Guidance to interpretation of Wetland Bird Survey Alerts

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BACKGROUND

The Wetland Bird Survey (WeBS) has been monitoring the UK's waterbirds for over 70 years, with coverage of major wetlands maintained at the levels seen today since the early-1970s. WeBS Core Count methodology is based on monthly counts of waterbirds at wetland sites on predetermined dates. Larger sites, including the majority of the UK's estuaries and sizeable inland sites, are subdivided for the purpose of recording numbers of waterbirds into manageable "count sectors". Counts on multi-sector sites are undertaken by teams of counters, coordinated so as to minimize double counting caused by bird

movements during the counting period. For estuarine sites, teams of observers typically target the period over high-tide. The sectors are defined principally to promote the collection of accurate waterbird numbers which, when combined, will produce a robust estimation of waterbird numbers across entire sites. Smaller sites may be divided into just a few sectors whilst larger sites like The Wash, Severn or Humber Estuary may be divided into 50 or more sectors.

This guidance document gives an overview of analyses that have been developed by WeBS for routine reporting of trends for protected sites including Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSIs; Great Britain) and Areas of Special Scientific Interest (ASSIs: Northern Ireland), and guidance to the interpretation of the resulting tables and plots of trends and trend comparisons.

Analyses focus on identifying trends in abundance of waterbird features of protected sites based on the WeBS Core Count data. Where declines of over 25% and 50% have been identified the waterbird feature on that site is assigned a medium or high Alert (coloured amber and red respectively in the report outputs). Alerts are intended to be advisory; subject to interpretation, they should be used as a basis on which to direct research and subsequent conservation efforts if required.

WeBS Alerts 2016/17 (which uses data up to the 2017/18 winter and is published in 2019) is the second report to be part of the WeBS Report Online. WeBS Alerts 2009/2010 (which uses data up to the 2010/11 winter and was published in 2013) was the first online Alerts report and can still be viewed by changing the report year option. Previous reports were published as written reports, many being available for download at: https://www.bto.org/our-science/publications/research-reports.

CORRESPONDENCE OF PROTECTED SITES WITH WeBS SITES

There is a high degree of correspondence between the boundaries of sites as monitored by the WeBS counter network and the boundaries of protected sites. Although some WeBS sites may extend beyond the boundaries of the protected sites, this is usually to incorporate adjoining land used by the waterbirds temporarily displaced from the site by disturbance or, in the case of coastal sites, by the rising tide (WeBS Core Count visits are coordinated to ensure synchronous counts corresponding to spring high tides). For surveying purposes, larger WeBS sites are subdivided into small manageable count sectors, which are counted synchronously by teams of fieldworkers. Therefore, for the small number of cases where the inclusion of counts for an entire WeBS site cannot be justified as representative of the numbers of waterbirds using the protected site, only data from relevant count sectors will be used.

Consequently, although there may be small differences in extent between the boundaries of WeBS sites and protected sites, this does not give cause to question the trends and any subsequent Alerts.

SPECIES CONSIDERED

The aim of the WeBS Alerts is to report on the site level trends of all waterbird species that are qualifying features of SPAs, SSSIs or ASSIs (i.e. the reason for which the site was designated). Lists of protected sites and their corresponding features were supplied by Department of Agriculture, Environment and Rural affairs (DAERA), Scottish Natural Heritage (SNH), National Resources Wales (NRW) and Natural England (NE).

Ideally, Alert status would be assessed for all species of waterbird for which sufficient time series data are available from the WeBS Core Counts. That said, whilst it is possible to undertake trend analysis for most wildfowl and wader species, there are certain groups of species, or aspects of site-specific usage by

particular species, for which meaningful analyses cannot be undertaken, or interpretation need to be taken with caution. For example:

- It is not possible to undertake these analyses for species that only ever occur in small numbers, such as Bittern or rarer grebes. Other species such as Grey Heron may fall into the category in a site-specific manner.
- It is not feasible to undertake trend analyses for species that only occur sporadically on a given site, for example, there are a number of SSSIs that are notified for Bewick's Swan, but on which this species may only occur intermittently e.g. in particularly harsh winters. Indeed there are a few examples of a feature never having been recorded during a WeBS Core Count visit.
- Although included as WeBS count species, certain species such as Moorhen, Snipe and Jack Snipe are considered too cryptic in behaviour for WeBS to generate meaningful trends at the site level. In the majority of cases, insufficient numbers of these species would be recorded to support a site trend anyway, but where an Alerts assessment has been made it should be interpreted with caution.
- Swans and geese are often associated with WeBS count sites by virtue of those sites being roosts, but during the day these species typically disperse from the roosts to forage in the wider countryside. Consequently, numbers recorded by WeBS observers during the daytime counts may be gross underestimates of numbers using the site, and furthermore be subject to fluctuation due to time of day, weather conditions and disturbance, to a greater extent than species that remain on site throughout the day. Consequently, we have not assessed Alert status for geese primarily using the sites for roosts and monitored preferentially by the Goose and Swan Monitoring Program including Greylag Goose, Greenland White-fronted Goose and Pink-footed Goose. We do assess Alert status for Brent Goose and European White-fronted Goose because they are recorded in representative numbers during the WeBS counts and for which WeBS is the preferential survey for monitoring populations. Exceptionally, roost counts have been substituted for daytime WeBS counts for Bewick's and Whooper Swans at three of their primary sites – the Ouse Washes, the Nene Washes and Martin Mere, three sites from which monthly roost counts are collated by WeBS.
- Sea-duck, divers, grebes and Cormorant counts recorded by WeBS observers at coastal sites may also be unrepresentative of numbers associated with a site due to variations in detectability under different sea-states or distance from shore both of which may be influenced by weather. Where the site trend for these species fluctuates Alerts will be accompanied by a note of caution.
- WeBS data are not considered suitable for monitoring breeding populations as they do not distinguish breeding individuals from the overall total. Furthermore, for some sites coverage outside the core September to March count season is less complete. It follows that Alerts cannot be assessed for summer migrants (Garganey, Little Ringed Plover and Common Sandpiper).
- Aside from breeding numbers, features may be designated for moulting flocks or passage numbers. In these cases, it may be that the abundance during the standard Alerts period is not related to abundance during these other periods. Nonetheless, these features may attract protection for the sites concerned throughout the year and so where data permits Alert status will be assessed using the standard non-breeding season. Where this is the case, any reported Alerts will be accompanied by a note of caution.
- The counting of gulls and terns is optional under the WeBS scheme. Consequently, counts may not be available, not be available across all sectors of a large site or the species may simply be recorded as present (with no count), the latter perhaps not unrelated to high numbers being present. For this reason, these species are not included in the WeBS Alerts process.

Alerts status is also assessed for the Waterbird Assemblage for a site where this is a notified feature.

Although Alert status can only apply to qualifying features of protected sites, nonetheless where feasible, analyses have also been undertaken for non-qualifying species. Although Alert status is not applied, where declines of over 25% and 50% occur for non-qualifying species these are highlighted light grey and dark grey respectively in the report outputs. Knowledge of trends for a wider suite of species, especially those that share similar habitat preferences or ecological requirements to a qualifying feature, can increase confidence in an observed change for a qualifying species, especially when close to the -25% or -50% threshold. Furthermore, they can provide context that may aid interpretation, for example, when a similar pattern occurs across a suite of species that share similar habitat preferences or ecological requirements to a qualifying feature, this may suggest that common, local, driving forces, underpin the change rather than a broad-scale species trend.

ANALYSES – TECHNICAL DETAILS

Smoothed Waterbird Trends and Percentage Change

As standard practise, WeBS characterises trends in waterbird abundance using an index based on the standard monthly WeBS Core Counts for the period September to March for all waterbirds other than waders, where November to March is used (Underhill & Prŷs-Jones 1994). For characterizing the numbers a site typically supports, WeBS routinely reports the "five-year mean peak", a value calculated as the average of the peak counts for each of five winters, although with some complexities associated with treatment of incomplete site coverage. For waterbirds, the five-year mean peak (presented in the Numbers and Trends pages of the WeBS annual report) for a given the baseline period is the metric associated with the identification of the majority qualifying features. The winter peaks are, however, less suitable for characterizing year on year changes as they are susceptible to missed survey visits and extreme observations due to atypical events such as severe weather or uncharacteristically high/low disturbance on survey days. Thus, when comparing numbers between years, it is more appropriate to use the annual index for a site (bird-months: i.e. the cumulative monthly count through the winter having imputed values for missing or compromised counts).

