Seasonal Habitat Vulnerability Mapping

CCW Policy Research Report No. 11/4

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Habitat Vulnerability Mapping

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Crynodeb

Cydnabyddir yn gynyddol bod mynediad i gefn gwlad at ddibenion hamdden yn esgor ar ystod eang o fanteision, megis effeithiau cadarnhaol ar iechyd a lles, manteision economaidd, gwell dealltwriaeth o'r amgylchedd naturiol a gwell cysylltiad ag ef. Fodd bynnag, mae mynediad i gefn gwlad yn esgor ar effeithiau negyddol hefyd, oherwydd gall presenoldeb pobl yno effeithio ar fudd safleoedd o ran cadwraeth natur. Cafodd yr effeithiau posibl hyn ar gefn gwlad Cymru eu hadolygu mewn adroddiad blaenorol, a awgrymodd fethodoleg ar gyfer cyflwyno'r wybodaeth mewn System Gwybodaeth Ddaearyddol er mwyn dangos sensitifrwydd tymhorol gwahanol ardaloedd yng Nghymru.

Mae'r adroddiad hwn yn cyflwyno cyfres o fapiau a grëwyd gan ddefnyddio'r fethodoleg a awgrymwyd. Bwriad y mapiau yw cynnig adnodd i lunwyr polisi, cynllunwyr a rheolwyr mynediad, sy'n nodi'r ardaloedd o gefn gwlad sy'n arbennig o sensitif neu fel arall i fynediad, a gallent lywio lleoliad isadeiledd mynediad, tai ac ati a'r modd y cânt eu darparu.

Mae mapiau wedi'u creu i ddangos dosbarthiad gofodol a'r graddau y mae cefn gwlad yn sensitif i bedwar prif fath o effaith: halogi, difrod, tân ac aflonyddwch. Mae halogi'n cynnwys effeithiau megis sbwriel a chyfoethogi o ran maetholion. Mae difrod yn cynnwys effaith cerdded ar lystyfiant a'r graddau y mae isbriddoedd yn erydu. Mae'r map tân yn mynd i'r afael ag effeithiau tân (tân damweiniol neu dân a gaiff ei gynnau'n fwriadol) ar anifeiliaid, cymunedau planhigion a'r pridd. Mae aflonyddwch (i famaliaid, adar, ymlusgiaid ac amffibiaid) yn ymdrin ag effeithiau anfwriadol presenoldeb pobl ar lwyddiant rhywogaethau o ran magu, goroesi ac ati, a marwolaethau a achosir yn uniongyrchol gan bobl, er enghraifft, wrth iddynt sathru ar nythod.

Caiff pob un o gynefinoedd y tir, dŵr croyw a'r arfordir eu cynnwys (ac eithrio cynefinoedd arfordirol sydd wedi'u cyfyngu i'r parthau islanwol a rhynglanwol). Defnyddiwyd mathau cyffredinol o gynefinoedd yn bennaf, ond cawsant eu mireinio mewn rhai achosion drwy ddefnyddio categorïau Dosbarthiad Cenedlaethol Llystyfiant.

Casglwyd y wybodaeth gan ddefnyddio celloedd 500m ar draws Cymru. Cyfrifwyd sgôr gronnol ar gyfer pob cell ym mhob tymor, a oedd yn deillio o sgorau unigol (a seiliwyd yn bennaf ar farn arbenigol a setiau data cyfredol) i gyfleu'r canlynol:

- Y cynefinoedd sy'n bresennol ym mhob cell (a sgorau cymharol ar gyfer pob cynefin yn cael eu cadarnhau gan farn arbenigol)
- Y mathau o bridd sy'n bresennol yng nghell y grid (mae rhai mathau o bridd yn fwy tebygol o erydu)
- Y llethr (mae erydu'n fwy tebygol o ddigwydd ar lethr sy'n fwy serth)
- Y rhywogaethau sy'n bresennol yn y gell neu wrth ei hymyl (a rhywogaethau allweddol yn cael eu cadarnhau gan farn arbenigol).

Mae'r System Gwybodaeth Ddaearyddol wedi'i ffurfio mewn modd a fydd yn caniatáu i'r sgorau neu'r setiau data gael eu haddasu ymhellach. Bydd hynny'n fodd i fireinio'r mapiau yn y dyfodol.

Summary

It is increasingly recognised that recreational access to the countryside has a wide range of benefits, such as positive effects on health and well-being, economic benefits and an enhanced understanding and connectivity of the natural environment. There are also negative effects of access however, as people's presence in the countryside can impact on the nature conservation interest of sites. A previous report reviewed these potential impacts to the Welsh countryside, and suggested a methodology for presenting the information within a GIS to show the seasonal vulnerability of different areas of Wales.

This report presents a series of maps created using the suggested methodology. The maps are intended to provide a tool for policy makers, planners and access managers, highlighting areas of the countryside particularly sensitive to access and vice versa, potentially guiding the location and provision of access infrastructure, housing etc.

Maps have been created to show the spatial distribution and degree of vulnerability to four main types of impacts: contamination, damage, fire and disturbance. Contamination includes impacts such as litter and nutrient enrichment. Damage includes the impact of footfall on vegetation and the erosion of substrates. The fire map addresses the impacts of fire (accidental or arson) on animals, plant communities and the soil. Disturbance (to mammals, birds and herptiles) covers the unintentional consequences of people's presence on breeding success and survival etc and also direct mortality, for example trampling of nests.

All terrestrial, freshwater and coastal habitats are included (excluding coastal habitats restricted to the sub-tidal and intertidal zones). Broad habitat types have largely been used, refined in some cases by use of National Vegetation Classification categories.

The information was captured using 500m cells across Wales. A cumulative score was calculated for each cell in each season, derived from individual scores (based largely on expert opinion and existing datasets) to capture the following:

- Habitats present within the cell (with comparative scores for each habitat finalised through expert opinion)
- Soil types present with the grid cell (certain soil types are vulnerable to erosion)
- Slope (a steeper slope increases vulnerability to erosion)
- Species present within or near the cell (key species finalised through expert opinion)

The GIS has been constructed in a way which will allow further modification of the scores or datasets included. This will enable future work to be undertaken in refining the maps.

Contents

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1. Introduction

1.1 This report builds on a previous review of the nature conservation impacts of recreational access to the Welsh Countryside (Liley et al. 2010). Here we present a series of maps that show the variation in vulnerability to impacts from recreation across Wales. The aim is to provide sensitivity maps that can be used with other data, such as recreation demand or predicted changes in recreation use, to explore where pressures may occur.

Background

1.2 It is now increasingly recognised that access to the countryside is crucial to the long term success of nature conservation projects and has wider benefits, for example improving well-being and health (English Nature 2002; Morris 2003; Bird 2004; Pretty et al. 2005) as well as providing inspiration (Tansley 1945). While access may have benefits for people, there are circumstances where visitors can have a detrimental effect on the sites they visit, for example through disturbance or trampling. These impacts are considered in a Welsh context in a previous report (Liley et al. 2010), which was commissioned by CCW in 2010. This first report provided a review of all types of access and activities and their impacts on terrestrial and coastal habitats (largely excluding marine/inter-tidal habitats). The review was structured around four main types of impact:

- Contamination (e.g. litter, fouling, eutrophication; also spread of non-native species by recreational users).
- Damage (direct damage to vegetation through harvesting and wear and impacts to soils such as erosion)
- Fire (both arson and accidental fire, resulting in direct mortality, habitat destruction, soil damage)
- Disturbance (which can result in energetic consequences, direct mortality, increased stress, increased predation etc.)

1.3 The review also considered how these impacts could be mapped, trialling different approaches and outlining a recommended method by which spatial data on the distribution of habitats and species could be combined with scores derived through consultation with experts and reference to published material. The review suggested that separate maps could be produced for each of the four impacts (the bullets above) in each of the four seasons.

Aims and Structure of the Report

1.4 In this report we develop the work of the initial review to present the maps. Such a mapping exercise is complex and novel. The aim of this report is therefore to ensure that the steps undertaken are clearly documented and the results presented in a way that can easily be developed in the future. We therefore describe in detail the methods used, including the scoring system and the steps used to generate the maps. The maps themselves, which make up the bulk of this report, are presented

at the same scale to allow direct comparisons to be made. A short discussion section identifies constraints and potential next steps in testing and improving the approach.

2. Our Approach

Overview and Description of Basic Grid

2.1 The maps were developed using a 500m grid covering the entirety of Wales and containing 86,860 cells. Information from various spatial datasets was then summarised or extracted to allow comparative values to be allocated for each grid cell, and a range of maps produced different types of impact for different seasons (spring, summer, autumn and winter). The following maps were generated:

- Damage: A map for each season, plus an overall map for all seasons combined
- Contamination: One map for all seasons combined
- Fire: A map for each season, plus an overall map for all seasons combined
- Disturbance/other species specific impacts: A map for each season, plus an overall map for all seasons combined
- All impacts combined: A map for each season, plus an overall map for all seasons combined

2.2 This resulted in a total of 21 maps. The steps used to generate these maps are set out below, structured by the types of impact. An overview of the mapping process is shown in Figure 1.

2.3 All mapping was undertaken using MapInfo (10.5). It is important that the mapping can be adapted in the future, allowing for the maps to be tested in different situations and revised accordingly if necessary. Due to the complexity in mapping the scores we have therefore generated the maps in a series of steps that have been saved within an Access database. This ensures that should, for example, habitat scores be changed, the revised maps can be easily generated.

Seasons

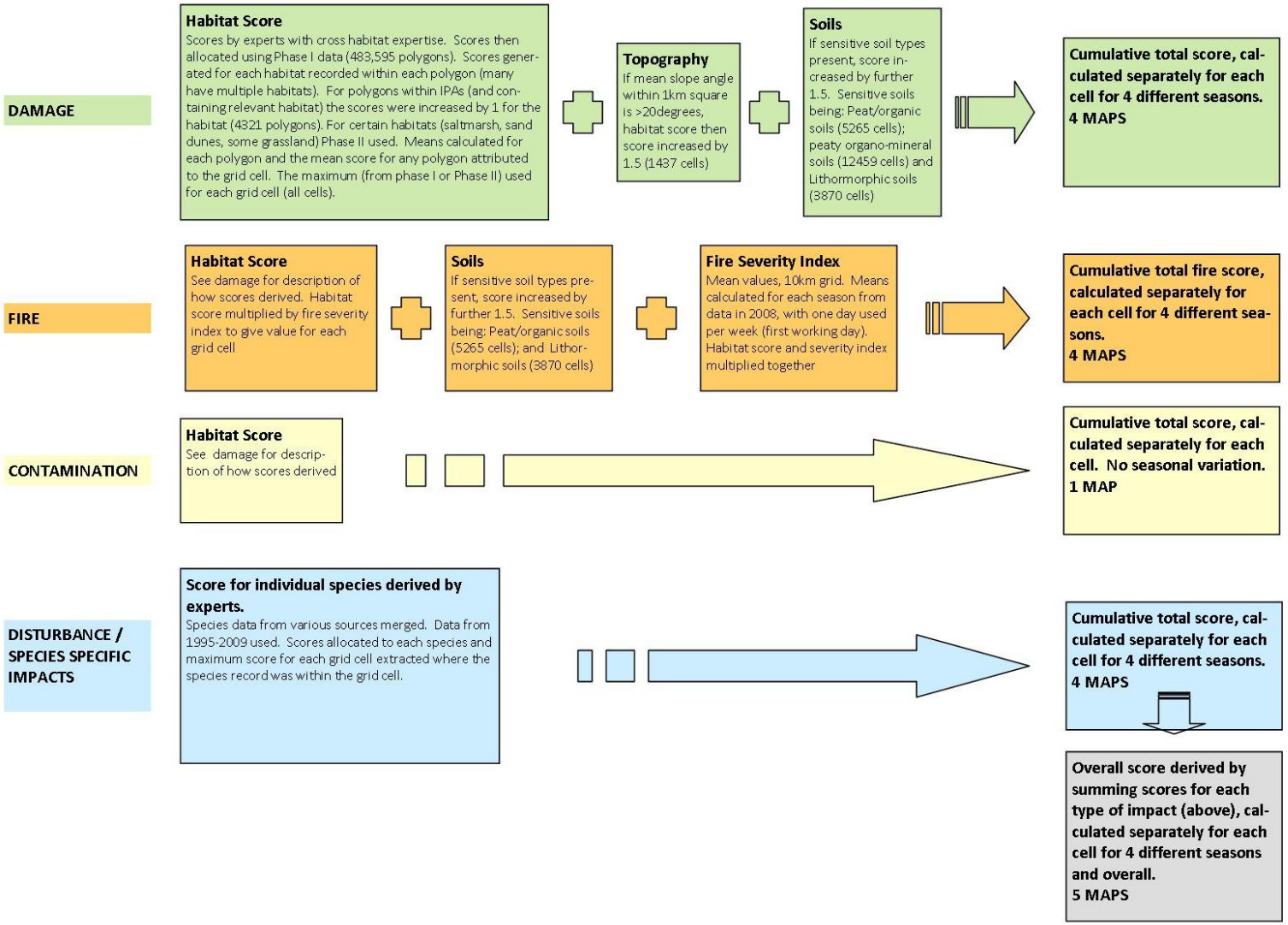
2.4 For the purposes of this project seasons were defined as follows:

- Spring: March- May
- Summer: June – August
- Autumn: September – November
- Winter: December - February

Incorporation of habitat data

2.5 The impacts on the vegetation of different habitat types were scored through consultation with a panel of experts. Experts were identified through consultation with CCW staff and others working in the fields of conservation and ecology in Wales. Those who agreed to contribute included staff from CCW, the three Welsh National Parks Authorities, RSPB, the National Trust, Aberystwyth University, and Montgomeryshire Wildlife Trust. A scoring system of 0 - 5 was used, with 0 indicating no concern whatsoever, and a score of 5 indicating a habitat for which even a small amount of recreation could result significant habitat change. For each category, the impact, not the risk that it might occur, was considered i.e. a habitat

Figure 1: Flowchart showing an overview of the mapping process used to create the seasonal recreational vulnerability maps for Wales.



(such as fen) would not be scored lower on the basis that it might be less likely to be accessed for recreational purposes than other habitats, and a season would not be scored higher or lower on the basis that there might be more or less recreational pressure at that time. The mean score was then used inform the scores allocated to generate the preliminary maps. Scores were then amended by the CCW habitat experts following consultation on the preliminary maps. The final scores used are presented in Table 4. The habitat types used were Phase 1 habitat categories as used in the Habitat Survey of Wales (Blackstock *et al.* 2010). For some habitats it was felt that Phase 1 categories were too generalised, or that identification of key habitat types was weak, and so scores were further refined as follows:

- For damage, contamination and fire, the score of broad-leaved woodland habitats and coniferous woodland was increased if the habitat polygon fell within an ancient woodland recorded in the Ancient and Semi-natural Woodland Dataset.
- For all impacts, habitat scores were then modified using the Important Plant Areas dataset (Plantlife International, n.d.). Within core IPAs, qualifying habitats were identified and their score increase by one point (IPAs designated for single species were therefore excluded). To enable this, Phase 1 categories were attributed to EUNIS level 2 and Annex 1 threatened habitat types (Table 4, see Appendix).
- Phase 1 heathland habitats (D.1.1 dry acid heath, D.2 wet heath, D.3 lichen/bryophyte heath, D.5 dry heath/acid grassland mosaic and D.6 wet heath/acid grassland mosaic) were split into upland and lowland categories (using an altitude of 300m above sea level) to allow differential scoring.
- Lowland grassland habitats were scored by National Vegetation Classification type (Phase 2) (Rodwell 1992). Scores are presented in Table 5.
- NVC scores were used rather than Phase 1 wherever NVC data were available.
- Calaminarian grasslands were identified and scored using the NVC community *Festuca ovina–Minuartia verna* community (Rodwell 2000).
- Coastal habitats were scored by NVC (Rodwell 2000). Scores are presented in Table 5. NVC scores were used rather than Phase 1 wherever NVC habitat data were available.
- Phase 2 coverage of woodland and most upland communities was not sufficiently comprehensive to be used for comparative purposes, while phase 1 habitat types were considered adequate for heathland and mire communities, given the size of the datasets already in use. However, upland and lowland heath were differentiated.

2.6 Habitat scores were extracted for each grid cell first by deriving an average score for each habitat polygon in the Phase I (i.e. if multiple habitats were recorded for the polygon, each habitat was scored and the mean score for all habitats was calculated). For each grid cell the average score was taken for all Phase I habitat polygons that intersected the grid cell. Where both NVC habitat data and Phase I

habitat data were used within a single grid cell (4154 grid cells), the highest score was used.

Species Data

2.7 Incorporating species data is important as the habitat scores are somewhat simplistic on their own. For example, black grouse *Tetrao tetrix* gather in the spring to lek, and such lek sites are potentially vulnerable to disturbance. However the habitat (e.g. improved upland grassland often used for leks) may not itself be vulnerable and therefore has a low score. Such areas must therefore be highlighted another way.

2.8 However, including data on individual species presents a number of potential difficulties:

- Species records can be patchy, with individual records likely to be concentrated in areas with good survey coverage.
- There are many rare species which are vulnerable precisely because they are rarity. For example a species occurring in a single location is clearly vulnerable to any change in habitat, contamination incident or similar. Deriving a map of all rare species is would involve a huge dataset, and deciding which species (i.e. level of rarity) to include is challenging.
- For many species potentially vulnerable to impacts from recreation, assigning specific categories can be complex. For example, manx shearwater *Puffinus puffinus* and puffins *Fratercula arctica* are both seabirds that nest in burrows. Disturbance during the breeding season is potentially an issue for both species, while at any time of year, heavy trampling can result in destruction of burrows. For these two species disturbance and damage are therefore both issues. For fish species, such as Salmon *Salar salar* water quality is important. Trampling (for example paddling/wading in the river) at spawning sites may result in increased turbidity and damage to the habitat, plus increased sediment etc. in the water. For this species damage and contamination may therefore be impacts. Similar issues occur with some herptiles, for example natterjack toads *Epidalea calamita* tend to breed in small pools. Repeated disturbance of such pools, for example through dogs swimming, people paddling etc could result in direct damage to spawn and trampling of toadlets, and potentially increases turbidity and sediment load in the pools. In the case of natterjack toad, therefore such impacts could be categorised as damage, disturbance or contamination.

2.9 Our approach to species data is a pragmatic one: we include species data in a single series of maps entitled ‘disturbance and other species-specific impacts’. In this series we have included invertebrates, fish, mammals, birds and other animals that are potentially vulnerable to access impacts. We have included species for which features of their ecology (besides rarity in its own right) make them vulnerable. We have avoided including individual plant species as habitat scores necessarily reflect the vulnerability of plant species within the habitat. We have increased scores for grid cells in IPAs (see 2.6) in an attempt to capture key plant species more vulnerable

than the habitat within which they are found in the mapping process. By including all individual species records in a single layer, it will be relatively straightforward to review the species included and add more records/species at a later date if necessary.

2.10 Species data came from a variety of sources, with the primary source a database of protected species records provided by CCW/COFNOD, containing in the region of 350,000 species records. These records varied in the level of resolution at which the record was plotted, how they were plotted (most records were point data, records relating to 1km grid cells were plotted as 1km squares) and the information provided, for example some records were dated, others related to a period of multiple years, or a season within a particular year.

2.11 For all records in the data from COFNOD/CCW, the centroids of each record were extracted using MapInfo and transferred to an Access database together with the geo-spatial data allowing records to be easily re-plotted subsequently within the GIS. This meant that all records plotted as polygons (i.e. 1km squares) were subsequently treated as point data, with the record plotted at the centre of the square. Within Access, all records prior to 1995 (or where a year was not given) were removed, and records were assigned a season where possible (i.e. March – May categorised as spring, June – August as summer, September – November as autumn and December – February as winter). Additional species data were added from the following sources:

- Seabird 2000, downloaded from MAGIC. This takes the form of point data indicating central point of a stretch of coast or seabird colony. All Welsh sites were extracted and the centroids added to the database. A 500m buffer was drawn around all point records and any of our 500m grid cells falling within this radius were identified and the central point of the grid cell was added to the database along with the associated seabird data.

- National survey data for nightjar *Caprimulgus europaeus* and Dartford warbler *Sylvia undata.* Data from the last national surveys (2004 and 2006 respectively) were plotted as point data.

- Target bird data from RSPB: core area data relating to 1km grid cells with records of a selection of key woodland and farmland bird species. These data were transferred to 500m cells by adding the centroids for all 500m grid cells within the core areas for each bird species to the Access Database.

Damage

2.12 We define damage as direct damage to vegetation through wear, loss of vegetation cover to expose bare soil and loss/damage of soil through erosion. Damage occurs as a result of footfall and abrasion from wheels.

