COMPARISON OF NEKTON HABITATS ASSOCIATED WITH PIPELINE CANALS AND NATURAL CHANNELS IN LOUISIANA SALT MARSHES

Lawrence P. Rozas
Louisiana Universities Marine Consortium
Marine Research and Education Center
Chauvin, LA 70344

Abstract: Nekton of Louisiana coastal marshes was sampled approximately twice monthly between June 1990 and May 1991 on marshes adjacent to canals and on natural marshes with flumes and (2) within canals and natural channels using a small trawl. Canals constructed using two different methods (flotation and push) were studied. Dagger-blade grass shrimp Palaemonetes pugio, blue crabs Callinectes sapidus, Gulf killifish Fundulus grandis, diamond killifish Adinia xenica, brown shrimp Penaeus aztecus, and sheepshead minnows Cyprinodon variegatus dominated catches in terms of numbers and biomass on marshes as well as in canals and natural channels. Although densities of some species differed among the various sites that were sampled (e.g., dominant cyprinodonts were most abundant in creek tributaries), densities in canal and natural channel habitats were not significantly different. Predator encounter rates in canals and natural channels were similar, suggesting that the value of habitat in canals may increase over time as slumping decreases depth and steepness of bottom profiles and creates shallow subtidal refugia along the canal-marsh interface. The nursery function of canals open to tidal flushing is probably enhanced by the presence of fringing marshes, which provide habitat for nekton at high tide.

Key Words: pipeline canals, fisheries impact, marsh surface, Louisiana.

INTRODUCTION

Man-made canals are a ubiquitous feature of the Louisiana coastal zone. The areal coverage by canals and associated dredge-material levees in coastal Louisiana is approximately 10% of total marsh area, about the same coverage as natural channels (Turner 1987). Most canals were constructed for navigation to oil and gas drilling sites or as corridors for laying pipelines (Davis 1973). Although the impact of deep navigation channels on estuaries and coastal wetlands can be significant (Ward 1980), canals constructed for developing petroleum resources (access and pipeline canals) have had a greater direct impact on coastal wetlands in Louisiana because they are much more numerous (Turner and Cahoon 1987).

Both access and pipeline canals are commonly surrounded by dredge-material levees. Placement of this material alongside canals converts marsh to upland, an environment unavailable to aquatic organisms except during extreme tides. Dredge material can also form a barrier causing ponding behind levees and limiting exchanges between canal waters and marshes to infrequent, high-water events (Swenson and Turner 1987). Such a disruption of marsh hydrology is thought to accelerate marsh erosion and conversion to open water (Turner et al. 1982, Turner and Cahoon 1987). Additionally, where canal density is high, marshes can become enclosed by levees and isolated from the rest of the estuary, resulting in a loss of habitat function for some species. Dredging also converts marshes and shallow subtidal areas to canals that may have very different physical properties than the former habitats. Newly dredged canals are typically straight, deep (2.4 m), and steep-sided (Wicker et al. 1989), whereas natural channels meander and contain shallow sloping banks, which provide refugia and foraging areas for marsh nekton (McIvor and Odum 1988).

Adkins and Bowman (1976) found that the nekton assemblages in pipeline canals open to tidal exchange were similar in species composition to a nearby natural embayment. However, canals closed to tidal exchange had fewer species and individuals than open areas (Adkins and Bowman 1976). Similarly, Neill and Turner (1987b) found significantly lower densities of transients (species that spawn outside the estuary but use estuarine nursery areas as postlarvae and juveniles) in closed canals than open canals. However, even a small
opening permitting regular tidal exchange allowed access by transient species, many of which are commercially and recreationally important (Gilmore et al. 1981, Neill and Turner 1987b).

Nektonic species occupy the vegetated marsh surface of Atlantic and Gulf of Mexico marshes when they are flooded at high tide (Talbot and Able 1984, Zimmerman and Minello 1984, Rozas and Odum 1987, McIvor and Odum 1988, Hettler 1989). Although under most conditions organisms residing in canals are precluded from using marshes behind levees, nekton can use narrow (<10 m wide) fringing marshes that occupy the intertidal area between canals and associated levees. In this paper, I examine the degree to which these fringing marshes function as nursery habitat for nekton residing in canals by comparing densities of nekton on marshes adjacent to pipeline canals and natural tidal creeks. In addition, I evaluate shallow subtidal habitats in the two environments (canals and natural channels) by comparing nekton abundance along the marsh edge at low tide and measuring predator encounter rates in both habitats.

