Department of Conservation
Te Papa Atawhai

NIWA
Taihoro Nukurangi

Vegetation Status in Waituna Lagoon: Summer 2024

Climate, Freshwater & Ocean Science

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Contents

DOC commissioned NIWA to undertake the 2024 summertime Waituna Lagoon survey to document the health of submerged vegetation and to provide an inter-annual comparison of its condition. This report summarises the key findings to guide further ecological management of the lagoon.

Key findings

Monitoring results for submerged vegetation in Waituna Lagoon are compared to six ecological targets (in bold below). In 2024, only one target was met;

- The target for **macroalgae cover** was achieved, being within the limit of <10% cover lagoon-wide. This is the second consecutive year of low summer macroalgae abundance.

Four targets relating to *Ruppia* status and one target relating to lagoon status were not achieved;

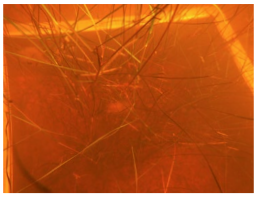
- Measures of lagoon-wide ***Ruppia* cover** and ***Ruppia* biomass index** were amongst the lowest values on record since 2009 and well below target levels.
- Targets for ***Ruppia* reproductive success** and ***Ruppia megacarpa* status** were not met, with measures of zero.
- The target for **lagoon closure** was not met, due to an emergency summer opening to disrupt a toxic algal bloom (cyanobacteria).

According to Environment Southland's water quality data, conditions for submerged vegetation growth were poor for months before the summer lagoon opening. The timing of declines in *Ruppia* abundance is unknown and may have started before the summer opening.

Signs of *Ruppia* germination from the seedbank were seen during the 2024 vegetation monitoring. The *Ruppia* seed bank is expected to be abundant after a very successful reproduction event in summer 2023 and vegetation recovery expected to proceed under usual lagoon conditions.

Purpose of this report

This report presents the 2024 annual summer monitoring data for submerged vegetation in Waituna Lagoon in relation to ecological targets that have been identified by the Lagoon Technical Group to guide ecological management. Results are compared to annual monitoring results since 2009.



Waituna Lagoon is an internationally important example of a coastal waterbody that remains in good ecological condition.

Background

The importance of Waituna Lagoon

Waituna Lagoon on the south coast of New Zealand is included within a Ramsar Wetland of International Importance. The Lagoon is of cultural significance to Ngāi Tahu recognised by a Statutory Acknowledgement under the Ngāi Tahu Claims Settlement Act 1998[1]. It is also significant for conservation of biological diversity and as a key recreational site.

The Department of Conservation has been monitoring submerged aquatic plants (including *Ruppia* spp.) in Waituna Lagoon since 2007 under the Arawai Kākāriki Wetland Restoration Programme.

Coastal lowland lakes like Waituna Lagoon are impacted by changes in land use in the catchment including sediment and nutrient loads from upstream run-off. It is now rare to find coastal lowland lakes with an intact ecological condition, but Waituna Lagoon remains highly valued for its associated plant, wetland, fish and birdlife.

[1] Ngāi Tahu Claims Settlement Act 1998 No. 97 (as at 23 May 2008), Public Act Schedule 73 Statutory acknowledgement for Waituna Wetland – New Zealand Legislation.

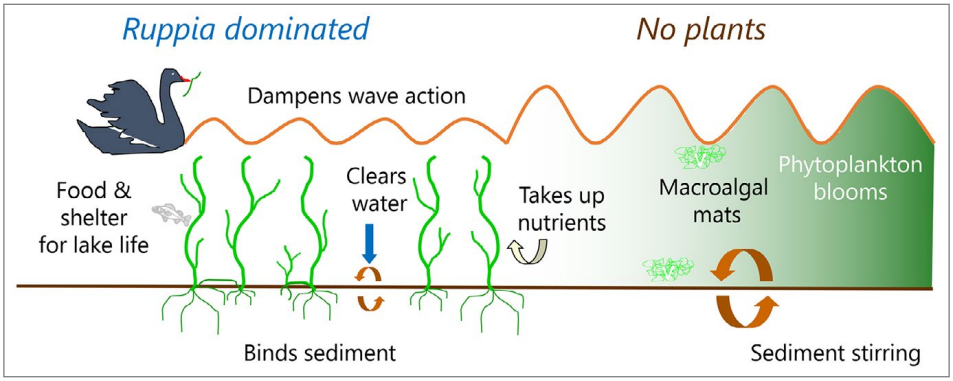
Ruppia safeguards the lagoon

When *Ruppia* grows densely in Waituna Lagoon it protects water quality, dampens wave action and stops the bed being stirred up.

