

Cone Production in *Equisetum arvense*

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Equisetum arvense L., the field horsetail, is an invasive and persistent weed introduced from the northern hemisphere. It grows by means of perennial underground rhizomes which spread widely and produce, each spring, aerial shoots that may either be strictly vegetative or terminate in reproductive cones (strobili). Vigorous growth of the rhizome in suitable habitats leads to rapid colonisation. Once established, the field horsetail is difficult to exterminate and, quite rightly, it is regarded by the man of the soil as a dangerous weed. However, horsetails are of considerable academic interest to botanists since they belong to a systematically isolated group of ancient lineage, and the curious absence of native species in Australasia has been lamented by John Lovis (1980) "as a positive hindrance in the teaching of systematic botany here in New Zealand". The occurrence of *E. arvense* as an adventive species in New Zealand thus provides a welcome source of material for the teacher, although the production of cones is often inconveniently erratic or even non-existent.

In view of *Equisetum*'s reputation in Europe as a serious weed, it comes as something of a surprise to discover that it was probably first introduced to New Zealand by no less a person than Leonard Cockayne. Annotated summaries of Cockayne's letters recently published by A. D. Thomson (1979) indicate that by April 1900 he had acquired four species of *Equisetum* from Karl Goebel in Munich and was growing them in his garden at New Brighton. By January 1901, however, he was regretting his choice of plants, noting in a letter to Goebel that "... at one time, it looked as if I should have to abandon Botany for ever and spend the rest of my life in a struggle with these diabolical plants. One piece dived under a brick wall and then recommenced to ascend a sand dune". In October he admitted defeat, stating "... I am reluctantly compelled to destroy the lot ... they would become a nuisance in my lifetime and I should be hanged ...". Unfortunately Cockayne's diligence in digging out his errant plants before they became firmly established did not prevent their subsequent reintroduction from overseas.

The field horsetail was subsequently recorded in New Zealand by E. H. Atkinson (1922), based on a collection from the Esplanade, Wanganui, by J. McGregor who considered that it had been introduced with iris roots from Japan. Since then it has been found in a number of other localities (Brownsey 1981). In Wanganui, it has been almost eliminated from its original site (Campbell 1971) but it is now well established at Virginia Lake Reserve. Independent introductions almost certainly account for the localised colonies of *E. arvense* reported from gardens and river banks in Havelock North, Dunedin and several places in Christchurch, although Lovis (1980) advises that it is "apparently currently extinct" in the latter area to the great relief of local gardeners.

More serious are populations established in isolated rural areas where the plant has been able to spread extensively before being recognised by itinerant botanists or worried landowners. Such populations, some of them now beyond control, occur along the Rangitikei River in the Manawatu, in the Mokihinui, Matiri, and Matakītaki River valleys in Nelson, and in the Woodside Creek and Awatere River valleys in Marlborough.

Since horsetails feature prominently in most University botany courses, the late Professor H. B. Kirk obtained material for Victoria University from Wanganui and grew it with appropriate precaution, in a tin, set in concrete, outside the building that now bears his name. Some time afterwards, disturbances to this enclosure allowed the plants to escape and they became established along the southern side of the building where they have persisted to this day, in spite of being covered periodically by bitumen. However, these plants have not borne cones for at least the last 25 years and teaching material has had to be obtained from elsewhere, often with great difficulty. Hence, it was with some elation that Barry Sneddon, currently teaching pteridophyte taxonomy, learned of a new, fertile *Equisetum* population on the banks of the Rangitikei River, chanced upon by Tom Moss in January 1978. Further trips to the site were made by the present authors on 11 February, 2 October and 2 December 1982.

Equisetum arvense is not mentioned by Alan Esler (1978) in his *Botany of the Manawatu* except in relation to the material on nursery land in Palmerston North reported by Ella Campbell (1971). However, the population near the Rangitikei River mouth is a large one, extending for several kilometres either side of the boat launching ramp at Tangimoana (NZMS1 N148 765437), and may well occur over a considerable length of the river. *Equisetum arvense* grows most abundantly in soft damp silt where the river banks slope gently into the water, the level of which, in this locality, is somewhat influenced by the tides. Horsetails extend from a point where they are submerged in some 30 cm of water at high tide, to about 30 m away from the river bank. They dominate the vegetation in a 3-4 m wide strip bordering the river but in the progressively drier and harder ground beyond they are gradually overwhelmed by introduced clovers, thistles and grasses. At our visits in February and October abundant fertile shoots bearing cones in all stages of development were found (Fig. 1), the vast majority on plants growing either close to or actually submerged in the river (Fig. 2). Vegetative shoots, which grow to about 45 cm tall, were the only shoots observed on drier ground.

