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Communal roost counts in the Netherlands: a summary of 10 years of monitoring

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Abstract. Communal roost counts are a useful tool for national and site-based monitoring of bird populations during the non-breeding period, particularly in situations when birds disperse widely during the day to forage and are hard to count at that time. Within the Dutch application of the European Bird Directive, specific numeric goals are set for 19 species in the Netherlands to safeguard their communal roosts in protected areas and populations in surrounding areas that depend on these roosts. Since the start of our national Communal Roost Census in 2009, we have greatly increased our knowledge of locations of roosts and the numbers they hold, particularly (but not only) in Bird Directive sites. Based on our experience from 10 years of monitoring, we discuss advantages and drawbacks of roost counts and share examples from Great Egret and Caspian Tern counts.

Introduction

Approximately 135 bird species make use of communal roosting sites in the Netherlands, including species that only roost socially at high tide (van den Bremer *et al.* 2008). There have been a great number of 'grey' publications dealing with this aspect of avian life history, mostly focusing on single species counts within a well-defined region during one or multiple seasons, often combined with a description of ecological aspects of communal roosting (e.g. Kleefstra 2010, Wymenga *et al.* 2013, Altenburg & van Horssen 2018). Here, we give a synopsis of the systematic, annual counts of communal roosts that have taken place since the winter season of 2009/10, as part of the Dutch Communal Roost Census.

In the Netherlands, Natura 2000 sites have been assigned under the EU Bird Directive for breeding, migrating/wintering and roosting birds. This means that any potential disturbance (e.g. changes in water level management, recreation, new infrastructure for transport or energy) for roosting birds in these areas needs prior research into possible consequences. For this purpose, numeric goals have been formulated for most species-area combinations, based on known numbers from available water bird and roost counts during the period 2008–2012 (van Kleunen *et al*. 2017). These are used as a reference, and compared with the results from counts that are carried out as part of the Dutch Communal Roost Census. Currently, 53 Natura 2000 sites have been assigned a communal roost function for 19 species (Table 1). Mostly, these concern large wetlands and species that are important in an international context. As a secondary goal of the census, roosts for other species and outside Natura 2000 sites are also gathered. These may after all affect the communal roost function of Natura 2000 sites or they may be used as a guideline for future designation of complementary sites.

Apart from this site-specific monitoring, for some species also the national trend of the non-breeding population is assessed using communal roost counts, instead of using counts of foraging birds made during the day, such as under the Dutch Wetland Bird Census (Hornman *et al.* 2019). With roost counts, a larger proportion of the population can be counted with a much more limited time investment. This concerns species that are restricted to a specific habitat, that are relatively scarce and show a strong, seasonal peak in occurrence or roost in large numbers in a limited number of locations: Caspian Tern *Hydroprogne caspia*, Gull-billed Tern *Gelochelidon nilotica*, Black Tern *Chlidonias niger*, Common Crane *Grus grus,* Ruff *Philomachus pugnax* and Black-tailed Godwit *Limosa limosa*. For the latter two species, a combination of non-overlapping wetland and roost counts is used to calculate a national trend (van Els *et al.* 2020). Roost counts are also suitable for more common species that forage in widely scattered locations in farmland (outside large

Table 1. Target species of the Dutch National Communal Roost Census and number of Bird Directive areas designated as roost sites for these species.

Species	Areas (n)
Eurasian Cormorant *Phalacrocorax carbo*	13
Great Egret *Ardea alba*	4
Bewick's Swan *Cygnus columbianus*	19
Whooper Swan *Cygnus cygnus*	4
Taiga Bean Goose *Anser fabalis*	3
Tundra Bean Goose *Anser serrirostris*	12
Pink-footed Goose *Anser brachyrhynchus*	4
Greater White-fronted Goose *Anser albifrons*	28
Lesser White-fronted Goose *Anser erythropus*	3
Graylag Goose *Anser anser*	27
Barnacle Goose *Branta leucopsis*	24
Brent Goose *Branta bernicla*	6
Eurasian Crane *Grus grus*	3
Eurasian Oystercatcher *Haematopus ostralegus*	1
Ruff *Philomachus pugnax*	5
Black-tailed Godwit *Limosa limosa*	19
Eurasian Curlew *Numenius arquata*	6
Caspian Tern *Hydroprogne caspia*	3
Black Tern *Chlidonias niger*	3

wetlands) during the daytime and are therefore difficult to assess completely using traditional water bird counts, such as Great Egret *Ardea alba*, and Great Cormorant *Phalacrocorax carbo*.

