Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 12.9: Offshore Ornithology Technical Report - Review of Seabird Monitoring Data 2000 to 2010

sse Renewables

Arklow Bank Wind Park 2

Technical Appendix 12.09 Offshore Ornithology

Review of Seabird Monitoring Data 2000 to 2010

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CONTENTS

LIST OF FIGURES

GLOSSARY

Term	Meaning
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore wind farm in Ireland.
Arklow Bank Wind Park 2 Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Arklow Bank Wind Park 2 (ABWP2)	Arklow Bank Wind Park 2 (ABWP2) (The Project) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operations Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure: This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operations and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.

ACRONYMS

Term	Meaning
ABWP1	Arklow Bank Wind Park 1
ABWP2	Arklow Bank Wind Park 2
ESAS	European Seabirds at Sea
SPA	Special Protection Area

UNITS

Unit	Description
km	Kilometre (distance)
Km^2	Kilometre squared (Area)
MW	Megawatt

1 OFFSHORE ORNITHOLOGY TECHNICAL REPORT – REVIEW OF SEABIRD MONITORING DATA: 2000 TO 2010

1.1 Introduction

1.1.1.1 This Technical Report provides a review of the seabird monitoring which has been conducted for Arklow Bank Wind Park 1 (ABWP1). ABWP1 is located in the Irish Sea, approximately 10 km off Arklow, and consists of seven 3.6 MW turbines which have been operating since 2003.

1.1.1.2 Ornithological monitoring via boat-based surveys was undertaken for ABWP1 between July 2000 and June 2009 in order to characterise the baseline environment and following construction to monitor for potential effects. In addition to the boat-based surveys, the seabird colony at Wicklow Head was surveyed in each summer (2001 to 2010) to estimate the sizes of breeding seabird populations.

1.1.1.3 The site-based survey data have been analysed to extract monthly densities in order to consider seasonal and inter-annual variations and determine if there is any evidence for effects related to the construction and operation of ABWP1.

1.1.1.4 The data discussed in this Technical Report have only been used to provide context and have not been used for the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure, hereafter referred to as “The Proposed Development” impact assessment (e.g. collision risk modelling or displacement estimation), which is based on the digital aerial survey data collected between March 2018 and April 2020.

1.2 Methodology

1.2.1 Boat-based surveys

1.2.1.1 Boat-based surveys were conducted on a monthly basis in two phases: between July 2000 and June 2008, utilising transects aligned with the coast covering a total survey area of approximately 380 km^2 (c. 12 km x 32 km; Figure 12.9.1), and from July 2008 to June 2009 using a different set of transects (Figure 12.9.2) which were more focussed on the Arklow Bank zone. The surveys were conducted using European Seabirds at Sea (ESAS) methods (Webb and Durinck, 1992). The frequency with which the different transect legs were surveyed varied over the course of the study, although the transects aligned alongside the Arklow Bank were surveyed at least monthly throughout. The frequency of surveying for the other legs varied between monthly and bi-monthly. In addition, the survey vessel was changed after March 2003 for one which could operate in shallower depths. Further details of the survey design are reported in Coveney Wildlife Consulting (2003, 2004, 2006), Fulmar Ecological Services (2006) and Cork Ecology (2007, 2009). The survey area and transects used between 2000 and 2009 are shown in Figure 12.9.1.

1.2.1.2 In July 2008 the survey was revised, with only the Arklow Bank transects retained, while the other transects were replaced with a different route (Figure 12.9.1).

