

**The NOAA's National Status and Trends
Mussel Watch Program in Galveston Bay:
Chlorinated Hydrocarbons in Oysters, 1986 - 1997**

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EDUCATION

1993 Doctor of Philosophy College of Geosciences and Maritime
Studies
1986 Master of Science Texas A&M University
College Station, Texas, U.S.A.
1977 Licenciado en Química Universidad Nacional del Sur
(A six-year Bachelor of Science Bahía Blanca, Buenos Aires, Argentina.
Program in Chemistry).
1976 Licenciado en Bioquímica
(A six-year Bachelor of Science
Program in Biochemistry)
1975 Químico
(A three-year intermediate degree
in Chemistry).

EXPERIENCE

1998-present Member of the Graduate Faculty at Texas A&M University.
1997-present Member of the Editorial Board of *Environmental Toxicology and
Chemistry - Environmental Chemistry* (1997-1999).
1996-present Assistant Research Scientist
College of Geosciences and Maritime Studies, Texas A&M University,
College Station, Texas, U.S.A.
1993-1996 Research Associate
College of Geosciences and Maritime Studies, Texas A&M University,
College Station, Texas, U.S.A.
1989-1993 Research Assistant
Texas A&M University, College of Geosciences, Department of
Oceanography, College Station, Texas, U.S.A.
1985-1989 Graduate Assistant Research

Texas A&M University, College of Geosciences, Department of
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1978-1984

Research Assistant

Instituto Argentino de Oceanografía (IADO), Bahía Blanca, Buenos Aires,
Argentina.

PROFESSIONAL INTEREST

- Determination, impact and fate of trace organic contaminants (chlorinated pesticides, polychlorinated biphenyls -including planar congeners-, dioxins/furans, polynuclear aromatic hydrocarbons and butyltin compounds) in the environment.
- Biomonitoring of environmental contaminants.
- Biomarkers of environmental contamination.
- Development of analytical techniques for the analysis of trace organic contaminants.

THE NOAA'S NATIONAL STATUS AND TRENDS MUSSEL WATCH PROGRAM IN GALVESTON BAY: CHLORINATED HYDROCARBONS IN OYSTERS, 1986-1997

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The Galveston Bay system constitutes one of the largest and most economically important estuaries along the northern coast of the Gulf of Mexico. For many years now, this area has been the recipient of various environmental contaminant inputs because of an aggressively growing urban and industrial development. The city of Houston, Deer Park, Baytown, Texas City and Galveston City, for example, are some of the most heavily industrialized areas on the coast of Texas. For this reason, the National Oceanic and Atmospheric Administration (NOAA) selected to monitor the levels of organic contaminants in bivalves from Galveston Bay as part of NOAA's National Status and Trends Mussel Watch (NS&T) Project.

Since 1986, the NS&T Project has been monitoring, on a national scale, the spatial and temporal trends in the concentrations of selected trace organic and inorganic contaminants through the annual collection and analysis of bivalve mollusks. Mussels and oysters are collected for this purpose because they can reflect changes in chemical concentrations in their environments. These organisms are capable of increasing or decreasing the concentrations of a number of contaminants in their tissues to mimic corresponding increases or decreases in their surroundings (Sericano, 1993a). The chlorinated hydrocarbon data (e.g. polychlorinated biphenyls, DDT and its metabolites, chlordane-related compounds) produced between 1986 and 1997 for six sampling locations in Galveston Bay are shown in Figure 1 (Houston Ship Channel, GBSC; Yacht Club, GBYC; Todd's Dump, GBTD; Hanna Reef, GBHR; Confederate Reef, GBCR).

The original sample sites in Galveston Bay (i.e., GBYC, GBTD, GBHR and GCCR) were selected to characterize the overall concentrations of contaminants away from known point sources of inputs (O'Connor 1990). In January 1988, additional new sites were selected closer to urban areas (i.e. GBSC and GBOB). Between 1986 and 1991, samples of indigenous *Crassostrea virginica* in Galveston Bay were collected from three stations in each of the sampling locations and analyzed individually. Starting in 1992, the samples from all three stations from a particular site were consolidated into one composite sample. Analyses of the samples were performed using Standard Operating Procedures (SOPs) to provide high quality, precise and reproducible data. Details of the method used have been published elsewhere (e.g., Sericano *et al.*, 1990; 1993b).

