APPENDIX 1. Report on UK empirical critical loads for nitrogen, estimated for Special Areas of Conservation and submitted to the CCE in response to the 2006/07 call for data

UNITED KINGDOM

National Focal Centre

Jane Hall
Centre for Ecology and Hydrology
Monks Wood, Abbots Ripton
Huntingdon PE28 2LS
Tel: +44 1487 772429
Fax: +44 1487 773467
Email: jrha@ceh.ac.uk
http://critloads.ceh.ac.uk

Collaborating institutions

Bill Bealey
Centre for Ecology and Hydrology
Bush Estate, Penicuik
Midlothian EH26 0QB
Email: bib@ceh.ac.uk

Clare Whitfield
Joint Nature Conservation Committee
Monkstone House, City Road
Peterborough, PE1 1JY
Email: clare.whitfield@jncc.gov.uk

Simon Bareham
Countryside Council for Wales
Plas Penrhos, Ffordd Penrhos
Bangor, LL57 2LQ
Email: s.bareham@ccw.gov.uk

Zoe Masters
Natural England
Coldharbour Farm, Wye,
Ashford, Kent, TN25 5DB
Email: zoe.masters@naturalengland.org.uk

John Houlgreave
Environment Agency Wales
Cambria House, 29 Newport Road
Cardiff, CF24 0TP
Email: john.houlgreave@environment-agency.wales.gov.uk

Introduction

In 2004 the UK submitted critical loads of acidity and nutrient nitrogen for UK Biodiversity Action Plan broad habitats sensitive to acidification and/or eutrophication. For eutrophication, empirical critical loads of nutrient

nitrogen, as agreed at the Berne workshop (Achermann & Bobbink, 2003) and in the UK (Hall et al, 2004) were applied to all habitats except managed woodlands for which the mass balance equation was used. In response to this call for data no changes have been made to the UK critical loads for broad habitats and hence no new habitat data have been submitted.

This submission from the UK is focused on applying the empirical nutrient nitrogen critical loads to the Special Areas of Conservation (SACs), a sub-set of the UK's Natura 2000 sites. There are 611 SACs in the UK ranging in area from <0.01 km^2 to >1500 km^2, and designated to protect between one and 21 features (Annex I habitats or Annex II species) per site. In conjunction with the UK conservation agencies and the UK environment agencies a method has been developed to assign "site relevant" critical loads to the designated features of SACs. These data are being used by the environment agencies to enable the identification of sites at risk from critical load exceedance. This is to inform the assessment of the impacts of "plans and projects" in relation to the provisions of Article 6.3 of the Habitats Directive. The data are also currently being used to inform the UK's air pollution assessment for the purposes of reporting on Favourable Conservation Status under Article 17 of the Habitats Directive.

This database has been submitted as an example of how empirical nutrient nitrogen critical loads may be applied to designated areas. This reflects the increasing demand for such an approach through drivers such as the Habitats Directive. It should be noted that if these data are used in conjunction with the UK habitat critical loads submitted in 2004 there will be some duplication of the total ecosystem areas.

Methods

The method for assigning site relevant critical loads was as follows:

- The individual features (Annex I habitats or Annex II plant species) were assessed in terms of their sensitivity to eutrophication; 83 of the the 90 features (77 habitats, 13 plant species) associated with the UK SACs are considered sensitive to eutrophication. "Non-plant" species listed in Annex II have not been included in this assessment.
- The corresponding EUNIS habitat class(es) of the sensitive features were identified. This can be done using either the EUNIS web site (http://eunis.eea.europa.eu/index.jsp) or the the Habitats Dictionary of the National Biodiversity Network (http://www.nbn.org.uk/habitats/); both sources have lookup tables from Annex I to EUNIS or vice versa.
- Where the sensitive feature was a plant species it was related to the EUNIS habitat in which it occurs.
- If nutrient nitrogen critical loads were available for the EUNIS class, they were applied. Where this was not the case, the critical loads for a similar EUNIS class were applied where appropriate (ie, where there was some "equivalence" between habitats). However, for 10 of the features (8 habitats, 2 plant species) identified as being sensitive to eutrophication there are currently no appropriate critical loads available (Table 1).
- The critical load values identified by EUNIS class above were assigned to each corresponding feature for each SAC, ie, no additional site-specific or spatial information was used in the assignment.