Risk of Waituna Lagoon shifting to a poor ecological condition

Submerged plants have an important role in keeping shallow lakes and lagoons clean and healthy (Figure 1). If submerged plant communities become too stressed, they can collapse. The lake or lagoon then enters a new, dirty water state, with high levels of resuspended sediment and development of macroalgal mats or phytoplankton blooms instead of plants. The submerged native plant species of *Ruppia* (horse's mane) safeguard water quality in Waituna Lagoon. *Ruppia* tolerates fluctuating levels of saltwater in lagoons better than other submerged plants, but does not occur in the sea. Other plants, including a nationally rare, salinity-tolerant charophyte, also occur at Waituna Lagoon.

Figure 1: *Ruppia* vegetation can safeguard water quality in the lagoon compared to a system with no plants.



Management of water level at Waituna Lagoon

Agencies, community and iwi are working together to manage and protect Waituna Lagoon. When water levels in the lagoon rise too high for land drainage, the management response has been to mechanically open the lagoon to the sea. Lagoon openings are usually undertaken once or twice a year to prevent catchment flooding and to flush nutrients from the lagoon, but lagoon closing only occurs naturally under certain sea conditions.

Management of these artificial openings is increasingly taking into account the Lagoon's ecology. The timing and length of openings ideally should not negatively impact on the survival of *Ruppia* and other vegetation. This requires managing openings to avoid critical periods in the life-history of *Ruppia* including spring to summer growth and seed production.

Previously, the lagoon had been opened to the sea once the water level of Waituna Lagoon reached a certain trigger level[2], which varied at different times of the year and had associated conditions. The coastal permit to open the lagoon expired in 2022. More recently, the optimal Resource Consent conditions for the ecological and cultural health of the lagoon ecosystem were assessed by an expert technical panel[3] as a step towards better management of lagoon openings.

[2] Resource Consent 20146407-01, 14 February 2017.

[3] Robertson, H.A., Ryder, G., Atkinson, N., Ward, N., Jenkins, C., de Winton, M., Kitson, J., Schallenberg, M., Holmes R. (2021) Review of conditions for opening Waituna Lagoon. Supporting Information. Prepared for Whakamana Te Waituna. 29 pp.

Natural lagoon level

Once, Waituna Lagoon would have naturally breached to the sea after several years of filling with freshwater. Today it is regularly opened and infiltrated by the sea.

What do openings mean for conditions in Waituna Lagoon?

Monitoring of the waters of Waituna Lagoon over time[4] has built up a picture of the key changes caused by opening events[5]. Water level is lower and salinity higher when the lagoon is open and temperature and nutrient concentrations are both reduced with flushing by the sea (Figure 2). These changes and their duration influence the vegetation of Waituna Lagoon.

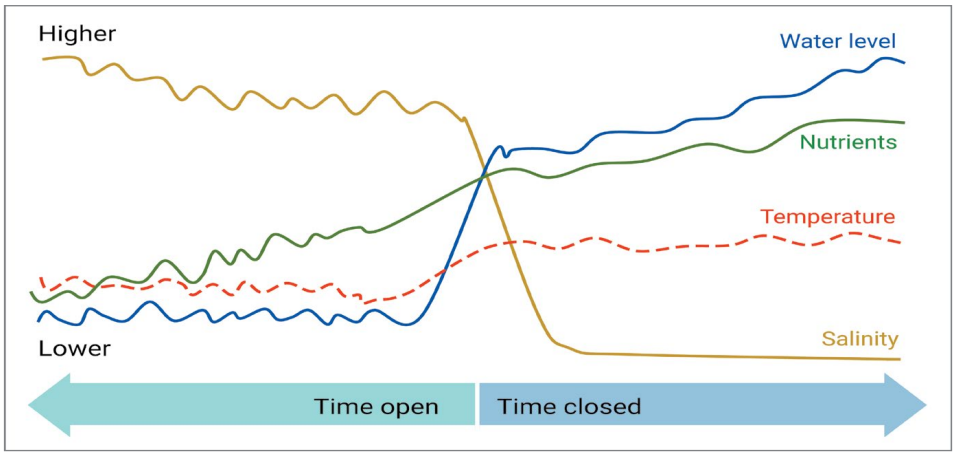


Figure 2: Key changes in the waters of Waituna Lagoon with time after opening or closing to the sea.

