EELGRASS BEDS IN
RICHARDSON BAY

ITEM 6.1.4

Assessing Eelgrass Damage in Richardson Bay

Habitat Monitoring – October 2023

Richardson Bay Eelgrass Bed August 2023
Photo: The 111th Aerial Photography

Contents

Prepared by:

Paige Fernandez, Biologist
paige.fernandez@audubon.org
Audubon California
1901 Harrison Street, Suite 1450
Oakland, CA 94612


Damage to Eelgrass Bed and Algae Presence in Richardson Bay
Photo: The 111th Aerial Photography

Measuring Eelgrass Damage in Richardson Bay

Audubon's Role

Richardson Bay Audubon Center & Sanctuary has been a part of the Marin County community since 1957. Staff are the stewards and protectors of a 900-acre subtidal waterbird sanctuary within the great waters of Richardson Bay. Furthermore, over the last 66 years, Audubon California's expertise in environmental engagement, habitat restoration, and waterbird conservation has helped protect countless acres throughout the greater San Francisco Bay.

Richardson Bay is critically important to tens of thousands of diving ducks, grebes and other waterbirds who rely on the bay for roosting and feeding each winter. During the winter months, Richardson Bay teems with Surf Scoters, Lesser and Greater Scaup, Western and Horned Grebes, Double-crested Cormorants and other birds. Richardson Bay is also well known for its annual winter herring runs that are an important local fishery and provide important food for wintering birds. There is concern that the long-term decline in bird numbers and herring in Richardson Bay and other parts of San Francisco Bay is linked to the decline in native eelgrass beds.

The purpose of this paper is to support Richardson Bay Regional Agency's Eelgrass Protection and Management Plan[1] through the synthesis of data gathered in August 2023 on the damage to Richardson Bay's eelgrass beds. All data is compared to previous years' studies conducted by Audubon California staff.

Goals

Audubon's primary goal was to complete a fourth year of aerial eelgrass surveys in Richardson Bay using metholodies from the previous studies in 2017, 2021, and 2022. This included working with the same aerial photography firm, the 111th Group, as well as utilizing the identical analysis process for captured images. On a larger scale, Audubon hopes to continue to support the protection of eelgrass habitat in Richardson Bay as well as provide Richardson Bay Regional Agency with needed data that could inform the Transition Plan and Eelgrass Protection and Management[2].

More specifically within the eelgrass imagery analysis, the goal was to re-map the bed within the minimum-bounding study area polygon identified in 2017. This previously identified polygon contains the highest use area by anchor-outs within the eelgrass bed observed during the 2017 Richardson Bay flyover. The analysis will also determine locations both unaffected and assumed to be damaged by anchor scour. All analysis was completed using methods consistent with Kelly et al. 2019[3]. As discussed in the following sections, the primary goal of this project was not met due to various factors outside of our control. Most significantly, a large macroalgae mat covering a large portion of the eelgrass bed.

Study Methodologies

For this study year's eelgrass bed analysis, we used the same study boundaries (37°52'30"N; 122°29'00"W) determined in Audubon's peer-reviewed article[1] in *Environmental Management*. A flight from the 111th Group, an aerial photography company that specializes in mapping and surveys, occurred on August 5th, 2023 from 10:36am to 10:59am when the low tide was between 0.15 – 0.3m (relative to Mean Lower Low Water[4]). Methodology for image collection was replicated from the flights completed in July 2017, July 2021, and August 2022.

Like the previous Audubon-led studies, staff began by attempting to analyze damage within the eelgrass bed by manually digitizing the location of damage within the study area. This is done to determine the hectares of anchor scars and eelgrass loss as a result of anchored out boats. However, during the 2023 analysis, aerial imagery contained several elements that resulted in an obstructed view of the eelgrass bed below. This resulted in inadequate conditions for digitization and it was ultimately not appropriate to replicate the methodology developed in 2022 to approximate damage due to the significant size of the obstructed area within the study polygon. The boundary of the algae mat was delineated so that the exact area can be analyzed next year to determine if any widespread damage occurred as a result (Figure 1).