2.13 The datasets used to derive the damage scores are summarised in Table 1. The following steps were used to derive the scores:

2.14 **Habitat Score:** Each grid cell was given a score to indicate relative vulnerability of the habitats present to damage. Scores were derived as outlined in section 2.5, and ranged from 0-5. In addition, the score of any woodland polygons identified within the Ancient Woodland Inventory for Wales was increased by one point (section 0), as were those habitat polygons within an IPA, where the habitat types was listed as a qualifying feature of the IPA.

2.15 **Soil Data**: Certain types of soil are particularly vulnerable to damage. Soil data in the form of "Natmap", vector data provided under licence by CCW were used to determine which grid cells contained potentially sensitive soils were identified. The following soil types were considered potentially vulnerable:

- Peat/organic soils (5,265 cells) (1013 Raw oligo-amorphous peat soils, 1022 Earthy eu-fibrous peat soils, 1024 Earthy eutro -amorphous peat soils);
- Peaty/organo-mineral soils (13,300 cells) (721 Cambic stagnohumic gley soils
- 871 Typical humic gley soils);
- Lithomorphic soils (3,870 cells) (311 Humic rankers, 313 Brown rankers, 361 Typical sand-pararendzinas

2.16 Where any of the above soil types were present within a grid cell, the habitat score for that cell was multiplied by 1.5.

2.17 **Slope**: The initial review identified slopes as a further factor that influenced level of damage. Slope data were provided by CCW on a 1km grid, with information on the maximum, minimum and average slope angle within each 1km grid cell. We used these data to identify 500m grid cells that were within 1km grid cells where the average slope angle was above 20 degrees. Twenty-degrees was chosen based on the information in the literature review. Where slopes above 20 degrees were identified, the score for the grid cell was increased multiplying by a further 1.5.

Table 1 Datasets used to derive the damage scores

Dataset	Information extracted	Notes/Source
Natmap vector data	Where polygons within Natmap data intersect grid cells	Cranfield, supplied under licence by CCW
Habitat Survey of Wales	Phase 1 habitat types for each grid cell	CCW
Ancient and semi-natural woodland dataset	Where grid cells fall within areas of ancient woodland	CCW
NVC lowland grassland survey	NVC habitats for each grid cell	CCW
NVC sand dune survey	NVC habitats for each grid cell	CCW
NVC saltmarsh survey	NVC habitats for each grid cell	CCW
NVC Calaminarian Grassland data	NVC habitats for each grid cell	CCW
CCW upland boundary	Data file of 201 polygons representing upland areas. This used to split upland and lowland heathland	CCW

Contamination

2.18 Contamination refers to the impacts of nutrient enrichment, for example through dog fouling, and also littering. The spread of exotic/non-native species were considered under this heading in the original literature review but are not considered within the vulnerability maps as it was considered that this issue is too difficult to map in a systematic way.

2.19 As with damage, each grid cell was given a score to indicate relative vulnerability of the habitats present to contamination. Scores were derived as outlined in section 2.5 - 0. The expert-derived scores for contamination showed no variation with season, and therefore a single map was produced for contamination.

Fire

2.20 By fire, we refer to the impact of fires caused either deliberately by members of the public or accidentally (e.g. sparks from barbeques etc.). We considered the impact of a medium intensity fire, assuming a medium risk of occurrence.

2.21 As for both damage and contamination, each grid cell was given a score to indicate relative vulnerability of the habitats present to fire. Scores were derived as outlined in section 2.5 - 0. The expert-derived scores for contamination showed no variation with season, and therefore a single map was produced for contamination.

2.22 Scores for peaty and lithomorphic soils (but not peaty/organo-mineral soils) were incorporated as in section 2.15

Disturbance and species-specific impacts

2.23 By disturbance we mean the impact on the behaviour or survival of an animal as a result of recreational activity. In mapping this impact we there focus on mapping the presence/absence of relevant species at the relevant times of year.

2.24 In addition, a selection of species were identified through discussion with relevant experts or through the original literature review as being particularly vulnerable to damage and/or contamination. Lists of species were circulated to a range of species experts and comparative scores for the vulnerability of the species in a given season derived, with the scores ranging from 0-5 (as with the habitat scores). All species used are listed in Table 2. Distribution data for these species were extracted from the dataset of protected species records provided by CCW/COFNOD (see section 2.7 onwards) and the other species datasets used. Where multiple species records occurred within a grid cell the maximum score was used, therefore the highest score for any cell was 5. This was done for all seasons, i.e. it was assumed that trampling damage (for example of puffin burrows) would have a similar impact in the winter as the spring.

2.25 For grid cells that contained any records of any of the above species, the habitat score was increased by 1.

Table 2: Species mapped and relevant scores. The common species names and scientific names are those used in the CCW/COFNOD species database. We have listed species in alphabetical order (according to common name), within each taxa.

Species	Scientific name	Spring	Summer	Autumn	Winter	Reason why species is included	Data source/how species is mapped
BIRDS							
Arctic Tern	*Sterna paradisaea*	5	4	0	0	Tern colonies vulnerable to disturbance and trampling of eggs.	All breeding records from COFNOD/CCW database combined with seabird 2000 data.
Black Grouse	*Tetrao tetrix*	3	3	2	2	Leks and nest sites	All records from COFNOD/CCW database combined with RSPB target bird area data. Records not split by season
Common Tern	*Sterna hirundo*	5	4	0	0	Tern colonies vulnerable to disturbance and trampling of eggs.	All breeding records from COFNOD/CCW database combined with seabird 2000 data.
Dartford Warbler	*Sylvia undata*	3	3	1	1	Work in Dorset shows breeding success lower in areas with high disturbance	All records from COFNOD/CCW database combined with national survey records (territory centres, 2006).
Eurasian Curlew	*Numenius arquata*	4	3	2	2	Nest sites and winter feeding/roosts of principal concern	All records from COFNOD/CCW database extracted, records separated by season. RSPB target bird area data included to generate spring and summer scores.
European Golden Plover	*Pluvialis apricaria*	4	3	2	2	Nest sites and winter feeding/roosts of principal concern	All records from COFNOD/CCW database extracted, records separated by season. RSPB target bird area data included to generate spring and summer scores.
European Nightjar	*Caprimulgus europaeus*	3	3	0	0	breeding sites - disturbance around nests	All records from COFNOD/CCW database combined with national survey records (territory centres,

Species	Scientific name	Spring	Summer	Autumn	Winter	Reason why species is included	Data source/how species is mapped
							2004) and the RSPB target bird area data
Guillemot	*Uria aalge*	3	3	0	0	Breeding colonies shown to be vulnerable to disturbance	All breeding records from COFNOD/CCW database combined with seabird 2000 data.
Hen Harrier	*Circus cyaneus*	4	3	2	3	Nest sites and communal roosts	All records from COFNOD/CCW database extracted, records separated by season.
Kittiwake	*Rissa tridacyla*	2	2	0	0	Breeding colonies shown to be vulnerable to disturbance	All records from COFNOD/CCW database combined with seabird 2000 data.
Little Plover	*Charadrius dubius*	3	2	0	0	Good evidence of disturbance impacts for ringed plover, little ringed plover probably similar	All records from COFNOD/CCW database.
Little Tern	*Sternula albifrons*	5	4	0	0	Nest sites - colonies	All records from COFNOD/CCW database combined with seabird 2000 data.
Manx Shearwater	*Puffinus puffinus*	3	3	1	1	Winter score indicates damage from trampling of burrows	All records from COFNOD/CCW database combined with seabird 2000 data.
Merlin	*Falco columbarius*	4	3	2	1	Winter roosts and nest sites vulnerable to disturbance	All records from COFNOD/CCW database extracted, records separated by season.
Northern Goshawk	*Accipiter gentilis*	2	1	0	0	Nest sites vulnerable to disturbance	Records from CAFNOC/CCW database, only using records for spring/summer/breeding
Northern Lapwing	*Vanellus vanellus*	4	3	1	2	Few remaining breeding pairs, occurs in various habitats. Disturbance potentially particularly an issue during breeding.	All records from COFNOD/CCW database combined with RSPB target bird area data. Records split by season
Peregrine Falcon	*Falco peregrinus*	3	2	0	0	Nest sites possibly vulnerable	All records from COFNOD/CCW database extracted, records separated by season – only breeding

Species	Scientific name	Spring	Summer	Autumn	Winter	Reason why species is included	Data source/how species is mapped
							records used
Puffin	*Fratercula arctica*	3	3	1	1	Winter score indicates damage from trampling of burrows	All records from COFNOD/CCW database combined with seabird 2000 data.
Red Kite	*Milvus milvus*	3	3	0	0	Concern re nest sites only	All records from COFNOD/CCW database extracted, records separated by season – only breeding records used.
Red-billed Chough	*Pyrrhocorax pyrrhocorax*	3	3	3	2	Work in Brittany indicates population consequences of disturbance.	All records from COFNOD/CCW database combined with RSPB target bird area data. Records not split by season.
Ringed Plover	*Charadrius hiaticula*	4	3	2	2	Breeding and wintering - e.g. Roosts	All records from COFNOD/CCW database extracted, records separated by season.
Sandwich Tern	*Sterna sandvicensis*	5	4	0	0	Tern colonies vulnerable to disturbance and trampling of eggs.	All breeding records from COFNOD/CCW database combined with seabird 2000 data.
Skylark	*Alauda arvensis*	2	2	1	1	Ground nesting species, potentially vulnerable to dogs, disturbance etc.	Records from CAFNOC/CCW database, records attributed to season
Willow Ptarmigan	*Lagopus lagopus*	2	1	0	0	Identified by experts as potentially of concern re disturbance	All records from COFNOD/CCW database combined with RSPB target bird area data. Records not split by season.
Wintering waterfowl		0	0	2	4	A range of studies show wintering waterfowl to be vulnerable to disturbance	WEBS data used to identify sites with waterfowl numbers above 10,000 (i.e. national importance).
FISH							

Species	Scientific name	Spring	Summer	Autumn	Winter	Reason why species is included	Data source/how species is mapped
Atlantic Salmon	*Salmo salar*	1	0	1	1	Spawning sites of concern, potentially vulnerable to trampling/disturbance of sediment	All records from COFNOD/CCW database.
Powan	*Coregonus lavaretus*	0	0	0	2	Spawning sites of concern, potentially vulnerable to trampling/disturbance of sediment	All records from COFNOD/CCW database.
River Lamprey	*Lampetra fluviatilis*	2	0	0	0	Spawning sites of concern, potentially vulnerable to trampling/disturbance of sediment	All records from COFNOD/CCW database.
Sea Lamprey	*Petromyzon marinus*	2	0	0	0	Spawning sites of concern, potentially vulnerable to trampling/disturbance of sediment	All records from COFNOD/CCW database.
Twaite Shad	*Alosa fallax*	0	1	0	0	Spawning sites of concern, potentially vulnerable to trampling/disturbance of sediment	All records from COFNOD/CCW database.
HERPTILES							
Adder	*Vipera berus*	4	4	3	0	Issues include deliberate killing, disturbance while basking; winter deep underground	All records from COFNOD/CCW database.
Natterjack Toad	*Epidalea calamita*	3	2	1	0	Spawning sites potentially vulnerable, dogs can damage spawn (e.g. Edgar 2002)	All records from COFNOD/CCW database.
Sand Lizard	*Lacerta agilis*	5	5	3	0	Reintroduction. Eggs can be destroyed by heavy trampling. Basking individuals vulnerable to disturbance in cool weather.	All records from COFNOD/CCW database.
MAMMALS							
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	1	1	5	5	Hibernacula and breeding sites – caves vulnerable to disturbance	All records from COFNOD/CCW database.
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	1	1	5	5	Hibernacula and breeding sites - caves	All records from COFNOD/CCW database.
European Otter	*Lutra lutra*	3	3	3	3	Holts and dens only of concern	All records of artificial holts, natural holts etc. extracted from CCW/COFNOD database

Species	Scientific name	Spring	Summer	Autumn	Winter	Reason why species is included	Data source/how species is mapped
INVERTEBRATES							
Pale Pin-pal	*Bembidion testaceum*					A beetle associated with riverine shingle where trampling is potentially an issue (Bates, Sadler, & Fowles 2006)	All records from COFNOD/CCW database.
Belted Beauty	*Lycia zonaria*	3	3	0	0	Identified in the original review, trampling may damage habitat. Trampling is listed as a threat in the BAP for this species.	All records from COFNOD/CCW database.
Shrill Carder Bee	*Bombus sylvarum*	1	1	0	0	identified in the original review, trampling may damage habitat	All records from COFNOD/CCW database.
A diving beetle	*Bidessus minutissimus*	1	1	1	0	A beetle associated with riverine shingle where trampling is potentially an issue (Bates, Sadler, & Fowles 2006)	All records from COFNOD/CCW database.
A rove beetle	*Meotica anglica*	1	1	1	0	Associated with riverine shingle where trampling is potentially an issue (Bates, Sadler, & Fowles 2006); listed in it's BAP as threatened by sediment in freshwater	All records from COFNOD/CCW database.
MOLLUSCS/CRAYFISH							
Depressed river mussel	*Pseudanodonta complanata*	1	1	1	1	Llisted in it's BAP as threatened by sediment in freshwater	All records from COFNOD/CCW database.
Freshwater Crayfish	*Austropotamobius pallipes*	1	2	1	0	Contamination and increased sediment an issue	All records from COFNOD/CCW database.
Freshwater Pearl Mussel	*Margaritifera margaritifera*	1	1	1	1	scored by Reynolds *et al.* (2004)as high sensitivity to increased suspended sediment load or soluble reactive phosphorous in the water; contamination/fouling therefore potentially an issue	All records from COFNOD/CCW database.
Geyer's Whorl Snail	*Vertigo geyeri*					Trampling often cited as an issue[1]	All records from COFNOD/CCW database.

[1] e.g. http://www.npws.ie/en/media/Media,6119,en.pdf

3. The Scores and the Maps

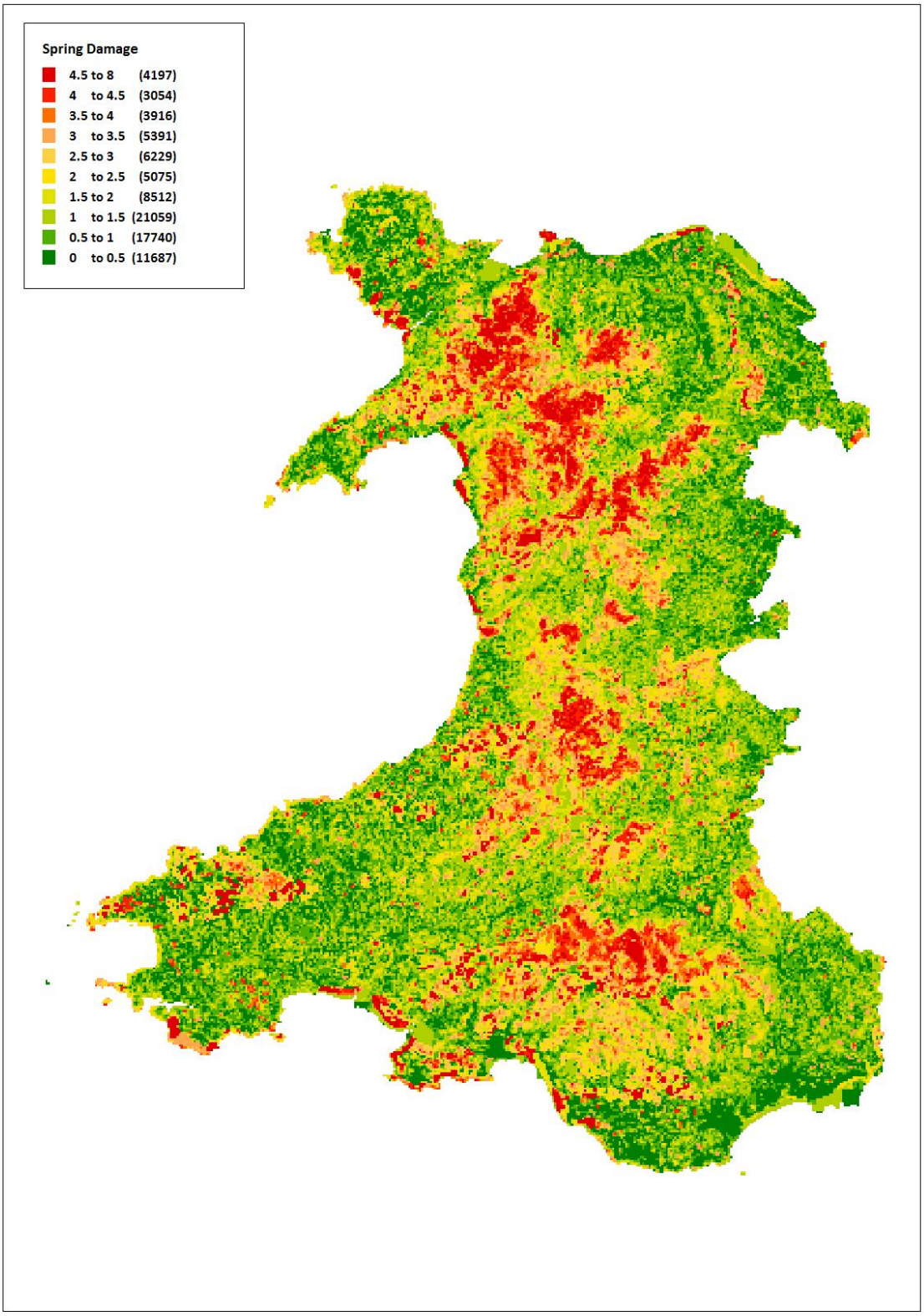
3.1 Twenty-one different maps were generated, using the 500m grid (containing 86,860 cells). These maps are shown subsequently within this section. The ranges and median values for each map showing the scores etc. and the order in which the maps are shown, is summarised in Table 3 below.

