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| From | Serena Keeler |
| To | Anne Murrow, MPI |
| CC | Irene Middleton, MPI |
| Date | 25/06/2025 |
| Subject | Report on sudden biomass reduction at Omakiwi Cove, Bay of Islands (SOW C0037391 - Variation 1) |
| File path <i>(right click to update)</i> | <i>Document1</i> |

Background: A four-person NIWA dive team undertook an assessment of the reported reduction in exotic *Caulerpa* biomass at Omakiwi Cove on 20–21 June 2025. The survey revealed a substantial decline in *Caulerpa* biomass compared to the previous NIWA survey conducted in November 2024.

No significant biomass reduction had been observed at Omakiwi Cove from the initial detection of exotic *Caulerpa* in May 2023 until late April 2025. During this period, *Caulerpa* steadily expanded from sandy and silty substrata in the central bay toward adjacent rocky reef habitats in shallower waters. However, in early May 2025, a rapid and substantial decline in biomass—estimated at 95–100%—occurred within a three-week period at depths of 6–7 m.

This event followed an extended period of heavy rainfall and stormy weather. Local observers suggested that the most likely causes were increased sedimentation and turbidity, which may have reduced light availability and caused physical smothering by silt. Importantly, the decline does not appear to have resulted from direct physical damage during the storm. Excessive rainfall into the surrounding catchment area and Omakiwi Cove would also have resulted in reduced salinity, possibly also a contributing factor to the observed biomass decline. Commercial divers reported healthy *Caulerpa* beds just three days after the storm, despite severely reduced visibility. The full spatial extent of this biomass reduction was assessed during the present survey.

Work Undertaken: NIWA divers surveyed 50 m × 2 m transects at 15 locations in and around Omakiwi Cove (Figure 1). Transects spanned a range of depths and substrata (including reef, sand, muddy sand, shelly gravel, cobbles, and foul) to assess changes in biomass across habitats. Survey sites were identical to those previously established in November 2024, enabling temporal comparison of percent cover using GPS-located coordinates (Keeler et al. 2025).

Divers recorded video imagery and estimated the percent cover of exotic *Caulerpa* at 10 m intervals along each transect using 0.25 m² quadrats.

All diving was conducted in buddy pairs using SCUBA. All participating divers had prior experience in exotic *Caulerpa* surveillance and delimitation, and were skilled in identifying the species, even at low densities.

Results: Survey conditions at Omakiwi Cove were particularly poor, with underwater visibility limited to approximately 1 m near the seafloor. Heavy sedimentation was observed on the shallow reef areas, and a high proportion of silt covered soft sediment habitats in the middle of the bay.

Analysis of percent cover data from quadrat imagery revealed extensive biomass reduction (estimated at 95–100%) across most sites. Very little exotic *Caulerpa* remained attached to the soft sediments, and only

sparse patches were observed on reefs. Of the residual biomass on soft sediments (which was minimal), most appeared in poor condition, exhibiting signs of degradation and limpness. Drift *Caulerpa* was also recorded on soft sediments and was similarly degraded. While some *Caulerpa* still attached to reef appeared healthy, the entire area was heavily silted.

Quantitative results based on quadrat data showed a sharp decline in *Caulerpa* cover compared to previous surveys. In November 2024, percent cover ranged between 23.4% and 99.8% across the 15 transects, with a mean \pm S.E. of $70.64 \pm 3.9\%$ (Figure 2). Data from June 2025 demonstrated a significant biomass reduction across all transects (Linear mixed model repeated measures ANOVA: $F = 65.17$, $d.f. = 14$, $P = 0.000$; Figure 2). Of the 15 transects surveyed, only three sites (BOI08, BOI11, and BOI13) showed persistence of exotic *Caulerpa*, all located in shallow water (0–5 m) with mixed substrata (shell, sand, and reef; Figure 2). These observations are consistent with diver reports that *Caulerpa* is now predominantly absent from soft sediments but remains established on reef habitats.

