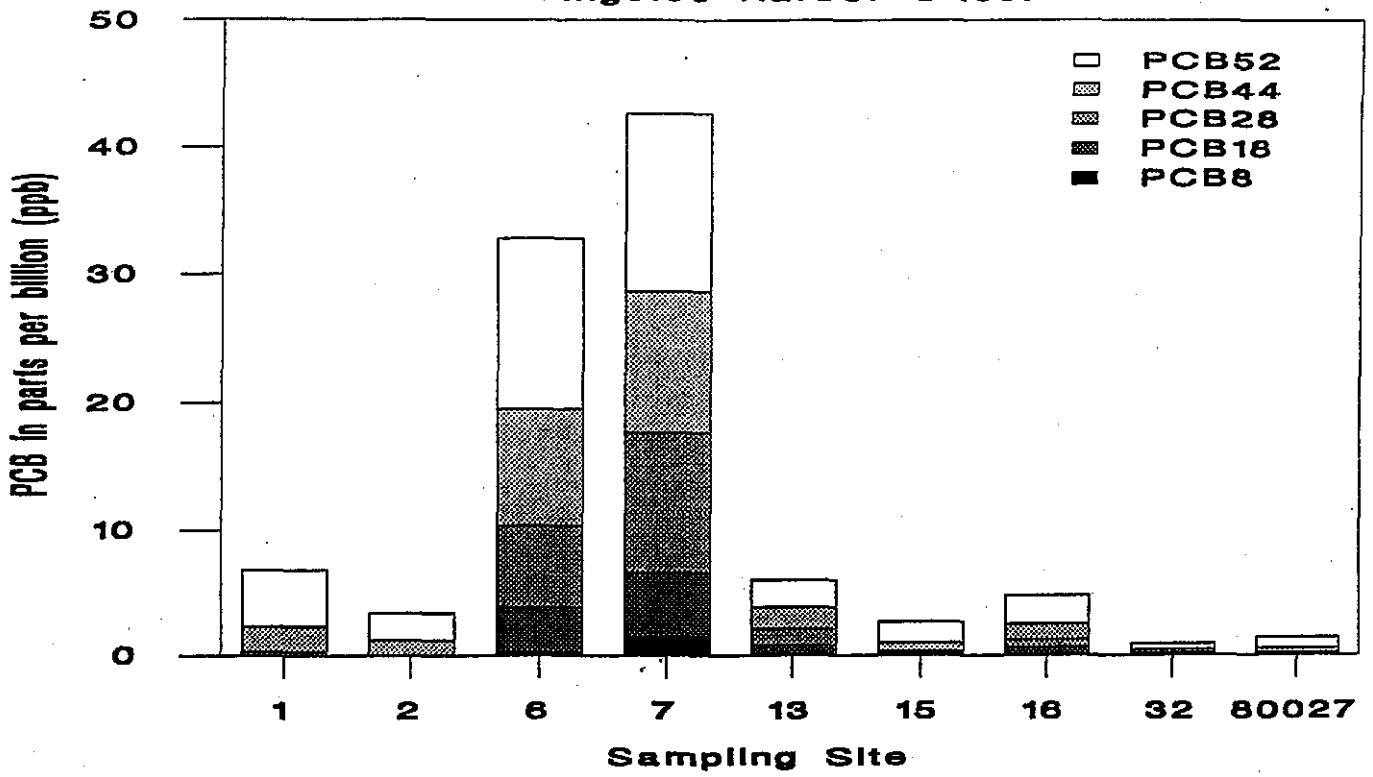


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 9d. Polyaromatic Hydrocarbon (MNP1, MNP2, MPH1, PER) Residues in Sediment from Nine Sites in the Los Angeles Harbor Area.

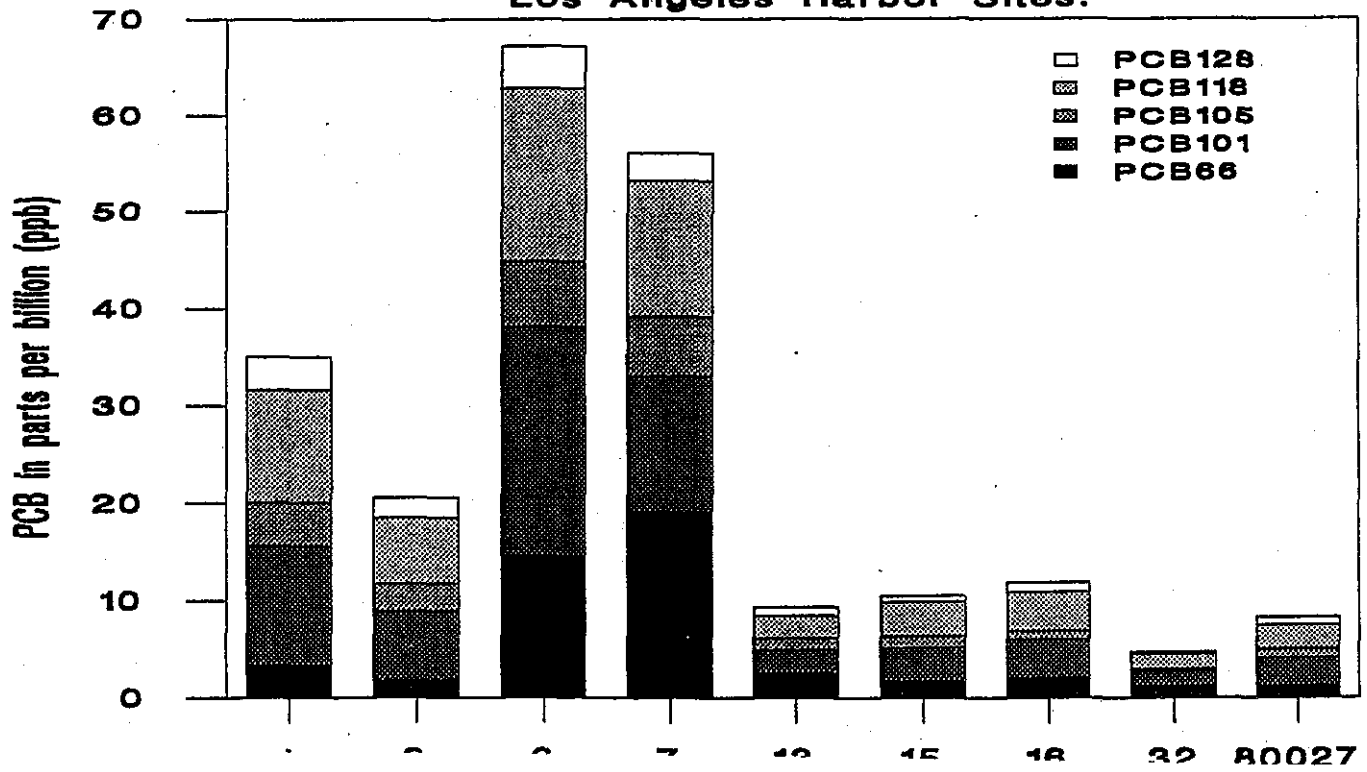


Appendix 10a. Polychlorinated Biphenyl (PCB 8, 18, 28, 44, 52) Levels in Sediment from Nine Los Angeles Harbor Sites.

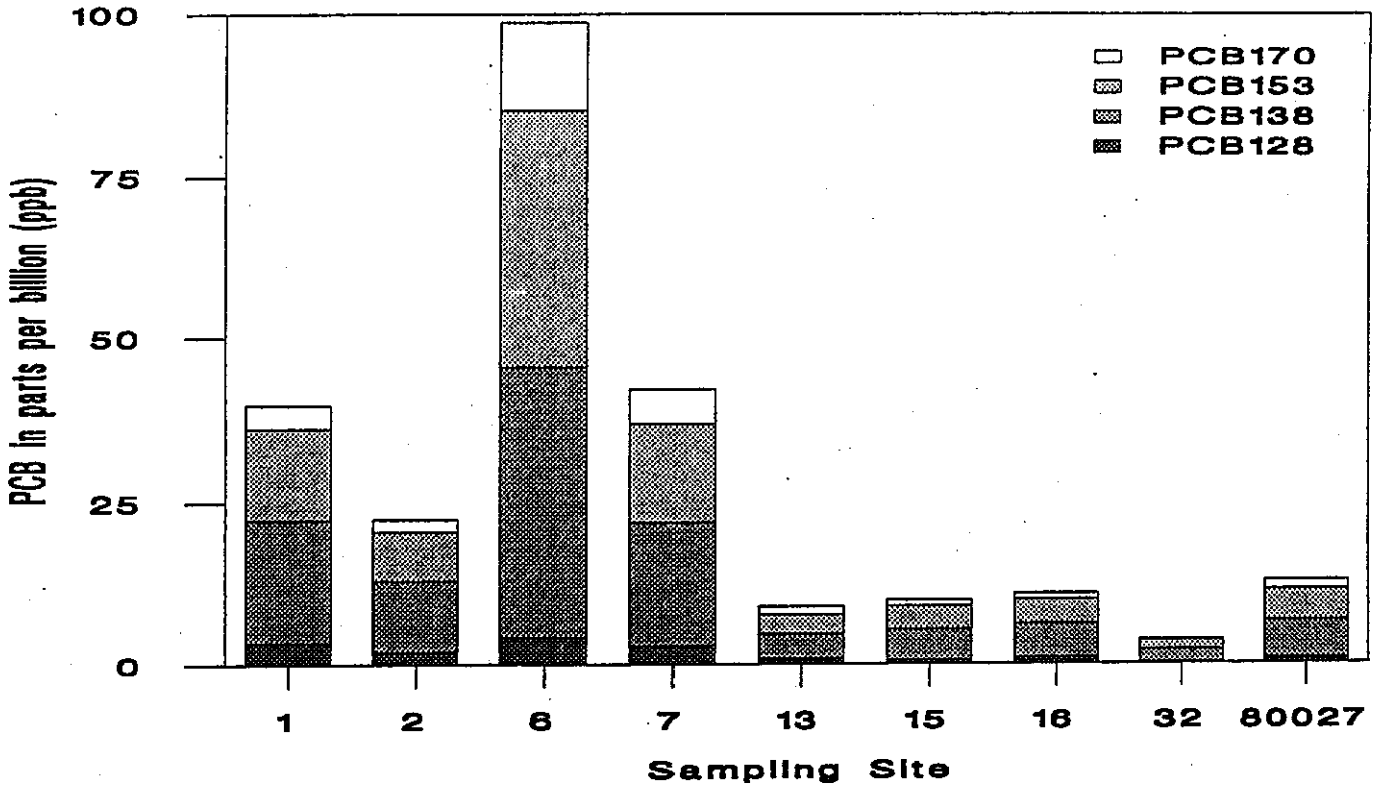


(all site numbers, except the last, are plus 40000; ie. site 1 = 40001)

Appendix 10b. Polychlorinated Biphenyl (PCB 66, 101, 105, 118, 128) Levels in Sediment from Nine Los Angeles Harbor Sites.

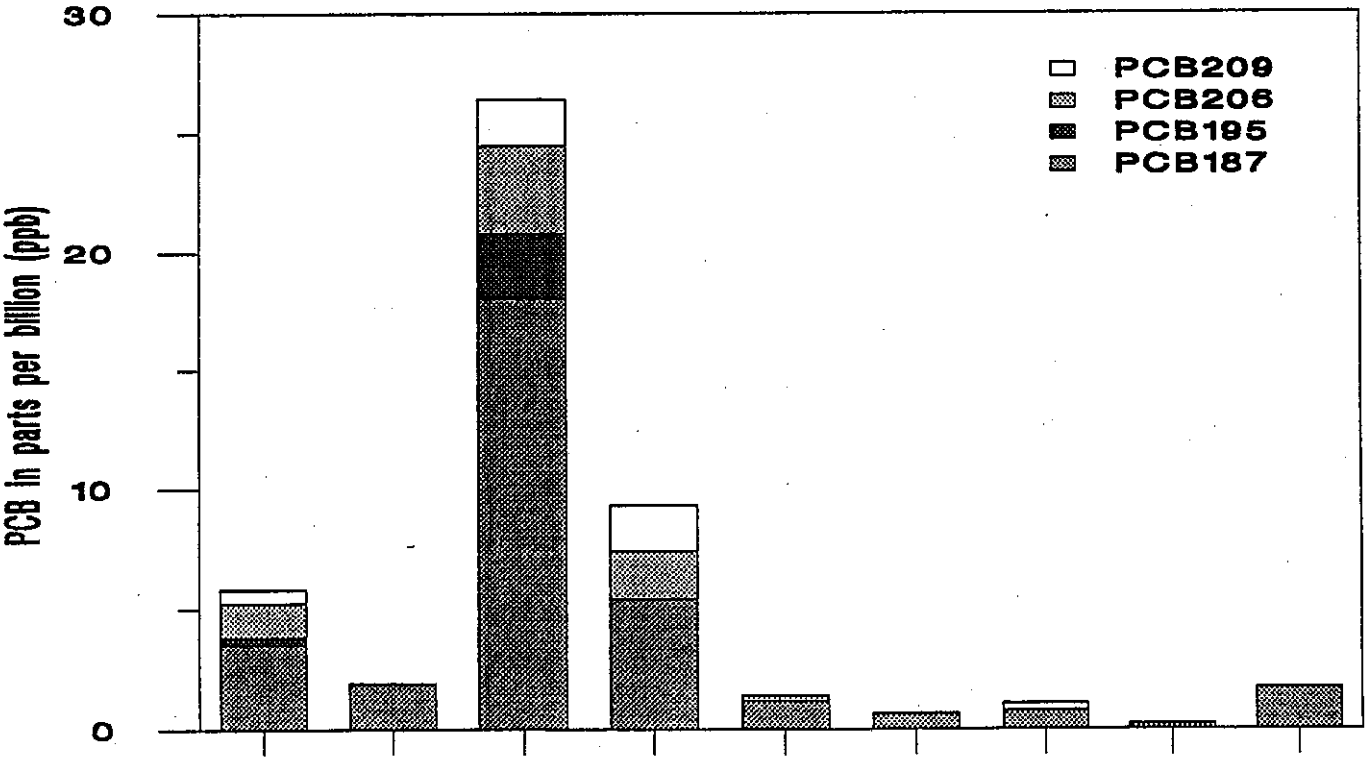


Appendix 10c. Polychlorinated Biphenyl (PCB 138, 153, 170, 180) Levels in Sediment from Nine Los Angeles Harbor Sites.



(all site numbers, except the last, are plus 40000; site 1 = 40001)

Appendix 10d. Polychlorinated Biphenyl (PCB 187, 195, 206, 209) Levels in Sediment from Nine Los Angeles Harbor Sites.



Appendix 11a. Goby Biomarker Study. Random Numbers.

UCD #	UCD Random #	ID ORG. #	SITE #	SITE NAME
1	93H 63 - 64	50136	40015	ENTRANCE TO FISH HARBOR
2	93H 63 - 23	50137	40015	ENTRANCE TO FISH HARBOR
3	93H 63 - 108	50138	40015	ENTRANCE TO FISH HARBOR
4	93H 63 - 80	50139	40015	ENTRANCE TO FISH HARBOR
5	93H 63 - 3	50140	40015	ENTRANCE TO FISH HARBOR
6	93H 63 - 26	50141	40015	ENTRANCE TO FISH HARBOR
7	93H 63 - 44	50142	40015	ENTRANCE TO FISH HARBOR
8	93H 63 - 88	50143	40015	ENTRANCE TO FISH HARBOR
9	93H 63 - 29	50144	40015	ENTRANCE TO FISH HARBOR
10	93H 63 - 6	50145	40015	ENTRANCE TO FISH HARBOR
11	93H 63 - 76	50146	40015	ENTRANCE TO FISH HARBOR
12	93H 63 - 89	50147	40015	ENTRANCE TO FISH HARBOR
13	93H 63 - 15	50031	40006	CONSOLIDATED SLIP
14	93H 63 - 30	50016	40001	SOUTHWEST SLIP
15	93H 63 - 110	50017	40001	SOUTHWEST SLIP
16	93H 63 - 62	50018	40001	SOUTHWEST SLIP
17	93H 63 - 119	50019	40001	SOUTHWEST SLIP
18	93H 63 - 12	50020	40001	SOUTHWEST SLIP
19	93H 63 - 125	50148	40015	ENTRANCE TO FISH HARBOR
20	93H 63 - 96	50149	40015	ENTRANCE TO FISH HARBOR
21	93H 63 - 7	50150	40015	ENTRANCE TO FISH HARBOR
22	93H 63 - 21	50181	40032	POLA 19
23	93H 63 - 123	50182	40032	POLA 19
24	93H 63 - 114	50183	40032	POLA 19
25	93H 63 - 34	50184	40032	POLA 19
26	93H 63 - 27	50185	40032	POLA 19
27	93H 63 - 84	50186	40032	POLA 19
28	93H 63 - 106	50187	40032	POLA 19
29	93H 63 - 50	50121	40016	TERM ISLAND STOP
30	93H 63 - 38	50122	40016	TERM ISLAND STOP
31	93H 63 - 39	50123	40016	TERM ISLAND STOP
32	93H 63 - 32	50124	40016	TERM ISLAND STOP
33	93H 63 - 122	50125	40016	TERM ISLAND STOP
34	93H 63 - 19	50126	40016	TERM ISLAND STOP
35	93H 63 - 90	50127	40016	TERM ISLAND STOP
36	93H 63 - 55	50128	40016	TERM ISLAND STOP
37	93H 63 - 45	50129	40016	TERM ISLAND STOP
38	93H 63 - 100	50130	40016	TERM ISLAND STOP
39	93H 63 - 37	50131	40016	TERM ISLAND STOP
40	93H 63 - 52	50132	40016	TERM ISLAND STOP
41	93H 63 - 4	50133	40016	TERM ISLAND STOP
42	93H 63 - 87	50134	40016	TERM ISLAND STOP
43	93H 63 - 10	50135	40016	TERM ISLAND STOP
44	93H 63 - 16	50001	40016	TERM ISLAND STOP
45	93H 63 - 77	50002	40016	TERM ISLAND STOP
46	93H 63 - 63	50003	40016	TERM ISLAND STOP
47	93H 63 - 103	50004	40016	TERM ISLAND STOP
48	93H 63 - 1	50005	40016	TERM ISLAND STOP
49	93H 63 - 13	50006	40016	TERM ISLAND STOP
50	93H 63 - 11	50007	40016	TERM ISLAND STOP
51	93H 63 - 59	50061	40007	LONG BEACH HARBOR, CHANNEL 2
52	93H 63 - 9	50062	40007	LONG BEACH HARBOR, CHANNEL 2
53	93H 63 - 75	50063	40007	LONG BEACH HARBOR, CHANNEL 2
54	93H 63 - 79	50064	40007	LONG BEACH HARBOR, CHANNEL 2
55	93H 63 - 92	50188	40032	POLA 19
56	93H 63 - 73	50189	40032	POLA 19
57	93H 63 - 54	50190	40032	POLA 19
58	93H 63 - 31	50065	40007	LONG BEACH HARBOR, CHANNEL 2
59	93H 63 - 70	50066	40007	LONG BEACH HARBOR, CHANNEL 2

Appendix 11b. Goby Biomarker Study. Random Numbers.

UCD #	HINTON ID #	ID ORG. #	SITE #	SITE NAME
61	93H 63 - 24	50068	40007	LONG BEACH HARBOR, CHANNEL
62	93H 63 - 42	50069	40007	LONG BEACH HARBOR, CHANNEL
63	93H 63 - 85	50070	40007	LONG BEACH HARBOR, CHANNEL
64	93H 63 - 104	50071	40007	LONG BEACH HARBOR, CHANNEL
65	93H 63 - 49	50072	40007	LONG BEACH HARBOR, CHANNEL
66	93H 63 - 47	50073	40007	LONG BEACH HARBOR, CHANNEL
67	93H 63 - 20	50074	40007	LONG BEACH HARBOR, CHANNEL
68	93H 63 - 36	50075	40007	LONG BEACH HARBOR, CHANNEL
69	93H 63 - 102	50091	40013	INNER QUEENSWAY BAY
70	93H 63 - 48	50092	40013	INNER QUEENSWAY BAY
71	93H 63 - 86	50093	40013	INNER QUEENSWAY BAY
72	93H 63 - 95	50094	40013	INNER QUEENSWAY BAY
73	93H 63 - 68	50095	40013	INNER QUEENSWAY BAY
74	93H 63 - 69	50096	40013	INNER QUEENSWAY BAY
75	93H 63 - 126	50097	40013	INNER QUEENSWAY BAY
76	93H 63 - 8	50098	40013	INNER QUEENSWAY BAY
77	93H 63 - 107	50099	40013	INNER QUEENSWAY BAY
78	93H 63 - 81	50100	40013	INNER QUEENSWAY BAY
79	93H 63 - 78	50101	40013	INNER QUEENSWAY BAY
80	93H 63 - 97	50102	40013	INNER QUEENSWAY BAY
81	93H 63 - 18	50103	40013	INNER QUEENSWAY BAY
82	93H 63 - 101	50104	40013	INNER QUEENSWAY BAY
83	93H 63 - 121	50105	40013	INNER QUEENSWAY BAY
84	93H 63 - 43	50076	40002	WEST BASIN PIER 143
85	93H 63 - 83	50077	40002	WEST BASIN PIER 143
86	93H 63 - 91	50078	40002	WEST BASIN PIER 143
87	93H 63 - 118	50079	40002	WEST BASIN PIER 143
88	93H 63 - 53	50080	40002	WEST BASIN PIER 143
89	93H 63 - 120	50081	40002	WEST BASIN PIER 143
90	93H 63 - 109	50082	40002	WEST BASIN PIER 143
91	93H 63 - 124	50083	40002	WEST BASIN PIER 143
92	93H 63 - 117	50084	40002	WEST BASIN PIER 143
93	93H 63 - 65	50085	40002	WEST BASIN PIER 143
94	93H 63 - 67	50086	40002	WEST BASIN PIER 143
95	93H 63 - 60	50087	40002	WEST BASIN PIER 143
96	93H 63 - 22	50088	40002	WEST BASIN PIER 143
97	93H 63 - 94	50089	40002	WEST BASIN PIER 143
98	93H 63 - 2	50090	40002	WEST BASIN PIER 143
99	93H 63 - 28	50032	40006	CONSOLIDATED SLIP
100	93H 63 - 35	50033	40006	CONSOLIDATED SLIP
101	93H 63 - 93	50034	40006	CONSOLIDATED SLIP
102	93H 63 - 58	50035	40006	CONSOLIDATED SLIP
103	93H 63 - 51	50036	40006	CONSOLIDATED SLIP
104	93H 63 - 99	50037	40006	CONSOLIDATED SLIP
105	93H 63 - 17	50038	40006	CONSOLIDATED SLIP
106	93H 63 - 111	50039	40006	CONSOLIDATED SLIP
107	93H 63 - 127	50040	40006	CONSOLIDATED SLIP
108	93H 63 - 25	50041	40006	CONSOLIDATED SLIP
109	93H 63 - 98	50042	40006	CONSOLIDATED SLIP
110	93H 63 - 105	50043	40006	CONSOLIDATED SLIP
111	93H 63 - 61	50044	40006	CONSOLIDATED SLIP
112	93H 63 - 56	50045	40006	CONSOLIDATED SLIP
113	93H 63 - 66	50008	40006	CONSOLIDATED SLIP
114	93H 63 - 46	50009	40006	CONSOLIDATED SLIP
115	93H 63 - 74	50010	40006	CONSOLIDATED SLIP
116	93H 63 - 33	50046	80027	HUNTINGTON HARBOR, MID
117	93H 63 - 82	50047	80027	HUNTINGTON HARBOR, MID
118	93H 63 - 112	50048	80027	HUNTINGTON HARBOR, MID
119	93H 63 - 14	50049	80027	HUNTINGTON HARBOR, MID
120	93H 63 - 41	50050	80027	HUNTINGTON HARBOR, MID
121	93H 63 - 57	50051	80027	HUNTINGTON HARBOR, MID
122	93H 63 - 5	50052	80027	HUNTINGTON HARBOR, MID
123	93H 63 - 72	50053	80027	HUNTINGTON HARBOR, MID
124	93H 63 - 115	50054	80027	HUNTINGTON HARBOR, MID
125	93H 63 - 40	50055	80027	HUNTINGTON HARBOR, MID

Appendix 12a. Goby Biomarker Study. Fish and Site Identification, Sorted According to Site.

