

**BROWNFIELD SITES AND MOTH DIVERSITY IN THE TEES ESTUARY**

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Studies relating to the moth fauna occurring on brownfield sites in the Tees estuary in north-east England are reported, including a number of species with first records for County Durham (VC 66), including Saltern Ear *Amphipoea fucosa*. Other important new records and key habitat indicator species are also discussed.

**Keywords:** Brownfield, Industry, Moth, Tees.

**Brownfield sites in the Tees estuary – a context**

Situated in the north-east of England, the Tees Estuary is within an area now referred to as the Tees Valley (formerly Teesside). For the purpose of this paper the term 'north-east England' refers to the geographical area covered by the counties of Durham, Northumberland and the former counties of Cleveland and Tyne & Wear; while reference to the 'Tees Estuary' denotes locations within the maximum tidal reach of the river from the Tees Barrage to Teesmouth, a distance of approximately 16 km. The estuary area falls within four unitary authorities, which were formed after the dissolution of the County of Cleveland in 1996. These boroughs are Hartlepool, Middlesbrough, Redcar & Cleveland and Stockton-on-Tees.

In terms of the definitions relating to biological recording, those areas north of the River Tees, which were formerly part of County



**Plate 10.** Neutral grassland that develops on brownfield sites such as here at Billingham supports a rich diversity of moth species.

Durham (Hartlepool and Stockton-on-Tees), are included as part of Watsonian Vice-county 66; areas south of the river, which were once part of North Yorkshire (Middlesbrough and Redcar & Cleveland), are within VC 62 (North-east Yorkshire).

The Tees Estuary is heavily industrialised and urbanised, a process which started in the early 1800s as the steel industry developed along the River Tees (North, 1975). Large areas of the estuary, such as Seal Sands, were reclaimed from the sea using dredgings and blast furnace slag, the latter being a by-product arising from the manufacture of iron and steel. Land reclamation continued until the 1970s. Today industry is still a major feature of the Tees Estuary, particularly heavy engineering, petrochemicals and steel. Much of this is situated on reclaimed land. Economic developments are very much in evidence within the estuary and its hinterland, but there is also a significant nature conservation interest. There are important areas outside of the developed areas which enjoy statutory protection. The largest areas are notified as the 'Teemouth and Cleveland Coast Special Protection Area' and the 'Tees and Hartlepool Foreshore and Wetlands Site of Special Scientific Interest' which are coincident.

Although outside of the main protected areas, many of the industrial areas across the estuary have for some considerable time been recognised as being important for their wildlife interest (Smith, 1988). The definition of what constitutes a post-industrial or brownfield site is open to debate and can be very confusing, though however defined they are widely recognised as having a great deal of importance for their invertebrate fauna, for example in the East Thames Corridor (Harvey, 2000 and other sources).

In recognition of the importance of brownfield habitats for invertebrates, 'Open Mosaic Habitat on Previously Developed Land' (OMH) was added to the UK Biodiversity Action Plan in 2007 as a Priority Habitat. OMH is listed as a habitat of principle importance on section 41 of the Natural Environment and Rural Communities Act, 2006 (NERC Act).

The Tees Estuary industrial sites are atypical of brownfield land in that the majority are still occupied. Some of the larger sites have parts with a high biodiversity potential as a result of having been largely untouched for many years and being closed to public access for reasons of safety and security. A small number of brownfield sites in the area are post-industrial and several sites, such as Maze Park and Gravel Hole, are managed as nature reserves (Tees Valley Wildlife Trust, 2012).

It is the restricted access to many of the Tees sites that has led to a poor understanding of their importance for invertebrates. Systematic study of the moth fauna has been lacking in this potentially important area. This paper details work carried out by the Industry Nature Conservation Association (INCA) in conjunction with a number of partner organisations over the four year period between 2008 and 2011 to begin to address this knowledge gap.

### Habitat diversity on brownfield sites in the Tees estuary

There is a great diversity in habitat within brownfield areas in the Tees estuary that is both a function of relic habitat and land use. Indeed there can be a considerable variation in the physical and chemical characteristics of the land between adjacent sites and even within a single site. This variation is dependent upon previous or existing land use and can involve difference in pH, levels of historical land contamination and very often difference in topography, land drainage and aspect.