Results

In 2023 we were unable to confidently provide a damage estimate to eelgrass by anchor scour. The study area contained a 29.0 hectare patch (Figure 1) of dense macroalgae- likely in the genus *Chaetomorpha*- within and on top of the eelgrass bed. There was also significant glare on the water in some portions of the image from the steeper angle of the sun, and deeper water than previous years because of the tide level the photographs were taken. Despite these factors, we were able to determine that the size of the eelgrass bed within the minimum-bounding study area polygon, particularly along the western edge, decreased by 1.73 hectares from 2022 to 2023 (Figure 2).

There were 94 boats located within the boundaries of the minimum-bounding polygon in 2017, which decreased to 53 boats in 2021 and 41 boats by 2022. By the date the 2023 image was taken, that number had again dropped slightly to 40 boats. (These numbers are a snapshot in time and do not represent the current or seasonal fluctuation in vessel numbers.)

Damage estimates from studies performed in 2017, 2021, and 2022 can be found in the report submitted in December 2022.

Major Takeaways and Limitations

Aerial images gathered in 2023 produced an extremely ambiguous picture of the Richardson Bay eelgrass bed. A combination of significant glare in portions of the image, deeper water conditions during imagery collection, and the presence of a significant macroalgae mat covering a large portion of the eelgrass bed, resulted in conditions unsuitable for accurate damage assessment (Figure 3). Therefore, we are unable to report numbers for both the high and low damage estimate to eelgrass. However, documentation of this type of event remains valuable when taken in the context of multiyear assessment efforts.

Annual surveys of this nature inherently run the risk of varying degrees of image quality. The strict conditions which need to be met in order to collect the imagery and opportunities arise infrequently and unpredictably. For example, a window of opportunity to capture the imagery of the eelgrass bed earlier in the season, before the algae bloom formed, unfortunately occurred in conjunction with President Biden's visit to San Francisco and prolonged closure of the airspace. As a result, the 111th Group was not allowed to fly during that opportune window of time. The next possible date that the tides and weather cooperated was in August, overlapping with the presence of the algae bloom in Richardson Bay. Uncertainties of this nature are inherent to the project design and will be offset by repeated years of sampling.

In 2022 the imagery displayed a large portion of the eelgrass bed that was colored differently than the rest of the bed. The cause of the coloration and the state of the underlying eelgrass bed could not be determined by simply investigating the aerial imagery during analysis. By chance, the 2022 image was collected in between two side scan sonar eelgrass surveys of Richardson Bay. These two surveys were performed independently of this project and through discussions with that team, we were able to determine that that eelgrass was present in April 2022 and gone by October 2022. It was only though these discussions we were able to determine that a localized event occurred sometime within that timeframe and likely killed the eelgrass. However, by analyzing our imagery collected in August 2022 in isolation of the independent side scan sonar surveys, it would not have been possible to determine that the cause of the discoloration was due to unknown, localized, damage to eelgrass bed. In completing another round of surveys in 2023, using the same image collection methodology as previous years, we were able to confirm that the eelgrass bed in the area of discoloration from 2022 was damaged (Figure 4).

Unfortunately, this class of disturbance is becoming more common. In 2022, San Francisco Bay experienced a multi-week harmful algal bloom caused by the invasive marine algae *Heterosigma akashiwo*. An algae bloom of this variety turns the water a reddish-brown color, which limits light from penetrating the water column and causes low dissolved oxygen. This was the largest bloom in recorded history within the San Francisco Bay. The same species of algae has caused another harmful algal bloom in July 2023 although the effects were much smaller than in 2022. The effects of climate change will likely increase the frequency and intensity of both macro- and micro-algal blooms as well as sever winter storms.

As a result, defining damage directly caused by anchor scour becomes increasingly difficult as the eelgrass bed degrades, or large areas of damage occur- resulting in blurred anchor scour circles.

Compounding damage events that occur within the same year and between years contribute to the increased rate of degradation of the bed. The large patch of damage from an unknow source first seen in 2022 may have begun with anchor scour but the addition of other environmental factors may have contributed to the large footprint of damaged area. High water temperatures, low light, and high nutrient availability have been shown to have a negative effect on eelgrass with various degrees of additive effects[5,6,7]. Some or all of these factors that may have contributed to eelgrass destruction.

