Florida Bay Watch Report

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Destructive Urchin Grazing in a Seagrass Bed in Western Florida Bay: When should resource managers intervene?

Resource managers face a challenging dilemma when the local abundance of a species increases or decreases dramatically: *whether or not to intervene*. If intervention is the chosen course of action, how this is accomplished can be critically important. In some cases, human action, although well intended, can be more deleterious to an ecosystem than no action.

A dilemma of this sort recently occurred in Florida Bay after fishermen found an immense aggregation of sea urchins in a seagrass bed north of Marathon. After describing this urchin population boom, we will discuss the issue of intervention.

The Urchin Population Boom

Seagrass beds are common in shallow, nearshore marine environments around the world. These beds are vital because, like land plants, their root systems stabilize the sediment and they provide shelter for a wide array of life. Many inhabitants, such as sea urchins, certain fishes, turtles, and manatees also depend on seagrasses as a source of food. These herbivores usually have limited impact on the seagrass. On occasion, however, intense grazing can cause severe damage, and in rare cases it has reduced productive seagrass beds to bare sand. Recently, such an event was discovered in western Florida Bay.

In August 1997, an aggregation of the variegated sea urchin (*Lytechinus variegatus*) was reported by a local fisherman approximately 12 miles north of Marathon, within an extensive manatee grass (*Syringodium filiforme*)-dominated bed that is approximately 230 square miles in area. Most urchins were concentrated in a long narrow band,

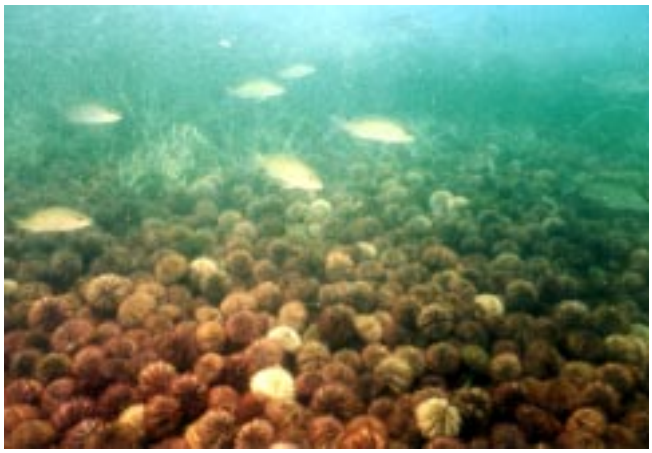

Figure 1. The urchin aggregation north of Marathon.

generally 3-9 urchins wide, and in some places stacked 4-6 individuals deep (Figure 1). Urchin densities in some places within this aggregation were estimated at more than 250 individuals per square yard. Although the variegated urchin is common in seagrass beds in Florida Bay and the Florida Keys, it typically occurs at densities well below one individual per two square yards. Behind this extraordinary "urchin front" the seagrass bed had been reduced to mostly barren sediment, with only isolated patches of seagrass remaining (Figure 2).

Figure 2. Overgrazed seagrass bed behind the urchin front.

Based on an aerial inspection, it was estimated that the aggregation had either completely or partially defoliated almost 4 square miles of the bed. The potential degradation of this seagrass bed could negatively affect water quality over a large area of western Florida Bay and the Florida Keys because it is located at a junction where water flowing south along the eastern Gulf of Mexico meets with water ebbing west from Florida Bay. In particular, there was the possibility of large quantities of sediments washing out through passes between the Keys and into the ocean.

Effects of Urchin Grazing on the Seagrass Meadow

Soon after discovering the urchin aggregation, researchers assessed the short-term impacts of their grazing on the seagrass bed by comparing seagrass biomass, sediment, and molluscan communities, between sites that had been recently overgrazed by urchins and reference sites in unaffected areas. The impact of the urchins was readily apparent. At overgrazed sites, virtually all the above ground plant material had been removed, and the biomass of root tissue was approximately 50% lower than that found at the ungrazed sites. Comparison of sediment grain-size from the grazed and ungrazed areas further revealed that fine-grained sediments were quickly suspended in the water column after the seagrass was removed. The suspension of these sediments probably contributed to the persistent turbidity over the area. Finally, the abundance (71% lower) and the number of species (64% lower) of molluscs in grazed portions of the seagrass bed were substantially lower than in ungrazed areas. Similar losses may have occurred among crustaceans and other seagrass-dwelling animals.

Severe overgrazing by urchins continued into mid-1998 as urchin densities remained in excess of 80 individuals per square yard in some places within the aggregation. Scientists were able to estimate that, from September 1997 through May 1998, a 2-mile segment of the urchin front had overgrazed an additional 33 acres of the seagrass bed.