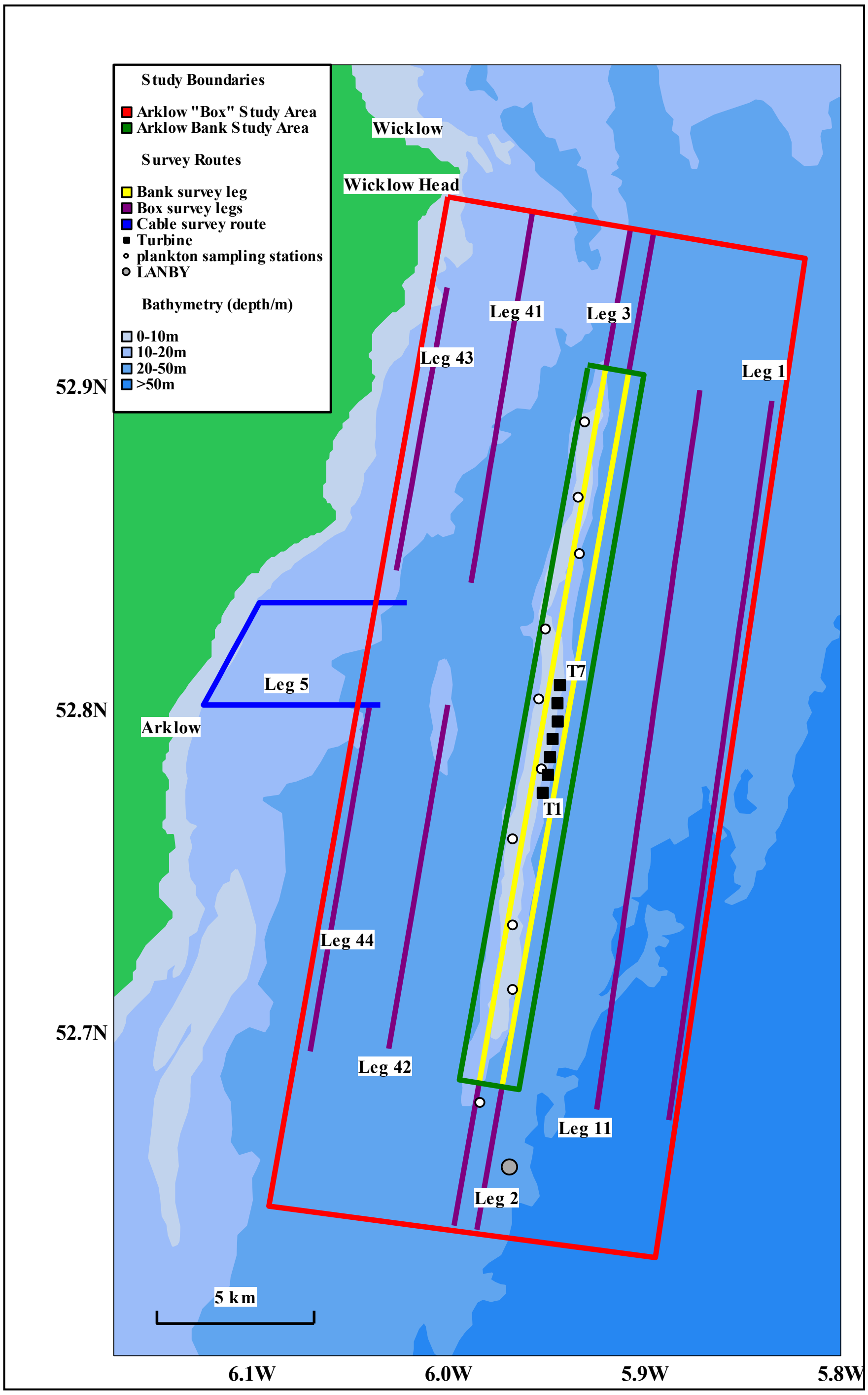

Figure 12.9.1: Study area and transects used for Arklow Bank seabird surveys between July 2000 and June 2008 (from Coveney Wildlife Consulting, 2003).

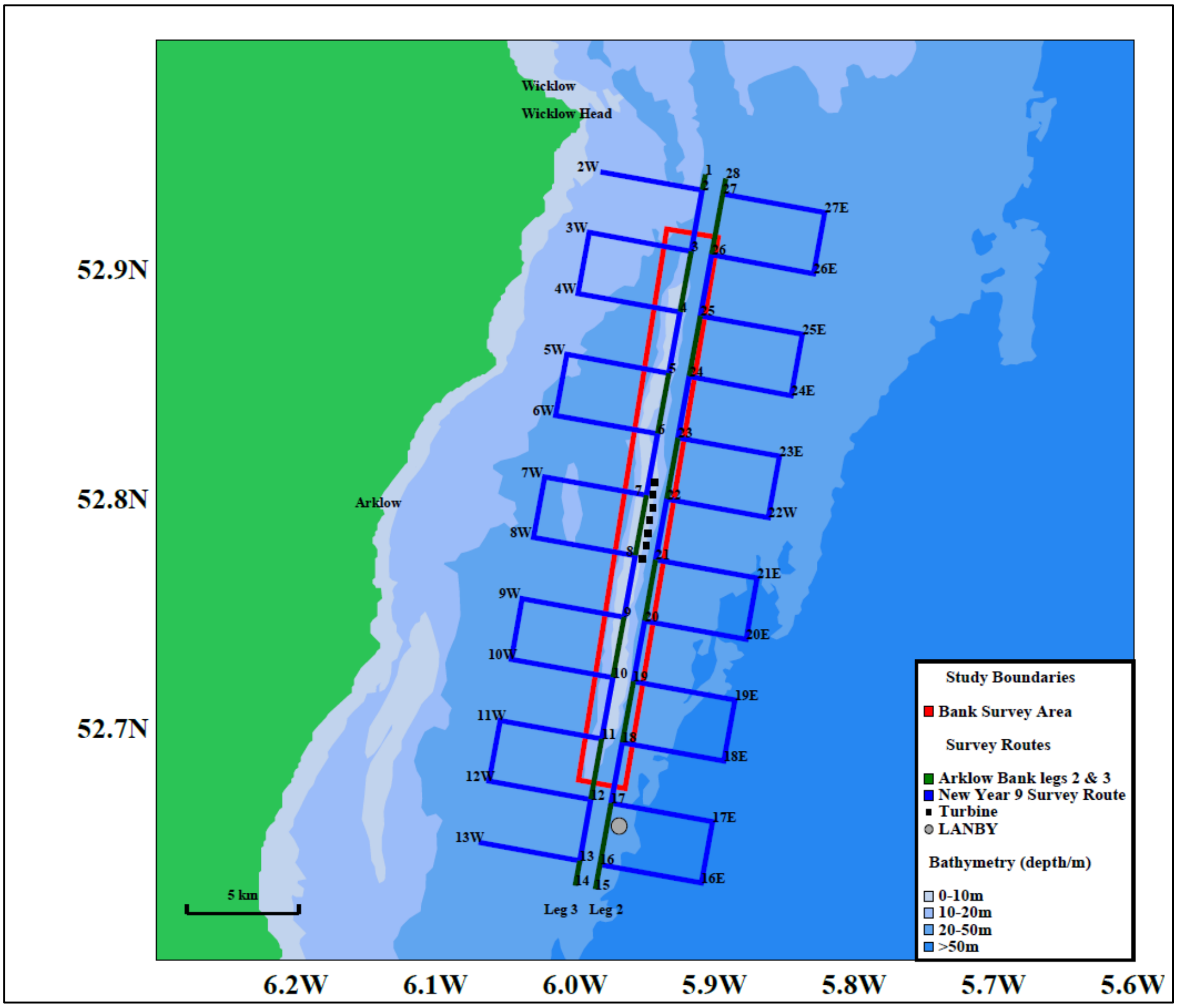

Figure 12.9.2: Study area and transects used for Arklow Bank seabird surveys between July 2008 and June 2009 (from Cork Ecology, 2009).

1.2.2 Data analysis

1.2.2.1 Although data were collected across the whole survey area there was a focus on the Arklow Bank, with the wider area subject to less frequent surveys. To accommodate this, the data were split into two for analysis, with separate analysis of the data collected along the Arklow Bank and of the wider area (i.e. the latter excluding that collected along the Bank transects).

1.2.2.2 For more abundant species (i.e. more than 50 observations), Distance analysis (Thomas *et al*., 2010) was used to estimate species-specific detection functions (estimated probability of detection allowing for reduced detection at increasing distance from the vessel). Detection functions were calculated using all data combined and then used to correct the observations for each survey to obtain the density of each species on each survey. The density estimates were then averaged for all surveys within each month and year. Owing to variability in survey effort between months, the relatively small areas surveyed, the localised nature of observations, and the sub-optimal survey design used (section 1.2.4), species' total abundances have not been calculated, as these were considered very likely to be unreliable.

