Successful translocation of the locally rare mottled grasshopper *Myrmeleotettix maculatus* to Jaywick flood defences in Essex, England

Tim Gardiner
Environment Agency, Fisheries, Recreation & Biodiversity (FRB), Iceni House, Cobham Road, Ipswich, Suffolk IP3 9JD, UK

Corresponding author e-mail: tim.gardiner@environment-agency.gov.uk

SUMMARY

The mottled grasshopper *Myrmeleotettix maculatus* is locally rare in Essex, southeast England. To increase the number of populations of this grasshopper in the county, 40 adults (20 female, 20 male) were captured using sweep netting at Colne Point (an Essex Wildlife Trust coastal nature reserve) and transferred to Environment Agency sand dune flood defences at the nearby town of Jaywick in July and August 2009. At least in the short-term, the translocation has been successful; in June and August 2010 at the release site a small number of adult female and male mottled grasshoppers were located indicating that successful breeding had occurred. It is hoped that a new population at Jaywick will establish and spread in the longer-term in adjacent sandy areas recently planted with marram grass *Ammophila arenaria*.

BACKGROUND

The mottled grasshopper *Myrmeleotettix maculatus* (Orthoptera: Acrididae) is widely distributed, but not necessarily common, throughout mainland Britain (Marshall & Haes 1988). However, in the county of Essex (southeast England) it is rare, being found at less than 10 sites (Gardiner & Benton 2009) and included in the Essex Red Data List (ERDL; Gardiner & Harvey 2004). At three former sites in Epping Forest, Essex (Almshouse Plain, Strawberry Hill and Sunshine Plain) *M. maculatus* has become extinct, the most likely cause being the development of tall grassland which has established in the absence of cattle grazing (Gardiner 2003). Its habitat requirements are short, dry turf on sandy, nutrient poor soils, with the presence of bare earth essential for basking and ovipositing (Wake 1997).

Gardiner & Benton (2009) class this grasshopper as disturbance dependent relying on active management of sites to maintain large areas of bare earth. Such conditions occur at Ministry of Defence (MOD) firing ranges near Colchester (north Essex), where a population of *M. maculatus* is found in irregular hollows, with hardly any vegetation cover (80-90% bare earth), which have been created behind the main range targets by exploding ordnance. Military use of the ranges, including use by heavy vehicles, churns up the sward and prevents succession to tall grassland and scrub.

The largest and most widespread Essex population of *M. maculatus* is at Colne Point, a coastal shingle spit nature reserve, close to the town of Brightlingsea (Harvey & Gardiner 2006). The shingle and sand habitats at Colne Point are nearly all that remains of much larger expanses that existed at the end of the 19th century between Walton-on-the-Naze and St Osyth, now mostly lost to development by the holiday industry (Gunton 2008). This loss of coastal habitat must have had a severe impact on invertebrates of sand and shingle environments, including *M. maculatus*. Low-

lying spits such as Colne Point (the site is generally less than 1 m above MSL) are also threatened by climate change induced sea level rise. The current rate of sea level rise in Essex (6 mm/yr; DEFRA 2006), indicates that Colne Point may be inundated within the next 100-200 years. However, rising sea levels may also alter coastal currents leading to changes in the rate and pattern of sediment deposition in the area, therefore the spit may move or become enlarged. Due to the possible threat from inundation of the spit, there is an opportunity to use Colne Point as a 'donor site', moving vulnerable insects (such as *M. maculatus*) and other fauna to more secure sites.

This paper describes the translocation of a small number of *M. maculatus* adults from Colne Point to flood defences at the nearby town of Jaywick. The author believes this to be the first attempt at grasshopper (Acrididae) translocation in the UK. However, the Zoological Society of London and Natural England have been captive breeding field crickets *Gryllus campestris* (Gryllidae) and have released 41,000 individuals in West Sussex and Hampshire since 1991. As a result, three new populations have become established.

