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ERAMMP Report-47

Prediction of Bird Counts Under Different Land-Change Scenarios Across Three Regions of Wales

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British Trust for Ornithology

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Abbreviations Used in this Report

BBS	Breeding Bird Survey
BTO	British Trust for Ornithology
CI	Confidence Interval
DA	Disadvantaged Area
Defra	Department for Environment, Food and Rural Affairs
EFT	ERAMMP Farm Type
ERAMMP	Environment and Rural Affairs Monitoring and Modelling Programme
GIS	Geographical Information System
GMEP	Glastir Monitoring and Evaluation Programme
JNCC	Joint Nature Conservation Committee
LCM	Land Cover Map
LiDAR	Light Detection and Ranging
RSPB	Royal Society for the Protection of Birds
UKUKCEH	UK Centre for Ecology & Hydrology
WCP	Woody Cover Product

Contents

1 INTRODUCTION & METHODS

This technical annex explores predictions of the consequence of three possible land-use scenarios on bird abundance in Wales based upon models of BTO/JNCC/RSPB British Breeding Bird Survey (BBS) data. It forms part of the Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP) modelling work as can be found in ERAMMP Report-12 'Quick Start' Modelling (Phase 1)[1].

1.1 Modelling Approach

Previous analyses used bird survey, land-use and land cover data to model species-specific breeding bird counts for the whole of Wales in order to predict the responses of bird populations to possible land-use changes following the UK's exit from the European Union (Kettel & Siriwardena 2018). Here, in order to predict the responses of birds to more specific scenarios for three case study regions in Wales (Conwy (north Wales), Vale of Clwyd (north Wales) and Heads of the Valleys (south Wales); Figure 1.1), these models have been applied to the focal regions and the predictions from the new scenarios. Hence, information from the whole of Wales is used to predict for the target regions. This assumes that relationships between birds and environmental variables that pertain across the whole nation also pertain at the regional scale.

Ideally, new models would have been run at the regional scale, to avoid this assumption, but sample sizes, in the form of bird survey site density per region, did not permit such analyses. In addition, land-uses that are important within a focal region but under-represented in the national data will not be incorporated adequately in the regional predictions. In principle, this should not occur with a random distribution of survey squares, but the bird survey data that have been used to date come from a volunteer survey, within which coverage of areas with lower observer density (such as upland Wales) is poor. Therefore, the analyses are limited with respect to the influences of such habitats and how they may change in the future.

The models considered bird counts at the 1km square scale as a function of the sum of parcel-level covers of each of farm (field) type, four non-farm land covers (acid grassland, heather, suburban habitat, urban habitat), woodland and rivers

1.2 Breeding Bird Survey

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) is a UK-wide survey that has been running since 1994, with the aim of monitoring population trends of the UK's breeding birds. The survey is organised by the British Trust for Ornithology (BTO) and carried out by volunteers. Participants in the BBS count all bird species seen or heard along two parallel 1-km transects within randomly-allocated 1-km grid squares (chosen through random sampling, stratified by observer density).

Here, we used the maximum annual count of each species per 1-km grid square in Wales over a five year period (2013 – 2017), having first extracted the maximum count across visits within years) to provide a best estimate of contemporary local counts. We chose a five year period because it provided a good amount of grid squares with BBS data, whilst remaining

[1] www.erammp.wales/12

up-to-date. A compromise between a short time window (minimising real population change in the focal squares) and a longer window (increasing sample size due to turnover in the sample) was important. Considering multiple years compensated for the high stochasticity in counts of all species and detection of scarcer species from the BBS method, so reduced stochastic fluctuations between squares.

For analysis, we only chose species that were present in at least 30 grid squares that also contained scenario data (described below). We chose a 30-square threshold because this is a standard for annual samples when producing bird trends using BBS data (e.g. Harris et al., 2018). The counts of 60 species could be predicted using this threshold (Table 1.1). We chose to run initial models on BBS data from the whole of Wales, rather than squares with scenario data because of the small sample sizes (i.e. number of squares with both scenario and BBS data) in each study region (Conwy: 10; Heads of the Valleys: 58; the Vale of Clwyd: 6). Note that, subject to annual turnover, a regional model might be feasible for the Heads of the Valleys in future work.

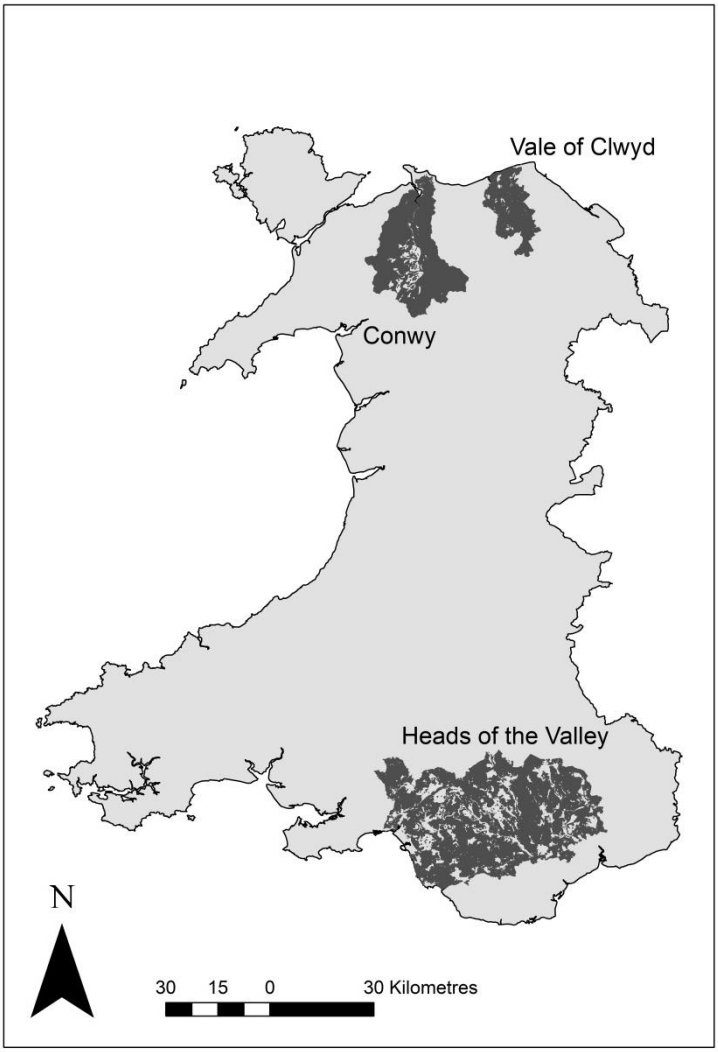

Figure. 1.1 Location of the three study areas in Wales.

Table 1.1 Species included in subsequent analyses. Species codes are used in subsequent tables.

Species code	Common name	Species code	Common name
GO	Goldfinch	RT	Redstart
GR	Greenfinch	SK	Siskin
JD	Jackdaw	SH	Sparrowhawk
K	Kestrel	TP	Tree pipit
RO	Rook	TC	Treecreeper
WP	Woodpigeon	WW	Willow Warbler
LI	Linnet	GL	Grey wagtail
S	Skylark	H	Grey heron
SG	Starling	RB	Reed bunting
WH	Whitethroat	MA	Mallard
B	Blackbird	HG	Herring gull
BT	Blue tit	BZ	Buzzard
BF	Bullfinch	CG	Canada goose
CH	Chaffinch	C	Carrion crow
D	Dunnock	CD	Collared dove
GT	Great tit	CK	Cuckoo
LT	Long-tailed tit	HM	House martin
R	Robin	HS	House sparrow
ST	Song thrush	LB	Lesser black-backed gull
WR	Wren	MG	Magpie
BC	Blackcap	MP	Meadow pipit
CC	Chiffchaff	M	Mistle thrush
CT	Coal tit	PH	Pheasant
GW	Garden warbler	PW	Pied wagtail
GC	Goldcrest	RN	Raven
GS	Great spotted woodpecker	KT	Red kite
G	Green woodpecker	SC	Stonechat
J	Jay	SL	Swallow
LR	Lesser redpoll	SI	Swift
NH	Nuthatch	W	Wheatear

1.3 Geographical Information System analysis

We used various datasets to calculate the amounts of different land-uses per 1-km grid square, matching the variables used in generating scenarios (see below) and adding contextual variables (not subject to change under the scenarios) as were considered important, from expert judgement and subject to data availability, for accurate prediction of bird counts. We used the Detailed River Network, a spatial dataset produced by the

Environment Agency[2], to calculate the total length of rivers per 1-km grid square in Wales. The Land Cover Map 2015 is a dataset produced by the UK Centre for Ecology and Hydrology (UKCEH) that used satellite imagery to map habitats based on Biodiversity Action Plan Broad Habitats for the whole of the UK (Rowland *et al*., 2017).

We used the LCM2015 to calculate the proportion of each 1-km grid square to contain different land-uses. We chose broad habitats that were widespread (so potentially influential for national populations of birds) and that were not conflicted by other datasets used (e.g. we did not calculate the area for woodland because this would be covered by the Woody Cover Product).

The Woody Cover Product (WCP) is a dataset produced by UKCEH that used a combination of airborne radar data, satellite imagery and data from the National Forest Inventory to map large hedgerows, individual trees and small patches of woodland for the entirety of Wales.

The area (ha) of each polygon was calculated by converting the raster data set to a vector data set (using the 'raster to polygon' tool in ArcMap) and using the 'calculate geometry' tool. The Forestry Commission's definition of a woodland is at least 0.5 ha of a stand of trees[3], so we selected all polygons with an area of at least 0.5 ha. The proportion of each 1-km grid square to contain woodland were then calculated. The level of afforestation (i.e. the change in woodland cover) for different land management scenarios (described below) were calculated and provided by UKCEH.

Finally, we used the ERAMMP Farm Type (EFT) spatial dataset provided by UKCEH that has classified farming types in Wales at the field level. The Farm types comprised: cereals, general cropping, dairy, lowland cattle/sheep, mixed, specialist sheep, specialist beef, various grazing in disadvantaged areas (DAs), mixed grazing in Severely and Disadvantaged Areas (SDAs). The total area (sqm) of each of these per 1-km was calculated using a Geographical Information System (GIS).

The aim of this work was to predict the counts of bird species under the five different scenarios, as provided by UKCEH: 'land abandonment 1', 'land abandonment 2', 'afforestation 1', 'afforestation 2' and 'peat', as well as all five scenarios combined. Note that no data were available to consider wetting of peat. Scenarios were obtained at the parcel level, with each parcel in the three regions designated as 'abandoned' or not, 'afforested' or not and 'converted to peat' or not. In each scenario, 'no change' parcels were assumed to retain the same cover as before. In the combined scenario, parcels could be any of the new covers, or unchanged.

Note, however, that many parcels across Wales, for the source models, and within the focal regions, for prediction here, had no EFT. All GIS parcels that had not been assigned an EFT were removed from analyses (59,017 out of 188,798 parcels across all three regions). For each scenario, therefore, land-use for prediction consisted of all parcels with EFTs, but with the land-use in parcels denoted as changing under the scenario changed to the cover

[2] Detailed River Network https://data.gov.uk/dataset/54d0c6b0-7bdc-4f66-90e7-42443b122c2e/detailed-river-network-afa036

[3] National Forestry Inventory https://data.gov.uk/dataset/ae33371a-e4da-4178-a1df-350ccfcc6cee/national-forest-inventory-woodland-england-2015

variable included in the model that provided the closest description to the land-use type described by the scenario (see below).