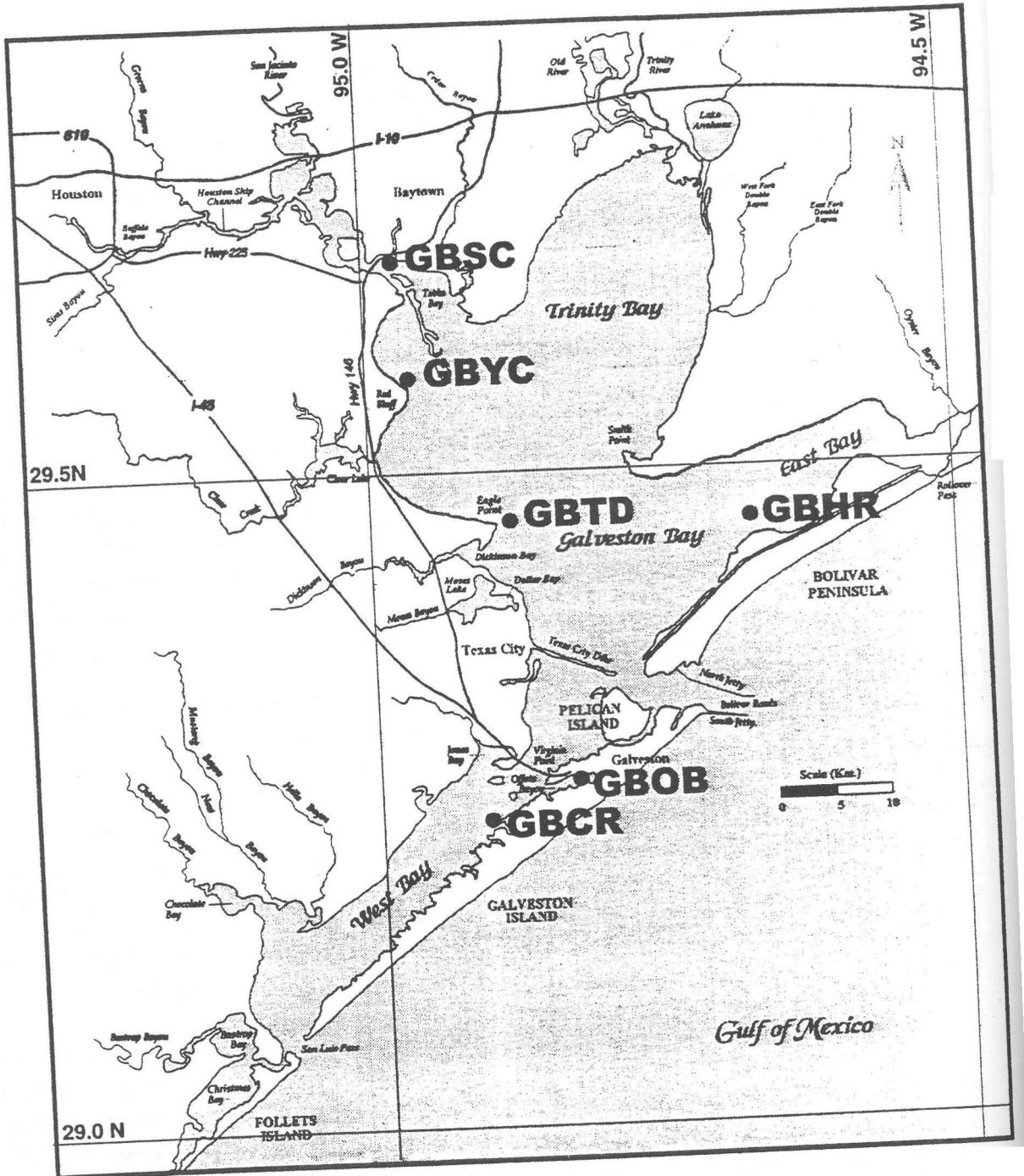


Figure 1. Sampling Locations in Galveston Bay

