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A review of the Hemiptera of Great Britain: The shieldbugs and allied families

Coreoidea, Pentatomoidea & Pyrrhocoroidea

Species Status No.26

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NATURAL ENGLAND

Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Background

Making good decisions to conserve species should primarily be based upon an objective process of determining the degree of threat to the survival of a species. The recognised international approach to undertaking this is by assigning the species to one of the IUCN threat categories.

This report was commissioned to update the national status of shield bugs using IUCN methodology for assessing threat. It covers all species of Coreoidea, Pentatomoidea & Pyrrhocoroidea in Great Britain, identifying those that are rare and/or under threat as well as non-threatened and non-native species.

Reviews for other invertebrate groups will follow.

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Natural England Project Manager - Jon Webb, **jon.webb@naturalengland.org.uk**

Author - Tristan Bantock

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Further information
This report can be downloaded from the Natural England website: **www.gov.uk/government/organisations/natural-england**. For information on Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk**.

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CONTENTS

1 Introduction to the Species Status project

1.1 The Species Status project

The Species Status project is a recent initiative, providing up-to-date assessments of the threat status of taxa using the internationally accepted Red List guidelines developed by the International Union for Conservation of Nature (IUCN) (IUCN, 2012a; 2012b; IUCN Standards and Petitions Subcommittee, 2013, 2014). It is the successor to the JNCC's Species Status Assessment project (http://jncc.defra.gov.uk/page-3352) which ended in 2008. This publication is one in a series of reviews to be produced under the auspices of the new project.

Under the Species Status project, the UK's statutory nature conservation agencies, specialist societies and NGOs will initiate, resource and publish Red Lists and other status reviews of selected taxonomic groups for Great Britain which will then be submitted to JNCC for accreditation (http://jncc.defra.gov.uk/page-1773). This means that the UK's statutory nature conservation agencies and JNCC will be able to publish red lists. All publications will explain the rationale for the assessments made. The approved threat statuses will be entered into the JNCC spreadsheet of species conservation designations (http://jncc.defra.gov.uk/page-3408).

1.2 The status assessments

This review adopts the procedures recommended for the regional application of the IUCN threat assessment guidelines which can be viewed at http://cmsdocs.s3.amazonaws.com/keydocuments/Reg_Guidelines_en_web%2Bcover%2Bbackcover.pdf. Section 3 and Appendix 1 provide further details. This is a two-step process, the first identifying the taxa threatened in the region of interest using information on the status of the taxa of interest in that region (IUCN, 2001), the second amending the assessments where necessary to take into account interaction with populations of the taxon in neighbouring regions (IUCN Standards and Petitions Subcommittee, 2013). In addition, but as a separate exercise, the standard GB system of assessing rarity, based solely on distribution, is used alongside the IUCN system.

1.3 Species status and conservation action

Sound decisions about the priority to attach to conservation action for any species should primarily be based upon objective assessments of the degree of threat to the survival of a species. This is conventionally done by assigning the species to one of the IUCN threat categories. However, the assessment of threats to survival should be separate and distinct from the subsequent process of deciding which species require action and what activities and resources should be allocated.

1.4 References and Further Reading

AINSWORTH, A.M., SMITH, J.H., BODDY, L., DENTINGER, B.T.M., JORDAN, M., PARFIITT, D., ROGERS, H.J. & SKEATES, S.J. 2013. Red List of Fungi for Great Britain: Boletaceae. A pilot conservation assessment based on national database records, fruit body morphology and DNA barcoding. *Species Status Assessment* No 14, ISSN 1473-0154, Joint Nature Conservation Committee, Peterborough.

ALEXANDER, K.N.A. (2014) *A review of the beetles of Great Britain: The Soldier Beetles and Their Allies.* Species Status No.16 Natural England Commissioned Reports, Number 134.

ALEXANDER, K.N.A, DODD, S. & DENTON, J.S. (2014) *A review of the beetles of Great Britain: The Darkling Beetles and Their Allies* Species Status No. 18. Natural England Commissioned Reports, Number 148.

BRATTON, J.H. (ed.). 1991. *British Red Data Books: 3. Invertebrates other than Insects*. Nature Conservancy Council, Peterborough.

CHEFFINGS, C. & FARRELL, L. (eds). 2005. The Vascular Plant Red Data List for Great Britain. *Species Status Assessment* No **7**, ISSN 1473-0154, Joint Nature Conservation Committee, Peterborough.

DAGUET, C., FRENCH, G. & TAYLOR, P. (eds.). 2008. The Odonata Red Data List for Great Britain. *Species Status Assessment* No 11, ISSN 1470-0154, Joint Nature Conservation Committee, Peterborough.

FOSTER, G.N. 2010. A review of the scarce and threatened Coleoptera of Great Britain Part (3): Water beetles of Great Britain. *Species Status* 1. Joint Nature Conservation Committee, Peterborough.

FOX, R., WARREN, M.S. and BRERETON, T.M. 2010. A new Red List of British Butterflies, *Species Status* 12; 1-32. Joint Nature Conservation Committee, Peterborough.

HUBBLE, D.S. 2014. *A review of the scarce and threatened beetles of Britain. The leaf beetles and their allies. Chrysomelidae, Megalopodidae and Orsodacnidae.* Species Status No.19. Natural England Commissioned Reports, Number 161.

HYMAN, P.S. (revised PARSONS, M.S.). 1992. A review of the scarce and threatened Coleoptera of Great Britain. Part 1. UK Nature Conservation: 3. Joint Nature Conservation Committee, Peterborough.

IUCN. 1994. *IUCN Red List Categories and Criteria: Version 2.3*, IUCN Species Survival Commission. IUCN, Gland.

IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Commission. IUCN, Gland and Cambridge.

IUCN. 2003. Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission IUCN, Gland and Cambridge.

IUCN. 2012a. *IUCN Red List Categories and Criteria*. Version 3.1. 2nd Edition, IUCN Species Survival Commission. IUCN, Gland.

IUCN. 2012b. Guidelines for Application of IUCN Red List Criteria at Regional and National Levels. Version 4.0, IUCN Species Survival Commission. IUCN, Gland.

IUCN, 2013. *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 10, IUCN Species Survival Commission. IUCN, Gland.

MACADAM, C (2015) *A Review of the Stoneflies (Plecoptera) of Great Britain.* Species Status No.20 Natural England Commissioned Reports, Number 174.

SHIRT, D.B. 1987. *British Red Data Books: 2 Insects*. Nature Conservancy Council, Peterborough.

WOODS, R.G. & COPPINS, B.J. 2012. A Conservation Evaluation of British Lichens and Lichenicolous Fungi. *Species Status Assessment* No 13, ISSN 1473-0154, Joint Nature Conservation Committee, Peterborough.

2. Introduction to this review

The shieldbugs and allies are amongst the most familiar representatives of the terrestrial Heteroptera and the group includes a number of common species which are large, colourful and often conspicuous. They are predominantly insects of warm climates; several species are at or close to the northern edge of their range in Britain and most have a southerly distribution. Just 12 of the 69 British species are found in Scotland. These environmental constraints have important implications for their suitability as sensitive indicators of climate change. It is pertinent that numerous species have expanded their distributions northwards in recent years and many of these range changes are probably attributable to a gradually warming climate (Kirby *et al*., 2001; Stewart & Kirby, 2010).

Although the standard reference work for the British terrestrial bug fauna remains Southwood & Leston (1959), the shieldbugs have received more attention in recent years, with the publication of additional literature dealing with their identification and ecology (Hawkins, 2003; Nau, 2004; Evans & Edmondson, 2005) as well as several county atlases (Hawkins, 2003; Hewitt, 2006; Boardman, 2014). Following this upsurge in popularity, a separate recording scheme for shieldbugs and allies was initiated in 2010, following the division of the Terrestrial Heteroptera Recording Scheme into two more manageable parts. The group has become increasingly accessible to non-specialists and many recent records of distinctive species such as *Corizus hyoscyami* and *Leptoglossus occidentalis* are the result of casual sightings made by members of the general public.

2.1 Taxa considered in this review

This review covers the 69 species included in the Shieldbugs & allies Recording Scheme, as of 2012 (Table 1). The Recording Scheme has, since its formation in 2010, collated information about these species from the following data sources:

- Historic records as published in the national journals (and in some cases also local journals);
- Published county reviews;
- Voucher specimens available through national and local museums;
- Modern records

The area covered in this review is Great Britain (i.e. England, Scotland and Wales only). While Northern Ireland forms part of the United Kingdom, the recent trend has been for that area to work with the Irish Republic over whole Ireland reviews. The Isle of Man and the Channel Islands are also not included.

Species names follow Aukema & Rieger (1995–2006); changes in taxonomy and nomenclature post-Southwood & Leston (1959) are summarized in Table 2.

Table 1. Taxa included in this review

Superfamily	**Family**	**Species**
Coreoidea	Alydidae	*Alydus calcaratus* (Linnaeus)
	Coreidae	*Arenocoris fallenii* (Schilling)
	Coreidae	*Arenocoris waltlii* (Herrich-Schäffer)
	Coreidae	*Bathysolen nubilus* (Fallén)
	Coreidae	*Ceraleptus lividus* Stein
	Coreidae	*Coreus marginatus* (Linnaeus)
	Coreidae	*Coriomeris denticulatus* (Scopoli)
	Coreidae	*Enoplops scapha* (Fabricius)
	Coreidae	*Gonocerus acuteangulatus* (Goeze)
	Coreidae	*Leptoglossus occidentalis* Heidemann
	Coreidae	*Spathocera dalmanii* (Schilling)
	Coreidae	*Syromastus rhombeus* (Linnaeus)
	Rhopalidae	*Brachycarenus tigrinus* (Schilling)
	Rhopalidae	*Chorosoma schillingii* (Schummel)
	Rhopalidae	*Corizus hyoscyami* (Linnaeus)
	Rhopalidae	*Liorhyssus hyalinus* (Fabricius)
	Rhopalidae	*Myrmus miriformis* (Fallén)
	Rhopalidae	*Rhopalus maculatus* (Fieber)
	Rhopalidae	*Rhopalus parumpunctatus* Schilling
	Rhopalidae	*Rhopalus rufus* Schilling
	Rhopalidae	*Rhopalus subrufus* (Gmelin)
	Rhopalidae	*Stictopleurus abutilon* (Rossi)
	Rhopalidae	*Stictopleurus punctatonervosus* (Goeze)
	Stenocephalidae	*Dicranocephalus agilis* (Scopoli)
	Stenocephalidae	*Dicranocephalus medius* (Mulsant & Rey)
Pentatomoidea	Acanthosomatidae	*Acanthosoma haemorrhoidale* (Linnaeus)
	Acanthosomatidae	*Cyphostethus tristriatus* (Fabricius)
	Acanthosomatidae	*Elasmostethus interstinctus* (Linnaeus)
	Acanthosomatidae	*Elasmucha grisea* (Linnaeus)
	Acanthosomatidae	*Elasmucha ferrugata* (Fabricius)
	Cydnidae	*Adomerus biguttatus* (Linnaeus)
	Cydnidae	*Canthophorus impressus* Horvath
	Cydnidae	*Geotomus punctulatus* (Costa)
	Cydnidae	*Legnotus limbosus* (Geoffroy)
	Cydnidae	*Legnotus picipes* (Fallén)
	Cydnidae	*Sehirus luctuosus* Mulsant & Rey
	Cydnidae	*Tritomegas bicolor* (Linnaeus)
	Cydnidae	*Tritomegas sexmaculatus* (Rambur)
	Pentatomidae	*Aelia acuminata* (Linnaeus)
		Carpocoris mediterraenus atlanticus Tamanini
		Carpocoris purpuripennis (De Geer)
		Chlorochroa juniperina (Linnaeus)
		Dolycoris baccarum (Linnaeus)
		Eurydema dominulus (Scopoli)