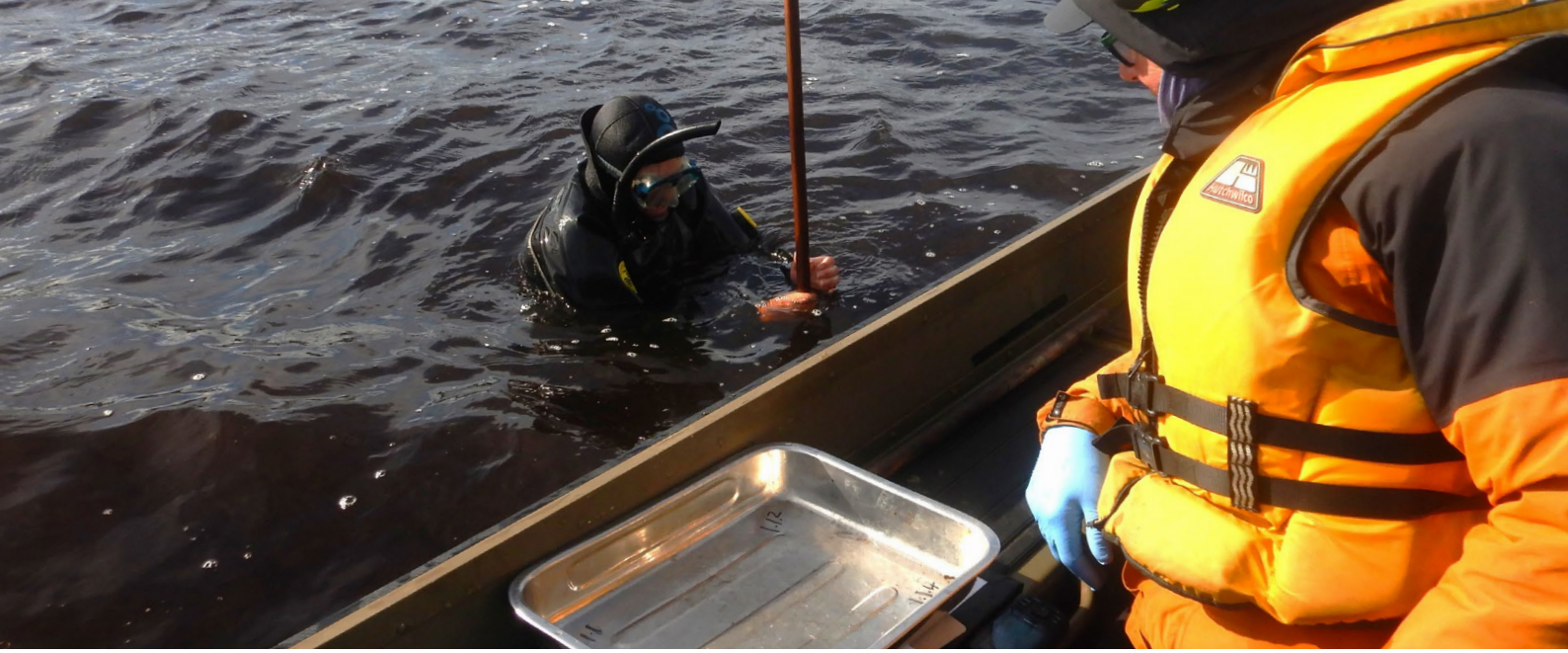
Catchment management

Agencies and the community aim to reduce sediment and nutrient inputs to Waituna Lagoon, focusing on strategies and initiatives for catchment management of contaminants, increasing biological processing of run-off and improving freshwater habitat. It is essential that these efforts meet the nutrient load reduction targets developed by the Lagoon Technical Group in 2013[6] to ensure the long-term persistence of *Ruppia* vegetation and safeguard the lagoon ecosystem. However, opening the lagoon to disrupt algal blooms provides a short-term solution for the ecological health of the lagoon.

[4] https://www.lawa.org.nz/explore-data/southland-region/lakes/waituna-lagoon/

[5] de Winton, M., Mouton, T. (2018) Technical Report on Vegetation Status in Waituna Lagoon: 2009–2018.

[6] Lagoon Technical Group (2013). Ecological Guidelines for Waituna Lagoon. *Report prepared for Environment Southland*.



What do we monitor?

Ruppia

Ruppia acts as an ecological sentinel in Waituna Lagoon, providing an early-warning system to detect deterioration. Department of Conservation oversee the monitoring of *Ruppia* and other aquatic plants and algae to determine status and trends in ecological health of the Lagoon. Monitoring supports specific resource consent conditions for lagoon opening, where opening avoids the spring to summer growth and reproduction phase for *Ruppia* although opening decisions at a lower water level may be acceptable where vegetation has been stable (key ecological targets met for a number of years), or where poor water clarity is likely to have an adverse ecological effect if the lagoon isn't opened and flushed.

Results of annual monitoring are compared with target conditions sought under the Ecological Guidelines[7] for Waituna Lagoon. Two additional targets were suggested by an analysis of all monitoring data in 2018[8]. These ecological targets are listed in Box 1.

Box 1: Ecological targets for *Ruppia* in Waituna Lagoon:

- Lagoon closed during *Ruppia* growing season (spring and summer).
- ➧30–60% for average % cover of *Ruppia* (and other native macrophytes[9]).
- <10% cover of benthic and epiphytic filamentous algae (macroalgae).
- ➧1000 average for *Ruppia* 'biomass index' (% cover x cm height).
- ≥40% of *Ruppia* samples in a flowering or post-flowering life-stage.
- ≥20% of the sites record *Ruppia megacarpa*.

