Microplastics: They're in the Birds

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Guest Experts

Plastic pollution and its degradation into microplastics has become an increasing concern globally, with estimates of plastics entering the oceans annually in the millions of metric tons. These plastics are then transported and spread by oceanic currents and tides where they can eventually end up in coastal ecosystems such as tidal marshes. Once flooded into the marshes, plastics can be deposited in the sediment and vegetation, where it can further degrade into smaller pieces, and when they reach a size smaller than 5mm, referred to as microplastics. Once microplastics settle into coastal marsh ecosystems, organisms such as marsh birds that live and feed in the marsh may potentially ingest, or swallow, these small particles.

Birds living in aquatic environments have been documented ingesting plastics and microplastics both inadvertently during foraging and purposefully by mistaking them as food items. Since other water-dwelling bird species have been found to ingest microplastics, scientists at Mississippi State University studied birds inhabiting tidal marshes to assess the level of those birds' microplastic ingestion.

Two types of birds were studied: clapper rails (*Rallus crepitans*) and seaside sparrows (*Ammospiza maritima*). Both bird species reside in tidal marshes of the Atlantic Coast and Gulf of Mexico. In the northern Gulf of Mexico these two species spend their entire lifecycle in tidal marsh systems. While both species rely on tidal marshes, they have differing foraging and life-history strategies and are very different in size and body shape. Clapper rails weigh roughly 300g and seaside sparrows weigh only 20g. The differences between these species may result in differing levels of exposure to these microplastics in the water and marsh substrate.

Clapper rails spend much of their lives primarily foraging for fiddler crabs, snails, and other invertebrates; although in winter months when food is scarce, they will also eat dead fish and vegetation to survive. While they often capture food on the marsh surface they also probe into the marsh mud with their elongated bills to capture fiddler crabs and other invertebrates. Therefore, clapper rails may swallow microplastics either directly from water or from the mud in which they probe and subsequently ingest. Further, they may be exposed to microplastics indirectly through the prey items they consume that have themselves ingested microplastics.

Clapper Rail

Seaside sparrows use their short, stubby bills to glean the marsh surface and vegetation for insects like moths, grasshoppers, and spiders. They will skim insects from the surface of both water and mud possibly resulting in the direct consumption of microplastics but likely resulting in fewer microplastics consumed relative to clapper rails. However, they may also fall victim to the plight common to many marine species by possibly mistaking certain microplastics for food items.

The content of these birds' stomachs tells the story of what they are eating. Assessing stomach contents, including microplastics, in birds can be done fairly easily through the procedure of gastric lavage, also called stomach flushing. This non-lethal process involves sliding a small semi-flexible tube down the bird's throat to pass through the bird's crop

