

# The effectiveness of a sickle-leaved hare's-ear *Bupleurum falcatum* subsp. *falcatum* propagation and introduction programme at Norton Heath roadside verge, Essex, England

Alan Roscoe<sup>1</sup> \*, Tim Gardiner<sup>2</sup> & Zoë Ringwood<sup>3</sup>

<sup>1</sup>Writtle College, School of Sustainable Environments, Lordship Road, Writtle, Chelmsford, Essex CM1 3RR, UK

<sup>2</sup>Beech Road, Rivenhall, Witham, Essex CM8 3PF, UK

<sup>3</sup>Natural England, Harbour House, Hythe Quay, Colchester, Essex CO2 8JF, UK

\* corresponding author e-mail: [alan.roscoe@writtle.ac.uk](mailto:alan.roscoe@writtle.ac.uk)

## SUMMARY

Sickle-leaved hare's-ear *Bupleurum falcatum* subsp. *falcatum* is an umbellifer that has a very limited distribution (currently one native locality) in the UK. Seeds (1,200) were collected from the single wild population in Essex (southeast England) and propagated using conventional techniques over the winter of 2007/08. A high proportion germinated (859; 71%) but 93% of the seedlings subsequently died in the spring and summer of 2008. The 57 young plants that survived were planted out at the donor site in January 2009, established well (all but one alive in July 2009) and competed strongly with other species already present. All grew well, all flowered and some produced seed. Growth was similar to that of plants in the nearby established colony.

## BACKGROUND

In the 19<sup>th</sup> century sickle-leaved hare's-ear *Bupleurum falcatum* (L.) subsp. *falcatum* was widely distributed in grassland between Chelmsford and Ongar in the county of Essex, southeast England (Adams 2001). The species, a biennial to short-lived perennial umbellifer (Adams 2001), has since drastically declined in this, its core area of distribution in the UK, and has been extirpated from all former known localities. In the UK the species is now listed as a Red Data Book species (Wigginton 1999) and receives legal protection under Schedule 8 of the Wildlife and Countryside Act 1981.

Sickle-leaved hare's-ear was first recorded at Norton Heath in central Essex in 1831 (Adams 1999) and post-1847 records provided by the Botanical Society of the British Isles confirm presence in the wild at various times in Surrey (vice-county 17), south Essex (vc18), north Essex (vc19), Glamorganshire (vc41), Cheshire (vc58) and mid-west Yorkshire

(vc64). In 1997 however, Stace noted the presence of the species at only one location in the UK (in Essex), this presumably corresponding to the current population at Norton Heath (Ordnance Survey grid ref: TL611045).

The Norton Heath site is a linear roadside strip running east-west, approximately 20 m wide x 170 m long. *B. falcatum* currently occupies a small sparsely vegetated mound of calcareous substrate (Gardiner & Vaughan 2009) at the eastern end of the strip. The site is fenced to protect against grazing by rabbits *Oryctolagus cuniculus* and is bounded by a grass verge on one side (along the roadside edge) and by scrub on the other. The site is undulating and surrounding land is predominantly arable.

It is believed the entire original population at Norton Heath was destroyed by hedge cutting and a subsequent brash fire in 1962 although, prior to this event, seed had been taken from the site and small 'backstop' collections

established in a private garden and at Cambridge University Botanic Garden (Adams 1999). The existing population was established in 1988 from seed derived from these collections (Ken Adams, *pers. comm.*). A total of 152 plants were recorded in July 2008, all of which were flowering. Based on numbers observed in previous years, the population appeared to be stable. However, due to its very small population size, it was considered pertinent to undertake measures to bolster numbers.

This study aimed to demonstrate whether the species could be propagated from seed using conventional techniques, grown on, and subsequently if young plants could be successfully transplanted into the wild.

### ACTION

On 2 October 2007, 1,200 ripe seeds were collected under Natural England licence from the Norton Heath site. The following day each seed was placed into its own growing cell in a modular seed-raising tray (4 cm deep with a root trainer). The growing medium used was Terra Eco Systems® multipurpose peat-free compost (made of recycled materials including composted biosolids and green waste) with a top layer of Sinclair® vermiculite.

The trays were kept outside in a half-shaded south facing location and were watered as and when they became dry. In May 2008, all seedlings were moved to larger growing-on pots (10 cm x 10 cm x 11 cm deep). The growing medium was again Terra Eco Systems® multipurpose compost, with Osmocote® slow-release fertiliser pellets added. The plants were kept outdoors in a rabbit protected polytunnel and watered as and when necessary.