The habitat is influenced in many areas by the presence of weathered blast furnace slag which in addition to use as infill in reclaimed areas has been used extensively to create hard-standing on industrial sites. The slag is mildly alkaline and consists primarily of a mixture of the aluminosilicate and silicate compounds of calcium and magnesium (Environment Agency, 2012). This substrate supports a range of specialised calcicolous plants when left undisturbed over a number of years and can result in a flora which is more reminiscent of calcareous grassland.

Wetland priority habitats which are associated with the Tees estuary brownfield sites include reedbeds and saltmarsh, while the grasslands growing on weathered slag (locally called 'slag grassland') are referred to as 'brownfields' within the Tees Valley Biodiversity Action Plan (Tees Valley BAP Partnership, 2012). In the UKBAP this habitat is termed 'Open Mosaic Habitat on Previously Developed Land', but the national definition refers to 'historical industrial use' (Riding *et al*, 2010). This does not quite fit for many of the sites within the industrial belt of the Tees Valley as most are currently occupied and are operational. It does however capture the true diversity of much of the open grasslands on the larger industrial sites, which are mosaics of habitat types rather than a single entity.

Sand dunes and coastal grassland are also well represented on sites at Teesmouth.

### Key indicator species of selected habitats

#### Grassland

The structure and type of grassland present on the Tees brownfield sites is very varied, often as a result of previous or existing land use. Much of the open mosaic habitat on these sites comprises of semi-improved calcareous grassland growing on the low nutrient slag substrate (Mann *et al*, 2009). This 'slag grassland' is characterised by a very short, open, species-rich sward with frequent bare patches.

Many plants which are highly localised on the Magnesian limestone of the wider countryside in east Durham are both abundant and widespread in such places. The floral diversity includes Bee Orchid *Ophrys apifera*, Bird's-foot Trefoil *Lotus corniculatus*, Blue Fleabane *Erigeron acer*, Carline Thistle *Carlina vulgaris*, Common Centaury *Centaureum erythraea*, Kidney Vetch *Anthyllis vulneraria* and Yellow-wort *Blackstonia perfoliata*. Such areas support established



**Plate 11.** Neutral grassland at Billingham. Moths here include *Hellinsia lienigiana* Zeller, which is rare in the region.



**Plate 12.** Dune grassland at Redcar steelworks supports species such as the Lyme Grass *Chortodes elymi* (Tr.).





**Plate 13.** Slag grassland at Seal Sands. This habitat is rich in calcicolous plants and supports a wide range of moths whose larvae feed on them.

populations of regionally local moth species including the Annulet *Charissa obscurata* (D. & S.) which has so far only occurred at Teesport. Barred Rivulet *Perizoma bifasciata* (Haw.) seems to be focused on sites inland around Billingham where Red Bartsia *Odontites verna* is more frequent, while the Small Elephant Hawk-moth *Deilephila porcellus* (L.) is more widespread – associated with Lady's Bedstraw *Galium verum* on brownfield sites both north and south of the river. The

Nationally Notable *Syncopacma sangiella* (Stt.) occurs among Bird's-foot Trefoil which grows extensively on the Brinefields. There is only one post-2000 record of this moth from VC 66.

*Eucosma conterminana* (Guen.), a Nationally Notable tortricid, is now reported from a number of brownfield sites across the estuary where Wild Lettuce *Lactuca virosa* flourishes. There are only a handful of other records of this species in north-east England and the record of 3 July 2008 from Billingham was the first for VC 66.

Other than two records dating from 1800, there are only three records of the local plume moth *Stenoptilia zophodactyla* (Dup.) from the north-east, which relate to a single moth recorded in the Seal Sands area in 1990 and two more recent records from south Northumberland in 2010 and 2011 (Tams, 2012). Rearing larvae found in seed pods of Yellow-wort taken in September 2010 led to the discovery of strong populations of this species at Greenabella Marsh and Seal Sands. It is also present in similar habitat at Teesport in VC 62. Yellow-wort is often abundant on brownfield sites where blast furnace slag is present so this moth is actually likely to be fairly common.

