Natural England Commissioned Report NECR316

A review of the status of the beetles of Great Britain

The Silphidae (Carrion Beetles)

Species Status No. 40

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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

Decisions about the priority to be attached to the conservation of species should be based upon objective assessments of the degree of threat to species. The internationally-recognised approach to undertaking this is by assigning species to one of the IUCN threat categories using the IUCN guidelines.

This report was commissioned to update the national threat status of beetles within the Silphidae. It covers all species in this group, identifying those that are rare and/or under threat as well as those which are non-threatened and non-native. Reviews for other invertebrate groups will follow.

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Natural England Project Manager – Allan Drewitt allan.drewitt@naturalengland.org.uk

Author – Steve A. Lane

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Further information
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1.1 The Species Status project

The Species Status project provides up-to-date assessments of the status and extinction risk faced by individual species using the internationally accepted Red List criteria and guidelines developed by the International Union for Conservation of Nature (IUCN) Standards and Petitions Subcommittee, 2017; (IUCN, 2012a; 2012b). It is the successor to the Joint Nature Conservation Committee's (JNCC) Species Status Assessment project () which ended in 2008.

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. All publications will explain the rationale for the assessments made. The approved threat and rarity statuses will be entered into the JNCC spreadsheet of species conservation designations (). This publication is one in a series of reviews to be produced under the auspices of the new project.

This Review adopts the procedures recommended for the regional application of the IUCN threat assessment guidelines (IUCN 2012b). Section 3 and Appendix 1 provide further details. This is a three-step process, the first identifying the taxa to be assessed, the second identifying those threatened in the region of interest using information only on the status of the taxa in that region (IUCN 2012a) and the third amending the initial assessment where necessary to take into account interaction with populations of the taxon in neighbouring regions (IUCN Standards and Petitions Subcommittee, 2017).

In addition, but as a separate exercise, the Great Britain Rarity System, used for assessing rarity and based solely on distribution, is used here alongside the IUCN system.

2 Introduction to the Beetle reviews

Many beetles are important ecological indicators (much more refined than most plants) due to their dependency on complex factors such as vegetation structure, microclimate and substrate. They are also found in a much wider range of habitats than some of the more popular groups of insects such as butterflies, dragonflies and bumblebees. Monitoring their status and abundance can provide a very useful indication of ecological 'health', in a way that monitoring plants, birds, bats or other insect groups, for example, may not.

Table 1 summarises the 21 taxa included in this Review. Nomenclature follows Duff (2018) which supersedes Duff (2012). Data has been collated from the following data sources.

- historic records published in local and national journals;
- published county reviews;

- voucher specimens in local and national museums;
- records arising from the activity of the biological recording community. The community is represented by amateur and professional recorders who have donated their data to the Biological Records Centres including the NBN, and also directly to the author of this Review.

It is important to note that whilst the process of data collection has been intensive, it has not been exhaustive.

Table 1. List of selected taxa

Order	Family	Taxon
Coleoptera	**Silphidae**	*Ablattaria laevigata* (Fabricius, 1775) *Aclypea opaca* (Linnaeus, 1758) *Aclypea undata* (Müller, O.F., 1776) *Dendroxena quadrimaculata* (Scolopi, 1771) *Necrodes littoralis* (Linnaeus, 1758) *Nicrophorus germanicus* (Linnaeus, 1758) *Nicrophorus humator* (Gleditsch, 1767) *Nicrophorus interruptus* Stephens 1830 *Nicrophorus investigator* Zetterstedt, 1824 *Nicrophorus vespillo* (Linnaeus, 1758) *Nicrophorus vespilloides* Herbst 1783 *Nicrophorus vestigator* Herschel, 1807 *Oiceoptoma thoracicum* (Linnaeus, 1758) *Phosphuga atrata* (Linnaeus, 1758) *Silpha carinata* Herbst, 1783 *Silpha obscura* Linnaeus, 1758 *Silpha tristis* Illiger, 1798 *Silpha tyrolensis* Laicharting, 1781 *Thanatophilus dispar* (Herbst, 1793) *Thanatophilus rugosus* (Linnaeus, 1758) *Thanatophilus sinuatus* (Fabricius, 1775)

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 to cover whole Ireland reviews. The Channel Islands and the Isle of Man are not included.

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

3.1 Summary of the 2001 Threat Categories

It is necessary to have a good understanding of the rationale behind red listing and the definitions used in the red listing process. This is because these definitions may differ from

standard ecological definitions e.g. “populations” or have very specific meanings e.g. “inferred”. Details regarding methods and terminology are contained in the Guidelines for Using the IUCN Red List Categories and Criteria (IUCN 2017) whilst a concise summary is provided by IUCN Red List Categories and Criteria: Version 3.1 (IUCN 2012a). The procedure for assessing taxa at a regional level differs from that at a global level and is summarised in the Guidelines for Application of IUCN Red List Criteria at Regional and National Levels IUCN (IUCN 2012b).

A brief outline of the revised IUCN criteria and their application is given below. The definitions of the categories are given in Table 2 and the hierarchical relationship of the categories in Figure 1.

