EELGRASS BEDS IN RICHARDSON BAY

ITEM 6.1.3

Measuring Eelgrass Damage in Richardson Bay

Habitat Monitoring – December 2022

Richardson Bay Eelgrass Bed August 2022
Photo: The 111th Aerial Photography

Contents

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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 65 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 2022 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 third year of aerial eelgrass surveys in Richardson Bay using the same metholodies as the previous studies from 2017 and 2021. 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 with the eelgrass imagery analysis, the goal was to re-map the bed within the minimum-bounding study area polygon identified in 2017. This polygon contains the highest use area by anchor-outs within the eelgrass bed observed during the 2017 Richardson Bay flyover. The analysis would 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].

Study Methodologies

For 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 14th, 2022 at 8:16am when the low tide was at -0.14 m (relative to Mean Lower Low Water[4]). Methodology for image collection was replicated from the flight completed in July 2017 and July 2021.

Like the previous Audubon-led study, staff assessed damage within the eelgrass bed by manually digitizing the location of damage within the study area to determine the hectares of anchor scars and eelgrass loss as a result of anchored out boats. To account for uncertainty in attributing eelgrass damage to anchored-out boats, we used manual classification to assess damage at two levels. For the low damage estimate, we identified anchor scars as circular scour areas in the eelgrass bed that appeared to be under anchored-out boats, or if not under anchored-out boats, had a similar appearance, suggesting direct damage by a vessel. For the high damage estimate, we included the former areas plus any circular scars in the bed that were near anchor-outs, and circular scars that were likely caused by boats (presumed to be past anchoring). In both cases, we manually digitized the extent of the eelgrass beds from the aerial imagery and calculated the overall maximum, minimum, and mean of the eelgrass bed extent within the minimum-bounding polygon.

During the 2022 analysis, aerial imagery exhibited a large, yet localized, patch of eelgrass damage caused by an unknown source. The extent of this localized, unknown damage was significant enough to mask the boundaries of multiple anchor scars delineated in the 2021 damage estimates. To account for the anchor damage that was no longer directly visible but that had definitely not recovered, the boundary of the localized damage from an unknown source was digitized into a new category. The areas of the 2021 damage estimates within that unknown damage area were remapped and classified into an additional new category. The hectares of known 2021 anchor damage within the area of damage from an unknown localized source captured in 2022 imagery were added to the total direct damage estimates for 2022. This methodology was implemented to ensure that anchor scour damage was not undercounted due to the boundaries being masked by an unknown source of damage.

Paige Fernandez, Audubon California's biologist based out of the Richardson Bay Audubon Center & Sanctuary, performed manual digitation and analyzed the imagery for eelgrass damage.

Results

In 2022 the low damage estimate indicated that of the 83.0 hectares of existing eelgrass bed, 28% was damaged by anchor scour. The high damage estimate indicated that 49% of the eelgrass bed was damaged by anchor scour. (See Figure 1.)

In 2017, the low damage estimate indicated that of the 84.4 hectares of existing eelgrass bed, 25% was damaged by anchor scour. The high damage estimate indicated that 41% of the eelgrass bed was damaged by anchor scour.

In 2021, the low damage estimate indicated that of the 83.2 hectares of existing eelgrass bed, 26% was damaged by anchor scour. The high damage estimate indicated that 52% of the eelgrass bed was damaged by anchor scour

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

Major Takeaways and Limitations

From 2017 to 2021, the low damage estimate of eelgrass damage increased 7% from 20.0 hectares to 21.3 hectares where the high damage estimate increased 27% from 34.0 hectares to 43.1 hectares.

From 2021 to 2022, the low damage estimate of eelgrass damage increased an additional 9% to 23.2 hectares

where the high damage estimate decreased 6% down to 40.7 hectares. (Table 1).

As described above, the 2022 imagery included a 5.5 hectare patch of localized damage from an unknown source. To calculate the final low damage estimate of 23.2 hectares, 22.3 hectares of direct damage to eelgrass beds was added to 0.9 hectares of anchor scour damage from 2021 included within the scar of damage from an unknown source in 2022. To calculate the final high damage estimate of 40.7 hectares, 37.5 hectares of direct damage to eelgrass beds was added to 3.2 hectares of anchor scour damage from 2021 included within the scar of damage from an unknown source in 2022.