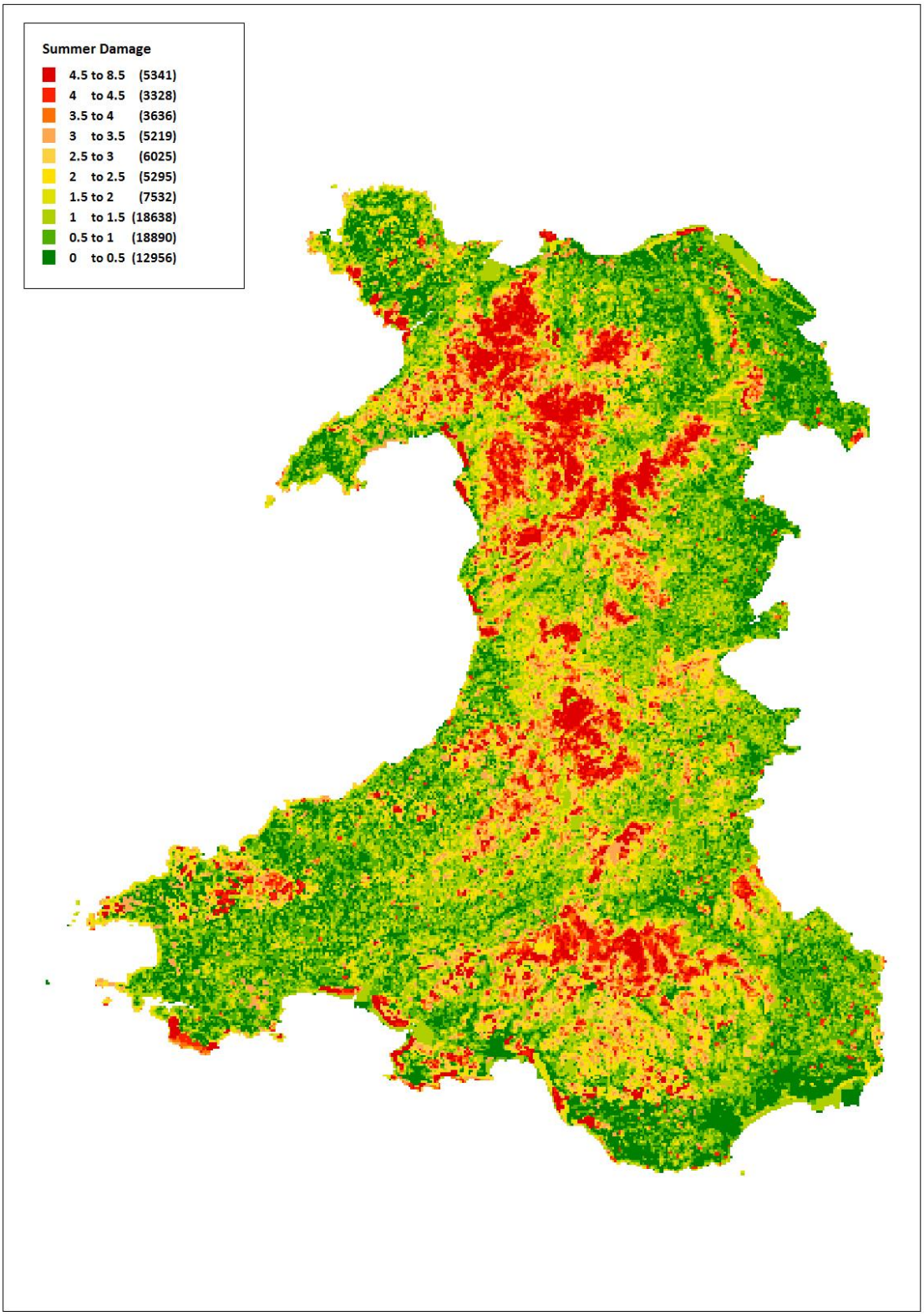
Table 3: Summary of maps

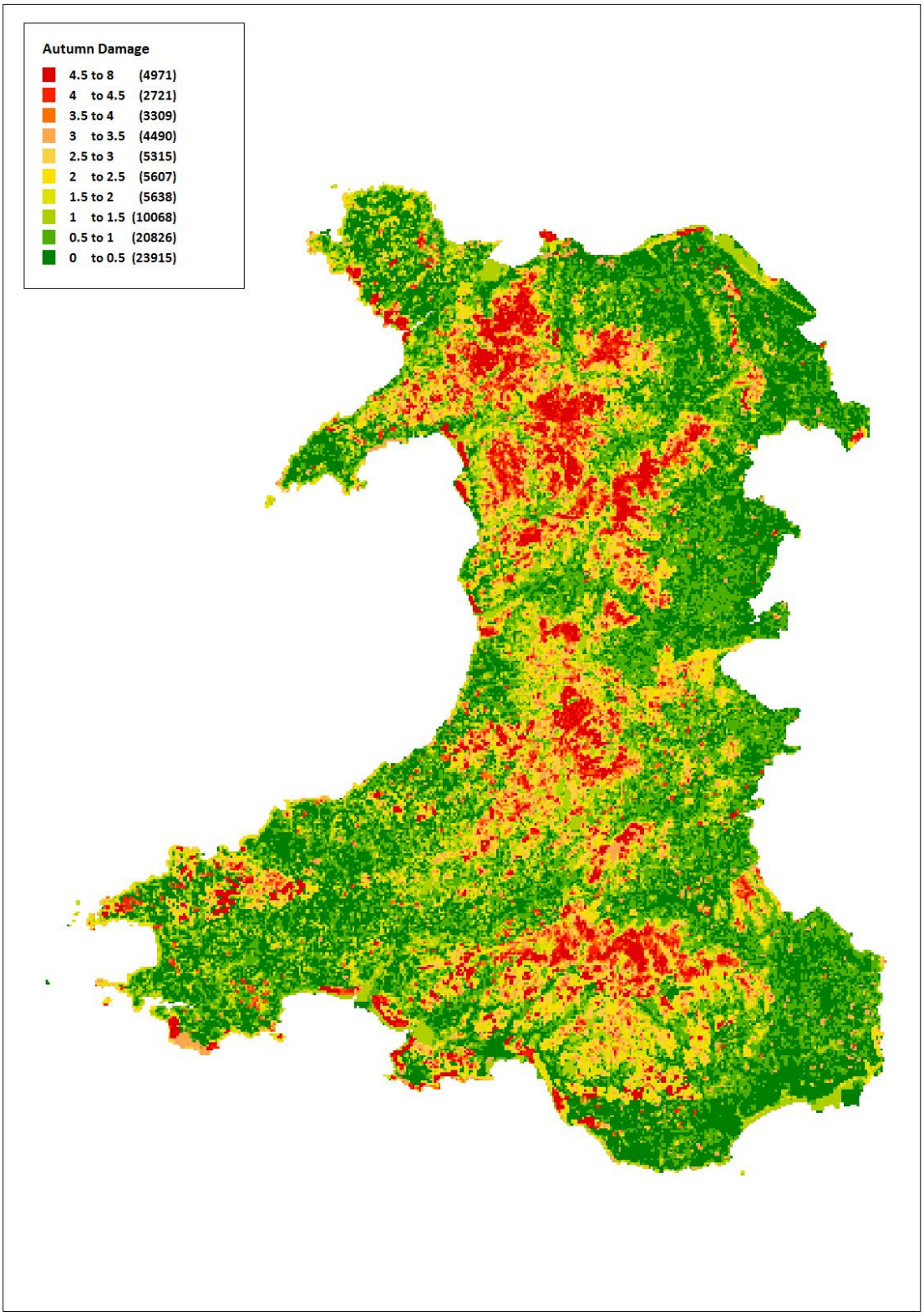
Page	Impact	Season	min	max	median
12	Damage	Spring	0	7.86	1.25
13	Damage	Summer	0	8	1.2
14	Damage	Autumn	0	7.9	0.9
15	Damage	Winter	0	6.68	1.5
16	Damage	All	0	36	5.14
17	Fire	Spring	0	12.1	2.81
18	Fire	Summer	0	9.45	2.07
19	Fire	Autumn	0	8.86	1.23
29	Fire	Winter	0	8.45	1.2
21	Fire	All	0	40.98	7.35
22	Contamination	All	0	5	1.62
23	Disturbance	Spring	0	5	0
24	Disturbance	Summer	0	5	0
25	Disturbance	Autumn	0	5	0
26	Disturbance	Winter	0	5	0
27	Disturbance	All	0	19	0
28	All	Spring	0	24.9	6.29
29	All	Summer	0	21.64	5.39
30	All	Autumn	0	21	3.98
31	All	Winter	0	22.63	4.56
32	All	All	0	87.81	15.4

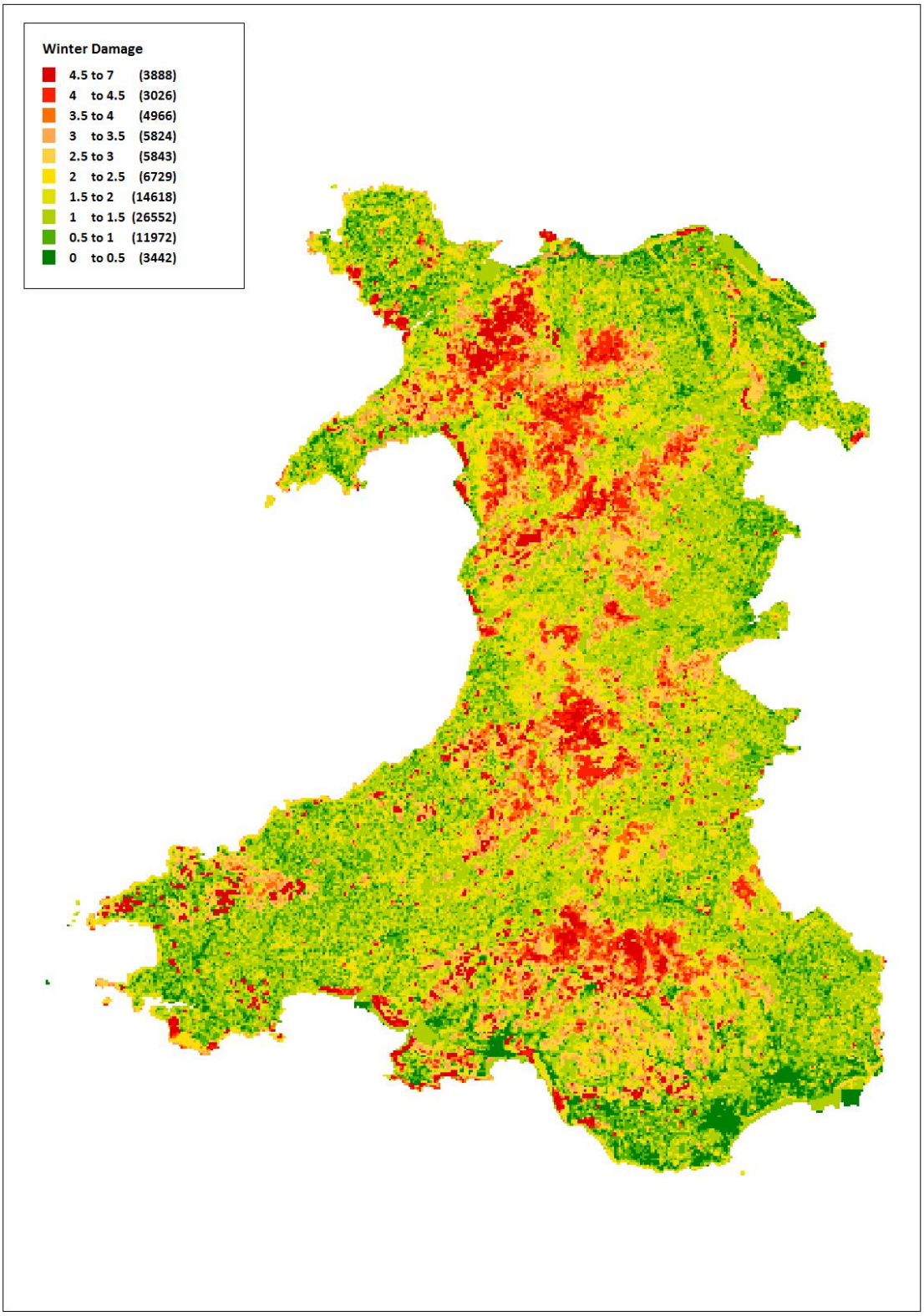
3.2 On page 33 an additional map simply provides context, showing place names, national parks and SSSIs.

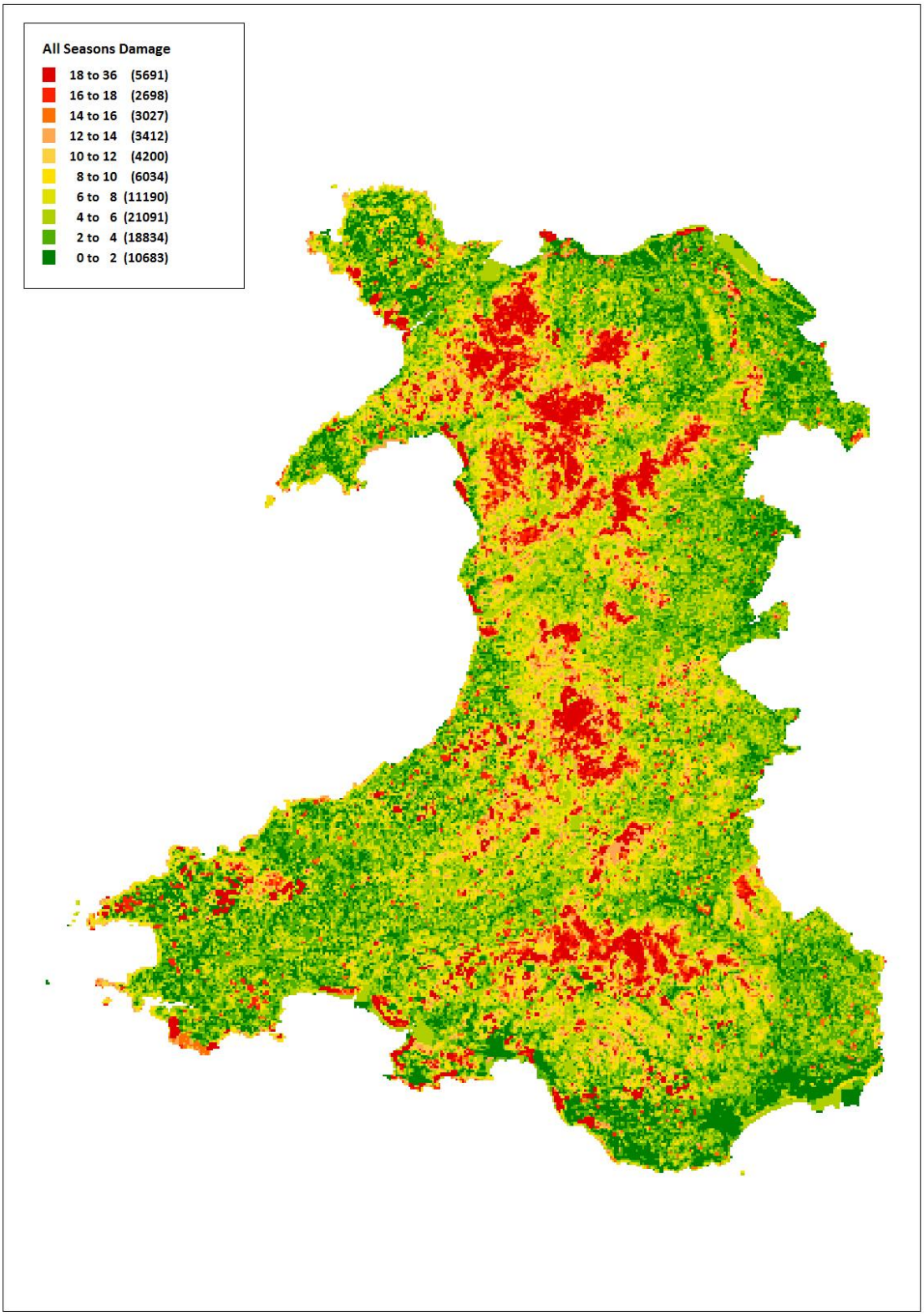
3.3 The maps are plotted using a standard set of colours applied to each map. The desicions at which to set the colour changes are in some ways fairly arbitrary. We have been consistent across groups of maps, applying the same colours at similar scores.

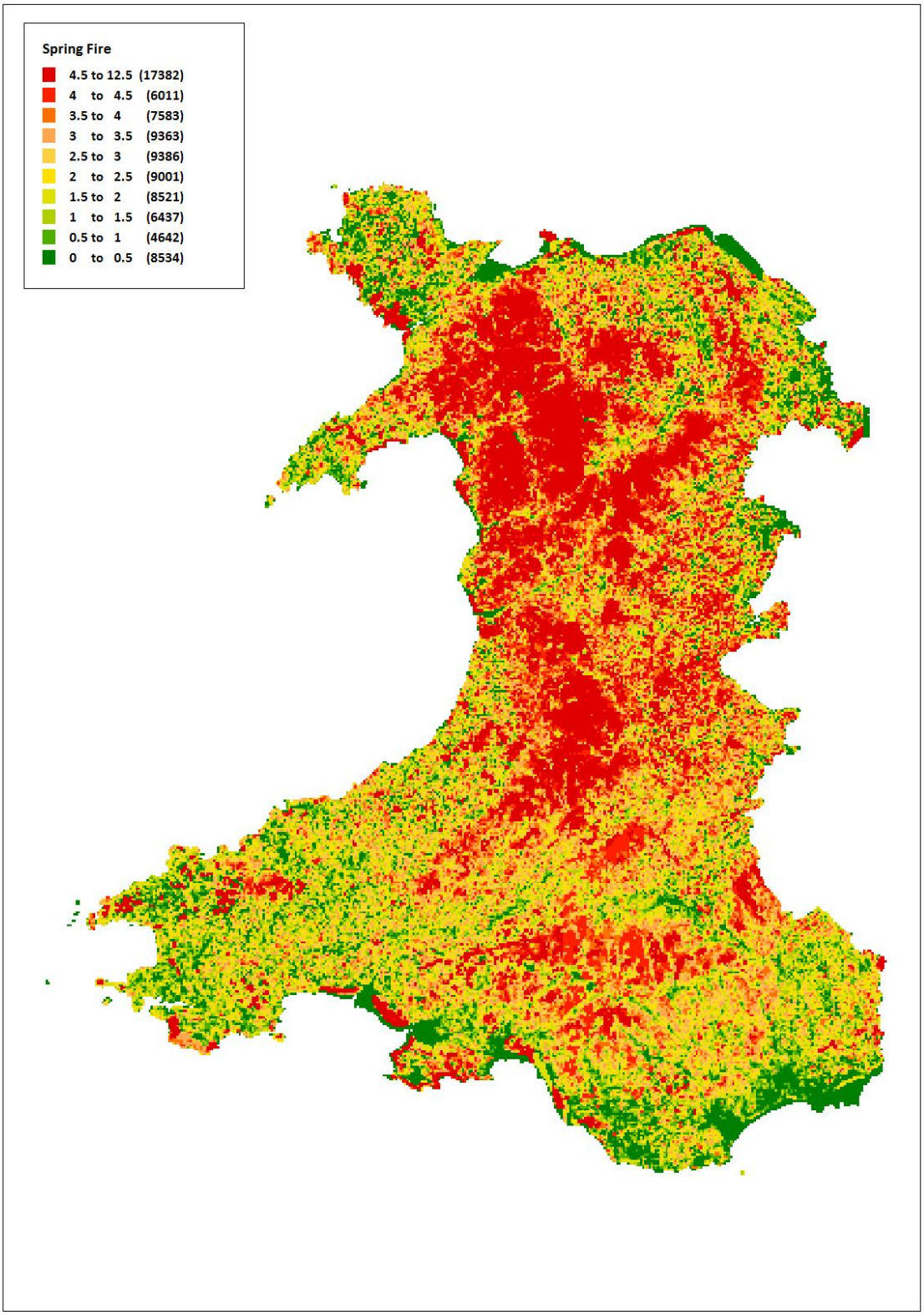

Spring Damage
4.5 to 8 (4197)
4 to 4.5 (3054)
3.5 to 4 (3916)
3 to 3.5 (5391)
2.5 to 3 (6229)
2 to 2.5 (5075)
1.5 to 2 (8512)
1 to 1.5 (21059)
0.5 to 1 (17740)
0 to 0.5 (11687)

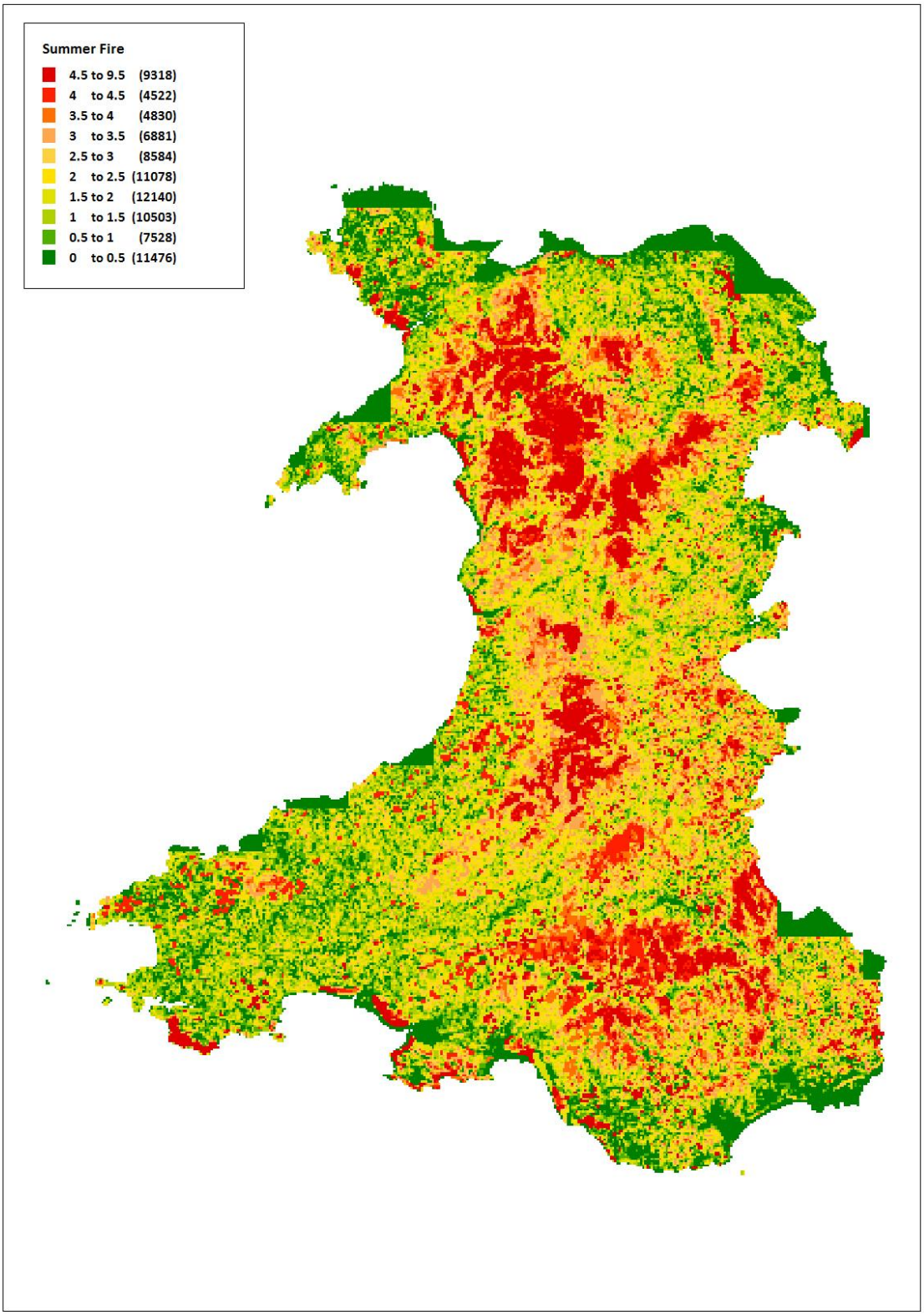

Summer Damage
4.5 to 8.5 (5341)
4 to 4.5 (3328)
3.5 to 4 (3636)
3 to 3.5 (5219)
2.5 to 3 (6025)
2 to 2.5 (5295)
1.5 to 2 (7532)
1 to 1.5 (18638)
0.5 to 1 (18890)
0 to 0.5 (12956)