Table 2. Definitions of IUCN threat categories (from IUCN 2012b with a more specific definition for regional extinction).

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 Appendix 2).
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 Appendix 2).
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 Appendix 2).
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.
NOT APPLICABLE (NA) Taxa deemed to be ineligible for assessment at a regional level because they are not wild populations or not within their natural range in the region, or non-natives (whether this is the result of accidental or deliberate importation), or because they are vagrants. A taxon may also be NA because it occurs at very low numbers in the region (i.e. when the regional Red List authority has decided to use a "filter" to exclude taxa before the assessment procedure) or the taxon may be classified at a lower taxonomic level (e.g. below the level of species or subspecies) than considered eligible by the regional Red List authority.

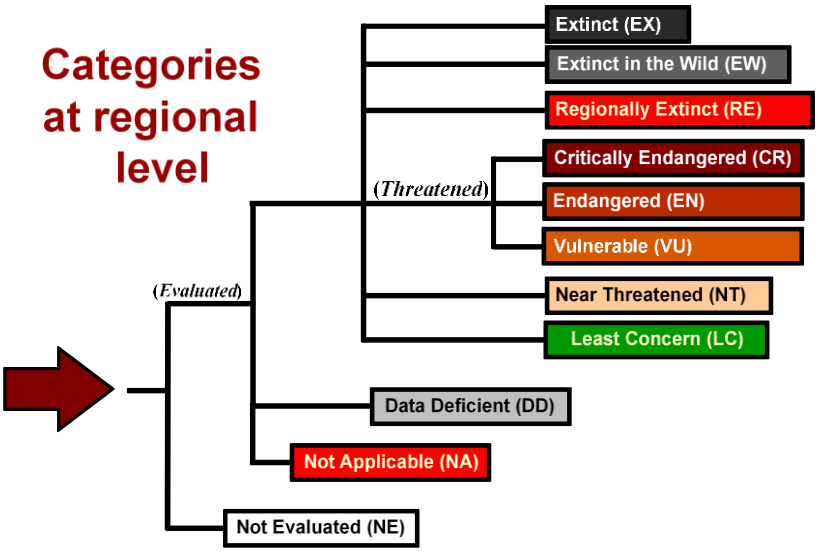

Figure 1. Hierarchical relationships of the categories adapted from IUCN (2001)

Taxa listed as *Critically Endangered*, *Endangered* or *Vulnerable* are defined as Threatened taxa. For each of these threat categories there is a set of five main criteria A-E, that indicate different reasons for the threat of extinction, 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. A taxon therefore need not meet all of the criteria A-E, but an attempt should be made to test information for each species against each of the five criteria. The taxon should then be listed against the highest threat category for one or more of the five criteria. The qualifying thresholds within the criteria A-E are detailed in Appendix 2: IUCN Criteria and Categories.

Status evaluation procedure relies on an objective assessment of the available evidence. Understanding data uncertainty and data quality is essential when applying the criteria. However, it is not always possible to have detailed and relevant data for every taxon. For this reason, the Red List Criteria are designed to incorporate the use of inference and projection, to allow taxa to be assessed in the absence of complete data. Although the criteria are quantitative in nature, the absence of high-quality data should not deter attempts at applying the criteria. In addition to the quality and completeness of the data (or lack of), there may be uncertainty in the data itself, which needs to be considered in a Red List assessment (data uncertainty is discussed in section 3.2; IUCN 2017). The IUCN criteria use the terms Observed, Estimated, Projected, Inferred, and Suspected to refer to the quality of the information for specific criteria and the specific IUCN red list definitions of these terms was used (see section 3.2; IUCN 2017).

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.

3.1.1 The use of the Not Applicable category

A taxon may be Not Applicable (NA) when it occurs in a region but is not included in the regional assessment because it a vagrant or an immigrant occurring in very insignificant numbers or for a very brief period of time.

3.1.2 The use of the Near Threatened category

The IUCN guidelines recognise a *Near Threatened* category to identify taxa that need to be kept under review to ensure that they do not further decline to become Threatened. This category would be best considered for those taxa that come close to qualifying as VU; i.e. meeting many but not all of the criteria and sub-criteria and there is ongoing threat. 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.

3.1.3 The three-stage process in relation to developing a Red List

The IUCN regional guidelines (IUCN, 2012b) indicate taxa should be assessed using a three-stage approach. Populations in the region identified for review should firstly be assessed using the global guidelines. That status should then be reassigned a higher or a lower category if their status within the region is likely to be affected by emigration or immigration (IUCN, 2012b).

3.2 Application of the Guidelines to the Silphidae

3.2.1 Use of criteria in this Review

The IUCN process requires that each species is evaluated against all 5 criteria (criteria 'A - E').

Data concerning British invertebrates have been collected since the 19th century. Often there is only enough information to identify the median point in the overall number of records gathered and compare occupancy in the periods before and after the median. Sometimes the data are more numerous and can be grouped into multiple 10 year periods (e.g. 1985 – 1994 and so forth).

An attempt was made to assess all taxa against Criterion A but only in a minority of cases were the data deemed sufficient enough to generate a robust test statistic.