Distinctive features of this population, not previously observed in New Zealand plants of *E. arvense*, are the occurrence of cones in mid-summer as well as in early spring, and the presence of whorls of branches as well as terminal cones on the fertile shoots produced in summer (Fig. 1). In the northern hemisphere this species occurs circumboreally, extending as far south as China and northern India. In early spring, it characteristically produces a flush of unbranched fertile shoots bearing terminal cones, and only later develops vegetative shoots which bear whorls of branches and which continue to arise for the rest of the growing season. However, in his monograph of northern hemisphere



Fig. 1. Fertile shoots of *Equisetum arvense* growing on the banks of the Rangitikei River near Tangimoana. *Left*, Unbranched spring shoots with stout stems and large cones (October, 1982); *Right*, Summer shoot with slender stem bearing whorls of branches and a small terminal cone (December, 1982); sterile vegetative shoots with several whorls of branches are visible in the background. Photos: B. V. Sneddon.

E. arvense, Hauke (1967) reported that he had encountered some specimens with branching fertile shoots. Moreover, these were mostly collected in the summer months of June, July and August. Every stage from fertile stems with few branches, to fertile stems with many whorls of branches was found, and branching appeared to be more common northwards. In the past, several different specific names have been applied to these forms but Hauke concluded that "there was no reason to consider them taxonomically anything but *E. arvense*".

Apart from the Rangitikei population, we have seen five other New Zealand collections of fertile material (see appendix). Three are from Wanganui and one each from the Awatere and Mokihinui Rivers. All were collected in September and all show only unbranched fertile shoots. It would seem, therefore, that antipodean plants, like those of the northern hemisphere, normally produce unbranched fertile shoots in early spring, but that occasional populations can give rise to branching fertile shoots later in the year, from early December to the end of February.

The factors governing the initiation of cones in *E. arvense* have not yet been determined. Hauke (1967) states categorically "the physiology of fruiting is not understood". He noted that not all stands in the wild formed cones, that in cultivation some clones fruit more readily than others, and that some clones regularly develop late-fruiting stems. This might suggest some genetic diversity, although environmental differences could also upset the hormonal control of fruiting. Hauke pointed