ACTION

Study species: *M. maculatus* is a small herbivorous grasshopper (adult length 12-19 mm; Marshall & Haes 1988) and a short sward specialist (Gardiner & Hassall 2009; Willott 1992). Eggs are oviposited in exposed soil and nymphs emerge from April to June; there are four nymphal instars. Adults may be heard stridulating (singing) from mid-June until October (Marshall & Haes 1988). The song is a long series of buzzing chirps lasting approximately 15 seconds (for a recording of the stridulation visit www.orthoptera.org.uk). The adults fly well, but nearly always return to the take-off location, indicating a sedentary habit.

Rationale behind translocation: Due to the threat posed by sea level rise at Colne Point, it was decided to translocate a small number of adult *M. maculatus* to recently created sand dune-enhanced flood defences at Jaywick. The Jaywick flood defences fall within the former range of the grasshopper, which was recorded near Clacton-on-Sea in about 1900 (Wake 1997). The populations of this grasshopper at Colne Point are only approximately 2.7 km from the proposed release site at Jaywick. However, given the sedentary nature of *M. maculatus* (Marshall & Haes 1988; Wake 1997) and the unfavourable habitats between the two sites (sections of hard engineered flood wall with no vegetation and a heavily eroded beach fronting Jaywick), it was deemed that a translocation of this insect was the only feasible way that it might establish in the emerging dunes.

Since 1986 at Jaywick, a number of projects have been undertaken to tackle the threat of sea flooding. Combined with the installation of breakwaters to stabilise existing sand, the Environment Agency (EA) has undertaken a beach recharge project. From September 2008 to January 2009, sand was added and spread by bulldozers to re-profile the beach. To create more natural looking flood defences in front of the existing concrete revetment, stands of marram grass *Ammophila arenaria* have been planted. It is hoped that these will promote sand accretion and develop into a linear corridor of sand dune vegetation with slacks and hummocks stretching over 1 km in length.

Because of this habitat creation, it was decided to translocate the grasshopper to the dunes so that it would have the chance to spread eastwards through the newly planted *A. arenaria* plots, which should provide a large interconnected area of favourable habitat in future decades.

Colne Point description (donor site): Colne Point is the largest shingle spit in Essex (c. 280 ha) and is a nature reserve owned and managed by Essex Wildlife Trust (EWT). It has extensive dunes and a shingle ridge enclosing an area of salt marsh. There are large areas of lichen heath and shrubby seablite *Suaeda vera.* The area from which the *M. maculatus* adults (donor stock) were taken (Ordnance Survey (OS) grid reference TM 098124) was largely unvegetated shingle with patches of *S. vera*.

Permission to remove a small number of *M. maculatus* adults was obtained from the landowner, EWT. As the site is within the Colne Estuary National Nature Reserve (NNR), and a designated Ramsar site, Special Protection Area (SPA), Site of Special Scientific Interest (SSSI) and within the Essex

Estuaries Special Area of Conservation (SAC), and the receptor site was also within the SAC, authorisation was obtained from Natural England (a government advisor on the natural environment).

The populations of *M. maculatus* at Colne Point were sufficiently widespread and abundant (Harvey & Gardiner 2006) to believe that the translocation of a small number of adults (< 50) would not be detrimental to the continued persistence of the grasshopper at the nature reserve. The Joint Committee for the Conservation of British Invertebrates guidelines (JCCBI 1986) suggest that stock of the same ecological type should be chosen for translocation, this will usually mean a source close to the receptor site. Given that the donor and receptor sites in this translocation are only 2.7 km distant and have similar habitats, this criterion has been satisfied. It was decided that 40 adults (20 female, 20 male) would be released at Jaywick. It was believed that this number was the minimum for the translocation to be successful.

Jaywick flood defences (receptor site): Following the principles of the JCCBI insect translocation guidelines, the receptor site at Jaywick was very carefully chosen. Given that this grasshopper requires habitats with a high amount of bare ground, suitable habitat was selected at Jaywick behind a breakwater, the installation of which led to stabilisation of the sand behind it. *A. arenaria* in the dunes (naturally accumulating behind the breakwater) that are forming is at a very early stage of succession, with plenty of exposed sand. The planting of *A. arenaria* to the east of the proposed release site ensures that favourable habitat will be present for them to colonise in future. The release site comprised a 1 ha area of emerging sand dune with *A. arenaria*, situated behind the breakwater (OS grid reference TM 139126). Nine fenced plots (each approximately 300 m^2) containing densely planted *A. arenaria* were situated 200 m to the east of the release site. These plantings were an attempt by the EA to stabilise the sand that had been dredged and dumped through the beach recharge scheme. It is hoped that in time these dunes will develop a natural hummock and slack profile, providing valuable sand dune habitat as a natural flood defence. The receptor site had a high occurrence of exposed sand (> 60%) with tussocks of *A. arenaria*, interspersed with sea holly *Eryngium maritimum* and sea spurge *Euphorbia paralias* (both Essex Red Data Listed species).

