Report as of FY2007 for 2006GU72B: "Polychlorinated Biphenyls (PCBs) and Organochlorine Insecticides in Biotic Components of Tanapag Lagoon, Saipan"

Publications

Project 2006GU72B has resulted in no reported publications as of FY2007.

Report Follows

PROJECT SYNOPSIS REPORT

Project Title: Polychlorinated Biphenyls (PCBs) and Organochlorine Insecticides in Biotic Components of Tanapag Lagoon, Saipan

Problem and Research Objectives

Tanapag Lagoon, on the western shore of central Saipan, harbors a rich diversity of marine life and supports a variety of commercial and recreational activities. Over the years, increased urban growth and commercial developments along the adjacent coastline have resulted in a loss of environmental quality, particularly in the southern half of the lagoon. Primary sources of anthropogenic disturbance in these waters include a power station and commercial port (Saipan Harbor), two small boat marinas, a sewer outfall, several garment factories, auto and boat repair shops, wood shops, government vehicle maintenance yards, a commercial laundry, and an acetylene gas producer. There are also a number of old military dumps and disposal sites in the area as well as a 50-year old municipal dump that served as the island's only solid waste disposal site until its closure a little over two years ago. Several streams and storm drains empty into the lagoon during the rainy season and provide a mode of transport into the ocean for any land-based contaminants. Overflows from sewer lines are also commonplace at this time of the year and the whole area is inundated by storm water runoff during periods of prolonged wet weather. The effects of these perturbations on the indigenous biota within the lagoon are largely unknown. Likewise, fundamental data describing the abundance and distribution of persistent and potentially toxic pollutants within the system is also lacking.

Mindful of these shortcomings, a contaminant assessment of surface sediments within Tanapag Lagoon was undertaken in 1999 (Denton *et al.* 2001, 2006a). The study revealed discrete areas of heavy metal enrichment within the lagoon and emphasized the need for an impact assessment of animal and plant communities within the area. To this end, a bioindicator survey was undertaken in 2003 and focused on dominant ecosystem representatives from nearshore waters within the lagoon (Denton *et al.* in prep). A survey of mercury and arsenic in resident fish followed shortly thereafter (Denton and Trianni. in prep.).

The current work focused on chlorinated hydrocarbons in dominant fish species from within the lagoon. Specimens chosen for analysis included those with restricted home ranges in order to delineated specific areas of potential enrichment, as well as species that were more roving in their feeding habits to provide information on the overall condition of the lagoon from a contamination standpoint. Representative species with different food preferences were selected from various trophic levels in order to evaluate the degrees of biological magnification that have taken place so far for each contaminant. The data thus far collected for PCBs is presented here.

Methodology

Fish were taken from seven sites between Muchot Point at the southern end of the lagoon and Pau-Pau Beach in the north. (Fig. 1). Sites 1-4 are impacted by land-based sources of contamination of one sort or another while sites 5-7 are not and serve as useful reference sites. Specimens were caught by local fishermen using hook and line, spear gun and Hawaiian sling. They were chilled immediately and transported to the laboratory in insulated containers. The fish examined during the study are identified in Table 2. The trophic level to which each belongs and their movements within the lagoon are also indicated.

