Inquiry Document reference 37.5.2

Planning Inspectorate Ref: APP/V2255/V/24/3355313 & APP/V2255/V/24/3355314
Application Ref: 21/503906/EIOUT & 21/503914/EIOUT

Highsted Park, Sittingbourne

Expert Evidence in respect of Biodiversity

Volume 2 – Plans and Appendices

By

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BA (Hons), MA (Oxon), MSc, CEcol, CEnv, MCIEEM

February 2025

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Plan 4657/AB1:

Air Quality Effects Associated with A249 - Showing Full SPA Areas

(CD 37.5.2.A)

Key:

- The Swale SPA
- Medway Estuary & Marshes SPA
- Additional Area Subject to Exceedance of Lower Critical Load for N Deposition ('With Development' Scenario Relative to Projected Baseline)

aspect ecology
APEM Group

Aspect Ecology Limited - West Court - Hardwick Business Park
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Highsted Park (North and South)	PROJECT
Air Quality Effects Associated with A249 - Showing Full SPA Areas	TITLE
4657/AB1	DRAWING NO.
A/DM	REV
February 2025	DATE

P:\Project\Aspect Ecology Projects\ECO 4650\ECO 4657\Graphics\QGIS\4657 Air Quality plan.qgs

Appendices:

Appendix 4657/AB1:

European ecological designations (SAC, SPA, Ramsar) taken from Swale Borough Council Local Plan HRA 2021

(CD 37.5.2.B)

Outer Thames Estuary

Medway Estuary & Marshes (Ramsar and SPA)

The Swale (Ramsar and SPA)

Queendown Warren

North Downs Woodlands

Blean Complex

LEGEND

- Swale Borough
- Ramsar
- Special Protection Area (SPA)
- Special Area of Conservation (SAC)

Purpose of Issue: FOR ISSUE

Client: SWALE BOROUGH COUNCIL

Project Title: SWALE LOCAL PLAN

Drawing Title: LOCATION OF INTERNATIONALLY DESIGNATED SITES

Drawn	Checked	Approved	Date
CN	TD	IHH	15/01/2021

AECOM Internal Project No.: 60562065

Scale @ A3: 1:200,000

AECOM
Midpoint
Alencon Link, Basingstoke
Hampshire, RG21 7PP
Telephone (01256) 310200
Fax (01256) 310201
www.aecom.com

Drawing Number: FIGURE A1

Rev: 01

2.5 0 2.5 5 7.5 10 12.5 km

N

File Name:\\5004 - Information Systems\60562065 - Swale Local Plan\02_Maps\HRA Figures\Figure A1 - International Designated Sites.mxd

Appendix 4657/AB2:

Correspondence from Natural England dated 03 February 2025

(CD 37.5.2.C)

Date: 03 February 2025
Our ref: 498479
Application refs: 21/503914/EIOUT and 21/503906/EIOUT
DAS ref: A017323

Ben Geering MRTPI
Development Director
Quinn Estates

ben@quinn-estates.com

BY EMAIL ONLY

Customer Services
Hornbeam House
Crewe Business Park
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T 0300 060 3900

Dear Ben Geering,

Discretionary Advice Service (Charged Advice)

Development proposal and location: Highsted Park (North & South)

This advice is being provided as part of Natural England's Discretionary Advice Service. Quinn Estates has asked Natural England to provide advice upon:

- Resolving Habitats Regulations Assessment matters, namely potential Functionally Linked Land and Air Quality impacts, with the aim of ascertaining that the proposal will not result in adverse effects on the integrity of The Swale Special Protection Area (SPA) and Ramsar site and Medway Estuary and Marshes SPA and Ramsar site.

This advice is provided in accordance with the Quotation and Agreement dated 09 January 2025.

The following advice is based upon the information provided within *Highsted Park (North and South) Shadow Habitats Regulations Assessment (including Appropriate Assessment) (Updated December 2024),* and is intended to summarise the discussion held during our DAS meeting, which was held on Tuesday 21st January 2025.

Functionally Linked Land

Following our review of the updated shadow Habitats Regulations Assessment (December 2024), Natural England is satisfied that the proposed 16ha. of mitigation land, together with dog-proof fencing and scrubby vegetation on the boundary, would provide suitable alternative curlew habitat provided there is a maintenance plan in perpetuity which we would expect to be secured should the scheme be consented.

During the DAS meeting, Natural England sought clarity over the meaning of an adaptive management plan (mentioned in para 5.3.34 of the sHRA 2024) and asked whether this was about habitat management (for example, earthworm populations, habitat manipulation etc.) rather than a reduction or change to the mitigation land. Aspect Ecology confirmed that there was no intention to reduce the 16ha proposed and that the management of the mitigation land would be reactive to ensure it functions well. We concur that such a plan would provide certainty around the mitigation measures, and we advise this is more fully reflected within the final shadow Habitats Regulations Assessment (sHRA) and secured by planning condition should consent be granted.

Natural England also highlighted that we had concerns that paragraphs 3.3.33 and 3.3.35 (sHRA, 2024) suggested the proposed mitigation land could be reduced or be inadequate and that an alternative site might need to be proposed. We advised that there must be reasonable certainty

around the current proposed mitigation land in order to conclude no adverse effect on integrity of The Swale Special Protection Area (SPA) and Ramsar site, and this should be clearly communicated if so. Aspect Ecology reassured us that they are confident the current site for the proposed mitigation land is confirmed and can be delivered in order to meet the requirements of the HRA. They further explained that the applicant seeks some flexibility in order to potentially bring forward another piece of land. Natural England agrees this is an acceptable approach, providing another site is equal or better quality for curlew and that the principles against which other potential sites would be considered are agreed by all parties. We advise this approach would need to be reflected in the updated sHRA and secured by the Secretary of State, should permission be granted.

Air Quality

Following our review of the updated shadow Habitats Regulations Assessment (December 2024), Natural England is satisfied that though the modelled changes in air quality are likely to cause a significant effect, we do not believe that there will be an adverse effect on the features of both The Swale SPA and Medway Estuary and Marshes SPA. We do however remain concerned about the impact that changes in air quality (specifically nutrient enrichment and direct toxicity from ammonia) may have upon The Swale Ramsar site and Medway Estuary and Marshes Ramsar site, particularly on the higher plant features which are of international importance.

It is our advice that the sHRA looks at the features of both The Swale and Medway Estuary and Marshes Ramsar sites in more detail, with walkover habitat suitability surveys undertaken of the areas of the sites impacted by significant changes in air quality to ascertain whether features are either present or likely to be present. A full assessment of air quality impacts should be made for any Ramsar site plant species present/likely to be present within the impacted area of the sites and robust conclusions should be drawn to assist the competent authority in making their assessment. It should be noted that where impacted areas of the Ramsar sites are **completely** tidally inundated we are not concerned about air quality impacts, given the large nutrient inputs they already receive. However, areas which are only partially inundated or not inundated at all will require assessment.

In addition to the above, it is important to consider the retardation impacts of the proposed development (i.e. whether the development will slow the predicted decline in the presence of NOx and nitrogen deposition). If the proposed development is predicted to only slow the decline by <1 year then we can accept this as having no adverse effect, as air quality is assessed on an annual basis. It is important to note that this argument cannot be applied to ammonia (NH_3) as we are not seeing the same declines in this pollutant as we are for NOx and nitrogen deposition, due to cleaner vehicles still emitting ammonia.

Within the submitted sHRA several arguments are used to explain why there will not be an adverse effect on the relevant designated sites in relation to air quality and we provide comment on these below.

Paragraphs 5.4.19 and 6.3.16 of the sHRA suggest that because only a small percentage of the total designated site area is impacted, there is unlikely to be an adverse effect. While this can be an acceptable argument, it cannot be used in every circumstance. It may be that this small part of a site holds a species which is not located anywhere else and therefore the use of this argument relies on greater detail pertaining to the specific designated site. Therefore, if this argument is to be used, further narrative around the location of the features on both of the Ramsar sites should be provided.

Paragraphs 5.4.19 and 6.3.16 of the sHRA also infer that as the designated sites are located next to the A249, they will already be impacted by traffic related pollutants. While we accept this argument up to 5m from the roadside, significant changes in air quality have been modelled up to 40m and both designated sites currently have a ‘restore’ objective in place in relation to air quality. This means that any additional pollutants being added will prevent or slow the ability of the site to return to a ‘maintain’ objective. We therefore advise that this argument is removed, apart from in reference to impacts immediately adjacent to the road (<5m).

During the DAS meeting reference was made to Natural England Guidance NECR210 (Caporn et al, 2016[1]), although this has not been included within the updated sHRA. We advised on the use of this guidance in a previous response (our ref. 468898, April 2024), stating that it was used inappropriately. We continue to advise that NECR210 should only be used as a supporting rather than sole argument for no adverse effect.

Finally, we recommend that references to areas of the designated sites where the 1% threshold is exceeded but have background levels below the site relevant critical load or level should be removed from the sHRA for clarity. This is because there is unlikely to be a significant impact given that the background level remains below the relevant critical load or level.

Next Steps

As agreed during our meeting, Natural England are now awaiting the sharing of an updated sHRA by yourselves, which reflects the information discussed above including the details from the site visit to assess habitat suitability for the notable plant species. Discussion during the meeting suggested that this should hopefully be shared before the end of February. Please consult us on this directly once it is available, so that we may review it as soon as possible. We welcome the opportunity to work together to try and resolve HRA matters ahead of the inquiry.

Final Comments

This letter concludes Natural England's Advice within the Quotation and Agreement dated 09 January 2025.

☒ The advice provided in this letter has been through Natural England's Quality Assurance process

The advice provided within the Discretionary Advice Service is the professional advice of the Natural England adviser named below. It is the best advice that can be given based on the information provided so far. Its quality and detail is dependent upon the quality and depth of the information which has been provided. It does not constitute a statutory response or decision, which will be made by Natural England acting corporately in its role as statutory consultee to the competent authority after an application has been submitted. The advice given is therefore not binding in any way and is provided without prejudice to the consideration of any statutory consultation response or decision which may be made by Natural England in due course. The final judgement on any proposals by Natural England is reserved until an application is made and will be made on the information then available, including any modifications to the proposal made after receipt of discretionary advice. All pre-application advice is subject to review and revision in the light of changes in relevant considerations, including changes in relation to the facts, scientific knowledge/evidence, policy, guidance or law. Natural England will not accept any liability for the accuracy, adequacy or completeness of, nor will any express or implied warranty be given for, the advice. This exclusion does not extend to any fraudulent misrepresentation made by or on behalf of Natural England.

Yours sincerely,

Ruby Musgrove-Ward
Higher Officer – Sustainable Development
Area Team 14 – Sussex & Kent
Natural England

Cc. Matt Duigan, Swale Borough Council (MattDuigan@Swale.gov.uk)

[1] Caporn, S., Field, C., Payne, R., Dise, N., Britton, A., Emmett, B., Jones, L., Phoenix, G., S Power, S., Sheppard, L. & Stevens, C. 2016. *Assessing the effects of small increments of atmospheric nitrogen deposition (above the critical load) on semi-natural habitats of conservation importance.* Natural England Commissioned Reports, Number 210.

Appendix 4657/AB3:

Extracts from Kent Rare Plant Register. March 2024

(CD 37.5.2.D)

Kent Rare Plant Register

Compiled by Geoffrey Kitchener and the Kent Botanical Recording Group

Issue date: **March 2024**

Species accounts

This is an alphabetical series of accounts of the Kent rare plant species, split into separate Parts A, B, etc. including photographs, analyses of trends, distribution maps and site details. They were prepared over the period 2011-2023 and annually updated in the light of new records and information.

These are followed by

Register Appendix A:

Accounts of plants which were once on the register, but which have been removed

Register Appendix B:

'Probably extinct' plants which otherwise would have qualified for the register

Register Appendix C:

How the register was put together

Oxybasis chenopodioides (L.) S. Fuentes, Uotila & Borsch (*Chenopodium chenopodioides* (L.) Aellen) (Saltmarsh Goosefoot)

vc 15 and 16

Rarity / scarcity status

Saltmarsh Goosefoot is **nationally scarce**, being largely restricted to Essex, so that the Thames estuary represents its core distribution. As it has diminished in its East Anglian range and is a characteristic species of good quality coastal grazing marsh and saltmarsh, it is perhaps surprising that its conservation status in England and in Great Britain as a whole is one of 'Least Concern', but this presumably reflects a view regarding the stability of its populations. In Kent, it is not common, but is locally frequent where it does occur, and does not warrant designation for rarity or scarcity. It is a Kent axiophyte and so is indicative of good habitat.

Account

The first Kent find of *Oxybasis chenopodioides* appears to have been by J.T.B. Syme in 1852 at Gravesend[533]. It may be conjectured that it in the distant past it may have been a feature of the tidal marshes up the Thames to London, given that its pollen has been identified in the excavation of Roman material at Finsbury Circus. The pollen may not have originated in situ, of course, and could have arrived by various means, even (per Francis Rose, perhaps somewhat fancifully, *in litt.)* with oysters, gathered by the Romans off north Kent and transported! Marshall (in the Victoria History of the County of Kent, 1908) stated that it "only grows in the Thames salt-marshes and near Sandwich"; and the assessment of Hanbury & Marshall (1899) was that it was rather rare. There are specimens from the Pegwell Bay area near Sandwich gathered from the 1850s to the 1870s, but this does not seem to have been a locality which has persisted. Thereafter, the main concentration of records appears to have been from Shorne to Grain, although Francis Rose in the 1940s to the 1960s took the distribution eastwards to the Swale. There was also an odd eastern outlier in a brackish dike north of Stuart, St Nicholas at Wade.

Uplees Marshes. Photo by Lliam Rooney, 5 October 2010

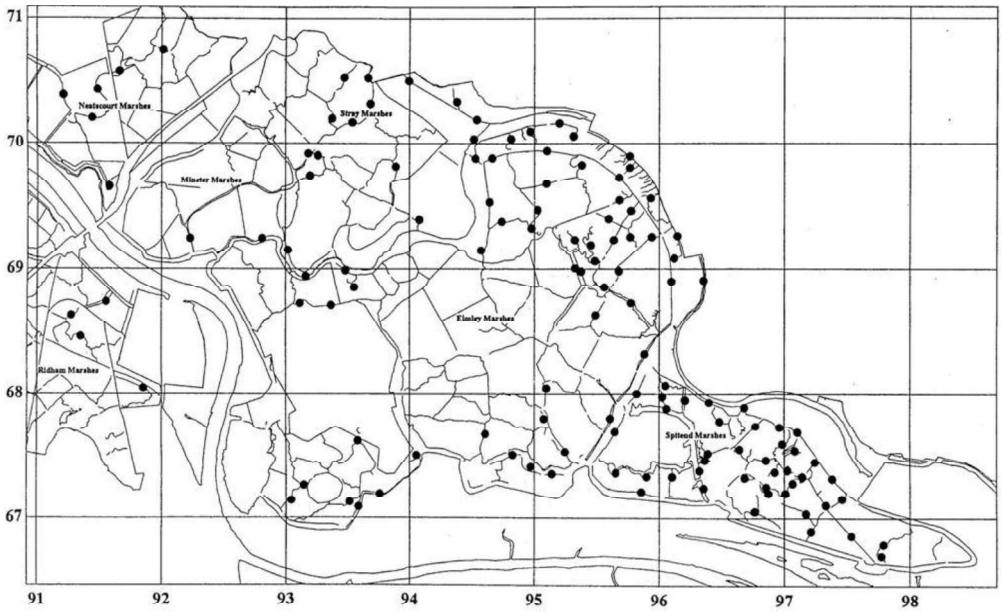
Philp (1982) for the period 1971-80 gave 21 tetrad records in the administrative county, almost all spanning the same part of the north Kent coast, and with concentrations at Grain and in south Sheppey. These records occur with greater continuity along the coast in Philp (2010), where 29 tetrad records are mapped. It is likely that the increase in records does not reflect a population increase, but rather relates to targeted recording. (The same is probably due of the coastal populations of *Oxybasis glauca* – see separate account.)

Nevertheless, there were during the survey period (1991-2005) further records not mapped in Philp (2010), arising in the course of a 1995 survey by Phil Williams[534]. of the ditches of the North Kent Marshes SSSIs, the first such comprehensive survey, and including the South Thames Estuary & Marshes SSSI, the Medway Estuary & Marshes SSSI and the Swale SSSI which together carry a drainage system of over 2,000 ditches. This survey covered *Oxybasis chenopodioides* records in 47 monads, which equate to 14 tetrads additional to the 29 tetrads given in Philp (2010). The extent of these records is such as to highlight that subsequent general recording can only be regarded as sampling. By way of illustration of the abundance of the species revealed by

[533] Mentioned in the Botanical Exchange Club Curator's Report for 1863 (1864), reviewed in Journal of Botany (1864).

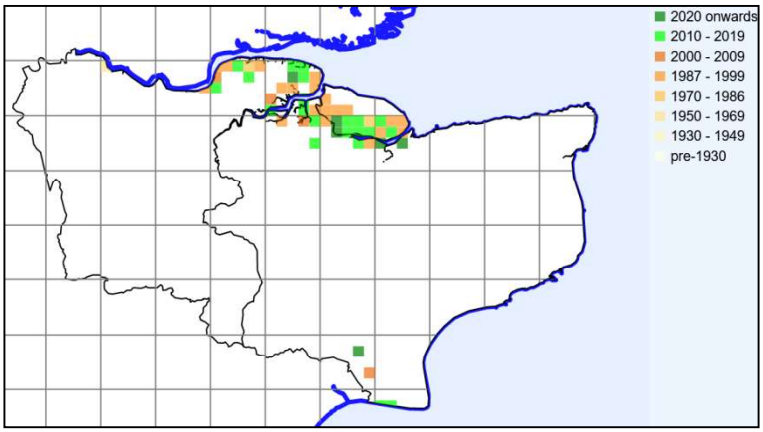
[534] Williams, P. (1996). *A survey of the ditch flora in the North Kent Marshes SSSIs, 1995*. English Nature Research reports no. 167.

full survey in 1995, the accompanying map, reproduced with kind permission of Phil Williams and Natural England, shows sites recorded in the south Sheppey marshes bounded by the old counter wall.



Neatcourt, Minster, Stray, Elmley and Spitend Marshes, 1995

There are occasional anomalies of Kent finds away from the Thames / Swale estuaries. Francis Rose recorded the species north west of Greatstone, in saltmarsh with *Bolboschoenus maritimus*, the site of the old Rother estuary. Both Philp (1982) and (2010) give an inland Romney Marsh record at TQ96T, which represents a population at Fairfield with records from 1962 (K.D. Rowlands, near the church, TQ 966 265) onwards. (The Fairfield site is 8 km inland, but the ditches are saline, which may be associated with the unusual thinness at this point of the layer of silty clay over peat, and with the possibility of the peat substrate holding salt from historic marine transgressions[535].) There have also been sightings (2013, 2018) by the A249 near Bobbing, presumably brought down from the estuary, but least 4km from any estuarial habitat. However, these are very much exceptions to the Thames / Swale focus of this species.



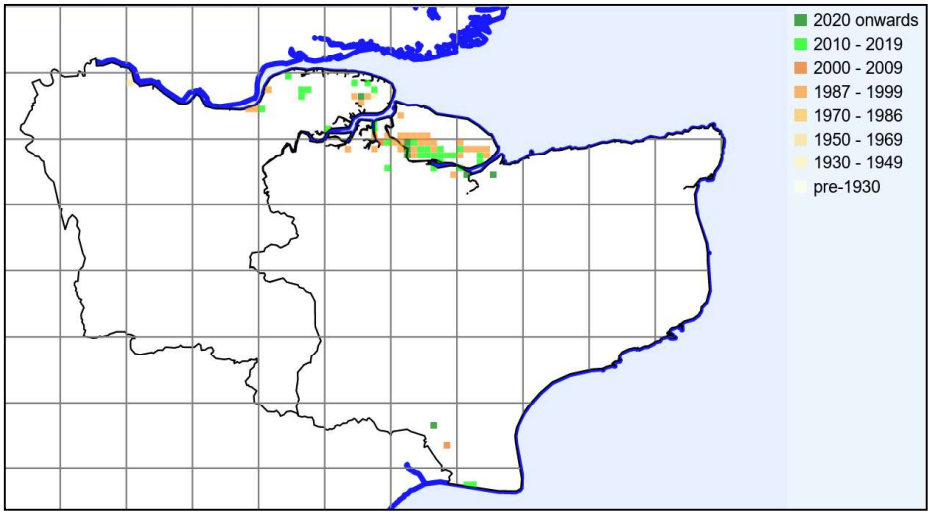
***Oxybasis chenopodioides* Kent records to 2023 mapped at tetrad level, from BSBI database.**

Our 2010-23 records have not quite reached the same coverage as obtained in Philp (2010), totalling 27 tetrads or 38 monads in comparison with 29 tetrads in the 1991-2005 survey. It is quite possible that this is a matter of underrecording, as many locations are remote of access and need to be visited at the right time of year. Not every year is suitable for this species: weather conditions in 2012 were not conducive, as summer and autumn rainfall kept water levels in ditches above where Saltmarsh Goosefoot would normally be growing.

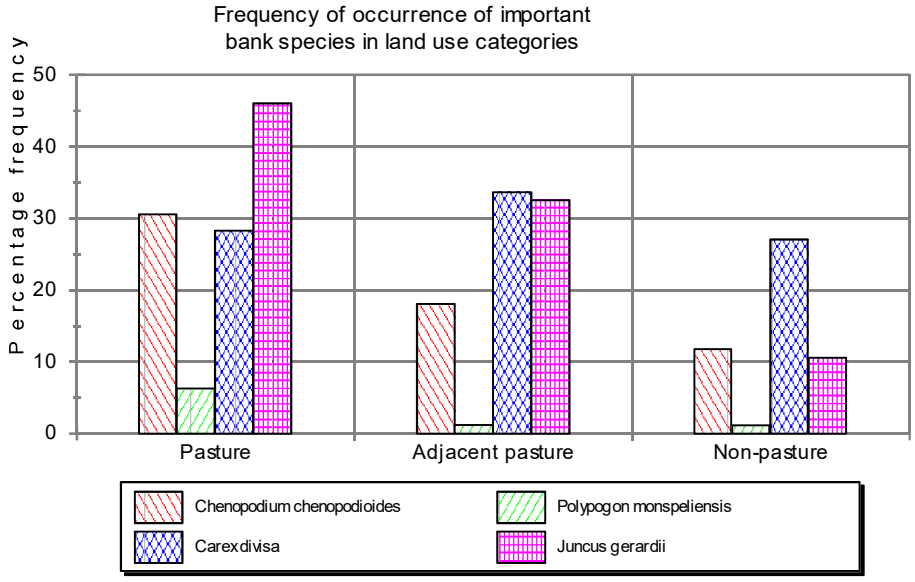
[535] Soil cross-section given in R.D. Green (1968). *Soils of Romney Marsh*, Agricultural research Council, Harpenden, pp. 32-33.

While absences of previously recorded sites are shown on the tetrad map above, fuller data at monad resolution are given in the distribution map below, largely confined to recent records as monad recording only became the norm in the county from 2010.

***Oxybasis chenopodioides* Kent records to 2023 mapped at monad level, from BSBI database.**



Saltmarsh Goosefoot is annual of brackish mud where exposed in late summer at the edge of coastal dikes or ditches, or in depressions in grazing marshes. Germination appears to require emergence of the mud from winter inundation (the water levels normally falling progressively through summer, drying out some ditches and increasing their salinity), so that the mud with its seed-bank is exposed to light and air. This may not be until July, so that the plant does not always reach full vigour until autumn. In a wet summer its numbers may be considerably reduced. Cattle or sheep stocking helps keep the mud open, trampling down the edges of ditches, and (observed by Rosemary FitzGerald at Swale NNR in 1986) creating through hoof-prints ephemeral habitats in which small plants may appear. The effect of poached ditch margins is borne out by Williams (1995) through an assessment of the frequency of the species in North Kent ditches adjoining different land uses. Saltmarsh Goosefoot was found to be most frequent in ditches adjoining pasture on both sides; less frequent in ditches adjoining pasture on one side; and least frequent in ditches adjoining non-pasture uses (see table below, reproduced with kind permission of Phil Williams and Natural England, in which the plant is given under its former name of *Chenopodium chenopodioides*). Population fluctuations may relate to the extent of disturbance (not just by cattle, but, including the excavation of mud when ditches are cleaned), or to the timing of mud drying out and warming up.



The more brackish ditches in the grazing marshes can be well populated by *Oxybasis chenopodioides*. Williams (1995) found it occurring in over 40% of the ditches in the Neatscourt to Spitend Marshes, in nearly 25% of the ditches in the Swale NNR and Capel Fleet (and along the entire length of Capel Fleet). Associated species are given by FitzGerald (1994)[536]and are mostly annuals reflecting the salinity of Saltmarsh Goosefoot's favoured habitats, including *Oxybasis rubra, Parapholis strigosa, Salicornia* spp. and *Suaeda maritima*; perennials include *Lysimachia maritima, Juncus gerardii* and *Spergularia* spp. At Shornmead fort (which Wolley Dod in 1893 supposed could have been Syme's original 1852 find location) it was found in October 1986 (Rosemary FitzGerald and Alan Leslie) in proximity to *Rumex palustris*, which also favours trampled ditch margins. At Grain, south of the A228 inside the sea wall of Colemouth Creek, it was in the same month recorded as associated with abundant *Polypogon monspeliensis*, which has similar habitat requirements, and was so plentiful that the course of the dried-up shallow fleets could be traced by its characteristic autumn red.

Fairfield. Photo by Owen Leyshon, September 2013

The frequent co-presence of *O. rubra* necessitates distinguishing its dwarf semi-prostrate forms from Saltmarsh Goosefoot. Typical Saltmarsh Goosefoot is more or less prostrate, red (at least on stem and leaf undersides) and with fleshy leaves, rounded-triangular and hardly (if at all) toothed. *O. rubra* is generally more erect, but often also red and with less fleshy leaves more toothed. The tepals of the lateral fruits in each cluster are in *O. chenopodioides* fused fully so as to hide the seed; in *O. rubra* they are fused half-way, so that the seed is visible.

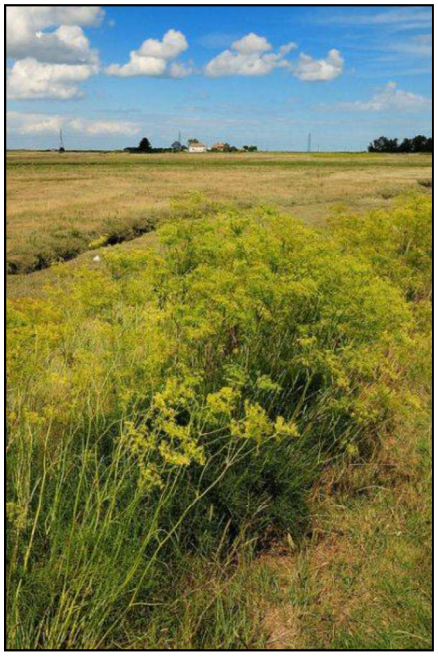
[536] *Chenopodium chenopodioides*, in Scarce Plants in Britain (1994), (eds.) A. Stewart, D.A. Pearman and C.D. Preston, JNCC, Peterborough.

Peucedanum officinale L. (Hog's Fennel)

vc15, extinct in vc16 (if it ever occurred there)

Rarity / scarcity status

Hog's Fennel is in the British Isles confined to coastal banks, grassland and saltmarsh in East Kent, Essex and Suffolk. It is **nationally rare**, but its conservation risk category is one of 'Least Concern'. Its European distribution is extraordinarily disjunct: the nearest continental localities are at Cap Fréhel on the north coast of Brittany west of Dinard, and in Alsace. In Kent, it is **scarce**. It is a Kent axiophyte and so is indicative of good habitat.



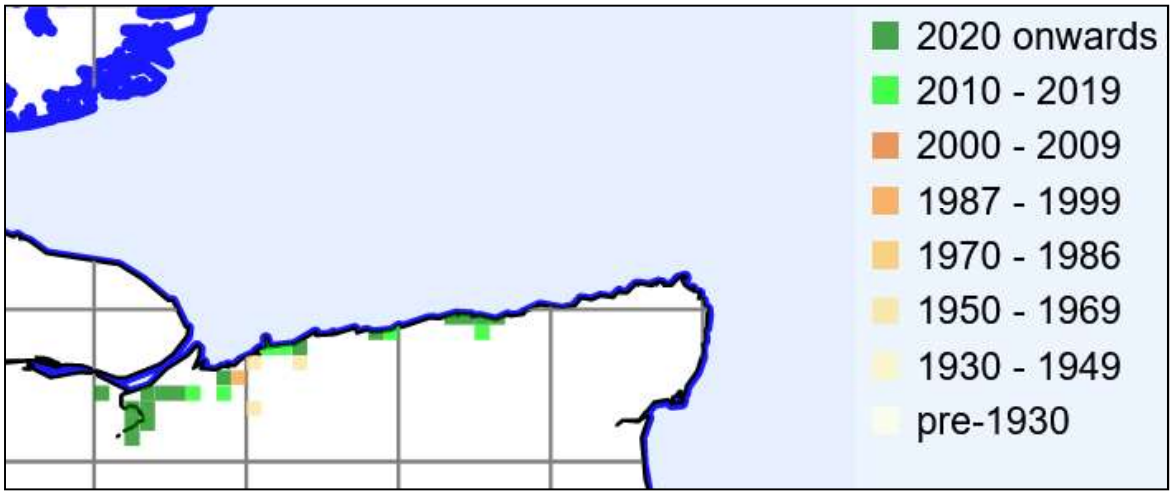
Faversham. Photo by Lliam Rooney, 31 July 2017

Account

John Gerard, in his *Herball* (1597), gave the first British records for 'Sulphurwoort or Hogs Fennell', showing knowledge of both Kent and Essex sites (it was not found in Suffolk until 1990). As regards Kent, he stated that it 'groweth…at Whitstable in Kent in a medow neere to the sea side, sometime belonging to Sir *Henrie Crispe*, and adjoining to his house there. It growth also in great plenty at Feversham in Kent, neere unto the haven upon the bankes thereof, and the medows adjoining.'.

These are still the core Kent locations, although there is now more extended presence along the north Kent coast between Faversham and Birchington. There is no indication that it has grown elsewhere in the county other than a reference in John Ray's *Catalogus Plantarum Angliae* (1677) to it growing at '*the River Thames in many places'*, which might well apply to West Kent. Given that there is no other such record, however, this must be regarded as questionable, although Hanbury & Marshall (1899) were of the view that 'The plant is quite likely to have grown by the river at that time, and to have become extinct owing to the erection of the existing high embankments and the drainage of the marshes'.

The distribution (for 2010-23 amounting to 13 tetrads, or 22 monads) is shown below, and, by and large this appears currently as extensive as it has ever been, if not more so. The status of the various populations is considered below in sections: Faversham; Faversham to Graveney Marshes; Seasalter/Whitstable; Whitstable/Tankerton to Swalecliffe and Herne Bay; Reculver to Birchington.



Peucedanum officinale **Kent records to 2023 mapped at tetrad level, from BSBI database.**

Faversham

This is a much-visited and extensive population. Historic records include John Blackstone's *Specimen Botanicu*m (1746) in which he refers to it 'On the Sea-wall leading from *Feversham* to *Thorne*, abundantly' – this is where Thorn Creek meets the east side of Faversham Creek, and it still grows there, although much of section from there to the centre of Faversham has been developed since. It is also present along the continuation of the sea wall coastwards, and Hanbury and Marshall (1899) refer to comments by A. Wolley Dod that it could be found as 'Abundant on the east side of Faversham Creek from the brickfields [these were between Thorne Creek and Faversham] to Nagden'. A visit communicated to the *Phytologist* (1861) **5:** 107-113 under the title *An account of a few hours' Observations in and about the ancient town of Faversham, Kent* also described what the botanical tourist might see: 'But the pride and the glory of the Faversham Flora is the Peucedanum officinale, a plant in these isles, almost exclusively confined to Kent; and this is the better known of its two Kentish reported stations. We hesitated about going to Whitstable in search of it, but ultimately concluded that our time would be better spent in searching the coast further south. This rare species still grows plentifully on the high bank which skirts the creek on the Faversham side of the river. If the tourist goes on straight to the harbour, and then follows the dike towards the east, leaving the creek on his right, he will soon see plenty of this plant'.

Faversham. Photo by Lliam Rooney, 23 July 2008

There are many later records, not adding a great deal of information other than simple presence, the most informative including:

- An estimate by Rosemary FitzGerald and C. Appleby on 14 June 1985 of as many as 10,000 plants along the seawall, TR 023 622.
- A count in 1989 communicated by Hector Wilks, of 8,000 plants for TR0262 and TR0362, but including the area enclosed as part of the old Nobel explosives factory only insofar as could be estimated by looking over the fence.
- G. Thornton, 1990, sightings at TR 023 619; TR 023 620; TR 024 620; TR 025 620; TR 025 621; TR 026 622; TR 028 624; TR 029 625; TR 030 625; TR 031 625 (these range from the outskirts of Faversham, beyond Thorn Creek but not as far as Nagden).

Some 2010-23 records are included in the data table below.

[Note: in this and subsequent data tables, only a selection of recent records is included.]

Site	Grid reference	Site status	Last record date	Recorder	Comments
Oare Marshes west	TR0064	SSSI	15 May 2023	LR & CW	TR 00981 64979, seawall, Swale west of Harty Ferry.
Faversham Creek south	TR0262	SSSI	(1) 20 April 2021 (2) 10 May 2014 (3) 5 May 2014 (4) 18 August 2010 (5) 30 April 2010	(1) CW (2) GK (3) GK (4) SB (5) GK	(1) Iron Wharf to mouth of Thorn Creek (noted as along sea wall on 13 April). (2) Still present along south side of creek from TR 0236 6213 to TR 029 625, with occasional gaps, sometimes in great abundance and locally dominant. (3) TR 02824 63373, several plants on sea defence embankment, west

					side of creek. (4) TR 02365 62136, plants ± continuous and closely spaced on both slopes of sea wall, Saxon Shore Way, for 300m. Then TR 02859 62442, plants ± continuous similarly northwards for 600m. (5) Many hundreds of plants by creek from TR 0236.6213 to TR 0300 6253 and beyond, also branch creek to TR 0235.6192, in rough tussocky grassland, except absent from a short section TR0266.6231 to TR0281.6239, less common further north.
Faversham Creek – Nagden Marshes	TR0263	SSSI	(1) 20 April 2021 (2) 5 May 2014	(1) CW (2) GK	(1) near Nagden (noted as along sea wall on 13 April). (1) TR 02824 63373, several plants on sea defence embankment, west side of creek, downstream of Nagden.
Faversham Creek Sandbanks	TR0362	SSSI	(1) 20 April 2021 (2) 10 May 2014 (3) 5 May 2014 (4) 15 August 2010 (5) 30 April 2010	(1) CW (2) GK (3) GK (4) SB (5) GK	(1) Thorn Creek to Nagden (2) Scattered along east side of creek, including TR 033 628, and most northerly on a grassy bank at TR 0328 6595. (3) TR 0303 6296, on grassy sea defence embankment, west side of creek. (4) TR 03279 62972 , Faversham Creek, east bank, south of Nagden Cottages, Plants densely spaced and continuous on grassy banks of sea wall (Saxon Shore Way) southwards for approx 170m. (5) Scattered plants alongside Faversham creek (east side) on or by rough grassy bank at least from TR 0300 6253 to TR 0310 6257.
Faversham Creek, Nagden	TR0363	SSSI	(1) 20 Apr 2021 (2) 14 March 2013	(1) CW (2) LR	(1) near Nagden (2) Scattered plants along the west side of Faversham Creek along the Saxon Shore Way.