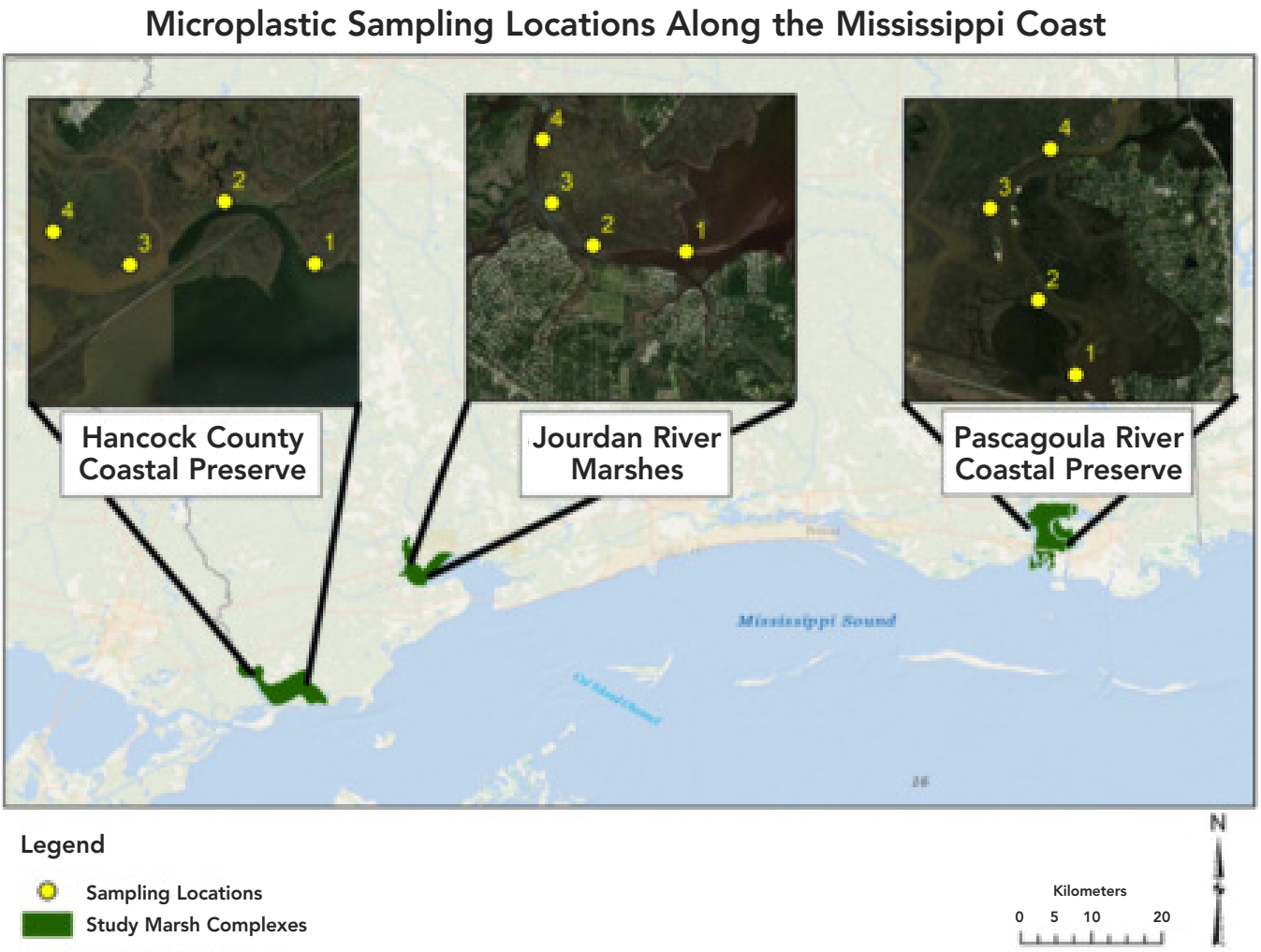

Figure 1: Microplastic Sampling Locations Along the Mississippi Coast
Spencer Weitzel et al., *Availability and assessment of microplastic ingestion by marsh birds in Mississippi Gulf Coast tidal marshes*, Marine Pollution Bulletin (May 2021).

and gizzard and into their stomach. Once the tube is clearly in the stomach, distilled air-temperature water is pumped slowly and gently into the stomach, causing the bird to regurgitate the water, along with stomach contents into a collection tray. The water and other contents can then be stored for later examination. In almost all cases, the non-lethal gastric lavage is a preferred alternative over lethal methods to assess stomach contents, because the birds can be released unharmed and continue their lives in the marsh.

Clapper rails and seaside sparrows had to be captured to have their stomachs flushed. Birds were caught at three different river-dominated estuarine tidal marshes in coastal Mississippi: the Hancock County Marsh Preserve; the Jordan River Preserve in Hancock and Harrison counties; and the Pascagoula River Marsh Preserve in Jackson County. Each of these marshes had four capture locations with the first point being located at the mouth of the river on the Gulf of Mexico and the remaining points placed upriver at equal distances (Figure 1). At each of these points, three seaside sparrows and three clapper rails were captured. Additionally, three sediment samples were collected at each site. These sediment samples were meant to represent the abundance of microplastic pieces at each point for comparison across marsh systems and in relation to bird stomach samples.