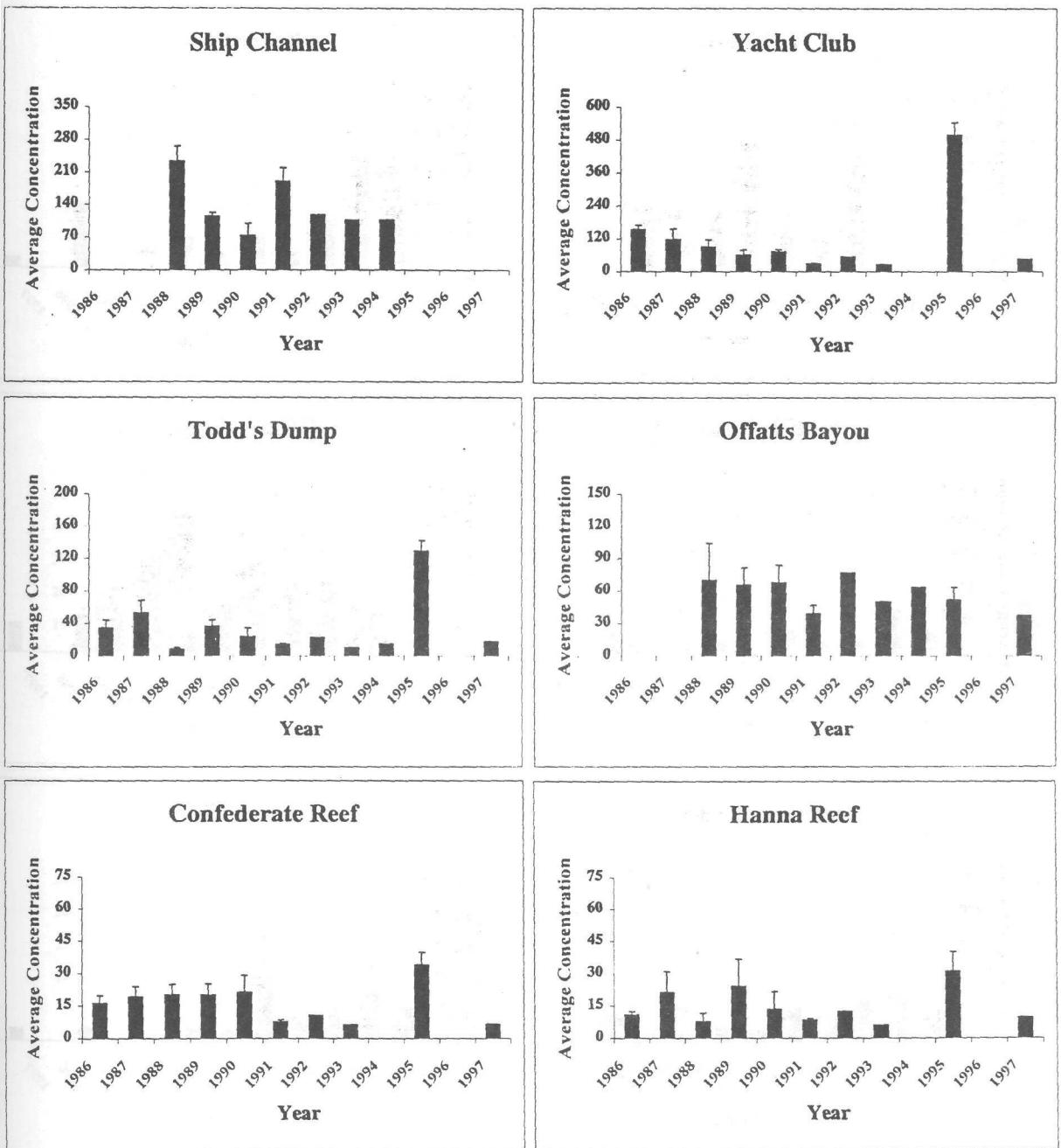


Figure 2. Average Total DDT Concentrations (ng/g, dry wt.) in Galveston Bay Oysters