Methods

To be able to count total numbers of roosting birds accurately, it is desirable to perform counts simultaneously at a regional or national level. For the Dutch Communal Roost Census (Fig. 1), two or three counts are organized within species-specific time windows per year since 2009 (and, for some species, outside of the framework of the Roost Census before that time). Time windows coincide with the peak occurrence of each particular species, and consist of a period of two weeks around a single preference date, to offer some flexibility to observers, and offer the possibility to combine the roost count with the mid-monthly wetland count. Two to three one-hour counts per year per site form a compromise between capturing some of the (large) fluctuations in numbers through time and attracting a sufficient number of volunteer observers. Of course, more counts per roost during the year are encouraged. During a time window, multiple species may be counted, that simultaneously have a peak in their occurrence (e.g. Eurasian Oystercatcher *Haematopus ostralegus*, Ruff *Calidris pugnax* and Black-tailed Godwit; Eurasian Cormorant and Great Egret). Roosts of several species (e.g. Great Egret, geese, terns) persist for many years, so that search time is reduced to a minimum, but other species are more capricious in their use of roosts (e.g. Starling *Sturnus vulgaris*, hirundines) and require more effort. New roosts can be found opportunistically, or by searching for promising locations based on the ecology of different species, always keeping in mind that predation and disturbance-free locations are most attractive. For several species (e.g. Great Cormorant, herons and egrets, geese, Crane), sheltered water bodies with or without woody vegetation are suitable, others frequent sand bars and islets (e.g. terns, waders), or isolated groups of trees (e.g. crows, pigeons), and some are decidedly picky: migrating swallows almost exclusively roost in reed beds. The Dutch Communal Roost Census database holds information on all known roosts; roosts that are no longer used or roosts that have become unavailable due to e.g. tree cutting are marked as unused, but may be used again in the future.

Out of two to three counts per year for each species, the highest number is used as a seasonal maximum per roost. Because numbers fluctuate at roosts, maxima are better representations of true numbers than means. This way of working has a few limitations; because roost counts are a snapshot in time, it is possible that the highest numbers are missed. This results in fairly large effects of chance in count results, so it will take longer before trends are detected at site level (Kleefstra 2010, Altenburg & van Horssen 2018), although preliminary statistical exploration indicates these chance effects do not hinder trend development. In addition, peak occurrence of particular species do not occur simultaneously everywhere in a country (Altenburg & van Horssen 2018). Traditionally, large nature reserves have been an obstacle to bird counts, but simultaneous counts (by sometimes >10 counters) of locally roosting birds offer a solution for this problem. Many roosts regularly move geographically and at the moment of counting (usually around dusk), so there may not be time to visit or search for another location. Another issue is counters only reporting positive numbers, leading to a lack of null counts. If null counts happen

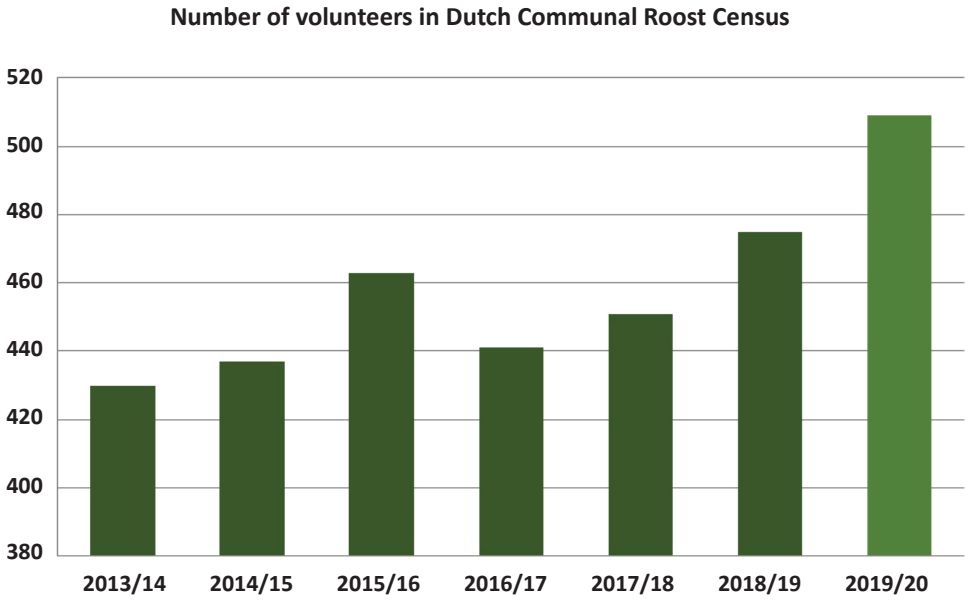

Figure 1. Number of participants in Dutch Communal Roost Census by year.

