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THE DISTRIBUTION OF WATER NET (*Hydrodictyon reticulatum*) IN NEW ZEALAND AND CONTROL OPTIONS

(A report to the Water Net Technical Committee)

by

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NIWA Ecosystems

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NIWA Ecosystems Publication No. 5

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Cataloguing-in-publication

Wells, R.D.S.
The distribution of water net (*Hydrodictyon reticulatum*) in New Zealand and control options. (A report to the Water Net Technical Committee)/ by R.D.S Wells and J.S. Clayton - Hamilton (NZ): NIWA Ecosystems, 1993.
(NIWA Ecosystems publication; 5)
ISSN 1772-3726
ISBN 0-478-08318-1

I Title, II Series, III Clayton, J.S., IV National Institute of Water and Atmospheric Research, V NIWA Ecosystems.

The NIWA Ecosystems publication series supersedes the Water Quality Centre publications.
Available from: NIWA Ecosystems Library
P.O. Box 11-115
HAMILTON, NEW ZEALAND
Phone: +64 - 07 - 856 7026

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1.0 DISTRIBUTION OF WATER NET IN NEW ZEALAND

1.1 Summary

Since winter 1991, the main changes in water net distribution have been its spread further into the Waikato Region, to Orakeikorako and the Whirinaki Arm of Lake Ohakuri and to two localities which drain into Lake Karapiro. Water net has disappeared from the upper Matata Lagoon and Kinloch Marina following habitat disturbance.

1.2 Introduction

Since water net was first found in 1986 at Welcome Bay, Tauranga it has since spread through much of the Bay of Plenty Region and to parts of the Waikato Region. The introduction, distribution and spread of water net prior to 1991 was documented in Hawes *et al.* (1991). This report updates the changes in distribution of water net since then.

1.3 Details of Distribution (Summer 1992/3)

The current distribution is shown in Map 1.

Welcome Bay
Water net was not present in the Ohauiti Road stream where it was first reported naturalised in New Zealand (Coffey and Miller 1988). It was present nearby, with healthy dense growths in ornamental plant, culture tanks and on concrete paths where water seeps from tanks, at Kingfisheries. No water net has been found north of this site.

Lower Kaituna and environs
Water net grew prolifically in a series of waterways draining into the lower Kaituna River (Bell Road drains, Kopuroa Canal, Raparapahoe Canal and 100 m up the lower Waiari Stream) and on the margins of the Kaituna River from a short distance above the Waiari Stream confluence to near the estuary, but not in areas influenced by salt water.

Pukehina Canal
Water net was present in small quantities in the Pukehina Canal and in the Pongakawa Canal near where the Pukehina Canal enters it.

Waitahanui Stream
Water net grew in the lower reaches of this stream, amongst marginal plants where it was protected from the current. It was not present in other streams in the area.

Matata Lagoon

Only a few colonies of water net were found in the upper lagoon. Water net may have been affected by earthworks to the outlet of the lagoon, which lowered the water level c. 400 mm to c. 200 mm deep (summer levels) prior to January 1993. Water net was still abundant in the stream that enters the lower lagoon and in the shallows of the lower lagoon. East of Matata, water net was present in several water ways of the Te Teko Ecological District (Map 1).

Rangitaiki River

In Lake Aniwhenua, water net grew abundantly in lagoons at the head of the lake and along margins of the lake associated with *Elodea.* Surplus water net drifted with the flow of water through the lake and collected against the boom in front of the dam. There it accumulated to form a large (c. 8 ha) floating mat in summer (1992/3) against the dam, as it had during the previous two summers.

In Lake Matahina (the next hydro-lake down from L. Aniwhenua) water net has not been found, contrary to the note in Hawes *et al.* (1991) based on a pers. comm. from Dr B.T. Coffey. This was subsequently confirmed to be an error (Dr B.T. Coffey pers. comm.).

Rotorua District

Water net has been abundant during warmer months in Lake Rotorua since 1989, particularly in sheltered bays along the southern shores. It has not been found in Hamurana Springs since January 1989. It was abundant in a stream and pool at the Amorangi museum, Hannahs Bay.