Faversham. Photo by Lliam Rooney, 23 July 2008

Faversham to Graveney Marshes

These are scattered plants running from the mouth of Faversham Creek towards Whitstable Bay; but the western section (TR0364, TR0464 and TR0564) does not seem to have records before 2010.

Site	Grid reference	Site status	Last record date	Recorder	Comments
Castle Coote	TR0364	SSSI	(1) 26 April 2020 (2) 27 May 2011	(1) CW (2) LR	(1) 2 plants (2) TR 03744 64642, one plant, behind the sea wall, by the South Bank of The Swale Nature Reserve (Castle Coote).
Cleve Marshes	TR0464	SSSI	(1) 15 September 2021 (1) 12 August 2010	(1)KBRG meeting (1) GK	(1) Single plants on landward slope of sea wall at TR 0417 6477 and TR 0483 6493 and TR 0499 6491. (1) TR 04999 64911, behind estuarial wall.
Cleve Marshes	TR0564	SSSI	(1) 20 August 2022 (2) 19 August 2021 (3) 7 August 2011	(1) AL (2) RM (3) KFC meeting	(1) TR 0557 6481. One clump below the path by the first fence. (2) TR 055 648. (3) TR 0556 6482.
Graveney Marshes	TR0664	SSSI	21 July 2010	LR	TR 0625 6478, Faversham Road near the Sportsman Pub: several plants.

Seasalter/Whitstable

Records from Seasalter go at least back to 1889 (specimen in **CGE** collected by G. Dowker). Historic records for Whitstable may relate to the TR0965 location, but where any detail is given on nineteenth century herbarium labels, they seem more likely to relate to the coast east of Whitstable, including Tankerton and Swalecliffe, dealt with separately below. The original Gerard site at Whitstable, the meadow near the sea side at one time belonging to Sir Henry Crisp (died 1575) and adjoining his house, appears from Hasted's *History and Topographical Survey of the County of Kent* (1799) to have applied to a place called Grimgill. A farm of this name (or Crimgill) exists on 18th and 19th century maps (located in TR1065), and was nearer the influence of the sea in Gerard's time, when Lower Island was separated from Whitstable Street by the Salts.

Site	Grid reference	Site status	Last record date	Recorder	Comments
Seasalter	TR0864		29 September 2011	CO	Along roadside.
Seasalter	TR0865		(1) 02 June 2022 (2) 29 July 2017 (3) 23 June 2012 (4) 1989 (5) 7 August 1985 (6) c. 1974	(1) AL (2) AL (3) LR (4) comm. HW (5) RF (6) Philp (1982)	(1) TR 0823 6501. Several plants; increasing. (2) TR 0823 6501, behind the sea wall at Seasalter. (3) TR 08223 65020. 10+ plants on a wide roadside verge, Faversham Road, Seasalter. (4) 7 plants. (5) TR 083 650, on dry roadside bank near sea wall by caravan site: a patch 2.7m x 8.8m containing seven plants of which four were in flower; not in good condition as bank had been mown. Associated species: *Centaurium erythrea, Daucus carota, Linum bienne, Trifolium pratense, Helminthotheca echioides, Leontodon saxatile, Senecio jacobaea, Hypochaeris radicata, Plantago lanceolata, Festuca rubra, Holcus lanatus, Cynosurus cristatus.* (6) Given as TR06X, but was the same site as last.
Seasalter /	TR0965		(1) 1990	(1) GTh	(1) TR 097 655.

Whitstable			(2) 1989 (3) 24 September 1985	(2) comm. HW (3) RF	(2) One plant, TR 097 655. (3) TR 097 655, one plant with fruiting stems on a rough grassy bank on the landward side of the sea wall between Whitstable and Seasalter. Associated species were: *Senecio erucifolius, Lotus corniculatus, Lepidium draba, Trifolium pratense, Rubus caesius, Helminthotheca echioides, Festuca rubra, Lathyrus nissolia, Daucus carota, Rumex crispus*.

Whitstable/Tankerton to Swalecliffe and Herne Bay

This has long comprised a major population, or series of populations, based on the slopes running down to the sea either derived from, or still constituting, slumped London Clay cliffs. *Peucedanum* was noted by the Rev. W. Wood at the undercliff between Whitstable and Herne Bay (given in Matthew Cowell's *A Floral Guide for East Ken*t, 1839); but literature references are greatly outnumbered by collected specimens. The more informative herbarium labels tell us: 'Undercliff on broken ground, between Whitstable and Stud Hill Bay' (A. Bennett, 1873); 'Tankerton Bay, Whitstable to Herne Bay…Abundant towards "The Rock" [=Long Rock?]' (S. Wood & W. West, 1897); 'Broken ground near the sea near Whitstable' (J. Groves, 1902); 'London Clay Cliffs E of Whitstable' (A.O. Hume, 1903); 'Extremely abundant on the slopes facing the sea at Tankerton, near Whitstable' (J.E. Lousley, 1930); 'Tankerton Cliffs E. of Whitstable. Slipped London Clay cliffs' (Francis Rose, 1950). This abundance was affected by drainage schemes which began in the 1920s and 1940s, with a particularly damaging scheme put forward in the 1960s involving 'landscaping' and drainage which destroyed about half of the *Peucedanum* population. The remaining patches owe much to lobbying by Hector Wilks of the (then) Kent Trust for Nature Conservation and have since been protected by SSSI status, designated because of the *Peucedanum* population. Subsequent drainage works have been more circumspect, as needing to take account of approvals required by that status, and there is evidence that seedling appearance has increased after approved drainage works. In 1986 at the instigation of the owners, Canterbury City Council, some 400,000 seeds and many container-grown plants were planted out in trial plots on the slopes. The seed was obtained from Tankerton in 1985, and treated in Wye College to encourage germination. However, the transplants and seeds apparently did not establish well in areas where there was existing vegetation. Whether because or in spite of these attempts, the total population in 1989 was assessed at 2,500 (TR1167 and TR1267). The slopes are currently managed by Canterbury City Council under a management plan[550] which attempts to reconcile a wish to ensure that instability does not result in regression of the top of the slopes into the amenity land and roadway above against the conditions which suit *Peucedanu*m, an environment of tension cracks and shallow surface movements. These aims are not necessarily consistent: the area of the slopes with the most *Peucedanum* is opposite Pier Avenue and apparently has no drainage.

Seeds. Photo by Lliam Rooney, 10 September 2012

Further east of the Tankerton slopes, the coast juts out at Long Rock, Swalecliffe. This area held many plants in 1897, and there appears to have been an inland presence as well, in rough pastures on clay, ½ mile south west of Swalecliffe church (E.C. Wallace,

[550] *Queen Elizabeth II Diamond Jubilee Field: Tankerton's Coastal Park Management Plan 2014-2024*. Canterbury City Council. This includes management actions such as the removal of encroaching scrub; hand-pulling *of Smyrnium olusatrum* (Alexanders); limited mowing alongside footpaths, avoiding damage to *Peucedanum*; and leaving an unmown buffer zone at the top of the slopes.

1945). There were still a couple of Long Rock plants in 1960, when recorded by Hector Wilks (salting north of Kite Farm), and more recent sightings are given in the data table below.

There are old records further east along the coast, at Herne Bay: a specimen collected by W. Christy (**CGE**, 1838) and a reference in James Smith's *English Flora,* vol. 2, 1824 ('on a cliff, by the sea, at Hearn, 6 miles from Whitstable. *Mr. Crow of Feversham*.'). Marshall in the *Victoria History of the Counties of England: Kent* (1908) considered it was still there. Plants in this area were thought perhaps to have long been lost to erosion, but were found by Colin Osborne to be present in 2021.

Site	Grid reference	Site status	Last record date	Recorder	Comments
Whitstable/West Tankerton	TR1167	SSSI	(1) 18 August 2010 (2) 29 July 2010	(1) & (2) SB	(1) TR 11990 67314, Tankerton Slopes, spread of plants c. 450m eastwards (into TR1267) on grassy clay slope, 50m above the promenade, sometimes very densely spaced with 7-8 plants per 10m and also with gaps of no or very few plants. Plants terminate where beach huts begin at TR 12391 67321. Kent Wildlife Trust keeps the slope clear of invasive *Smyrnium olusatrum*. (2) TR 11958 67295, c. 70 plants on clay slope above promenade.
Tankerton	TR1267	SSSI	(1) 28 September 2019 (2) 9 April 2015 (3) 18 August 2010	(1) AW (2) JP (3) SB	(1) TR 123 673, Tankerton Slopes. (2) Survey of slopes and beach below Marine Parade. Several young plants now on edge of shingle. (2) TR 12128 67324, Tankerton Slopes, Spread of plants (from TR1167) c. 300m eastwards, details as above in relation to TR1167.
Swalecliffe	TR1367	SSSI	(1) 13 May 2023 (2) 9 September 2021 (3) 182 August 2021 (4) 28 June 2011 (5) 1990 (6) 1989 (7) 31 December 1987	(1) KFC meeting (2) BB (3) CO (4) LR (5) GTh (6) comm. HW (7) RF & JPtt	(1) TR 13730 67697. (2) rare in MG1a coastal neutral grassland, centre point TR 13535 67558. (3) Well grown plants on Long Rock SSSI. (4) TR 1369 6754. 20+ plants at Swalecliffe. (5) TR 136 675. (6) 37 plants at TR 136 675. (7) TR 1366 6754 [inferred]. Over 20 plants on ditch bank bordering disturbed ground. Associated species: *Anthriscus sylvestris*, *Artemisia vulgaris, Cirsium arvennse, Dactylis glomerata, Daucus carota, Elytrigia repens, Melilotus* sp., *Pastinaca sativa,, Helminthotheca echioides, Senecio erucifolius.*
Herne Bay	TR1868		(1) 19 July 2022 (2) 16 July 2021 (3) 2 May 2021	(1), (2), (3) CO	(1) Two plants adjoining top path at c. TR 188 683 plus four above promenade centered on c. TR 188 684 (2) 0ne large plant at Downs top at c. TR 188 683; three large plants plus one small just east of Coastguard Watch Hut. (3) Two patches of one and four plants just east of Coastguard Watch Hut, edge of slopes in proposed location for new beach huts.
Herne Bay, Beltinge	TR1968		6 May 2018	CO	One new plant behind sea wall at c. TR 1925 6845.

Reculver-Birchington

There are no early records for the coastline between Reculver and Birchington up to and including the 1971-80 survey of Philp (1982). The first appears to have been Rosemary FitzGerald's visit to Minnis Bay in 1987, when over 30 plants were seen around the sea defences. It has since been recorded in five tetrads and appears to be spreading.

Site	Grid reference	Site status	Last record date	Recorder	Comments
Reculver	TR2369	SSSI	(1) 25 August 2021 and 13 June 2020 (2) 9 September 2010 (3) 29 July 2010	(1) CO (2) CO (3) SB	(1) c. 8x6m patch at base of seawall (2)One plant on slope of sea wall. Recent colonist from Coldharbour (TR2569). (3) One plant each on landward slope of sea wall at TR 23432 69426, TR 23778 69430, TR 23979 69428, TR 23993 69429.
Knock Point, Reculver	TR2469	SSSI	(1) 25 August 2021 (2)12 April 2016	(1) CO (2) SB	(1) - (2) Single plant at TR 24300 69401.
South of Coldharbour lagoon	TR2568		(1) 2 July 2013 (2) 2 August 2010	(1) CO (2) SB	(1) Inland, near junction of railway embankment and track to sea, one plant. (2) One plant each on grassy bank by dyke, TR 25110 68738, TR 25170 68920.
Coldharbour lagoon	TR2569	SSSI	(1) 25 August 2021 (2) 29 July 2010 (3) 16 August 1987	(1) CO (2) SB (3) RF & HF	(1) - (2) (a) TR 25205 69263, dense stand of plants >80m x 10m. (b) TR 25224 69244, dense stand >100m x 25m on grassy bank of sea wall, south facing. (c) TR 25306 69262, plants scattered for further 70m eastwards on north facing side of sea wall. (3) TR 2525 6924 [inferred], over 30 plants scattered around the junction of embanked paths (sea defences) from railway and along coast, south of lagoon. Associated species: *Achillea millefolium, Cirsium arvense, Daucus carota, Elytrigia repens, Heracleum sphondylium, Melilotus alba, Medicago lupulina, Ononis spinosa, Pastinaca sativa, Picris hieracioides, Phragmites australis, Rumex crispus, Sonchus arvensis, Senecio erucifolius, Tripleuro-spermum maritimum.*
North of Wade Marsh	TR2669	SSSI	(1) 24 June 2021 (2) 5 September 2013 (3) 23 September 2011 (4) 30 September 2010	(1) CO (2) CO (3) CO (4) SB	(1) - (2) One patch at eastern end on landward side of seawall at c. TR 267 692. (3) One plant on seaward side of seawall at diversion round lagoon c. TR 267 692. (4) TR 26746 69196, seven plants, top of landward side of sea wall.

Reculver to Birchington. Photo by Sue Buckingham, 2 August 2010

The restriction of Hog's Fennel to these sites and coastal Essex and Suffolk suggests that a Continental climate favours the species, with relatively high summer temperatures and coastal prolongment of the growing season being required for seed to ripen fully. Our sites are on London Clay, most frequently on embankments, but also on damp ground below. It may be that the embanked clay habitats provide opportunities for seed establishment where summer baking of the clay opens up crack and winter rain erodes; and the classic slumping clay cliff habitat offers similar opportunities, due also to instability from drainage-related movement. It appears that Hog's Fennel grows typically where the summer water table is near the surface or less than 50cm below, but our embankment plants grow well where this is unlikely to be the case, which may be due, at least when established, to the massive and far-reaching tap root. Our plants on lower ground are clearly capable of tolerating the saline conditions of upper saltmarsh; this is particularly evident along parts of Faversham Creek.

Faversham. Photo by Lliam Rooney, 23 July 2008

The *Biological Flora of the British Isl*es account[551] mentions plants at Tankerton slopes as being the tallest in Britain, with many plants over 2m high and bearing as many as 50 flowering stems per plant in 1990. These large clumpy plants may be of considerable age and although there is no direct evidence of life expectancy, a sample mature plant excavated has been considered to be at least 25 years old. Shoots may emerge through root extension up to 50cm from a mature plant. Hog's Fennel may also spread by seed, with potential for up to 500,000 seeds from the largest plants. It is tempting to think of coastal spread as occurring by water, such as with the tides along Faversham Creek and thence into the Swale. But the seeds apparently have a flotation time of 4-6 days if undisturbed and this does not seem capable of affording any satisfactory explanation of coastal spread: the only young plants on shingle which have been noted recently have evidently spread from the land above, and most of our plants (except, perhaps, for Faversham) are on banks or cliff slopes, where spread of seed by wind is more relevant. But it is of course possible for seed which has fallen into the water of ditches and sunk to be spread on ditch banks in the course

[551] Randall, R.E. & Thornton, G. (1996). Biological Flora of the British Isles: *Peucedanum officinale* L. *Journal of Ecology* **84**: 475-485.

of ditch clearing. Similarly, coastal defence maintenance or construction works resulting in the movement of soil may distribute seed or rootstock.

Peucedanum officinale is the sole host plant in Great Britain for larvae of the micromoth *Agonopterix putridella*, recorded at Tankerton Slopes and Coldharbour. *Gortyna borelii lunata* (Fisher's estuarine moth) uses it as its main host plant and about 20% of moth's UK population is at Tankerton/Swalecliffe.

It is unlikely that *Peucedanum officinale* will be confused with any other British plant, except perhaps for *Foeniculum vulgare* (Fennel) which can occupy similar coastal habitats but which is less robust and has filiform (rather than linear) leaflets which smell of aniseed when crushed.

Bupleurum tenuissimum L. (Slender Hare's-ear)

vc15 and 16

Rarity / scarcity status:

The Slender Hare's-ear is **nationally scarce**. Although the distribution has been regarded as largely stable for some time[78], there have been some losses, particularly in the northerly part of its distribution, such that it is considered to be **Vulnerable**, both in England and Great Britain as a whole. It is included as a species of principal importance for the purpose of conserving biodiversity under Section 41 of the Natural Environment and Rural Communities Act 2006 and is said to be a good indicator of a coastal habitat threatened by agricultural intensification and development (the quality of its habitat is recognised by the plant's treatment as a Kent axiophyte). In Kent, it is uncommon, but sufficiently well represented around Sheppey and the Hoo peninsular so as not to be treated as locally rare or scarce.

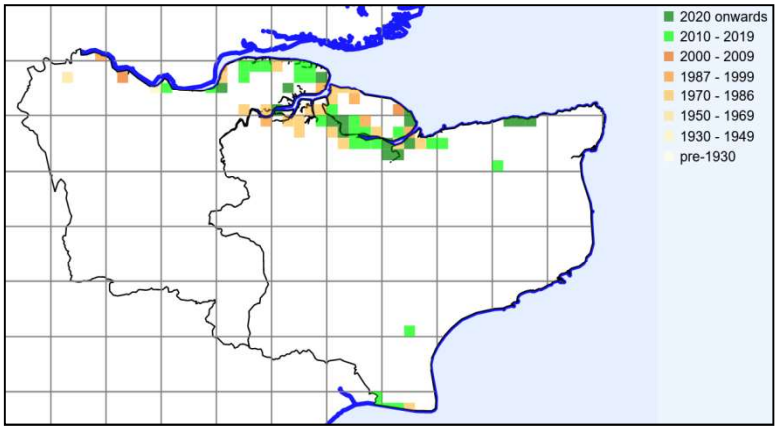
Leysdown. Photo by Lliam Rooney, 22 August 2011

Account:

This species was first noted in Kent by John Ray in his *Synopsis Methodica Stirpium Britannicarum* (3rd edn., 1724) as found "near the Ferry in the Isle of Thanet, by Mr. J Sherard". Hanbury & Marshall (1899) refer to it as being frequent at banks and marshes near the sea and tidal waters, giving a historic distribution including its present north Kent range, but extending also to the north east coast and to the Dymchurch area. These latter locations no longer harbour *Bupleurum tenuissimum* to the same degree, but Philp (1982) gives three tetrad records in the Lydd Ranges area. The non-appearance of records here in Philp (2010) represents difficulties of access to the Ranges, rather than a distributional decline.

Overall, Philp (1982) recorded it in 45 tetrads, noting it as very local but sometimes quite abundant on the north coast. The total of 24 tetrads given in Philp (2010) for the period 1991-2005 suggests a decline of 47%. However, this is not borne out by our 2010-23 records, which total 43 tetrads (60 monads).

***Bupleurum tenuissimum* Kent records to 2023 mapped at tetrad level, from BSBI database**

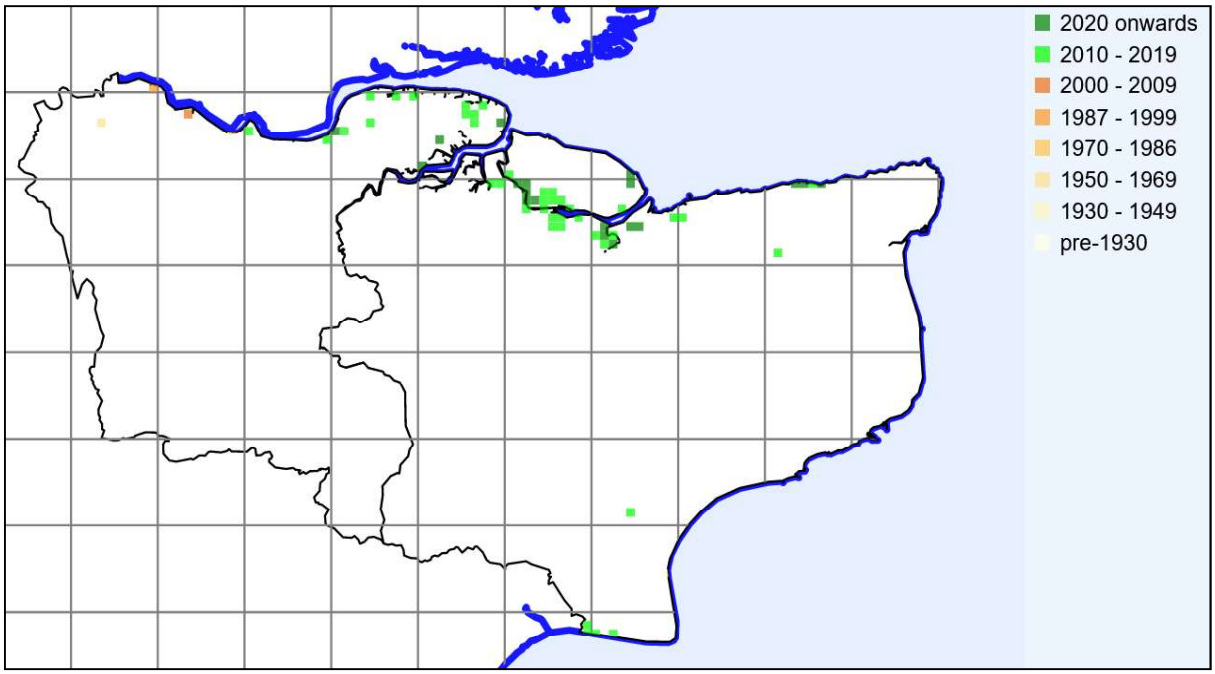


Recording in 2010-23 has re-found in nearly all locations where records were made in 1991-2005. This has included re-finding at some earlier locations as well, e.g. at Reculver and Dungeness, where records were shown in the vicinity in Philp (1982). However, we have not re-found the full extent its occurrence identified in the 1971-80 survey along the Medway estuary, including part of Sheppey. The issues may be the same as for *Artemisia maritima* (Sea Wormwood), i.e. that the absence of recent record may be an effect of riparian development together with difficulties of access. Subject to this, it

[78] According to the *New Atlas of the British and Irish Flora* (2002).

looks as though the distribution may have been broadly stable from the 1970s; or if there has been any decline, then it is not continuing. The current position is shown at higher resolution in the following distribution map. Since recording was not usually undertaken at this level of resolution before 2010, our register data given here at monad level include only one older record (Margot Godfrey's 2009 record on the west side of the River Darent flood barrage, TQ5377, the only established metropolitan West Kent, or indeed, Greater London, site).

***Bupleurum tenuissimum* Kent records to 2023 mapped at monad level, from BSBI database**



Elsewhere in Great Britain, there have been some inland populations, now largely gone; but this does not appear to have been a type of occurrence in Kent, other than the discovery in 2014 by Alfred Gay of two small groups of plants on slightly damp and disturbed areas on colliery spoil at Stodmarsh NNR, about 8 km inland from the nearest coastal population at Reculver. The species was seen in 1982 on the centre reservation of the A2 near Dartford, but otherwise has not followed the passage of saltmarsh plants along highways affected by de-icing salt, although it has been seen in 2017 by ordinary residential roads at Whitstable/Seasalter. A 2019 record from Newchurch, over 5km from the coast, was of plants on roadside bare ground where vehicles are likely to have parked; its origin, however, remains mysterious, as this is over 13km from the nearest coastal colonies which themselves are not conventionally accessible to vehicles, being within Lydd Ranges MOD land: it may represent spread from undetected survival at Dymchurch.

Allhallows Marshes. Photo by David Steere, 19 August 2018

Bupleurum tenuissimum is an inconspicuous annual, flowering from July to September, and appears reliant upon open areas with some bare ground for germination and establishment. It is accordingly subject to population fluctuations. Normally, members of

Apiaceae have seeds with relatively short-lived viability, but seeds of *Bupleurum tenuissimum* have been germinated from herbarium specimens 144 years old[79], which may suggest that populations may recover from apparent extinction if appropriate conditions are provided, although it may be that development after germination is insufficient to ensure viability.

Cleve Marshes. Photo by Geoffrey Kitchener, 12 August 2010. An extensive colony of *B. tenuissimum* in the vehicle tracks below the sea wall.

Characteristically, it may be found on the landward side of sea or estuarial walls, where there is saline influence and there has been some disturbance, such as trampling or vehicle movement. In particular, it is often seen on open grassy ground between sea walls and parallel marsh dykes, where vegetation is not too coarse. It may be overlooked because the thin, wiry stems merge with the grass and the flowers are small. Francis Rose (MS *Flora of Kent*) mentions an association with *Sison* (*Petroselinum*) *segetum*, both growing near the coast and tidal rivers in habitats where competition, except from grasses, is slight.

Habitat, Allhallows Marshes. Photo by David Steere, 19 August 2018

Cleve Marshes. Photo by Lliam Rooney, 12 August 2010, showing how inconspicuous the plant is, against a background of grasses

[79] Godefroid, S. *et al.* (2011.) Viability of seeds from old herbarium specimens, *Taxon* **60 (2):** 565–569.

Spartina maritima (Curtis) Fernald (Small Cord-grass)

vc 15, gone from vc16

Rarity / scarcity status

Spartina maritima is a coastal or estuarial plant, whose main current distribution is in Hampshire, including the Isle of Wight; Essex; Suffolk and the Wash. It was formerly much more widespread, but its range has contracted such that its status is now **nationally scarce** and **Endangered**, the extent of its occupancy in England having declined by 57% in comparing data from 1930-60 and 1987-99 respectively. It is a species of principal importance for the purpose of conserving biodiversity under Section 41 of the Natural Environment and Rural Communities Act 2006. In Kent, there was an absence of sightings after 1990 which led to it being placed on the 'probably extinct' list; but it was re-found in 2020 and is to be regarded as very **rare**.

Castle Coote. Photo by Lliam Rooney, 26 October 2020

Account

The first Kent record of this species is probably by Thomas Johnson in his *Iter Plantarum* (1629), where he mentions *Spartum nostras parvum* along the seashore.[800] Otherwise, it is not noted until the early nineteenth century. Samuel Goodenough, Bishop of Carlisle, noted it as plentiful on Sheppey Isle (given in Sir James Smith's *English Flora*, vol. 1, 1824). Matthew Cowell's *A Floral Guide for East Kent, etc*. (1839) attributed to the Rev. W. Wood a record of the Cord-grass between Whitstable and Seasalter; and referred to it also being alongside Oare Creek and at Harty Ferry. Hanbury & Marshall (1899) gave only these records, and described it as rare and very local on muddy sea-shores.

Castle Coote. Photo by Lliam Rooney, 19 July 2021

Francis Rose in his manuscript *Flora of Kent* mentioned it as rare in St Mary's Bay, St Mary Hoo in 1958; this appears to be the last vc16 record. He also noted it as still present in some of the historic sites: it was still present at Sheppey (Shellness, 1946-60; East Harty Marshes, 1946; West Harty Marshes, 1947; and Windmill Creek at the east end of Elmley, 1949) and also on the mainland across the Swale, viz. at Nagden Marshes (1924 and 1945-60) as well as the west side of Oare Creek.

Philp (1982) described it as a very rare plant of mudflats, then only known from one locality along the Swale off Nagden Marshes (TR06H). The reference to "off" Nagden Marshes suggests that this was Castle Coote (South Bank of Swale Nature Reserve) because this low-lying area projects into the Swale north of the marshes. At this location it was sighted by a WFS meeting on 12 August 1990[801] (subsequently confirmed by Eric Philp from material collected then). Whilst it was

[800] The identity is not beyond doubt. This Latin name has elsewhere been applied to *Nardus stricta* (Mat-grass), which can scarcely have been present here. Francis Rose considered that there was a possibility *that Elymus athericus* was intended, although *Spartina maritima* was more likely.

[801] Local meetings, 1990, in *Wild Flower Magazine* (1991) **420**: 12.

apparently also seen by Eric Philp at Harty Ferry in 1988, in Philp (2010) he declared that, although specifically searched for, it could not be found in any of its previous known localities during his 1991-2005 survey and might be extinct.

The species was subsequently placed on the county 'probably extinct' list and it was not until 2020 that it was seen again, in one of the traditional localities, at Castle Coote. This sighting was made on 23 October by Fred Rumsey, Lliam Rooney and Caroline Ware, and the latter two revisited the next day to gather further data. Plants were seen at TR 03447 64736, which is a relatively high, dry and flat area of saltmarsh in the *Puccinellia maritima* (Common Saltmarsh-grass) zone, containing a few shallow pools. *Spartina anglica* (Common Cord-grass) was also present, mostly around the pool margins. Other associated species were those to be expected in such a saltmarsh habitat, including *Salicornia ramosissima* (Purple Glasswort) and *Salicornia disarticulata* (One-flowered Glasswort). The *S. maritima* plants were noticeable as being in tightly clustered spiky tufts with upright leaves, narrower than those of *S. anglica* in not exceeding 6mm across (those of *S. anglica* are 6-11mm across when flat).

S. anglica should be capable of being differentiated by the long terminal bristle extending the rachis of the inflorescence (1.8-5(5.5)cm, compared with 0.8-1.8(2.1) cm for *S. maritima*), but this could not observed consistently because of the loss of *S. anglica* bristles. Ligules also differ between the species, with that of *S. anglica* being (1)1.4-3.2mm long and *S.maritima* 0.3-0.8mm; in this case, the ligules were so small as to be scarcely observable. The site was also visited by a KBRG meeting on 15 September 2021, when the grass was noted as scattered in an area of saltmarsh c.25m x 10m.

Habitat, Castle Coote (note the presence of *Limonium vulgare* as well). Photo by Lliam Rooney, 19 July 2021

As well as being the smallest European *Spartina* species, *S. maritima* has an appearance of weak growth amongst other saltmarsh vegetation, contrasting with the larger and more vigorous *S. anglica*, which often forms large colonies on otherwise bare coastal or estuarial mud. Marchant & Goodman (1969)[802], however, refer to a wider amplitude of habitat for *S. maritima* elsewhere, including soft mud within gullies or alone in saltmarsh pans flooded at each high tide, as well as long-established turf of the upper saltmarsh. Gray (1994)[803] describes its upper saltmarsh habitat as one where the lower turf, with its wetter, possibly more saline depressions is preferred: *Limonium vulgare* (Common Sea-lavender) is a constant companion, and the presence of *Tripolium pannonicum* (Sea Aster) and *Atriplex portulacoides* (Sea-purslane) at more than a low density may show that it is too wet for *S. maritima*.

Small Cord-grass may spread by its relatively short rhizomes, or from vegetative fragments. Seed is probably very rare in Britain and this, coupled with its lack of vigour, may be a consequence of its being at the northern

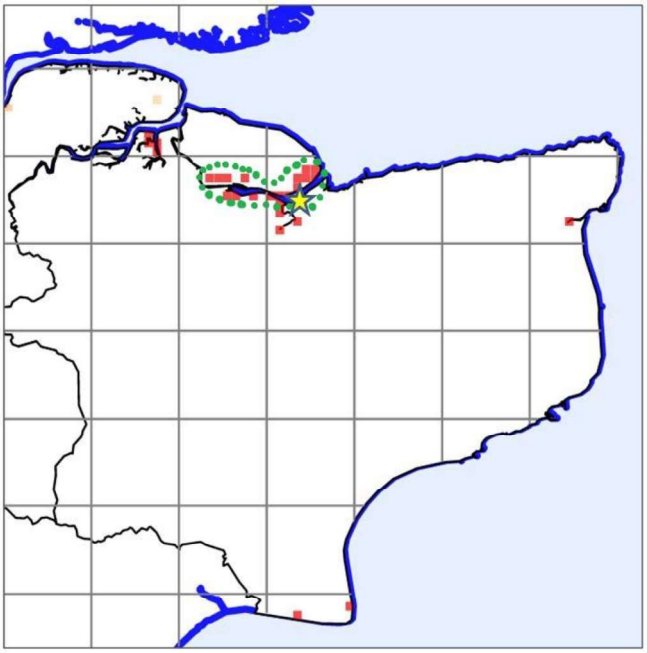
[802] Marchant, C.J. & Goodman, P.J. (1969). *Spartina maritima* (Curtis) Fernald. Biological Flora of the British Isles. Journal of Ecology **57**: 287-291.

[803] Gray, A.J. (1994). *Spartina maritima* (Curtis) Fern. Small cord-grass. In (eds.) Stewart, A., Pearman, D.A. & Preston, C.D. (1994) *Scarce Plants in Britain*, JNCC, Peterborough.

edge of its range. Gray (1994) refers to it being a tall, sward-forming plant in Spain and the southern part of its range, and possessing a method of photosynthesis more typical of tropical species. Always rare in Kent, it is unlikely that it has been ousted by *S. anglica*; Raybould et al. (1991)[804] attribute much of its British decline to physical erosion of its habitats, which may produce bare mud suitable for colonisation by *S. anglica*. It is possible that other successional changes could occur affecting growth conditions, such as the invasion of tall *Atriplex portulacoides* (Sea-purslane).

S. maritima and *S. anglica* are both related. *S. maritima* was originally the only British Cord-grass, but it encountered introduced *Spartina alterniflora* (Smooth Cord-grass) in Southampton Water before 1870, and the two species hybridised. By 1892 a new fertile form had arisen there of allopolyploid origin, although not named as a species (*S. anglica*) until 1978. All Kent records of *S. maritima* x *alterniflora* (*S*. x *townsendii*) are likely to be of *S. anglica*, which has been planted to consolidate mud-flats as well as having spread on its own account.

It will be worthwhile searching the other historic sites mentioned above in order to see if *S. maritima* has been overlooked elsewhere. In order to focus on appropriate habitat, it is suggested that attention is directed to where *Salicornia disarticulata* may be found. The accompanying map shows East Kent monads where the *Salicornia* has been found 2010-23; a yellow star marks the *Spartina maritima* site; and green dots encircle the historic sites for that species, where search may be concentrated.



[804] Raybould, A.F., Gray, A.J., Lawrence, M.J. & Marshall, D.F. (1991). The evolution of *Spartina anglica* C.E. Hubbard (Gramineae): genetic variation and status of parental species in Britain. *Biological Journal of the Linnean Society* **44**: 369-380.

Limbarda crithmoides (L.) Dumort. (= *Inula crithmoides* L.) (Golden-samphire)

Limbardaa crithmoides was on the rare plant register 2011-23. It was removed because, although it was originally included on the basis of national scarcity, the BSBI's reassessment in the course of its Atlas 2020 project removed that status. It remains a Kent axiophyte, indicative of good habitat, especially as regards coastal or estuarial margins and upper saltmarsh. This account is the March 2022 version and, except as regards insect data, has not been updated since.

vc 15 and 16

Rarity / scarcity status:

Limbarda crithmoides is a local plant of coastal habitats in southern parts of the British Isles. Its conservation status is regarded as one of 'Least Concern', both in England and Great Britain as a whole; but it is a **nationally scarce** species. North Kent is one of the areas in which it is most abundant, and it warrants no particular rarity/scarcity designation in the county.