		Eurydema oleracea (Linnaeus)
		Eurydema ornata (Linnaeus)
		Eysarcoris aeneus (Scopoli)
		Eysarcoris venustissimus (Schrank)
		Jalla dumosa (Linnaeus)
		Neottiglossa pusilla (Gmelin)
		Nezara viridula (Linnaeus)
		Palomena prasina (Linnaeus)
		Pentatoma rufipes (Linnaeus)
		Peribalus strictus (Fabricius)
		Picromerus bidens (Linnaeus)
		Piezodorus lituratus (Fabricius)
		Podops inuncta (Fabricius)
		Rhacognathus punctatus (Linnaeus)
		Rhaphigaster nebulosa (Poda)
		Sciocoris cursitans (Fabricius)
		Troilus luridus (Fabricius)
		Zicrona caerulea (Linnaeus)
	Scutelleridae	*Eurygaster austriaca* (Schrank)
		Eurygaster maura (Linnaeus)
		Eurygaster testudinaria (Geoffroy)
		Odontoscelis fuliginosa (Linnaeus)
		Odontoscelis lineola Rambur
	Thyreocoridae	*Thyreocoris scarabaeoides* (Linnaeus)
Pyrrhocoroidea	Pyrrhocoridae	*Pyrrhocoris apterus* (Linnaeus)

Table 2. Changes in taxonomy and nomenclature since Southwood & Leston (1959)

Southwood & Leston (1959)	**Aukema & Rieger (1995–2006)**	**Rationale**
Arenocoris falleni (Schilling)	*Arenocoris fallenii* (Schilling)	Synonym
Arenocoris waltli (Herrich-	*Arenocoris waltlii* (Herrich-	Synonym
Spathocera dahlmanni (Schilling)	*Spathocera dalmanii* (Schilling)	Synonym
Chorosoma schillingi (Schummel)	*Chorosoma schillingii* (Schummel)	Synonym
Aeschyntelus maculatus (Fieber)	*Rhopalus maculatus* (Fieber)	Synonym
Sehirus biguttatus (Linnaeus)	*Adomerus biguttatus* (Linnaeus)	Synonym
Sehirus bicolor (Linnaeus)	*Tritomegas bicolor* (Linnaeus)	Synonym
Sehirus dubius (Scopoli)	*Canthophorus impressus* Horvath	Originally misidentified as *Canthophorus dubius* (Scopoli) (=*Sehirus dubius* (Scopoli) (Nau, 2002)
Pitedia juniperina (Linnaeus)	*Chlorochroa juniperina* (Linnaeus)	Synonym
Eysarcoris fabricii (Kirkaldy)	*Eysarcoris venustissimus* (Schrank)	Synonym
Holcostethus vernalis (Wolff)	*Peribalus strictus* (Fabricius)	Synonym (Ribes & Pagola-Carte, 2013)
Odontoscelis dorsalis (Fabricius)	*Odontoscelis lineola* Rambur	Originally misidentified as *Odontoscelis dorsalis* (Fabricius)

2.2 Previous reviews

2.2.1 British Red Data Books: 2. Insects (1987)

The first account of threatened British Hemiptera was included in the *British Red Data Books: 2. Insects* (Shirt, 1987). Data sheets were given for each of the Category 1 (Endangered) and 2 (Vulnerable) species. Table 3 lists the species of shieldbugs and allies covered in this review by family, allowing for taxonomic changes which have occurred since 1987.

Table 3. Species assigned to Red List categories (Shirt, 1987)

Family	**Category 1 Endangered**	**Category 2 Vulnerable**	**Category 3 Rare**	**Appendix (No post 1900**
Acanthosomatidae				*Elasmucha ferrugata*
Coreidae	*Gonocerus acuteangulatus*	*Arenocoris waltlii*		
Cydnidae	*Geotomus punctulatus*			
Pentatomidae		*Eysarcoris aeneus*	*Peribalus strictus*	*Chlorochroa juniperina*
Pyrrhocoridae	*Pyrrhocoris apterus*			
Rhopalidae				*Stictopleurus abutilon, Stictopleurus punctatonervosus*
Scutelleridae	*Eurygaster austriaca*		*Odontoscelis fuliginosa*	

2.2.2 A review of the scarce and threatened Hemiptera of Great Britain (1992)

The *British Red Data Book* volume was followed by the publication of *A review of the scarce and threatened Hemiptera of Great Britain* (Kirby, 1992) which reviewed the status for all British Heteroptera and Auchenorrhyncha and presented data sheets for all scarce and threatened species. Table 4 lists the species of shieldbugs and allies covered in this review by family, allowing for taxonomic changes which have occurred since 1992.

Table 4. Species included in *A review of the scarce and threatened Hemiptera of Great Britain* (Kirby, 1992)

Family	**RDB1**	**RDB2**	**RDB3**	**RDBK**	**Extinct**	**Notable**
Acanthosomatidae					*Elasmucha ferrugata*	
Coreidae	*Gonocerus acuteangulatus*	*Arenocoris waltlii*				*Spathocera dalmanii, Bathysolen nubilus*
Cydnidae	*Geotomus punctulatus*					*Legnotus picipes, Canthophorus impressus, Adomerus biguttatus*
Pentatomidae			*Peribalus strictus, Eysarcoris aeneus*		*Chlorochroa juniperina, Jalla dumosa*	*Eurydema dominulus, Sciocoris cursitans*
Pyrrhocoridae	*Pyrrhocoris apterus*					
Rhopalidae			*Rhopalus rufus*	*Liorrhysus hyalinus*	*Stictopleurus abutilon, Stictopleurus punctatonervosus*	*Rhopalus maculatus*
Scutelleridae			*Odontoscelis fuliginosa*		*Eurygaster austriaca*	*Eurygaster maura, Odontoscelis lineola*
Stenocephalidae						*Dicranocephalus agilis, Dicranocephalus medius*

2.2.3 The new review

The present review will provide an up to date assessment of the status of this group (shieldbugs and allies) in the IUCN format now almost universally adopted for the assessment of threat to any taxa. It should be borne in mind that the IUCN criteria highlight those in imminent danger of regional extinction, in contrast to the earlier non-IUCN assessments which identified Nationally Rare and Nationally Scarce species purely on the basis of their geographic distribution and did not consider historic population trends.

3. The IUCN threat categories and selection criteria as adapted for Invertebrates in Great Britain

3.1 Summary of the 2001 Threat Categories

A brief outline of the revised IUCN criteria and their application is given below. For a full explanation see Appendix 2 IUCN (2001; 2013) and the IUCN web site (http://www.iucnredlist.org/; www.iucn.org/). The definitions of the categories are given in Figure 1 and the hierarchical relationship of the categories in Figure 2. The categories *Extinct in the wild* and *Regionally Extinct* have not been applied in this review. All categories refer to the status in Great Britain (not globally).

REGIONALLY EXTINCT (RE)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. In this review the last date for a record is set at fifty years before publication.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Table 4).

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Table 4).

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Table 4).

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Figure 1. Definitions of IUCN threat categories (from IUCN 2001 with a more specific definition for regional extinction)

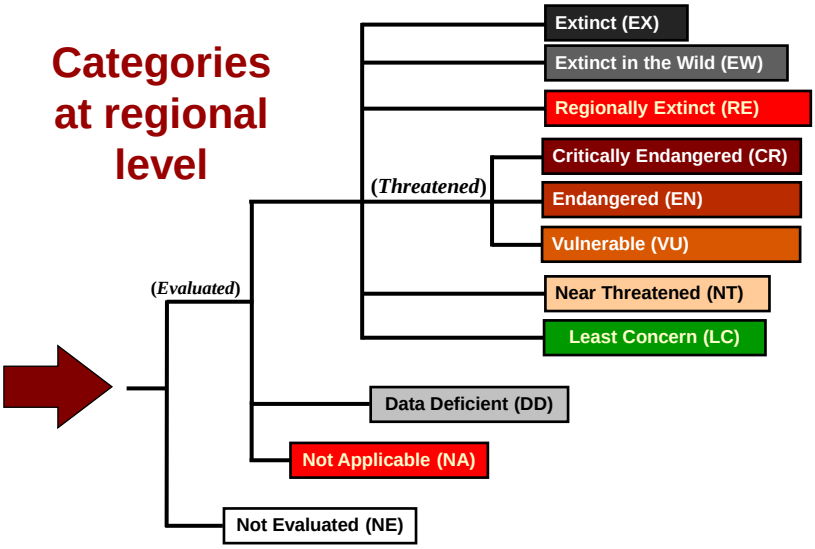

Figure adapted from IUCN (2001)

Figure 2. Hierarchical relationships of the categories

Taxa listed as *Critically Endangered*, *Endangered* or *Vulnerable* are defined as Threatened (Red List) species. For each of these threat categories there is a set of five main criteria A-E, with a number of sub-criteria within A, B and C (and an additional sub-criterion in D for the *Vulnerable* category), any one of which qualifies a taxon for listing at that level of threat. The qualifying thresholds within the criteria A-E are detailed in Appendix 2: Summary of IUCN Criteria.

In the main, the status evaluation procedure relies on an objective assessment of the available evidence. In certain cases, however, subjective assessments are acceptable as, for example, in predicting future trends and judging the quality of the habitat and methods involving estimation, inference and projection are acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can be reasonably supported. Suspected or inferred patterns in the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified as part of the documentation. Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible or nearly so (IUCN, 2001). Since the criteria have been designed for global application and for a wide range of organisms, it is hardly to be expected that each will be appropriate to every taxonomic group or taxon. Thus a taxon need not meet all the criteria A-E, but is allowed to qualify for a particular threat category on any single criterion.

The guidelines stipulate/advise that a precautionary approach should be adopted when assigning a taxon to a threat category and this should be the arbiter in borderline cases. The threat assessment should be made on the basis of reasonable judgment, and it should be particularly noted that it is not the worst-case scenario that will determine the threat category to which the taxon will be assigned.

The categorization process is only to be applied to wild populations inside their natural range (IUCN, 2001), with a long-term presence (since 1500 AD) in Britain. Taxa deemed to be ineligible for assessment at a regional level were placed in the category of '**Not Applicable (NA)'.** This category is typically used for introduced non-native species whether this results from accidental or deliberate importation. It may also be used for recent colonists (or attempted colonists) responding to the changing conditions available in Britain as a result of human activity and/or climate change.

3.2 Application of the Guidelines to Invertebrates

The criteria A, C, D1 and E are rarely appropriate for shieldbugs and their allies as population data have not been gathered and quantitative analysis has not been undertaken for this group.

In this Review, **Extent of occurrence** (EOO) is not applied to most species shieldbugs and their allies as an agreed methodology for its measurement in relation to these species is not available. There are some instances where the known EOO can be measured but these are the exception. These tend to be species known to occur from one or a few sites and where their habitat resource is easily definable, in a restricted area and where intensive survey work has been undertaken to ascertain their distribution. Where EOO has been applied, the terms of this use has been defined within the status sheets on a species by species basis.

Area of occupancy (AOO) is another measure that is difficult to apply to invertebrate records and populations as defined by the IUCN guidelines (IUCN, 2012a; 2012b; 2013).

"Area of occupancy is defined as the area within its 'extent of occurrence' that is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g. irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, it may be necessary to standardize estimates by applying a scale-correction factor. It is difficult to give strict guidance on how standardization should be done because different types of taxa have different scale-area relationships." (IUCN, 2012a).

The IUCN have recommended a scale of $4km^2$ (a tetrad) as the reference scale (IUCN, 2013). This needs to be applied with caution and there will be instances where a different scaling is more applicable, or where attempting to apply any scale is extremely difficult. For common and widespread species applying this rule will lead to under-estimation of their true AOO and a degree of interpretation is required. This highlights the importance of peer review and shared expert opinion for making decisions on scale. For rarer, more restricted, species the tetrad is more applicable, in particular those species which may occur on a few fragmented sites within the UK and/or whom are often restricted to certain, well-defined habitat types that are easily identified. In most instances, the reviewer (and his peers) is best placed to judge which these species are.

3.2.1 The two-stage process in relation to developing a Red List

The IUCN regional guidelines (IUCN, 2003) indicate that if a given taxon is known to migrate into or out of the region it should be assessed using a two-stage approach. Populations in the region under review should firstly be assessed as if they were isolated taxa. They should then be reassessed and can be assigned a higher or a lower category if their status within the region is likely to be affected by emigration or immigration. Although recruitment from abroad has clearly accounted for the establishment of some newcomers to the British fauna, migration within Britain and between Britain and the Continent of populations of shieldbugs and their allies under threat is not considered to be a significant factor.