Clapper rails were caught by luring the birds into nets by playing rail calls over a speaker. Once the rail was caught in the 9-foot net, it was carefully removed, banded, and measured. Seaside sparrows were captured using mist-nets, a thinner delicate net that is difficult for birds to see, that were set into a 12m long and 2.5m tall line across the marsh. Sparrows were herded and flushed into the nets, then carefully removed, banded, and measured.

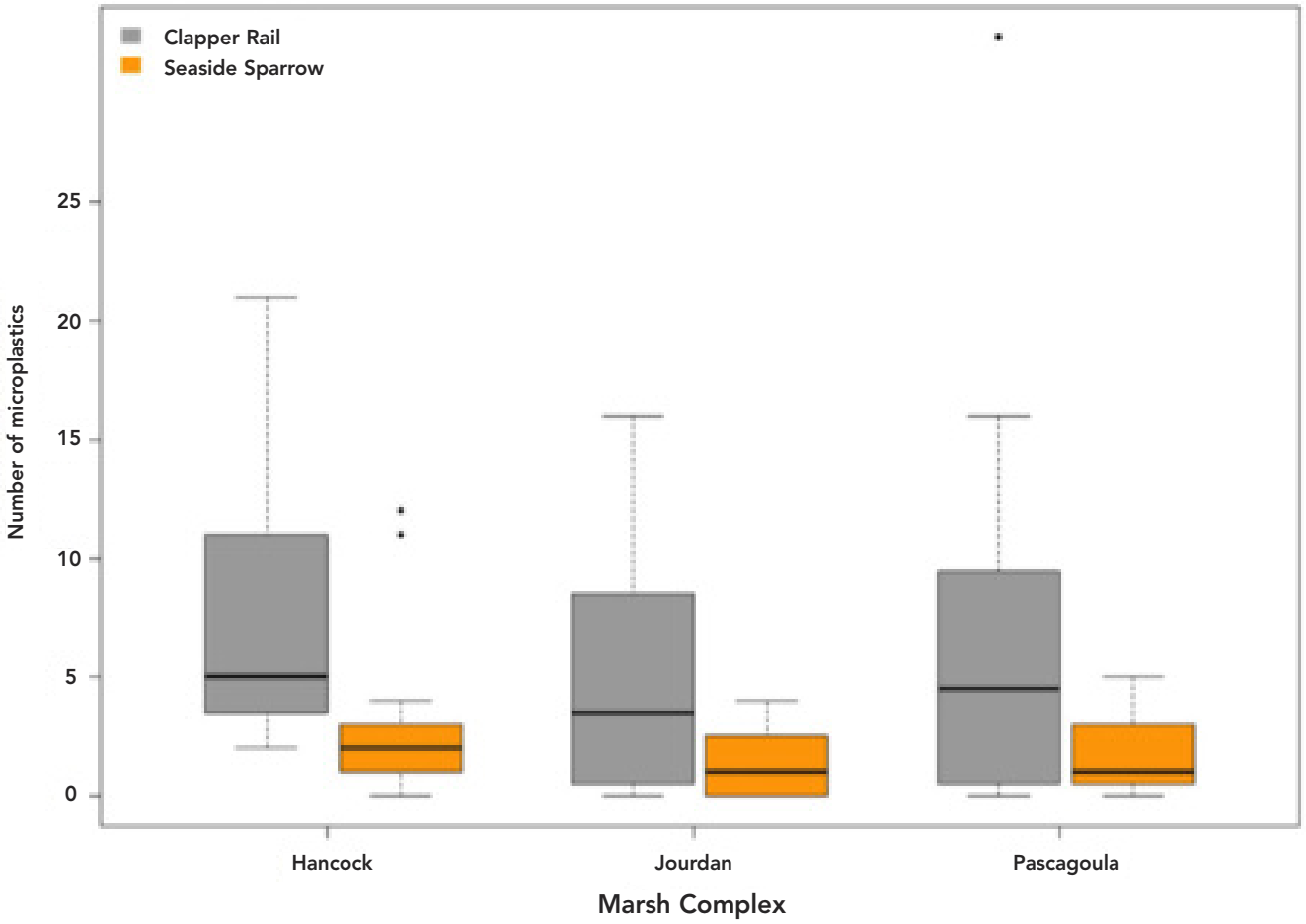

Figure 2: Number of Microplastics by Species and Location
Spencer Weitzel et al., *Availability and assessment of microplastic ingestion by marsh birds in Mississippi Gulf Coast tidal marshes*, Marine Pollution Bulletin (May 2021).

After being banded and measured, rails and sparrows had their stomachs flushed. Stomach and sediment samples were processed to remove organic material and other non-plastics to allow for easier counting and categorizing of microplastic pieces into their four categories: beads, fibers, films, and fragments. Once the microplastic pieces were isolated, the samples were examined using a microscope to count the number and type of microplastics in each sample.

Microplastics were detected in 63% of all sediment samples, 83% of clapper rail samples, and 69% of seaside sparrow samples. In stomach samples where microplastics were present, an average of 6 microplastic pieces were found in clapper rails and an average of 2 were found in seaside sparrows, with one clapper rail sample containing over 30 pieces of microplastics. On average, clapper rail stomach samples also contained more microplastic pieces than seaside sparrows (Figure 2). In these bird species, nearly all the microplastics detected were fibers, with only 2% being fragments. The sediment samples showed no significant difference in microplastic concentration between sites or sampling locations at each site. This also resulted in no relationship between microplastic concentrations in sediment to the bird stomach samples collected at each site.[1]

While clapper rail stomach samples had a higher percentage containing microplastics than seaside sparrows, the explanation for these results are still uncertain. These results could be due to a difference in foraging strategy or stomach volume between the two species. Another possibility is that microplastics present in the stomach may simply be passing through the digestive tract and haven't had enough time to be evacuated. Clapper rails are capable of regurgitating pellets containing crab and snail shells, and would likely move some microplastics out with the shells and other undigested material. Seaside sparrows, however, are not capable of regurgitating pellets, and would likely only be able to pass microplastics through their entire digestive system, to be finally expelled through feces. If so,

