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MOVEMENT OF SPOTTED SEATROUT TAGGED IN TRINITY BAY, TEXAS

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ABSTRACT: Spotted seatrout (*Cynoscion nebulosus*) were tagged and recaptured to determine migration patterns within the Galveston Bay system in Texas. Based on 54 recaptures of 488 tagged fish, fish tagged in northwest Trinity Bay did not frequent East or West Galveston Bay. Fish moved toward the Gulf of Mexico in late spring and summer, perhaps to feed or as part of a spawning migration, then returned to the tagging site in fall. The fitted relationship between distance traveled (Y) and Julian recapture date (X), $Y = 9.97 + 50.58 \lvert \sin[0.986 (X-90)] \rvert$, was significant ($P < 0.01$) and explained 37% of the variation in Y. The possibility of one population and a spatial separation of fish into at least two estuarine groups can not be eliminated.

The spotted seatrout (*Cynoscion nebulosus*) is primarily an estuarine species that periodically moves to nearshore waters of the Gulf of Mexico (Pearson 1929, Simmons 1951, Guest and Gunter 1958, McEachron and Matlock 1980, Baker et al. 1986) and Atlantic Ocean (Tabb 1966, Music and Pafford 1984) for spawning (Tabb and Manning 1961, Tabb 1966). Despite its extensive range, inter-estuarine movement of spotted seatrout appears limited. Tagging studies in Florida indicated a series of nearly isolated groups, with most recaptures occurring within 50 km of the tagging site (Moffett 1961, Iversen and Moffett 1962, Beaumariage 1969, Moe 1972). Tagging in Texas indicated a similar pattern with little inter-bay movement (Bryan 1971, McEachron and Matlock 1980, Baker et al. 1986). Electrophoretic studies suggest that separate stocks exist among bays from Texas to Florida (Weinstein 1975, Weinstein and Yerger 1976).

Spatial separation of groups may occur within some bays. For example, spotted seatrout tagged in Bastrop Bayou in West Bay of the Galveston Bay system, Texas, (Fig. 1) showed little movement to other portions of the system (McEachron and Matlock 1980, Baker et al. 1986). However, the movement of fish from other areas within the Galveston Bay system to West Bay has not been examined. Lack of movement from east to west would further substantiate that spotted seatrout within the Galveston Bay system separate into at least two groups. The objective of this study was to investigate the possibility of spatially separate groups of fish within the Galveston Bay system.

MATERIALS AND METHODS

Spotted seatrout were caught on hook and line in or immediately adjacent to Houston Lighting and Power Company's (HLP) Cedar Bayou cooling pond on northwest Trinity Bay (Fig. 1) during April and May 1982, and March and April 1983 by personnel from Texas Parks and Wildlife Department (TPWD) and HLP. Fish in apparently good condition were measured without any chemical treatment to the nearest mm total length (TL), then tagged with an internal abdominal tag with an external plastic yellow streamer as described by Moffett (1961). Handling time before releasing into the adjacent Trinity Bay was less than 30 seconds per fish. Uniquely numbered tags were made of semi-hard glossy red plastic (25.4 x 6.4 x 0.8 mm) with round corners, imprinted with "Texas PWD Rockport." Rewards for reporting recaptures ranging from $1 to $25 were paid by the Gulf Coast Conservation Association.

Minimum distances traveled (km) were determined by plotting the tagging and recapture sites and measuring the shortest aquatic distance between the two sites on appropriate nautical charts. Seasonal movements to and from the tagging site were examined using recapture data from fish returned through December 1983. Each recapture date was converted to Julian date. A model based on the sine function was fit to the distance traveled (Y) and Julian date (X) of each fish recaptured using linear regression. The model, $Y = a + b\,|\sin[0.986\,(X\text{-}90)]|$, included two adjustments to each X: the date of each recapture was corrected for an assumed release date of 1 April (i.e., 90 days were subtracted from each X); and the calendar year was divided into 360 days instead of 365 (i.e., multiplying the result of each (X-90) by 0.986). The absolute value of the sine