Translocations: On 31 July 2009, 15 female and 15 male adult *M. maculatus* were collected using a sweep net (30 cm diameter) and transferred into transparent plastic containers (approx. 20 x 10 cm in size, no vegetation was provided, about four adults per container) for transit by road to the Jaywick release site. Care was taken to ensure that adults transferred were in good condition (i.e. did not have any legs missing or body damage). Inevitably, a very small number (< 5) were damaged while sweeping; these were released at the site of capture. Once at the receptor site, the adults were released from the containers into suitable dune habitat. The adults were translocated in two batches to keep the time held in the containers to no longer than 2 hours; between 10:00 and 13:00 h (10 female, 8 male), and 14:00 and 16:00 h (5 female, 7 male). The air temperature was approximately 24^oC and it was predominantly sunny with little cloud. This hot weather made grasshopper capture very time consuming due to the high activity levels, therefore it was only possible to collect 30 adults in 5 h.

Due to this slow rate of capture, a further day was needed to capture and move the last 10 adults. The desired number of target individuals were captured on 3 August 2009 (5 female, 5 male), and transferred and released between 11:00 and 13:00 h. The air temperature was approximately 22^oC, and again it was predominantly sunny.

Post release monitoring: Post release monitoring was undertaken at the receptor site on 18 August 2009 (15 days after the last release of adults) to ascertain if any stridulating males were present, mating individuals were also searched for. Subsequently the site was surveyed on 23 June and 9 August 2010, to determine whether breeding had taken place in summer 2009 and eggs had overwintered and successfully hatched. A 15 min visual search (no sweep net used) of the general release area (about 50 x 50 m) and its periphery was made on both survey dates. Within the approximately 2,500 m^2 survey area, the observer walked briskly (to avoid 'double counting' of individuals) recording grasshopper presence both visually and by listening for stridulating males.

Plant surveys: Ten frame quadrats (50 x 50 cm) were placed randomly at the receptor and donor sites on 9 August 2010 to determine vegetation cover at both locations to aid further translocations of this grasshopper in the future. The quadrats had 100 divisions (5 x 5 cm) to assist percentage vegetation cover estimates. In each quadrat, the number of squares in which each vascular plant species was present was recorded as a measure of frequency of occurrence (e.g. if a species appeared in 100 squares it was recorded as having 100% occurrence). Additionally the percentage cover of exposed substrate (sand and shingle) was noted.

CONSEQUENCES

Four stridulating males were located on 18 August 2009 at Jaywick flood defences. This indicated that adults had remained in the immediate vicinity of the release site. No mating individuals were found.

During the survey on 23 June 2010, three adult males and four adult females were located, indicating that mating in late summer 2009 at Jaywick had occurred, and that eggs were laid and successfully overwintered. Four adult males and three females were recorded on 9 August 2010, although it is acknowledged that these may be the same individuals observed on the June survey. Hatching and maturation must have occurred in spring 2010, leading to the establishment of a small breeding population. No adults or nymphs were found outside of the 50 x 50 m release area. The small numbers of individuals observed in 2010 indicates that breeding success at the receptor site may be very low.

Both the donor and receptor sites were characterised by high occurrence of exposed substrate (60-70%; Table 1). At Colne Point the exposed shingle was interspersed with patches of sea couch *Elytrigia atherica* and *S. vera*, whilst *E. atherica* was in higher abundance on the emerging dunes at Jaywick. Small patches of *Eryngium maritimum* and *Euphorbia paralias* were scattered across the receptor site at Jaywick.