3.2.2 The use of the Near Threatened category

The IUCN guidelines recognise a Near Threatened category to identify species that need to be kept under review to ensure that they have not become Threatened. This category is used for species where a potential threat, natural habitat dependency or range change demand frequent review of status.

This category would be best considered for those species that come close to qualifying as CR, EN or VU but not quite; i.e. meets many but not all of the criteria and sub-criteria. For those criteria that are not quite met, there should be sufficient evidence to show that the taxon is close to the relevant threatened thresholds. As such, it is up to the reviewers to provide evidence and methods for discerning this.

The Invertebrate Inter Agency Working Group and JNCC have defined the following for the use of B2bii which is commonly used in reviews. Continuing decline has to be demonstrated – and proven that it isn't an artefact of under-recording. If decline is demonstrated then the reviewer needs to consider whether or not B2a (and B2c if the data is present) is met:

- If 10 or less current localities then Critically Endangered, Endangered, Vulnerable is applicable;
- If 11 or 12 current localities then Near Threatened applies;
- If 13-15 and the taxon can be shown to be vulnerable to a specific and realistic threat, then Near Threatened applies;
- If more than 15 locations then Least Concern applies.

4. The use of an Amber list category

As previously outlined, the IUCN threat criteria are principally concerned with identifying species at high risk of extinction. Despite taking population trends into account, they are only able to highlight species which are both very rare *and* have a history of decline. Even the *Near Threatened* category is suitable only for species which are close to qualifying for a threat status in the near future and are present in less than 20 hectads.

In order to categorize species which are rapidly declining, but still quite widely distributed, the creation of an Amber List category is desirable. This should focus solely on assessing decline and be entirely independent of absolute rarity, such that species which do not have a GB Rarity status are eligible for inclusion. It is proposed that species which have declined by 50% or more in terms of occupied hectads but are still present in more than 15 hectads should qualify for the Amber List.

5. GB Rarity Status categories and criteria

At the national level, countries are permitted to refine the definitions for the non-threatened categories and to define additional ones of their own. The Nationally Rare and Nationally Scarce categories are unique to Britain. Broadly speaking, the Nationally Rare category is equivalent to the Red Data Book categories used by Shirt (1987) and Kirby (1992), namely: Endangered (RDB1), Vulnerable (RDB2), Rare (RDB3), Insufficiently Known (RDBK) and Extinct (RDB Appendix). These are not used in this review. The Nationally Scarce category is directly equivalent to the combined Nationally Notable A (Na) and Nationally Notable B (Nb) categories used by Kirby (1992).

For the purposes of this review, the following definitions of Nationally Rare and Nationally Scarce have been applied:

Nationally Rare	Native species which have not been recorded from more than 15 British hectads since 31st December 1989 and where there is reasonable confidence that exhaustive recording would not find them in more than 15 hectads. This category includes species which are probably extinct.
Nationally Scarce	Native species which are not regarded as Nationally Rare AND which have not been recorded from more than 100 British hectads since 31st December 1989 and where there is reasonable confidence that exhaustive recording would not find them in more than 100 hectads.
None	Native species which are not regarded as Nationally Rare or Nationally Scarce AND non-native species.

The choice of 1990 as the start of the modern recording period is discussed in Section 6.2.

6. Methods and sources of information

6.1 Introduction

The most recent published list of scarce and threatened Hemiptera (Kirby, 1992) was based on the Red Data Book criteria used in the British Insects Red Data Book (Shirt, 1987) with the addition of the category RDBK (Insufficiently Known) after Wells, Pyle & Collins (1983). The original IUCN criteria for assigning threat status used in these publications had the categories Endangered, Vulnerable and Rare, which were defined rather loosely and without quantitative thresholds. The application of these categories was largely a matter of judgment, and it was not easy to apply them consistently within a taxonomic group or to make comparisons between groups of different organisms.

6.2 Data sources

The present review assesses the status of all shieldbugs and allied species using the data sources described below and the methodology outlined in Sections 3 and 6. During the process the views of other specialists were sought (see Acknowledgements). The bulk of the data (c.30,000 records) was derived from the Shieldbugs and allied species Recording Scheme, in addition to information from Statutory Agencies, such as Natural Resources Wales and Local Biological Record Centres from around the UK. This was supplemented by information on NBN Gateway (not all of this is currently in the recording scheme), although records which required further checking were omitted if they could not be verified.

The recording scheme dataset is somewhat biased towards the present day, since the group has become much more popular amongst amateur recorders during the last decade. Furthermore, many historic sources have not been collated, although a start has been made in extracting literature records from the main national entomological journals and major museum collections. All records on which the previous status review (Kirby 1992) was based were digitized from recording cards and used in this review.

7. The assessments

7.1 The data table

The key outcome of this Review is the generation of a table which lists all of the taxa covered. The full table has been produced as a spreadsheet which accompanies this text. Appendix 1 provides an extract of the key data. The columns completed in the accompanying Excel table are as follows:

Species name

BRC number (identification code)

NBN taxon number (identification code)

Presence in:

- England
- Scotland
- Wales

Area of occupancy

Total number of hectads occupied for period up to and including 1989

Total number of hectads occupied from period from 1990-2012

Total number of tetrads occupied from 1990-2012 (only for species with an IUCN threat status)

Total number of dual hectads (those in which the species has been recorded in both date classes)

Proposed GB IUCN status

Qualifying criteria

Proposed Amber List species

Rationale

Current global IUCN status

Suggested GB Rarity status

Status in Shirt (1987)

Status in Kirby (1992)

Larval habitat key habitat / microhabitat

Adult habitat key habitat / microhabitat

Ecological account

Popular synonyms

7.2 Date classes

This review uses 1990 as the **point of measurement** between old and recent date classes to assess decline as this was judged to be the date most applicable to the data concerned. It was judged that the adoption of a later date would have resulted in far too many species being found to have fewer than 100 hectads in the modern time period. This would obviously have seriously undermined the value of the assessments made. The use of this date has the consequence that Criterion B2b – continuing decline – has to rely heavily on estimation, inference and projection. For some criteria, the IUCN assess declines based on data from the last ten years, or three generations. Very few species have been comprehensively surveyed in the past ten years (or even over three generations). The reviewer has needed therefore to assess whether reductions in the Area of Occupancy represent significant decline or lack of data. This will vary considerably between taxonomic groups and for different species within

taxonomic groups depending on survey effort. Use of B2b for any taxon therefore demands justification by an explanation of confidence in the rate of decline.

Habitat decline values can be used as a proxy for population declines for species that are strongly associated with specific habitat types. However, it should be acknowledged that quantitative data on a species' habitats are also rarely available, and that the reviewer needs to work with very imperfect data.

Extinct is a difficult concept to apply to most invertebrates and an arbitrary cut-off has to be applied. Species not recorded in Britain since 1900 are typically assumed to now be extinct and have been recorded as Regionally Extinct (RE). In the case of species that, if they were present, should have been picked up by routine monitoring, this cut-off has been applied if a species has not been recorded since 1950. Species not recorded since 1950 but known to be especially difficult to find on demand have been tagged as Possibly (Regionally) Extinct (IUCN 2011). This was developed to identify those Critically Endangered species that are likely to be Extinct, but for which confirmation is still required.

8. Format of the species accounts

8.1 Information on the species accounts

Species accounts have been prepared for each of the CR, EN, VU and NT species. Previous reviews have also included species accounts for Nationally Rare and Nationally Scarce taxa.

Information on each species is given in a standard form. The data sheets are designed to be largely self-contained in order to enable site managers to compile species-related information on site files; this accounts for some repetition between the species accounts. This section provides context for seven items of information on each of the data sheets.

8.2 The species name

Nomenclature is intended to be as up to date as possible and is based on Aukema & Rieger (1995–2006).

8.3 Identification

The identification of the British shieldbugs and allies is usually quite straightforward and with a little experience it is possible to identify most adults with relative certainty in the field. Almost all members of the group were assigned to the two lowest levels of identification difficulty during the creation of verification rulesets for the NBN Record Cleaner software. However, in some cases microscopic examination may be necessary to confirm ambiguous specimens.

It is also possible to identify many nymphal stages to species level by taking into account their appearance, the host plant or habitat with which they are associated and the time of year. Final instar nymphs are particularly well-known.

Since Southwood & Leston (1959), there have been a number of publications focusing solely on the identification and ecology of the British shieldbugs and alllies (Hawkins, 2003; Nau, 2004; Evans & Edmondson, 2005). References for the identification of recently arrived species not covered by these works are given in 15.1.

8.4 Distribution

Records held in the database of the Shieldbugs and allied species Recording Scheme form the basis for determining the distribution of each species. As previously described, these were supplemented by information on NBN Gateway, although records which required further checking were omitted if they could not be verified

8.5 Habitat and ecology

Like all members of the Hemiptera, the shieldbugs and allies are hemimetabolous insects which undergo incomplete metamorphosis. As such, their larval stages are better referred to as ‘nymphs’ which resemble small, wingless versions of the adults. Almost all have five nymphal instars between egg and adult and their ecology is usually very similar or identical to that of the adult. This is in direct contrast to many other insect orders, for example Coleoptera, Diptera and Lepidoptera.

All British species are univoltine, although it is possible that some undergo a partial second generation in particularly hot summers. Usually around 6 weeks are required to complete the life cycle from egg to adult. Given the great sensitivity of these insects to temperature, it is possible that some species may become more regularly bivoltine in the future, particularly in southern Britain.

Most species overwinter as adults, although three species pass the winter as eggs (*Myrmus miriformis*, *Chorosoma schillingii* and *Picromerus bidens*) and three as nymphs (*Odonotoscelis fuliginosa*, *Odontoscelis lineola* and *Pentatoma rufipes*).

The eggs of shieldbugs are laid in batches, often on the food plant in the case of phytophagous species. Most are spherical or elongate in shape, but some pentatomids produce barrel-shaped eggs with a ring of micropylar processes around the rim. Several species exhibit parental care by brooding the eggs and first instar nymphs. This is particularly well-documented for *Elasmucha grisea*, the so-called 'Parent Bug', but is also reported for *Tritomegas bicolor* (Southwood & Leston, 1959).

Most shieldbugs and allies are phytophagous, feeding on grasses, herbaceous hosts or woody shrubs and trees, although a few species such as *Pentatoma rufipes* may be partly predatory or scavenge on dead invertebrates. All parts of a given host plant may be exploited for feeding, although unripe fruits are particularly favoured. Many species are polyphagous, feeding on a variety of plant species, while some are largely confined to host plants in a single family, for example *Eurydema oleracea* (Brassicaceae) and *Syromastus rhombeus* (Caryophyllaceae). The Stenocephalidae are commonly known as Spurge bugs and both British representatives are associated with species of *Euphorbia*. A few shieldbugs appear to be entirely monophagous in Britain and some of these have highly specialised ecological requirements. For example, *Canthophorus impressus* is associated solely with large stands of Bastard Toadflax *Thesium humifusum,* itself an uncommon indicator of high quality chalk grassland. The closely related *Adomerus biguttatus* feeds on Common Cow-wheat *Melampyrum pratense* growing in woodland rides and coppices and has strong ecological parallels with the Heath Fritillary *Melitaea athalia*.

A few species have widened their host plant range in recent years and in some cases this has facilitated dramatic population expansions. *Gonocerus acuteangulatus* and *Cyphostethus tristriatus* have both shifted onto alternative foodplants and are now much more widespread than they were historically (Kirby & Stewart, 2010). *Corizus hyoscyami* is the latest species to follow this pattern and is now present in a variety of habitats outside its former stronghold in south-west Britain, feeding on numerous species of Asteraceae.

Species of Pentatomidae in the subfamily Asopinae are obligate predators of other insects. Two of these specialize on chrysomelid beetles; *Rhacognathus punctatus* feeding mainly on the larvae of *Lochmaea suturalis* and *Zicrona caerulea* predating the larvae of *Altica* species. *Picromerus bidens* usually feeds on the larvae of sawflies and certain Lepidoptera, while *Troilus luridus* is more of a generalist and has been recorded feeding on a range of invertebrates.