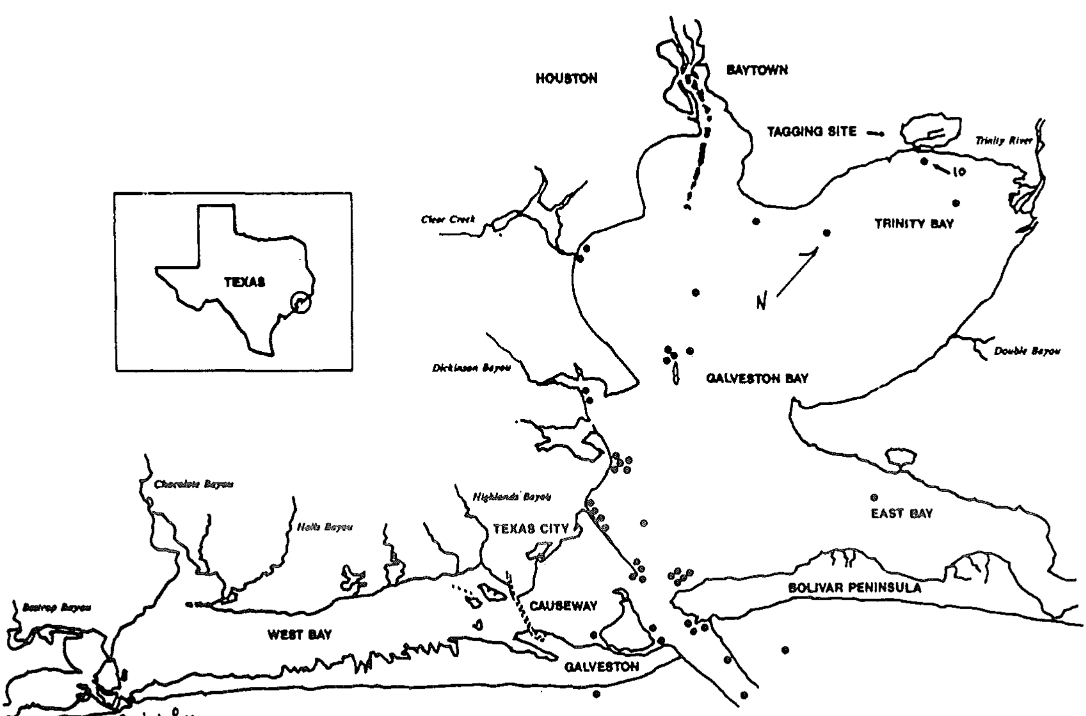

Figure 1. Recapture sites (dots) of *Cynoscion nebulosus* tagged at Houston Lighting and Power Company discharge in northwest Trinity Bay, Texas (April-May 1982 and March-April 1983).

transformation was used because fish could move in only one general direction ("downstream") from the tagging site (i.e., no negative values for Y were physically possible). Physical constraints at the tagging site, including a dam separating the cooling pond from the bay, precluded movement "upstream." This model was selected because Baker et al. (1986) concluded there was a cyclic movement of fish from the upper reaches of West Bay to the Gulf of Mexico in summer and winter, and returns in spring and fall, and visual inspection of this study's data suggested a similar pattern.

RESULTS

A total of 488 spotted seatrout was tagged during April and May 1982 and March and April 1983. Average size of tagged fish was 464 mm TL. Most fish tagged were 400 to 500 mm TL long, with the overall length frequency distribution skewed slightly to the right (Fig. 2).

As of 31 December 1983, there were 54 reported recaptures (11.1%). The average distance traveled was 31 km, and the average number of days free was 103. Only one fish was caught in East Bay, and no fish were caught in West Bay (Fig. 1). However, one fish was caught in San Luis Pass, the southern pass into West Bay. All Gulf and pass returns occurred in late May, June, and July.

The plotted relationship indicated that local movements within the Galveston Bay system prevail instead of long distance movements (Figs. 1 and 3). The fitted relationship between distance traveled (Y) and Julian date (X), $Y = -9.97 + 50.58 \mid \sin [0.986 (X\text{-}90)] \mid$, was significant ($P<0.01$) and explained 37% of the

