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Foraminifera of petroleum platforms, Louisiana shelf, Gulf of Mexico

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ABSTRACT

Species of benthic foraminifera presumably colonized the bacteria- and diatom-rich biofilms on the metallic surfaces of Louisiana-shelf petroleum platforms soon after their emplacement. At present, however, most underwater platform legs are covered by a thick growth of macrofoulers, predominantly barnacles and bivalves. Scraped samples from five such platforms (water depth 16–61 m) yielded 104 species of benthic foraminifera—44 of them with attached individuals. Among the obligate sessile species, *Dyocibicides biserialis* and *Planorbulina mediterranensis* were especially widespread. This group of epibionts also includes *Calcituba polymorpha*, *Carpenteria candei*, *Cornuspiramia antillarum*, *Lepidodeuterammina ochracea*, *Nubeculinita inhaerens*, *Planorbulina acervalis*, *Planorbulinoides retinaculatus*, *Sagenina divaricans*, *Webbina bonairensis*, and *Webbina rugosa*.
The platforms are habitat islands; the surrounding soft, clastic substrate does not support the growth of most sessile species. The putative source areas of these colonists of Louisiana platforms are carbonate hardgrounds to the west (banks or reefs formed over salt diapirs) and other platforms. The foraminiferal species diversity on the platforms is most likely controlled by their distances from these sources, and the dimensions of the settlement surfaces. The eastward transport of propagules in summer by the Louisiana–Texas Coastal Current facilitates the species migration.

1. Introduction

The typical substrate on the northwestern Gulf of Mexico shelf, especially off the Louisiana coast, is composed of silt, clay, or sandy mud (e.g., Coleman et al., 1991; Buczkowski et al., 2006). Within this large expanse of soft sediment, patches of natural hardgrounds—carbonate banks and reefs, and shell beds—exist (Fig. 1; see also Rezak et al., 1985; http://gulfbase.org/reef/). In addition, numerous islands of artificial hard substrate are present in the form of oil and gas platforms. The estimated submerged surface area of an average platform is about 0.004 km^2 (Kolian, 2011); for 3959 fixed platforms in the Gulf of Mexico in 2008, the total surface area was estimated to be about 18 km^2 (Kolian and Sammarco, 2008). Close to the Louisiana shore, petroleum platforms are the only known hardgrounds (Stanley and Wilson, 1990).

These platforms and the debris of shell material shed from them (i.e., both accreted and eroded material) provide suitable habitats, including attachment surfaces, for many epibenthic species and some endobenthic species. We studied the biofouling material from five Louisiana petroleum platforms (Plate 1) to investigate the foraminiferal colonization of these highly restricted hard substrates. The populations we studied were recovered from a biogenic carbonate substrate attached to the platform legs, and not directly from the metal surface of the platforms; many individuals were thus true epibionts, i.e., attached to surfaces of living organisms (Wahl, 1997). We examined all species with mineralized tests, whether motile or sessile, but our focus was on the latter. A preliminary account, based on partial data, was incorporated in an agency document (Sen Gupta and Smith, 2009). In spite of numerous studies of the fouling communities associated with petroleum platforms (reviewed by Carney, 2005; Page et al., 2010), the foraminiferal component has been ignored. With the exception of three species observed, but not identified, off the coast of California (Bascom et al., 1976), we know of no documentation of foraminifera collected from petroleum platforms. Our samples were scraped directly from vertical platforms located within a 3000 km^2 area on the southeastern Louisiana coast (Fig. 1, Table 1), a region of high productivity (e.g., Rabalais et al., 2002). The water-depths at the platform bases range between 16 and 61 m.

2. Study area and macrofouling community

Five petroleum platforms were sampled in the Grand Isle (GI) and South Timbalier (ST) blocks on two cruises from Port Fourchon, Louisiana (Fig. 1, Table 1). All were heavily encrusted with fouling macrobenthos. The most conspicuous substrate-forming organisms were barnacles on the nearshore platforms, and bivalves on the offshore platforms, agreeing with the general distribution reported for this area (Lewbel et al., 1987; Carney, 2005). In particular, the biofoulers of inshore platforms ST 23 and ST 67H were similar to those described from other coastal Louisiana platforms (George and Thomas, 1979; Gallaway et al., 1981; Gallaway

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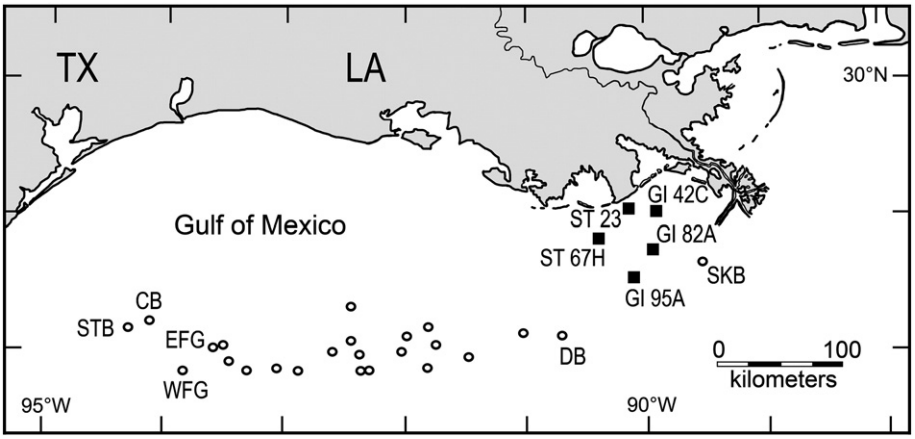

Fig. 1. Locations of sampled platforms (solid squares), and those of nearby areas of hard substrate (open circles). The names of 6 such areas are indicated: CB = Claypile Bank; DB = Diaphus Bank; EFG = East Flower Garden Bank; SKB = Sackett Bank; STB = Stetson Bank; WFG = West Flower Garden Bank.
Source: http://gulfbase.org/reef.

and Lewbel, 1982; Carney, 2005). The uneven surfaces of barnacles were frequently covered with hydroids, sponges, sea anemones, tubiculous polychaetes, and encrusting bryozoans. Byssate bivalves were common on these shallower platforms, and boring bivalves were plentiful at the deeper sampling level on ST 23 (Anderson, 2009).