Note that land-uses after changes under the 'abandonment' and 'peat' scenarios could often only be approximated within the limited number of cover types available. All GIS analyses were conducted using ArcMap version 10.5.1.

For abandonment, parcels in upland areas were assumed to become open grass moorland and parcels in lowland farmland were assumed to become scrubland (for which deciduous woodland was the closest available proxy). Therefore, for each parcel labelled as 'abandoned' in the abandonment scenarios, we made the EFT blank (zero area) and, where the EFT was previously specialist sheep, specialist beef, DA or SDA (i.e. those we believed would largely be in upland areas), then we set the LCM cover to "acid grassland" and recalculated the LCM and EFT totals per 1km square.

Where the EFT was cereal, general cropping, dairy, lowland cattle/sheep or mixed, then we added the total area of these parcels per 1km square to the 1km-square-specific value for 'woodland' from woody cover data.

For afforestation, we assumed that all parcels became deciduous woodland. Hence, for each parcel labelled as 'afforested' in the afforestation scenarios, we again made the EFT blank and the total area of the parcel was added to the 1km-square-specific value for 'woodland' from the woody cover data.

For peat, we assumed that parcels would become open grass moorland. Therefore, for parcels labelled as 'peat', all EFTs were made blank and we set to the LCM category to 'acid grassland' again, before recalculating the LCM and EFT totals.

1.4 Predictive modelling

In the original source models, we first fitted generalised linear models with Poisson error structures to BBS bird count data to predict the count of bird species with respect to farm type, land-use and land cover for the whole of Wales (Kettel & Siriwardena 2018). The maximum count of the species per 1-km grid square was fitted as the response variable. Fixed effects included the different land-uses and field types per 1-km square: total length of rivers, and proportion of acid grassland, heather, suburban habitat, urban habitat, woodland cover, cereals, general cropping, dairy, lowland cattle/sheep, mixed, specialist sheep, specialist beef, DA various grazing, SDA mixed grazing.

The fitted model coefficients were then used to predict bird counts for the baseline (current land-use) and under the five different scenarios for all 1km squares in each of the case study regions, using the *predict* function in R and using datasets containing the changed amounts of the farm types and land-uses using the LCM and woody cover product, as described above.

This method predicted counts per 1-km square under each scenario. The total count across all grid squares was then calculated so that comparisons between the baseline data and the different scenarios could be made.

Models were fitted for each species separately. Predicted counts under the different scenarios are reported for species listed as 'woodland' (n = 26), 'farmland' (n = 10), 'water and wetland' (n = 4), 'seabird (n = 1) or 'other' (n = 20; i.e. those not included in any of the

other indicator lists) specialists, as reported in Defra's wild bird indicator document (Defra, 2017).

Once the predicted counts of each species under the different scenarios was calculated, the diversity of species under each scenario was calculated using Simpson's Diversity Index, where n is the number of individuals of each species and N is the total number of all individuals:

$$D = 1 - \frac{\Sigma\, n(n-1)}{N(N-1)}$$

The mean diversity of species was compared among the different scenarios using ANOVA tests and post-hoc Tukey's tests. Predicted counts and species diversity was calculated for each study region (Conwy, Heads of the Valleys and Vale of Clwyd) separately.

These tests should be taken as indicative only, since the predicted counts and diversity values for individual squares were all derived from modelled data and cannot be regarded as independent. Moreover, the calculations do not account for the uncertainty in the predictions.

2 RESULTS

2.1 General patterns

Predictions were made for all species of interest, but the confidence intervals (CIs) around the estimates for different species were highly variable. Moreover, those for some species were very large and encompassed zero (CIs not shown in the tables below). Clearly, this shows that the predictions are not reliable for those species.

2.2 Predicted counts: Abandonment scenarios

Both abandonment scenarios resulted in similar amount of species to have higher or lower predicted counts compared to the baseline. In general, more species had lower predicted counts, although the changes were small (Table 2.1).

Table 2.1 Number of species to have predicted counts higher or lower than the baseline prediction in three regions of Wales under two abandonment scenarios.

	Abandonment 1			Abandonment 2		
	Conwy	Heads of the Valleys	Vale of Clwyd	Conwy	Heads of the Valleys	Vale of Clwyd
Higher	25	31	27	23	26	27
Lower	34	29	32	36	34	32

In Conwy, there was an almost equal split of woodland species that were predicted to have higher or lower counts in the abandonment scenarios compared to the baseline: 12 species (mostly generalist woodland species) were predicted to have lower counts, whilst 14 (mostly specialist woodland species) were predicted to have higher counts. Most (8 out of 10) farmland species were predicted to have lower counts in both abandonment scenarios compared to the baseline. All of the water and wetland species where predictions were made (n = 3) had higher counts. Six 'other' species were predicted to have higher counts, whilst 13 were predicted to have lower counts (Table 2.2).

There was also an almost equal split of woodland species that were predicted to have higher or lower counts in both abandonment scenarios compared to the baseline in the Heads of the Valleys: conversely to Conwy, specialist woodland species tended to have lower predicted counts, whilst generalist species tended to have higher predicted counts. Most (8 out of 10) farmland species were predicted to have higher counts in both abandonment scenarios. The counts of 'other', water and wetland and seabird species was fairly mixed (Table 2.3).

In the Vale of Clwyd, most (22 out of 26) woodland species were predicted to have a higher count under both abandonment scenarios, compared to the baseline. Conversely, all farmland species (n = 10) and most 'other' (14 out of 19) were predicted to have lower counts under both abandonment scenarios compared to the baseline (Table 2.4).

Table 2.2 Predicted counts and the percentage difference in predicted counts from the baseline in Conwy under two abandonment scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Abandonment 1			Abandonment 2		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	3,067	(3683,2576)		1,234	(1555,981)	-60%	1,080	(1365,856)	-65%
BT	Woodland	Generalist	987	(1378,732)		691	(1017,474)	-30%	655	(976,445)	-34%
BF	Woodland	Generalist	6,169	(7037,5452)		1,669	(2001,1394)	-73%	1,512	(1817,1260)	-75%
CH	Woodland	Generalist	150	-		35	-	-76%	34	-	-77%
D	Woodland	Generalist	3,719	(4349,3207)		649	(843,500)	-83%	509	(665,390)	-86%
GT	Woodland	Generalist	5,328	(6017,4736)		4,876	(5652,4212)	-8%	4,381	(5082,3781)	-18%
LT	Woodland	Generalist	2,469	(2983,2058)		544	(731,406)	-78%	524	(706,390)	-79%
R	Woodland	Generalist	6,084	(7034,5301)		2,547	(3302,1966)	-58%	3,048	(3952,2352)	-50%
ST	Woodland	Generalist	1,858	(2473,1478)		209	(310,143)	-89%	187	(279,127)	-90%
WR	Woodland	Generalist	1,249	(1696,942)		398	(587,272)	-68%	370	(550,251)	-70%
BC	Woodland	Specialist	9,563	(10484,8745)		11,311	(12604,10158)	18%	10,224	(11394,9181)	7%
CC	Woodland	Specialist	7,446	(8400,6646)		8,601	(9867,7507)	16%	7,201	(8267,6279)	-3%
CT	Woodland	Specialist	1,024	(4128,691)		1,324	(2012,895)	29%	1,257	(1905,843)	23%
GW	Woodland	Specialist	12,067	(13242,11020)		15,433	(17200,13856)	28%	14,119	(15716,12690)	17%
GC	Woodland	Specialist	2,639	(3156,2228)		1,830	(2279,1473)	-31%	1,702	(2125,1367)	-35%
GS	Woodland	Specialist	4,347	(5052,3764)		5,321	(6324,4486)	22%	4,892	(5815,4122)	13%
G	Woodland	Specialist	1,367	(2150,989)		1,097	(1627,748)	-20%	1,024	(1525,694)	-25%
J	Woodland	Specialist	8,421	(9339,7615)		13,273	(14936,11806)	58%	12,266	(13793,10916)	46%
LR	Woodland	Specialist	4,254	(4980,3661)		12,340	(14623,10438)	190%	12,160	(14390,10294)	186%
NH	Woodland	Specialist	11,892	(12944,10940)		20,042	(22144,18150)	69%	19,315	(21326,17500)	62%
RT	Woodland	Specialist	3,085	(3711,2595)		6,865	(8341,5673)	123%	6,663	(8117,5491)	116%
SK	Woodland	Specialist	3,677	(4301,3165)		7,453	(8911,6253)	103%	6,731	(8071,5630)	83%
SH	Woodland	Specialist	2,112	(2729,1669)		10,488	(13668,8115)	397%	11,478	(14910,8894)	443%
TP	Woodland	Specialist	1,207	(1903,827)		1,781	(2794,1151)	48%	1,680	(2618,1090)	39%
TC	Woodland	Specialist	2,380	(2995,1920)		10,569	(13460,8351)	344%	10,827	(13730,8581)	355%
WW	Woodland	Specialist	1,335	(2377,941)		1,741	(2495,1229)	30%	1,588	(2267,1121)	19%
GL	Water/wetland	Fast flowing	1,277	(931923,505)		1,781	(861458,882)	39%	1,907	(1011016,954)	49%
H	Water/wetland	Other	1,134	(1645,810)		2,185	(3201,1506)	93%	2,160	(3144,1494)	90%
RB	Water/wetland	Reedbeds	-	-		-	-	-	-	-	-
MA	Water/wetland	Slow/ standing	1,637	(2777,1172)		2,718	(4003,1867)	66%	2,591	(3812,1776)	58%
HG	Seabird		3,268	-		1,722	-	-47%	1,561	-	-52%
BZ	Other		1,756	(2.39E+24,1292)		8,992	(6.66E+23,6535)	412%	10,556	(7.49E+23,7673)	501%
CG	Other		149	(2596,32)		238	(1626,53)	59%	254	(1600,58)	70%
C	Other		1,356	-		3,478	-	157%	3,868	-	185%
CD	Other		826	(1927,496)		845	(1526,478)	2%	812	(1471,456)	-2%
CK	Other		8,141	(9198,7228)		17,557	(20206,15275)	116%	18,292	(21010,15941)	125%
HM	Other		-	-		-	-	-	-	-	-
HS	Other		279	-		78	-	-72%	60	-	-79%
LB	Other		1,175	-		220	-	-81%	234	-	-80%
MG	Other		1,767	(2462,1309)		1,153	(1779,750)	-35%	1,195	(1856,772)	-32%
MP	Other		4,644	(5261,4122)		398	(474,336)	-91%	355	(421,301)	-92%
M	Other		1,057	(1468,779)		765	(1181,499)	-28%	692	(1064,452)	-35%
PH	Other		1,432	-		909	-	-37%	910	-	-36%
PW	Other		9,185	(10165,8322)		2,508	(2929,2148)	-73%	2,058	(2405,1762)	-78%
RN	Other		1,292	(2011,912)		543	(927,324)	-58%	539	(941,314)	-58%
KT	Other		1,112	(2750,766)		1,623	(4141,980)	46%	1,775	(4486,1073)	60%
SC	Other		980	(1423,711)		886	(1425,556)	-10%	755	(1220,471)	-23%
SL	Other		7,130	(8336,6224)		3,680	(4461,3045)	-48%	3,313	(4048,2720)	-54%
SI	Other		2,003	(2568,1597)		416	(623,278)	-79%	343	(517,228)	-83%
W	Other		2,580	(3141,2146)		872	(1163,656)	-66%	743	(995,557)	-71%
GO	Farmland	Generalist	12,767	(14148,11575)		2,358	(2941,1895)	-82%	2,702	(3370,2172)	-79%
GR	Farmland	Generalist	1,726	(2245,1345)		2,731	(3710,2019)	58%	2,808	(3802,2080)	63%
JD	Farmland	Generalist	3,468	(4293,2825)		3,015	(4034,2260)	-13%	2,771	(3736,2062)	-20%
K	Farmland	Generalist	2,092	(2714,1643)		576	(840,396)	-72%	497	(726,342)	-76%
RO	Farmland	Generalist	1,031	(1465,745)		462	(757,284)	-55%	432	(706,267)	-58%
WP	Farmland	Generalist	720	-		357	-	-50%	314	-	-56%
LI	Farmland	Specialist	1,823	(2.25E+51,1361)		392	(1.09E+48,222)	-79%	399	(1.12E+48,226)	-78%
S	Farmland	Specialist	2,375	(2908,1960)		773	(1024,584)	-67%	593	(787,447)	-75%
SG	Farmland	Specialist	148	-		452	-	206%	530	-	259%
WH	Farmland	Specialist	2,837	(3727,2267)		116	(229,62)	-96%	118	(234,63)	-96%