A 3 x 3m control plot (encompassing an area with established *Bupleurum*) was identified (Plot 1) – its purpose was to provide a height comparison with the newly-established plants.

On 21 January 2009, all surviving plants were planted in a grid at intervals of 30 cm into a 3 x 3 m area (Plot 2) five metres from Plot 1 (Fig. 1). The ground which had only sparse vegetative cover (approx 10% cover) was not pre-prepared for planting in any way.



**Figure 1.** Planting out sickle-leaved hare's-ear, Plot 2, Norton Heath, 21 January 2009.

The establishment rate and growth of 20 randomly selected plants was monitored on a monthly basis between February and July 2009. On the final recording date, height measurements for 20 random plants in Plot 1 were also taken.

Soil samples from Norton Heath (adjacent to where established *B.falcatum* was present) were taken with an augur (22 cm depth) on 1 September 2008 and analysed for key nutrients and pH. The compost used for propagation was similarly analysed.

### CONSEQUENCES

#### **Germination and initial seedling survival:**

As at 26 March 2008 a total of 859 seeds (71% of those sown) had germinated. At the end of April 2008 with no symptoms of disease apparent, a large proportion began to die. In May 2008, the remaining 180 seedlings (21% of those that had germinated) were transplanted into the growing-on pots.

On 18 July 2008, only 63 plants were still alive, but survival after this was good with 57 alive on 21 January 2009 (just before transplanting at the roadside reserve).

#### **Planting out and establishment:**

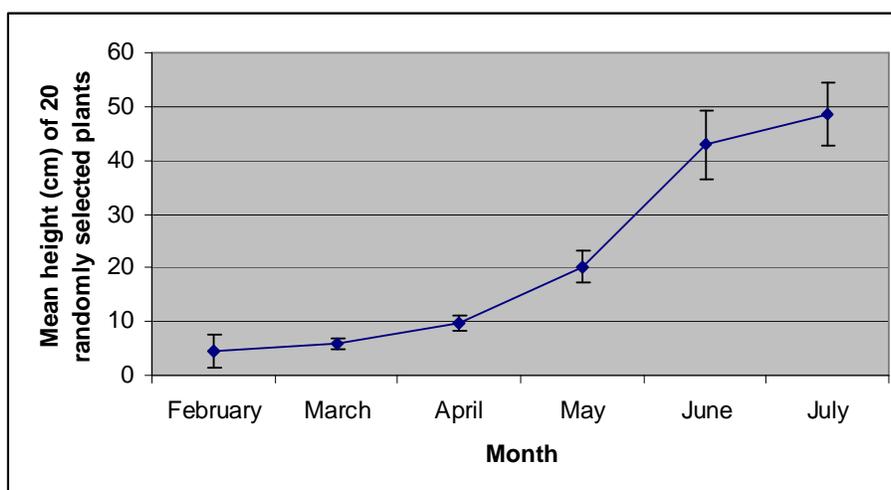
Following planting out in Plot 2 in January 2009, all but one of the 57 plants was still alive and growing strongly in July. Twenty four other vascular plant species were recorded in Plot 2 in July 2009 (Table 1); the dominant species was *B.falcatum* with percentage ground cover estimated at 80%. By July all 56 plants had flowered and a small number were setting seed.

All 20 randomly selected plants survived, grew well and by July had a mean height of 48.5cm ( $\pm 5.79$ ; Fig. 2). The plants in Plot 1 had a mean height of 53.45cm ( $\pm 5.63$ ). There was no significant difference in the mean July heights

of plants in Plot 1 and Plot 2 ( $U = 162.5$ ,  $n_{\text{plot1}} = 20$ ,  $n_{\text{plot2}} = 20$ ,  $P > 0.05$ ), and plants in both plots were similar in general size and stature (Figs. 3 and 4).