The Invertebrate Inter Agency Working Group has defined the following for the use of Criterion B which is commonly used in invertebrate reviews. Continuing decline has to be

demonstrated, and proven that it is not an artefact of under-recording. If decline is demonstrated then the reviewer needs to consider whether or not B2a, and B2c if the data are present, are met.

Criterion C could not be applied to any taxa in this Review because no population counts exist for the species other than random counts of individuals (e.g. in pitfall trap samples). No standardised or regular-frequency monitoring have been carried out on any of these taxa in Britain to the author's knowledge.

Criterion D was applied to taxa in this Review.

It was not possible to use Criterion E as the available data do not allow for determining the probability of extinction using population modelling.

3.2.2 Scale for calculating decline and area

The IUCN recommend a scale of 4km^2 (a tetrad) as the reference scale (IUCN, 2017). This needs to be applied with caution and there will be instances where a different scaling may be more applicable, or where attempting to apply any scale is extremely difficult. It should be noted that, historically, invertebrate datasets used hectads (10km square) as the default scale. Old records (e.g. pre 1950) have usually only been reported at this scale. This means that, for some taxa, estimates of decline can only be made at this scale. Hectads are also used to determine the Great Britain Rarity Status, so records which are only at this scale are less problematical. For rarer, more range-restricted, taxa the tetrad is applied where possible and is a significant scale for taxa which may occur on a few fragmented sites within the UK and/or which are often restricted to certain, well-defined habitat types that are easily identified. Tetrads have therefore been recorded for taxa that have been recorded in 15 or fewer hectads since 1990 or which appear to be significantly geographically localised in their distribution. Some of these taxa qualify as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Future reviews should make efforts to record all Nationally Rare and significantly geographically restricted taxa at a 1km^2 scale.

Rate of Decline is used in Criteria A, B & C to assess threat status. For Criterion A and C1 a decline threshold is related to a specific number of years. For Criterion A it is the last ten years or the period of three generations, whichever is longer, and for Criterion C1 precisely the longer of 3 years or 1 generation, or 5 years and 2 generations or 10 years and 3 generations (exceptionally up to 100 years for long-lived species such as *Margaritifera margaritifera*). Criterion A is usually dependent on a pattern of decline in population size over the last 10-year period (unless quality data exist to prove significant former decline or projected future decline). Where data are patchy, this decline can be calculated from an estimate over a non-contemporary time interval providing, significantly, that a decline can be demonstrated, be it exponential, linear or otherwise. Decline (particularly linear decline) is easy to establish for taxa that have been the subject of repeated and regular population counts, where constant monitoring protocols or controlled sampling procedures have been adopted. Examples might be transect butterfly counts, MV-light trapping of moth species over a

prolonged period at regular intervals at a specific location and regular bird count and nesting surveys. The Silphidae, without exception, have not been sampled with this degree of regularity or control and as a consequence, the data are often too few to establish a rate of decline. Criterion C1 likewise utilises population size decline measured over specific time intervals but places more emphasis on population counts referring throughout to the number of mature individuals.

Criterion B also relies on a pattern of continuing decline. The number of hectads (older data are often only given to hectad resolution and are therefore not suitable for use in determining AoO at tetrad level) is calculated for several pre-determined periods. The degree of accuracy/resolution with which the location is recorded is variable and often imprecise.

For any analysis, if a decline is apparent within the main recording period (i.e. between counts for the pre-1990 and post-1989 recording blocks), then reference to a later 'contemporary' time period division may be used to reinforce or weaken the suggestion of a 'continuing decline'. The quality of the data in the contemporary time period is invariably better than that in the earlier date class and may allow us to consider AoO (Area of Occupancy) to tetrad detail or better. In this latter date period, the number of locations is also calculated for taxa recorded from 15 or fewer hectads. The resulting figures are used for application of the spatial distribution Criteria under B.

For most invertebrate taxa, data are gathered by observation of presence in a particular location. The data are generated by field observation, the location and timing of which is at the whim of collectors of varying skills. However, it is usually possible to ascribe some degree of decline whether observed, or inferred (i.e. the balance of probability suggests that a decline is present). Using Criterion B, there is no specific requirement for the decline to be within the last 10-year period nor the requirement to meet any threshold. Continuous decline is assessed by the observation of a reduction in the AoO between the prescribed contemporary time periods. The number of contemporary locations is also a significant factor in the evaluation and is relatively straightforward to appreciate and is reliable. The author's and his peer group's professional and field knowledge and intuition of a species can play an integral part in the application of this criterion where the data are patchy.

Under Criterion B, the application of B1 (Extent of Occurrence) has also been carried out in the Review. For a taxon to qualify under Criterion B1, it must have a range that does not exceed 20,000 km² and then must satisfy two of the following criteria: severely fragmented OR occurring at 10 or fewer locations or either continuing decline or subject to extreme fluctuations. For all taxa in this Review, extreme fluctuations and fragmentation are factors of decline which cannot be inferred from the data, so to satisfy B1 reliance has to be upon the area of the range of the taxon being below the minimum threshold value, implication of continuing decline and modern locations numbering 10 or less. Thus for taxa which are known from 10 or fewer post-1989 locations, the approximate area of their range in km² (i.e. equivalent to IUCN ‘Minimum Convex Hull’) has been calculated using mapping tools and

then the same quantitative decline analysis applied as for Criterion B2. These individual analyses are detailed in the accompanying evaluation spreadsheet.