UCD #	ID ORG. #	REP #	SITE #	SITE NAME	SPECIES	CONDITION	DATE
13	50031	REP 01	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/5/93
99	50032	REP 02	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
100	50033	REP 03	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
101	50034	REP 04	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
102	50035	REP 05	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
103	50036	REP 06	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
104	50037	REP 07	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
105	50038	REP 08	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
106	50039	REP 09	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
107	50040	REP 10	40006	CONSOLIDATED SLIP	WHITE CROAKER	DEAD	10/8/93
108	50041	REP 11	40006	CONSOLIDATED SLIP	WHITE CROAKER	MORIBUND	10/8/93
109	50042	REP 12	40006	CONSOLIDATED SLIP	WHITE CROAKER	MORIBUND	10/8/93
110	50043	REP 13	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/8/93
111	50044	REP 14	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	MORIBUND	10/8/93
112	50045	REP 15	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/8/93
113	50008*	REP 16	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/8/93
114	50009*	REP 17	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/8/93
115	50010*	REP 18	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	LIVE	10/8/93
1	50136	REP 01	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
2	50137	REP 02	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
3	50138	REP 03	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
4	50139	REP 04	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
5	50140	REP 05	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
6	50141	REP 06	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
7	50142	REP 07	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
8	50143	REP 08	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
9	50144	REP 09	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
10	50145	REP 10	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
11	50146	REP 11	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	LIVE	10/5/93
12	50147	REP 12	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	DEAD	10/5/93
19	50148	REP 13	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	LIVE	10/6/93
20	50149	REP 14	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	LIVE	10/6/93
21	50150	REP 15	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	LIVE	10/6/93
116	50046	REP 01	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
117	50047	REP 02	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
118	50048	REP 03	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
119	50049	REP 04	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
120	50050	REP 05	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
121	50051	REP 06	80027	HUNTINGTON HARBOR, MID	YELLOWFIN GOBY	LIVE	10/8/93
122	50052	REP 07	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
123	50053	REP 08	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
124	50054	REP 09	80027	HUNTINGTON HARBOR, MID	STINGRAY	LIVE	10/8/93
125	50055	REP 10	80027	HUNTINGTON HARBOR, MID	STINGRAY	DEAD	10/8/93
126	50056	REP 11	80027	HUNTINGTON HARBOR, MID	STINGRAY	DEAD	10/8/93
127	50057	REP 12	80027	HUNTINGTON HARBOR, MID	YELLOWFIN GOBY	LIVE	10/8/93

Appendix 12b. Goby Biomarker Study. *Fish and Site Identification*, Sorted According to Site.

UCD #	ID ORG. #	REP #	SITE #	SITE NAME	SPECIES	CONDITION	DATE
69	50091	REP 01	40013	INNER QUEENSWAY BAY	WHITE CROAKER	MORIBUND	10/7/93
70	50092	REP 02	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
71	50093	REP 03	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
72	50094	REP 04	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
73	50095	REP 05	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
74	50096	REP 06	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
75	50097	REP 07	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
76	50098	REP 08	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
77	50099	REP 09	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
78	50100	REP 10	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
79	50101	REP 11	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
80	50102	REP 12	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
81	50103	REP 13	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
82	50104	REP 14	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
83	50105	REP 15	40013	INNER QUEENSWAY BAY	WHITE CROAKER	LIVE	10/7/93
51	50061	REP 01	40007	LONG BEACH HARBOR, CHANNEL 2	WHITE CROAKER	DEAD	10/7/93
52	50062	REP 02	40007	LONG BEACH HARBOR, CHANNEL 2	WHITE CROAKER	DEAD	10/7/93
53	50063	REP 03	40007	LONG BEACH HARBOR, CHANNEL 2	WHITE CROAKER	DEAD	10/7/93
54	50064	REP 04	40007	LONG BEACH HARBOR, CHANNEL 2	WHITE CROAKER	DEAD	10/7/93
58	50065	REP 05	40007	LONG BEACH HARBOR, CHANNEL 2	BASKETWEAVE CUSK EEL	MORIBUND	10/7/93
59	50066	REP 06	40007	LONG BEACH HARBOR, CHANNEL 2	BASKETWEAVE CUSK EEL	MORIBUND	10/7/93
60	50067	REP 07	40007	LONG BEACH HARBOR, CHANNEL 2	BASKETWEAVE CUSK EEL	MORIBUND	10/7/93
61	50068	REP 08	40007	LONG BEACH HARBOR, CHANNEL 2	BASKETWEAVE CUSK EEL	MORIBUND	10/7/93
62	50069	REP 09	40007	LONG BEACH HARBOR, CHANNEL 2	BASKETWEAVE CUSK EEL	MORIBUND	10/7/93
63	50070	REP 10	40007	LONG BEACH HARBOR, CHANNEL 2	WHITE CROAKER	LIVE	10/7/93
64	50071	REP 11	40007	LONG BEACH HARBOR, CHANNEL 2	YELLOWFIN GOBY	LIVE	10/7/93
65	50072	REP 12	40007	LONG BEACH HARBOR, CHANNEL 2	YELLOWFIN GOBY	LIVE	10/7/93
66	50073	REP 13	40007	LONG BEACH HARBOR, CHANNEL 2	TONGUE FISH	LIVE	10/7/93
67	50074	REP 14	40007	LONG BEACH HARBOR, CHANNEL 2	TONGUE FISH	LIVE	10/7/93
68	50075	REP 15	40007	LONG BEACH HARBOR, CHANNEL 2	TONGUE FISH	DEAD (RECENT)	10/7/93
22	50181	REP 01	40032	POLA 19	WHITE CROAKER	LIVE	10/6/93
23	50182	REP 02	40032	POLA 19	WHITE CROAKER	LIVE	10/6/93
24	50183	REP 03	40032	POLA 19	BASKETWEAVE CUSK EEL	LIVE	10/6/93
25	50184	REP 04	40032	POLA 19	TONGUE FISH	LIVE	10/6/93
26	50185	REP 05	40032	POLA 19	TONGUE FISH	LIVE	10/6/93
27	50186	REP 06	40032	POLA 19	TONGUE FISH	LIVE	10/6/93
28	50187	REP 07	40032	POLA 19	TONGUE FISH	LIVE	10/6/93
55	50188	REP 08	40032	POLA 19	WHITE CROAKER	DEAD (24)	10/7/93
56	50189	REP 09	40032	POLA 19	WHITE CROAKER	DEAD (24)	10/7/93
57	50190	REP 10	40032	POLA 19	WHITE CROAKER	DEAD (24)	10/7/93

Appendix 12c. Goby Biomarker Study. Fish and Site Identification, Sorted According to Site.

UCD #	ID ORG. #	REP #	SITE #	SITE NAME	SPECIES	CONDITION	DATE
14	50016	REP 01	40001	SOUTHWEST SLIP	WHITE CROAKER	MORIBUND	10/6/93
15	50017	REP 02	40001	SOUTHWEST SLIP	WHITE CROAKER	MORIBUND	10/6/93
16	50018	REP 03	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	LIVE	10/6/93
17	50019	REP 04	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	LIVE	10/6/93
18	50020	REP 05	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	LIVE	10/6/93
29	50121	REP 01	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
30	50122	REP 02	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
31	50123	REP 03	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
32	50124	REP 04	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
33	50125	REP 05	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
34	50126	REP 06	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
35	50127	REP 07	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
36	50128	REP 08	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
37	50129	REP 09	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
38	50130	REP 10	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
39	50131	REP 11	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
40	50132	REP 12	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
41	50133	REP 13	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
42	50134	REP 14	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
43	50135	REP 15	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
44	50001	REP 16	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
45	50002	REP 17	40016	TERM ISLAND STOP	TONGUE FISH	LIVE	10/6/93
46	50003	REP 18	40016	TERM ISLAND STOP	WHITE CROAKER	LIVE	10/6/93
47	50004	REP 19	40016	TERM ISLAND STOP	WHITE CROAKER	LIVE	10/6/93
48	50005	REP 20	40016	TERM ISLAND STOP	WHITE CROAKER	LIVE	10/6/93
49	50006	REP 21	40016	TERM ISLAND STOP	BASKETWEAVE CUSK EEL	LIVE	10/6/93
50	50007	REP 22	40016	TERM ISLAND STOP	YELLOWFIN GOBY	LIVE	10/6/93
84	50076	REP 01	40002	WEST BASIN PIER 143	WHITE CROAKER	MORIBUND	10/8/93
85	50077	REP 02	40002	WEST BASIN PIER 143	WHITE CROAKER	MORIBUND	10/8/93
86	50078	REP 03	40002	WEST BASIN PIER 143	WHITE CROAKER	LIVE	10/8/93
87	50079	REP 04	40002	WEST BASIN PIER 143	WHITE CROAKER	LIVE	10/8/93
88	50080	REP 05	40002	WEST BASIN PIER 143	WHITE CROAKER	LIVE	10/8/93
89	50081	REP 06	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	DEAD	10/8/93
90	50082	REP 07	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	LIVE	10/8/93
91	50083	REP 08	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	LIVE	10/8/93
92	50084	REP 09	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	LIVE	10/8/93
93	50085	REP 10	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93
94	50086	REP 11	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93
95	50087	REP 12	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93
96	50088	REP 13	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93
97	50089	REP 14	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93
98	50090	REP 15	40002	WEST BASIN PIER 143	TONGUE FISH	LIVE	10/8/93

Appendix 13a. Goby Biomarker Study. Sample Data.

					BIOCHEM SAMPLE		HISTOPATHOLOGY SAMPLES				P-450 IMMUNO		CHEMISTRY
UCD #	ID ORG. #	SITE #	SPECIES	CONDITION	P-450	BILE	LIVER	SPLEEN	SKIN	GONAD	LIVER	GILL	SAMPLES
1	50136	40015	YELLOWFIN GOBY	LIVE	ND	1	1	1	ND	1	1	1	1
2	50137	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
3	50138	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
4	50139	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
5	50140	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
6	50141	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
7	50142	40015	YELLOWFIN GOBY	LIVE	ND	ND	1	1	ND	1	1	1	1
8	50143	40015	YELLOWFIN GOBY	LIVE	ND	1	1	1	ND	1	1	1	1
9	50144	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
10	50145	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
11	50146	40015	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
12	50147	40015	YELLOWFIN GOBY	DEAD	ND	ND	1	1	ND	1	ND	ND	1
13	50031	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
14	50016	40001	WHITE CROAKER	MORIBUND	ND	1	1	1	ND	1	1	1	1
15	50017	40001	WHITE CROAKER	MORIBUND	ND	1	1	1	ND	1	1	1	1
16	50018	40001	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
17	50019	40001	YELLOWFIN GOBY	LIVE	ND	1	1	1	ND	1	1	1	1
18	50020	40001	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
19	50148	40015	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
20	50149	40015	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
21	50150	40015	WHITE CROAKER	LIVE	ND	1	1	1	ND	1	1	1	1
22	50181	40032	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
23	50182	40032	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
24	50183	40032	BW CUSK-EEL	LIVE	1	1	1	1	ND	1	1	1	1
25	50184	40032	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
26	50185	40032	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
27	50186	40032	TONGUEFISH	LIVE	1	1	1	1	1	1	1	1	1
28	50187	40032	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
29	50121	40016	TONGUEFISH	LIVE	ND	ND	1	1	ND	1	1	1	1
30	50122	40016	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
31	50123	40016	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
32	50124	40016	TONGUEFISH	LIVE	ND	ND	1	1	ND	1	1	1	1
33	50125	40016	TONGUEFISH	LIVE	ND	1	1	1	1	1	1	1	1
34	50126	40016	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
35	50127	40016	TONGUEFISH	LIVE	ND	ND	1	1	1	1	1	1	1
36	50128	40016	TONGUEFISH	LIVE	ND	1	1	1	1	1	1	1	1
37	50129	40016	TONGUEFISH	LIVE	1	1	1	1	1	1	1	1	1
38	50130	40016	TONGUEFISH	LIVE	ND	ND	1	1	ND	1	1	1	1
39	50131	40016	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
40	50132	40016	TONGUEFISH	LIVE	1	1	1	1	1	1	1	1	1
41	50133	40016	TONGUEFISH	LIVE	ND	1	1	1	1	1	1	1	1
42	50134	40016	TONGUEFISH	LIVE	1	1	1	1	1	1	1	1	1
43	50135	40016	TONGUEFISH	LIVE	ND	1	1	1	ND	1	1	1	1
44	50001	40016	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
45	50002	40016	TONGUEFISH	LIVE	ND	ND	1	1	ND	1	1	1	1
46	50003	40016	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
47	50004	40016	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
48	50005	40016	WHITE CROAKER	LIVE	ND	ND	1	1	ND	1	1	1	1
49	50006	40016	BW CUSK-EEL	LIVE	1	ND	1	1	ND	1	1	1	1
50	50007	40016	YELLOWFIN GOBY	LIVE	ND	1	1	1	ND	1	1	1	1
51	50061	40007	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
52	50062	40007	WHITE CROAKER	DEAD	1	1	1	1	ND	1	ND	ND	1
53	50063	40007	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
54	50064	40007	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
55	50188	40032	WHITE CROAKER	DEAD (24)	1	ND	1	1	ND	1	ND	ND	1
56	50189	40032	WHITE CROAKER	DEAD (24)	1	ND	1	1	ND	1	ND	ND	1
57	50190	40032	WHITE CROAKER	DEAD (24)	ND	ND	1	1	ND	1	ND	ND	1
58	50065	40007	BW CUSK-EEL	MORIBUND	1	1	1	1	ND	1	1	1	1
59	50066	40007	BW CUSK-EEL	MORIBUND	1	1	1	1	ND	1	1	1	1
60	50067	40007	BW CUSK-EEL	MORIBUND	1	1	1	1	ND	1	1	1	1

ppendix 13b. Goby Biomarker Study. Sample Data.

					BIOCHEM SAMPLES		HISTOPATHOLOGY SAMPLES				P-450 IMMUNO		CHEMISTRY
UCD #	ID ORG. #	SITE #	SPECIES	CONDITION	P-450	BILE	LIVER	SPLEEN	SKIN	GONAD	LIVER	GILL	SAMPLES
61	50068	40007	BW CUSK-EEL	MORIBUND	1	1	1	1	ND	1	1	1	1
62	50069	40007	BW CUSK-EEL	MORIBUND	1	1	1	1	ND	1	1	1	1
63	50070	40007	WHITE CROAKER	LIVE	ND	1	1	1	ND	1	1	1	1
64	50071	40007	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
65	50072	40007	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
66	50073	40007	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
67	50074	40007	TONGUEFISH	LIVE	ND	1	1	1	ND	1	1	1	1
68	50075	40007	TONGUEFISH	DEAD (FRESH)	ND	1	1	1	ND	1	ND	ND	1
69	50091	40013	WHITE CROAKER	MORIBUND	1	1	1	1	ND	1	1	1	1
70	50092	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
71	50093	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
72	50094	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
73	50095	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
74	50096	40013	WHITE CROAKER	LIVE	1	ND	1	1	ND	1	1	1	1
75	50097	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
76	50098	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
77	50099	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
78	50100	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
79	50101	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
80	50102	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
81	50103	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
82	50104	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
83	50105	40013	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
84	50076	40002	WHITE CROAKER	MORIBUND	1	1	1	1	ND	1	1	1	1
85	50077	40002	WHITE CROAKER	MORIBUND	1	1	1	1	ND	1	1	1	1
86	50078	40002	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
87	50079	40002	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
88	50080	40002	WHITE CROAKER	LIVE	1	1	1	1	ND	1	1	1	1
89	50081	40002	YELLOWFIN GOBY	DEAD	1	ND	1	1	ND	1	ND	ND	1
90	50082	40002	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
91	50083	40002	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
92	50084	40002	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
93	50085	40002	TONGUEFISH	LIVE	ND	1	1	1	ND	1	1	1	1
94	50086	40002	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
95	50087	40002	TONGUEFISH	LIVE	1	1	1	1	ND	1	1	1	1
96	50088	40002	TONGUEFISH	LIVE	ND	1	1	1	ND	1	1	1	1
97	50089	40002	TONGUEFISH	LIVE	ND	1	1	1	ND	1	1	1	1
98	50090	40002	TONGUEFISH	LIVE	ND	ND	1	1	ND	1	1	1	1
99	50032	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
100	50033	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
101	50034	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
102	50035	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
103	50036	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
104	50037	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
105	50038	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
106	50039	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
107	50040	40006	WHITE CROAKER	DEAD	ND	ND	1	1	ND	1	ND	ND	1
108	50041	40006	WHITE CROAKER	MORIBUND	1	1	1	1	ND	1	1	1	1
109	50042	40006	WHITE CROAKER	MORIBUND	1	1	1	1	ND	1	1	1	1
110	50043	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
111	50044	40006	YELLOWFIN GOBY	MORIBUND	1	1	1	1	ND	1	1	1	1
112	50045	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
113	50008*	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
114	50009*	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
115	50010*	40006	YELLOWFIN GOBY	LIVE	1	1	1	1	ND	1	1	1	1
116	50046	80027	ROUND STINGRAY	LIVE	1	1	1	1	1	1	1	1	1
117	50047	80027	ROUND STINGRAY	LIVE	1	1	1	1	ND	1	1	1	1
118	50048	80027	ROUND STINGRAY	LIVE	1	1	1	1	ND	1	1	1	1
119	50049	80027	ROUND STINGRAY	LIVE	1	1	1	1	1	1	1	1	1
120	50050	80027	ROUND STINGRAY	LIVE	1	1	1	1	1	1	1	1	1
121	50051	80027	YELLOWFIN GOBY **	LIVE	1	1	1	1	ND	1	1	1	1
122	50052	80027	ROUND STINGRAY	DEAD (FRESH)	ND	1	1	1	ND	1	1	1	1
123	50053	80027	ROUND STINGRAY	LIVE	1	1	1	1	1	1	1	1	1
124	50054	80027	ROUND STINGRAY	LIVE	1	1	1	1	1	1	1	1	1
125	50055	80027	ROUND STINGRAY	DEAD	1	ND	1	1	1	1	ND	ND	1
126	50056	80027	ROUND STINGRAY	DEAD	ND	1	1	1	ND	1	ND	ND	1
127	50057	80027	YELLOWFIN GOBY	LIVE	ND	1	1	1	ND	1	1	1	1

SAMPLE TOTALS

BIOCHEM SAMPLES		HISTOPATHOLOGY SAMPLES				P-450 IMMUNO		CHEMISTRY
P-450	BILE	LIVER	SPLEEN	SKIN	GONAD	LIVER	GILL	SAMPLES
85	99	127	127	14	127	106	106	127

ıdix 14a. Goby Biomarker Study. Histopathology of the Spleen.

LESION ABBREVIATIONS:

1. SEX = M or F (male or female)
2. LN = lymphoid necrosis
3. RPN = red pulp necrosis
4. PSH = periarteriolar sheath hyperplasia
5. LH = lymphoid hyperplasia
6. SC = splenic congestion
7. SMA = splenic macrophage aggregates
8. LD = lymphoid depletion

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	SPLENIC LESIONS LN	RPN	PSH	LH	SC	SMA	LD
1.	50016	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 030	3	3	0	0	0	1	1
2.	50017	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 110	3	2	0	0	0	1	0
3.	50018	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 062	0	0	0	0	3	1	2
4.	50019	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 119	0	0	0	0	0	1	0
5.	50020	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 012	0	0	0	0	3	1	2
					Average	1.2	1	0	0	1.2	1	1
					Standard Error	0.657	0.566	0	0	0.657	0	0.4

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	SPLENIC LESIONS LN	RPN	PSH	LH	SC	SMA	LD
1.	50076	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 043	2	2	0	0	0	1	0
2.	50077	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 083	2	3	0	0	0	1	0
3.	50078	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 091	1	3	0	0	0	0	0
4.	50079	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 118	3	1	0	0	0	2	0
5.	50080	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 053	2	2	0	0	0	2	0
6.	50081	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 120	1	2	0	0	0	1	1
7.	50082	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 109	2	0	1	0	2	2	2
8.	50083	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 124	1	1	1	0	1	1	0
9.	50084	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 117	2	0	2	0	2	1	1
10.	50085	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 065	0	0	0	0	1	1	3
11.	50087	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 060	0	1	0	0	0	3	2
12.	50088	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 022	3	2	0	0	0	0	2
13.	50089	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 094	0	0	0	0	1	1	2
14.	50090	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 002	0	0	0	0	2	0	3
					Average	1.357	1.214	0.286	0	0.643	1.143	1.143
					Standard Error	0.279	0.289	0.157	0	0.217	0.223	0.301

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	SPLENIC LESIONS LN	RPN	PSH	LH	SC	SMA	LD
1.	50031	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 015	0	0	1	0	3	1	2
2.	50035	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 058	1	1	1	0	0	2	0
3.	50038	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 017	1	2	0	0	0	1	0
4.	50040	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 127	2	0	0	0	0	1	1
5.	50041	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 025	3	2	0	0	0	1	0
6.	50042	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 098	2	3	0	0	1	1	2
7.	50043	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 105	2	1	1	0	1	1	1
8.	50044	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 061	0	0	0	0	0	2	0
9.	50045	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 056	2	1	0	0	1	2	0
10.	50008	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 066	0	0	0	0	2	1	0
11.	50009	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 046	2	1	1	0	2	2	1
12.	50010	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 074	0	0	2	0	0	1	0
					Average	1.25	0.917	0.5	0	0.833	1.333	0.583
					Standard Error	0.292	0.275	0.186	0	0.285	0.136	0.219

Appendix 14b. Goby Biomarker Study. Histopathology of the Spleen.