Average total concentrations of DDTs (sum of o-p' DDT, p-p' DDT, o-p' DDD, p-p' DDD, o-p' DDE and p-p' DDE) in Galveston Bay between 1986 and 1997 are shown in Figure 2. Average concentrations ranged from the lowest, detected in GBHR samples (14.5 ± 8.31 ng/g), to the highest concentration of 135 ± 55.8 ng/g in GBSC. A significant spike in total DDT concentration was observed at several locations in 1995. During that year, the highest concentration was measured in bivalves collected near the Houston Yacht Club (500 ng/g).

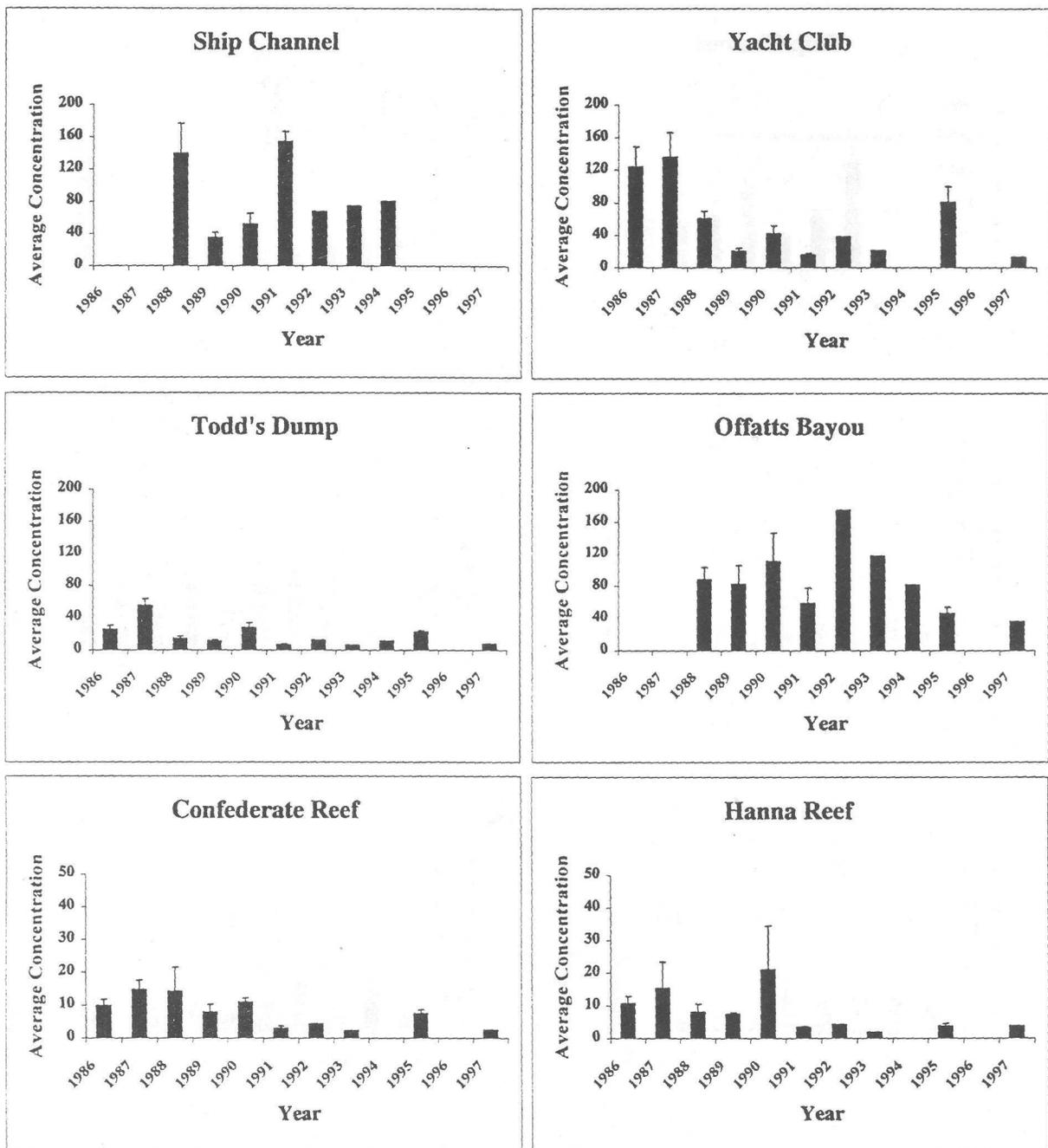


Figure 3. Average Total Chlordane Concentrations (ng/g, dry wt.) in Galveston Bay Oysters

