Toxic Contaminant Characterization of Aquatic Organisms in Galveston Bay: A Pilot Study

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EXECUTIVE SUMMARY

Little information regarding historical trends and concentrations of heavy metals, hydrocarbons, pesticides and PCBs in aquatic organisms from Galveston Bay is available to guide decision makers and regulators. Each year millions of pounds of fish and shellfish are caught by commercial and sport fishermen in Galveston Bay and consumed by the public. However, little or no testing of edible tissues for toxic contamination by heavy metals, hydrocarbons, pesticides and PCBs has been conducted to assure public health and safety. For this reason, the Galveston Bay National Estuary Program (GBNEP), funded by the U.S. Environmental Protection Agency (EPA) and the Texas Water Commission (TWC), undertook this study to characterize contamination in edible fish and shellfish from Galveston Bay.

The sampling design called for the analysis of trace contaminants in five species from four sites in Galveston Bay. The five species of edible fish or shellfish targeted for collection and analyzed were: two macro invertebrates, *Crassostrea virginica*, the Virginia oyster, and *Callinectes sapidus*, the blue crab; and three vertebrate marine fishes, *Cynoscion nebulosus*, the spotted seatrout, *Pogonias cromis*, the black drum, and *Paralichthys lethostigma*, the southern flounder. The goal of the sampling program was to collect ten specimens of each target organism that were of legal market size from each collection site. Standard fisheries data were recorded for all collections. The collection sites for these target species were Morgans Point, at the mouth of the Houston Ship Channel, Eagle Point off San Leon, Carancahua Reef in West Bay, and Hanna Reef in East Bay.

Four samplings of aquatic organisms were launched for GBNEP. The first sampling in late May (23-25) 1990 collected oyster and crab samples; however, trawling for fish was not very successful because Trinity River flooding caused low salinity water. A second sampling was undertaken in early June (6-8) 1990 that involved gill netting at the four sites. This sampling had some success in collecting drum, sea catfish, trout and flounder from some of the sites, although not in sufficient quantities for most analyses. Most fish samples were collected from July 30 to August 3, 1990, after the bay had returned to a more normal salinity. However, the Apex Barge spill on July 28, 1990, complicated late July sampling. Because of this spill, few fish were collected near Eagle Point (close to the oil spill site). A final sampling trip on September 4-6, 1990 completed the collection at Eagle Point.

The analytical program called for the analyses of 10 individual specimens of the target organisms from each site [200 edible tissue (muscle) samples]. Fifty (50) liver samples were composed for analysis from the ~120 fishes. The trace

contaminants that were measured included heavy metals, polynuclear aromatic hydrocarbons (PAH's), pesticides and PCBs and a GC-MS scan for other EPA organic priority pollutants. Trace elements of interest in this study were those on the EPA Priority Pollutant List (PPL) which included: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag) and zinc (Zn). GC/MS/SIMs determined polynuclear aromatic hydrocarbons (PAHs) including thirty-nine (39) two- to five-ring aromatics and selected alkylated homologs. Gas chromatography with electron capture detection (ECD) determined pesticides and PCBs. Selected chlorinated pesticides (aldrin, chlordane, dieldrin, endrin, heptachlor, BHC, heptachlor epoxide, hexachlorobenzene, lindane, mirex, transnonachlor, toxaphene, DDTs, DDDs and DDEs) and 20 individual PCB congeners were quantitated. Analytical methods for both trace metal and trace organic analyses followed procedures of the NOAA National Status and Trends Mussel Watch Program.

In general, trace contaminants were higher in oyster and crab tissues than fish tissue. This was especially true for trace organics and certain trace metals such as zinc, lead, nickel, copper, cadmium and silver. Mercury showed the opposite trend with higher concentrations in fish tissue. Based on the distribution of PAHs and their alkylated homologs, most PAHs in Galveston Bay seem to originate from combustion sources (atmospheric deposition or runoff) and not from petroleum inputs. Low levels of DDT and its metabolites (DDD and DDE) represented the chlorinated hydrocarbons. As expected, higher contaminant levels were generally found in the upper portion of Galveston Bay (Morgans Point) near the Houston Ship Channel.

It is important to note that this study gives only snapshot information about contamination of Galveston Bay seafood. Several unusual environmental conditions occurred during the sampling program which may have altered the representativeness of the organisms collected. First was the flooding of the Trinity River during 1990. The Trinity River dumped an extremely high volume of fresh water into Galveston Bay in the spring of 1990. This flooding produced atypically low salinities during the sampling period. As a result, the samplings were not always successful in collecting target organisms that would have been present under normal salinity conditions. Also, the Apex barge spill, which occurred during the third sampling period, could have had adverse effects on the representativeness of the levels measured and the species collected. If the oil spill added extra contamination to the samples, the values used would be unusually high. Conversely, exposure of the target organisms to pollutants may have been reduced, since it is likely that the organisms were in residence for relatively brief periods due to the prolonged low salinities and the oil spill. If these organisms did not reside in the estuary for periods of time which could be considered typical for estuarine species, due to the unusual conditions, then the data might not be totally representative of typical bay conditions.

In using the data reported here, one should consider the potential implications of these extended unusual environmental conditions and their potential effects on the exposure histories of the organisms collected. With these caveats, the following conclusions were made from the data collected during this study:

- Morgans Point is the most contaminated sampling site
- Contamination generally decreased downbay (except PAH)
- Oysters are generally the most contaminated species, crabs the least
- PAHs and PCBs are responsible for most of the carcinogenic risk associated with consumption of Galveston Bay seafood
- Risk associated with consumption of average amounts of seafood in some parts of the bay is above the 1×10^{-4} benchmark risk level which EPA has previously used to flag possible problems.