TRAWLING BYCATCH IN THE GALVESTON BAY SYSTEM

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I. EXECUTIVE SUMMARY

The Galveston Bay National Estuary Program (GBNEP) commissioned an investigation to characterize shrimp trawl bycatch in the Galveston Bay system. The characterization study, performed by the National Marine Fisheries Service (NMFS) Galveston Laboratory, was conducted in three phases: 1) a review of historical bycatch studies, 2) initiation of new data collection efforts on commercial vessels and 3) a comparison of new data collected with fishery independent surveys of the Texas Parks and Wildlife Department (TPWD). Three historical studies regarding bycatch in Galveston Bay were identified and reviewed. Matlock (1982) analyzed the catch of gulf and southern flounder (*Paralichthys albigutta* and *P. lethostigma*, respectively[1]) in 34 tows from a commercial shrimp vessel during April-November 1978. He concluded bycatch of flounder was lower in Galveston Bay than in other Texas bay systems. Monthly averages ranged between 0 and 19.3 flounder caught per hour, with the overall average (April-November) for Galveston Bay being 1.7 ± 1.2 (SE) flounder caught per hour. Lamkin (1984) reviewed bycatch in tows sampled from one bait shrimp vessel in lower and West Galveston Bay during July 1981-June 1982. He identified 56 bycatch species (52 finfish species) from 62 samples (34 trips); bycatch averaged 27.2% of total catch weight (range = 17-42%). Lamkin observed that five species accounted for ~71% of the bycatch by number and 65% of bycatch biomass. These species included Atlantic croaker, sand seatrout, blue crab, spot and gulf menhaden. Lamkin's conclusion of minimal bycatch among bait shrimpers may have been biased because only one vessel was used for data collection and the fisherman utilized an unconventional "bottomless" net during trawling operations. Bessette (1985) accompanied 6 different bait shrimpers throughout 5 areas of Galveston Bay during May-November 1984. In 107 tows sampled, Bessette identified 66 species of finfish and 8 invertebrates. Bycatch comprised 3-99% of total catch weight with an average of 65%. Overall, bycatch catch per unit effort (CPUE) was 35.3 ± 35.8 (SD) kg/hr. Baywide, Bessette observed 4.1 kg of fish captured for each kg of shrimp landed. However, in West Bay, she observed 0.9 kg of fish captured per kg of shrimp landed. The fisherman utilized in West Bay during the Bessette study was the same one in Lamkin's (1984) study. Bessette observed that this fisherman had the lowest bycatch and highest shrimp CPUE among all shrimpers who participated in her study. Atlantic croaker, gulf menhaden, spot and sand

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[1] Common and scientific names for finfish, molluscs and crustaceans used in this report follow nomenclature guidelines set forth by the American Fisheries Society (Turgeon et al. 1988; Williams et al. 1988; Robins et al. 1991). Throughout the text, common names will be used to refer to individual species; for species where no common name is provided by AFS special publications, scientific names will also be provided to avoid confusion. A complete directory of the common and scientific names of individual species is provided in Appendix 1 for reference purposes.

seatrout were the dominant bycatch species in terms of numbers and biomass. In the Bessette study, 6 species accounted for 75% of the bycatch by number; 9 species accounted for 81% of the biomass. Blue crab was conspicuously absent from the most dominant species in the Bessette study, in contrast with those results reported by Lamkin (1984).

New data collection was initiated in 1992 by NMFS. Prior to collecting samples, an industry advisory panel was assembled for the purpose of reviewing and approving the sampling design and methods. The panel was composed of 3 members of the Galveston Bay shrimp industry who were also involved in addressing various other concerns relative to fisheries in Galveston Bay. The panel members also reviewed quarterly and final reports and assisted in enlisting fishermen to participate in this study.

For data collection and analysis purposes, Galveston Bay was divided into three fishing areas: 1) Trinity Bay, 2) upper Galveston and East bays and 3) lower Galveston and West bays. A pool of commercial and live-bait fishermen who volunteered to participate was assembled for each of the 3 fishing areas; vessels and sampling days were randomly selected for each area on a monthly basis. Vessel captains/owners were compensated (on a per sample basis, up to a predetermined maximum) for allowing observers to remove samples of shrimp and bycatch from each tow. Up to 11.5 kg of shrimp and bycatch were collected (per tow) by observers during normal trawling operations; intensity of new sampling efforts was patterned after historical levels of shrimping effort. Catch subsamples were iced and returned to the laboratory for processing.

Twenty-five vessel owners agreed to participate in 1992 sampling efforts and 19 vessels were utilized (based on random selection). Of these vessels, 10 operated primarily under a commercial bay license, 6 were primarily live-bait vessels and 3 others operated equally under both bay and bait licenses. A total of 296 samples were collected during March- November 1992 (Trinity Bay = 34, Upper/East bays = 171, Lower/West bays = 91). Tows sampled covered trawlable bottom throughout the Galveston Bay system except for the Galveston ship channel. Few samples were available from Trinity Bay due to low shrimp catches (and consequently, effort levels) which were attributed to freshwater conditions caused by high precipitation/freshwater inflow during the early portion of the year.