LESION ABBREVIATIONS:

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4. PSH = periarteriolar sheath hyperplasia
5. LH = lymphoid hyperplasia
6. SC = splenic congestion
7. SMA = splenic macrophage aggregates
8. LD = lymphoid depletion

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50061	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 059	1	2	0	0	0	1	2
2.	50062	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 009	1	2	0	0	0	1	0
3.	50065	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 031	0	0	0	0	0	0	3
4.	50066	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 070	0	0	0	0	1	0	3
5.	50067	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 116	0	1	0	0	0	0	1
6.	50068	40007	LONG BEACH HBR, CH2	BW CUSK EEL	93H 63 - 024	2	1	0	0	0	0	1
7.	50069	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 042	0	0	0	0	0	1	2
8.	50070	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 085	1	2	0	0	0	1	0
9.	50071	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 104	0	0	1	0	1	2	2
10.	50072	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 049	0	0	0	0	0	2	2
11.	50073	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 047	0	1	0	0	2	2	3
12.	50074	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 020	1	0	0	0	0	0	2
13.	50075	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 036	2	2	0	0	0	1	2
					Average	0.615	0.846	0.077	0	0.308	0.846	1.769
					Standard Error	0.205	0.239	0.074	0	0.168	0.213	0.27

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50091	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 102	2	3	0	0	0	1	2
2.	50092	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 048	2	1	0	0	0	2	1
3.	50093	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 086	2	0	0	0	1	1	0
4.	50094	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 095	1	0	0	0	1	1	0
5.	50095	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 068	2	0	0	0	1	1	0
6.	50096	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 069	3	1	0	0	0	1	0
7.	50097	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 126	3	1	0	0	1	1	0
8.	50098	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 008	1	0	0	0	0	1	1
9.	50099	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 107	1	0	0	0	1	1	0
10.	50100	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 081	1	0	1	0	1	1	1
11.	50101	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 078	3	1	0	0	1	1	0
12.	50102	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 097	3	1	0	0	1	1	0
13.	50103	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 018	1	0	0	0	0	1	0
14.	50104	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 101	2	0	0	0	2	1	1
15.	50105	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 121	3	0	0	0	3	1	1
					Average	2	0.533	0.067	0	0.867	1.067	0.467
					Standard Error	0.211	0.208	0.064	0	0.208	0.064	0.16

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50136	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 064	0	0	0	0	1	1	0
2.	50137	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 023	1	1	1	0	0	1	1
3.	50138	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 108	1	0	0	0	3	1	2
4.	50139	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 080	1	1	1	0	2	1	2
5.	50140	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 003	0	0	3	0	1	1	2
6.	50141	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 026	1	0	1	0	0	1	0
7.	50142	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 044	1	0	0	0	3	1	3
8.	50143	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 088	1	0	1	0	1	2	2
9.	50144	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 029	1	1	2	0	1	1	1
10.	50145	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 006	0	0	2	0	0	2	0
11.	50146	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 076	1	1	1	0	1	1	0
12.	50147	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 089	0	1	0	0	1	1	3
13.	50148	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 125	1	1	0	0	1	1	0
14.	50149	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 096	2	0	0	0	1	2	0
15.	50150	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 007	1	0	0	0	0	1	0
					Average	0.8	0.4	0.8	0	1.067	1.2	1.067
					Standard Error	0.14	0.126	0.235	0	0.24	0.103	0.29

Appendix 14c. Goby Biomarker Study. Histopathology of the Spleen.

LESION ABBREVIATIONS:

1. SEX = M or F (male or female)
2. LN = lymphoid necrosis
3. RPN = red pulp necrosis
4. PSH = periarteriolar sheath hyperplasia
5. LH = lymphoid hyperplasia
6. SC = splenic congestion
7. SMA = splenic macrophage aggregates
8. LD = lymphoid depletion

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50001	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 016	0	0	0	0	0	1	3
2.	50002	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 077	0	0	0	0	3	1	3
3.	50003	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 063	1	0	0	0	1	1	0
4.	50004	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 103	3	2	0	0	0	1	0
5.	50005	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 001	2	0	0	0	0	1	1
6.	50006	40016	TERM ISLAND STOP	BW CUSK EEL	93H 63 - 013	0	0	0	0	1	0	3
7.	50007	40016	TERM ISLAND STOP	YELLOWFIN GOBY	93H 63 - 011	2	0	1	0	0	1	1
8.	50121	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 050	0	0	0	0	3	1	3
9.	50122	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 038	0	0	0	0	3	1	3
10.	50123	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 039	0	0	0	0	2	2	2
11.	50124	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 032	0	0	0	0	1	2	3
12.	50125	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 122	0	0	0	0	3	2	3
13.	50126	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 019	0	0	0	0	1	1	3
14.	50127	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 090	0	0	0	0	3	0	3
15.	50129	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 045	1	0	0	0	2	1	2
16.	50130	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 100	0	1	0	0	3	2	3
17.	50131	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 037	0	0	0	0	3	1	3
18.	50132	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 052	0	0	0	0	2	1	3
19.	50133	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 004	0	0	0	0	0	3	2
20.	50134	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 087	0	0	0	0	3	1	3
21.	50135	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 010	0	0	0	0	1	1	3
					Average	0.429	0.143	0.048	0	1.667	1.19	2.381
					Standard Error	0.185	0.102	0.046	0	0.264	0.145	0.218

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50181	40032	POLA 19	WHITE CROAKER	93H 63 - 021	1	0	0	0	0	2	0
2.	50182	40032	POLA 19	WHITE CROAKER	93H 63 - 123	3	1	0	0	1	2	0
3.	50183	40032	POLA 19	BW CUSK EEL	93H 63 - 114	0	0	0	0	2	0	3
4.	50184	40032	POLA 19	TONGUE FISH	93H 63 - 034	1	1	0	0	0	3	2
5.	50185	40032	POLA 19	TONGUE FISH	93H 63 - 027	0	0	0	0	2	2	3
6.	50186	40032	POLA 19	TONGUE FISH	93H 63 - 084	0	0	0	0	2	1	3
7.	50187	40032	POLA 19	TONGUE FISH	93H 63 - 106	0	0	0	0	1	2	3
8.	50188	40032	POLA 19	WHITE CROAKER	93H 63 - 092	1	1	0	0	0	2	0
					Average	0.75	0.375	0	0	1	1.75	1.75
					Standard Error	0.342	0.171	0	0	0.306	0.293	0.492

						SPLENIC LESIONS						
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LN	RPN	PSH	LH	SC	SMA	LD
1.	50046	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 033	3	2	2	0	0	0	0
2.	50047	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 082	2	3	2	0	0	0	0
3.	50048	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 112	1	0	1	0	0	0	0
4.	50049	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 014	0	0	0	0	0	0	0
5.	50050	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 041	1	0	0	0	0	0	0
6.	50051	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 057	0	1	0	0	2	1	2
7.	50052	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 005	1	0	1	0	0	0	0
8.	50053	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 072	0	0	1	0	0	0	0
9.	50054	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 115	2	3	1	0	0	0	1
10.	50055	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 040	1	1	1	0	0	0	0
11.	50056	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 113	3	3	2	0	1	0	0
12.	50057	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 071	0	0	1	0	0	1	0
					Average	1.167	1.083	1	0	0.25	0.167	0.25
					Standard Error	0.308	0.362	0.204	0	0.172	0.108	0.172

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Appendix 14d.

Goby Biomarker Study. Histopathology of the Yellowfin Goby Spleens.

#	Site #	Site Name	ID #	Random #	LN	RPN	PSH	LH	SC	SMA	LD
1.	40001	Southwest Slip	50018	93H 63 - 062	0	0	0	0	3	1	2
2.	40001	Southwest Slip	50019	93H 63 - 119	0	0	0	0	0	1	0
3.	40001	Southwest Slip	50020	93H 63 - 012	0	0	0	0	3	1	2
				Average	0	0	0	0	2	1	1.333
				Standard Error	0	0	0	0	0.816	0	0.544
1.	40002	West Basin Pier 143	50081	93H 63 - 120	1	2	0	0	0	1	1
2.	40002	West Basin Pier 143	50082	93H 63 - 109	2	0	1	0	2	2	2
3.	40002	West Basin Pier 143	50083	93H 63 - 124	1	1	1	0	1	1	0
4.	40002	West Basin Pier 143	50084	93H 63 - 117	2	0	2	0	2	1	1
				Average	1.5	0.75	1	0	1.25	1.25	1
				Standard Error	0.25	0.415	0.354	0	0.415	0.217	0.354
1.	40006	Consolidated Slip	50031	93H 63 - 015	0	0	1	0	3	1	2
2.	40006	Consolidated Slip	50043	93H 63 - 105	2	1	1	0	1	1	1
3.	40006	Consolidated Slip	50044	93H 63 - 061	0	0	0	0	0	2	0
4.	40006	Consolidated Slip	50045	93H 63 - 056	2	1	0	0	1	2	0
5.	40006	Consolidated Slip	50008	93H 63 - 066	0	0	0	0	2	1	0
6.	40006	Consolidated Slip	50009	93H 63 - 046	2	1	1	0	2	2	1
7.	40006	Consolidated Slip	50010	93H 63 - 074	0	0	2	0	0	1	0
				Average	0.857	0.429	0.714	0	1.286	1.429	0.571
				Standard Error	0.374	0.187	0.265	0	0.389	0.187	0.275
1.	40007	Long Beach Harbor, Ch.2	50071	93H 63 - 104	0	0	1	0	1	2	2
2.	40007	Long Beach Harbor, Ch.2	50072	93H 63 - 049	0	0	0	0	0	2	2
				Average	0	0	0.5	0	0.5	2	2
				Standard Error	0	0	0.354	0	0.354	0	0
1.	40015	Entrance to Fish Harbor	50136	93H 63 - 064	0	0	0	0	1	1	0
2.	40015	Entrance to Fish Harbor	50137	93H 63 - 023	1	1	1	0	0	1	1
3.	40015	Entrance to Fish Harbor	50138	93H 63 - 108	1	0	0	0	3	1	2
4.	40015	Entrance to Fish Harbor	50139	93H 63 - 080	1	1	1	0	2	1	2
5.	40015	Entrance to Fish Harbor	50140	93H 63 - 003	0	0	3	0	1	1	2
6.	40015	Entrance to Fish Harbor	50141	93H 63 - 026	1	0	1	0	0	1	0
7.	40015	Entrance to Fish Harbor	50142	93H 63 - 044	1	0	0	0	3	1	3
8.	40015	Entrance to Fish Harbor	50143	93H 63 - 088	1	0	1	0	1	2	2
9.	40015	Entrance to Fish Harbor	50144	93H 63 - 029	1	1	2	0	1	1	1
10.	40015	Entrance to Fish Harbor	50145	93H 63 - 006	0	0	2	0	0	2	0
11.	40015	Entrance to Fish Harbor	50146	93H 63 - 076	1	1	1	0	1	1	0
12.	40015	Entrance to Fish Harbor	50147	93H 63 - 089	0	1	0	0	1	1	3
				Average	0.667	0.417	1	0	1.167	1.167	1.333
				Standard Error	0.136	0.142	0.264	0	0.285	0.108	0.319
1.	40016	Term Island Stop	50007	93H 63 - 011	2	0	1	0	0	1	1
1.	80027	Huntington Harbor, Mid	50051	93H 63 - 057	0	1	0	0	2	1	2
2.	80027	Huntington Harbor, Mid	50057	93H 63 - 071	0	0	1	0	0	1	0
				Average	0	0.5	0.5	0	1	1	1
				Standard Error	0	0.354	0.354	0	0.707	0	0.707

Goby Biomarker Study. Histopathology of the White Croaker Spleens.

#	Site #	Site Name	ID #	Random #	LN	RPN	PSH	LH	SC	SMA	LD
1.	40001	Southwest Slip	50016	93H 63 - 030	3	3	0	0	0	1	1
2.	40001	Southwest Slip	50017	93H 63 - 110	3	2	0	0	0	1	0
				Average	3	2.5	0	0	0	1	0.5
				Standard Error	0	0.354	0	0	0	0	0.354
1.	40002	West Basin Pier 143	50076	93H 63 - 043	2	2	0	0	0	1	0
2.	40002	West Basin Pier 143	50077	93H 63 - 083	2	3	0	0	0	1	0
3.	40002	West Basin Pier 143	50078	93H 63 - 091	1	3	0	0	0	0	0
4.	40002	West Basin Pier 143	50079	93H 63 - 118	3	1	0	0	0	2	0
5.	40002	West Basin Pier 143	50080	93H 63 - 053	2	2	0	0	0	2	0
				Average	2	2.2	0	0	0	1.2	0
				Standard Error	0.283	0.335	0	0	0	0.335	0
1.	40006	Consolidated Slip	50035	93H 63 - 058	1	1	1	0	0	2	0
2.	40006	Consolidated Slip	50038	93H 63 - 017	1	2	0	0	0	1	0
3.	40006	Consolidated Slip	50040	93H 63 - 127	2	0	0	0	0	1	1
4.	40006	Consolidated Slip	50041	93H 63 - 025	3	2	0	0	0	1	0
5.	40006	Consolidated Slip	50042	93H 63 - 098	2	3	0	0	1	1	2
				Average	1.8	1.6	0.2	0	0.2	1.2	0.6
				Standard Error	0.335	0.456	0.179	0	0.179	0.179	0.358
1.	40007	Long Beach Harbor, Ch.2	50061	93H 63 - 059	1	2	0	0	0	1	2
2.	40007	Long Beach Harbor, Ch.2	50062	93H 63 - 009	1	2	0	0	0	1	0
3.	40007	Long Beach Harbor, Ch.2	50070	93H 63 - 085	1	2	0	0	0	1	0
				Average	1	2	0	0	0	1	0.667
				Standard Error	0	0	0	0	0	0	0.544
1.	40013	Inner Queensway Bay	50091	93H 63 - 102	2	3	0	0	0	1	2
2.	40013	Inner Queensway Bay	50092	93H 63 - 048	2	1	0	0	0	2	1
3.	40013	Inner Queensway Bay	50093	93H 63 - 086	2	0	0	0	1	1	0
4.	40013	Inner Queensway Bay	50094	93H 63 - 095	1	0	0	0	1	1	0
5.	40013	Inner Queensway Bay	50095	93H 63 - 068	2	0	0	0	1	1	0
6.	40013	Inner Queensway Bay	50096	93H 63 - 069	3	1	0	0	0	1	0
7.	40013	Inner Queensway Bay	50097	93H 63 - 126	3	1	0	0	1	1	0
8.	40013	Inner Queensway Bay	50098	93H 63 - 008	1	0	0	0	0	1	1
9.	40013	Inner Queensway Bay	50099	93H 63 - 107	1	0	0	0	1	1	0
10.	40013	Inner Queensway Bay	50100	93H 63 - 081	1	0	1	0	1	1	1
11.	40013	Inner Queensway Bay	50101	93H 63 - 078	3	1	0	0	1	1	0
12.	40013	Inner Queensway Bay	50102	93H 63 - 097	3	1	0	0	1	1	0
13.	40013	Inner Queensway Bay	50103	93H 63 - 018	1	0	0	0	0	1	0
14.	40013	Inner Queensway Bay	50104	93H 63 - 101	2	0	0	0	2	1	1
15.	40013	Inner Queensway Bay	50105	93H 63 - 121	3	0	0	0	3	1	1
				Average	2	0.533	0.067	0	0.867	1.067	0.467
				Standard Error	0.211	0.208	0.064	0	0.208	0.064	0.16
1.	40015	Entrance to Fish Harbor	50148	93H 63 - 125	1	1	0	0	1	1	0
2.	40015	Entrance to Fish Harbor	50149	93H 63 - 096	2	0	0	0	1	2	0
3.	40015	Entrance to Fish Harbor	50150	93H 63 - 007	1	0	0	0	0	1	0
				Average	1.333	0.333	0	0	0.667	1.333	0
				Standard Error	0.272	0.272	0	0	0.272	0.272	0
1.	40016	Term Island Stop	50003	93H 63 - 063	1	0	0	0	1	1	0
2.	40016	Term Island Stop	50004	93H 63 - 103	3	2	0	0	0	1	0
3.	40016	Term Island Stop	50005	93H 63 - 001	2	0	0	0	0	1	1
				Average	2	0.667	0	0	0.333	1	0.333
				Standard Error	0.471	0.544	0	0	0.272	0	0.272
1.	40032	Pola 19	50181	93H 63 - 021	1	0	0	0	0	2	0
2.	40032	Pola 19	50182	93H 63 - 123	3	1	0	0	1	2	0
3.	40032	Pola 19	50188	93H 63 - 092	1	1	0	0	0	2	0

Appendix 14f.

Goby Biomarker Study. Histopathology of the Tonguefish Spleens.

#	Site #	Site Name	ID #	Random #	LN	RPN	PSH	LH	SC	SMA	LD
1.	40002	West Basin Pier 143	50085	93H 63 - 065	0	0	0	0	1	1	3
2.	40002	West Basin Pier 143	50087	93H 63 - 060	0	1	0	0	0	3	2
3.	40002	West Basin Pier 143	50088	93H 63 - 022	3	2	0	0	0	0	2
4	40002	West Basin Pier 143	50089	93H 63 - 094	0	0	0	0	1	1	2
5.	40002	West Basin Pier 143	50090	93H 63 - 002	0	0	0	0	2	0	3
				Average	0.6	0.6	0	0	0.8	1	2.4
				Standard Error	0.537	0.358	0	0	0.335	0.49	0.219
1.	40007	Long Beach Harbor, Ch.2	50073	93H 63 - 047	0	1	0	0	2	2	3
2.	40007	Long Beach Harbor, Ch.2	50074	93H 63 - 020	1	0	0	0	0	0	2
3.	40007	Long Beach Harbor, Ch.2	50075	93H 63 - 036	2	2	0	0	0	1	2
				Average	1	1	0	0	0.667	1	2.333
				Standard Error	0.577	0.577	0	0	0.667	0.577	0.333
1.	40016	Term Island Stop	50001	93H 63 - 016	0	0	0	0	0	1	3
2.	40016	Term Island Stop	50002	93H 63 - 077	0	0	0	0	3	1	3
3.	40016	Term Island Stop	50121	93H 63 - 050	0	0	0	0	3	1	3
4.	40016	Term Island Stop	50122	93H 63 - 038	0	0	0	0	3	1	3
5.	40016	Term Island Stop	50123	93H 63 - 039	0	0	0	0	2	2	2
6.	40016	Term Island Stop	50124	93H 63 - 032	0	0	0	0	1	2	3
7.	40016	Term Island Stop	50125	93H 63 - 122	0	0	0	0	3	2	3
8.	40016	Term Island Stop	50126	93H 63 - 019	0	0	0	0	1	1	3
9.	40016	Term Island Stop	50127	93H 63 - 090	0	0	0	0	3	0	3
10.	40016	Term Island Stop	50129	93H 63 - 045	1	0	0	0	2	1	2
11.	40016	Term Island Stop	50130	93H 63 - 100	0	1	0	0	3	2	3
12.	40016	Term Island Stop	50131	93H 63 - 037	0	0	0	0	3	1	3
13.	40016	Term Island Stop	50132	93H 63 - 052	0	0	0	0	2	1	3
14.	40016	Term Island Stop	50133	93H 63 - 004	0	0	0	0	0	3	2
15.	40016	Term Island Stop	50134	93H 63 - 087	0	0	0	0	3	1	3
16.	40016	Term Island Stop	50135	93H 63 - 010	0	0	0	0	1	1	3
				Avearge	0.063	0.063	0	0	2.063	1.313	2.813
				Standard Error	0.061	0.061	0	0	0.272	0.17	0.098
1.	40032	Pola 19	50184	93H 63 - 034	1	1	0	0	0	3	2
2.	40032	Pola 19	50185	93H 63 - 027	0	0	0	0	2	2	3
3.	40032	Pola 19	50186	93H 63 - 084	0	0	0	0	2	1	3
4.	40032	Pola 19	50187	93H 63 - 106	0	0	0	0	1	2	3
				Average	0.25	0.25	0	0	1.25	2	2.75
				Standard Error	0.217	0.217	0	0	0.415	0.354	0.217

Appendix 14g.

Goby Biomarker Study. Histopathology of Basketweave Cusk-eels Spleens.

#	Site #	Site Name	ID #	Random #	LN	RPN	PSH	LH	SC	SMA	LD
1.	40007	Long Beach Harbor, Ch.2	50065	93H 63 - 031	0	0	0	0	0	0	3
2.	40007	Long Beach Harbor, Ch.2	50066	93H 63 - 070	0	0	0	0	1	0	3
3.	40007	Long Beach Harbor, Ch.2	50067	93H 63 - 116	0	1	0	0	0	0	1
4.	40007	Long Beach Harbor, Ch.2	50068	93H 63 - 024	2	1	0	0	0	0	1
5.	40007	Long Beach Harbor, Ch.2	50069	93H 63 - 042	0	0	0	0	0	1	2
				Average	0.4	0.4	0	0	0.2	0.2	2
				Standard Error	0.358	0.219	0	0	0.179	0.179	0.4
1.	40016	Term Island Stop	50006	93H 63 - 013	0	0	0	0	1	0	3
1.	40032	Pola 19	50183	93H 63 - 114	0	0	0	0	2	0	3

Appendix 14h.

Goby Biomarker Study. Histopathology of Round Stingray Spleens.

#	Site #	Site Name	ID #	Random #	LN	RPN	PSH	LH	SC	SMA	LD
1.	80027	Huntington Harbor, Mid	50046	93H 63 - 033	3	2	2	0	0	0	0
2.	80027	Huntington Harbor, Mid	50047	93H 63 - 082	2	3	2	0	0	0	0
3.	80027	Huntington Harbor, Mid	50048	93H 63 - 112	1	0	1	0	0	0	0
4.	80027	Huntington Harbor, Mid	50049	93H 63 - 014	0	0	0	0	0	0	0
5.	80027	Huntington Harbor, Mid	50050	93H 63 - 041	1	0	0	0	0	0	0
6.	80027	Huntington Harbor, Mid	50052	93H 63 - 005	1	0	1	0	0	0	0
7.	80027	Huntington Harbor, Mid	50053	93H 63 - 072	0	0	1	0	0	0	0
8.	80027	Huntington Harbor, Mid	50054	93H 63 - 115	2	3	1	0	0	0	1
9.	80027	Huntington Harbor, Mid	50055	93H 63 - 040	1	1	1	0	0	0	0
10.	80027	Huntington Harbor, Mid	50056	93H 63 - 113	3	3	2	0	1	0	0
				Average	1.4	1.2	1.1	0	0.1	0	0.1
				Standard Error	0.322	0.42	0.221	0	0.095	0	0.095

ppendix 15a. Goby Biomarker Study. Histopathology of the Liver.