3.2.3 Taxa applicable to this Review

Taxa with wild populations inside their natural range and a long-term presence (at any time since 1500 AD) in Britain are considered for review. All other taxa are deemed to be ineligible for assessment at a regional level, e.g. non-natives, are placed in the category of **'Not Applicable (NA)'** and include perceived recent colonists (or attempted colonists) responding to the changing conditions available in Britain as a result of human activity and/or climate change, with the exception of those with established breeding populations for greater than ten consecutive years (IUCN 2012b).

3.2.4 Knowledge about immigration and emigration effects for this group

The author is not aware of any research on this subject within the Silphidae, both taxonomically and geographically (North Temperate region).

4 GB Rarity Status categories and criteria

At the national level, countries are permitted under the IUCN guidelines to refine the definitions for the non-threatened categories and to define additional ones of their own. The Nationally Rare and Nationally Scarce categories adopted by this Review are unique to Britain. Broadly speaking, the Nationally Rare category is equivalent to the Red Data Book categories used by Hyman (revised Parsons) (1992, 1994), namely: Endangered (RDB1), Vulnerable (RDB2), Rare (RDB3), Insufficiently Known (RDBK), Indeterminate (RDBI) and Extinct. The Nationally Scarce category is directly equivalent to the combined 'Notable', Nationally Notable A (Na) and Nationally Notable B (Nb) categories used in the assessment of various taxonomic groups by Hyman (revised Parsons) (1992, 1994).

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

Great Britain Rarity Status	
Nationally Rare	A species (not including introduced taxa) recorded from between 1- 15 hectads of the Ordnance Survey national grid in Great Britain since 1990 and: • There is reasonable confidence that exhaustive recording would not find them in more than 15 hectads. • Where it is believed to occur as a breeding species within each of these hectads (i.e. discount those that are known to contain only casual immigrants).

	• This category includes species that are possibly extinct, such as those in the CR(PE) category, but not those where there is confidence that they are regionally extinct (RE).
Nationally Scarce	A species (not including introduced taxa) recorded from between 16 - 100 hectads of the Ordnance Survey national grid in Great Britain since 1990 and: • There is reasonable confidence that exhaustive recording would not find them in more than 100 hectads. • Where it is believed to occur as a breeding species within each of these hectads (i.e. discount those that are known to contain only casual immigrants).

This national set of definitions is referred to as the GB Rarity Status within this document. Importantly, Nationally Rare and Nationally Scarce are not categories of threat.

5 The Assessments

5.1 The data table

The key output of this Review is a table which provides information on a list of attributes (below) for all taxa embraced by the review. **The full table has been produced as a stand-alone spreadsheet which accompanies this text**. Appendix 1 provides an extract of the key data. The columns completed in the full accompanying Excel table are as follows:

Species name
GB IUCN status (2017)
Qualifying criteria
Rationale
GB Rarity status (2017)
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 1990-2019
- Total number of dual hectads occupied by a species in both date classes
- Number of tetrads occupied 1990-2019, for species that qualify as at least NR (i.e. 15 or less hectads from 1990-2019)

Number of locations, for species that qualify as NR (i.e. 15 or less hectads from 1990-2019)
Total number of hectads occupied during fifteen year period 1990-2004
Total number of hectads occupied during fifteen year period 2005-2019
Total number of hectads occupied during ten year period 1990-1999
Total number of hectads occupied during ten year period 1999-2009
Total number of hectads occupied during ten year period 2010-2019
BRC concept code
NBN taxon number
Status in Shirt (1987)
Status in Hyman (1986)
Status in Hyman (revised Parsons) (1992)
Ecological account

5.2 Category columns introduced in this Review

5.2.1 Recent date ranges for hectad counts (columns denoting the two most recent 15-year periods and the three most recent 10-year periods).

The issue of 'continuing decline' is fundamental to the IUCN categorisation process. In common with many other taxa, declines in the size and/or range of several species in this group occurred historically (e.g. before 1950), before the period relevant to an IUCN assessment to the group. In order to determine whether any species in the current review is also undergoing 'continuing decline', evidence of current or recent decline was sought by examining change in hectad occupancy between more recent recording period divisions 2005-2019 and an equivalent, earlier period 1990-2004. The "standard" 'main recording period' (<1990 and 1990-2019) counts provide vital information about the species' historical distribution and decline and was applied to all species, but the additional use of the two smaller recording periods in the analysis ensures that any 'false positives' arising from an analysis of change during the main recording period can be identified and excluded.

A further, still more fine-grained, measure of 'continuing decline' was used to examine the data for the purpose of applying Criterion A, with occupancy in the ten-year periods 1990-1999, 1999-2009 and 2010-2019 being identified. Such scrutiny was only undertaken when the initial assessment (using the "main recording period") suggested a decline.