Some of the species found in the herb layer are predominantly ground-dwelling and rarely ascend the vegetation. These include the smaller members of the Coreidae, the pentatomids *Podops inuncta* and *Sciocoris cursitans* and our only thyreocorid, *Thyreocoris scarabaeoides*. All the Cydnidae are strongly terrestrial and frequently burrow below the ground surface, as do two species of Scutelleridae in the genus *Odontoscelis.* Early successional habitats with extensive areas of bare or sparsely-vegetated ground are often essential for the continued presence of these species.

A number of uncommon parasites are associated with the shieldbugs and allies, in particular several species of Tachinidae. The pentatomids *Sciocoris cursitans* and *Aelia acuminata* are specific hosts of *Gymnosoma nitens* and *Cistogaster globosa* respectively, while *Subclytia rotundiventris* is a parasitoid of the Acanthosomatidae.

8.6 Status

Status is largely based on range size and both short and long term trends, but association of a species with particular habitats under threat is also taken into account. Counts of hectads known to be occupied since 1990 were used to establish whether or not a species might be considered scarce. The IUCN guidelines (see Section 3 and Appendix 2) were then used to decide whether such species might also be considered under threat, and to assign a category. Detailed survey data are extremely rare but have been used where available. Also, the large increase in recording effort increases the probability that apparent declines are real, rather than artefacts of under-recording or failure to re-visit known sites.

Only species which have been assessed as Critically Endangered, Endangered, Vulnerable or Near Threatened are provided with species accounts. The status of other species is summarised in Appendix 1.

The IUCN criteria are not rigid about the need for real data, but allow for expert opinion on some evidence – 'estimated, inferred, projected or suspected' are acceptable reasons. It should also be noted that some species currently known from fewer than one hundred hectads have been excluded from Nationally Scarce (Great Britain rarity status) on this basis. It is appreciated that some species of shieldbugs and allies are not yet recorded from more than one hundred hectads but are expected to be found to occur in more than one hundred when their distribution is better known. For example, *Rhacognathus punctatus* is known from 71 hectads since 1990 but has a very wide distribution in Britain, including upland areas, where recording effort is at its lowest. Where studies have been undertaken there are no indications of any decline in those areas, and under-recording is therefore presumed to be the cause for the low number of hectads. It appears reasonable to estimate its actual distribution is in excess of 100 hectads.

8.7 Threats

As a group the shieldbugs and allies have generally prospered in recent years. Many species have expanded their ranges and the British fauna has witnessed a number of new additions. However, despite this mainly positive picture, some species with highly specialized ecological requirements have declined. Loss of suitable habitat is undoubtedly the most immediate threat to populations of these species. In many cases this is the result of changes in management which have adverse effects on habitat quality.

Species dependent on early-successional habitats, such as heathlands and grasslands, are particularly vulnerable to the cessation of grazing by livestock, leading to invasion by coarse grasses and scrub. In many such habitats, grazing by rabbits is also particularly important, creating localized disturbances which allow the maintenance of open field conditions and the persistence of various pioneer plant species. *Canthophorus impressus* is at particular risk from changes in grazing pressure on chalk downland sites, since its host plant *Thesium humifusum* will not tolerate the loss of warm, open conditions.

Several shieldbugs are associated with the ground flora of deciduous woods, in particular *Adomerus biguttatus* and *Eurydema dominulus*. The widespread abandonment of traditional woodland management practices such as coppicing and ride creation have probably posed the greatest threat to these species in recent years.

Many post-industrial or brownfield sites are now recognized as highly significant for invertebrates and 'open mosaic habitats on previously developed land' have recently been classified as a UK BAP

priority habitat (Maddock, 2008). These sites are often characterized by a large component of bare ground, creating warm microclimates suitable for ground-dwelling shieldbugs and frequently supporting a suite of uncommon species such as *Sciocoris cursitans*, *Bathysolen nubilus* and *Ceraleptus lividus*. Unfortunately, such habitats are subject to heavy pressures, being extremely susceptible to redevelopment. Even when retained they are frequently modified for recreational use or subject to planting and reseeding schemes, usually with consequent loss of invertebrate interest.

8.8 Published sources

Literature references that refer to the previous conservation status of the species in Britain, or that have contributed information to the Data Sheet, are cited here.

9. Acknowledgements

A number of people provided invaluable comments on draft versions of the review spreadsheet, Pete Kirby, Jim Flanagan, Alex Ramsay, Mike Howe, Bill Dolling, Jon Webb and those members of the Inter-Agency Working Group (IAWG) whose comments were anonymised or combined.

Much of this review is based on records supplied to the Shieldbugs and allies Recording Scheme. It is not possible to list every individual that has contributed to the recording scheme. Special thanks must be made to Roger Hawkins, Pete Boardman and Peter Harvey, who provided county datasets.

It is also important to acknowledge the support of many organisations, in particular Natural England and Natural Resources Wales. This work was funded by Natural England.

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Tristan Bantock

101 Crouch Hill

London

N8 9RD

10. Species listed by IUCN status category

In this list the species are given in taxonomic order within status categories.

Regionally Extinct

Pentatomidae	*Carpocoris mediterraneus atlanticus*
Pentatomidae	*Jalla dumosa*
Scutelleridae	*Eurygaster maura*

Critically Endangered (Possibly Extinct)

Acanthosomatidae	*Elasmucha ferrugata*
Pentatomidae	*Chlorochroa juniperina*

Critically Endangered

Coreidae	*Arenocoris waltlii*
Cydnidae	*Geotomus punctulatus*

Endangered

Pentatomidae	*Eurydema dominulus*
Pentatomidae	*Eysarcoris aeneus*

Vulnerable

Scutelleridae	*Odontoscelis fuliginosa*

11. Species listed by GB Rarity Status category

In this list the species are given in taxonomic order within status categories.

Nationally Rare

Coreidae	*Arenocoris waltlii*
Cydnidae	*Geotomus punctulatus*
Pentatomidae	*Eurydema dominulus*
	Eysarcoris aeneus
	Peribalus strictus
Scutelleridae	*Odontoscelis fuliginosa*

Nationally Scarce

Alydidae	*Alydus calcaratus*
Coreidae	*Arenocoris fallenii*
	Bathysolen nubilus
	Ceraleptus lividus
	Enoplops scapha
	Spathocera dalmanii
Cydnidae	*Adomerus biguttatus*
	Canthophorus impressus
	Legnotus picipes
Pentatomidae	*Sciocoris cursitans*
Rhopalidae	*Liorhyssus hyalinus*
	Rhopalus maculatus
	Rhopalus parumpunctatus
Scutelleridae	*Eurygaster maura*
	Odontoscelis lineola
Stenocephalidae	*Dicranocephalus agilis*
	Dicranocephalus medius
Thyreocoridae	*Thyreocoris scarabaeoides*

12. Amber listed species

Scientific name	AoO (hectads) <1990	AoO (hectads) 1990-2012	GB rarity status	Rationale
Rhopalus maculatus	39	18	NS	Evidence of a contraction in range; modern records are mostly from southern England on the heaths of Surrey, Hampshire and Dorset. Principally found in bogs and wet flushes on heathland, feeding on *Potentilla* sp, particularly *P. palustris*. Other host plants include *Cirsium palustre*.
Adomerus biguttatus	53	18	NS	Historically widespread and regarded as common in parts of southern England during the 19th century, but has since undergone a serious decline which has continued until the present day. Now apparently absent from many sites in the south-east, formerly a stronghold for the species. A woodland species, associated with *Melampyrum pratense* growing in coppices and rides; plants growing in shade are unsuitable. The species has probably suffered greatly from the decline in traditional woodland management practices.

13. Criteria used for assigning species to threatened categories

(see Appendix 2 for criteria and categories)

Scientific name	**Status**	**Criteria used**
Elasmucha ferrugata	CR(PE)	C1, C2a(i), D
Arenocoris waltlii	CR	B2a, bii, biii, biv
Geotomus punctulatus	CR	B2a, bii, biv
Chlorochroa juniperina	CR(PE)	C1, C2a(i), D
Eurydema dominulus	EN	B2a bii biv
Eysarcoris aeneus	EN	B2a bii biv
Odontoscelis fuliginosa	VU	B2a bii biv

14. Taxonomic list of Threatened and Nationally Scarce Species

Scientific name	Shirt (1987)	Kirby, 1992	This review (GB Rarity status)	This review (IUCN status)
Acanthosomatidae				
Elasmucha ferrugata	Appendix	Extinct		CR(PE)
Alydidae				
Alydus calcaratus			NS	LC
Coreidae				
Arenocoris fallenii			NS	LC
Arenocoris waltlii	RDB2	RDB2	NR	CR
Bathysolen nubilus		Nb	NS	LC
Ceraleptus lividus			NS	LC
Enoplops scapha			NS	LC
Gonocerus acuteangulatus	RDB1	RDB1		LC
Spathocera dalmanii		Na	NR	LC
Cydnidae				
Adomerus biguttatus		Nb	NS	LC
Canthophorus impressus		Nb	NS	LC
Geotomus punctulatus	RDB1	RDB1	NR	CR
Legnotus picipes		Nb	NS	LC
Pentatomidae				
Chlorochroa juniperina	Appendix	Extinct		CR(PE)
Jalla dumosa		Extinct		RE
Carpocoris mediterraneus				RE
Eurydema dominulus		Na	NR	EN
Eysarcoris aeneus	RDB2	RDB3	NR	EN
Peribalus strictus		RDB3	NR	LC
Sciocoris cursitans		Nb	NS	LC
Pyrrhocoridae				
Pyrrhocoris apterus	RDB1	RDB1	NR	LC
Rhopalidae				
Liorhyssus hyalinus		RDBK	NS	LC

Scientific name	Shirt (1987)	Kirby, 1992	This review (GB Rarity status)	This review (IUCN status)
Rhopalus maculatus		Nb	NS	LC
Rhopalus parumpunctatus			NS	LC
Rhopalus rufus		RDB3	NR	LC
Stictopleurus abutilon	Appendix	Extinct		NA
Stictopleurus punctatonervosus	Appendix	Extinct		NA
Scutelleridae				
Eurygaster austriaca	RDB1	Extinct		RE
Eurygaster maura		Nb	NS	LC
Odontoscelis fuliginosa		RDB3	NR	VU
Odontoscelis lineola		Nb	NS	LC
Stenocephalidae				
Dicranocephalus agilis		Nb	NS	LC
Dicranocephalus medius		Nb	NS	LC
Thyreocoridae				
Thyreocoris scarabaeoides			NS	LC

15. Downgraded species

Several species which were considered Red Data Book taxa in earlier reviews (Shirt, 1987; Kirby, 1992) do not qualify for an IUCN threat status in the current assessment. These are listed below in Table 6.

Table 6. Previous RDB species not qualifying for an IUCN status

Scientific name	Status in Kirby (1992)	IUCN status	GB rarity status	Rationale
Gonocerus acuteangulatus	RDB1	LC		Historically confined to just one site, Box Hill in Surrey, where it was associated solely with *Buxus sempervirens*. Since 1990, this species has undergone an unprecedented range expansion to occupy 111 hectads and is now widespread in southern England, facilitated by a shift onto alternative foodplants including hawthorn and a range of other rosaceous shrubs.
Pyrrhocoris apterus	RDB1	LC	NR	A large population has been present on the Ore Stone rock, Devon since the 19th century and is probably still extant. There are also historic records from Wales, Dorset, Yorkshire, Cheshire and Suffolk, but these locations no longer support populations and may never have done so. Since 1980 the species has formed several new colonies in Surrey and Bedfordshire, which are probably the result of horticultural introductions and two further colonies have been reported from coastal sites in Sussex and Kent, the origin of which is less clear. There are several reports from inland locations which refer to isolated imports. All colonies are fairly localised and since macropterous individuals have never been observed in Britain, the insect must have poor powers of dispersal here.
Peribalus strictus	RDB3	LC	NR	All historic records probably relate to migrants other than those from Kent and Sussex, where the bug seems to have been established at several sites. All records after the 1950s are from the south coast and suggest renewed attempts at colonisation; repeat records from the Boscombe area of Bournemouth suggest that the species is now established there.
Liorhyssus hyalinus	RDBK	LC	NS	Historically regarded as a rare vagrant to Britain, but has appeared much more frequently since the 1990s and become established in some areas, with a recent history of records from the coast of south Wales (Judd, 2011).
Rhopalus rufus	RDB3	LC	NR	Very similar to *R. parumpunctatus* and some old records may refer to this species; Welsh records are likely to be erroneous and have been discounted. No evident contraction in range. Largely confined to the heaths of Dorset, Hampshire and Surrey, with several modern records from the coasts of Suffolk and Norfolk.

