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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 4-2: Assessment of Historical Data from Thanet OWF in comparison to more recent Thanet Extension Data

June, 2018, Revision A

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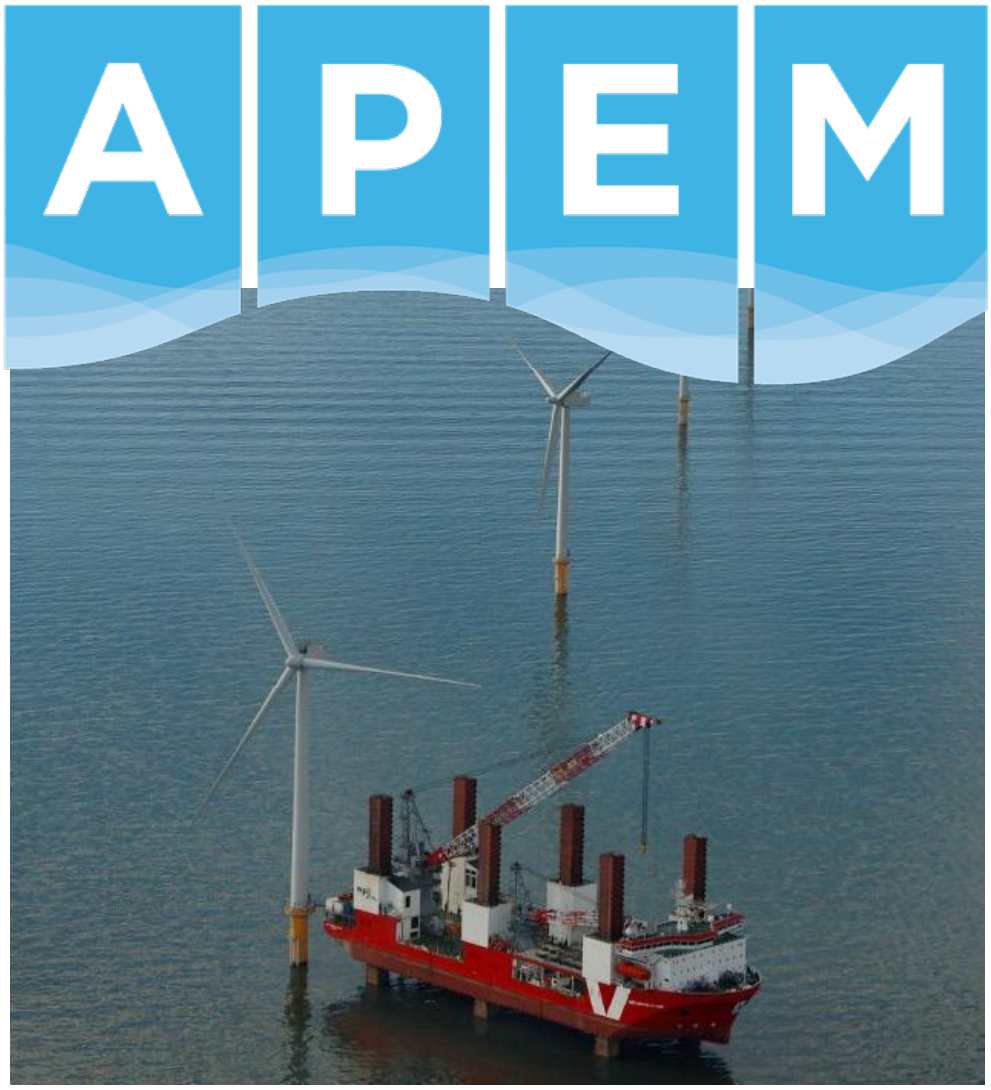
June, 2018

Drafted By:	APEM
Approved By:	Helen Jameson
Date of Approval	June 2018
Revision	A



Thanet Extension Environmental Statement

Volume 4, Chapter 4, Annex 2

Assessment of Historical Data from Thanet OWF in comparison to more recent Thanet Extension Data

Vattenfall Wind Power Ltd

APEM Ref: P1988a

June 2018

Sean Sweeney, Dr Roger Buisson, Dr Stephanie McGovern and Scott Reid

Client:	**Vattenfall Wind Power Ltd**
Address:	**1 Tudor Street**
	London
	EC4Y 0AH
Project reference:	**P1988a**
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Project Director:	**Dr Roger Buisson**
Project Manager:	**Sean Sweeney**
Other:	Dr Stephanie McGovern and Scott Reid

APEM Ltd
Riverview
A17 Embankment Business Park
Heaton Mersey
Stockport
SK4 3GN

Tel: 0161 442 8938
Fax: 0161 432 6083

Registered in England No. 02530851

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Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.0	18/01/2018	All	All	Draft Template Created	SS
1.1	26/01/2018	All	All	Data & Draft Text	SR
1.2	07/02/2018	All	All	Review & Additional text	SS
1.3	09/02/2018	All	All	Review prior to issue to client	RB
1.4	13/02/2018	All	All	Final amends prior to issue to client	SS
2.0	10/04/2018	All	All	Amends post client review & additional data	SS
2.1	30/05/2018	All	All	Client review	JKL
2.2	01/06/2018	All	All	Revisions to address client comments	RB
2.3	05/06/2018	All	All	FINAL VERSION	SS

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1. Introduction

1.1 Background

Vattenfall Wind Power Ltd (VWPL) is committed to undertaking an Environmental Impact Assessment (EIA) that provides the detailed level of baseline data needed to inform a robust assessment of the potential impacts of the proposed Thanet Extension Offshore Wind Farm (Thanet Extension) on birds. VWPL is also committed to consultation with stakeholders about the data gathering, data analysis and impact assessment, with that consultation formalised through the Nationally Significant Infrastructure Project (NSIP) Evidence Plan process. The offshore ornithology baseline technical report (APEM, 2017), that informed the Preliminary Environmental Information Report (PEIR), included data from the boat-based surveys (three months between January and March 2016) and aerial digital surveys (13 months between January 2016 and March 2017). That baseline technical report has been subject to consultation with stakeholders as part of consultation on the PEIR. Responses to this report received from Natural England and the RSPB (through the Section 42 consultation responses and during Expert Topic Group meetings as part of the Evidence Plan process) was that it would be useful to see a comparison of the information on seabird occurrence from the surveys contracted for the proposed Thanet Extension with the historic survey data collected for Thanet Offshore Wind Farm (Thanet). The historic survey data includes that from the baseline and post consent monitoring (pre-, during and post-construction) programmes. It should be noted that Natural England and RPSB both expressed a preference for a full 24 month period of data to be used in the EIA process.

This report details how, in response to the consultation process, information on seabird occurrence in and around the Thanet and Thanet Extension sites (across the years for which data has been collected) have been analysed and compared to determine whether observed patterns in the fluctuation of seabird densities remains relatively consistent across the years and through seasons.

There is a considerable amount of data available on bird activity and abundance from the area within and around Thanet collected in the pre-application and post-consent (pre-, during and post-construction) phases (Table 1) and Percival (2015).

In addition, APEM completed monthly aerial digital surveys of the Survey Area (which includes Thanet, Thanet Extension and a 4 km buffer) (Figure 1) to provide information on the abundance, distribution and behaviour of birds and marine mammals. This survey programme finished in February 2018, with a total of 24 months of data available for site characterisation in the revised baseline technical report for the ES Chapter and subsequent assessment of impacts on seabirds for the EIA.

Prior to the aerial digital surveys commencing three months of boat-based surveys collected data between January and March 2016, inclusive, which are also described in this report.

Detailed studies of bird flight activity and abundance have been undertaken at Thanet, as a consequence of the Offshore Renewable Joint Industry Programme's (ORJIP) bird collision avoidance study. The report and data from that project was recently published (Skov *et al*., 2018), but the results have not been used to inform this report.

Table 1 Historic and Future Offshore Ornithology Reports/data on Thanet and Thanet Extension available for use in a comparative analysis

Data source	Report Date	Type	Report
1	November 2008	Environmental Statement	Chapter 8 Ornithology
2			Appendix 8.1 Proposed Thanet Offshore Wind Farm Aerial and Boat Based Surveys: Methodologies, results and statistical analysis (Royal HaskoningDHV)
3			Appendix 8.2 Bird Collision Risk Assessment (Royal HaskoningDHV)
4	February 2009	Monitoring Protocol	Thanet Offshore Wind Farm During and Post-construction Bird Monitoring Protocol (Royal HaskoningDHV)
5	October 2009	Annual Report (pre-construction)	Thanet Offshore Wind Farm Annual Ornithological Monitoring Report 2009 survey season (Royal HaskoningDHV)
6	July 2010	Annual Report (construction)	Thanet Offshore Wind Farm Annual Ornithological Monitoring Report (During Construction) 2009-2010 (Royal HaskoningDHV)
7	March 2012	Annual Report (post-construction Year 1)	Thanet Offshore Wind Farm Ornithological Monitoring 2010-2011 (Royal HaskoningDHV)
8	June 2012	Annual Report (post-construction Year 2)	Thanet Offshore Wind Farm Ornithological Monitoring 2011-2012 (Royal HaskoningDHV)
9	June 2013	Annual Report (post-construction Year 3)	Thanet Offshore Wind Farm Ornithological Monitoring 2012-2013 (Royal HaskoningDHV)
10	January 2016	Data Report	Three months data from boat surveys Thanet Extension (APEM)
11	April 2017	Annual Report Year 1 Baseline	Thanet Extension 12 month report from Aerial Digital Surveys (APEM)
12	Unpublished	Year 2 Aerial Digital Data	Data from APEM Aerial Digital Surveys between March 2017 and February 2018 (12 months) (APEM, as yet unpublished data)
13	April 2018	Monitoring Report	ORJIP Bird Collision Avoidance Study (Skov., *et al*)

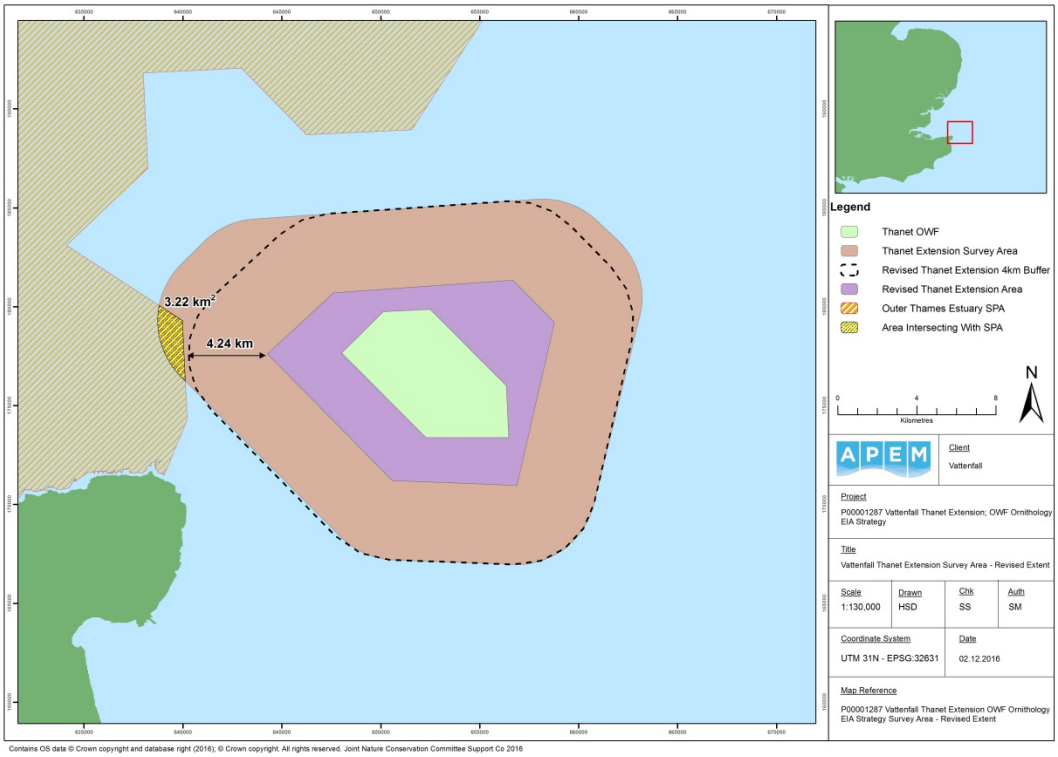

Figure 1 Location of the revised Thanet Extension aerial digital survey areas (PEIR site), including the current operational Thanet (shown in green), the proposed Thanet Extension (shown in purple) and the outer limit of the survey area (shown in brown), which includes the Thanet Extension 4 km buffer (black dotted line).

1.2 Data Analysis Methodology

The survey methodologies and survey areas differed across the different years that data has been collected. As a result this analysis applies a comparison of seabird densities, rather than abundances, since that accounts for the variation in areas surveyed.