[7] Lagoon Technical Group (2013). Ecological Guidelines for Waituna Lagoon. *Report prepared for Environment Southland*.

[8] de Winton, M., Mouton, T. (2018) Technical Report on Vegetation Status in Waituna Lagoon: 2009–2018.

[9] Other native macrophytes comprised <35% of all occurrence records for all surveys.

Monitoring methods

The lagoon is monitored each year in late summer at 47-48 sites (Figure 3a). At each site, an assessment of environmental quality includes depth and water quality measurements (Figure 3b). Substrate characteristics are measured in four samples of the lagoon bed retrieved using a garden hoe, and the composition and abundance of vegetation is also described, including *Ruppia* life-stage as flowering or vegetative. Submerged native plants and dominant macroalgae are shown in Figure 4.

Figure 3a: Map showing the location of sampling sites (47-48).

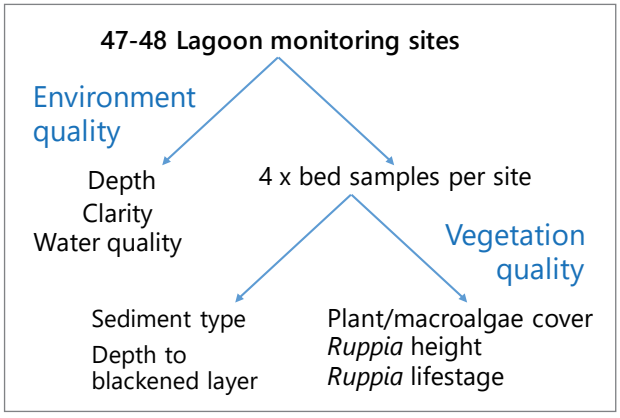


Figure 3b: Sampling design diagram.

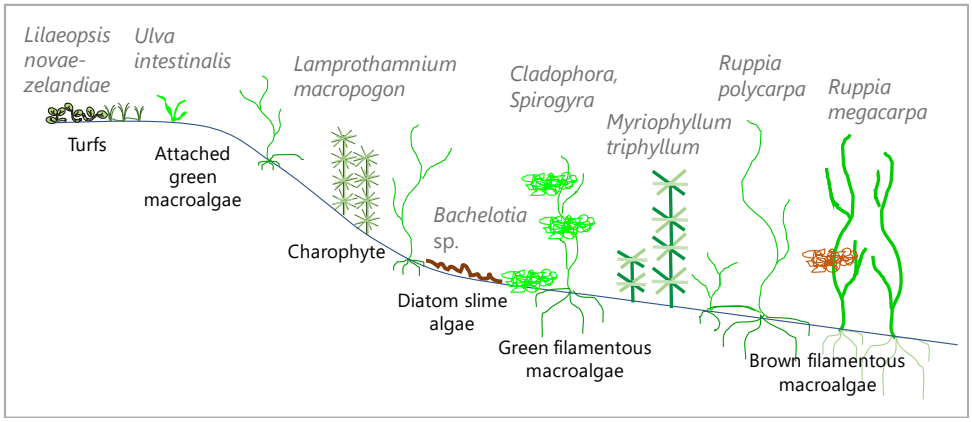


Figure 4: Common submerged plants and macroalgae types in Waituna Lagoon.

Did 2024 results achieve ecological targets for Waituna Lagoon?

The results of annual summer monitoring of the submerged vegetation in Waituna Lagoon are analysed and compared to the six ecological targets to track the health of the *Ruppia* community.

1. Lagoon closure

Target lagoon closure was not achieved in 2024, nor was it in 2021, 2020, 2017, 2014, 2013 and 2011.

A closed lagoon over spring and summer (defined as the three months before monitoring) is an ecological target that provides stable conditions for the *Ruppia* growing season (Box 1). Whether the lagoon is closed or open has a strong influence on conditions that affect plants, such as depth, salinity, and temperature.

In 2024, the lagoon closure target was not met (Table 1). Over summer 2024, the lagoon was opened to the sea by Environment Southland under emergency works powers, to disrupt a toxic algal bloom (cyanobacteria). This resulted in the lagoon remaining open for two months and it closed just 15 days before the *Ruppia* monitoring. Therefore, closed conditions were not achieved over the critical spring-summer growth period for *Ruppia* growth and reproduction (Table 1).

Table 1: Months that the lagoon has been closed (positive numbers) or open (negative numbers) prior to each monitoring event. Occasions that the target is met are shown as bold, in highlighted cells.

