

Patterns of Gamebird Release, Management and Shooting in Wales

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Crynodeb Gweithredol

Mae rhyddhau adar helwriaeth (ffesantod *Phasianus colchicus* a phetris coesgoch *Alectoris rufa*), a'r gwaith rheoli dilynol, ar gyfer saethu hamdden yng Nghymru yn weithgaredd hirsefydlog ac eang. Gall y gweithgareddau hyn gael effaith ar fflora a ffawna nad ydynt yn adar helwriaeth, yn enwedig mewn ardaloedd sy'n agos at safleoedd rhyddhau a gallant esbonio cynnydd a gostyngiad ym mhoblogaethau'r rhywogaethau hyn nad ydynt yn adar helwriaeth. Mae hefyd gan y gweithgareddau ganlyniadau economaidd-gymdeithasol (nad ydynt yn cael eu cynnwys yn yr adolygiad hwn). Er mwyn asesu'n gywir effeithiau ecolegol net ac effeithiau eraill y gweithgareddau hyn, mae'n hanfodol cael data cywir ar raddfa a graddau rhyddhau adar helwriaeth a gweithgareddau rheoli. Er mwyn deall a chadarnhau'r berthynas rhwng y gweithgareddau hyn a newidiadau yn y boblogaeth nad ydynt yn adar helwriaeth, mae'n ddefnyddiol deall tueddiadau amser. Ar hyn o bryd, ychydig a wyddys am ble mae adar helwriaeth yn cael eu rhyddhau, faint sydd dan sylw, a sut y cânt eu rheoli ar ôl eu rhyddhau. Mae'r adolygiad hwn yn dwyn ynghyd set wahanol o dystiolaeth sydd ar gael, gan gynnwys cofnodion cofrestru adar helwriaeth swyddogol, hysbysebion cyhoeddus ar gyfer digwyddiadau saethu, data arolygon diwydiant, a gwyddoniaeth dinasyddion gan gynnwys arolygon adar a data lladd y ffordd i ddatblygu crynodeb o leoliadau, niferoedd a rheolaeth adar helwriaeth a ryddhawyd. Defnyddiais gyfres o ddulliau cydnaws i archwilio pa mor dda y mae amcangyfrifon a mesurau sy'n deillio o wahanol setiau data neu ragdybiaethau yn cyfateb i'w gilydd ac felly pa mor ddibynadwy ydynt.

Rwy'n amcangyfrif bod rhwng 0.8-2.3 miliwn o adar helwriaeth yn cael eu rhyddhau'n flynyddol rhwng 171 a 431 o ddigwyddiadau saethu yng Nghymru. Mae hyn yn cynnwys ~4% o'r adar helwriaeth yr adroddwyd eu bod yn cael eu dal i'w rhyddhau yn y DU. Mae'n ymddangos bod digwyddiadau saethu yng Nghymru yn debyg i'r rhai yng ngweddill y DU, gyda gogwydd cryf i'r dde o ran dosbarthiadau maint, yn cynnwys llawer o ddigwyddiadau saethu bach (rhyddhau a saethu cymharol ychydig o adar dros ychydig gannoedd o erwau) ac ychydig o rai mawr iawn (rhyddhau niferoedd mawr o adar a'u saethu dros filoedd o erwau ar lawer o ddyddiau yn ystod y tymor saethu). Mae tua thri chwarter o ddigwyddiadau saethu Cymru yn rhyddhau llai na 3,000 o adar yn flynyddol. Mae'n bosibl bod y gogwydd hwn, a allai fod hyd yn oed yn gryfach yng Nghymru na'r DU yn gyffredinol, yn esbonio pam mae nifer cymedrig yr adar sy'n cael eu rhyddhau ar ddigwyddiad saethu yng Nghymru (4,692) tua 20% yn uwch nag ar ddigwyddiadau saethu yng ngweddill y DU (3,908) ond nid yw canolrif y niferoedd a ryddhawyd ym mhob ardal yn wahanol (y ddau = 1,000). Y gwahaniaeth mawr rhwng digwyddiadau saethu yng Nghymru o gymharu â gweddill y DU yw bod llai o betris yn cael eu rhyddhau yn gymesur yng Nghymru a llai o ddigwyddiadau saethu sy'n eu cynnig fel ysglyfaeth, yn ôl pob tebyg oherwydd gwahaniaethau cynefin gros. O blith y digwyddiadau saethu a hysbysebwyd yng Nghymru, roedd 17% wedi'u cofrestru fel rhan o gynllun sicrhau ansawdd y British Game Assurance Scheme (BGA) y mae ei archwiliad yn ystyried ystod o safonau gofynnol sy'n debygol o ddylanwadu ar effeithiau ecolegol. Mae hyn yn uwch na'r 12% o ddigwyddiadau saethu yng ngweddill y DU a achredwyd gan y cynllun hwn.

Nid yw'r gwahanol setiau data a oedd ar gael i mi ac a ddefnyddiais, gan gynnwys Cofrestr Dofednod yr Asiantaeth Iechyd Anifeiliaid a Phlanhigion (APHA) a gwefan sy'n hysbysebu digwyddiadau saethu masnachol yn cyfateb yn dda wrth ystyried union leoliad y digwyddiadau saethu, sy'n awgrymu bod y data cyfredol ar leoliad digwyddiadau saethu a

nifer yr adar helwriaeth y maent yn eu rhyddhau yn anghyflawn ac felly mae lefel resymol o ansicrwydd ynghylch ble a faint o adar helwriaeth sy'n cael eu rhyddhau. Gallaf fod yn fwy sicr ynghylch dosbarthiad eang y digwyddiadau saethu hyn, gyda chrynodiadau i'w gweld yn nwyrain a gogledd-ddwyrain y wlad ac absenoldebau mewn ardaloedd ucheldirol yn bennaf megis Eryri a Bannau Brycheiniog. Mae data ar dueddiadau amser sy'n benodol i Gymru yn annibynadwy iawn, fodd bynnag, o ystyried y tebygrwydd o ran maint digwyddiadau saethu i weddill y DU, o ran niferoedd canolrifol yr adar sy'n cael eu rhyddhau a gogwydd dosbarthiad maint y digwyddiadau saethu, gallem ddisgwyl bod y patrymau rhyddhau hefyd yn debyg i gynnydd cyson yn nifer yr adar sy'n cael eu rhyddhau, hyd at ganol 2010 o leiaf. Mae rhai arwyddion bod rhyddhau adar helwriaeth yng Nghymru (ac efallai gweddill y DU) wedi gostwng dros y tair blynedd diwethaf oherwydd COVID-19 a Ffliw Adar Pathogenig lawn HPAI. Mae ansicrwydd ynghylch sut y bydd ddigwyddiadau saethu yn gweithredu yn y blynyddoedd i ddod yng ngoleuni'r gostyngiadau diweddar hyn, sydd ar hyn o bryd yn ei gwneud hi'n hynod anodd a thybiannol i ragweld tueddiadau'r dyfodol o ran rhyddhau adar helwriaeth.

Mae'n bosibl bod y lefel uchel o ansicrwydd yn fy amcangyfrifon a'r bylchau yn y data yn deillio o gydymffurfedd gwael wrth adrodd i'r Gofrestr Dofednod APHA orfodol os cedwir mwy na 50 o adar, set ddata a ddylai ddarparu'r wybodaeth fwyaf cywir am leoliad a maint gweithgareddau rhyddhau adar helwriaeth. Ceisiais bennu lefelau cydymffurfio â Chofrestr Dofednod APHA yng Nghymru drwy archwilio a oedd digwyddiadau saethu sy'n hysbysebu wedi'u lleoli'n agos at leoliadau ar y gofrestr lle adroddwyd bod adar helwriaeth yn cael eu cadw i'w rhyddhau neu am resymau eraill. Gwneuthum gyfres o ragdybiaethau am y sŵn gofodol tebygol yn y setiau data, ac o'r rhain, deilliais werthoedd cydymffurfio o rhwng 29% a 73%. Ni chanfûm unrhyw dystiolaeth bod patrymau cydymffurfio yn amrywio rhwng digwyddiadau saethu o wahanol feintiau, na bod cydymffurfedd yng ngweddill y DU yn debygol o fod yn llawer gwahanol. Mae'n ymddangos bod cydymffurfedd gwirfoddol â safonau a osodwyd gan sefydliadau saethu yn isel. O blith y digwyddiadau saethu sy'n hysbysebu yng Nghymru, datganodd 17% eu bod yn ystyried dilyn arferion gorau yn dilyn archwiliad a gynhaliwyd gan y British Game Assurance Scheme (BGA). Mae data o ddigwyddiadau saethu Lloegr yn dangos bod <15% o gorrannau rhyddhau yn dal dwyseddau islaw'r uchafswm a argymhellir gan y diwydiant saethu, sef 700-1,000 o adar/ha.

Gan dderbyn yr ansicrwydd o ran maint a lleoliad y gweithgareddau rhyddhau adar helwriaeth, ond heb roi cyfrif amdano, asesais yn fyr pa mor agos yw lleoliadau sydd wedi'u cofrestru yng Nghofrestr Dofednod APHA fel rhai sy'n dal adar helwriaeth i'w rhyddhau i dri dynodiad o ardaloedd gwarchodedig: Safleoedd o Ddiddordeb Gwyddonol (SoDdGA), Ardaloedd Gwarchodaeth Arbennig (AGA) ac Ardaloedd Cadwraeth Arbennig (ACA). Gan ddefnyddio'r band pellter 500m y mae Defra GL43 yn dibynnu arno, o'r 125 o leoliadau a ystyriwyd, roedd ~30% o fewn y pellter hwn i SoDdGA, ~16% i ACA a ~4% i AGA. Y pellteroedd cymedrig a chanolrifol o'r lleoliadau i'r ardaloedd gwarchodedig oedd: SoDdGA – 1,406m a 1,067m; ACA – 2,986m a 2,094m; AGA – 13,107m a 10,466m.

Adroddaf am dri bwlch amlwg mewn gwybodaeth a fyddai'n elwa ar waith ymchwilio pellach i wella'r data. Yn gyntaf, mae angen cofnod mwy dibynadwy o leoliad a nifer yr adar helwriaeth sy'n cael eu rhyddhau. Yn ail, byddai manylion am reolaeth yr adar ar ôl eu rhyddhau ar safleoedd yn ddefnyddiol i bennu eu heffeithiau tebygol, yn enwedig pan allai gweithgareddau rhyddhau a rheoli adar helwriaeth ddigwydd yn agos at safleoedd ecolegol pwysig neu ardaloedd gwarchodedig. Yn drydydd, mae deall ymddygiad tebygol

rheolwyr helwriaeth yn y dyfodol yn dilyn y newidiadau amlwg mewn rhyddhau a rheoli adar helwriaeth dros y tair blynedd diwethaf oherwydd COVID-19 a HPAI yn hanfodol er mwyn rhagweld yn gywir senarios rhyddhau a rheoli adar helwriaeth yn y dyfodol, ac felly eu canlyniadau ecolegol.