Between March and November 2024, *Caulerpa* cover increased at shallow sites (0–5 m depth, mean \pm S.E. = $11.6 \pm 8.6\%$), remained relatively unchanged at 5–10 m (mean \pm S.E. = $-2.6 \pm 7.6\%$), and decreased significantly at depths over 10 m (mean \pm S.E. = $-26.7 \pm 7.0\%$). Cover increased only on transects with mixed sand and patch reef substrata (mean \pm S.E. = $21.2 \pm 13.7\%$).

In June 2025, *Caulerpa* cover declined across all depth ranges (Figure 4). The smallest reduction occurred at shallow sites—corresponding with those where the species persisted (0–5 m depth, mean \pm S.E. = $-45.5 \pm 8.0\%$)—while the largest reductions were at greater depths: 5–10 m: mean \pm S.E. = $-62.2 \pm 7.7\%$ and 10–15 m: mean \pm S.E. = $-66.4 \pm 5.8\%$ (Figure 4).



Figure 1. Exotic Caulerpa biomass reduction sampling sites in Omakiwi Cove, June 2025. The same sites were surveyed previously in November 2024.

The growth form of exotic *Caulerpa* on soft sediment appeared unhealthy and was predominantly present as drift material. The small amount that remained attached to the sediment was limp and showed signs of decay. In contrast, the exotic *Caulerpa* persisting on reef substrata appeared healthy, although it was covered by a thick layer of sediment.