Much of the survey effort to inform impact assessments, post-consent monitoring surveys and marine designations within the southern North Sea has focussed on seabirds in the non-breeding period. The emphasis on surveys in the winter period at Thanet and Thanet Extension is as a result of decisions made as part of the consent for the former project, whereby the post-consent monitoring programmes were carried out to reflect the key sensitive ornithological receptor – non-breeding red-throated divers, an interest feature of the nearby Outer Thames Estuary Special Protection Area. As a result there is not a substantive data set from which to make comparisons of bird densities in the breeding season and an analysis for that season has not been carried out.

This assessment methodology takes a qualitative approach to the seabird density data obtained from the boat-based and aerial digital surveys. Estimated densities recorded at monthly intervals per non-breeding period for both boat-based and aerial digital surveys are plotted on graphs for each of the key non-breeding period species for which an account is provided in Section 2.

The key species for the non-breeding period are;

- Red-throated diver;
- Gannet;
- Kittiwake;
- Herring gull;
- Great black-backed gull;
- Lesser black-backed gull;
- Razorbill; and
- Guillemot.

Information on seabird densities by month is provided to illustrate how seabird occurrence differs across non-breeding periods as well as within each individual period. Any patterns and / or trends in the data sets provide evidence that indicates whether the variations in density remain relatively consistent within and between non-breeding periods for each species.

The data sets that have been used for the analysis are listed in Table 2.

Table 2 Historic and Recent Offshore Ornithology data sets from Thanet and Thanet Extension used in analysis

Survey Site	Method	Winter Period (Oct to Mar)	Short-hand Survey Programme Reference	Densities Available
Thanet	Pre-construction boat-based surveys	2004/05	Pre-1	Yes
		2005/06	Pre-2	
		Mean of 2004/05 & 2005/06	Mean Pre - Thanet	Yes
Thanet	Construction boat-based surveys	2009/10	Construction	Yes
Thanet	Post construction boat-based surveys	2010/11	Post-1	Yes
		2011/12	Post-2	
		2012/13	Post-3	
		Mean of 2010/11, 2011/12 & 2012/13	Mean Post - Thanet	Yes
Thanet & Thanet Extension	Baseline aerial digital surveys	2015/16	Winter 1 – Aerial	Limited (March only)
	Baseline boat-based surveys	2015/16	Winter 1 – Boat	Limited (Jan to Mar only)
Thanet & Thanet Extension	Baseline aerial digital surveys	2016/17	Winter 2 – Aerial	Yes
Thanet & Thanet Extension	Baseline aerial digital surveys	2017/18	Winter 3 - Aerial	Oct to Feb

Each species account in Section 2 presents in graphical form and discusses a comparison within and between:

1. The boat-based surveys conducted as part of the post-consent monitoring programme, that is pre-, during- and post-construction; and
2. The boat-based and aerial digital surveys conducted as part of the gathering of baseline information for the Thanet Extension project.

There were a number of occasions during the post-consent monitoring programme where there was more than one boat-based survey carried out (Royal HaskoningDHV, 2013). In those months the graphs present the mean density values for that month.

The species accounts consider monthly species occurrence in the context of the bio-seasons defined in Furness 2015.

The legends in the figures that accompany each species account identify the name of the individual survey data set in short-hand form and this short-hand is explained in column four of Table 2.

Appendix 1 provides scatter graph plots of the Thanet post-consent monitoring (boat-based) surveys and shows, in the case of multiple surveys in same month, the individual survey densities and hence the range of densities that occurred.

2. Species Accounts

2.1 Red-throated diver

Red-throated divers were consistently recorded in low densities throughout the Thanet post-consent monitoring surveys (Figure 2). The densities recorded were lower than all the other key species included within this report and within the impact assessment for Thanet Extension. The general pattern of species occurrence was to increase from no birds being present in October through to peak densities in either January (winter bio-season), February or March (spring migration bio-season). The densities remain fairly consistent across each survey programme between December and March (between 0.1 and 0.4 birds/km^2), though the peak densities were of approx. 0.7 and 1.1 birds/km^2 in January and February, respectively. With regard to the maximum density recorded in any individual survey (see Appendix 1) red-throated divers also peaked in January and February.

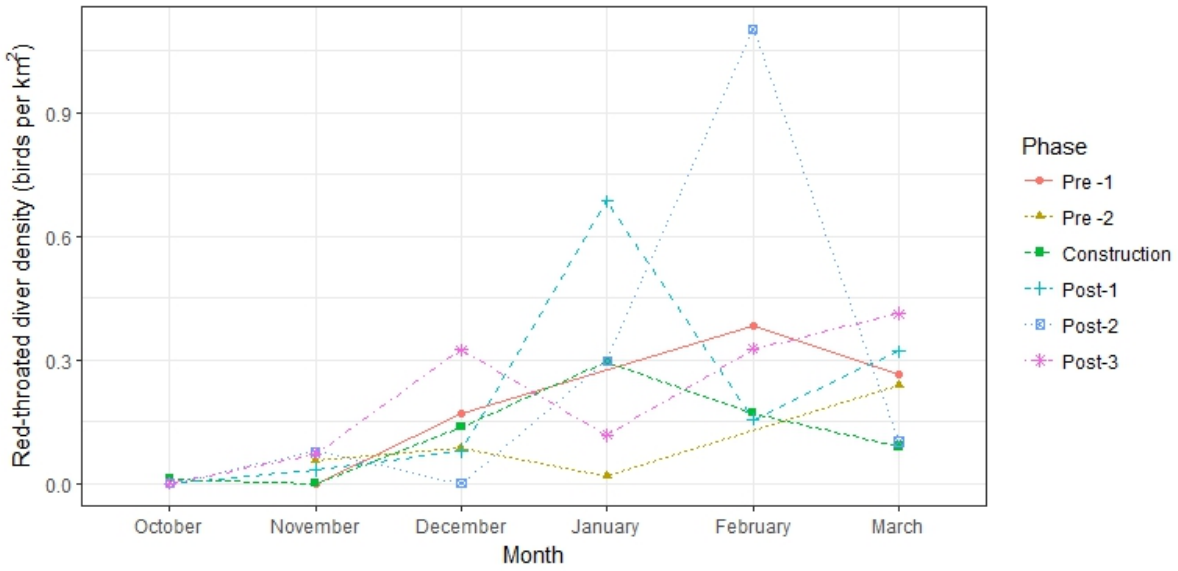

Figure 2 Red-throated diver densities from historic Thanet boat-based data.

Red-throated divers were also consistently recorded in relatively low densities throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 3) compared to the other key species included in this report. The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are generally consistent with those collected during the Thanet post-consent monitoring programme. That is no birds were recorded in October followed by increasing densities through from November to March, peaking in January or February (>1 birds/km^2).

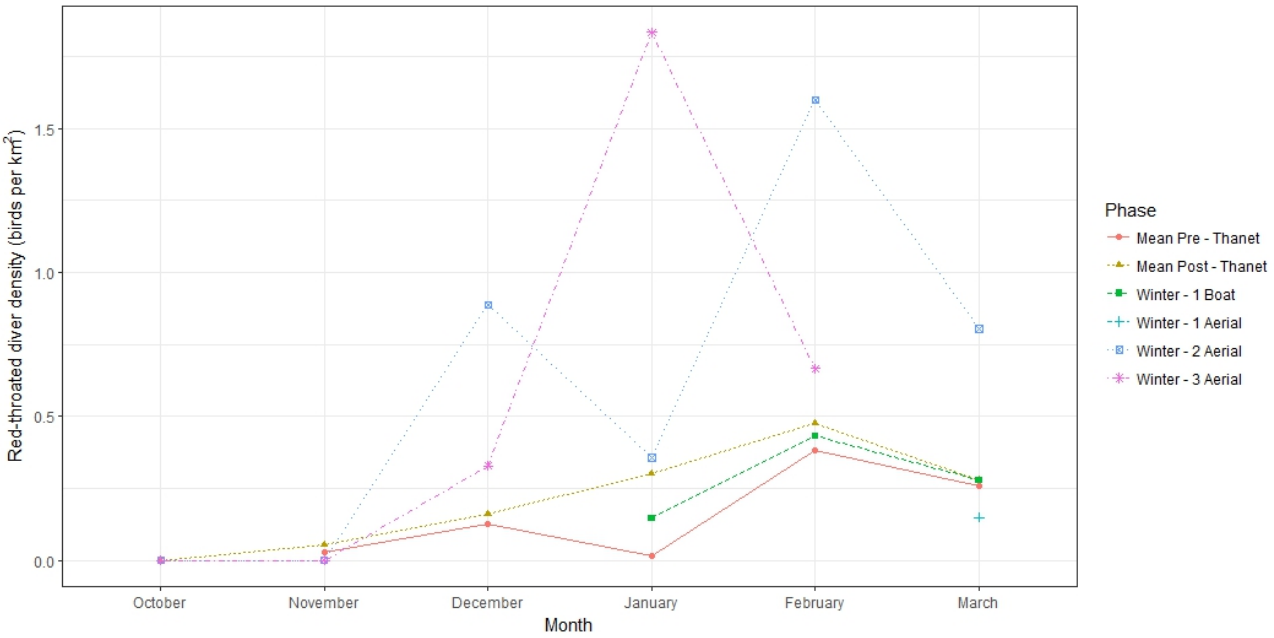

Figure 3 Red-throated diver densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

Overall the aerial digital survey data contributes density values that are higher than most individual counts derived from boat-based surveys (Appendix 1), although they do follow the general pattern of abundance across the non-breeding season, with peak densities in January and February. When comparing aerial digital survey data with boat-based data for red-throated diver consideration has to be given for the potential for the boat-based data to underestimate red-throated diver presence since they may be flushed ahead of the survey boat and not be recorded in the transect (Camphuysen *et al*., 2004). However this was accounted for in the boat-based survey method applied with a third observer looking forward to count divers in advance of any being flushed (Royal HaskoningDHV, 2011).

2.2 Gannet

Gannets were recorded throughout the Thanet post-consent monitoring surveys (Figure 4) with a relatively consistent pattern of seasonal occurrence. The species generally occurred in highest densities in November during the non-breeding autumn migration bio-season, reflecting the migratory behaviour of this species away from North Sea colonies through the Strait of Dover and towards more southerly wintering locations (Stienen *et al*., 2007). The densities remain fairly consistent (<0.5 birds/km^2) across each survey programme in December and January (the spring migration bio-season), with increases in density, to varying degrees, in February and March (the last two months of the spring migration bio-season). With regard to the maximum density recorded in any individual survey (see Appendix 1) gannets also generally peaked in November, before reducing in density through December and January and rising again in February and March.

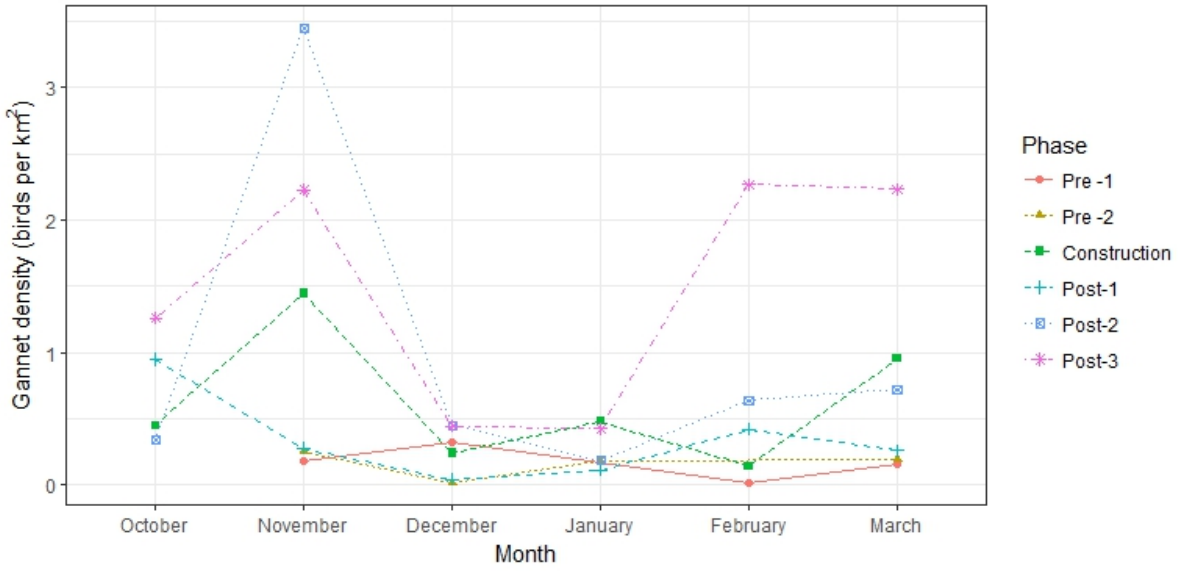

Figure 4 Gannet densities from historic Thanet boat-based data.

Gannets were recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 5), but with very small numbers in October (in the autumn migration bio-season). The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are generally consistent with those collected during the Thanet post-consent monitoring programme with birds peaking in November (the autumn migration bio-season) and then again in March (the spring migration bio-season). There was though very high variation in the March counts.