Of note, low light and increased temperatures have been shown to have the strongest individual negative effect on eelgrass. Within the 2023 Richardson Bay eelgrass bed, it is possible that the presence of the macroalgal mat, the occurrence of a microalgal bloom, and decreased salinity from the heavy winter rains all within the same growing season may have detrimental effects to the already stressed, anchor scoured eelgrass bed.

Fortunately, over the last seven years, there has been a concerted effort to reduce the number of anchored vessels in Richardson Bay, which has been shown to aid in decreasing the total hectares of damaged eelgrass. The removal of the remaining boats anchored in the eelgrass bed should aid in future improvement to the damaged areas; however, as boat removal has slowed in pace, the pace of eelgrass bed recovery nearest to the locations of existing anchored boats will likely slow as well.

References

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Figures

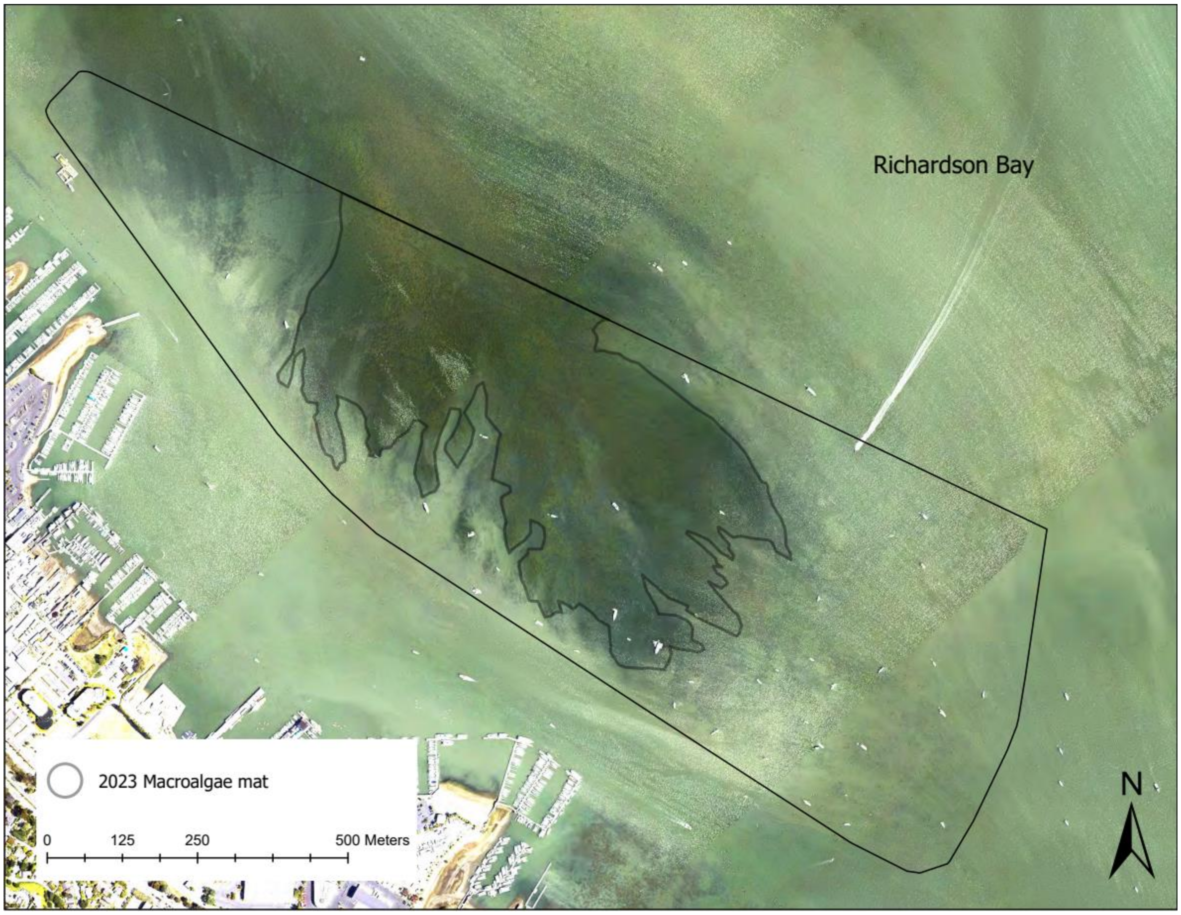

Figure 1. Delineation of extent of macroalgae mat (*Chaetomorpha sp.*) within the within the minimum-bounding study area polygon.