Furthermore, when calculating changes in waterbird abundance at a site, it is important to concentrate attention on the underlying trend rather than focus on actual annual index values. It is therefore appropriate to fit a smooth trend through the annual index values using a Generalized Additive Model (GAM). This smoothing ensures that winter-specific factors, such as poor conditions on the breeding grounds or particularly harsh weather on the wintering grounds, which are not related to changes in the quality of the site itself, do not contribute overly to the percentage change calculated over a given time period. Full details pertaining to the use of GAMs for the calculation of annual waterbird indices and the fitting of smoothed trend curves by the WeBS Alert system are available in Atkinson *et al.* (2006).

Alerts status

WeBS Alert status is assessed as percentage change on the smoothed abundance trend for short- (5yr) medium- (10yr) and long- (25yr) terms. Additionally, the percentage change is calculated since the mid-point of the baseline period (i.e. the period that site designation was based on). Baseline periods were provided by the country agencies for all SPAs but not for SSSIs/ASSIs. Consequently, the baseline comparison is currently available only for SPAs.

Declines in trend abundance of at least 25% but below 50% are flagged as medium-Alerts (coloured Amber), and declines of 50% or greater are flagged as high-Alerts (coloured Red). The percentage change in trend for non-features are calculated in the same manner but correspondingly large declines do not constitute a formal WeBS Alert and should be referenced as moderate- or substantial declines. Note the corresponding percentage change required to balance the numbers to their former level following a decline are likewise termed moderate (at least 33% but below 100%) and substantial (100% or greater) increases.

The percentage change in trend abundance is calculated with reference to the penultimate winter in the available time series (hereafter reference winter) chosen to avoid using the less reliable end-points of the smoothed abundance trend. By way of example, for the short-term percentage change relating to the reference winter 2016/17, the change between winter 2011/12 and 2016/17 and is calculated as

$$\text{Percentage change} = 100 \times ((W_{16/17} - W_{11/12}) / W_{11/12})$$

Where $W_{16/17}$ is the trend value for winter 2016/17 and $W_{11/12}$ is the trend value for winter 2011/12.

This is a standard practice when reporting trends using GAM analysis due to lower confidence in the first and last year of data included in the model.

Likewise the medium- and long-term percentage changes are expressed as changes from winter 2006/07 and winter 1991/92 respectively. Where data are not available across the long-term time series, the long-term percentage change has been calculated from the earliest available winter (given as "first year" in the table of Alerts). In a few cases it has been necessary to calculate change in abundance from the winter that a given species was first recorded on the site in question rather than the standard time period if the latter pre-dates the former (to avoid infinite increase).

Placing the Smoothed Waterbird Indices into Context

The trends for a given site are compared with those for broader regions to determine whether they are following those broader trends or not and so indicate whether any declines (or increases) are following or departing from those broad-scale trends (Banks & Austin 2004). Thus the comparisons between sites and regions are obtained from a logistic regression model with a binomial error term. The resulting plots depict the percentage contribution of numbers from the site to numbers across the broader region. The associated confidence limits represent both variation in this proportion between months in a given year and the underlying sample size. This is based on the winter period as routinely used for all WeBS reporting (Nov-Mar for waders and Sep-Mar for other species). Only data from months where counts across the site have been assessed as complete are used.

In general, if waterbird numbers of a given species on a given site follow those of the species across the broader region then the proportion contribution of numbers from the site would remain constant whereas deviation from a constant proportion would indicate that the species is faring either better or worse than would be expected from broader trend. This holds regardless of whether abundance on the site is increasing, stable or declining and so both the trend in abundance and trend in proportional contribution to the broader picture need to be considered together to come to a plausible explanation about why alerts may have been triggered (see Interpretation).