Table 1. Annex 1 habitats and Annex II plant species found in the UK and for which there are no appropriate nutrient nitrogen critical loads available

Annex I habitats Annex II species	Interest Name
H1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
H1340	Inland salt meadows
H2160	Dunes with Hippophae rhamnoides (sea-buckthorn)
H3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara ssp.
H3150	Natural eutrophic lakes often dominated by pondweed
H3170	Mediterranean temporary ponds
H3180	Turloughs

H3260	Water courses of plain to montane levels with floating vegetation (water-crowfoot)
S1390	Marsupella profunda (Western rustwort)
S1833	Najax flexilis (Slender naiad)

Table 2 below lists the remaining 73 sensitive designated features together with the EUNIS class used to set the critical load values. For consistency with the habitat critical loads data previously submitted, the agreed UK "mapping values" have been used (Hall et al, 2003a; 2003b); where no mapping value had previously been defined the mid-range value has been applied. It should be noted that the environment agencies in their site screening assessments have applied a more precautionary approach and used the value at the lower end of each range.

As stated above the number of features associated with an individual site varies, however, information on the location and area occupied by each feature within the sites is not currently readily available. Therefore for this data submission the "EcoArea" associated with each data record is based on the total SAC site area divided by the number of features for which nutrient nitrogen critical loads are available. Further, for some sites more than one feature is associated with the same EUNIS class; where this is the case the feature areas (as defined above) have been aggregated to enable the data to be submitted as a single record per EUNIS class per SAC.

Table 2. EUNIS habitat critical loads assigned to Annex I habitats and species

Annex I habitat Annex II species	EUNIS class (same or most similar to Annex I habitat)	CLnutN (kg N ha^{-1} yr^{-1})	UK Mapping Value (kg N ha^{-1} yr^{-1})
H1130 Estuaries	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1140 Mudflats & sandflats	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1150 Coastal lagoons	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1220 Perennial vegetation of stony banks	B1.3 Shifting coastal dunes	10-20	15
H1310 Salicornia & other annuals on mud & sand	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1320 Spartina swards	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1330 Atlantic salt meadows	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H1420 Mediterranean & thermo-Atlantic halophilous scrubs	A2.64/A2.65 Pioneer & low-mid salt marshes	30-40	35*
H2110 Embryonic shifting dunes	B1.3 Shifting coastal dunes	10-20	15
H2120 Shifting dunes along shore (Ammophila arenaria)	B1.3 Shifting coastal dunes	10-20	15
H2130 Fixed dunes with herbaceous vegetation	B1.4 Coastal stable dune grasslands	10-20	15
H2140 Decalcified fixed dunes (Empetrum nigrum)	B1.5 Coastal dune heaths	10-20	15*
H2150 Atlantic decalcified fixed dunes	B1.5 Coastal dune heaths	10-20	15*
H2170 Dunes (Salix repens ssp. Argentea)	B1.8 Moist to wet dune slacks	10-25	17.5*
H2190 Humid dune slacks	B1.8 Moist to wet dune slacks	10-25	17.5*
H21A0 Machairs	B1.4 Coastal stable dune grasslands	10-20	15