Mesotrophic or neutral grasslands are also present within the grassland mosaic where blast furnace slag is absent. The floral diversity in these areas includes Bird's-foot Trefoil, Common Mouse-ear *Cerastium fontanum* and taller herbs such as Black Knapweed *Centaurea nigra*, Broad-leaved Dock *Rumex obtusifolius*, Common Nettle *Urtica dioica*, Mugwort *Artemisia vulgaris*, Ox-eye Daisy *Leucanthemum vulgare*, Tansy *Tanacetum vulgare* and Yarrow *Achillea millefolium*. Invasive ruderal species such as Bramble *Rubus fruticosus*, Creeping Thistle *Cirsium arvense*, Ragwort *Senecio jacobaea* and Rosebay Willowherb *Chamerion angustifolium* are often a feature in these areas where the ground has been disturbed.

These neutral brownfield grasslands support a number of regionally scarce species. Among these *Hellinsia lienigiana* (Zell.) a plume moth using Mugwort, is recorded from a site in Billingham. The moth reported on 30 June 2010 was the first record for VC 66; it is very local and in the north-east area is also known from occasional records in Northumberland (Tams, 2012) and Yorkshire (Beaumont, 2002). The plume moth, *Gillmeria ochrodactyla* (D.& S.), which occurs locally in the north-east, was found among Tansy at Portrack Marsh. Another Tansy-feeding species, *Isophrictis striatella* (D.& S.) also occurred at this site. This local species is known from only a small number of records in this region. The very localised Marsh Pug *Eupithecia pygmaeata* (Hb.) has so far been found only at one brownfield site, Maze Park, where it flies among *Cerastium*.

Interestingly, 2011 saw the appearance of Great Mullein *Verbascum thapsus* across a number of brownfield sites in the estuary where it has not been seen before. On one site at Billingham it was accompanied by a larva of The Mullein *Shargacucullia verbasci* (L.) which although common in the south of England, is rare on sites here.

While thistle species can become a problem on the Tees estuary brownfield sites, there are several local moths using the various species as larval foodplant which have been found on brownfield sites in the region. Prior to this work *Phlyctaenia perlucidalis* (Hb.) had only been reported from North Gare, in the northern part of the estuary and was the only record for this moth in North-east England. It is now known to occur on five sites across the northern part of the estuary, including three in Billingham, at Portrack Marsh and also at Seal Sands. There are no records to date from brownfield sites in the southern part of the estuary. Another scarce, thistle-feeding species which is known from the Tees brownfields sites is *Myelois circumvoluta* (Geoff.). This local species has a scattered distribution within the region and occurs on brownfield grassland at Maze Park and Portrack Marsh.

Rosebay Willow-herb, although potentially invasive, can also be useful for a number of species. One such species, *Mompha sturnipennella* (Tr.), was found among this plant at Portrack Marsh. The moth is spreading north through Yorkshire and has a scattering of records in the north-east. Also at Portrack Marsh was the gorse-feeding Gelechiid *Brachmia blandella* (Fabr.). The moth found on 3 July 2011 is the first record for Durham. It is scarce across the Tees in the northern part of Yorkshire, but is often widespread and common further south.

Extensive areas of coastal dune grassland are present both north and south of the Teesmouth, at North Gare and South Gare respectively. The area of dunes at Teesmouth is the most extensive on the north-east coast between Spurn Point in East Yorkshire and those in south Northumberland. Very little of this habitat, however, is present on brownfield sites in the Tees estuary. Of this much is focused around the northern boundary of the steelworks site at Redcar which has an area of around three hectares of dune grassland at Bran Sands. This adjoins the area of sand dunes at South Gare. The dune grassland is rich in flora which is typical for the area and is very much dominated by Lyme Grass *Leymus arenarius* and Marram *Ammophila arenaria*.

