Results of Galveston Bay Oyster Growth and Recruitment Models

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Eric Powell has been a research oceanographer for the past 20 years at Texas A & M University and Rutgers University and is presently the Director of the Haskin Shellfish Research Laboratory. Over that time, Powell has published over 120 articles in refereed journals and has averaged more than 2 major oceanographic cruises per year during which he has routinely served as chief scientist. Powell is the leader or co-leader of several national programs including SSETI (Shelf and Slope Experimental Taphonomy Initiative), the biological component of NS & T (National Status and Trends), Mussel Watch, and the MMS (Minerals Management Service) Chemosynthesis study. He has taken part in a number of other large sampling programs including GOOMEX (Gulf of Mexico Offshore Operations Monitoring Experiment) and numerous geological and biological surveys of the Gulf of Mexico shelf and slope. Powell has considerable experience in numerical modeling and statistical analysis, as well as mapping and GIS analysis. The oyster population dynamics model used in this study was developed from the National Sea Grant College Program and the U.S. Army Corps of Engineers (USACE). This model is unique in being a coupled disease-population dynamics model, having within it the principle disease of Gulf oysters, Dermo disease. This model is also the only peer-reviewed model of its type in the world and has been used in the USACE Houston Ship Channel Project, the USACE Deleware Bay Ship Channel Project, and the NOAA ODR (Oyster Disease Research) program. It is presently being applied to the case of Korean oyster culture in an international program with Cheju University and to predict the spread of disease under various global warming scenarios. In addition, under continued ODR funding, Powell and coworkers at ODU have developed and tested a second disease subcomponent to the model, for MSX disease. This will make the model the only dual-disease model in shellfish population dynamics.

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An oyster population dynamics model was coupled with the Army Corps of Engineers hydrodynamic model for Galveston Bay as part of the study of impacts of enlargement of the Houston Ship Channel. The impacts were calculated for three hydrologies, present, 2024, and 2049, and under three freshwater inflow regimes, high, mean and low flow. In simulations comparing only the changes in hydrology between present-day conditions and 2024 conditions, oyster densities dropped dramatically in many bay areas due to a decline in freshwater inflow and a diversion of freshwater from the Trinity River watershed to the San Jacinto River watershed. Focusing on the change in market-size abundance under mean freshwater inflow conditions, reefs west of the Houston Ship Channel from Eagle Point to Morgan Point, reefs along the Houston Ship Channel, and reefs south of Smith Point saw greater than average declines. So did reefs in West Bay. Reefs in East Bay and in parts of Trinity Bay saw greater than average increases. Low freshwater inflow produced a more widespread gain in abundance in the central bay, however, overall, abundances still declined, led by West Bay, lower Galveston Bay and, in most cases, East Bay. Under high freshwater inflow conditions, oyster populations, on the average, did not vary much from present-day.

The results of these comparisons are consistent with a decrease in total freshwater inflow into the bay and an increase in freshwater inflow in the San Jacinto River watershed which is part of the expected effect of freshwater diversion from the Trinity River watershed. The primary result of the diversion of freshwater from the Trinity River to the San Jacinto River is to vary the isohaline structure so that the bay west of the Houston Ship Channel remains fresher during the spring and early summer while salinity rises south of Eagle Point and Smith Point. The bay area west of the Houston Ship Channel from Eagle Point to Morgan Point represents a much smaller volume than does Trinity Bay. This smaller volume is less able to buffer increased freshwater inflows so that salinity drops in the central bay during periods of high freshwater inflow. The negative impact of this change in salinity is produced by an increase in mortality and a reduction in scope for growth that reduces fecundity and increases susceptibility to { Perkinsus marinus} during the warmer, higher salinity months. In addition, the decline in total freshwater inflow promotes the development of { P.~marinus} epizootics in downestuary reefs and significantly reduces larval survivorship throughout much of the bay system which, in aggregate, result in substantially reduced oyster abundances in most areas of the bay.