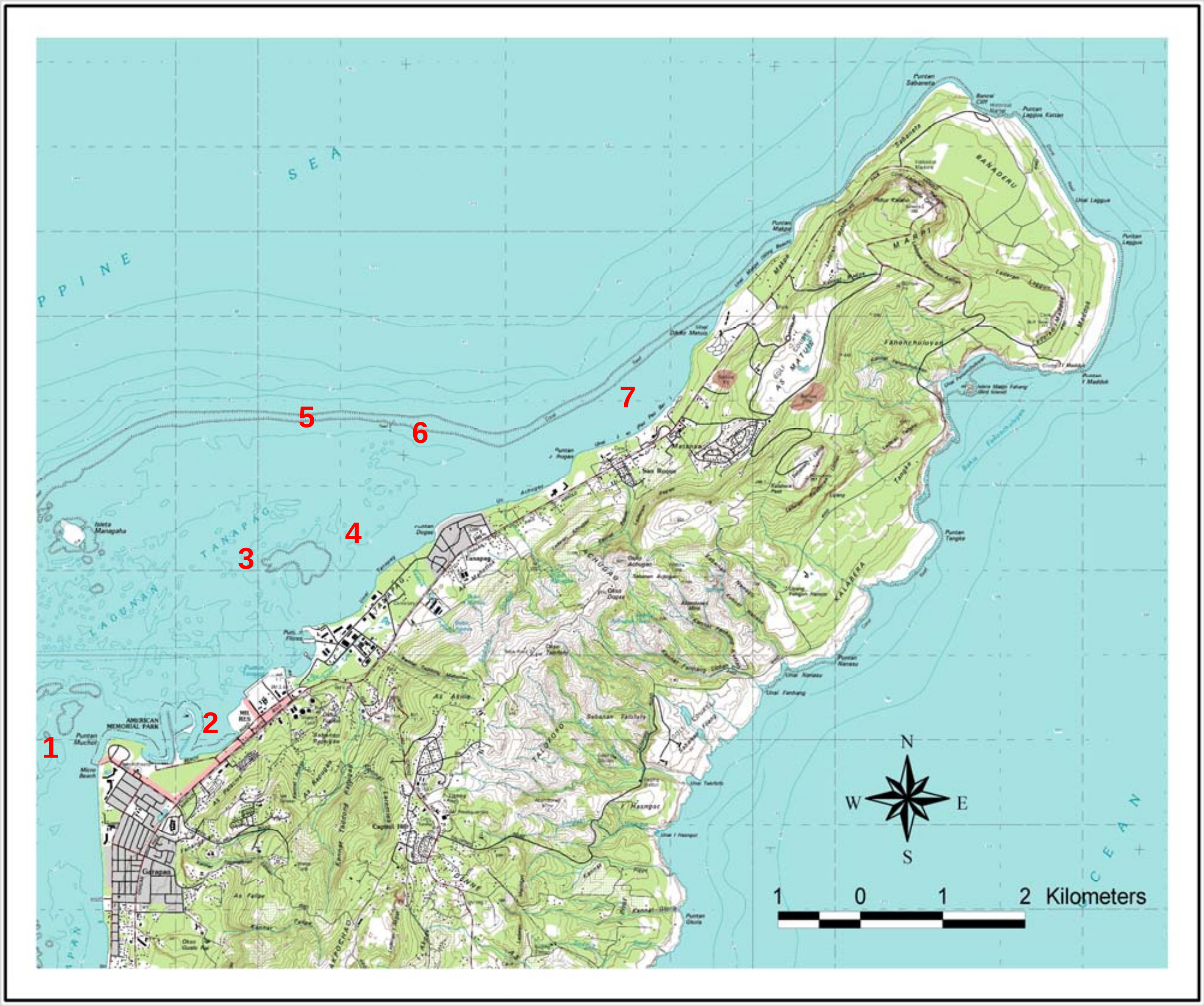

Figure 1: Map of northern Saipan showing fish sampling sites 1-7

In the laboratory, axial muscle was taken from directly under the dorsal fin on the right side of the fish analysis using high quality stainless steel instruments. Most fish were readily identified and processed within a few hours of capture. Those that weren't were deep-frozen as quickly as possible and processed within one month of returning to Guam. All tissue samples were homogenized and freeze dried prior to analysis. Approximately, 3 g of dried tissue was extracted with approximately 40 ml of hexane in an accelerated solvent extractor (Dionex 200 ASE). Following alumina cleanup, the extract was reduced to a final volume of 0.1 ml before gas chromatographic analysis. The surrogate and internal standard used to determine PCB recoveries were PCB 103 (100 pg/µl) and petachloronitrobenzene (250 pg/µl) respectively.

Table 2: Fish Sampled During the Present Survey

Species	Trophic Level*	Micro Beach/Reef	Puerto Rico Dump (seaward edge)	Seaplane Reef	Outer Lagoon Site 1	Outer Lagoon Site 2 (Dankulo Rock)	Tanapag Shoals	Pau-Pau Shoals
Acanthurus blochii	H,DI,R							
Acanthurus lineatus	H, DI, S	22		12		3		2
Acanthurus nigricans	H, DI, R	1					1	
Acanthurus nigricauda	H, DI, R		1				1	
Acanthurus nigrofuscus	H, DI, S		2		1			
Acanthurus olivaceous	O, DI, R					1		
Acanthurus triostegus	H/P, DI, R					1		1
Balistiodes viridescens	C, DI, S		1					
Calotomus carolinus	H, DI, R	2		1				
Caranx melampygus	C, DI, R			2				
Chaetodon ornatissimus	C, DI, S			1				
Cheilinus chlorous	C, DI, R					1		
Cheilinus trilobatus	C, DI, R			2	1		1	
Cheilo inermis	C, DI, R					I		
Chlorurus frontalis	H, DI, R					1		
Chlorurus sordidus	H, DI, R					4	3	
Coris aygula	C, DI, R			1				
Ctenochaetus striatus	H, DI, S	1				2	4	1
Epinephelus maculatus	C, DI, S					1		
Epinephelus howlandi	C, DI, S			2				
Epinephelus merra	C, DI, S			1		1		
Gnathodentex aurolineatus	C, NO, R	1				1	1	1
Halichoeres trimaculatus	C, DI, R					1		
Hemigymnus melapterus	C, DI, R				2			
Heteropriacanthus cruentatus	C, NO, S	1						
Kyphosus biggibus	H, DI, R					1		