Dune grassland on the steelworks site is home to a number of nationally notable moths, including Lyme Grass *Chortodes elymi* (Tr.), Shore Wainscot *Mythimna littoralis* (Curtis) and the Pyralid *Evergestis extimalis* (Scop.). Regionally local species recorded from these dunes include *Agriphila geniculea* (Haw.), *Agriphila latistria* (Haw.), *Eudonia angustea* (Curtis), *Phycitodes maritima* (Tengst.), Archer's Dart *Agrotis vestigialis* (Hufn.), and Heart and Club *Agrotis clavis* (Hufn.).

The record of *Pima boisduvaliella* (Guen.) from a pumping station at nearby Teesport on 27 July 2011 is only the third record of this nationally rare moth from the Yorkshire coast. The other two were recorded in 2003, just a few kilometres distant at Redcar Steelworks by Colin Plant, reported in Langmaid and Young (2004) and in 2006, when several were seen a little further south at Marske in June (D. Money, S. Farish; unpublished data).



**Plate 14.** Habitat at North Tees including relic saltmarsh, which supports Saltern Ear *Amphipoea fucosa* (Freyer) and Crescent Striped *Apamea oblonga* (Haw.).



**Plate 15.** *Phragmites* reedbed on a North Tees brownfield site. Moths here include *Archanara dissoluta* (Tr.), *Mythimna obsoleta* (Hb.) and *Arenostola phragmitidis* (Hb.).



## Saltmarsh

This habitat in the Tees Estuary is largely restricted to the Boroughs of Hartlepool and Stockton-on-Tees. The land area covered by this habitat is relatively small, approximately 26.5 hectares (Gibson, 2003) which is diminutive in a national context. It is nevertheless of regional importance as there are few areas of saltmarsh along the coast between the Humber estuary and the Scottish border. It is a rare habitat in the Tees Valley and is also a UKBAP Priority Habitat.

One area of saltmarsh, comprising an area of approximately five hectares in the North Tees area of the Borough of Stockton-on-Tees is an operating brinefield. Habitat on this site consists of a rich mosaic, including relic saltmarsh and areas which now have a halophytic saltmarsh vegetation as a result of deliberate application of brine as a nature conservation measure to encourage habitat rich in saltmarsh plants including various species of Glasswort *Salicornia* spp. and Common Saltmarsh-grass *Puccinellia maritima*.

In surveys of the moths of this site during 2010 and 2011 at least five nationally important saltmarsh indicator species were found. The abundance of some of the scarcer species was also noteworthy. This includes the Dog's Tooth *Lacanobia suasa* (D.& S.) recorded on 17 June 2010 and the Saltern Ear *Amphipoea fucosa* (Freyer) recorded on the 4 August 2010. At least 40 individuals of the former species and 20 of the latter were found in surveys during summer 2010 indicating that both are well established on the site. Saltern Ear, presumably as wanderers from this main population, has also been found in small numbers on sites at Cowpen Bewley and Seal Sands 3.5km west and 1 km south-east of this location respectively (Woods, 2011a; Woods, 2011b). This finding is important especially in view of the fact that both species were previously known only from a very few sites in North-east England (Tams, 2012). The record of Saltern Ear is particularly noteworthy as it is new to the VC 66 fauna and the nearest known established colonies are at Spurn Point in Yorkshire and on Holy Island in north Northumberland, both some distance from Teesmouth.

In addition to the Dog's Tooth and Saltern Ear other significant records of moths from the same site include specialised saltmarsh species such as the Crescent Striped *Apamea oblonga* (Haw.), which is associated with various species of Saltmarsh-grass *Puccinellia* spp. This moth was recorded initially on the basis of four specimens on 4 August 2010, but then in the peak emergence season of this species in good numbers (23 specimens) on 11 July 2011. The site remains as the only known breeding population of this species in North-east England.

A number of interesting microlepidopteran species were also found on the same site. Of these, *Coleophora salicorniae* Hein. was first represented by six moths which were recorded on 4 August 2010, the first for VC 66 and apparently the most northerly record for this species in the UK, the nearest again being Spurn

Point. It was also recorded on the Brinefields on 11 July 2011. Various species of Glasswort *Salicornia* spp. are used as the larval foodplant by this moth. These plants abound in parts of the Brinefields site. The crambid *Agriphila selasella* (Hb.) was also recorded from the site on 4 August 2010. This local species, which uses *Puccinellia maritima* and other grasses, is only known from three previous records in VC 66.