The impacts of the urchin grazing had the potential to cause broad-scale changes in the Florida Bay ecosystem. The resuspension into the water column of sediments caused by the loss of seagrass had the potential to block sunlight needed by the surviving seagrass and to be a source of nutrients that could fuel microalgal blooms. Moreover, seagrass beds also serve as habitat for juvenile spiny lobster and pink shrimp, so the loss of this seagrass bed reduced the availability of essential habitat for both species.

However, by late 1998, the well-defined urchin front was no longer evident, and only small pockets of urchins were found. During the first half of 1999, urchin densities continued to decline to approximately 2 individuals per square yard in the portion of the seagrass bed where remnants of the aggregation could be detected. It is not known if these lower densities reflected an urchin die-off, or the dispersal of the aggregation throughout the seagrass bed. Regardless, the overall impacts of the urchins on the seagrass bed were much less severe than they would have been if the aggregation had remained intact. Though overgrazing of seagrass remained evident in late 1998, the urchins were no longer consuming all the seagrass biomass as they moved through the bed. By June 1999, only minimal evidence of overgrazing continued to be detected and new seagrass blades were growing within areas that had been less severely grazed, indicating that some areas of the bed were recovering.

Origin of the Urchin Aggregation

The origins of this extraordinary event remain speculative. Destructive overgrazing by urchins has been reported in other ecosystems. In perhaps the best documented cases, overgrazing by sea urchins has completely denuded kelp beds along both coasts of the U.S. and in eastern Canada. Normally, urchin grazing in seagrass beds is less extensive, and only small areas of overgrazing are typical where barren “halos” are formed around coral reefs. However, in the early 1970s overgrazing by a large aggregation of variegated urchins denuded approximately 20% of a turtlegrass (*Thalassia testudinum*)-dominated seagrass bed near the mouth of the Steinhatchee River, Florida. The mechanisms behind urchin booms are poorly understood, but it is believed that they begin with an enormous settlement of juveniles, a large-scale immigration of adults, or both. Because the urchins in this aggregation were of similar size, and therefore presumably the same age, they likely were a single cohort that resulted from an isolated incident of unusually successful settlement.

Future of the Seagrass Community and Urchin Aggregation

Recent observations suggest that the destructive overgrazing event has ended. The short-term impacts of overgrazing were readily apparent, but the long-term impacts of the seagrass loss to the bed and the Florida Bay ecosystem in general, remain unknown. Although no substantial regrowth of seagrass has yet been observed within the area of the bed that underwent the most severe overgrazing in 1997-98, researchers believe there is no reason why seagrasses will not eventually recolonize the area. It is also possible that there could be long-term beneficial consequences from this event. For example, the removal of a portion of this dense seagrass habitat could allow other seagrasses, macroalgae, sponges, and corals to repopulate the area, leading to increased habitat complexity.

Several unanswered questions remain concerning the size of the affected seagrass bed, the ability of the seagrass to recolonize this area, and the effects of increased turbidity on the remaining seagrass or on the sea urchins. Therefore researchers will continue to monitor both the seagrass bed and the urchins in order to understand and predict the long-term impacts of this event and its potential influence on the Florida Bay ecosystem. The continued monitoring will also determine whether or not the seagrass community fully re-establishes itself and stabilizes sediments from further transport to the ocean.

Should Resource Managers Intervene?

Given the magnitude of this sea urchin population boom and the extent of the overgrazing of seagrass habitat, should resource managers have done something to get rid of the urchins? When human activities cause environmental damage, such as a ship grounding, most managers agree that some form of habitat restoration should be considered. Natural events such as hurricanes are another matter, and here opinions are mixed. Some managers believe that restoration is not appropriate after natural events because the ecosystem evolved under these conditions. Such changes to the system have occurred for millennia and will continue long into the future. On the other hand, some managers believe that ecosystems have already been modified so much by human activities that intervention after a natural event **is** appropriate. For example, if a storm toppled coral heads on a heavily used reef, some managers believe that the heads should be reattached upright in their original location, but other managers do not.

In the case of the sea urchin population boom and seagrass overgrazing described here, resource managers decided to monitor this natural event as it progressed and not to intervene. There were several reasons for this decision. First, marine invertebrates, such as sea urchins, are notorious for having extremely variable settlement of juveniles from the planktonic larval dispersal stage. A certain location during an occasional year may experience an enormous influx of young, followed by many years of little settlement. In fact, such unpredictable, sporadic “good” years may be very important to the overall distribution and abundance of a species. Another good reason for nonintervention is that the maximum life span of the variegated urchin is probably about five years; the localized population boom thus had to have a limited duration. Finally, the very act of removing or destroying such a huge number of urchins would have had its own detrimental impact on the environment. All in all, this appears to have been an example when no action was the best action.

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