**STUDY AREA AND SAMPLE SITES**

The study area was within the Terrebonne-Timbalier estuary and the Mississippi River Deltaic Plain. Sample sites were near latitude 29°14'N and longitude 90°40'W, approximately 4 km southwest of the Louisiana Universities Marine Consortium (LUMCON) Marine Center (Figure 1). Tides in the estuary are predominantly diurnal and have a mean range of approximately 0.4 m (Shirzad et al. 1989, U.S. Department of Commerce 1990). Marshes within the study area are classified as saline (Chabreck and Linscombe 1991). Marsh vegetation was dominated by Spartina alterniflora Loisel, although Spartina patens (Aiton) Muhl. and small patches of Juncus roemerianus Scheele were also present. Distichlis spicata (L.) Greene was common on marshes of slightly higher elevation (e.g., on the natural levees of tidal creeks).

Three pipeline canals constructed using either of two methods (push or flotation) were studied. The push method causes less habitat modification because it requires excavation of a relatively narrow (1.2–1.8 m), shallow (2.4–3.0 m) trench that is usually backfilled after pipeline installation (Tabberer et al. 1985). Because a portion of the dredge material volume is lost through compaction and organic decomposition, backfilling does not completely fill the trench, but the final depth is usually <1 m (Neill and Turner 1987a, Abernethy and Gosselink 1988). The flotation method requires a canal large enough to accommodate a pipe-laying barge, 12.1–15.2 m wide and 1.8–3.6 m deep (Tabberer et al. 1985). Therefore, most pipeline canals constructed using the flotation method are deeper than pipeline trenches and have levees, as they are seldom backfilled.

Initially, I selected sampling sites on a shallow flotation canal, a pipeline trench, a natural tidal creek of order 3, and three, order-2 tributaries, having maximum depths of approximately 1.9, 0.8, 1.8, 0.8, 0.4, and 0.8 m, respectively. Each of the four channel types contained three sampling sites (Figure 1). For general characteristics of tidal creeks related to stream order, see Odum (1984). In January 1991, I added three sampling sites on a deep (3.6 m) flotation canal (Figure 1) and discontinued flume sampling of order-2 tributaries; however, trawl collections were continued at tributary sites. All study canals were open to tidal exchange. Henceforth, the flotation canals will be referred to as shallow or deep canals, the pipeline trench as trench, the order-3 tidal creek as tidal creek, and the order-2 tributaries as creek tributaries.

**MATERIALS AND METHODS**

Water temperature and salinity were monitored at each sample site (at high tide when flumes were sampled and at low tide when trawling) with a meter. Nekton was sampled on marshes and in channels along the marsh edge at each site using flumes and a small trawl, respectively. Flumes were similar to those described by McIvor and Odum (1986) and Rozas and Odum (1987), except wider (2 m vs. 1.5 m), and 3-mm mesh walls were constructed of plastic rather than nylon netting. Flume length was 20 m, except along canals where the length of each flume was equal to the marsh width (5–8 m). Briefly, flumes were sampled in the following manner. No fewer than 3 hours prior to sampling, each flume end net (constructed of 3-mm mesh nylon netting) was positioned above the flume entrance and held in place by small wooden pegs inserted into holes drilled into end posts. A nylon cord was tied to each peg and a small wooden post 5 m away. At high tide, the pegs were pulled out, and the end net dropped into place, blocking the flume entrance. Organisms within the flumes drained into the end nets during the subsequent ebb tide. The cod end nets and their contents were retrieved at low tide when the marsh had completely drained.

Samples of the entire water column along the marsh edge were taken in tidal creeks, the trench, and canals using a trawl pulled by hand (Rogers 1989). The trawl was constructed of 3-mm mesh nylon netting attached to an aluminum frame (1 m wide × 0.6 m high) and mounted on aluminum skids to allow sampling over soft sediments. Trawl tows of 15 m were made near each flume site during daylight when the marsh surface was not flooded. At each sample site, the trawl with a 16-m rope attached was carefully placed in shallow...