Table 2.3 Predicted counts and the percentage difference in predicted counts from the baseline in Heads of the Valleys under two abandonment scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Abandonment 1			Abandonment 2		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	8,929	(10394,7699)		12,384	(14227,10796)	39%	10,993	(12682,9539)	23%
BT	Woodland	Generalist	3,585	(4665,2792)		4,603	(5883,3626)	28%	4,346	(5629,3378)	21%
BF	Woodland	Generalist	21,486	(23654,19555)		26,212	(28807,23871)	22%	24,449	(26939,22201)	14%
CH	Woodland	Generalist	184	-		292	-	58%	314	-	70%
D	Woodland	Generalist	8,523	(10010,7296)		14,332	(16302,12622)	68%	11,464	(13137,10020)	34%
GT	Woodland	Generalist	19,987	(22083,18121)		16,230	(17997,14648)	-19%	14,807	(16450,13335)	-26%
LT	Woodland	Generalist	5,393	(6507,4501)		11,325	(13133,9795)	110%	11,453	(13269,9899)	112%
R	Woodland	Generalist	9,949	(11480,8686)		20,870	(23491,18571)	110%	26,799	(29794,24124)	169%
ST	Woodland	Generalist	8,606	(10298,7273)		10,576	(12734,8832)	23%	9,411	(11466,7768)	9%
WR	Woodland	Generalist	2,980	(3990,2271)		6,439	(8072,5188)	116%	6,078	(7664,4855)	104%
BC	Woodland	Specialist	33,355	(36042,30900)		27,245	(29461,25207)	-18%	24,746	(26795,22859)	-26%
CC	Woodland	Specialist	22,046	(24342,20000)		15,914	(17612,14388)	-28%	13,531	(15052,12170)	-39%
CT	Woodland	Specialist	3,023	(4953,2199)		3,269	(4529,2380)	8%	3,122	(4391,2237)	3%
GW	Woodland	Specialist	27,694	(30144,25477)		24,898	(26983,22982)	-10%	22,696	(24635,20912)	-18%
GC	Woodland	Specialist	8,342	(9716,7192)		10,037	(11575,8719)	20%	9,461	(10951,8183)	13%
GS	Woodland	Specialist	13,093	(14890,11544)		12,013	(13668,10567)	-8%	11,095	(12670,9720)	-15%
G	Woodland	Specialist	4,142	(5549,3157)		4,288	(5587,3308)	4%	3,994	(5262,3043)	-4%
J	Woodland	Specialist	25,059	(27456,22903)		20,592	(22564,18801)	-18%	18,995	(20849,17309)	-24%
LR	Woodland	Specialist	13,019	(14912,11403)		8,462	(9722,7372)	-	8,216	(9451,7146)	-
NH	Woodland	Specialist	32,724	(35350,30323)		26,885	(29007,24926)	-18%	25,902	(27948,24010)	-21%
RT	Woodland	Specialist	10,209	(11932,8773)		8,777	(10286,7501)	-14%	8,467	(9978,7195)	-17%
SK	Woodland	Specialist	11,294	(13018,9835)		8,797	(10125,7654)	-22%	8,076	(9352,6983)	-28%
SH	Woodland	Specialist	6,397	(7958,5196)		4,001	(5100,3147)	-37%	4,320	(5504,3396)	-32%
TP	Woodland	Specialist	2,997	(4362,2133)		2,331	(3346,1631)	-22%	2,196	(3194,1514)	-27%
TC	Woodland	Specialist	6,724	(8247,5530)		3,809	(4744,3065)	-43%	3,888	(4845,3124)	-42%
WW	Woodland	Specialist	3,604	(4891,2742)		3,282	(4322,2503)	-9%	3,022	(4015,2280)	-16%
GL	Water/wetland	Fast flowing	2,140	(11690,1305)		1,365	(2425,825)	-	1,477	(2593,895)	-
H	Water/wetland	Other	2,914	(3947,2182)		2,401	(3279,1766)	-18%	2,355	(3233,1719)	-19%
RB	Water/wetland	Reedbeds	-	-		-	-	-	-	-	-
MA	Water/wetland	Slow/standing	4,518	(6103,3441)		3,599	(4831,2690)	-20%	3,423	(4645,2527)	-24%
HG	Seabird		5,861	-		6,377	-	9%	5,758	-	-2%
BZ	Other		5,286	-		4,696	-	-11%	5,549	-	5%
CG	Other		339	(3401,101)		311	(1181,103)	-8%	318	(989,110)	-6%
C	Other		2,986	-		3,826	-	28%	4,419	-	48%
CD	Other		2,184	(3587,1424)		2,235	(3485,1444)	2%	2,146	(3419,1354)	-2%
CK	Other		18,522	(20741,16583)		14,900	(16650,13341)	-20%	15,286	(17075,13687)	-17%
HM	Other		-	(8.64E+32,1252)		-	(4.69E+32,792)	-	-	(4.64E+32,748)	-
HS	Other		845	(30967418,431)		894	(58081429,483)	6%	749	(58480222,389)	-11%
LB	Other		2,496	-		5,891	-	136%	6,290	-	152%
MG	Other		6,511	(8205,5213)		5,380	(6906,4207)	-17%	5,564	(7198,4310)	-15%
MP	Other		13,907	(15604,12431)		50,368	(55120,46088)	262%	42,011	(46105,38328)	202%
M	Other		1,946	(2676,1447)		1,928	(2537,1472)	-1%	1,770	(2328,1348)	-9%
PH	Other		7,156	-		2,268	-	-68%	2,340	-	-67%
PW	Other		19,212	(21076,17535)		20,924	(22799,19213)	9%	17,600	(19217,16122)	-8%
RN	Other		5,317	(7005,4127)		6,559	(8712,4997)	23%	6,476	(8852,4801)	22%
KT	Other		2,119	(3234,1465)		2,396	(3428,1694)	13%	2,618	(3701,1864)	24%
SC	Other		3,022	(4119,2255)		3,225	(4335,2413)	7%	2,839	(3872,2093)	-6%
SL	Other		32,961	(36351,29991)		29,671	(32940,26767)	-10%	25,731	(28873,22975)	-22%
SI	Other		6,667	(8095,5535)		6,252	(7644,5132)	-6%	5,234	(6459,4252)	-21%
W	Other		8,807	(10248,7602)		8,205	(9578,7042)	-7%	7,120	(8362,6069)	-19%
GO	Farmland	Generalist	15,571	(17445,13997)		30,969	(33982,28262)	99%	37,327	(40627,34324)	140%
GR	Farmland	Generalist	4,381	(5538,3495)		3,962	(4991,3153)	-10%	4,071	(5115,3243)	-7%
JD	Farmland	Generalist	6,846	(8466,5589)		8,099	(9725,6760)	18%	7,872	(9535,6507)	15%
K	Farmland	Generalist	4,084	(5106,3290)		4,893	(6016,3989)	20%	4,283	(5298,3465)	5%
RO	Farmland	Generalist	1,768	(2532,1277)		2,144	(2878,1606)	21%	2,025	(2710,1516)	15%
WP	Farmland	Generalist	718	-		640	-	-11%	581	-	-19%
LI	Farmland	Specialist	3,486	(1.18E+21,2485)		5,794	(2.78E+21,4544)	66%	6,102	(2.79E+21,4831)	75%
S	Farmland	Specialist	4,992	(6052,4147)		7,125	(8392,6060)	43%	5,801	(6874,4900)	16%
SG	Farmland	Specialist	508	-		760	-	50%	945	-	86%
WH	Farmland	Specialist	3,064	(4107,2387)		7,174	(8899,5823)	134%	7,646	(9366,6268)	150%