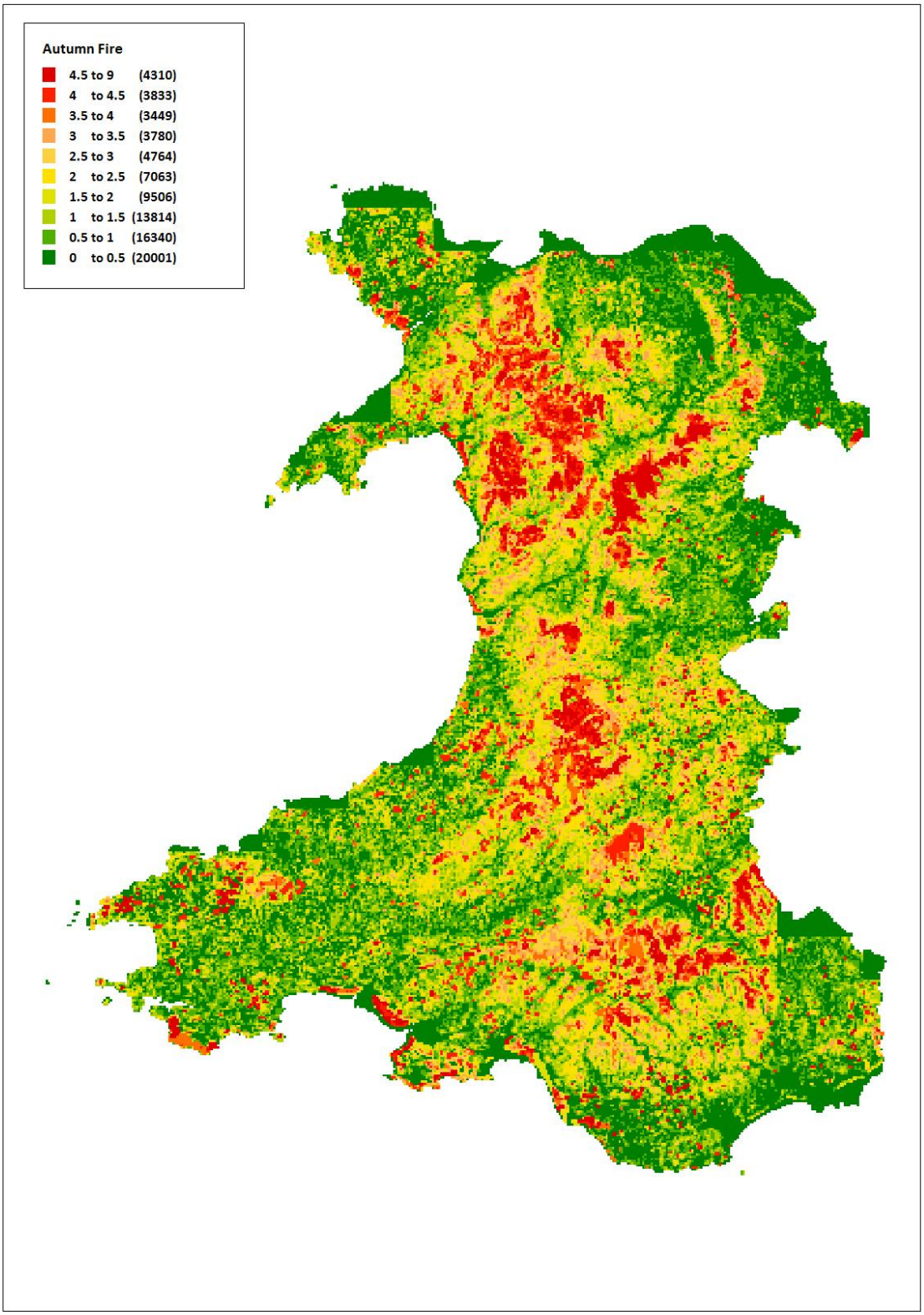

Autumn Damage
4.5 to 8 (4971)
4 to 4.5 (2721)
3.5 to 4 (3309)
3 to 3.5 (4490)
2.5 to 3 (5315)
2 to 2.5 (5607)
1.5 to 2 (5638)
1 to 1.5 (10068)
0.5 to 1 (20826)
0 to 0.5 (23915)

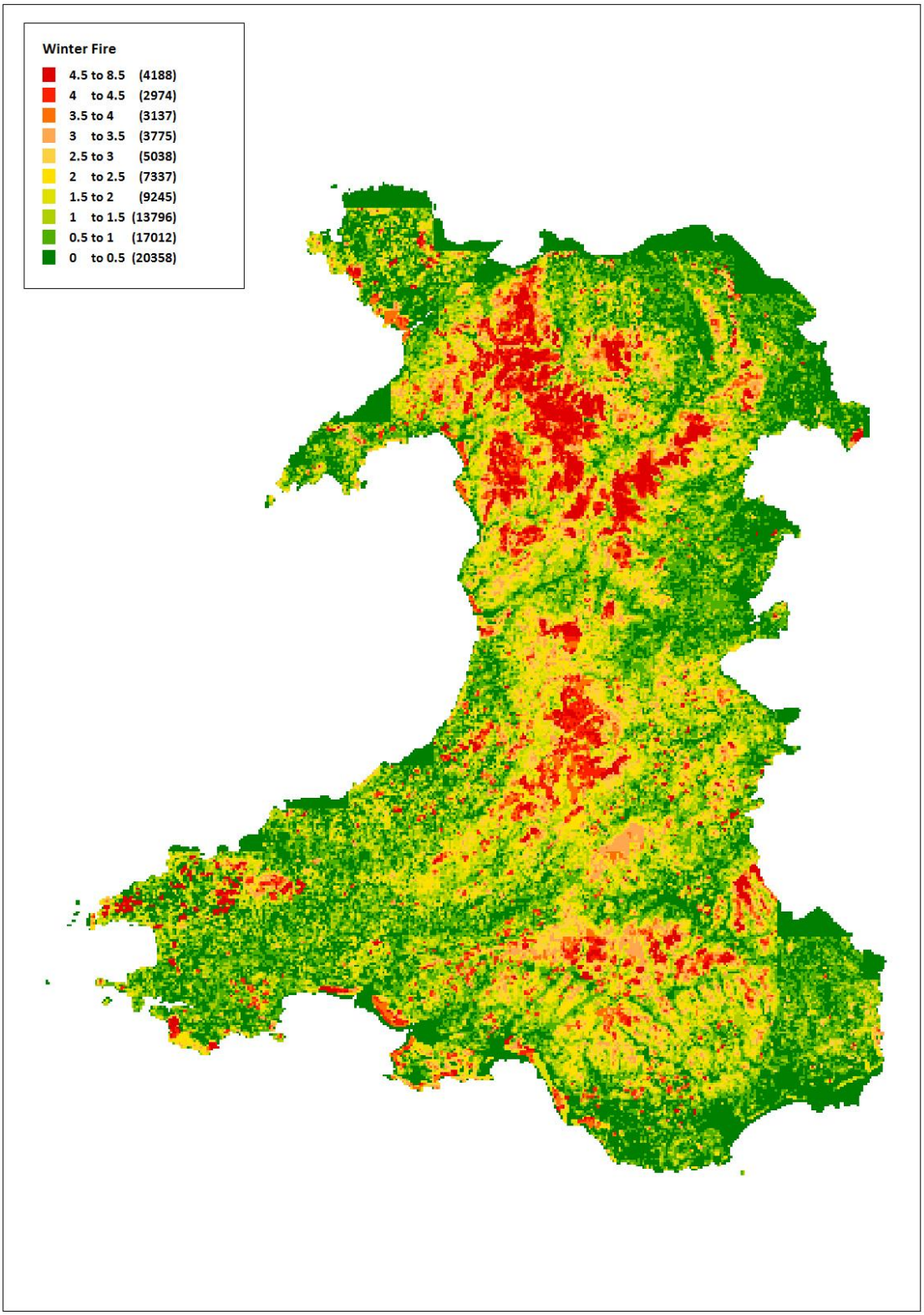

Winter Damage
4.5 to 7 (3888)
4 to 4.5 (3026)
3.5 to 4 (4966)
3 to 3.5 (5824)
2.5 to 3 (5843)
2 to 2.5 (6729)
1.5 to 2 (14618)
1 to 1.5 (26552)
0.5 to 1 (11972)
0 to 0.5 (3442)

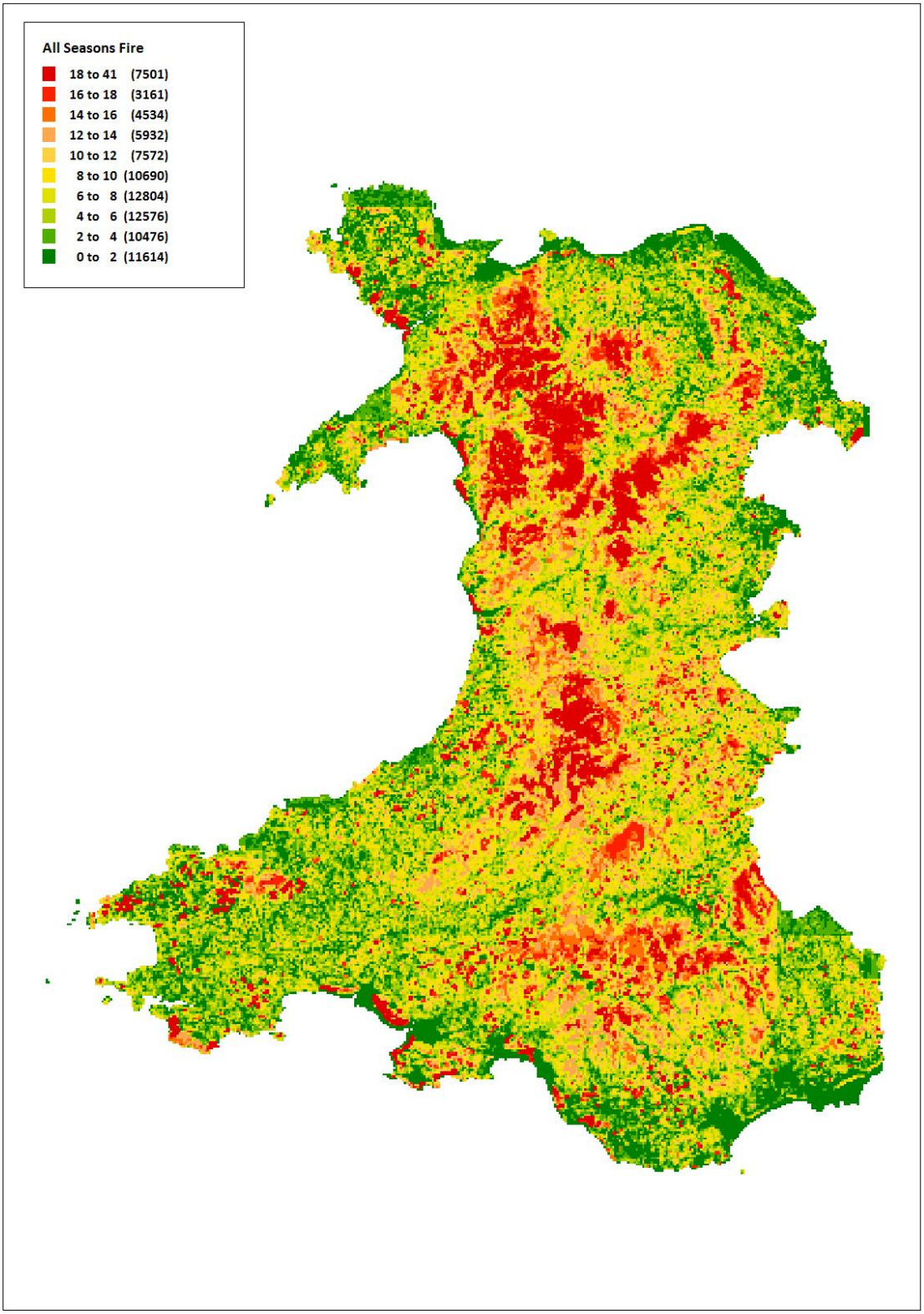

All Seasons Damage
18 to 36 (5691)
16 to 18 (2698)
14 to 16 (3027)
12 to 14 (3412)
10 to 12 (4200)
8 to 10 (6034)
6 to 8 (11190)
4 to 6 (21091)
2 to 4 (18834)
0 to 2 (10683)

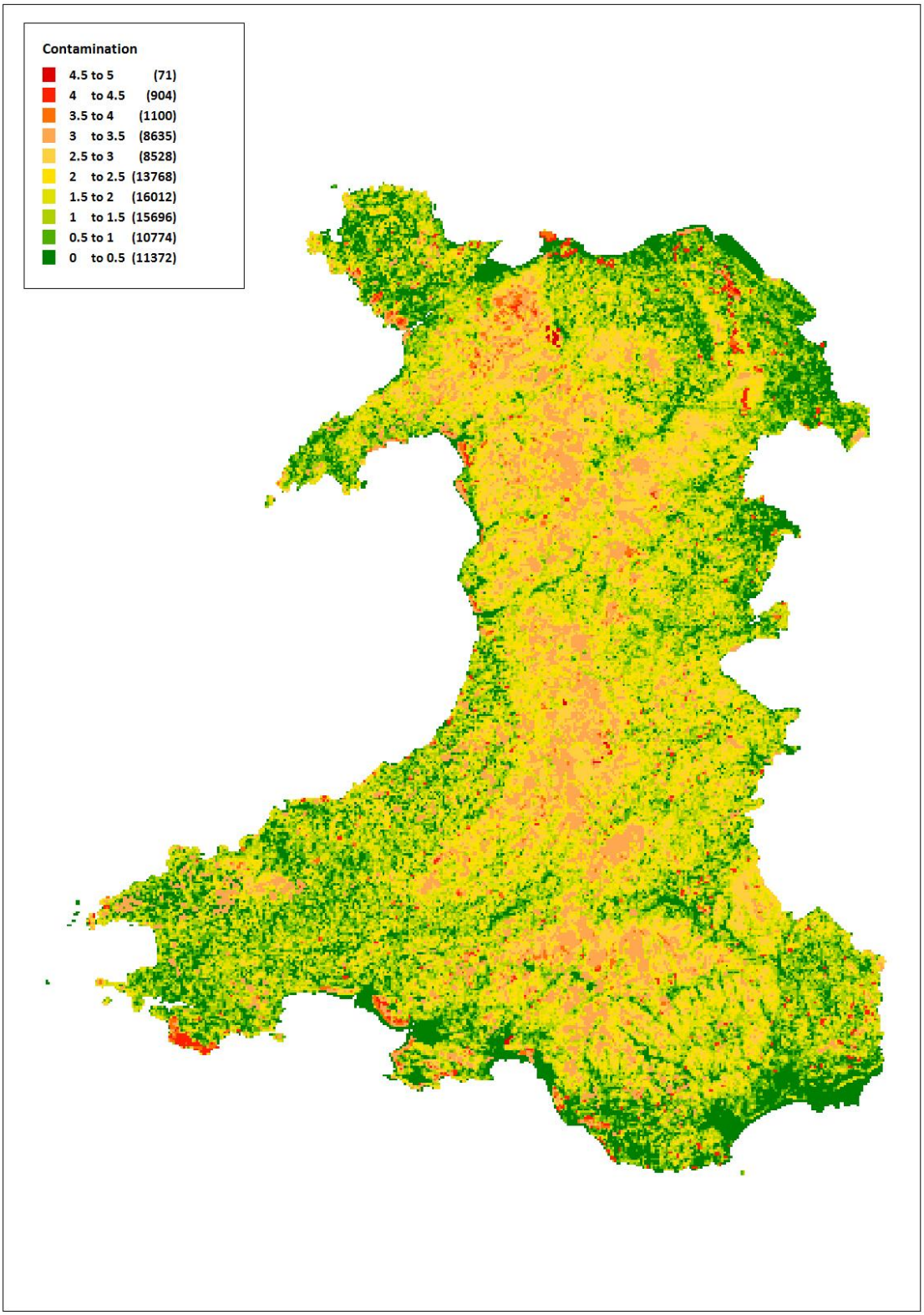

Spring Fire
4.5 to 12.5 (17382)
4 to 4.5 (6011)
3.5 to 4 (7583)
3 to 3.5 (9363)
2.5 to 3 (9386)
2 to 2.5 (9001)
1.5 to 2 (8521)
1 to 1.5 (6437)
0.5 to 1 (4642)
0 to 0.5 (8534)

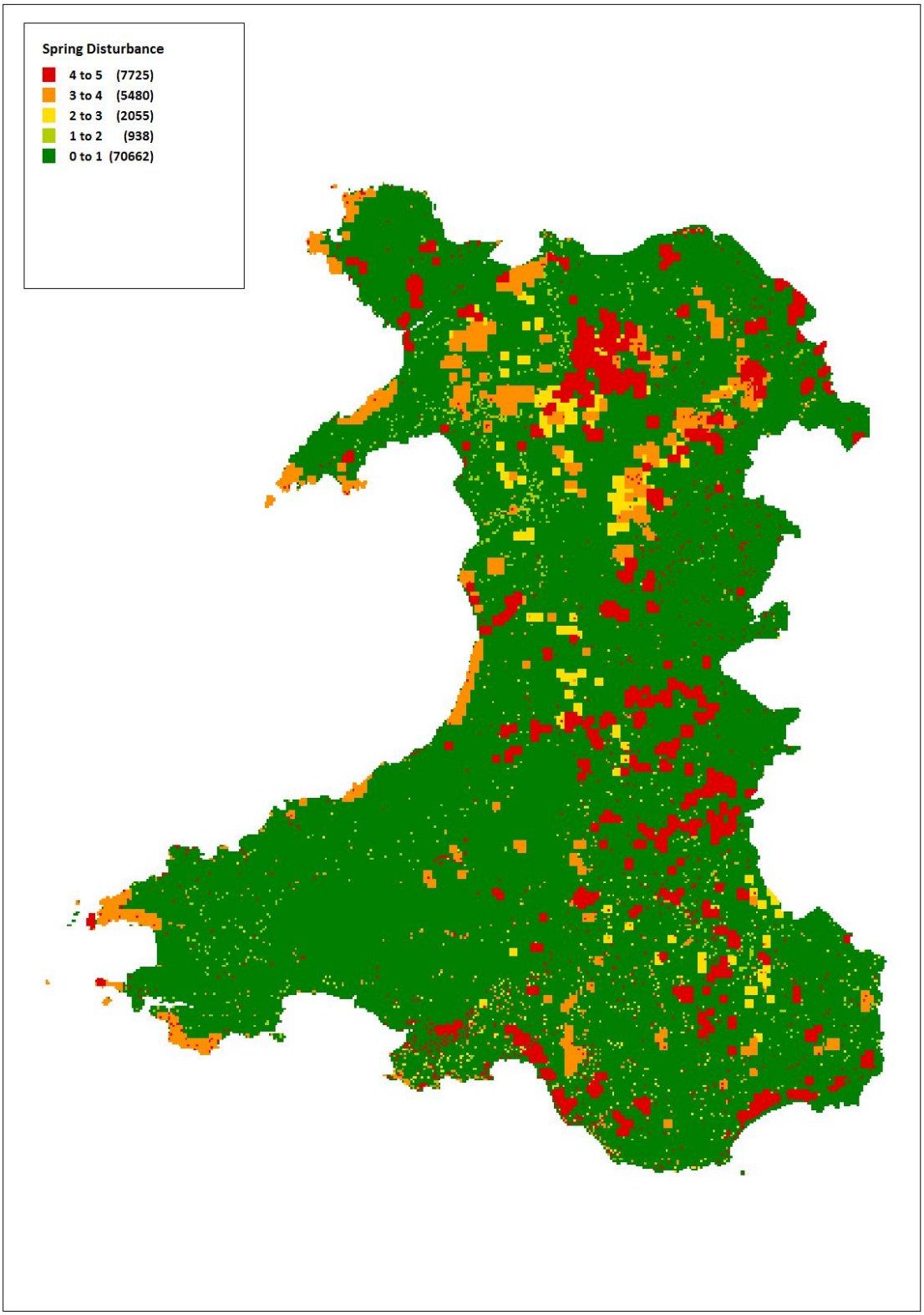

Summer Fire
4.5 to 9.5 (9318)
4 to 4.5 (4522)
3.5 to 4 (4830)
3 to 3.5 (6881)
2.5 to 3 (8584)
2 to 2.5 (11078)
1.5 to 2 (12140)
1 to 1.5 (10503)
0.5 to 1 (7528)
0 to 0.5 (11476)