The locations of damaged eelgrass has shifted slightly from 2021 and closely follows the current location of anchoring vessels. A significant number of damaged areas remain in the eelgrass bed due to a continued presence of anchored vessels from 2017, 2021, and 2022. (Figures 2, 3, 4)

Over the last six years, there has been a concerted effort to reduce the number of anchored out vessels in Richardson Bay, which will likely aid in decreasing the total hectares of damaged eelgrass observed in future surveys.

By comparing the imagery across the three separate study years, it is clear there has been a handful of locations where the removal of an anchored-out vessel resulted in the recolonization of eelgrass in a previous scar. One clear example of eelgrass growth in a previous scar can be found in Figure 5. Unsurprisingly, there are a number of damaged areas that were clear of boats in the 2021 imagery that have still not recovered by the time the 2022 aerial imagery was collected suggesting that the grass will take longer than one year to recover in some instances. (Figure 6)

Overall, aerial images gathered in 2022 produced a much clearer picture of the Richardson Bay eelgrass bed than in 2021. However, the cause of the large, localized, portion of the eelgrass bed that was damaged by an unknown source could not be determined by simply investigating the aerial imagery during analysis.

Local eelgrass experts were contacted to assist in determining the source of this damage. The distinctive brown coloration, timing, and location within the larger bed were discussed. Through these discussions we learned that eelgrass surveys of Richardson Bay were performed, independently of this project, in April and October 2022. In April 2022 their surveys displayed eelgrass within the area of question but when surveyed again in October 2022, it was clear that eelgrass was no longer present within that same area. Through these discussions we know that a localized event occurred between April and October 2022 that killed the eelgrass; however, by analyzing our imagery collected in August 2022 we could not determine a cause.

This instance reinforces the idea that on the ground site visits would be extremely beneficial in reducing the number of assumptions that need to be made while digitizing the imagery. On the ground visits would best serve the project if they were performed on the same day as, or within a short window before or after, the aerial imagery was collected. These on the ground surveys could entail a staff person aboard a kayak lowering a camera down to the bay floor to capture imagery of the eelgrass in a number of areas of interest. This would allow us to ground truth what we believe we are seeing in the aerial imagery either confirming that damage did indeed occur and the eelgrass is no longer in the area or allowing us to see small eelgrass shoots in an area we previously believed barren.

References

1. Lesberg, R.S. 2021. Richardson Bay Regional Agency: Richardson's Bay Eelgrass Protection and Management Plan. Coastal Policy Solutions (Document No. 0721). Vallejo, CA
2. Richardson Bay Regional Agency: Transition Plan. Adopted June 11, 2020
3. Kelly, J. J., Orr, D., & Takekawa, J. Y. (2019). Quantification of damage to eelgrass (Zostera marina) beds and evidence-based management strategies for boats anchoring in San Francisco Bay. Environmental management, 64(1), 20-26.
4. NOAA Tides & Currents. Retrieved June 1, 2022, from https://tidesandcurrents.noaa.gov