5.3 Other considerations

Information on habitat loss can be used as a proxy for population decline for species that are strongly associated with specific habitat types (see *e.g.* Lane & Mann (2016) - evaluation of *Gnormus nobilis* (Linnaeus)). However, it should be acknowledged that evidence of habitat fidelity in most of the Silphidae is generally anecdotal. Even where such fidelity exists, quantitative data on habitat loss are rarely available and the reviewer needs to work with very imperfect data.

6 Excluded species

Species excluded from assessment on the basis they are introduced non-natives, whether this is the result of accidental or deliberate importation, are assigned to the category 'Not Applicable (NA)' as required under the IUCN Guidelines. Even where these species occur in 100 hectads or less, they have not been assessed for scarcity or rarity as they are not considered to be native to Britain. A list of the excluded species and the rationale for their exclusion is provided in Table 3.

Table 3 Species categorised as 'Not Applicable (NA)'.

Scientific name	Post-1990 hectads	Rationale for exclusion
Nicrophorus germanicus	7	Recorded from Berkshire, Buckinghamshire, East Norfolk and East Sussex (Fairlight) in the 19th century and also apparently from Tresco (Scilly Isles) in 1959 which Duff (2012) suggests could relate to an adventive specimen. The paucity of dated records and dated Museum specimens is suspect and may indicate that the species was never genuinely British. Alternatively, it may be a long-extinct native or a species which was historically a casual immigrant or introduction. The species is established throughout lowland central and eastern Europe. A designation of NA seems most appropriate until evidence of established populations is forthcoming.

7 Species listed by IUCN threat status category

In this list the species are given in alphabetical order within status categories (nomenclature follows Duff, 2018).

Regionally Extinct
Aclypea udata

Critically Endangered (Possibly Extinct)
Silpha carinata

Vulnerable
Nicrophorus vestigator
Thanatophilus dispar

Near Threatened
Silpha obscura
Silpha tyrolensis

8 Species listed by GB Rarity Status category

In this list the species are given in alphabetical order within status categories (nomenclature follows Duff, 2018).

Nationally Rare
Nicrophorus vestigator
Silpha carinata
Silpha obscura
Silpha tyrolensis
Thanatophilus dispar

Nationally Scarce
Aclypea opaca
Dendroxena quadrimaculata
Nicrophorus interruptus

9 Taxa with level of IUCN threat status of VU or greater

Table 4. Taxa with level of threat VU or greater, not including Regionally Extinct (RE) or Data Deficient (DD) species. (See Appendix 2 for summary of criteria and categories).

Scientific Name	**Status**	**Criteria used**
Silpha carinata	CR(PE)	A2(ac), B1(ab)i,iv, B2(ab)ii, iv
Nicrophorus vestigator	VU	A2(ac), B2(ab)ii, iv
Thanatophilus dispar	VU	D2

10 References and further reading

BUCKLAND, P.I. & BUCKLAND, P.C. 2006. *Bugs coleopteran ecology package Software* [Component versions: Bugs CEP: Release 7.43; Bugsdata: Release 7.09; Bugs MCR: Release 2.0; Bustats: Release 1.2] [CDROM].

DANDY, J.E. 1969. *Watsonian vice-counties of Great Britain*. London, Ray Society.

DUFF, A.G. (ed.) 2008 *Checklist of Beetles of the British Isles, 2008 edition*. Wells: A.G. Duff.

DUFF, A.G. (ed.) 2012. *Checklist of Beetles of the British Isles*. 2nd edition. Iver: Pemberley Books.

DUFF, A.G. (ed.) 2018. *Checklist of Beetles of the British Isles*. Third edition. Iver: Pemberley Books.

DUFF, A.G. 2012. *Beetles of Britain and Ireland Volume 1:Sphaerusidae to Silphidae.*

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.

HYMAN, P.S. (revised PARSONS, M.S.). 1994. *A review of the scarce and threatened Coleoptera of Great Britain*. Part 2. UK Nature Conservation: 12. Joint Nature Conservation Committee, Peterborough.

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

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

IUCN. 2012b. *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels*. Ver. 4.0. IUCN Species Survival Commission. IUCN, Switzerland & Cambridge, UK.

IUCN. 2017. *Guidelines for Using the IUCN Red List Categories and Criteria*. Version 13. IUCN Species Survival Commission. IUCN, Gland, Switzerland.

LANE, S.A. & MANN, D.J. 2016. *A review of the beetles of Great Britain: The stag beetles, dor beetles, dung beetles, chafers and their allies - Lucanidae, Geotrupidae, Trogidae and Scarabaeidae*: Species Status No.31. Natural England Commissioned Reports, Number 224.

MACGOWAN 2010 MACGOWAN, I. 2010. A study of the endangered beetle Thanatophilus dispar (Herbst, 1973) at Loch Leven National Nature Reserve. Nuffield Foundation. 16pp

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

Appendix 1: summary table – an alphabetical list of the Silphidae

(Note: figures in parentheses refer to tally counts which include unverified records; more information in accompanying excel spreadsheet).