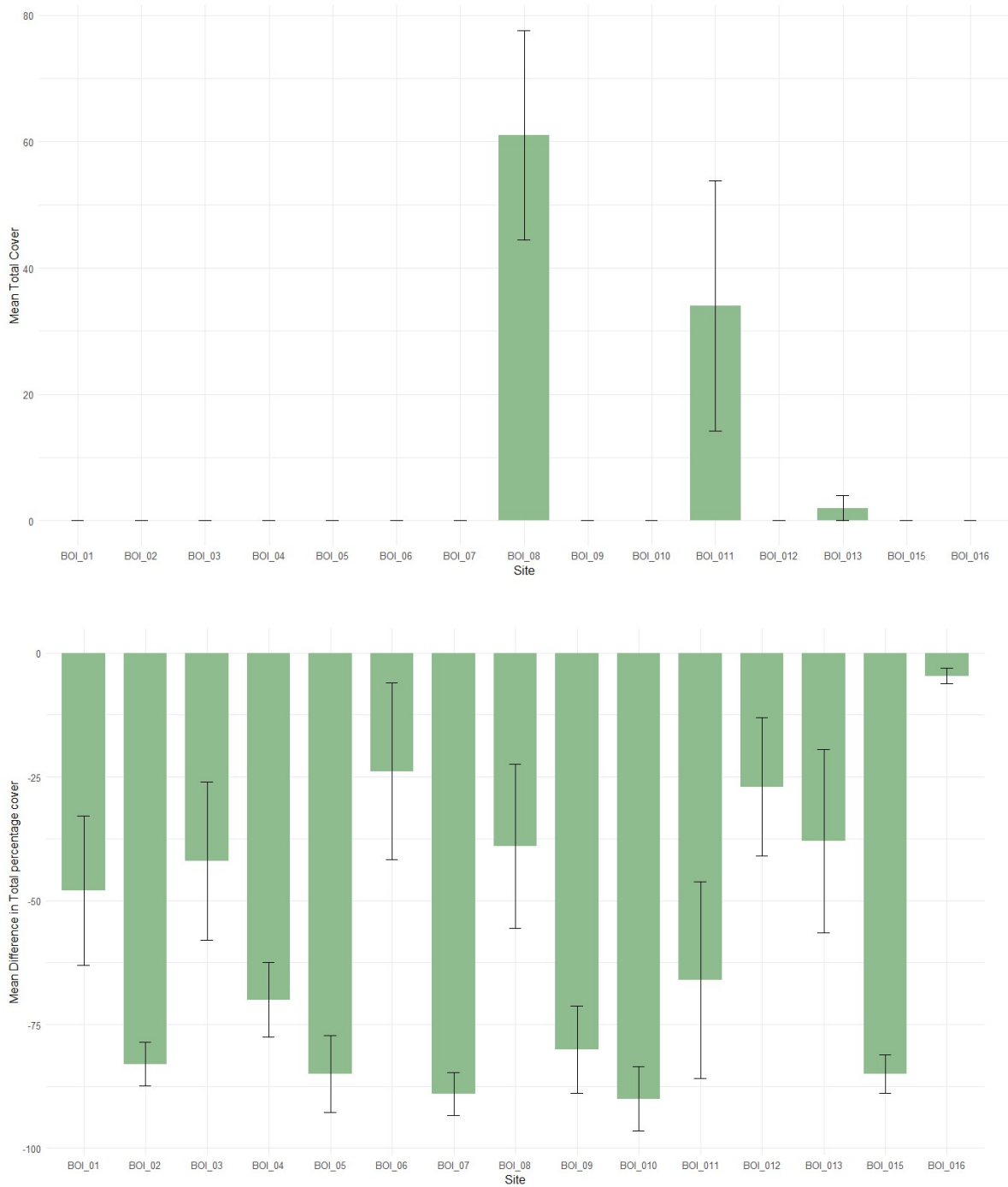


Figure 2. Top: Mean total percentage cover of exotic *Caulerpa* at sites sampled at Omakiwi Cove in June 2025 (\pm S.E.). Bottom: Changes in the mean total percentage cover at surveyed transects in Omakiwi Cove between June 2025 and the earlier survey in November 2024. Codes on the lower axis denote individual transects (\pm S.E.).