Mae'r adolygiad hwn yn datgelu y gall patrymau cyffredinol rhyddhau a rheoli adar helwriaeth yng Nghymru fod yn weddol debyg i'r hyn a welir yng ngweddill y DU, ac y mae rhagor o wybodaeth amdanynt ar gael ar hyn o bryd. Mae llawer o ddigwyddiadau saethu bach ac ychydig iawn o ornestau saethu mawr; mae'r rhan fwyaf o ddigwyddiadau saethu yn rhyddhau tua 1,000 o adar yn flynyddol; mae tua un o bob chwe digwyddiad saethu sy'n hysbysebu wedi'i hachredu i gydymffurfio ag arferion gorau'r diwydiant; ac mae cydymffurfedd â chofrestriad yn debygol o fod yn weddol isel. Mae'r adolygiad hefyd yn datgelu bod y data penodol ynghylch union leoliadau a meintiau rhyddhau adar helwriaeth yng Nghymru yn debygol o fod yn anghyflawn ac felly'n annibynadwy. Er efallai y byddwn yn gallu amcangyfrif nifer y digwyddiadau saethu coll ac yn wir ryddhau adar helwriaeth, ni allwn allosod na rhyngosod yn ddibynadwy lle gallai pob gweithgaredd rhyddhau ddigwydd na'i faint. Mae'r data coll hwn yn golygu nad yw ein dealltwriaeth bresennol o raddfa a graddau rhyddhau a rheoli adar helwriaeth yng Nghymru yn gwbl gywir. Mae hyn yn broblematic os ydym yn dymuno deall pa effeithiau ecolegol (a/neu economaidd-gymdeithasol) y gellir eu priodoli i'r gweithgaredd, os ydym yn dymuno pennu effeithiau ecolegol net ar draws y dirwedd.

Executive summary

The release and subsequent management of gamebirds (pheasants *Phasianus colchicus* and red-legged partridges *Alectoris rufa*) for recreational shooting in Wales is a long-standing and widespread activity. These activities can exert effects on non-game fauna and flora, especially in areas close to release sites and may explain both increases and decreases in populations of these non-game species. The activities also have socioeconomic consequences (not covered by this review). In order to accurately assess the net ecological and other effects of these activities, it is essential to have accurate data on the scale and extent of gamebird releases and management activities, and in order to understand and confirm relationships between these activities and changes in non-game populations it is helpful to understand temporal trends. Currently, little is known about where gamebirds are released, how many are involved, and how they are managed post-release. This review draws together a disparate set of available evidence, including official gamebird registration records, public adverts for shoots, industry survey data, and citizen science including bird surveys and roadkill data to develop a summary the locations, numbers and management of released gamebirds. I used a series of complementary approaches to explore how well estimates and measures derived from different datasets or assumptions correspond to one another and hence how reliable they may be.

I estimate that there are somewhere between 0.8-2.3 million gamebirds released annually at somewhere between 171 and 431 shoots in Wales. This comprises ~4% of the gamebirds reported as being held for release in the UK. Shoots in Wales appear to be similar to those in the rest of the UK, with a strong rightward skew in size distributions, comprising many small shoots (releasing and shooting relatively few birds over a few hundred acres) and a few very large ones (releasing large numbers of birds and shooting

them over several thousand acres on many days during the shooting season). Around three-quarters of Welsh shoots release fewer than 3000 birds annually. This skew, which may be even stronger in Wales than the UK in general, may explain why the mean number of birds released on a Welsh shoot (4,692) is around 20% higher than on shoots in the rest of the UK (3,908) but the median numbers released in each area don't differ (both = 1000). The major difference between shoots in Wales compared with the rest of the UK is that there are proportionately fewer partridges being released in Wales and fewer shoots offering them as quarry, probably because of gross habitat differences. Of the advertising shoots in Wales, 17% were registered as part of the voluntary British Game Assurance Scheme (BGA) whose audit considers a range of minimum standards likely to influence ecological effects. This is higher than the 12% of shoots in the rest of the UK accredited by this scheme.

The different datasets that I had available and made use of, including the APHA Poultry Register and a website advertising commercial game shoots do not match well when considering the precise location of shoots, suggesting that the current data on the location of shoots and the numbers of gamebirds that they release is incomplete and thus there is a reasonable level of uncertainty as to where and how many gamebirds are released. I can be more certain about the broad distribution of these shoots, with concentrations seen in the east and north-east of the country and absences in the predominantly upland areas such as Eryri and the Brecon Beacons. Data on temporal trends specific to Wales is very unreliable, however given the similarity in shoot sizes with the rest of the UK, both in terms of the median numbers of birds being released and the skewed distribution of shoot sizes, we might expect that release patterns are also comparable with a consistent increase in the numbers of birds being released, at least up to the middle of the 2010. There are some indications that releases in Wales (and perhaps the rest of the UK) have declined over the past three years due to COVID and Highly Pathogenic Avian Influenza HPAI. How shoots will act in the coming years in the light of these recent declines is uncertain, which currently makes predicting future trends in releases extremely difficult and speculative.

The high level of uncertainty in my estimates and the gaps in the data may be due to poor compliance in reporting to the mandatory APHA Poultry Register if more than 50 birds are kept, a dataset which should provide the most accurate information about the location and size of releases of gamebirds. I attempted to determine levels of compliance with the APHA Poultry Register in Wales by exploring whether shoots that advertise were situated close to locations in the register where gamebirds were reported as being held for release or for other reasons. I made a series of assumptions about the likely spatial noise in the datasets and from these derived compliance values of between 29-73%. I found no evidence that compliance patterns differed between shoots of different sizes, or that compliance in the rest of the UK was likely to be much different. It appears that voluntary compliance with standards set by shooting organisations is low. Of the advertising shoots in Wales, 17% self-declared that they considered to follow best practice following an audit run by the British Game Assurance Scheme (BGA). Data from English shoots indicates that <15% of release pens hold densities below the shooting industry recommended maximum of 700-1000 birds/ha.

Accepting, but not accounting for, the uncertainty in the scale and location of releases, I briefly assessed how close locations registered in the APHA Poultry Register as holding gamebirds for release are to three designations of protected areas: Sites of Scientific Interest (SSSIs), Special Protection Areas (SPAs) and Special Areas of Conservation

(SACs). Using the 500m distance band on which the DefraGL43 depends, of the 125 locations considered, ~30% were within this distance to SSSIs, ~16% to SACs and ~4% to SPAs. Mean and median distances from the locations to the protected areas were: SSSI – 1406m & 1067m; SAC – 2986m & 2094m; SPA – 13,107m & 10,466m.

I report three obvious knowledge gaps that would benefit from further investigation to improve the data. First, a more reliable record of the location and scale of releases is needed. Second, details of the management of the birds post release at sites would be helpful to determine their likely impacts, especially when releases and management may occur close to ecologically important sites or protected areas. Third, understanding the likely future behaviour of game managers following the apparent marked changes in gamebird release and management over the past three years due to COVID and HPAI is essential to accurately predict future scenarios of gamebird release and management and thus their ecological consequences.

This review reveals that the general patterns of gamebird releases and management in Wales may be broadly similar to that exhibited in the rest of the UK, and about which more information is currently available. There are many small shoots and relatively few large shoots; most shoots release around 1000 birds annually; around one in six advertising shoots is accredited as complying with industry best practice; and compliance with registration is likely to be fairly low. The review also reveals that the specific data regarding the precise locations and sizes of releases in Wales are likely to be incomplete and thus unreliable. Whilst we may be able to estimate the number of missing shoots and indeed release gamebirds, we cannot reliably extrapolate or interpolate where each missing release may occur or its size. This missing data means that our current understanding of the scale and extent of gamebird release and management in Wales is not entirely accurate. This is problematic if one wishes to understand what ecological (and/or socio-economic) effects can be attributed to the activity, if one wishes to determine net ecological effects across the landscape.

1. Introduction

The release and management of gamebirds, predominantly pheasant *Phasianus colchicus* and red-legged partridge *Alectoris rufa*, for recreational hunting (hereafter shooting) has been common in the UK for at least a century (Martin 2011, 2012). However, the great majority of published work concerning its history, ecological effects and role in society have focused on case in England. In Martin's two papers entitled "The Transformation of Lowland Game Shooting in England and Wales...", the only specific mentions were to note that areas in Wales where shooting was historically popular were those with "topography not dissimilar to that in lowland England" (Martin 2012 p1145) and that with the reduction in killing of raptors by gamekeepers, buzzards have spread from Wales (Martin 2011 p214). The three recent reviews of the ecological effects of gamebird release and management (Madden & Sage 2020, Mason et al. 2020, Sage et al. 2020) do not make any specific comments about the activity in Wales and the evidence that they consider is predominantly drawn from work in England and to a lesser extent Scotland (Madden 2023). Consequently, there is little published data on the scale, extent or temporal trends of gamebird release and shooting in Wales. Such data are necessary in order to understand the net ecological effects of the activity and thus determine how it should best be practiced.

This report seeks to determine where gamebird release, management and shooting occurs in Wales, what the scale of the activity is in terms of numbers of birds being released, and how the distribution and scale of this activity may have changed over the past decades. Any negative effects of this activity may be of greatest conservation interest if occurring in or close to protected areas for which there is a duty of care. Therefore, I have made a crude attempt to assess the patterns of proximity of release locations to protected areas including European sites and SSSIs. I have also attempted to assess how much of this activity complies with either the few legal requirements that pertain, namely registration of releases via the Animal and Plant Health Agency (APHA) Poultry Register (see section 2b), or that follows industry best practice guidelines. Where possible and appropriate I make deliberate comparisons with patterns of the extent or temporal trends of gamebird release and shooting in the rest of the UK in order to determine how similar the patterns may be across the UK and thus how might any findings in these better-studied countries be relied on when considering the activity in Wales.

There are two main problems to be considered when attempting to answer these questions. First, the release and management of gamebirds for shooting is currently lightly regulated and this, coupled with a concern about privacy and security in the face of disturbance from some people opposed to shooting, mean that there is little incentive to collect or publish data relating to release sites and sizes. Second, there is likely to be poor compliance with the regulation that does exist in the form of the APHA Poultry Register which requires people with holdings of more than 50 gamebirds for release to declare them (Madden 2021). Therefore, I draw on a range of sources (see section 2) that are either known to contain errors, biased or skewed, or are being interpreted for a purpose other than that which they were designed to answer. This results in a range of sources that may be described as "messy data" (Dobson et al. 2020). One solution to such messy data is available when several separate, alternative datasets can be used to address the same question and therefore confidence in the result is increased if it is reached by multiple different analytical approaches. Consequently, I have adopted a triangulation approach

whereby I search for consistencies or inconsistencies across different methods of obtaining estimates of the same measures (Dobson et al. 2020).