Table 2.4 Predicted counts and the percentage difference in predicted counts from the baseline in Vale of Clwyd under two abandonment scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Abandonment 1			Abandonment 2		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	6,615	(7181,6107)		7,157	(8019,6402)	8%	7,064	(7916,6319)	7%
BT	Woodland	Generalist	4,484	(4967,4059)		5,807	(6694,5050)	29%	5,710	(6584,4964)	27%
BF	Woodland	Generalist	532	(760,390)		681	(1022,465)	28%	683	(1025,466)	28%
CH	Woodland	Generalist	4,966	(5461,4528)		7,377	(8312,6562)	49%	7,404	(8342,6586)	49%
D	Woodland	Generalist	2,265	(2623,1970)		1,196	(1497,960)	-47%	1,187	(1487,953)	-48%
GT	Woodland	Generalist	2,444	(2803,2143)		2,938	(3525,2462)	20%	2,920	(3504,2446)	19%
LT	Woodland	Generalist	705	(935,546)		530	(781,367)	-25%	525	(774,363)	-25%
R	Woodland	Generalist	4,407	(4872,3994)		7,233	(8211,6385)	64%	7,225	(8202,6377)	64%
ST	Woodland	Generalist	1,913	(2227,1652)		5,691	(6815,4778)	197%	5,740	(6871,4822)	200%
WR	Woodland	Generalist	6,066	(6604,5581)		10,453	(11648,9395)	72%	10,459	(11653,9401)	72%
BC	Woodland	Specialist	1,967	(2301,1690)		4,083	(4947,3386)	108%	4,107	(4975,3407)	109%
CC	Woodland	Specialist	2,803	(3192,2471)		5,553	(6616,4680)	98%	5,528	(6584,4660)	97%
CT	Woodland	Specialist	500	(688,374)		2,828	(3824,2158)	465%	2,933	(3957,2242)	486%
GW	Woodland	Specialist	253	(418,163)		465	(783,292)	84%	471	(793,296)	86%
GC	Woodland	Specialist	727	(928,576)		3,787	(4907,2963)	421%	3,875	(5013,3037)	433%
GS	Woodland	Specialist	581	(791,436)		869	(1259,610)	50%	870	(1259,610)	50%
G	Woodland	Specialist	245	.		388	.	58%	393	.	61%
J	Woodland	Specialist	466	(663,337)		927	(1415,626)	99%	929	(1414,627)	99%
LR	Woodland	Specialist	-	.		-	.	-	-	.	-
NH	Woodland	Specialist	557	(775,409)		1,120	(1662,766)	101%	1,127	(1675,771)	102%
RT	Woodland	Specialist	662	.		518	.	-22%	509	.	-23%
SK	Woodland	Specialist	288	(4.03E+53,169)		1,674	(1.74E+54,1160)	481%	1,743	(1.59E+54,1215)	505%
SH	Woodland	Specialist	306	(2349595,28)		490	(4426161,26)	60%	562	(5076803,28)	84%
TP	Woodland	Specialist	614	.		1,010	.	65%	1,046	.	70%
TC	Woodland	Specialist	335	(569,210)		362	(685,202)	8%	362	(686,202)	8%
WW	Woodland	Specialist	1,568	(1846,1344)		4,202	(4975,3581)	168%	4,289	(5075,3657)	173%
GL	Water/wetland	Fast flowing	-	.		-	.	-	-	.	-
H	Water/wetland	Other	129	(9.97E+42,66)		50	(3.48E+42,17)	-61%	49	(3.49E+42,17)	-62%
RB	Water/wetland	Reedbeds	339	.		56	.	-	57	.	-
MA	Water/wetland	Slow/standing	1,257	(1626,993)		528	(815,348)	-58%	520	(803,343)	-59%
HG	Seabird		4,170	(4807,3661)		164	(212,127)	-96%	159	(205,123)	-96%
BZ	Other		476	(687,353)		377	(625,242)	-21%	374	(620,240)	-22%
CG	Other		663	.		492	.	-26%	483	.	-27%
C	Other		5,655	(6225,5158)		1,691	(1996,1436)	-70%	1,639	(1936,1391)	-71%
CD	Other		942	(1478,728)		245	(464,149)	-74%	243	(463,147)	-74%
CK	Other		554	(1749856,91)		862	(2708878,160)	55%	855	(2642898,164)	54%
HM	Other		430	(621,314)		359	(591,226)	-	357	(589,224)	-
HS	Other		6,069	(6622,5580)		2,214	(2627,1870)	-64%	2,170	(2577,1830)	-64%
LB	Other		2,222	(2705,1854)		351	(530,234)	-84%	336	(507,223)	-85%
MG	Other		1,831	(2147,1581)		520	(699,390)	-72%	504	(679,378)	-72%
MP	Other		828	(1089,676)		225	(304,175)	-73%	237	(319,184)	-71%
M	Other		569	(768,429)		906	(1286,651)	59%	916	(1299,658)	61%
PH	Other		1,795	(2170,1503)		1,524	(2025,1157)	-15%	1,521	(2020,1155)	-15%
PW	Other		833	(1077,662)		271	(406,185)	-67%	263	(395,179)	-68%
RN	Other		326	(500,227)		181	(314,109)	-44%	186	(321,112)	-43%
KT	Other		37	.		55	.	50%	56	.	54%
SC	Other		321	.		80	.	-75%	81	.	-75%
SL	Other		1,898	(2248,1617)		639	(851,483)	-66%	629	(837,474)	-67%
SI	Other		94	.		118	.	25%	121	.	28%
W	Other		458	(9019,312)		24	(381,11)	-95%	24	(405,11)	-95%
GO	Farmland	Generalist	2,280	(2653,1976)		789	(1003,623)	-65%	776	(988,612)	-66%
GR	Farmland	Generalist	882	(1137,701)		441	(643,307)	-50%	438	(641,305)	-50%
JD	Farmland	Generalist	5,401	(5932,4937)		1,055	(1269,879)	-80%	1,032	(1242,859)	-81%
K	Farmland	Generalist	75	.		19	.	-75%	19	.	-75%
RO	Farmland	Generalist	4,832	(5455,4306)		661	(862,508)	-86%	638	(833,489)	-87%
WP	Farmland	Generalist	4,708	(5199,4278)		3,609	(4198,3112)	-23%	3,541	(4120,3053)	-25%
LI	Farmland	Specialist	1,490	(1830,1230)		259	(358,188)	-83%	259	(358,188)	-83%
S	Farmland	Specialist	1,215	(1527,986)		385	(518,288)	-68%	401	(539,301)	-67%
SG	Farmland	Specialist	1,984	(3225,1679)		122	(243,81)	-94%	118	(235,78)	-94%
WH	Farmland	Specialist	941	(1204,752)		243	(357,167)	-74%	242	(355,166)	-74%

2.3 Predicted counts: Afforested scenarios

Both afforestation scenarios resulted in similar amount of species to have higher or lower predicted counts compared to the baseline. In the Head of Valleys, more species had a predicted count higher than the baseline than those that had a lower predicted count. There were slightly fewer species to have higher predicted counts in Conwy and the Vale of Clwyd than those that had lower predicted counts (Table 2.5).

Table 2.5 Number of species to have a predicted count higher or lower than the baseline prediction in three regions of Wales under two afforestation scenarios.

	Afforested 1			Afforested 2		
	Conwy	Heads of the Valleys	Vale of Clwyd	Conwy	Heads of the Valleys	Vale of Clwyd
Higher	27	34	27	27	36	27
Lower	32	26	32	33	24	32

In Conwy, the predicted counts of 15 woodland species were higher under both afforestation scenarios compared to the baseline, most of these being specialist woodland species. Eleven woodland species were predicted to have counts lower than the baseline under both afforestation scenarios, most of these being generalists.

Six farmland species were predicted to have lower counts under the scenarios compared to the baseline, and three higher. All of the water and wetland species where predictions were made (n = 3) had higher counts. Six ‘other’ species were predicted to have higher counts, whilst 12 were predicted to have lower counts (Table 2.6).

In the Heads of the Valleys, the counts of 13 woodland species in the first afforestation scenario and 15 woodland species in the second afforestation scenario were predicted to be higher than the baseline predictions, with a mix of generalist and specialist species. The counts of all but two farmland species (woodpigeon and greenfinch) in the first scenario and all but one farmland species (woodpigeon) in the second scenario were predicted to be higher than the baseline. In general, there was a mix of responses from species listed as ‘other’ or water and wetland (Table 2.7).

In the Vale of Clwyd, counts of most woodland species were predicted to be higher under both afforestation scenarios compared to the baseline, though the predicted counts of dunnock, long-tailed tit and redstart were predicted to be slightly lower (Table 2.8). Conversely, the predicted counts of all farmland species were predicted to be lower under the afforestation scenarios compared to the baseline.

Similarly, the predicted counts of all but four ‘other’ or water and wetland species (cuckoo, magpie, red kite and swift) were predicted to be lower (Table 2.8).

Table 2.6 Predicted counts and the percentage difference in predicted counts from the baseline in Conwy under two afforestation scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline		Afforested 1			Afforested 2		
Species	Habitat	Generalism	Count	CI	Count	CI	%	Count	CI	%
B	Woodland	Generalist	3,067	(3683,2576)	1,298	(1660,1019)	-58%	1,103	(1434,853)	-64%
BT	Woodland	Generalist	987	(1378,732)	648	(962,445)	-34%	621	(949,415)	-37%
BF	Woodland	Generalist	6,169	(7037,5452)	1,710	(2072,1415)	-72%	1,404	(1721,1149)	-77%
CH	Woodland	Generalist	150	-	39	-	-74%	32	-	-79%
D	Woodland	Generalist	3,719	(4349,3207)	709	(930,544)	-81%	494	(657,375)	-87%
GT	Woodland	Generalist	5,328	(6017,4736)	5,388	(6314,4610)	1%	5,333	(6333,4504)	0%
LT	Woodland	Generalist	2,469	(2983,2058)	496	(671,368)	-80%	407	(558,299)	-84%
R	Woodland	Generalist	6,084	(7034,5301)	1,287	(1704,976)	-79%	1,181	(1594,880)	-81%
ST	Woodland	Generalist	1,858	(2473,1478)	205	(309,140)	-89%	163	(245,111)	-91%
WR	Woodland	Generalist	1,249	(1696,942)	397	(589,271)	-68%	353	(534,237)	-72%
BC	Woodland	Specialist	9,563	(10484,8745)	12,786	(14380,11388)	34%	13,510	(15349,11913)	41%
CC	Woodland	Specialist	7,446	(8400,6646)	11,307	(13186,9740)	52%	11,406	(13474,9700)	53%
CT	Woodland	Specialist	1,024	(4128,691)	1,409	(3683,923)	38%	1,549	(3992,985)	51%
GW	Woodland	Specialist	12,067	(13242,11020)	18,613	(21061,16480)	54%	19,092	(21815,16740)	58%
GC	Woodland	Specialist	2,639	(3156,2228)	1,787	(2255,1423)	-32%	1,645	(2113,1288)	-38%
GS	Woodland	Specialist	4,347	(5052,3764)	5,948	(7193,4942)	37%	6,302	(7740,5155)	45%
G	Woodland	Specialist	1,367	(2150,989)	1,159	(1872,770)	-15%	1,120	(1864,724)	-18%
J	Woodland	Specialist	8,421	(9339,7615)	15,203	(17326,13369)	81%	17,138	(19754,14902)	104%
LR	Woodland	Specialist	4,254	(4980,3661)	13,132	(15959,10880)	209%	17,974	(22126,14680)	322%
NH	Woodland	Specialist	11,892	(12944,10940)	22,273	(24892,19958)	87%	25,648	(28951,22753)	116%
RT	Woodland	Specialist	3,085	(3711,2595)	7,122	(8780,5826)	131%	9,296	(11635,7481)	201%
SK	Woodland	Specialist	3,677	(4301,3165)	8,403	(10156,6989)	129%	10,179	(12512,8321)	177%
SH	Woodland	Specialist	2,112	(2729,1669)	9,579	(13106,7165)	353%	17,182	(23798,12587)	713%
TP	Woodland	Specialist	1,207	(1903,827)	1,990	(3481,1209)	65%	2,121	(3806,1251)	76%
TC	Woodland	Specialist	2,380	(2995,1920)	11,016	(14639,8429)	363%	17,987	(24230,13509)	656%
WW	Woodland	Specialist	1,335	(2377,941)	2,072	(3506,1384)	55%	2,257	(3893,1463)	69%
GL	Water/wetland	Fast flowing	1,277	(931923,505)	2,133	(985176,700)	67%	2,334	(40401,736)	83%
H	Water/wetland	Other	1,134	(1645,810)	2,359	(3737,1537)	108%	2,803	(4563,1770)	147%
RB	Water/wetland	Reedbeds	-	-	-	-	-	-	(2.9E+68,1633)	-
MA	Water/wetland	Slow/standing	1,637	(2777,1172)	3,156	(5489,2050)	93%	3,713	(6617,2315)	127%
HG	Seabird		3,268	-	2,329	-	-29%	2,069	-	-37%
BZ	Other		1,756	(2.39E+24,1292)	6,360	(1.04E+24,4528)	262%	12,025	(8126951,8228)	585%
CG	Other		149	(2596,32)	228	(3845,37)	53%	248	(3559,38)	66%
C	Other		1,356	-	2,467	-	82%	2,917	-	115%
CD	Other		826	(1927,496)	892	(2046,473)	8%	922	(2196,468)	12%
CK	Other		8,141	(9198,7228)	18,340	(21660,15586)	125%	22,605	(27006,18980)	178%
HM	Other		-	-	-	(5.67E+76,511)	-	6,098	(1960+10,498)	-
HS	Other		279	-	118	(174e+100,38)	-58%	103	(12603,31)	-63%
LB	Other		1,175	-	178	-	-85%	156	-	-87%
MG	Other		1,767	(2462,1309)	997	(1616,626)	-44%	938	(1570,571)	-47%
MP	Other		4,644	(5261,4122)	428	(511,361)	-91%	371	(440,316)	-92%
M	Other		1,057	(1468,779)	914	(1494,569)	-14%	814	(1381,489)	-23%
PH	Other		1,432	-	1,222	-	-15%	1,226	-	-14%
PW	Other		9,185	(10165,8322)	3,227	(3817,2732)	-65%	2,478	(2963,2076)	-73%
RN	Other		1,292	(2011,912)	458	(786,278)	-65%	411	(729,242)	-68%
KT	Other		1,112	(2750,766)	1,479	(4243,840)	33%	1,610	(2987,897)	45%
SC	Other		980	(1423,711)	851	(1423,524)	-13%	753	(1329,443)	-23%
SL	Other		7,130	(8336,6224)	3,719	(4564,3066)	-48%	3,389	(4227,2754)	-52%
SI	Other		2,003	(2568,1597)	426	(658,279)	-79%	312	(495,201)	-84%
W	Other		2,580	(3141,2146)	975	(1325,722)	-62%	796	(1106,578)	-69%
GO	Farmland	Generalist	12,767	(14148,11575)	1,690	(2141,1340)	-87%	1,451	(1856,1138)	-89%
GR	Farmland	Generalist	1,726	(2245,1345)	2,681	(3811,1913)	55%	3,010	(4408,2084)	74%
JD	Farmland	Generalist	3,468	(4293,2825)	3,240	(4404,2397)	-7%	2,964	(4149,2133)	-15%
K	Farmland	Generalist	2,092	(2714,1643)	733	(1112,488)	-65%	595	(927,386)	-72%
RO	Farmland	Generalist	1,031	(1465,745)	540	(937,316)	-48%	463	(836,262)	-55%
WP	Farmland	Generalist	720	-	815	-	13%	820	-	14%
LI	Farmland	Specialist	1,823	(2.25E+51,136)	354	(7.58E+47,197)	-81%	299	(73e+10,162)	-84%
S	Farmland	Specialist	2,375	(2908,1960)	979	(1328,726)	-59%	768	(1063,558)	-68%
SG	Farmland	Specialist	148	-	228	-	54%	262	-	77%
WH	Farmland	Specialist	2,837	(3727,2267)	107	(213,56)	-96%	82	(163,43)	-97%