There are several species that occur in 100 hectads or less, but which the author believes should not be listed as Nationally Scarce. The rationale for these exclusions is given in Table 7.

Table7. Species occurring in 100 hectads or less which are not considered Nationally Scarce

Scientific name	Number of post-1990 hectads	Rationale for exclusion
Syromastus rhombeus	66	Has undergone a marked inland range expansion in recent years; soon likely to be present in more than 100 hectads.
Sehirus luctuosus	79	Ground-dwelling and probably under-recorded. Likely to be present in more than 100 hectads.
Neottiglossa pusilla	79	Widespread but rarely found in high densities; probably under-recorded and likely to be present in more than 100 hectads.
Rhacognathus punctatus	71	Although localized, this is a very widespread species and probably under-recorded in northern and upland Britain.

15.1 Recent arrivals

The British Heteroptera fauna has undergone considerable change during the last two decades. More than 30 species have been added since 1990, of which 9 belong to the shieldbugs and allies. All of these are new arrivals, rather than overlooked resident species or the result of taxonomic revisions.

It is too simplistic to consider all these species as 'non-native'. Many are present on the adjacent continent and have been expanding their European ranges in recent years. Some of these are most likely to have arrived following natural dispersal, rather than via horticultural introduction, although it is often difficult to determine the exact pathways of arrival for any given species. An interesting case is afforded by the rhopalids *Stictopleurus punctatonervosus* and *S. abutilon*, which recently recolonised Britain during a series of hot summers, following an absence of almost a century. This subject area has been given a comprehensive treatment by Kirby *et al*. (2001) and Stewart & Kirby (2010). Recent changes to the British Heteroptera fauna are further summarised by Ryan (2012).

The Western Conifer Seed Bug, *Leptoglossus occidentalis* is surely the most spectacular species to appear in recent years. This large and unmistakeable coreid is native to North America and associated with various species of Pinaceae. First reported in Europe from Italy in 1999, following accidental introduction, the species spread remarkably fast and reached northern Europe by 2007. Colonisation of Britain was largely achieved via unassisted dispersal across the English Channel, first observed during the autumn of 2008, when large numbers of adults reached the south coast of England (Malumphy *et al.*, 2008) and since repeated annually. Four years on, the species has been found in 187 hectads and now seems well-established in England and Wales. This unprecedented spread is all the more remarkable since the vast majority of records originate from interested members of the public rather than entomologists. The species is most frequently encountered in synanthropic settings owing to its propensity to enter buildings in search of hibernation sites.

Under the IUCN Guidelines these species have been assigned to the category 'Not Applicable' and are listed in Table 8. Although most occur in less than 100 hectads, none should be considered Nationally Scarce as they have not yet fully consolidated their ranges.

Table 8. Taxa listed as 'Not Applicable'

Species	Number of post-1990 hectads	Rationale for exclusion
Leptoglossus occidentalis	187	First recorded in Britain in 2007. Has rapidly colonised much of England and Wales from 2008 onwards (Bantock & Stewart, 2011). Likely to extend its range into Scotland.
Tritomegas sexmaculatus	4	First recorded in Kent in 2011 (Bantock, 2011). Arrival too recent for conservation status to be assessed, but likely to expand its range.
Carpocoris purpureipennis	2	First recorded in Gloucestershire in 1995 (Barclay & Nau, 2001). A vagrant from the continent which has probably never bred in Britain.
Eurydema ornata	7	First recorded in 1997 in Dorset (Slade *et al*. 2005) and locally established along the southern coast of England. Arrival too recent for conservation status to be assessed.
Nezara viridula	29	First recorded in 2003 in London (Barclay, 2004) and most records since are from the London area. Has been arriving in imported vegetable produce for many years. Arrival too recent for conservation status to be assessed.
Rhaphigaster nebulosa	4	First recorded in 2010 in London (Bantock *et al*. 2011). Arrival too recent for conservation status to be assessed.
Brachycarenus tigrinus	5	First recorded in 2003 in the London area (Jones, 2004). Arrival too recent for conservation status to be assessed.
Stictopleurus abutilon	59	Recorded at four localities during the 19th century but then not until 1992, when the species recolonised Britain. Has since spread widely as far north as Yorkshire, and is still undergoing range expansion.
Stictopleurus punctatonervosus	88	Recorded at two localities during the 19th century but then not until 1997, when the species recolonised Britain. Has since spread widely as far north as Yorkshire, and is still undergoing range expansion.

16. The data sheets

Data sheets for all species qualifying as Regionally Extinct, Critically Endangered, Endangered, Vulnerable or Near Threatened are given in this section. The data sheets are given in alphabetical order by scientific name within each family (which are also arranged alphabetically).

ELASMUCHA FERRUGATA

CRITICALLY ENDANGERED (POSSIBLY EXTINCT) C2a(i), D

Order HEMIPTERA

Family ACANTHOSOMATIDAE

Elasmucha ferrugata (Fabricius, 1787)

Identification: Keyed by Southwood & Leston (1959) and Hawkins (2003).

Distribution: A widespread species on the continent, but a great rarity in Britain with just five historic records of single specimens from widely-scattered locations: Bradford (1889), Bangor (1899; Sharp, 1900), Derby (1903). Glossop (1950) and an undated specimen from Leeds market (Kirby, 1992; Dolling & Flanagan, 2011).

Habitat and ecology: Associated with berry-bearing Rosaceous and Ericaceous shrubs in Europe, including hawthorn *Crataegus*, blackberry *Rubus fruticosus*, raspberry *Rubus idaeus*, dog rose *Rosa canina* and bilberry *Vaccinium myrtillus*. Hostplants are unclear for all the British captures except the record from Derby, which was found on cultivated raspberries. The Bangor specimen was swept from low vegetation in a wooded valley and may have been associated with bilberry. On the continent adults overwinter; in Britain they have been found in June and July.

Status: The records present a confusing picture of its status in Britain. The Glossop example was found in a kitchen and appears to be synanthropic in origin, as do the records from Derby and Leeds. If it were not for the Bangor specimen, which was undoubtedly collected in a natural habitat far from human habitation, it might be tempting to suggest that the species is a horticultural introduction which failed to become established, rather than a very rare native. However, the pattern of records does not really suggest an imported origin, and neither does the absence of records after 1950, given that the importation of plants and landscaping materials is now much more frequent than it was historically. Kirby (1992) considered the species extinct, while conceding that large areas of potentially suitable habitat exist in upland Britain and that the possibility of undiscovered populations could not be ruled out. This species is considered 'Possibly Extinct' as it has not been seen since 1950 and would qualify as CR(PE) C2a(i), D on the basis that it is likely to have populations of less than 50 mature individuals and have declined over the stated period.

Threats: None known.

Management and Conservation: If the species does reappear in Britain, efforts should be made to locate a colony and determine the species' ecological requirements.

Published sources: Dolling & Flanagan (2011), Hawkins (2003), Howe (2004), Kirby (1992), Sharp (1900), Southwood & Leston (1959)

ARENOCORIS WALTLII

CRITICALLY ENDANGERED B2a, bii, biii, biv

Breckland Leatherbug

Order HEMIPTERA

Family COREIDAE

Arenocoris waltlii (Herrich-Schäffer, 1834)

Identification: Very similar to the closely-related and much more widespread *A. fallenii*. In addition to the characters given by Southwood & Leston (1959), *A. waltlii* lacks the two converging rows of pale tubercles on the pronotum, as stressed by Hawkins (2003). The nymphs of both species are probably not separable.

Distribution: Widely distributed in Europe, but historically always very rare and range-restricted in Britain. Most confirmed records are from the Breckland area of Suffolk and Norfolk, although the locality of the first British capture was given by Thouless (1902) as West Walton, Norfolk, on the edge of the fens. Before 2011, *A. waltlii* was last recorded in 1964 from Tuddenham, Suffolk (Evans & Edmondson, 2005) and the species was considered extinct or extremely rare by Kirby (1992). Two records from Deal, Kent are not traceable and must be considered erroneous. In 2011 the species was discovered in the Brecks at Ramparts Field SSSI, Icklingham, Suffolk and also at a brownfield site in March, Cambridgeshire, not far from West Walton (Bantock & Stewart, 2012).

Habitat and ecology: There seem to be no discernible ecological differences between A. *waltlii* and *A. fallenii*. Both are strongly ground-dwelling species favouring warm and sparsely-vegetated sandy areas with extensive growth of Common Storksbill *Erodium cicutarium*, probably the only host plant in Britain.. However, *A. waltlii* is generally found at much lower densities, with most recent records referring to single specimens amongst much larger numbers of *A. fallenii*. There is probably a single generation each year. Adults overwinter and have been found in all months between May and September.

Status: Has declined from six hectads before 1990 to two hectads in the period 1990-2012 (B2bii, iii, iv), although the habitat at Ramparts Field is no longer suitable and recent searches for the bug have proved negative. On this basis the species qualifies as Critically Endangered, occurring in one hectad which corresponds to a single tetrad. The species therefore has an AoO of less than 10km^2 and is present at a single location (B2a).

Threats: Cessation or reduction of rabbit grazing is probably the greatest threat to the early successional habitats favoured by *Arenocoris* species. Open breck and brownfield habitats are at risk from development, agricultural improvement and afforestation.

Management and Conservation: Rabbit grazing is the most effective means of maintaining favourable habitat condition for this species and rabbits should be encouraged as far as possible on all sites. Such small scale disturbance is essential to create areas of bare, loose sand suitable for colonisation by *Erodium* and inhibit the growth of tall grasses. Periodic mechanical disturbance by rotovation or scarification may be useful a management strategy in the absence of rabbits, or in cases where rabbit grazing pressure has become insufficient. The site in Cambridgeshire is under active management to retain open field conditions.

Published sources: Bantock & Stewart (2012), Evans & Edmondson (2005), Kirby (1992), Hawkins (2003), Southwood & Leston (1959), Thouless (1902)

GEOTOMUS PUNCTULATUS

CRITICALLY ENDANGERED B2a, bii, biv

Cornish Shieldbug

Order HEMIPTERA

Family CYDNIDAE

Geotomus punctulatus (Costa, 1847)

Identification: Keyed by Southwood & Leston (1959) and Hawkins (2003).

Distribution: A southern European species on the northern edge of its range in Britain, where it is confined to the Sennen Cove and Whitesand Bay area of Cornwall. The species was discovered there in 1864 and has been recorded regularly until the present day (Alexander, 2008). In 1999 and 2000, a large number of suitable sand dune sites in Cornwall and on the Isles of Scilly were searched for the species without success (P. Kirby, *pers. comm.*) The only other British record is from Cowbridge, Glamorgan in the late nineteenth century (Saunders, 1892).

Habitat and ecology: A strongly ground-dwelling and burrowing species, like most members of the Cydnidae. Inhabits sand dunes and appears to live in small colonies, which are found in sparsely-vegetated areas with a short sward and loose surface sand. Nymphs have been found by grubbing beneath *Galium verum*, which has been suggested many times as a probable host plant (Kirby, 1992, Alexander, 2008). There is a single generation each year. Adults overwinter and have been found in all months between May and September.

Status: The species qualifies as Critically Endangered on the basis of occurring in two tetrads and having an AoO of less than 10km^2 (B2), presence at a single site (B2a) and a decline from two hectads before 1990 to one in the period 1990-2012 (bii, biv). However, the population at Sennen Cove remains strong and is clearly resilient given its long history. The bug has been recorded in considerable numbers on some occasions (Alexander, 2008).