However, the density estimates are considered to be robust with regards to the surveyed areas and provide a valuable seasonal and inter-annual index of seabird activity.

1.2.2.3 Species for which there were insufficient data to permit use of distance analysis (i.e. fewer than 50 observations for estimating detection functions) were analysed using an approach involving estimation of the number of observations per kilometre travelled on each survey.

1.2.2.4 For both distance corrected densities and numbers per kilometre travelled, results are presented as the mean and standard error in each month, averaged across all years of survey. Results were assigned to either before or after construction of ABWP1, with a cut-off date of July 2003.

1.2.3 Wicklow colony counts

1.2.3.1 The numbers of breeding seabirds at Wicklow Head Special Protection Area (SPA) were recorded each summer (May to July) between 2001 and 2010 following standard methods (Walsh *et al*., 1995). The species monitored in all years were fulmar, kittiwake, guillemot, razorbill and shag, with herring gull also counted from 2006. For fulmar, kittiwake, herring gull and shag the count unit was pairs ('apparently occupied nests or sites') while for guillemots and razorbills the count unit was individual adults. The colony counts are tabulated here for consideration alongside the boat-based survey results. Kittiwake productivity was also monitored at a selection of subplots within the colony. Productivity was calculated as the maximum number of fledglings in each plot divided by the estimated number of apparently occupied nests within the plot which was then averaged across plots, giving an estimate of the number of chicks reared per nest.

1.2.4 Limitations

1.2.4.1 The seabird monitoring undertaken between 2000 and 2010 in relation to ABWP1 provides a valuable span of continuous density data which reveals both species-specific seasonal patterns and also the large degree of inter-annual variation present in the marine environment.

1.2.4.2 Although birds were recorded in a manner consistent with ESAS formats, thereby enabling the use of distance analysis, the previous survey reporting did not use these methods to estimate densities, but instead reported observations as numbers of birds per distance travelled along transects. For the current reporting, where sufficient data have been collected, distance analysis has been used (implemented in the R package 'Distance') as this enables correction for the relationship between detection probability and distance from the survey vessel. However, while this is a more robust method for estimating densities, the survey was not designed with this analytical approach in mind.

1.2.4.3 The primary limitation in the survey design is due to the small number of long transects which were aligned along linear features (e.g. the Arklow Bank and coastline). The recommended design for surveying a region such as this is to employ a larger number of shorter transects and for these to be oriented across environmental gradients (e.g. distance to shore or depth). Therefore, in this case a more robust design would have been based on shorter transects aligned perpendicularly to the coast and crossing the Arklow Bank. Nonetheless, the data does provide an index of seabird presence across the survey period.

1.3 Results

1.3.1 Boat-based surveys

1.3.1.1 The densities (for more abundant species) and the counts per kilometre travelled (for less abundant species) are presented in Figure 12.9.3 to Figure 12.9.4, with species presented in alphabetical order of their common name (Arctic skua to shag). In all figures, the blue lines represent data collected before construction of the ABWP1 wind turbines (up to and including June 2003) and the red lines represent data collected after construction (July 2003 onwards). The solid lines are the mean monthly estimates and the dashed lines show the 95% confidence intervals around the means. The absence of dashed lines for some species and months indicates sparse records (i.e. rarely observed species recorded too rarely for variance estimation). Plots are provided for data collected along transects in the wider survey area 'Box' and along the two Arklow Bank transects (see Figure 12.9.1 and Figure 12.9.2). Note that these were exclusive datasets (i.e. the Bank data were not included in the wider 'Box' data).

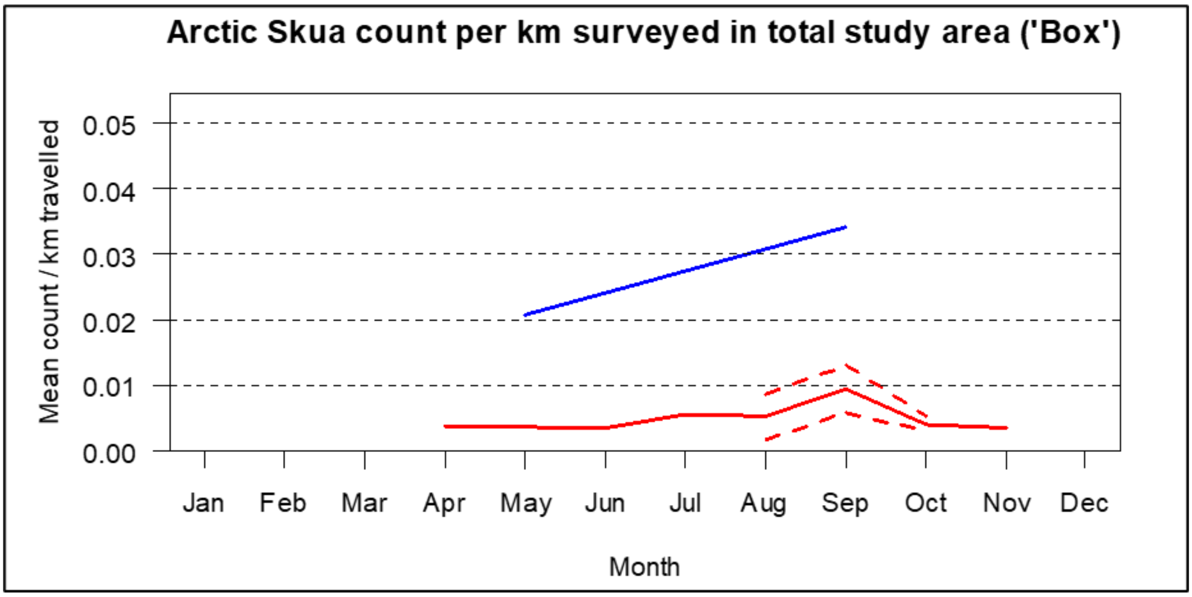

Figure 12.9.3: Arctic skua monthly counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