Rationale: unless otherwise specified neither EOO nor AOO approach the thresholds for consideration as Threatened under Criterion B and/or D2 and the number of locations exceeds the threshold under Criterion D2. Data were not available for an assessment against Criteria C and E

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Ablattaria laevigata	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - approx. 63,000 km² – taxon does not qualify. Category B2 (AOO) – 640 km² minimum, no decline evidenced, no fragmentation evidenced, more than 10 modern locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	102	163	58								Predatory on snails in short turf grassland habitat on free-draining soils, including dune systems and calcareous grassland and downs. With a distinct southern distribution. Adults are present in the field mainly between April and September.
Aclypea opaca	LC		Category A – decline detected, historical or otherwise – over 70 yr period, 10 yr decline calculated at 8%, which is well below the 30% minimum threshold for threat designation - taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 252 km² minimum, no continuing decline evidenced by post-1989 data periods, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	NS	E	S	W	116	63	6			33	33	24	18	26	Phytophagous. Most frequently recorded in arable crops where it is known to cause damage to the root systems of beet and turnip crops in particular. Widely distributed throughout Britain. Adults have been recorded in the field mainly between May and August.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Aclypea undata	RE	A2(ac), B1(ab)i,iv, B2(ab)ii,iv	Category A – significant decline, over 70 year period, 10 year decline calculated at 100% - mechanism of population crash not understood and probably irreversible – taxon qualifies under Critically Endangered A2(a)(c). Category B1 (EOO) and B2 (AOO) – recent EOO and AOO are 0km². The species was officially last recorded in Britain in 1936, although the database holds a more recent record; from South Lincolnshire in 1948 which requires validation – taxon qualifies under Critically Endangered B1(b) and B2(b). The lack of records for over 70 years for what is a large and relatively distinctive species suggests that the most appropriate designation is RE (Regionally Extinct)).	EXTINCT	E		W	9	0	0	0	0	0	0	0	0	0	Phytophagous and thought to be associated with basal parts of the plant. Hyman (1992) suggests that the species is non habitat-specific. Adults have been recorded in March and from May to July.
Dendroxena quadrimaculata	LC		Category A – historical decline detected, – over 70 yr period, 10 yr decline calculated at 11%, well below 30% minimum threshold for threat designation - taxon does not qualify. Categories B1 (EOO) and B2 (AOO) –EOO is approximately 87000 km², AOO is 264km². There is no continuing decline evidenced by post-1989 data periods, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	NS	E	S	W	145	66	24			34	40	33	14	34	Predatory as adults and probably also larvae, on lepidopterous caterpillars on trees, in wooded habitats, particularly in ancient woodland and pasture woodland habitats. Adults are active in the field, mainly between May and August. They overwinter in leaf litter, in logs, under bark etc.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Necrodes littoralis	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 1,320 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	189	330	59								A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults lay eggs near dead animals and the larvae develop in the decomposing organic material. Adults are attracted to both Mercury Vapour and actinic light traps. They are active in the field mainly between April and October.
Nicrophorus germanicus	NA		Recorded from Oxfordshire, Berkshire and/or Buckinghamshire, East Norfolk and East Sussex (Fairlight) in the 19th century and also apparently from Tresco (Scilly Isles) in 1959 which Duff (2012) suggests could relate to an adventive specimen. The lack of dated records and dated Museum specimens is suspect and may indicate that the species was never genuinely British. Alternatively, it may be a long-extinct native or a species which was historically a casual immigrant or introduction. The species is established throughout lowland central and eastern Europe. A designation of NA seems most appropriate until evidence of established populations is forthcoming.	NA	E			4 (min)	0	0	**0**	**0**	**0**	**0**	0	0	0	Data on the circumstance of capture of this species in Britain is very poor. In Berkshire, it was collected from game carcases in the 19th century. In other parts of its world range, the species has a similar life cycle to other members of the genus Nicrophorus.
Nicrophorus humator	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 3004 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	318	751	183								A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults are attracted to Mercury Vapour and actinic light traps. They are active mainly between April and September.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Nicrophorus interruptus	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 400 km² minimum, no continuing decline evidenced by post-1989 data periods, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN. [Although every effort has been made to only include reliable and validated records, there are likely to be misidentifications of investigator for this species in the database, in all periods. Consequently, the true hectad counts are likely to be lower than the figures presented here].	NS	E		W	94	100	22			35	70	25	24	62	A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults are attracted to both Mercury Vapour and actinic light traps. They are active in the field mainly between July and September.
Nicrophorus investigator	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 2168 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	259	542	112								A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults are attracted to both Mercury Vapour and actinic light traps. They are active in the field mainly between July and September.
Nicrophorus vespillo	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 1692 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5	LC	E	S	W	209	423	103								A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults are attracted