Threats: Whitesand Bay is subject to considerable recreational use and the associated trampling pressure has lead to erosion of the fore-dunes in the past. However, this is unlikely to pose a major threat to *G. punctulatus*, which occurs further inland and prefers more stabilised sand (Kirby, 1992).

Management and Conservation: The bug is listed by the Joint Committee for the Conservation of British Insects as a species to be collected with restraint. The sand dunes at Whitesand Bay should be monitored regularly to avoid further erosion.

Published sources: Alexander (2008), Hawkins (2003), Howe (2004), Kirby (1992), Saunders (1892), Southwood & Leston (1959)

CARPOCORIS MEDITERRANEUS ATLANTICUS

REGIONALLY EXTINCT

Order HEMIPTERA

Family PENTATOMIDAE

Carpocoris mediterraneus atlanticus Tamanini, 1958

Identification: Recently resurrected as a valid species by Lupoli *et al*. (2013), who provide a key to European *Carpocoris* species. However, treated as synonymous with *Carpocoris fuscispinus* (Boheman, 1851) by Ribes & Pagola-Carte (2013). The genus has been the subject of much taxonomic debate.

Distribution: The historic literature suggests this species may have been very locally established in south-west Britain during the late 19th century (Alex Ramsay, *pers. comm*.), in which case it should be regarded as a British native. A single undated specimen from Devon is present in the British Collection of the Natural History Museum, London.

Habitat and ecology: Unknown in Britain. On the continent the species is markedly polyphagous on a wide range of herbaceous plants.

Status: Not recorded since the 19th century and presumed extinct. The species was not considered by Kirby (1992).

Threats: None known.

Management and Conservation: Not applicable.

Published sources: Lupoli *et al*. (2013), Ribes & Pagola-Carte (2013)

CHLOROCHROA JUNIPERINA

CRITICALLY ENDANGERED (POSSIBLY EXTINCT) C2a(i), D

Order HEMIPTERA

Family PENTATOMIDAE

Chlorochroa juniperina (Linnaeus, 1758)

Identification: Keyed by Southwood & Leston (1959), Hawkins (2003) and Ribes & Pagola-Carte (2013).

Distribution: There are confirmed historic records from Surrey, Kent, Lancashire and Derbyshire. The species is widespread in Europe and Asia.

Habitat and ecology: All British specimens were associated with Common Juniper *Juniperus communis* and most records are from chalk downland in southern England. The bug has occasionally been found on other plants on the continent (Ribes & Pagola-Carte, 2013). Adults overwinter and there is a single generation each year.

Status: Not recorded in Britain for nearly 90 years and considered extinct by Kirby (1992). In southern England *C. juniperina* was known from Surrey and Kent and was collected in numbers at one site in Surrey during the 1870s on at least one occasion (Scott, 1873). There are few other records and it is difficult to assess its status further north, although it seems to have been extremely scarce. The last published record was for Derbyshire in 1902, from a site with no juniper and the last British specimen was collected in 1925 in Lancashire. Butler (1923) considered the species to be exceedingly scarce and almost entirely confined to Surrey. This species is considered 'Possibly Extinct' as it has not been seen for decades and would qualify as CR(PE) , C2a(i), D on the basis that it is likely to have populations of less than 50 mature individuals and have declined at a rate of 25% in three years.

Threats: Juniper has been lost from many chalk downland sites in southern England, largely due to scrub invasion following the abandonment of grazing. However, the disappearance of *C. juniperina* took place when its host was still relatively common and is difficult to explain. Climatic factors seem unlikely to have driven its decline, given that Britain lies within the northern limit of the species' range in Europe and the bug is widespread in Scandinavia.

Conservation and management: The species seems unlikely to be re-found in Britain. Remaining stands of juniper in southern England are very scattered and have been well-worked for insects. Northern England and Scotland were considered more likely locations for an overlooked population (Kirby, 1992), but recent searches have been unsuccessful, despite uncovering populations of several other juniper-feeding heteroptera species (Eales, 2001; Hawkins, 2013).

Published sources: Eales (2001), Hawkins (2003), Hawkins (2013), Kirby (1992), Ribes & Pagola-Carte (2013), Scott (1873), Southwood & Leston (1959).

EURYDEMA DOMINULUS

ENDANGERED B2a, bii, biv

Scarlet Shieldbug

Order HEMIPTERA

Family PENTATOMIDAE

Eurydema dominulus (Scopoli, 1763)

Identification: A distinctive red and black species, although similar to the recent arrival *Eurydema ornata* which is established at a few sites along the coast of southern England. Keyed by Southwood & Leston (1959), Hawkins (2003) and Derjanschi & Péricart (2005).

Distribution: Widespread in Europe but strongly southern in Britain, with all recent records from a small area of Kent and Sussex. Historically the species was evidently much more widespread, although still very scattered and rare, with records from Surrey, Hampshire, Devon, Northamptonshire, Norfolk, Middlesex and Glamorgan (Kirby, 1992). A recent record published for Dorset (Cross, 2000) is erroneous and refers to *E. ornata* (Nau, 2006).

Habitat and ecology: Primarily a woodland species in Britain, most frequently associated with Lady's smock *Cardamine pratensis* growing in damp rides and clearings. Most recent Kent records are from woods where *C. pratensis* has appeared in response to coppicing. On the continent it has been found on a range of other Brassicaceae including *Arabis hirsuta, Sinapis arvensis, Brassica campestris* and *Descurainia sophia*, although plants from other families are also recorded as hosts, including members of the Apiaceae and Lamiaceae, in particular *Mentha* species (Derjanschi & Péricart, 2005). Interestingly, there are historic records of adults and nymphs from both umbellifers and Water mint *Mentha aquatica* in Britain (Butler, 1923). There is a single generation each year; adults overwinter and have been recorded between April and October.

Status: There have been only eight records of this conspicuous shieldbug since 1990, suggesting that it is genuinely very sporadic and rare. The species qualifies as Endangered on the basis of an AoO of less than 500km^2 (B2) presence at five locations (B2a) and a decline from 19 hectads before 1990 to four in the period 1990-2012 (bii, biv).

Threats: The widespread abandonment of traditional woodland management practices such as coppicing and ride creation have probably posed the greatest threat to this species in recent years. Drainage of wet pastures may also have reduced habitat availability at non-wooded sites.

Management and Conservation: Known sites and suitable areas of nearby habitat in Kent and Sussex should be managed appropriately to retain and encourage stands of *C. pratensis*. This should include the maintenance of broad and open woodland rides and possibly the reintroduction of coppicing in cases where the coppice cycle has been abandoned and the canopy closed over.

Published sources: Hawkins (2003), Kirby (1992), Nau (2006), Southwood & Leston (1959)

EYSARCORIS AENEUS

ENDANGERED B2a, bii, biv

New Forest Shieldbug

Order HEMIPTERA

Family PENTATOMIDAE

Eysarcoris aeneus (Scopoli, 1763)

Identification: Keyed by Southwood & Leston (1959), Hawkins (2003) and Derjanschi & Péricart (2005).

Distribution: Widely distributed in Europe, north Africa and Asia. A very range-restricted species in Britain, with all recent records from the New Forest area of Hampshire and the Parkhurst Forest and Ningwood Common area of the Isle of Wight. Historically the bug seems to have been much more widespread and old records exist for Cornwall, Kent, Suffolk, Sussex, Surrey, Bedfordshire and Ceredigion (Kirby, 1992).

Habitat and ecology: Seems to occur in small colonies which can be extremely localised. Most British records are from damp heathland, but the bug has also been recorded from damp grassland, as well as woodland rides and clearings. Slender St John's Wort *Hypericum pulchrum* is the sole confirmed host plant in Britain, but the species has been found in its absence and must surely be polyphagous. Butler (1923) lists *Leonurus*, *Marrubium*, *Trifolium*, *Fragaria* and *Rosa canina* as associated plants in Britain and numerous species of Lamiaceae are cited as hosts on the continent (Derjanschi & Péricart, 2005). There is a single generation each year. Adults overwinter and have been found in all months between May and September.

Status: The species qualifies as Endangered on the basis of its AoO of less than 500km^2 presence at four locations (B2a) and a decline from 12 hectads before 1990 to four in the period 1990-2012 (bii, biv).

Threats: The small and discrete nature of colonies mean they are at high risk of local extinction through habitat loss or changes in habitat condition. In the New Forest, the intensity of grazing by ponies may be an important factor since both overgrazing and undergrazing could potentially affect the cover of *H. pulchrum* and other herbaceous hosts. At Parkhurst Forest and Ningwood Common, the loss of ground flora to scrub incursion and canopy closure is the most likely threat to populations of the bug.

Management and Conservation: Most of the New Forest National Park is a SSSI and SPA. Parkhurst Forest is a SSSI. Woodland rides and clearings should be kept broad and open to maintain a diverse ground flora. Ride side vegetation and road verges should not be cut during the summer, to avoid the species' breeding season. Areas of damp heathland should be kept in suitable condition by light to moderate grazing.

Published sources: Hawkins (2003), Derjanschi & Péricart (2005). Kirby (1992), Southwood & Leston (1959)

JALLA DUMOSA

REGIONALLY EXTINCT

Order HEMIPTERA

Family PENTATOMIDAE

Jalla dumosa (Linnaeus, 1758)

Identification: Keyed by Péricart (2010). The species is mentioned by Southwood & Leston (1959) and by Hawkins (2003).

Distribution: Widely distributed but uncommon in Europe. Recorded only once in Britain from the Sandwich Bay and Deal area of Kent in the late 19th century.

Habitat and ecology: A strongly ground-dwelling species, associated with warm, sparsely-vegetated habitats. Like other members of the Asopinae, both adults and nymphs are entirely predatory. The British records are from sand dunes; one specimen was reportedly beaten from sea buckthorn *Hippophae rhamnoides* (Kirby, 1992).

Status: Very few British specimens are known and all were taken within a narrow period in the late 19th century. However, the material in the British Collection of the Natural History Museum, London includes a nymph, indicating that it successfully bred here even if its presence was only transitory. The species was considered presumed extinct by Kirby (1992). Sandwich Bay and similar habitats on the coast of southern England are well-worked for heteroptera and the chances of an overlooked colony would seem remote.

Threats: None known.

Management and Conservation: Not applicable. The species is an unlikely candidate to reappear in Britain as it has declined in parts of its range, although was recently rediscovered in the Netherlands following an absence of 45 years (Aukema & Kiewiet, 2014).

Published sources: Aukema & Kiewiet (2014), Hawkins (2003), Kirby (1992), Southwood & Leston (1959), Péricart (2010).

EURYGASTER AUSTRIACA

REGIONALLY EXTINCT

Order HEMIPTERA

Family SCUTELLERIDAE

Eurygaster austriaca (Schrank, 1776)

Identification: Keyed by Southwood & Leston (1959) and Hawkins (2003).

Distribution: Widely distributed in Europe. Recorded only from the Sandwich Bay & Deal, Margate and Folkestone areas of Kent during the 19th century.

Habitat and ecology: Polyphagous on grasses and usually found in tall grasslands on the continent; frequently associated with cereal fields. In Britain all records are from sparsely-vegetated sand dunes, probably reflecting the warm microclimate required by a species on the northern edge of its range. Adults overwinter and there is single generation each year.

Status: Always a great rarity, but may have been well-established where it occurred. All British specimens were taken between 1850 and 1885. The species was considered presumed extinct by Kirby (1992). Sandwich Bay and similar habitats on the coast of southern England are well-worked for heteroptera and the chances of an overlooked population would seem remote.

Threats: None known. Probably limited by climatic factors in Britain, which are the most likely explanation for its extinction.

Management and Conservation: Not applicable. The species is probably an unlikely candidate to reappear in Britain, as it has declined in parts of its range and has not been seen in Holland for over 50 years (Aukema, 2004).

Published sources: Aukema (2004), Hawkins (2003), Kirby (1992), Southwood & Leston (1959).