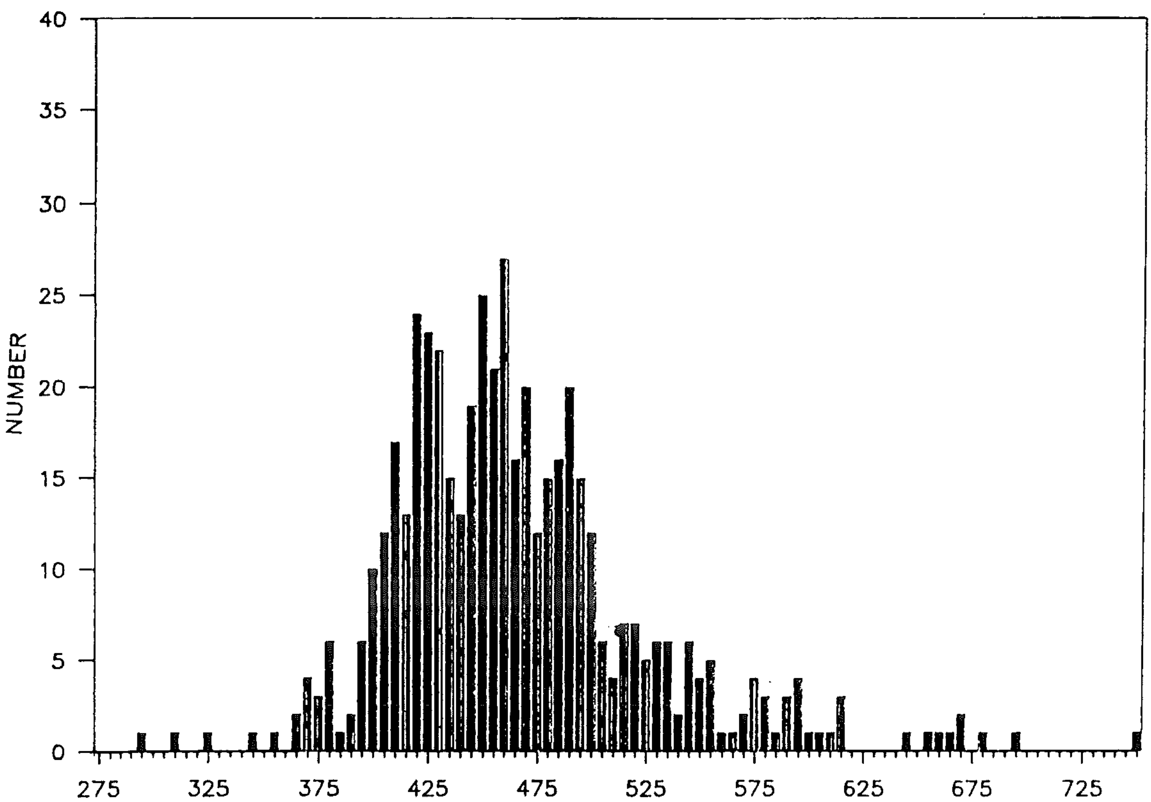

Figure 2. Total length frequency of *Cynoscion nebulosus* tagged at Houston Lighting and Power Company discharge in northwest Trinity Bay, Texas (April-May 1982 and March-April 1983.)