H2250 Coastal dunes (Juniperus spp.)	B1.5 Coastal dune heaths	10-20	15*
H2330 Inland dunes (open Corynephorus & Agrostis)	E1.94 Inland dune pioneer grasslands	10-20	15*
H3110 Oligotrophic waters containing few minerals	C1.1 Permanent oligotrophic waters: softwater lakes	5-10	7.5*
H3130 Oligotrophic to mesotrophic standing waters with vegetation	C1.1 Permanent oligotrophic waters: softwater lakes	5-10	7.5*
H3160 Natural dystrophic lakes & ponds	C1.1 Permanent oligotrophic waters: softwater lakes	5-10	7.5*
H4010 Northern Atlantic wet heaths (Erica tetralix)	F4.11 Northern wet heath: Erica tetralix dominated	10-25	15
H4020 Temperate Atlantic wet heaths (Erica cilliaris & tetralix)	F4.11 Northern wet heath: Erica tetralix dominated	10-25	15
H4030 European dry heaths	F4.2 Dry heaths	10-20	12
H4040 Dry Atlantic coastal heaths (Erica vegans)	F4.2 Dry heaths	10-20	12
H4060 Alpine & boreal heaths	F2 Arctic, alpine, subalpine scrub habitats	5-15	10*
H4080 Sub-Arctic Salix spp. Scrub	F2 Arctic, alpine, subalpine scrub habitats	5-15	10*
H5110 Stable xerothermophilous formations (Buxus sempervirens)	E1.26 Sub-Atlantic semi-dry calcareous grasslands	15-25	20
H5130 Juniperus communis on heaths or calcareous grasslands	F4.2 Dry heaths	10-20	12
H6130 Calaminarian grasslands of Violetalia calaminariae	E1.26 Sub-Atlantic semi-dry calcareous grasslands	15-25	20
H6150 Siliceous alpine & boreal grasslands	E4.3 Alpine & subalpine grasslands	10-15	12.5*
H6170 Alpine & subalpine calcareous grasslands	E4.3 Alpine & subalpine grasslands	10-15	12.5*
H6210 Semi-natural dry grasslands & scrubland facies (calcareous)	E1.26 Sub-Atlantic semi-dry calcareous grasslands	15-25	20
H6211 Semi-natural dry grasslands & scrubland facies (orchid sites)	E1.26 Sub-Atlantic semi-dry calcareous grasslands	15-25	20
H6230 Species-rich Nardus grassland (siliceous, mountain)	E1.7 Non-mediterranean dry acid & neutral closed grassland	10-20	15
H6410 Molinia meadows (calcareous, peaty, clay-silt soils)	E3.51 Moist & wet oligotrophic grasslands: Molinia caerulea	15-25	20*
H6430 Hydrophilous tall herb fringe communities (plains, montane)	E4.3 Alpine & subalpine grasslands	10-15	12.5*
H6510 Lowland hay meadows	E2.2 Low & medium altitude hay meadows	20-30	25*
H6520 Mountain hay meadows	E2.3 Mountain hay meadows	10-20	15*
H7110 Active raised bogs	D1 Raised & blanket bogs	5-10	10
H7120 Degraded raised bogs capable of natural regeneration	D1 Raised & blanket bogs	5-10	10
H7130 Blanket bogs	D1 Raised & blanket bogs	5-10	10
H7140 Transition mires & quaking bogs	D1 Raised & blanket bogs	5-10	10
H7150 Depressions on peat substrates (Rhynchosporion)	D1 Raised & blanket bogs	5-10	10
H7210 Calcareous fens (Cladium	D4.1 Rich fens	15-35	25*