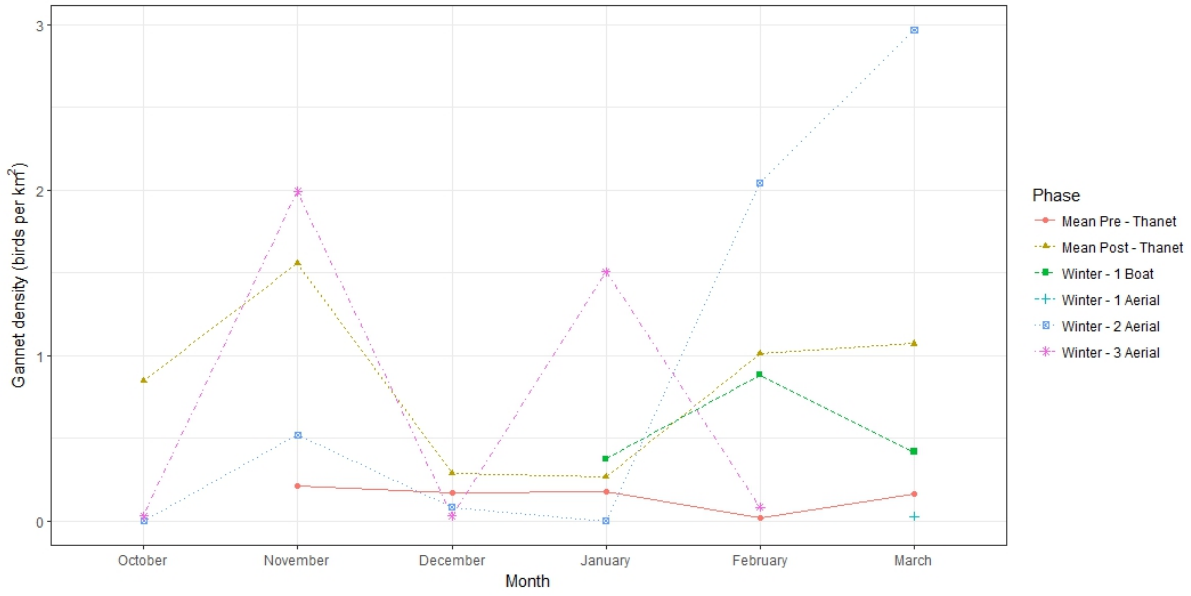

Figure 5 Gannet densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

The March peak recorded by the aerial digital survey data is greater than all other surveys. Overall, the aerial digital survey data density values are similar to the counts derived from boat-based surveys. The aerial digital survey values follow the general pattern of abundance across the non-breeding season, with peaks in November (autumn migration bio-season) when birds are moving out of the North Sea followed by peaks in February and March (spring migration bio-season) when birds are returning to the North Sea.

2.3 Herring gull

Herring gulls were recorded throughout the Thanet post-consent monitoring surveys (Figure 6). Two different density patterns occurred for this species, one during the pre-construction period and the second during the during-construction / post-construction periods. During the pre-construction surveys the species peaked in December (the winter bio-season) and January (the spring migration bio-season). However, during the construction and post-construction periods the species generally occurred in highest densities in March (the spring migration bio-season), reflecting the migratory behaviour of this species through the Strait of Dover back into the North Sea towards colonies from more southerly wintering locations (Stienen *et al.*, 2007). The densities remain fairly consistent across each survey programme between October and February (<2.0 birds/km^2), though a notably high density (~6 birds/km^2) occurred in October (in the autumn migration bio-season) during the second year of post-construction surveys. With regard to the maximum density recorded in any individual survey (see Appendix 1) herring gulls peaked in October, December and March and the least scatter of counts occurred in November and February.

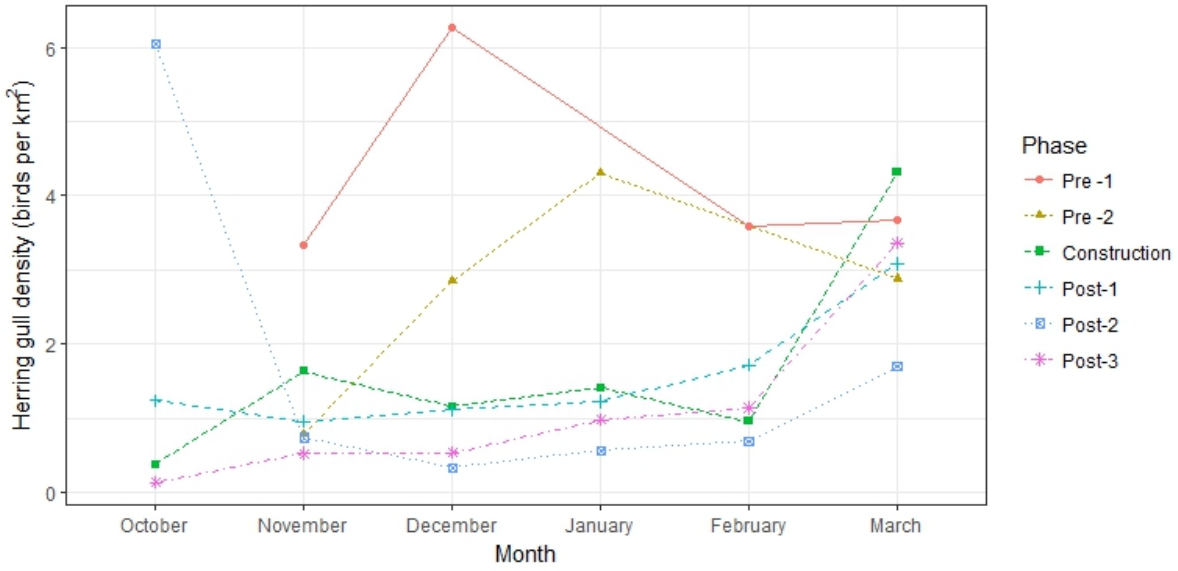

Figure 6 Herring gull densities from historic Thanet boat-based data.

Herring gulls were also consistently recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 7) but the density was in all months lower than that of the mean values for the pre- and post-construction surveys in the post-consent programme. The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are generally consistent with those collected during the Thanet post-construction surveys and not consistent with those from the pre-construction period. The overall pattern was for a peak in October (the autumn migration bio-season) followed by a period of lower densities (mostly <1 bird/km^2) before peaking again in March (the spring migration bio-season).

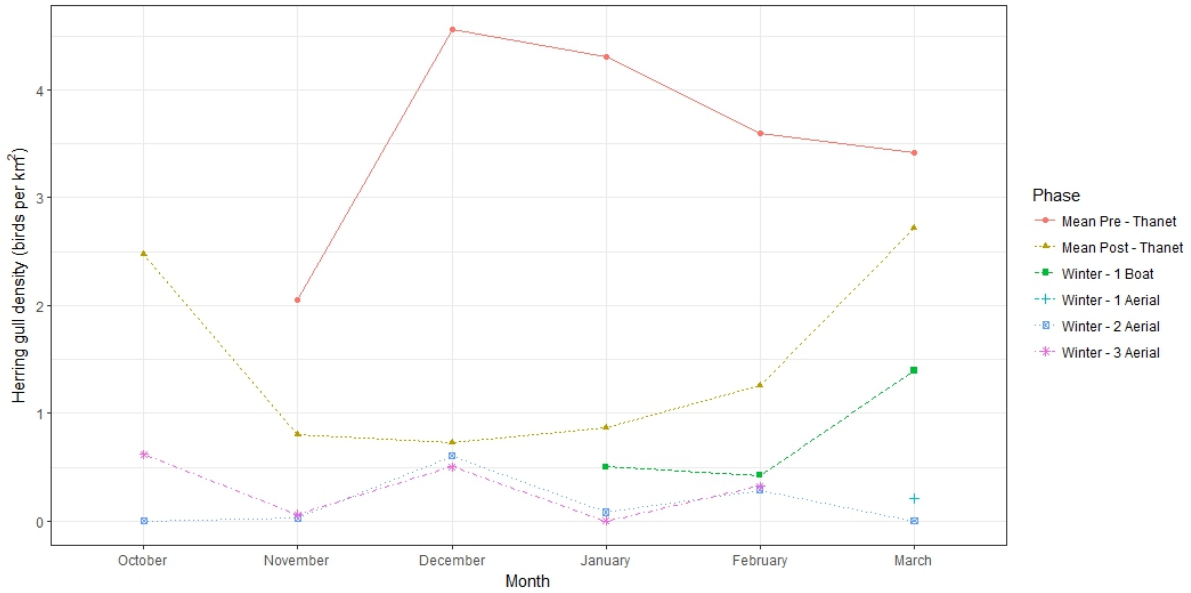

Figure 7 Herring gull densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

It is considered that the more recent aerial digital surveys follow the general pattern that was recorded in the Thanet post-construction surveys, but do not follow the pattern of those from the pre-construction period. It is possible that part of the reason for the lower density recorded in the aerial digital surveys (including in January and February) results from the different survey methods. Aerial digital survey removes the potential for attraction bias created by the survey boat that gull species investigate as a potential source of food (Webb and Hawkins, 2013). No specific reason is known for the large variation in density recorded between the Thanet pre-construction surveys and the during-construction / post-construction surveys, but a review of the ability to detect significant changes in seabird numbers from at-sea surveys (Maclean *et al*., 2013) noted that seabird numbers fluctuate greatly at any given location.

2.4 Great black-backed gull

Great black-backed gulls were recorded throughout the Thanet post-consent monitoring surveys (Figure 8). A consistent pattern can be observed with the species recorded in highest densities in October and November (the autumn migration bio-season). A notable reduction in densities occurred between December (the winter bio-season) through to March (the spring migration bio-season), with generally <1 bird / km^2, though a slight increase in densities occurred in March (the spring migration bio-season). The peaks reflect the migratory behaviour of this species of gull during the autumn migration bio-season away from more northern colonies through the Strait of Dover and towards more southerly wintering locations (Stienen *et al*., 2007) followed by the reverse behaviour during the spring migration bio-season. With regard to the maximum density recorded in any individual survey (see Appendix 1) the pattern was the same – a peak in October before reducing in density between November and February with a slight increase in March.

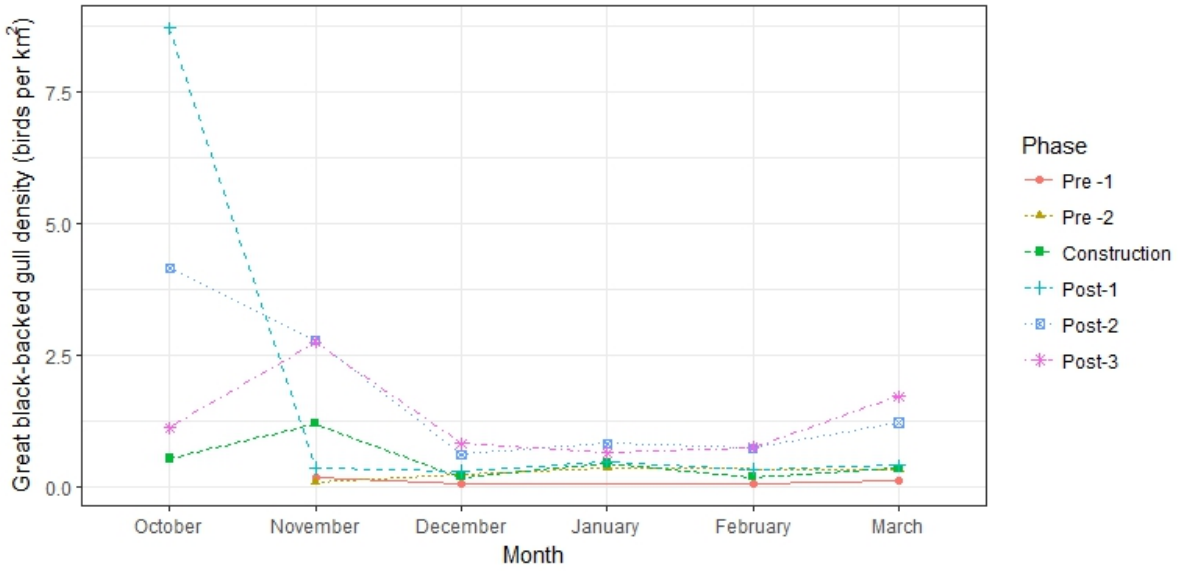

Figure 8 Great black-backed gull densities from historic Thanet boat-based data.

Great black-backed gulls were also consistently recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 9). The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys were similar to those collected during the post-consent monitoring programme with low densities (<1 bird/km^2) between November through to February. The main differences are that the more recent data sets do not have peaks in October or March from the aerial digital data, though a peak did occur in the boat-based data. An earlier peak in February (the spring migration bio-season) occurred for this species in the aerial digital data though, which may reflect an earlier onset of migration in comparison to previous years.