Seaside Sparrow

these samples may not represent total microplastics consumed, and they may be more representative of a bird's ability or inability to purge microplastics from their systems.

The presence of microplastic in the birds' stomachs indicates that species like seaside sparrow may be at future risk, should environmental microplastic concentrations increase, if they are mistakenly consuming microplastics that appear to be food items. When too many plastics are ingested, they may become lodged in the digestive system creating blockages and causing damage or provide a feeling of satiation with no caloric value; or both problems may occur. Severe instances of either scenario could ultimately lead to a bird's starvation. This phenomenon is seen in larger seabirds, such as albatross, and with plastics larger than 5mm.

These results set a baseline for evidence of microplastic ingestion by these two tidal marsh species. However, the direct effects of these levels of microplastics on clapper rails and seaside sparrows are still unknown. While detrimental effects of microplastic ingestion on these birds may be minor or non-existent currently, the increase in plastic pollution in the environment and its potential settlement in tidal marsh systems in the coming years may continue to increase ingestion rates to hazardous levels. While this project is not currently continuing, plans to improve and expand upon this work in the future would include collecting more samples in addition to capturing birds throughout the year.

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Endnotes

1. Spencer Weitzel et al., *Availability and assessment of microplastic ingestion by marsh birds in Mississippi Gulf Coast tidal marshes*, Marine Pollution Bulletin (May 2021).

In Sum.

A Summation of the Facts and Figures of Interest in this Edition

★ *Number of U.S. birds FWS lists as migratory:*	1,093
★ *Number of wildlife bridges and crossings on I-75 in Alligator Alley, FL:*	60
★ *Average number of pieces of microplastic found in Mississippi clapper rails' stomachs:*	6
★ *Percentage of seaside sparrows captured having ingested microplastic:*	69%