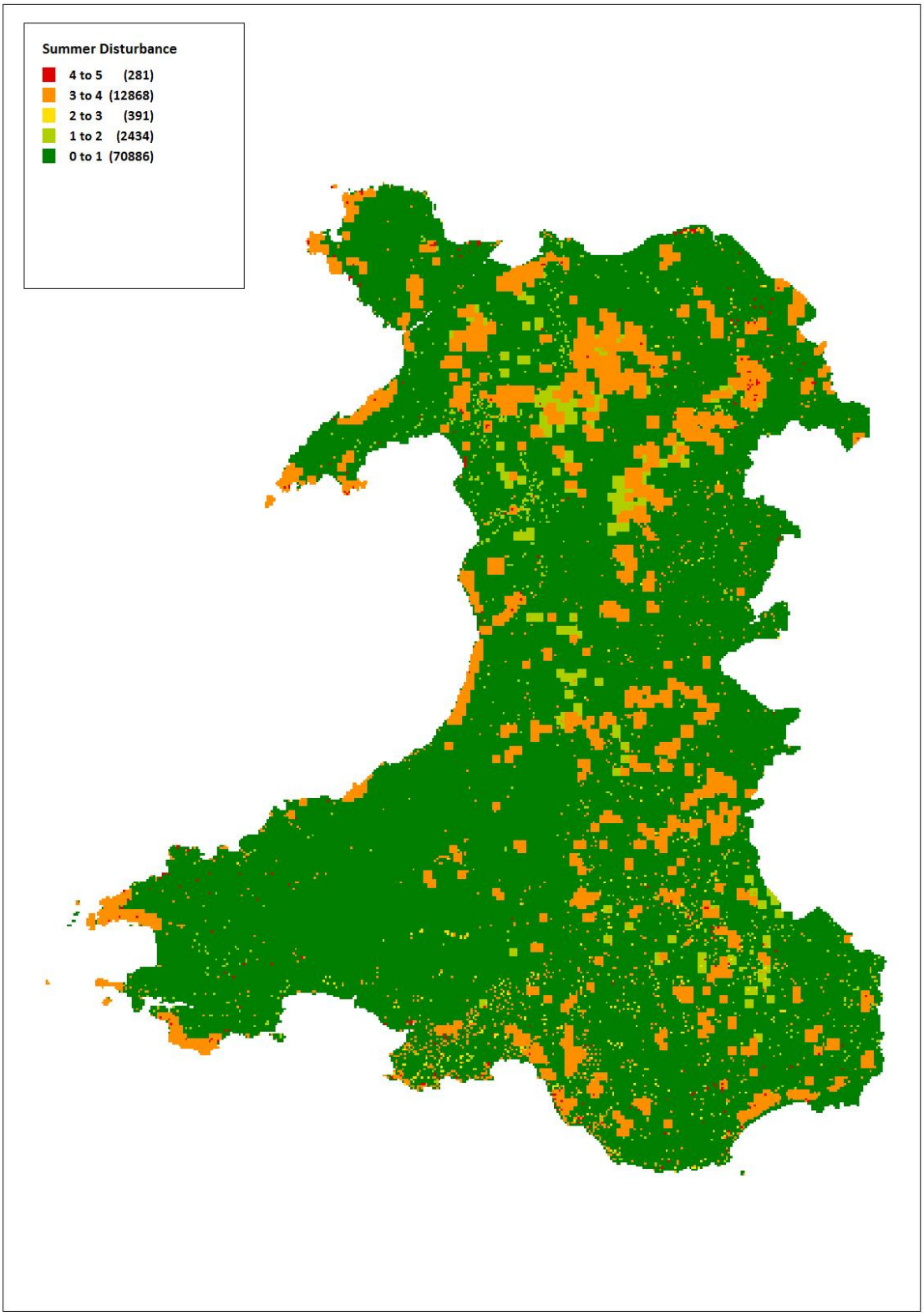

Autumn Fire
4.5 to 9 (4310)
4 to 4.5 (3833)
3.5 to 4 (3449)
3 to 3.5 (3780)
2.5 to 3 (4764)
2 to 2.5 (7063)
1.5 to 2 (9506)
1 to 1.5 (13814)
0.5 to 1 (16340)
0 to 0.5 (20001)

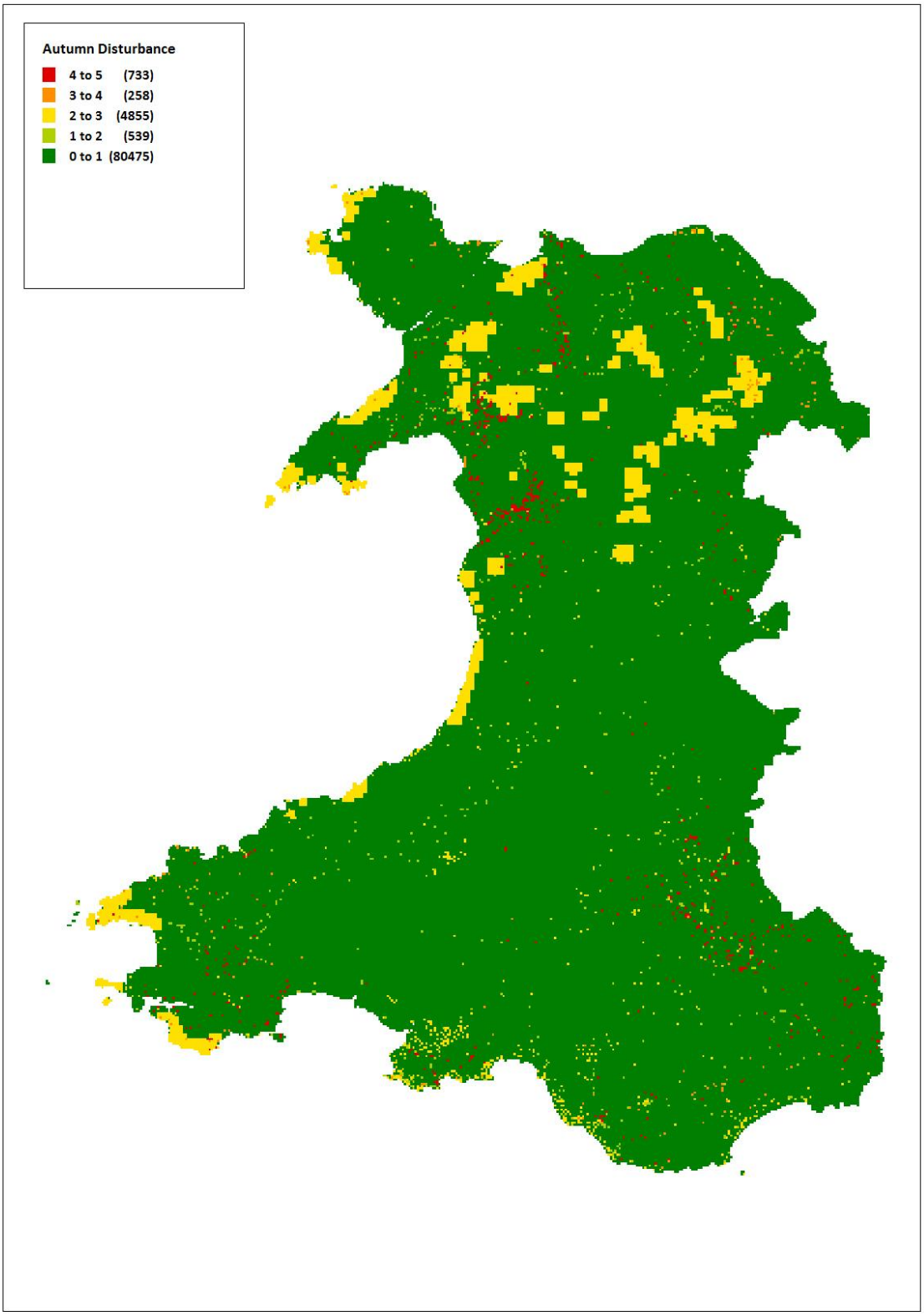

Winter Fire
4.5 to 8.5 (4188)
4 to 4.5 (2974)
3.5 to 4 (3137)
3 to 3.5 (3775)
2.5 to 3 (5038)
2 to 2.5 (7337)
1.5 to 2 (9245)
1 to 1.5 (13796)
0.5 to 1 (17012)
0 to 0.5 (20358)

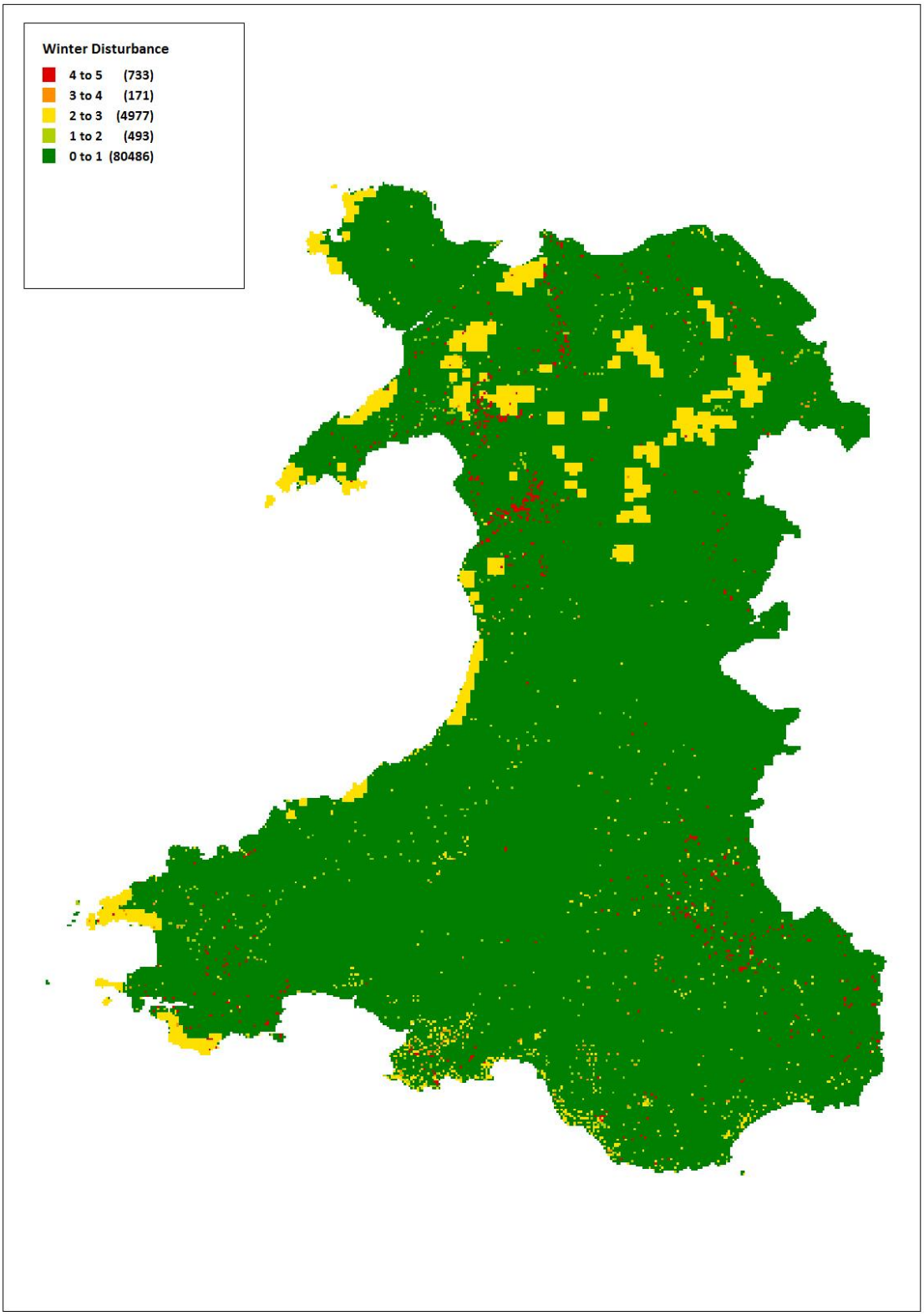

All Seasons Fire
18 to 41 (7501)
16 to 18 (3161)
14 to 16 (4534)
12 to 14 (5932)
10 to 12 (7572)
8 to 10 (10690)
6 to 8 (12804)
4 to 6 (12576)
2 to 4 (10476)
0 to 2 (11614)

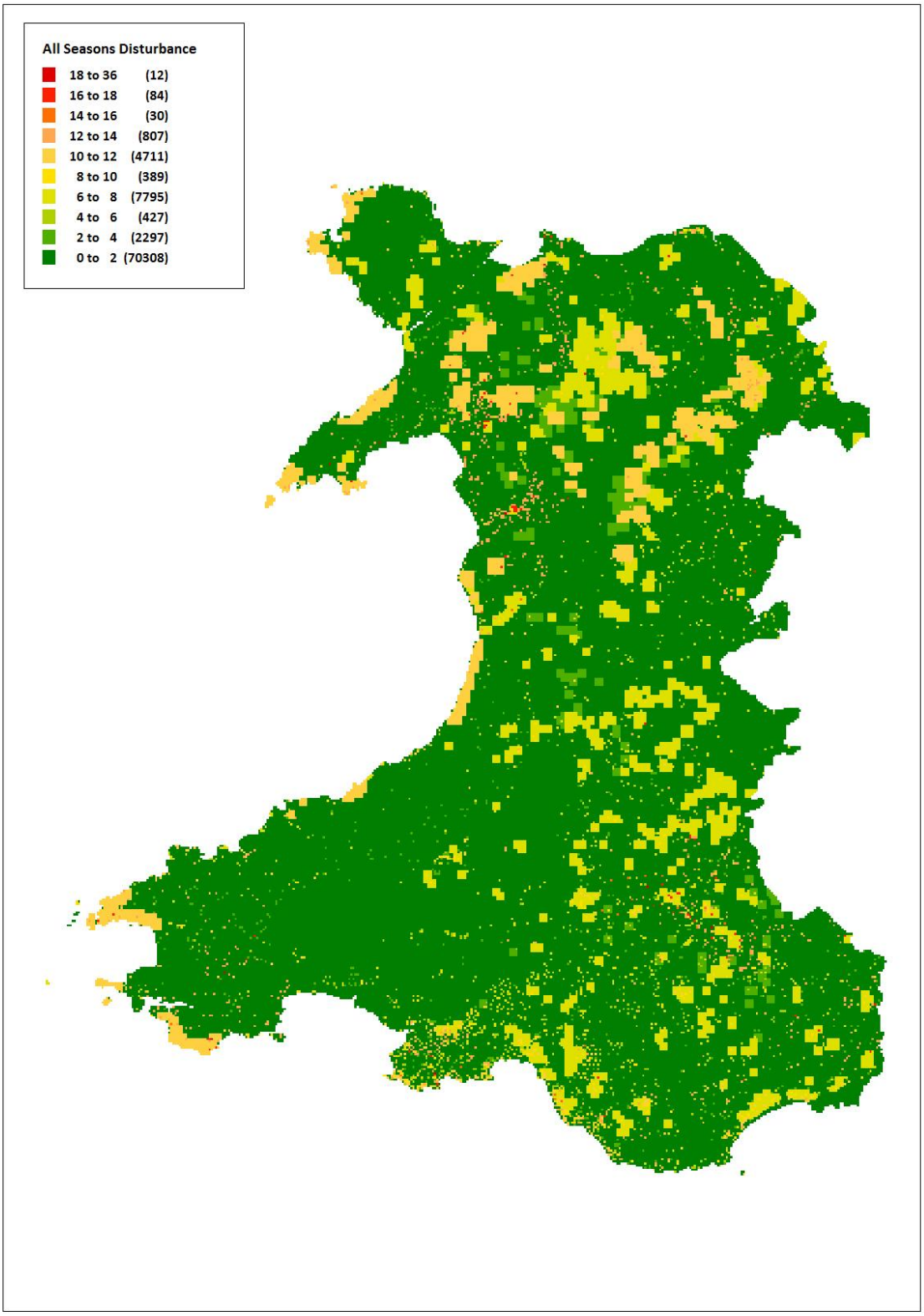

Contamination
4.5 to 5 (71)
4 to 4.5 (904)
3.5 to 4 (1100)
3 to 3.5 (8635)
2.5 to 3 (8528)
2 to 2.5 (13768)
1.5 to 2 (16012)
1 to 1.5 (15696)
0.5 to 1 (10774)
0 to 0.5 (11372)

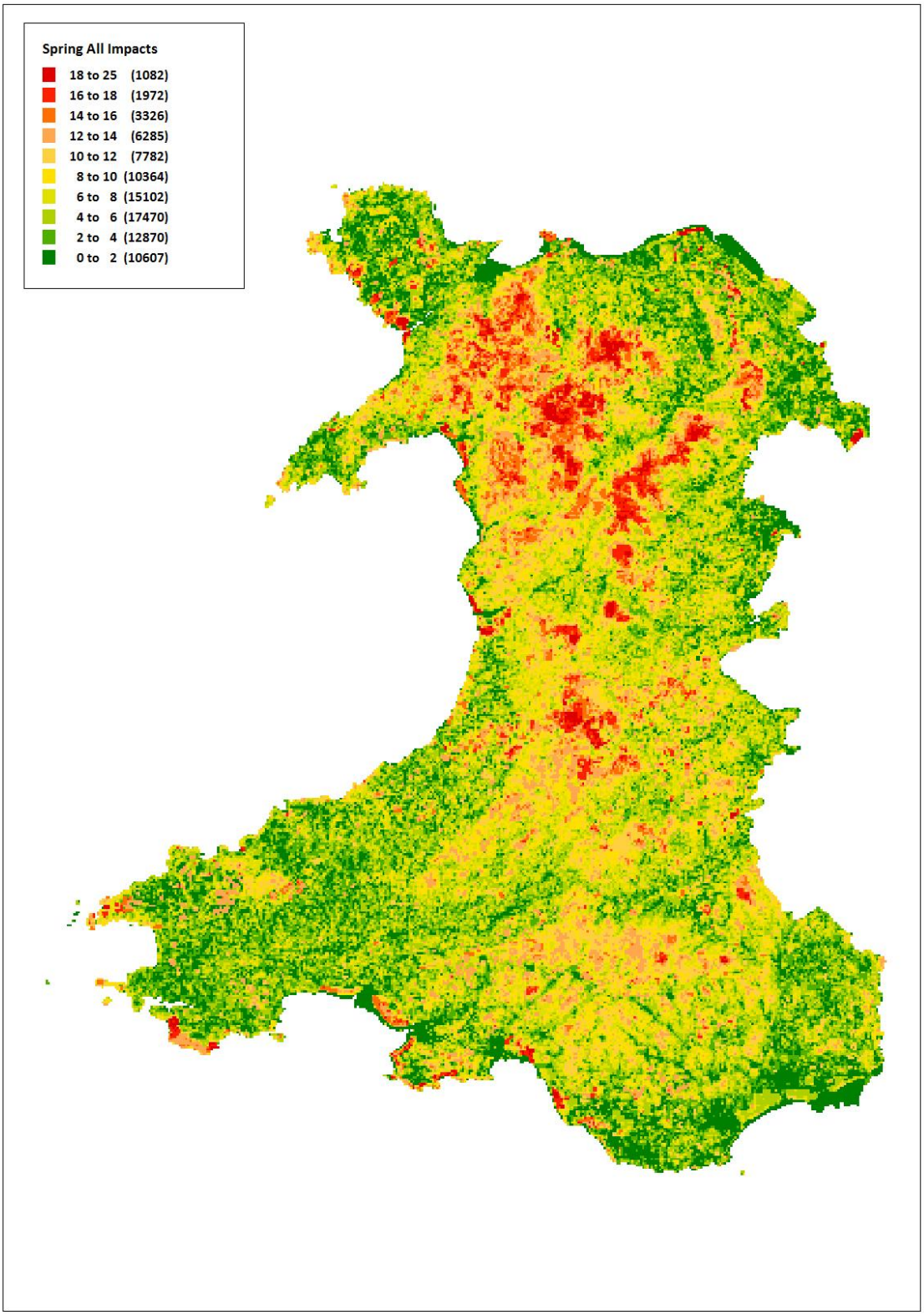

Spring Disturbance
4 to 5 (7725)
3 to 4 (5480)
2 to 3 (2055)
1 to 2 (938)
0 to 1 (70662)