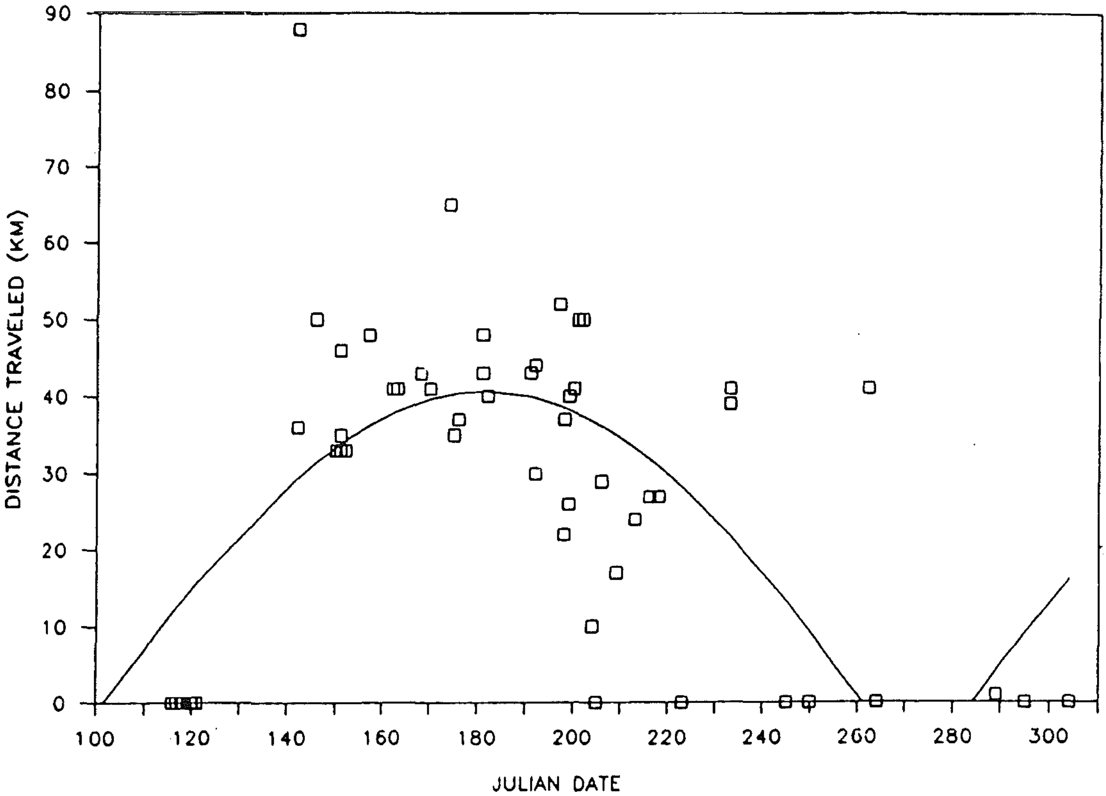

Figure 3. Relationship between distance traveled and time free for *Cynoscion nebulosus* tagged at Houston Lighting and Power Company discharge in northwest Trinity Bay, Texas (April-May 1982 and March-April 1983). Solid line represents fitted equation.

variation in distance traveled.

DISCUSSION

At least some spatial separation of spotted seatrout occurred while in the Galveston Bay system. Fish tagged in Bastrop Bayou generally did not move north of the Texas City Dike (Baker et al. 1986), and those tagged in the northwest part of Trinity Bay generally did not move south of the Dike (results of this study). Further, fish tagged in lower West Bay did not mix with fish in the remainder of the system (Baker et al. 1986), and fish tagged during the present study in northwest Trinity Bay did not readily mix with fish in East or West Galveston Bays. However, the spatial separation observed in bays was not maintained after fish moved to the Gulf of Mexico. Fish tagged in each of Bastrop Bayou (Baker et al. 1986) and Trinity Bay (this study) were recaptured off Galveston Island and Bolivar Peninsula in summer and may have co-mingled during summer spawning.

The conclusion that intra-estuarine spotted seatrout separation occurs is critically dependent on the assumption that the probability of recapture was similar among all portions of the Galveston Bay system. Data collected by TPWD concerning the distribution of private sport boat fishing effort within the Galveston Bay system since 1975 (unpublished on-site angler interview data, except that aggregates for the entire system are available in Green et al. 1991 and similar TPWD publications) indicate that this assumption is not completely satisfied. However, there is sufficient angling effort distributed in West Bay relative to the remainder of the Galveston Bay system to afford the opportunity for

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recapture if fish moved from Trinity Bay to West Bay, as indicated by spotted seatrout recaptures reported by Baker et al. (1986). During our study, few recaptures were reported from the eastern part of Trinity Bay. This probably reflects the relatively low fishing pressure, instead of a lack of movement to that area. About three times more fishing access points and effort are located in the western part of Galveston Bay than in Trinity or East Bays (Spiller 1987, unpublished TPWD data referenced above).

Reasons for this spatial separation of fish within the Galveston Bay system are unknown, and need further investigation. Two inherent characteristics of the system may be contributing factors. The Galveston Bay system is the largest estuarine system on the Texas coast, with a surface area of about 141,600 ha (Diener 1975). There are numerous riverine tributaries and three Gulf passes which create diverse habitat conditions throughout the system (Diener 1975). These characteristics may enhance the potential for subgroups which might be delineated by ecological or physiological traits, rather than genetic ones.

The apparent cyclic movement model for spotted seatrout within the Galveston Bay system is probably too simple. It explained only 37% of the variation in distance traveled. Sex, age, maturity stage, and environmental factors like temperature and salinity, should be included in future models. Unfortunately, these data were not collected during this study.

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