Table 2: Fish Sampled During the Present Survey (cont.)

Species	Trophic Level*	Micro Beach/Reef	Puerto Rico Dump (seaward edge)	Seaplane Reef	Outer Lagoon Site 1	Outer Lagoon Site 2 (Dankulo Rock)	Tanapag Shoals	Pau-Pau Shoals
Lethrinus atkinsoni	C, NO, R	2				1		
Lethrinus erythracanthus	C, NO, R					1		
Lethrinus harak	C, NO, R	10	3	5			4	1
Lethrinus obsoletus	C, NO, R	1			1			
Lethrinus olivaceous	C, NO, R					2		
Lethrinus xanthochilus	C, NO, R	3				3		2
Lutjanus fulvus	C, NO, R	1				1		
Lutjanus kasmira	C, NO, R			1		1	2	
Lutjanus monostigmus	C, NO, R	1						
Myripristis amaena	P/C, NO, S	2				1		7
Myripristis berndti	P, NO, S	1	10	2		7	2	1
Myripristis kuntee	P/C, NO, S	1						
Myripristis murdjan	P/C, NO, S	1						
Myripristis pralina	P/C, NO, S	2					4	
Myripristis violacea	P/C, NO, S	7	4					8
Naso annulatus	H, DI, R					1		
Naso lituratus	H, DI, R	4	14	15		1	5	15
Naso unicornis	H, DI, R		1		1		1	1
Naso vlamingii	H, DI, S						1	
Neoniphon argenteus	C, NO, S					1		
Neoniphon opercularis	C, NO, S		1					
Neoniphon sammara	C, NO, S	3						3
Parupeneus barberinus	C, DI, R				1		1	2
Parupeneus multifasciatus	C, DI, R	1	2			1		
Plectropomis laevis	C, DI, R						1	
Pseudobalistes fuscus	C, DI, S					2		
Rhinecanthus aculeatus	O, DI, S						4	
Rhinecanthus rectangulus	O, DI, S			1				
Sargocentron spiniferum	C, NO, S		1	1		1		6
Scarus ghobban	H, DI, R	1		2	3			
Scarus globiceps	H, DI, R				2			
Scarus psittacus	H, DI, R			2		1		
Scarus sp.	H, DI, R			1				
Siganus spinus	H, DI, R		1				1	1
Sphyraena flavicauda	C, DI, R			2				
Sufflamen chrysoptera	O, DI, S					1		
Thalassoma trilobatum	C, DI, R					1		
Triaenodon obesus	C, NO, R			1				
Zanclus cornutus	O, DI, R			1				

* H = herbivore benthic; P = planktivore; C = carnivore; O = omnivore; R = roving/large home range; S = sedentary/small home range
NO = nocternal feeder; DI = diurnal feeder

PCB analysis was performed by gas chromatography (Varian 3400CX) using an electron capture detector and a 60 m x 0.25 mm i.d. fused silica MDN-5S, polymethyl-5% phenyl-siloxane (0.25µm film thickness) capillary column (Supelco). Gas flows (N_2), through the column and the detector, were 1 ml/min and 30 ml/min respectively. The initial column temperature was maintained at 50°C for the first minute of each run. It was then ramped to 150°C at 30°C/min, then to 280°C at 25°C/min, where it was held for 20 min to give a total run time of 76 min. Injector and detector temperatures were held constant at 280°C and 310°C respectively.