Maps and Eelgrass Damage Table

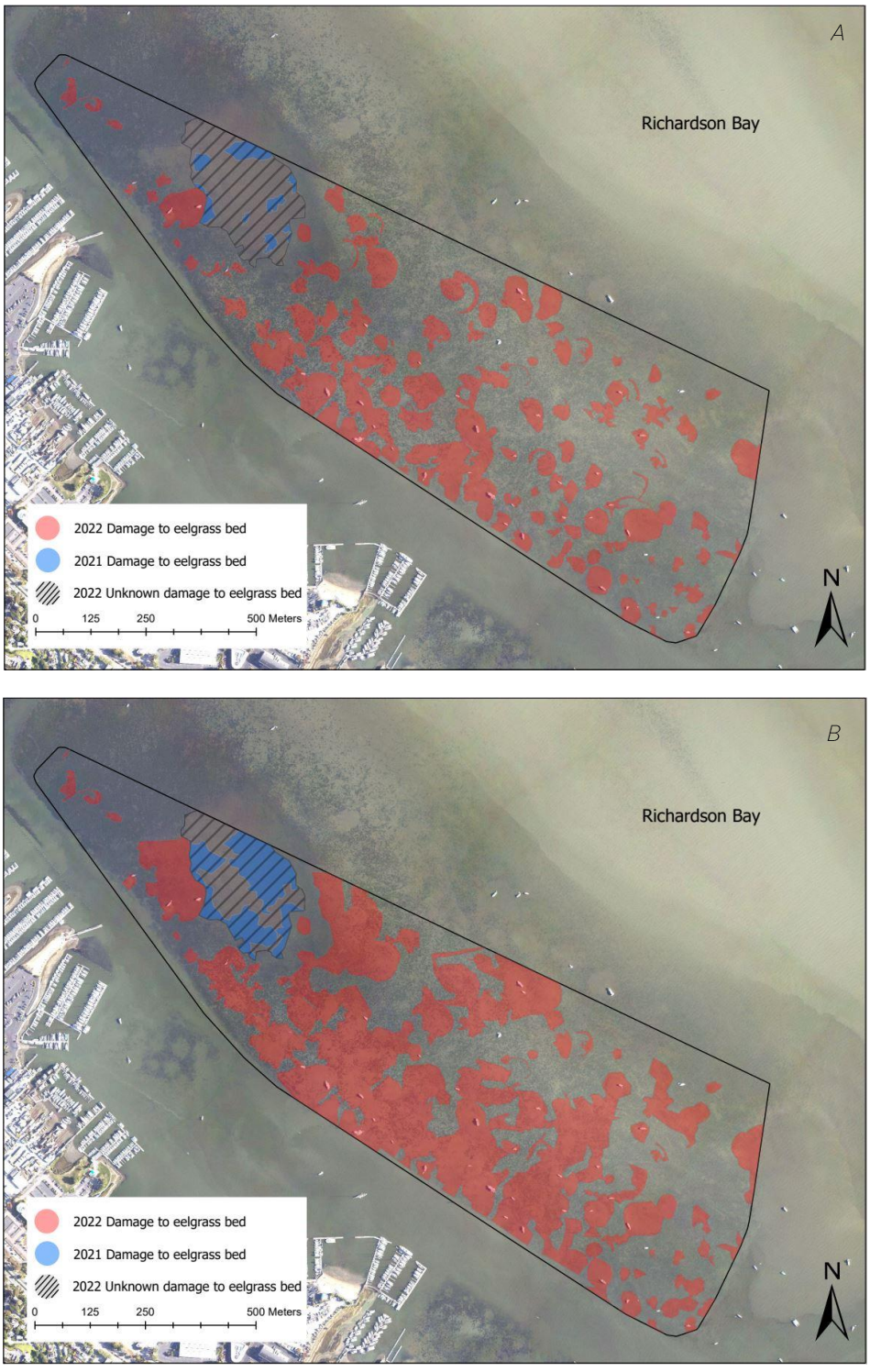

Figure 1. **Map A (above)** shows 2022 low damage estimate of eelgrass loss in red underneath vessels. **Map B (below)** shows 2022 high damage estimate of eelgrass loss below vessels and is assumed to be past anchor scours. Red denotes 2022 direct damage to eelgrass bed. Black hatch denotes an area of localized damage from an unknown source to eelgrass bed in 2022. Blue denotes unrecovered 2021 damage present within the unknown damage area.

Figure 2. **Map A (above)** shows low damage estimate of eelgrass loss in 2022 (red), 2021 (blue), and combined years (purple) below vessels. **Map B (below)** shows high damage estimate of eelgrass loss in 2022 (red), 2021 (blue), and combined years (purple) below vessels and is assumed to be past anchor scours. Black hatch denotes an area of localized damage from an unknown source to eelgrass bed in 2022.