Between 1986 and 1997, the average total concentrations of selected chlordane-related compounds (sum of heptachlor, heptachlor epoxide, *alpha*-chlordane and *trans*-nonachlor) ranged from 7.76 ± 4.67 ng/g to 88.3 ± 44.3 ng/g in samples from GBCR and GBOB, respectively (Figure 3). Comparable low concentrations were encountered in samples from Hanna Reef (average = 7.95 ± 6.15 ng/g) while concentrations in samples from GBSC collected near the Houston Ship Channel (average = 86.3 ± 44.3 ng/g) were similar to those reported in samples from GBOB. The highest concentration between 1986 and 1997 was measured in a composite sample from GBOB (175 ng/g) collected in 1992.

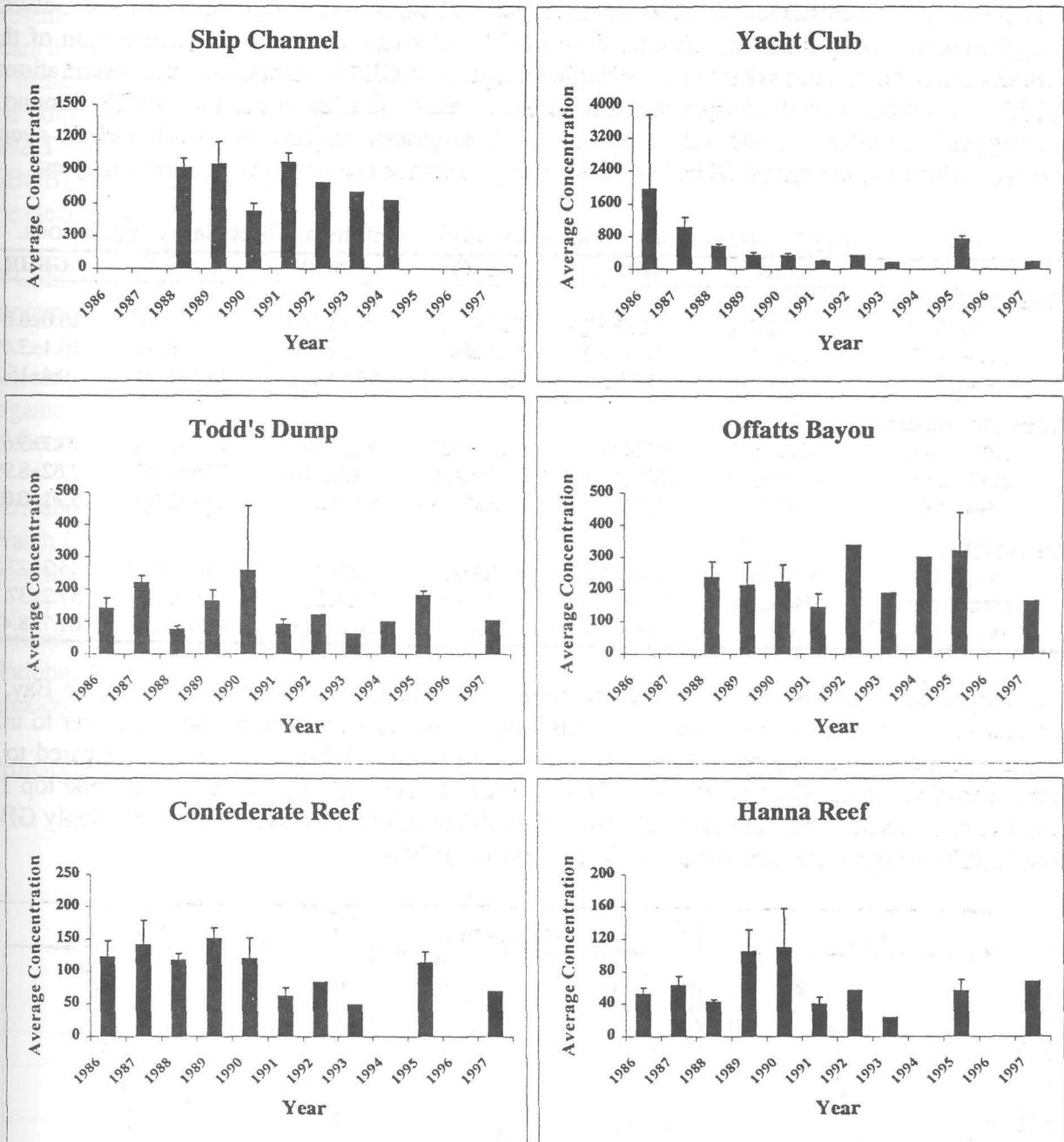


Figure 4. Average Total DDT Concentrations (ng/g, dry wt.) in Galveston Bay Oysters

Average total concentrations of polychlorinated biphenyls [determined as the sum of 18 individual congeners and extrapolated to total PCB based on the correlation between the total of all measurable PCBs and the sum of selected congeners determined during the first years of the NS&T Program (Jackson et al., 1998)] ranged from 61.4 ± 27.4 ng/g to 783 ± 173 ng/g in samples from GBHR and GBSC, respectively (Figure 4). The highest average concentration for a site was measured in a set of samples from GBYC (1950 ng/g) in 1986.

The trends in concentrations of these contaminants with time were not obvious in most Galveston Bay locations. Only samples collected from GBYC showed a decrease in concentration of these chlorinated contaminants with time. With the exception of GBYC samples, total concentrations of these chlorinated contaminants