PCB quantification was accomplished using a 20-congener calibration standard representing PCB homologues Cl_2 to Cl_{10} (NOAA 1993). These congeners are selected on the basis of their potential toxicity, bioaccumulation and/or frequency of occurrence in environmental samples (McFarland and Clarke 1989). Complete chromatographic separation of all congeners was achieved although several of them are known to co-elute with other PCB congeners present in commercial PCB mixtures.

The $\sum_{20}$PCB content of the sample was calculated from the sum of the individual congener data. Undetectable congeners were set to zero during this process. PCB congener recoveries from a certified standard reference material (marine mussel: SRM 1974) were within acceptable limits. Method detection limits for individual chlorobiphenyls in the standard mix ranged from 0.02-0.15 ng/g.

Principal Findings and Significance

Over 300 fish representing 65 different species were sampled for analysis during the course of this work. The data thus far collected are summarized in Table 3. Congener prevalence and abundance were in line with that reported earlier for reef fish from Guam (Denton *et al.* 2006b). ΣPCB_{20} in the samples ranged from 1.17-116 ng/g dry wt. The data was converted to ng/g wet weight using a wet to dry weight ratio of 5 (Denton *et al.* 1999). 'Total' PCB concentrations were estimated by doubling the sum of all detectable chlorobiphenyls in the calibration standard (O'Connor 1998).

Muscle tissue of marine fish from relatively uncontaminated waters usually contains total PCBs in the low ng/g range on a wet weight basis while specimens from contaminated environments may contain levels two to three orders of magnitude higher. The data presented here range from ~0.47-46.4 ng/g when converted to total PCBs on a wet weight basis with close to 80% of all fish analyzed so far having levels of <10 ng/g (Fig. 2).

The current FDA food standard for PCBs in fish is 2.0 µg/g wet weight/, well below the maximum concentration encountered during the present work. Unfortunately, this blanket standard does not address variations in consumption rates and so may not adequately protect people living in predominantly fish eating communities like those of the Pacific Islands. The more conservative USEPA risk-based consumption guidelines for PCBs in fish are therefore more appropriate here (USEPA 2000). These guidelines are based on an interim reference dose (RfD) of 20 ng PCB/kg body weight/day for a person weighing 70 kg. They take into account the PCB levels in the fish consumed and indicate the maximum number of 8 oz fish meals that may be consumed each month. Unrestricted consumption (i.e., more than sixteen 8-oz fish meals per month) is recommended only for fish with PCB levels of 5.9 ng/g wet weight or less.

Table 3: PCB Levels in Axial Muscle of Dominant Food Fish from Tanapag Lagoon, Saipan