Table 2.7 Predicted counts and the percentage difference in predicted counts from the baseline in the Heads of the Valleys under two afforestation scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Afforest1			Afforest2		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	8,929	(10394,7699)		12,825	(14633,11257)	44%	11,374	(12888,10044)	27%
BT	Woodland	Generalist	3,585	(4665,2792)		4,597	(5763,3687)	28%	4,452	(5498,3616)	24%
BF	Woodland	Generalist	21,486	(23654,19555)		26,491	(28991,24227)	23%	22,963	(25047,21061)	7%
CH	Woodland	Generalist	184	-		273	-	48%	220	-	19%
D	Woodland	Generalist	8,523	(10010,7296)		15,515	(17574,13720)	82%	11,637	(13155,10305)	37%
GT	Woodland	Generalist	19,987	(22083,18121)		17,599	(19417,15965)	-12%	17,661	(19351,16125)	-12%
LT	Woodland	Generalist	5,393	(6507,4501)		10,566	(12220,9166)	96%	8,845	(10195,7690)	64%
R	Woodland	Generalist	9,949	(11480,8686)		14,297	(16297,12567)	44%	12,955	(14706,11426)	30%
ST	Woodland	Generalist	8,606	(10298,7273)		10,552	(12555,8902)	23%	8,277	(9759,7036)	-4%
WR	Woodland	Generalist	2,980	(3990,2271)		6,192	(7670,5046)	108%	5,476	(6663,4520)	84%
BC	Woodland	Specialist	33,355	(36042,30900)		30,122	(32443,27980)	-10%	31,242	(33466,29173)	-6%
CC	Woodland	Specialist	22,046	(24342,20000)		18,932	(20809,17235)	-14%	19,100	(20876,17481)	-13%
CT	Woodland	Specialist	3,023	(4953,2199)		3,508	(4727,2622)	16%	3,776	(4971,2882)	25%
GW	Woodland	Specialist	27,694	(30144,25477)		27,924	(30135,25885)	1%	28,372	(30469,26426)	2%
GC	Woodland	Specialist	8,342	(9716,7192)		10,181	(11656,8909)	22%	9,705	(11020,8555)	16%
GS	Woodland	Specialist	13,093	(14890,11544)		13,148	(14846,11656)	0%	13,695	(15339,12235)	5%
G	Woodland	Specialist	4,142	(5549,3157)		4,506	(5768,3537)	9%	4,356	(5490,3467)	5%
J	Woodland	Specialist	25,059	(27456,22903)		23,061	(25138,21167)	-8%	25,072	(27148,23163)	0%
LR	Woodland	Specialist	13,019	(14912,11403)		9,394	(10699,8259)	-28%	11,585	(13026,10312)	-11%
NH	Woodland	Specialist	32,724	(35350,30323)		29,214	(31411,27182)	-11%	32,514	(34751,30428)	-1%
RT	Woodland	Specialist	10,209	(11932,8773)		9,547	(11045,8265)	-6%	11,270	(12872,9879)	10%
SK	Woodland	Specialist	11,294	(13018,9835)		9,961	(11341,8761)	-12%	11,414	(12861,10138)	1%
SH	Woodland	Specialist	6,397	(7958,5196)		4,261	(5329,3419)	-33%	6,298	(7659,5194)	-2%
TP	Woodland	Specialist	2,997	(4362,2133)		2,552	(3563,1839)	-15%	2,673	(3646,1969)	-11%
TC	Woodland	Specialist	6,724	(8247,5530)		4,296	(5268,3514)	-36%	6,088	(7279,5105)	-9%
WW	Woodland	Specialist	3,604	(4891,2742)		3,660	(4732,2844)	2%	3,903	(4952,3086)	8%
GL	Water/wetland	Fast flowing	2,140	(11690,1305)		1,267	(2093,778)	-41%	1,401	(2228,892)	-35%
H	Water/wetland	Other	2,914	(3947,2182)		2,556	(3423,1919)	-12%	2,897	(3783,2227)	-1%
RB	Water/wetland	Reedbeds	-	-		-	(737e+15,2118)	-	-	(75e+15,2757)	-
MA	Water/wetland	Slow/standing	4,518	(6103,3441)		4,014	(5267,3072)	-11%	4,504	(5807,3505)	0%
HG	Seabird		5,861	-		7,134	(2.68E+22,5794)	22%	6,204	(2.6E+22,506)	6%
BZ	Other		5,286	(4620000000,3713)		4,422	(6066,3288)	-16%	6,602	(8653,5111)	25%
CG	Other		339	(3401,101)		287	(1114,99)	-15%	313	(906,122)	-8%
C	Other		2,986	-		3,247	-	9%	3,757	-	26%
CD	Other		2,184	(3587,1424)		2,329	(3496,1563)	7%	2,386	(3497,1637)	9%
CK	Other		18,522	(20741,16583)		15,624	(17356,14076)	-16%	18,360	(20215,16684)	-1%
HM	Other		-	(8.64E+32,1252)		1,376	(11693,876)	-	1,379	(11627,906)	-
HS	Other		845	(309e+4,431)		1,057	(1927,598)	25%	959	(1712,547)	13%
LB	Other		2,496	-		5,090	-	104%	4,378	-	75%
MG	Other		6,511	(8205,5213)		4,907	(6183,3910)	-25%	4,582	(5716,3681)	-30%
MP	Other		13,907	(15604,12431)		52,319	(57080,48010)	276%	42,056	(45694,38733)	202%
M	Other		1,946	(2676,1447)		2,047	(2673,1577)	5%	1,818	(2348,1412)	-7%
PH	Other		7,156	-		2,223	-	-69%	2,277	-	-68%
PW	Other		19,212	(21076,17535)		23,271	(25280,21434)	21%	18,179	(19715,16767)	-5%
RN	Other		5,317	(7005,4127)		6,159	(7881,4847)	16%	5,579	(7058,4428)	5%
KT	Other		2,119	(3234,1465)		2,256	(3196,1609)	6%	2,469	(3412,1799)	17%
SC	Other		3,022	(4119,2255)		3,444	(4553,2621)	14%	3,262	(4270,2503)	8%
SL	Other		32,961	(36351,29991)		30,581	(33583,27872)	-7%	27,080	(29618,24776)	-18%
SI	Other		6,667	(8095,5535)		6,521	(7915,5391)	-2%	5,005	(6042,4155)	-25%
W	Other		8,807	(10248,7602)		8,740	(10127,7556)	-1%	7,420	(8559,6439)	-16%
GO	Farmland	Generalist	15,571	(17445,13997)		23,829	(26301,21618)	53%	19,539	(21542,17736)	25%
GR	Farmland	Generalist	4,381	(5538,3495)		4,039	(5042,3247)	-8%	4,423	(5427,3612)	1%
JD	Farmland	Generalist	6,846	(8466,5589)		8,389	(9951,7089)	23%	7,998	(9447,6782)	17%
K	Farmland	Generalist	4,084	(5106,3290)		5,269	(6412,4340)	29%	4,209	(5106,3475)	3%
RO	Farmland	Generalist	1,768	(2532,1277)		2,212	(2945,1671)	25%	1,874	(2472,1426)	6%
WP	Farmland	Generalist	718	-		678	-	-6%	655	-	-9%
LI	Farmland	Specialist	3,486	(1.18E+21,2485)		5,236	(8771,4095)	50%	4,314	(7252,3384)	24%
S	Farmland	Specialist	4,992	(6052,4147)		7,930	(9276,6791)	59%	6,469	(7534,5559)	30%
SG	Farmland	Specialist	508	-		576	-	13%	665	-	31%
WH	Farmland	Specialist	3,064	(4107,2387)		6,219	(7740,5029)	103%	4,185	(5238,3356)	37%