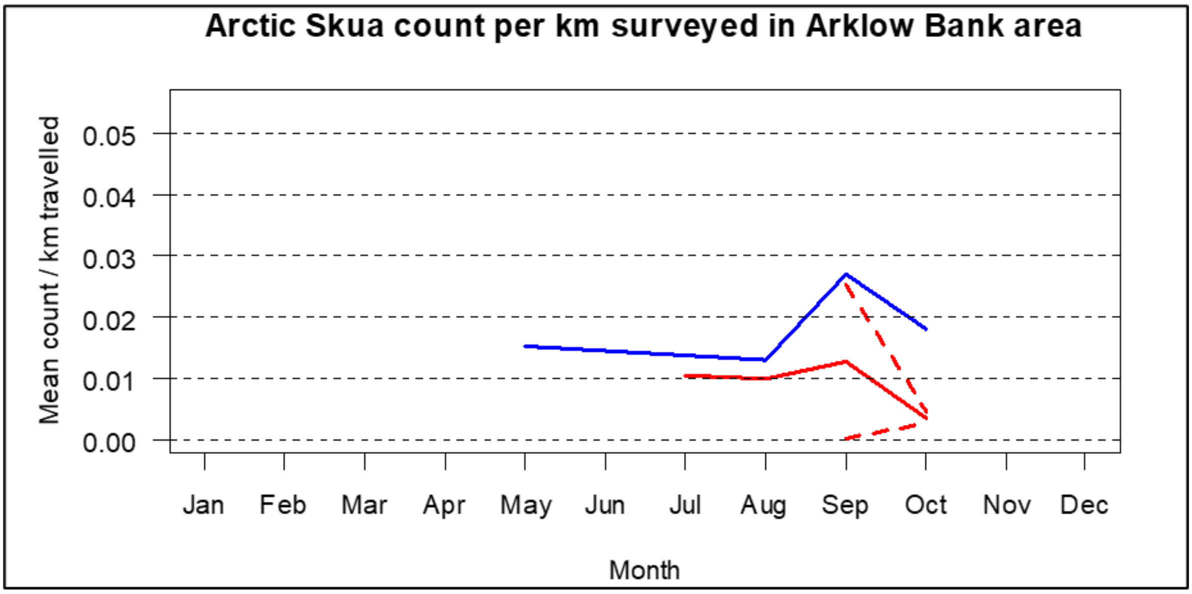

Figure 12.9.4: Arctic skua monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.2 Arctic skuas were only recorded between April and November, and within that period most observations were made in September. Numbers were low throughout and there was no clear preference for the wider study area or Arklow Bank. Densities prior to construction were higher than post-construction but given the limited number of observations this is considered likely to be a chance effect, and cannot be tested statistically with the existing data set.

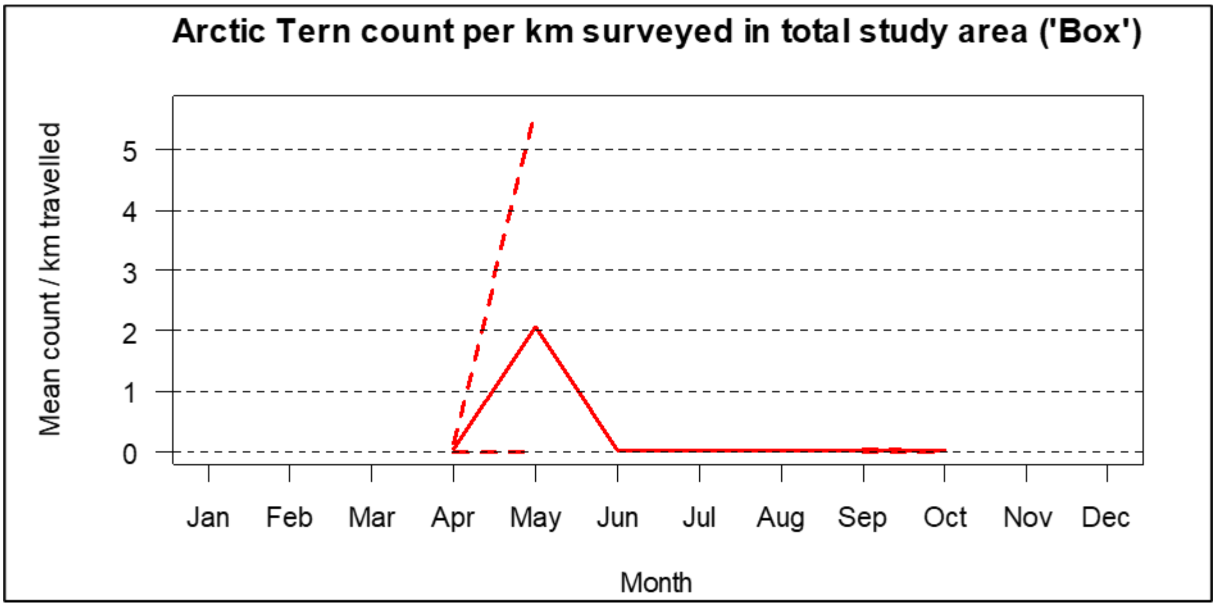

Figure 12.9.5: Arctic tern monthly counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