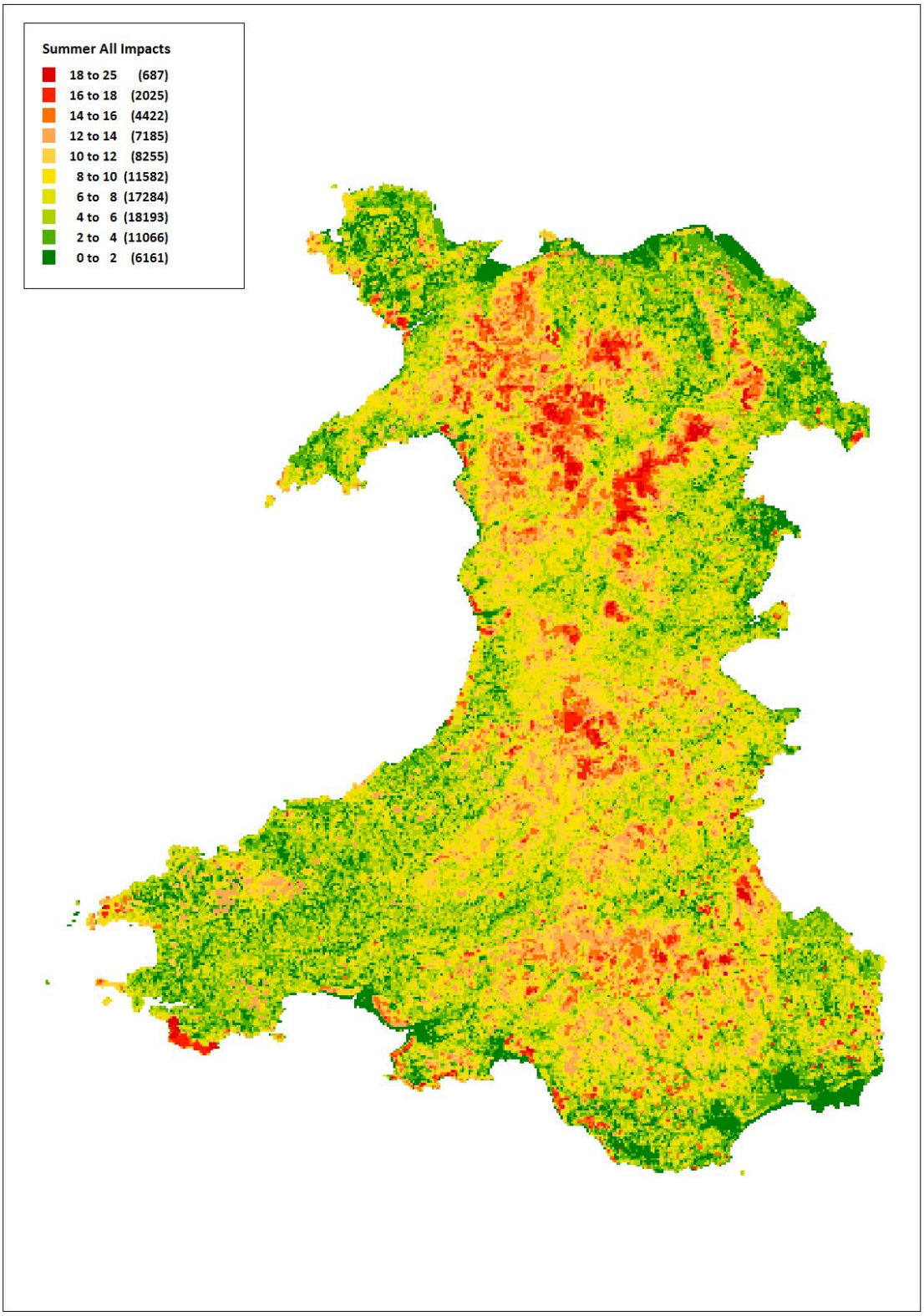

Summer Disturbance
4 to 5 (281)
3 to 4 (12868)
2 to 3 (391)
1 to 2 (2434)
0 to 1 (70886)

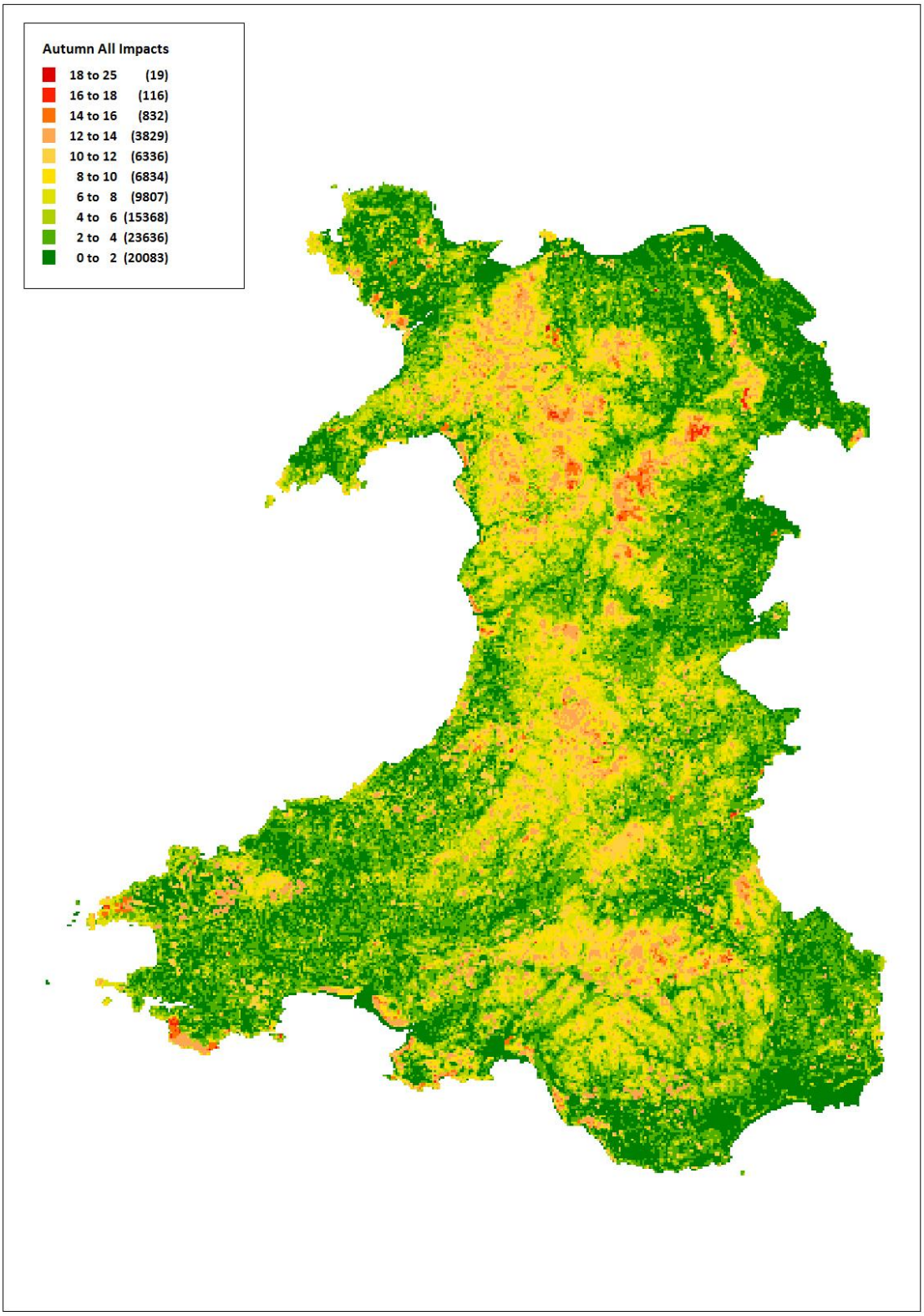

Autumn Disturbance
4 to 5 (733)
3 to 4 (258)
2 to 3 (4855)
1 to 2 (539)
0 to 1 (80475)

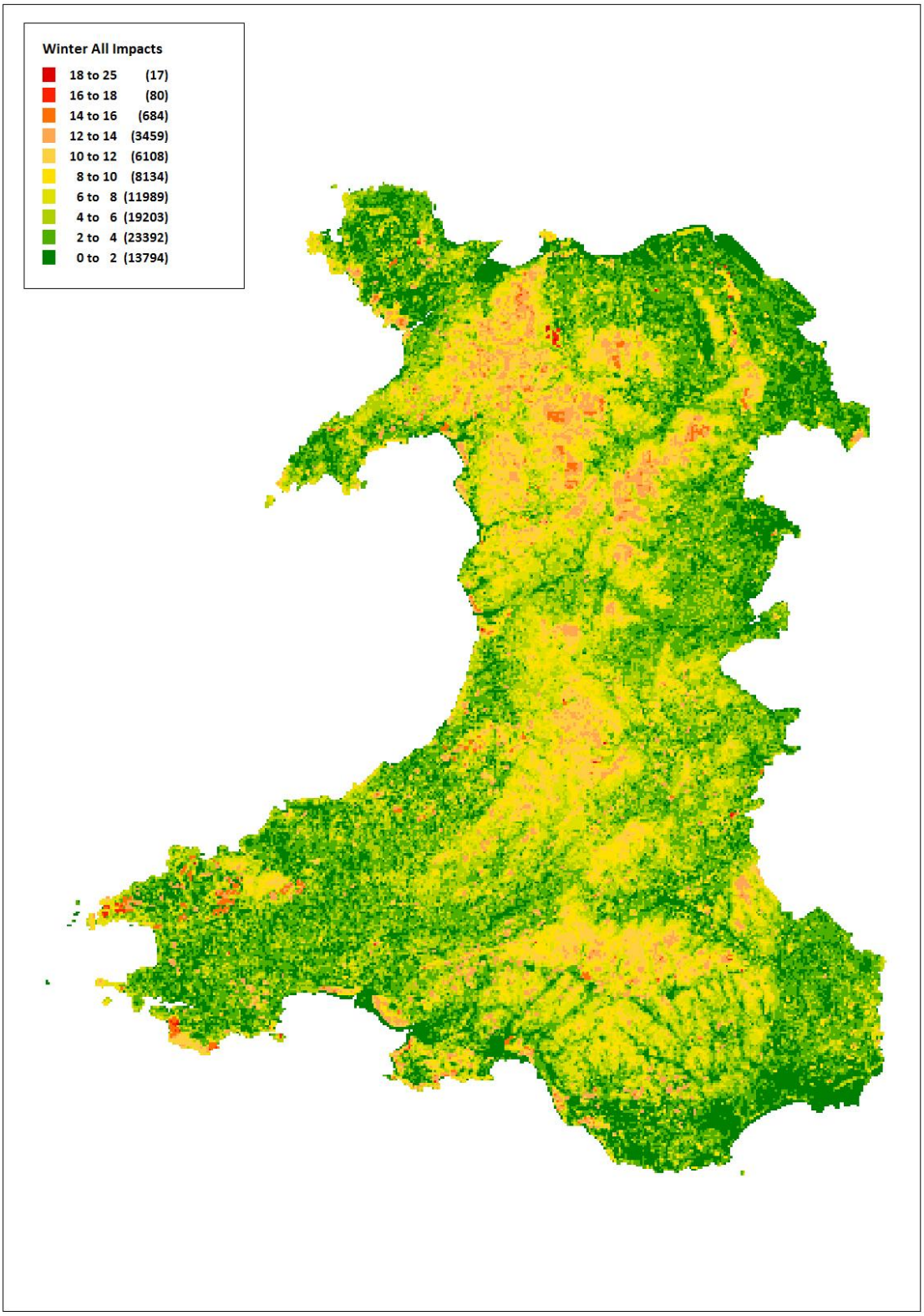

Winter Disturbance
4 to 5 (733)
3 to 4 (171)
2 to 3 (4977)
1 to 2 (493)
0 to 1 (80486)

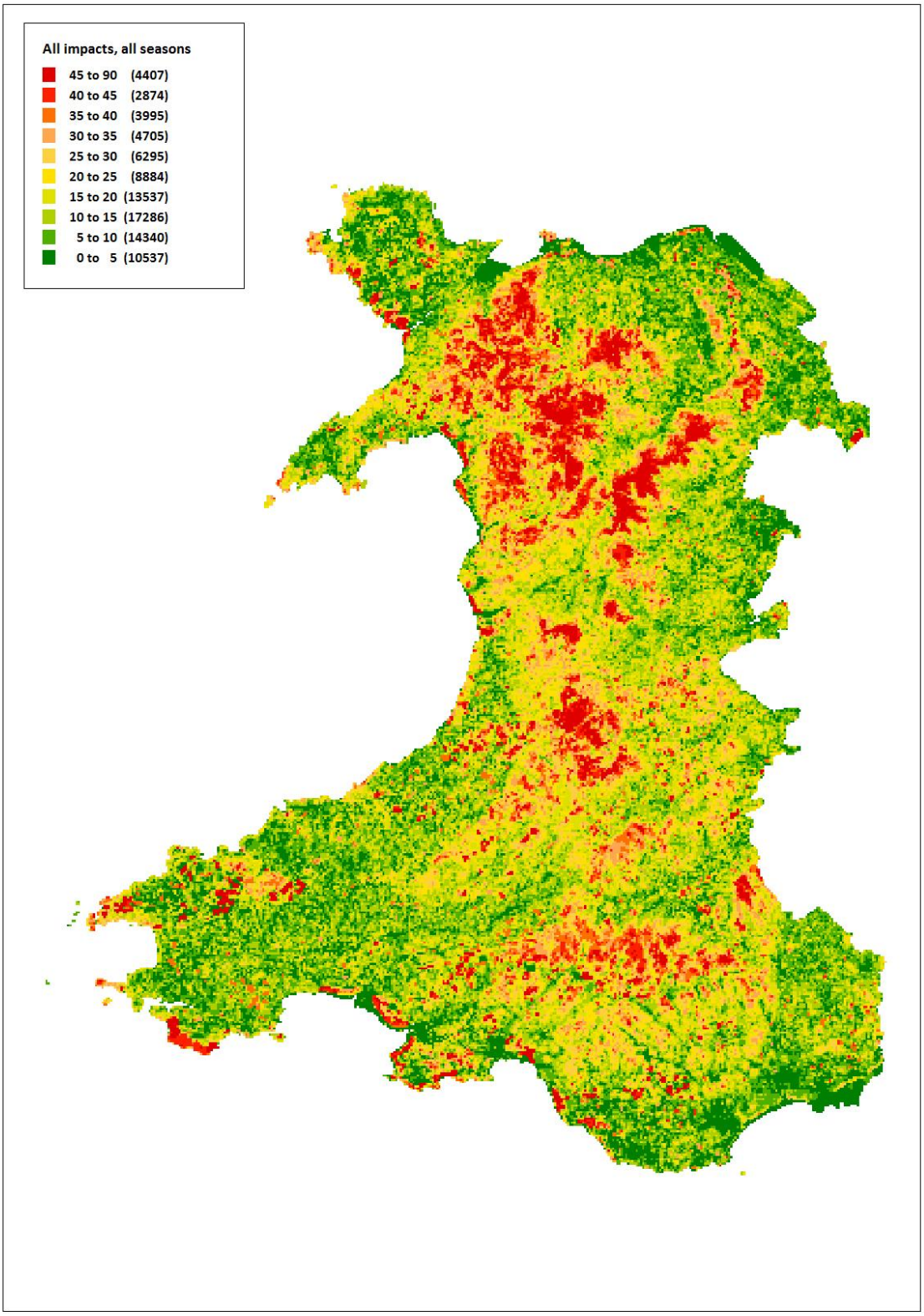

All Seasons Disturbance
18 to 36 (12)
16 to 18 (84)
14 to 16 (30)
12 to 14 (807)
10 to 12 (4711)
8 to 10 (389)
6 to 8 (7795)
4 to 6 (427)
2 to 4 (2297)
0 to 2 (70308)

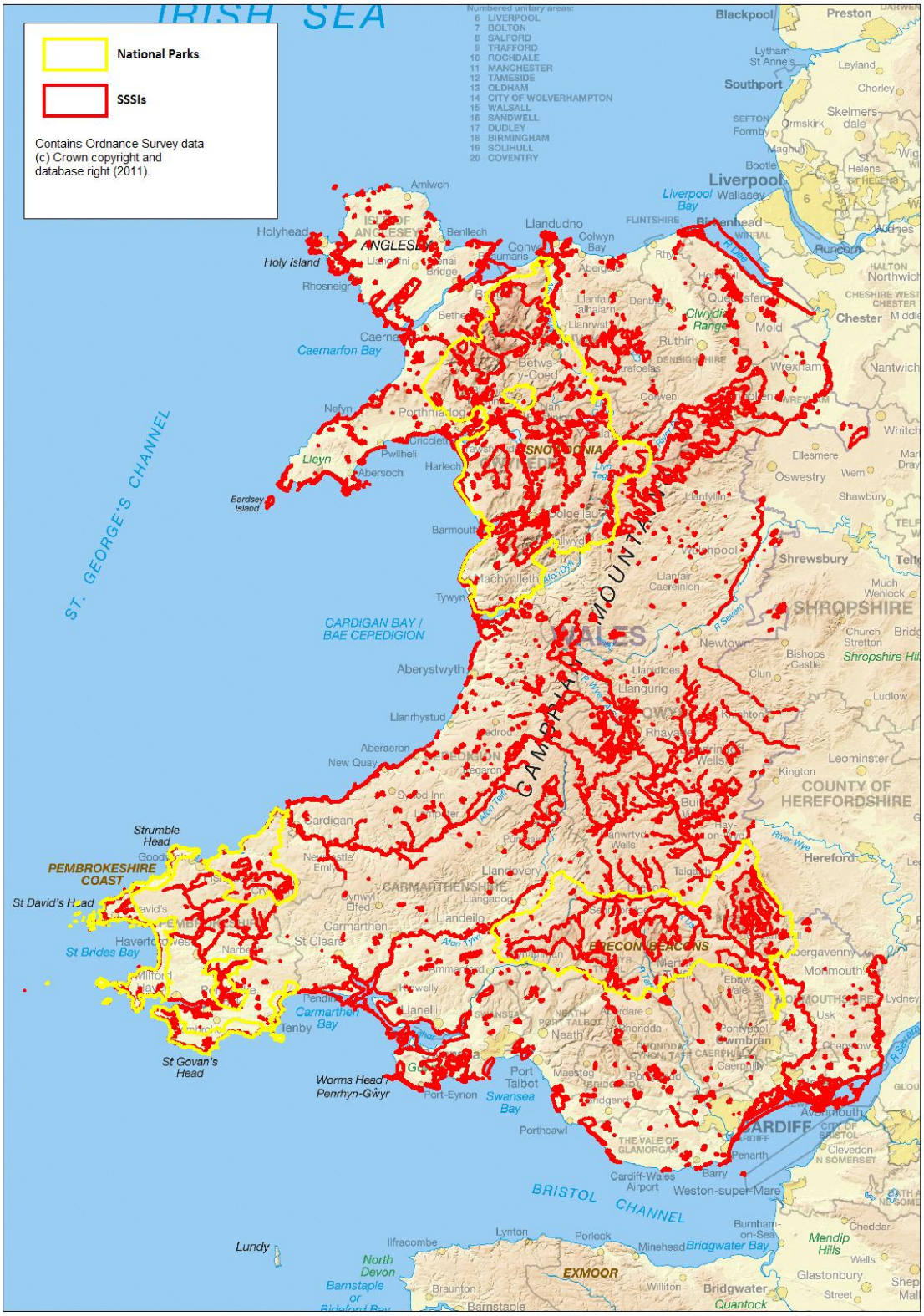

Spring All Impacts
18 to 25 (1082)
16 to 18 (1972)
14 to 16 (3326)
12 to 14 (6285)
10 to 12 (7782)
8 to 10 (10364)
6 to 8 (15102)
4 to 6 (17470)
2 to 4 (12870)
0 to 2 (10607)


Summer All Impacts
18 to 25 (687)
16 to 18 (2025)
14 to 16 (4422)
12 to 14 (7185)
10 to 12 (8255)
8 to 10 (11582)
6 to 8 (17284)
4 to 6 (18193)
2 to 4 (11066)
0 to 2 (6161)


Autumn All Impacts
18 to 25 (19)
16 to 18 (116)
14 to 16 (832)
12 to 14 (3829)
10 to 12 (6336)
8 to 10 (6834)
6 to 8 (9807)
4 to 6 (15368)
2 to 4 (23636)
0 to 2 (20083)


Winter All Impacts
18 to 25 (17)
16 to 18 (80)
14 to 16 (684)
12 to 14 (3459)
10 to 12 (6108)
8 to 10 (8134)
6 to 8 (11989)
4 to 6 (19203)
2 to 4 (23392)
0 to 2 (13794)


All impacts, all seasons
45 to 90 (4407)
40 to 45 (2874)
35 to 40 (3995)
30 to 35 (4705)
25 to 30 (6295)
20 to 25 (8884)
15 to 20 (13537)
10 to 15 (17286)
5 to 10 (14340)
0 to 5 (10537)


National Parks
SSSIs
Contains Ordnance Survey data
(c) Crown copyright and
database right (2011).
IRISH SEA
ST. GEORGE'S CHANNEL
BRISTOL CHANNEL
CARDIGAN BAY / BAE CERETIGION
CAMBRIAN MOUNTAINS
SNOWDONIA
WALES
SHROPSHIRE
COUNTY OF HEREFORDSHIRE
PEMBROKESHIRE COAST
BRECON BEACONS
EXMOOR
Caernarfon Bay
Carmarthen Bay
Swansea Bay
Liverpool Bay
Bardsey Island
Holy Island
Strumble Head
St David's Head
St Brides Bay
St Govan's Head
Worms Head / Penrhyn-Gŵyr
Lundy
Mendip Hills
Quantock
Clwydian Range

4. Discussion

4.1 We have generated vulnerability maps for the whole of Wales representing a range of different impacts from recreation. The maps summarise a range of complex information and highlight areas, at a national level, where recreation may have particular impacts. The approach is novel and the maps have a range of potential applications.