Year	Months closed before monitoring
2009	**4.7**
2010	**4.6**
2011	-5.6
2012	**4.6**
2013	-3.9
2014	-6.2
2015	**6.2**
2016	**3.2**
2017	1.0
2018	**13.7**
2019	**3.5**
2020	-4.1
2021	-4.8
2022	**4.5**
2023	**16.6**
2024	0.5

The target lagoon-wide *Ruppia* cover was not achieved in 2024, and previously has only been achieved in 2023, 2019 and 2016.

2. *Ruppia* cover

A healthy *Ruppia* community occupies a large habitat area in Waituna Lagoon. This is measured by calculating the percentage cover of *Ruppia* across all sites in the Lagoon. The ecological target is >30–60% cover for *Ruppia* across the whole lagoon (Box 1).

In 2024, lagoon-wide cover of *Ruppia* was only 2% (Table 2) and did not meet the ecological target. *Ruppia* was recorded at fewer than half of the monitoring sites and cover exceeded 30% at only one site. The occasions when the *Ruppia* cover target has been met are shown as bold, in highlighted cells in Table 2. The years 2016, 2019 and 2023 that met this target (Table 2, Figure 5) were the second of two consecutive years of lagoon closure during the critical spring-summer growth period for *Ruppia*.

Table 2: *Ruppia* measurements including % sites, average cover at sites and % sites where >30% cover, and overall averaged lagoon-wide cover. Occasions the target is met are shown as bold, in highlighted cells.

Year	% Sites where *Ruppia* present	Average cover (sites where present)	% Sites with >30% cover	Lagoon-wide average cover
2009	73	**33**	23	24
2010	52	**31**	21	16
2011	25	7	2	2
2012	60	14	8	9
2013	33	22	13	7
2014	19	16	2	3
2015	70	**29**	23	21
2016	87	**46**	53	**40**
2017	74	12	6	9
2018	100	26	12	26
2019	96	**37**	43	**36**
2020	68	8	4	5
2021	30	9	0	3
2022	72	19	19	13
2023	100	**52**	68	**52**
2024	40	6	2	2

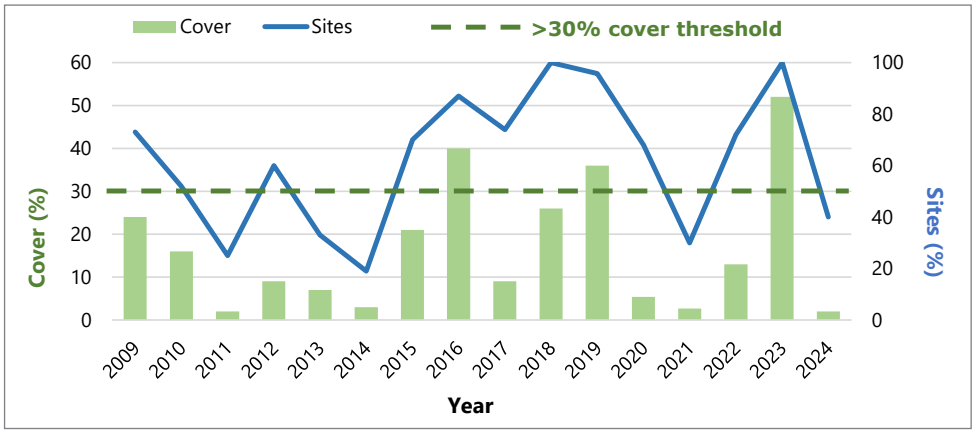


Figure 5: Lagoon-wide cover of *Ruppia* is shown as green bars and percentage of sites at which *Ruppia* was present as a blue line.

3. *Ruppia* biomass index

Target lagoon-wide *Ruppia* biomass index was not achieved in 2024. Previous years this target was met were 2015, 2016, 2018, 2019 and 2023.

Although *Ruppia* biomass is not sampled annually, a proxy for biomass can be derived by multiplying *Ruppia* cover by height as a 'biomass index'. In a healthy *Ruppia* community a biomass index >1000 is expected (Box 1). This might be visualised as a 10% cover of plants that are 100 cm tall or by a 100% cover of plants that are 10 cm tall, and other combinations.

In 2024, *Ruppia* biomass index over 1000 was not recorded at any of the sites and the lagoon-wide target was not achieved (Table 3). The biomass index averaged across the lagoon was one of the lowest values recorded (Table 3).

To date, the years where the target biomass index has been achieved are also those when the lagoon closure target has been met (Table 1). In addition, consecutive years of meeting the lagoon closure target have resulted in higher values in the second year (2015–2016, 2018–2019, 2022–2023).

Table 3: *Ruppia* presence at sites, number of sites where target biomass index was achieved and average biomass index calculated lagoon-wide. Occasions the target is met are shown as bold, in highlighted cells.