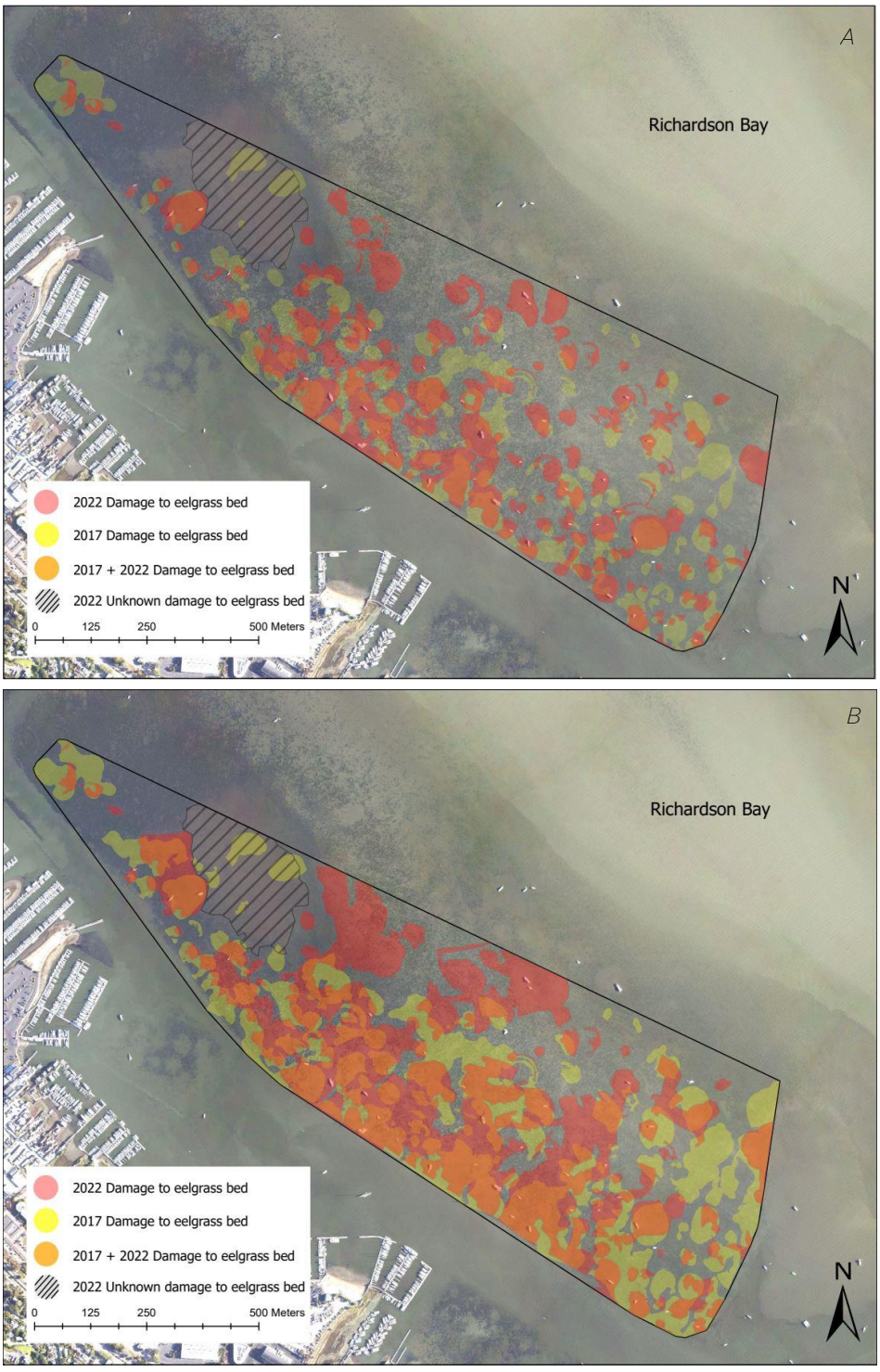

Figure 3. **Map A (above)** shows low damage estimate of eelgrass loss in 2022 (red), 2017 (yellow), and combined years (orange) below vessels. **Map B (below)** shows high damage estimate of eelgrass loss in 2022 (red), 2017 (yellow), and combined years (orange) below vessels and is assumed to be past anchor scours. Black hatch denotes an area of localized damage from an unknown source to eelgrass bed in 2022.