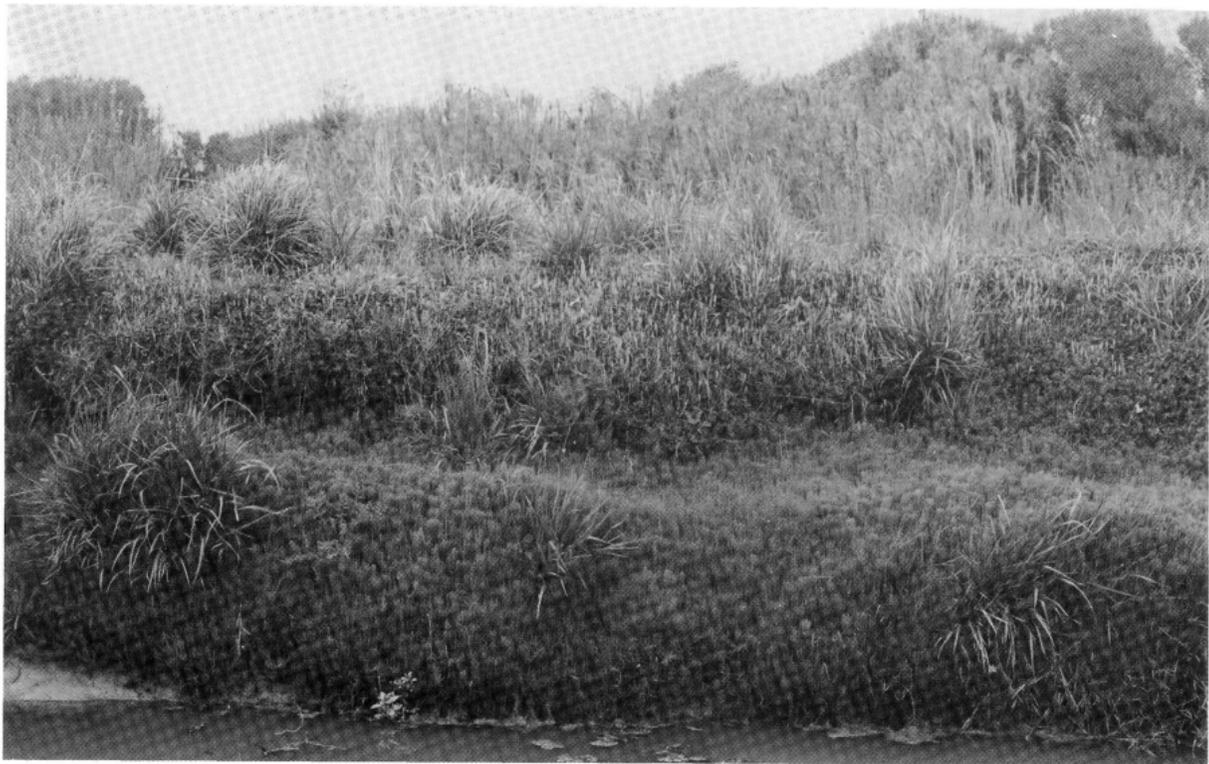


Fig. 2. A bank of the Rangitikei River densely covered by horsetails (October, 1982).

Photo: B. V. Sneddon.

out that the influence of frost could be correlated with the observed increase in late-fruiting in more northerly populations. He also suggested that the plants might need to attain a certain age before coning.

Ella Campbell (1971) reported in an issue of this Bulletin that glasshouse plants of *E. arvense* at Massey University, which had been allowed to dry out during a hot summer, had produced cones in May and June shortly after watering had been resumed. She suggested that heat and drought in summer promoted cone production in the following growth season whereas plants kept under cooler moister conditions remained sterile. However, our observations on the Rangitikei population do not support this idea, at least in so far as drought is concerned. Cones were most numerous in the wettest part of the plant's habitat — i.e. a short distance either side of high tide level. No evidence of coning was found more than a few metres away from the water's edge. If cones were produced in response to heat and dryness one would expect to find them on plants growing away from the river on higher ground which must dry out severely during summer. The puzzling feature of Campbell's observations is that cones should have been produced in May and June at the beginning of winter, more especially as the fertile shoots illustrated by her are of the unbranched type normally associated with spring growth. It may be, quite simply, that they were "spring" shoots appearing unusually early in response to the warmer conditions of a glasshouse. Care is therefore needed in comparing these observations from cultivated material with those from wild plants.

The occurrence of a large population of *E. arvense* relatively close to Wellington provides a good opportunity for further observations to be made on coning behaviour in this species. It would be informative to know whether spring and summer cones are both produced every year or whether the coning season is influenced by environmental factors. Regular observations on the population at appropriate times over a number of years would certainly provide some interesting results.

ACKNOWLEDGMENTS

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APPENDIX

List of herbarium specimens bearing fertile shoots of *Equisetum arvense*:

Wanganui, 24.9.1922, J. McGregor (AK 110803), -9.1925, F. J. Walker (WELT P3888); Wanganui, Virginia Lake Reserve, 2.9.1977, I. McNeur (CHR 312720); Manawatu, Rangitikei River, Tangimoana, -1.1978, T. C. Moss (WELT P10246), 11.2.1982, 2.12.1982, P. J. Brownsey (WELT P11076 & P11744), 2.10.1982, B. V. Sneddon (WELT P11722); Marlborough, Awatere River, Altimarlock Station, 8.9.1971, K. J. Warren & V. C. Laird (CHR 196969); Nelson, Mokihinui River (South branch), 15.9.1976, G. Park (CHR 287119).

Some Advice from the Past

A. P. Druce, Wellington

William Fox 1843: "Each person also had a blanket sewed into a bag into which he crept for the night, and with one or two more loose ones to wrap around, makes a very comfortable bed. Some changes of linen, a spare pair of shoes, and soap brushes etc should be taken. Razors are unnecessary. The dress used should be chiefly woollen or flannel; trousers should be of canvas, or moleskin to prevent their tearing to shreds in the bush."¹

William Colenso 1883: "And here I may be permitted briefly to mention, for the especial benefit of my lady and young hearers, and also of strangers (if any) who have not yet realised the great advantages of diving into the depths of our New Zealand forests, — that to see our ferns in all their natural beauty, they should be visited in their cool sequestered retreats and bowers and grotts."²

R. I. Kingsley 1893: "We carried our tents and provisions ourselves without the aid of a horse, and could therefore stop where and when we chose. For real enjoyment and effective work this method, although somewhat laborious, has many advantages over the customary trap or pack-horse."³

1 Journal of an expedition to Wiararapa (sic). Original MS held in Hocken Library Dunedin.

2 *Trans. N.Z. Inst.* 15: 311-20.

3 *Trans. N.Z. Inst.* 25: 304-5.