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Progress report on research trials to establish Sea Hog's Fennel *Peucedanum officinale* L. at Abbots Hall Farm, Gt. Wigborough.

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Essex Biodiversity Project

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Background

Sea Hog's Fennel is a rare coastal plant in Britain occurring in three isolated populations, the largest being in the Walton Backwaters, Essex with the majority of this population growing on the EWT reserve Skippers Island. The UK population appears to be stable, although it occupies rather tenuous sites, subject to the vagaries of a changing coastline (Essex Biodiversity Action Plan, 1999). The plant appears in the British Red Data Book for vascular plants as Lower Risk, Near Threatened putting it somewhere between RDB3 and Nationally Scarce (because of its abundance at the few sites at which it occurs).

Whilst interesting in itself the plant is important as the exclusive foodplant of Fisher's Estuarine Moth *Gortyna borelii lunata*. In the UK this moth occurs only in the Walton Backwaters area (and one other secret location in Kent) with the majority of the population confined to Skippers Island.

Both of these species have been adopted as a Biodiversity Action Plan (BAP) species within Essex and consequently are the focus of research and conservation effort. The plant also supports another rare (RDB3) micro-moth species *Agonopterix putridella* which occurs both in the Backwaters and Kent.

The long-term viability of the Sea Hog's Fennel population and its dependant moth species is severely threatened in the Walton Backwaters. The key site, Skippers Island is low lying with deteriorating sea walls. As a consequence of sea level rise inundation at some point in the future is inevitable, indeed an extreme weather/tide event could occur at any time. The resulting prolonged immersion would have a severely detrimental effect on the plants and moths.

There is an urgent need to establish self-sustaining populations of Sea Hog's Fennel elsewhere. The ideal solution to safeguard the plant and its dependant moth species would be the creation of a string of coastal sites close to the Backwaters which are not imminently threatened by the sea and could be sympathetically managed and protected. The project at Abbots Hall Farm aims to assess methods of introducing, establishing and managing populations of the plant at new sites.

Ecology

A full autecological account of *Peucedanum officinale* is presented by Randall & Thornton (1996). To summarise the plant in the UK grows entirely on heavy London Clay soils with a pH of 5.5 – 8.0 and is never found in very acidic soils. It is tolerant of both water logged conditions and drought with considerable tolerance of salinity. The overwhelming majority of plants in the UK grow within 15m of brackish or salt water generally in well lit places, but also occurring in partial shade.

Flowers are held in compact umbels with very variable numbers of fruits per umbel. Estimates suggest that seed production for mature specimens may be up to 500,000 fruits per annum (Randall & Thornton 1996). Seed is dispersed from late August through September.

Blyth (1987) tested the germination of seed in a variety of ground cover conditions, success was varied with no seedling establishment in an uncut grass sward with best

survival rates between 10-20% in bare soil conditions. Best overall germination rates were obtained from seed that had been dry frozen at -20°C (Blyth 1987).

Germination takes approximately 14 days with slug and snail grazing resulting in a high proportion of seedling mortality in the wild (Harvey & Meredith 1981). Blyth (1987) observed growth rates of between 6 and 30 cm achieved by sown seedlings in their first year

Project outline

To create trial areas at EWT site Abbotts Hall Farm to identify successful methods of introducing Sea hogs fennel. Prior to seed collection and introduction of seed and seedlings all necessary consents were obtained from English Nature, Essex Wildlife Trust and RDS/Defra. There are two introduction methods, direct seeding and planting from pots in autumn and spring into existing grassland and ruderal/disturbed ground.

In each of the four plots a different method of establishing Hog's Fennel has been conducted as follows:

Plot a Seed broadcast by hand into grassland in October 2003

Plot b Pot grown seedlings planted out into grassland in October 2004.

Plot c Seed broadcast by hand into ruderal area in October 2003.

Plot d Seed broadcast by hand into ruderal area following rotavation in March 2004
Pot grown seedlings planted out in October 2004.

Trial areas

Two 0.5 hectare trial areas were identified initially, site 1 'Pond Field' and site 2 'Meadows'. However site 1 'Pond Field' was not used as sufficient space and ground variation was available at site 2. The 'Meadows' 0.5 hectare plot was subdivided into 4 trial plots each measuring 1250m².