Account:

Golden-samphire enjoys very early notice in the county, being recorded by John Gerard in his *Herball* (1597) as Crithmum Chrysanthemum or Golden Sampier which 'groweth in the mirie Marsh in the yle of Shepey, as you go from the Kings ferrie to Sherland house' (presumably Shurland Hall, Eastchurch). Except for orthography, this description of distribution remained unaltered in Thomas Johnson's 1633 edition of the *Herball*. Johnson had himself seen it at Sheppey, listing it in his *Iter Plantarum* (1629) amongst plants such as *Atriplex portulacoides* (Sea-purslane) and *Salicornia* sp. (Glasswort) around Sheerness, after his botanical party had survived interrogation by the Mayor of Queenborough, who was suspicious of the group's motives.

Oare. Photos by Lliam Rooney, 19 August 2010.

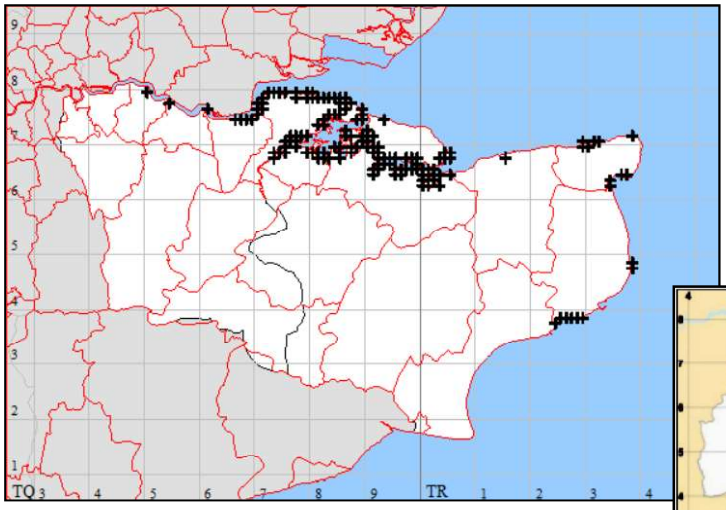
Hanbury and Marshall (1899) regarded *Limbarda crithmoides* as rare and very local on muddy coasts (so the position has changed since then) , listing it (as well as at Sheppey) on the mainland coast in locations from Rainham to Faversham and Seasalter. Habitats included creeks and ditches, and it was reported by C.P. Hurst for the 1899 Flora as being abundant at Conyer's Creek. Abundance below Rainham can also be inferred from the Flora's listed records, although these do not include a collection by Joseph French in 1848 at the marshes there (specimen in the University of Birmingham herbarium).

Francis Rose considered it to be a native of well-drained upper parts of salt-marshes, both on firm alluvial mud and on sand, usually with *Atriplex portulacoides* (Sea-purslane), *Elymus athericus* (Sea Couch) and *Festuca rubra* (Red Fescue), and on stone-faced sea walls, common and abundant

locally in the Thames-Medway-Swale estuarine system from High Halstow on the Thames and above Upnor on the Medway, to Seasalter; also on chalk cliffs, very rare and only known at Minnis Bay and Folkestone warren.

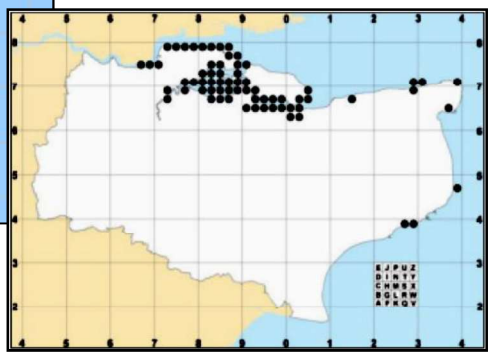
In the 1971-80 county survey (Philp, 1982), Eric Philp described it as very local, but often frequent where it does occur. That survey gave records for 63 tetrads, and the 1991-2005 survey (Philp, 2010) evidenced a fairly similar distribution, with 67 tetrads. The position is again broadly similar as regards 2010-21 records, with 81 tetrads (148 monads), so that the distributional status is fairly stable and, if anything, increasing.

As Golden-samphire is not uncommon in Kent, the distributional data maintained in this register will be at 1km square (monad) level. This will entail recording at a finer scale than the tetrads given in Philp (2010), from which the following 1991-2005 map is taken (with kind permission of the late Eric Philp and the Kent Field Club).



Limbarda crithmoides **(Golden-samphire) 2010-21**

Limbarda crithmoides **(Golden-samphire) 1991-2005**



It may be that the species has become more common in Kent since 1899 (or, indeed, 1930), since its presence was not then recognized along the Thames estuary on the north of the Hoo peninsula and towards Eastcourt Marshes; nor on Thanet and down the coast as far as Folkestone. It is possible that sea wall construction or improvement has provided suitable habitat for Golden-samphire, although the reverse might have been expected, and it does not provide an explanation for some of the newer locations.

Hoo, shoreline habitat. Photo by David Steere, 31 July 2015.

Limbarda crithmoides is frequently found in linear populations along the north Kent coast, particularly by the Thames, Medway and Swale estuaries just within reach of high tides. These populations may be extensive: in 2010 it was recorded as an almost unbroken chain along the coastline between Harty Ferry (Oare) and Conyer Creek. It may be found within the north Kent saltmarshes, amongst saltmarsh plants such as *Atriplex portulacoides* (Sea-purslane) *Limonium vulgare* (Common Sea-lavender) and it may line the channels there. More often, however, it is seen growing along the upper reaches of saltmarsh, merging into

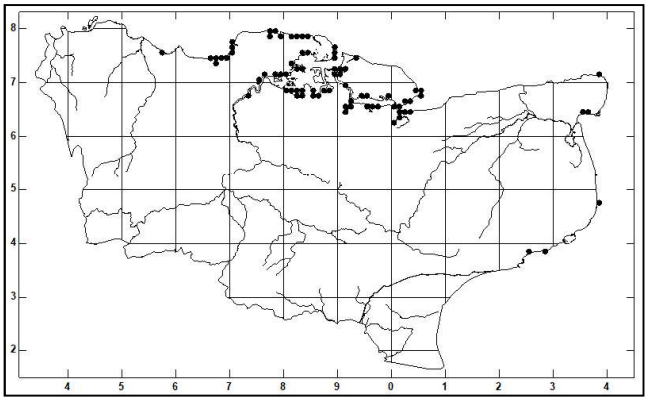
the spring high tidemark habitat where it also grows extensively in the absence of saltmarsh. It has been recorded at the base of sea walls (on the maritime side); within the sea wall sloping stone batter; and at the crest, where land vegetation begins. Occasionally, it appears alongside saline ditches landward of the sea wall, and it has been recorded further inland near Faversham, by a sandy track over 400m inland from Oare Creek.

Unusually, it appears scattered on the East Kent chalk cliffs, a habitat which was not observed at all by the earlier botanists in Kent and which appears[980] to be a habitat type found in Kent and westwards in Great Britain from Purbeck. The earliest such sighting appears to have been by Francis Rose, who collected material in 1947 from chalk cliffs by the sea at East Wear Bay, Folkestone; and this may have been the location within the more exposed cliff zone subject to spraydrift with halophyte vegetation mentioned in Rose & Gehu (1964)[981]. We now have records from 2010 onwards, not only for the base of chalk cliffs at East Wear Bay, but also at Samphire Hoe, Ramsgate, Cliftonville, Westgate, Birchington and at the base of cliffs on the edge of a small salt marsh created by a break in sea defences at Kingsdown. Rodwell (2000)[982] points to the possibility of there being distinct ecotypes of *Limbarda crithmoides* in view of the striking difference in distribution of the saltmarsh and maritime cliff vegetation communities.

Grain, sea wall habitat. Photo by David Steere, 23 June 2015.

Limbarda crithmoides should not be capable of confusion with other species, but a non-flowering plant might resemble *Suaeda vera* (Shrubby Sea-blite), which is rare in Kent. Both have succulent leaves (as with many plants which need to store water in a saline environment), but those of *Inula crithmoides* are somewhat toothed.

A fly, *Myopites eximius* Séguy (sometimes given as *eximia*), known globally only from the coasts of northern France, including the Channel Islands, and the coasts of southern England and Wales, is associated exclusively with *Limbarda crithmoides*. Larvae form galls in the capitula, which become thickened and enlarged, with a hard woody texture, within which the larvae are cocooned. The first known Kent record was in 1939, and after 1950 there appears to have been a gap in sightings until 1982. The cumulative position to 2022 as regards Kent records (77 of them) is illustrated in the accompanying monad map which necessarily is also a record for the presence of *Limbarda crithmoides.*



Myopites eximius, Kent monad records

This account has benefited greatly from the assistance of Laurence Clemons as regards the insect associations of the plant.

[980] Malloch, A.J.C. (1994), *Inula crithmoides* L. . in eds. Stewart, A., Pearman, D.A. & Preston, C.D., *Scarce Plants in Britain,* JNCC.

[981] Rose, F. & Géhu, J.M. (1964), Essai de phytogéographie comparée. La végétation du Sud-Est de L'Angleterre et ses analogies avec celle du Nord de la France. *Bulletin de la société botanique de France 90ème session extraordinaire:* 38-70.

[982] Rodwell, J.S., ed., *British Plant Communities* vol.5, Maritime communities and vegetation of open habitats.

Carex divisa Huds. (Divided Sedge)

vc 15 and 16

Rarity / scarcity status

Carex divisa is regarded as **scarce** and **Vulnerable** in Great Britain, primarily a plant of the south east, with potential to be affected by coastal development or conversion of grazing marshes, and it is treated as a species of principal importance for the purpose of conserving biodiversity under Section 41 of the Natural Environment and Rural Communities Act 2006. In spite of this, its risk status in England is one of 'Least Concern'. Indeed, in Kent it is quite common in low coastal areas and no county designation of scarcity is appropriate, but it is listed as a county axiophyte, indicative of good habitat.

Grain marshes. Photo by Geoffrey Kitchener, 10 May 2011

Account

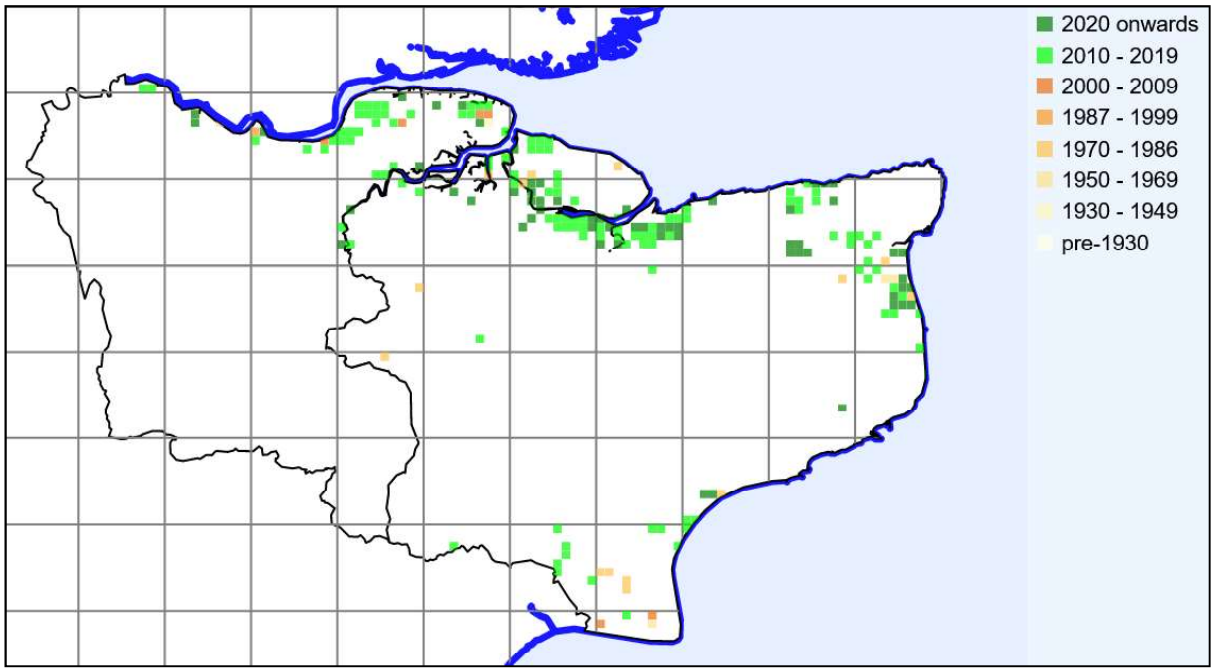
In Kent, *Carex divisa* is first mentioned in John Ray's *Synopsis* (3rd edition, 1724) as the "*Marsh Cyperus-grass...with a divided head*... (by *Hithe* in *Kent; Mr. J. Sherard*)". Hanbury & Marshall (1899) regarded it as very common in the Thames valley and Romney Marsh, frequenting marshes near the sea and tidal rivers. Philp (2010) recorded it in 95 tetrads, with a primary focus on the north Kent coast from Gravesend to Whitstable. Although this is a reduction from 113 tetrads in Philp (1982), it may not represent a diminution on the ground.

Divided Sedge may typically be found on flat, somewhat brackish grazing marshes, seldom above 10 metres altitude. Francis Rose described it as to be found in pastures and on dike banks on the alluvial coastal and estuarial flats derived from former saltings. It may be at the edge of ditches or in more open areas, often in or at the margin of slight depressions, but not in permanent standing water. It forms large patches and it is often difficult to identify where one plant ends and another begins. These patches may be somewhat darker than the neighbouring sward and may be picked out from a distance, even if only vegetative. The species is distinctive by virtue of its somewhat compressed panicle, normally overtopped by the lowest bract.

Seasalter. Photo by Lliam Rooney, 7 May 2010

The Kent records are primarily coastal, but not invariably so. Nationally, inland records have been known on a historic basis, but these have largely disappeared[101]. In Kent, however, there are several atypically inland sites. Its appearance in the gutter of the M20 between Ashford and Maidstone (RD, 1975, at TQ 792 573) appears to be related to the saline habitat created by highway de-icing salt. But other post-1970 locations are not necessarily of this character: the Stour Valley at Chartham (TR15C); by the A252 between Chilham and Molash (TR0542); a wet sheep pasture at Hernhill (TR 068 599); a damp field south of Harrietsham (TQ8651); and two sites at Linton near Maidstone (TQ74P). There is also a record of cover along 150-200m of broad verge alongside the Ashford Road above Ham Street at an elevation of over 50m, and 8-10km away from any other site[102]. These records (other than Chartham) indicate an ability to grow on substrates other than coastal alluvium, as also its presence at the bottom of a disused chalk pit at Swanscombe (TQ 607 745) to which it appears to have migrated from grassland habitat (since overgrown) around the top.

***Carex divisa* Kent records to 2023 mapped at monad level, from BSBI database.**

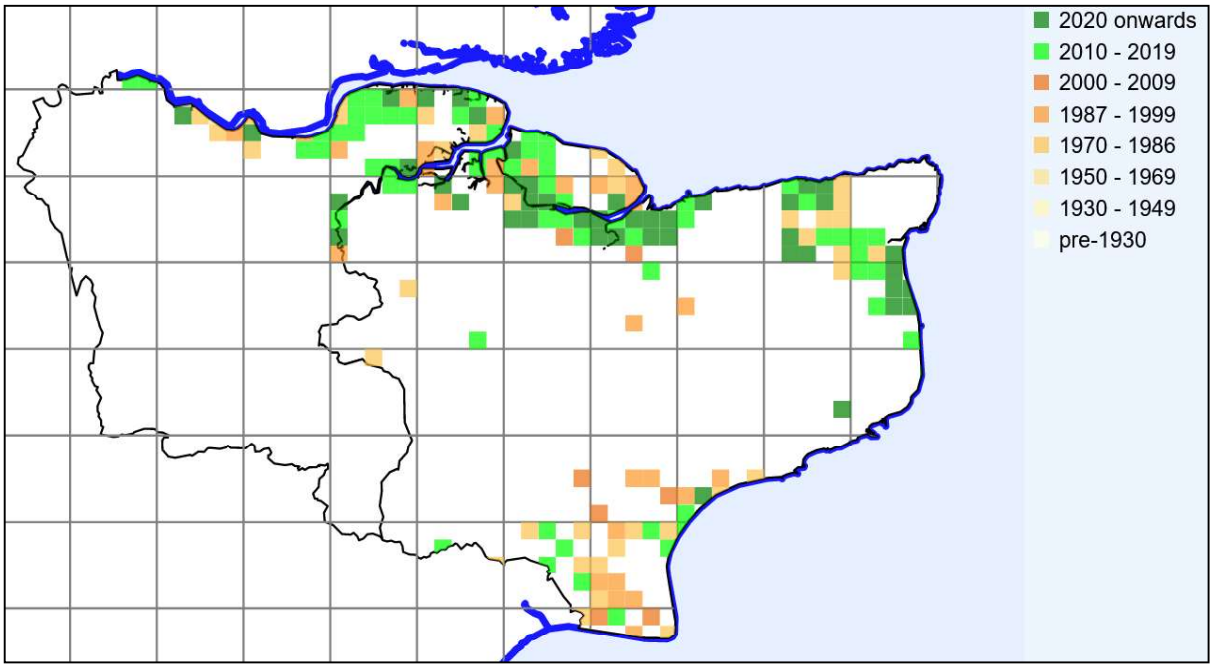


The records for 2010-23 include some sites unrecognised in Philp (2010), but the total is 107 tetrads (179 monads), well exceeding the total achieved in the 1991-2005 survey (95 tetrads), although lacking the full extent of what was earlier found on Romney Marsh, where there are either losses, presumably from land use changes, or incomplete coverage. We have found more in the low lying land around the Isle of Thanet, although not as much as in the 1971-80 survey (Philp, 1982). The fuller earlier recording in Romney Marsh and

[101] It might still be worth checking the A20 verge west of Newington (Frogholt) and a roadside bank at Chilton near the source of the Dour.

[102] Moyse, R. (2001). An inland record of Divided Sedge *Carex divisa* Huds. *The Newsletter of the Kent Field Club* **48**: 6. The supposition was that it may have been introduced to the verge with top soil following road widening; associated flora was otherwise unremarkable.

around Thanet is shown in the tetrad distribution map below, since recording before 2010 was more generally carried out at that level of resolution and so more data are available.



Carex divisa **Kent records to 2023 mapped at tetrad level, from BSBI database.**

Trifolium squamosum L. (Sea Clover)

vc 15 & 16

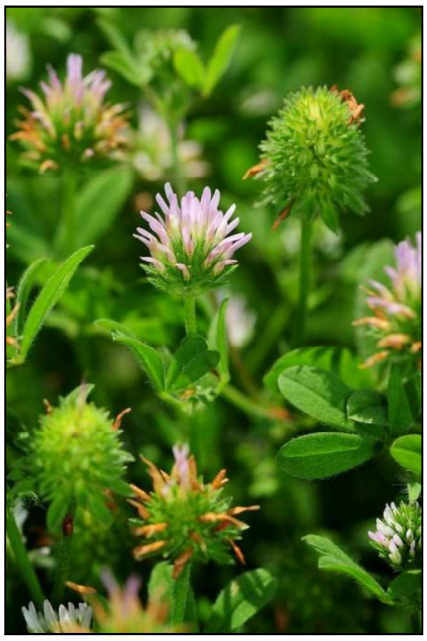
Rarity / scarcity status

Trifolium squamosum is an annual clover of saline or brackish estuarial or coastal habitat in south Britain and the Channel Islands. It is **nationally scarce**, although its conservation threat assessment in both England and Great Britain as a whole is one of 'Least Concern'. That assessment, for England, was based on a comparison of data between the periods 1930-1969 and 1987-1999 which showed a decline of area of occupancy and/or extent of occurrence of less than 30%; if, however, 1987+ data had been taken as a proportion of all data (including re-1930), the decline would have been 49%. It is neither rare nor scarce in Kent, although virtually restricted to the north coast, but its Kent populations are significant in a national context. It is a Kent axiophyte and so is indicative of good habitat.

Seasalter. All photos by Lliam Rooney, 13 June 2010

Account

The first Kent record was by Thomas Johnson, who 'first observed it in Dartford salt marish, the tenth of June, 1633', and was able to incorporate this into his edition of Gerard's *Herball* published the same year. It was then new to the British flora: 'for any thing that I know is not figured nor described by any...I have named this *Trifolium stellatum glabrum*, Smooth starrie headed Trefoile'. Later historic records cover the Thames and Medway estuaries and the Kent north coast, from Erith to Reculver. The only out-of-normal-range records appear to be Dillwyn's record (published 1802[874]) as *Trifolium maritimum* 'In Sandwich salt marshes' (reported also by Gerard Smith as 'Marshes near Sandwich' in a manuscript note no later than 1835; by David McClintock in 1937; and by Elizabeth Norman in 1982); Pegwell Bay in 1954 (credited by Francis Rose to 'J.O.'); and a doubtful record for Folkestone[875]. (A recent Camber record is discussed further below.)



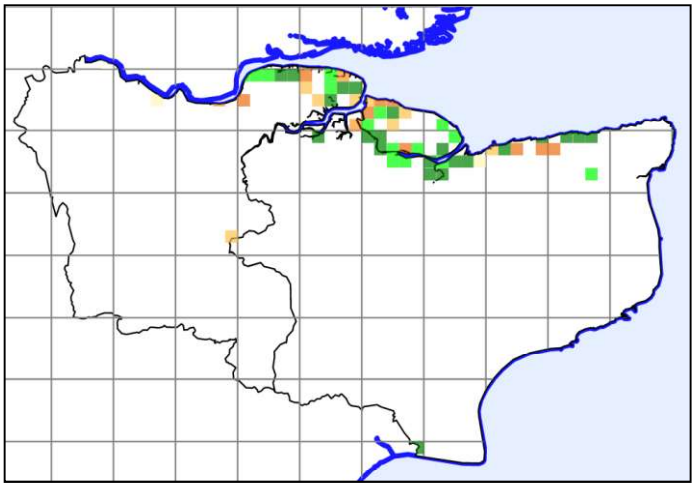
Hanbury & Marshall (1899) described it as a native of 'Banks and marshes, near the sea and tidal rivers; locally plentiful in N. Kent'. After their publication, some odd casual records turned up (from near Wye, 1901, and a brickfield in Wickham Lane, Plumstead, 1907, both specimens in **SLBI**), but there is no obvious cause for their occurrence, unless the latter was an early wool alien. Francis Rose, covering the position up to the 1960s, considered *Trifolium squamosum* to be a plant of dry saltmarshes, sea walls, and grassy banks, on clay or silt soil near the coast and estuaries, being very local and apparently confined now to the North Kent coast. By 1971-80 (covered by Philp, 1982), it was still considered to be frequent in parts of Sheppey and the North Kent coast, although that survey

[874] Dillwyn, L.W. (1802. Catalogue of the more rare Plants found in the Environs of Dover, with occasional Remarks. *Transactions of the Linnean Society of London* **6**:177-184.

[875] In *The Wild Flowers and Ferns of the District round Folkestone* (1950) compiled by J.W. Walton 'based upon the work of the late Mr. G.C. Walton, F.L.S., as published in 1894'. This was evidently an 1894 list plant and although accepted by Hanbury and Marshall (1899), was apparently rejected by Francis Rose for the purposes of his manuscript *Flora of Kent*.

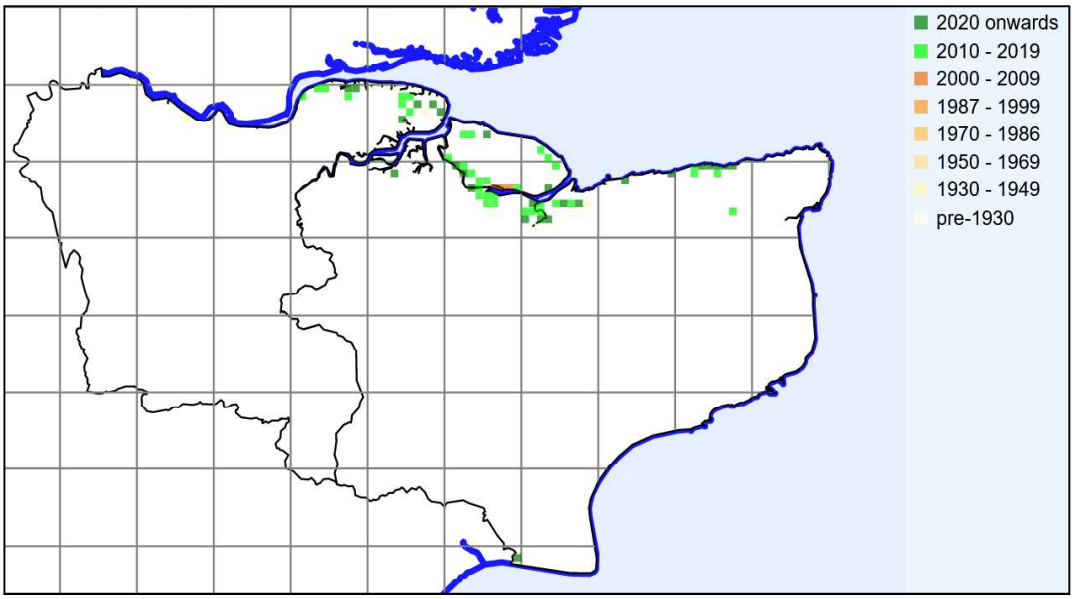
failed to record presence westwards of mid-Hoo peninsula. There was also then an inland sighting of a wool shoddy introduction near Wateringbury. The total of tetrads in which the species was recorded was 30. This compares with 28 in the 1991-2005 survey (Philp, 2010), so there is ostensibly somewhat fuller recording along the north west Kent coast, but overall no significant change. Our 2010-23 records suggest that the north Kent populations are well sustained, if not expanding, albeit within the same area of general distribution, with a total of 37 tetrads (61 monads). There is a possible contraction of range, in that there is no post-2000 record for hectad TQ67, where it was last recorded near Eastcourt Marshes, Gravesend; this would be worth searching for.

There is, however, an extension of range as regards East Sussex coast populations which, although concentrated around the Ouse and Cuckmere outlets, have been found to have outliers eastwards, with one having established at Jury's Gap near Camber. This comprised in 2012 at least three vigorous patches on the inland side of a grassy roadside verge with halophytes nearby, and is in the administrative county of East Sussex but for recording purposes lies in East Kent, vice county15. It was still present in 2021, and receives the equivalent of sea spray by adjoining a large puddle, brackish at times due to its proximity to the sea, which is splashed by passing cars. The historical distribution of records is given in the map below at tetrad level, which was the standard recording unit of area from about 1970.



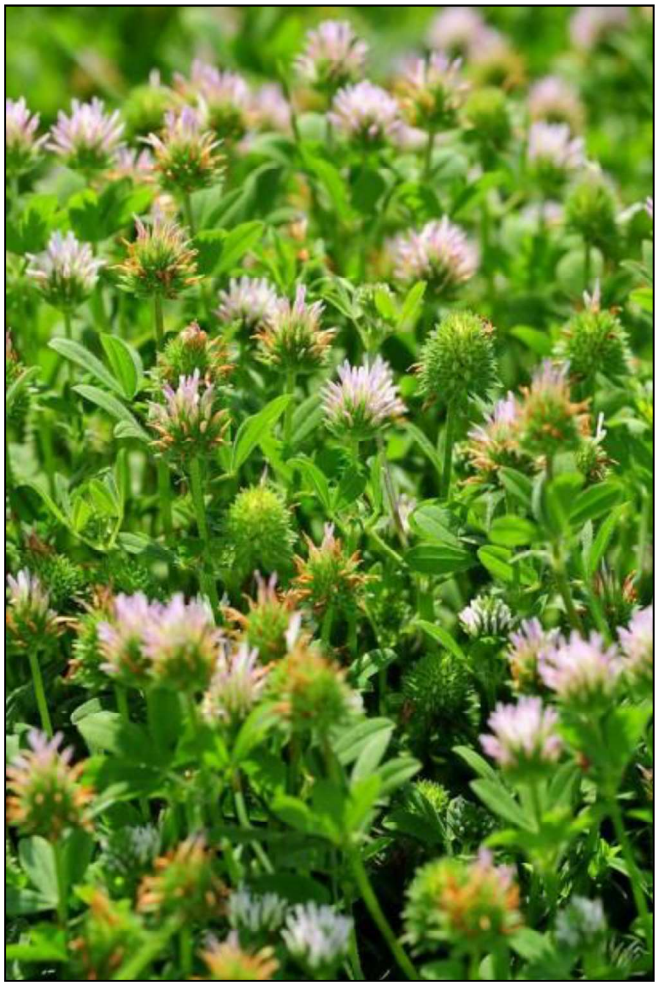
***Trifolium squamosum* Kent records to 2023 mapped at tetrad level, from BSBI database.**

***Trifolium squamosum* Kent records to 2023 mapped at monad level, from BSBI database.**



From 2010, monad level recording became standard and this is how the register data is currently collected, as shown in the accompanying distribution map.

Trifolium squamosum is generally regarded as a usually maritime plant of saltmarsh edges, eroded saltings, sea walls, brackish meadows, tidal rivers and creeks, generally growing on saline clay[876]. It is an annual, tolerant of some competition, but not trampling or grazing, being an upright plant (to 40cm) as distinct from many of our other coastal clovers which are ground-hugging and can accept or escape grazing. Our post-2010 records refer to its presence on the top and sides of grassy sea walls and neighbouring grassland, bare estuarial sand, brackish hollows, alongside a saline lake, towards the bottom of slumping cliffs of London Clay and on dried-out coastal marshland. Associated species noted include *Bupleurum tenuissimum* (Slender Hare's-ear – the grassy ground just landward of sea defence walls is a shared characteristic habitat), *Parapholis strigosa* (Hard-grass), *Sagina maritima* (Sea Pearlwort) and *Trifolium fragiferum* (Strawberry Clover)



It may be identified as an erect, hairy clover, whose oval heads of pink flowers become dominated by the green calyces with their teeth prominent in fruit, so that, although it is said that it is best recorded in May or June when in full flower, the characteristic appearance of the fruiting or decaying heads have enabled us to continue to record into September and October.

[876] Coombe, D.E. (1994). *Trifolium squamosum* L. Sea clover. In (eds.) Stewart, A., Pearman, D.A. & Preston, C.D. *Scarce Plants in Britain*, JNCC, Peterborough.

Hordeum marinum Huds. (Sea Barley)

vc 15 and 16

Rarity / scarcity status

Hordeum marinum is an annual grass of southern England and Wales, generally confined to coastal areas, especially along the Essex coast, the north Kent coast and Severn estuary, but also present by inland roads treated with de-icing salt. It is regarded as **Vulnerable** to the risk of extinction in the wild, both in England and in Great Britain as a whole. Its vulnerability is indicated by a comparison of its area of occupancy in England over the periods 1930-1969 and 1987-1999, which produced a calculated decline of 40%, in the likelihood of recording the species. This is attributed to habitat changes: the rebuilding of sea defences, infilling of pools and ditches and the cessation of grazing, with or without conversion of the grazing land to arable. It is a species of principal importance under s.41 Natural Environment and Rural Communities Act 2006. It is **nationally scarce** and the Kent and Essex populations are significant in a national context, even though in Kent it is neither rare nor scarce, largely concentrated on land adjoining the Thames and Swale estuaries. It is a Kent axiophyte, and so is an indicator of good habitat.

Shellness Hamlet, Sheppey. Photo by Lliam Rooney, 22 August 2011

Account

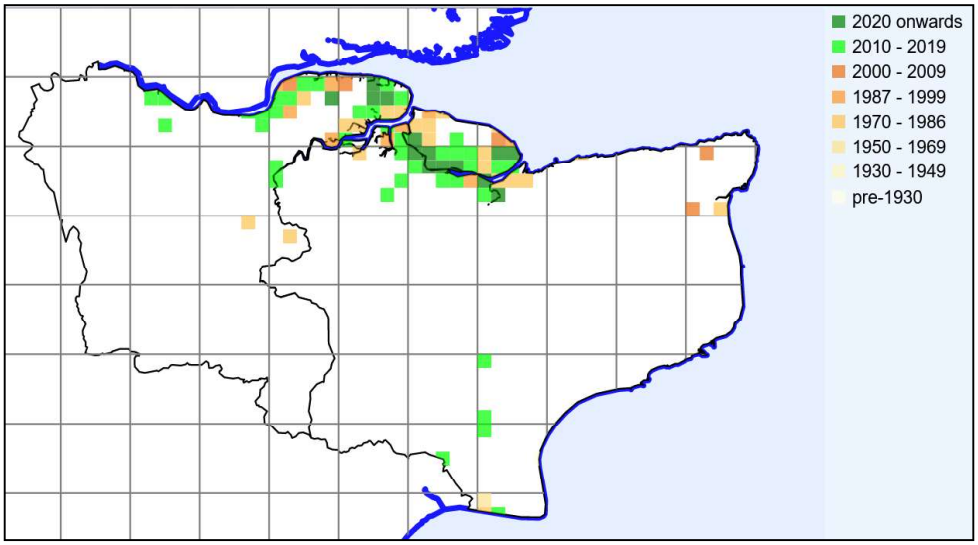
According to Hanbury & Marshall (1899), the first Kent notice of Sea Barley is given by Dawson Turner and Lewis Dillwyn in their *Botanist's Guide through England and Wales* (1805), in which they refer to the species as found at 'Salt marshes at Seabrook, near Hithe', on the authority of Mr Joseph Woods, junior. It is perhaps a little surprising that this ostensible first sighting was in the south east of the county, where there have been relatively few records since, instead of the north coast of Kent between Gravesend and the eastern mouth of the Swale where it is currently centred. However, the 1805 record is preceded by one made by Pehr Kalm, a pupil of Linnaeus, in 1748 at Gravesend in his diary, the relevant part of which was not translated into English until 2013[307]. There are other somewhat later historic records away from what we would now regard as the main distribution area: Matthew Cowell, in his *Floral Guide for East Kent* (1839), refers to records at the sandhills between Deal and Sandwich (Miss Hervey) and at the salt pans between Sandwich and Pegwell. Hanbury & Marshall (1899) refer to the species as frequent in pastures, on banks and waste ground near the sea and tidal rivers, extending up the Thames to Greenwich and the Medway nearly to Burham; this reference provides a clearer indication of the importance of north Kent coastal areas

Rushenden, Sheppey, trackside habitat. Photo by Geoffrey Kitchener, 21 August 2012

Philp (1982) regarded Sea Barley as fairly common along the north Kent coast between Gravesend and Whitstable, but scarce elsewhere. A couple of new habitats had emerged inland: an orchard where wool-

[307] Edgington, J. (2017). Agrarian practices and the flora of London in the eighteenth century. *The London Naturalist* **96**: 54-62.

shoddy had been used[308], and the edge of the M20[309] together with other halophyte species. It was seen in 60 tetrads, whereas during the subsequent 1991-2005 survey published as Philp (2010), only 48 tetrad records were made, which gives some support for the national picture of decline. It was then described as growing on bare vegetated patches on sea walls and coastal tracks and on trampled margins of dried up coastal pools and ditches; no inland habitats were noted. Such inland habitats, however, do figure in 2010-23 data, as Sea Barley has been seen during that period alongside the A249 for several kilometres southwards from the Sheppey Crossing, and also scattered alongside the A2070 (Ashford to Brenzett road), and at the M25/A2 junction, in each case colonising semi-bare habitats subject to saline influence.