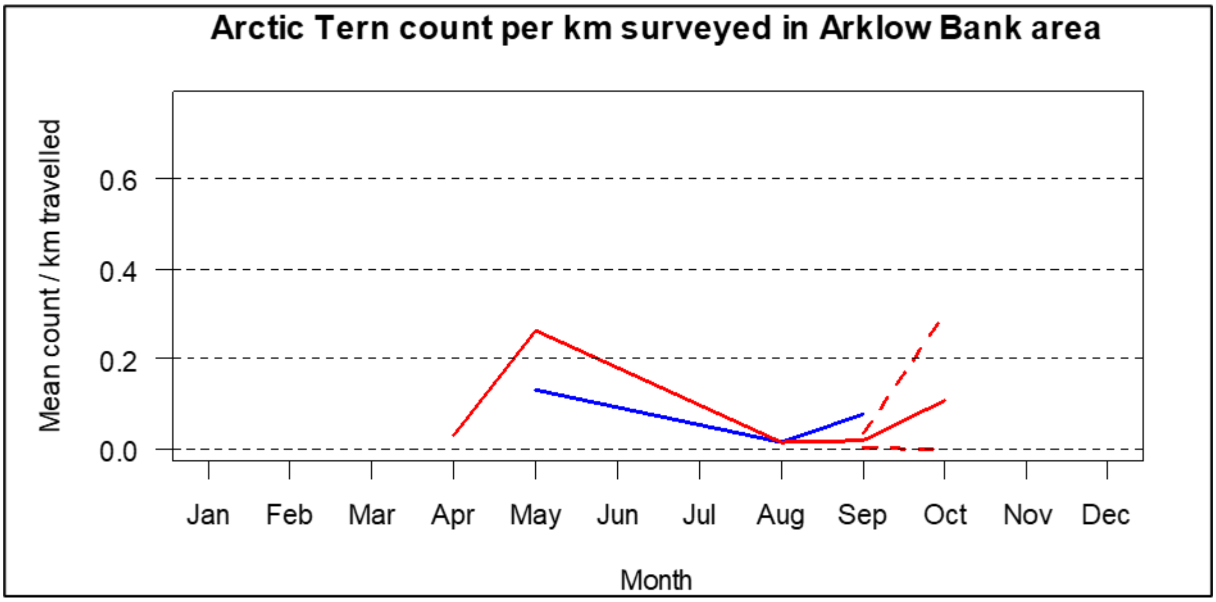

Figure 12.9.6: Arctic tern monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.3 Arctic terns were recorded in highest numbers in May (pre-breeding passage), with a second period of presence during post-breeding dispersal (August to October). There were very few observations, especially prior to construction, so it is not possible to comment on the relative densities, other than to observe that this species is not frequent in the area.

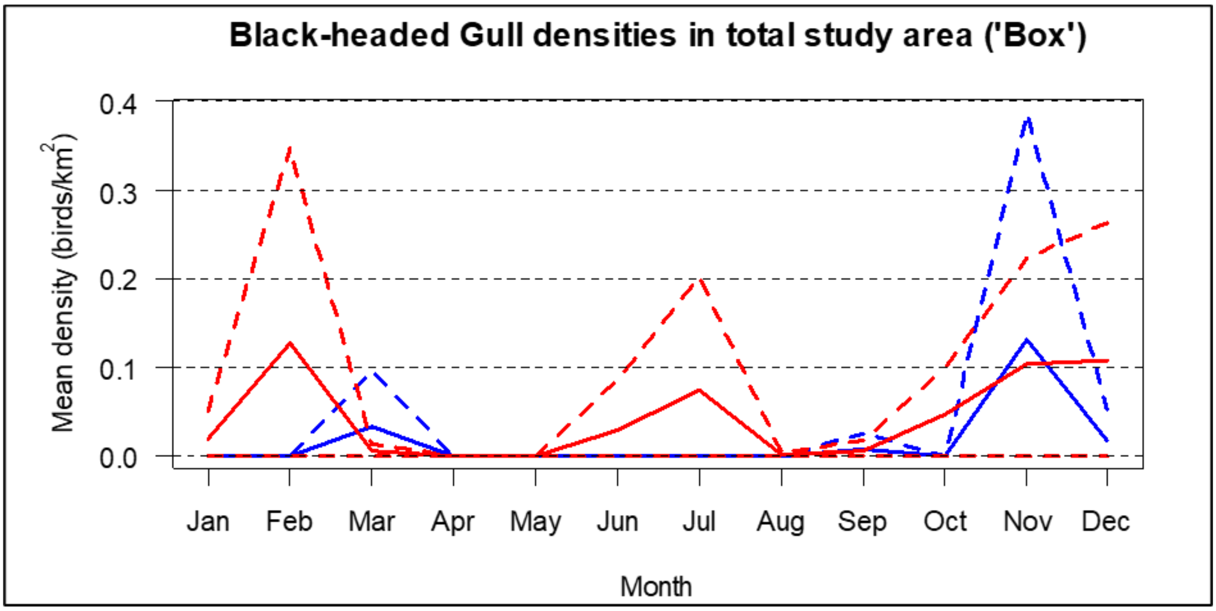

Figure 12.9.7: Black-headed gull densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

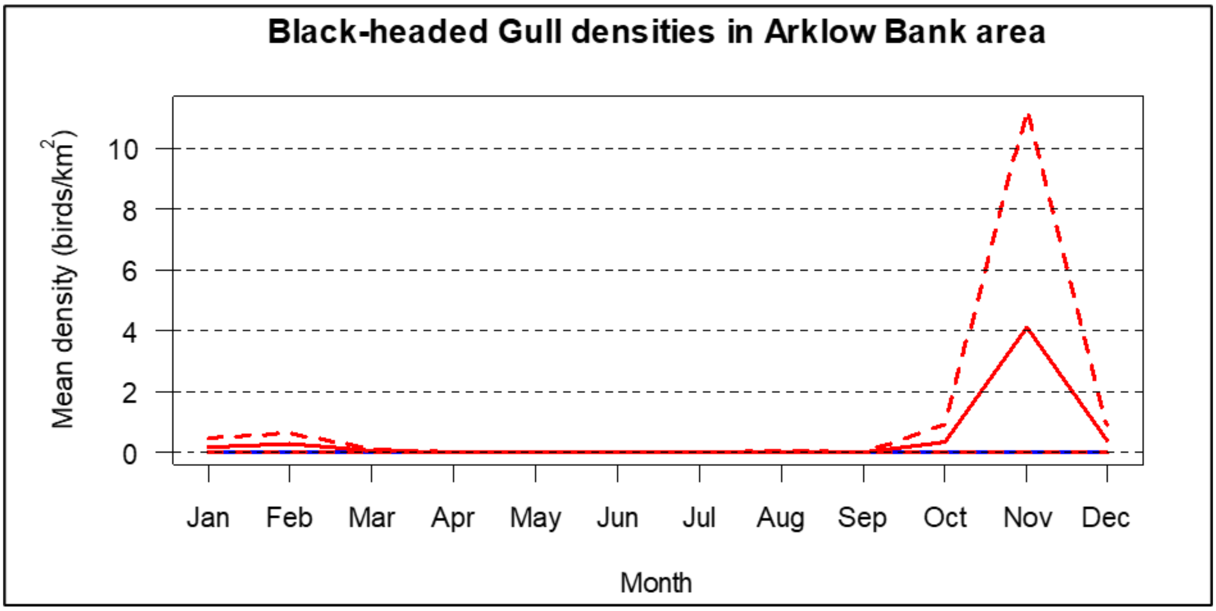

Figure 12.9.8: Black-headed gull densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.4 Black-headed gulls were generally recorded in variable but low numbers in the wider study area, with a notable peak recorded on the Arklow Bank in November. There were no clear trends in presence prior to and after construction.