A total of 85 species of finfish and 49 invertebrates were identified in new sampling efforts. The greatest diversity of individual bycatch species was observed during June-July and in the upper bay area. The high level of species diversity for the upper bay fishing zone is possibly because the majority of new samples were collected from this area, thus a greater number of 'rare' or uncommon species were captured. Furthermore, the upper bay fishing zone is polyhaline (brackish) and is thus inhabited by more freshwater, brackish and marine species (compared with the oligohaline (freshwater) Trinity Bay and more euryhaline (marine) lower bay fishing zones).

Overall, bycatch species comprised 38% of the total number of individuals captured and averaged 71% of total catch weight (range = 2-98%). Nine species (of 134 total) accounted for 80% of the bycatch by number and 79% by weight. These included gulf menhaden, Atlantic croaker, spot, cutlassfish, sand seatrout, bay anchovy, Atlantic

brief squid, hardhead catfish and blue crab. Invertebrate bycatch species were primarily composed of crabs, roughback shrimp, mantis shrimp, various jellyfish and mollusks.

CPUE data for shrimp and bycatch species were extremely variable with respect to time and area fished. Shrimp outnumbered finfish during May-November; shrimp outnumbered other invertebrates during April-November. The overall ratio of the number of finfish to shrimp caught was 0.53 to 1. Greater numbers of finfish were captured during March-April, a period prior to recruitment of brown shrimp into the Galveston Bay fishery. During March-November, finfish biomass (kg) was greater than shrimp landings by a ratio of 2.64 to 1 (monthly range = 1.04 - 32.78). Ratio of fish to shrimp biomass was also highest during March and April, prior to brown shrimp recruitment into the fishery. Ratios of invertebrates to shrimp captured were 0.09 to 1 (numerically) and 0.39 to 1 (biomass). Life histories of individual finfish and invertebrate species (as well as those of brown and white shrimp) are important in regulating bycatch ratios throughout the year. Migration of fish into and out of the estuary during specific months may also coincide with peak periods of shrimp recruitment. Ratios of finfish and invertebrates to shrimp were compared with 1992 landings to estimate the magnitude of total bycatch in the Galveston Bay system. Annual finfish bycatch is estimated at 3.7 million kg (monthly mean ± SD is 456 ± 320 thousand kg) and annual invertebrate bycatch is estimated 548 thousand kg (monthly X ± SD is 80 ± 104 thousand kg).

Several species which could not be utilized in analyses included alligator gar, crevalle jack, large sharks, stingrays, black drum, cutlassfish, southern flounder; also observed were butterflyfish (a reef species), tripletail (generally associated with *Sargassum* rafts and other flotsam in marine waters) and cormorants (waterfowl). These species were recorded as being present in trawls (field observations) but may or may not have been represented in subsamples which were processed in the laboratory. Consequently, reported CPUE values for these species may be underestimated. Overall, debris items ranked 15th in terms of total catch weight. Presence of spotted seatrout and southern flounder were among those species observed in freshwater conditions in Trinity Bay during early 1992.

Gulf menhaden, Atlantic croaker and sand seatrout were the only species of commercial or recreational value which were captured in great numbers. These species were also reported as the dominant species in two of the historical studies reviewed. However, it appears that fewer blue crab and more cutlassfish and hardhead catfish were observed during 1992 than in previous studies. All other recreational species (spotted seatrout, southern flounder, red drum, etc.) were captured relatively infrequently. Magnitude and composition of bycatch depends on numerous ecological factors, fishing gear and fishing methods. Additional analyses are required to determine the importance of factors such as tow speed and duration, gear differences, hydrology and climatic conditions.

A comparison of 1992 bycatch observations with TPWD fishery independent surveys indicates frequency, magnitude, and composition of bycatch are comparable for individual species during some months and not for others. Significant differences were found among length-frequency distributions for each species in one or more months. Furthermore, significant differences in CPUE (TPWD vs. NMFS data) are also

observed for each species in one or more months. Consequently, data from the TPWD fishery independent surveys may only provide an indication of baywide bycatch on a case by case basis (month by month, for certain species). However, mesh size in TPWD survey nets is smaller than that found in commercial fishing gear, thus affecting the comparibility of analyses.

1992 sampling efforts addressed only the magnitude and composition of bycatch observed in trawls. Data were highly variable and continued characterization efforts would greatly enhance the estimation of magnitude and composition of bycatch species. In addition, bycatch mortality was not specifically examined in this investigation, thus mortality estimates cannot be calculated from these data. Mortality of individual bycatch species is likely affected by a wide variety of factors and merits further investigation. Other studies addressing bycatch should consider the role of bycatch in ecological nutrient cycles and niches, predator-prey/competition interactions of individual species and stock assessment of individual species to determine the proportion of bycatch species relative to individual baywide (or gulfwide) populations.