Hordeum marinum **Kent records to 2023 mapped at tetrad level, from BSBI database.**

In comparison with the 48 tetrad records given in Philp (2010), there have been sightings in 2010-23 for 53 tetrads (89 monads). This does not indicate a continuation of decline since the 1991-2005 survey and it may be that more intensive survey of the Hoo peninsula would bring records back to the 1971-80 level of 60 tetrads.

Hordeum marinum, as an annual, relies upon the existence of open areas minimizing competition. It is spring-germinating; it is unclear how far autumn-germinating seedlings survive).

Allhallows. Photo by David Steere, 19 August 2018

Typically in Kent these open areas are patches of ground on London Clay on the landward side of sea walls where through the existence of seepage or depressions, the salinity has prevented

[308] It is possible that this occurrence was of subsp. *gussoneanum* (Mediterranean Barley), although not named as such; our usual plant being subsp. *marinum*.

[309] In contrast with abundant *Puccinellia distans* (Reflexed Saltmarsh-grass), only one small colony of *Hordeum marinum* was noted in J. Feltwell & E. Philp (1980). Natural History of the M20 motorway. *Transactions of the Kent Field Club* **8:** 101-114.
A scattering was also seen in the centre reservation of the A2 in 1982 – G.D. Kitchener (1983). Maritime plants on inland roadsides of West Kent. *Transactions of the Kent Field Club* **9**: 87-94.

growth of perennial vegetation. Presumably, germination follows a temporary reduction in salinity after winter rains; and these areas generally dry out in spring and set hard in summer. Ground kept open by cattle trampling or rutting by vehicles, often around entrances to fields in brackish grazing marshes, also provides typical habitat; and the grass may be found ringing brackish pools, where the mature spikelets will have broken up and have been dispersed along the winter flood-line levels. It may also be found in the spray zone, for example along the south shore of Sheppey lining the Swale where it forms a continuous line for long distances.

Several sites were surveyed in 2010 for the BSBI Threatened Plant Project. There was evidence for the loss of the species where under-grazing had permitted coarse perennial vegetation to invade sea wall slopes and the intervening ground between them and parallel drainage dykes; but there were also management steps being taken to restore heavier grazing. The most frequent associates were: *Agrostis stolonifera* (Creeping Bent), *Elymus athericus* (Sea Couch), *Lolium perenne* (Perennial Rye-grass), *Parapholis strigosa* (Hard-grass), *Plantago coronopus* (Buck's-horn Plantain), *Plantago major* (Greater Plantain) and *Polygonum aviculare* (Knotgrass). Occasionally, other rare plant register species of saltmarsh or brackish grazing marshes were noted in the immediate vicinity: *Carex divisa* (Divided Sedge), *Limbarda (Inula*) *crithmoides* (Golden-samphire), *Puccinellia fasciculata* (Borrer's Saltmarsh-grass) and *Rumex palustris* (Marsh Dock).

Rushenden, Sheppey, pool margin habitat.
Photo by Geoffrey Kitchener, 21 August 2012

Hordeum marinum is not readily confusable with other British species except, perhaps, depauperate *Hordeum murinum* (Wall Barley). However, Sea Barley is a smaller, stiffer species, bluer-green, and with shorter spikelets, the awns being wide-spreading and the glumes of the central spikelet of each triad being scabrid (rather than ciliate).

Parapholis incurva (L.) C.E. Hubb. (Curved Hard-grass)

vc15 and 16

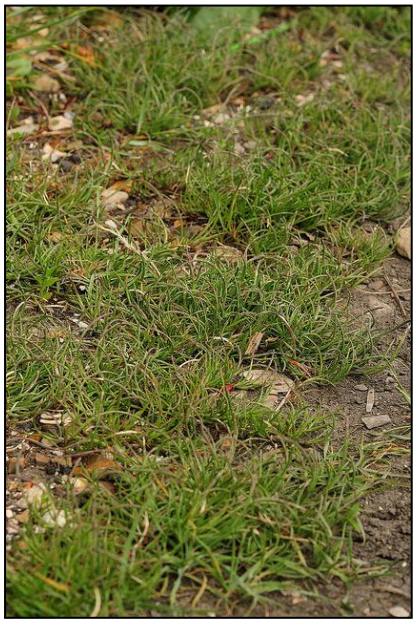
Rarity / scarcity status

Parapholis incurva is a coastal plant of saline conditions, and also found by inland roads affected by de-icing salt, with its main British distribution along the south and east coasts of England and the south coast of Wales. It is a **nationally scarce** plant whose conservation risk status in both England and Great Britain as a whole is one of 'Least Concern'. It is reasonably well represented in Kent, particularly along the north coast from Seasalter to Thanet, and is neither rare nor scarce in the county. It is a Kent axiophyte and so is indicative of good habitat, other than by inland roads.

From Seasalter. Photo by Lliam Rooney, 22 March 2017

Account

Early records of *Parapholis* (given under *Rotbollia* or *Lepturus*) are not easy to interpret: the separation into which we now call *Parapholis strigosa* (Hard-grass) and *Parapholis incurva* was not well understood. Hanbury & Marshall (1899) identify the first published Kent record of a *Parapholis* species as being by Thomas Johnson in his *Descriptio Itineris* (1632), when in the course of botanising on the shore and steep cliffs near the (then) fort at Margate he recorded 'Gramen parvum marinum spica loliacea'. This, in the edition edited by J.S.L. Gilmour, in which he had the assistance of Francis Rose in identifying current plant names, was taken to be *Agropyron pungens* (Pers.) Roem. & Schult., or possibly the hybrid with *A. junceiforme* (*A.* x *acutum* auct,). These taxa have since been called *Elymus athericus* (Sea Couch) and *Elymus junceiformis* (Sand Couch), with their hybrid, *Elymus* x *obtusiusculus*. The assumption that a couch grass was involved has not been followed elsewhere – see below.



Seasalter. Photo by Lliam Rooney, 22 May 2015

Hanbury & Marshall (1899) doubted that Kent records of *Parapholis* generally were anything other than what we now call *Parapholis strigosa*. They hesitated a little over G.E. Smith's description (in his *Catalogue of rare or remarkable phaenogamous plants, collected in South Kent*, 1829) of Hard Grass growing 'Upon the shore, and in dry salt marshes at Dimchurch: upon the shore, Folkestone West', where he saw plants 'with an elongated straight stem and spike' and others 'with a very different habit, and besides its obvious, pale green color…remarkable and deeply striated'. Whilst he was clearly seeing *P. strigosa* and perhaps *P. incurva* as well, Smith felt he did not have enough experience to say if they were separate species. Indeed, in his 1830-33 manuscript notes to his own copy of the *Catalogue*, from observations at Shoreham, Sussex, and Freshwater, Isle of Wight, he took the view that upright growth was a consequence of crowding, and the *incurva* habit ('resembling a small reversed birds' nest') was associated with growing detached from other plants.

Returning to Johnson's Margate find, David Pearman (*The Discovery of the Native Flora of Britain and Ireland*, 2017) took this to be *P. strigosa*, although John Edgington[537] had considered it to be *Parapholis incurva.* Fortunately we have more evidence of what Johnson found, as he wrote it up in his 1633 edition of Gerard's *Herball*. He says 'The last yeare at Margate [this would be 1632] in the Isle of Tenet, neere to the seaside and by the chalky cliffe I observed a pretty little grasse which from a small white fibrous roote sent up a number of stalkes of an unequall height; for the longest, which were those that lay partly spred upon the ground, were some handful high, the others that grew straight up were not so much; and of this, one inch and a half was taken up by the spike or eare, which was not thicker than the rest of the stalke, and seemed nothing else but a plaine smooth stalke, unless you looked upon it earnestly, and then you might perceive it to be like Darnell grasse wherefore in the journall that I wrote of this Simpling voyage [the *Descriptio Itineris*], I called it *pag .3. Gramen parvum marinum spica Loliacea*'.

There can be no doubt from this description that he saw *Parapholis* (in which the flowers appear as though hidden in the culm) and that Gilmour and Rose were wrong in supposing that it was a couch grass. As to whether it was *P. strigosa* or *P. incurva*, Johnson refers to the longest stalks as partly spread on the ground (which they do in *P. incurva* before spreading upwards and incurving) and other shorter stalks as growing straight up (which sounds like *P. strigosa*, but the central stalks of *P. incurva* can do this as well, especially when young).

For further evidence of identity we need to consider also habitat, Johnson's find being near to the shore and by the chalky cliff. There is no suggestion of salt marsh (the upper parts of which would be suitable for *P. strigosa*), nor does the present coastline here (the former fort promontory near the harbour) render it likely. The presence of cliffs points more to *P. incurva*, which prefers drier ground, often within reach of sea spray. In habitat terms, *P. incurva* appears more likely and, indeed, was recorded for the tetrad including Johnson's site, in Philp (1982). More recently (2019) it has been recorded for what, making allowances for reclamation and sea defence works since the 17th century, must be virtually the exact spot of Johnson's find, insofar as it can be reconstituted – remarkable persistence on the part of an annual.

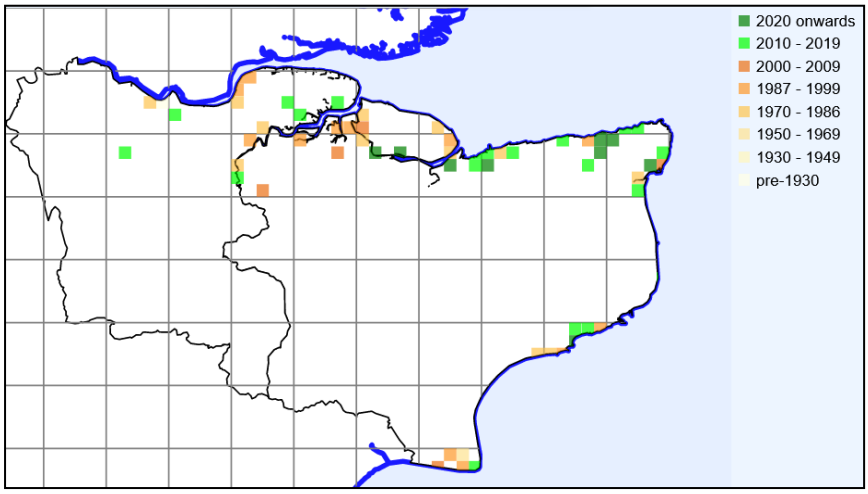
Margate, Johnson's 1632 location. Photo by Sarah Kitchener, 16 July 2019

Parapholis strigosa has also been recorded further west and although both species are present along the continuation of the north Kent coast westwards, *P. strigosa* was probably the more common species in Johnson's day beyond Seasalter, when one would have left behind the chalk cliffs and, without the benefit of sea defences, have come to the flat lands with the residual Wantsum channel cutting off the Isle of Thanet. But as regards Johnson's site at the chalk coastline by Margate harbour, *Parapholis incurva* is the more likely species to have encountered, then and now. If this accepted, the Kent record is also the first British record.

[537] Edgington, J.A. (2010). First British record of *Nardus stricta*. *Watsonia* 28: 123-127. David Pearman (personal communication) has since acknowledged that there a case for Johnson's find indeed being *Parapholis incurva*.

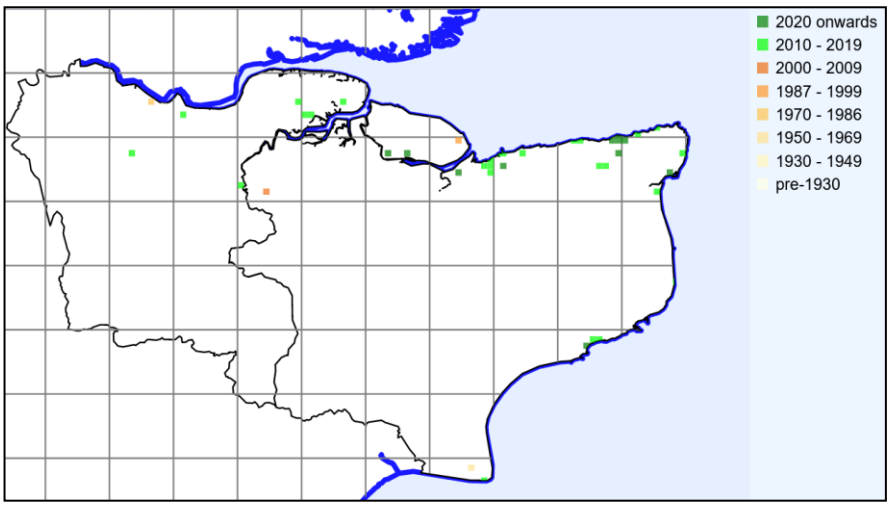
North of Graveney Marshes, habitat. Photo by Lliam Rooney, 3 August 2011

Francis Rose knew of *Parapholis incurva* on the north Kent coast at Grain north and south beaches (1945, 1955); near Upnor (1951 and 1960) Shellness (Sheppey, 1956); west of Minnis Bay (1961); and Westgate (1946); also at Oare Creek and at Cuxton near the tidal Medway. On the east coast, it was found at Shellness (Sandwich, 1952) and by J.P.M. Brenan in 1937 at the foot of the chalk cliffs between Folkestone and Dover. There were a couple more finds in a habitat much like the last – on a shingly bank behind the cliff base sea-wall at Lydden Spout (1953-55) and similarly below Abbot's Cliff (1960). Some of these locations were still extant for Philp (1982), in which 24 tetrads were recorded with a distribution from the tidal Medway, around Sheppey, along the north coast, around Thanet, between Dover and Folkestone, and an outlier at Dungeness. Its habitat was given as on bare ground along sea-walls and on cliffs in coastal areas, often growing in a narrow band along an area that will be reached by the salt spray during rough weather. The position was very broadly similar in Philp (2010), although with 21 tetrads, including additional records in the Cliffe and Dungeness areas, but less on Sheppey, the north coast through to Thanet and the Dover/Folkestone area.



***Parapholis incurva* Kent records to 2023 mapped at tetrad level, from BSBI database.**

The 2010-23 records cover 30 tetrads (37 monads), noticeably exceeding the 1991-2005 total, and with a somewhat different distribution, concentrated on the coastline from Faversham to Margate rather than the lower Medway and Cliffe. The likelihood is that the difference is a product of the manner of survey, given that habitats are unlikely to have changed enough.



***Parapholis incurva* Kent records to 2023 mapped at monad level, from BSBI database.**

Mapping is given here separately at tetrad and monad resolution, as the former displays hiistoric records more fully, given that tetrad recording was the norm in Kent for 1970-2009 and monad recording from 2010 onwards.

There is, however, an interesting development mainly in West Kent, where the grass is now increasingly encountered away from the coastal spray zone and on inland roads affected by de-icing salt. There are roadside records by the A20 near Farningham; by the A226 south of Northfleet; on the A228 verge near Holborough (and again near High Halstow); by the B2001, Grain Road; and in East Kent, by the A2990, Whitstable. Older roadside records not included here are in the centre reservation of the A21 Tonbridge bypass from 1984 to 1994, when it was lost by roadworks substituting a surfaced centre with crash barriers; and by the A229 at Blue Bell Hill (East Kent) in 2009. While a number of salt-tolerant grass species have made the transition from coastal saltmarshes to their artificial inland linear equivalent, *Parapholis incurva* does not seem to have done so in Kent as successfully as some others, such as *Parapholis strigosa* (Hard-grass), *Puccinellia* spp. (Saltmarsh-grasses) and *Catapodium marinum* (Sea Fern-grass). The reason for this is not evident, except that the rarer the grass in its coastal habitats, presumably the fewer are the opportunities to spread, if hitching a lift on vehicle tyres is the means of doing so. It has been noted in some coastal localities on shingle stabilised with sandy soil, to which vehicles have access.

It is an annual, subject to population fluctuations from year to year. Accompanying species noted in Kent include *Catapodium marinum*, *Parapholis strigosa* and *Spergularia marina* (Lesser Sea-spurrey). Because of the unusual flower structure, the only other species (except for rare aliens) with which it might be confused is *Parapholis strigosa.* However, *Parapholis incurva* is generally shorter (rarely over 10cm high) with strongly curved culms and with shorter anthers. Anther length is 0.5-0.81(1.1)mm in *P. incurva*; (1.5)2.2-3.1(3.5)mm in *P. strigosa.* Anther length is recommended for determination, as inland plants may well adopt a slender, perfectly upright habit similar to that of *P. strigosa*[538]*;* the author has replicated this growth habit by transplanting Kent material into garden soil. However, it is not so apparent that *P. strigosa* may be affected by growth conditions so as to mimic the short, incurved habit of *P. incurva*; so anther length is more relevant to confirmation of the identity of *P. strigosa*. There may have been some under-recording of *P. incurva* due to reluctance to record outside the flowering season (early June to mid-July), when anthers are present.

Folkestone Warren, flower spike with anthers exserted.
Photo by David Steere, 9 June 2018

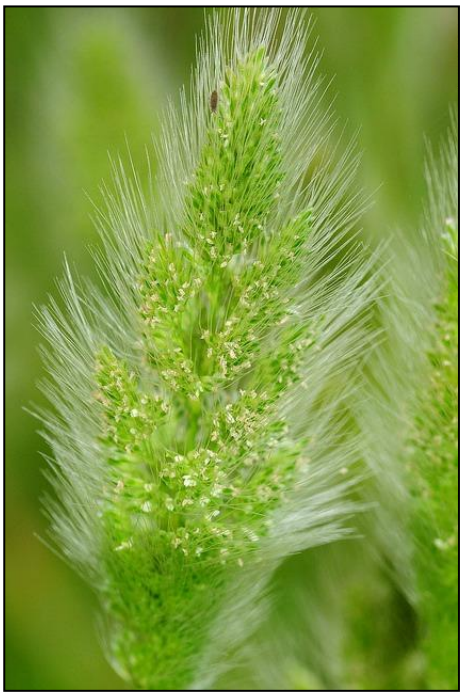
[538] Cope, T. & Gray, A. (2009). *Grasses of the British Isles*. Botanical Society of the British Isles, London.

Polypogon monspeliensis (L.) Desf. (Annual Beard-grass)

vc15 and 16

Rarity / scarcity status

Annual Beard-grass is a plant of brackish places near the sea or estuaries, mostly in the southern part of the British Isles, with concentrations around the Thames estuary and the Solent. It is classed as **nationally scarce**, although its threat status for conservation purposes is assessed as of 'Least Concern'. In Kent, it is neither rare nor scarce, and there is some evidence of recent spread.



Sheppey. Photo by Lliam Rooney, 5 July 2012

Account

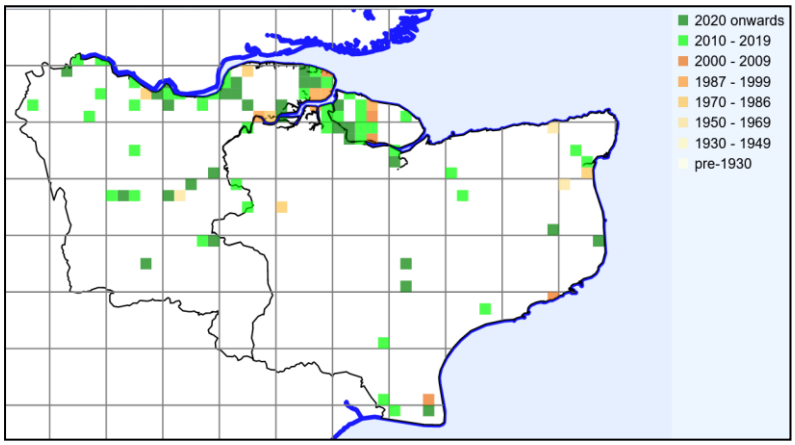
The first published county record appears to be Thomas Johnson's record, in his *Descriptio Itineris* (1632), of 'Alopecurus maxima Anglica paludosa Lob.' which was accepted by Hanbury & Marshall (1899) as likely to be *Polypogon monspeliensis.* Francis Rose, in the 1972 edition of that work, agreed, placing Johnson's locality as probably along the Swale estuary, or near Strood, or in Milton Creek.[581] Johnson, from his edition of Gerard's *Herball* (1633) also knew the plant elsewhere in Kent, as a 'Fox-taile...which grows naturally in many watry salt places of this kingdome, as in Kent by Dartford....The stalkes of this plant are grassy, and some two foot high...The eare is very large, being commonly four or five inches long, downy, soft like silk, & of a brownish colour'. Hanbury & Marshall (1899) regarded the species as a rare and very local native of submaritime marshes and ditches; their records were near the north coast of the county, and also at 'Sandwich Flats, on the margin of the ditches inside the River-wall' (a classic type of habitat).

Francis Rose knew of it as a grass of brackish marshes and alluvial dikes, usually on mud drying out in late summer, where it was very rare, but locally plentiful. The main records for the 1940s to 1960s were on the Hoo peninsula and on Sheppey. There were also sightings of Annual Beard-grass as a casual at Sandwich, Comp and Wrotham, where introduced by the use of wool shoddy as an agricultural fertiliser.

These inland occurrences had more or less died out by the time of the 1971-1980 survey covered by Philp (1982). While this noted occasional introductions inland, the records (17 tetrads) were still concentrated on Hoo/Grain, where found in damp meadows, brackish marshes and ground disturbed by cattle or vehicles. The 17 tetrads of 1971-90 became 25 tetrads in 1990-2005 (Philp, 2010) although the focus remained around Hoo and Sheppey, so the increase could have been explicable by the intensity of recording. However, more recent records (2010-23) give 74 tetrads (99 monads) and it is clear that there has been a significant extension of recorded range.

[581] Rose also speculated as to whether the same species was intended by Johnson's Sheppey record, in his *Iter Plantarum* (1629), referring to 'Gra. Tomentosum & acerosum Calamagrostis quorundum Lob.'. This had been interpreted by Hanbury & Marshall (1899) as *Calamagrostis epigejos* (Wood Small-reed), but Rose suggested that *Polypogon monspeliensis,* which grows in Sheppey, was just as likely. It seems odd to suppose that Johnson would give such different names to the same species (and Rose accepted the name as applying to *Calamagrostis epigejos* in *Descriptio Iter*!); but Johnson clearly had in mind what was illustrated by Lobelius' *Plantarum seu stirpium icones* (1576), where a tall plant looking more like *C. epigejos* than *P. monspeliensis* is shown.

The apparent increase in occurrences runs counter to what had earlier been considered to be the the national position, where some decline is thought to have taken place with conversion of arable to grazing marshes and the drainage or infilling of backish pools. In about 1990 *Polypogon monspeliensis* covered several acres of the Cleanaway site in the Essex part of TQ57J, which has certainly contributed to its greater frequency on both sides of the Thames since, though the site itself is now under a more permanent grass (Rodney Burton, personal communication). However, the national position has, according to *Plant Atlas 2020*, been affected by a very substantial increase in the 21st century of ruderal inland occurrences. These, so far as Kent is concerned, are discussed further below.



***Polypogon monspeliensis* Kent records to 2023 mapped at tetrad level, from BSBI database.**

Polypogon monspeliensis is now found along the Thames estuary westwards of the Hoo peninsula, although the westernmost location is on the north side of the Thames, in that anomalous part of vc16 which is surrounded by Essex. Presence at Dungeness has also strengthened, but what is particularly noticeable is the number of inland records. These fall into a number of categories:

- There is possible evidence of introduction through sown roadside grass and proprietary compost.
- Urban street occurrences may be derivative from bird seed, but there is the possibility of transmission on vehicle tyres, as with other saltmarsh grasses. However, it is not seen in quantity along main road verges affected by highway de-icing salt, as are *Puccinellia distans* (Reflexed Saltmarsh-grass) and *Parapholis strigosa* (Hard-grass), although it was found in 2018 below the A21 overbridges at Haysden, where salt run-off had brought a number of halophytes onto the semi-bare gravel below.
- There are occurrences related to present or former sand or gravel quarries, at Chipstead Lakes (now a sailing lake); Sevenoaks Sand Quarry (still operational); Darenth Road Quarry, Dartford (used for materials supply); Hale Street (sand quarrying activities apparently being wound down, but records here over three monads); Wrotham Quarry (infilled part of sandpit and Addington Sand Quarry). It is possible that, where such a location is being used for reception / storage / transmission of materials, *Polypogon monspeliensis* may have come in with the movement of vehicles and materials from an estuarial site such as Cliffe, where off-loaded by the Thames (where the grass has been recorded). Where this origin seems unlikely, seed transmission is probably by birds, especially where the habitat includes a waterbody with shallow margins.

Kent coastal or estuarial sites are also often on sandy gravel, but also on London Clay, generally close to pools, ditches, dikes and the hopes or fleets which represent original water channels from reclaimed saltings. The grass grows where cattle have trampled the ground, keeping it open for seedling germination and establishment. Gray (1994)[582] refers to associates in such habitats as including *Agrostis stolonifera* (Creeping Bent), *Tripolium pannonicum* (Sea Aster), *Bolboschoenus maritimus* (Sea Club-rush), *Juncus gerardii* (Saltmarsh Rush), *Ranunculus sceleratus* (Celery-leaved Buttercup) and *Salicornia* species (Glassworts). These species are very much what we would expect to find in Kent sites; *Hordeum marinum* (Sea Barley) also has similar habitat requirements for saline disturbed ground and we have noted it growing with *Polypogon monspeliensis.*

[582] Gray, A.L. (1994). Polypogon monspeliensis (L.) Desf. Annual beard-grass. In (eds.) Stewart, A., Pearman, D.A. & Preston, C.D., *Scarce Plants in Britain*, JNCC, Peterborough.

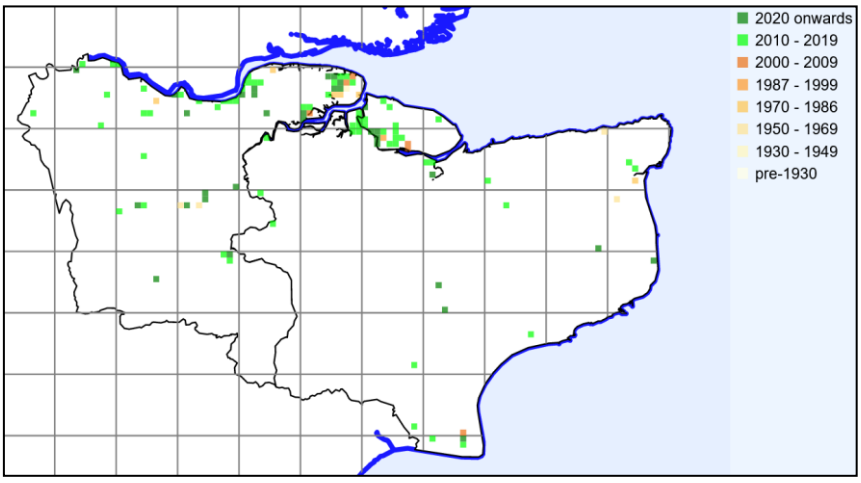
Cope & Gray (2009)[583] state that seeds seem to survive for many years in the soil-bank, as disturbance of former sites by activities such as ditch clearance or the construction of new sea walls takes place. Where the disturbance is of an extensive character, the resultant colonisation and seed production can be enormous: a six acre cleared site at London Medway Commercial Park, Hoo, in 2018 held millions of plants, ranging from large to minute.

Sheppey. Photo by Lliam Rooney, 5 July 2012

With its dense, long-awned panicles, *Polypogon monspeliensis* is unlikely to be confused with other grasses. While *Lagurus ovatus* (Hare's-tail) might be supposed to bear a passing similarity, Hare's-tail's soft, near-globose white panicles are distinct from the greenish-white panicles of *Polypogon monspeliensis* which go brown and disarticulate with age. The latter does, however, hybridise with *Agrostis stolonifera* (Creeping Bent) to produce X *Agropogon lutosus*, whose panicle is somewhat branched (as in the *Agrostis* parent) and lemmas awned (not usually so, in the *Agrostis* parent) but whose spikelets do not disarticulate with age (as distinct from the *Polypogon* parent). This hybrid has been known in Kent at least since 1803 (when the specimen figured in Smith's English Botany as *Agrostis littoralis* was gathered at Woolwich) and has been found 17 times during the period 2010-22, at Sheppey, Chetney Marshes, Faversham, Borough Green and the Hoo peninsula.

Oare Marshes, habitat. Photo by David Steere, 28 June 2016

***Polypogon monspeliensis* Kent records to 2023 mapped at monad level, from BSBI database.**



583 Cope, T. & Gray, A.L. (2009). *Grasses of the British Isles*. Botanical Society of the British Isles, London.

Puccinellia fasciculata (Torr.) E.P. Bicknell (Borrer's Saltmarsh-grass)

vc15 and 16

Rarity / scarcity status

Puccinellia fasciculata is a southern coastal plant, mostly found in Kent, Essex and Suffolk, occasionally inland on salt-treated roads. Its threat status for conservation purposes in both Great Britain as a whole and in England is **Near Threatened**. A comparison of its area of occupancy in England over the periods 1930-1969 and 1987-1999 produced a calculated decline of 23% in the likelihood of its being recorded. It is a **nationally scarce** plant and a species of principal importance for the purpose of conserving biodiversity under Section 41 of the Natural Environment and Rural Communities Act 2006, having been a priority species for the UK Biodiversity Action Plan due to its status as a good indicator of a threatened habitat and its decline with loss of grazing marsh to development and arable conversion. In Kent it is neither rare nor scarce, although there is evidence of decline; but Kent still holds more of this grass than any other county in the British Isles except Essex. It is a Kent axiophyte and so is indicative of good habitat.

From Halling. Photo by Lliam Rooney, 26 June 2013

Account

The first published Kent record seems to be Matthew Cowell's reference (in *A Floral Guide for East Kent, etc.,* 1839, p.67) to the finding, by G.E. Smith, of *Glyceria Borreri* at Dymchurch in 'muddy places by the sea'. This was culled by Cowell from Smith's notes in an interleaved copy dated 1838[621] of Smith's own work, *A catalogue of rare or remarkable phaenogamous plants collected in South Kent* (1829), and Cowell adds later (p.90) Smith's notes on identification characteristics. Hanbury & Marshall(1899) described the grass as a locally plentiful native of muddy salt marshes. Along the north Kent coast, it was known in the nineteenth century at Plumstead Marshes, from Greenhithe to Gravesend, Higham Marshes, the Isle of Grain and in the Medway estuary at Frindsbury and south of Rochester; further east, on Sheppey, and at Faversham Creek and east of Whitstable. On the north east coast, it was known between Ramsgate and Sandwich.

Francis Rose, through his records from the 1940s to 1960s, was aware of a broadly similar coastal distribution in the north and north east. On the south east coast, he found it at St Mary's Bay (which suggests some continuity with G.E. Smith's Dymchurch record) and saw, or had reports, of it by the Royal Military Canal near Hythe, and near Littlestone. It was also reported from Fairfield 1952-62 (where it remained present in 2013), a location which, although inland on Romney Marsh, is still saline from former sea incursions. From the 1971-80 county survey (Philp, 1982) a comparable distribution was identified, amounting to 78 tetrads. It was seen on

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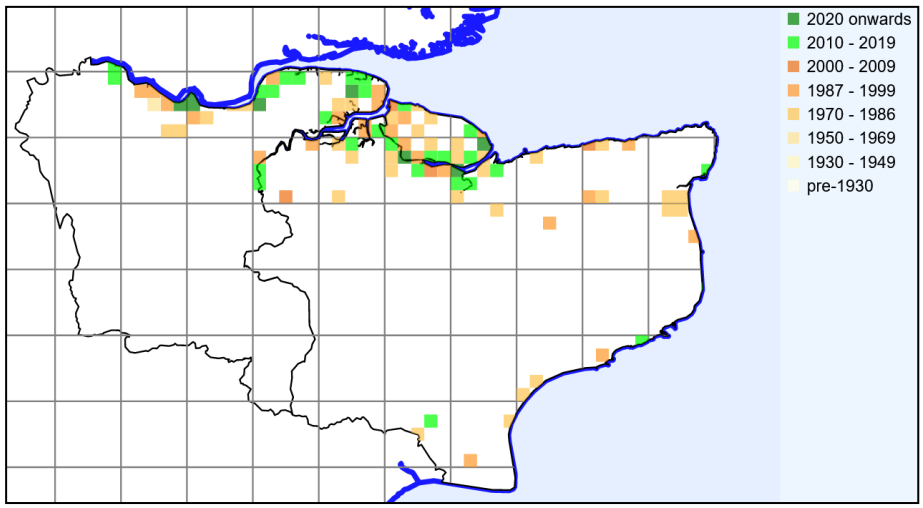
621 The copy is actually marked by Smith in 1833 as with corrections and additions in 1830, 31, 32, etc., although it is not impossible that some were later, and presumably Cowell borrowed the copy in 1838. Smith's original note refers to *G. dubia*, Doubtful Sweet Grass (a name without any currency), but to this is added later 'now distinguished as *G. Borreri*, Suppl. to E.B. f.', which is a reference to Charles Babington's naming of the grass in *the Supplement to English Botany*, volume 3, published in 1843. Cowell was already using this name in 1839, although Babington had earlier called it *Festuca Borreri* in a paper (Description of a new British Grass) read to the Linnean Society in February 1837 (*Transactions of the Linnean Society* (1837) **17**: 565.

So there may have been some expectation that Babington was going to re-name this grass of which Smith and Cowell were aware. Indeed, the plate in the 1843 publication is dated May 1837, so its associated account may have been held over for volume publication, while subsequent plates and species accounts were prepared; but in any event Smith was clearly in touch with the latest plant developments of the time.

sea walls, the drier parts of salt-marshes and bare muddy areas near the coast. Rarely, it was seen away from the coast on roadsides, as a consequence of winter road-salting creating new habitat; and a survey in 1982[622] located it in four tetrads along the A21, north and south of Sevenoaks.

However, in contrast with the 78 tetrads of 1971-80, Philp (2010) gave only 45 tetrads for 1991-2005, an apparent decline of 42%. No reason was assigned for this; its habitats were described as much the same, noting also its occurrence in bare patches near gateways in coastal marshes. Our recent records do not offer any more encouragement as regards the tenure of this species: they amount only to 36 tetrads (44 monads).



***Puccinellia fasciculata* Kent records to 2023 mapped at tetrad level, from BSBI database.**

If the limited number of recent records reflects limitations of survey, rather than increased scarcity, we should be concentrating search in the areas of Dartford, Sheppey, the Swale and between Herne Bay and Margate; there may also be more scope for roadside investigations.

The habitats noted under 2010-23 records mostly relate to saline gravelly, coastal tracks, often just landward of the sea wall. These areas are likely to be winter-wet, open and with limited vegetation generally. We have noted the grass in company with *Puccinellia distans* (Reflexed Saltmarsh-grass), with *Puccinellia rupestris* (Stiff Saltmarsh-grass) and with *Alopecurus bulbosus* (Bulbous Foxtail); the same habitats ought also to produce *Hordeum marinum* (Sea Barley). In saltmarsh, where it might be expected to favour the higher levels, it has been seen with *Tripolium pannonicum* (Sea Aster), *Salicornia ramosissima* (Purple Glasswort) and *Spartina anglica* (Common Cord-grass). It has been seen in grazing marshes, where the ground is bare or cattle-trampled. Such habitats restrict competition by virtue of salinity and trampling.