A further complication is that the release and shooting of gamebirds over the past few three years (2020-2022) has been greatly disrupted, first by COVID and then by Highly Pathogenic Avian Influenza (HPAI often referred to as bird flu). These events led to shoots: i) unable to access birds to release; ii) unwilling to purchase such birds with the risk of future disruption and the loss of revenue; iii) unable to release birds due to HPAI restrictions; iv) unable to shoot birds or a combination of all four reasons. Evidence for these effects at a UK level is seen in industry surveys and reports suggest that overall, there was a drop of around 27% in shooting days in the 2020-21 season ([How much shooting will there ACTUALLY be this season? - GunsOnPegs](#)) and this drop was mirrored in observations from gamebird feed manufacturers and gamebird veterinarians who reported decreases of around 20-30% in birds being reared in 2020, albeit with large variations between regions in the UK (Raymond et al. in press). Further evidence of reduced releases comes from a reduction of 74% in the relative numbers of roadkill pheasants reported to the Project Splatter database during the second UK-wide lockdown during Winter/Spring 2020-21 compared to previous years (Raymond et al. in press). During Spring 2022, risks of HPAI meant that the import of eggs and chicks from France (the main international supplier of gamebirds to the UK) was halted. Estimates vary and again, accurate figures are hard to obtain and interpret, but it is suggested that ~40% of released UK pheasants and ~90% of released UK partridges originate from France and consequently perhaps 70% of partridge shoots and one third of pheasant shoots may have been cancelled during the 2022/23 season (<https://www.theguardian.com/uk-news/2022/jul/30/game-over-for-uk-shooting-season-as-bird-flu-and-brexit-take-a-heavy-toll>). These shortfalls may have been partially compensated for by increased egg/chick production in the UK, but consequently, at least some shoots were unable to obtain birds for release in summer 2022. Additionally, some shoots deliberately chose not to release birds in summer 2022, perhaps because they were concerned about the responsibility that they would bear towards local poultry units or wild birds if the gamebirds became infected and infectious. Others refrained because of the risk of the birds dying before the shooting season started, leaving no chance to recoup the costs through shoot members or visiting guns. Finally, at least some shoots that did release birds then contracted HPAI (<https://www.scribhound.com/shooting-talk/s/shooting-talk/firthys-frothings-ai-bird-flu-the-way-forward>). The effects of this mortality on game-shooting and management is currently unclear, but it may lead to disruption of shooting this season and, through financial consequences, alter patterns of game release and management in future years. Consequently, data from mid 2020-2022 is likely to be anomalous.

How game-shooting will respond to these recent events is unknown. Almost any future is conceivable, ranging from shoots increasing releases and shooting in order to recoup costs lost over the past few years or satisfy unmet demands from guns who reduced their shooting during that period, through a deliberate reduction in the scale of shooting as motivations, demands and expectations change in response to what has become normalised over the past years, to a large-scale collapse of the activity as businesses and financial reserves vanish and guns switch to new activities. This report does not and cannot evaluate the future of game release and shooting, so the patterns that I report here should be interpreted with the caveat that they may not persist in future years.

Terms of Reference

Welsh Government Ministers have asked Natural Resources Wales and officials from Welsh Government to consider options for regulating gamebird releases in Wales. Currently in Wales, whilst releases within the boundary of Sites of Special Scientific Interest (SSSI) usually require consent, there is little regulation outside of protected sites. Concerns have been raised about the effectiveness of the current regulatory provisions to effectively monitor and manage potential environmental impacts, particularly on European protected sites. Following a legal challenge, Defra has introduced an interim regulatory approach. However, that approach applies only to releases in England. NRW have been tasked with reviewing the available evidence and develop proposals for a proportionate regulatory approach to gamebird releases in Wales (here after the gamebird review). As part of this review, I will address the key evidence gap identified by NRW in relation to i) the scale of game bird release in Wales, ii) a review in relation to the efficacy and compliance with current legislative and voluntary approaches (for example adherence to best practice guidelines and APHA voluntary registration) in Wales, and iii) make a preliminary and crude assessment of the proximity of gamebird release sites to a set of protected areas in Wales.

The review will:

- 1) Using relevant data from the APHA poultry register and other sources, provide a qualitative review of key information relating to the distribution, size, species composition of gamebird (pheasants and red-legged partridges hereafter simply partridges) releases in Wales, and indicative total number of gamebirds released in Wales. Where/if possible it will describe any trends in gamebird releases in Wales. These data will be used to make a preliminary and crude assessment of the proximity of gamebird release sites to a set of protected areas (European sites and SSSIs) in Wales.
- 2) Drawing on additional data/sources of information (such as the “Guns on Pegs” website or biological record data) where appropriate, provide a preliminary assessment as to what these may indicate about the levels of compliance in Wales with regard to the registration of gamebirds on the APHA poultry register, and if/where possible adherence to voluntary approaches such the GWCT guidance on release density.

2. Data sources

a) British Trust for Ornithology BBS/Winter bird Surveys

The BTO conduct a series of surveys and from these, compile Atlas records of occurrence and abundance available for both the winter and breeding season (Balmer et al. 2013). Replicated methods allow changes in these measures over decades to be detected. I have not analysed these raw data (given time constraints) but rather have studied the summary maps and data presented in Balmer et al. (2013). Although these surveys offer a national coverage, they seldom coincide with periods of gamebird release (August/September) and typically extrapolate data for 10km² tetrads from a smaller number of transects or surveys.

Depending on whether these surveys intersect release areas, local densities may be missed or under/over-represented.

b) The Road Lab

This citizen science project, run from Cardiff University (<https://www.theroadlab.co.uk/>) collates records of roadkill spotted in the UK. Data are available from 2013 and over 89,000 records have been received. Such data are subject to biases in observing and reporting rates and road traffic characters. As such it must be interpreted with care. It is useful for making relative comparisons, taking into account these biases that may be held constant across sites, but these data may provide little accurate information about absolute numbers. Pheasants are conspicuous roadkill items and commonly reported. Partridges are less obvious.

c) Guns on Pegs

Guns on Pegs (<https://www.gunsonpegs.com/>) is a commercial advertising site where shoots looking to let days or attract syndicate members can advertise. They can enter free-text descriptions of their shoot. From these entries and the reviews provided by guns who have visited the shoot we can extract data on the shoot location, quarry species and the bag sizes offered (with all quarry species combined), the area over which each shoot operates and whether the shoot has an accreditation from the British Game Assurance Scheme (BGA) (see section 3g). This database is likely to be biased towards larger, more commercially orientated shoots. I accessed this website between 15-25 November 2022.

d) APHA Poultry Register

Compulsory registration is required for individuals or organisations that breed, rear or release >50 gamebirds. Voluntary registration is available to those releasing <50 birds (Anon 2019). During the registration process, registrants are asked to report: Species (pheasant, partridge (no separation of red-legged partridge and grey partridge *Perdix perdix*) and duck (no distinction by species); Livestock Unit Animal Production Usage (Shooting, Other); Livestock Unit Animal Purpose (breeding for shooting, rearing for shooting, release for shooting); and Usual Stock Numbers. I engaged in a Data Sharing Agreement with the APHA in conjunction with Natural England and received the data on 10 February 2021.

e) The Economic and Environmental Impact of Sporting Shooting Report (PACEC 2014)

PACEC (Public and Corporate Economic Consultants) conducted surveys of shooting providers and participants in 2011/2012 with responses from 16,234 in 2011/2012 (PACEC 2014), including 3843 described as providers of recreational shooting including target sports, pest control, deer stalking, wild-bird game shooting and released bird game shooting. These respondents provided information about the volume of shooting that they offered or engaged in, some measures of management conducted as part of their shooting, provided numbers of people engaged in game shooting and the total number of

gun-days when game shooting occurred, with some data broken down to regions/nations within the UK.

3. Results

a) The Spatial Distribution of Welsh Shoots

I collated four data sets that may indicate where gamebird release and shooting occurs in Wales (see section 2a-d), and searched for commonalities between them.

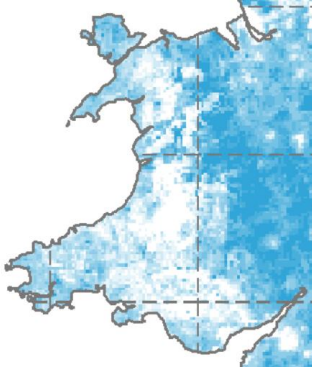
The first two relate to records of gamebirds, dead and alive. I examined BTO Winter Atlas data (see section 2a), which shows records of pheasants and red-legged partridges. These might be expected to correspond to where the gamebirds are soon after their release and during the time they are being shot. As can be seen in Figure 1A, records of red-legged partridges are very sparse or absent from the majority of Wales apart from concentrations on Ynys Môn and hotspots in north Powys, Monmouthshire and Wrexham/Flintshire/Denbighshire. Records of pheasants also show concentrations in these areas, but with greater densities in the rest of Powys, Conwy, Pembrokeshire and the Vale of Glamorgan. I then mapped data from roadkill reported to The Road Lab by citizen scientists usually via an app (see section 2b). These might be expected to correspond to where gamebird roadkill occurs with the expectation that higher densities, indicated by a higher proportion of gamebirds reported compared to other roadkill, are found in areas where these gamebirds are released for shooting. These data are inevitably biased by road type and location, but again there are clusters of high proportion reports in north Powys, Monmouthshire and Wrexham/Flintshire/Denbighshire with smaller numbers through the rest of Powys, Monmouthshire, Pembrokeshire and the north Wales coast.

The second two datasets relate to sites where gamebirds are released and shot. The Guns on Pegs website advertises shoots that wish to sell days or syndicate membership (see section 2c). The precise locations of these shoots are not published (maps on the website showing their location are deliberately offset by several kilometres to conceal precise locations) but they are listed by County. I examined the 64 shoots listed in Wales as offering pheasant shooting. These contained all the 32 shoots that also offered partridge shooting, so these 64 comprise the advertising gamebird shoots in Wales. These provide a partial sample of shoots in Wales but although we might expect them to be biased towards the larger shoots that rely on attracting guns through advertising, we do not expect them to be spatially biased. Most (25) are listed as in Powys, with 12 in Denbighshire. Other counties all have less than 5 listed. Finally, I filtered the APHA Poultry Register for holdings in Wales that reported holding gamebirds for release for shooting (see section 2d). This register may be incomplete due to poor compliance, but we do not expect it to be spatially biased. The highest numbers of such holdings are in Powys, Denbighshire and Monmouthshire, with other holdings being spread fairly thinly across southern and western Wales.