At GI 42C, encrusting bryozoans, hydroids, sponges, and polychaete tubes grew on barnacle surfaces, and byssate bivalves were common. Many octocorals, typical of an offshore faunal assemblage (Gallaway and Lewbel, 1982), were observed at the 20-m sampling level. At GI 82A, the byssate bivalve *Isognomon bicolor* was abundant

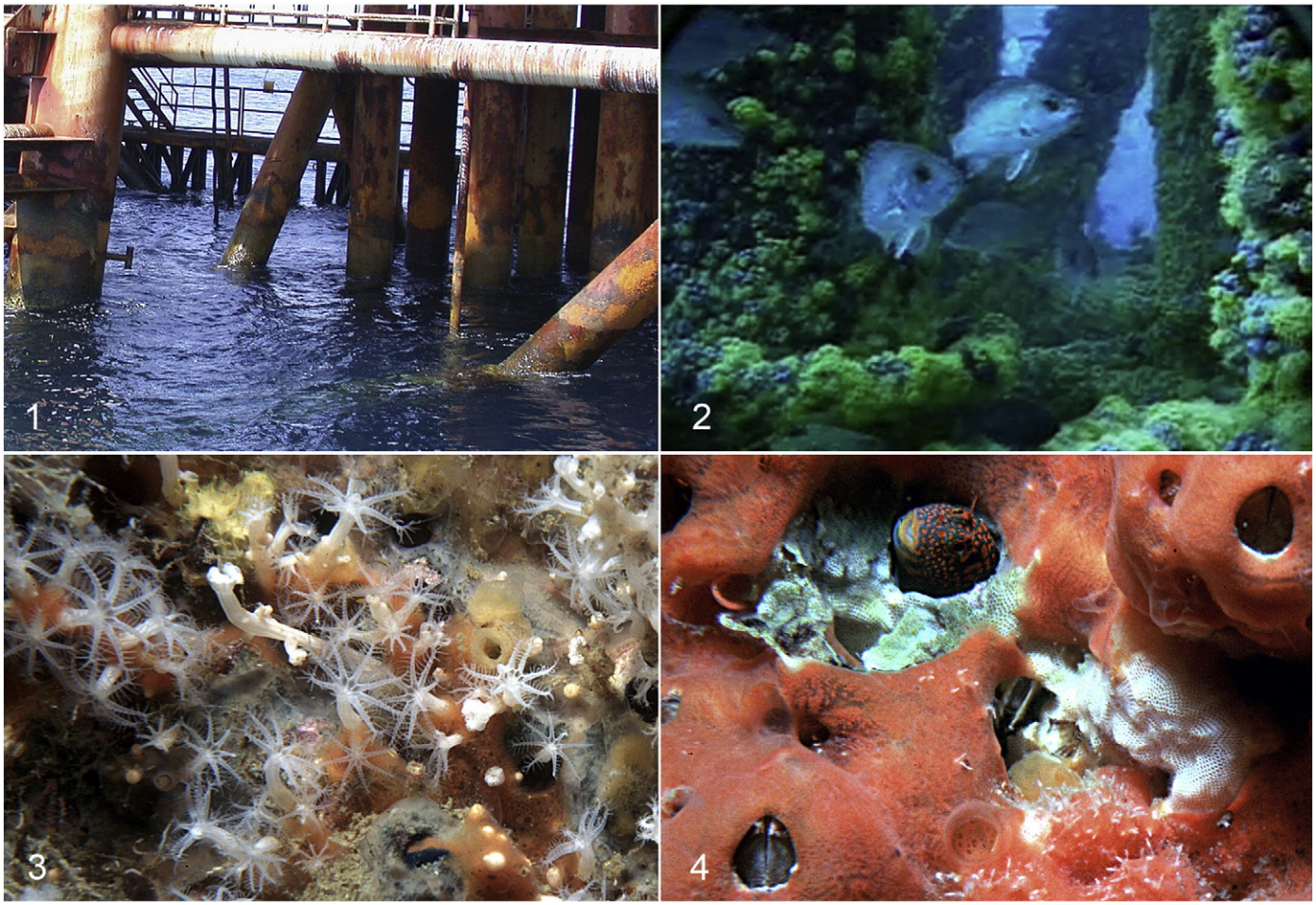

Plate 1. Fouling on Gulf of Mexico oil platforms. 1. Platform GI 95A, sea-level view. 2. GI 95A, close to seafloor, frame from video, showing heavy biofouling on platform structures (courtesy of Gregory Boland). 3. GI 94 (near GI 95A), octocorals and sponges growing on barnacles (photograph courtesy of Robert Carney). 4. GI 94, a blenny peers out from an encrusted barnacle shell (photograph courtesy of Robert Carney).