Species	PCB Congeners (ng/g dry wt.)																				Σ_{20}PCB	Total PCB (wet wt.)
	8	18	28	44	52	66	77	101	105	118	126	128	138	153	170	180	187	195	206	209		
Micro Reef and Beach Area (site 1)																						
Acanthurus lineatus	nd	0.81	nd	nd	0.42	nd	nd	1.40	nd	0.52	nd	0.43	nd	nd	nd	0.08	0.26	nd	nd	nd	3.92	1.57
Acanthurus nigricans	4.47	4.11	nd	nd	0.31	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.17	nd	nd	0.52	9.58	3.83
Acanthurus lineatus	nd	0.22	nd	nd	1.29	nd	nd	3.36	0.82	2.78	nd	0.74	1.77	1.71	0.26	0.71	0.17	nd	nd	nd	13.8	5.52
Acanthurus lineatus	nd	nd	nd	nd	1.29	nd	nd	2.27	0.37	1.30	nd	0.34	0.93	0.96	nd	0.13	nd	nd	nd	nd	7.59	3.04
Acanthurus lineatus	nd	nd	nd	nd	0.81	1.64	nd	nd	nd	0.15	nd	nd	nd	nd	nd	0.07	nd	nd	nd	nd	2.67	1.07
Acanthurus lineatus	27.5	0.34	nd	nd	1.11	nd	nd	2.66	nd	0.20	nd	nd	nd	0.14	nd	nd	0.15	nd	nd	nd	32.1	12.8
Acanthurus lineatus	nd	nd	nd	nd	1.10	nd	nd	nd	0.07	0.33	nd	0.13	0.30	0.15	nd	nd	0.12	nd	nd	nd	2.21	0.88
Acanthurus lineatus	nd	0.84	nd	nd	2.02	nd	0.17	nd	nd	nd	nd	0.10	nd	nd	nd	0.05	nd	nd	nd	nd	3.17	1.27
Acanthurus lineatus	nd	nd	nd	nd	nd	1.17	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.17	0.47
Acanthurus lineatus	nd	nd	nd	nd	nd	nd	0.96	nd	1.50	2.61	nd	0.73	2.19	0.85	nd	0.58	0.24	nd	nd	4.79	14.4	5.78
Calotomus carolinas	nd	nd	nd	0.78	2.29	nd	nd	3.59	0.16	0.96	nd	0.22	0.55	0.60	nd	0.08	nd	nd	nd	nd	9.22	3.69
Calotomus carolinas	0.50	0.35	nd	nd	0.39	1.32	nd	nd	nd	nd	nd	nd	nd	1.41	nd	nd	nd	nd	nd	nd	3.96	1.58
Ctenochaetus striatus	nd	0.95	1.06	nd	0.73	nd	nd	3.72	1.02	3.06	nd	0.70	1.19	0.81	0.16	0.33	0.18	nd	nd	nd	13.9	5.57
Gnathodentex anrolineatus	2.37	1.88	4.18	2.57	3.52	nd	1.53	12.3	5.99	12.8	1.16	5.10	8.39	7.08	3.27	3.64	2.45	1.85	2.09	2.56	84.7	33.9
Heteropricanthus cruentatus	0.69	0.98	2.09	nd	0.54	nd	nd	1.60	nd	0.80	nd	0.20	0.36	nd	nd	0.18	0.49	nd	nd	0.55	8.49	3.40
Lutjanus fulvus	0.66	0.48	nd	nd	0.92	nd	nd	2.54	nd	1.10	nd	nd	0.58	nd	nd	0.70	0.48	nd	nd	nd	7.45	2.98
Naso lituratus	0.28	0.24	nd	1.78	2.26	nd	0.72	12.0	4.28	10.0	nd	2.53	nd	5.04	0.90	1.37	0.49	nd	0.12	nd	42.1	16.8
Naso lituratus	2.46	4.77	nd	nd	0.71	nd	nd	nd	0.07	0.62	nd	0.13	nd	nd	0.15	nd	0.87	0.11	0.11	nd	9.99	4.00