Table 2.8 Predicted counts and the percentage difference in predicted counts from the baseline in the Vale of Clwyd under two afforestation scenarios. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Afforest1			Afforest 2		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	6,615	(7181,6107)		7,187	(8063,6419)	9%	7,459	(8447,6597)	13%
BT	Woodland	Generalist	4,484	(4967,4059)		5,832	(6735,5063)	30%	5,907	(6899,5068)	32%
BF	Woodland	Generalist	532	(760,390)		693	(1043,471)	30%	797	(1229,525)	50%
CH	Woodland	Generalist	4,966	(5461,4528)		7,453	(8408,6622)	50%	7,934	(9024,6987)	60%
D	Woodland	Generalist	2,265	(2623,1970)		1,172	(1472,938)	-48%	995	(1270,783)	-56%
GT	Woodland	Generalist	2,444	(2803,2143)		2,960	(3559,2475)	21%	3,184	(3882,2622)	30%
LT	Woodland	Generalist	705	(935,546)		530	(785,365)	-25%	531	(810,353)	-25%
R	Woodland	Generalist	4,407	(4872,3994)		7,408	(8421,6531)	68%	8,509	(9764,7427)	93%
ST	Woodland	Generalist	1,913	(2227,1652)		5,921	(7101,4963)	209%	8,416	(10211,6956)	340%
WR	Woodland	Generalist	6,066	(6604,5581)		10,682	(11916,9590)	76%	12,179	(13698,10840)	101%
BC	Woodland	Specialist	1,967	(2301,1690)		4,222	(5125,3494)	115%	5,291	(6520,4307)	169%
CC	Woodland	Specialist	2,803	(3192,2471)		5,654	(6751,4754)	102%	6,342	(7700,5239)	126%
CT	Woodland	Specialist	500	(688,374)		3,036	(4108,2316)	507%	7,081	(9579,5289)	1316%
GW	Woodland	Specialist	253	(418,163)		480	(812,301)	90%	652	(1108,396)	158%
GC	Woodland	Specialist	727	(928,576)		4,041	(5242,3159)	456%	7,873	(10333,6035)	983%
GS	Woodland	Specialist	581	(791,436)		889	(1292,622)	53%	1,042	(1561,705)	79%
G	Woodland	Specialist	245	.		388	.	58%	443	.	81%
J	Woodland	Specialist	466	(663,337)		951	(1456,639)	104%	1,177	(1842,765)	152%
LR	Woodland	Specialist	-	.		-	.	-	-	.	-
NH	Woodland	Specialist	557	(775,409)		1,164	(1735,793)	109%	1,569	(2453,1018)	182%
RT	Woodland	Specialist	662	.		519	.	-22%	550	.	-17%
SK	Woodland	Specialist	288	(4.03E+53,169)		1,823	(1.74E+54,1269)	532%	4,998	(1.7E+54,3383)	1633%
SH	Woodland	Specialist	306	(2349595,28)		484	(4263104,26)	58%	319	(3119777,21)	4%
TP	Woodland	Specialist	614	.		985	.	60%	1,139	.	86%
TC	Woodland	Specialist	335	(569,210)		365	(696,202)	9%	393	(768,209)	17%
WW	Woodland	Specialist	1,568	(1846,1344)		4,408	(5223,3752)	181%	6,985	(8316,5888)	345%
GL	Water/wetland	Fast flowing	-	.		-	.	-	-	.	-
H	Water/wetland	Other	129	(9.97E+42,66)		50	(3.48E+42,17)	-61%	43	(3.47E+42,13)	-67%
RB	Water/wetland	Reedbeds	339	.		54	.	-	47	.	-
MA	Water/wetland	Slow/standing	1,257	(1626,993)		501	(778,328)	-60%	391	(628,247)	-69%
HG	Seabird		4,170	(4807,3661)		157	(204,121)	-96%	124	(162,95)	-97%
BZ	Other		476	(687,353)		362	(603,231)	-24%	314	(536,193)	-34%
CG	Other		663	.		480	.	-28%	413	.	-38%
C	Other		5,655	(6225,5158)		1,605	(1900,1359)	-72%	1,148	(1372,963)	-80%
CD	Other		942	(1478,728)		237	(454,143)	-75%	198	(376,116)	-79%
CK	Other		554	(1749856,91)		872	(2550349,165)	57%	690	(1622928,232)	25%
HM	Other		430	(621,314)		357	(593,224)	-	376	(650,223)	-
HS	Other		6,069	(6622,5580)		2,157	(2568,1815)	-64%	1,851	(2246,1530)	-69%
LB	Other		2,222	(2705,1854)		328	(499,217)	-85%	199	(310,128)	-91%
MG	Other		1,831	(2147,1581)		499	(675,373)	-73%	398	(552,290)	-78%
MP	Other		828	(1089,676)		222	(300,172)	-73%	228	(306,175)	-72%
M	Other		569	(768,429)		928	(1321,665)	63%	1,151	(1668,804)	102%
PH	Other		1,795	(2170,1503)		1,481	(1979,1119)	-17%	1,293	(1786,945)	-28%
PW	Other		833	(1077,662)		256	(385,173)	-69%	197	(305,130)	-76%
RN	Other		326	(500,227)		173	(302,104)	-47%	151	(271,87)	-54%
KT	Other		37	.		58	.	59%	83	.	126%
SC	Other		321	.		79	.	-75%	73	.	-77%
SL	Other		1,898	(2248,1617)		597	(800,449)	-69%	427	(582,314)	-78%
SI	Other		94	.		116	.	23%	117	.	24%
W	Other		458	(9019,312)		22	(377,10)	-95%	15	(245,7)	-97%
GO	Farmland	Generalist	2,280	(2653,1976)		759	(969,598)	-67%	630	(817,489)	-72%
GR	Farmland	Generalist	882	(1137,701)		431	(632,299)	-51%	392	(590,264)	-56%
JD	Farmland	Generalist	5,401	(5932,4937)		1,006	(1215,836)	-81%	760	(930,622)	-86%
K	Farmland	Generalist	75	.		18	.	-76%	12	.	-84%
RO	Farmland	Generalist	4,832	(5455,4306)		605	(793,462)	-87%	393	(523,296)	-92%
WP	Farmland	Generalist	4,708	(5199,4278)		3,570	(4162,3072)	-24%	3,297	(3892,2800)	-30%
LI	Farmland	Specialist	1,490	(1830,1230)		250	(348,181)	-83%	197	(279,140)	-87%
S	Farmland	Specialist	1,215	(1527,986)		375	(507,280)	-69%	334	(458,246)	-73%
SG	Farmland	Specialist	1,984	(3225,1679)		115	(232,75)	-94%	80	(159,51)	-96%
WH	Farmland	Specialist	941	(1204,752)		237	(349,162)	-75%	195	(296,130)	-79%

2.4 Predicted counts: Peat scenario and all scenarios combined

More species were predicted to have higher counts than the baseline under a peat scenario in the Heads of the Valley compared to Conwy and Vale of Clwyd, where more species were predicted to have lower counts than the baseline (Table 2.9). All species in the Heads of the Valley and Vale of Clwyd were predicted to have lower counts when all scenarios were combined, compared to the baseline, and only one species (starling) was predicted to have a slightly higher predicted count under a combined scenario compared to the baseline (Table 2.9; Table 2.10).

Table 2.9 Number of species to have a predicted count higher or lower than the baseline prediction in three regions of Wales under a peat scenario and all scenarios combined.

	Peat			Combined scenarios		
	Conwy	Heads of the Valleys	Vale of Clwyd	Conwy	Heads of the Valleys	Vale of Clwyd
Higher	25	34	27	1	0	0
Lower	34	26	32	58	60	59

In Conwy, the counts of 14 woodland species were predicted to be higher under a peat scenario compared to the baseline; all were specialist woodland species. Conversely, the counts of 12 woodland species were predicted to be lower under a peat scenario compared to the baseline predictions. The predicted counts of starling and greenfinch were higher under a peat scenario compared to the baseline predictions, but the counts of all other farmland species were predicted to be lower under a peat scenario. All three water and wetland species were predicted to have higher counts under a peat scenario, and seven of the 19 'other' species (Table 2.10).

Conversely to the pattern found in Conwy, in the Heads of the Valleys, most of the woodland species that were predicted to have higher counts under a peat scenario were generalist (9 out of 12 that were predicted to have higher counts). Thirteen woodland species were predicted to have lower counts under a peat scenario, most of these (n = 12) were specialist woodland species.

The counts of greenfinch and woodpigeon were predicted to be lower under a peat scenario, but all other farmland species were predicted to have higher counts than the baseline predictions. Twelve of the 18 'other' species were predicted to have higher counts under a peat scenario (Table 2.11). In the Vale of Clwyd, all but three woodland species (dunnock, long-tailed tit and redstart) were predicted to have higher counts under a peat scenario. The counts of all farmland species and 17 out of 21 'other' and water and wetland species were lower than the baseline (Table 2.12).

Table 2.10 Predicted counts and the percentage difference in predicted counts from the baseline in Conwy under a peat scenario and all scenarios combined. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Peat			Combined scenarios		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	3,067	(3683,2576)		1,310	(1646,1043)	-57%	1,497	(1723,1303)	-51%
BT	Woodland	Generalist	987	(1378,732)		695	(1016,480)	-30%	584	(759,453)	-41%
BF	Woodland	Generalist	6,169	(7037,5452)		1,790	(2141,1498)	-71%	3,277	(3628,2967)	-47%
CH	Woodland	Generalist	150	-		35	-	-76%	55	-	-64%
D	Woodland	Generalist	3,719	(4349,3207)		744	(964,575)	-80%	1,548	(1769,1359)	-58%
GT	Woodland	Generalist	5,328	(6017,4736)		5,175	(5987,4477)	-3%	2,430	(2685,2201)	-54%
LT	Woodland	Generalist	2,469	(2983,2058)		556	(745,415)	-78%	1,408	(1630,1217)	-43%
R	Woodland	Generalist	6,084	(7034,5301)		2,320	(3003,1794)	-62%	3,756	(4180,3379)	-38%
ST	Woodland	Generalist	1,858	(2473,1478)		227	(337,156)	-88%	1,042	(1341,846)	-44%
WR	Woodland	Generalist	1,249	(1696,942)		403	(592,276)	-68%	702	(890,558)	-44%
BC	Woodland	Specialist	9,563	(10484,8745)		12,006	(13358,10798)	26%	4,170	(4501,3867)	-56%
CC	Woodland	Specialist	7,446	(8400,6646)		9,726	(11122,8514)	31%	2,555	(2830,2312)	-66%
CT	Woodland	Specialist	1,024	(4128,691)		1,368	(2038,934)	34%	498	(855,358)	-51%
GW	Woodland	Specialist	12,067	(13242,11020)		16,441	(18298,14780)	36%	4,388	(4731,4071)	-64%
GC	Woodland	Specialist	2,639	(3156,2228)		1,876	(2330,1513)	-29%	1,412	(1627,1228)	-46%
GS	Woodland	Specialist	4,347	(5052,3764)		5,601	(6638,4733)	29%	1,891	(2141,1672)	-57%
G	Woodland	Specialist	1,367	(2150,989)		1,154	(1696,793)	-16%	619	(833,474)	-55%
J	Woodland	Specialist	8,421	(9339,7615)		13,939	(15659,12419)	66%	3,504	(3817,3218)	-58%
LR	Woodland	Specialist	4,254	(4980,3661)		12,127	(14332,10285)	185%	1,753	(1993,1544)	-59%
NH	Woodland	Specialist	11,892	(12944,10940)		20,443	(22557,18536)	72%	5,019	(5377,4686)	-58%
RT	Woodland	Specialist	3,085	(3711,2595)		6,820	(8253,5657)	121%	1,501	(1756,1287)	-51%
SK	Woodland	Specialist	3,677	(4301,3165)		7,597	(9052,6395)	107%	1,549	(1776,1354)	-58%
SH	Woodland	Specialist	2,112	(2729,1669)		9,595	(12445,7463)	354%	931	(1160,752)	-56%
TP	Woodland	Specialist	1,207	(1903,827)		1,835	(2862,1192)	52%	443	(629,318)	-63%
TC	Woodland	Specialist	2,380	(2995,1920)		10,027	(12720,7956)	321%	908	(1101,751)	-62%
WW	Woodland	Specialist	1,335	(2377,941)		1,841	(2612,1307)	38%	536	(745,407)	-60%
GL	Water/wetland	Fast flowing	1,277	(931923,505)		1,651	(843777,823)	29%	378	(462473,224)	-70%
H	Water/wetland	Other	1,134	(1645,810)		2,177	(3175,1507)	92%	469	(626,354)	-59%
RB	Water/wetland	Reedbeds	-	-		-	-	-	-	-	-
MA	Water/wetland	Slow/standing	1,637	(2777,1172)		2,821	(4103,1955)	72%	641	(884,486)	-61%
HG	Seabird		3,268	-		1,920	-	-41%	992	-	-70%
BZ	Other		1,756	(2.39E+24,1292)		7,786	(6.39E+23,5699)	343%	1,041	(2.49E+23,793)	-41%
CG	Other		149	(2596,32)		225	(1612,50)	50%	66	(471,23)	-56%
C	Other		1,356	-		3,132	-	131%	756	-	-44%
CD	Other		826	(1927,496)		863	(1537,493)	4%	364	(597,237)	-56%
CK	Other		8,141	(9198,7228)		17,242	(19815,15023)	112%	3,203	(3541,2900)	-61%
HM	Other		-	-		-	(5.61E+76,452)	-	-	(3.69E+76,168)	-
HS	Other		279	-		99	(21e+16,35)	-65%	89	(413+15,44)	-68%
LB	Other		1,175	-		216	-	-82%	759	-	-35%
MG	Other		1,767	(2462,1309)		1,103	(1694,722)	-38%	991	(1289,769)	-44%
MP	Other		4,644	(5261,4122)		436	(521,366)	-91%	3,344	(3696,3032)	-28%
M	Other		1,057	(1468,779)		793	(1218,520)	-25%	347	(450,271)	-67%
PH	Other		1,432	-		883	-	-38%	448	-	-69%
PW	Other		9,185	(10165,8322)		2,867	(3342,2460)	-69%	3,020	(3279,2782)	-67%
RN	Other		1,292	(2011,912)		543	(916,328)	-58%	849	(1212,615)	-34%
KT	Other		1,112	(2750,766)		1,543	(3968,937)	39%	535	(1841,374)	-52%
SC	Other		980	(1423,711)		909	(1455,574)	-7%	446	(606,335)	-54%
SL	Other		7,130	(8336,6224)		3,877	(4676,3223)	-46%	3,454	(3923,3065)	-52%
SI	Other		2,003	(2568,1597)		453	(678,304)	-77%	826	(1013,679)	-59%
W	Other		2,580	(3141,2146)		957	(1271,722)	-63%	1,068	(1256,912)	-59%
GO	Farmland	Generalist	12,767	(14148,11575)		2,221	(2766,1789)	-83%	5,473	(5995,5026)	-57%
GR	Farmland	Generalist	1,726	(2245,1345)		2,701	(3655,2005)	57%	773	(952,630)	-55%
JD	Farmland	Generalist	3,468	(4293,2825)		3,091	(4111,2330)	-11%	1,449	(1745,1207)	-58%
K	Farmland	Generalist	2,092	(2714,1643)		647	(940,448)	-69%	701	(864,574)	-67%
RO	Farmland	Generalist	1,031	(1465,745)		488	(795,301)	-53%	347	(462,265)	-66%
WP	Farmland	Generalist	720	-		353	-	-51%	134	-	-81%
LI	Farmland	Specialist	1,823	(2.25E+51,136)		392	(1.09E+48,223)	-79%	829	(4.57E+48,654)	-55%
S	Farmland	Specialist	2,375	(2908,1960)		888	(1173,673)	-63%	847	(1001,719)	-64%
SG	Farmland	Specialist	148	-		355	-	140%	160	-	8%
WH	Farmland	Specialist	2,837	(3727,2267)		117	(229,63)	-96%	1,079	(1414,886)	-62%