At the broadest scale, site trends are compared to either those of Great Britain or Northern Ireland. Within Great Britain further broad scale comparisons are made with finer level regions. The regions used for comparisons within Great Britain have been based on the Environment Agency (EA) regions or Scottish Environment Protection Agency (SEPA) areas, chosen because they are relevant to water resource

management and are well aligned to river catchments. The regions may therefore differ from similar names used in alternative context - for example, Wales the region does not correspond to Wales the country. Given its smaller geographic extent, Northern Ireland does not lend itself to being further sub-divided. In practice, it has been necessary to combine the Scottish regions and compare trends for Scottish sites to the whole of Scotland. However, when considering sites spanning regional borders (e.g. The Solway Flats and Marshes) neighbouring Scottish and English regions have been combined appropriately. Similarly, neighbouring Welsh and English regions have been combined for comparisons with the Severn Estuary and the Welsh Dee, and adjacent English regions have been combined for comparisons of sites lying between two regions (e.g. Humber Estuary). Boundaries of some of these EA and SEPA regions have been redefined/sub-divided since originally adopted by WeBS in 2003.

Map of WeBS Index/Alerts regions

SPECIFIC OUTPUTS FROM THE ANALYSIS

Table of Alerts

The table of Alerts presents the trend percentage change for each feature of the protected site over the various time periods.

First Winter

The column "First winter" refers to the start winter for the assessment of long-term change in abundance. In the current report, for larger protected sites corresponding to WeBS sites this will generally be winter 1991/92, assuming the site has been surveyed by WeBS from at least one winter prior to this. There are a number of exceptions to this general rule:

- Some sites, particularly inland or open coast may have a more recent long-term start winter having first been included in the WeBS Core Count scheme more recently. More commonly the case with SSSIs/ASSIs, where the protected site only partially covers a WeBS site, a later long-term start winter may result from absence of WeBS Core Count data held at a suitable sector level or from more recent sub-division of larger sites/sectors.
- The long-term assessment for non-features may vary between species as in some cases a species has colonised the site within the past 25 years. This is the case on some sites for Little Egret, Avocet and Black-tailed Godwit in particular. The long-term assessment is made from the year the species first established on the site (because an increase from zero would be infinity).

Reference Winter

The "Reference winter" is the winter for which the Alerts status is being reported. This is generally the penultimate winter of the time series (which ran to 2017/2018 at the time of analysis), and with few exceptions will be winter 2016/17. Exceptions to this general rule may occur because:

- No WeBS counts were obtained for the most recent winters. This is only an issue with smaller, generally inland, sites monitored by individual counters rather than teams.
- In the case of a feature that has disappeared from a site, the tabulated decrease will correctly be given for the expected reference winter as 100% in the table of Alerts. However, the reference year used for the trend plot will have been adjusted to the last year the feature occurred on the site (otherwise earlier year would have an index of infinity) so as to allow the trend to be represented.

Percentage Change over standard periods

Trend expressed as percentage change over the short-, medium- and long-terms, corresponding to 5, 10 and 25 year periods. Where the longest period available is <25 years then the percentage change over the long-term will be calculated on maximum period available. High-Alerts are colour-coded red, medium-Alerts colour-coded orange.

Baseline winter

Features of protected sites will generally have been notified based on a [normally] five-year mean peak count (WeBS data) known as the baseline. However, the WeBS Alerts analysis is based on change between two points on a modelled trend through the annual index. The baseline winter used to assess Alerts status is therefore taken as the middle winter of the baseline period, a value that will be close to the five-year mean peak of the baseline period but allowing change to be calculated using an approach consistent with that used for calculating percentage change over the other Alert periods. Although generally the case that

most features on a site will share their baseline period, this is not always the case. The baseline winter may therefore vary between features.

Baseline information was provided by DAERA, SNH, NRW and NE for SPAs. Note that equivalent information was unavailable for SSSIs/ASSIs.

Percentage Change since baseline

Trend expressed as percentage change since the baseline winter. In rare cases (typically small, inland sites), percentage change will not be reported for one of the terms. These cases correspond to gaps in survey coverage for the site in question across which the abundance trend will be less reliable.

Supplementary Table of non-features

This table presents the same information as the Table of Alerts but without the red/orange colour coding (instead using grey). This is to emphasise that the "moderate" or "substantial" declines identified by the percentage change do not constitute Alerts. As non-features a percentage change since baseline would not be a valid metric and so is not presented.