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
			locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.															to both Mercury Vapour and actinic light traps. They are active in the field mainly between May and September.
Nicrophorus vespilloides	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 2988 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	296	747	186								A burying or sexton beetle. Found in a variety of habitats. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults are attracted to both Mercury Vapour and actinic light traps. They are active in the field mainly between May and September.
Nicrophorus vestigator	VU	A2(ac), B2(ab)ii, iv	Category A – decline detected, historical or otherwise – over 70 yr period, 10 yr decline calculated at 18%, which is below 30% minimum threshold for threat designation; of later recording periods, 10 yr decline calculated at 40% for larger recording blocks and 39% overall for the three decade blocks, both declines exceeding the minimum threshold for threatened status - taxon qualifies under A2 Vulnerable because decline is not understood and may not be reversible and may not have ceased. Category B1 (EOO) - is approximately 24,000 km² and thus exceeds threshold for threat designation– taxon does not qualify. Category B2 (AOO) – 64 km² minimum – this species is highly mobile and is likely to be present in wider areas within the hectads in which it has been recorded so the AOO is a low estimate and a probable underestimate (true estimate is between 64 and 1500km² but most likely to be significantly closer to the lower rather than the higher value of this estimate), there is continuing decline	NR	E		W	62	15	4	16	15	14	3	9	6	2	A burying or sexton beetle. Found in a variety of habitats but with a distinct preference for sandy soils and a predominantly southern distribution, hence its prevalence in the Breckland region of East Anglia. The adults and larvae feed on decomposing carcases, primarily of birds and mammals. The adults excavate the ground beneath dead animals, laying their eggs with the corpse. The larvae develop in the decomposing organic material. Adults have been attracted to Mercury Vapour light. They are active in the field mainly between May and September.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
			evidenced by post-1989 data periods, fragmentation is strongly suspected due to the populations outside of the East Anglian Breckland being widely separated and isolated, there are recently more than 10 locations – taxon qualifies most appropriately under Vulnerable for Category B2. It does not qualify under D2 as AOO >20km² and there are more than 5 locations. VULNERABLE															
Oiceoptoma thoracicum	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 1704 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	204	426	80								A carrion beetle often associated with woodland or lightly-wooded habitats where adults and larvae inhabit bird and mammal carrion, predating the larvae of other insects. Adults, which are also attracted to fungi and dung, are active in the field mainly between April and August.
Phosphuga atrata	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 3840 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	489	960	329								A carrion beetle that is found in a variety of habitats where it predates snails. The beetle's head and mouthparts are narrow – an adaptation for accessing the aperture of pulmonate molluscs. The larvae also predate earthworms. Widely distributed and, aside from those taxa that visit moth traps, the most regularly recorded species in the group. Adults can be found in the field throughout the year and are frequently recorded in logs and under bark during the winter period.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Silpha carinata	CR (PE)	A2(ac), B1(ab)i,iv, B2(ab)ii, iv	Category A – apparent significant decline, over 70 year period, 10 year decline calculated at 100% - records are few and it is possible that the species, which has not been recorded since 1985, may still be present at low population levels in a very restricted area of our region. However, recent attempts to find it by carrion-trapping at its most recent site have failed to find the species. If decline is irreversible and not understood then the taxon qualifies under Critically Endangered A2(a)(c). Category B1 (EOO) and B2 (AOO) – recent EOO and AOO are 0 km², but known EOO from earlier data suggests a previously known range encompassing the area between its three known locations of approximately 2900 km² and its known AOO was16 km² (4 tetrads). Due to the lack of recent records at the Great Ridge Wood site where it was taken with some continuity in the 1980's, the taxon currently qualifies under Critically Endangered B1(b) and B2(b). The lack of records for over 30 years, despite attempts to rediscover it, suggests that the species should be designated as CRITICALLY ENDANGERED (Possibly Extinct).	NR	E			3	0	0	0	0	0	0	0	0	0	A carrion beetle which has a highly restricted range in Wiltshire and South Hampshire. It has occurred to date in scrub habitat on chalk downland and at the edges of broad-leaved woodland. Specimens have been collected from cut grass on a a woodland ride and in dead straw in a heathland area in woodland. It has also been recorded from carrion-baited pitfall traps. In captivity, both adults and larvae have been found to eat both plant and dead animal material. Adults have been recorded in the field in April, May and August.
Silpha obscura	NT		Category A – apparent significant decline, over 70 year period, 10 year decline calculated at 18% which is below the minimum threshold for qualification under threat category Vulnerable A2; decline is probably irreversible and not understood. Category B1 (EOO) – recent EOO is approximately 9070 km² and recent AOO is 48 km² (12 tetrads), the population appears to be severely fragmented and the number of locations is more than 10 (exceeding this threshold value by one location only). There may be an indication of continuing decline in the first of the more recent 30 year period	NR	E	S	W	50	12	4	12	11	9	5	4	5	4	A carrion beetle with recent records from scattered coastal locations only. It appears to be associated with sandy areas such as dune systems. At Southwold in Suffolk, adults were found buried in sand at the base of cliffs on the upper shore. Other records are from the roots of plants and under stones. It is suggested that the adults and larvae rarely feed on carrion and are possible predators of molluscs. Adults have been recorded between March and September.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
			recording blocks, but this is not evidenced in the three-decade blocks, and with such little data it is hard to justify a distinct decline. Although significant fluctuations in numbers have been observed in the Southwold population, this is a casual anecdotal observation and there is no research on population dynamics here to indicate that this observation is part of a significant trend. So although the taxon is very close to qualifying under B1 and B2 as Vulnerable and Endangered respectively, it fails to do so on current information. It also fails to qualify under VUD2 because it has been found at more than 5 recent locations and there is no plausible threat. Because the species is close to qualifying under A2, B1 and B2, a designation of Near Threatened is appropriate, but research on the populations is desirable to establish any trends that would necessitate re-evaluation. NEAR THREATENED.														
Silpha tristis	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 1104 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	*S*	W	151	276	76								This widely distributed carrion beetle is found in a range of usually open habitats, including short turf grassland and dune systems. Adults and larvae may feed on carrion or on molluscs or both. Adults have been recorded throughout the year and have been found overwintering in the base of grass tussocks.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Silpha tyrolensis	NT		Category A – historical decline detected with a significant retraction of range such that it is now only regularly encountered in Machair habitat on the western coastline of the Outer Hebrides – over 70 yr period, 10 yr decline calculated at 19%, which is below the minimum 30% threshold for threat designation; there are no recent declines evidenced in the dataset - taxon does not qualify. Category B1 (EOO) - range is approximately 5,300 km² which falls into the Vulnerable Category, but there are more than 10 locations (exceeded by just one location only); however, there is no continuing decline evidenced by the post-1989 data (see later hectad counts) – taxon does not qualify. Category B2 (AOO) – 108 km² minimum which falls into the Endangered Category, but there is no continuing decline evidenced by post-1989 data periods and no severe fragmentation evidenced – taxon does not qualify. D2 – plausible threat, in that tidal events may impact on machair, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon comes close to qualifying as threatened under Vulnerable B. NEAR THREATENED.	NR	E	S	W	63	15	5	27	11	3	12	2	5	12	A carrion beetle with a distinctly northern and western distribution in Britain and which currently occurs mainly in Machair habitat along the western coastline of the Outer Hebrides. Both adults and larvae are probably predators of snails or slugs. The species is usually encountered, aside from in pitfall traps, under stones and at the base of plants. Adults are active in the field mainly between April and September.
Thanatophilus dispar	VU	D2	Category A – historical decline detected – over 70 yr period, 10 yr decline calculated at 6%, which is well below the minimum 30% threshold for threat designation. There are no declines evidenced by the post-1989 data, although the increases since 2008 are due mainly to research work carried out on the populations in the Outer Hebrides and Loch Leven, Scotland. Category B1 (EOO) - range is approximately 2563 km² which falls into the Endangered Category. There are less than 10 locations but no continuing decline so the taxon fails to qualify under	NR	E	S		12	8	2	19	5	4	8	4	1	7	A widely but highly locally-distributed carrion beetle that is found in a variety of habitats where it feeds on carrion. In Scotland it is associated with loch shores. Adults have been observed at corpses of fish, birds and sheep. Adults have been recorded between April and October.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
			B1 although close. Category B2 (AOO) – 76 km² (19 tetrads) minimum which falls into the Endangered Category, but again because no continuing decline is evidenced, the species fails to qualify under B2. The population at Loch Leven was estimated at 481 individuals minimum, in 2010 (MacGowan, 2010) when it was thought to have remained relatively stable since 2003 at least. No estimates have been made on the Outer Hebridean populations, but it is highly likely that the entire British population at its two extant regions would number less than 10,000 individuals in which case it would qualify under the first criterion of Category C as Vulnerable. However, the lack of any recent or projected decline again means that the taxon fails to qualify for threat status under C. Applying the criteria for VU D2, there are only 5 locations, there is a plausible threat at least to the machair habitat in the Outer Hebrides by tidal events, which could effectively drive the British population into the Critically Endangered category, so the taxon qualifies under VUD2 VULNERABLE.														
Thanatophilus rugosus	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 1232 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	278	308	76								A widely distributed carrion beetle that is found as adults and larvae in the carcases of decomposing mammals, birds and fish. It is not habitat-specific. Adults have been recorded as active in the field between March and September. Overwintering adults have been found in moss and grass tussocks.