From Halling. Photo by Lliam Rooney, 26 June 2013

It is a short-lived perennial, self-pollinating, and it spreads by seed, forming small tufts, sometimes clustered together in patches. It is a glaucous grass, the straw-coloured remains of older leaves often remaining at the base of the tuft, and is characterised by the panicle being stiff and one-sided. The panicle branches do not deflex, as do the lower the lower

622 Kitchener, G.D. (1983). Maritime plants on inland roadsides of west Kent, *Transactions of the Kent Field Club* **9**: 87-94. The tetrads were not published, but were: TQ45V, TQ55F, TQ55K and TQ54P. It was also found at TQ55G in 1991.

branches of *P. distans*, and those branches are not bare for much of their length towards the base (as are those of *P. distans*). The lemmas have a very slightly projecting middle nerve and are less than 3mm long (those of *P. rupestris* are ≥3mm).

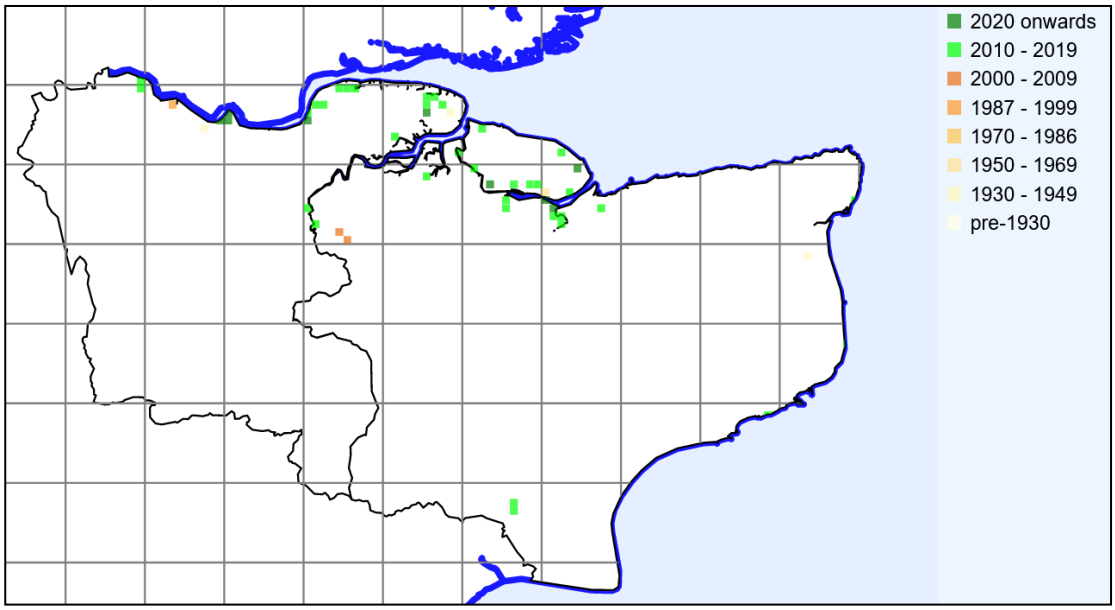
The occasional existence of intermediates between *P. fasciculata* and *P. distans* creates complications. If sterile, with indehiscent anthers, they may be expected to be the hybrid, and this was recorded by Eric Philp on Swanscombe Marshes, TQ67C, in 2006; Philp (2010) refers to this at Dartford Marshes, TQ57N, and Northfleet, TQ57X, as well.

Halling. Photo by Lliam Rooney, 25 June 2013

If fertile, it may be expected to be what has been called *P. pseudodistans*, but which is now generally considered to be a variety of *P. fasciculata*. This variety, which Eric Philp thought to be a fertile form of the hybrid, was more fully recorded when thought to be a species in its own right and has 18 tetrad records in Philp (1982), mainly on the north west Kent coast and in the Medway estuary, but also inland on a roadside and on road sweepings, as well as the inland saline terrain of Fairfield. Philp (1982) described it as very local but sometimes abundant where it does occur. We have no recent records, but the recording infrastructure of the MapMate database does not support it as a separate taxon in any event.

A further variant was named by Marshall in 1894[623] as var. *humilis*, a small prostrate plant with a short and compact inflorescence found on dried-up, or drying, mud close to the (now long vanished) station at Port Victoria, Isle of Grain. Little, if any, attention seems to have been paid to this since.

***Puccinellia fasciculata* Kent records to 2023 mapped at monad level, from BSBI database.**



[623] Marshall, E.S. (1894). Notes on Kentish plants observed during 1893. *Journal of Botany* **32**: 144-9.

Sarcocornia perennis DA.J. Scott (Perennial Glasswort)

vc 15 and 16

Rarity / scarcity status

Sarcocornia perennis is a succulent perennial of saltmarshes in the south and east British Isles, especially on the coast of Hampshire, around the Wash and from Suffolk, down through Essex and along the north Kent coast. It is **nationally scarce**, but its threat assessment for conservation risk purposes is one of 'Least Concern'. In Kent, it is neither rare nor scarce. There is possible evidence of decline in the county between 1971-80 and 1991-2005, but this has limited support from later records. It is a Kent axiophyte and so is indicative of good habitat.

Oare. Photo by Lliam Rooney, 30 September 2010

Account

The first Kent record of Perennial Glasswort is from Sheppey: 'There was observed near the island of Sheppey by Dr Sloane a geniculate glasswort or another new perennial species of glasswort' (*Kali geniculatum majus sive alia nova species Kali perennis a D. Sloane observatum est prope insulam Shepey*). This was given in the Appendix of additions in vol.2 of John Ray's *Historia Plantarum* (1688), the record being too late for inclusion in the first volume (1686). The finding was communicated by Dr. Hans Sloane in a letter to Ray dated 10 August 1686[734]. 'In our simpling journey to Sheppey we found a perennial Kali differing somewhat from that on the Mediterranean shores; and Mr. Watts assures me it is a perennial. It grows near King's Ferry, in Sheppey, where also is cast upon the shore the *Fucus spongiosus Ger. emac*. In the same place, in the ditch, grows plentifuly *Atriplex maritima folio sinuato candicante angusto*…I send you down specimens of them' Ray replied on 24 August: 'The *Kali geniculatum*, I agree with you and Mr. Wattes to be different from that of the Mediterranean shores, and a new species, as far as I can discern from the dried plant'.

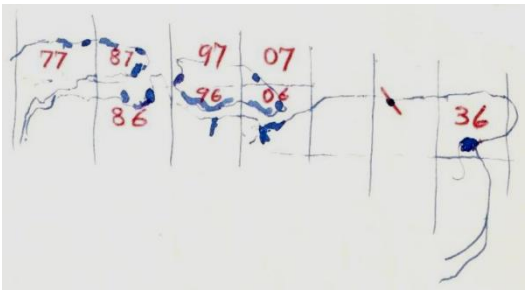
Harty, habitat. Photo by Lliam Rooney, 2017

This correspondence shows not only the contemporary network for exchange of botanical information, but also how discoveries were bound up with herbal investigations for medicinal purposes. The find was on a 'simpling' (i.e. herborizing) expedition, just as Johnson had undertaken with his fellow apothecaries in 1629 and 1632. Hans Sloane had already taken his MD at the University of Orange, and his interest in botany helped him to membership of the Royal Society in 1685. He had a close association with Chelsea Physic Garden, the curator then being John Watts, whose opinion on the

[734] (ed.) Lankester, E. (1848), *The correspondence of John Ray*. The Ray Society, London.

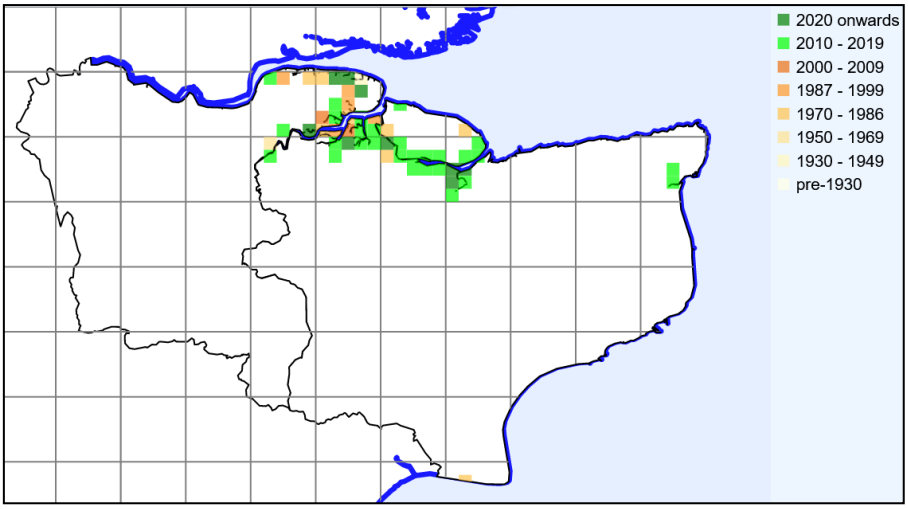
perennial status of the plant was obviously worth having (and who had helped, or promised to help, Ray with information regarding rare plants).

It was also given as growing abundantly in the Isle of Grain by Dillenius in the third edition of Ray's *Synopsis Methodica Stirpium Britannicarum* (1724). Hanbury & Marshall (1899) gave additional records for other locations: Whitstable, Pegwell Bay, Deal and New Romney, considering it to be locally plentiful on muddy shores. Francis Rose, in his manuscript *Flora of Kent*, treated it as a plant on firm consolidated mud in the general salt marsh community; sometimes on more sandy mud; not extending up estuaries far away from the zone of highest salinity; and no longer to be found on the S. Kent coast. He mapped it as present in eight hectads.



Map by Francis Rose: *Sarcocornia perennis* distribution, 1945-56.

This is the same total as given in Philp (1982) for 1970-81, although the latter omits Pegwell Bay, but includes a Dungeness sighting. The eight 1970-81 hectads were represented by 39 tetrad records. These had become 32 tetrads by the 1991-2005 survey published in Philp (2005), suggesting an 18% decrease. If there had been a decrease, then it has not been of that order, as our 2010-23 records cover 37 tetrads (62 monads). The fundamental distribution remains the same, clustered around the Swale and Medway estuaries and the neighbouring Thames estuary, with an outlier at Pegwell Bay. The species can readily be overlooked, especially in large areas of saltmarsh with varying accessibility as a result of interruption by deep, sinuous channels, and where it may be concealed by other vegetation.



***Sarcocornia perennis* Kent records to 2023 mapped at tetrad level, from BSBI database**

The norm in Kent is for it to be found, as mentioned in Philp (2010), in the middle and upper parts of salt-marshes. This is often in muddy areas dominated by *Atriplex portulacoides* (Sea-purslane), but we have also seen it at a saltmarsh margin with sand (Rainham), and on flat mud of channels and pools, not intermixed with other species (Kemsley Marshes). It has been claimed for ditches near Sheerness, which is unusual, and Kent records include at tidal creeksides and around saltmarsh pools, which tend to be in the upper saltmarsh. This versatility is also indicated by Leach (1994)[735], who refers to presence in both eroding lower parts of saltmarshes and in higher levels along drift-lines and on shell- and shingle-banks, including occasionally bare ground above the drift-line, such as trackways behind sea walls. While we have noted Kent habitats as frequently muddy, the species is considered intolerant in relation to a waterlogged substrate (Davy, A.J. et al., 2006[736], despite its regular inundation, and so underlying sediments may be expected to be

[735] Leach, S.J. (1994), in (eds.) Stewart, A., Pearman, D.A. & Preston, C.D., *Scarce Plants in Britain*, JNCC, Peterborough.

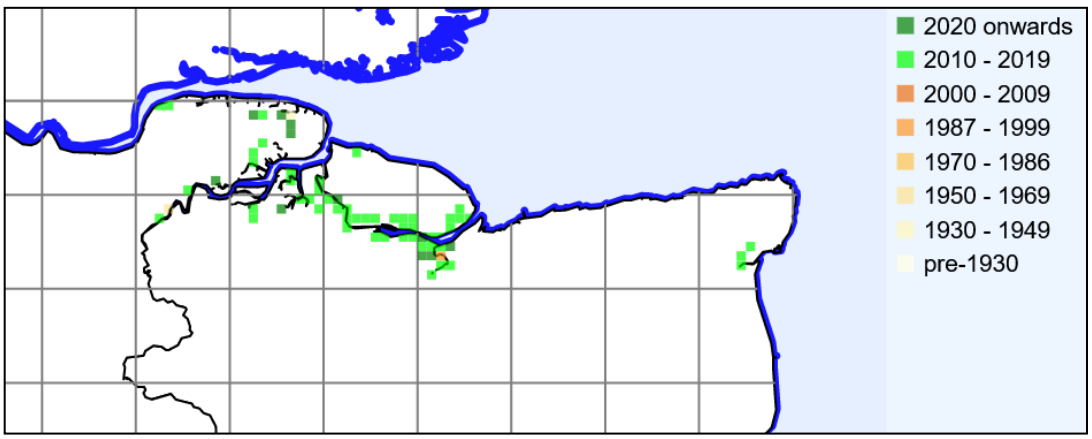
[736] Davy, A.J. et al., (2006). Biological Flora of the British Isles: *Sarcocornia perennis* (Miller) A.J. Scott. *Journal of Ecology* **94**: 1035-1048

relatively well-drained. We have not kept records of associated species, but have recorded, as present in the same saltmarsh, species such as *Puccinellia maritima* (Common Saltmarsh-grass), *Suaeda maritima* (Annual Sea-blite), *Atriplex portulacoides*, *Salicornia* spp., *Limonium vulgare* (Common Sea-lavender), *Tripolium pannonicum* (*Aster tripolium*, Sea Aster) and *Spartina anglica* (Common Cord-grass). All these are mentioned by Davy, A.J. et al. (2006) as most frequently associated with *S. perennis* in English saltmarshes, in this order of frequency.

Oare. Photo by Lliam Rooney, 26 September 20150

It is readily distinguishable from *Salicornia* spp. by its perennial character, and so is difficult to pull up. The woody stems are often procumbent, rooting at the nodes, and Leach (1994) refers to 'bushes' up to 1 metre across. The triads of flowers (cymes) are distinctive in that all three, ranging alongside above the base of a fertile segment, are almost of equal height. Not all stems bear fertile spikes and they are usually little-branched, developing from green to yellow-, orange- or reddish-brown.

***Sarcocornia perennis* Kent records to 2023 mapped at monad level, from BSBI database**



Salicornia disarticulata Moss (*S. pusilla* Woods) (One-flowered Glasswort)

vc 15; probably still in vc16 although not seen recently

Rarity / scarcity status

Salicornia disarticulata is a succulent, salt-tolerant annual of saltmarshes in southern parts of the British Isles, with its main distribution in south Wales, Hampshire and East Anglia down to north Kent. It is a **nationally scarce** species and one whose conservation risk status is regarded as of 'Least Concern'. However, this assessment of risk is based on the level of decline in records for the period 1930-99, which did not reach a level of least 30% (qualifying for Vulnerable status); but if 1987+ data were considered against all records, including those before 1930, a decline of 33% would have been shown. In Kent, there is some evidence of decline (35%) between the periods 1971-80 and 1991-2005, but not since, except as regards an absence of post-2000 records for the Hoo peninsula. Whilst local, it is neither rare nor scarce in the county. It is a Kent axiophyte and so is indicative of good habitat.

Account

The first record of this species in Kent appears to be a pressed specimen in **CGE**, collected by E.S. Marshall at New Romney on 17 September 1891 (det. P. Sell). Marshall was evidently taking an interest in *Salicornia* spp. at New Romney in 1891 as there is a long account by him in Hanbury & Marshall (1899) regarding a plant on the muddy flats near Great Stone which he named as *S. appressa*. However, there is no mention there of any one-flowered glasswort, in spite of the 1891 gathering. On the other hand, Marshall (1915[682]), in writing up a prostrate form of *S. disarticulata* from Devon, which he named as var. *humifusa*, referred to his 1891 '*S. appressa*' plant as probably the same as a prostrate form of *S. disarticulata* seen by Dr C. Moss in both Brittany and England.

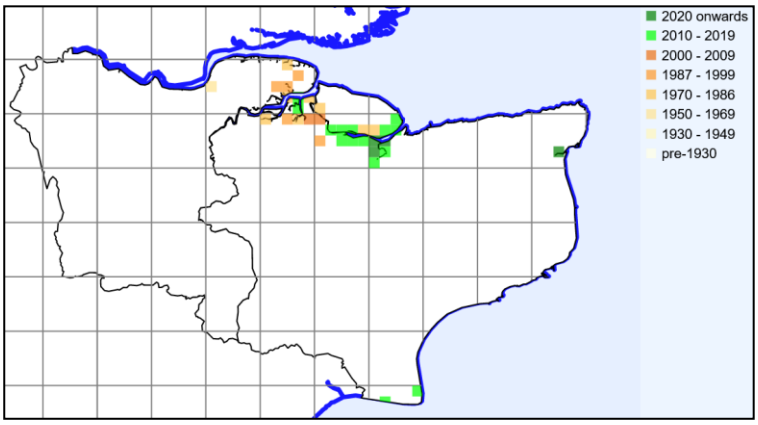
Oare. Photo by Lliam Rooney, 22 September 2010

Subsequently, Francis Rose assessed *S. pusilla/disarticulata* as locally frequent in the Thames, Medway and Stour Estuaries and noted records from Frindsbury, 1945 (the BSBI database credits A.J. Willmott as the first finder for vc16, West Kent here); Grain, 1948; Funton Creek, 1962; Conyer Creek; Faversham Creek (Nagden); Elmley, 1950-54; Harty, 1945-63; Shellness, Sheppey, 1949-63; Whitstable, 1926 (by G.C. Druce); Castle Coot, 1960-62; and Shellness at the mouth of the River Stour, 1954.

Records in Philp (1982), covering the 1971-80 county survey, showed no sign of the earlier New Romney and Shellness (Stour) presence, but gave 23 tetrads for upper saltmarshes in the Swale and Medway estuaries and just edging round Grain to the Thames estuary. Whilst the 1991-2005 survey (Philp, 2010) gave only 15 tetrads in the same area of distribution, it is possible that the ostensible decline relates to the practicalities of recording: the window of recording is effectively late September to mid-November and some of the saltmarshes are remote and difficult to access. Those considerations may also apply to 2010-23 recording,

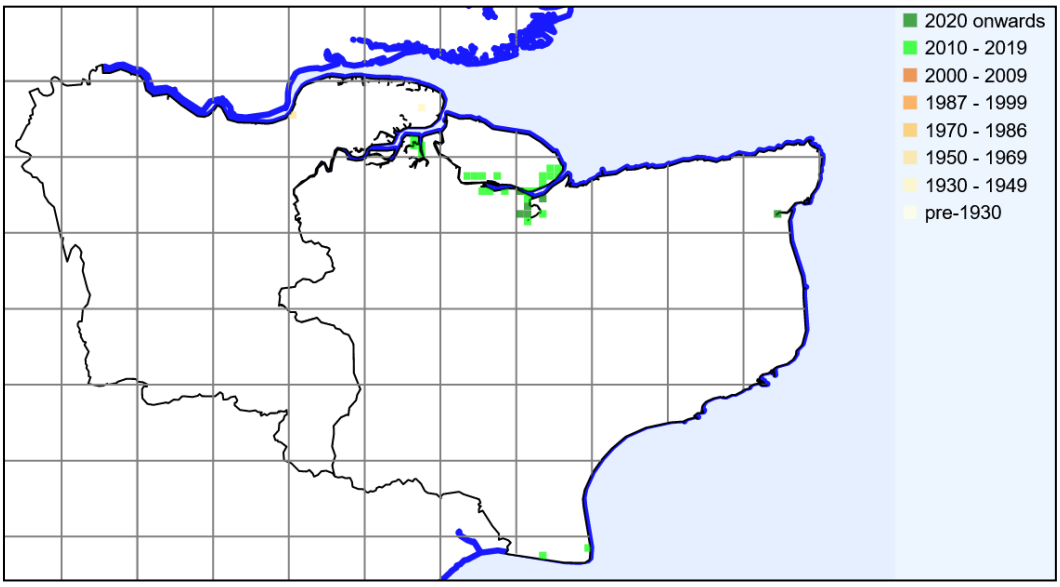
[682] Marshall, E.S. (1915). A new Salicornia variety and hybrid. *Journal of Botany* **53**: 362-363.

which has produced 19 tetrads (30 monads). However, 2010-23 recording has been successful in confirming continued presence at the mouth of the River Stour and, although no longer at New Romney, the species has been found in two sites at Dungeness. Mapping here is given at both tetrad and monad level, the former showing historic tetrad records, the latter giving finer resolution and omitting older records as monad recording only became the norm in Kent from 2010.



Salicornia disarticulata **Kent records to 2023 mapped at tetrad level, from BSBI database.**

Salicornia disarticulata **Kent records to 2023 mapped at monad level, from BSBI database.**

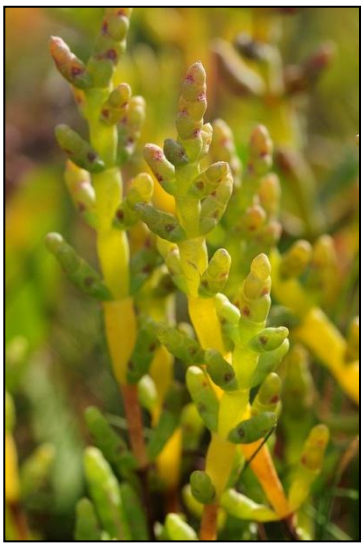


The limits to its presence are of course the availability of suitable saltmarsh. At Dungeness, the habitat is relatively unusual for Kent in that it is landward of the sea wall or shingle banks, which are penetrated by saltwater seepage. Elsewhere in the county, the norm appears to be saltmarshes which are subject to direct tidal influence and which lie seaward of any coastal or estuarial defences.

Oare, habitat. Photo by Lliam Rooney , 16 October 2018

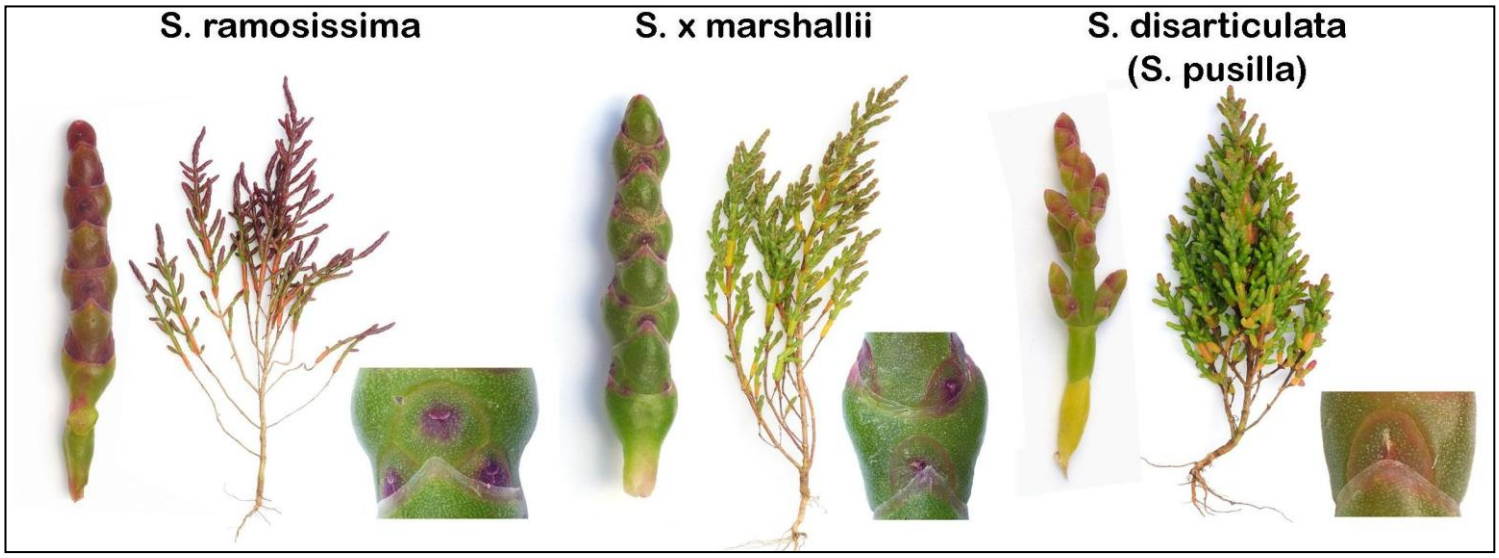
Typically, *Salicornia disarticulata* is to be found on the higher and drier parts of saltmarshes, just around or slightly above the level of normal tides; often growing on open flat areas, sometimes surrounding small

shallow pools. Such areas are without heavy cover of *Atriplex portulacoides* (Sea-purslane), and associated species are *Puccinellia maritima* (Common Saltmarsh-grass) and *Salicorna ramosissima* (Purple Glasswort).



Oare. Photo by Lliam Rooney, 22 September 2010

One-flowered Glasswort is, unsurprisingly, readily recognizable by its single flowers (cymes). Other British glassworts have their flowers, when fully developed, in groups of three. Occasionally, Kent plants have been found with flowers in a mixture of ones, twos and threes. Where this mix can be seen not to a consequence of an early stage of development in which flowers in groups of three have not fully emerged with expansion of the spike or branch segment, then it can be concluded that this is *Salicornia x marshallii*, a hybrid between one- and three- flowered species (*S. disarticulata* x *ramosissima*). This is mentioned as known in East Kent by Dalby (1975)[683] and it was reported at Bedlams Bottoms, Iwade, TQ86Z, by Geoff Smith, although not included in Philp (1982). The first recent record was by Lliam Rooney, near Oare, in 2010, after which, with the benefit of annual *Salicornia* expeditions by the Kent Botanical Recording Group, Kent botanists have become accustomed to its recognition and it has been seen in 12 monads in the period 2010-23. It is named after the *Flora of Kent* co-author, E.S. Marshall, who first described the hybrid, from Devon, as a cross between *S. disarticulata* and *Salicornia smithiana* (since treated as subsumed into *S. ramosissima*). Hybrids may arise as first generation through wind pollination between the parents, or as a subsequent generation since hybrids are fertile, varying but generally closer to *S. disarticulata* in appearance.[684] Both parents and hybrid are annuals.



From Glassworts crib sheet prepared by Lliam Rooney from Kentish specimens

Other characteristics of *S. disarticulata* are its yellow-green colour, becoming brownish- or pinkish-yellow (grey-green in an occasional prostrate form[685]); the fairly short terminal spike and side branches; also, the plant disarticulates (cf. *disarticulata*) when the fruit is ripe, so that the branches with their fertile segments become detached and settle on the ground or are moved by the tides elsewhere. The segments with their

[683] Dalby, D.H. (1975) Salicornia L. in (ed.) Stace, C.A., *Hybridization and the Flora of the British Isles*, BSBI/Academic Press, London.

[684] Salicornia L., in Stace, C.A., Preston, C.D. & Pearman, D.A. (2015). *Hybrid Flora of the British Isles*, BSBI, Bristol.

[685] D.H. Dalby (1994) Salicornia pusilla J. Woods. In (eds.) Stewart, A., Pearman, D.A. & Preston, C.D. *Scarce Plants in Britain*, JNCC, Peterborough.

seeds may float in sea water for up to three months and are characteristically deposited on high points.[686] It is perhaps the easiest *Salicornia* species to identify because of its single flowers; otherwise the boundaries between the species are often difficult to identify in view of their plasticity, the differentiation within a species of inbreeding populations and the general lack of discontinuities in the range of variation between the various taxa.

[686] Dalby, D.H. *(*1963*)* Seed dispersal in *Salicornia pusilla. Nature* **199:** 197–198.

Appendix 4657/AB4:

Case Studies of woodland compensation ratios and consultation with Natural England

Appendix 4657/AB4a:

A1 in Northumberland - Morpeth to Ellingham

(CD 37.5.2.E)

A1 in Northumberland: Morpeth to Ellingham

Scheme Number: TR010059

6.7 Ancient Woodland Strategy (Clean)

Rule 8(1)(c)

Planning Act 2008

Infrastructure Planning (Examination Procedure) Rules 2010

June 2021

This Ancient Woodland Strategy (as submitted at Deadline 9 of the Examination) has been further updated in response to final comments received by Natural England. These changes are made in **paragraphs 4.5.12, 5.2.1, 5.3.1, 5.4.1, 5.6.5 and Appendix A**. This document is an update to [REP4-054 and 055] and presents the 'Revised Scenario' – i.e. with the inclusion of the Stabilisation Works and Southern Access Works within the Scheme.

The Change Request was accepted by the ExA on 9 April 2021, and the information presented within this document assumes that the proposed changes are accepted by the Secretary of State for Transport. If accepted, this report for the Revised Scenario would supersede the previous iteration of the strategy **[REP4-008 and 009]** (Original Scenario) in respect of the Scheme subject to those amendments.

The Scheme has been designed to avoid, as far as possible, the loss of ancient woodland. However, no suitable alternative has been identified to completely avoid impacts. In addition, mitigation through Scheme design and construction methods/actions would only partially address the impacts to ancient woodland. As such, compensation to address impacts to ancient woodland is required. It is acknowledged that compensation is considered a last resort, that ancient woodland is irreplaceable, and the quality of the compensation habitat would be inferior and would take years to establish.

Several limitations have been identified to achieving the objectives of this strategy. These are detailed within this document and have been considered during the development of the strategy.

In total, 0.96 ha of ancient woodland (of which 0.27 ha is designated and 0.69 ha is adopted, as detailed within this strategy) would be impacted by the Scheme and 11.54 ha of woodland planting (including rides and glades) is proposed ('Woodland Creation Area' and 'Replanted Area', as defined in **paragraph 1.1.10**), a 12:1 ratio in terms of planting to loss. There is no set ratio for woodland compensation in relation to ancient woodland, with assessments made on a case-by-case basis.

A range of techniques would be employed to establish the Woodland Creation Area, including: preparation of the Woodland Creation Area (soil analysis and manipulation), the salvage/translocation of ancient woodland material (such as soil, saplings and ground flora), the establishment of a hay meadow ground flora and woodland tree planting.

Similar techniques would also be employed to replant the Replanted Area, including: preparation of the Replanted Area (soil analysis and manipulation), woodland tree planting and the salvage/translocation of material (saplings and ground flora).

Following establishment and replanting, suitable and long-term management would be undertaken within the Woodland Creation Area and Replanted Area, tailored in accordance with ongoing monitoring, for a minimum period of 50 years.

This document provides an account of the proposed strategy to address impacts to ancient woodland as a result of the Scheme. The strategy has been developed in consultation and collaboration with Natural England. Finer details of the strategy shall be developed at the

Appendix 4657/AB4b:

M54 – M6 link

(CD 37.5.2.F)

highways england

M54 to M6 Link Road
TR010054
Volume 6
6.1 Environmental Statement
Chapter 8 – Biodiversity

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

October 2020

Designated and non-designated sites

8.8.3 The following mitigation measures would be put in place to reduce the effects of potentially significant Scheme construction phase impacts on designated and non-designated sites (where applicable):

- **Pollution prevention control measures**. Water pollution prevention control measures and standard best practice measures to control construction dust and noise would be implemented during the construction phase via the CEMP (refer to Chapter 5: Air Quality; Chapter 11: Noise and Vibration; Chapter 13: Road Drainage and the Water Environment; and the OEMP [TR010054/APP/6.11]).
- **Ancient woodland** is an irreplaceable habitat and therefore the loss of this habitat cannot be mitigated. It is assumed that works within 15 m of ancient woodland could result in its loss due to compaction of tree roots and soil. This 'loss' would be compensated for at a ratio of 7:1 by area as agreed with Natural England. The woodland planting would be provided adjacent to an existing area of ancient woodland (within Brookfield Farm LWS and SBI). The location of the land identified for these compensation measures is illustrated on the Environmental Masterplan on Figures 2.1 to 2.7 [TR010054/APP/6.2]. In addition, habitat improvement to Oxden Leasow (Whitgreaves wood) to be agreed with Natural England and the National Trust will be undertaken. The risk of damage (direct and dust depostition impacts) to retained trees and hedgerows will be mitigated by implementation of protection measures included in BS5837: 2012 (Ref 8.42), which include fencing boundaries of working areas with appropriate standoffs where required to protect both above-ground vegetation and roots.
- **Habitat creation.** New woodland planting, new standing water habitats, new marshy and wet grassland and species-rich grassland are being created in response to the impacts to Lower Pool LWS and SBI and Brook Fieldfarm LWS and SBI sites.

Habitats

8.8.4 The following mitigation measures would be put in place to reduce the effects of potentially significant Scheme construction phase impacts on ecological habitats:

- **Pollution prevention control measures.** Water pollution prevention control measures and standard best practice measures to control construction dust and noise would be implemented during the construction phase via the CEMP (refer to Chapter 5: Air Quality; Chapter 11: Noise and Vibration; Chapter 13: Road Drainage and the Water Environment; and the OEMP [TR010054/APP/6.11]).
- **Management of invasive plant species.** Invasive plant species would be managed according to an Biosecurity Management Plan as documented within the OEMP [TR010054/APP/6.11]. Treatment and control would be undertaken by an approved specialist contractor. Pre-construction surveys would be undertaken to inform the Management Plan. This would be implemented

disturbance including light and noise. Within the Brookfield Farm LWS and SBI Woodland, no woodland would be directly lost, but there is an assumed loss of 0.029 ha as a result of work being required within 15 m buffer zone of the ancient woodland.

8.9.27 This would result in a total loss of ancient woodland of 0.349 ha. This loss would be compensated for by replacement planting on a ratio of 7:1 (2.44 ha of woodland) within the immediate vicinity of the Brookfields Farm LWS and SBI woodland which has been agreed with Natural England. The location of the land identified for these compensation measures is illustrated on Figures 2.1 to 2.7 [TR010054/APP/6.2]. In combination with the compensatory planting, conservation led management of both ancient woodlands would seek to develop and improve upon the woodland structure.

8.9.28 The NPSNN (Ref 8.12) acknowledges ancient woodland to be an irreplaceable habitat because of the long continuity of woodland cover, which means that even woodland sites which have been replanted are important as part of the resource. Its loss cannot be fully compensated by new planting. Many of the species of ancient woodland have poor ability to colonise from areas of existing ancient woodland and into separate new habitats, and this may even be the case after the periods of decades that are required for planted trees to develop on a new site.

8.9.29 Although there would be no severance of woodland habitat at Oxden Leasow (Whitegeaves Wood), the loss of woodland west of the Brookfields Farm ancient woodland as a result of the Scheme could have indirect effects on the quality of the habitat of adjacent retained woodland as it may become more exposed to light and inclement weather.

8.9.30 This exposure may cause further damage and result in the growth of more vigorous species rather than those that favour stable conditions. However, the additional woodland planting proposed immediately adjacent to the retained woodland is considered to minimise this process in the long term once habitats have established.