LESION ABBREVIATIONS:
1. GD = GLYCOGEN DEPLETION
2. LIP = LIPIDOSIS
3. ECI = EOSINOPHILIC CYTOPLASMIC INCLUSIONS
4. HMA = HEPATIC MACROPHAGE AGGREGATES
5. MM = MELANOMACROPHAGES
6. FBG = FOREIGN BODY GRANULOMA
7. LYM = LYMPHOCYTIC INFLAMMATION
8. IHN = INDIVIDUAL HEPATOCYTE NECROSIS
9. MEG = MEGALOCYTOSIS
10. PCA = FOCI OF CELLULAR ALTERATION
11. FW = FIBRIN WHORLS
12. NEM = NEMATODES
13. HVW = HYALINIZATION OF VESSEL WALLS
14. EP = EXOCRINE PANCREAS (1 = PRESENT; 2 = ABSENT)

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50016	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 030	3	1	0	1	0	0	0	0	0	0	0	0	1	1
2.	50017	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 110	2	0	0	0	0	0	1	3	0	0	0	0	0	1
3.	50018	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 062	3	3	0	1	0	1	0	0	0	0	0	0	0	1
4.	50019	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 119	2	2	1	1	0	0	0	1	0	0	0	0	0	1
5.	50020	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 012	3	3	0	1	0	0	0	0	0	0	0	0	0	1
					SUM	13	9	1	4	0	1	1	4	0	0	0	0	1	5
					AVERAGE	2.6	1.8	0.2	0.8	0	0.2	0.2	0.8	0	0	0	0	0.2	1
					STD ERROR	0.245	0.583	0.2	0.2	0	0.2	0.2	0.583	0	0	0	0	0.2	0

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50076	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 043	2	0	0	1	0	0	0	3	0	0	0	0	0	1
2.	50077	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 083	1	0	0	0	0	0	0	0	0	0	0	0	0	1
3.	50078	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 091	3	0	0	0	0	0	0	0	0	0	0	0	0	1
4.	50079	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 118	2	0	0	1	0	0	0	1	1	1	0	0	0	1
5.	50080	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 053	2	0	0	1	0	0	0	1	1	0	0	0	1	1
6.	50081	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 120	2	1	1	0	0	0	1	0	0	0	0	0	0	1
7.	50082	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 109	3	1	0	0	0	0	0	0	1	0	0	0	0	1
8.	50083	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 124	3	3	1	1	0	0	0	1	1	0	0	0	0	1
9.	50084	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 117	2	2	0	0	0	0	0	0	1	0	0	0	1	1
10.	50085	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 065	2	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	50086	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 067	3	0	3	0	0	0	0	0	0	0	0	0	0	0
12.	50087	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 060	3	0	0	0	0	0	0	0	0	0	0	0	0	0
13.	50088	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 022	3	0	1	0	0	0	0	1	0	0	0	0	0	0
14.	50089	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 094	3	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	50090	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 002	1	0	1	0	0	0	0	0	2	0	0	0	0	0
					SUM	35	7	7	4	0	0	1	7	7	1	0	0	2	9
					AVERAGE	2.333	0.467	0.467	0.267	0	0	0.067	0.467	0.467	0.067	0	0	0.133	0.6
					STD ERROR	0.187	0.236	0.215	0.118	0	0	0.067	0.215	0.165	0.067	0	0	0.091	0.131

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50031	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 015	3	3	0	2	0	2	0	0	0	0	0	0	1	1
2.	50032	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 028	2	0	0	1	0	0	0	1	0	0	0	0	0	1
3.	50033	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 035	1	1	0	0	0	0	0	0	1	0	0	0	0	1
4.	50034	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 093	2	0	0	0	0	0	0	0	0	0	1	0	0	1
5.	50035	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 058	3	0	0	1	0	0	0	0	0	0	0	0	0	1
6.	50036	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 051	2	0	0	1	0	0	1	0	0	0	0	0	0	1
7.	50037	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 099	1	1	0	0	0	0	0	0	0	0	0	0	0	1
8.	50038	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 017	3	0	0	0	0	0	1	1	0	0	0	0	0	1
9.	50039	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 111	3	0	0	0	0	0	0	0	0	0	0	0	0	1
10.	50040	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 127	2	1	0	1	0	0	0	2	0	0	0	0	0	1
11.	50041	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 025	2	0	0	1	0	0	0	0	0	0	0	0	0	1
12.	50042	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 098	3	0	0	0	0	0	0	1	1	0	0	0	1	1
13.	50043	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 105	2	3	2	0	0	0	0	0	0	0	0	0	0	1
14.	50044	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 061	3	2	0	0	0	0	0	0	0	0	0	0	0	1
15.	50045	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 056	3	1	0	1	0	0	0	2	1	0	0	0	0	1
16.	50008	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 066	3	3	0	1	0	3	0	1	0	0	0	0	0	1
17.	50009	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 046	2	2	1	1	0	1	0	0	0	0	0	0	0	1
18.	50010	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 074	2	2	0	0	0	0	0	0	0	0	0	0	0	1
					SUM	42	19	3	10	0	6	2	8	3	0	1	0	2	18
					AVERAGE	2.333	1.056	0.167	0.556	0	0.333	0.111	0.444	0.167	0	0.056	0	0.111	1
					STD ERROR	0.162	0.274	0.121	0.145	0	0.198	0.076	0.166	0.09	0	0.056	0	0.076	0

Appendix 15b. Goby Biomarker Study. Histopathology of the Liver.

LESION ABBREVIATIONS:
1. GD = GLYCOGEN DEPLETION
2. LIP = LIPIDOSIS
3. ECI = EOSINOPHILIC CYTOPLASMIC INCLUSIONS
4. HMA = HEPATIC MACROPHAGE AGGREGATES
5. MM = MELANOMACROPHAGES
6. FBG = FOREIGN BODY GRANULOMA
7. LYM = LYMPHOCYTIC INFLAMMATION
8. IHN = INDIVIDUAL HEPATOCYTE NECROSIS
9. MEG = MEGALOCYTOSIS
10. PCA = FOCI OF CELLULAR ALTERATION
11. FW = FIBRIN WHORLS
12. NEM = NEMATODES
13. HVW = HYALINIZATION OF VESSEL WALLS
14. EP = EXOCRINE PANCREAS (1 = PRESENT; 2 = ABSENT)

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50061	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 059	2	1	0	1	0	0	0	2	0	0	0	0	0	1
2.	50062	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 009	2	0	0	0	0	0	0	0	0	0	0	0	0	1
3.	50063	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 075	2	2	0	0	0	0	0	0	0	0	0	0	0	1
4.	50064	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 079	3	0	0	0	0	0	0	0	0	0	0	0	0	1
5.	50065	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 031	3	0	0	0	0	0	0	0	0	0	0	0	1	0
6.	50066	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 070	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	50067	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 116	3	0	0	0	0	0	0	0	0	0	0	0	1	0
8.	50068	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 024	3	0	0	0	0	0	0	0	1	0	0	0	0	0
9.	50069	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 042	3	0	0	0	0	0	0	0	0	1	0	0	0	0
10.	50070	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 085	2	0	0	0	0	0	0	0	0	0	0	0	0	1
11.	50071	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 104	3	3	0	0	0	1	0	0	0	0	0	0	0	1
12.	50072	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 049	3	0	0	0	0	0	0	0	0	0	0	0	0	1
13.	50073	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 047	3	0	0	0	0	0	0	0	0	0	0	0	0	0
14.	50074	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 020	3	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	50075	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 036	3	0	0	0	0	0	0	1	0	0	0	0	0	0
					SUM	39	6	0	1	0	1	0	3	1	1	0	0	2	7
					AVERAGE	2.6	0.4	0	0.07	0	0.07	0	0.2	0.07	0.07	0	0	0.13	0.47
					STD ERROR	0.163	0.235	0	0.067	0	0.067	0	0.145	0.067	0.067	0	0	0.091	0.133

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50091	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 102	3	0	0	0	0	0	0	1	0	0	0	0	0	1
2.	50092	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 048	0	0	0	1	0	0	0	0	0	0	0	0	0	1
3.	50093	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 086	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4.	50094	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 095	1	0	0	0	0	0	0	0	0	1	0	0	0	1
5.	50095	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 068	1	0	0	1	0	0	1	0	0	0	0	0	0	1
6.	50096	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 069	2	0	0	0	0	0	0	1	0	0	0	0	0	1
7.	50097	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 126	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8.	50098	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 008	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9.	50099	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 107	0	0	0	1	0	0	0	0	0	0	0	0	0	1
10.	50100	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 081	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11.	50101	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 078	0	0	0	0	0	0	1	0	0	0	0	0	0	1
12.	50102	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 097	1	0	0	1	0	0	1	0	0	0	0	0	0	1
13.	50103	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 018	0	0	0	0	0	0	0	0	0	0	0	0	1	1
14.	50104	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 101	2	0	0	0	0	0	0	0	0	0	0	0	0	1
15.	50105	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 121	1	0	0	0	0	0	0	0	0	0	0	0	0	1
					SUM	11	0	0	4	0	0	3	2	0	1	0	0	1	15
					AVERAGE	0.73	0	0	0.27	0	0	0.2	0.13	0	0.07	0	0	0.07	1
					STD ERROR	0.25	0	0	0.12	0	0	0.11	0.09	0	0.07	0	0	0.07	0

						LIVER LESIONS												
#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	PCA	FW	NEM	HVW	EP
1.	50136	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 064	3	3	0	1	0	0	0	1	0	0	0	0	0	1
2.	50137	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 023	3	3	0	1	0	0	0	0	0	0	0	0	0	1
3.	50138	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 108	3	3	0	0	0	0	0	0	0	0	0	0	0	1
4.	50139	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 080	3	3	0	1	0	0	0	0	0	0	0	0	1	1
5.	50140	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 003	3	3	0	0	0	0	0	0	0	0	0	0	0	1
6.	50141	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 026	3	3	0	1	0	2	0	0	0	0	0	0	0	1
7.	50142	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 044	3	2	0	1	0	0	0	0	0	0	0	0	0	0
8.	50143	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 088	3	1	0	3	0	0	0	3	0	0	0	0	0	1
9.	50144	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 029	3	3	0	0	0	0	0	0	0	0	0	0	0	1
10.	50145	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 006	2	2	0	0	0	0	1	0	1	0	0	0	0	1
11.	50146	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 076	3	2	0	0	0	0	0	0	1	0	0	0	0	1
12.	50147	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 089	3	3	0	0	0	1	0	0	0	0	0	0	0	1
13.	50148	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 125	3	0	0	1	0	0	0	0	0	0	0	0	0	1
14.	50149	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 096	2	0	0	0	0	0	0	0	0	0	0	0	0	1
15.	50150	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 007	3	0	1	1	0	0	0	3	0	0	0	0	0	1
					SUM	43	31	1	10	0	3	1	7	2	0	0	0	1	14
					AVERAGE	2.87	2.07	0.07	0.67	0	0.2	0.07	0.47	0.13	0	0	0	0.07	0.93
					STD ERROR	0.09	0.32	0.07	0.21	0	0.14	0.07	0.27	0.09	0	0	0	0.07	0.07

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Appendix 15c. Goby Biomarker Study. Histopathology of the Liver.

LESION ABBREVIATIONS:
1. GD = GLYCOGEN DEPLETION
2. LIP = LIPIDOSIS
3. EOI = EOSINOPHILIC CYTOPLASMIC INCLUSIONS
4. HMA = HEPATIC MACROPHAGE AGGREGATES
5. MM = MELANOMACROPHAGES
6. FBG = FOREIGN BODY GRANULOMA
7. LYM = LYMPHOCYTIC INFLAMMATION
8. IHN = INDIVIDUAL HEPATOCYTE NECROSIS
9. MEG = MEGALOCYTOSIS
10. FCA = FOCI OF CELLULAR ALTERATION
11. FW = FIBRIN WHORLS
12. NEM = NEMATODES
13. HVW = HYALINIZATION OF VESSEL WALLS
14. EP = EXOCRINE PANCREAS (1 = PRESENT; 2 = ABSENT)

Scores:
0 = not present
1 = mild
2 = moderate
3 = severe

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LIVER LESIONS GD	LIP	EOI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50001	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 016	2	1	0	1	0	0	1	0	1	0	0	0	0	0
2.	50002	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 077	2	0	0	0	0	0	0	0	1	0	0	0	0	1
3.	50003	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 063	3	0	0	0	0	0	0	1	0	0	0	0	0	1
4.	50004	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 103	3	0	0	1	0	0	0	1	0	0	0	0	0	1
5.	50005	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 001	2	0	0	0	0	0	0	1	0	1	0	0	0	1
6.	50006	40016	TERM ISLAND STOP	BW. CUSK EEL	93H 63 - 013	3	3	0	0	0	1	0	0	0	0	0	1	1	0
7.	50007	40016	TERM ISLAND STOP	YELLOWFIN GOBY	93H 63 - 011	3	3	0	0	0	0	0	1	0	0	0	0	0	1
8.	50121	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 050	1	0	0	0	0	0	1	0	0	0	0	0	0	0
9.	50122	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 038	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10.	50123	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 039	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.	50124	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 032	1	0	0	2	0	0	1	0	0	0	0	0	0	0
12.	50125	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 122	3	0	0	0	0	0	0	0	0	0	0	0	0	1
13.	50126	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 019	0	0	0	0	0	0	0	0	0	0	0	0	1	0
14.	50127	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 090	2	0	0	0	0	0	0	0	0	0	0	0	0	0
15.	50128	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 055	2	0	0	0	0	0	1	0	0	0	0	0	0	0
16.	50129	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 045	1	0	0	1	0	1	0	0	0	0	0	0	0	0
17.	50130	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 100	3	0	0	1	0	0	1	0	0	0	0	0	0	0
18.	50131	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 037	2	0	0	1	0	0	1	0	1	0	0	0	0	0
19.	50132	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 052	2	0	0	2	0	0	0	0	0	0	0	0	0	0
20.	50133	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 004	0	0	0	0	0	0	0	0	0	0	0	0	1	0
21.	50134	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 087	3	0	0	1	0	0	0	0	0	0	0	0	0	0
22.	50135	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 010	2	0	0	0	0	0	0	0	0	0	0	0	0	0
					SUM	41	7	0	10	0	2	6	4	3	1	0	1	3	6
					AVERAGE	1.86	0.32	0	0.45	0	0.09	0.27	0.18	0.14	0.05	0	0.05	0.14	0.27
					STD ERROR	0.22	0.19	0	0.14	0	0.06	0.1	0.08	0.07	0.05	0	0.05	0.07	0.1

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LIVER LESIONS GD	LIP	EOI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50181	40032	POLA 19	WHITE CROAKER	93H 63 - 021	3	0	0	0	0	0	1	0	0	0	0	0	0	1
2.	50182	40032	POLA 19	WHITE CROAKER	93H 63 - 123	3	0	0	0	0	0	0	1	0	0	0	0	0	1
3.	50183	40032	POLA 19	BW. CUSK EEL	93H 63 - 114	2	2	0	1	0	0	0	0	0	0	0	0	1	0
4.	50184	40032	POLA 19	TONGUE FISH	93H 63 - 034	1	0	0	2	0	0	0	0	0	0	0	0	1	0
5.	50185	40032	POLA 19	TONGUE FISH	93H 63 - 027	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.	50186	40032	POLA 19	TONGUE FISH	93H 63 - 084	2	0	0	0	0	0	0	0	0	0	0	0	0	0
7.	50187	40032	POLA 19	TONGUE FISH	93H 63 - 106	2	0	0	0	0	0	0	1	0	0	0	0	0	0
8.	50188	40032	POLA 19	WHITE CROAKER	93H 63 - 092	2	1	0	2	0	0	0	1	0	0	0	0	0	1
9.	50189	40032	POLA 19	WHITE CROAKER	93H 63 - 073	2	1	0	0	0	0	0	2	0	0	0	0	0	1
10.	50190	40032	POLA 19	WHITE CROAKER	93H 63 - 054	3	1	0	1	0	0	0	1	0	0	0	0	0	1
					SUM	20	5	0	6	0	0	1	6	0	0	0	0	2	5
					AVERAGE	2	0.5	0	0.6	0	0	0.1	0.6	0	0	0	0	0.2	0.5
					STD ERROR	0.3	0.22	0	0.27	0	0	0.1	0.22	0	0	0	0	0.13	0.17

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	LIVER LESIONS GD	LIP	EOI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50046	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 033	2	2	0	0	1	0	2	0	0	0	0	0	0	0
2.	50047	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 082	2	2	0	0	1	0	2	0	0	0	1	0	0	0
3.	50048	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 112	2	1	0	0	2	0	1	0	0	0	0	0	1	0
4.	50049	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 014	2	2	0	0	3	0	0	0	0	0	1	0	0	0
5.	50050	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 041	2	2	0	0	3	0	1	0	1	0	0	0	0	0
6.	50051	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 057	3	3	0	0	0	0	0	0	0	0	0	0	0	1
7.	50052	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 005	0	0	0	0	0	0	0	0	0	0	2	0	0	0
8.	50053	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 072	2	2	0	0	3	0	0	0	0	0	0	0	0	0
9.	50054	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 115	2	2	0	0	1	0	1	0	0	0	0	0	0	0
10.	50055	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 040	3	3	0	0	2	0	0	0	1	0	0	0	0	0
11.	50056	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 113	2	2	0	0	1	0	1	0	0	0	0	0	0	0
12.	50057	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 071	3	3	0	0	0	0	0	0	0	0	0	0	0	1
					SUM	25	24	0	0	17	0	8	0	2	0	4	0	1	2
					AVERAGE	2.08	2	0	0	1.42	0	0.67	0	0.17	0	0.33	0	0.08	0.17
					STD ERROR	0.23	0.25	0	0	0.34	0	0.22	0	0.11	0	0.19	0	0.08	0.11

Appendix 15d. Goby Biomarker Study. Histopathology of the Yellowfin Goby Liver.

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50018	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 062	3	3	0	1	0	1	0	0	0	0	0	0	0	1
2.	50019	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 119	2	2	1	1	0	0	0	1	0	0	0	0	0	1
3.	50020	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	93H 63 - 012	3	3	0	1	0	0	0	0	0	0	0	0	0	1
					Average	2.667	2.667	0.333	1	0	0.333	0	0.333	0	0	0	0	0	1
					Standard Error	0.333	0.333	0.333	0	0	0.333	0	0.333	0	0	0	0	0	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50081	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 120	2	1	1	0	0	0	1	0	0	0	0	0	0	1
2.	50082	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 109	3	1	0	0	0	0	0	0	1	0	0	0	0	1
3.	50083	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 124	3	3	1	1	0	0	0	1	1	0	0	0	0	1
4.	50084	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	93H 63 - 117	2	2	0	0	0	0	0	0	1	0	0	0	1	1
					Average	2.5	1.75	0.5	0.25	0	0	0.25	0.25	0.75	0	0	0	0.25	1
					Standard Error	0.289	0.479	0.289	0.25	0	0	0.25	0.25	0.25	0	0	0	0.25	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50031	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 015	3	3	0	2	0	2	0	0	0	0	0	0	1	1
2.	50043	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 105	2	3	2	0	0	0	0	0	0	0	0	0	0	1
3.	50044	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 061	3	2	0	0	0	0	0	0	0	0	0	0	0	1
4.	50045	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 056	3	1	0	1	0	0	0	2	1	0	0	0	0	1
5.	50008	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 066	3	3	0	1	0	3	0	1	0	0	0	0	0	1
6.	50009	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 046	2	2	1	1	0	1	0	0	0	0	0	0	0	1
7.	50010	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	93H 63 - 074	2	2	0	0	0	0	0	0	0	0	0	0	0	1
					Average	2.571	2.286	0.429	0.714	0	0.857	0	0.429	0.143	0	0	0	0.143	1
					Standard Error	0.202	0.286	0.297	0.286	0	0.459	0	0.297	0.143	0	0	0	0.143	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50071	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 104	3	3	0	0	0	1	0	0	0	0	0	0	0	1
2.	50072	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	93H 63 - 049	3	0	0	0	0	0	0	0	0	0	0	0	0	1
					Average	3	1.5	0	0	0	0.5	0	0	0	0	0	0	0	1
					Standard Error	0	1.5	0	0	0	0.5	0	0	0	0	0	0	0	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50136	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 064	3	3	0	1	0	0	0	1	0	0	0	0	0	1
2.	50137	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 023	3	3	0	1	0	0	0	0	0	0	0	0	0	1
3.	50138	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 108	3	3	0	0	0	0	0	0	0	0	0	0	0	1
4.	50139	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 080	3	3	0	1	0	0	0	0	0	0	0	0	0	1
5.	50140	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 003	3	3	0	0	0	0	0	0	0	0	0	0	1	1
6.	50141	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 026	3	3	0	1	0	2	0	0	0	0	0	0	0	1
7.	50142	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 044	3	2	0	1	0	0	0	0	0	0	0	0	0	0
8.	50143	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 088	3	1	0	3	0	0	0	3	0	0	0	0	0	1
9.	50144	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 029	3	3	0	0	0	0	0	0	0	0	0	0	0	1
10.	50145	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 006	2	2	0	0	0	0	1	0	1	0	0	0	0	1
11.	50146	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 076	3	2	0	0	0	0	0	0	1	0	0	0	0	1
12.	50147	40015	ENTRANCE FISH HARBOR	YELLOWFIN GOBY	93H 63 - 089	3	3	0	0	0	1	0	0	0	0	0	0	0	1
					Average	2.917	2.583	0	0.667	0	0.25	0.083	0.333	0.167	0	0	0	0.083	0.917
					Standard Error	0.083	0.193	0	0.256	0	0.179	0.083	0.256	0.112	0	0	0	0.083	0.083

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50007	40016	TERM ISLAND STOP	YELLOWFIN GOBY	93H 63 - 011	3	3	0	0	0	0	0	1	0	0	0	0	0	1

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
1.	50051	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 057	3	3	0	0	0	0	0	0	0	0	0	0	0	1
2.	50057	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	93H 63 - 071	3	3	0	0	0	0	0	0	0	0	0	0	0	1
					Average	3	3	0	0	0	0	0	0	0	0	0	0	0	1
					Standard Error	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 15e.

Goby Biomarker Study. Histopathology of the White Croaker Liver.