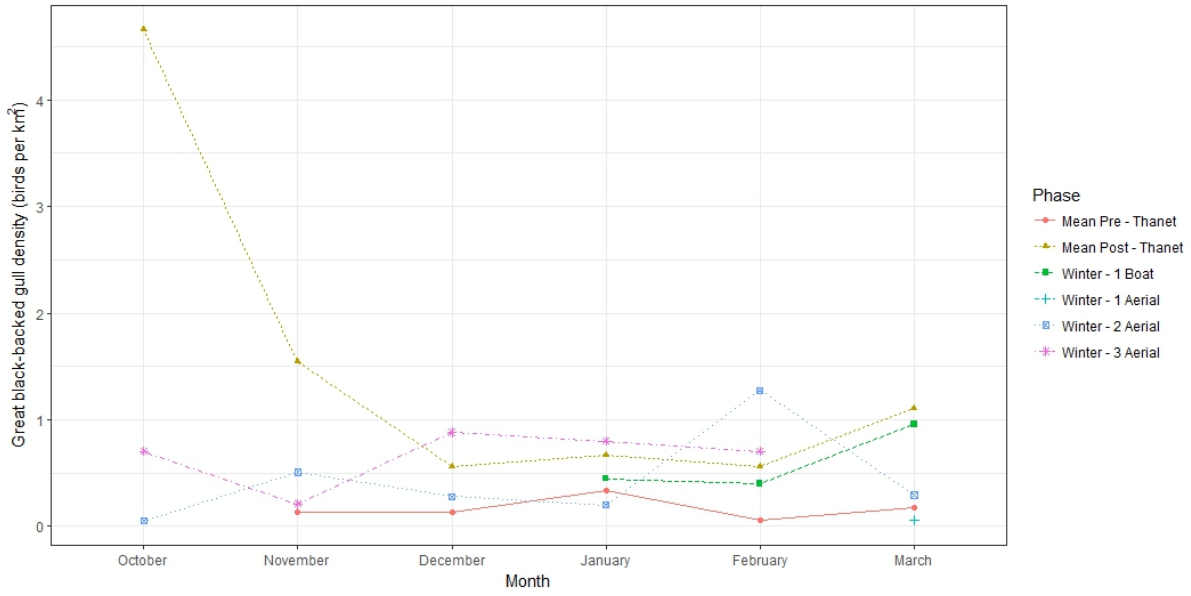

Figure 9 Great black-backed gull densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

It is considered that, with the exception of the months of October and March, densities during the more recent aerial digital survey datasets follow the general pattern of occurrence. The lower densities recorded for this species during the months October through to January in comparison to the post-construction surveys may result from the different survey method. Aerial digital survey removes the potential for attraction bias created by the survey boat that gull species investigate as a potential source of food (Webb and Hawkins, 2013).

2.5 Lesser black-backed gull

Lesser black-backed gulls were recorded throughout the Thanet post-consent monitoring surveys (Figure 10). The species occurred in highest densities in the months of October (the autumn migration bio-season) through to December (the winter bio-season). This is consistent with other migratory species moving away from North Sea colonies through the Strait of Dover and towards more southerly wintering locations (Stienen *et al.*, 2007). Within this overall pattern, densities in the pre-construction and during-construction period were higher than in the post-construction period. High densities did not occur in the months of November to February in the post-construction period (spanning the autumn migration and winter bio-seasons). With regard to the maximum density recorded in any individual survey (see Appendix 1) lesser black-backed gulls peaked in October and November before decreasing in density between December and February and then increasing again in March.

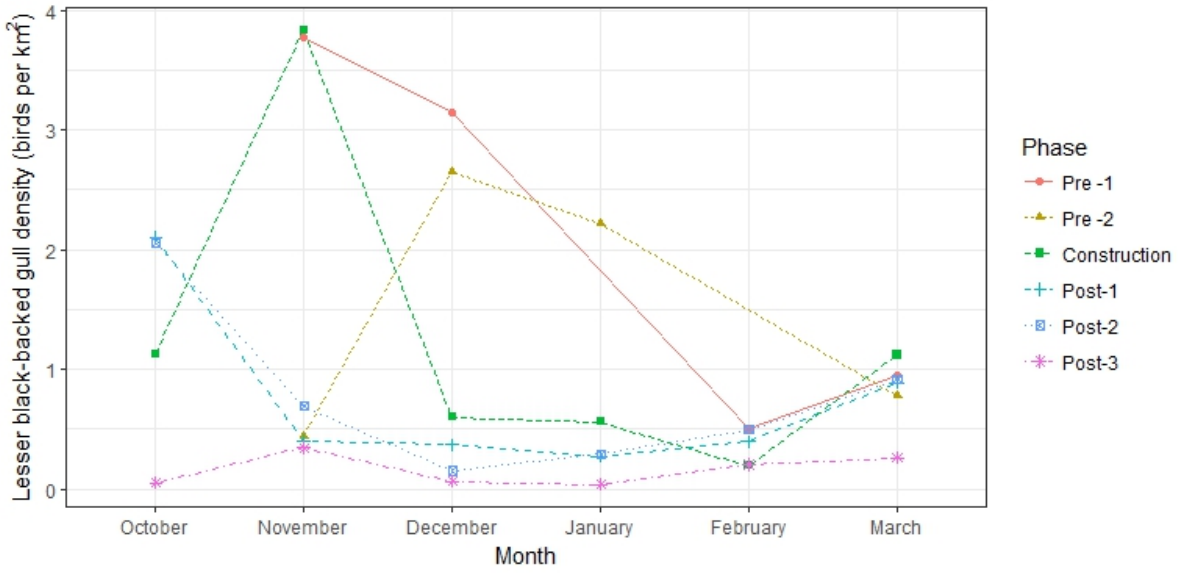

Figure 10 Lesser black-backed gull from historic Thanet boat-based data.

Lesser black-backed gulls were consistently recorded at low densities (<0.25 birds/km^2) throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 11) and showed neither autumn or spring migration peaks. The recorded monthly densities were all below the mean densities for the Thanet pre-construction and post-construction survey programme, with the exception of one month (February) that was between the two.

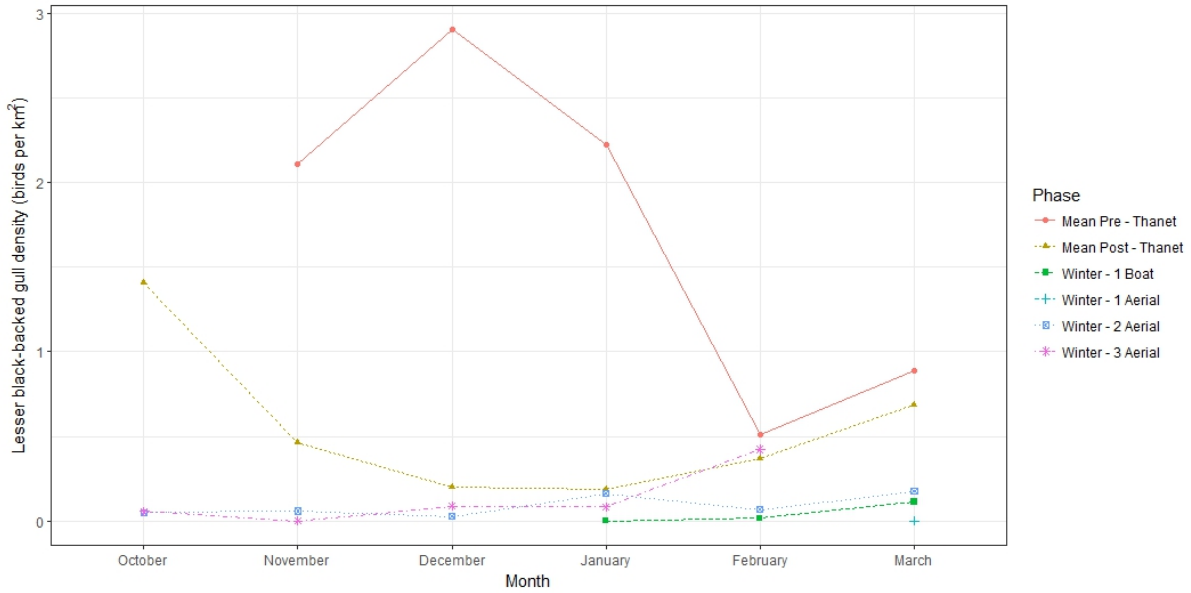

Figure 11 Lesser black-backed gull densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

The densities recorded by the aerial digital surveys are lower than those recorded in the same months in earlier surveys but the very variable nature of the recorded densities over the winter months means that there is no clear pattern or trend to be identified. This difference in density may reflect the highly variable nature of lesser black-backed gull occurrence in the area. A review of the ability to detect significant changes in seabird numbers from at-sea surveys (Maclean *et al*., 2013) noted that seabird numbers fluctuate greatly at any given location.

2.6 Large gull species

Gull species only identified to the large gull species group level (which includes herring, great black-backed and lesser black-backed gulls) were consistently recorded throughout the Thanet post-consent monitoring post-construction surveys, though none were recorded during the pre-construction surveys (Figure 12). The pattern of occurrence, with corresponding densities, generally peaked in October and November (3-4 birds/km^2) followed by a decrease to approximately 0.5 birds/km^2 through the months of December to February with a consistent increase in March (1-2 birds/km^2). This is generally consistent with the density patterns for each of the three large gull species described in this report (Sections 2.3 to 2.5), though it must be noted that other factors determine the numbers (and hence densities) of unidentified large gull species during boat surveys, such as observer experience, distance from vessel, light conditions and the age of individuals. With regard to the maximum density recorded in any individual survey (see Appendix 1) unidentified large gull species provided a similar pattern of densities across the winter survey programmes, with peaks in October / November and then in March.

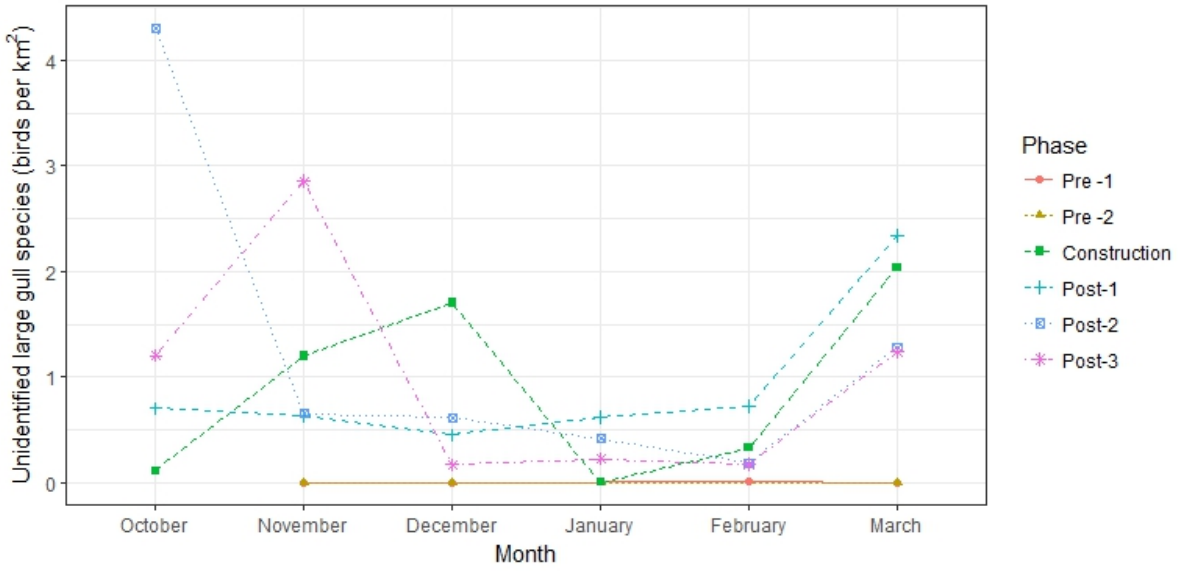

Figure 12 Unidentified large gull species densities from historic Thanet boat-based data.

Gull species only identified to the large gull species group level were fewer in number (and hence density) from the aerial digital surveying, reflecting the higher species identification rates from this survey method (Figure 13). Due to the low densities for large gull species from the aerial digital survey data it is not possible to compare in a meaningful way this data set with those from other surveys.