Table 2.11 Predicted counts and the percentage difference in predicted counts from the baseline in Heads of the Valleys under a peat scenario and all scenarios combined. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Peat			Combined scenarios		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	8,929	(10394,7699)		13,453	(15401,11770)	51%	4,490	(5135,3932)	-
BT	Woodland	Generalist	3,585	(4665,2792)		4,729	(5980,3762)	32%	1,891	(2417,1492)	-
BF	Woodland	Generalist	21,486	(23654,19555)		28,058	(30766,25610)	31%	10,696	(11703,9786)	-
CH	Woodland	Generalist	184	-		289	-	57%	111	-	-
D	Woodland	Generalist	8,523	(10010,7296)		16,873	(19134,14905)	98%	3,985	(4567,3484)	-
GT	Woodland	Generalist	19,987	(22083,18121)		17,431	(19295,15760)	-13%	7,748	(8501,7066)	-
LT	Woodland	Generalist	5,393	(6507,4501)		11,471	(13289,9934)	113%	3,888	(4509,3358)	-
R	Woodland	Generalist	9,949	(11480,8686)		16,138	(18325,14239)	62%	9,109	(10145,8194)	-8%
ST	Woodland	Generalist	8,606	(10298,7273)		11,578	(13848,9726)	35%	3,919	(4707,3290)	-
WR	Woodland	Generalist	2,980	(3990,2271)		6,608	(8236,5354)	122%	2,077	(2629,1652)	-
BC	Woodland	Specialist	33,355	(36042,30900)		29,340	(31685,27182)	-12%	13,042	(13996,12157)	-
CC	Woodland	Specialist	22,046	(24342,20000)		18,255	(20130,16564)	-17%	7,324	(8051,6668)	-
CT	Woodland	Specialist	3,023	(4953,2199)		3,412	(4660,2516)	13%	1,462	(2429,1078)	-
GW	Woodland	Specialist	27,694	(30144,25477)		26,967	(29173,24938)	-3%	11,072	(11931,10278)	-
GC	Woodland	Specialist	8,342	(9716,7192)		10,457	(12017,9115)	25%	4,210	(4821,3682)	-
GS	Woodland	Specialist	13,093	(14890,11544)		12,811	(14527,11308)	-2%	5,549	(6243,4935)	-
G	Woodland	Specialist	4,142	(5549,3157)		4,523	(5835,3522)	9%	1,856	(2412,1449)	-
J	Woodland	Specialist	25,059	(27456,22903)		21,999	(24061,20123)	-12%	9,984	(10842,9197)	-
LR	Woodland	Specialist	13,019	(14912,11403)		8,569	(9820,7486)	-34%	4,879	(5512,4323)	-
NH	Woodland	Specialist	32,724	(35350,30323)		27,776	(29947,25774)	-15%	13,776	(14735,12881)	-
RT	Woodland	Specialist	10,209	(11932,8773)		8,929	(10406,7674)	-13%	4,474	(5184,3870)	-
SK	Woodland	Specialist	11,294	(13018,9835)		9,371	(10735,8192)	-17%	4,297	(4905,3771)	-
SH	Woodland	Specialist	6,397	(7958,5196)		3,702	(4700,2924)	-42%	2,683	(3297,2190)	-
TP	Woodland	Specialist	2,997	(4362,2133)		2,457	(3475,1746)	-18%	1,164	(1625,841)	-
TC	Woodland	Specialist	6,724	(8247,5530)		3,738	(4642,3016)	-44%	2,416	(2916,2006)	-
WW	Woodland	Specialist	3,604	(4891,2742)		3,526	(4604,2712)	-2%	1,518	(2022,1175)	-
GL	Water/wetland	Fast flowing	2,140	(11690,1305)		1,233	(2198,749)	-42%	889	(4567,557)	-
H	Water/wetland	Other	2,914	(3947,2182)		2,422	(3281,1795)	-17%	1,250	(1651,951)	-
RB	Water/wetland	Reedbeds	-	-		-	-	-	-	-	-
MA	Water/wetland	Slow/standing	4,518	(6103,3441)		3,784	(5023,2860)	-16%	1,822	(2420,1399)	-
HG	Seabird		5,861	-		7,058	(3.4E+175,5693)	20%	2,462	(2.05E+22,1908)	-
BZ	Other		5,286	(462e-8,3713)		3,945	(163e-9,2884)	-25%	2,891	(3846,2209)	-
CG	Other		339	(3401,101)		288	(1167,95)	-15%	165	(531,61)	-
C	Other		2,986	-		3,290	-	10%	1,917	-	-
CD	Other		2,184	(3587,1424)		2,309	(3521,1524)	6%	1,016	(1593,674)	-
CK	Other		18,522	(20741,16583)		14,566	(16255,13061)	-21%	8,099	(8936,7343)	-
HM	Other		-	(8.64E+32,1252)		-	(4.641E+32,833)	-	707	(11286,460)	-
HS	Other		845	(309e+4,431)		1,074	-	27%	310	(606,169)	-
LB	Other		2,496	-		5,535	-	122%	2,180	-	-
MG	Other		6,511	(8205,5213)		5,096	(6456,4038)	-22%	2,932	(3672,2350)	-
MP	Other		13,907	(15604,12431)		57,245	(62585,52428)	312%	11,217	(12328,10223)	-
M	Other		1,946	(2676,1447)		2,069	(2713,1586)	6%	802	(1041,620)	-
PH	Other		7,156	-		2,224	-	-69%	1,311	-	-
PW	Other		19,212	(21076,17535)		24,333	(26460,22390)	27%	7,591	(8234,6999)	-
RN	Other		5,317	(7005,4127)		6,545	(8474,5099)	23%	2,909	(3899,2212)	-
KT	Other		2,119	(3234,1465)		2,206	(3172,1554)	4%	1,204	(1663,879)	-
SC	Other		3,022	(4119,2255)		3,549	(4721,2683)	17%	1,279	(1699,970)	-
SL	Other		32,961	(36351,29991)		31,749	(34981,28845)	-4%	12,756	(14190,11510)	-
SI	Other		6,667	(8095,5535)		7,128	(8667,5883)	7%	2,394	(2898,1985)	-
W	Other		8,807	(10248,7602)		9,179	(10667,7913)	4%	3,397	(3927,2944)	-
GO	Farmland	Generalist	15,571	(17445,13997)		26,104	(28823,23682)	68%	12,294	(13466,11244)	-
GR	Farmland	Generalist	4,381	(5538,3495)		3,888	(4888,3101)	-11%	2,072	(2536,1695)	-
JD	Farmland	Generalist	6,846	(8466,5589)		8,472	(10089,7130)	24%	3,407	(4100,2836)	-
K	Farmland	Generalist	4,084	(5106,3290)		5,524	(6745,4535)	35%	1,809	(2201,1488)	-

			Baseline			Peat			Combined scenarios		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
RO	Farmland	Generalist	1,768	(2532,1277)		2,264	(3030,1702)	28%	840	(1125,633)	-
WP	Farmland	Generalist	718	-		678	-	-6%	325	-	-
LI	Farmland	Specialist	3,486	(1.18E+21,2485)		5,643	(2.776E+21,4412)	62%	2,337	(4396,1821)	-
S	Farmland	Specialist	4,992	(6052,4147)		8,360	(9802,7143)	67%	2,224	(2621,1890)	-
SG	Farmland	Specialist	508	-		594	-	17%	410	-	-
WH	Farmland	Specialist	3,064	(4107,2387)		6,986	(8707,5646)	128%	2,241	(2809,1806)	-

Table 2.12 Predicted counts and the percentage difference in predicted counts from the baseline in the Vale of Clwyd under a peat scenario and all scenarios combined. Light blue: increases of up to 50%, dark blue: increases of more than 50%, light orange: declines of up to 50%, dark orange: declines of more than 50%.