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50016	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 030	3	1	0	1	0	0	0	0	0	0	0	0	1	1
2.	50017	40001	SOUTHWEST SLIP	WHITE CROAKER	93H 63 - 110	2	0	0	0	0	0	1	3	0	0	0	0	0	1
					Average	2.5	0.5	0	0.5	0	0	0.5	1.5	0	0	0	0	0.5	1
					Standard Error	0.5	0.5	0	0.5	0	0	0.5	1.5	0	0	0	0	0.5	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50076	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 043	2	0	0	1	0	0	0	3	0	0	0	0	0	1
2.	50077	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 083	1	0	0	0	0	0	0	0	0	0	0	0	0	1
3.	50078	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 091	3	0	0	0	0	0	0	0	0	0	0	0	0	1
4.	50079	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 118	2	0	0	1	0	0	0	1	1	1	0	0	0	1
5.	50080	40002	WEST BASIN PIER 143	WHITE CROAKER	93H 63 - 053	2	0	0	1	0	0	0	1	1	0	0	0	1	1
					Average	2	0	0	0.6	0	0	0	1	0.4	0.2	0	0	0.2	1
					Standard Error	0.32	0	0	0.24	0	0	0	0.55	0.24	0.2	0	0	0.2	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50032	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 028	2	0	0	1	0	0	0	1	0	0	0	0	0	1
2.	50033	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 035	1	1	0	0	0	0	0	0	1	0	0	0	0	1
3.	50034	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 093	2	0	0	0	0	0	0	0	0	0	1	0	0	1
4.	50035	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 058	3	0	0	1	0	0	0	0	0	0	0	0	0	1
5.	50036	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 051	2	0	0	1	0	0	1	0	0	0	0	0	0	1
6.	50037	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 099	1	1	0	0	0	0	0	0	0	0	0	0	0	1
7.	50038	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 017	3	0	0	0	0	0	1	1	0	0	0	0	0	1
8.	50039	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 111	3	0	0	0	0	0	0	0	0	0	0	0	0	1
9.	50040	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 127	2	1	0	1	0	0	0	2	0	0	0	0	0	1
10.	50041	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 025	2	0	0	1	0	0	0	0	0	0	0	0	0	1
11.	50042	40006	CONSOLIDATED SLIP	WHITE CROAKER	93H 63 - 098	3	0	0	0	0	0	0	1	1	0	0	0	1	1
					Average	2.18	0.27	0	0.45	0	0	0.18	0.45	0.18	0	0.09	0	0.09	1
					Standard Error	0.23	0.14	0	0.16	0	0	0.12	0.21	0.12	0	0.09	0	0.09	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50061	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 059	2	1	0	1	0	0	0	2	0	0	0	0	0	1
2.	50062	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 009	2	0	0	0	0	0	0	0	0	0	0	0	0	1
3.	50063	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 075	2	2	0	0	0	0	0	0	0	0	0	0	0	1
4.	50064	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 079	3	0	0	0	0	0	0	0	0	0	0	0	0	1
5.	50070	40007	LONG BEACH HBR, CH2	WHITE CROAKER	93H 63 - 085	2	0	0	0	0	0	0	0	0	0	0	0	0	1
					Average	2.2	0.6	0	0.2	0	0	0	0.4	0	0	0	0	0	1
					Standard Error	0.2	0.4	0	0.2	0	0	0	0.4	0	0	0	0	0	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50091	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 102	3	0	0	0	0	0	0	1	0	0	0	0	0	1
2.	50092	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 048	0	0	0	1	0	0	0	0	0	0	0	0	0	1
3.	50093	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 086	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4.	50094	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 095	1	0	0	0	0	0	0	0	0	1	0	0	0	1
5.	50095	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 068	1	0	0	1	0	0	1	0	0	0	0	0	0	1
6.	50096	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 069	2	0	0	0	0	0	0	1	0	0	0	0	0	1
7.	50097	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 126	0	0	0	0	0	0	0	0	0	0	0	0	0	1
8.	50098	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 008	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9.	50099	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 107	0	0	0	1	0	0	0	0	0	0	0	0	0	1
10.	50100	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 081	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11.	50101	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 078	0	0	0	0	0	0	1	0	0	0	0	0	0	1
12.	50102	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 097	1	0	0	1	0	0	1	0	0	0	0	0	0	1
13.	50103	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 018	0	0	0	0	0	0	0	0	0	0	0	0	1	1
14.	50104	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 101	2	0	0	0	0	0	0	0	0	0	0	0	0	1
15.	50105	40013	INNER QUEENSWAY BAY	WHITE CROAKER	93H 63 - 121	1	0	0	0	0	0	0	0	0	0	0	0	0	1
					Average	0.73	0	0	0.27	0	0	0.2	0.13	0	0.07	0	0	0.07	1
					Standard Error	0.25	0	0	0.12	0	0	0.11	0.09	0	0.07	0	0	0.07	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50148	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 125	3	0	0	1	0	0	0	0	0	0	0	0	0	1
2.	50149	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 096	2	0	0	0	0	0	0	0	0	0	0	0	0	1
3.	50150	40015	ENTRANCE FISH HARBOR	WHITE CROAKER	93H 63 - 007	3	0	1	1	0	0	0	3	0	0	0	0	0	1
					Average	2.67	0	0.33	0.67	0	0	0	1	0	0	0	0	0	1
					Standard Error	0.33	0	0.33	0.33	0	0	0	1	0	0	0	0	0	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50003	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 063	3	0	0	0	0	0	0	1	0	0	0	0	0	1
2.	50004	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 103	3	0	0	1	0	0	0	1	0	0	0	0	0	1
3.	50005	40016	TERM ISLAND STOP	WHITE CROAKER	93H 63 - 001	2	0	0	0	0	0	0	1	0	1	0	0	0	1
					Average	2.67	0	0	0.33	0	0	0	1	0	0.33	0	0	0	1
					Standard Error	0.33	0	0	0.33	0	0	0	0	0	0.33	0	0	0	0

#	ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	PBG	LYM	IHN	MEG	PCA	PW	NEM	HVW	EP
1.	50181	40032	POLA 19	WHITE CROAKER	93H 63 - 021	3	0	0	0	0	0	1	0	0	0	0	0	0	1
2.	50182	40032	POLA 19	WHITE CROAKER	93H 63 - 123	3	0	0	0	0	0	0	1	0	0	0	0	0	1
3.	50188	40032	POLA 19	WHITE CROAKER	93H 63 - 092	2	1	0	2	0	0	0	1	0	0	0	0	0	1
4.	50189	40032	POLA 19	WHITE CROAKER	93H 63 - 073	2	1	0	0	0	0	0	2	0	0	0	0	0	1
5.	50190	40032	POLA 19	WHITE CROAKER	93H 63 - 054	3	1	0	1	0	0	0	1	0	0	0	0	0	1
					Average	2.6	0.6	0	0.6	0	0	0.2	1	0	0	0	0	0	1
					Standard Error	0.24	0.24	0	0.4	0	0	0.2	0.32	0	0	0	0	0	0

Appendix 15f.

Goby Biomarker Study. Histopathology of Tonguefish Liver.

ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50085	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 065	2	0	0	0	0	0	0	0	0	0	0	0	0	0
50086	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 067	3	0	3	0	0	0	0	0	0	0	0	0	0	0
50087	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 060	3	0	0	0	0	0	0	0	0	0	0	0	0	0
50088	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 022	3	0	1	0	0	0	0	1	0	0	0	0	0	0
50089	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 094	3	0	0	0	0	0	0	0	0	0	0	0	0	0
50090	40002	WEST BASIN PIER 143	TONGUE FISH	93H 63 - 002	1	0	1	0	0	0	0	0	2	0	0	0	0	0
				Average	2.5	0	0.83	0	0	0	0	0.17	0.33	0	0	0	0	0
				Standard Error	0.34	0	0.48	0	0	0	0	0.17	0.33	0	0	0	0	0

ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50073	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 047	3	0	0	0	0	0	0	0	0	0	0	0	0	0
50074	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 020	3	0	0	0	0	0	0	0	0	0	0	0	0	0
50075	40007	LONG BEACH HBR, CH2	TONGUE FISH	93H 63 - 036	3	0	0	0	0	0	0	1	0	0	0	0	0	0
				Average	3	0	0	0	0	0	0	0.33	0	0	0	0	0	0
				Standard Error	0	0	0	0	0	0	0	0.333	0	0	0	0	0	0

ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50001	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 016	2	1	0	1	0	0	1	0	1	0	0	0	0	0
50002	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 077	2	0	0	0	0	0	0	0	1	0	0	0	0	1
50121	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 050	1	0	0	0	0	0	1	0	0	0	0	0	0	0
50122	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 038	1	0	0	0	0	0	0	0	0	0	0	0	0	0
50123	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 039	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50124	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 032	1	0	0	2	0	0	1	0	0	0	0	0	0	0
50125	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 122	3	0	0	0	0	0	0	0	0	0	0	0	0	1
50126	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 019	0	0	0	0	0	0	0	0	0	0	0	0	1	0
50127	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 090	2	0	0	0	0	0	0	0	0	0	0	0	0	0
50128	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 055	2	0	0	0	0	0	1	0	0	0	0	0	0	0
50129	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 045	1	0	0	1	0	1	0	0	0	0	0	0	0	0
50130	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 100	3	0	0	1	0	0	1	0	0	0	0	0	0	0
50131	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 037	2	0	0	1	0	0	1	0	1	0	0	0	0	0
50132	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 052	2	0	0	2	0	0	0	0	0	0	0	0	0	0
50133	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 004	0	0	0	0	0	0	0	0	0	0	0	0	1	0
50134	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 087	3	0	0	1	0	0	0	0	0	0	0	0	0	0
50135	40016	TERM ISLAND STOP	TONGUE FISH	93H 63 - 010	2	0	0	0	0	0	0	0	0	0	0	0	0	0
				Average	1.59	0.06	0	0.53	0	0.06	0.35	0	0.18	0	0	0	0.12	0.12
				Standard Error	0.24	0.06	0	0.17	0	0.06	0.12	0	0.1	0	0	0	0.08	0.08

ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50184	40032	POLA 19	TONGUE FISH	93H 63 - 034	1	0	0	2	0	0	0	0	0	0	0	0	1	0
50185	40032	POLA 19	TONGUE FISH	93H 63 - 027	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50186	40032	POLA 19	TONGUE FISH	93H 63 - 084	2	0	0	0	0	0	0	0	0	0	0	0	0	0
50187	40032	POLA 19	TONGUE FISH	93H 63 - 106	2	0	0	0	0	0	0	1	0	0	0	0	0	0
				Average	1.25	0	0	0.5	0	0	0	0.25	0	0	0	0	0.25	0
				Standard Error	0.48	0	0	0.5	0	0	0	0.25	0	0	0	0	0.25	0

g. Goby Biomarker Study. Histopathology of Cusk-eel Liver.

ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50065	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 031	3	0	0	0	0	0	0	0	0	0	0	0	1	0
50066	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 070	1	0	0	0	0	0	0	0	0	0	0	0	0	0
50067	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 116	3	0	0	0	0	0	0	0	0	0	0	0	1	0
50068	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 024	3	0	0	0	0	0	0	0	1	0	0	0	0	0
50069	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	93H 63 - 042	3	0	0	0	0	0	0	0	0	1	0	0	0	0
				Average	2.6	0	0	0	0	0	0	0	0.2	0.2	0	0	0.4	0
				Standard Error	0.4	0	0	0	0	0	0	0	0.2	0.2	0	0	0.245	0
50006	40016	TERM ISLAND STOP	BW. CUSK EEL	93H 63 - 013	3	3	0	0	0	1	0	0	0	0	0	1	1	0
50183	40032	POLA 19	BW. CUSK EEL	93H 63 - 114	2	2	0	1	0	0	0	0	0	0	0	0	1	0

5h. Goby Biomarker Study. Histopathology of Stingray Livers.

					LIVER LESIONS													
ID #	SITE #	SITE NAME	SPECIES	UCD Random ID #	GD	LIP	ECI	HMA	MM	FBG	LYM	IHN	MEG	FCA	FW	NEM	HVW	EP
50046	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 033	2	2	0	0	1	0	2	0	0	0	0	0	0	0
50047	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 082	2	2	0	0	1	0	2	0	0	0	1	0	0	0
50048	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 112	2	1	0	0	2	0	1	0	0	0	0	0	1	0
50049	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 014	2	2	0	0	3	0	0	0	0	0	1	0	0	0
50050	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 041	2	2	0	0	3	0	1	0	1	0	0	0	0	0
50052	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 005	0	0	0	0	0	0	0	0	0	0	2	0	0	0
50053	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 072	2	2	0	0	3	0	0	0	0	0	0	0	0	0
50054	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 115	2	2	0	0	1	0	1	0	0	0	0	0	0	0
50055	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 040	3	3	0	0	2	0	0	0	1	0	0	0	0	0
50056	80027	HUNTINGTON HBR, MID	STINGRAY	93H 63 - 113	2	2	0	0	1	0	1	0	0	0	0	0	0	0
				Average	1.9	1.8	0	0	1.7	0	0.8	0	0.2	0	0.4	0	0.1	0
				Standard Error	0.233	0.249	0	0	0.335	0	0.249	0	0.133	0	0.221	0	0.1	0

5a. Goby Biomarker Study. P450 Immunohistochemistry of Fixed Tissues.

sion Abbreviations:

GPC = gill pillar cell
GEC = gill epithelial cell
E-GA = endothelium of gill arch
4. GO-VE = gonadal vascular endothelium
5. SVE = splenic vascular endothelium
6. HEP = hepatocytes
7. BD = bile ducts
8. LVE = liver vascular endothelium
9. KT = kidney tubules
10. KVE = kidney vascular endothelium
11. IVE = intestinal vascular endothelium
12. IE = intestinal epithelium
13. NP = not present
14. ND = not done
15. NA = not applicable

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40001	SOUTHWEST SLIP	WHITE CROAKER	50016	93H 63 - 030	15	15	12	0	4	3	NP	9	NP	NP	NP	NP
2.	40001	SOUTHWEST SLIP	WHITE CROAKER	50017	93H 63 - 110	15	15	15	12	9	15	0	12	NP	NP	NP	NP
3.	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50018	93H 63 - 062	10	10	12	0	0	4	NP	0	NP	NP	NP	NP
4.	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50019	93H 63 - 119	0	8	6	6	6	0	0	0	NP	NP	NP	NP
5.	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50020	93H 63 - 012	12	12	4	0	9	3	NP	9	4	6	NP	NP
					SUM	52	60	49	18	28	25	0	30	4	6	NA	NA
					AVERAGE	10.4	12	9.8	3.6	5.6	5	0	6	4	6	NA	NA
					STD ERROR	2.77	1.38	2.06	2.4	1.69	2.59	0	2.51	NA	NA	NA	NA

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40002	WEST BASIN PIER 143	WHITE CROAKER	50076	93H 63 - 043	15	15	15	NP	NP	12	NP	15	NP	NP	NP	NP
2.	40002	WEST BASIN PIER 143	WHITE CROAKER	50077	93H 63 - 083	15	15	15	15	15	9	NP	12	NP	NP	NP	NP
3.	40002	WEST BASIN PIER 143	WHITE CROAKER	50078	93H 63 - 091	15	15	15	NP	15	15	NP	15	NP	NP	NP	NP
4.	40002	WEST BASIN PIER 143	WHITE CROAKER	50079	93H 63 - 118	15	15	15	12	12	15	0	12	NP	NP	NP	NP
5.	40002	WEST BASIN PIER 143	WHITE CROAKER	50080	93H 63 - 053	15	15	15	12	0	6	NP	0	NP	NP	NP	NP
6.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50081	93H 63 - 120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50082	93H 63 - 109	6	0	0	0	12	8	NP	0	6	6	NP	NP
8.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50083	93H 63 - 124	0	0	0	0	0	0	0	0	2	0	NP	NP
9.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50084	93H 63 - 117	8	0	0	0	0	0	0	0	NP	NP	NP	NP
0.	40002	WEST BASIN PIER 143	TONGUE FISH	50085	93H 63 - 065	15	0	15	NP	12	15	NP	15	6	15	15	8
1.	40002	WEST BASIN PIER 143	TONGUE FISH	50086	93H 63 - 067	0	0	0	NP	NP	0	NP	0	NP	NP	NP	NP
2.	40002	WEST BASIN PIER 143	TONGUE FISH	50087	93H 63 - 060	10	0	NP	NP	12	15	NP	15	NP	NP	15	15
3.	40002	WEST BASIN PIER 143	TONGUE FISH	50088	93H 63 - 022	12	0	3	15	15	12	NP	15	NP	NP	NP	NP
4.	40002	WEST BASIN PIER 143	TONGUE FISH	50089	93H 63 - 094	12	0	6	12	12	15	NP	15	12	4	15	12
5.	40002	WEST BASIN PIER 143	TONGUE FISH	50090	93H 63 - 002	15	0	15	NP	NP	15	NP	15	8	15	15	15
					SUM	153	75	114	66	105	137	0	129	34	40	60	50
					AVERAGE	10.92	5.36	8.77	8.25	9.55	9.79	0	9.21	6.8	8	15	12.5
					STD ERROR	1.47	1.99	1.99	2.45	1.89	1.62	0	1.92	1.62	3.02	0	0.89

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50008	93H 63 - 066	8	8	12	NP	4	6	NP	9	NP	NP	NP	NP
2.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50009	93H 63 - 046	0	0	0	NP	12	3	NP	6	NP	NP	NP	NP
3.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50010	93H 63 - 074	0	0	0	0	0	0	NP	0	NP	NP	0	0
4.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50031	93H 63 - 015	8	0	4	0	0	0	NP	0	NP	NP	NP	NP
5.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50032	93H 63 - 028	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
6.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50033	93H 63 - 035	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50034	93H 63 - 093	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
8.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50035	93H 63 - 058	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50036	93H 63 - 051	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50037	93H 63 - 099	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50038	93H 63 - 017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50039	93H 63 - 111	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50040	93H 63 - 127	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
14.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50041	93H 63 - 025	15	15	6	NP	12	9	NP	12	NP	NP	NP	NP
15.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50042	93H 63 - 098	15	15	15	0	18	18	NP	18	NP	NP	NP	NP
16.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50043	93H 63 - 105	0	6	0	0	0	6	0	4	NP	NP	NP	NP
17.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50044	93H 63 - 061	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
18.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50045	93H 63 - 056	3	0	0	0	3	3	NP	4	NP	NP	NP	NP
					SUM	49	44	37	0	49	45	0	53	0	0	0	0
					AVERAGE	5.44	4.89	4.11	0	5.44	5	0	5.89	NA	NA	0	0
					STD ERROR	2.11	2.16	1.93	0	2.27	1.94	NA	2.06	NA	NA	NA	NA

16b. Goby Biomarker Study. P450 Immunohistochemistry of Fixed Tissues.

Lesion Abbreviations:

1. GPC = gill pillar cell
2. GEC = gill epithelial cell
3. B-GA = endothelium of gill arch
4. GO-VE = gonadal vascular endothelium
5. SVE = splenic vascular endothelium
6. HEP = hepatocytes
7. BD = bile ducts
8. LVE = liver vascular endothelium
9. KT = kidney tubules
10. KVE = kidney vascular endothelium
11. IVE = intestinal vascular endothelium
12. IE = intestinal epithelium
13. NP = not present
14. ND = not done
15. NA = not applicable

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50061	93H 63 - 059	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50062	93H 63 - 009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50063	93H 63 - 075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50064	93H 63 - 079	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
5.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50065	93H 63 - 031	6	0	0	NP	12	10	NP	12	NP	NP	NP	NP
6.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50066	93H 63 - 070	0	0	0	0	0	0	0	0	NP	NP	NP	NP
7.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50067	93H 63 - 116	9	0	6	NP	12	15	0	0	NP	NP	NP	NP
8.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50068	93H 63 - 024	2	0	2	0	NP	6	NP	0	NP	NP	0	0
9.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50069	93H 63 - 042	9	0	0	NP	15	12	12	NP	NP	NP	NP	NP
10.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50070	93H 63 - 085	15	15	15	15	15	15	12	15	NP	NP	NP	NP
11.	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50071	93H 63 - 104	0	0	0	0	0	0	0	0	NP	NP	NP	NP
12.	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50072	93H 63 - 049	9	0	6	NP	0	15	NP	0	NP	NP	NP	NP
13.	40007	LONG BEACH HBR, CH2	TONGUE FISH	50073	93H 63 - 047	10	0	12	NP	9	9	NP	12	NP	NP	10	12
14.	40007	LONG BEACH HBR, CH2	TONGUE FISH	50074	93H 63 - 020	10	0	8	9	NP	9	NP	15	NP	NP	15	NP
15.	40007	LONG BEACH HBR, CH2	TONGUE FISH	50075	93H 63 - 036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
					SUM	70	15	49	24	63	91	24	54	0	0	25	12
					AVERAGE	7	1.5	4.9	4.8	7.88	9.1	4.8	6	NA	NA	8.33	6
					STD ERROR	1.56	1.5	1.72	3.09	2.4	1.79	2.94	2.4	NA	NA	4.41	6

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50091	93H 63 - 102	12	8	0	0	0	12	0	6	NP	NP	NP	NP
2.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50092	93H 63 - 048	8	0	8	0	0	3	NP	3	NP	NP	NP	NP
3.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50093	93H 63 - 086	8	0	8	12	2	6	0	2	NP	NP	NP	NP
4.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50094	93H 63 - 095	4	0	0	0	0	0	NP	0	NP	NP	NP	NP
5.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50095	93H 63 - 068	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
6.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50096	93H 63 - 069	0	0	0	0	0	0	0	0	NP	NP	NP	NP
7.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50097	93H 63 - 126	10	0	0	0	0	9	0	NP	NP	NP	NP	NP
8.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50098	93H 63 - 008	15	15	15	0	0	3	NP	3	NP	NP	NP	NP
9.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50099	93H 63 - 107	12	0	12	9	9	9	NP	12	NP	NP	NP	NP
10.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50100	93H 63 - 081	15	0	0	0	0	3	NP	9	NP	NP	NP	NP
11.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50101	93H 63 - 078	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
12.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50102	93H 63 - 097	9	0	9	0	9	9	0	0	NP	NP	NP	NP
13.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50103	93H 63 - 018	15	15	15	15	9	12	NP	15	NP	NP	15	9
14.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50104	93H 63 - 101	12	12	12	12	9	15	0	6	NP	NP	NP	NP
15.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50105	93H 63 - 121	8	8	6	NP	4	15	0	9	NP	NP	NP	NP
					SUM	128	58	85	48	42	96	0	65	0	0	15	9
					AVERAGE	8.53	3.87	5.67	3.43	2.8	6.4	0	4.64	NA	NA	15	9
					STD ERROR	1.39	1.54	1.55	1.54	1.04	1.43	0	1.33	NA	NA	NA	NA

