Biodiversity Journal, 2015, 6 (3): 683–686

Occurrence of a nine-armed sea star larvae, *Luidia senegalensis* (Lamark, 1816) (Asteroidea Luidiidae), further north along Florida's east coast

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ABSTRACT The nine-armed sea star, *Luidia senegalensis* (Lamark, 1816) (Asteroidea Luidiidae), typically ranges from South American marine waters into Florida. Previous reports have documented this species collected as far north as latitude 28°N. This observation at 29.89°N represents the farthest north this species has been collected.

KEY WORDS *Luidia senegalensis*; Matanzas River Estuary; marine; sea star.

Received 19.06.2015; accepted 08.08.2015; printed 30.09.2015

INTRODUCTION

One of the major consequences of climate change is a shift in the latitudinal distributions of species (Parmesan, 2006). This shift is occurring in Northeast Florida, as the coastal marine ecosystem is changing from one dominated by salt marsh to one dominated by mangroves (Cavanaugh et al., 2015). Animal species also have been migrating northward, i.e. the mangrove tree crab, *Aratus pisonii* Milne-Edwards, 1853 (Decapoda Sesarmidae) (Riley et al., 2014) and gray snapper, *Lutjanus griseus* (Linnaeus, 1758) (Perciformes Lutjanidae), (Hare et al., 2012). The increase in air and water temperatures has the potential to open areas previously unavailable to non-native species (Kolbe et al., 2012). In aquatic systems, non-native species tend to have a decided advantage over native species in aquatic systems (Sorte et al., 2013).

The nine-armed sea star (*Luidia senegalensis*) (Lamark, 1816) (Asteroidea Luidiidae), has been documented in Florida, but the exact extent of its range is unknown (Tiffany, 1978; Lawrence et al., 1993). Observations indicate that this species is known from latitude 28°N and south in Florida (Tiffany, 1978).

Due to the continued increase in water and air temperatures, it is imperative to monitor for non-native species that can disrupt an ecosystem. The aim of the over-arching study in which this nine-armed sea star was discovered is to relate patterns of fish biodiversity, phytoplankton diversity and total chlorophyll-a, and major nutrient concentrations in the Matanzas River Estuary (MRE) region of northeast Florida. The study area is located from 26.6°-26.9°N latitude and is generally characterized by oceanic salinities > 30 ‰, low water residence times, and relatively low chlorophyll-a concentrations as compared to similar systems such as the Indian River Lagoon estuary system further south.

MATERIAL AND METHODS

As part of a monthly fish and phytoplankton sampling, two plankton tows were conducted

simultaneously on March 10th, 2015 in the Intracoastal Waterway in downtown St. Augustine, FL, USA (29.89°N, -81.31°W). The net consisted of 153 µm mesh with a 12.7 cm opening attached to a 1.16 m pole. Each phytoplankton tow was done for 3 minutes in duration. As the nets were pulled through the water, the sample was collected in a 125 ml plastic bottle with a screw cap and transported to the lab for identification.

Plankton identification from the duplicate tow samples was performed on March 11th, 2015 at Flagler College (St. Augustine, FL). 200 µl aliquots of sample were placed on a Lovin Field Finder Gridded Micro-slide (Cat #72266-01) and species were identified using a Nikon Eclipse E100 microscope under 100X magnification. When the organism was located, a picture was taken using an iPhone 4 camera (Fig. 1). Based on the grid size of the micro-slide, the species is approximately 100 µm in diameter. The picture was sent to the Florida Fish and Wildlife Conservation Commission (FWC) for verification on the identification of the species.

DISCUSSION

The positive identification received from FWC indicated that the species in Fig. 1 was indeed the nine-armed sea star. As stated previously, this species is commonly found in Florida, but has typically been documented to reside south of latitude 28°N (Tiffany, 1978). The observation of this species at 28.89°N likely represents the farthest north this species has ever been documented.

Figure 1. Picture of the nine-armed sea star (*Luidia senegalensis*) obtained from a plankton tow in the Matanzas River Estuary (MR in downtown St. Augustine).

The diet of the nine-armed sea star tends to consist primarily of gastropods and bivalves (Halpern, 1970; Gibran, 2002), most notably the common Atlantic abra, *Abra aequalis* (Say, 1822) (Veneroida Semelidae) (Halpern, 1970). Previous studies indicate that the MRE is home to the Atlantic abra and several other species preferred by the nine-armed sea star (Frazel, 2009; Hymel, 2009). Temperature and food are often cited as the some of the most important factors that determine sea star growth rates, and it appears that there is a food resource that can be exploited by the nine-armed sea star in the MRE.