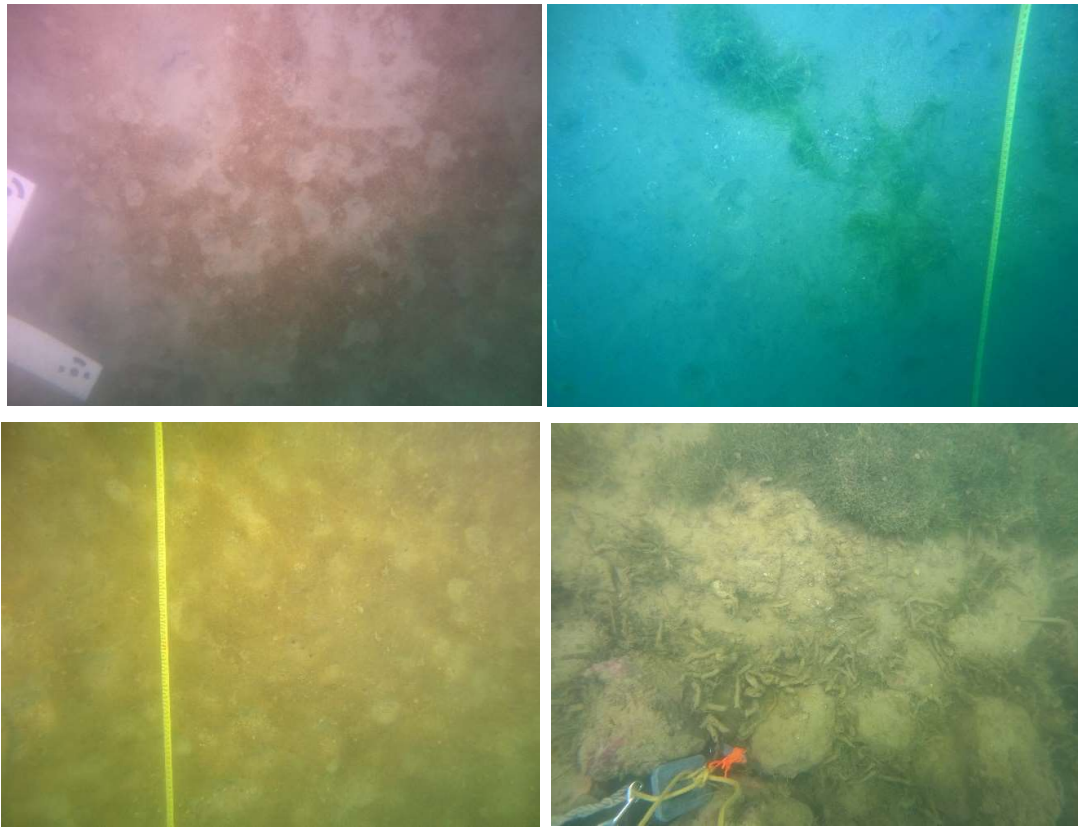


Figure 3. Examples of significant biomass reduction at Omakiwi Cove. Clockwise from top left, bare sediment at a previously high-density site (BOI005) in the middle of Omakiwi Cove, sparse patch of *Caulerpa* at a previously high-density site (BOI011) on sediment, and on reef at same site (BOI011) showing heavy sedimentation, bare sediment at previously high-density site (BOI015) located outside Omakiwi Cove (photos: Crispin Middleton, NIWA).

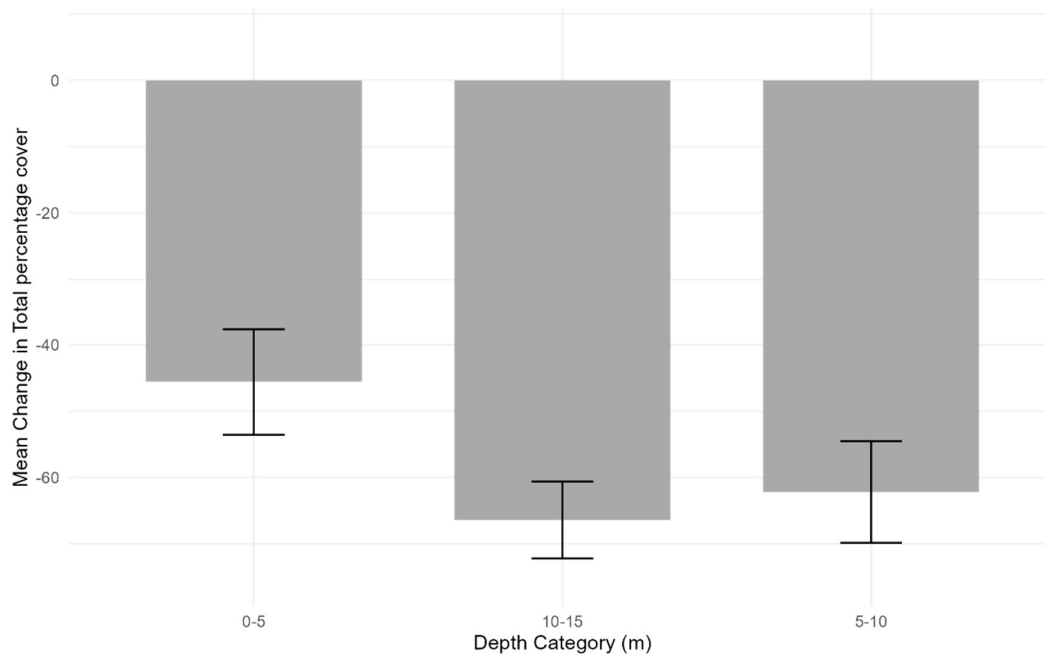


Figure 4. Mean changes in exotic *Caulerpa* total percentage cover at surveyed transects between November 2024 and June 2025. Percent cover changes are shown for three depth categories: shallow (0–5 m), mid-depth (5–10 m), and deep (>10 m) (\pm S.E.).

These preliminary investigations suggest that widespread and significant reduction in exotic *Caulerpa* biomass has occurred across the sites surveyed at Omakiwi Cove, Bay of Islands, between November 2024 and June 2025. While no data have been collected on sea surface temperatures, salinity, turbidity or sedimentation, it is likely that the conditions in Omakiwi Cove immediately following the storm event have contributed to this sudden and significant biomass decline.