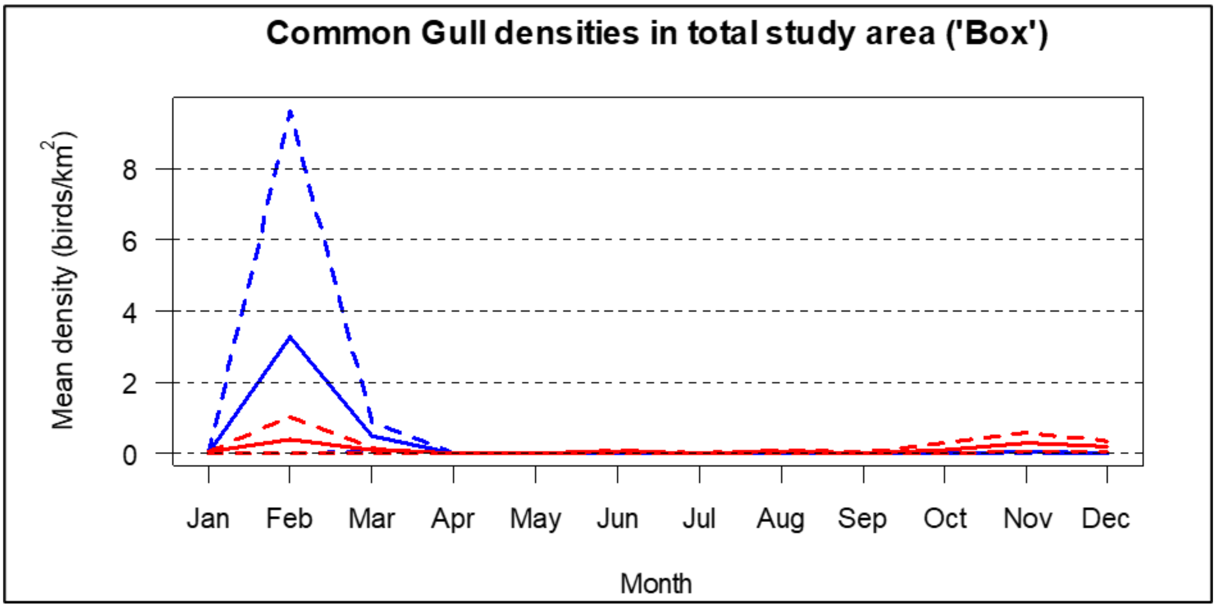

Figure 12.9.9: Common gull densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

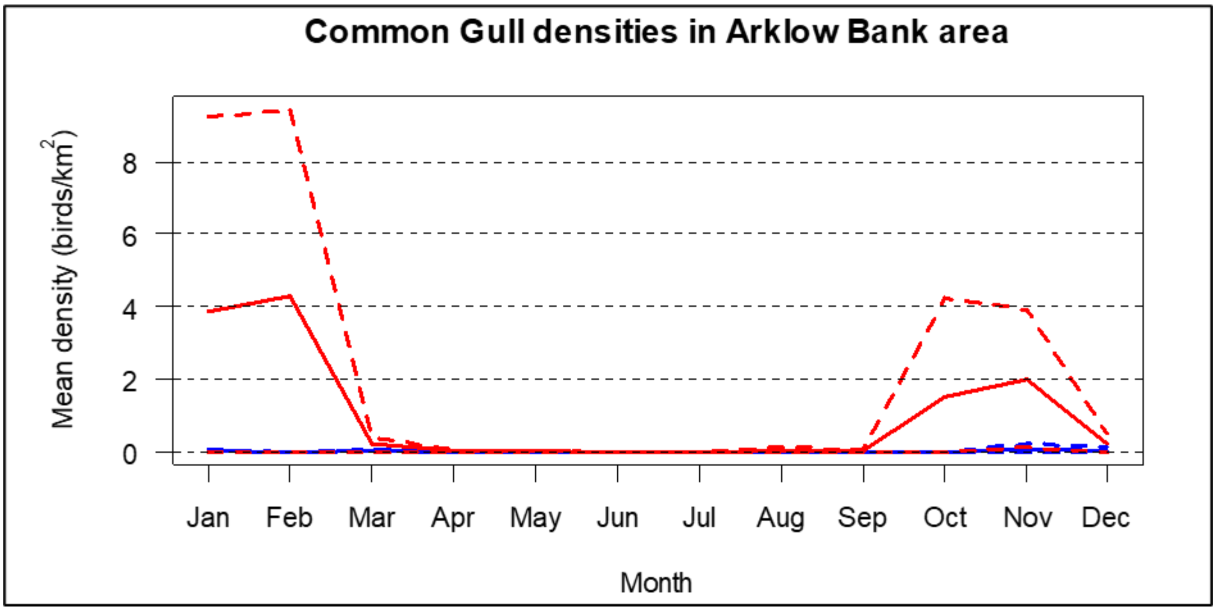

Figure 12.9.10: Common gull densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.5 Common gulls were almost entirely absent between April and September, with peaks in November and February, particularly on Arklow Bank. Presence before construction was higher outside the Bank, whereas presence post-construction was higher on the Bank.