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50136	93H 63 - 064	0	0	0	NP	0	0	NP	0	NP	NP	NP	NP
2.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50137	93H 63 - 023	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
3.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50138	93H 63 - 108	0	0	0	0	0	3	0	0	NP	NP	NP	NP
4.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50139	93H 63 - 080	0	0	9	0	0	0	0	0	NP	NP	NP	NP
5.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50140	93H 63 - 003	0	0	0	NP	0	0	NP	0	0	0	NP	NP
6.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50141	93H 63 - 026	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
7.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50142	93H 63 - 044	0	0	0	NP	0	0	NP	0	NP	NP	NP	NP
8.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50143	93H 63 - 088	0	0	12	0	0	0	0	0	NP	NP	NP	NP
9.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50144	93H 63 - 029	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
10.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50145	93H 63 - 006	0	0	4	0	0	0	NP	0	NP	NP	NP	NP
11.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50146	93H 63 - 076	0	0	0	0	0	0	0	0	NP	NP	NP	NP
12.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50147	93H63 - 089	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
13.	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50148	93H 63 - 125	6	6	4	0	0	12	0	0	NP	NP	NP	NP
14.	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50149	93H 63 - 096	10	10	6	0	6	6	NP	0	NP	NP	NP	NP
15.	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50150	93H 63 - 007	15	15	15	NP	12	15	NP	15	NP	NP	NP	NP
					SUM	31	31	50	0	18	36	0	15	0	0	0	0
					AVERAGE	2.21	2.21	3.57	0	1.29	2.57	0	1.07	0	0	NA	NA
					STD ERROR	1.27	1.27	1.37	0	0.93	1.33	0	1.07	NA	NA	NA	NA

6c. Goby Biomarker Study. P450 Immunohistochemistry of Fixed Tissues.

sion Abbreviations:

GPC = gill pillar cell
GEC = gill epithelial cell
E-GA = endothelium of gill arch
4. GO-VE = gonadal vascular endothelium
5. SVE = splenic vascular endothelium
6. HEP = hepatocytes
7. BD = bile ducts
8. LVE = liver vascular endothelium
9. KT = kidney tubules
10. KVE = kidney vascular endothelium
11. IVE = intestinal vascular endothelium
12. IE = intestinal epithelium
13. NP = not present
14. ND = not done
15. NA = not applicable

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40016	TERM ISLAND STOP	TONGUE FISH	50001	93H 63 - 016	6	0	0	0	0	0	NP	0	NP	NP	0	0
2.	40016	TERM ISLAND STOP	TONGUE FISH	50002	93H 63 - 077	0	0	0	0	0	0	0	0	NP	NP	0	0
3.	40016	TERM ISLAND STOP	WHITE CROAKER	50003	93H 63 - 063	8	0	0	0	0	9	NP	0	NP	NP	NP	NP
4.	40016	TERM ISLAND STOP	WHITE CROAKER	50004	93H 63 - 103	12	8	6	0	0	12	0	0	NP	NP	NP	NP
5.	40016	TERM ISLAND STOP	WHITE CROAKER	50005	93H 63 - 001	15	15	15	0	0	12	NP	12	NP	NP	NP	NP
6.	40016	TERM ISLAND STOP	BW. CUSK EEL	50006	93H 63 - 013	0	0	0	NP	0	0	NP	0	NP	NP	0	0
7.	40016	TERM ISLAND STOP	YELLOWFIN GOBY	50007	93H 63 - 011	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
8.	40016	TERM ISLAND STOP	TONGUE FISH	50121	93H 63 - 050	10	0	0	0	0	0	NP	0	NP	NP	NP	NP
9.	40016	TERM ISLAND STOP	TONGUE FISH	50122	93H 63 - 038	15	0	NP	0	0	0	NP	0	NP	NP	0	0
10.	40016	TERM ISLAND STOP	TONGUE FISH	50123	93H 63 - 039	12	0	0	0	0	0	NP	0	NP	NP	NP	NP
11.	40016	TERM ISLAND STOP	TONGUE FISH	50124	93H 63 - 032	8	0	0	NP	0	15	NP	0	NP	NP	NP	NP
12.	40016	TERM ISLAND STOP	TONGUE FISH	50125	93H 63 - 122	4	0	0	0	0	9	NP	NP	NP	NP	NP	NP
13.	40016	TERM ISLAND STOP	TONGUE FISH	50126	93H 63 - 019	10	8	0	9	3	6	NP	12	NP	NP	NP	NP
14.	40016	TERM ISLAND STOP	TONGUE FISH	50127	93H 63 - 090	12	0	12	12	6	6	0	12	NP	NP	NP	NP
15.	40016	TERM ISLAND STOP	TONGUE FISH	50128	93H 63 - 055	8	0	6	0	NP	0	NP	0	NP	NP	NP	NP
16.	40016	TERM ISLAND STOP	TONGUE FISH	50129	93H 63 - 045	6	0	2	0	0	0	NP	0	NP	NP	NP	NP
17.	40016	TERM ISLAND STOP	TONGUE FISH	50130	93H 63 - 100	10	0	0	9	6	3	0	12	NP	NP	NP	NP
18.	40016	TERM ISLAND STOP	TONGUE FISH	50131	93H 63 - 037	6	0	0	0	0	0	NP	0	NP	NP	NP	NP
19.	40016	TERM ISLAND STOP	TONGUE FISH	50132	93H 63 - 052	8	0	0	NP	0	0	NP	0	NP	NP	NP	NP
20.	40016	TERM ISLAND STOP	TONGUE FISH	50133	93H 63 - 004	15	0	0	NP	0	0	NP	0	0	0	NP	NP
21.	40016	TERM ISLAND STOP	TONGUE FISH	50134	93H 63 - 087	8	0	0	0	0	0	0	0	NP	NP	NP	NP
22.	40016	TERM ISLAND STOP	TONGUE FISH	50135	93H 63 - 010	15	0	0	0	0	0	NP	4	NP	NP	NP	NP
					SUM	188	31	41	30	15	72	0	52	0	0	0	0
					AVERAGE	8.55	1.41	1.95	1.67	0.71	3.27	0	2.48	0	0	0	0
					STD ERROR	1.01	0.82	0.91	0.91	0.41	1.06	0	1.05	NA	NA	0	0

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40032	POLA 19	WHITE CROAKER	50181	93H 63 - 021	3	0	2	0	0	6	NP	0	NP	NP	NP	NP
2.	40032	POLA 19	WHITE CROAKER	50182	93H 63 - 123	4	0	0	0	0	6	NP	NP	NP	NP	NP	NP
3.	40032	POLA 19	BW. CUSK EEL	50183	93H 63 - 114	4	0	0	0	0	0	0	0	NP	NP	NP	NP
4.	40032	POLA 19	TONGUE FISH	50184	93H 63 - 034	8	0	0	0	0	0	NP	0	NP	NP	NP	NP
5.	40032	POLA 19	TONGUE FISH	50185	93H 63 - 027	6	0	0	0	0	0	NP	0	NP	NP	NP	NP
6.	40032	POLA 19	TONGUE FISH	50186	93H 63 - 084	8	0	0	NP	6	0	0	4	NP	NP	NP	NP
7.	40032	POLA 19	TONGUE FISH	50187	93H 63 - 106	8	0	0	0	0	0	0	0	NP	NP	0	12
8.	40032	POLA 19	WHITE CROAKER	50188	93H 63 - 092	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
9.	40032	POLA 19	WHITE CROAKER	50189	93H 63 - 073	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
10.	40032	POLA 19	WHITE CROAKER	50190	93H 63 - 054	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
					SUM	41	0	2	0	6	12	0	4	0	0	0	12
					AVERAGE	5.86	0	0.29	0	0.86	1.71	0	0.67	NA	NA	0	12
					STD ERROR	0.83	0	0.29	0	0.86	1.11	0	0.67	NA	NA	NA	NA

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GILL			GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
						GPC	GEC	E-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	80027	HUNTINGTON HBR, MID	STINGRAY	50046	93H 63 - 033	4	0	4	NP	0	9	0	0	NP	NP	NP	NP
2.	80027	HUNTINGTON HBR, MID	STINGRAY	50047	93H 63 - 082	4	0	4	NP	4	9	0	4	NP	NP	NP	NP
3.	80027	HUNTINGTON HBR, MID	STINGRAY	50048	93H 63 - 112	0	6	4	12	9	12	0	0	NP	NP	NP	NP
4.	80027	HUNTINGTON HBR, MID	STINGRAY	50049	93H 63 - 014	12	6	12	12	12	0	NP	0	NP	NP	NP	NP
5.	80027	HUNTINGTON HBR, MID	STINGRAY	50050	93H 63 - 041	6	0	4	0	0	9	0	0	NP	NP	NP	NP
6.	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	50051	93H 63 - 057	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
7.	80027	HUNTINGTON HBR, MID	STINGRAY	50052	93H 63 - 005	9	0	0	NP	0	12	NP	0	0	0	NP	NP
8.	80027	HUNTINGTON HBR, MID	STINGRAY	50053	93H 63 - 072	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
9.	80027	HUNTINGTON HBR, MID	STINGRAY	50054	93H 63 - 115	12	0	NP	12	4	9	0	0	NP	NP	NP	NP
10.	80027	HUNTINGTON HBR, MID	STINGRAY	50055	93H 63 - 040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11.	80027	HUNTINGTON HBR, MID	STINGRAY	50056	93H 63 - 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12.	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	50057	93H 63 - 071	0	0	0	0	0	0	NP	0	NP	NP	0	0
					SUM	47	12	28	36	29	60	0	4	0	0	0	0
					AVERAGE	4.7	1.2	3.11	5.14	2.9	6	0	0.4	0	0	0	0
					STD ERROR	1.55	0.8	1.3	2.62	1.39	1.67	0	0.4	NA	NA	NA	NA

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5d. Goby Biomarker Study. P450 Immunohistochemistry of Fixed Tissues from Yellowfin Gobies.

						GILL		GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50018	93H 63 - 062	10	10	12	0	0	4		0				
40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50019	93H 63 - 119	0	8	6	6	6	0	0	0				
40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50020	93H 63 - 012	12	12	4	0	9	3		9	4	6		
				Average	7.33	10	7.33	2	5	2.33	0	3	4	6		
				Standard Error	3.71	1.15	2.4	2	2.65	1.2		3				
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50081	93H 63 - 120												
40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50082	93H 63 - 109	6	0	0	0	12	8		0	6	6		
40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50083	93H 63 - 124	0	0	0	0	0	0	0	0	2	0		
40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50084	93H 63 - 117	8	0	0	0	0	0	0	0				
				Average	4.67	0	0	0	4	2.67	0	0	4	3		
				Standard Error	2.4	0	0	0	4	2.67	0	0	2	3		
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50008	93H 63 - 066	8	8	12		4	6		9				
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50009	93H 63 - 046	0	0	0		12	3		6				
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50010	93H 63 - 074	0	0	0	0	0	0		0			0	0
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50031	93H 63 - 015	8	0	4	0	0	0		0				
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50043	93H 63 - 105	0	6	0	0	0	6	0	4				
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50044	93H 63 - 061	0	0	0	0	0	0		0				
40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50045	93H 63 - 056	3	0	0	0	3	3		4				
				Average	2.71	2	2.29	0	2.71	2.57	0	3.29			0	0
				Standard Error	1.43	1.31	1.71	0	1.67	1.02		1.32				
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50071	93H 63 - 104	0	0	0	0	0	0	0	0				
40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50072	93H 63 - 049	9	0	6		0	15		0				
				Average	4.5	0	3	0	0	7.5	0	0				
				Standard Error	4.5	0	3		0	7.5		0				
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50136	93H 63 - 064	0	0	0		0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50137	93H 63 - 023	0	0	0	0	0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50138	93H 63 - 108	0	0	0	0	0	3	0	0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50139	93H 63 - 080	0	0	9	0	0	0	0	0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50140	93H 63 - 003	0	0	0		0	0		0	0	0		
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50141	93H 63 - 026	0	0	0	0	0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50142	93H 63 - 044	0	0	0		0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50143	93H 63 - 088	0	0	12	0	0	0	0	0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50144	93H 63 - 029	0	0	0	0	0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50145	93H 63 - 006	0	0	4	0	0	0		0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50146	93H 63 - 076	0	0	0	0	0	0	0	0				
40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50147	93H63 - 089												
				Average	0	0	2.27	0	0	0.27	0	0	0	0		
				Standard Error	0	0	1.29	0	0	0.27	0	0				
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
40016	TERM ISLAND STOP	YELLOWFIN GOBY	50007	93H 63 - 011	0	0	0	0	0	0	NP	0	NP	NP	NP	NP
SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	50051	93H 63 - 057	0	0	0	0	0	0		0				
80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	50057	93H 63 - 071	0	0	0	0	0	0		0			0	0
				Average	0	0	0	0	0	0		0			0	0
				Standard Error	0	0	0	0	0	0		0				

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#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GILL GBC	B-GA	GONAD GO-VE	SPLEEN SVE	HEP	LIVER BD	LVE	KIDNEY KT	KVE	INTESTINE IVE	IE
1.	40001	SOUTHWEST SLIP	WHITE CROAKER	50016	93H63 - 030	15	15	12	0	4	3		9				
2.	40001	SOUTHWEST SLIP	WHITE CROAKER	50017	93H63 - 110	15	15	15	12	9	15	0	12				
					Average	15	15	13.5	6	6.5	9	0	10.5				
					Standard Error	0	0	1.5	6	2.5	6		1.5				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40002	WEST BASIN PIER 143	WHITE CROAKER	50076	93H63 - 043	15	15	15			12		15				
2.	40002	WEST BASIN PIER 143	WHITE CROAKER	50077	93H63 - 083	15	15	15	15	15	9		12				
3.	40002	WEST BASIN PIER 143	WHITE CROAKER	50078	93H63 - 091	15	15	15		15	15		15				
4.	40002	WEST BASIN PIER 143	WHITE CROAKER	50079	93H63 - 118	15	15	15	12	12	15	0	12				
5.	40002	WEST BASIN PIER 143	WHITE CROAKER	50080	93H63 - 053	15	15	15	12	0	6		0				
					Average	15	15	15	13	10.5	11.4	0	10.8				
					Standard Error	0	0	0	1	3.57	1.75		2.78				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1	40006	CONSOLIDATED SLIP	WHITE CROAKER	50032	93H63 - 028												
2	40006	CONSOLIDATED SLIP	WHITE CROAKER	50033	93H63 - 035												
3	40006	CONSOLIDATED SLIP	WHITE CROAKER	50034	93H63 - 093												
4	40006	CONSOLIDATED SLIP	WHITE CROAKER	50035	93H63 - 058												
5	40006	CONSOLIDATED SLIP	WHITE CROAKER	50036	93H63 - 051												
6	40006	CONSOLIDATED SLIP	WHITE CROAKER	50037	93H63 - 099												
7	40006	CONSOLIDATED SLIP	WHITE CROAKER	50038	93H63 - 017												
8	40006	CONSOLIDATED SLIP	WHITE CROAKER	50039	93H63 - 111												
9	40006	CONSOLIDATED SLIP	WHITE CROAKER	50040	93H63 - 127												
10	40006	CONSOLIDATED SLIP	WHITE CROAKER	50041	93H63 - 025	15	15	6		12	9		12				
11	40006	CONSOLIDATED SLIP	WHITE CROAKER	50042	93H63 - 098	15	15	15	0	18	18		18				
					Average	15	15	10.5	0	15	13.5		15				
					Standard Error	0	0	4.5		3	4.5		3				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50061	93H63 - 059												
2.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50062	93H63 - 009												
3.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50063	93H63 - 075												
4.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50064	93H63 - 079												
5	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50070	93H63 - 085	15	15	15	15	15	15	12	15				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50091	93H63 - 102	12	8	0	0	0	12	0	6				
2.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50092	93H63 - 048	8	0	8	0	0	3		3				
3.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50093	93H63 - 086	8	0	8	12	2	6	0	2				
4.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50094	93H63 - 095	4	0	0	0	0	0		0				
5.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50095	93H63 - 068	0	0	0	0	0	0		0				
6.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50096	93H63 - 069	0	0	0	0	0	0	0	0				
7.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50097	93H63 - 126	10	0	0	0	0	9	0					
8.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50098	93H63 - 008	15	15	15	0	0	3		3				
9.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50099	93H63 - 107	12	0	12	9	9	9		12				
10.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50100	93H63 - 081	15	0	0	0	0	3		9				
11.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50101	93H63 - 078	0	0	0	0	0	0		0				
12.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50102	93H63 - 097	9	0	9	0	9	9	0	0				
13.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50103	93H63 - 018	15	15	15	15	9	12		15			15	9
14.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50104	93H63 - 101	12	12	12	12	9	15	0	6				
15.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50105	93H63 - 121	8	8	6		4	15	0	9				
					Average	8.53	3.87	5.67	3.43	2.8	6.4	0	4.64			15	9
					Standard Error	1.39	1.54	1.55	1.54	1.04	1.43	0	1.29				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50148	93H63 - 125	6	6	4	0	0	12	0	0				
2	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50149	93H63 - 096	10	10	6	0	6	6		0				
3	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50150	93H63 - 007	15	15	15		12	15		15				
					Average	10.33	10.33	8.33	0	6	11	0	5				
					Standard Error	2.6	2.6	3.38	0	3.46	2.65		5				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1	40016	TERM ISLAND STOP	WHITE CROAKER	50003	93H63 - 063	8	0	0	0	0	9		0				
2	40016	TERM ISLAND STOP	WHITE CROAKER	50004	93H63 - 103	12	8	6	0	0	12	0	0				
3	40016	TERM ISLAND STOP	WHITE CROAKER	50005	93H63 - 001	15	15	15	0	0	12		12				
					Average	11.67	7.67	7	0	0	11	0	4				
					Standard Error	2.03	4.33	4.36	0	0	1		4				

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VE	SVE	HEP	BD	LVE	KT	KVE	IVE	IE
1	40032	POLA 19	WHITE CROAKER	50181	93H63 - 021	3	0	2	0	0	6		0				
2	40032	POLA 19	WHITE CROAKER	50182	93H63 - 123	4	0	0	0	0	6						
3	40032	POLA 19	WHITE CROAKER	50188	93H63 - 092												
4	40032	POLA 19	WHITE CROAKER	50189	93H63 - 073												
5	40032	POLA 19	WHITE CROAKER	50190	93H63 - 054												
					Average	3.5	0	1	0	0	6		0				
					Standard Error	0.5	0	1	0	0	0						

ndix 16f. Goby Biomarker Study. P450 Immunohistochemistry of Fixed Tissues from Tonguefish.

							GILL		GONAD	SPLEEN		LIVER		KIDNEY		INTESTINE	
#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VB	SVB	HBP	BD	LVB	KT	KVB	IVB	IB
1	40002	WEST BASIN PIER 143	TONGUE FISH	50085	93H 63 - 065	15	0	15		12	15		15	6	15	15	8
2	40002	WEST BASIN PIER 143	TONGUE FISH	50086	93H 63 - 067	0	0	0			0		0				
3	40002	WEST BASIN PIER 143	TONGUE FISH	50087	93H 63 - 060	10	0			12	15		15			15	15
4	40002	WEST BASIN PIER 143	TONGUE FISH	50088	93H 63 - 022	12	0	3	15	15	12		15				
5	40002	WEST BASIN PIER 143	TONGUE FISH	50089	93H 63 - 094	12	0	6	12	12	15		15	12	4	15	12
6	40002	WEST BASIN PIER 143	TONGUE FISH	50090	93H 63 - 002	15	0	15			15		15	8	15	15	15
					Average	10.67	0	7.8	13.5	12.75	12		12.5	8.67	11.33	15	12.5
					Standard Error	2.28	0	3.09	1.5	0.75	2.45		2.5	1.76	3.67	0	1.66

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VB	SVB	HBP	BD	LVB	KT	KVB	IVB	IB
1	40007	LONG BEACH HBR, CH2	TONGUE FISH	50073	93H 63 - 047	10	0	12		9	9		12			10	12
2	40007	LONG BEACH HBR, CH2	TONGUE FISH	50074	93H 63 - 020	10	0	8	9		9		15			15	
3	40007	LONG BEACH HBR, CH2	TONGUE FISH	50075	93H 63 - 036												
					Average	10	0	10	9	9	9		13.5			12.5	12
					Standard Error	0	0	2			0		1.5			2.5	

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VB	SVB	HBP	BD	LVB	KT	KVB	IVB	IB
1	40016	TERM ISLAND STOP	TONGUE FISH	50001	93H 63 - 016	6	0	0	0	0	0		0			0	0
2	40016	TERM ISLAND STOP	TONGUE FISH	50002	93H 63 - 077	0	0	0	0	0	0	0	0			0	0
3	40016	TERM ISLAND STOP	TONGUE FISH	50121	93H 63 - 050	10	0	0	0	0	0		0				
4	40016	TERM ISLAND STOP	TONGUE FISH	50122	93H 63 - 038	15	0		0	0	0		0			0	0
5	40016	TERM ISLAND STOP	TONGUE FISH	50123	93H 63 - 039	12	0	0	0	0	0		0				
6	40016	TERM ISLAND STOP	TONGUE FISH	50124	93H 63 - 032	8	0	0		0	15		0				
7	40016	TERM ISLAND STOP	TONGUE FISH	50125	93H 63 - 122	4	0	0	0	0	9						
8	40016	TERM ISLAND STOP	TONGUE FISH	50126	93H 63 - 019	10	8	0	9	3	6		12				
9	40016	TERM ISLAND STOP	TONGUE FISH	50127	93H 63 - 090	12	0	12	12	6	6	0	12				
10	40016	TERM ISLAND STOP	TONGUE FISH	50128	93H 63 - 055	8	0	6	0		0		0				
11	40016	TERM ISLAND STOP	TONGUE FISH	50129	93H 63 - 045	6	0	2	0	0	0		0				
12	40016	TERM ISLAND STOP	TONGUE FISH	50130	93H 63 - 100	10	0	0	9	6	3	0	12				
13	40016	TERM ISLAND STOP	TONGUE FISH	50131	93H 63 - 037	6	0	0	0	0	0		0				
14	40016	TERM ISLAND STOP	TONGUE FISH	50132	93H 63 - 052	8	0	0		0	0		0				
15	40016	TERM ISLAND STOP	TONGUE FISH	50133	93H 63 - 004	15	0	0		0	0		0	0	0		
16	40016	TERM ISLAND STOP	TONGUE FISH	50134	93H 63 - 087	8	0	0	0	0	0	0	0				
17	40016	TERM ISLAND STOP	TONGUE FISH	50135	93H 63 - 010	15	0	0	0	0	0		4				
					Average	9	0.47	1.25	2.14	0.94	2.29	0	2.5	0	0	0	0
					Standard Error	0.99	0.47	0.79	1.15	0.53	1.05	0	1.2			0	0

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	GPC	GBC	B-GA	GO-VB	SVB	HBP	BD	LVB	KT	KVB	IVB	IB
1	40032	POLA 19	TONGUE FISH	50184	93H 63 - 034	8	0	0	0	0	0		0				
2	40032	POLA 19	TONGUE FISH	50185	93H 63 - 027	6	0	0	0	0	0		0				
3	40032	POLA 19	TONGUE FISH	50186	93H 63 - 084	8	0	0		6	0	0	4				
4	40032	POLA 19	TONGUE FISH	50187	93H 63 - 106	8	0	0	0	0	0	0	0			0	12
					Average	7.5	0	0	0	1.5	0	0	1			0	12
					Standard Error	0.5	0	0	0	1.5	0	0	1				

7a. Goby Biomarker Study. Hepatic EROD Activity as expressed in pmol/min-mg.