**Table 1.** Vascular plant species present in Plot 2, Norton Heath, July 2009.

Species	Percentage cover (%)
Field maple <i>Acer campestre</i>	<5
Agrimony <i>Agrimonia eupatoria</i>	<5
Cow parsley <i>Anthriscus sylvestris</i>	<1
False oat-grass <i>Arrhenatherum elatius</i>	<5
Sickle-leaved hare's-ear <i>Bupleurum falcatum</i>	80
Pendulous sedge <i>Carex pendula</i>	<5
Spear thistle <i>Cirsium vulgare</i>	<1
Field bindweed <i>Convolvulus arvensis</i>	<1
Cock's-foot <i>Dactylis glomerata</i>	<1
Common couch <i>Elytrigia repens</i>	<10
American willow-herb <i>Epilobium ciliatum</i>	<1
Hoary willow-herb <i>Epilobium parviflorum</i>	<1
Square-stalked willow-herb <i>Epilobium tetragonum</i>	<1
Blue fleabane <i>Erigeron acer</i>	10
Red fescue <i>Festuca rubra</i>	15
Ash <i>Fraxinus excelsior</i>	<5
Yorkshire fog <i>Holcus lanatus</i>	<1
ox-tongue <i>Picris sp.</i>	<1
Ribwort plantain <i>Plantago lanceolata</i>	<5
Creeping buttercup <i>Ranunculus repens</i>	<5
Hoary ragwort <i>Senecio erucifolius</i>	<5
Common ragwort <i>Senecio jacobaea</i>	<1
Dandelion <i>Taraxacum officinale</i> agg.	<1
Goat's-beard <i>Tragopogon pratensis</i>	<1
Hairy violet <i>Viola hirta</i>	15



**Figure 2.** Mean plant height ( $\pm$  one standard error) of newly-established sickle-leaved hare's-ear *Bupleurum falcatum* subsp. *falcatum* at Norton Heath, February to July 2009.



**Figure 3.** Newly established sickle-leaved hare's-ear, Plot 2, July 2009.



**Figure 4.** The original (longer-established) sickle-leaved hare's-ear colony, Plot 1, July 2009.

Analysis of the Norton Heath soil revealed a pH of 8.2 and generally low nutrient levels (Table 2). Unusually, there was no detectable extractable phosphorous. The compost used for propagation had a pH of 6.7 with nutrient levels considerably higher than the Norton Heath soil.

**Table 2.** Key nutrient analysis (extractable nutrient level) and pH of soil at Norton Heath verge and of Terra Eco Systems multipurpose peat-free compost.

	Norton Heath	Terra Eco Systems compost
Phosphorus	None detected	1.3 mg/l
Potassium	115 mg/l	442 mg/l
Magnesium	69 mg/l	84 mg/l
pH	8.2	6.7

**Discussion:** The cause of large-scale seedling loss in late April 2008 is unknown. It is

suggested that the subsequent loss of two thirds (123 of 180) of the potted out seedlings was attributable to one of two reasons (or a combination of both). Firstly, empirical evidence elsewhere indicates that *Bupleurum* seedlings may suffer high mortality if transplanted (Ken Adams, *pers. comm.*). Secondly, the low level of key soil nutrients at Norton Heath suggest that similarly low levels in any compost used for propagation may increase the chances of seedling survival. The elevated nature of the Norton Heath mound encourages leaching of nutrients, providing very different substrate conditions to those experienced by the potted out seedlings.

Research is currently being undertaken at Writtle College (Essex) to better understand germination requirements. Sowing of seeds directly into pots to avoid losses that may occur due to seedling disturbance when repotting at a young growth stage, may also be tested.

Although only a single site study, early indications are that, once established in suitable ground, *B. falcatum* has the ability both to compete with other species and to grow at a rate similar to that of long-established plants.

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## REFERENCES

- Adams K. (1999) '*Bupleurum falcatum* L. (Apiaceae)' in: M. J. Wigginton (ed.) (1999) *British Red Data Books, 1 Vascular plants* (3<sup>rd</sup> edition). p.62, JNCC, Peterborough, UK.
- Adams K. (2001) Notes on Essex specialities. 5: Sickle-leaved hare's-ear *Bupleurum falcatum* L. subsp. *falcatum*. *Essex Naturalist*, **18** (New series), 157-160.
- Gardiner T. & Vaughan A. (2009) Scrub clearance and soil disturbance increases bee orchid *Ophrys apifera* frequency in calcareous grassland at Norton Heath roadside verge, Essex, England. *Conservation Evidence*, **6**, 39-41.

Stace C. (1997) *New Flora of the British Isles* (2<sup>nd</sup> edition). Cambridge University Press, Cambridge, UK.

Wigginton M. J. (ed.) (1999) *British Red Data Books, 1 Vascular plants* (3<sup>rd</sup> edition). JNCC, Peterborough, UK.

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