8.9.31 It is recognised that ancient woodland with its long history and complexity of habitat cannot be replicated, and certainly not within 15 years. Even when the measures incorporated into the Scheme are taken together (comprising minimising loss of ancient woodland, increased (non-ancient) woodland area through new planting and improvements in management of retained woodland) the losses of ancient woodland from these two areas represent a reduction in the overall extent of this irreplaceable habitat resulting in a major adverse impact, which is an effect of large significance.

Habitats

8.9.32 The construction of the Scheme would result in both losses and gains of habitat. The permanent habitat gains are those classified as habitats created as part of the Scheme. Table 8.18 provides a summary of all habitat losses and gains within the Scheme boundary. It does not correspond to the total area of land required for the Scheme because it does not include highway or other built infrastructure.

Appendix 4657/AB4c:

Lower Thames Crossing

(CD 37.5.2.G)

national highways

Lower Thames Crossing

6.1 Environmental Statement Chapter 8 – Terrestrial Biodiversity (Clean version)

APFP Regulation 5(2)(a) & 5(2)(l)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 6

DATE: December 2023
DEADLINE: 9

Planning Inspectorate Scheme Ref: TR010032
Application Document Ref: TR010032/APP/6.1

VERSION: 2.0

8.6.134 Habitat losses south of the River Thames in the short term would have a temporary moderate adverse impact on bats. The remaining habitat losses, comprising predominantly arable, amenity grassland, species-poor semi-improved grassland, semi improved neutral grassland and improved grassland would result in the irreversible loss of suboptimal foraging habitat. This classification as suboptimal foraging habitat is shown by low levels of bat activity at Transect 7 and Transect 8 and 9 automatic static locations, all of which are in the aforementioned habitats.

8.6.135 The replacement planting of semi-improved natural broadleaved woodland and plantation woodland habitat is predicted to be of at least equal value to what is going to be lost and likely higher quality compared to the plantation woodland, although would take at least 30 years to become sufficiently established. The irreversible lost ancient woodland is classed as irreplaceable habitat, although to help compensate the loss, 48.75ha of ancient woodland compensation planting would be provided. The habitat lost is likely to be of a high value to bats, however, there are large areas of ancient woodland habitat in the wider landscape which the local bat population would still be able to utilise. A total of 4.84km of hedgerow habitat would be lost but new hedgerow habitat would be created as well as improving existing hedgerows which would take approximately five to ten years to become sufficiently established.

8.6.136 Replacing lower quality grassland with grassland that has a greater species diversity would result in greater invertebrate numbers and diversity, resulting in better foraging for bats once habitats begin to establish (approximately five to ten years).

8.6.137 One tree roost (Tree 284 a soprano pipistrelle day roost (peak count 1), one probable brown long-eared bat day roost (peak count 1)) and one building roost would be lost (1 Longview, a common pipistrelle day roost (peak count 3)) as part of the construction of the Project. These roosts supported three widespread and common species and their removal of the roosts would be undertaken under a European Protected Species mitigation licence with respect to bats from Natural England (Appendix 8.16 (Application Document 6.3)). Compensation and mitigation measures would be implemented prior to their removal, including the installation of artificial bat roosts on retained trees suitable for these species and the creation of a new shelter structure for hibernating.

8.6.138 The habitat loss associated with woodlands and trees would result in the additional loss of 20 high suitability and 31 moderate suitability bat roost trees. The loss of these features would be compensated in advance of any loss, as outlined in Section 8.5 and the REAC (Appendix 2.2 (Application Document 6.3), REAC Ref. TB009) through the provision of artificial bat roosts within retained areas of woodlands and trees. This is in addition to the habitat creation which would have a minor medium to long term beneficial impact on bats.

8.6.139 Overall, impacts of habitat loss on the bat assemblage, which is of county importance, would be compensated by the proposed mitigation and compensation measures such that the level of impact in the short to medium term would be permanent minor adverse, resulting in effects that would be slight adverse and **not significant.**

Table 8.31 Habitat losses and gains associated with the Project to the south of the River Thames

Existing habitat	Importance	Habitat loss (ha)	New semi-natural habitat (from Environmental Masterplan)	Habitat permanent gain	Net permanent gain (gain–loss)
Ancient woodland	National	5.35ha	Ancient Woodland Compensation Planting (LE8.2)	48.75ha	43.40ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Ancient and veteran trees	National	Three veteran trees lost. No loss of ancient trees. See Figure 8.2 (Application Document 6.2) for locations.	Scattered trees (LE2.7) and individual trees (LE5.1)	0.05ha	0.05ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Semi-natural broadleaved woodland	County	7.03ha	Native woodland (LE2.1), woodland with non-native species (LE2.11), woodland edge (LE2.2), linear belt of shrubs and trees (LE2.4)	104.23ha	62.34ha
Plantation woodland	County	34.86ha			
Scrub	County	4.39ha	Scrub (LE2.8), shrubs with intermittent trees (LE2.5)	11.23ha	6.84ha
Scattered and parkland trees	Local	Not calculated, see Figure 8.2 (Application Document 6.2) for locations	See scattered trees (LE2.7) and individual trees (LE5.1) above	–	–
Neutral grassland	County (BAP habitat)	9.87ha	Species-rich grassland (LE1.3) and annual wildflower grassland (LE1.32)	120.62ha	100.55ha
	Local	10.2ha			
Calcareous grassland	County	2.73ha	Species-rich chalk grassland (LE1.31)	30.78ha	28.05ha

Table 8.35 Habitat losses and gains associated with the Project to the north of the River Thames

Existing habitat	Importance	Habitat loss	New semi-natural habitat (from EMP)	Habitat permanent gain	Net permanent gain (gain – loss)
Ancient woodland	National	2.01ha	Ancient woodland mitigation planting (LE8.2)	32ha	29.9ha (Not considered a net gain due to the irreplaceable nature of the habitat lost)
Ancient and veteran trees	National	Three veteran trees lost. No loss of ancient trees. See Figure 8.2 (Application Document 6.2) for locations.	Scattered Trees (LE2.7)	0.13ha	0.13ha
Semi-natural broadleaved and mixed woodland	County	9.9ha	Native Woodland (LE2.1), woodland with non-native species (LE2.11), wet/carr woodland (LE2.14), woodland edge (LE2.2), scrub woodland (LE2.22), linear belts of shrubs and trees (LE2.4)	173.73ha	98.91ha
Plantation woodland	Local	64.92ha			
Scrub	Local	24.03ha	Scrub (LE2.8), shrubs with intermittent trees (LE2.5)	45.88ha	21.85ha
Scattered and parkland trees	Local	Not calculated, see Figure 8.2 (Application Document 6.2) for locations.	See scattered trees (LE2.7) above	–	–
Acid grassland	County	1.14ha	Translocated acid grassland (LE8.6)	5.03ha	3.89ha

Appendix 4657/AB5:

Extract from Planner's Manual for Ancient Woodland and Trees. Woodland Trust. 2019

(CD 37.5.2.H)

Practical Guidance

Planning for Ancient Woodland

Planners' Manual for Ancient Woodland and Veteran Trees

July 2019

WOODLAND TRUST

Compensation for loss of ancient woodland

Replacement planting

Natural England states that ancient woodland, the product of centuries of habitat continuity and undisturbed soils, is an irreplaceable resource. As such, its loss cannot be mitigated for by creating a new woodland – an irreplaceable habitat cannot, by definition, be replaced.

Consequently, where it is deemed that there is going to be unavoidable residual damage or loss to ancient woodland, the measures taken to compensate for this must be of a scale and quality commensurate with loss of irreplaceable habitat. Where ancient woodland is to be replaced by new woodland, this should aim to create 30 hectares of new woodland for every hectare lost. In commenting on the proposals for the new HS2 rail link, Natural England has supported a 30:1 ratio[25], stating:

"... a commitment to such a ratio would be a clear statement by HS2 Ltd that it recognises the critical importance of ancient woodland and the scale of newly created woodland provided would leave a positive legacy for the natural environment and for the communities along its route. It would also make a significant contribution to the [sic] delivering the recommendations of the Lawton report and set the standard for future projects (Lawton et al., 2010)".

Habitat and soil translocation

Compensation proposals for the loss of ancient woodland often include suggestions to move or *'translocate'* the soil, or even individual trees (as coppice stools), from the ancient woodland to a new receptor site where woodland creation is proposed. However, translocation should be viewed only as a measure of last resort, and:

- should only be used as a form of partial compensation for damaging development when all other alternatives to protect the habitat have been exhausted;
- should not be viewed as a benefit and will not make a proposed development on ancient woodland more palatable.

The Standing Advice states emphatically that:

"You cannot move an ancient woodland ecosystem because:

- *it's not possible to replicate the same conditions at another site*
- *it's no longer an ancient woodland"*

The reason an ancient woodland ecosystem cannot be moved is because it has developed at this site over hundreds, sometimes thousands of years. The soil composition and structure, varied topography, range of micro-habitats, species assemblages, and mycorrhiza fungi associations with tree roots, cannot be moved intact.

The Joint Nature Conservation Committee's (JNCC) guidance on translocation[26] remains the most up-to-date detailed advice. It states:

"Habitats translocation has been proposed as a means of saving wildlife from areas threatened by development. These translocations have been portrayed by some as a means of reducing the impact of developments (mitigation), whereas in reality they can only partly make amends for developments (as incomplete compensation)."

A comprehensive review of the limited evidence available on translocation was published by the Woodland Trust in 2013[27].

Where translocation is considered, a monitoring period of at least 50 years will be required, along with alternative plans to ensure the stated benefits will be achieved if the translocation fails. Furthermore, the new site should be identified as an *'ancient woodland translocation site'* in the LPA's Local Plan, and properly protected from future development.

Jane Corey/WTML

Every ancient wood is the unique product of its location, geology, soils, climate and history –conditions that cannot be re-created elsewhere

25 Natural England. (2016). *Review of the High Speed 2 'no net loss in biodiversity' metric.* Available at: www.gov.uk/government/publications/review-of-hs2-ltds-no-net-loss-in-biodiversity-metric

26 JNCC. (2003). *A Habitats Translocation Plan for Britain.* Available at: jncc.defra.gov.uk/pdf/habitats_policy.pdf

27 Ryan, L. (2013). *Translocation and Ancient Woodland.* Available at: www.woodlandtrust.org.uk/mediafile/100115770/Translocation-and-Ancient-Woodland.pdf

Appendix 4657/AB6:

Case Study – Counting Irish Hares at Belfast Airport. 2015

(CD 37.5.2.I)

Counting Irish hares at Belfast International Airport

26 January 2015

The Irish hare is one of the few species unique to Ireland

By Allan Preston

BBC News NI

The light catches the reflection from two small eyes and an animal hurriedly hops away.

For years now the Irish hare - one of the few species unique to Ireland - has been happy to make its home on the runways despite the usual noise of landing planes.

Dr Neil Reid, a conservation biologist with Queen's University, is conducting the study.

"They don't seem to mind about vehicles, their main concern is probably that there's fewer foxes round here and the grass is cut less often than the rest of the countryside, which does them a lot of good."

The Irish hare population declined during the 20th century across Ireland due to agricultural expansion. It's hoped the survey can help paint a wider picture of the local ecosystem and the general biological health of farmland.

"By studying hare population and how their numbers increase or decrease it gives us some information about the intensity of general agriculture in the countryside and reflects population trends in other farmland species," Dr Reid says.

Last week at the airport, 48 hares were counted in total. This week it's 58, as well as two foxes lurking nearby, although as the Irish hare is capable of running at speeds of up to 45 mph they are difficult to catch

The money for the survey comes from the Northern Ireland Challenge Fund (5p plastic bag tax) which funds a number of environmental projects across Northern Ireland.

A total of 12 sites (two from each county) will be surveyed as well as additional sites known for their high densities of hares including Belfast International Airport and Rathlin Island.

MATHIEU LUNDY

More on this story

Appendix 4657/AB7:

TN01 Arboricultural Technical Note. Aspect Arboriculture. 04 February 2025

(CD 37.5.2.J)

Technical Note

PROJECT: Land to the South and East of Sittingbourne, Kent

TN01: Arboricultural Technical Note

4th February 2025

Introduction

1.1. Aspect Arboriculture have been involved in the current proposed development since January 2018. The purpose of Aspect Arboriculture's appointment was to undertake a tree survey to classify tree constraints, to input to the design stages of the proposal and to confirm the effect of the scheme put forward. Aspect Arboriculture subsequently provided input into the scheme and produced an Arboricultural Impact Assessment document detailing the scheme's effect; submitted to inform the planning application (ref: 21/503914/EIOUT).

1.2. Subsequently, Aspect Arboriculture have provided input into the forthcoming Public Inquiry, including agreeing arboricultural elements within the Statement of Common Ground with Swale Borough Council.

1.3. This Technical Note is intended to provide arboricultural clarification to a query identified during the production of Aspect Ecology's Proof of Evidence, which it is intended to be read in conjunction with.

Effect on Ancient Woodland

2.1. Natural England Standing Advice identifies 'Changing the woodland ecosystem by removing the woodland edge or thinning trees - causing greater wind damage and soil loss' as a direct effect resulting from development.

2.2. The risk associated with increased wind exposure, resulting from the partial removal of Highsted Wood has been considered during assessment of the effect of the proposed infrastructure scheme. To clarify, Highsted Wood is characterised by Sweet Chestnut coppice, as illustrated within Figure 1 overleaf:

2.3. Figure 1: Typical structure of Highsted Wood

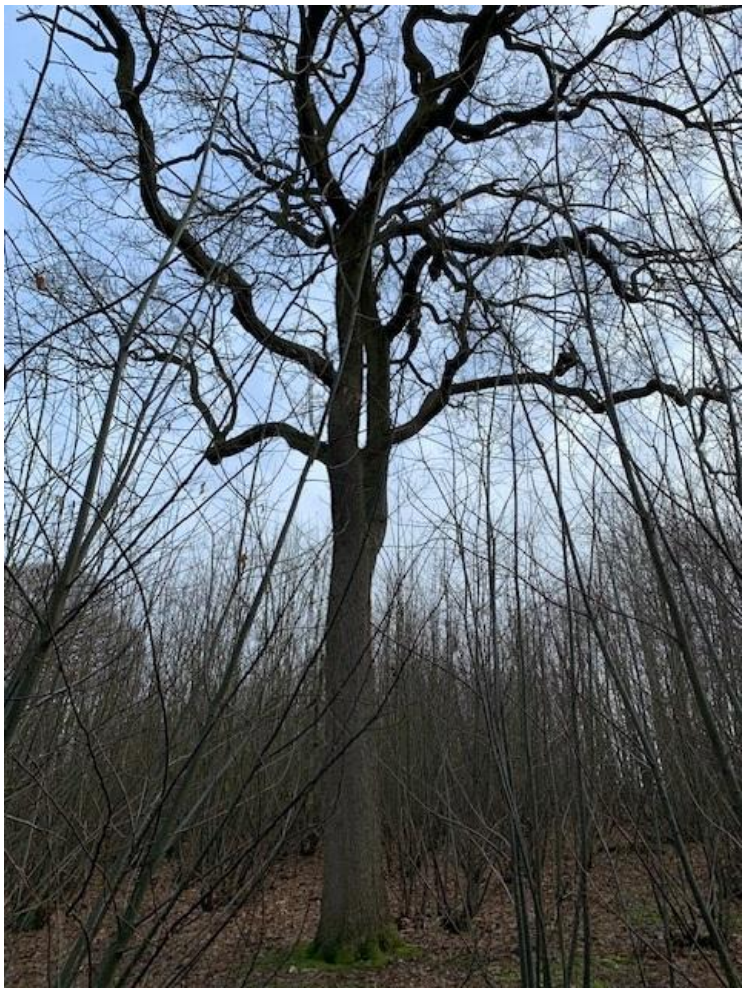
2.4. It is evident that this management of Highsted Wood is ongoing. Figure 2 below demonstrates the continuation of the coppicing regime, visible as a felled compartment in 2022 (left), with regenerative growth evident a year later (right).

2.5. Figure 2: Evidence of ongoing management of Highsted Wood as coppice

2.6. By virtue of the coppicing of Highsted Wood, the partial removal of the section to the northwest, to accommodate the infrastructure proposal, is not anticipated to result in an uplift in the likelihood of windthrow within the woodland interior. Whilst occasional standards remain within Highsted Wood, as illustrated within Figure 3 overleaf, these trees have been subject to periods of increased wind exposure by virtue of the management of the surrounding coppice. In response, the standards within the retained section of Highsted Wood are expected to be sufficiently

windfirm to readily withstand any increased exposure resulting from the introduction of the proposed infrastructure.

2.7. Figure 3: Standard tree within Highsted Wood



Conclusions

3.1. Aspect Arboriculture have provided arboricultural input to inform the proposed introduction of development at Land South and East of Sittingbourne, Kent. During the production of Aspect Ecology's Proof of Evidence, a query was identified relating to whether the proposals increase the risk of windthrow within the interior of Highsted Wood.

3.2. As demonstrated above, by virtue of the current and ongoing management of Highsted Wood as coppice, the introduction of the proposed infrastructure is not anticipated to result in an increased likelihood of windthrow within the retained section of the woodland.

Prepared by:
James Bardey BSc (Hons) MArborA

Appendix 4657/AB8:

Green bridges: safer travel for wildlife. Press release. Gov.uk. 2015

(CD 37.5.2.K)

GOV.UK

Press release

Green bridges: safer travel for wildlife

Natural England reports that bridges built across roads and railways to allow wildlife movement can stop species from becoming isolated and reduce the number of traffic accidents.

From: **Natural England (/government/organisations/natural-england)**

Published 31 July 2015

A21 Scotney Bridge © Land Use Consultants/Natural England

The bridges are known as green bridges, landscape bridges or wildlife overpasses and are usually planted with a variety of local trees or shrubs and other vegetation. They allow birds, mammals and insects to keep moving despite a road or railway blocking their path.

Green bridges are common in Europe and North America, but only a few have been built in Britain.

The report: “Green Bridges – a literature review” was undertaken by Land Use Consultants on behalf of Natural England. It looks at scientific evidence from 56 examples across the world, ranging from the Mile End green bridge in east London to the Compton Road faunal overpass in Brisbane, Australia.

It is the first worldwide study of green bridges and has found that they could become an important part of the sustainability of future transport projects by:

- creating a safe crossing point for wildlife movement
- joining up habitats and connecting colonies, as they are also used by wildlife as a home in their own right
- creating a crossing point for people and benefit pollinators
- integrating roads and railways into the surrounding landscape

As the government's conservation agency, Natural England's role is to make sure that the natural environment is conserved, enhanced and managed for the benefit of present and future generations. It gives advice on environmental impacts to planning authorities and developers to promote sustainable development.

The information contained in the review will help developers and planners involved in major infrastructure projects to factor new green bridges into their construction plans or consider converting existing bridges to green bridges.

Clare Warburton, Natural England's Senior Transport Specialist, said:

> " People often think of roads and railways as cutting a swathe through important wildlife habitat but this study shows that green bridges can significantly reduce their environmental impact. Not only can green bridges provide an important connection between wildlife colonies, they can also provide a home for wildlife in their own right.
>
> " By giving wildlife a clear route across major roads, green bridges also increase safety for roads users and animals alike. If sensitively designed to accommodate wildlife and people, they can also provide attractive routes that help local communities access the wider countryside. I hope the evidence in this review will help those planning transport projects to decide how and when to use green bridges both in England and beyond."

Sheena Crombie, Senior Ecological Advisor at Highways England, said:

> " Highways England recognises that roads may prevent effective movement for some species around the wider countryside, contributing to habitat fragmentation. Over the years it has investigated the possibility of providing green bridges at key localities but has found two significant problems when considering their construction. One has been a lack of knowledge on how the structures work and function, and secondly the high cost for what were unproven benefits. This document will help to give a better understanding on both these issues, providing clear guidance on the

design of green bridges to designers and planners working to improve and enhance the environmental performance of the Strategic Road Network. The publication will add to the knowledge base for civil engineers and the ecological community."

Examples of green bridges

England

The UK currently has a small number of green bridges. One of the most celebrated spans the A21 at Scotney Castle in Kent in the High Weald Area of Natural Beauty (AONB). Completed in 2005 as part of a dual carriageway by-pass for Lamberhurst, it enabled the historic drive to the castle to be preserved, reduced the impact on local landscape and was soon being used by dormice.

In London, a green bridge was built to overcome the fragmentation of Mile End Park by a number of roads and railway lines. Spanning five lanes of the A11, the Mile End green bridge is 25m wide with landscaped parkland. Rainwater runs off the bridge into tanks on either side and is then recycled to maintain the water content of the soil.

Europe

Green bridges were pioneered in the Netherlands, where at least 47 ecoducts as they are known have been constructed since the first in 1988. One of the earliest ecoducts was the Terlet overpass which is planted with trees. Within six years three species of deer were recorded using it, along with wild boar, red fox, badger, wood mice, common shrew and common vole.

Groene Woud ecoduct, also in the Netherlands, has a chain of small pools across the overpass and its access ramps for amphibians. Common toad, common frog, marsh frog, edible frog, smooth newt and great crested newt were all found on the ecoduct.

An overpass in Sweden enabled roe deer and moose populations to move around without having to cross the road. Allied to the construction of roadside fences, the overpass led to a 70% reduction in accidents caused by roe deer.

Trans-Atlantic

Further afield, two green bridges over the Trans Canadian Highway in Banff have allowed sufficient movement of bears to prevent genetic isolation. In

Brisbane, the Compton Road faunal overpass closely resembles the dense, surrounding eucalyptus forest and is remarkably similar in species richness.

A study found that twice as many species of bird were flying over the bridge as were flying over the road.

See: Green Bridges – a literature review (http://publications.naturalengland.org.uk/publication/6312886965108736) undertaken by Land Use Consultants on behalf of Natural England.

Published 31 July 2015

Appendix 4657/AB9:

Extract from research paper: Common Dormouse Movement in a Landscape Fragmented by Roads. Canin & Gubert. 2012

(CD 37.5.2.L)

Common dormouse (*Muscardinus avellanarius*) movements in a landscape fragmented by roads

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Abstract: The common dormouse (*Muscardinus avellanarius*) is widespread in Europe but populations have declined in some countries as a result of habitat loss and fragmentation. A population of common dormice living beside a dual carriageway road in southwest England was studied in 2007-2010 in order to investigate the impacts of roads on habitat fragmention at the local scale (tens of metres), i.e. the possible isolating effects of roads for a population. Each carriageway was eight metres wide with verges of two metres. Nest boxes and nest tubes were installed on each side of the road, and on the central reservation where areas of woodland or scrub existed. Animals were individually marked using implanted microchips (PIT tags). Common dormice were found in fragments of woodland or scrub as small as 0.2 ha and breeding was regularly recorded in fragments of 0.5 ha or larger. Common dormice were not present in all fragments in all years. Two individuals moved between the central reservation and the side of the road and there was indirect evidence of additional road crossings. This has implications for the conservation of dormice at the landscape scale where it is important to understand the extent to which roads are barriers to movement and the extent to which dormice will use fragmented habitats. It is also important to understand the extent to which dormice use habitats which are fragmented by roads when carrying out surveys for common dormice in connection with development and in mitigating the impacts of this development.

Keywords: *Muscardinus avellanarius*, dormouse, habitat fragmentation, metapopulation, road.

Introduction

The common dormouse (*Muscardinus avellanarius*) is a small arboreal rodent which is found throughout Europe, from southwest England and Brittany to northern Turkey and parts of central Russia and from southern Sweden to Sicily and central Greece (Juškaitis 2008). In many parts of its range (including the UK) it has declined in numbers in recent years (Verbeylen 2006) and is protected throughout the European Union as a consequence (Bright et al. 2006).

It has been suggested that the main reasons for its decline in the UK are loss and fragmentation of habitat combined with changes in woodland management practices which have led to a massive reduction in the practice of coppicing (Anonymous 2010). Juškaitis (2008) reviewed reports from several European countries citing similar impacts.

Common dormice are considered to be woodland specialists and it has been suggested that semi-natural ancient woodland where hazel is managed on a long rotation coppice cycle provides the best conditions for them (Bright et al. 1996). However, Eden & Eden (1999) have pointed out the importance of both hedgerows and scrub as habitats for common dormice in southern England and the Dormouse Conservation Handbook

Table 3. Pattern of use of each section by dormice during the four years of the study.

	2007	2008	2009	2010
N1	-	Present	Present	Present
N2	Breeding	Breeding	Breeding	-
C1	Present	Present	Present	Present
C2	Breeding	Breeding	Present	Breeding
C3	Breeding	Present	Present	Present
S1	-	-	Present	Breeding
S2	-	-	-	-
S3	Present		Breeding	Present
S4	-	-	-	-

(two out of 16 opportunities). Nevertheless one female dormouse produced a litter in the smallest section, i.e. 0.2 ha in extent (table 3). Excluding S4 there is a significant difference in the frequency that breeding was recorded in blocks less than 0.5 ha compared to those of 0.5 ha or greater ($\chi^2 = 5.24$, df=1, $P<0.05$)

Discussion

Our results do not contradict those of Bright et al. (1994) and Bright (1998) who stated that common dormice were 'reluctant' to cross gaps and populations were 'less likely to persist' in woods smaller than 20 ha. However, the results presented here do demonstrate that common dormice are more flexible in their use of habitats than may be implied by these authors. While dormice might be reluctant to cross gaps, they are clearly capable of crossing at least one carriageway of a major road which, during the summer, can be very busy. In addition, while isolated populations in small woods may be vulnerable to extinction, aggregations of very small fragments of habitat (<1 ha) might enable populations to persist over considerable periods of time, where they are sufficiently close to one another to permit recolonisation.

It is difficult to compare our results with those of Mortelliti et al. (2010) who worked in a very different landscape where arable land and land cultivated for vines, fruit and olive trees dominated the landscape. Much of southwest England is farmed as pasture with very small fields and a dense network of hedges. Their conclusion, that the distribution of common dormice is affected by habitat fragmentation, is likely to be dependent on the scale at which fragmentation is measured. We have shown that dormice were breeding in fragments of habitat isolated by roads at least 25 years after the road was constructed.

The area studied by Büchner (2008) in East Germany is more similar to ours, in that his habitat fragments were relatively small (0.66 ha to 4.25 ha), though more widely separated than ours. Capturing common dormice in both nest boxes and live traps, he marked 204 animals in a two year period. Of the 164 recaptures of dormice, six were of dormice which had moved between woodlands over distances ranging from 350-840 m. All these movements involved travelling on the ground through crops including clover, wheat and maize. The minimum distances crossed on the ground ranged between 250 m and 500 m.

Schulz et al. (in press), found considerable numbers of dormouse nests in some areas of roadside habitat. At one complex interchange they recorded 153 nests over a period of three years in 8.8 ha of woodland. Seventy-five percent of these were in fragments of habitat isolated by roads from the surrounding countryside. They concluded that dormice do not avoid the proximity of roads and suggested that roadside habitat might function as a good habitat for dormice, including as dispersal routes. However they also pointed out that as well as offering potential benefits to dormice, roads might have negative impacts resulting from noise, pollution and road deaths.

They observed the presence of dormice in fragments smaller than any of ours (<0.2 ha) noting that in their sample, fragments large than this all had dormice present whereas not all of those smaller than this did. They did not catch or mark individual dormice and had no indication as to whether or not breeding

occurred but pointed out that they recorded more than 20 instances where dormice had crossed a road at least once to colonise habitat which had been planted following road construction.

Bright et al. (1994) stated that their data imply a possible metapopulation model and our results, together with those of Büchner (2008) and Schulz et al. (l.c.) support that hypothesis. Bright et al. emphasised the importance of connecting hedges in this context but we have shown that dormice are willing to cross very open, exposed ground for short distances as have Schulz et al. while Büchner's data indicate that they may cross a few hundred metres over ground which has no trees or shrubs but does offer concealment in the form of agricultural crops.

A study by Macpherson et al. (2010) showed that both wood mice (*Apodemus sylvaticus*) and bank voles (*Myodes glareolus*) crossed small, single carriageway roads. In the absence of intervention, 7% of wood mice and 12% of bank voles crossed a six metre wide road, with 28% and 22% respectively crossing a road of 2.5 metres in width. Both species frequently travelled distances greater than these road widths in the course of their normal travels, suggesting that home ranges were normally confined to one side of the road or the other. Forty nine animals were translocated from one side of a road to the other and 16 (33%) of these crossed back again. In our study there is strong evidence that six (11%) of 53 adults crossed the road with no intervention. Given that common dormice are arboreal whereas wood mice and bank voles spend a considerable amount of time on the ground, this seems high, but may reflect the fragmented nature of the habitat in our study site such that dispersal movements of any dormice were likely to include a road crossing.

We were unable to determine whether or not the presence of the road has an impact on the mortality of common dormice. Of the 62 dormice marked, 10 were caught in two consecutive years and none in three or more years. However, our sample is very small and apart from the few juveniles that were marked we did not know the ages of the animals we captured. Therefore comparisons with the life tables presented by Juškaitis (2008) are very difficult to make. He showed that spring-born young had mortality rates of 60-70% in the first two years of life so the probability of finding dormice of three years or greater was small in our area with the sample size that was achieved.

Reasons for crossing

We only know the actual timing of crossing for one animal (Dm39), which crossed twice in April/May but there is a preponderance of first captures of dormice in S1 and C1 during these two months, not long after dormice have left hibernation and just before the onset of the breeding season. However we do not know whether these dormice had crossed the carriageway immediately before they were captured or in the previous autumn prior to hibernation. Crossing of the road might therefore be a dispersal movement or in connection with breeding.

A further possibility is that dormice crossed the road to gain access to food. Comparisons of the species present in the sections between which movements occurred or were inferred, show that ash (*Fraxinus excelsior*) is the main species present in C1 but not N1. One would expect ash to be particularly favoured when it is fruiting, later in the year than these movements. Bright and Morris (1993) found that common dormice did not favour ash trees and that fruit-bearing species, such as wayfaring tree (*Viburnum lantana*) and bramble (*Rubus fruticosus*), were taken in preference. Ash trees were visited most frequently during August and October in their study. The main difference between S3 and C3 (one movement recorded) is that willow (*Salix sp.*) is present in the latter. The timing of crossing is unknown but the animal was present in C3 in the spring not the fruiting season.

Juškaitis (2008) observed that 90% of first year common dormice were found in the same area in the spring as they had been the previous autumn suggesting that most dispersal on his study site occurred before hibernation although dispersal movements also occurred at the beginning of the year following birth, where young male dormice were found sharing nest boxes with adult males and subsequently moved away. The high proportion of females crossing the road in our study suggests that breeding may not be the primary motivation since there is good evidence that it is the males which move the greatest distances during the breeding season (Juškaitis 2008, Naim 2010). Our data therefore provide greater (though weak) support for movements across the road being related to dispersal rather than breeding.

One factor which may promote dispersal across roads in our study site is the fact that habitat fragments are small.

Conclusions

We have shown that common dormice are able to exploit small fragments of habitat (<1 ha) separated by roads where the distances to be crossed are no greater than twelve metres. These results have implications for the conservation of this rare species and in the practical implementation of legislation which affects it.

A recent review of national conservation efforts in the UK pointed out the need to "Enhance connections between, or join up, sites, either through physical corridors, or through 'stepping stones'." (Lawton et al. 2010). Local efforts to achieve this have been initiated, with common dormice considered a significant beneficiary (Nelson 2010, Al Fulaij 2010). Small fragments of habitat, which are partially isolated but not remote from each other may have an important role to play as such 'stepping stones', and medium sized roads (up to 12 m including verge) should not be seen as barriers to the movements of common dormice.

These factors may also be important in planning mitigation for common dormice where development might otherwise lead to fragmentation and loss of habitat. Consideration could be given to incorporating roadside planting in an effort to minimise the distances that dormice have to cross over open ground as an alternative to promising, although somewhat more complex, approaches using bridges over roads (Stride 2009, Morris & Minato 2012). Planting of even quite small areas of scrub or woodland may increase breeding opportunities for dormice provided the level of isolation is low and the areas are greater than 0.5 ha. Extensive planting of suitable habitat along roads will also promote dispersal and has the potential to link patches of habitat which would otherwise be otherwise isolated. Further studies to assess the risk of these patches creating a sink would be valuable.

We also believe that guidelines for ecological consultants who are considering whether or not habitat is suitable for common dormice, may need to be revised to take into account the fact that small fragments of habitat are readily used by them. For example, the Dormouse Conservation Handbook (Bright et al. 2006) states that "Dormice have been found in small woods (even down to two hectares where other suitable habitat is adjacent)". Clearly this value can be reduced by an order of magnitude.

In addition, the fact that dormice do not permanently inhabit some fragments means that surveys done in a single season and limited to one fragment may fail to reveal the fact that an area is used by dormice, though not on a permanent basis. Under such circumstances, where dormice are not found during surveys but are known to be present nearby, it would be prudent to act on the assumption that dormice could be present in subsequent years.

Acknowledgements: This research was supported by the Highways Agency and EnterpriseMouchel. English Nature provided grants covering equipment and Paul Chanin's time in the second year. We are grateful to

Ursula Digby for supporting a pilot project in 2006 and to Matt Pickard for drawing our attention to the existence of dormice on the central reservation of the A30. Pat Morris, Johnny Birks and Sven Büchner very kindly read a draft and suggested several improvements. We are grateful to two referees whose comments enabled us to substantially improve the manuscript.

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Appendix 4657/AB10:

Extract from Mitigating Against Effects on Badgers. DMRB. 2001

(CD 37.5.2.M)

VOLUME 10 ENVIRONMENTAL DESIGN AND MANAGEMENT
SECTION 4 NATURE CONSERVATION

PART 2

HA 59/92

MITIGATING AGAINST EFFECTS ON BADGERS

SUMMARY

This Advice Note provides details of the effects of roads on Badgers.

INSTRUCTIONS FOR USE

1. Remove HA 59/92 Amdt 1 from Volume 10, Section 1, Part 5.

2. Insert HA 59/92 Amdt 1, with new title page, into Volume 10, Section 4, Part 2.

3. Archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from the Stationery Office Ltd.

DESIGN MANUAL FOR ROADS AND BRIDGES HA 59/92
Incorporating Amendment
No. 1 dated February 1997

THE HIGHWAYS AGENCY

THE SCOTTISH EXECUTIVE DEVELOPMENT DEPARTMENT

THE NATIONAL ASSEMBLY FOR WALES
CYNULLIAD CENEDLAETHOL CYMRU

THE DEPARTMENT FOR REGIONAL DEVELOPMENT*

Mitigating Against Effects on Badgers

* A Government Department in Northern Ireland

Summary: This amendment includes revisions to Chapter 5.3.

9. MITIGATION MEASURES

Fencing, Tunnels, Underpasses and Overbridges

9.1 The only proven method for deterring badgers from crossing a road is the use of badger fencing, although it must be stressed that no fencing suitable for highway use can truly be described as badger proof. **Fencing will only be effective as a deterrent if it is used to direct badgers to a suitable crossing point**. In the past, a variety of fencing specifications have been used on road schemes often with little success: 'chicken wire' and lightweight stock netting can easily be dug under and can be physically broken by badgers, and rectangular mesh stockproof fencing can be climbed by badgers, which they will do if there is no suitable crossing point near.