ODONTOSCELIS FULIGINOSA

VULNERABLE B2a, bii, biv

Greater-streaked Shieldbug

Order HEMIPTERA

Family SCUTELLERIDAE

Odontoscelis fuliginosa (Linnaeus, 1761)

Identification: Keyed by Southwood & Leston (1959) and Hawkins (2003).

Distribution: Widely distributed in Europe, North Africa and Asia. In Britain all recent records are from two strongholds where the species has a long history; the Sandwich Bay and Deal area of Kent and sand dune systems on the south coast of Pembrokeshire. The bug seems to have disappeared from many historic sites, such as the coasts of Cornwall, Cheshire, Norfolk, Suffolk and the Isle of Wight. (Kirby, 1992). However, interpretation of range contraction is confounded by confusion with the similar *O. lineola*; records from the breckland areas of East Anglia are considered to refer to this species on the basis of a mis-identified specimen of *O. lineola* standing in Liverpool Museum.

Habitat and ecology: A strongly ground-dwelling and burrowing species which inhabits open or semi-fixed sand dunes. The bug lives in small, discrete colonies in bare or very sparsely-vegetated areas and all life stages are associated with Common Storksbill *Erodium cicutarium*, probably the only host plant. In Kent, the species frequently co-occurs with *O. lineola*, which shares a similar ecology. In Pembrokeshire, adults and nymphs have also been found under *Melilotus* species and Common Bird's-foot-trefoil *Lotus corniculatus* (Howe, 2004; Judd, 2004), although these associations may well be purely incidental. There is a single generation each year. The species overwinters as third or fourth instar nymphs and adults have been found in all months between June and September.

Status: The species qualifies as Vulnerable on the basis of its AoO of less than 2000km^2 (B2), presence at fewer than 10 locations (B2a) (although present in 11 hectads, two constitute a single site at Sandwich Bay) and a decline from 17 hectads before 1990 to seven in the period 1990-2012 (bii, biv).

Threats: Coastal developments are a major threat to this species and have reduced available habitat at some sites and possibly destroyed entire colonies at others. At Sandwich Bay, the species has survived extensive conversion of dune habitat to golf courses and the population is largely confined to a narrow zone of low-eroded sandhills behind the beach. Populations in Wales are at risk from the increasing stability of many dune systems and their recent tendency to become less mobile. In south Pembrokeshire, several dune systems which support populations of *O. fuliginosa* have lost large areas of bare sand since the 1950s, in particular Broomhill & Kilpaison Burrows and Brownslade & Linney Burrows (Howe *et al*. 2012).

Management and Conservation: Small scale disturbance in the form of rabbit grazing and digging is essential to maintain open conditions suitable for *Erodium* and rabbits should be encouraged on all sites as far as possible. Some sites in Pembrokeshire may be suitable for large scale dune rejuvenation work to increase the extent of early successional habitats, which would benefit a whole suite of invertebrate species including *O. fuliginosa* (Howe *et al*. 2012).

Published sources: Hawkins (2003), Howe (2004), Howe *et al*. (2012), Judd (2004), Kirby (1992), Southwood & Leston (195

17. References

Alexander, K. N. A. (2008) The Land and Freshwater bugs (Hemiptera) of Cornwall and the Isles of Scilly, Occasional Publication No 2, CISFBR & ERCCIS.

Aukema,, B. (1989) Annotated checklist of Hemiptera-Heteroptera of the Netherlands. Tijdschrift voor Entomologie 132: 1-104.

Aukema,, B. (2004) Recent changes in the Dutch Heteroptera. Het News (2),3: 2-5.Aukema, B. & Rieger, C. (1995–2006) (Eds.) Catalogue of the Heteroptera of the PalaearcticRegion, 5 volumes, Netherlands Entomological Society, Amsterdam.

Aukema,, B. & T. Kieweit (2014) De wants *Jalla dumosa* na 45 jaar weer in Nederland waargenomen (Heteroptera: Pentatomidae). Nederlande Faunistiche Mededelingen 43: 9-15.

Bantock, T. M. (2011) *Tritomegas sexmaculatus* (Cydnidae) arrives in Britain. Het News 17/18: 4–5.

Bantock, T. M., Notton, D. & Barclay, M. V. L. 2011. *Rhaphigaster nebulosa* (Pentatomidae: Pentatomini) arrives in Britain. Het News 17/18: 5.

Bantock, T. M. & A. J. Stewart (2011) Hemiptera Report. British Wildlife 22,4: 286-288.

Bantock, T. M. & A. J. Stewart (2012) Hemiptera Report. British Wildlife 23, 4: 277-279.

Barclay, M. V. L. & Nau, B. S. (2001) A recent record of *Carpocoris purpureipennis* (De Geer) (Hem., Pentatomidae) from the West of England. Entomologist's Monthly Magazine 137: 72.

Barclay, M. V. L. (2004) The Green Vegetable Bug *Nezara viridula* (L., 1758) (Hem.: Pentatomidae) new to Britain. Entomologists' Record and Journal of Variation 116: 55–58.

Boardman, P. (2014) A provisional atlas of the shieldbugs and allies of Shropshire. Field Studies Council.

Butler, E. A. (1923) A Biology of the British Hemiptera-Heteroptera. London, Witherby.

Cross, I. C. (2000) *Eurydema dominulus* Scopoli Hem., Pentatomidae new to Dorset. Entomologist's Monthly Magazine 136: 52.

Derjanschi, V. & Péricart, J. (2005) Hemiptères Pentatomoidea euro-méditerranéens. Vol. 1. Généralités. Systématique: Première Partie Paris: Éditions Faune de France 90.

Dolling, W. R. & J. Flanagan (2011) Historic records of *Elasmucha ferrugata* in Yorkshire. Het News (2), 17:20.

Eales, H. T. (2001). The occurrence of the Juniper Shieldbug *Elasmostethus tristriatus* (Fabr.) (Het: Acanthosomatidae) in Northumberland and Co. Durham. Entomologists' Record and Journal of Variation. 113: 13-16.

Evans, M. & R. Edmondson (2005) A photographic guide to the shieldbugs and squashbugs of the British isles. WGUK.

Hawkins, R. D. (2003) Shieldbugs of Surrey. Surrey Wildlife Trust.

Hawkins, R. D. (2013) *Zygimus nigriceps* still in Speyside. Het News (2), 19/20: 9

Hewitt, S. (2006) Cumbrian Shieldbugs, Tullie House Museum, Carlisle

Howe. M. A. (2004) A provisional checklist of the invertebrates recorded in Wales. 4. True bugs (Hemiptera: Heteroptera). Countryside Council for Wales.

Howe, M. A., Litt. E. & K. Pye (2012) Rejuvenating Welsh dunes. British Wildlife 24, 2:85-94.

Jones, R. A. 2004. *Brachycarenus tigrinus* (Schilling) (Hemiptera: Rhopalidae) new to Britain. British Journal of Entomology and Natural History 17: 137–141.

Judd, S. (2004). The current status and distribution of true bugs (Hemiptera: Heteroptera) associated with bare and partially-vegetated ground on the dunes of Castlemartin peninsula, Pembrokeshire, with particular reference to the Red Data Book shieldbug *Odontoscelis fuliginosa* and seedbug *Pionosomus varius*. CCW West Region Report No. 59, Countryside Council for Wales.

Judd, S. (2011). The scent-less plant bug *Liorhyssus hyalinus* (Hemiptera: Rhopalidae) - regular migrant or established British species. British Journal of Entomology and Natural History 24: 227–234.

Kirby, P. (1992) A Review of the Scarce and Threatened Hemiptera of Great Britain. UK Nature Conservation, number 2. Joint Nature Conservation Committee.

Kirby, P., Stewart, A. J. A. & M. R. Wilson (2001). True bugs, leaf- and planthoppers, and their allies. In: D. Hawksworth The Changing Wildlife of Great Britain and Ireland. London: Taylor & Francis. 262-299.

Lupoli, R., Dusoulier, F., Cruaud, A., Cros-Arteil, S. & J.C. Streito (2013) Morphological, biogeographical and molecular evidence of *Carpocoris mediterraneus* as a valid species (Hemiptera: Pentatomidae). Zootaxa 3609,4: 392–410.

Maddock, A. (ed.) (2008) UK Biodiversity Action Plan Priority Habitat Descriptions: Open Mosaic Habitat on Previously Developed Land. Biodiversity Information and Recording Group (Updated July 2010). Joint Nature Conservancy Committee, Peterborough

Malumphy, C., Botting, J., Bantock, T. & Reid, S. (2008) Influx of *Leptoglossus occidentalis* Heidemann (Coreidae) in England. Het News 12: 7–9

Nau, B.S. (2002) *Canthophorus dubius* (Scopoli) (Hem., Cydnidae) in Britain are *C. impressus* Horváth. Entomologist's Monthly Magazine, 138: 148

Nau, B. S. (2004) Shieldbugs of the British Isles. Field Studies Council.

Nau. B. S. (2006) Literature relating to British Heteroptera. Het News (2), 8:16-20

Péricart, J. (2010) Hemiptères Pentatomoidea euro-méditerranéens. Vol. 3. Systématique: Trosième Partie Sous-Familles Podopinae et Asopinae: Éditions Faune de France 93.

Ribes, J. & S. Pagola-Carte (2013) Pentatomoidea euro-méditerranéens. Vol. 2. Systématique: Deuxième Partie Sous-Familles Pentatominae (suite et fin): Éditions Faune de France 96.

Ryan, R. (2012). An addendum to Southwood & Leston's Land and Water Bugs of the British Isles. British Journal of Entomology & Natural History 25: 205-215.

Saunders, E. (1892). Hemiptera Heteroptera of the British Islands. London.

Scott, J. (1873) Note on the capture of *Pentatoma juniperina*. Entomologist's Monthly Magazine 9:292.

Sharp, W. E. (1900). *Elasmostethus ferrugatus*, Fab., in Wales. Entomologist's Monthly Magazine 36: 131.

Shirt, D.B. (ed.) (1987). British Red Data Books: 2. Insects. NCC, Peterborough.

Slade, D., Collins, A. R. & Nau, B. S. 2005. *Eurydema ornatum* (L.) (Hem.: Pentatomidae) established on the Dorset coast and a key to European *Eurydema* species. Entomologists' Record and Journal of Variation 117: 221–227.

Southwood, T.R.E. & Leston, D. (1959) Land & Water Bugs of the British Isles, Frederick Warne & Co. Ltd.

Stewart, A. J. A. & Kirby, P. (2010) Chapter 28: Hemiptera. In Silent Summer: The State of Wildlife in Britain and Ireland, ed. Norman McLean. Cambridge University Press 2010.

Thouless, H. J. (1902) *Pseudophloeus waltlii*, H.-S., a species new to the British Fauna. Entomologist's Monthly Magazine, 38: 80.