Plots

For each feature / protected site, a combination of plots is presented:

- The trend in abundance for the site
- The trend in abundance for the region (unless reporting a site in Northern Ireland)
- The trend for Northern Ireland or Great Britain as appropriate
- The abundance on the site as a proportion of the regional abundance (unless reporting a site in Northern Ireland)
- The abundance on the site as a proportion of the abundance in Northern Ireland or Great Britain as appropriate.

Interpretation

A commentary is provided for all features of all SPAs for which Alert status has been assessed together with a site overview. It has not been feasible to provide such commentaries for SSSIs/ASSIs. Consequently, the guidelines below are intended to both aid the understanding of the logic underpinning the commentaries for SPAs and provide a reference to aid stakeholders in making their own interpretations of Alert status for features of SSSIs/ASSIs.

Alerts are intended to identify where issues may exist that may require further investigation and research and may warrant precautionary measures to be taken in the meantime. Importantly, the calculations of percentage change in abundance and the flagging of medium- and high-Alerts provides evidence for notable declines in abundance on a site, but does not in itself indicate what pressures may be driving those declines. However, comparison of site trends with broader scale trends and between trends of other species on the site with similar habitat or other resource requirements or sensitivities can help elucidate whether declines of a given feature are likely being driven primarily by site-level pressures or part of a broader pattern and this in turn may guide the urgency with which further research is undertaken or whether site-level precautionary measures maybe warranted.

Consequently:

- where a decline on a site reflects a decline across the broader region it is likely that the observed site trend is being driven by a broadly acting pressure, such as climate change, rather than local pressures affecting that site alone, such as disturbance or habitat degradation.

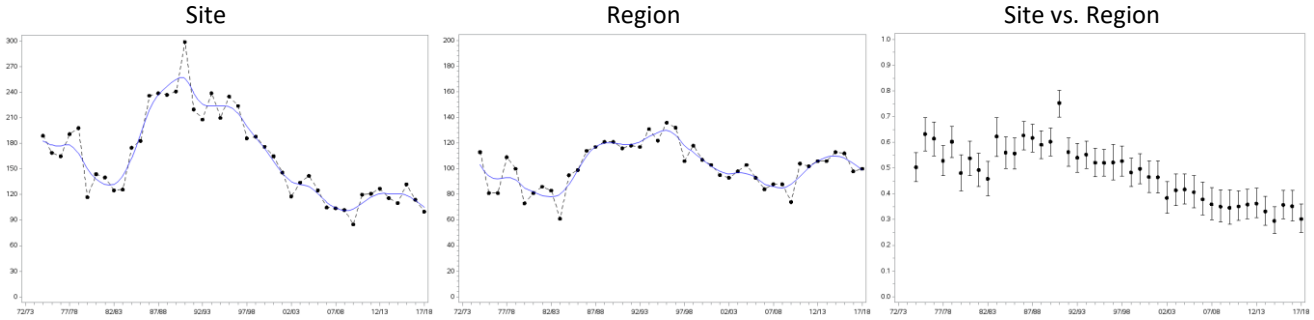
- where a decline on a site is more substantial than that across the region as a whole, this may suggest that observed site trend is being, at least in part driven by local pressures

- where a decline on a site is less marked than the decline across the broader scale, this suggests that relatively favourable conditions on that site are off-setting declines due to broad scale pressures and are helping to buffer those broader declines

- where an increase on a site is less marked than that across the broader region, this suggests that either the site is already at carrying capacity for the species in question or, if historically it supported greater numbers, that the quality of the site to that species has diminished

- where an increase on a site is greater than that across the broader region, this suggests that trends on that site are, at least in part, contributing to the broader scale increase