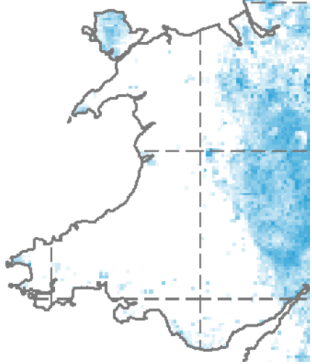
These four datasets provide a fairly consistent picture of where gamebirds are released, shot and observed. The highest concentrations appear to be along the Welsh/English border region, continuing up into Denbighshire. There are also lesser regions including the

Vale of Glamorgan, the Gower Peninsula, Pembrokeshire, south Gwynedd and Anglesey. There are obvious large areas where I found low or no records of birds being observed, shot or released. These are, unsurprisingly, the urban centres and the uplands including the valleys, Brecon Beacons, Cambrian mountains and Eryri (Snowdonia), comprising habitats unsuitable for either the release of pheasants and partridges, or where shooting them is unfeasible.

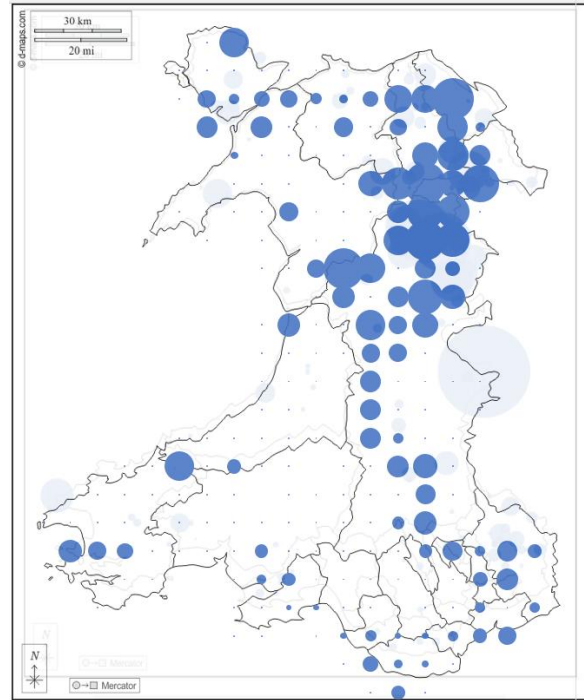
Ai) Pheasants



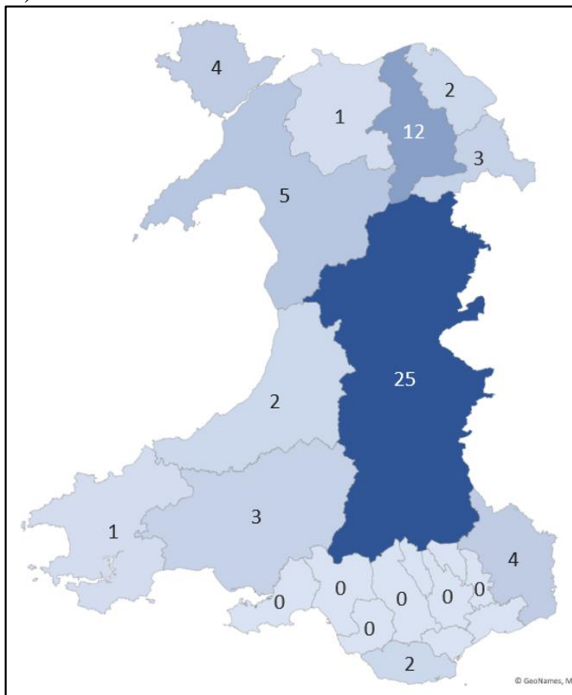
Aii) Red-legged partridges



B)



C)



D)

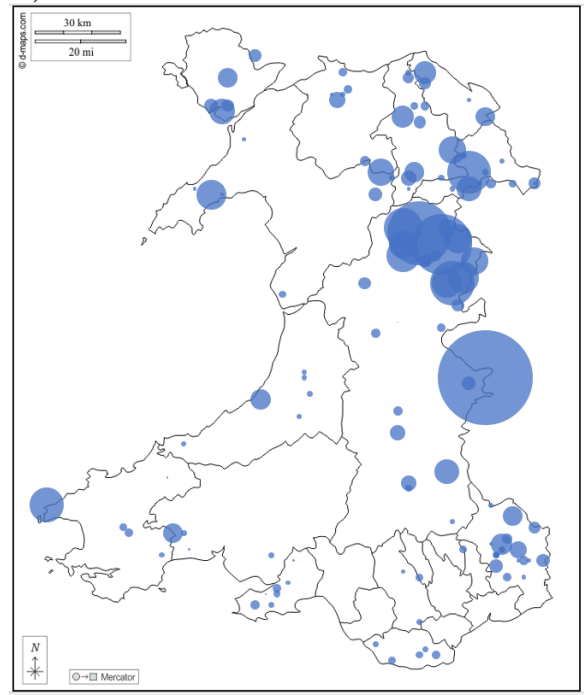


Figure 1 Records of gamebirds and shoots in Wales, indicating spatial patterns of their releases. A) BTO Winter relative abundance records for pheasants and red-legged partridges in 2007-2011, with darker blue shading indicating higher abundances; B) Proportions of roadkill that are gamebirds within each 10km² tetrad as reported to Project Splatter 2014-2019 (Project Splatter), with larger circles indicating a higher proportion of the roadkill reported being gamebirds; C) Shoots advertising pheasant shooting on the Guns on Pegs website in November 2022, separated by County, with darker counties hosting more shoots and the total number of shoots recorded in that County shown as text; D) The distribution and size of 125 holdings in Wales that have reported holding gamebirds for release for shooting in the APHA Poultry Register 2019-2020, with larger circles representing larger releases (locations have been deliberately jittered slightly to conceal exact release locations). Maps Ai & ii reproduced from Bird Atlas 2007-11 (Balmer et al. 2013) which is a joint project between BTO, Birdwatch Ireland, and the Scottish Ornithologists' Club. Maps reproduced with permission from the British Trust for Ornithology.

b) The Scale of Releases on Welsh Shoots

I analysed the records of the 125 locations in Wales contained in the 2019 APHA Poultry Register that reported holding any gamebirds for releasing for shooting. A further 73 locations held gamebirds for either breeding or rearing but did not report holding any for release. These locations may be shoots whose owners completed the register erroneously, perhaps misunderstanding that they should record birds held for each of the three purposes, or they may be game farms where birds are bred and reared before being sent elsewhere for releases. It comprised records of 581,176 birds, compared with the 13,673,562 birds recorded as being held for release in the rest of the UK, meaning that birds released in Wales comprise 4.1% of gamebirds released in the UK. The largest number of birds reported being held for release at a Welsh shoot was 120,750 compared to a maximum of 255,500 at the largest shoot in the rest of the UK. Shoots in Wales released on average a mean of 4,692 and a median of 1000 pheasants and partridge, whereas those in the rest of the UK released a mean of 3,908 and a median of 1000 pheasants and partridge. Despite the mean values being higher for Wales, they did not differ from those in the rest of the UK ($t_{3623} = 0.65$, $P = 0.51$). **The distribution of release numbers was very skewed (Figure 2), with 59 shoots (47%) reporting releasing fewer than 1000 birds and 15 (12% reporting releasing more than 10,000 birds. This skew and the overall patterns of release sizes match those seen in patterns of releases in the rest of the UK.**

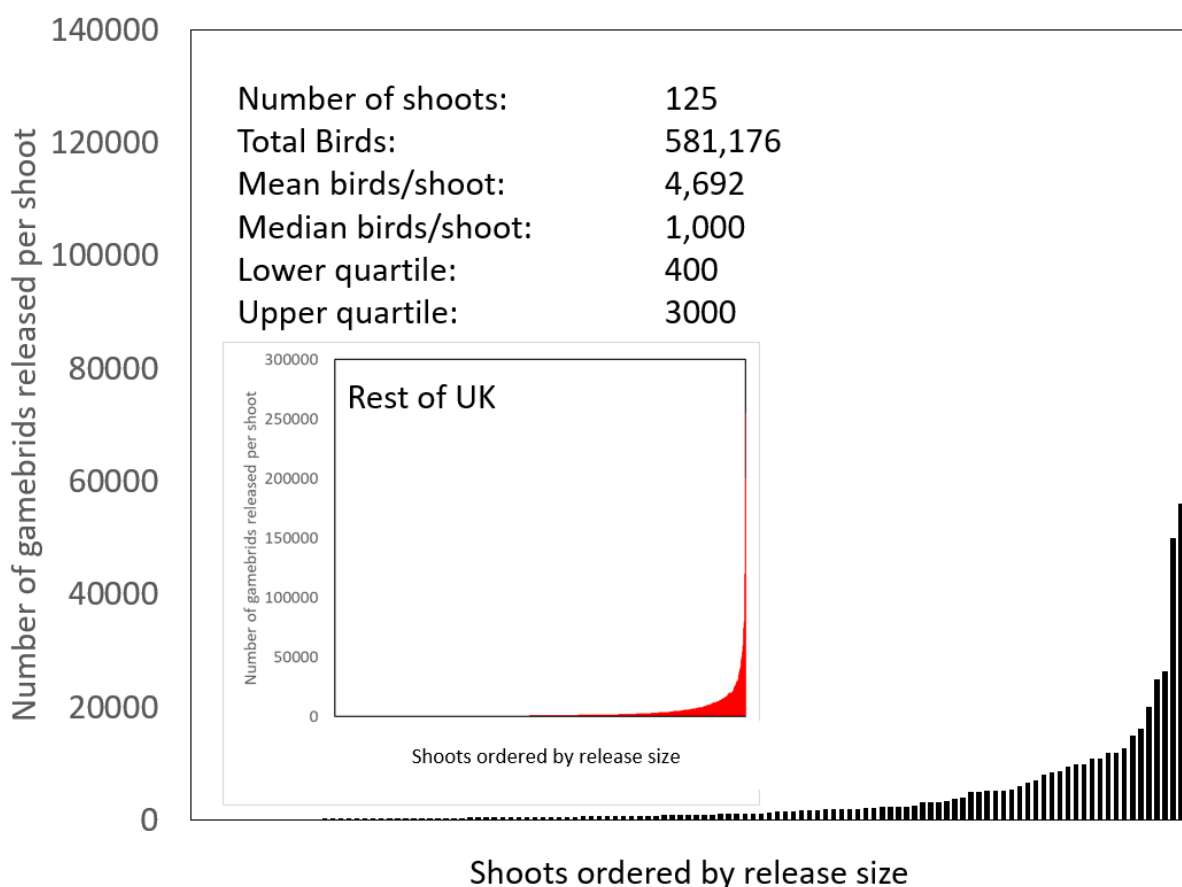


Figure 2. The distribution of gamebirds reported as being held for release at locations reporting to the APHA Poultry Register in Wales (main graph) and the UK (inset graph).