repeatedly, the motivation to count decreases, even though numbers at roosts fluctuate naturally. For these reasons, roost counts are sometimes incomplete, especially in large areas that consist of a network of multiple smaller roosts. However, the advantages of capturing large numbers of birds during a relatively small time interval generally outweigh the disadvantages and there are workaround solutions for incomplete counts. A post-hoc correction is applied by imputing numbers on known roosts that were not counted. Missing values are imputed according to a multiplicative model of site, year, and month factors in UINDEX (Underhill & Prŷs-Jones 1995). Imputing is only applied and used when there is a predefined minimum amount of count data available.

Case examples of roost counts: Great Egret and Caspian Tern

Great Egret *Ardea alba*

With over 11,000 counts since the inception of the National Roost Census, the Great Egret is the most frequently counted species. This is also evident from the geographic spread of counts (Fig 2a); there are only a few areas in the Netherlands that lack roost counts of the species. The near-absence of Great Egrets on the sandy soils in the eastern half of the country is genuine. Roosts are generally found in and around all sorts of sheltered water bodies. Because roosts tend to be compact and birds are easily counted because of their conspicuous coloration, few observers are generally needed. The largest roosts are found in the river Rhine basin, in the western polders and around Lake IJsselmeer and the lake-district in the north of the country. These are all areas where the species has always been numerous, ever since the explosive spread of the species across the country. The median number of birds per roost is 12 (1st–3rd quantile: 5–27). Roost counts have resulted in 30% higher totals of the species compared to the results from the Wetland Bird Survey, because birds foraging in agricultural areas are not well represented in these counts (Klaassen 2012).

Caspian Tern *Hydroprogne caspia*

In the Netherlands, the Caspian Tern occurs only for a very short period during migration (Fig. 2b, 3). Numbers are higher during mid-August through the beginning of September than during April and May, so simultaneous roost counts with >20 count participants nationwide are organised during three days in late summer. The species often forages individually during the day over large water bodies, where they range widely, so that roost counts are the ideal way to monitor the species. The largest roosts are found on sand bars near the shores of Lake IJsselmeer. Numbers of the Caspian Tern have increased steadily during