Two Gelechiid moths were represented among the scarcer saltmarsh microlepidopteran species occurring on the Brinefields. *Scrobipalpa salinella* (Zell.), of which three were recorded on 17 June 2010, is the first for VC 66 since at least 1912 while the Nationally Notable species *Monochroa tetragonella* (Stt.), taken as a single specimen on 17 June 2010, is represented by only two records from nearby Greatham in July 1881.

### Reedbed

The Tees Valley has around 170 hectares of reedbed (Gibson, 2003). Industrial sites across the Tees estuary are home to a significant amount of this, which is often found as small stands within the overall habitat mosaic found on such sites. Reedbed is in itself scarce, being listed as a UKBAP Priority Habitat.

Many of the reedbeds on industrial brownfield sites in the northern part of the Tees estuary and in Billingham have become important for wainscot species which are at the northern edge of their range. As more of the larger reedbeds are investigated it is increasingly being found to be the case that those which are dominated by Common Reed *Phragmites australis* support established populations of Brown-veined Wainscot *Archanara dissoluta* (Tr.) Obscure Wainscot *Mythimna obsoleta* (Hb.) and Southern Wainscot *Mythimna straminea* (Tr.). These species were first reported in the Teesmouth area during 2004 and 2005 from a reedbed at Dorman's Pool (J. Duffie, A. Wheeldon; unpublished data).

In addition the Fen Wainscot *Arenostola phragmitidis* (Hb.) is the most recent to have been found to have become established. Apart from one record originating from 1976 during survey of a reedbed at Haverton Hill in the Borough of Stockton-on-Tees (Russell McAndrew, pers.comm., 2010) it was hitherto unknown in north-east England. Six areas of reedbed on brownfield sites in the North Tees and Billingham areas have now been shown to support this species which is resident at a low density on all of the sites with records spanning the period mid July to mid August. It has also now been found in Northumberland in 2011 (Tams, 2012).

The most important reedbed to date has been shown to be Portrack Marsh which supports good populations of Fen Wainscot and most of the other species (Woods, 2011b). Portrack Marsh was also the only brownfield wetland site to support populations of Double-lobed *Apamea ophiogramma* (Esper) and *Eudonia pallida* (Curtis) which are very local in north-east England.

### **Conservation of brownfield habitat in the Tees estuary**

The reported study of moths on brownfield sites in the Tees estuary has led to the discovery of resident populations of a number of species that are of national importance. These species lack statutory protection and they occur on sites which by the nature of their economic function also do not have statutory protection. Inevitably the biggest single threat to biodiversity in the Tees estuary is habitat loss or fragmentation in such an industrialised area where there is intensive pressure for land development. Areas can become so small and isolated that they begin to support critically small population sizes which cannot survive. Lack of active management can also be an important factor causing habitat loss in that reedbeds and grasslands will ultimately revert to scrub. It is, however, a quirk of fortune that many brownfield sites within the estuary have large areas of low-nutrient slag as substrate. This arrests the development of a dense sward containing competitive plant species.

Today's mantra in conservation is very much about a landscape approach that aims to link local populations by enhancing the connectivity of habitat across areas rather than by working with local populations in isolation. It can be seen that brownfield, post-industrial sites and industrial areas on the Tees are very important in this context, so it is important to adopt an approach that works with landowners. While this is not always possible some large organisations in the estuary are allowing parts of their land-holding to be managed for the purpose of nature conservation thus providing a valuable contribution to this landscape level approach to conservation. INCA has worked with a number of industrial organisations across the estuary since 1989 to achieve this aim. Working in partnership with industrial organisations to retain areas that have been identified as having a high potential for biodiversity has been very successful. To date at least six commercial organisations are working to maintain or enhance parts of their sites for biodiversity an approach which can only benefit wildlife including moths.

Thus, in summary, although there are a number of factors that potentially threaten the moth biodiversity in the geographical area covered by this paper there is also hope that a balance might be achieved which will allow wildlife to continue to co-exist successfully with the continuing need for progression and regional development.

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