Within the trial plots there are three ground habitats –

Plots a and b - permanent grass sward above the 4m contour. The grassland was established within an ESA agreement in September/October 2002. The seed mixture comprised 40% Perennial ryegrass *Lolium perenne* with Italian ryegrass *Lolium multiflorum*, Cocksfoot *Dactylis glomerata*, Timothy *Phleum pratense*, *Festuca* spp and white clover *Trifolium repens*.

Plot c - undisturbed stubble with a developed ruderal plant community below the 4m contour.

Plot d - lightly disturbed (cultivated with a rotare to a depth of ca.10cm to remove the ruderal plant community) ground below the 4m contour.

The ruderal plant community in plots c and d were dominated by Creeping thistle *Cirsium arvense*, Black mustard *Brassica nigra*, hedge mustard *Sisymbrium officinale*

and Bristly oxtongue *Picris echioides*. An NVC survey of the plot area was undertaken and plant community showed a lot of similarity to community OV25 with the exception that nettle *Urtica dioica* was absent. There was no fencing of the plots to exclude rabbits and hares.

The soil characteristics of each of the four trial plots are given in Table 1. There was little variation in soil characteristics between plots. All plots had a relatively neutral pH, with low levels of Phosphorus, fairly high levels of Magnesium and silty clay/silty clay loam texture. The conductivity levels were low and therefore the soil had a low level of salinity.

Table 1. Soil characteristics of each of the four trial plots

	pH	Phosphorus (mg/l) (index)	Potassium (mg/l) (index)	Magnesium (mg/l) (index)	Conductivity (μ S/cm) (index)	L.O.I (%)	Soil texture
Plot a ESA grassland	7.1	1 (0)	184 (2)	390 (6)	2000 (0)	7.7	Silty clay
Plot b ESA grassland	6.9	2 (0)	189 (2)	485 (6)	1990 (0)	5.7	Silty clay loam
Plot c ruderal	6.9	6 (0)	204 (2)	300 (5)	2000 (0)	5.3	Silty clay loam
Plot d Disturbed/ruderal	6.8	9 (0)	276 (3)	435 (6)	2030 (0)	5.6	Silty clay

Introduction of seed

Sea Hogs Fennel seed was collected by hand at Skippers Island during mid September 2003. After allowing the seed to air dry at room temperature for several days the seed was stored in four batches in sealed plastic containers in a cool (but frost free) shed in darkness. Surplus seed remains in storage at Abbots Hall Farm, however its viability is unknown.

Approximately 2000cc of seed was broadcast on each 1250m² trial plot which is 1.6cc per m² = 40 seeds per m². The seed was subdivided to ensure as far as possible that the seed coverage was evenly broadcast.

Planting and introduction of plug grown plants

In mid October 2003 2500 half-litre pots were planted with 5-10 seeds per pot. The growing medium was B&Q Multipurpose Organic Peat Free compost. The pots were placed on ground cover matting to prevent weed growth in an open but sheltered area fenced to exclude rabbits. The seeds germinated from late January 2004 onwards. Germination rates were estimated at 90% and all pots contained viable plants. The seedlings were thinned to 2-3 plants per pot in May and the pots were top dressed with slow release fertiliser granules. The pots were weeded at intervals and watered during dry periods over the summer. Growth slowed during July and August and

some dieback was evident. The largest pot plants reached a height of ca.12cm substantially larger than those germinated within the trial plots.

On 22 Oct 2004 870 pots were planted in the trial plots. Most pots contained several seedlings. They were spaced at 1m intervals in a 10m strip through plots b and d crossing the 4m contour. Modified spades with a square steel section welded to the blade with the same dimensions as the pots. They were very effective, speeding up the planting, and ground conditions were good with moist and workable soil.

Since planting out a number (ca.10%) have been dug up, presumably by rabbits, hares or birds. The planting pits are distinct containing the dark compost against the lighter clay soil and may attract attention. There is anecdotal evidence that Sea Hogs Fennel is eaten avidly by Hares (C Gibson pers comm.). Temporary/electric fencing may be required to exclude hares if too many plants are being lost. Furthermore, the planting pits also tend to fill with water which could result in significant mortality in periods of extended wet or freezing weather.

Several hundred pots with plants remain within the storage area. These will be retained and some will be potted up into larger pots to grow on.