Example 1: Oystercatcher on the Exe Estuary SPA



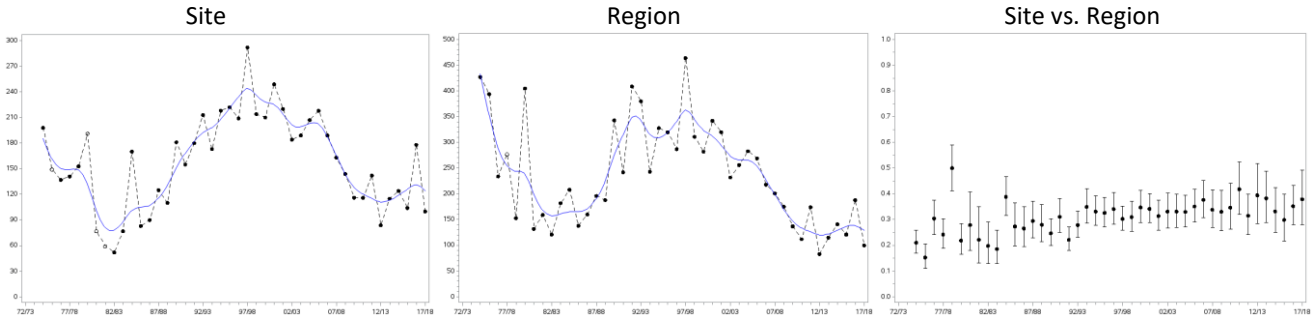
The first plot shows the year on year winter index (dots) and the smoothed trend (line) for the site. This clearly shows that there was a sustained decrease in abundance for just over a decade between the all-time high in the late 1980 and the turn of the century, but that since the turn of the century the underlying trend has remained relatively stable. Consequently, a long-term high-Alert has been triggered because of the substantial 53% decline from 1991/92 to 2016/17, but no Alerts have been triggered for the short- and medium-terms.

The second plot shows the year on year winter index and smoothed trend across the whole region – in this particular case the Southwest Region or, strictly speaking, across those sites in this region monitored by WeBS. This identifies that during the period of decline on the SPA the species was also declining across the southwest of England.

The third plot is the key to putting the trend on the site into context. A cursory comparison of the first and second plots might conclude that abundance of the site and region are following similar patterns. However, the statistical comparison of the SPA to the region indicated that the abundance of Oystercatchers on the SPA was declining more rapidly than those across the region. During this period the there was a consistent

winter on winter reduction in the proportion of Oystercatchers in southwest England that occurred on the Exe Estuary SPA, falling from around 60% to around 35%. Because of the relative importance of this site, the decline on the SPA would have been a major contributor to the regional decline. At best, this proportion has remained at this level since, if not continuing to fall even further. Consequently, although there have been no notable changes in abundance on the Exe Estuary SPA in the short- or medium-terms, the importance of the site remain much lower in the regional context that it has been in the past and maybe not fully realising the turn-around apparent across the region. This may suggest that the decline in Oystercatcher abundance underpinning the Alert has been driven, at least in part, by local pressures.

Example 2: Lapwing on the Firth of Forth SPA

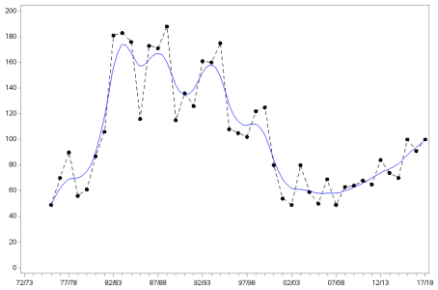


The trend in Lapwing abundance on the Firth of Forth SPA displays similar ups and downs to those for Oystercatcher on the Exe Estuary SPA region. In this case Lapwing abundance increase consistently from an all-time low in the early 1980s to an all-time high in the mid to late 1990s. Thereafter there was a consistent decline for the next decade, with a levelling out in more recent winters. A consequence of Lapwing abundance stabilising at a relatively low level over the shorter-term, has been that no Alert has been trigger for the short-term but medium-Alerts have been triggered for the medium- and long-terms.