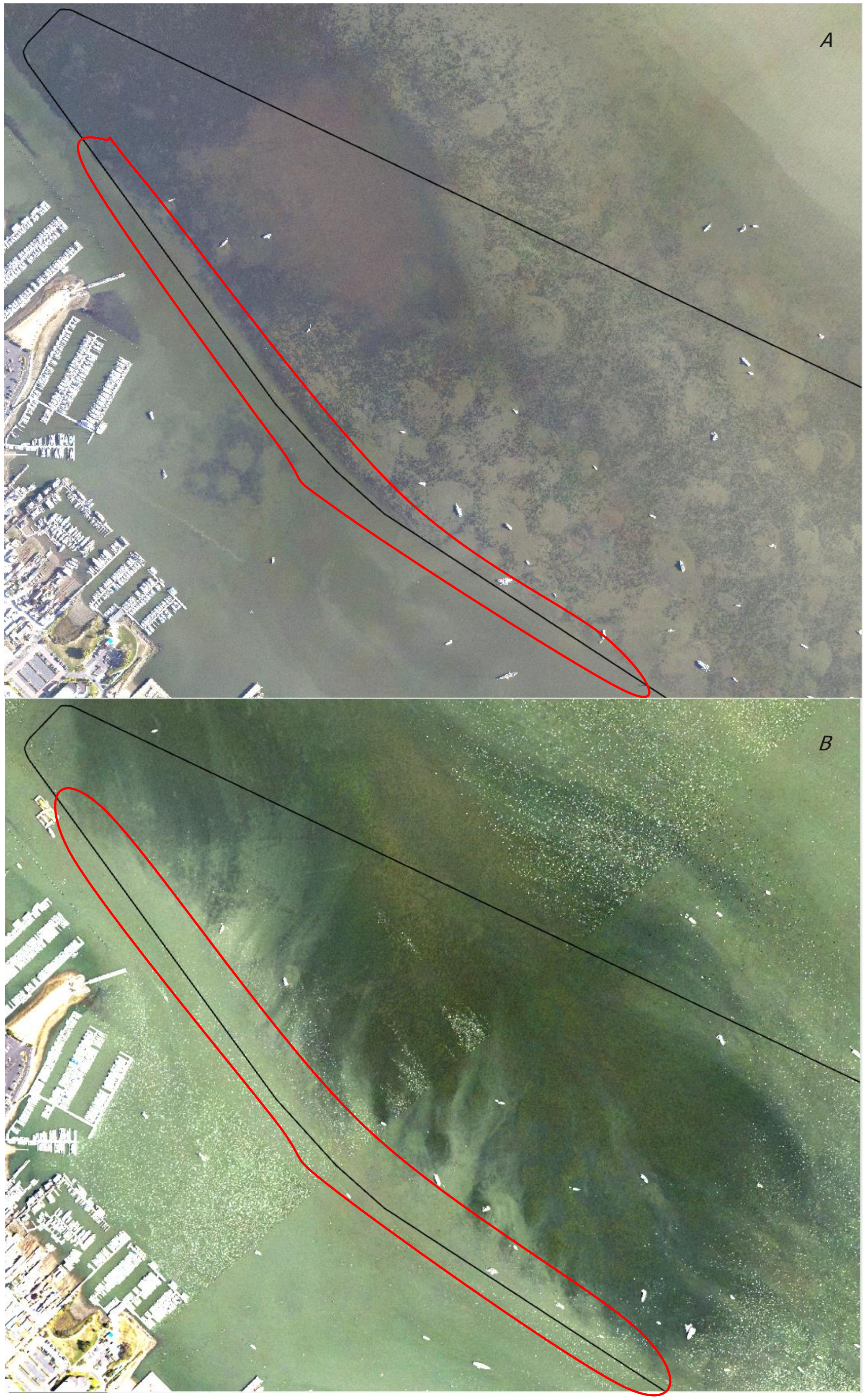

Figure 2. Degradation of the western boundary of the Richardson Bay eelgrass bed in 2022 (A) versus 2023 (B).