Table 2 Diagrammatic representation of trial plots

landward	
<p style="text-align: center;">plot a</p> <p style="text-align: center;">1250m² permanent grass established Sept/Oct 2002</p> <p>October 2003 - seed broadcast by hand</p> <p>May – Aug 2003 monitoring of seedlings</p> <p>4m contour</p>	<p style="text-align: center;">plot b</p> <p style="text-align: center;">1250m² permanent grass established Sept/Oct 2002</p> <p>October 2004 - pot grown seedlings planted out 1m spacing.</p>
<p style="text-align: center;">plot c</p> <p style="text-align: center;">1250m² undisturbed stubble with ruderal plant community</p> <p>October 2003 - seed broadcast by hand</p> <p>June 2003 - area brushcut to reduce height of ruderals to ca 10cm.</p> <p>May – Aug 2003 monitoring of seedlings</p>	<p style="text-align: center;">plot d</p> <p style="text-align: center;">1250m² lightly cultivated ground</p> <p>March 2004 - seed broadcast by hand</p> <p>No germination of broadcast seed</p> <p>October 2004 - pot grown seedlings planted out 1m spacing.</p>
seaward	

Monitoring of seeded trial plots

Between May and August 2004, the plots where Hog’s Fennel seed had been broadcast were surveyed once a month. During every survey, five quadrats (1m²) were randomly placed within each of the plots. Within each quadrat the number of Hog’s Fennel seedlings was counted and the height and width of each seedling was measured. If more than five seedlings were present in a quadrat, the height and width of only the first five recorded was measured.

The ruderal area where seed was broadcast in autumn 2003 was cut to a height of approximately 10 cm (cuttings removed) at the beginning of June 2004. It was necessary to conduct this cut as tall thistles were smothering out Hog’s Fennel seedlings.

The area of the plots had been under arable cultivation until August 2002 prior to the establishment of the grassland and ruderal areas. Soil samples were taken to a depth of 25 cm, using a soil auger, at three representative locations within each plot. The samples were analysed for pH, conductivity, texture, loss on ignition (L.O.I) and available phosphorus, potassium and magnesium.

Results of monitoring of seeded trial plots

Hog’s Fennel seedlings were found throughout the survey period in the two plots (ESA and ruderal) where seed was broadcast in autumn. There was, however, no

Hog's Fennel seedlings recorded in the rotavated/ruderal area where seed was broadcast in the spring, despite extensive searches.

The average height of Hog's Fennel seedlings, in the two plots (ESA and ruderal) where seed was broadcast in autumn 2003, throughout the survey period is shown in Figure 1. With the exception of the first survey date, the Hog's Fennel seedlings were taller in the ruderal area than in the area of ESA grassland. The greatest difference between areas was recorded on 15/06/04 when the average height in the ruderal area was 78 mm, compared with just 60 mm in the ESA grassland. In contrast, on 10/08/04 the Hog's Fennel seedlings within the ruderal area were only 4 mm taller than in the area of ESA grassland. The trends recorded for Hog's Fennel width (Figure 2) were similar to those described above for height.

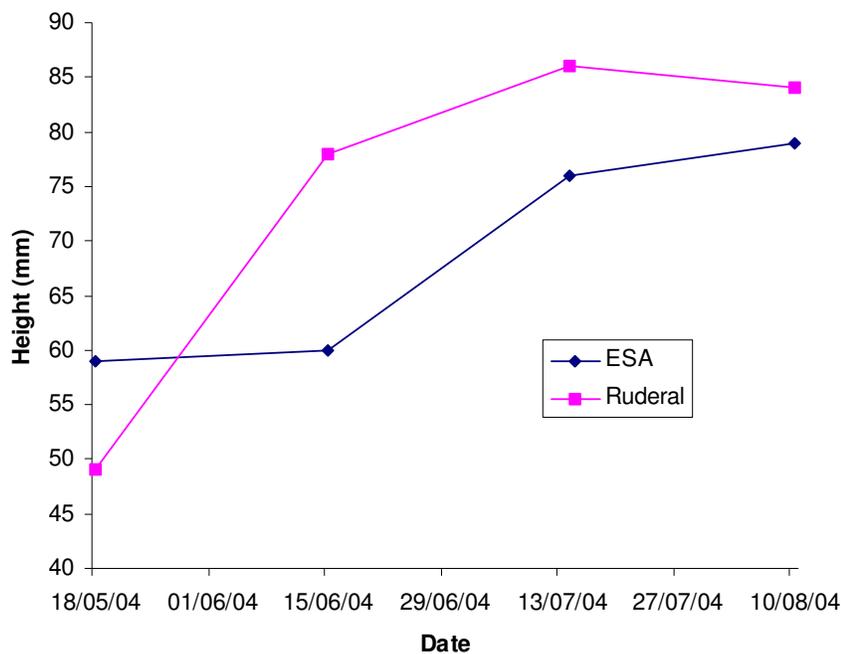


Figure 1. The mean height of Hog's Fennel in the two areas (ESA and ruderal) where seed was broadcast in the autumn