Year	% Sites where *Ruppia* present	% Sites with >1000 biomass index	Lagoon-wide average biomass index
2009	73	25	734
2010	52	21	899
2011	25	0	9
2012	60	4	177
2013	33	2	98
2014	19	2	114
2015	70	23	**1252**
2016	87	32	**1362**
2017	75	6	697
2018	100	19	**1324**
2019	96	45	**1872**
2020	68	4	199
2021	30	4	103
2022	72	4	462
2023	100	66	**4246**
2024	40	0	53

Limits for lagoon-wide macroalgae cover were met in 2024, and also from 2009 to 2012, 2014, 2018 and 2023.

4. Macroalgae cover

Nutrient enrichment of waterbodies may result in excessive macroalgae growth that smothers and shades *Ruppia* plants. One ecological target (Box 1) recognises that macroalgae on the lagoon bed (benthic), on plants (epiphytic) and floating mats should be no more than minor (<10% cover).

In 2024, the target for macroalgae cover was met (Table 4) and this year was one of the lowest values yet recorded. It is the second year in a row the target has been met, following four years (2019–2022) of high summer macroalgal development (Table 4, Figure 6). There is no pattern of high or low macroalgal development with the status of the lagoon closure target (Table 1).

Table 4: Percentage of sites recording macroalgae, their average cover, percentage of sites achieving <10% cover and average lagoon-wide cover. Occasions the target is met are shown as bold, in highlighted cells.

Year	% Sites where macroalgae present	Average % cover (sites where present)	Sites with >10% cover (%)	Lagoon-wide average cover (%)
2009	19	17	6	**3**
2010	8	29	6	**2**
2011	17	**3**	0	**<1**
2012	23	16	8	**4**
2013	27	52	19	14
2014	27	17	11	**4**
2015	89	50	70	45
2016	79	36	49	28
2017	64	27	26	17
2018	11	**2**	0	**<1**
2019	89	73	85	66
2020	79	31	32	25
2021	25	28	12	15
2022	85	63	66	54
2023	32	16	9	**5**
2024	13	**<1**	0	**<1**

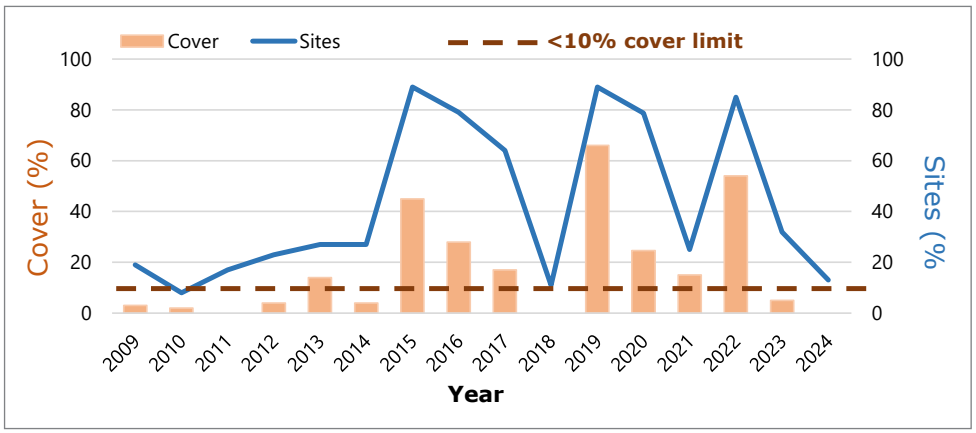
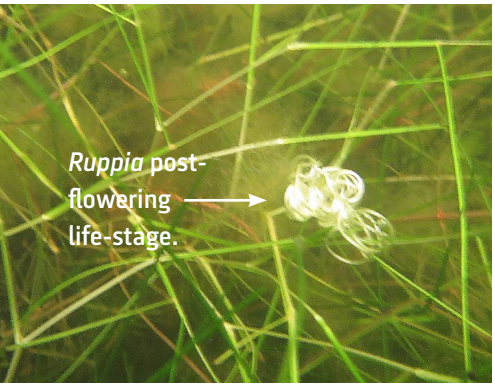


Figure 6: Lagoon-wide cover of macroalgae is shown as orange bars and percentage of sites at which macroalgae was present as a blue line.



5. *Ruppia* reproductive success

This ecological target focuses on the reproductive success of *Ruppia* and the likely replenishment of the seed bank which is vital for vegetation recovery after any major disturbance (e.g., extended lagoon opening). The target is ≥40% of *Ruppia* samples at sites in a flowering or post-flowering life-stage, to incorporate sites with both *Ruppia* species (*R. polycarpa* and *R. megacarpa*).

The reproductive success target was not achieved in 2024 (Table 5). All *Ruppia* plants that were surveyed were vegetative. This year follows the results in 2023 when a very high reproductive success was observed (Table 5).

Table 5: Percentage of sites recording reproductive success for *Ruppia* as either flowering or post-flowering status. Occasions the target is met are shown as bold, in highlighted cells.