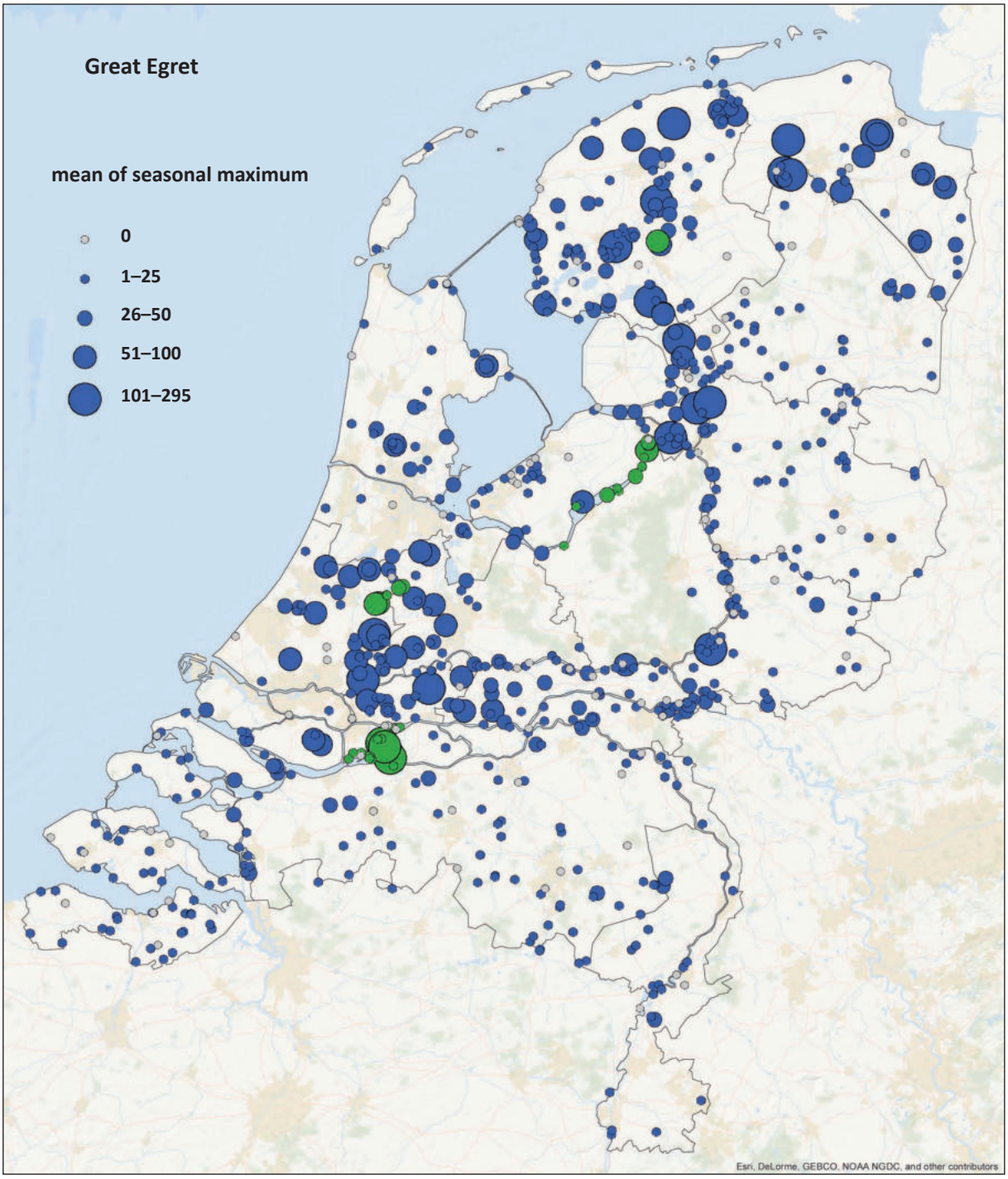

Figure 2a. Distribution and size (mean of seasonal maximum counts, 2009–17) of communal roosts in the Netherlands of Great Egret. Green symbols refer to sites with a specific target for communally roosting birds, blue symbols are outside the Natura 2000-network or are without targets for roosting birds.

the last decade, from >10 individuals in the 1980s to on average >100 individuals in the last decade. This contrasts with the trend of breeding pairs in the Baltic, which decreased for long and has now stabilized (Eskildsen & Vikstrøm 2011), and could indicate a change in migratory route. In general, Caspian Tern roosts are small, with a mean of 8 (3–18) individuals. A challenge in counting roosts of the species is that Caspian Terns frequently change roost sites due to varying water levels. The enthusiasm of volunteer counters to track these every time makes up for this, however.