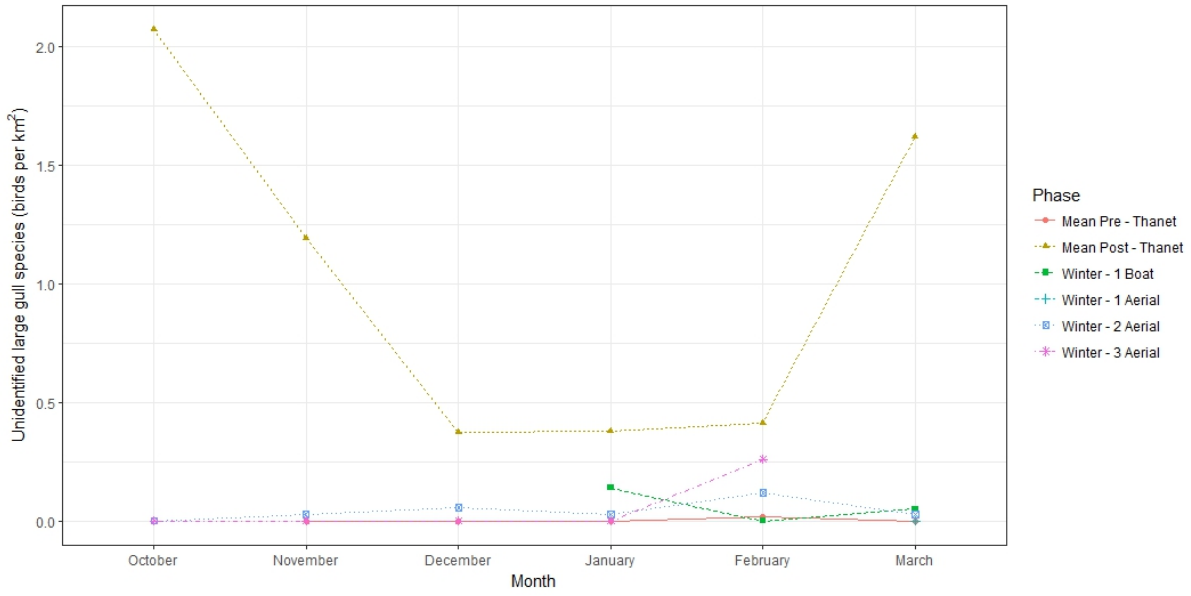

Figure 13 Unidentified large gull species densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

The unidentified large gull species records are treated in a particular way when preparing the records for inclusion within the density and abundance estimate calculations for the baseline technical report that informs the assessment. That is through an apportionment process by which unidentified birds are allocated between each of the three large gull species.

2.7 Kittiwake

Kittiwakes were recorded throughout the Thanet post-consent monitoring surveys (Figure 14). The general pattern was for lower densities in October (the autumn migration bio-season) and March (the spring migration bio-season) and densities of approx. 1-2 birds/km^2 between the months of November and February (spanning the autumn and spring migration bio-seasons, there being no winter bio-season for kittiwake) with the post consent survey in January having the peak density. Kittiwake do not breed in significant numbers close to the Thanet Extension site (APEM, 2017) and the lower densities in October and March is consistent with birds moving in to, and through, the area from more northerly breeding colonies. With regard to the maximum density recorded in any individual survey (see Appendix 1) kittiwake density is generally low in October before rising to peak in December and January, before gradually decreasing in density during February and March.

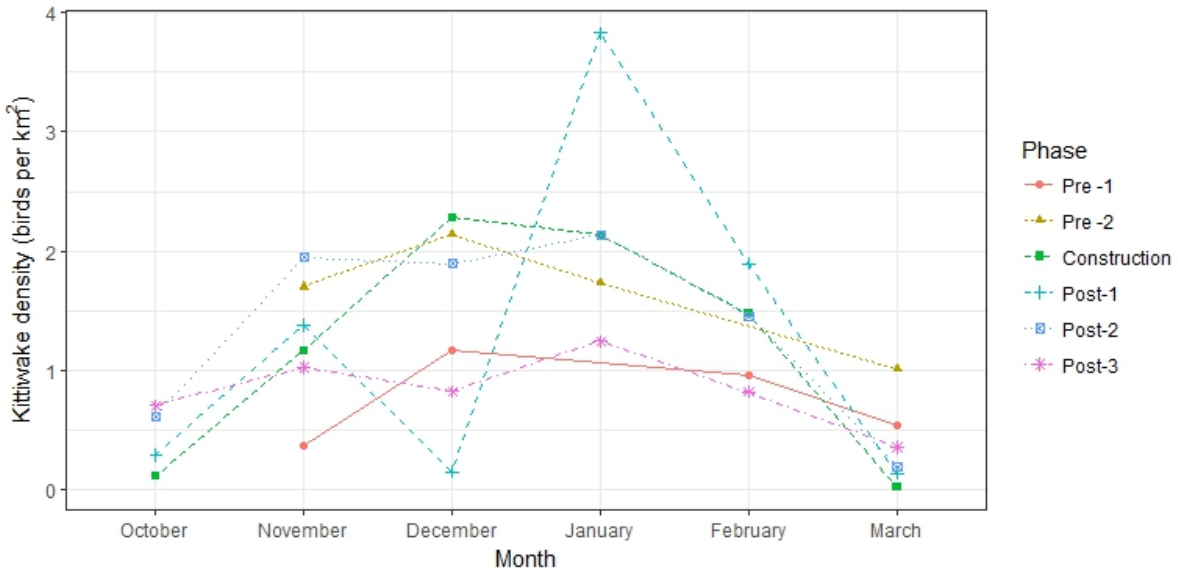

Figure 14 Kittiwake densities from historic Thanet boat-based data.

Kittiwakes were also consistently recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 15), though in lower densities overall with the exception of a peak in January from the aerial digital surveys (~4 birds/km^2) and February from the boat based surveys (~5 birds/km^2). The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are consistent with those collected during the post-consent monitoring survey programmes in terms of the pattern of lower densities in October and March and higher densities between January and February with some indication that the peak of the post-consent surveys occurs in February rather than December or January.

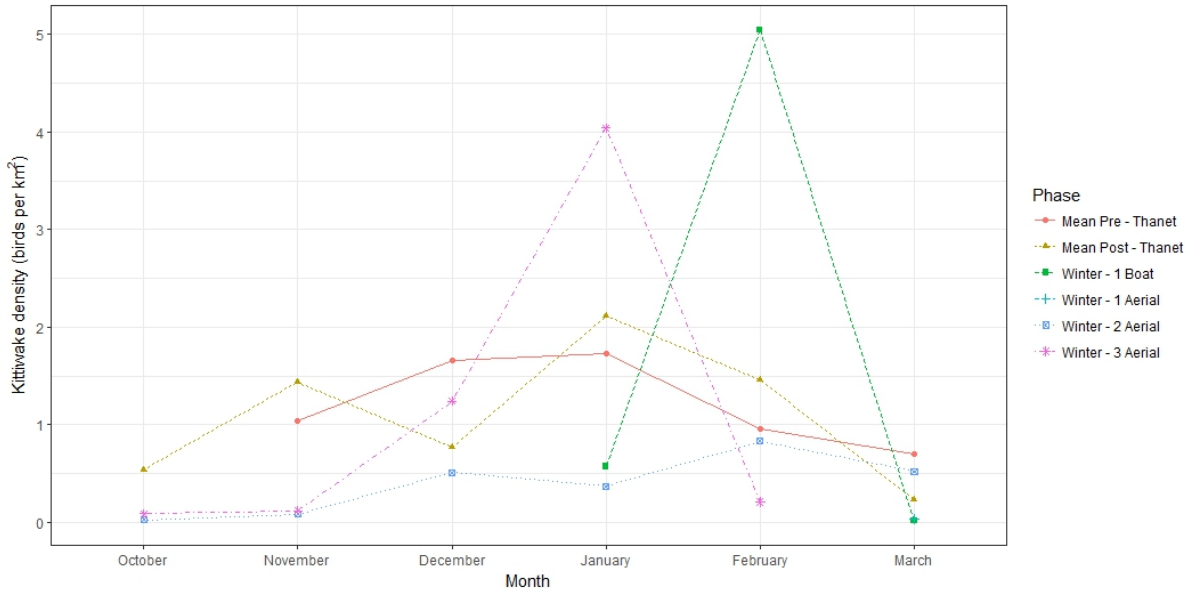

Figure 15 Kittiwake densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

It is considered that the more recent surveys follow the general pattern of occurrence. The overall lower densities recorded for this species by aerial digital survey may result from the different survey method. Aerial digital survey removes the potential for attraction bias created by the survey boat that gull species investigate as a potential source of food (Webb and Hawkins, 2013).

2.8 Razorbill

Razorbills were recorded throughout the Thanet post-consent monitoring surveys (Figure 16). The species occurred in highest densities in December (winter bio-season) and January (spring migration bio-season). The peak density recorded across the sets of surveys, other than for the post-consent year 2, remained fairly consistent (0.5-1.0 birds/km^2), however there were considerable fluctuations within a season (between approximately 0 birds/km^2 and 2.5 birds/km^2) that did not follow a consistent pattern. With regard to the maximum density recorded in any individual survey (see Appendix 1) peaks in excess of 1.5 birds/km^2 occurred in October, December, January and February.

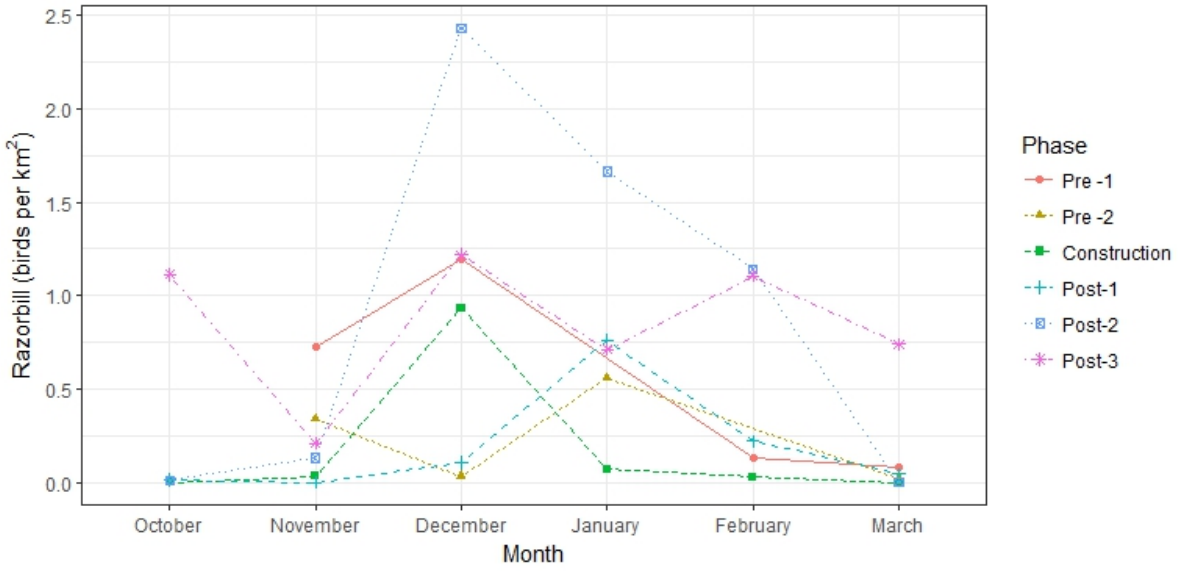

Figure 16 Razorbill densities from historic Thanet boat-based data.

Razorbills were also recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 17). The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are generally consistent with those collected during the post-consent monitoring survey programmes with lower densities of birds in October and November, rising in December and January, before decreasing again in February and March. The exception is a high peak density in March (spring migration bio-season) that was recorded during the recent aerial digital surveys.

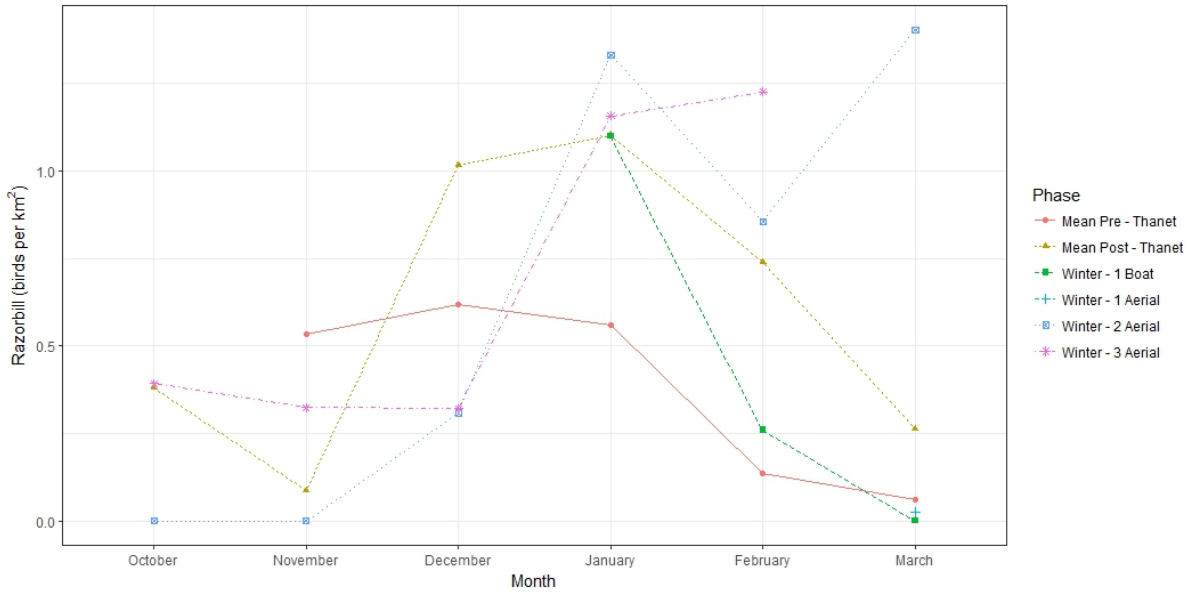

Figure 17 Razorbill densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

It is considered that the more recent aerial digital surveys follow the general pattern of the seasonal fluctuations and densities.