9.2 Experience has shown that the most effective specification is for chain link or welded mesh fencing attached to wooden post and rail fences using heavy duty staples. As a minimum standard, this should be at least 1m high above ground with a lower section of 600mm buried below ground; 300mm down into the soil and a further 300mm turned away from the fence in the direction from which badgers will approach. Where the fencing is to be placed on undulating ground, or where it is not possible to provide crossing points close to pre-existing pathways, it may be necessary to provide fencing buried to depths of up to 500mm with an equal length turned outwards (see Annex C).

9.3 Any gap or potential weak spot in the fencing may negate the entire package of protective measures. For this reason it is of particular importance that where the fencing crosses difficult features - for example undulating ground or streams - it is installed under the supervision of a suitably experienced person. Gaps must be avoided where the fencing abuts other features such as hedgebanks, footbridges, gates or stiles.

9.4 Similarly, problems have arisen in the past on trunk road schemes where it has not been possible to provide the full required length of fencing because landowners have been unwilling to allow badger netting to be included as part of accommodation works, or have failed to properly maintain this aspect of the accommodation works. Where this has happened the remaining lengths of badger fencing have proved inadequate. If it has been decided that badger fencing (or other specialised wildlife fencing) should be provided, then ownership of the badger fencing, and the maintenance responsibility, should remain with the highway authority promoting the scheme.

9.5 On trunk roads, the fenceline will normally mark the land ownership boundary. If netting is attached and turned out under the ground, it will obviously encroach onto adjacent land. Many landowners may be willing to allow this encroachment, and it is worth seeking their approval to this course of action. Where permission is not given, the fenceline should be installed within the highway boundary a sufficient distance to allow the turned netting to remain on highway land. Adjacent landowners should be informed that the fenceline does not mark the extent of land ownership.

9.6 Underpasses suitable for badgers have been developed over a number of years, and if correctly sited on or near to an existing badger path, are proven to be effective. Studies have also shown that badgers are fairly adaptable and will readily utilise a variety of different crossing structures including overbridges, culverts, agricultural bridges, and underpasses, provided that they are forced/encouraged to do so through the use of appropriate fencing. However, crossings that are heavily used by pedestrians are unlikely to be used because of human scent.

9.7 Where specialised tunnels are to be used, these should be constructed of Class M 600mm diameter concrete pipes - widened at the entrances if possible. Where headwalls are required, the precise design will not alter the effectiveness of the tunnel. Crossings will be more readily used if the approaches are 'softened' through the use of appropriate planting. Badgers may also be encouraged to use new tunnels by laying syrup or peanuts at the tunnel entrance or by laying scent trails using bedding or dung produced by the relevant social group.

9.8 In some (if not most) cases, crossings will be needed for more than one species. It is sensible to adopt an integrated approach under these circumstances. For example, it is possible to combine the needs of badgers and amphibians. A culvert can be adapted to provide a dry run and in certain circumstances the provision of a Class H 1050mm diameter concrete pipe may be appropriate. The use of plastic pipes is not recommended although in some cases plastic culverts over natural ground may be an effective alternative to concrete pipes.

Appendix 4657/AB11:

Extract from Bats and Artificial Lighting at Night. Institute of Lighting Professionals. 2023

(CD 37.5.2.N)

Bat Conservation Trust

104

INSTITUTION OF LIGHTING PROFESSIONALS

GUIDANCE NOTE 08/23

BATS AND ARTIFICIAL LIGHTING AT NIGHT

Brown long-eared bat. Image credit Hugh Clark / BCT

Guidance Note

GN08/23

Bats and Artificial Lighting At Night

The ILP and BCT would like to thank the steering group, all contributors and reviewers for their considerable input and hard work producing this document. Their contribution or the use of proprietary and commercial trade names in this document does not necessarily imply endorsement of the product or company by the authors or publishers.

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advise on the most appropriate dimensions to use according to the likely locations of bat flight around the site's habitats

- The contours (and/or coloured numbers) for 0.2, 0.5, 1, 5, and 10 lux must be clearly shown, as well as appropriate contours for values above these
- Each illuminance/lux contour plan should be accompanied by a table showing their minimum and maximum illuminance/lux values
- Where buildings are proposed in proximity to key features or habitats, plots should also model the contribution of light spill through nearby windows, making assumptions as to internal luminaire specification, internal lighting levels, and visible light transmittance of windows. It should be assumed that blinds or curtains are absent or fully open. Assumptions will need to be made as to the internal luminaire specification and levels of illuminance likely to occur on 'Day 1' of operation. These assumptions should be clearly stated and guided by the building/room type and discussions between architect, client and lighting professional. Consideration may also need to given to the site topography, and differences in ground levels between key features and lit areas or buildings. It is acknowledged that in many circumstances, only a 'best effort' can be made in terms of accuracy of these calculations as it is often not possible to account for all 'real world' conditions and variables which influence light. Note that evidence-based professional judgement is needed to assess whether light from windows should undergo a full assessment, dependent on factors such as the distance between light source and critical habitats
- Modelled plots should not include any light attenuation factor from new or existing planting, due to the lag time between planting and establishment and the risk of damage, removal or failure of vegetation. This may result in difficulties in the long-term achievement of the screening effect and hamper any post-construction compliance surveys
- The illuminance contour plots should be accompanied by an explanatory note from the lighting professional to list where, in their opinion, sources of glare acting upon the key habitats and features may occur, and what has been done/can be done to reduce their impacts

4.54 **N.B.** It is acknowledged that, especially for vertical calculation planes, very low levels of light (<0.5 lux) may occur even at considerable distances from the source if there is little intervening attenuation. It is therefore very difficult to demonstrate 'complete darkness' or a 'complete absence of illumination' on vertical planes where some form of lighting is proposed on site, despite efforts to reduce them as far as possible and where horizontal plane illuminance levels are zero. Consequently, where 'complete darkness' on a feature or buffer is required, it may be appropriate to consider this to be where illuminance is at or below 0.2 lux on the horizontal plane, and at or below 0.4 lux on the vertical plane. These figures are still lower than what may be expected on a moonlit night and are in line with research findings for the illuminance found at hedgerows used by lesser horseshoe bats, a species well known for its light averse behaviour. [xvi]

Appendix 4657/AB12:

Extract from Nature Conservation Advice in Relation to Bats.

Interim Advice Note 116/08. Highways Agency. 2008

(CD 37.5.2.O)

Interim Advice Note 116/08

Nature Conservation Advice In Relation To Bats

(b) Increase the height that bats fly over roads

Encourage bats to fly higher over roads by using false cuttings, fences, tree planting etc. Bechstein's, Natterer's, lesser horseshoe and long-eared bats will fly through undergrowth vegetation, so for these species consider the use of fences 4-6m high located close to the road but within trees (in order to reduce visual impact and provide shelter from wind). In order to sustain the height of the flyway, trees on the road side of the fence should have their lower branches (below the height of fence) regularly pruned back to the trunk, and all undergrowth should be kept cleared. Lights may also be used at low level to prevent bats dropping to the road. Such measures may be referred to as 'hop-overs'.

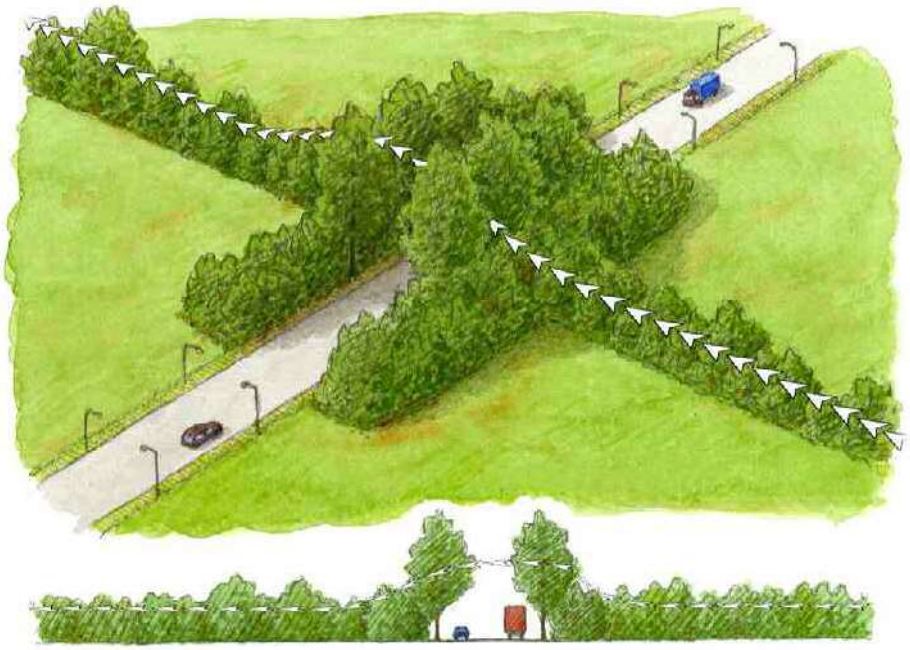


Photo © Peter Twisk

Image 8.9 '*Hop over' – bats can be encouraged to fly high over road and traffic by enhanced planting and use of lighting columns; allow tree canopies to touch if possible.*

Where wide roads, for example, dual carriageways and motorways are concerned, there is a danger that bats will not fly at sufficient height over the width of the road. Some species are more likely than others to drop down towards the road surface and risk collision with traffic. Tall vegetation in the central reservation enables some bat species to cross wide roads, acting as a double hop-over. However, culverts may be more successful for low flying species. Where use of vegetation is not possible, fences or walls can be used (although these will have a less pleasing visual effect on the landscape).

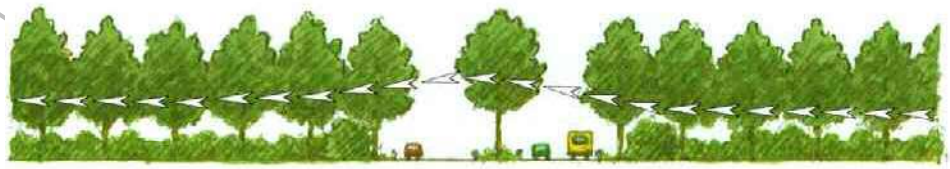


Photo © Peter Twisk

Image 8.10 'Double hop overs' should be considered for wide roads such as dual carriageways; by planting in the central reservation the space between tree canopies is reduced.

Where a road passes through woodland or has trees along its length on both sides, there may not be a favoured crossing point. In such cases, the use of a fence or wall should be considered to raise bats over the entire length.

The place and height at which the bats are meant to cross must be unlit. Should there be any requirement for lighting, for example, along an adjacent footpath, the lighting should be designed not to shine on the bat flyway.

If a flyway is along a tree-lined footpath or cycleway, for example, that crosses the road and a screen adjacent to the road is not possible, the bats must be brought up to a safe height further from the road. This can be done by removing undergrowth and lower branches up to 25m from the road whilst retaining a dense closed crown layer (refer to Image 8.11).

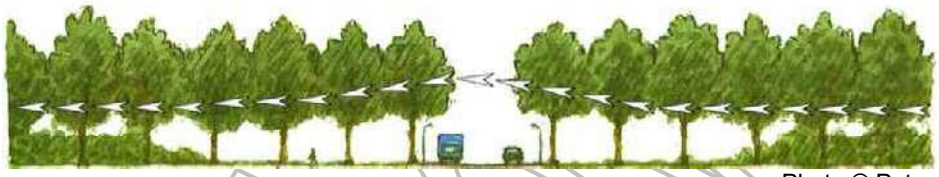


Photo © Peter Twisk

Image 8.11 Understorey vegetation removed to increase bat flight height in advance of hop-over.

(c) Provide bat crossing structures

In addition to increasing the height of flyway approaches, structures can be used to maintain bats at height as they cross the road or allow them to cross under the road. Examples include vegetated bridges, wires strung across the road and culverts.

In determining design of structure, the following points should be considered:

- Cost effectiveness, e.g., combining with other compatible uses, such as pedestrian/accommodation bridges and watercourse/wildlife culverts may help to justify costs.
- Structures should ideally be positioned along the line of existing flyways and connect with adjacent landscape features used by commuting bats, e.g., hedgerows/tree lines.
- Shorter span structures are likely to be more successful;
- Structures should not be lit.
- Required design life.
- Structures may require approval from the Highways Agency, encompassing safety requirements.
- Visual impact should be minimised.
- Design should be informed by current best practice information.

Photo © Peter Twisk

Image 8.12 A green (or vegetated) bridge may be the best option but to be successful needs to link in with established flight-lines on both sides of the highway.

Photo © BCT

Image 8.13 A green (or vegetated) bridge over a dual carriageway; lighting columns have been placed under the bridge and along the road to deter bats from going under the green bridge

Where it is not possible to use existing or proposed bridges by adaption then consideration can be given to the use of purpose built crossing structures, noting the uncertainty of their effectiveness.

Wire/mesh structures

Such structures may provide a solution; however, it is not yet clear how effective they are, particularly over larger spans (refer to Images 8.14-7.16). In the short-term it may be that bats try to remain faithful to their traditional routes and such structures could reduce the risk of road collisions, whilst in the longer term bats

Appendix 4657/AB13:

Bat-friendly Highway Lighting First for the UK. Jacobs. 2019

(CD 37.5.2.P)

NEWS • OCT 24, 2019

Bat-friendly Highway Lighting First for the UK

Lighting the way for drivers, pedestrians, cyclists and… bats? Jacobs and Worcestershire County Council collaborate on the first bat highway crossing in the U.K.

Picture this: A crossing for pedestrians, cyclists and those using mobility scooters that enhances local connectivity in Worcestershire, U.K. The difference? While the road is illuminated with 'typical' white LED lights, the crossing is lit up with colored LED lights to facilitate typical behavior of bats, who respond to the red light as they would the dark.

Jacobs, in collaboration with **Worcestershire County Council**, knew that there was a need to light the road for the new crossing and couldn't provide a dark area where the nocturnal mammals could fly from one side to the other, as would be the conventional solution.

friendly and enables bats to fly and feed normally.

We knew of successful schemes in the Netherlands that had used red lighting to minimize the impact on wildlife and proposed this as an option to trial. This is the first set of bat-friendly highway lights to be switched on in the U.K.; if the trial is successful, the Institution of Lighting Professionals will update the guidance and standards. Already, video footage has shown the crossing being used by bats.

The project has won the award for Environmental Sustainability Project of the Year from the Institute of Highway Engineers, and the lights have been described as "ground-breaking" by the county council's Cabinet Member with responsibility for Economy and Infrastructure, Ken Pollock.

The composition of the light has been developed to suit not just bats and other local wildlife, but residents and road users as well. The lights do not affect visibility for anyone using the roads and conform to the required safety standards.

Jacobs employee Stuart Morton who has worked on the project explained what it means to him, "We work on major projects all over the country which are nationally significant, but it's extra special to contribute something as innovative and important as this back into our local community."

Jacobs has been in partnership with Worcestershire County Council for almost 25 years, providing highways and Transportation consultancy support in a range of discipline areas.

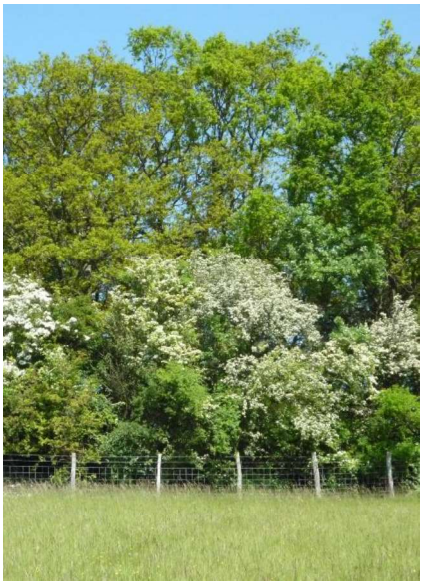
News of the trial also flew far afield reaching more than 300 media outlets across the U.K., Europe and the U.S.

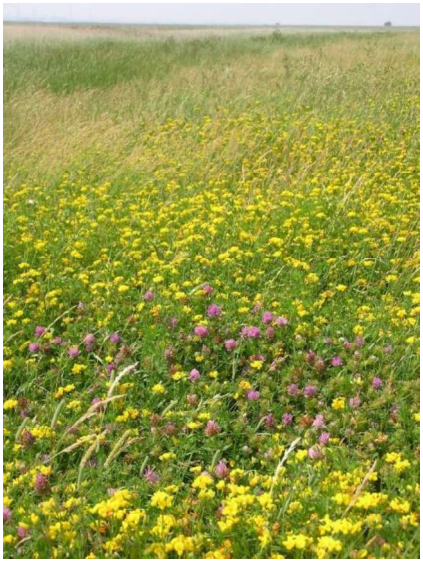
Appendix 4657/AB14:

Local Wildlife Sites in Kent. Criteria for Selection and Delineation. V1.8. 2022

(CD 37.5.2.Q)

Local Wildlife Sites in Kent





(Formerly called Sites of Nature Conservation Interest)

Criteria for Selection and Delineation

Version 1.8

December 2022

Kent Wildlife Trust
on behalf of the Kent Nature Partnership

Selection of Local Wildlife Sites based on habitat features

Broadleaved woodland

37) Without human interference, woodland would be the natural vegetation cover over most of the British Isles. After the last ice-age, and prior to the arrival of settled farming communities, woodland may have covered 80 to 90% of the British land surface. As a result of human activity, almost all this woodland disappeared, so that, by the end of the 19th century, woodland covered little over 4% of the British Isles. This area increased over the 20th century, primarily through planting, but also as a result of natural regeneration as marginally productive pastures have been abandoned.

38) Britain now has around 10% woodland cover. However, much of the wildlife interest of our woodlands resides in those fragments of previously existing woodlands which survived the centuries of clearance. A distinction is therefore made between ancient woodland, defined as woodland known to have been in existence since at least 1600, and woodland of more recent origin.

39) Ancient woodland normally has a more natural complement of species, and a greater diversity of species, than more recent woodland. Their soils, with long established microbial and mycorrhizal communities, have also been found to be of great importance and value, even when the tree species have been altered over time, such as in plantations on ancient woodlands.

40) By combining data from the 2012 Kent Habitat Survey and Natural England's Provisional Inventory of Ancient Woodlands, we find that
    a) There are approximately 28460 hectares of ancient woodland in Kent and Medway, representing around 7% of the land surface;
    b) This area consists of some 9598 individual blocks of woodland, although some of these blocks are only separated from others by minor roads;
    c) The 1518 woodland blocks of over 5 ha in extent make up 72% of the total area of ancient woodland in Kent;
    d) The 2723 woodland blocks of over 2.5 ha in extent make up over 87% of the total area of ancient woodland in Kent;
    e) The 4296 woodland blocks of over 1 ha in extent make up 96% of the total area of ancient woodland in Kent.

41) Woodland is the commonest type of semi-natural habitat found in Kent. Nevertheless, ancient woodland covers only around 7.3% of Kent's land surface, and continues to be lost despite strongly protective planning policies. The low capacity for dispersal of many plant and invertebrate species associated with ancient woodland means that it is an impossible habitat to recreate.

    Wet Woodland and Lowland Beech and Yew Woodland are priority habitats in the England Biodiversity Strategy (EBS) and Kent Biodiversity Strategy (KBS). The KBS includes targets to maintain the current extent of both these habitats. In Kent, only 663 ha of Wet Woodland and 613 ha of Lowland Beech and Yew Woodland were identified by the 2012 Kent Habitat Survey. It should be noted that woodland need not be ancient to be considered as Wet Woodland or Lowland Beech and Yew Woodland priority habitat.

42) The JNCC gives the following description of Wet Woodland:
    "Wet woodland occurs on poorly drained or seasonally wet soils, usually with alder, birch and willows as the predominant tree species, but sometimes including ash, oak, pine and beech on the drier riparian areas. It is found on floodplains, as successional habitat on fens, mires and bogs, along streams and hill-side flushes, and in peaty hollows. These woodlands occur on a

range of soil types including nutrient-rich mineral and acid, nutrient-poor organic ones. The boundaries with dryland woodland may be sharp or gradual and may (but not always) change with time through succession, depending on the hydrological conditions and the treatment of the wood and its surrounding land. Therefore wet woods frequently occur in mosaic with other woodland key habitat types (e.g. with upland mixed ash or oakwoods) and with open key habitats such as fens."

43) The JNCC gives the following descriptions of Lowland Beech and Yew Woodland:
"Calcareous beech and yew woodland forms perhaps 40% of the total amount of lowland beech and yew habitat type … The canopy can include mixtures of beech, ash, sycamore (non-native), yew and whitebeam. Oak is less common than in the other beechwoods, and pure stands of yew occur in places. Promotion of high quality beech for silviculture has often led to an artificial dominance of beech. Characteristic uncommon or rare plants can include box Buxus sempervirens*, red helleborine* Cephalanthara rubra*, coralroot bitter-cress* Cardamine bulbifera*, and bird`s nest orchid* Neottia nidus-avis*. In some areas, this woodland type occurs as intricate mosaics with lowland mixed deciduous woods. The majority of stands have a high forest structure. This type occurs on the limestone and chalk outcrops in southern Britain (e.g. chalk scarps of the North and South Downs …*

Beech woodland on neutral-slightly acidic soils comprises about 45% of the habitat. It is found on heavier soils (pH 7 to 4) and often where the drainage is poor or impeded. The boundary with the other beech types is often defined by pH, drainage and soil texture; thus it is common to find this type grading into one of the others. Again stands tend to be dominated by beech, but oak Quercus robur *and sometimes* Q. petrea *is a common associate. Bramble* Rubus fruticosus *forms a characteristic ground layer. Often a shrub layer is lacking, although holly can form a second tier of trees, occasionally with yew. Violet helleborine* Epipactis purpurata *is a rare plant found in this community. Mosaics with oak/ bracken/ bramble woodland are common, and in some areas beech can be found colonising western oakwoods. This type tends to occur as high forest or relict wood-pasture (with pollards), less often abandoned coppice. It is common in (but not confined to) the High and Low Weald…"*

44) Woodland is not generally considered to be a particularly fragile habitat. However, many of the important features of woodland are fragile:
   a) Rides and glades quickly lose their interest if appropriate management ceases;
   b) Many important woodland species, such as dormouse, are vulnerable to fragmentation and isolation; and
   c) Woodland ground flora can be severely damaged by excessive trampling or grazing pressure.

45) Ancient woodland is a relatively natural habitat, is generally rich in species (certainly when compared to more recent woodland) and is impossible to recreate. It is therefore appropriate to consider all ancient woodland to be of substantive nature conservation value., even where it has become significantly damaged or degraded. The damage is generally restricted to the above ground component of the habitat, and the ancient woodland soils are considered more resilient, with a long-lived seedbank and well established microbial and mycorrhizal communities. With appropriate management, the above ground diversity of these sites can be restored with relative ease.

46) For practical purposes, it is considered appropriate to set a size threshold for sites to be considered for Local Wildlife Site status. This has been set at 5 hectares in order to reduce to a reasonable level the number of woodland blocks which will need to be considered for Local Wildlife Site status while still capturing the majority of the resource. Because this size threshold has been set purely for practical purposes, it may be reasonable to revise it downwards at a future review of these criteria.

WO1
Ancient woodland in Kent should be identified by reference to the provisional ancient woodland inventory produced by Natural England (and/or shown with the habitat data on www.magic.gov.uk). Where a wood is not indicated as ancient, it may nonetheless be considered as ancient if

- **It holds at least ten ancient woodland indicator species drawn from the list in Appendix 1;**
  OR
- **It holds at least five ancient woodland indicator species and includes other features associated with ancient woodland, such as a sinuous outline or marginal woodbank;**
  OR
- **There is other clear, specified evidence that the woodland should be considered as ancient.**

WO2
All blocks of ancient woodland of 5 ha or more in continuous extent should be designated as Local Wildlife Sites, unless

- **The tree and/or shrub element has been substantially modified by replanting;**
  OR
- **There are other clear and obvious reasons to believe that the wildlife interest of the site has been lost or substantially damaged.**

WO3
Blocks of ancient woodland which have been substantially modified by replanting should only be designated as Local Wildlife Sites where

- **They provide a link between blocks of otherwise isolated ancient woodland with a total area of more than 5ha;**
  OR
  Where they are EITHER over 5 ha in continuous extent OR are part of a larger ancient woodland which qualifies as a Local Wildlife Site AND
  - **They demonstrate the continuous quality of the soil by retaining a typical woodland ground flora with at least ten ancient woodland indicator species drawn from the list in Appendix 1,**
    OR
  - **They support an important species or assemblages of species, such as woodland orchids,**
    OR
  - **They form the matrix for an important network of woodland rides and/or glades.**

WO4
Blocks of ancient woodland under 5 ha in continuous extent may be designated as Local Wildlife Sites where

- **They are only narrowly separated from other ancient woodlands, for example, by a minor road of no more than two lanes, so that the joint area of these woodlands would be 5 ha or more;**
  OR
- **They are linked to another woodland by a hedgerow or area of scrub or secondary woodland, so that the joint area of these woodlands would be more than 5 ha, in which case the connecting feature should be considered for inclusion within the Local Wildlife Site boundary;**
  OR

- **There is a clear potential for linking the blocks through the restoration of hedges, scrub or woodland;**
  OR
- **They form part of a complex of separate but closely spaced (i.e. 200m or less apart at their closest point) woodlands of similar character, at least one of which is 5 hectares or more in extent;**
  OR
- **They form part of a matrix of semi-natural habitats where the woodland contributes to the overall nature conservation value of the site, and where the matrix as a whole is considered worthy of identification as a Local Wildlife Site;**
  OR
- **They consist of the UK BAP priority habitats of Wet Woodland or Lowland Beech and Yew Woodland;**
  OR
- **Where the site is considered particularly important for its recorded history.**

WO5
Where the primary interest of a woodland is the network of rides and glades within the woodland matrix, for simplicity the boundary should be drawn around the woodland as a whole. However, it should be made clear on the Local Wildlife Site schedule where the particular interest of the site lies.

WO6
All blocks of Wet Woodland or Lowland Beech and Yew Woodland which are not ancient woodland should normally be designated as Local Wildlife Sites providing that they are 5 ha or more in continuous extent, or form part of a larger Wildlife Site which is 5 ha or more in continuous extent.

WO7
Where a Local Wildlife Site has been selected on the basis of its Wet Woodland, the boundary of the site should, where appropriate, be drawn to encompass the water courses or water bodies which support the habitat.

WO8
The boundaries of a Local Wildlife Site designated for its ancient woodland may include areas of secondary or replanted woodland or scrub where these are contiguous with the ancient woodland AND

- **They provide a connection with other blocks of ancient woodland or UK BAP priority woodland habitats;**
  OR
- **They have the potential for colonisation by species associated with ancient woodland;**
  OR
- **They provide a link between the woodland and another habitat which qualifies for Local Wildlife Site status;**
  OR
- **They are used by national priority species (as identified by the JNCC), Nationally Rare species, Nationally Scarce species, Kent Red Data Book species, or other, specified, important species associated with the woodland.**

Wood-pasture and parkland

68) In line with the national commitment to halt the loss of biodiversity, the Kent Biodiversity Strategy sets a target to maintain the current extent and distribution of the total resource of this grassland type. Because of this, and because of the rarity of acid grassland in Kent, the following policies are considered appropriate.

GA1
All areas of Lowland Dry Acid Grassland over 0.5 ha in extent should be designated as Local Wildlife Sites. Areas designated would normally be expected to support a suite of species from the list in Appendix 2.

GA2
All areas of Lowland Dry Acid Grassland up to 0.5 ha in extent should be included as parts of larger Local Wildlife Sites where they are contiguous with other habitats which qualify for designation.

GA3
Site boundaries should include any areas of bare ground, scrub, or other vegetation which could potentially be restored to acid grassland or which might contribute to the biodiversity interest of the acid grassland habitat.

GA4
On acid grassland sites managed as wood pasture and with mature, native trees, the trees should be considered an important element of the biodiversity interest of the site.

Lowland Calcareous Grassland

69) The 2012 Kent Habitat Survey has identified a total of 1922 ha of Lowland Calcareous Grassland (chalk grassland) larger than 0.001 ha in extent, distributed between over nearly individual blocks. This total area represents around 3% of all existing Lowland Calcareous Grassland in the UK. The UK BAP identifies fragmentation and reduction in size of sites as being a key factor negatively affecting this habitat. Statistics on a range of size classes of blocks of chalk grassland in Kent are presented below; it is notable that only 4% of all sites are 10 ha or more in extent.

Block size	Number of sites	% of all sites	Total area (ha)	% of total resource
>/= 10 ha	42	4	746	39
>/= 5 ha	96	9	1119	58
>/= 2 ha	237	22	1543	80
>/= 1 ha	373	35	1733	90
>/= 0.5 ha	530	50	1843	96
>/= 0.001 ha	1005	95	1930	100

70) Some 554 ha of chalk grassland in Kent lies within existing Sites of Special Scientific Interest. This represents about 29% of the total resource in the county.

71) Chalk grassland is has undergone a rapid decline in extent over recent decades. Chalk grassland can be entirely destroyed by conversion to arable (although for larger sites this is now covered by the EIA regulations) or built development. However, much recent loss is due to neglect. Removal of grazing from chalk grassland results in changes in the sward, which may be difficult to reverse, and eventually to encroachment by scrub, although it may be some decades before all

interest is lost from the site. The increase in traffic and road infrastructure over time has also increased nitrogen deposition in some areas, potentially affecting sensitive species.

72) Analysis of changes to existing Local Wildlife Sites surveyed during the period 1996 to 2002 shows that around 102 ha of chalk grassland was noted as having been damaged or lost since the sites were first designated. Of this area, 46% was lost to agricultural improvement or conversion to arable, and 13% was lost to built development. Only 4% was noted as having degraded due to lack of management.

73) From 2003-12 the Kent Habitat Survey change analysis shows almost 10% (164 ha) of the chalk grassland in Kent and Medway recorded in 2003 was lost by 2012 and the main loss (4.4%) was a change to the broadleaved woodland category which includes scrub woodland. This is likely to be due to a lack of management allowing scrub encroachment. Other significant losses occurred to neutral (3.6%) and improved (1.2%) grasslands, when the specialist chalk species are lost, often also after a reduction in management and/or an increase in nutrients (improvement) allowing coarse grass species to dominate.

74) However, the loss over the past 10 years has been balanced by gains of just over 10% (207 ha) due to conservation action: the habitat survey recorded gains of chalk grassland recovered by scrub control but more so from restoration of improved and neutral grassland and even arable land, often under agri-environment schemes.

75) The development of scrub may lead to deeper soils developing, so that scrub clearance may not immediately restore the habitat conditions which favour typical chalk grassland plant species. In addition, most of these species fail to persist in the seed bank, so that restoration of a badly degraded site may be a very long term process.

76) Chalk grassland is typically rich in herbaceous plant species. Typical chalk grassland which has not been improved agriculturally would probably be expected to hold at least ten of the indicator species listed in Appendix 3. There is probably a positive relationship between the number of indicator species and the size of a site, so that a large site, of, say, 10 ha or more, might be expected to support fifteen or more indicator species.

77) The structural diversity provided by scrub may add to the biodiversity interest of chalk grassland sites. The scrub which characteristically develops on chalk grassland sites is typically species-rich in itself, although species-poor hawthorn scrub can eventually come to dominate. Species-rich scrub is of nature conservation interest in its own right, providing habitat for a range of insect species. However, even species-poor scrub can be of value, particularly as cover for herpetofauna (the grass/scrub interface provides important basking habitat for lizards and snakes), and by protecting grazing-intolerant species (such as man orchid) from grazing animals.

78) In line with the national commitment to halt the loss of biodiversity the Kent Biodiversity Strategy includes a target to maintain the current extent of this habitat, and an action to protect as Local Wildlife Sites all unimproved chalk grassland sites over 2ha in extent, although this would only result in protection of about 80% of the total resource in Kent (including all chalk grassland in existing SSSIs). In order to maximise the amount of chalk grassland protected, and to ensure that which is protected is of sufficient quality, the following policies are appropriate.

GC1
All areas of contiguous Lowland Calcareous Grassland of 10 ha or greater in extent should be designated as Local Wildlife Sites in order to prevent further fragmentation of the largest sites.

GC2
Areas of Lowland Calcareous Grassland over 2.0 ha in extent should be designated as Local Wildlife Sites if they support ten or more of the chalk grassland indicator species listed in Appendix 3.

GC3
All areas of Lowland Calcareous Grassland up to 2.0 ha in extent should be included as parts of larger Local Wildlife Sites if

- **They are contiguous with other habitats which qualify for designation;**
  AND
- **They support five or more of the chalk grassland indicator species listed in Appendix 3.**

GC4
A chalk grassland site dominated by scrub, or with a substantial proportion of scrub, may be designated as Local Wildlife Site, providing that the scrub is of the species-rich type associated calcareous substrates and

- **There is potential for restoration to increase the area of chalk grassland present;**
  OR
- **The scrub is important for supporting an identifiable element of the biodiversity interest of the site.**

GC5
A Local Wildlife Site designated for its chalk grassland may include species-poor scrub providing that

- **There is potential for restoration to increase the area of chalk grassland present;**
  OR
- **The species-poor scrub does not constitute more than one-quarter of the overall area of the site;**
  OR
- **The scrub is important for supporting an identifiable element of the biodiversity interest of the site.**

Neutral grassland

79) The 2012 Kent Habitat Survey has identified a total of 28494 ha of neutral grassland. 994 ha (3.4%) of the total has been identified as species-rich neutral grassland which meets the Natural England Farm Environment Plan Manual 3rd Edition Lowland Meadows BAP habitat type definition.

80) It is therefore clear that high-quality neutral grassland is actually a very rare habitat. This suggests that consideration should be given to designating semi-improved neutral grassland (i.e. grassland that has been modified by the use of fertilizers, herbicides, reseeding or intensive grazing). The Integrated Habitat System, upon which the 2003 and 2012 Kent Habitat Surveys were based, does not classify grassland as 'semi-improved', unlike the Phase One methodology which underpinned the 1990 Habitat Survey. However we can use the GNZ Other Neutral Grassland category (definition: All unimproved and semi-improved neutral grasslands in the lowlands outside the indicative floodplain and/or not included in the plant communities described above i.e. lowland hay meadow, maritime grassland, grazing marsh, inundation grassland or coarse neutral grassland") to gain a figure for grassland which is not classic Lowland Hay Meadow but still may be of substantial nature conservation interest. The total of this grassland category from the 2012 Kent Habitat Survey is 12703 ha.

This semi-improved neutral grassland is distributed over more than 9000 blocks, three-quarters of which are less than 2 ha in extent. The distribution of size classes is given in the following table.

Block size	Number of sites	% of all sites	Total area	% of total resource
>/= 50 ha	5	< 1	299 ha	< 1
>/= 25 ha	22	< 1	853 ha	< 1
>/= 10 ha	206	2	3639 ha	28
>/= 5 ha	621	6	6491 ha	51
>/= 2 ha	1599	16	9609 ha	75

81) It is therefore clear that if the all the unimproved and species-rich neutral grassland, and all blocks of semi-improved neutral grassland over 5 ha, were covered by a protective designation, this would still represent only the best 30% of the county's neutral grassland resource.