4.2 Drawing comparison between the scores for national parks and designated sites highlights that these areas are, as expected, more vulnerable to impacts from recreation, potentially giving some confidence to the scoring.

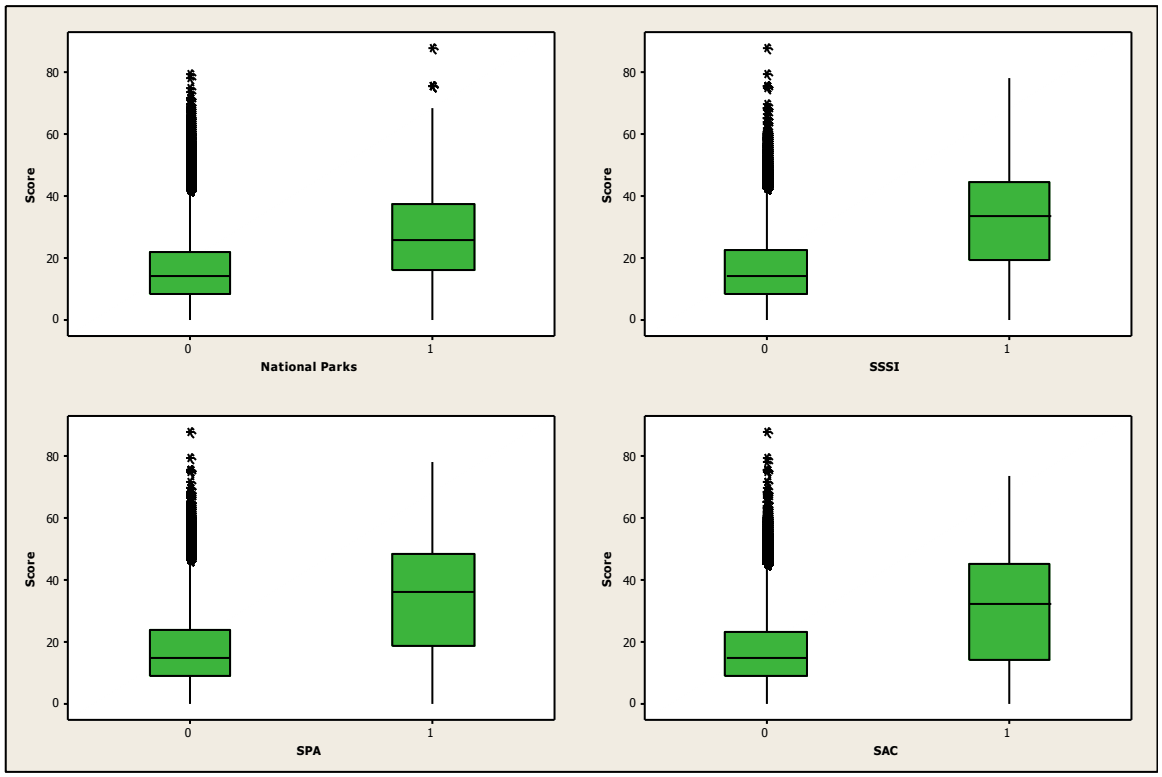


Figure 2: Comparison of scores (all impacts combined, all seasons) for grid cells within (denoted by a "1") and outside "0" different types of site.

4.3 In the rest of this section we discuss some potential issues relating to interpretation and use.

Constraints

4.4 There are issues with many of the datasets used and how that should be borne in mind when the maps are interpreted. In addition, it is important to take into account the manner in which the scores are present spatially. These are discussed here.

4.5 We have based the maps on a 500m grid. The choice of 500m was a pragmatic decision, based on the resolution of the various data used to derive the maps. The soil data is mapped at a scale of 1:250,000, the slope data is mapped on a 1km grid, the fire severity index is based on 10km squares, the species records are at a range

of different resolutions and the habitat data is also at different levels of detail. The choice of 500m cells seems a reasonable basis with which to summarise and collate the different data. The use of smaller cells would give an artificial impression of accuracy and spatial detail.

4.6 In producing the maps we have used colour scales that show ten colours and range from green to red. When viewing the maps it is important to recognise that the colours represent bands of data, as opposed to any particular biological threshold. We have used standard scores between impacts and the colouring is such that maps of each impact can be directly compared.

4.7 Inevitably the mapping is only as accurate and precise as the underlying data. The habitat scoring is based on Phase 1 data as NVC data is not available for all habitat types. Where identification of some particular habitat had been of concern (e.g. lowland grassland) and it has generally been possible to use supplementary data to increase the accuracy and precision of mapping. However, other inaccuracies within the original survey may not have been picked up.

4.8 It was not possible to use NVC data for the uplands. In particular, this may have lead to over-scoring in parts of the uplands. For example, bare rock communities (but not upland species rich ledges) were scored as zero, unless within an IPA designated for relevant communities. Within an IPA designated for the Annex 1 habitats 8220 Siliceous rocky slopes with chasmophytic vegetation, 6150 Siliceous alpine and boreal grasslands, 8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsetalia ladani*), 8210 Calcareous rocky slopes with chasmophytic vegetation it was recommended that the phase 1 categories I.1 natural rock exposure, I.1.1 inland cliff, I.1.1. acid/neutral inland cliff, I.1.2 scree, I.1.2.1 acid/neutral scree, I.1.2.2 basic scree, I.1.4 other rock exposure, I.1.4.1 acid/neutral rock, I.1.4.2 cave, I.2.1 quarry should be given a higher score. However, these categories cover large areas, whereas in reality the species vulnerable to recreational pressure are fragmented in their distribution, and a much finer scale would be needed to pick them up (B. Jones, pers. comm.).

4.9 Comprehensive NVC data was not available for woodlands. Within the phase 1 category A.1.1.1 Semi-natural broadleaved woodland there is much variation in terms of vulnerability to recreational pressure. Wet ravine woodlands and those with a species rich ground flora are likely to be particularly vulnerable. It was attempted to highlight these by using the Ancient and semi-natural woodland dataset, and the use of slope and skeletal soils. However, ground truthing is recommended to establish the extent to which this has been successful. In addition, the difference in vulnerability between coniferous plantations with semi-natural heathy ground floras and those without has not been distinguished.

4.10 Although NVC data for maritime communities was available, this was largely restricted to sand dune and saltmarsh sites surveyed, therefore cliff-top communities are under-represented at the phase 2 level.

4.11 There are a number of issues relating to how data were selected for scoring within the GIS. For example, in the phase 1 dataset many polygons contained more than one habitat type. In these cases, the scores were averaged, meaning of course that vulnerable habitats had their score lowered, while the least vulnerable had their score raised. Using the maximum score was considered to over-emphasis the extent of vulnerable areas. However, this has particularl relevance in the lowlands, where habitat patches are likely to be smaller, and therefore the scores of particularly vulnerable habitat are likely to have been lowered.

4.12 Similarly, some grid cells contained both NVC and phase 1 data. In this case, the highest score was used. Phase 1 scores were generally around the average for the NVC types within that Phase 1 category. This therefore means that the score of habitats identified by NVC as being of low vulnerability (e.g. *Spartina* saltmarsh) have been raised.

4.13 No distinction was made between areas of standing, running and open water supporting a good macrophytic flora and those without, except for those areas within an IPA designated for this feature.

4.14 In general, the expert panel found the task of scoring habitats according to their vulnerability to recreation pressure quite taxing, largely due to the wide variation in vulnerability due to specific factors that could not be included in the GIS (e.g. the condition and management of the habitat). In particular, comparative scoring between different broad habitat groups was difficult to achieve.

4.15 Further discussion on specific vulnerable species may be merited once the maps have been tested on the ground. For example, the list of invertebrates included is quite limited, and many more could be added. Similarly it may be considered that adding plant species will enhance the sensitivity of the maps rather than making them unworkably complex to interpret once they are applied to situations on the ground. For example, BARS (the UKs biodiversity action reporting system) lists wild asparagus *Asparagus prostratus,* Derbyshire feather-moss *Thamnobryum angustifolium* and petalwort *Petalophyllum ralfsii* as threatened by trampling in Wales . For three-lobed water crowfoot *Ranunculus tripartitus* and violet crystalwort *Riccia huebenerian,* watersports/fishing are listed as threats in Wales on the respective BAP, while river jelly lichen *Collema dichotum* is threatened by increased sediment load.

4.16 The recreational vulnerability maps presented here are recognised as being a first step in an ongoing project. The next step will be to test the maps, and the mapping has been undertaken in a manner intended to make future adjustment of scores relatively straightforward should this be necessary.

5. References

Bates, A.J., Sadler, J.P. & Fowles, A.P. (2006) Livestock Trampling Reduces the Conservation Value of Beetle Communities on High Quality Exposed Riverine Sediments. *Biodiversity and Conservation*, **16**, 1491-1509.

Bird, D.M. (2004) *Natural fit, can green space and biodiversity increase levels of physical activity*. RSPB, Sandy, Bedfordshire.

Blackstock, T., Howe, E., Stevens, J., Burrows, C. & Jones, P. (2010) *Habitat of Wales. A comprehensive field survey 1979-1997*. University of Wales Press, Cardiff.

Edgar, P. (2002) *The effects of public access on amphibians and reptiles. an assessment of the potential effects of increased public access due to the introduction of the countryside and rights of way act 2000*. CCW Contract Science, Bangor.

English Nature. (2002) *Revealing the value of nature*. English Nature, Peterborough.

Liley, D., Lake, S., Underhill-Day, J., Sharp, J., White, J., Hoskin, R., Cruickshanks, K. & Fearnley, H. (2010) *Welsh Seasonal Habitat Vulnerability Review*. Footprint Ecology / CCW.

Morris, N. (2003) *Health, well-being and open space literature review*. Edinburgh Colleage of Art and Heriot-Watt University, Edinburgh.

Plantlife International. *Important Plant Areas in the UK: technical report*. Plantlife International.

Pretty, J., Griffin, M., Peacock, J., Hine, R., Selens, M. & South, N. (2005) A countryside for health and well-being: the physical and mental health benefits of green exercise. *Countryside Recreation*, **13**, 2-7.

Reynolds, B., Norris, D.A., Hilton, J., Bass, J.A. & Hornby, D. D. (2004) *The current and potential impact of diffuse pollution on water dependent biodiverstiy in Wales*. CEH.

Rodwell, J.S. (2000) *British Plant Communities, Volume 5: Maritime Communities and Vegetation of Open Habitats*. Cambridge University Press, Cambridge UK.

Rodwell, J. (1992) *British Plant Communities, Volume 3: Grasslands and Montane Communities*. Cambridge University Press, Cambridge.

Tansley, A.G. (1945) *Our Heritage of Wild Nature*. Cambridge University Press.

6. Appendix

Table 4 Scores allocated to each Phase 1 category. No season variation was identified for contamination

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
A.1.1.1	semi-natural broadleaved woodland	3	2	2	1	3	4	3	1	2
A.1.1.2	planted broadleaved woodland	2	2	2	1	3	4	3	1	1
A.1.3.1	semi-natural mixed woodland	2	2	2	1	3	4	3	1	2
A.1.3.2	planted mixed woodland	1	1	1	1	3	4	3	1	1
A.4.1	felled broadleaved woodland	1	1	1	1	3	4	3	1	1
A.4.3	felled mixed woodland	1	1	1	1	3	4	3	1	1
A.1.2.1	semi-natural coniferous woodland	3	2	2	1	3	4	3	2	2
A.2.1	dense scrub	1	1	1	1	2	2	2	2	1
A.1.2.2	planted coniferous woodland	1	1	1	1	3	4	3	2	1
A.4.2	felled coniferous woodland	1	1	1	1	3	4	3	2	1
B.1.1	unimproved acid grassland	2	2	2	1	3	4	3	2	3

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
B.1.2	semi-improved acid grassland	1	1	1	0	3	4	3	2	3
B.2.1	unimproved neutral grassland	3	4	3	2	3	4	3	2	3
B.2.2	semi-improved neutral grassland	2	3	2	1	3	4	3	2	3
B.5	marshy grassland	4	3	4	5	4	4	4	4	3
B.5.1	marshy grassland *Juncus* dominated	4	3	4	5	4	4	4	4	3
B.5.2	marshy grassland *Molinia* dominated	4	3	4	5	4	4	4	4	3
B.3.1	unimproved calcareous grassland	3	3	3	3	3	4	3	2	4
B.3.2	semi-improved calcareous grassland	1	1	1	1	3	4	3	2	3
B.4	improved grassland	0	0	0	0	0	0	0	0	1
C.1.1	bracken	1	1	1	0	2	2	2	2	1
C.2	upland species rich ledges	5	5	5	4	3	3	3	3	3
C.3.2	non-ruderal herb and fern	4	4	4	3	3	3	3	3	3
C.3.1	tall ruderal herb	1	1	1	1	1	1	1	1	1

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
D.1.1	upland dry acid heath	2	2	3	3	3	3	4	4	1
D.1.1	lowland dry acid heath	3	3	4	4	4	4	5	5	3
D.2	upland wet heath	2	2	3	3	4	4	5	5	1
D.2	lowland wet heath	3	3	4	4	4	4	5	5	3
D.3	upland lichen/bryophyte heath	5	5	5	5	4	4	5	5	2
D.3	lowland lichen/bryophyte heath	4	4	4	4	4	4	5	5	3
D.5	upland dry heath/acid grassland mosaic	2	2	2	1	2	2	3	3	3
D.5	lowland dry heath/acid grassland mosaic	3	3	3	3	3	3	4	4	2
D.6	upland wet heath/acid grassland mosaic	2	2	2	2	2	2	3	3	1
D.6	lowland wet heath/acid grassland mosaic	3	3	3	3	3	3	4	4	2
D.1.2	dry basic heath	3	3	2	2	3	3	4	4	3
D.7	basic dry heath/calcareous grassland mosaic	3	3	2	2	3	3	4	4	3

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
E.1.6.1	blanket bog	4	4	5	5	3	4	3	3	3
E.1.6.2	raised bog	4	4	5	5	3	4	3	3	3
E.1.7	wet modified bog	2	2	3	3	3	4	3	3	3
E.1.8	dry modified bog	2	2	2	2	3	4	3	3	3
E.4	bare peat	0	0	0	0	0	0	0	0	0
E.3.1	valley mire	5	5	5	5	3	4	3	3	3
E.3.1.1	modified valley mire	2	2	2	2	3	4	3	3	3
E.3.2	basin mire	5	5	5	5	3	4	3	3	3
E.3.2.1	modified basin mire	2	2	2	2	3	4	3	3	3
E.2	flush and spring	5	5	5	5	3	4	3	3	3
E.2.1	acid/neutral flush	5	5	5	5	3	4	3	3	3
E.2.2	basic flush	5	5	5	5	3	4	3	3	3
E.2.3	brophyte-dominated spring	5	5	5	5	3	4	3	3	3
E.3	fen	4	4	4	4	3	3	2	2	3
E.3.3	flood-plain mire	4	4	4	4	3	3	2	2	3

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
E.3.3.1	modified flood plain mire	2	2	2	2	3	3	2	2	3
F.1	swamp	3	3	3	3	3	3	2	2	3
F.1.1	scattered swamp	2	2	2	2	3	3	2	2	3
F.2.2	inundation vegetation	4	4	3	3	2	2	1	1	2
G.1	standing water	2	2	1	1	0	0	2	0	0
G.2	running water	3	3	2	2	0	0	0	0	0
H.1.1	intertidal mud/sand	1	1	1	1	0	0	0	0	0
H.1.2	intertidal cobbles/shingle	0	0	0	0	0	0	0	0	0
H.1.3	intertidal rocks/boulders	2	2	2	2	0	0	0	0	0
H.4	rocks/boulders above mhw	1	1	1	1	0	0	0	0	0
H.2.4	scattered salt marsh plants	2	2	2	2	3	3	3	3	3
H.2.6	salt marsh	3	3	3	3	3	3	3	3	3
H.3.1	mud/sand above mhw	1	1	1	1	0	0	0	0	0
H.3.2	shingle/gravel above mhw	1	1	1	1	0	0	0	0	0
H.6.4	dune slack	4	4	4	4	3	3	2	2	3

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
H.6.5	dune grassland	4	4	4	4	3	3	3	3	3
H.6.6	dune heath	3	3	3	3	3	3	4	4	3
H.6.7	dune scrub	1	1	1	1	2	2	2	2	2
H.6.8	open dune	3	3	3	3	3	3	2	2	3
H.8.1	hard cliff	4	4	4	4	3	4	3	2	3
H.8.2	soft cliff	4	4	4	4	3	4	3	2	3
H.8.4	coastal grassland	3	4	3	2	3	4	3	2	3
H.8.5	coastal heath	4	4	4	4	5	5	5	5	3
H.8.6	coastal heath/coastal grassland mosaic	3	3	3	3	4	4	4	4	3
I.1	natural rock exposure	0	0	0	0	0	0	0	0	0
I.1.1	inland cliff	0	0	0	0	0	0	0	0	0
I.1.1.1	acid/neutral inland cliff	0	0	0	0	0	0	0	0	0
I.1.1.2	basic inland cliff	0	0	0	0	0	0	0	0	0
I.1.2	scree	0	0	0	0	0	0	0	0	0

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
I.1.2.1	acid/neutral scree	0	0	0	0	0	0	0	0	0
I.1.2.2	basic scree	0	0	0	0	0	0	0	0	0
I.1.3	limestone pavement	0	0	0	0	0	0	0	0	0
I.1.4	other rock exposure	0	0	0	0	0	0	0	0	0
I.1.4.1	acid/neutral rock	0	0	0	0	0	0	0	0	0
I.1.4.2	basic rock	0	0	0	0	0	0	0	0	0
I.1.5	cave	0	0	0	0	0	0	0	0	0
I.2.1	quarry	0	0	0	0	0	0	0	0	0
I.2.2	spoil	0	0	0	0	0	0	0	0	0
I.2.3	mine	0	0	0	0	0	0	0	0	0
I.2.4	refuse-tip	0	0	0	0	0	0	0	0	0
J.1.1	arable	0	0	0	0	0	0	0	0	0
J.1.2	amenity grassland	0	0	0	0	0	0	0	0	0
J.1.3	ephemeral/short perennial	0	0	0	0	0	0	0	0	0
J.1.4	introduced scrub	0	0	0	0	0	0	0	0	0

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
J.1.5	gardens	0	0	0	0	0	0	0	0	0
J.3.4	caravan site	0	0	0	0	0	0	0	0	0
J.3.6	buildings	0	0	0	0	0	0	0	0	0
J.3.5	sea-wall	0	0	0	0	0	0	0	0	0
J.3.7	track (not comprehensively digitised)	0	0	0	0	0	0	0	0	0
J.4	bare ground	0	0	0	0	0	0	0	0	0
NA	not accessed land	0	0	0	0	0	0	0	0	0
?	habitat code illegible on the original vegetation map	0	0	0	0	0	0	0	0	0

Table 5 Phase 2 habitats used in scoring

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
Calcareous grassland communities										
CG1	*Festuca ovina–Carlina vulgaris* grassland	4	4	4	4	5	5	5	5	4
CG2	*Festuca ovina–Avenula pratensis* grassland	3	3	3	3	3	4	3	2	4
CG3	*Bromus erectus* grassland	3	3	3	3	3	4	3	2	4
CG4	*Brachypodium pinnatum* grassland	3	3	3	3	3	4	3	2	4
CG5	*Bromus erectus–Brachypodium pinnatum* grassland	3	3	3	3	3	4	3	2	4
CG6	*Avenula pubescens* grassland	3	3	3	3	3	4	3	2	4
CG7	*Festuca ovina–Hieracium pilosella–Thymus praecox/pulegioides* grassland	3	3	3	3	3	4	3	2	4
CG8	*Sesleria albicans–Scabiosa columbaria* grassland	3	3	3	3	3	4	3	2	4
CG9	*Sesleria albicans–Galium sterneri* grassland	3	3	3	3	3	4	3	2	4
CG10	*Festuca ovina-Agrostis capillaris-Thymus praecox grassland*	3	3	3	3	3	4	3	2	4
Acid grassland communities										
U1	*Festuca ovina–Agrostis capillaris–Rumex acetosella* grassland	4	4	4	4	5	5	5	5	4