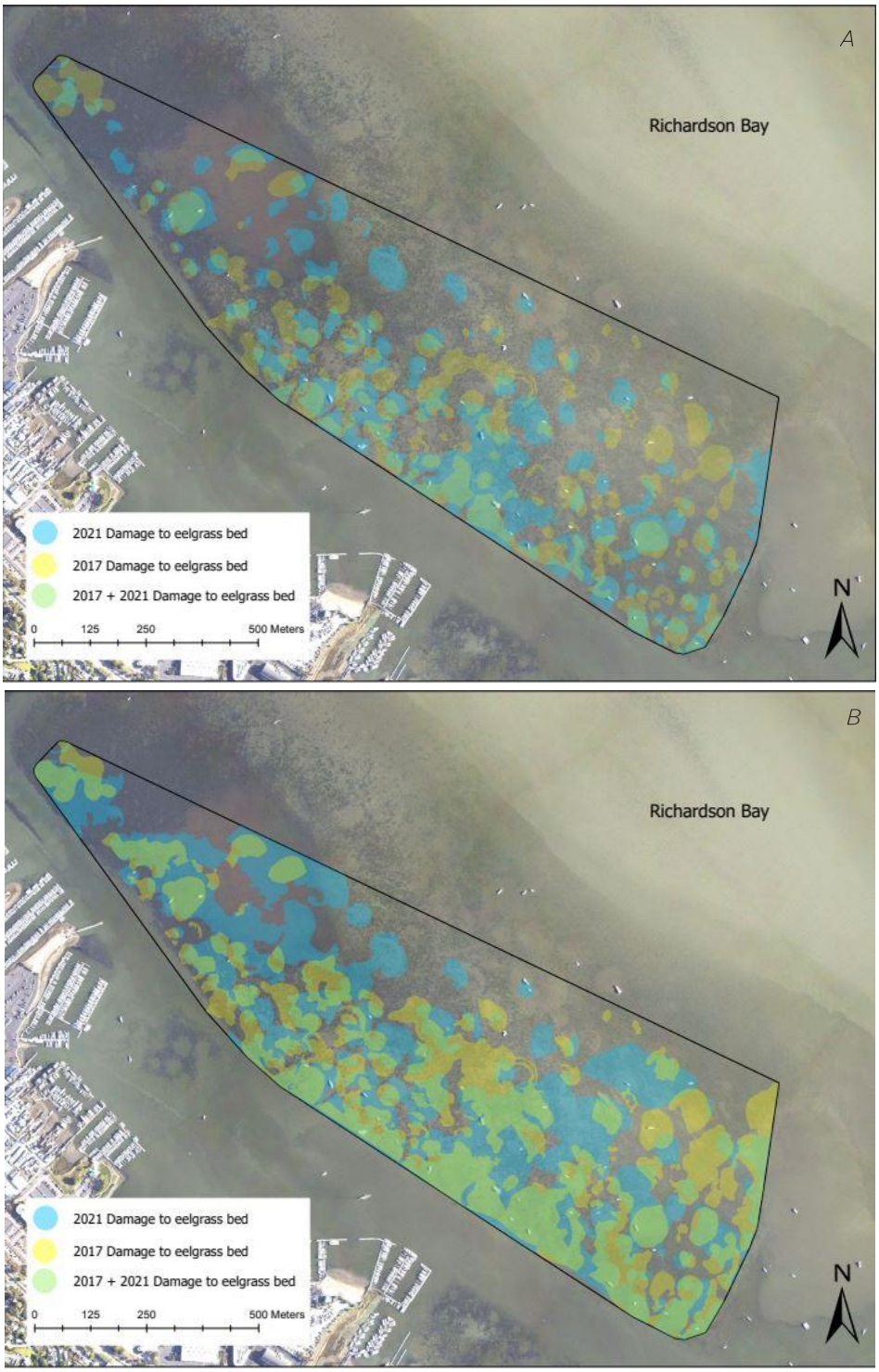

Figure 4. **Map A (above)** shows low damage estimate of eelgrass loss in 2021 (blue), 2017 (yellow), and combined years (green) below vessels. **Map B (below)** shows high damage estimate of eelgrass loss in 2021 (blue), 2017 (yellow), and combined years (green) below vessels and is assumed to be past anchor scours.

Figure 5. Examples of anchor scars in Richardson Bay eelgrass bed from 2021 (A) that have begun to recover in 2022 (B).

Figure 6. Examples of anchor scars in Richardson Bay eelgrass bed from 2021 (A) that have not recovered well in 2022 (B).

	Estimate	Direct Damage	Not Directly Damaged	Not Eelgrass	Damage from Unknown Source
2017	Low Damage	20.0	60.7	3.7	0
	High Damage	34.0	48.8	1.7	0
2021	Low Damage	21.3	61.8	1.2	0
	High Damage	43.1	40	1.2	0
2022	Low Damage	23.2 (22.3 +0.9)	55.2	1.4	5.5
	High Damage	40.7 (37.5+3.2)	40	1.4	5.5

Table 1. Anchor scour damage (ha) to eelgrass in Richardson Bay, San Francisco Bay, California, USA. Direct Damage in 2022 includes: total damage (direct 2022 damage + direct 2021 damage within localized patch of damage from an unknown source).