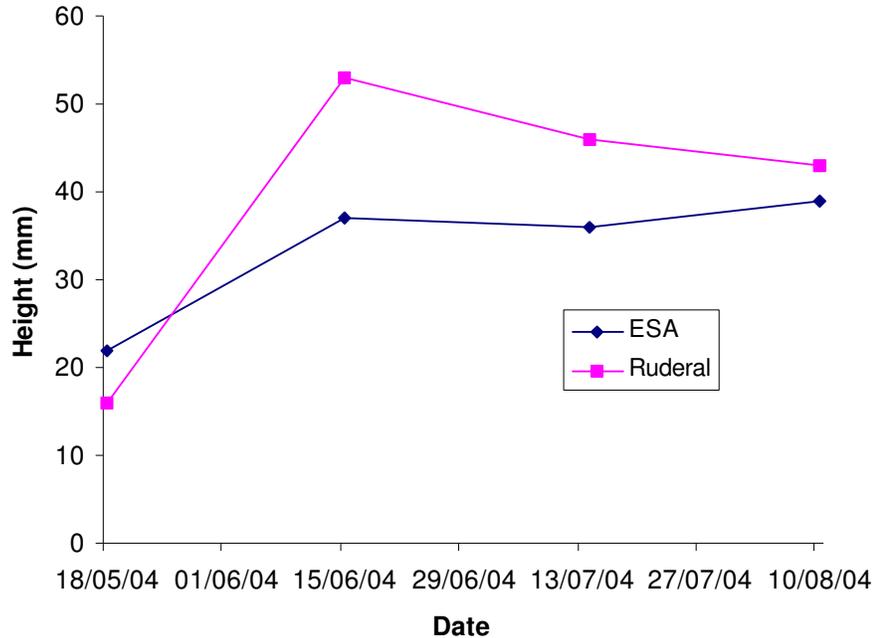


Figure 2. The mean width of Hog's Fennel in the two areas (ESA and ruderal) where seed was broadcast in the autumn

Details of the density of Hog's Fennel seedlings within the two areas where seed was broadcast in the autumn are given in Table 3. Although the mean number of plants per m² varied between the two areas throughout the survey period, the mean of all survey dates was virtually the same for each area. The highest number of Hog's Fennel seedlings recorded in a quadrat was 17 and this occurred on two occasions within the ruderal area.

Table 3. The average (mean) number of Hog's Fennel seedlings per m² recorded in the two areas where seed was broadcast in the autumn on each survey date

Mean no. Hog's Fennel plants per m ² (range)		
Date	grassland	ruderal area
18/05/04	5.0 (0 – 9)	6.0 (0 – 17)
15/06/04	7.7 (0 – 9)	4.0 (0 – 16)
14/07/04	4.4 (0 – 11)	7.4 (3 – 13)
10/08/04	7.2 (0 – 14)	7.2 (0 – 17)
Total	6.1 (0 – 14)	6.2 (0 – 17)

Discussion

The results from the first season of monitoring indicate that Hog's Fennel seed should be broadcast in autumn for successful establishment. This is the time of year that Hog's Fennel seed would be dispersed naturally and it may be that the seed requires a certain amount of time in cold temperatures and wet conditions before germination. It may also be possible that storing the seed over the winter lowered its viability.

There was little difference between the establishment of Hog's Fennel in the ESA grassland and ruderal area (Figures 1 and 2; Table 3). It is suggested that the higher growth rate of Hog's Fennel seedlings within the ruderal area during June and July was the result of the area being cut at the beginning of June. This would have lowered competition and opened up the area to the benefit of seedling growth.

The soil conditions within the plots are within the general range of those found at Skipper's Island, where the plant grows in abundance. Consequently, soil conditions should not be adversely effecting growth of Hog's Fennel at this site.

It is important that the plots continue to be monitored using the same methodology in subsequent years, to enable a direct comparison to be made between results. It will be interesting to see if density of Hog's Fennel decreases substantially as the plants grow. It will also be important to determine the success rate of planting-out one season old Hog's Fennel plants and to make a comparison between the growth rate of these and those that established from seed.

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