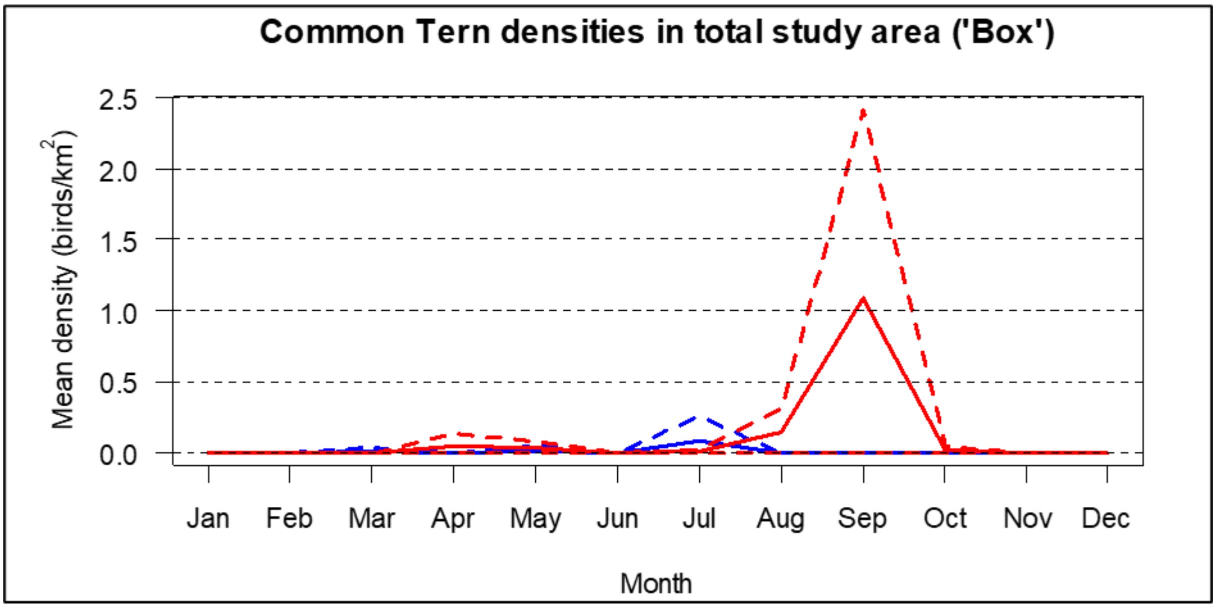

Figure 12.9.11: Common tern densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

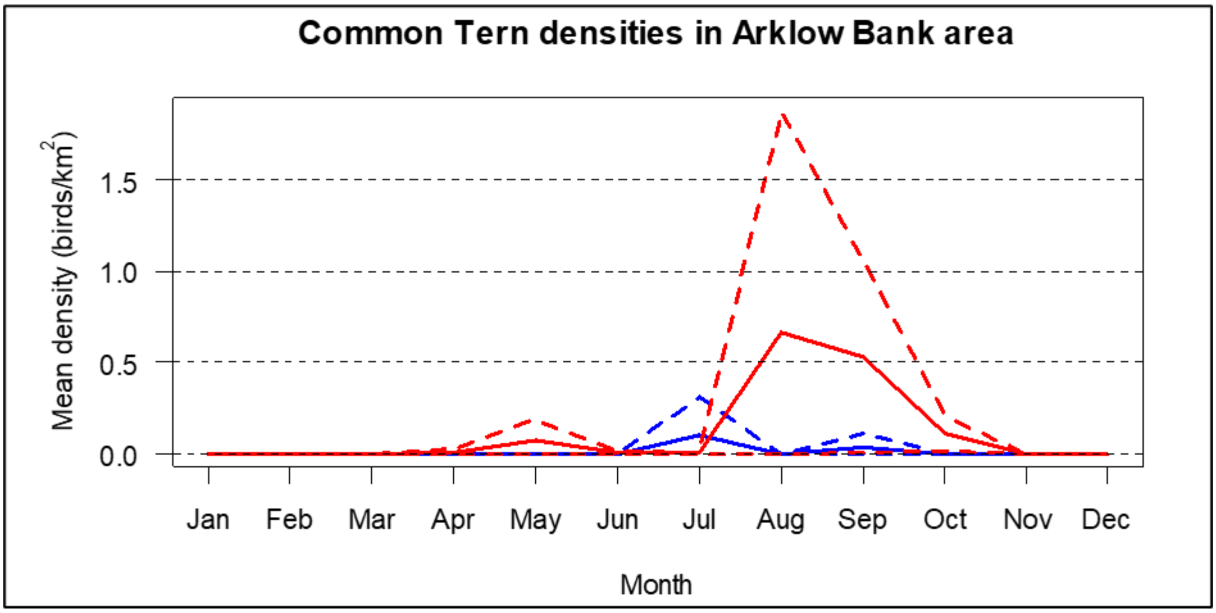

Figure 12.9.12: Common tern densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.6 Common terns were recorded in very low numbers between April and July with moderate peaks during the post breeding period in August and September. Both areas (wider region and Bank) showed higher densities in the post-breeding period following construction of ABWP1.