with time. With the exception of GBYC samples, total concentrations of DDTs, chlordane-related compounds and PCBs at each location seem to oscillate around an average concentration. If the data is grouped in three groups of four years each and the average concentrations are compared (Table 1), a decreasing trend can be observed for some analytes.

Table 1. Average Concentrations in Galveston Bay Locations in Three Sampling Periods.

	GBSC	GBYC	GBTD	GBOB	GBCR	GBHR
Total DDTs						
1986-1989	175±83.4	105±39.5	32.7±18.2	67.8±3.02	18.9±1.86	16.0±8.04
1990-1993	122±49.2	45.4±21.8	17.5±6.41	58.2±17.1	11.5±6.79	10.1±3.49
1994-1997	107	273±321	53.6±65.3	50.6±13.2	20.3±19.4	20.4±15.3
Total Chlordanes						
1986-1989	87.3±73.7	85.3±54.4	26.5±20.1	85.2±4.17	11.7±3.33	10.3±3.61
1990-1993	87.2±45.9	29.2±13.0	13.2±10.1	115±57.6	5.18±3.95	7.62±8.99
1994-1997	80.57	47.1±48.1	14.0±7.70	57.5±23.7	5.03±3.55	3.71±0.03
Total PCBs						
1986-1989	937±24.5	964±719	150±59.6	225±17.1	133±15.6	65.3±27.5
1990-1993	746±184	254±91.3	133±86.9	223±82.8	78.6±31.3	57.2±37.7
1994-1997	627	458±396	128±46.0	261±85.0	91.5±31.1	61.7±8.41

Not surprisingly, the lowest concentrations were observed in more remote regions of the Bay, i.e. Hanna Reef, while the highest concentrations were measured in samples collected closer to urban areas. When concentrations encountered in locations within Galveston Bay are compared to the other locations in the Gulf of Mexico (Figure 5), GBSC and GBYC are ranked with the top 10% most contaminated locations followed closely by GBTD and GBOB in the next 10%. Only GBHR and GBCR samples are occasionally ranked in the lower 50%.