Species Name	GB IUCN Status (2020)	Qualifying criteria	Rationale	GB Rarity status (2020)	Presence in England	Presence in Scotland	Presence in Wales	AoO (hectads) <1990	AoO (hectads) 1990-2019	Dual Hectads	AoO (tetrads) 1990-2019	No. of Locations 1990-2019	AoO (hectads) 1990-2004	AoO (hectads) 2005-2019	AoO Hectads 1990-1999	AoO Hectads 1999-2009	AoO Hectads 2010-2019	Ecological account
Thanatophilus sinuatus	LC		Category A – no decline detected, historical or otherwise – taxon does not qualify. Category B1 (EOO) - in excess of 100,000 km² – taxon does not qualify. Category B2 (AOO) – 756 km² minimum, no continuing decline evident, no fragmentation evidenced, more than 10 locations – taxon does not qualify. D2 – no plausible threat, AOO >20km², more than 5 locations – taxon does not qualify. NT – taxon is not close to any of the threat categories. LEAST CONCERN.	LC	E	S	W	167	189	60								A widely distributed carrion beetle that is found as adults and larvae in the carcases of decomposing mammals, birds and fish. It is not habitat-specific. Adults have been recorded as active in the field between April and September. Overwintering adults have been found in moss.

Appendix 2. Summary of IUCN Criteria

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): (up to a max. 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)
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