Naso lituratus	5.10	6.91	nd	nd	1.74	nd	0.23	8.94	2.87	7.04	nd	nd	nd	2.93	1.97	1.42	1.43	nd	nd	nd	40.6	16.2
Neoniphon sammara	nd	nd	nd	nd	0.58	nd	nd	3.16	0.13	1.19	nd	0.39	0.67	nd	nd	0.42	0.39	nd	0.48	nd	7.42	2.97
Neoniphon sammara	1.32	nd	nd	nd	1.11	nd	nd	nd	nd	0.37	nd	nd	0.56	1.18	0.23	1.25	0.39	nd	nd	nd	6.40	2.56
Parupeneus multifasciatus	0.85	1.47	1.63	nd	1.55	nd	nd	1.53	nd	1.94	nd	0.67	1.36	0.91	nd	0.97	0.83	nd	nd	nd	13.7	5.49
Myripristis amaena	nd	0.40	nd	0.68	0.91	nd	0.32	3.27	0.10	1.18	nd	0.30	0.42	0.10	0.12	0.23	0.21	0.06	nd	0.60	8.90	3.56
Myripristis pralina	nd	1.10	3.32	0.96	1.30	nd	nd	4.52	0.29	2.46	nd	0.69	0.12	0.40	0.29	0.54	0.25	nd	nd	1.32	17.6	7.02
Myripristis murdjan	1.29	1.15	4.44	0.85	1.00	nd	0.20	3.51	nd	1.19	nd	0.35	0.42	nd	nd	0.24	0.81	0.05	0.07	0.61	16.2	6.47
Neoniphon sammara	1.42	1.11	4.00	nd	1.12	nd	nd	4.12	0.51	3.56	nd	1.07	2.10	1.10	0.36	0.73	0.41	nd	0.48	0.79	22.9	9.15
Myripristis kuntee	0.67	0.46	nd	nd	0.75	nd	nd	3.60	nd	1.62	nd	0.39	0.80	0.30	0.09	0.64	0.26	nd	0.24	0.46	10.3	4.12
Myripristis berndti	2.21	1.72	6.55	nd	2.25	nd	nd	3.86	nd	1.46	nd	0.51	0.46	nd	nd	0.59	0.34	nd	nd	1.94	21.9	8.75
Myriprisits pralina	nd	nd	nd	0.68	0.41	2.08	nd	1.71	nd	0.31	nd	0.09	nd	0.36	nd	0.17	nd	nd	nd	nd	5.79	2.32
Myripristis violacea	nd	nd	nd	nd	0.41	3.31	nd	nd	nd	0.78	nd	nd	0.10	0.51	nd	0.30	nd	nd	nd	nd	5.41	2.16
Myripristis violacea	nd	nd	nd	0.94	1.01	nd	nd	4.16	0.71	2.40	nd	0.56	1.30	1.47	0.13	1.36	0.40	nd	nd	nd	14.4	5.77
Myripristis amaena	nd	nd	nd	1.25	0.36	1.92	nd	nd	nd	0.46	nd	0.10	0.09	0.21	nd	0.69	nd	nd	nd	nd	5.07	2.03
Myripristis violacea	nd	nd	nd	1.58	1.37	4.60	nd	3.53	0.16	1.18	nd	0.19	nd	0.39	nd	2.22	nd	nd	nd	nd	15.2	6.09
Myripristis violacea	nd	nd	nd	2.12	0.75	nd	nd	nd	nd	0.76	nd	0.15	nd	0.77	nd	0.54	nd	nd	nd	nd	5.09	2.04
Myripristis violacea	nd	nd	nd	1.71	1.85	2.67	nd	nd	nd	0.42	nd	0.21	nd	0.39	nd	0.37	nd	nd	nd	0.31	7.92	3.17
Myripristis violacea	nd	nd	nd	nd	0.63	2.32	nd	nd	0.26	0.77	nd	0.28	0.47	0.60	0.08	0.19	0.34	nd	nd	nd	5.93	2.37
Myripristis violacea	nd	nd	nd	nd	nd	2.31	nd	nd	nd	0.15	nd	0.09	nd	0.15	nd	0.53	nd	nd	nd	nd	3.24	1.29
Scarus ghobban	nd	nd	1.05	0.57	0.80	nd	nd	3.63	0.76	3.28	nd	0.83	2.02	0.84	0.30	0.46	0.25	nd	nd	nd	14.8	5.91