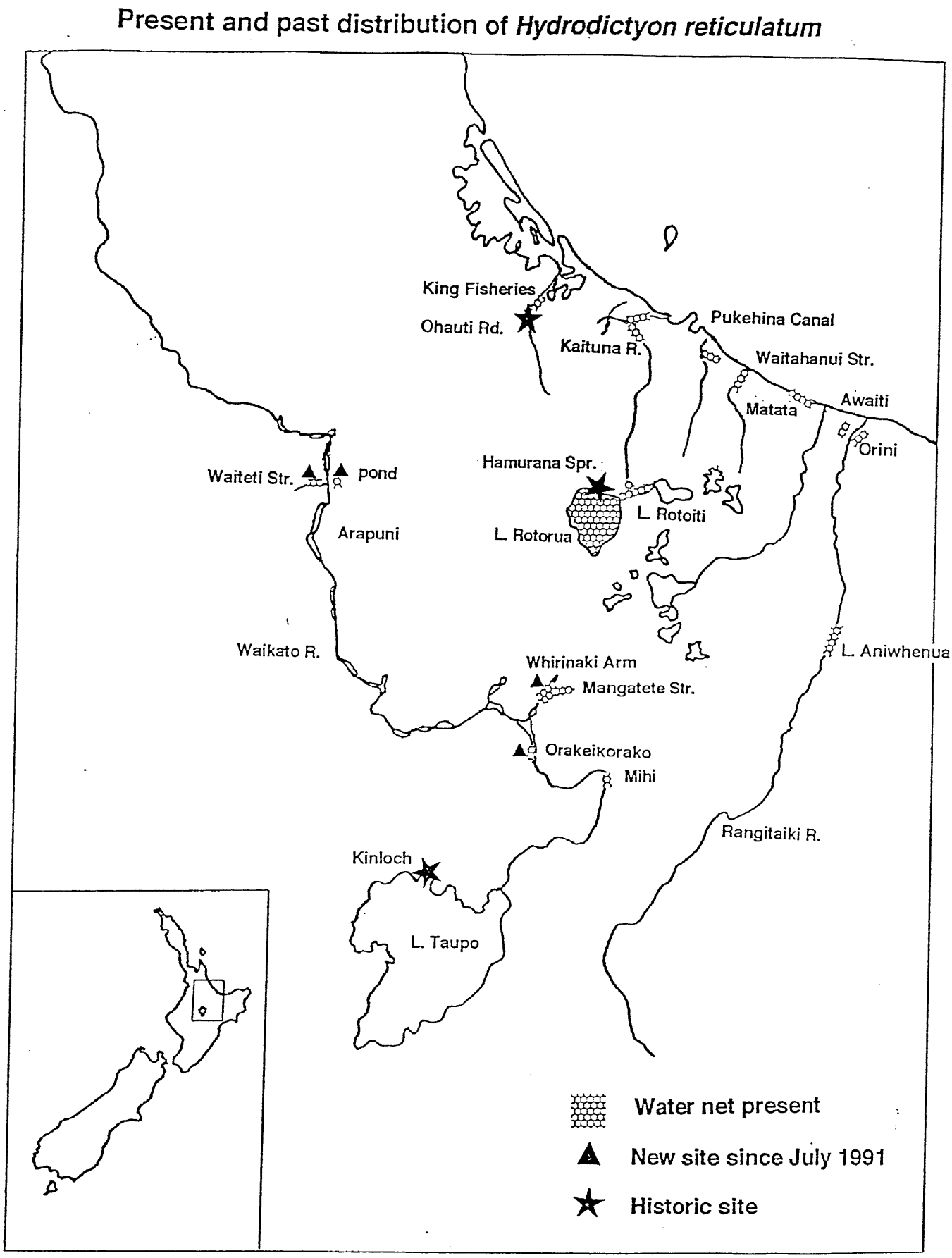
In Lake Rotoiti it was abundant in the Okere Arm and in Okawa Bay and was present, though not as abundant as it has been in previous yeas in Te Weta Bay. It was found in small quantities at Otara Marae, but has not been seen in the eastern sector of the lake.

No water net has been found in Lake Tarawera since December 1990 when a small amount was found at the boat ramp near Kariri Pt just after a boat with much attached water net had been launched. Lake Tarawera is therefore now considered not to have supported water net. Water net was not found in any other lakes in the Rotorua area.

Waikato Region

Water net was not present in the Kinloch Marina (January 1993) and has not been reported since the marina was drained and sediment removed, even though it has been refilled. No water net was found in Lake Taupo, in January 1993, despite linspections of numerous likely localities around the lake.