mariscus)			
H7220 Petrifying springs with tufa formation	D4.2 Mountain rich fens	15-25	20*
H7230 Alkaline fens	D4.1 Rich fens	15-35	25*
H7240 Alpine pioneer formations (Caricion bicoloris-atrofuscae)	D4.2 Mountain rich fens	15-25	20*
H8110 Siliceous scree of montane to snow levels	F2 Arctic, alpine, subalpine scrub habitats	5-15	10*
H8120 Calcareous & calcshist screes of montane/alpine levels	F2 Arctic, alpine, subalpine scrub habitats	5-15	10*
H8210 Calcareous rocky slopes with chasmophytic vegetation	E4.3 Alpine & subalpine grasslands	10-15	12.5*
H8220 Siliceous rock slopes with chasmophytic vegetation	F2 Arctic, alpine, subalpine scrub habitats	5-15	10*
H8240 Limestone pavements	E4.3 Alpine & subalpine grasslands	10-15	12.5*
H9120 Taxus in the shrublayer	G Temperate & boreal forests: ground flora	10-15	12
H9130 Asperulo-Fagetum beech forests	G Temperate & boreal forests: ground flora	10-15	12
H9160 Sub-Atlantic & medio-European oak oak-hornbeam forests	G Temperate & boreal forests: ground flora	10-15	12
H9180 Tilio-Acerion forests of slopes, screes & ravines	G Temperate & boreal forests: ground flora	10-15	12
H9190 Old acidophilous oak with Quercus robur on sandy plains	G Temperate & boreal forests: ground flora	10-15	12
H91A0 Old sessile oak with Ilex & Blechnum (British Isles)	G Temperate & boreal forests: epiphytic lichens	10-15	10
H91C0 Caledonian forest	G Temperate & boreal forests: ground flora	10-15	12
H91D0 Bog woodland	D1 Raised & blanket bogs	5-10	10
H91J0 Taxus baccata woods (British Isles)	G Temperate & boreal forests: ground flora	10-15	12
S1386 Buxbaumia viridis	G Temperate & boreal forests: ground flora	10-15	12
S1393 Drepanocladus (Hamatocaulis) vernicosus	D2.2 Poor fens	10-20	15
S1395 Petalophyllum ralfsii	B1.8 Moist to wet dune slacks	10-25	17.5*
S1421 Trichomanes speciosum	G Temperate & boreal forests: ground flora	10-15	12
S1441 Rumex rupestris	B1.8 Moist to wet dune slacks	10-25	17.5*
S1528 Saxifraga hirculus	E4.3 Alpine & subalpine grasslands	10-15	12.5*
S1614 Apium repens	E2.2 Low & medium altitude hay meadows	20-30	25*
S1654 Gentianella anglica	E1.26 Sub-Atlantic semi-dry calcareous grassland	15-25	20
S1831 Luronium natans	C1.1 Permanent oligotrophic waters: softwater lakes	5-10	7.5*
S1902 Cypripedium calceolus	G Temperate & boreal forests: ground flora	10-15	12
S1903 Liparis loeselii	B1.8 Moist to wet dune slacks	10-25	17.5*

* No UK Mapping Value set for this EUNIS class, so mid-range value applied.

Conclusions

- This method enabled empirical nutrient nitrogen critical loads to be assigned to 73 out of the 83 designated features (Annex I habitats or Annex II plant species) within the UK SACs considered to be sensitive to eutrophication. Ten features were identified for which it was not possible to assign appropriate critical loads.
- In terms of sites, of the 611 SACs in the UK, 516 contain features (Annex I habitats or Annex II plant species) sensitive to eutrophication. Using the methodology described above it was possible to assign nutrient nitrogen critical loads to the features of 472 of the SACs in the UK.
- Whilst it is possible using the available databases on the web to relate the Annex I habitats to their corresponding EUNIS classes, there may not always be a direct relationship or correspondence. In addition, nutrient nitrogen critical loads are not available for all the EUNIS classes identified and expert opinion has been used to select a similar class where possible.
- For many of the EUNIS classes in Table 2 a critical load value within each range had previously been agreed (ie, UK Mapping Value) for use in data submissions and for exceedance calculations; where this was not the case the mid-range value has been applied. However, there is still some uncertainty about where within the range the critical load should be set. The UK environment agencies have chosen to use the range minima in their assessments because of the precautionary approach enshrined within Article 6.3 of the Habitats Regulations. Ashmore & Hicks (2006) have proposed a decision support matrix incorporating some of the endorsement theory approaches developed by Wadsworth & Hall (2007) for acidity. This method would make use of the Ellenberg scores for fertility (N), acidity (R), and moisture (F) identified for given classes of the National Vegetation Classification (Rodwell, 1991), together with user inputs on rare species occurrence and management activities. By assigning a "weight of evidence" to each of these parameters at the site-level an overall endorsement for using the critical load at the lower, middle or upper part of the range can be determined. Such approaches will be examined further within the UK and their applicability and ease of use ascertained.

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