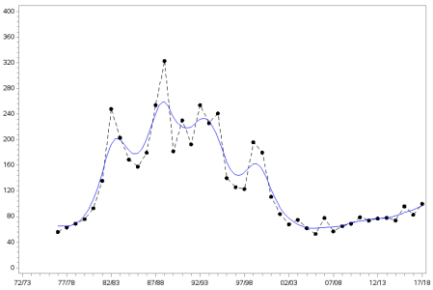
The pattern of change across the broader region, in this case the overall trend for Scotland, shows a similar pattern, and indeed the direct comparison confirms this. In fact throughout the period for which data are available the proportion of the regional numbers occurring on the SPA has remained consistent at between about 20% and 30% with a suggestion of long-term increase. So although the abundance of Lapwing has shown increases and decreases over time and Alerts have been triggered in the medium- and long-terms, unlike the previous example abundance on the SPA appears to have been tracking broader-scale changes and so is unlikely to have been driven by local pressures. This is not to say that local pressures are not influencing Lapwing abundance on the site but rather that the influence of any local pressures is dwarfed by broader-scale pressures. It may still be the case that were known local pressures to be moderated, Lapwing abundance on the site could increase towards former levels and counter-balance declines on other SPAs in the region.

Example 3: Purple Sandpiper on Northumbria Coast SPA

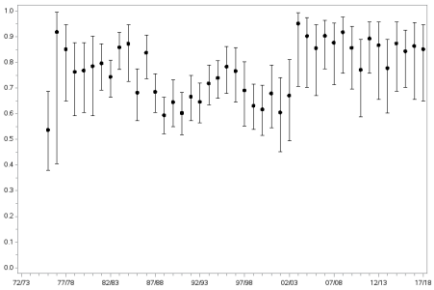
Site



Region



Site vs. Region

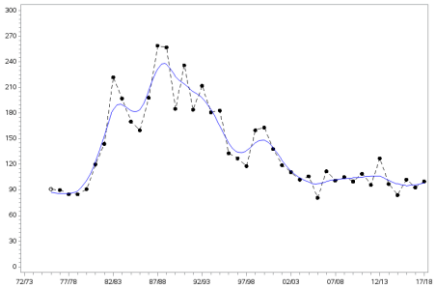


The trend in abundance of Purple Sandpiper on the Northumbria Coast SPA has fluctuated over time but the underlying trend has been one of accelerating decline throughout the 1980s and 1990s, followed by a period of relative stability and, more recently, the beginning of a gradual but sustained increase. Despite the recent increase, abundance is still relatively low compared to levels in the 1990s and consequently a long-term medium-Alert has been triggered.

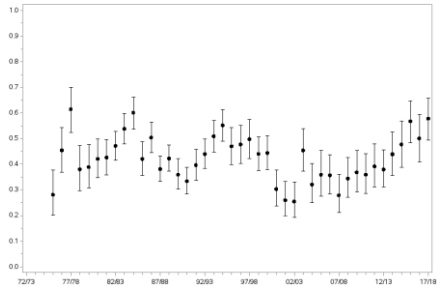
The regional trend, in this case that for Northeast England, is reasonably similar. This is not surprising given that the proportion of Purple Sandpiper in the Northeast of England that occur on the Northumbria Coast SPA has rarely dropped below 60% and has generally exceeded 80% since the turn of the century. Consequently, changes on the SPA are the principal contributor to those for the region. It is also apparent that the recovery in abundance during the past decade has not been mirrored elsewhere along the Northeast of England coast, emphasising the importance of this protected site to Purple Sandpiper.

More so than in the previous two examples, in this case it is also worth considering the comparison to the overall trend for Great Britain, the Northumbria Coast SPA appears to support a substantial proportion of Purple Sandpiper over-wintering in Great Britain, or at least over-wintering on sites monitored by WeBS (between 20% and 60%). However, consideration should be given that this is a species that occurs on the non-estuarine coast that is less well monitored by WeBS (with more data available from the Non-Estuarine Waterbird Survey, accessible via another tab in the WeBS Report Online).

Great Britain



Site vs. Great Britain



The trend for Great Britain is similar to that for Northeast England other than there is no hint of increase since the turn of the century. Furthermore it is apparent that the Northumbria Coast SPA has been steadily increasing in importance to Purple Sandpiper over this same period indicating that numbers elsewhere have not recovered to the same extent.

For a species with clearly delineated habitat preferences like Purple Sandpiper, it is also worth considering other species on the site with similar preferences. It is no surprise to find that similar patterns are apparent

for both Turnstone and Ringed Plover and similar Alerts have been triggered for Turnstone (the declines over similar periods for Ringed Plover do not constitute Alerts as the species is not an SPA feature).

References

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