Table 3 (cont.): PCB Levels in Axial Muscle of Dominant Food Fish from Tanapag Lagoon, Saipan

Species	PCB Congeners (ng/g dry wt.)																				Σ_{20}PCB	Total PCB (wet wt.)
	8	18	28	44	52	66	77	101	105	118	126	128	138	153	170	180	187	195	206	209		
Puerto Rico Dump (site 2)																						
Balistoides viridescens	2.04	0.62	nd	1.22	0.41	nd	nd	5.40	0.09	0.89	nd	nd	nd	1.05	nd	0.49	nd	nd	nd	nd	12.2	4.89
Lethrinus harak	2.54	1.77	4.99	2.04	0.69	nd	nd	5.76	nd	1.56	nd	0.22	nd	3.02	nd	1.90	1.21	nd	nd	nd	25.7	10.3
Lethrinus harak	3.71	1.36	nd	1.29	0.60	nd	nd	6.21	1.08	2.92	nd	0.89	1.45	4.10	0.61	1.49	1.15	0.12	nd	nd	27.0	10.8
Naso lituratus	2.33	1.67	3.70	nd	nd	nd	nd	2.89	nd	1.01	nd	0.18	nd	1.68	nd	0.07	nd	nd	nd	nd	13.5	5.41
Naso lituratus	2.63	1.28	nd	nd	1.20	nd	0.89	5.47	nd	1.01	nd	0.18	nd	nd	nd	0.51	0.34	nd	nd	nd	13.5	5.41
Naso lituratus	3.08	1.03	nd	nd	0.28	nd	nd	4.28	0.20	1.18	nd	0.18	nd	1.81	nd	0.41	0.16	nd	nd	nd	12.6	5.04
Naso lituratus	2.96	1.47	0.26	nd	0.74	nd	nd	7.41	1.43	4.05	0.58	0.82	0.72	2.37	nd	0.51	nd	nd	nd	nd	23.3	9.32
Naso lituratus	3.51	2.38	6.30	1.66	2.39	nd	nd	19.3	6.11	13.1	0.16	3.07	4.65	6.92	nd	1.15	0.47	nd	nd	nd	71.1	28.4
Naso lituratus	2.67	1.94	0.35	nd	nd	nd	nd	5.40	0.25	1.15	0.87	nd	nd	0.15	nd	nd	nd	nd	nd	nd	12.8	5.11
Naso lituratus	2.04	2.51	nd	nd	nd	nd	nd	8.42	2.57	5.58	nd	1.34	1.60	4.83	nd	0.75	0.41	nd	nd	nd	30.1	12.0
Naso lituratus	2.13	1.57	3.48	nd	nd	nd	nd	3.36	0.11	1.33	0.15	0.16	nd	nd	nd	0.33	nd	nd	nd	nd	12.6	5.05
Naso lituratus	1.27	0.70	0.83	nd	0.32	nd	nd	2.08	nd	0.35	nd	0.20	nd	nd	nd	0.14	nd	nd	nd	nd	5.88	2.35
Naso lituratus	0.93	0.57	2.17	0.50	2.27	nd	nd	11.0	3.45	8.28	nd	2.02	3.96	6.22	0.85	1.48	0.65	nd	0.17	nd	44.5	17.8
Naso lituratus	2.61	0.90	nd	nd	0.26	5.84	nd	nd	nd	0.17	nd	0.12	nd	nd	0.06	0.09	nd	nd	nd	nd	10.1	4.02
Naso lituratus	nd	nd	0.16	3.53	2.68	nd	nd	27.8	10.2	24.3	4.41	5.94	13.3	14.3	2.41	3.71	1.23	nd	0.72	1.14	116	46.4
Naso lituratus	0.48	1.04	2.92	nd	0.43	nd	nd	nd	nd	0.27	nd	0.08	nd	nd	nd	0.26	0.29	0.37	nd	0.68	6.81	2.73
Naso lituratus	nd	0.87	nd	nd	1.10	nd	nd	5.17	1.63	3.76	nd	1.09	2.08	1.53	0.29	0.81	0.59	nd	nd	0.34	19.2	7.70
Parupeneus multifasciatus	10.5	6.68	0.83	nd	2.67	nd	nd	12.3	3.20	7.81	nd	2.54	3.82	16.14	2.02	6.95	4.43	nd	nd	nd	79.9	32.0
Parupeneus multifasciatus	2.53	2.35	nd	nd	1.02	nd	nd	10.6	0.50	3.01	nd	0.42	0.56	4.25	0.57	2.67	nd	nd	0.88	nd	29.4	
Outer Lagoon (sites 5 and 6)																						
Acanthurus nigrofuscus	2.72	0.80	nd	2.19	1.66	nd	0.81	14.7	2.73	7.72	nd	1.42	2.58	3.73	0.23	0.48	nd	nd	nd	nd	41.8	16.7
Cheilinus tribolatus	nd	0.56	nd	2.00	0.99	nd	nd	8.08	1.73	5.45	nd	0.89	1.71	2.48	0.16	0.33	nd	nd	nd	nd	24.4	9.76
Hemigymnus melapterus	2.51	0.91	2.62	0.29	0.56	nd	nd	3.11	nd	0.69	0.13	0.08	0.59	3.26	0.26	0.66	1.11	nd	nd	nd	16.8	6.71
Hemigymnus melapterus	3.00	0.91	nd	3.40	1.80	nd	nd	8.66	0.42	1.96	nd	nd	0.28	1.17	0.13	0.22	nd	nd	nd	nd	22.0	8.78
Lethrinus obsoletus	nd	0.67	nd	nd	0.312	nd	nd	2.98	nd	0.73	nd	nd	nd	0.46	nd	nd	nd	nd	nd	nd	5.15	2.06
Naso unicornis	3.00	5.24	nd	2.85	2.20	nd	nd	14.4	3.97	11.0	0.23	2.48	4.51	4.83	0.67	1.07	0.54	nd	nd	nd	57.0	22.8
Parupeneus barberinus	1.78	1.20	2.21	nd	0.44	nd	nd	2.09	nd	0.61	nd	nd	nd	0.43	nd	nd	nd	nd	nd	nd	8.8	3.50
Scarus ghobban	2.17	0.93	2.24	1.28	1.23	nd	0.70	6.45	1.15	3.25	nd	0.68	0.81	1.68	nd	0.53	0.36	nd	nd	nd	23.5	9.39
Scarus ghobban	1.63	0.86	0.13	1.26	1.00	nd	nd	3.98	0.09	0.91	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	9.85	3.94
Scarus globiceps	2.20	1.38	nd	1.10	0.64	nd	nd	4.21	nd	0.71	nd	0.07	nd	0.82	nd	0.07	nd	nd	nd	nd	11.2	4.48