Year	% Sites recording reproduction
2009	18
2010	32
2011	0
2012	**53**
2013	9
2014	10
2015	**59**
2016	**71**
2017	3
2018	**44**
2019	**46**
2020	6
2021	4
2022	30
2023	**94**
2024	0

The target for *Ruppia* reproductive success was not met in 2024, but was earlier met in 2012, 2015, 2016, 2018, 2019 and 2023.

6. Status of *Ruppia megacarpa*

Ruppia megacarpa is associated with taller, denser submerged vegetation in Waituna Lagoon. It acts as a strong 'ecosystem engineer', which subsequently supports the local environment that promotes further vegetation development. The target states ≥20% of the sites should record *R. megacarpa*. A threshold of 20% of sites is recommended because this represents known sampled areas that are favourable for this species[10].

Ruppia megacarpa was not recorded in 2024 and the target was not met (Table 6). This follows 2023 as the year *R. megacarpa* had the most widespread distribution recorded in the lagoon (Table 6).

The target for status of *Ruppia megacarpa* was not met in 2024 but was achieved in five of the previous six years.

Table 6: Percentage of sites recording *Ruppia megacarpa*. Occasions the target is met are shown as bold, in highlighted cells.

Year	% sites recording *Ruppia megacarpa*
2009	10
2010	**23**
2011	17
2012	2
2013	6
2014	0
2015	4
2016	9
2017	6
2018	**30**
2019	**32**
2020	**21**
2021	6
2022	**23**
2023	**38**
2024	0

[10] de Winton, M. (2019) Vegetation Status in Waituna Lagoon: Summer 2019. *NIWA Publication*.

Conclusions

Ecological targets in 2024

One ecological target was achieved in 2024, out of the six targets.

In 2024, just one of the six ecological targets was achieved (Table 7). This was the **macroalgae cover** target that reflected very low abundance of macroalgae, being within the acceptable limit for the lagoon.

Failure to achieve further targets reflected the poor ecological conditions apparent in the lagoon during the 2023/24 summer. A toxic algal bloom (cyanobacteria) saw the lagoon opened by Environment Southland under emergency powers with the aim of preventing imminent, severe ecological harm. The lagoon remained open for two months and at the time of monitoring, the lagoon had been closed for just 15 days. Therefore, the **Lagoon closure** target was not met (Table 7). Moreover, none of the four *Ruppia*-related targets were met (Table 7), suggesting conditions stemming from the bloom and/or the summer opening were detrimental to persistence of the submerged vegetation.

The toxic algal bloom delayed vegetation monitoring by c. 1 to 2 months due to health concerns, however, seasonality would not explain the low abundance of *Ruppia* in 2024. Earlier monitoring[11] established that *Ruppia* vegetation is perennial if lagoon conditions permit.

Table 7: Summary of 2024 results for all ecological targets.

Ecological target	Targets met?	Comment
Lagoon closure	✗	Lagoon was opened for two months over the summer *Ruppia* growing season.
Ruppia cover	✗	Lagoon-wide *Ruppia* cover did not meet the target (>30% cover).
Ruppia biomass index	✗	*Ruppia* biomass index did not meet the target (>1000).
Macroalgae cover	✓	Macroalgae development did not exceed the limit of 10% cover.
Ruppia reproductive success	✗	All *Ruppia* recorded was vegetative.
Status of *Ruppia megacarpa*	✗	No *Ruppia megacarpa* was recorded.

[11] de Winton, M., Mouton, T. 2018. Seasonal monitoring of submerged vegetation at Waituna Lagoon: 2014 to 2017. *NIWA Client Report* No: 2018284HN, prepared for Department of Conservation. 32 pp.

Ecological targets over all monitoring years

- Only one ecological target was met in 2024 (Table 8). Similar poor performance against targets (one or none achieved) has been recorded in six previous years (Table 8).
- These seven occasions when only one or no targets have been met (Table 8) were also those years that did not meet the lagoon closure target (closed for 3 months prior to summer monitoring).
- Higher numbers of targets (≥4) tended to be achieved in the second of consecutive closed lagoon years (Table 8).
- The target of macroalgae cover (limit of <10% cover) has not shown strong links to lagoon closure target (Table 8).

Table 8: Summary of results for six ecological targets over all monitoring years. Darker rows indicate greater numbers of targets were met.