2.9 Guillemot

Guillemots were recorded throughout the Thanet post-consent monitoring surveys (Figure 18) and had the highest density of any species recorded in the surveys. Guillemots generally occurred in lowest densities in October (autumn migration bio-season) and March (spring migration bio-season). The peak density in any one set of post-consent monitoring surveys occurred at any month between November and February without a consistent pattern being evident. Guillemot densities were lower (0.5-4 birds/km^2) throughout pre-construction surveys, the construction survey and the first post construction survey, before significantly increasing between November and February during the second and third post-construction surveys (7-8 birds/km^2). This difference is likely to be due to inter-annual seabird fluctuations (Maclean *et al*., 2013) rather than a cause associated with the operation of the wind farm, as the densities are greater than in both the pre and during-construction survey programmes. With regard to the maximum density recorded in any individual survey (see Appendix 1) guillemot peak density also generally occurs between December and February, with lower densities in particular in October and March.

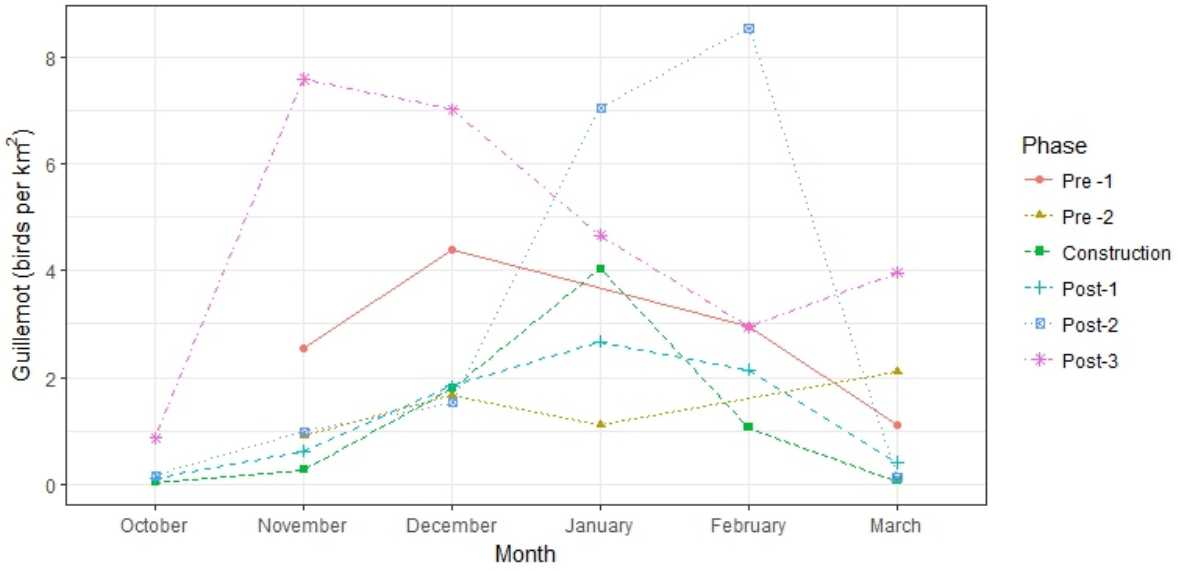

Figure 18 Guillemot densities from historic Thanet boat-based data.

Guillemots were recorded throughout the Thanet and Thanet Extension surveys most recently undertaken (Figure 19). The pattern of peaks and troughs in recorded density from these Thanet and Thanet Extension surveys are generally consistent with those collected during the Thanet post-consent monitoring programme with peak densities between December to February (spring migration bio-season) and lower densities in October, November and March. High peak densities in January from the aerial digital surveys (~13 birds/km^2) and February during the boat-based survey are notable as being the highest density surveys (~13 birds/km^2).

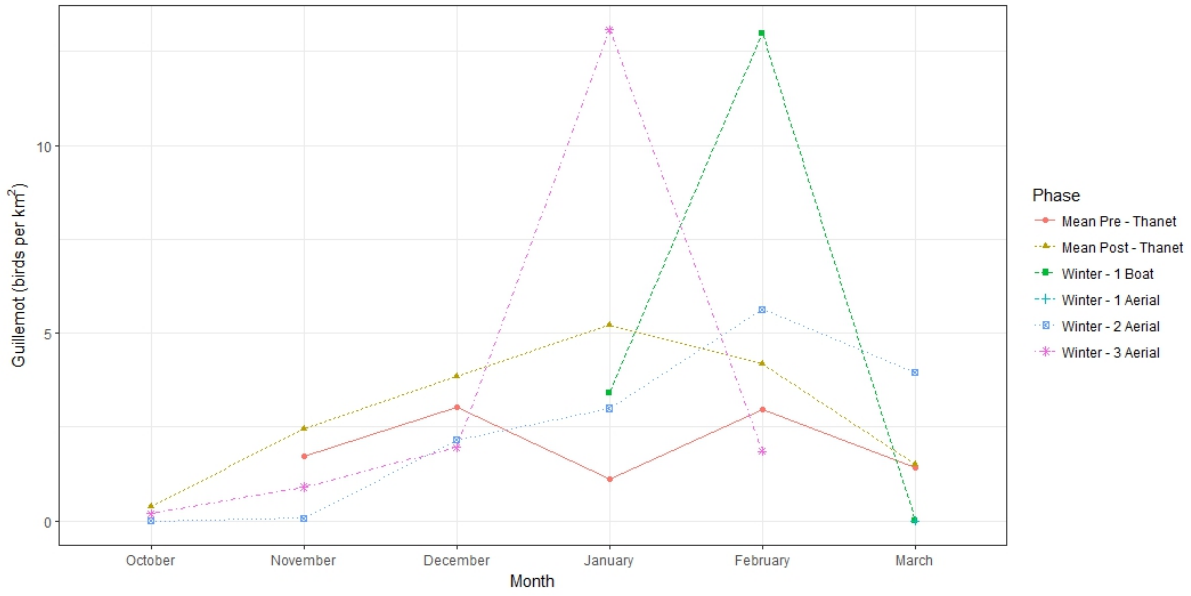

Figure 19 Guillemot densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

It is considered that the more recent surveys follow the general pattern, but the January and February peaks in those more recent surveys are greater than the earlier surveys in those months.

2.10 Unidentified auks species

Auk species only identified to the species group level (which include guillemot, razorbill and puffin) were recorded throughout the Thanet post-consent monitoring post-construction surveys, (Figure 20). Auk species generally occurred in low densities in October and November (approx. 0.5 birds/km^2), followed by peaks in the months of December, January and February (generally <1 birds/km^2) (spring migration bio-season for guillemot – the most abundant auks species) and predominantly returning to lower densities in March. This is generally consistent with the density patterns for each of the two auk species described in this report (Sections 2.8 and 2.9), though it must be noted that other factors determine the numbers recorded (and hence densities) of unidentified auk species, such as observer experience, distance from vessel and light conditions. With regard to the maximum density recorded in any individual survey (see Appendix 1) auk species occurrence predominantly peaked in the same months of December through to February.

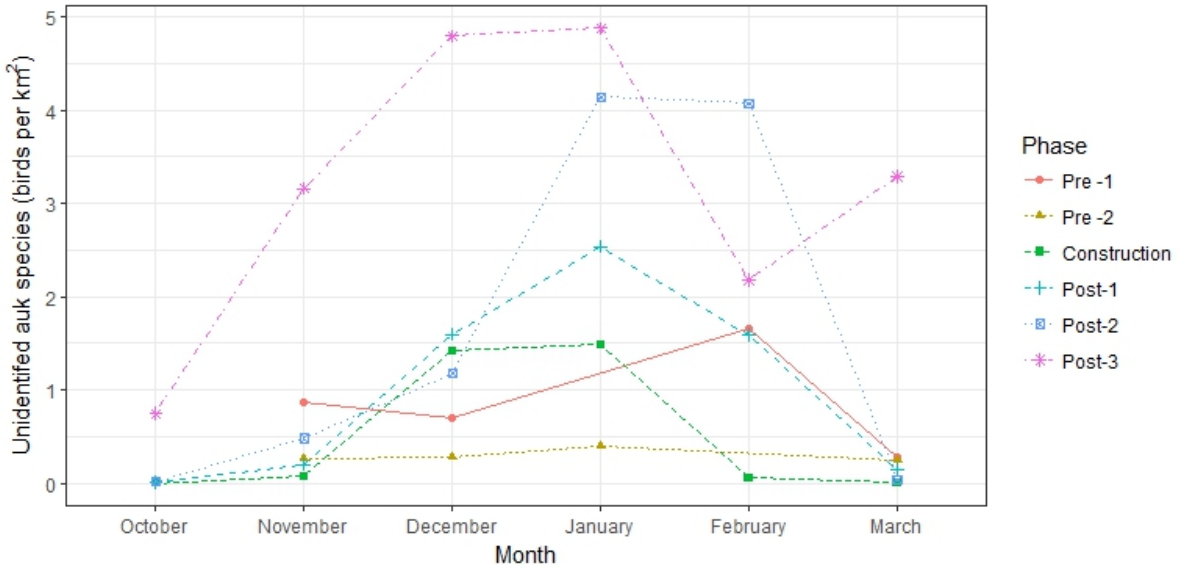

Figure 20 Unidentified auk species densities from historic Thanet boat-based data.

Auk species only identified to the species group level were fewer in number (and hence density) from the aerial digital surveying, reflecting the much higher species identification rates from this survey method (Figure 21) with the potential for this to result in higher densities of identified species compared to the results from boat surveys. Due to the low densities for auk species from the aerial digital survey data it is not possible to compare in a meaningful way this data set with those from other surveys.

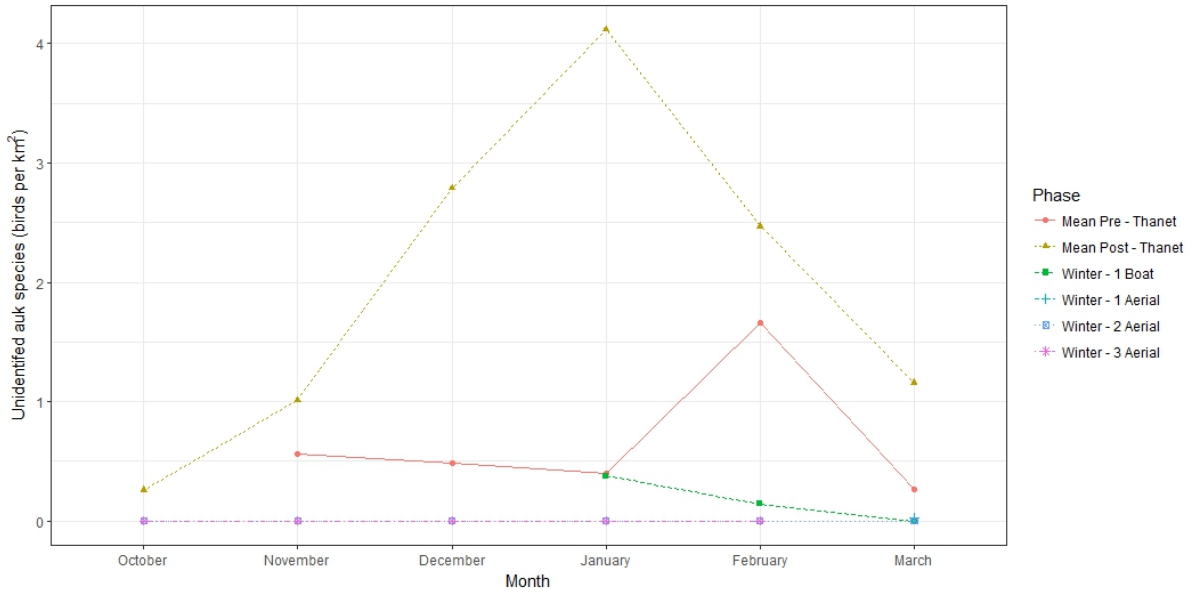

Figure 21 Unidentified auk species densities from historic and recent Thanet & Thanet Extension survey data (including boat-based and aerial digital).

The unidentified auk species records are treated in a particular way when preparing the records for inclusion within the density and abundance estimate calculations for the baseline technical report that informs the assessment. There is an apportionment process by which unidentified auks are allocated between identified auk species in that month.