Water net has not established in Lake Aratiatia since a small fragment was found on the power station screens in 1991. It was abundant in two wetlands associated with the Waikato River just upstream of Mihi Bridge and was found at Orakeikorako (January 1993) in thermal inflows. The Whirinaki Arm of Lake Ohakuri had large quantities of water net in its upper reaches and it was first noted in summer 1991/92. It was also present in some streams (especially the Mangatete) which flow into the Whirinaki Arm. No water net was found in surveys of the other hydro lakes on the Waikato River but it was found in a spring fed pond near the Waikato River just north of the Arapuni Dam and close by in the lower reaches of the Waiteti Stream for 0.5 km or more from the mouth of the stream inflow to the Waikato River.



Map 1. Water net present and past distribution in New Zealand to March 1993.

2.0 EVALUATION OF BARLEY STRAW FOR WATER NET CONTROL IN THE MATATA LAGOON

2.1 Summary

The results indicated that barley straw had an inhibitory effect on growth of water net as water net did not form nuisance growths near the bales yet nuisance growths were present elsewhere in the lagoon and at the same site during the previous summer when barley straw was not present. The results of this trial were however, inconclusive as it was a one off observation and the bioassay technique proved unsatisfactory in the lagoon environment.

2.2 Introduction

In the United Kingdom barley straw has been reported to inhibit growth of both planktonic and filamentous algal species in laboratory trials (Gibson *et al.* 1990) and in natural waterways (Welch *et al.* 1990). Barley straw, at rates of 5 g (or less) to 100 g m^{-3}, produced a short lived algal growth inhibitor (factor X) from about one month after being added to water, for about 6 months (Welch *et al.* 1990).

If barley straw was effective in controlling water net (*Hydrodictyon reticualtum)*, under New Zeland field conditions then it would be potentially one of the best control options available because of:

1. its availability and price;
2. the lack of obvious signs of adverse effects on the environment (no fish or macrophyte toxicity has been observed);
3. the inhibitory effect could be long lasting (c. 6 months) suggesting one treatment could give one seasons control.

In 1991 BoP Regional Council, DoC and locals decided to add barley straw to the Matata Lagoon in the hope that it might avert a recurrence of the extensive water net infestation that had occurred during the previous summer. While the site was difficult from an experimental point of view (being without an adequate control) the opportunity was taken to monitor the effects of barley straw additions to the lagoon.

2.3 Site description

Matata Lagoon is located west of Whakatane, near the Tarawera River on the East Coast of the North Island, New Zealand. The lagoon is a wildlife refuge, but during the 1990/91 summer large mats of water net, particularly at the western end, were of concern to DoC managers. The lagoon (Map 2) is about 800 m long and between 150 and 200 m wide. It had a surface area of about 11.6 ha and an average depth of 0.85 m deep (24 July gauging) except near the margins. Its volume was calculated to be c. 98,000 m^3. The only surface inflow to the lagoon was the Awatarariki Stream (0.0413 m^3 sec^{-1}, 24 July 1991) which entered at the western end after dividing several times and filtering through a dense band of marginal aquatic species dominated by raupo (*Typha orientalis*). The outflow stream was also gauged at the same time and had a flow of 0.0317 m^3 sec^{-1}. During this period, evapo-transpiration would have had a minimal effect, so the net loss of c. 25% was probably due to seepage through the sand dunes. The retention time of the lagoon was also calculated to be about 27 days and if there was an even flow through the lagoon, then water movement would have been about 1.2 m hr^{-1}.

By summer (December 1991) the depth of the lagoon had dropped to 0.4 m deep (about half its winter depth), and therefore it contained about half its winter volume. In early summer 1992 / 93 the outflow of the lagoon was modified causing the level in the lagoon to drop to about 0.2 m depth.

Matata Lagoon was inspected by boat and SCUBA in winter (24.7.91). Submerged macrophytes in the lagoon included *Chara globularis, Ruppia* sp. and *Potamageton crispus*. Water net was found (over wintering) in a few patches (Map 2A) either on the lagoon sediment or with *Chara globularis*. No water net was found elsewhere in the lagoon.

Surface floating mats of water net were noted during the previous summer (March 1991) at the western end of the lagoon where *Potamogeton* and *Ruppia* were abundant. Growths of water net are often associated with tall growing macrophytes in New Zealand and a repeated infestation was expected at this site during the following summer.