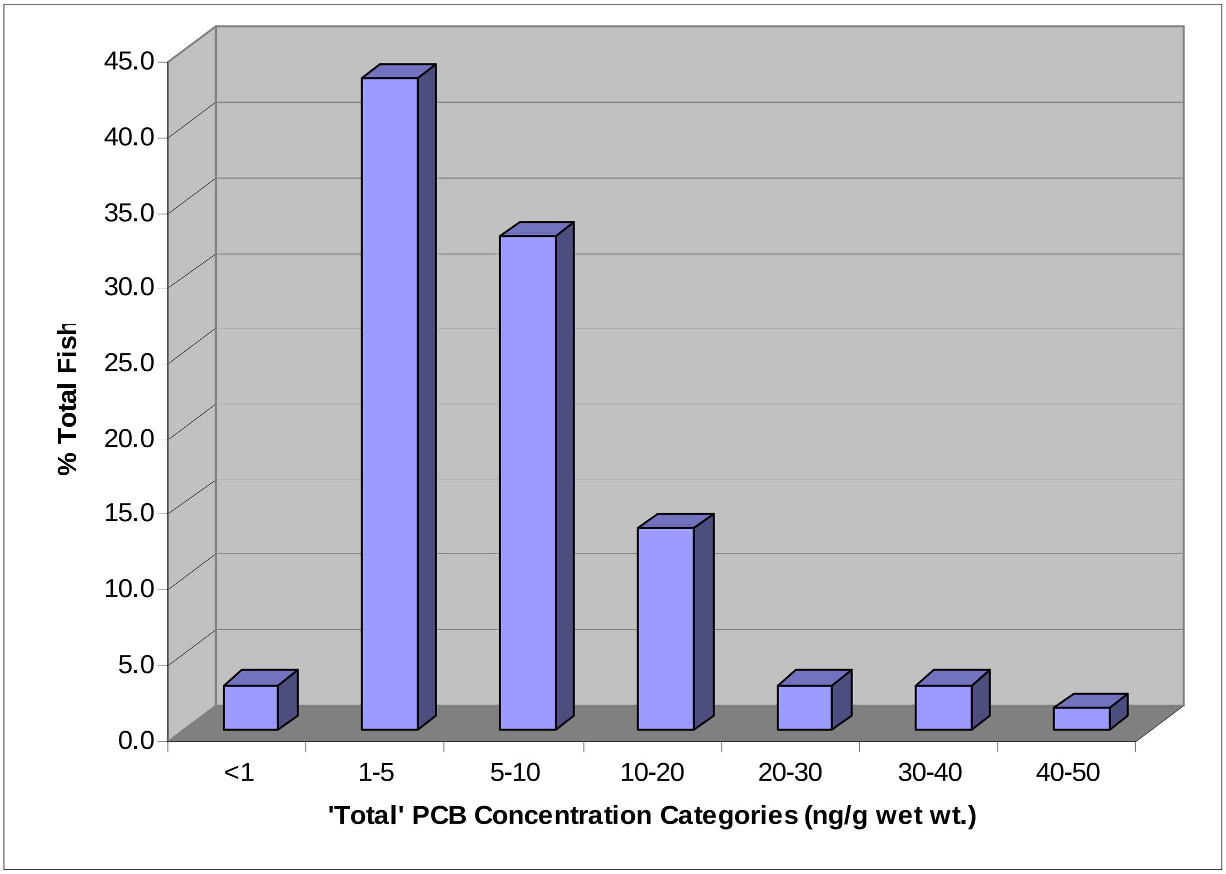

Figure 2: Frequency distribution histogram of 'total' PCB levels in fish examined to date

63% of the total number of fish analyzed to date fell into the unrestricted consumption category, and a further 22% contained levels that permit consumption of up to sixteen 8 oz fish meals per month (i.e. 6-12 ng PCB/g dry wt.). It should be noted that these guidelines are based on noncancer health endpoints and are four times higher (less sensitive) than the equivalent USEPA fish meal consumption rate guidelines derived using cancer health endpoints (based on an acceptable cancer risk of 1 in 100,000 over a 70 year lifetime). That said, it would seem that PCB levels in fish from Tanapag Lagoon are comparable with those found in specimens from relatively clean environments and do not represent a particularly significant health risk to consumers enjoying moderate consumption of these resources.

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