As discussed later, the APHA Poultry Register is likely to be incomplete with levels of compliance estimated to be around one third (Madden 2021).

c) Distribution of Shoots of Different Sizes

Teanby et al. (2019) crudely classified shoots into three classes. Small shoots release up to 3000 birds (species unspecified) with a mean release of 1,532 birds and shoot over an average of 964 acres for an average of nine days per season during which time they shoot an average of 80 birds per day. Medium shoots released 3000-10,000 birds with a mean release of 6,212 birds and shoot over an average of 1,795 acres for an average of 16 days per season during which time they shoot an average of 148 birds per day. Large shoots released more than 10,000 birds with a mean release of 26,241 birds and shoot over an average of 3,860 acres for an average of 41 days per season during which time they shoot an average of 232 birds per day. To allocate shoots to these classes based on a single measure for which data is most publicly available, we considered those shooting <114 birds per day (the average of 80 and 148) as being small, those shooting 114-190 as medium and those shooting >190 birds per day as large. Of the 46 Welsh shoots for which a mean daily bag size could be obtained from the adverts on Guns on Pegs website, 17 shoots (37%) shot <114 birds and so were classed as small; 11 shoots (24%) shot between 114-190 birds and so were classed as medium; and 20 (39%) shot >190 birds and so were classed as large. Of the 33 Welsh shoots that reported the acreage that they shot over on Guns on Pegs website, 13 (39%) occupied <1375 acres and so were classed as small; 7 (21%) occupied between 1375-2825 acres and so were classed as medium; and 13 (39%) occupied >2825 acres and so were classed as large. These are closely comparable to the distributions seen in the larger sample of English shoots (Table 1).

Of the 125 Welsh shoots reporting holding gamebirds for release in the APHA Poultry Register, 91 (73%) reported holding <3000 birds and so were classed as small; 19 (15%) reported holding 3000-10000 and so were classed as medium; and 15 (12%) reported holding >10000 and so were classed as medium. These are closely comparable to the distributions seen in the larger sample of 3499 other UK shoots (Table 1).

Generally, the size distribution of shoots in Wales closely matches that in the rest of the UK. Unsurprisingly, large shoots are overrepresented as advertising on the Guns on Pegs website, likely because they are partly or primarily commercial and so wish to attract outside guns, whereas smaller shoots are less likely to be commercial and so have no need to attract outside guns. **Using the APHA Poultry Register as the most complete record of gamebirds held for release and thus shoot sizes currently available, it can be seen that almost three-quarters of Welsh shoots can be classed as small, reporting releasing less than 3000 birds. Almost half of all Welsh shoots report releasing less than 1000 birds.** If, as is usual (Robertson et al. 2017) one-third of released birds are shot, then such small shoots could be expected to offer less than 10 days of shooting per year, harvesting less than 100 birds/day.

	Shoot size	Welsh Shoots	Rest of UK Shoots
Based on mean daily bag size from Guns on Pegs website adverts	Small	37%	32%
	Medium	24%	28%
	Large	39%	39%
Based on acreage shot over from Guns on Pegs website adverts	Small	39%	38%
	Medium	21%	32%
	Large	39%	29%
Based on records of gamebirds held for release in the 2019 APHA Poultry Register	Small	73%	75%
	Medium	15%	16%
	Large	12%	9%

Table 1. A comparison of the size distributions of shoots in Wales compared to those in the rest of the UK

d) The Composition of Gamebirds being Released in Wales

Of the 581,867 gamebirds being reported as being held for release in Wales in the APHA Poultry Register, 521,922 (89.7%) were pheasants and 59,875 (10.3%) were partridges. Of the 125 locations reporting holding gamebirds for release, 117 (93.6%) reported holding pheasants and 24 (19.2%) as holding partridges. Only three locations (2%) in Wales reported holding partridges but not pheasants for release. Comparable figures from the rest of the UK reveal that of the 13,673,562 gamebirds reported being held for release, 9,926,174 (66.9%) were pheasants and 3,747,388 (32.1%) were partridges. Of the 3,499 locations reporting holding gamebirds for release in the rest of the UK, 3,270 (93.4%) reported holding pheasants and 1327 (37.9%) as holding partridges. Of these, 160 (5%) reported holding partridges but not pheasants for release.

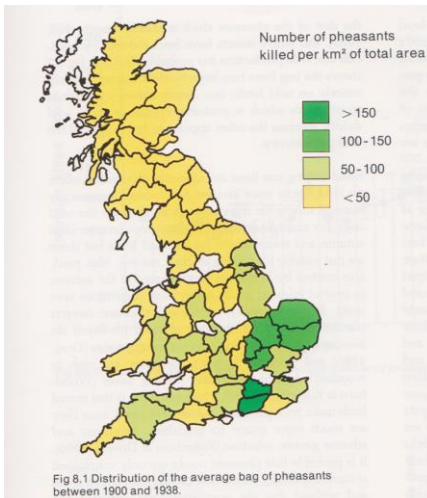
Of the shoots advertising on Guns on Pegs in Wales, all the 32 shoots that offered partridge shooting also offered pheasant shooting, while a further 32 only offered pheasant

shooting, indicating that 50% of such shoots included partridges (and so presumably released them). In the rest of the UK, 666 shoots offered partridge shooting, with 648 of these also offering pheasant shooting and 216 offering just pheasant shooting, indicating that 75.5% of shoots included partridges and 99.1% of shoots included pheasants.

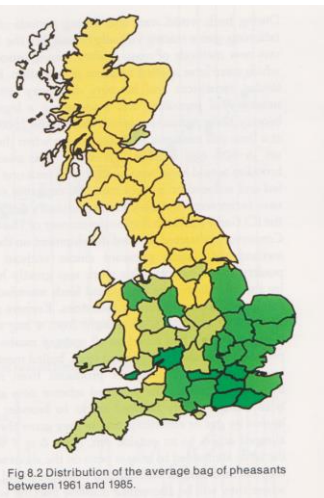
In Wales, the primary gamebird being released and shot is the pheasant. This matches historic patterns of bag composition. Tapper (1992) reports bag records (number of birds killed/km²) by county, with no county in Wales exceeding 1 bird/km² for red-legged partridge, compared with 10 English counties reporting >4 bird/km² between 1961 and 1985. At that time, such Welsh harvest levels were comparable with those in northern England and Scotland (Fig 3C). By contrast, for pheasant bags over the same period, records for several counties in Wales exceeded 50 bird/km² comparable with many English counties south of the Humber/Mersey line (Fig 3A,B). These historic differences may be explained by the differences in suitable habitat. Although none of Wales is deemed to be "Optimum" habitat for pheasant or partridge (Tapper 1999), almost none of Wales, apart from some regions along the south Wales coast was considered to be even suboptimal (Fig 4B) for partridge. In contrast, almost all of Wales, apart from the Brecon Beacons, Cambrian mountains and Snowdonia/Eryri, was considered to be sub-optimal (Fig 4A), being capable of sustaining wild pheasant populations with either more intensive game management or artificial rearing and release.

These results reveal a fundamental difference in patterns of gamebird release and shooting between Wales and the rest of the UK. In Wales, partridges comprise a much smaller proportion of the birds being released or shot, both in terms of absolute numbers and the number of locations where they are released or shot. They are reported as being held for release about three times less in Wales, and as being released on about half the number of sites expected compared to the rest of the UK. When considering advertised shoots, there were about 50% more shoots offering partridges as quarry in the rest of the UK.

A)



B)



C)

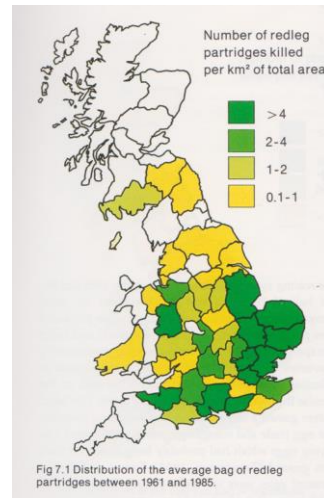


Figure 3. Historic patterns of harvest of pheasants in Great Britain between A) 1900-1938 and B) 1961-1985 and for partridges C) between 1961-1985. Figures taken from Tapper 1992. White counties indicate missing data.

A)



B)



Figure 4. Maps showing the suitability of habitats for A) pheasants and B) partridges, derived from ITE land cover data. Yellow areas indicate optimum habitat, deemed suitable for wild bird populations; Green areas indicate suboptimum habitats where wild populations may persist with additional game management or population supplementation. Figures taken from Tapper (1999).

e) Temporal Trends in Gamebirds in Wales

There is very little robust data on historic patterns of gamebird release in Wales. The longest running dataset on releases and shooting of lowland gamebirds is the GWCT National Gamebird Census which documents the annual number of birds released and shot by species, days on which shooting occurred and the area of the shoot (<https://www.gwct.org.uk/research/long-term-monitoring/national-gamebag-census/>).

These data are not publicly available, but it is reported that typically, several hundred shoots each year report their bag data. However, given that Wales hosts only a very small proportion of shoots in the UK, it is highly likely that there will be rather few records from Wales, risking bias. For example, Tapper (1992) illustrates the distribution of contributors to the NGC (Fig 32.3, p115) and his map shows that only 9 (2.4%) of the 371 contributors in 1977 were in Wales. Thus, long term data may only be available for a small and potentially unrepresentative sample of Welsh shoots.

Across the UK more generally, the number of pheasants and red-legged partridges being released had started to increase since the early 1960s (Robertson et al. 2017). By the early 1980s, the index of release density for pheasants was around three times higher than in 1961. This increase continued at a rate of 4.3%/year so that in the 2010s, the index of release density for pheasants was around nine times higher than in 1961 (Robertson et al. 2017). This increase in release density index has been accompanied by a fall in the contribution to the bag of birds that were not released that year. Pre 1990s, the bag comprised around 30 birds/10km² that had not been released on the participating estate, and a correlation between this value and the productivity rates of wild grey partridge suggests that those birds not released were wild born. The number of pheasants in the bag that had not been released declined post 1990 to around 10 birds/10km² and the relationship with the grey partridge chick index fell markedly, indicating that wild-born pheasants no longer made up a substantial part of the harvest but that shoots were more reliant on their released birds (Robertson et al. 2017). A similar pattern is seen for red-legged partridges, with the release index in 2016 being around 200 times greater than in 1961, although the bag index is only nine times higher than in 1961 (Aebischer 2019).