82) Neutral grassland is particularly susceptible to agricultural improvement, as it responds well to fertilizers and, unlike, for example, chalk grassland, is usually on ground accessible to the plough. As a result, loss of unimproved neutral grassland has been substantial: the Kent Biodiversity Action Plan quoted a 97% decrease in area in the UK between the 1930s and the 1990s. The special interest of grazing marsh is dependent on the local water regime, and can be severely affected by improved drainage. Therefore, this does suggest that high quality neutral grassland should be treated as a rare habitat, and that consideration should be given to protecting the most important examples of semi-improved neutral grassland.

83) It is considered that when selecting neutral grassland Local Wildlife Sites, the emphasis should be on selection of sites which would normally be considered as unimproved, that is,
   a) Where there is evidence that the site has a long history of being managed unintensively and without reseeding, the addition of artificial fertilizers or use of herbicides;
   b) Where the grassland does not appear to have been altered, or has only been slightly altered, by artificial drainage, or by the application of pesticides or fertilisers;
   c) Where the sward is generally species-rich and includes suite of species from the list in Appendix 4;
   d) Where perennial rye grass *Lolium perenne* and/or white clover *Trifolium repens* are infrequent or rare;
   e) Where ant-hills are frequent; and/or
   f) Where several species of wax caps, fairy clubs or gastromycetes are present.

84) If neutral grassland which does not meet the above criteria is to be considered for Local Wildlife Site status, then care must be taken to ensure that sites are of sufficiently high value before the designation is confirmed. Sites should
   a) Support grassland that does not appear to have been very substantially altered by artificial drainage, or by the application of pesticides or fertilisers;
   b) Be reasonably floristically diverse, with a range of grass and forb species (including at least 4 species from the list in Appendix 4); and
   c) Not have abundant perennial rye grass *Lolium perenne* or white clover *Trifolium repens*;
   d) Or, be a good example of NVC MG6 with potential to develop into MG5.

85) In line with the national commitment to halt the loss of biodiversity, a target of the Kent Biodiversity Strategy is to prevent the further loss of species-rich neutral grassland, and to maintain the existing extent of coastal grazing marsh. The following policies are considered appropriate for the selection of neutral grassland Local Wildlife Sites.

GN1
All areas of unimproved neutral grassland should be designated as Local Wildlife Sites.

GN2
Other areas of neutral grassland should be considered for selection as Local Wildlife Sites where forbs are well represented within the grassland, with at least 4 of the species listed in Appendix 4 present (2 frequent and 2 occasional) and where

- **The grassland area under consideration contributes to the nature conservation value of adjacent unimproved grassland (for example, where it provides additional habitat for key species found on the unimproved grassland);**
  OR
- **Where it is reasonable to believe that there is potential for enhancement of the biodiversity interest of the grassland (e.g. good NVC MG6 with potential to become MG5);**
  OR
- **Where the grassland is contiguous with ancient woodland, standing water or running water which qualifies as a Local Wildlife Site in its own right.**

GN3
Neutral grassland sites which do not meet the criteria for unimproved grassland may be selected as Local Wildlife Sites where they form all or part of an extensive area of grazing marsh important for breeding or wintering birds, OR where the grassland does not consist of sown grassland AND it supports

- **One or more scarce species of terrestrial or aquatic invertebrates;**
  OR
- **An important network of wet dykes.**

Where a Local Wildlife Site is selected for its wet dykes, the dykes should qualify as Wildlife Sites in their own right.

GN4
Where the primary interest of an area of neutral grassland is the network of dykes within the grassland matrix, for simplicity the boundary should be drawn around the site as a whole. However, it should be made clear on the Local Wildlife Site citation where the particular interest of the site lies.

GN5
A neutral grassland site with a substantial proportion of scrub, may be designated as Local Wildlife Site, providing that

- **There is potential for restoration to increase the area of neutral grassland present;**
  OR
- **The scrub is important for supporting an identifiable element of the biodiversity interest of the site.**

Heathland

86) The Kent Wildlife Habitat Survey shows only 74 ha of Lowland Heathland. This is characterised in the Integrated Habitat System as vegetation with a greater than 25% cover of ericoid shrubs and/or dwarf gorse *Ulex minor*. The heathland is recorded in more than 50 blocks spread over 10 locations plus a few outliers, showing the fragmented nature of Kent's remaining heathland resource.

Appendix 3 Indicators of Unimproved Chalk Grassland in Kent

Species	English name	Notes
Anthyllis vulneraria	Kidney vetch	
Arabis hirsuta	Hairy rock cress	
Asperula cynanchica	Sqinancywort	
Astragalus glycyphyllos	Wild liquorice	
Avenula pratensis	Meadow oat-grass	
Blackstonia perfoliata	Yellow-wort	
Briza media	Quaking grass	
Campanula glomerata	Clustered bellflower	
Campanula rotundifolia	Harebell	
Carex caryophyllea	Spring sedge	
Carlina vulgaris	Carline thistle	
Centaurea scabiosa	Greater knapweed	
Cephalanthera damasonium	White helleborine	
Cirsium acaule	Dwarf thistle	
Cirsium eriophorum	Woolly thistle	
Clinopodium acinos	Basil thyme	
Clinopodium vulgare	Wild basil	
Coeloglossum viride	Frog orchid	
Danthonia decumbens	Heath grass	At rabbit burrows
Euphrasia pseudokerneri	Eyebright	
Festuca ovina	Sheep's Fescue	
Filipendula vulgaris	Dropwort	
Gentianella amarella	Autumn gentian	
Helianthemum nummularium	Common rock rose	
Helictotrichon pubescens	Downy oat-grass	
Hippocrepis comosa	Horseshoe vetch	
Juncus subnodulosus	Blunt-flowered rush	In damp areas
Koeleria macrantha	Crested hair grass	
Leontodon hispidus	Rough hawkbit	
Linum bienne	Pale flax	East Kent
Linum catharticum	Fairy flax	
Neottia ovata	Common twayblade	
Onobrychis viciifolia	Sainfoin	
Ophioglossum vulgatum	Adder' s-tongue fern	
Ophrys apifera	Bee orchid	
Ophrys insectifera	Fly orchid	
Orchis anthropophora	Man orchid	
Orchis mascula	Early-purple orchid	
Origanum vulgare	Marjoram	
Orobanche elatior	Knapweed broomrape	
Pilosella officinarum	Mouse-ear hawkweed	
Pimpinella saxifraga	Burnet saxifrage	
Plantago media	Hoary plantain	
Polygala amarella	Dwarf milkwort	
Polygala calcarea	Chalk milkwort	
Polygala vulgaris	Common milkwort	
Poterium sanguisorba	Salad burnet	
Primula veris	Cowslip	
Ranunculus bulbosus	Bulbous buttercup	
Rhinanthus minor	Yellow rattle	
Salvia pratensis	Meadow clary	
Scabiosa columbaria	Small scabious	
Spiranthes spiralis	Autumn lady's tresses	
Thymus polytrichus	Wild thyme	
Thymus pulegioides	Large thyme	
Trisetum flavescens	Yellow oat-grass	
Viola hirta	Hairy violet	

Appendix 4 Indicators of Unimproved Neutral Grassland in Kent

Species	English name	Notes
Achillea ptarmica	Sneezewort	3
Agrimonia eupatoria	Agrimony	3
Agrimonia odorata	Fragrant agrimony	
Ajuga reptans	Bugle	3
Alopecurus bulbosus	Bulbous foxtail	1
Anagallis tenella	Bog pimpernel	
Avenula pubescens	Downy oat grass	
Betonica officinalis	Betony	3
Briza media	Quaking grass	
Bromus commutatus	Meadow brome	
Bromus racemosus	Smooth brome	
Caltha palustris	Marsh marigold	2, 3
Carex caryophyllea	Spring sedge	
Carex distans	Distant sedge	
Carex disticha	Brown sedge	
Carex divisa	Divided sedge	1
Carex flacca	Glaucous sedge	3
Carex nigra	Common sedge	2, 3
Carex ovalis	Oval sedge	
Carex pallescens	Pale sedge	
Carex panicea	Carnation Sedge	3
Centaurea nigra	Common knapweed	3
Conopodium majus	Pignut	3
Dactylorhiza incarnata	Early marsh orchid	
Dactylorhiza praetermissa	Southern marsh orchid	
Euphrasia spp.	Eyebrights	3
Festuca pratensis	Meadow fescue	
Filipendula ulmaria	Meadowsweet	3
Filipendula vulgaris	Dropwort	3
Galium palustre	Marsh-bedstraw	3
Galium uliginosum	Fen Bedstraw	3
Galium verum	Lady's Bedstraw	3
Genista tinctoria	Dyers greenwood	3
Hordeum maritum	Sea barley	1
Hordeum secalinum	Meadow barley	
Hydrocotyle vulgaris	Marsh pennywort	2
Knautia arvensis	Field Scabious	3
Lathyrus linifolius	Bitter vetch	3
Lathyrus nissolia	Grass vetchling	
Lathyrus pratensis	Meadow Vetchling	3
Leontodon hispidus	Rough Hawkbit	3
Leucanthemum vulgare	Oxeye Daisy	3
Lotus pedunculatus	Greater bird’s-foot-trefoil	2, 3
Lotus tenuis	Narrow leaved bird’s-foot-trefoil	1
Lysimachia nummularia	Creeping jenny	2
Mentha aquatica	Water Mint	3
Oenanthe lachenalii	Parsley water-dropwort	2
Oenanthe pimpinelloides	Corky fruited water-dropwort	2
Oenanthe silaifolia	Narrow leaved water-dropwort	2, 3
Ononis spinosa	Spiny restharrow	
Ophioglossum vulgatum	Adder’s-tongue fern	
Orchis morio	Green winged orchid	
Persicaria bistorta	Common Bistort	3
Petroselinum segetum	Corn parsley	
Pimpinella saxifraga	Burnet saxifrage	3
Polygala spp.	Milkwort species	3
Potentilla erecta	Tormentil	3
Poterium sanguisorba	Salad Burnet	3
Primula veris	Cowslip	3
Pulicaria dysenterica	Fleabane	2

Notes: 1 = Occurs on grazing marsh 2 = Occurs in damp areas 3 FEP GO6 indicator of neutral hay meadows

Rhinanthus minor	Yellow rattle	3
Scirpus sylvaticus	Wood club-rush	2
Scorzoneroides autumnalis	Autumn Hawkbit	3
Senecio erucifolius	Hoary ragwort	
Serratula tinctoria	Saw-wort	3
Silaum silaus	Pepper saxifrage	3
Silene flos-cuculi	Ragged-Robin	2, 3
Sison amomum	Stone parsley	
Succisa pratensis	Devils bit scabious	3
Thalictrum flavum	Common Meadow-rue	3
Tragopogon pratensis	Goat's-beard	3
Trifolium fragiferum	Strawberry clover	1
Trifolium medium	Zigzag clover	
Triglochin palustris	Marsh arrowgrass	1, 2
Valeriana dioica	Marsh valerian	2, 3
Valeriana officinalis	Common valerian	
Vicia cracca	Tufted vetch	
Viola riviniana	Common dog violet	
	Orchid species	3

4657/AB15:

Chalk stream data

4657/AB15a:

Extract from North Kent Chalk Streams Survey. SE Rivers Trust. 2023

(CD 37.5.2.R)

North Kent Chalk Streams Survey 2023

south east rivers trust

This survey has been funded by Medway Swale Estuary Partnership.
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Executive Summary

The South East Rivers Trust {SERT) was contracted over the winter of 2022/23 to carry out surveys of 11 streams which had been identified by Medway Swale Estuary Partnership as probable chalk stream priority habitats. These streams neighbour existing "low certainty" chalk streams which have been identified as amendments to the UK Biodiversity Action Plan {BAP) national chalk stream map by Natural England. This survey identified that all of the streams surveyed displayed a chalk-derived baseflow, as indicated by chalk stream indicator vegetation and water quality sampling. However, many of the streams suffer from physical modification that has created un-natural channel forms and reduced their channel gradient, causing excess in-channel siltation. Therefore, only three of the surveyed streams, which do not suffer from this modification and exhibit a gravel-bed, offer realistic opportunities for chalk stream restoration.

This report combines observations from the South East Rivers Trust's public chalk stream mapping and condition consultation as well as field observations, carried out by SERT, of streams within an area between Sittingbourne and Faversham. These observations comply with those required within Natural England's 'Guidance for stakeholders on proposing local refinements to the BAP map of chalk rivers'. Broadly these observations include: water quality, physical habitat and hydrogeology. No parameter in isolation creates the mosaic of habitats which encompass a chalk stream. Therefore, the sum of these observations have been used to inform final river habitat classifications for these streams.

Table of Contents

1. Aims and Objectives

The aim of this report is to summarise the findings of the South East River Trust's Chalk Stream Review and to detail chalk stream survey findings within North Kent, broadly within an area between Sittingbourne and Faversham. This report is intended to be used by Catchment Partners, he Environment Agency and Natural England as a resource to inform the whereabouts of Chalk Stream priority habitats within the North Kent catchment.

The report provides survey observations of chalk stream characteristics as well as observations on water quality and hydrogeology.

Main objectives of the report are:

- Provide SERT wide consultation results specific to North Kent;
- Provide observations from Chalk Stream survey of 11 streams, highlighting potential for restoration;
- Identify chalk streams in North Kent and suggest these as amendments to the existing Biodiversity Action Plan map of Chalk Stream Priority Habitat

2. Survey Site Introduction

Surveys were carried out in North Kent, south of the Swale Estuary between Sittingbourne and Faversham. Four known chalk streams occur within the survey area arising from the Seaford Chalk Formation. These are low certainty chalk streams, as identified in the Natural England chalk stream dataset from March 2022.

The purpose of this survey was to survey neighbouring streams within the area that are subject to the same hydrogeological regime as these low certainty chalk streams.

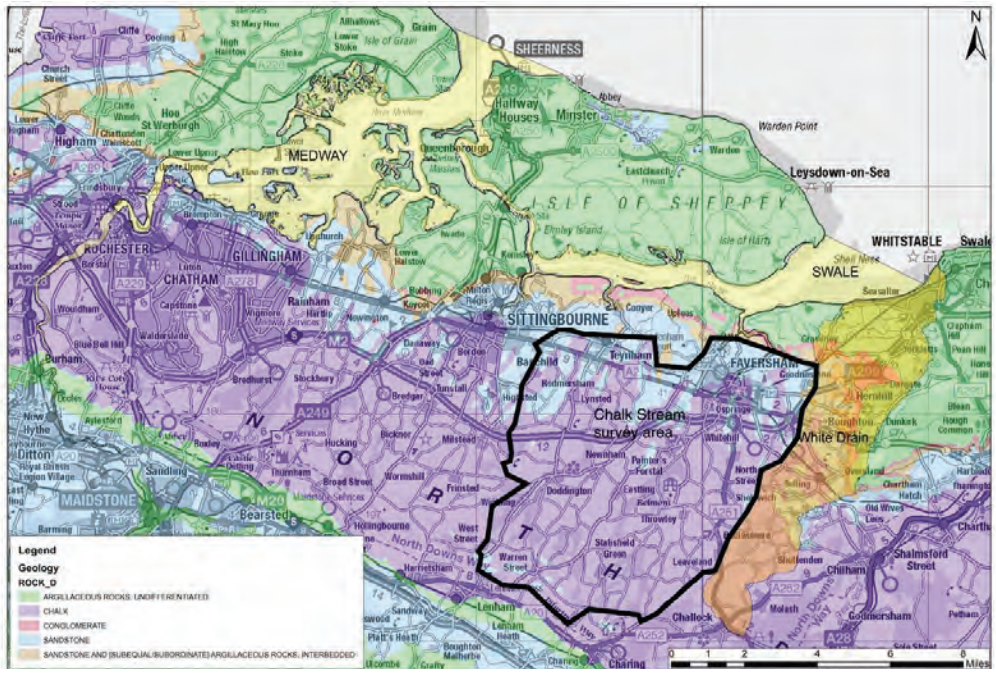


Figure 1: MSEP Chalk stream survey area map with chalk geology shown in purple

3. Methodology

In order to provide survey observations in line with those detailed as acceptable by Natural England, key criteria from Natural England's Guidance for stakeholders on helping to revise the map of chalk rivers in England was used in parallel with hydrogeological understanding and water quality.
Sites were surveyed for:

- Chalk stream indicator species;
- Chalk stream geomorphological characteristics;
- Hydrogeological connectivity;
- Water quality;
- Channel modification and surrounding land-use.

3.1 Public Consultation

In lieu and alongside SERT surveys, information was gathered through a public consultation which allowed local groups / individuals to provide observations of local rivers which emerge from chalk, greensand or neighbour existing "low certainty" chalk streams, as identified in the amended UK BAP chalk stream map by Natural England. The premise was to allow those with local knowledge of these streams, who have long-term relationships with them and who are more likely to be able to capture their seasonal characteristics, to provide information. Seasonal characteristics are often missed in spot-surveys but are a key indicator of groundwater influence.

The public consultation received spatial point or polygon data on:

- Source of the stream - chalk / greensand/ unknown;
- Morphology of the stream - the stream - artificial straightening, naturalness of banks, presences of weirs and other features of human modification;
- Water quality - based on visible observations of clarity and any specific types of pollution;
- Types of aquatic plants;
- Fish - presence/absence and types observed;
- Extent of stream baseflow - e.g. baseflow - e.g. seasonality, stream drying in summer months, or drought impacts indicated by drying during the extreme 2022 drought event.

Results from this consultation can be viewed on an interactive map at the following link:
https://experience.arcgis.com/experience/1453572dbd994cb4b995cc13858fc78f

3.2 Field based Chalk Stream Surveys

Alongside the above public consultation, SERT carried out field surveys of each of the eleven streams and fed their observations into the same consultation tool as used by the public. These observations identified features in the list below, as detailed by Natural England's Guidance for stakeholders on helping to revise the map of chalk rivers in England and from internal expertise. Expert judgement allowed in-depth observations on the above, as well as more specialist indicators as identified below.

Chalk Stream Characteristics:

- Winterbournes (intermittent flow);
- Low-energy stream which runs off the chalk dip-slope;
- Upwelling in river beds;
- Knuckerholes;
- Flushes / seepages in wider floodplain;
- Flushes / seepages in riparian zone;
- Peat present in the valley-side spring-line;
- Reedbeds present beyond immediate bankside;
- Wet woodland (carr) present beyond immediate bankside;
- Tufa;
- Encroaching marginal vegetation;
- Gravel-bed channel;
- Water crowfoot;
- Tall fen vegetation;
- Lowland peat deposits;
- Fern/moss/liverwort dominated ghyll environment;
- Exposed coarse sediments;
- Apium, Berula and Callitriche species;
- Salmon and brown trout.

3.3 Water Quality

Combined with observations of vegetation as a bio-indicator of water quality, 16 water quality parameters were collected across the 11 streams.

Water quality measurements were used to provide a further insight as to the provenance of the water from these 11 streams: each was compared with a water sample from an artesian borehole at Oare Marshes which is screened in the Seaford Chalk. This provides a water sample from the primary aquifer that these streams are likely to receive baseflow from, for comparison to that of the surveyed streams.

3.4 Description of a Chalk Stream

To classify whether these streams showed chalk stream characteristics, data from section 3.1 was merged with observations from section 3.2. No observation alone encompasses the entirety of a chalk stream priority habitat, rather a combination of observations which demonstrate that the "trinity of ecological health" (water quantity, water quality and habitat quality) are present, or have potential, is required.

A chalk stream must have ¾ of its baseflow supplied by water derived from a chalk aquifer. From this, it gains excellent water quality, a consistent temperature year round, and a consistent flow regime, which, buffered by groundwater, is somewhat resilient to meteorological droughts. The warm water (as evidenced in the temperature plot of section 6 of the report) provides an extended growing season for in-channel and marginal plants.

Chalk streams are low-energy streams with little erosive power; they are characterised by wide lateral channels as well as wet floodplains with active springs. In their headwaters they commonly have winterbourne sections of river (winter rivers which extend the river upstream as the water table rises}, which are home to unique temporary stream species.

These North Kent streams surveyed occur in a geological spring-line, likely historically with perennially wet woodland, fens and flushes in between streams.

Therein this report aims to collate data from the public consultation, surveys and interpret these to provide recommendation on the presence of chalk stream priority habitats within the study area.

4.0 Hydrogeology of the area

Chalk groundwater plays a significant part in maintaining the particular ecosystems of the rivers and coastline of the North Downs (Adams *et al*., 2008). Chalk bedrock in the survey area is the Seaford Chalk Formation, a subdivision of the White Chalk Subgroup. This dips gently to the north east and has numerous structures within it. Atop the Seaford Chalk Formation are Paleogene sediments, of the Thanet Formation. These consist of sands, silts and clays, with an increase in clay towards their basal contact with the Seaford Chalk. Atop these is the Lambeth Group which occurs continuously with the Thanet Formation and as erosional outliers, or "pipes", within it. Alluvial deposits occur atop this, often reaching to the spring-heads observed in this survey.

The high clay content of the Thanet Sands in North Kent instigates the genesis of a series of contact spring-line streams - as is a classic spring contact with chalk and clay in the South East.

Structural controls on groundwater flow within the chalk are a controlling variable on the flow of water within the chalk. Major fractures occur within the chalk as indicated by dry valleys clearly developed south of Sittingbourne and Faversham which branch from the Maidstone-Ashford fault zone to the south west. These are shown to have a high transmissivity and are targeted for abstraction by water companies. These structures are orientated NW-SE and E-W and are likely to persevere below the overlying Paleogene sediments.

The presence of springs in the Thanet Formation along from mapped chalk fault-zones to the south, could explain the hydrological connection of these chalk stream surface waters to groundwater fed by fractures within the underlying chalk.

Connectivity with groundwater can be observed in chalk streams through morphological features such as knuckerholes as well as visible seeps and flushes. The rise and fall of the water table within chalk aquifers is evidenced through the presence of winterbournes and the presence of flushes or seepages in the floodplain. Vegetation types such as Apium, Berula and Callitriche act as biological indicators of good water quality and perennial flow. An extended growing season, due to warmer aquifer-derived waters, is also a characteristic of groundwater dominated stream baseflow.

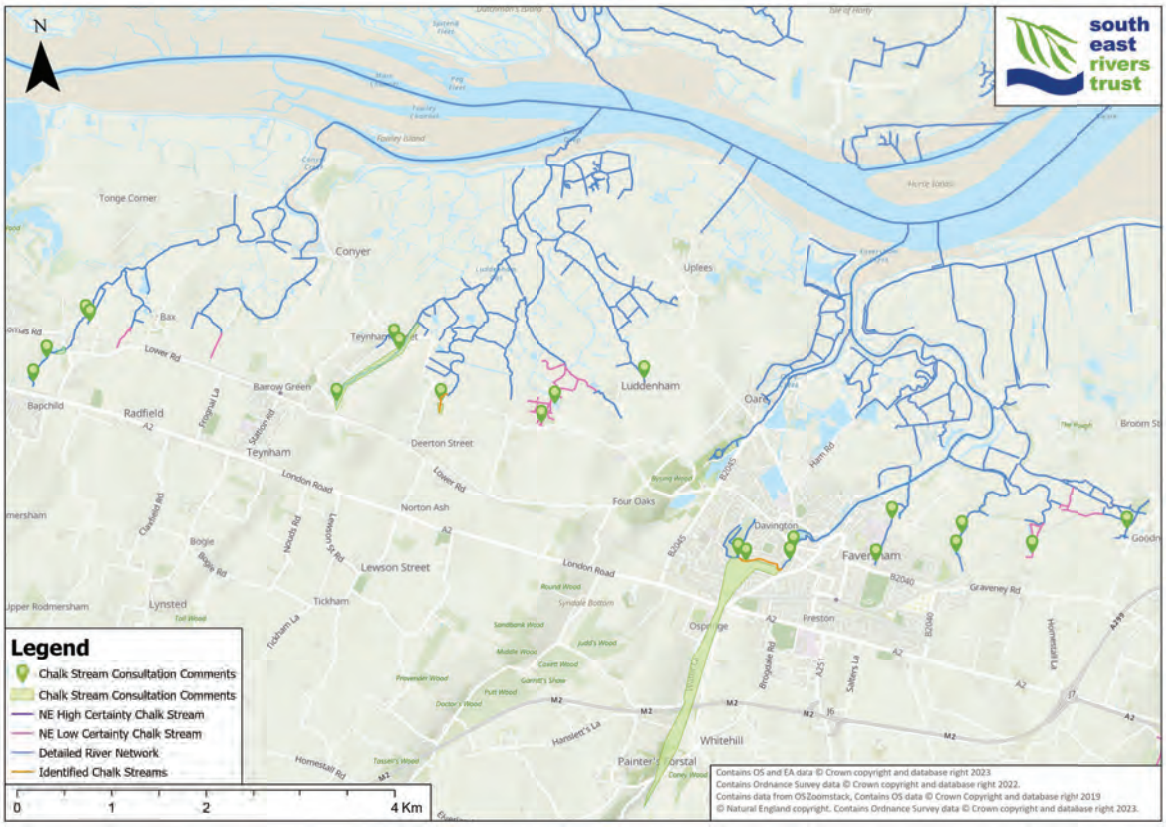
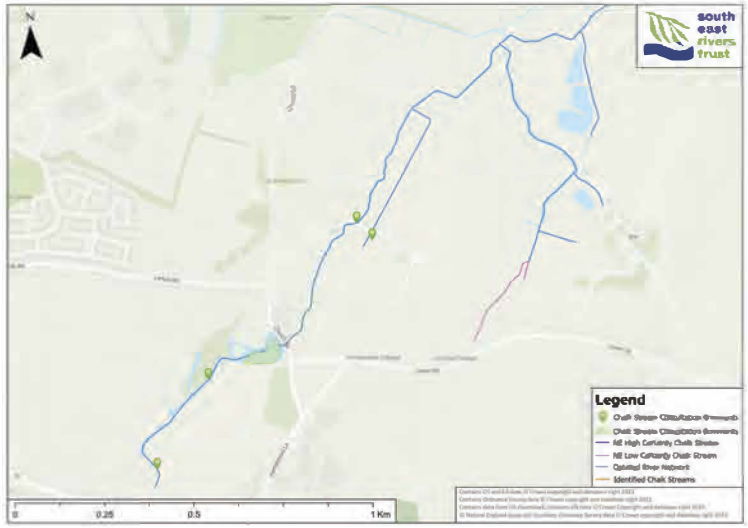


Figure 2: Map of survey area with public consultation, SERT walkover observation and verified chalk streams.

Figure 3: 1:50k map of geology of survey area. Provided by Friends of the Westbrook with imagery courtesy of British Geological Society. Note chalk in lime green, Thanet formation in blue. Note the dendritic erosional relationship of chalk and Thanet formation as well as E-W strike of springheads in a spring-line, offset likely by faulting between points 5-7.

1) Bapchild Stream

Summary: This stream begins at Thomas Beckett's Spring, is impounded by the infrastructure of an old water mill (Tonge Mill Cottage, Tonge Mill, Sittingbourne ME9 9AP) and then flows through fields to the Swale Estuary.
Chalk Stream Indicator Species: The channel is densely vegetated with species such as, fools watercress and water starwort which encroach in-channel. In its upper reaches the crowded channel has an anastomosing form through wet woodland. Water starwort is prevalent in channel here as are bryophytes.
Channel Morphology: This river has been modified. At its head, the stream bed shows coarse gravels, with large pebbles of angular chalk and flint. Historic (1796) maps show a pond wherein the spring originally discharged, this was likely channelized, as it now is, to convey water to the mill downstream, narrowing the river. River occurs in a mildly incised channel with a bed smothered in silt (~30cm thick). Floodplain has drainage ditches within it.
Surrounding Land Use: Orchards and improved grassland for grazing.
Water Quality: Very clear in parts with the millpond having a detrimental effect on water quality by increasing suspended sediment load due to siltation of the millpond and resuspension by wild fowl etc.
Hydrogeology: The river's source is Thomas Beckett's spring, a spring has existed here since at least 700AD. Downstream at St Giles Church, a low certainty chalk stream on the existing BAP map is shown on the adjacent stream at the same latitude here. Knuckerholes and seeps in the floodplain indicate the neighbouring low certainty chalk stream and this stream may share the same hydrogeological system.
Conclusion: This stream has a clear groundwater input as evidenced by knuckerholes, seeps on the floodplain and excellent water quality. It contains Apium species and encroaching marginal vegetation. **The uppermost reaches of this stream are chalk stream habitat,** the impacts of Bapchild mill-pond and low channel gradient downstream prevent chalk stream habitat from occurring.



Top: Bapchild stream with survey observations.

Left: Knuckerholes visible in lower catchment in stream bed, stream bed is smothered in 30cm of silt.

Right: Encroaching marginal vegetation in stream facing upstream

7.0 Conclusions & Recommendations

7.1 Water Quality

Water quality readings clearly showed that water quality within these streams is of a chalk origin, as confirmed by floral communities observed. Little variation occurred between stream water quality and that of samples from the artesian borehole at Oare Marshes which is screened in chalk.

7.2 Water Quality & Quantity

All these streams show a similar origin: emerging from spring-line contacts between chalk and clay in an E-W spring-line, with an exception observed at Oare Creek. Holocene erosion patterns have left a dendritic exposure of this hydrogeological setting within the surveyed area. Interestingly, there are discrepancies between geological maps and the occurrence of these streams. For example, the Bapchild stream does not have any overlapping contact with chalk lithology but clearly shows water quality indicative of that derived from a chalk source. It could be that this is due to the resolution of mapping available.

The observed position of the current spring line could be different from what it was historically. For example, the Westbrook Stream at Faversham has an old mill in its headwaters that is currently a dry watercourse. When this mill was operational, in theory it would have been powered by a consistent stream flow to make the mill viable indicating that current aquifer levels are lower than historically, likely due to abstraction.

7.3 Habitat Quality

The 11 streams offer a range of habitat types, although mostly their riparian zones are arable land which is used for grazing. In the headwaters of the Bapchild stream, Downs Well stream, and Westbrook stream, are areas of wet-woodland which show seeps and visible upwelling within the woodland channel. This is a perennially wet priority habitat.

Unfortunately, the majority of streams within this survey suffer from excess siltation, although they may display good water quality and connectivity with chalk groundwater. Along significant stretches of their channel they lack a gravel-bed channel, or rather it is smothered in silt. This may be in part due to the low channel slope or gradient, as the rivers are largely on reclaimed low-lying land, but also due to other human modification such as historic dredging or over-widening. However, Westbrook stream, the top of Downs Well stream and Bapchild stream (see Figure 2 for locations) show a clear link with chalk-derived baseflow and provide a gravel-bed river.

Therefore, we recognise these hold the greatest restoration potential. Encouraging in-channel features to scour and deposit silt are also recommended, although the effect these may have whilst gradient remains the same may be languid. The other watercourses do not have the gradient for their restoration as chalk streams but offer potential as calcareous fen habitats for local biodiversity benefits.

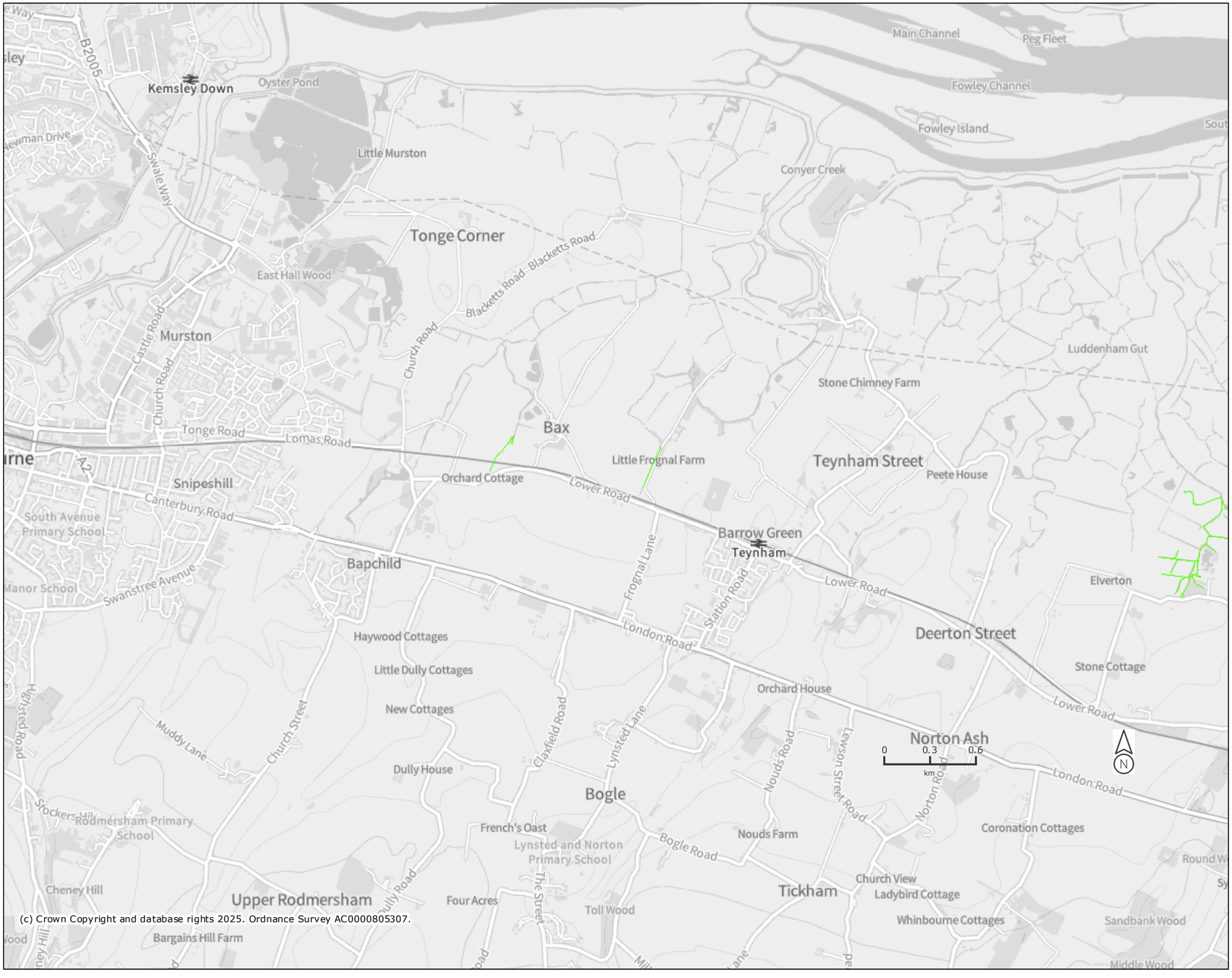
4657/AB15b:

MAGIC plot of chalk stream dataset

(CD 37.5.2.S)

MAGIC

Chalk Rivers



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Legend

Chalk Rivers

- High certainty
- Low certainty

Projection = OSGB36
xmin = 588500
ymin = 160300
xmax = 601100
ymax = 166700

0 0.5 1
km

Map produced by MAGIC on 7 February, 2025.

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