Discussion: Although it is not known how the population will fare in the long-term, the translocation of the 40 *M. maculatus* adults has led to successful breeding and overwintering. It was an inexpensive and simple process to capture, transport, and release the adults at the receptor site. It is hoped in the longer-term that the grasshoppers colonise the newly planted *A. arenaria* enclosures to the east of the release site. Future surveys will be conducted to assess whether the population persists. As far as the author is aware, there are no data on whether releases of small numbers of grasshoppers may lead to inbreeding depression. However, the release of small numbers of longer-lived tree wetas (these breed across several seasons) in New Zealand (52-80) has been successful (Green 2005; Stringer 2005). Due to the possibility of inbreeding depression it may be useful to supplement an established population at Jaywick with small numbers of individuals from Colne Point in future years to enhance genetic diversity.

To the author's knowledge this is the first successful grasshopper translocation in the UK.

Table 1. Mean percentage ground cover (± standard error) and mean number of plant species per quadrat at Colne Point (donor site) and Jaywick dunes (receptor site) on 9 August 2010.

Plant species/exposed substrate	**Colne Point** (donor site)	**Jaywick dunes** (receptor site)
exposed substrate	70.5 ± 5.9	60.5 ± 11.3
Bucks-horn plantain *Plantago coronopus*	5.4 ± 2.6	0.0 ± 0.0
Marram grass *Ammophila arenaria**	1.1 ± 1.1	2.0 ± 2.0
Sea couch *Elytrigia atherica*	13.6 ± 5.5	40.2 ± 11.5
Sea holly *Eryngium maritimum**	0.0 ± 0.0	3.2 ± 1.1
Sea purslane *Halimione portulacoides**	2.9 ± 2.9	0.0 ± 0.0
Sea spurge *Euphorbia paralias**	0.0 ± 0.0	0.9 ± 0.6
Shrubby seablite *Suaeda vera**	8.8 ± 3.4	0.0 ± 0.0
Mean number of species/quadrat ± SE	**2.3 ± 0.2**	**1.9 ± 0.2**

* = Essex Red Data List species

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REFERENCES

DEFRA (2006) *Flood and Coastal Defence Appraisal Guidance*. DEFRA, London, UK.

Gardiner T. & Benton T. (2009) Grasshoppers and bush-crickets (Orthoptera) of military training grounds near Colchester. *Entomologist's Record & Journal of Variation*, **121**, 167-171.

Gardiner T. & Harvey P. (2004) Red Data List for Essex Orthoptera and allied insects. *Bulletin of the Amateur Entomologists' Society*, **63**, 19-25.

Gardiner T. & Hassall M. (2009) Does microclimate affect grasshopper populations after cutting of hay in improved grassland? *Journal of Insect Conservation*, **13**, 97-102.

Gardiner T. (2003) Orthoptera and allied insects of Essex 2002. *Essex Naturalist* (New Series), **20**, 62-66.

Green C. (2005) Using artificial refuges to translocate and establish Auckland tree weta *Hemideina thoracica* on Korapuki Island, New Zealand. *Conservation Evidence*, **2**, 94-95

Gunton T. (2008) *Explore Wild Essex*. Lopinga Books and EWT, Wimbish, UK.

Harvey P. & Gardiner T. (2006) Pitfall trapping of scarce Orthoptera at a coastal nature reserve in Essex, UK. *Journal of Insect Conservation*, **10**, 371-373.

JCCBI (1986) Insect re-establishment – a code of conservation practice. *Antenna*, **10**, 13-18

Marshall J.A. & Haes E.C.M. (1988) *Grasshoppers and allied insects of Great Britain and Ireland*. Harley Books, Colchester, UK.

Stringer I. (2005) Translocation of the Middle Island tusked weta *Motuweta isolata*, The Mercury Islands, New Zealand. *Conservation Evidence*, **2**, 83-85.

Wake A. (1997) *Grasshoppers and crickets (Orthoptera) of Essex*. Colchester Natural History Society, Colchester, UK.

Willott S.J. (1992) *The thermal ecology and population dynamics of grasshoppers in relation to grazing on a Breckland grass heath*. Unpublished PhD thesis, University of East Anglia, UK.