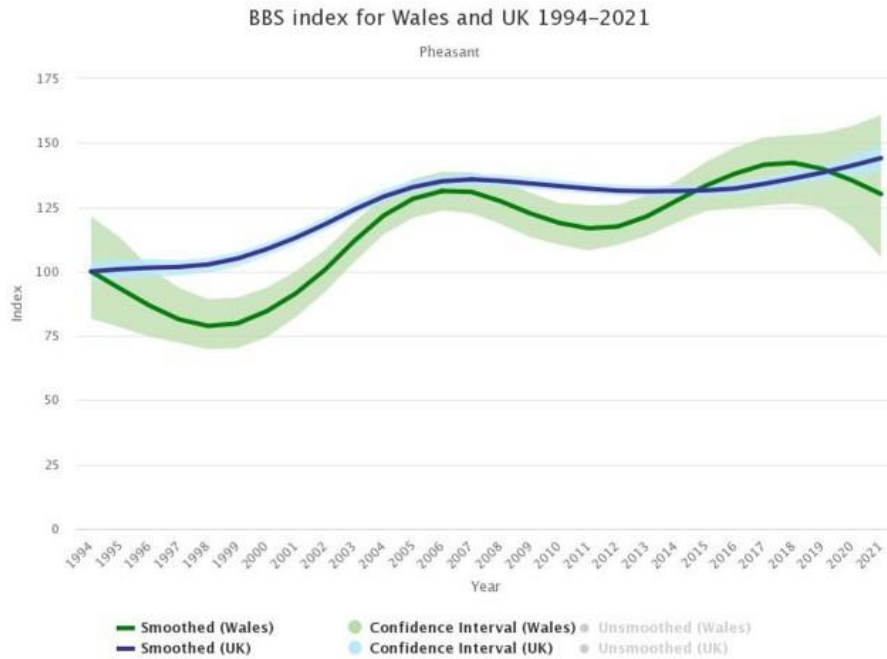


Figure 5. Smoothed breeding Bird Survey index for pheasant in Wales and the UK as a whole covering 1994-2021. Data from Harris et al. (2022).

A crude index of temporal and spatial patterns of gamebird releases may be obtained from the various surveys of birds conducted nationally and more locally by ornithologists. These measures should be interpreted to several key caveats. First, records collected during the breeding season, such as the Breeding Bird Survey, typically occur when only 9-15% of released gamebirds are likely to survive and after the shooting season and much game management has reduced or ceased meaning that the birds may have dispersed (Madden et al. 2018). Second, those collected during the winter periods may due the stratified nature of sampling (e.g. the Winter Atlas) or the reluctance of shooting estates to permit easy access in the case of amateur bird recorders (e.g. Bird Track data) underrepresent the patchy high concentrations of gamebirds in particular sites (shoots) where they are being concentrated by management. Thus, they may capture records of birds in habitats naturally suitable for them where they have dispersed to, but they may not accurately represent where or how many birds have been released. However, taking these caveats into account, such measures may provide a rough indication of trends. The Breeding Bird Survey smoothed index for pheasants in Wales has increased by 30% since 1995 (CI = 6-61%), whereas for England, the increase has been 52% (CI = 47-57%). A similar index value was also seen around 2006, with fluctuations above and below this level over the past 15 years, suggesting that there have not been consistent increases in Wales in the last decade or so. No comparable data is available for partridge, likely due to their low numbers in Wales. Interestingly, the pheasant index in Wales fell from 140 (CI = 125-154) in 2019 to 130 (CI = 106-161) in 2021, perhaps due to a reduction in releases or game management following COVID, whereas in England, the index increased over the same time from 142 (CI = 139-146) to 151 (CI = 147-157). It is notable that this index data showing a UK wide increase of ~40% from 1995-2020 does not match the Robertson et al. (2017) pattern of an increase of about 2.5 times in the same period.

Using Atlas data which indicates changes from 1968/72-2008/11 (breeding data) and 1981/84 – 2007-11 (winter data) (Balmer et al. 2013), changes in distributions may relate to changes in numbers of gamebirds being released (Table 2).

	1968/72	2008/11	% change
Breeding season Pheasant	213	244	+15%
Breeding season Partridge	19	77	+305%
	1981/84	2007/11	
Winter Pheasant	196	246	+26%
Winter Partridge	21	84	+300%

Table 2. The number of the 261 surveyed tetrads in Wales that contained records of pheasants or partridges during the 1968/72 and 2008/11 BBS surveys and the 1981/84 and 2007/11 winter bird atlas surveys and the changes in those numbers between the two survey periods.

Therefore, these crude estimates based on ornithological surveys suggest that pheasant numbers, observed in the wild likely not on shoots, may have increased in Wales by ~15-30% since the late twentieth century, while partridge numbers may have increased threefold over a similar period. These increases are markedly lower than those expected if such data were to accurately reflect the UK wide patterns of changes in releases reported by Robertson et al. (2017).

As explained in the Introduction, the trends reported here are likely to have been markedly disrupted over the past three years by COVID and HPAI. This is suggested by the downturn in the BBS Index 2019-2021 (Figure 5) but the extent of the decline mentioned in industry reports presented in the Introduction would be expected to result in an even greater decrease than currently detected. Extrapolating any future trends is difficult.

f) Indications of Compliance with the APHA Poultry Register

I could reasonably accurately locate 56/64 shoots that advertised for Guns on Pegs for pheasant shooting in Wales. This was achieved by: searching the advert for any description of location, e.g nearby village/hotel/geographical feature; searching for the name of the shoot on Google; if the shoot advertised separately, searching its website for a location/postcode; entering location names into Google Earth and extracting the grid reference for the location; cross checking the extracted grid reference to ensure that it fell within the crude map provided on Guns on Pegs.

Locations of these advertising shoots were then plotted alongside the location data from the APHA Poultry register, with locations in the register separated into locations that reported holding gamebirds for release and those that reported holding gamebirds for rearing/breeding but not release. The locations were analysed with a precision of 1km² resolution. However, the locations of both releases and shoots may be imprecise and inaccurate. For APHA locations, the provided location may refer to the specific release pens within the shoot, but for shoots with multiple pens, the registrant may have chosen a single representative one or an average location within the shoot, or provided the keeper's own home address (examining a subset of location data from English shoots revealed that a percentage of those apparent release locations were situated in (Semi) urban areas where it is unlikely that releases occurred). For the Guns on Pegs data, the location chosen was usually a named locations such as a hotel where the guns may stay or a general area in a geographical feature. In the first case, guns may start the day at the hotel but drive several kilometres to the shoot itself. In the second case, without accurate maps of the shoot it was a case of guesswork as to where the area concerned actually covered. For this reason, I allowed a margin of error of 2km around both the shoot and the APHA locations. I assessed how many of the 56 advertising shoots were within 4km of an APHA location. Maps illustrating these patterns are not included because they risk identifying the locations and compliance status of individual shoots.

When allowing a generous margin of error of 4km, 31/56 (55%) shoots were within 4km of an APHA location that reported holding gamebirds for release. A further 10 shoots (so 41/56 = 73%) were within 4km of an APHA location that reported holding gamebirds for any reason. Fifteen shoots (27%) were further than 4km from any location recorded in the APHA Poultry Register.

When allowing a more stringent margin of error of 2km, 27/56 (48%) shoots were within 2km of an APHA location that reported holding gamebirds for release. A further 7 shoots (so 34/56 = 61%) were within 2km of an APHA location that reported holding gamebirds for any reason. Twenty-two shoots (39%) were further than 2km from any location recorded in the APHA Poultry Register.

I searched for any patterns in compliance depending on shoot size. There was no difference in reported mean bag size/day between shoots that were far from any APHA location and those close to them when considering either the 4km or 2km zones (4km: 177 vs 167, $t_{39} = 0.79$, $P = 0.78$; 2km: 155 vs 198, $t_{39} = 0.95$, $P = 0.17$). When considering whether there were any differences in shoot classes (see section 3c) situated near or far from APHA locations, I found none (at 2km: $\chi^2 = 2.54$, $P = 0.28$; at 4km: $\chi^2 = 0.78$, $P = 0.68$).

Comparisons of Compliance with the Rest of the UK

The percentage of APHA release locations that are situated in Wales is 125/3624 = 3.4% of all UK locations that are registered. The percentage of shoots advertising on Guns on Pegs situated in Wales is 64/927 = 6.9% of UK shoots. This difference could be interpreted either as that a lower percentage of shoots in Wales register with the APHA, or that a higher percentage of shoots in Wales advertise their shooting availability, compared with the rest of the UK.

Evidence suggesting that compliance with the register may not be markedly lower in Wales compared to the rest of the UK is that the percentage of birds recorded as being held for

release in Wales is $581,867/14,255,429 = 4.1\%$ of birds released in UK, which closely matches the independent measures of “gun days provided” (PACEC 2014, p38) in Wales being $450,000/11,000,000 = 4.1\%$, and the number of “Shooting Providers” (PACEC 2014, p38 – note that these also include target shooting) in Wales being $2,900/70,000 = 4.1\%$. These consistent indications that shooting in Wales comprises about 4% of that in the rest of the UK also correspond to the proportion of the UK population that lives in Wales, being $3,169,586/67,081,234 = 4.7\%$. (National population data drawn from [Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland - Office for National Statistics \(ons.gov.uk\)](https://www.ons.gov.uk)). These figures are somewhat similar to ratios derived from surveys of gamebirds in the wild during the breeding season. Woodward et al. (2020) gives a UK pheasant population of 2,350,000 females while Hughes et al. (2020) give a figure of 165,000 (CI: 160,000-175,000) females in Wales, indicating that ~7.5% of the UK pheasants are in Wales. Woodward et al. (2020) gives a UK red-legged partridge population of 72,500 territories while Hughes et al. (2020) give a figure of 1,400 (CI: 940-1850) territories in Wales, indicating that ~2.0% of the UK partridges are in Wales. These figures suggest that there are approximately the expected number of (wild) gamebirds in Wales that we might expect given total numbers in the UK and thus that compliance with the poultry register is likely to be similar between Wales and the rest of the UK. The interpretation that a higher percentage of shoots in Wales advertise their availability is hard to support given that the distribution of size classes of shoots in Wales, which may serve as a proxy for their commercial status, is very similar to that of the rest of the UK (see section 3c).

g) Best Practice Compliance

Shoots advertising on Guns on Pegs may declare that they are a “Best Practice Shoot” <https://www.scribhound.com/shooting-talk/s/conservation/are-the-estates-where-you-shoot-following-best-practice>. This is an audit run by the British Game Assurance Scheme (BGA) who state that they have devised their criteria in association with organisations including the GWCT, BASC, the Countryside Alliance and the NGO. Full details here <https://www.britishgameassurance.co.uk/wp-content/uploads/Shoot-Standards-V1-June-2021.docx.pdf>

In Wales, 11/64 (17.2%) of advertising shoots (that give pheasant as a quarry species, surveyed 21 November 2022) are self-declared as Best Practice. In England, this figure is 82/698 (11.7%); in Scotland, 22/147 (15.0%); and in Northern Ireland 1/14 (7%). Therefore, voluntary, declared compliance with the industry-own assurance schemes is relatively high in Wales compared to the rest of the UK.