2.4 Methods

Sixty bales of barley straw, each about 16 kg fresh weight, (80% dry matter) were added to the western end of the lagoon, in August 1991, where *Potamogeton* and *Ruppia* were abundant. They were contained in anchored gabion baskets with three bales per basket (Plate 1). This treatment gave a calculated addition for the whole lagoon of 7.8 g d.wt. barley straw m^{-3} (winter volume) or c. 15 g m^{-3} (summer volume). The bales were concentrated at the

western end of the lagoon near the inflow (Plate 2), rather than spreading them evenly throughout the lagoon, to optimise the chances of an effect at the western end of the lagoon and to create a gradient of inhibition with distance from the bales.

The distribution and abundance of water net in the lagoon was monitored periodically by subjectively assessing its % cover from a boat and recording its distribution on sketch maps. In addition, the distribution of water net was described in late summer from observations made using SCUBA, and water net biomass was estimated by collecting five quadrats (each 0.3 m^2) from the site of densest occurrence and five quadrats from near the bales.

Attempts were also made to compare the growth rate of water net at locations near the bales and sites some distance from the bales, to quantify the degree of inhibition (if any) of decomposing barley straw on water net growth. Fifty grams wet weight of free drained water net was added to culture bags (0.4 x 0.3 m) of fine (500 micron) Nybolt fabric (nylon and polyester weave), which allow >90% light transmission. Five culture bags were attached to the bales and five were placed in a line from the bales, to the Awatarariki Stream (inflow) and cultured for 10 days.

In a parallel study by the Taupo Research Laboratory water was collected from the Awatarariki Stream, from the area near the bales, and from the outflow of the lagoon, for comparison in a bioassay using water net to test for barley straw inhibitory effects (Hawes and Smith 1992).

The barley straw was removed from the lagoon in September 1992.

2.5 Results

Water net increased in abundance and area within Matata Lagoon as water temperatures rose from October 1991 to February 1992. However, water net did not form high covers near the barley straw at any time during the 1991/92 summer reaching a maximum of about 5% only. The small amounts of water net present were confined to diffuse growths, near the surface, amongst the *Ruppia* sp. and *Potamogeton crispus*. It was entangled with macrophytes and quantities were too small to be sampled. However, 200 m south-east of the bales, water net densely covered about 2 ha, filling the water column from the water surface to the lagoon sediment. Over an area of about 0.1 ha there was a dense surface mat with 100% cover, and samples of water net from five quadrats ranged from 141-184 g m^{-2} d.wt., with an average of 163 g m^{-2}. During the following summer (1992 / 93) after removal of the barley straw in September 1992, water net was present only in small amounts in the shallows on the north side of the lagoon.

The culture bags became covered in thick silt and periphyton and water net did not grow in any of them.

The bioassays conducted in the Taupo Laboratory showed no differences in water net growth in water collected from near the bales compared with elsewhere in the lagoon (Hawes & Smith 1992).

2.6 Discussion

If water net had grown abundantly in the west end of Matata Lagoon, as it had the year before, then it would have been concluded that the barley straw was not inhibiting the growth of water net. However, even though little water net was found in the vicinity of the bales, it cannot be concluded that this was caused by the barley straw as the trial was not replicated with a control treatment. The straw was likely to have controlled water net growth near the bales, but did not produce sufficient inhibitory effect to prevent abundant growth elsewhere in the lagoon. However, if the inhibiting factor is short lived in the water as suggested by Welch *et al.* (1990) then this would have accounted for inhibition being restricted to near the bales due to the slow water movement in the lagoon.

The lack of water net growth in the Nybolt bags was not surprising considering the large silt and periphyton deposits on the mesh. In clean water (at Ruakura) the bags had proven to be a suitable enclosure method as they remained clean and continued to absorbed less than 5% of the light passing through to the water net during the culture period. In Matata Lagoon, (and also in another test in Lake Rotorua) the bags became covered in periphyton and silt and this severely reduced light levels for water net growth rendering the method inappropriate for field trials.

Inhibition of water net growth in the bioassay of water samples collected from near the bales compared with samples from elsewhere in the lagoon (where water net was abundant) would have confirmed that there was an inhibitory effect. The observed lack of inhibition, however is considered inconclusive because of the likelihood that the inhibitory factor may be short lived (Welch *et al.* 1990). The time between collection and testing (and duration of the tests) could have reduced any inhibitory effect that might have existed to ineffective levels.

The barley straw attracted large numbers of snails (*Potamopyrgus*) and eels which burrowed into the bales. Such observations support reports from the U.K. where no negative environmental impacts have been observed and where the presence of straw is suggested to increase productivity of invertebrates and therefore benefit fisheries.