Figure 3. Examples of factors preventing Richardson Bay eelgrass delineation. (A) Macroalgae mat floating on top of eelgrass bed. (B) Glare distorting image, preventing visual of eelgrass bed. (C) Deep water preventing visual of eelgrass bed.

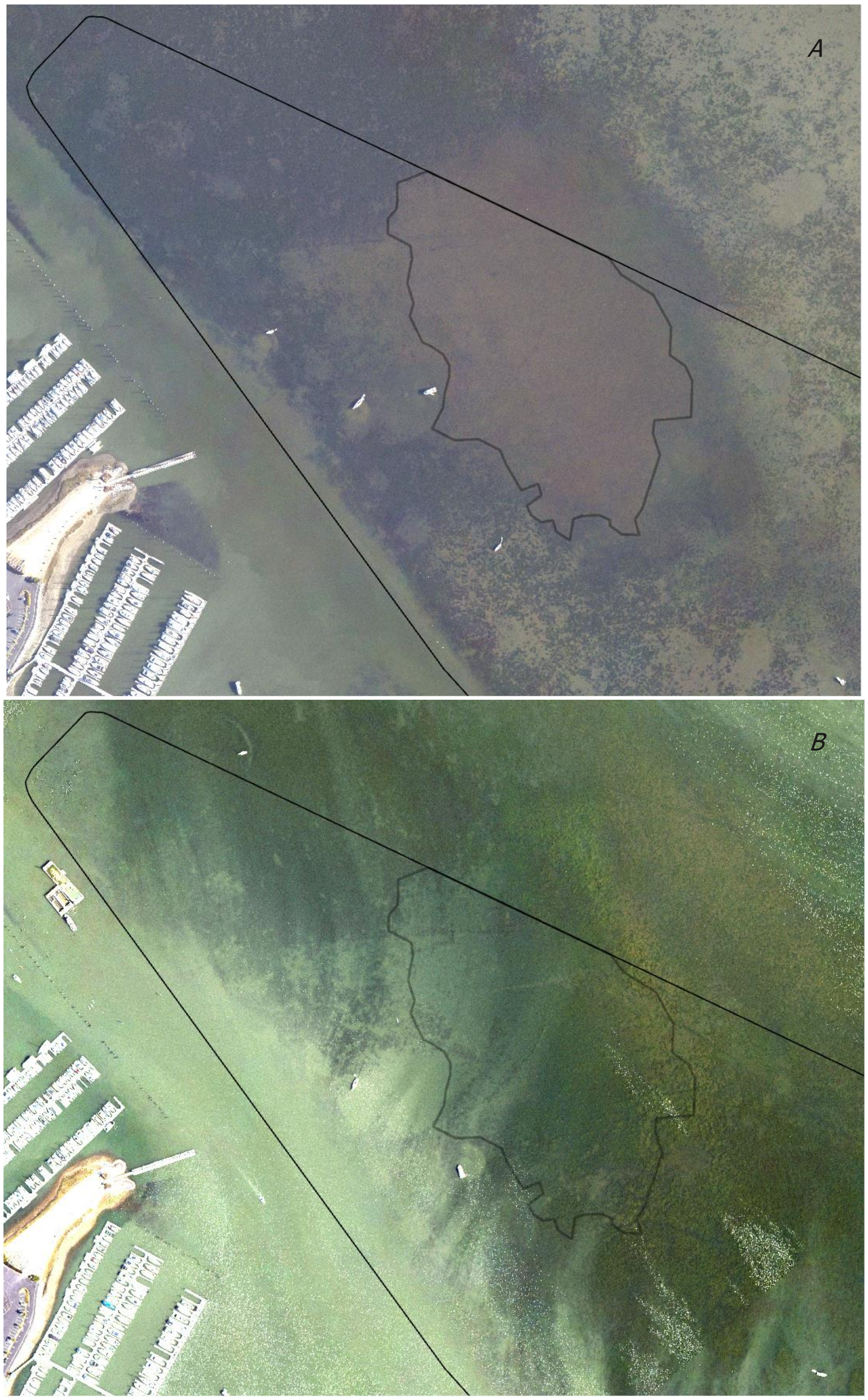

Figure 4. Damage to eelgrass bed from an unknow source in 2022 (A) and 2023 (B).