Five of the 15 (33%) shoots that were >4km from any APHA location were classed as ‘Best Practice Shoots’ and thus BGA assured, compared with 5/41 (12%) shoots that were <4km from any APHA location. This comprises 5/10 (50%) such accredited shoots in Wales for which I could determine location. When the buffer was reduced to 2km, this was 7/36 (19%) shoots >2km from any APHA location compared with 3/20 (15%). This suggests that compliance with ecological best practice is not always strongly linked to compliance with legal requirements.

I could find no data on whether shoots voluntarily followed the Code of Good Shooting Practice (<https://www.gwct.org.uk/media/768987/CodeGoodSHootingPractice.pdf>). I

attempted to assess compliance by looking at release sizes and the area being shot over where such data were available, but it involved making too many assumptions about the size and number of release pens and the woodland quality on the shoot.

I searched for published data about release densities to give an indication of voluntary compliance with at least some aspects of the Code of Good Shooting Practice (<https://www.gwct.org.uk/media/768987/CodeGoodSHootingPractice.pdf>). Three studies have reported release densities in pens, but it appears that none of those pens are in Wales. Sage et al. (2005) report that in a sample of 43 pens in 1988, the mean stocking density was 2250 birds \pm 163 (1SE) birds/ha with a range of 338-4950 birds/ha. In the same area in 2004, they report that in a sample of 53 pens, the mean stocking density had fallen to 1800 birds/ha (again with no detail on densities <1000 or 700). In 2006-2008 at a different set of sites in S England, Neumann et al. (2015) surveyed 37 pens and reported a mean stocking density of 1489 birds \pm 126 (1SE) /ha with a maximum of 3,409 birds. They state that 11% of the pens were stocked at <700 birds/ha. Hall et al. (2021) surveyed 65 pens in west and central England and reported a mean stocking density of 2606 birds \pm 184 (1SE) with a range of 216-7317 birds/ha. In this study, 3/65 pens (5%) and 9/65 (14%) having densities of <700 and <1000 birds/ha respectively. These results indicate that at most pens in England, there is low voluntary compliance with the Code of Good Shooting Practice, derived and supported by the body of shooting organisations, with perhaps ~15% of shoots complying with recommended stocking densities. There is some weak evidence that mean stocking densities may be decreasing over time, with the later high densities reported in Hall et al. (2021) being explained as arising from small shoots where pens are generally small, compared with the pens of the larger, perhaps commercial shoots studied by Sage et al. (2005) and Neumann et al. (2015). A more detailed and stratified sample of pen densities is required, specifically with a focus on Welsh shoots, to understand levels of compliance in Wales.

Other indicators of compliance such as when birds are released, predator control practice, the type and location of supplementary feeding, or habitat management activities are not available at a shoot-by-shoot level, although some aggregated indicators of this behaviour across the industry as a whole of the UK are provided in a survey of gamekeepers (Ewald & Gibbs 2020).

h) Estimated Release Numbers of Gamebirds in Wales

If the APHA Poultry Register is accurate, then annually 581,867 gamebirds are being released in Wales, comprising 521,922 (89.7%) pheasants and 59,875 (10.3%) partridges. However, as explained (see section 3f) this accuracy is questionable due to poor compliance, so I make a series of alternative estimates.

If compliance with the APHA Poultry register is determined using my methods in Section 3f, and non-compliant shoots are assumed to match the distribution patterns of the registrants, then with compliance ranging from 29-73%, release annual numbers might range from 796,132 (73% compliance), to 1,056,684 (55%), to 1,614,377 (36%), to 2,004,055 (29%). If these compliance figures are used to account for missing data in the Poultry register then given that 125 release locations/shoots are currently registered in

Wales we may conclude that there are between 171 (73% compliance) and 431 (29% compliance) shoots in Wales,.

Based on the Madden (2021) calculations that 40.6 million pheasants and partridges are released annually in the UK and that 4.1% of these are in Wales, then 1.66 million birds are released annually. Based on the Aebischer (2019) calculations that 57 million pheasants and partridges were released in the UK in 2016, then 2.34 million such birds are released in Wales.

Considering these six possible values (4 compliance estimates and 2 total release estimates), but excluding the assumption that the APHA Poultry register indicates complete compliance, then **between around 800,000 to 2.3 million pheasants and partridges are released in Wales annually, with a mean estimate of around 1.6 million birds.** It is notable that such a value would also indicate compliance with the APHA Poultry register to be around a third – an estimate similar to that suggested by Madden (2021) based on a range of different approaches. Taking the proportions of the two species as being 90% pheasants and 10% partridges (see section 3d), then I estimate that, in ‘normal’ years around 1.44 million pheasants and 160,000 partridges are released annually in Wales. Using the range of possible compliance levels described above, this produces possible ranges of 720,000-2,070,000 pheasants and 80,000-230,000 partridges released annually in Wales.

i) The Proximity of Release Locations to Protected Areas in Wales

I explored how close locations reporting in the APHA Poultry Register that they held gamebirds for release in Wales were to three categories of protected areas. Using the NNJoin plugin in QGIS (<https://plugins.qgis.org/plugins/NNJoin/>), I derived nearest neighbour distances for each location. From these, I could produce a range of descriptives and count the number within a range of distance bands including that of 500m which is the Defra buffer zone where gamebird releases are covered by GL43 (Table 3, Fig 6). Given the likely low compliance with reporting to the register (see section 3f), and uncertainty as to whether there are any spatial biases in this under-reporting, it is difficult to extrapolate or interpolate where the potentially ~50-300 missing shoots are located and hence how representative these proximity patterns are.

	Nearest SSSI	Nearest SAC	Nearest SPA
Mean (m)	1406	2986	13107
Median (m)	1067	2094	10466
Max (m)	4951	16250	38636

Count <1000m	62 (49.6%)	38 (30.4%)	8 (6.4%)
Count <750m	44 (35.2%)	26 (20.8%)	6 (4.8%)
Count <500m	37 (29.6%)	20 (16.0%)	5 (4.0%)

Table 3. Table 3 Distances to the nearest protected area, of each of three categories, from the 125 locations in Wales registered as holding gamebirds for release. Count data reports the number of locations less than 500, 750 or 1000m from each category of protected area.

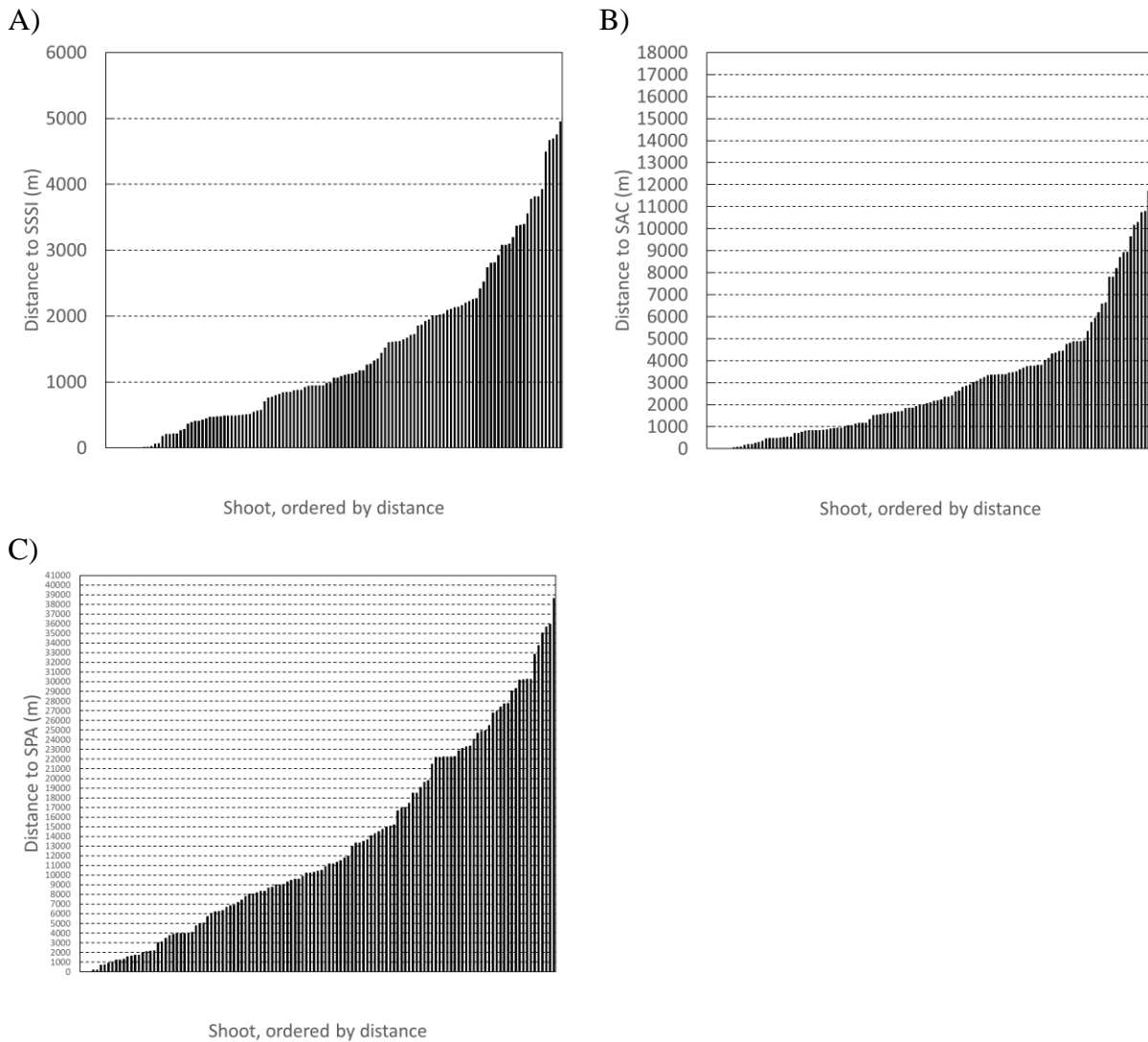


Figure 6. Distributions of distances between each location reporting in the APHA Poultry Register that they held gamebirds from release and protected areas in Wales including A) Special Sites of Scientific Interest: SSSI, B) Special Areas of Conservation: SAC, c) Special Protected Area (SPA). Please note marked differences in the Y axes in each graph.