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Gobies Only
1.	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50018	93H 63 - 062	52.13	52.13
2.	40001	SOUTHWEST SLIP	YELLOWFIN GOBY	50020	93H 63 - 012	31.07	31.07
					SUM	83.2	83.2
					AVERAGE	41.6	41.6
					STD ERROR	10.53	10.53

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Croakers Only	EROD Activity Gobies Only
1.	40002	WEST BASIN PIER 143	WHITE CROAKER	50076	93H 63 - 043	61.07	61.07	
2.	40002	WEST BASIN PIER 143	WHITE CROAKER	50077	93H 63 - 083	51.15	51.15	
3.	40002	WEST BASIN PIER 143	WHITE CROAKER	50078	93H 63 - 091	64.64	64.64	
4.	40002	WEST BASIN PIER 143	WHITE CROAKER	50079	93H 63 - 118	125.81	125.81	
5.	40002	WEST BASIN PIER 143	WHITE CROAKER	50080	93H 63 - 053	28.26	28.26	
6.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50081	93H 63 - 120	10.52		10.52
7.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50082	93H 63 - 109	21.54		21.54
8.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50083	93H 63 - 124	17.56		17.56
9.	40002	WEST BASIN PIER 143	YELLOWFIN GOBY	50084	93H 63 - 117	8.11		8.11
10.	40002	WEST BASIN PIER 143	TONGUE FISH	50086	93H 63 - 067	10.73		
					SUM	399.39	330.93	57.73
					AVERAGE	39.939	66.186	14.4325
					STD ERROR	11.67316204	16.19883903	3.103485608

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Croakers Only	EROD Activity Gobies Only
1.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50041	93H 63 - 025	0.22	0.22	
2.	40006	CONSOLIDATED SLIP	WHITE CROAKER	50042	93H 63 - 098	87.39	87.39	
3.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50043	93H 63 - 105	3.29		3.29
4.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50044	93H 63 - 061	0.02		0.02
5.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50045	93H 63 - 056	17.97		17.97
6.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50008	93H 63 - 066	29.21		29.21
7.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50009	93H 63 - 046	27.5		27.5
8.	40006	CONSOLIDATED SLIP	YELLOWFIN GOBY	50010	93H 63 - 074	2.52		2.52
					SUM	168.12	87.61	80.51
					AVERAGE	21.015	43.805	13.41833333
					STD ERROR	10.39710519	43.585	5.382873716

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Cusk Eels Only	EROD Activity Gobies Only
1.	40007	LONG BEACH HBR, CH2	WHITE CROAKER	50062	93H 63 - 009	0		
2.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50065	93H 63 - 031	126.6	126.6	
3.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50066	93H 63 - 070	242.67	242.57	
4.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50067	93H 63 - 116	43.13	43.13	
5.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50068	93H 63 - 024	62.86	62.86	
6.	40007	LONG BEACH HBR, CH2	BW. CUSK EEL	50069	93H 63 - 042	7.67	7.67	
7.	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50071	93H 63 - 104	7.69		7.69
8.	40007	LONG BEACH HBR, CH2	YELLOWFIN GOBY	50072	93H 63 - 049	9.37		9.37
9.	40007	LONG BEACH HBR, CH2	TONGUE FISH	50073	93H 63 - 047	0		
					SUM	499.99	482.93	17.06
					AVERAGE	55.55444444	96.586	8.53
					STD ERROR	27.17151302	41.3173192	0.84

Appendix 17b. *Goby Biomarker Study. Hepatic EROD Activity as expressed in pmol/min-mg.*

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Croakers Only
1.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50091	93H 63 - 102	16.68	16.68
2.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50092	93H 63 - 048	15.87	15.87
3.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50093	93H 63 - 086	39.82	39.82
4.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50094	93H 63 - 095	5.17	5.17
5.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50095	93H 63 - 068	13.74	13.74
6.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50096	93H 63 - 069	71.32	71.32
7.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50097	93H 63 - 126	58.01	58.01
8.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50098	93H 63 - 008	8.43	8.43
9.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50099	93H 63 - 107	26.39	26.39
10.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50100	93H 63 - 081	5.95	5.95
11.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50101	93H 63 - 078	67.02	67.02
12.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50102	93H 63 - 097	66.11	66.11
13.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50103	93H 63 - 018	35.84	35.84
14.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50104	93H 63 - 101	57.73	57.73
15.	40013	INNER QUEENSWAY BAY	WHITE CROAKER	50105	93H 63 - 121	63.37	63.37
					SUM	551.45	551.45
					AVERAGE	36.76333333	36.76333333
					STD ERROR	6.47630036	6.47630036

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Gobies Only	EROD Activity Croakers Only
1.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50137	93H 63 - 023	17.09	17.09	
2.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50138	93H 63 - 108	32.1	32.1	
3.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50139	93H 63 - 080	83.3	83.3	
4.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50140	93H 63 - 003	30.17	30.17	
5.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50141	93H 63 - 026	22.49	22.49	
6.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50144	93H 63 - 029	19.99	19.99	
7.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50145	93H 63 - 006	23.66	23.66	
8.	40015	ENTRANCE TO FISH HARBOR	YELLOWFIN GOBY	50146	93H 63 - 076	22.88	22.88	
9.	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50148	93H 63 - 125	130.19		130.19
10.	40015	ENTRANCE TO FISH HARBOR	WHITE CROAKER	50149	93H 63 - 096	20.14		20.14
					SUM	402.01	251.68	150.33
					AVERAGE	40.201	31.46	75.165
					STD ERROR	11.71615167	7.609245316	55.025

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All Fish	EROD Activity Tonguefish Only	EROD Activity Croakers Only
1.	40016	TERM ISLAND STOP	TONGUE FISH	50122	93H 63 - 038	27.4	27.4	
2.	40016	TERM ISLAND STOP	TONGUE FISH	50123	93H 63 - 039	20.29	20.29	
3.	40016	TERM ISLAND STOP	TONGUE FISH	50126	93H 63 - 019	3.27	3.27	
4.	40016	TERM ISLAND STOP	TONGUE FISH	50129	93H 63 - 045	4.08	4.08	
5.	40016	TERM ISLAND STOP	TONGUE FISH	50131	93H 63 - 037	0	0	
6.	40016	TERM ISLAND STOP	TONGUE FISH	50132	93H 63 - 052	0	0	
7.	40016	TERM ISLAND STOP	TONGUE FISH	50134	93H 63 - 087	6.47	6.47	
8.	40016	TERM ISLAND STOP	TONGUE FISH	50001	93H 63 - 016	6.22	6.22	
9.	40016	TERM ISLAND STOP	WHITE CROAKER	50003	93H 63 - 063	62.36		62.36
10.	40016	TERM ISLAND STOP	WHITE CROAKER	50004	93H 63 - 103	50.88		50.88
11.	40016	TERM ISLAND STOP	BW. CUSK EEL	50006	93H 63 - 013	146.61		
					SUM	327.58	67.73	113.24
					AVERAGE	29.78	8.46625	56.62
					STD ERROR	13.30995403	3.527730927	5.74

#	SITE #	SITE NAME	SPECIES	ID #	UCD Random ID #	EROD Activity All fish	EROD Activity Stingrays Only
1.	80027	HUNTINGTON HBR, MID	STINGRAY	50046	93H 63 - 033	23.52	23.52
2.	80027	HUNTINGTON HBR, MID	STINGRAY	50047	93H 63 - 082	36.45	36.45
3.	80027	HUNTINGTON HBR, MID	STINGRAY	50048	93H 63 - 112	33.78	33.78
4.	80027	HUNTINGTON HBR, MID	STINGRAY	50049	93H 63 - 014	18.92	18.92
5.	80027	HUNTINGTON HBR, MID	STINGRAY	50050	93H 63 - 041	58.02	58.02
6.	80027	HUNTINGTON HBR, MID	YELLOWFIN GOBY	50051	93H 63 - 057	4.67	
7.	80027	HUNTINGTON HBR, MID	STINGRAY	50053	93H 63 - 072	33.51	33.51
8.	80027	HUNTINGTON HBR, MID	STINGRAY	50054	93H 63 - 115	43.54	43.54
9.	80027	HUNTINGTON HBR, MID	STINGRAY	50055	93H 63 - 040	64.29	64.29
					SUM	316.7	312.03
					AVERAGE	35.18888889	39.00375
					STD ERROR	6.209884246	5.55601956

Appendix 18a. Goby Biomarker Study. Gross measurements and Indices.

ABBREVIATIONS:

ID Org. # = Identification Organism Number
(used by California Department of Fish and Game)
Random # = Random Number
(used by University of California at Davis)

SL = standard length (mm)
BW = body weight (gm)

LW = liver weight (gm)
GW = gonad weight (gm)

HSI = hepatosomatic index
HSI = (LW/BW)(100)
GSI = gonadosomatic index
GSI = (GW/BW)(100)
CI = condition index
CI = (BW/SL^3)(100,000)

Gross = identification of sex via gross exam
Histo = identification of sex via histopath exan

U = unknown
I = intersex
M = male
ND = not done
NA = not applicable
F = female
Mi/a = male with immature/atrophic testes

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40001	50016	93H63- 30	Croaker	81	9.393	0.13	0.18	1.384	1.916	1.767	U	F
2	40001	50017	93H63- 110	Croaker	79	8.612	0.109	0.032	1.266	0.372	1.747	U	F
3	40001	50018	93H63- 62	Goby	108	13.372	0.406	0.036	3.036	0.269	1.062	U	M
4	40001	50019	93H63- 119	Goby	90	7.973	0.108	0.047	1.355	0.589	1.094	U	F
5	40001	50020	93H63- 12	Goby	75	5.314	0.111	0.007	2.089	0.132	1.26	U	M
				Sum	433	44.664	0.864	0.302	9.13	3.278	6.93		
				Average	86.6	8.933	0.173	0.06	1.826	0.656	1.386		
				Standard Error	5.887	1.305	0.058	0.031	0.336	0.324	0.155		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40002	50076	93H63- 43	Croaker	72	7.66	0.125	ND	1.632	NA	2.052	U	I
2	40002	50077	93H63- 83	Croaker	85	10.47	0.169	ND	1.614	NA	1.705	U	F
3	40002	50078	93H63- 91	Croaker	71	6.789	0.092	ND	1.355	NA	1.897	U	Mi/a
4	40002	50079	93H63- 118	Croaker	72	7.555	0.137	0.034	1.813	0.45	2.024	U	F
5	40002	50080	93H63- 53	Croaker	144	56.668	0.84	0.152	1.482	0.268	1.898	U	M
6	40002	50081	93H63- 120	Goby	81	6.138	0.1	0.031	1.629	0.505	1.155	U	F
7	40002	50082	93H63- 109	Goby	85	6.405	0.083	ND	1.296	NA	1.043	U	M
8	40002	50083	93H63- 124	Goby	99	10.525	0.213	ND	2.024	NA	1.085	U	M
9	40002	50084	93H63- 117	Goby	79	4.547	0.087	0.03	1.913	0.66	0.922	U	F
10	40002	50085	93H63- 65	Tonguefish	75	3.668	0.034	ND	0.927	NA	0.869	U	U
11	40002	50086	93H63- 67	Tonguefish	86	6.239	0.054	ND	0.866	NA	0.981	U	U
12	40002	50087	93H63- 60	Tonguefish	70	3.229	0.034	ND	1.053	NA	0.941	U	U
13	40002	50088	93H63- 22	Tonguefish	69	3.012	0.02	ND	0.664	NA	0.917	U	F
14	40002	50089	93H63- 94	Tonguefish	64	2.926	0.017	ND	0.581	NA	1.116	U	F
15	40002	50090	93H63- 2	Tonguefish	54	1.521	0.012	ND	0.789	NA	0.966	U	U
				Sum	1206	137.35	2.017	0.247	19.638	1.883	19.571		
				Average	80.4	9.157	0.134	0.062	1.309	0.471	1.305		
				Standard Error	5.314	3.463	0.053	0.016	0.121	0.042	0.119		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40006	50008	93H63- 66	Goby	86	6.859	0.134	ND	1.954	NA	1.078	U	U
2	40006	50009	93H63- 46	Goby	82	6.407	0.099	ND	1.545	NA	1.162	U	M
3	40006	50010	93H63- 74	Goby	62	2.441	0.046	ND	1.884	NA	1.024	U	F
4	40006	50031	93H63- 15	Goby	110	15.056	0.778	0.063	5.167	0.418	1.131	M?	F
5	40006	50032	93H63- 28	Croaker	81	11.882	0.12	ND	1.01	NA	2.236	U	M
6	40006	50033	93H63- 35	Croaker	68	6.566	0.122	ND	1.858	NA	2.088	U	Mi/a
7	40006	50034	93H63- 93	Croaker	70	6.457	0.083	ND	1.285	NA	1.883	U	F
8	40006	50035	93H63- 58	Croaker	60	3.55	0.059	ND	1.662	NA	1.644	U	U
9	40006	50036	93H63- 51	Croaker	67	6.336	0.105	ND	1.657	NA	2.107	U	F
10	40006	50037	93H63- 99	Croaker	70	6.545	0.077	ND	1.176	NA	1.908	U	F
11	40006	50038	93H63- 17	Croaker	74	7.972	0.122	ND	1.53	NA	1.967	U	Mi/a
12	40006	50039	93H63- 111	Croaker	72	7.076	0.083	ND	1.173	NA	1.896	U	Mi/a
13	40006	50040	93H63- 127	Croaker	65	5.875	0.095	ND	1.617	NA	2.139	U	U
14	40006	50041	93H63- 25	Croaker	75	7.148	0.076	ND	1.063	NA	1.694	U	Mi/a
15	40006	50042	93H63- 98	Croaker	70	5.775	0.069	ND	1.195	NA	1.684	U	F
16	40006	50043	93H63- 105	Goby	ND	7.134	0.152	0.038	2.131	0.533	NA	U	F
17	40006	50044	93H63- 61	Goby	65	2.823	0.041	ND	1.452	NA	1.028	U	M
18	40006	50045	93H63- 56	Goby	81	5.644	0.071	0.021	1.258	0.372	1.062	U	F
				Sum	1258	121.55	2.332	0.122	30.617	1.323	27.731		
				Average	74	6.753	0.13	0.007	1.701	0.441	1.631		
				Standard Error	2.871	0.688	0.039	0.004	0.218	0.048	0.109		

Appendix 18b. *Goby Biomarker Study. Gross measurements and Indices.*

ABBREVIATIONS:

ID Org. # = Identification Organism Number
(used by California Department of Fish and Game)
Random # = Random Number
(used by University of California at Davis)

SL = standard length (mm)
BW = body weight (gm)
LW = liver weight (gm)
GW = gonad weight (gm)

HSI = hepatosomatic index
HSI = (LW/BW)(100)
GSI = gonadosomatic index
GSI = (GW/BW)(100)
CI = condition index
CI = (BW/SL^3)(100,000)

Gross = identification of sex via gross exam
Histo = identification of sex via histopath exam

U = unknown
I = intersex
M = male
ND = not done
NA = not applicable
F = female
Mi/a = male with immature/atrophic testes

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40007	50061	93H63- 59	Croaker	75	7.78	0.064	0.04	0.823	0.514	1.844	U	F
2	40007	50062	93H63- 9	Croaker	64	4.186	0.044	ND	1.051	NA	1.597	U	Mi/a
3	40007	50063	93H63- 75	Croaker	44	1.808	0.029	ND	1.604	NA	2.122	U	F
4	40007	50064	93H63- 79	Croaker	54	2.756	0.025	ND	0.907	NA	1.75	U	F
5	40007	50065	93H63- 31	Cusk-eel	137	13.28	0.173	0.009	1.303	0.068	0.516	U	U
6	40007	50066	93H63- 70	Cusk-eel	129	12.262	0.249	0.101	2.031	0.824	0.571	U	F
7	40007	50067	93H63- 116	Cusk-eel	123	10	0.125	0.01	1.25	0.1	0.537	U	Mi/a
8	40007	50068	93H63- 24	Cusk-eel	107	6.555	0.122	0.039	1.861	0.595	0.535	U	F
9	40007	50069	93H63- 42	Cusk-eel	95	4.065	0.065	ND	1.599	NA	0.474	U	I
10	40007	50070	93H63- 85	Croaker	51	2.363	0.031	ND	1.312	NA	1.781	U	U
11	40007	50071	93H63- 104	Goby	120	16.58	0.645	0.078	3.89	0.47	0.959	U	F
12	40007	50072	93H63- 49	Goby	85	5.831	0.059	ND	1.012	NA	0.949	U	U
13	40007	50073	93H63- 47	Tonguefish	102	8.404	0.043	ND	0.512	NA	0.792	U	U
14	40007	50074	93H63- 20	Tonguefish	72	2.728	0.02	ND	0.733	NA	0.731	U	U
15	40007	50075	93H63- 36	Tonguefish	59	1.732	ND	ND	NA	NA	0.843	U	M
				Sum	1317	100.33	1.694	0.277	19.888	2.571	16.001		
				Average	87.8	6.689	0.121	0.046	1.421	0.429	1.067		
				Standard Error	7.943	1.194	0.044	0.015	0.222	0.12	0.15		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40013	50091	93H63- 102	Croaker	112	28.156	0.357	0.096	1.268	0.341	2.004	U	F
2	40013	50092	93H63- 48	Croaker	170	114.78	2.043	2.107	1.78	1.836	2.336	M	M
3	40013	50093	93H63- 86	Croaker	126	39.589	0.797	0.126	2.013	0.318	1.979	U	F
4	40013	50094	93H63- 95	Croaker	110	26.462	0.396	0.149	1.496	0.563	1.988	U	F
5	40013	50095	93H63- 68	Croaker	108	24.926	0.427	0.017	1.713	0.068	1.979	U	M
6	40013	50096	93H63- 69	Croaker	112	26.858	0.44	0.083	1.638	0.309	1.912	U	F
7	40013	50097	93H63- 126	Croaker	117	29.144	0.563	0.11	1.932	0.377	1.82	U	F
8	40013	50098	93H63- 8	Croaker	112	29.192	0.724	0.031	2.48	0.106	2.078	U	M
9	40013	50099	93H63- 107	Croaker	106	24.597	0.572	0.052	2.325	0.211	2.065	U	F
10	40013	50100	93H63- 81	Croaker	100	19.779	0.393	0.031	1.987	0.157	1.978	U	Mi/a
11	40013	50101	93H63- 78	Croaker	98	19.025	0.395	0.012	2.076	0.063	2.021	U	M
12	40013	50102	93H63- 97	Croaker	100	21.039	0.39	0.081	1.854	0.385	2.104	U	F
13	40013	50103	93H63- 18	Croaker	90	14.703	0.31	0.022	2.108	0.15	2.017	U	F
14	40013	50104	93H63- 101	Croaker	97	17.252	0.224	0.049	1.298	0.284	1.89	U	F
15	40013	50105	93H63- 121	Croaker	100	19.156	0.282	0.018	1.472	0.094	1.916	U	I
				Sum	1658	454.66	8.313	2.984	27.44	5.262	30.087		
				Average	110.53	30.311	0.554	0.199	1.829	0.351	2.006		
				Standard Error	4.853	6.241	0.114	0.137	0.092	0.112	0.03		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40015	50136	93H63- 64	Goby	89	7.988	0.124	ND	1.552	NA	1.133	U	U
2	40015	50137	93H63- 23	Goby	137	30.891	0.775	0.118	2.509	0.382	1.201	M	F
3	40015	50138	93H63- 108	Goby	115	18.997	0.765	0.075	4.027	0.395	1.249	M	F
4	40015	50139	93H63- 80	Goby	104	12.947	0.335	0.8	2.587	6.179	1.151	M	F
5	40015	50140	93H63- 3	Goby	107	14.023	0.344	ND	2.453	NA	1.145	U	M
6	40015	50141	93H63- 26	Goby	95	9.597	0.264	0.027	2.751	0.281	1.119	U	F
7	40015	50142	93H63- 44	Goby	86	6.317	0.083	0.035	1.314	0.554	0.993	M?	F
8	40015	50143	93H63- 88	Goby	78	5.366	0.053	0.022	0.988	0.41	1.131	U	F
9	40015	50144	93H63- 29	Goby	99	11.24	0.281	0.053	2.5	0.472	1.158	U	F
10	40015	50145	93H63- 6	Goby	90	8.602	0.136	0.043	1.581	0.5	1.18	U	F
11	40015	50146	93H63- 76	Goby	90	7.948	0.154	0.009	1.938	0.113	1.09	U	M
12	40015	50147	93H63- 89	Goby	85	7.806	0.173	0.026	2.216	0.333	1.271	U	F
13	40015	50148	93H63- 125	Croaker	100	19.226	0.279	0.048	1.451	0.25	1.923	U	F
14	40015	50149	93H63- 96	Croaker	111	28.237	0.3	0.129	1.062	0.457	2.065	U	F
15	40015	50150	93H63- 7	Croaker	75	7.154	0.049	ND	0.685	NA	1.696	U	Mi/a
				Sum	1461	196.34	4.115	1.385	29.614	10.326	19.505		
				Average	97.4	13.089	0.274	0.115	1.974	0.861	1.3		
				Standard Error	4.115	2.043	0.058	0.063	0.224	0.485	0.083		

Appendix 18c. Goby Biomarker Study. Gross measurements and Indices.