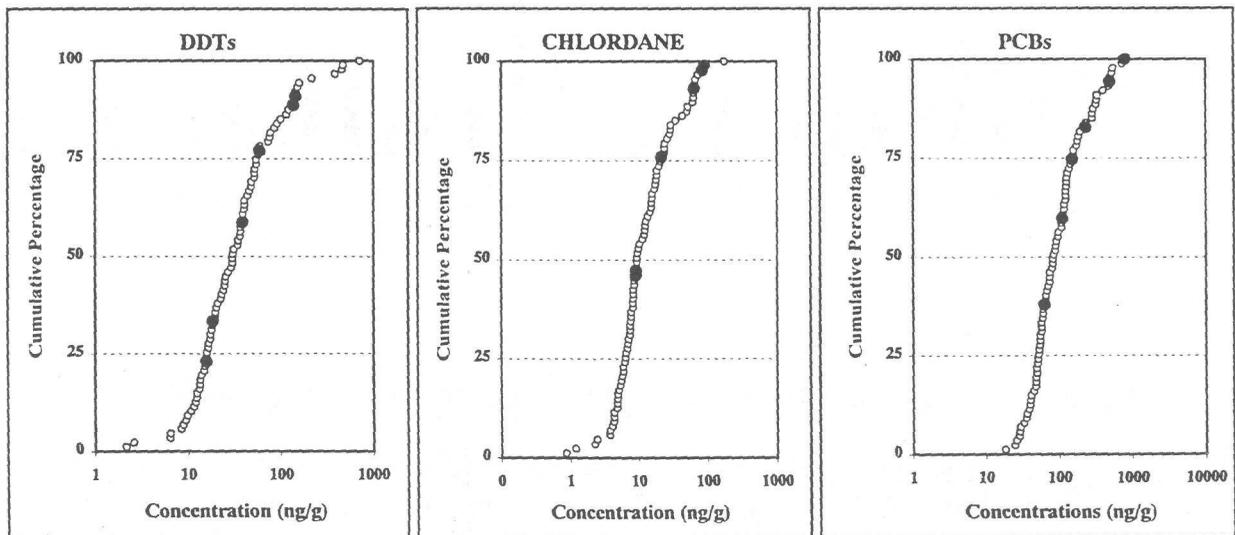


Figure 5. Cumulative Percentage Distribution Plot of Average Concentrations of Total DDTs, Chlordanes and PCBs in Gulf of Mexico Oysters.

In conclusion, concentrations of these chlorinated hydrocarbons in Galveston Bay oysters do not present a clear trend with time.. Although, the variability in concentrations that occur among the years at one given site is significant, a decreasing trend can be observed at some locations for some of these analytes if the data is grouped and the average concentrations compared. A comparison of the contaminant concentrations measured in Galveston Bay oysters with those reported for the NS&T Project in the Gulf of Mexico shows that three Galveston Bay sites (GBSC, GBYC and GBOB) are ranked within the most contaminated sites. On the other hand, GBHR is ranked within the cleanest locations in the Gulf of Mexico.

O'Connor, T.P. (1990). Coastal environmental quality in the United States – Chemical contamination in sediments and tissues. A special NOAA 20th Anniversary Report.

Sericano J.L. (1993a). The American oyster (*Crassostrea virginica*) as a bioindicator of trace organic contamination. Doctor of Philosophy Dissertation, Department of Oceanography, College of Geosciences and Maritime Studies, Texas A&M University, xix+242 pp.

Sericano J.L., Atlas, E.L., Wade T.L., & Brooks, J.M. (1990). NOAA's Status and Trends Mussel Watch Program: Chlorinated pesticides and PCBs in oysters (*Crassostrea virginica*) and sediments from the Gulf of Mexico, 1986-1987. *Marine Environmental Research*, 29:161-203.

Sericano, J.L., Wade, T.L., Brooks, J.M., Atlas, E.L., Fay, R.R., & Wilkinson, D.L. (1993b). National Status and Trends Mussel Watch Program: Chlordane-related compounds in Gulf of Mexico oysters, 1986-1990. *Environmental Pollution*, 82:23-32.

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