3. Conclusions

This evaluation of the historic survey data and its comparison with recent survey data has identified that for:

- **Red throated diver** – the more recent aerial digital survey data contributes density values are higher than most boat-based post-consent survey counts.
- **Gannet** – the more recent aerial digital survey data follow the general pattern as does the recorded density.
- **Herring gull** – whilst the general pattern of occurrence is similar, the density figures from the aerial digital survey data are at the lower end those recorded in the boat-based post-consent monitoring survey programme.
- **Great black-backed gull** – it is considered that, with the exception of the months of October and March, densities during the more recent aerial digital surveys follow the general pattern of occurrence, which is of low densities throughout the non-breeding period.
- **Lesser black-backed gull** – it is considered that the more recent aerial digital surveys follow the general pattern of the boat-based post-consent surveys, albeit with lower densities, particularly during the two months of October and March.
- **Kittiwake** – the pattern of peaks and troughs in recorded density are generally consistent throughout all survey programmes in terms of the pattern of lower densities in October and March and higher densities between January and February.
- **Razorbill** – It is considered that the more recent aerial digital surveys follow the general pattern of the seasonal fluctuations and densities as those recorded in the boat-based post consent surveys.
- **Guillemot** – It is considered that the more recent aerial digital surveys follow the general pattern, but the January and February peaks are greater than earlier surveys in this month.
- **Unidentified large gulls and auks** – these are treated in a particular way when preparing the records for inclusion within the density and abundance estimate calculations for the baseline technical report that informs the assessment. There is an apportionment process by which unidentified birds are allocated between each of the relevant species. Both species groups are subject much higher species identification rates from the aerial digital surveying methods with the consequence that the comparison of counts and trends between survey data sets has to be treated with caution.

The causes of some of the general and species specific differences that have been noted between surveys could include:

- The consequence of the large inter-annual variations in numbers of seabirds that occur at any given location (Maclean *et al*., 2013);
- the consequence of the Thanet Extension survey area including large areas of sea that are out with the earlier Thanet monitoring area and hence might differ in potential food supply, water depth, distance to the coast etc;
- with respect to gulls, it is possible that the instances of lower densities recorded in aerial digital surveys could result from the different survey method with the aerial digital

survey technique removing the potential for attraction bias created by the survey boat that gull species investigate as a potential source of food (Webb and Hawkins, 2013); and

The known effect whereby diver species fly off in advance of the survey boat was accounted for in the boat-based transect method by having a third observer looking forward to count divers in advance of any being flushed (Royal HaskoningDHV, 2011).

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Appendix 1 Historic Data Scatter Graphs

1.1 Red-throated diver

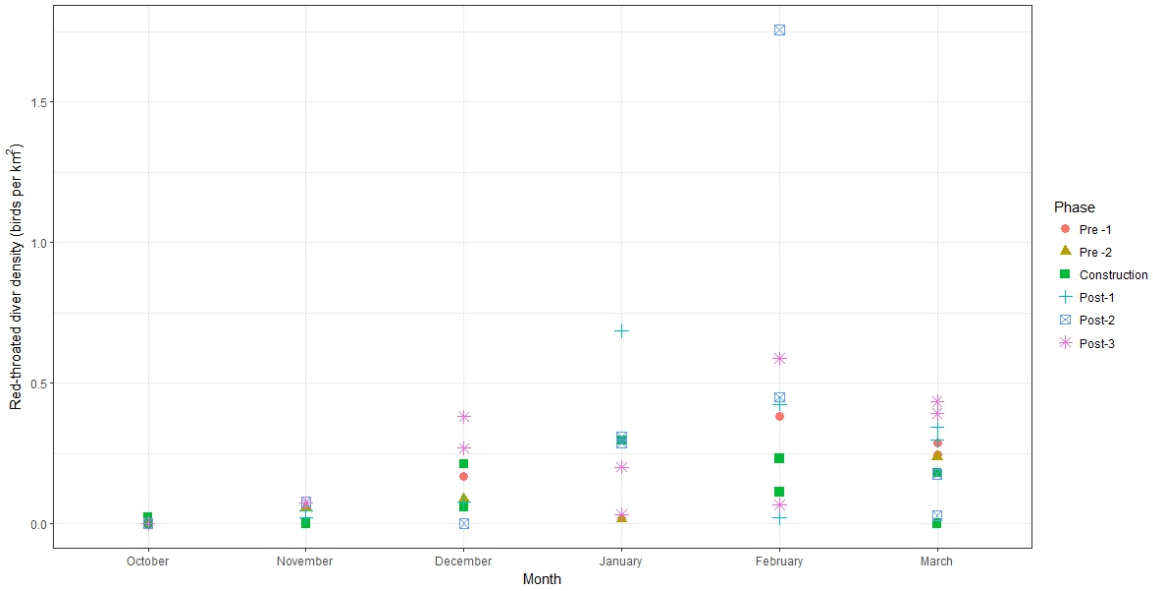

Figure 22 Red-throated diver densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.2 Gannet

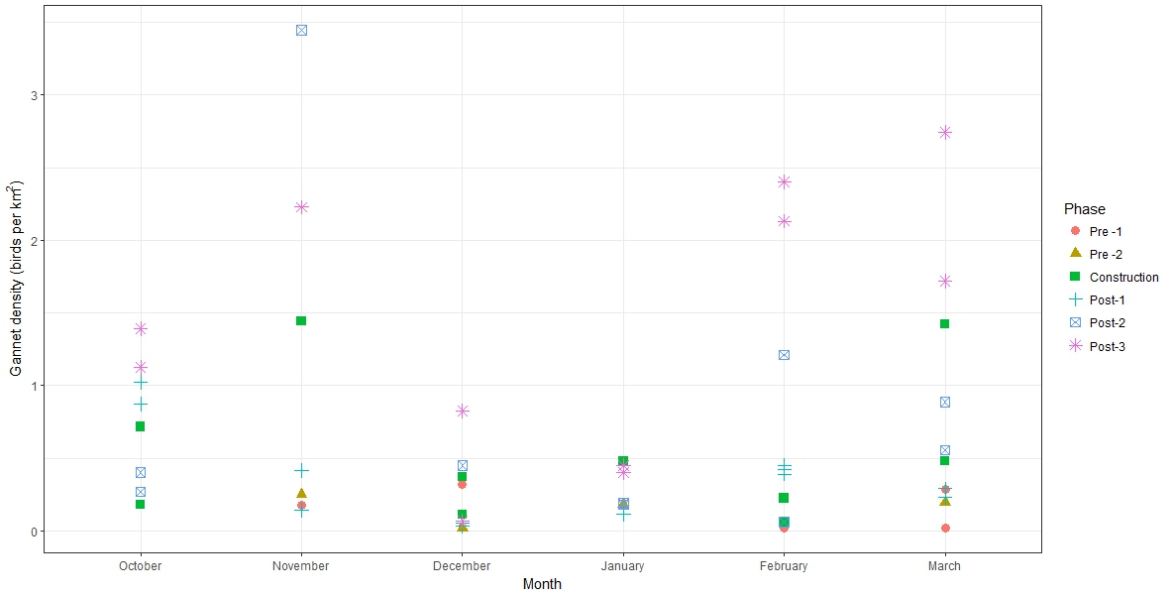

Figure 23 Gannet densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.3 Herring gull

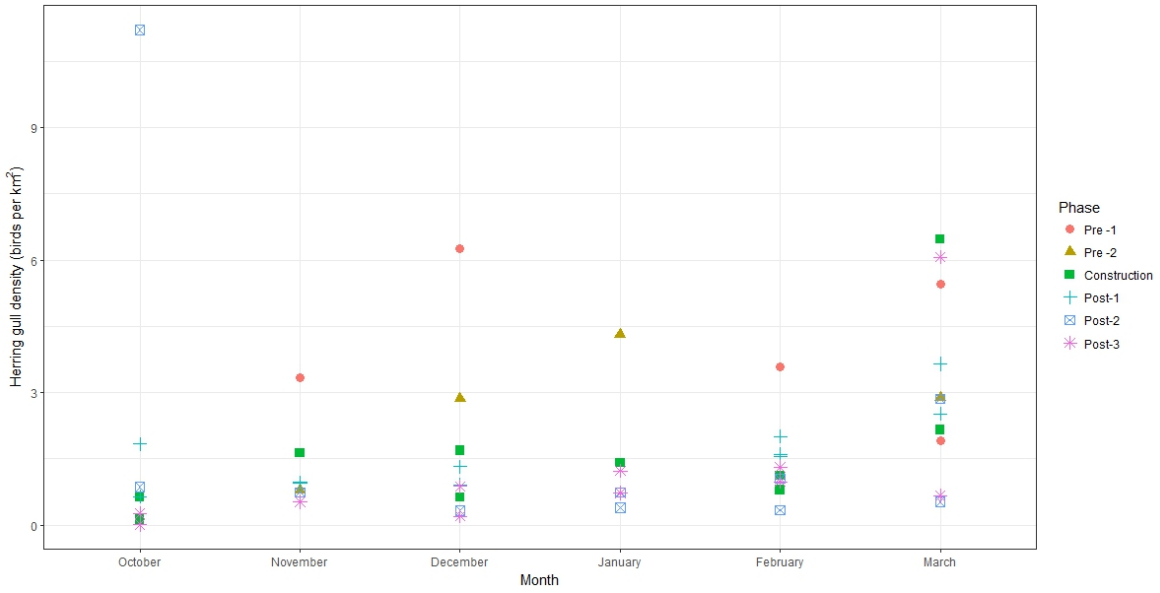

Figure 24 Herring gull densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.4 Great black-backed gull

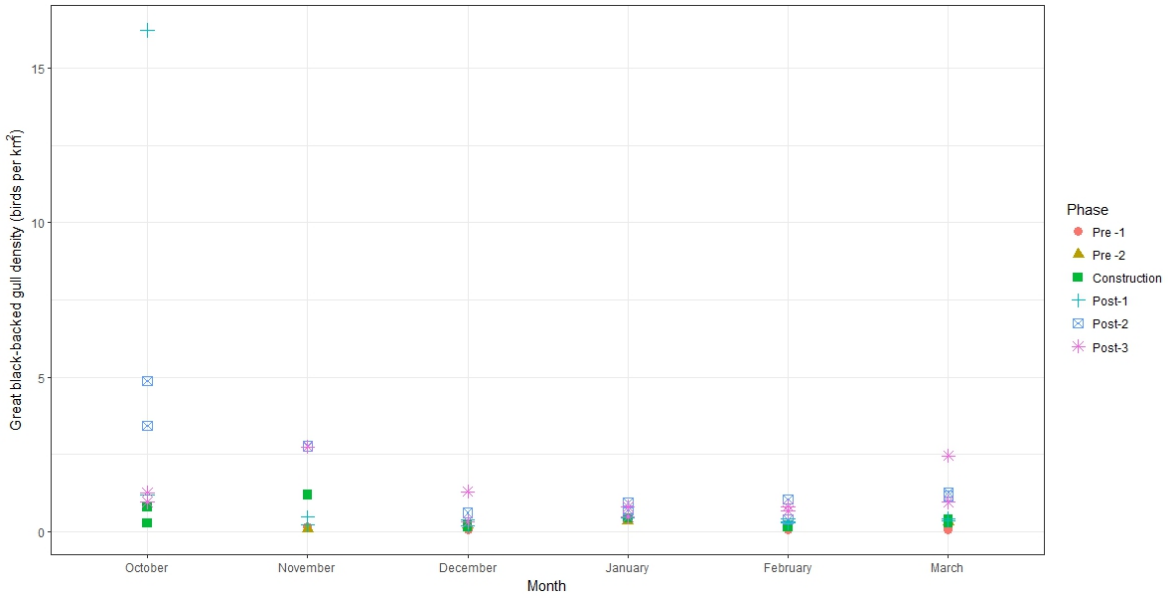

Figure 25 Great black-backed gull densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.5 Lesser black-backed gull