ABBREVIATIONS:

ID Org. # = Identification Organism Number
(used by California Department of Fish and Game)
Random # = Random Number
(used by University of California at Davis)

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BW = body weight (gm)
LW = liver weight (gm)
GW = gonad weight (gm)

HSI = hepatosomatic index
HSI = (LW/BW)(100)
GSI = gonadosomatic index
GSI = (GW/BW)(100)
CI = condition index
CI = (BW/SL^3)(100,000)

Gross = identification of sex via gross exam
Histo = identification of sex via histopath exan

U = unknown
I = intersex
M = male
ND = not done
NA = not applicable
F = female
Mi/a = male with immature/atrophic testes

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40016	50001	93H63- 16	Tonguefish	103	8.554	0.05	ND	0.585	NA	0.783	M?	F
2	40016	50002	93H63- 77	Tonguefish	95	8.001	0.047	ND	0.587	NA	0.933	U	F
3	40016	50003	93H63- 63	Croaker	121	34.389	0.352	0.032	1.024	0.093	1.941	M	M
4	40016	50004	93H63- 103	Croaker	93	14.565	0.143	0.024	0.982	0.165	1.811	M	Mi/a
5	40016	50005	93H63- 1	Croaker	87	12.344	0.131	0.055	1.061	0.446	1.875	U	Mi/a
6	40016	50006	93H63- 13	Cusk-eel	212	57.584	2.449	0.069	4.253	0.12	0.604	M	U
7	40016	50007	93H63- 11	Goby	91	8.452	0.168	0.027	1.988	0.319	1.122	U	F
8	40016	50121	93H63- 50	Tonguefish	133	27.619	0.271	0.287	0.981	1.039	1.174	F?	F
9	40016	50122	93H63- 38	Tonguefish	129	21.615	0.148	ND	0.685	NA	1.007	U	F
10	40016	50123	93H63- 39	Tonguefish	125	17.18	0.183	0.015	1.065	0.087	0.88	U	M
11	40016	50124	93H63- 32	Tonguefish	96	7.306	0.039	0.012	0.534	0.164	0.826	M?	F
12	40016	50125	93H63- 122	Tonguefish	90	6.175	0.029	0.01	0.47	0.162	0.847	M	M
13	40016	50126	93H63- 19	Tonguefish	137	25.682	0.247	0.042	0.962	0.164	0.999	M	M
14	40016	50127	93H63- 90	Tonguefish	112	12.518	0.1	0.256	0.799	2.045	0.891	M	F
15	40016	50128	93H63- 55	Tonguefish	103	9.997	0.088	0.116	0.88	1.16	0.915	U	F
16	40016	50129	93H63- 45	Tonguefish	135	23.091	0.169	0.029	0.732	0.126	0.939	M	M
17	40016	50130	93H63- 100	Tonguefish	119	14.543	0.07	0.137	0.481	0.942	0.863	U	F
18	40016	50131	93H63- 37	Tonguefish	99	9.665	0.048	0.011	0.497	0.114	0.996	M	M
19	40016	50132	93H63- 52	Tonguefish	96	8.891	0.066	0.01	0.742	0.112	1.005	M	U
20	40016	50133	93H63- 4	Tonguefish	125	18.657	0.0186	ND	0.1	NA	0.955	U	F
21	40016	50134	93H63- 87	Tonguefish	113	12.882	0.082	0.129	0.637	1.001	0.893	F	F
22	40016	50135	93H63- 10	Tonguefish	104	10.485	0.05	0.071	0.477	0.677	0.932	F	F
				Sum	2518	370.2	4.9486	1.332	20.522	8.936	23.191		
				Average	114.46	16.827	0.225	0.074	0.933	0.496	1.054		
				Standard Error	5.76	2.512	0.107	0.02	0.176	0.128	0.075		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40032	50181	93H63- 21	Croaker	110	26.677	0.284	0.114	1.065	0.427	2.004	U	F
2	40032	50182	93H63- 123	Croaker	104	20	0.166	0.111	0.83	0.555	1.778	U	F
3	40032	50183	93H63- 114	Cusk-eel	173	28.98	0.668	ND	2.305	NA	0.56	U	M
4	40032	50184	93H63- 34	Tonguefish	140	23.898	0.108	ND	0.452	NA	0.871	U	M
5	40032	50185	93H63- 27	Tonguefish	121	15.487	0.148	ND	0.956	NA	0.874	U	F
6	40032	50186	93H63- 84	Tonguefish	109	12.802	0.079	ND	0.617	NA	0.989	U	U
7	40032	50187	93H63- 106	Tonguefish	105	10.584	0.108	0.131	1.02	1.238	0.914	F?	F
8	40032	50188	93H63- 92	Croaker	139	54.896	0.825	0.272	1.503	0.495	2.044	F	F
9	40032	50189	93H63- 73	Croaker	112	29.397	0.334	ND	1.136	NA	2.092	U	M
10	40032	50190	93H63- 54	Croaker	125	36.24	0.489	0.207	1.349	0.571	1.855	U	F
				Sum	1238	258.96	3.209	0.835	11.233	3.286	13.981		
				Average	123.8	25.896	0.321	0.167	1.123	0.657	1.398		
				Standard Error	6.846	4.114	0.082	0.032	0.164	0.147	0.191		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	80027	50046	93H63- 33	Stingray	320	ND	26.107	ND	NA	NA	NA	M	F
2	80027	50047	93H63- 82	Stingray	255	ND	10.606	1.851	NA	NA	NA	M	F
3	80027	50048	93H63- 112	Stingray	300	ND	35.472	19.412	NA	NA	NA	M	M
4	80027	50049	93H63- 14	Stingray	370	ND	54.428	32.363	NA	NA	NA	M	M
5	80027	50050	93H63- 41	Stingray	375	ND	33.222	25.545	NA	NA	NA	M	M
6	80027	50051	93H63- 57	Goby	118	20.554	0.584	ND	2.841	NA	1.251	U	M
7	80027	50052	93H63- 5	Stingray	138	41.237	1.844	0.219	4.472	0.531	1.569	M	U
8	80027	50053	93H63- 72	Stingray	304	ND	40.575	21.088	NA	NA	NA	M	M
9	80027	50054	93H63- 115	Stingray	285	ND	20.114	9.539	NA	NA	NA	M	M
10	80027	50055	93H63- 40	Stingray	324	ND	26.623	23.945	NA	NA	NA	M	M
11	80027	50056	93H63- 117	Stingray	310	ND	21.94	4.252	NA	NA	NA	U	M
12	80027	50057	93H63- 71	Goby	100	10.756	0.168	0.054	1.562	0.502	1.076	U	F
				Sum	3199	72.547	271.68	138.27	8.875	1.033	3.896		
											0.5165	1.299	

Appendix 18d. Goby Biomarker Study. Gross measurements and Indices for Yellowfin Gobies.

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40001	50018	93H63- 62	Goby	108	13.372	0.406	0.036	3.036	0.269	1.062	U	M
2	40001	50019	93H63- 119	Goby	90	7.973	0.108	0.047	1.355	0.589	1.094	U	F
3	40001	50020	93H63- 12	Goby	75	5.314	0.111	0.007	2.089	0.132	1.26	U	M
				Average	91	8.886	0.208	0.03	2.16	0.33	1.139		
				Standard Error	9.539	2.371	0.099	0.012	0.487	0.135	0.061		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40002	50081	93H63- 120	Goby	81	6.138	0.1	0.031	1.629	0.505	1.155	U	F
2	40002	50082	93H63- 109	Goby	85	6.405	0.083		1.296		1.043	U	M
3	40002	50083	93H63- 124	Goby	99	10.525	0.213		2.024		1.085	U	M
4	40002	50084	93H63- 117	Goby	79	4.547	0.087	0.03	1.913	0.66	0.922	U	F
				Average	86	6.904	0.121	0.031	1.716	0.583	1.051		
				Standard Error	4.509	1.275	0.031	0	0.163	0.077	0.049		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40006	50008	93H63- 66	Goby	86	6.859	0.134		1.954		1.078	U	U
2	40006	50009	93H63- 46	Goby	82	6.407	0.099		1.545		1.162	U	M
3	40006	50010	93H63- 74	Goby	62	2.441	0.046		1.884		1.024	U	F
4	40006	50031	93H63- 15	Goby	110	15.056	0.778	0.063	5.167	0.418	1.131	M?	F
5	40006	50043	93H63- 105	Goby		7.134	0.152	0.038	2.131	0.533		U	F
6	40006	50044	93H63- 61	Goby	65	2.823	0.041		1.452		1.028	U	M
7	40006	50045	93H63- 56	Goby	81	5.644	0.071	0.021	1.258	0.372	1.062	U	F
				Average	81	6.623	0.189	0.041	2.199	0.441	1.631		
				Standard Error	7.033	1.576	0.099	0.012	0.508	0.048	0.023		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40007	50071	93H63- 104	Goby	120	16.58	0.645	0.078	3.89	0.47	0.959	U	F
2	40007	50072	93H63- 49	Goby	85	5.831	0.059		1.012		0.949	U	U
				Average	102.5	11.206	0.352	0.078	2.451	0.47	0.954		
				Standard Error	17.5	5.375	0.293		1.439		0.005		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40015	50136	93H63- 64	Goby	89	7.988	0.124		1.552		1.133	U	U
2	40015	50137	93H63- 23	Goby	137	30.891	0.775	0.118	2.509	0.382	1.201	M	F
3	40015	50138	93H63- 108	Goby	115	18.997	0.765	0.075	4.027	0.395	1.249	M	F
4	40015	50139	93H63- 80	Goby	104	12.947	0.335	0.8	2.587	6.179	1.151	M	F
5	40015	50140	93H63- 3	Goby	107	14.023	0.344		2.453		1.145	U	M
6	40015	50141	93H63- 26	Goby	95	9.597	0.264	0.027	2.751	0.281	1.119	U	F
7	40015	50142	93H63- 44	Goby	86	6.317	0.083	0.035	1.314	0.554	0.993	M?	F
8	40015	50143	93H63- 88	Goby	78	5.366	0.053	0.022	0.988	0.41	1.131	U	F
9	40015	50144	93H63- 29	Goby	99	11.24	0.281	0.053	2.5	0.472	1.158	U	F
10	40015	50145	93H63- 6	Goby	90	8.602	0.136	0.043	1.581	0.5	1.18	U	F
11	40015	50146	93H63- 76	Goby	90	7.948	0.154	0.009	1.938	0.113	1.09	U	M
12	40015	50147	93H63- 89	Goby	85	7.806	0.173	0.026	2.216	0.333	1.271	U	F
				Average	97.917	11.81	0.291	0.121	2.201	0.962	1.152		
				Standard Error	4.654	2.05	0.07	0.076	0.233	0.581	0.021		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40016	50007	93H63- 11	Goby	91	8.452	0.168	0.027	1.988	0.319	1.122	U	F

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	80027	50051	93H63- 57	Goby	118	20.554	0.584		2.841		1.251	U	M
2	80027	50057	93H63- 71	Goby	100	10.756	0.168	0.054	1.562	0.502	1.076	U	F
				Average	109	15.655	0.376	0.054	2.202	0.502	1.164		
				Standard Error	9	4.899	0.208		0.64		0.087		

Appendix 18e. Goby Biomarker Study. Gross measurements and Indices for White Croakers.

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40001	50016	93H63- 30	Croaker	81	9.393	0.13	0.18	1.384	1.916	1.767	U	F
2	40001	50017	93H63- 110	Croaker	79	8.612	0.109	0.032	1.266	0.372	1.747	U	F
				Average	80	9.0025	0.1195	0.106	1.325	1.144	1.757		
				Standard Error	1	0.39	0.011	0.074	0.059	0.772	0.01		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40002	50076	93H63- 43	Croaker	72	7.66	0.125		1.632		2.052	U	I
2	40002	50077	93H63- 83	Croaker	85	10.47	0.169		1.614		1.705	U	F
3	40002	50078	93H63- 91	Croaker	71	6.789	0.092		1.355		1.897	U	Mi/a
4	40002	50079	93H63- 118	Croaker	72	7.555	0.137	0.034	1.813	0.45	2.024	U	F
5	40002	50080	93H63- 53	Croaker	144	56.668	0.84	0.152	1.482	0.268	1.898	U	M
				Average	88.8	17.828	0.273	0.093	1.579	0.359	1.915		
				Standard Error	14.041	9.73	0.142	0.037	0.077	0.058	0.061		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40006	50032	93H63- 28	Croaker	81	11.882	0.12		1.01		2.236	U	M
2	40006	50033	93H63- 35	Croaker	68	6.566	0.122		1.858		2.088	U	Mi/a
3	40006	50034	93H63- 93	Croaker	70	6.457	0.083		1.285		1.883	U	F
4	40006	50035	93H63- 58	Croaker	60	3.55	0.059		1.662		1.644	U	U
5	40006	50036	93H63- 51	Croaker	67	6.336	0.105		1.657		2.107	U	F
6	40006	50037	93H63- 99	Croaker	70	6.545	0.077		1.176		1.908	U	F
7	40006	50038	93H63- 17	Croaker	74	7.972	0.122		1.53		1.967	U	Mi/a
8	40006	50039	93H63- 111	Croaker	72	7.076	0.083		1.173		1.896	U	Mi/a
9	40006	50040	93H63- 127	Croaker	65	5.875	0.095		1.617		2.139	U	U
10	40006	50041	93H63- 25	Croaker	75	7.148	0.076		1.063		1.694	U	Mi/a
11	40006	50042	93H63- 98	Croaker	70	5.775	0.069		1.195		1.684	U	F
				Average	70.182	6.835	0.092		1.384		1.931		
				Standard Error	1.661	0.605	0.007		0.087		0.06		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40007	50061	93H63- 59	Croaker	75	7.78	0.064	0.04	0.823	0.514	1.844	U	F
2	40007	50062	93H63- 9	Croaker	64	4.186	0.044		1.051		1.597	U	Mi/a
3	40007	50063	93H63- 75	Croaker	44	1.808	0.029		1.604		2.122	U	F
4	40007	50064	93H63- 79	Croaker	54	2.756	0.025		0.907		1.75	U	F
5	40007	50070	93H63- 85	Croaker	51	2.363	0.031		1.312		1.781	U	U
				Average	57.6	3.779	0.039	0.04	1.139	0.514	1.819		
				Standard Error	5.409	1.075	0.007		0.143		0.086		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40013	50091	93H63- 102	Croaker	112	28.156	0.357	0.096	1.268	0.341	2.004	U	F
2	40013	50092	93H63- 48	Croaker	170	114.78	2.043	2.107	1.78	1.836	2.336	M	M
3	40013	50093	93H63- 86	Croaker	126	39.589	0.797	0.126	2.013	0.318	1.979	U	F
4	40013	50094	93H63- 95	Croaker	110	26.462	0.396	0.149	1.496	0.563	1.988	U	F
5	40013	50095	93H63- 68	Croaker	108	24.926	0.427	0.017	1.713	0.068	1.979	U	M
6	40013	50096	93H63- 69	Croaker	112	26.858	0.44	0.083	1.638	0.309	1.912	U	F
7	40013	50097	93H63- 126	Croaker	117	29.144	0.563	0.11	1.932	0.377	1.82	U	F
8	40013	50098	93H63- 8	Croaker	112	29.192	0.724	0.031	2.48	0.106	2.078	U	M
9	40013	50099	93H63- 107	Croaker	106	24.597	0.572	0.052	2.325	0.211	2.065	U	F
10	40013	50100	93H63- 81	Croaker	100	19.779	0.393	0.031	1.987	0.157	1.978	U	Mi/a
11	40013	50101	93H63- 78	Croaker	98	19.025	0.395	0.012	2.076	0.063	2.021	U	M
12	40013	50102	93H63- 97	Croaker	100	21.039	0.39	0.081	1.854	0.385	2.104	U	F
13	40013	50103	93H63- 18	Croaker	90	14.703	0.31	0.022	2.108	0.15	2.017	U	F
14	40013	50104	93H63- 101	Croaker	97	17.252	0.224	0.049	1.298	0.284	1.89	U	F
15	40013	50105	93H63- 121	Croaker	100	19.156	0.282	0.018	1.472	0.094	1.916	U	I
				Average	110.53	30.311	0.554	0.199	1.829	0.351	2.006		
				Standard Error	4.853	6.241	0.114	0.137	0.092	0.112	0.03		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40015	50148	93H63- 125	Croaker	100	19.226	0.279	0.048	1.451	0.25	1.923	U	F
2	40015	50149	93H63- 96	Croaker	111	28.237	0.3	0.129	1.062	0.457	2.065	U	F
3	40015	50150	93H63- 7	Croaker	75	7.154	0.049		0.685		1.696	U	Mi/a
				Average	95.333	18.206	0.209	0.089	1.066	0.354	1.895		
				Standard Error	10.651	6.107	0.08	0.041	0.221	0.104	0.107		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40016	50003	93H63- 63	Croaker	121	34.389	0.352	0.032	1.024	0.093	1.941	M	M
2	40016	50004	93H63- 103	Croaker	93	14.565	0.143	0.024	0.982	0.165	1.811	M	Mi/a
3	40016	50005	93H63- 1	Croaker	87	12.344	0.131	0.055	1.061	0.446	1.875	U	Mi/a
				Average	100.33	20.433	0.209	0.037	1.022	0.235	1.876		
				Standard Error	10.477	7.008	0.072	0.009	0.023	0.108	0.038		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40032	50181	93H63- 21	Croaker	110	26.677	0.284	0.114	1.065	0.427	2.004	U	F
2	40032	50182	93H63- 123	Croaker	104	20	0.166	0.111	0.83	0.555	1.778	U	F

Appendix 18f. Goby Biomarker Study. Gross measurements and Indices for Tonguefish.

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40002	50085	93H63- 65	Tonguefish	75	3.668	0.034		0.927		0.869	U	U
2	40002	50086	93H63- 67	Tonguefish	86	6.239	0.054		0.866		0.981	U	U
3	40002	50087	93H63- 60	Tonguefish	70	3.229	0.034		1.053		0.941	U	U
4	40002	50088	93H63- 22	Tonguefish	69	3.012	0.02		0.664		0.917	U	F
5	40002	50089	93H63- 94	Tonguefish	64	2.926	0.017		0.581		1.116	U	F
6	40002	50090	93H63- 2	Tonguefish	54	1.521	0.012		0.789		0.966	U	U
				Average	69.667	3.433	0.029		0.813		0.965		
				Standard Error	4.372	0.634	0.006		0.071		0.034		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40007	50073	93H63- 47	Tonguefish	102	8.404	0.043		0.512		0.792	U	U
2	40007	50074	93H63- 20	Tonguefish	72	2.728	0.02		0.733		0.731	U	U
3	40007	50075	93H63- 36	Tonguefish	59	1.732					0.843	U	M
				Average	77.667	4.288	0.032		0.623		0.789		
				Standard Error	12.732	2.078	0.012		0.111		0.032		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40016	50001	93H63- 16	Tonguefish	103	8.554	0.05		0.585		0.783	M?	F
2	40016	50002	93H63- 77	Tonguefish	95	8.001	0.047		0.587		0.933	U	F
3	40016	50121	93H63- 50	Tonguefish	133	27.619	0.271	0.287	0.981	1.039	1.174	F?	F
4	40016	50122	93H63- 38	Tonguefish	129	21.615	0.148		0.685		1.007	U	F
5	40016	50123	93H63- 39	Tonguefish	125	17.18	0.183	0.015	1.065	0.087	0.88	U	M
6	40016	50124	93H63- 32	Tonguefish	96	7.306	0.039	0.012	0.534	0.164	0.826	M?	F
7	40016	50125	93H63- 122	Tonguefish	90	6.175	0.029	0.01	0.47	0.162	0.847	M	M
8	40016	50126	93H63- 19	Tonguefish	137	25.682	0.247	0.042	0.962	0.164	0.999	M	M
9	40016	50127	93H63- 90	Tonguefish	112	12.518	0.1	0.256	0.799	2.045	0.891	M	F
10	40016	50128	93H63- 55	Tonguefish	103	9.997	0.088	0.116	0.88	1.16	0.915	U	F
11	40016	50129	93H63- 45	Tonguefish	135	23.091	0.169	0.029	0.732	0.126	0.939	M	M
12	40016	50130	93H63- 100	Tonguefish	119	14.543	0.07	0.137	0.481	0.942	0.863	U	F
13	40016	50131	93H63- 37	Tonguefish	99	9.665	0.048	0.011	0.497	0.114	0.996	M	M
14	40016	50132	93H63- 52	Tonguefish	96	8.891	0.066	0.01	0.742	0.112	1.005	M	U
15	40016	50133	93H63- 4	Tonguefish	125	18.657	0.0186		0.1		0.955	U	F
16	40016	50134	93H63- 87	Tonguefish	113	12.882	0.082	0.129	0.637	1.001	0.893	F	F
17	40016	50135	93H63- 10	Tonguefish	104	10.485	0.05	0.071	0.477	0.677	0.932	F	F
				Average	112.59	14.286	0.1	0.087	0.66	0.599	0.932		
				Standard Error	3.809	1.651	0.019	0.026	0.058	0.168	0.022		

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	Gross	Histo
1	40032	50184	93H63- 34	Tonguefish	140	23.898	0.108		0.452		0.871	U	M
2	40032	50185	93H63- 27	Tonguefish	121	15.487	0.148		0.956		0.874	U	F
3	40032	50186	93H63- 84	Tonguefish	109	12.802	0.079		0.617		0.989	U	U
4	40032	50187	93H63- 106	Tonguefish	105	10.584	0.108	0.131	1.02	1.238	0.914	F?	F
				Average	118.75	15.693	0.111	0.131	0.761	1.238	0.912		
				Standard Error	7.857	2.913	0.014		0.136		0.027		

Appendix 18g. Goby Biomarker Study. Gross measurements and Indices for Baskerweave Cusk-eels.

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	40007	50065	93H63- 31	Cusk-eel	137	13.28	0.173	0.009	1.303	0.068	0.516	U	U
2	40007	50066	93H63- 70	Cusk-eel	129	12.262	0.249	0.101	2.031	0.824	0.571	U	F
3	40007	50067	93H63- 116	Cusk-eel	123	10	0.125	0.01	1.25	0.1	0.537	U	Mi/a
4	40007	50068	93H63- 24	Cusk-eel	107	6.555	0.122	0.039	1.861	0.595	0.535	U	F
5	40007	50069	93H63- 42	Cusk-eel	95	4.065	0.065		1.599		0.474	U	I
				Average	118.2	9.232	0.147	0.04	1.609	0.397	0.527		
				Standard Error	7.605	1.732	0.031	0.022	0.152	0.187	0.016		
1	40016	50006	93H63- 13	Cusk-eel	212	57.584	2.449	0.069	4.253	0.12	0.604	M	U
1	40032	50183	93H63- 114	Cusk-eel	173	28.98	0.668		2.305		0.56	U	M

Appendix 18h. Goby Biomarker Study. Gross measurements and Indices for Round Stingrays.

#	Site	ID Org.#	Random #	Species	SL	BW	LW	GW	HSI	GSI	CI	SEX Gross	SEX Histo
1	80027	50046	93H63- 33	Stingray	320		26.107					M	F
2	80027	50047	93H63- 82	Stingray	255		10.606	1.851				M	F
3	80027	50048	93H63- 112	Stingray	300		35.472	19.412				M	M
4	80027	50049	93H63- 14	Stingray	370		54.428	32.363				M	M
5	80027	50050	93H63- 41	Stingray	375		33.222	25.545				M	M
6	80027	50052	93H63- 5	Stingray	138	41.237	1.844	0.219	4.472	0.531	1.569	M	U
7	80027	50053	93H63- 72	Stingray	304		40.575	21.088				M	M
8	80027	50054	93H63- 115	Stingray	285		20.114	9.539				M	M
9	80027	50055	93H63- 40	Stingray	324		26.623	23.945				M	M
10	80027	50056	93H63- 117	Stingray	310		21.94	4.252				U	M
				Average	298.1	41.237	27.093	15.357	4.472	0.531	1.569		
				Standard Error	21.102		4.741	3.882					