Year	Lagoon closure	*Ruppia* cover	*Ruppia* biomass index	Macroalgae cover	*Ruppia* reproductive success	Status of *Ruppia megacarpa*	Targets met
2009	✓	✗	✗	✓	✗	✗	2
2010	✓	✗	✗	✓	✗	✓	3
2011	✗	✗	✗	✓	✗	✗	1
2012	✓	✗	✗	✓	✓	✗	3
2013	✗	✗	✗	✗	✗	✗	0
2014	✗	✗	✗	✓	✗	✗	1
2015	✓	✗	✓	✗	✓	✗	3
2016	✓	✓	✓	✗	✓	✗	4
2017	✗	✗	✗	✗	✗	✗	0
2018	✓	✗	✓	✓	✓	✓	5
2019	✓	✓	✓	✗	✓	✓	5
2020	✗	✗	✗	✗	✗	✓	1
2021	✗	✗	✗	✗	✗	✗	0
2022	✓	✗	✗	✗	✗	✓	2
2023	✓	✓	✓	✓	✓	✓	6
2024	✗	✗	✗	✓	✗	✗	1

Implications for lagoon health

- Widespread plant development across the lagoon plant diversity and successful reproduction according to identified targets indicate Waituna Lagoon's vegetation is in good ecological health.
- Ecological targets for Waituna Lagoon are not met when lagoon openings occur or extend over late spring to summer.
- Two or more consecutive years of openings during the main vegetation growth period should be avoided to ensure *Ruppia* can regenerate successfully.
- At least two consecutive years of a favourable closed lagoon over the main vegetation growth period enable higher *Ruppia* development.
- Ecological targets for lagoon-wide *Ruppia* cover and biomass index are likely to be met when *Ruppia megacarpa* is more prevalent, due to its ability to form tall, high cover beds.
- A 'super-fruiting' event for *Ruppia* in 2023 will have replenished the seed bank and will improve vegetation establishment potential.
- There are trade-offs between a stable closed lagoon for good *Ruppia* development and risk of nutrient build-up fuelling macroalgae and phytoplankton blooms.
- The need to address severe phytoplankton blooms by emergency openings should be a priority over the risk for *Ruppia*, as extended blooms are also likely to impact on vegetation.
- Drivers for phytoplankton blooms, as occurred in 2024, do not appear to be the same as for macroalgal blooms. Alternatively, macroalgae development is deleteriously impacted by phytoplankton blooms.

Related information

A deterioration in water quality was reported for Waituna Lagoon over mid-2023 to summer 2024[12]. Nutrient levels and phytoplankton pigments increased from June 2023, a cyanobacteria bloom (reaching record levels) developed from December 2023, and low water clarity resulting in restricted light penetration into the lagoon. These factors would represent stresses for submerged vegetation even before the lagoon was opened in summer. Therefore, we cannot determine if a vegetation decline preceded the lagoon opening or was subsequent, or both. Regardless, the large decline in *Ruppia* vegetation by summer 2024, directly after its substantial development in summer 2023, shows this ecological system remains unstable and vulnerable.

The artificial opening of the lagoon in 2024 was in the eastern sector for the first time during the 16 years of vegetation monitoring. Once the lagoon was open, the public warning for the toxic algal bloom was removed within 1.5 months and other water quality parameters were seen to improve. The lagoon closed after 2 months, 15 days before the vegetation monitoring.

Vegetation monitoring less than one month after the lagoon closed showed most of the remnant *Ruppia* vegetation in the south-west sector of the lagoon, away from the eastern lagoon opening site. When the lagoon has been opened at the previous south-west site, remnant vegetation has tended to persist at the eastern sector.

New seedlings of *Ruppia* were seen during monitoring. Vegetation recovery is expected to proceed from the seedbank following its replenishment by successful fruiting in 2023, under usual lagoon conditions. If the algal bloom had not been disrupted by a lagoon opening, poor conditions for *Ruppia* recovery would have continued through the summer and retarded germination.

[12] Monitored by Environment Southland.

Glossary

Term	Definition
Benthic	Relating to, or occurring at the bottom of a body of water.
Biomass index	An indicator of biomass for *Ruppia* species that is based on multiplying measured cover (%) by height (cm).
Catchment	The area of land bounded by watersheds draining into a basin.
Charophyte	A group of freshwater algae that superficially resemble higher submerged plants in that they are anchored to the substrate and have stems and whorls of 'branchlets'.
Ecosystem engineer	An organism that creates, significantly modifies, maintains or destroys a habitat.
Ecosystem health	A way to describe the state of a system relative to a desired management target or reference condition.
Epiphytic	Living on the surface of plants.
Life-stage	Stages in form and function through which an organism passes during its lifespan that include reproductive status.
Macroalgae	Collective term used for seaweeds and other benthic marine or freshwater algae that are generally visible to the naked eye.
Resource consent	Official permission to carry out an operation that has an environmental impact.
Run-off	The draining away of water (or substances carried in it) from the surface of an area of land.
Submerged vegetation	Plants that grow entirely beneath the surface of the water, except for flowering parts in some species, including charophytes but excluding macroalgae.

Referral links

- Awarua-Waituna Wetlands: (doc.govt.nz)
- Land, Air, Water Aotearoa (LAWA) – Waituna Lagoon at Lagoon Centre
- Waituna Lagoon • Living Water
- Home – Whakamana te Waituna