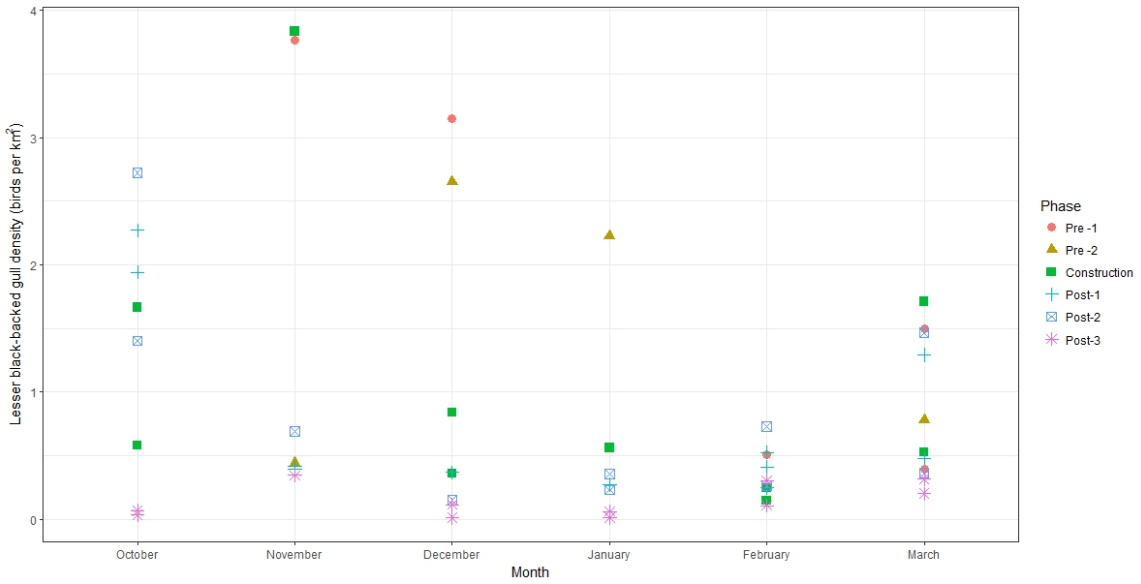

Figure 26 Lesser black-backed gull densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.6 Large gull species

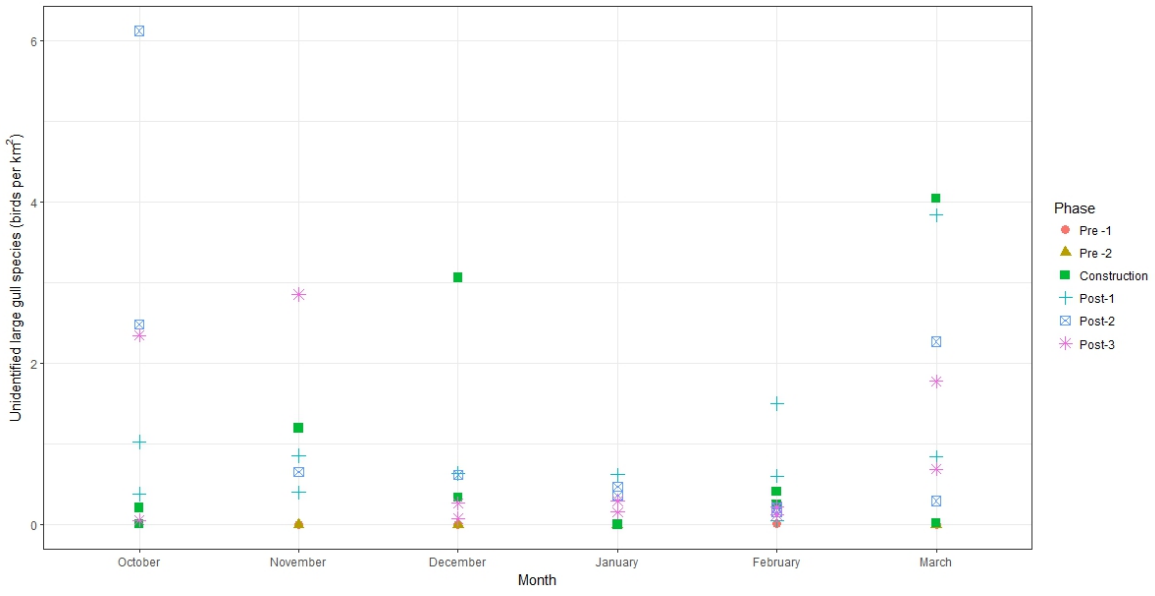

Figure 27 Unidentified large gull species densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.7 Kittiwake

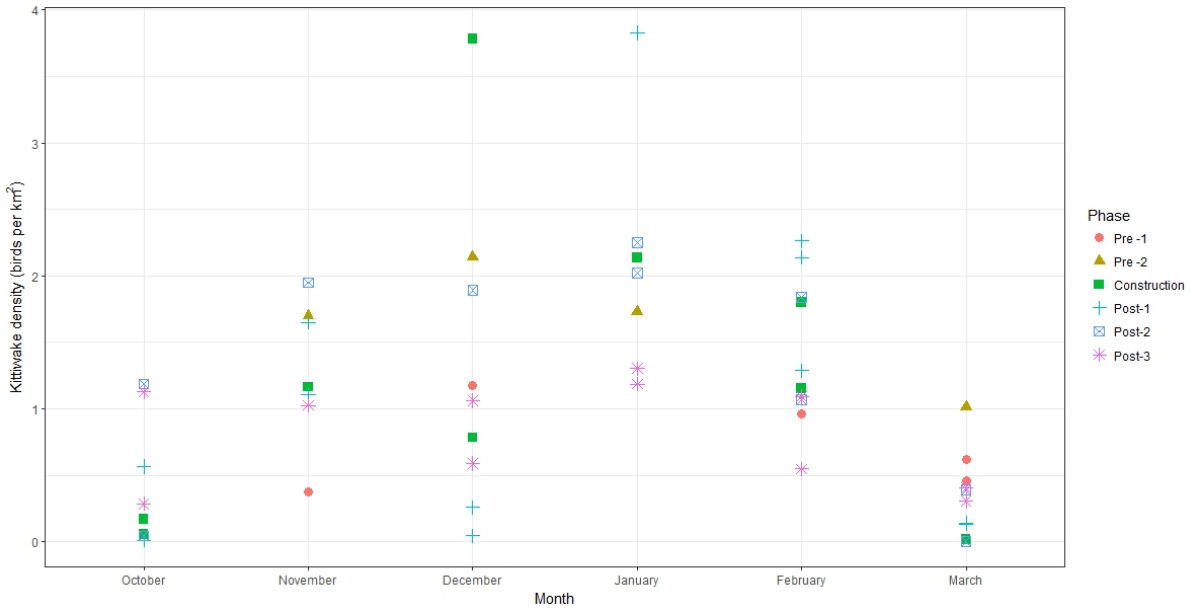

Figure 28 Kittiwake densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.8 Razorbill

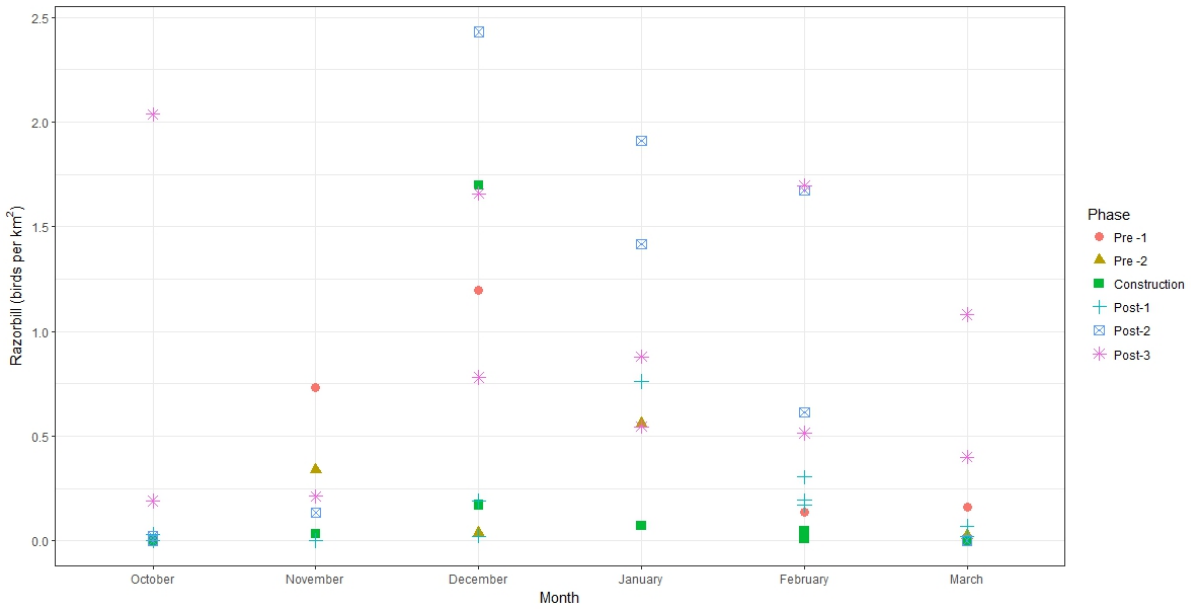

Figure 29 Razorbill densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.9 Guillemot

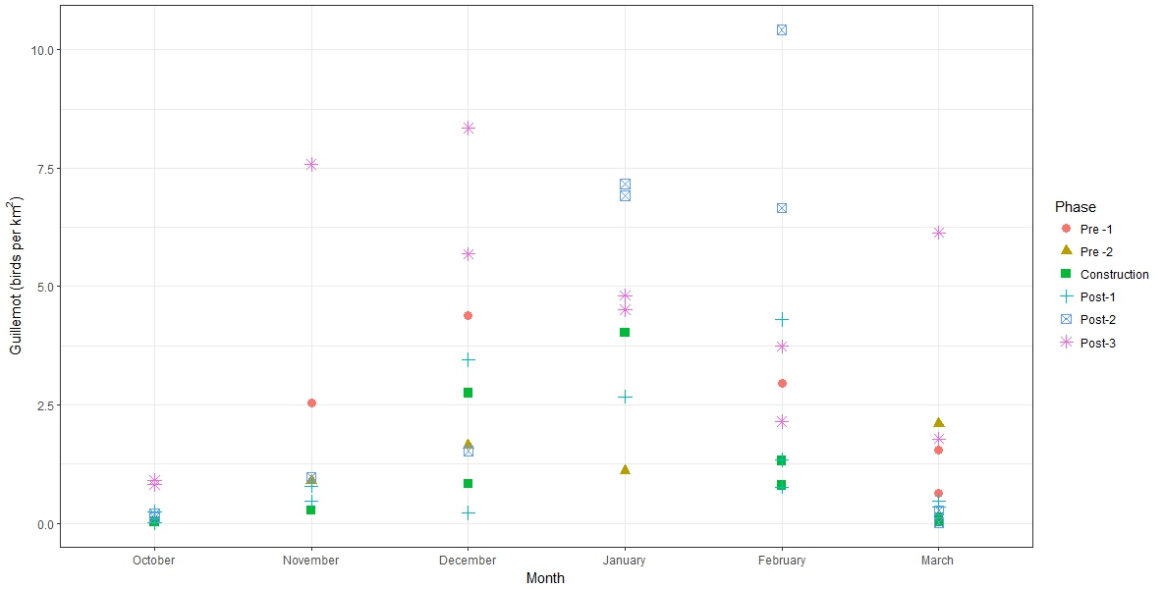

Figure 30 Guillemot densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.

1.10 Auk species

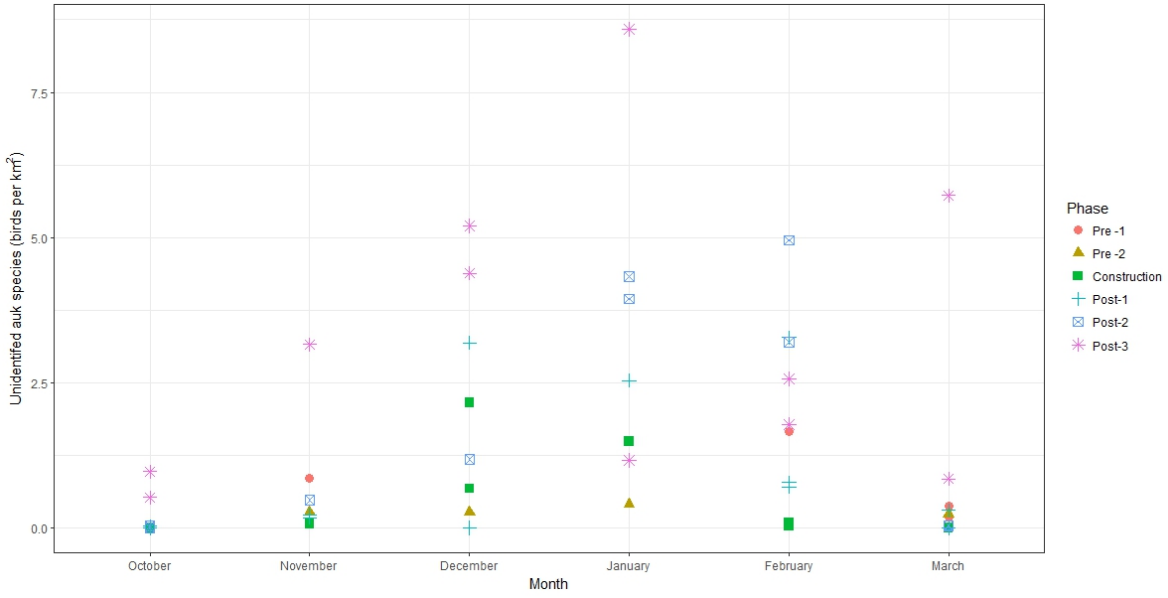

Figure 31 Unidentified auk species densities from historic Thanet boat-based data where multiple surveys in same month scatter points represent maximum and minimum densities.