The MRE currently is home to three documented sea star species: the Forbes sea star, *Asterias forbesi* (Desor, 1848) (Asteroidea Asteriidae), the royal sea star, *Astropecten articulatus* (Say, 1825) (Asteroidea Astropectinidae), and the lined sea star, *Luidia clathrata* (Say, 1825) (Asteroidea Luidiidae) (Frazel, 2009). Diet studies indicate that both the Forbes sea star (Menge, 1986) and the royal sea star (Wells at al., 1961) are generalists and consume gastropods as well as bivalves encountered, although the majority of the diet for the royal sea star tends to be gastropods rather than bivalves. McClintock & Lawrence (1985) found that the last species, the lined sea star, preferably feeds on the dwarf surf clam, *Mulinia lateralis* Say, 1822 (Veneroida Mactridae) when available, but will also feed on gastropods and other bivalves as well. The similar diet patterns of the various sea stars indicate the possibility of trophic overlap if the nine-armed sea star were to become established. Halpern (1970) notes that the growth rate of this sea star is much greater than many other temperate sea stars. This could become a decided advantage for limited food resources if competition did arise.

The second factor that is necessary for sea star survival is temperature (Halpern, 1970), however, very little information exists on the temperature tolerances of the nine-armed sea star. The Encyclopedia of Life has limited information based on collections made, and state the temperature range at which this organism is found is between 22.67 – 27.58 °C (*Luidia senegalensis,* 2015). Temperature

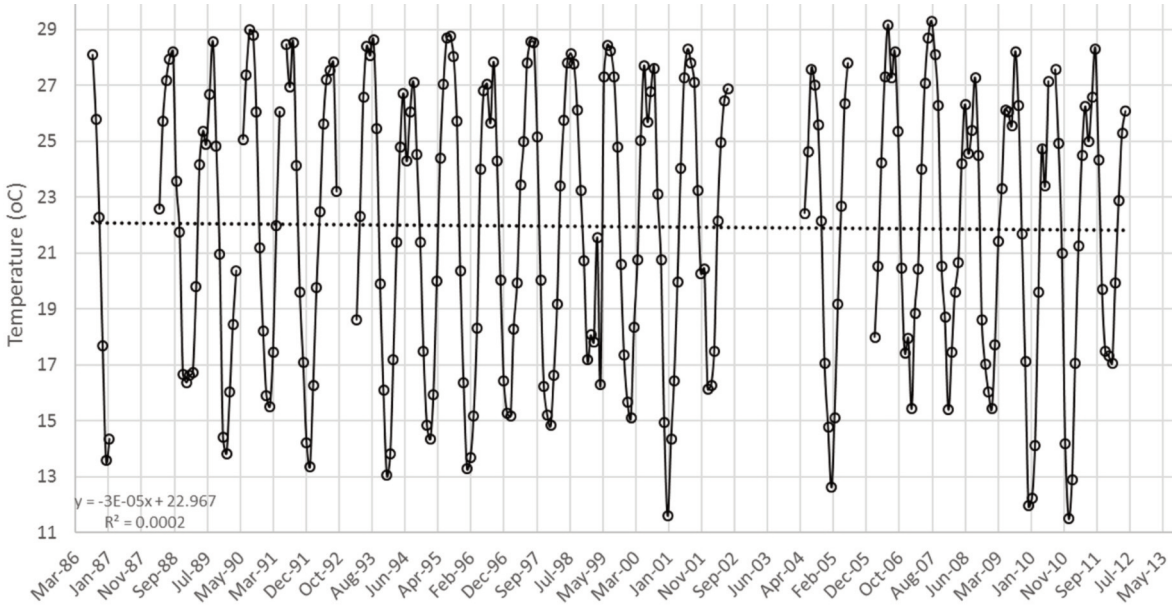

Figure 2. Temperature profile for St. Augustine pier from September 1986 to June 2012. These values were obtained from the National Oceanic and Atmospheric Administration's National Data Buoy Center; coordinates: 29.857°N, 81.265°W. Missing values indicate no data from that time point.

profiles from the St. Augustine pier (Fig. 2) indicate that ocean waters flowing into the MRE fall between these temperatures at times of the year. There are many instances in which the temperature does fall below 22.67 °C, which could be a limiting factor for this species. Assessment of temperatures from 1986–2012 also indicate that temperatures have not been increasing in this area. With so little information on temperature tolerances of this species, more intensive sampling will be necessary to determine if this species is indeed moving northward and capable of establishing a stable population.

Sampling efforts in the southeast US Intracoastal Waterway and MRE system are being conducted monthly. Along with plankton samples, fishes are sampled in this waterbody to monitor for changes in the community structure, and the possible presence of invasive species. A genetic barcoding effort has been started to positively identify each fish species and determine if non-native species are present or if hybridization is occurring in this ecotone. Documenting the current status of the estuary will be invaluable to determining the climatic and species changes that we have already begun to record.

ACKNOWLEDGMENTS

The authors would like to thank C. van Kuiken for assistance with plankton sampling and fish monitoring during the collection of this specimen. We would also like to thank the numerous undergraduate students who have been involved with this sampling project since its inception.

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