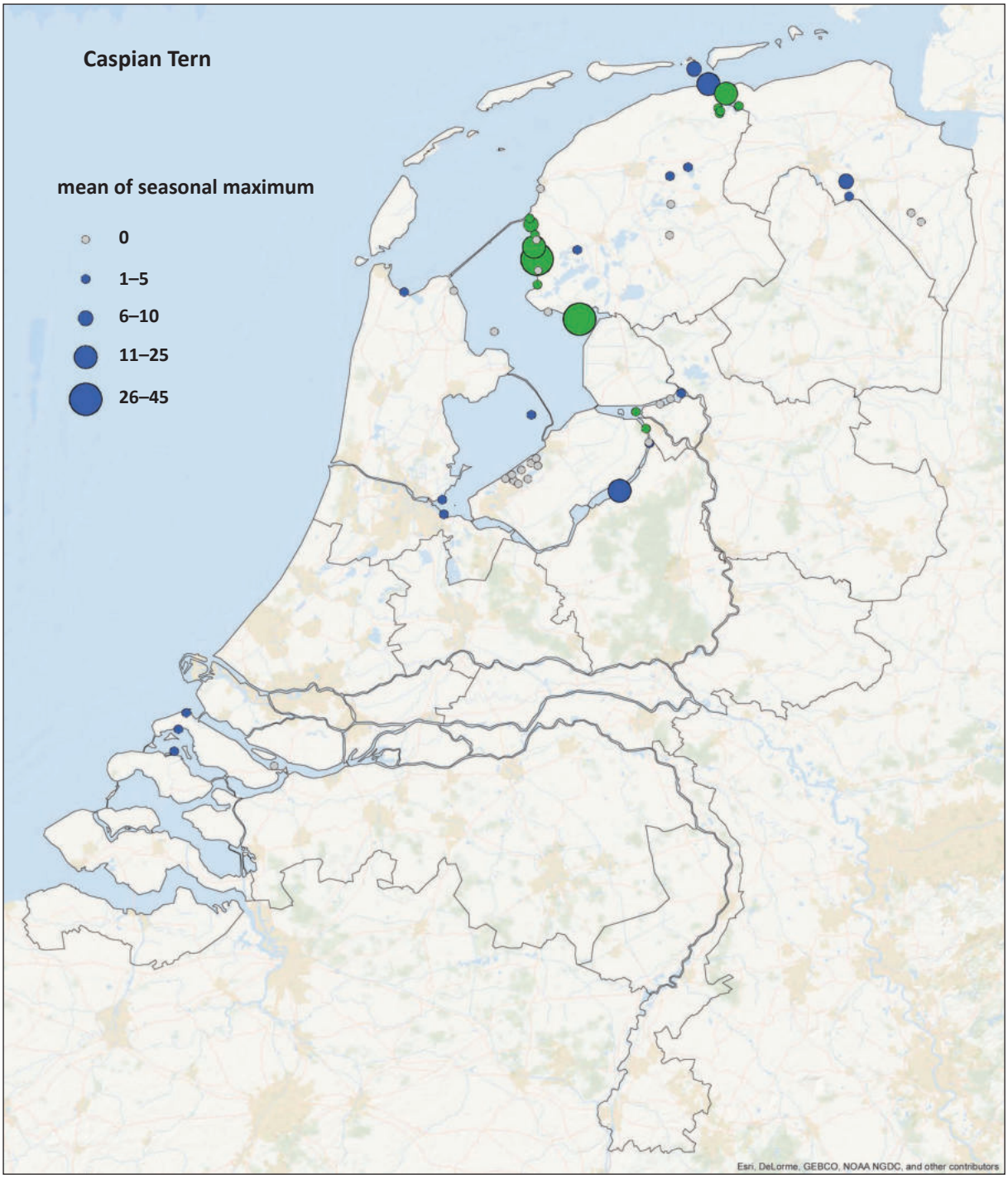

Figure 2b. Distribution and size (mean of seasonal maximum counts, 2009–17) of communal roosts in the Netherlands of Caspian Tern. Green symbols refer to sites with a specific target for communally roosting birds, blue symbols are outside the Natura 2000-network or are without targets for roosting birds.

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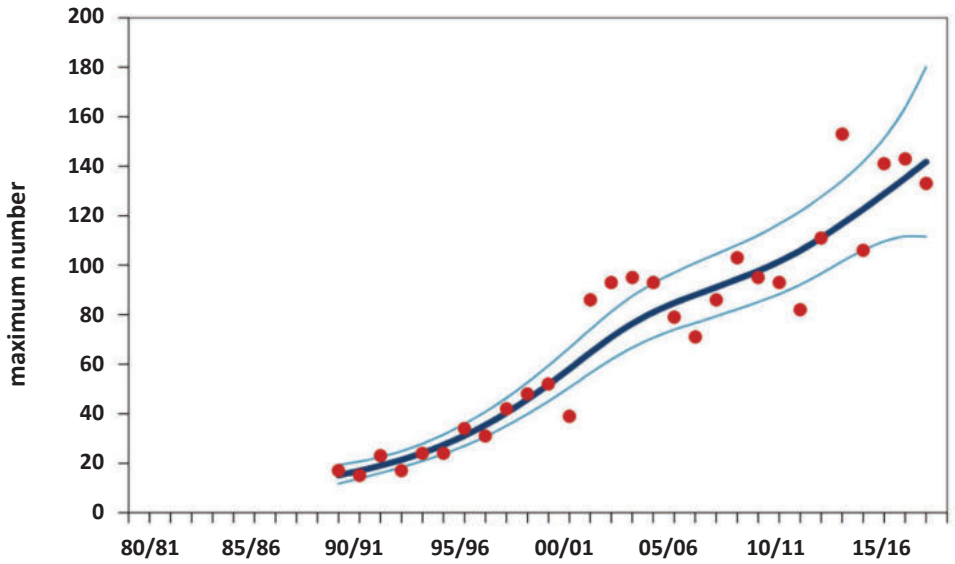

Figure 3. Trends in seasonal maximum counts of Caspian Tern. The dark blue line represents the trend, light blue lines indicate confidence intervals and red dots are individual seasonal maximum counts.

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