4. Knowledge Gaps

There is a fundamental knowledge gap revealed by this analysis: that reliable data on the scale, extent or history of gamebird releases in Wales is extremely poor. Throughout the review, I have had to rely on incomplete data to make extrapolations. Where possible I have tried to triangulate my estimates by taking complementary approaches based on different data sets and assumptions. The fact that my resulting estimates are often highly variable indicates that none of the available data are accurate. Consequently, it is uncertain exactly how many gamebirds are released annually in Wales, where all of those releases occur, how many may be close to protected areas or how these numbers and locations have changed over time.

A secondary knowledge gap made evident by this review is that it is unknown what are the management methods that accompany each release including their compliance with recommended best practice guidelines. The estimates that I have obtained are based on reported membership of a paid-for accreditation scheme and are likely to be skewed towards larger commercial shoots such that we have little understanding of any voluntary compliance with best-practice guidance issued by the GWCT by non-commercial shoots. The ecological effects of gamebird release and management are likely to be strongly dependent on adherence to these guidelines, with poor compliance (e.g. high densities of releases, insensitive siting of release pens, feeding provision that facilitates disease spread) likely to produce highly negative effects, whilst good compliance may deliver net ecological benefits (Sage et al. 2020). Without accurate information about the scale and extent of compliance with these guidelines, in conjunction with the primary knowledge gap relating to the scale, extent and history of releases, it becomes extremely difficult to reliably determine the net ecological effects of gamebird release and management in Wales.

A final knowledge gap is that there appear to have been marked changes in release, management and shooting behaviour in Wales and more generally in the UK over the past three years as a result of COVID and HPAI. It is likely that this has led to the cessation or significant reduction in releases at particular sites where either a strategic decision has been taken to pause releases or financial costs have made them unviable. There is currently no publicly available data on where these marked changes have occurred, nor on what the likely future behaviour of game managers at these or other sites may be in the coming years. This makes developing realistic long-term future scenarios depicting gamebird release and management in Wales difficult.

5. Discussion

This review makes it clear that there is currently little reliable evidence about the scale, extent, history or methods of gamebird release and management in Wales. The estimates that I can calculate are subject to large errors, of around 2.5 fold and the extrapolations that I make are often based on restricted and perhaps skewed data. I estimate that there are somewhere between 0.8-2.3 million gamebirds released annually at somewhere between 171 and 431 shoots in Wales. I can be more certain about the broad distribution of these shoots, with concentrations in the east and north-east of the country and absences in the uplands. The distribution of shoots of different sizes in Wales registered with APHA appears to be similar to that seen in the rest of the UK, with many small shoots and a few very large ones. Around three-quarters of Welsh shoots release fewer than 3000 birds annually. The mean number of birds released on a Welsh shoot (4,692) is around 20% higher than on shoots in the rest of the UK (3,908) but the median numbers don't differ (both = 1000). This suggests that there is a somewhat stronger skew towards a few very large shoots in Wales compared to the distribution seen in the rest of the UK. The major difference between shoots in Wales compared with the rest of the UK is that there are proportionately fewer partridges being released in Wales and fewer shoots offering them as quarry. This is likely a reflection that large arable areas, especially suitable for partridges, are less common in Wales than in other parts of the UK. Data on temporal trends in Wales is very unreliable. Given that the distribution of shoots of different types matches that seen in the rest of the UK, we might expect that release patterns are also

comparable, in which case the trends described by Robertson et al. (2017) might apply, representing a consistent increase in the numbers of birds being released, at least up to the middle of the 2010. There are some indications that releases in Wales (and perhaps the rest of the UK) have declined over the past three years due to COVID and HPAI. How shoots will act in the coming years in the light of these recent declines is uncertain, which currently makes predicting future trends in releases extremely difficult and speculative. Advertising shoots in Wales were more likely to self-declare that they complied with the British Game Assurance scheme than shoots in the rest of the UK, with 17% of them meeting the assurance criteria, indicative of industry-prescribed best-practice.

Accurate data about the scale, locations and temporal trends in gamebird releasing and management are vital in order to understand the net ecological effects of this activity. As described in Madden & Sage (2020), determining the net ecological effects requires a consideration of several distinct aspects. The direct effects of the birds themselves, including their predation on invertebrates and vertebrates, the damage they cause to flora, the nutrient depositions associated with their defecation, their role in disease transmission to non-game fauna and livestock and their competition with non-game fauna for resources, are typically negative, related to the number and more so the density of releases, and are generally confined to areas close to the release site (Sage et al. 2020). The associated effects of game management and shooting activity that accompany the releases, including predator control, supplementary feeding, creation, enhancement or retention of habitats, and the disturbance occurring during shooting, are effective over a wider area and may be more closely related to the attitude and ethos of the game manager than the number of birds being released. Finally, the indirect effects of the release and management that percolate through the ecosystem, including changes to numbers of predators or scavengers that benefit from game release and management which go on to alter trophic interactions more generally, or gross changes in species composition due to e.g. supplementary feeding or changes in nutrient profiles, may operate over much wider landscape scales, affecting areas that are not under control of shoot managers and may spill into protected areas and/or areas of ecological interest. Given that the release and management of gamebirds exerts a multitude of effects on a wide range of fauna and flora, calculating the net ecological consequences of this activity is not trivial and requires accounting for both the positive and negative effects that may arise which may involve considering different 'currencies' (e.g. an increase in farmland birds is accompanied by a decrease in numbers of beetles). Understanding net ecological effects of this activity is only possible if patterns of gamebird release can be related to patterns of biodiversity change and this demands accurate spatial and numerical data. With poor data comes the risk of inaccurate assessments of ecological impacts.

Improving data quality requires both a refinement of existing data sources and the development of new data sources. The best existing data source is the APHA Poultry Register, although it was not specifically designed to be used to map gamebird releases. It is subject to several weaknesses (discussed below). The other data sources are also imperfect.

The timing of bird surveys and their design, intended to provide a representative sample of the area of interest and cover a wide range of species means that although they may provide some long-term data on broad trends, they fail to capture the concentrated nature of releases and the sheer number of birds being released is unlikely to be recorded accurately. It is unlikely that an observer is going to count tens of thousands of a single

species or even detect them, especially when release sites are often deliberately sited away from public access to reduce disturbance. Therefore, these data sources have limited use when considering a highly localised activity that is concentrated in space (around the release pen and drives on the shoot) and in time (with releases in late summer, followed by rapid mortality both before and during the shooting season (Madden et al. 2018) such that only around 15% of the released birds are still alive the following spring when the summer surveys occur).

The data available from the shooting industry in the form of publicly available adverts is currently limited to those shoots who seek to attract guns. This may exclude small shoots which comprise long-term syndicate members or larger shoots that are run privately to which guns are invited without a desire to make a profit. Again, such adverts are not intended to provide accurate and representative data and so should be treated with caution. Furthermore, the locations of shoots on Guns on Pegs are deliberately distorted for privacy reasons. Assumed locations can be derived following intensive searches of remote sensing data or confirmatory information from other sources (as I did when assessing levels of compliance) but this is not trivial. This dataset depends on the shoots deciding to advertise and publicly presenting information to their potential customers. It is not easy to imagine how an increase in the volume or quality of these data may be obtained.

A final useful piece of data that is currently missing is an indication of the management practices of the gamekeepers. Sage et al. (2020) describe how some of the negative ecological effects of gamebird release can be reduced or removed by appropriate management. Such management forms the basis of the Code of Good Shooting Practice, which in turn informs the British Game Assurance scheme. In Wales, 17% of advertising shoots state that they have been accredited as part of the BGA scheme and so practice such management. However, this is likely a minimum value because there are financial costs to accreditation and other shoots that do not advertise may not see the value of the scheme yet may comply with the good practice voluntarily. I could find or derive no data specific to Wales that indicated levels of voluntary compliance at any particular shoot location. Relying on data from English shoots, it appears that <15% of pens are stocked at densities below the maximum numbers recommended by the Code of Good Shooting Practice, produced and endorsed by all the main organisations involved in gamebird shooting. It was not possible to determine compliance with other aspects of the code, relating to timings and locations of releases, predator control or supplementary feeding patterns. Such shoot-specific compliance data is useful to assess the ecological impacts of releases and management occurring there. This fine-scale, detailed and site-specific information would best be obtained with the cooperation of gamekeepers being willing to accurately report how they manage their released birds.

The data from the APHA Poultry Register appears to have three fundamental weaknesses with respect to our understanding the scale and extent of gamebird releases in Wales. First, compliance is incomplete (likely ranging from 27-73%), despite it being a legal requirement. This means that we do not know where all releases occur, nor how large they are. This makes it difficult currently to accurately assess any effects that the release and management of the birds might have on the ecology of the local area, specifically when interested in proximity to protected areas. Second, the registering and analysis of gamebird numbers appears to be confused. This confusion can occur in two ways. There is the possibility that birds reported by a gamebird manager as being held for one purpose

e.g. breeding or rearing, are also being released at that site but this is not reported. This would lead to an under-estimation of release numbers and release locations. There is also the possibility that the data are misinterpreted by researchers as has been done previously (e.g. Pringle et al. 2019), such that birds reported as being held for rearing or breeding are being assumed to also be released at those sites. This would lead to an over-estimation of release numbers and release locations. Even if these types of errors cancel each other out, although the resulting overall numbers of birds released may be somewhat reliable, the locations of releases might be highly inaccurate with either sites where releases do occur being entirely missed, or sites where no release occur being designated as being susceptible to the birds and their management. Finally, it does not appear to be possible to collect a time-series of the register from the APHA via an FOI request such that temporal changes in the scale and extent of releases can be analysed. This means that longitudinal studies of gamebird release and management cannot be conducted using official data but instead must rely on either proxies such as the BTO or local wildlife group survey data, or on data held privately by the GWCT as part of their National Gamebag Census.

6. Conclusion

This review provides a depiction of the scale, extent and history of gamebird release and management in Wales, subject to the obvious and serious limits imposed by the available data. It provides a crude general picture of the activity across Wales: what regions it occurs in, how many shoots there might be in the country, how many birds might be released and general levels of compliance with industry-proposed good practice. Because gamebird release and management in Wales comprises only a small percentage of the activity occurring across the whole of the UK, it is helpful to find that the practice seems fairly similar to that seen in the UK more widely and about which more data are available. However, there are critical gaps in the data required to make any accurate analysis about the consequences of gamebird release and management in Wales. Specifically, data at the level of the individual shoot location, the numbers of birds being released there and the management practices that accompany those releases is rather unreliable and partial. More accurate data, either obtained through improved compliance with the existing registration requirements or derived through new sources could improve the accuracy and coverage of our knowledge about this activity and its ecological (and socio-economic) effects.

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