Appendix 1: A complete listing of all species reviewed

Species	GB IUCN status	Qualifying criteria	Rationale	GB Rarity status	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2012	Dual hectads
Elasmucha ferrugata	CR(PE)		Four British records from Caernarvonshire, Derbyshire and Yorkshire between 1899 and 1950, all of single adults.		E		W	4	0	0
Acanthosoma haemorrhoidale	LC		Widespread throughout Britain. Continued range expansion into Scotland during the last two decades.		E	S	W	140	523	127
Cyphostethus tristriatus	LC		Widespread throughout Britain. Range expansion during last two decades as a result of host-switching from *Juniperus* onto cultivated *Cupressus.*		E	S	W	30	181	27
Elasmostethus interstinctus	LC		Widespread throughout Britain.		E	S	W	154	469	139
Elasmucha grisea	LC		Widespread throughout Britain.		E	S	W	133	370	120
Alydus calcaratus	LC		A distinctive species which is unlikely to be significantly under-recorded. Probably present in <100 hectads.	NS	E		W	39	52	25
Arenocoris fallenii	LC		Despite signs of recent inland range expansion, still rather localised and mainly coastal.	NS	E		W	22	26	9

Arenocoris waltlii	CR	B2a, bii, biii, biv	Historically very rare and mainly restricted to the breckland area of Suffolk and Norfolk. Not recorded between 1964 and 2010, but since discovered in 2011 in Cambridgeshire and West Suffolk.	NR	E			6	2	2
Bathysolen nubilus	LC		Historically very rare but has expanded its range in the south-east and east anglia. Strongly terrestrial and unobtrusive; likely to be significantly under-recorded.	NS	E			15	22	5
Ceraleptus lividus	LC		Despite recent northerly range expansion, still unikely to be present in >100 hectads.	NS	E			18	49	9
Coreus marginatus	LC		Widespread in England and Wales; expanding northwards.		E		W	35	386	33
Coriomeris denticulatus	LC		Widespread in England and Wales.		E		W	42	208	37
Enoplops scapha	LC		Rather localised on southern and western coasts; probably not present in >100 hectads	NS	E		W	34	44	16
Gonocerus acuteangulatus	LC		Historically confined to a single site at Box Hill, Surrey. Now widespread in south-eastern and central England following rapid range expansion from 1998 onwards.		E			1	111	1
Leptoglossus occidentalis	NA		A recent arrival from the continent, first recorded in 2007 on the south coast of England. Now present in much of England and Wales and has reached Scotland. A large and spectacular species native to North America.		E	S	W	0	187	0
Spathocera dalmanii	LC		Scarce, but undergoing range expansion; now found as far north as Norfolk.	NS	E			17	26	14

Syromastus rhombeus	LC		Historically a mainly coastal species; recent northerly and inland range expansion. Likely to be present in >100 hectads.		E		W	30	66	20
Adomerus biguttatus	LC		Historically widespread and regarded as common in parts of southern England during the 19th century, but has undergone a serious decline. Now absent from many sites in the south-east, formerly a stronghold for the species.	NS	E		W	53	18	8
Canthophorus impressus			Historically known from many chalk downland sites in southern England, but has undergone a decline in the eastern half of its range, with no recent records from Surrey, Kent, West Sussex or East Anglia.	NS	E			40	21	11
Geotomus punctulatus		B2a, bii. biv	Recently known only from a single site in Cornwall (Whitesand Bay, Sennen Cove). Although the population seems stable, the site is subject to heavy recreational use.	NR	E		(Extinct)	2	1	1
Legnotus limbosus			Widespread in England and Wales.		E		W	30	114	16
Legnotus picipes	LC		Always a very localised species. Chiefly southern and eastern, although known from a single site in Cornwall and south Wales. There is evidence of a recent decline, particuarly at inland sites and in the south-east, but like *L. limbosus*, this species is small, ground-dwelling and and easily overlooked.	NS	E		W	32	17	5
Sehirus luctuosus	LC		Strongly ground-dwelling and easily overlooked. Likely to be present in >100 hectads		E		(Extinct)	29	79	20
Tritomegas bicolor	LC		Widespread in England and Wales.		E		W	84	225	76
Tritomegas sexmaculatus	NA		Recent arrival from the continent, first recorded 2011 in Kent.		E			0	4	0

Chlorochroa juniperina	CR(PE)		Confirmed records from Surrey, Lancashire and Derbyshire, most recently in 1925.		E			6	0	0
Jalla dumosa	RE		Former native species or transitory vagrant; established as a breeding species at Sandwich Bay during the 19th Century.		E			1	0	0
Aelia acuminata	LC		Widespread in England and Wales. Recent northerly range expansion.		E		W	43	252	42
Carpocoris mediterraneus atlanticus	RE		Possible established in south-west Britain during the late 19th century on the basis of old museum specimens.		E			1	0	0
Carpocoris purpureipennis	NA		Vagrant from the continent, probably never established in Britain.		E			0	2	0
Dolycoris baccarum	LC		Widespread in England and Wales, mainly coastal in Scotland. Recent northerly range expansion.		E	S	W	83	488	82
Eurydema dominulus	EN	B2a, bii, biv	Historically widespread but very scattered and always rare, with a stronghold in Kent and Sussex. A marked recent decline is evident, with just eight records from four hectads during the last 20 years. A conspicuous red and black species which is unlikely to be under-recorded.	NR	E		(Extinct)	19	4	2
Eurydema oleracea	LC		Widespread in southern and central England; recent northerly range expansion.		E			11	160	9
Eurydema ornata	NA		Recent arrival from the continent, recorded from several coastal sites in Dorset, Hampshire and Sussex.		E			0	7	0
Eysarcoris aeneus	EN	B2a, bii, biv	Historically widespread but very scattered and always rare. All recent records are from the New Forest and Isle of Wight, which has always been a stronghold for the species.	NR	E		(Extinct)	12	4	3

Eysarcoris venustissimus	LC		Widespread in England and Wales; expanding northwards.		E		W	49	298	48
Neottiglossa pusilla	LC		Widespread in England and Wales; likely to be present in >100 hectads.		E		W	38	79	22
Nezara viridula	NA		Recent arrival from the continent, first recorded 2003 in the London area.		E			0	29	0
Palomena prasina	LC		Historically largely southern and coastal; marked inland and northerly range expansion during the last two decades.		E		W	86	650	85
Pentatoma rufipes	LC		Widespread throughout Britain.		E	S	W	160	642	144
Peribalus strictus	LC		All historic records probably relate to migrants other than those from Kent and Sussex, where the bug seems to have been established at several sites. All records after the 1950s are from the south coast and suggest renewed attempts at colonisation; repeat records from Bournemouth suggest the species is now established there.	NR	E			10	5	0
Picromerus bidens	LC		Widespread throughout Britain.		E	S	W	91	255	72
Piezodorus lituratus	LC		Widespread throughout Britain.		E	S	W	99	411	86
Podops inuncta	LC		Widespread in England and Wales.		E		W	59	142	44
Rhacognathus punctatus	LC		Widespread throughout Britain, but very local. Probably present in >100 hectads.		E	S	W	52	71	34
Rhaphigaster nebulosa	NA		Recent arrival from the continent, first recorded 2010 in the London area.		E			0	4	0
Sciocoris cursitans	LC		Widespread in south-east England but strongly ground-dwelling and easily overlooked.	NS	E			21	28	19
Troilus luridus	LC		Widespread throughout Britain, recent range expansion in Scotland.		E	S	W	62	284	50
Zicrona caerulea	LC		Widespread throughout Britain.		E	S	W	114	222	82

Pyrrhocoris apterus	LC		A large and well-established population has been present on the Ore Stone rock, Devon since the 19th century and is probably still extant. There are historic records from Wales, Dorset, Yorkshire, Cheshire and Suffolk, but these locations no longer support populations and may never have done so. Since 1980 the species has formed several new colonies in Surrey, Bedfordshire, Sussex and Kent, which are probably the result of horticultural introductions.	NR	E		(Extinct)	9	6	0
Brachycarenus tigrinus	NA		Recent arrival from the continent, first recorded 2003 in the London area. Recorded also from Surrey and Oxfordshire.		E			0	9	0
Chorosoma schillingii	LC		Historically a coastal species; continued northerly and inland range expansion. Likely to be present in >100 hectads.		E		W	57	89	52
Corizus hyoscyami	LC		Historically confined to southern and western coasts; significant range expansion inland and northwards during the last decade.		E		W	36	265	30
Liorhyssus hyalinus	LC		Historically regarded as a rare vagrant to Britain, but has appeared much more frequently since the 1990s and become established in some areas, with a recent history of records from the coast of south Wales. (Judd, 20--)	NS	E		W	6	55	2
Myrmus miriformis	LC		Widespread in England and Wales.		E		W	70	150	55
Rhopalus maculatus	LC		Evidence of a contraction in range; modern records are mostly from southern England on the heaths of Surrey, Hampshire and Dorset.	NS	E		(Extinct)	39	18	9

Rhopalus parumpunctatus	LC		Rather localised; probably not present in >100 hectads	NS	E		W	17	56	10
Rhopalus rufus	LC		Very similar to *R. parumpunctatus*; some old records may refer to this species. No evident contraction in range. Largely confined to the heaths of Dorset, Hampshire and Surrey.	NR	E			15	14	5
Rhopalus subrufus	LC		Widespread in England and Wales.		E		W	49	230	43
Stictopleurus abutilon	LC		Recorded at four localities during the 19th century but then not until 1992, when the species recolonised Britain. Has since spread widely as far north as Yorkshire, and is still undergoing range expansion. Likely to be present in >100 hectads		E			4	59	0
Stictopleurus punctatonervosus	LC		Recorded at two localities during the 19th century but then not until 1997, when the species recolonised Britain. Has since spread widely as far north as Yorkshire, and is still undergoing range expansion. Likely to be present in >100 hectads		E			2	88	0
Eurygaster austriaca	RE		Established on the Kent coast during the 19th century but not recorded since 1885.		E			3	0	0
Eurygaster maura	LC		No evidence of range contraction, although picture complicated by confusion with the very similar *E. testudinaria*. Confirmed records from Kent, Surrey, Hampshire and Essex	NS	E			22	23	13
Eurygaster testudinaria	LC		Widespread in England and parts of Wales; recent northerly range expansion		E		W	30	170	27

Odontoscelis fuliginosa	VU		Seems to have disappeared from many historic sites, such as the coasts of Cornwall, Hampshire (Isle of Wight), Norfolk and Suffolk. All modern records are from two strongholds; the Sandwich Bay/Deal area of Kent and sand dune systems on the south coast of Pembrokeshire.	NR	E		W	17	7	4
Odontoscelis lineola	LC		No evidence of a decline, although remains very localised.	NS	E			17	21	12
Dicranocephalus agilis	LC		No evidence of a decline, although remains very localised on southern and western coasts.	NS	E		W	37	33	16
Dicranocephalus medius	LC		Suggestion of a decline, particularly in south-east England, but also some indication of a northwards range expansion during the last two decades. Remains a very localised species.	NS	E			33	23	6
Thyreocoris scarabaeoides	LC		Although a small and strongly ground-dwelling species, probably not present in >100 hectads	NS	E		W	49	49	20

Appendix 2: IUCN Criteria and Categories

Summary of the five criteria (A–E) used to evaluate if a taxon belongs in a threatened category (Critically Endangered, Endangered or Vulnerable)

	Critically Endangered	Endangered	Vulnerable
A. Population reduction			
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3 & A4	≥ 80%	≥ 50%	≥ 30%

A1. Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible **AND** understood **AND** have ceased, based on and specifying any of the following:

(a) direct observation

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality

(d) actual or potential levels of exploitation

(e) effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

A2. Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under A1.

A3. Population reduction projected or suspected to be met in the future (up to a maximum of 100 years) based on (b) to (e) under A1.

A4. An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a maximum of 100 years in future), and where the causes of reduction may not have ceased **OR** may not be understood **OR** may not be reversible, based on (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) AND/OR B2 (area of occupancy)			
B1. Extent of occurrence (EOO)	< 100 km²	< 5,000 km²	< 20,000 km²
B2. Area of occupancy (AOO)	< 10 km²	< 500 km²	< 2,000 km²

AND at least 2 of the following:

(a) Severely fragmented, **OR**

Number of locations	= 1	≤ 5	≤ 10

(b) Continuing decline observed, estimated, inferred or projected in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** area, extent and/or quality of habitat; **(iv)** number of locations or subpopulations; **(v)** number of mature individuals.

(c) Extreme fluctuations in any of: **(i)** extent of occurrence; **(ii)** area of occupancy; **(iii)** number of locations or subpopulations; **(iv)** number of mature individuals.

C. Small population size and decline			
Number of mature individuals	< 250	< 2,500	< 10,000
AND at least one of C1 or C2:			
C1. An observed, estimated or projected continuing decline of at least (up to a maximum of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
(up to a max. of 100 years in future)			
C2. An observed, estimated, inferred or projected continuing decline **AND** at least 1 of the following 3 conditions:			
(a i) Number of mature individuals in each subpopulation:	≤ 50	≤ 250	≤ 1,000
or			
(a ii) % of mature individuals in one subpopulation =	90–100%	95–100%	100%
(b) Extreme fluctuations in the number of mature individuals.			

D. Very small or restricted population			
Either:			
Number of mature individuals	< 50	< 250	**D1.** < 1,000
D2. *Only applies to the VU category*. Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time.			**D2.** typically: AOO < 20 km² or number of locations ≤ 5
E. Quantitative Analysis			
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Species index