			Baseline			Peat			Combined scenarios		
Species	Habitat	Generalism	Count	CI	.	Count	CI	%	Count	CI	%
B	Woodland	Generalist	6,615	(7181,6107)		7,088	(7935,6345)	7%	2,758	(2972,2566)	-58%
BT	Woodland	Generalist	4,484	(4967,4059)		5,744	(6616,5000)	28%	1,783	(1962,1626)	-60%
BF	Woodland	Generalist	532	(760,390)		672	(1005,460)	26%	265	(358,201)	-50%
CH	Woodland	Generalist	4,966	(5461,4528)		7,324	(8245,6521)	47%	2,172	(2359,2004)	-56%
D	Woodland	Generalist	2,265	(2623,1970)		1,203	(1504,967)	-47%	978	(1117,863)	-57%
GT	Woodland	Generalist	2,444	(2803,2143)		2,906	(3483,2438)	19%	1,084	(1227,963)	-56%
LT	Woodland	Generalist	705	(935,546)		530	(779,368)	-25%	325	(418,258)	-54%
R	Woodland	Generalist	4,407	(4872,3994)		7,143	(8101,6311)	62%	1,971	(2156,1805)	-55%
ST	Woodland	Generalist	1,913	(2227,1652)		5,544	(6629,4662)	190%	842	(962,740)	-56%
WR	Woodland	Generalist	6,066	(6604,5581)		10,328	(11500,9291)	70%	2,667	(2876,2477)	-56%
BC	Woodland	Specialist	1,967	(2301,1690)		4,008	(4849,3328)	104%	902	(1038,787)	-54%
CC	Woodland	Specialist	2,803	(3192,2471)		5,452	(6488,4600)	95%	1,148	(1292,1023)	-59%
CT	Woodland	Specialist	500	(688,374)		2,670	(3597,2047)	434%	294	(377,235)	-41%
GW	Woodland	Specialist	253	(418,163)		459	(771,290)	81%	129	(196,89)	-49%
GC	Woodland	Specialist	727	(928,576)		3,601	(4653,2827)	395%	362	(442,299)	-50%
GS	Woodland	Specialist	581	(791,436)		858	(1239,604)	48%	275	(360,213)	-53%
G	Woodland	Specialist	245	.		387	.	58%	91	.	-63%
J	Woodland	Specialist	466	(663,337)		914	(1390,618)	96%	210	(286,157)	-55%
LR	Woodland	Specialist	-	.		-	.	-	-	.	-
NH	Woodland	Specialist	557	(775,409)		1,100	(1625,756)	97%	277	(371,209)	-50%
RT	Woodland	Specialist	662	.		520	.	-22%	302	.	-54%
SK	Woodland	Specialist	288	(4.03E+53,169)		1,595	.	453%	232	(9.1E+48,159)	-20%
SH	Woodland	Specialist	306	(2349595,28)		485	(4244404,26)	58%	138	(704070,13)	-55%
TP	Woodland	Specialist	614	.		993	.	62%	252	.	-59%
TC	Woodland	Specialist	335	(569,210)		360	(679,201)	7%	160	(258,105)	-52%
WW	Woodland	Specialist	1,568	(1846,1344)		4,112	(4861,3510)	162%	846	(965,747)	-46%
GL	Water/wetland	Fast flowing	-	.		-	.	-	-	.	-
H	Water/wetland	Other	129	(9.97E+42,66)		50	(3.48E+42,17)	-61%	60	(3.35E+39,33)	-53%
RB	Water/wetland	Reedbeds	339	.		57	.	-	199	.	-
MA	Water/wetland	Slow/standing	1,257	(1626,993)		528	(812,349)	-58%	481	(610,389)	-62%
HG	Seabird		4,170	(4807,3661)		167	(215,129)	-96%	2,702	(3037,2427)	-35%
BZ	Other		476	(687,353)		377	(623,243)	-21%	178	(248,137)	-63%
CG	Other		663	.		492	.	-26%	245	.	-63%
C	Other		5,655	(6225,5158)		1,720	(2029,1462)	-70%	2,123	(2322,1951)	-62%
CD	Other		942	(1478,728)		246	(467,150)	-74%	452	(704,354)	-52%
CK	Other		554	(1749856,91)		834	(2519207,159)	50%	327	(740911,60)	-41%
HM	Other		430	(621,314)		355	(583,224)	-	203	(283,153)	-
HS	Other		6,069	(6622,5580)		2,222	(2634,1878)	-63%	2,479	(2687,2292)	-59%
LB	Other		2,222	(2705,1854)		362	(546,242)	-84%	799	(971,670)	-64%
MG	Other		1,831	(2147,1581)		524	(704,394)	-71%	729	(844,637)	-60%
MP	Other		828	(1089,676)		229	(308,178)	-72%	573	(714,483)	-31%
M	Other		569	(768,429)		898	(1270,647)	58%	271	(353,212)	-52%
PH	Other		1,795	(2170,1503)		1,522	(2018,1158)	-15%	749	(886,642)	-58%
PW	Other		833	(1077,662)		272	(406,185)	-67%	349	(436,285)	-58%
RN	Other		326	(500,227)		181	(313,109)	-44%	141	(201,103)	-57%
KT	Other		37	.		55	.	51%	20	.	-47%
SC	Other		321	.		81	.	-75%	194	.	-40%
SL	Other		1,898	(2248,1617)		640	(851,484)	-66%	754	(876,654)	-60%
SI	Other		94	.		118	.	25%	50	.	-47%
W	Other		458	(9019,312)		25	(397,12)	-95%	254	(4089,187)	-45%
GO	Farmland	Generalist	2,280	(2653,1976)		789	(1003,624)	-65%	1,030	(1182,905)	-55%
GR	Farmland	Generalist	882	(1137,701)		440	(641,307)	-50%	401	(505,325)	-55%
JD	Farmland	Generalist	5,401	(5932,4937)		1,067	(1282,889)	-80%	2,311	(2517,2130)	-57%
K	Farmland	Generalist	75	.		20	.	-74%	29	.	-62%
RO	Farmland	Generalist	4,832	(5455,4306)		672	(876,517)	-86%	1,797	(2011,1616)	-63%
WP	Farmland	Generalist	4,708	(5199,4278)		3,592	(4175,3100)	-24%	1,850	(2029,1693)	-61%
LI	Farmland	Specialist	1,490	(1830,1230)		264	(364,192)	-82%	773	(916,659)	-48%
S	Farmland	Specialist	1,215	(1527,986)		392	(527,294)	-68%	707	(849,598)	-42%
SG	Farmland	Specialist	1,984	(3225,1679)		125	(249,83)	-94%	843	(1392,722)	-58%
WH	Farmland	Specialist	941	(1204,752)		247	(362,170)	-74%	482	(593,398)	-49%

2.5 Species diversity

There was no significant difference in species diversity among the different scenarios in Conwy (ANOVA: $f_{(6,4121)} = 1.58$, $p = 0.149$; Table 2.13).

Table 2.13 Mean Simpson's diversity and 95% confidence intervals for the different scenarios in Conwy.

Scenario	Mean Simpson's diversity	Upper/lower CI
Baseline	0.9613	0.9570,0.9655
Peat	0.9671	0.9631,0.9712
Abandon 1	0.9672	0.9632,0.9712
Abandon 2	0.9673	0.9633,0.9714
Afforestation 1	0.9641	0.9600,0.9682
Afforestation 2	0.9667	0.9637,0.9696
Combined scenarios	0.9603	0.9511,0.9695

There was a significant difference in species diversity among the different scenarios in the Heads of the Valley (ANOVA: $f_{(6,10061)} = 6.3$, $p < 0.001$; Table 2.14). Post hoc Tukey's test revealed significant differences ($p < 0.001$) in diversity between the baseline and abandonment 1, baseline and abandonment 2, baseline and afforested 1, and baseline and afforest 2, although absolute differences were small. There were no other differences in diversity between the other scenarios.

Table 2.14 Mean Simpson's diversity and 95% confidence intervals for the different scenarios in the Heads of the Valley.

Scenario	Mean Simpson's diversity	Upper/lower CI
Baseline	0.9727	0.9716,0.9738
Peat	0.9755	0.9744,0.9766
Abandon 1	0.9757	0.9748,0.9767
Abandon 2	0.9759	0.9749,0.9768
Afforestation 1	0.9760	0.9753,0.9797
Afforestation 2	0.9761	0.9753,0.9768
Combined scenarios	0.9750	0.9739,0.9762

There was no significant difference in species diversity among the different scenarios in the Vale of Clwyd (ANOVA: $f_{(6,1612)} = 0.378$, $p = 0.894$; Table 2.15).

Table 2.15 Mean Simpson's diversity and 95% confidence intervals for the different scenarios in the Vale of Clwyd.

Scenario	Mean Simpson's diversity	Upper/lower CI
Baseline	0.9171	0.8984,0.9357
Peat	0.9221	0.9047,0.9395
Abandon 1	0.9222	0.9047,0.9396
Abandon 2	0.9222	0.9048,0.9396
Afforestation 1	0.9221	0.9047,0.9395
Afforestation 2	0.9347	0.9195,0.9499
Combined scenarios	0.9207	0.8946,0.9467

3 DISCUSSION

The results presented here show that the counts of woodland, farmland and water and wetland bird species show mixed responses to the different scenarios, and in different regions: some have higher predicted counts in the different scenarios compared to the baseline, whilst others have lower predicted counts. However, before drawing any conclusions or assumptions, the caveats of this work must be noted.

For example, predictions were based on assumptions that the scenarios would alter the land-uses in ways that were limited by the variables that were included in the all-Wales models (e.g. in the peat scenario, management for peat was assumed to be reflected in the amount of acid grassland and, for afforestation and lowland abandonment, woodland planting and natural succession were assumed to be represented by mature woodland).

For woodland, this is a particular issue, because the models used combined data on coniferous and broadleaved woodland, whereas these provide very different types and qualities of habitat for bird species and communities.

In reality, land-use changes will not be as simple as this; thus future work should focus on gaining a deeper understanding of how different land-uses are likely to change in different scenarios, by building source models using more sophisticated predictor variables that reflect likely land cover types and changes more accurately.

To improve predictions, we need to improve estimates of the current cover of each parcel, from a combination of EFTs, LCM and the woody cover product, as used here, along with other data sources as they become available (such as LiDAR data). In addition, there are inconsistencies between data sets, such as between EFTs and LCM broad habitats, that mean that a clear hierarchy is needed to make decisions on the best estimate of land cover per parcel.

A further caveat is that our models had to ignore parcels with no recorded EFT, so real land-uses per square may be inaccurate if significant areas of those land-uses were obscured by the lack of an EFT, which would cause noise in both the original model and prediction to 1km squares for which there are no BBS data.

Future developments of the modelling approach would benefit from further work to refine the land-use data available to ensure that all parcels have an EFT or appropriate alternative definition of cover.

Third, the models here were all based on the national BBS scheme, which is standardized and features a random selection of survey squares, but which is subject to spatial variation in coverage and unpredictable square turnover because it depends on volunteer survey effort. It would be valuable to explore the integration of professional survey data collected under the GMEP project between 2013 and 2016 with the BBS data in future models. These data used a different survey protocol, so require consideration of best approaches for combining data, but were also based on a random sample of 1km squares and have better coverage of upland habitats, in particular.

Despite the variations in predicted counts between scenarios among individual species, there was little evidence for large effects on overall diversity, although the variation for the Heads of the Valleys was statistically significant, probably reflecting the larger sample size for this region.

This suggests that predicted increases in counts tend to be accompanied by decreases in other species in the same squares, leading to little net effect on diversity. Note, however, that

larger effects on diversity are likely to be caused by the arrival or loss of rarer species, which we were unable to consider because they are not sampled effectively by BBS.

Finally, it is noteworthy that many of the predicted species-specific abundances for the regions were very imprecise or obviously unreliable (CIs encompassing zero; see Tables above).

These estimates reflect highly variable counts between BBS squares and/or small samples of squares with relevant habitats in the target regions. More generally, they show the limitations of prediction from national data to individual regions, wherein certain habitats that are poorly represented in the national data may be relatively important.

Fundamentally, a randomized, low-intensity scheme without highly concentrated uptake in a focal region or habitat is not suitable for monitoring or prediction at that scale. This is why a different sampling design was used for bird surveys in GMEP and illustrates that bespoke, almost certainly professional, monitoring is required to characterize small regions adequately.

The BBS and predictions from it, especially for rarer species and habitats at the scale being considered, is best suited to the national scale or that of large regions. There may be exceptions in regions with a high density of survey squares, but these are typically found in areas of high observer density, which are those that are more highly populated by people, so tend to be of lower conservation interest.

4 REFERENCES

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