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
U2	*Deschampsia flexuosa* grassland	2	2	2	1	3	4	3	2	3
U3	*Agrostis curtisii* grassland	2	2	2	1	3	4	3	2	3
U4a	*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland typical sub-community	2	2	2	1	3	4	3	2	3
U4b	*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland *Holcus lanatus-Trifolium repens* sub-community	2	2	2	1	3	4	3	2	3
U4c	*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland *Lathyrus montanus-Stachys betonica* sub-community	3	3	3	2	3	4	3	2	4
U4d	*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland *Luzula multiflora-Rhytidiadelphus loreus* sub-community	2	2	2	1	3	4	3	2	3
U4e	*Festuca ovina–Agrostis capillaris–Galium saxatile* grassland *Vaccinium myrtillus-Deschampsia flexuosa* sub-community	2	2	2	1	3	4	3	2	3
U5	*Nardus stricta–Galium saxatile* grassland	2	2	2	1	3	4	3	2	3
Mesotrophic grassland communities										
MG5	*Cynosurus cristatus–Centaurea*	3	4	3	2	3	4	3	2	4

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
	nigra grassland									
MG4	*Alopecurus pratensis–Sanguisorba officinalis* grassland	4	3	4	5	3	4	3	2	4
MG8	*Cynosurus cristatus–Caltha palustris* grassland	4	3	4	5	3	4	3	2	4
M22	*Juncus subnodulosus–Cirsium palustre* fen-meadow	4	3	4	5	4	4	4	4	3
M23	*Juncus effusus/acutiflorus–Galium palustre* rush-pasture	4	3	4	5	4	4	4	4	3
M24	*Molinia caerulea–Cirsium dissectum* fen-meadow	4	3	4	5	4	4	4	4	3
M25	*Molinia caerulea–Potentilla erecta* mire	4	3	4	5	4	4	4	4	3
M26	*Molinia caerulea–Crepis paludosa* mire	4	3	4	5	4	4	4	4	3
Open communities										
OV37	*Festuca ovina–Minuartia verna* community	5	5	5	5	5	5	5	5	5
Maritime cliff communities										
MC1	*Crithmum maritimum–Spergularia rupicola* maritime rock-crevice community	5	5	5	5	4	4	3	3	4
MC3	*Rhodiola rosea–Armeria maritima* maritime cliff-ledge community	5	5	5	5	4	4	3	3	4
MC4	*Brassica oleracea* maritime cliff-	5	5	5	5	4	4	3	3	4

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
	ledge community									
MC5	*Armeria maritima–Cerastium diffusum* ssp. *diffusum* maritime therophyte community	4	4	4	4	4	4	3	3	4
MC6	*Atriplex prostrata–Beta vulgaris* ssp. *maritima* sea-bird cliff community	1	1	1	1	2	2	2	1	1
MC7	*Stellaria media–Rumex acetosa* sea-bird cliff community	1	1	1	1	2	2	2	1	1
MC8	*Festuca rubra–Armeria maritima* maritime grassland	4	3	2	2	4	4	3	3	4
MC9	*Festuca rubra–Holcus lanatus* maritime grassland	4	3	2	2	4	4	3	3	4
MC10	*Festuca rubra–Plantago* spp. maritime grassland	4	3	2	2	4	4	3	3	4
MC11	*Festuca rubra–Daucus carota* ssp. *gummifer* maritime grassland	4	3	2	2	4	4	3	3	4
MC12	*Festuca rubra–Hyacinthoides non-scripta* maritime bluebell community	4	3	2	2	4	4	3	3	4
Shingle, strandline and sand-dune communities										
SD1	*Rumex crispus–Glaucium flavum* shingle community	4	4	3	3	3	3	3	2	3
SD4	*Elymus farctus* ssp. *boreali-*	3	3	3	3	3	3	2	2	3

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
	atlanticus foredune community									
SD5	*Leymus arenarius* mobile dune community	3	3	3	3	3	3	2	2	3
SD6	*Ammophila arenaria* mobile dune community	3	3	3	3	3	3	2	2	3
SD7	*Ammophila arenaria–Festuca rubra* semi-fixed dune community	3	3	3	3	3	3	2	2	3
SD8	*Festuca rubra–Galium verum* fixed dune grassland	4	3	3	3	4	3	3	3	4
SD9	*Ammophila arenaria–Arrhenatherum elatius* dune grassland	4	3	3	3	4	3	3	3	4
SD10	*Carex arenaria* dune community	4	3	3	3	4	3	3	3	4
SD11	*Carex arenaria–Cornicularia aculeata* dune community	5	5	5	5	5	5	5	5	5
SD12	*Carex arenaria–Festuca ovina–Agrostis capillaris* dune grassland	4	3	3	3	4	3	3	3	4
SD13	*Sagina nodosa–Bryum pseudotriquetrum* dune-slack community	4	4	3	3	3	3	3	2	4
SD14	*Salix repens–Campylium stellatum* dune-slack community	4	4	3	3	3	3	3	2	4
SD15	*Salix repens–Calliergon cuspidatum* dune-slack community	4	4	3	3	3	3	3	2	4

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
SD16	*Salix repens–Holcus lanatus* dune-slack community	4	4	3	3	3	3	3	2	4
SD17	*Potentilla anserina–Carex nigra* dune-slack community	4	4	3	3	3	3	3	2	4
SD19	*Phleum arenarium–Arenaria serpyllifolia* dune annual community	4	3	3	3	2	2	2	1	3
Saltmarsh communities										
SM1	*Zostera* communities	2	2	2	2	1	1	1	1	4
SM2	*Ruppia maritima* salt-marsh community	2	2	2	2	1	1	1	1	4
SM3	*Eleocharis parvula* salt-marsh community	4	4	4	4	4	4	4	4	5
SM6	*Spartina anglica* salt-marsh community	0	0	0	0	0	0	0	0	0
SM7	*Arthrocnemum perenne* stands	4	4	4	4	4	4	4	4	5
SM8	Annual *Salicornia* salt-marsh community	3	3	3	3	3	3	3	3	4
SM9	*Suaeda maritima* salt-marsh community	3	3	3	3	3	3	3	3	4
SM10	Transitional low-marsh vegetation with *Puccinellia maritima* annual *Salicornia* species and *Suaeda maritima*	3	3	3	3	3	3	3	3	4

Code	Phase 1 category	Damage				Fire				Contamination
		Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	All seasons
SM11	*Aster tripolium* var. *discoideus* salt-marsh community	3	3	3	3	3	3	3	3	4
SM12	Rayed *Aster tripolium* stands	3	3	3	3	3	3	3	3	4
SM13	*Puccinellia maritima* salt-marsh community	2	2	2	2	3	3	3	3	4
SM16	*Festuca rubra* salt-marsh community	2	2	2	2	3	3	3	3	4
SM24	*Elymus pycnanthus* salt-marsh community	2	2	2	2	3	3	3	3	4
SM28	*Elymus repens* salt-marsh community	2	2	2	2	3	3	3	3	4

Table 6 Core Important Plant Areas

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Snowdon/ Eryri	Moel Hebog/Moel yr Ogof (vascular plants), Capel Craig area (fw algae), Afon Gwyrfai a Llyn Cwellyn (habitat), Eryri/ Snowdonia (vascular, lichens, habitat)	Luronium natans; Euphrasia hotspot; Trichomanes speciosum	C1 Surface standing waters, C2 Surface running waters, D1 Raised & blanket bogs, D2 Valley mires, poor fens & transition mires, E1 Dry Grasslands, E2 Mesic Grasslands, E3 Seasonally wet & wet grasslands, F2 Arctic, alpine & subapline scrub habitats, H2 Screes, F4 Temperate shrub heathland, H3 Inland cliffs, rock pavements & outcrops	6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels, 8220 Siliceous rocky slopes with chasmophytic vegetation, 6150 Siliceous alpine and boreal grasslands, 8110 Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsetalia ladani), 8210 Calcareous rocky slopes with chasmophytic vegetation, 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanjuncet	B.1.1, B.3.1, B.5, B.5.1, B.5.2, C.3.2, D.3, E.1.6.1, E.2, E.2.1, E.2.3, E.3, E.3.2, F.2.2, G.1, G.2, I.1, I.1.2, I.1.2.1, I.1.4, I.1.4.1, I.2.1, I.2.
Meirionnydd Oakwoods	Coed Ganllwyd; Coed y Rhygen (bryophytes), Meirionnydd Oakwoods (habitat), Bont Ddu; Ceunant Llennyrch; Coed Crafnant; Dolmelynllyn Coed Ganllwydd; Nannau (lichens)		G1 Broadleaved deciduous woodland	91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae), 91A0 Old sessile oak woods with Ilex and Blechnum in British Isles, 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation, 4010 Northern Atlantic wet heaths with Erica tetralix, 4030 European dry heaths, 9180 Tilio-Acerion forests of slopes, screes	A.1.1.1, D.1.1, D.5, D.6, G.2, I.1.1.1, I.1.4.1

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
				and ravines.	
Cadair Idris	Cader Idris	E*uphrasia anglica, Euphrasia cambrica Pugsley, Euphrasia pseudokerneri, Euphrasia rivularis*	E4 Alpine & sub-alpine grasslands, F2 Arctic, alpine & subapline scrub habitats, G1 Broadleaved deciduous woodland, H2 Screes, H3 Inland cliffs, rock pavements & outcrops.	91A0 Old sessile oak woods with Ilex and Blechnum in British Isles, 91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*, 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae), 3130 Oligotrophic to mesotrophic standing waters witth vegetation of the Littorelletea uniflorae and/or Isoeto-Nanjuncet, 8210 Calcareous rocky slopes with chasmophytic vegetation, 8220 Siliceous rocky slopes with chasmophytic vegetation, 8110 Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsetalia ladani).	A.1.1.1, B.3.1, B.5, B.5.1, B.5.2, A.2.1, G.1, I.1.1.1, I.1.2, I.1.2.1, I.1.4, I.1.4.1, I.2.1, C.3.2

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Great Ormes Head/ Pen y Gogarth			Calcareous grassland (vascular plants)	Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia); European dry heaths	B.3.1, D.1.1, D.1.2, D.7, D.5
Anglesey Fens/ Corsydd Môn			D4 Base-rich fens BB1, Coastal dune and sand habitats, BC2 Surface running waters, BE3 Seasonally wet & wet grassland.	4010 Northern Atlantic wet heaths with Erica tetralix, 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae), 7230 Alkaline fens, 7210* Calcareous fens with Cladium mariscus and species of the Caricion davallianae*, 3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	E.2.2, E.3, E.3.1, E.3.2, G.1
NW Anglesey Heaths and Seacliffs	Holy Island Coast/ Glannau Ynys Gybi (vascular plants), Glannau Ynys Gybi/ Holy Island Coast; Glaswelltiroedd Cefn Cribwr/ Cefn Cribwr Grasslands (habitats)	*Tephroseris integrifolia* spp *maritima* (vascular)		European dry heaths; Vegetated sea cliffs of the Atlantic and Baltic coasts: Includes Glaswelltiroedd Cefn Cribwr/ Cefn Cribwr Grasslands Molinia meadows on calcareous, peaty or clayey-silt-laden soi	B.5, D.1.1, D.2, D.5, E.2.1, H.1.3, H.4, H.8.1, H.8.4, H.8.5, H.8.6

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Anglesey Dunes	Abermenai to Aberffraw Dunes/ Y Twyni o Abermenai i Aberffraw (vascular plants, habitat), Newborough Warren (stoneworts)	*Petalophyllum ralfsii, Rumex rupestris*	B1 Coastal dune and sand habitats	1310 Salicornia and other annuals colonising mud and sand, 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae), 2110 Embryonic shifting dunes, 2120 Shifting dunes along the shoreline with Ammophila arenaria (white dunes), 2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 2170 Dunes with Salix repens ssp. argentea (Salicion arenariea), 2190 Humid dune slacks.	H.2.6, H.6.4, H.6.5, H.6.8
Lleyn Sea Cliffs	Bardsey and Aberdaron Cliffs (lichens)		B3 Rock cliffs, ledges & shores, including the supralittoral, F4 Temperate shrub heathland, B1 Coastal dune and sand habitats, E1 Dry Grasslands.	1230 Vegetated sea cliffs of the Atlantic and Baltic coasts	D.2, D.5, H.6.5, H.3.2, H.3.1, H.6.5, H.4, H.8.1, H.8.2, H.8.5, H.8.6, H.8.4
Welsh Marches Cliffs and Steppe grasslands	Stanner Rocks (vascular)		H3 Inland cliffs, rock pavements & outcrops, E1 Dry Grasslands		I.1.2.1, I.2.1

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Cambrian Mountain Woodlands	Rheidol Woods and Gorge (vascular, bryophyte, habitat), Elan Valley Woodlands (habitat), Cwm Doethie – Mynydd Mallaen (habitat), Elan Valley Complex (lichens)	*Trichomanes speciosum*	Broadleaved deciduous woodland (bryophytes), Broadleaved deciduous woodland: oceanic woodland (lichens)	9180* Tilio-Acerion forests of slopes, screes and ravines*, 4030 European dry heaths, 6130 Calaminarian grasslands of the Violetalia calaminariae, 7130(*) Blanket bogs (* if active bog), 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation, 91A0 Old sessile oak woods with Ilex and Blechnum in British Isles.	A.1.1.1
Cambrian Mountains Orefield	Grogwynion (habitat), Coed Rheidol Mine, Cwm Brwyno, Cwmsymlog, Cwmystwyth, Dyffryn Castell, Eaglebrook, Esgair Hir and Esgar Ffraith, Grogwynion/Ystwyth River Shingles (lichens		H5 Miscellaneous inland habitats with very sparse or no vegetation, J6 Waste deposits	7130(*) Blanket bogs (* if active bog), 3130 Oligotrophic to mesotrophic standing waters witth vegetation of the Littorelletea uniflorae and/or Isoeto-Nanjuncet, 4030 European dry heaths, 6130 Calaminarian grasslands of the Violetalia calaminariae.	I.1, I.1.2, I.1.2.1, I.1.4.1, I.2.2, I.2.3
Ceredigian Bogs	Cors Caron, Cors Fochno (bryophytes, habitat)		D1 Raised & blanket bogs	7120 Degraded raised bogs still capable of natural regeneration, 7140 Transition mires and quaking bogs, 7150 Depressions on peat substrates of the Rhynchosporion, 91D0 Bog woodland, 3260 Water courses of plain to montane	E.1.6.2

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
				levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation, 3130 Oligotrophic to mesotrophic standing waters witth vegetation of the Littorelletea uniflorae and/or Isoeto-Nanjuncet, 7110 Active raised bogs	
Waun Rhydd	Waun Rhydd	*Pallavicinia lyellii* (bryophytes)			exclude IPA
River Wye/ Afon Gwy		Collema dichotomum	C2 Surface running waters (Littoral zone)	3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation, 7140 Transition mires and quaking bogs	G.2, I.1.4.1
Kenfig	Kenfig/ Cynffig (vascular plants), Kenfig Burrows (stoneworts, habitat)	Liparis loeselii, Petalophyllum ralfsii	B1 Coastal dune and sand habitats, C1 Surface standing waters	1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae), 2170 Dunes with Salix repens ssp. argentea (Salicion arenariea), 2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp., 2190 Humid dune slacks.	H.6.4, H.6.5, H.6.6, G.1

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Gower	Gower, Hunt's Farm (vascular plants), Gower Ashwoods; Gower commons (habitat)	Liparis loeselii, Petalophyllum ralfsii	B1 Coastal dune and sand habitats, B2 Coastal shingle habitats, B3 Rock cliffs, ledges & shores, including the supralittoral, D1 Raised & blanket bogs, D2 Valley mires, poor fens & transition mires, D4 Base-rich fens, E1 Dry Grasslands, E2 Mesic Grasslands, E3 Seasonally wet & wet grasslands, F4 Temperate shrub heathland	4010 Northern Atlantic wet heaths with Erica tetralix, 4030 European dry heaths, 6410 Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae), 9180* Tilio-Acerion forests of slopes, screes and ravines*, 2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 2170 Dunes with Salix repens ssp. argentea (Salicion arenariea), 2190 Humid dune slacks.	A.1.1.1, B.1.1, B.3.1, B.5, D.1.1, D.1.2, D.2, D.5, D.6, E.2.1, E.2.2, H.3.2, H.6.4, H.6.5, H.6.6, H.8.1, H.8.2, H.8.4, H.8.5, I.1.2.1, I.1.4.1, I.1.5, J.1.1
Dynefor Deer Park	Dynefor Deer Park		Broadleaved deciduous woodland: parkland (lichens)		A.1.1.1

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Pembrokeshire Limestone Coast	Brownslade Burrows (bryophytes), Pembrokeshire Coast & Islands (lichens), Stackpole (vascular plants), Limestone Coast of South West Wales, Pembrokeshire Bat Sites and Bosherston Lakes (habitat)	Petalophyllum ralfsii	Rock cliffs, ledges and shores including the supralittoral: coastal rocks, Temperate shrub heath: coastal rocks, Broadleaved deciduous woodland (lichens)	Fixed dunes with herbaceous vegetation (`grey dunes`); Vegetated sea cliffs of the Atlantic and Baltic coasts; Pembrokeshire Bat Sites and Bosherston Lakes/ Safleoedd Ystlum Sir Benfro a Llynnoedd Bos	A.1.1.1,B.3.1, D.1.1, D.1.2, E.2.2, G.1, H.1.3, H.4, H.6.4, H.6.5, H.6.8, H.8.1, H.8.4, H.8.5, I.1.4.2
Skomer, Skokholm and Dale Peninsula	Skomer Island		B3 Rock cliffs, ledges & shores, including the supralittoral, A2 Littoral sediments, E1 Dry Grasslands, E3 Seasonally wet & wet grasslands, F4 Temperate shrub heathland	1130 Estuaries, 1160 Large shallow inlets & bays, 1170 Reefs, 1110 Sandbanks which are slightly covered by sea water all the time, 1140 Mudflats & sandflats not covered by seawater at low tide, 1150* Coastal Lagoons*, 1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae),	H.4, H.8.1, H.1.3, H.8.2

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
St Davids Heaths and Cliffs	St David`s/ Ty Ddewi (vascular plants), North West Pembrokeshire Commons (habitat)	Luronium natans (vascular plants)	Heathlands, Coastal cliffs (vascular plants)	European dry heaths; Vegetated sea cliffs of the Atlantic and Baltic coasts; North West Pembrokeshire Commons/ Comins Gogledd Orllewin Sir Benfro: European dry heaths; Transition mires and quaking bog	D.1.1 , D.2 , D.5 , D.6 , F.1 , F.2.2 , G.1 , H.4 , H.8.1 , H.8.2 , H.8.4 , H.8.5 , H.8.6
Mwnt Arable Fields	Mwnt Fields		I1 Arable land & market gardens		J.1.1
Cliffs of the Brecon Beacons National Parks	Brecon Beacons Cliffs (vascular plants), Cwm Clydach Woodlands / Coedydd Cwm Clydach (habitat)	Sorbus leptophylla , Sorbus leyana , Sorbus minima	E4 Alpine & sub-alpine grasslands, F2 Arctic, alpine & subapline scrub habitats, G1 Broadleaved deciduous woodland, H2 Screes, H3 Inland cliffs, rock pavements & outcrops	4030 European dry heaths, 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels, 9120 Atlantic acidophilous beech forests with Ilex and sometimes also Taxus in the shrublayer, 9180 Tilio-Acerion forests of slopes, screes and ravines, 8210 Calcareous rocky slopes with chasmophytic vegetation, 8220 Siliceous rocky slopes with chasmophytic vegetation, 9130 Asperulo-Fagetum beech forests	A1.1.1, I.1.1, I.1.1.1, I.1.1.2, I.1.3, I.1.4, I.1.4.1

Name	Component sites	Criterion A – Threatened species	Criterion B – Botanical richness (EUNIS level 2 code & name)	Criterion C – Threatened habitats (Annex 1 name & code)	Phase 1 habitat
Carmarthen Bay Dunes/ Twyni Bae Caerfyrddin		Liparis loeselii		Dunes with Salix repens ssp. argentea (Salicion arenariae); Embryonic shifting dunes; Fixed dunes with herbaceous vegetation (`grey dunes`); Humid dune slacks; Shifting dunes along the shoreline 2190 Humid dune slacks (disparity between databases – CHECK)	H.1.1, H.2.6, H.3.1, H.6.4, H.6.5, H.6.8
STRICTLY CONFIDENTIAL	CONFIDENTIAL	Trichomanes speciosum			exclude IPA