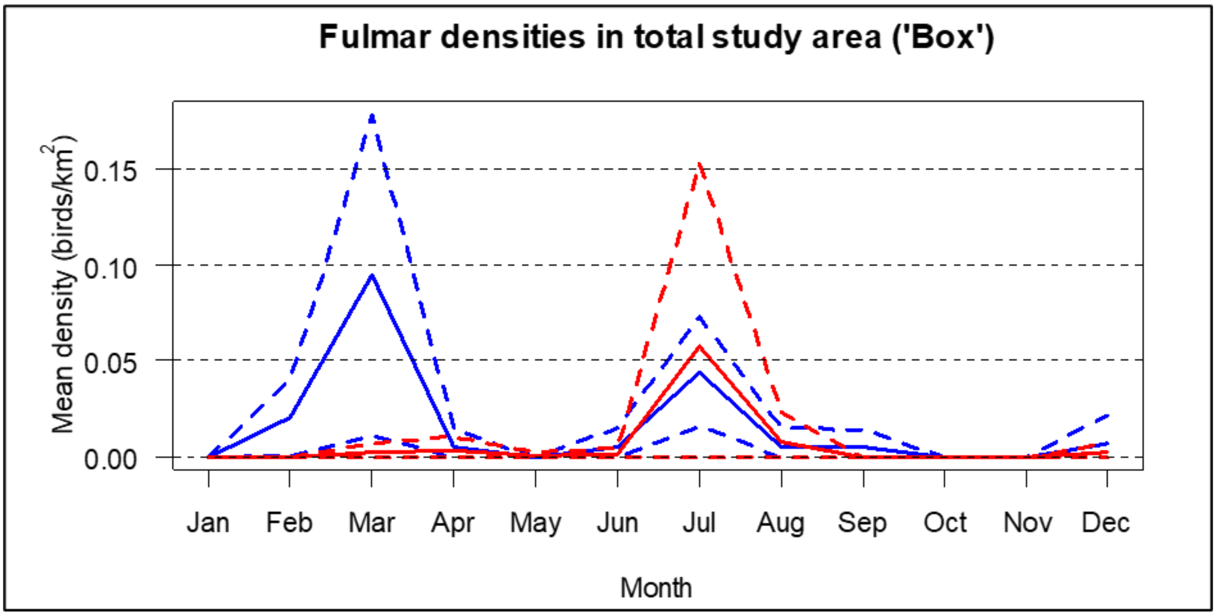

Figure 12.9.13: Fulmar densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

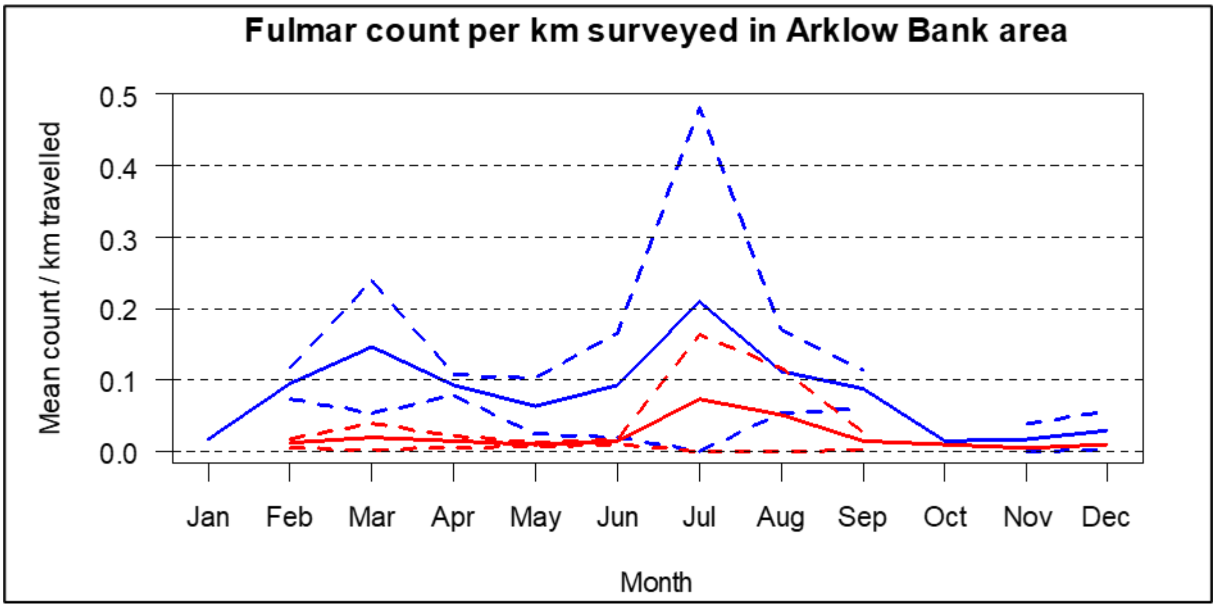

Figure 12.9.14: Fulmar monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.7 Fulmars were observed in most months, albeit in low numbers, with moderate peaks in March and July. There were generally higher densities before construction in both the wider area and on the Bank, with a slightly clearer trend on the Bank which may indicate avoidance of the ABWP1 wind turbines.

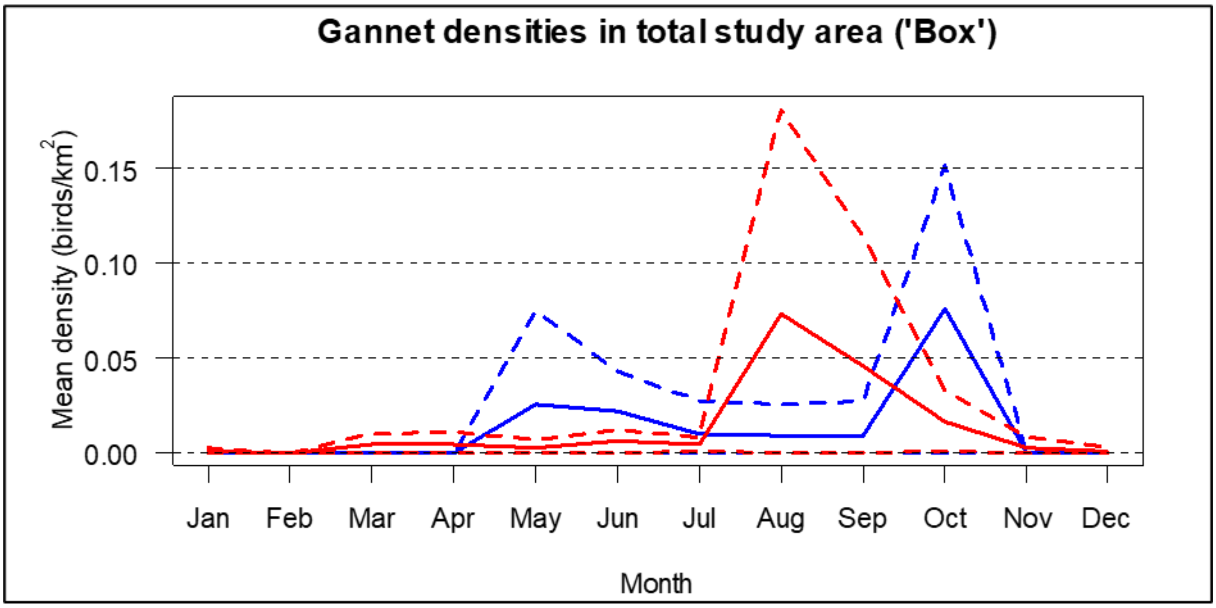

Figure 12.9.15: Gannet densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

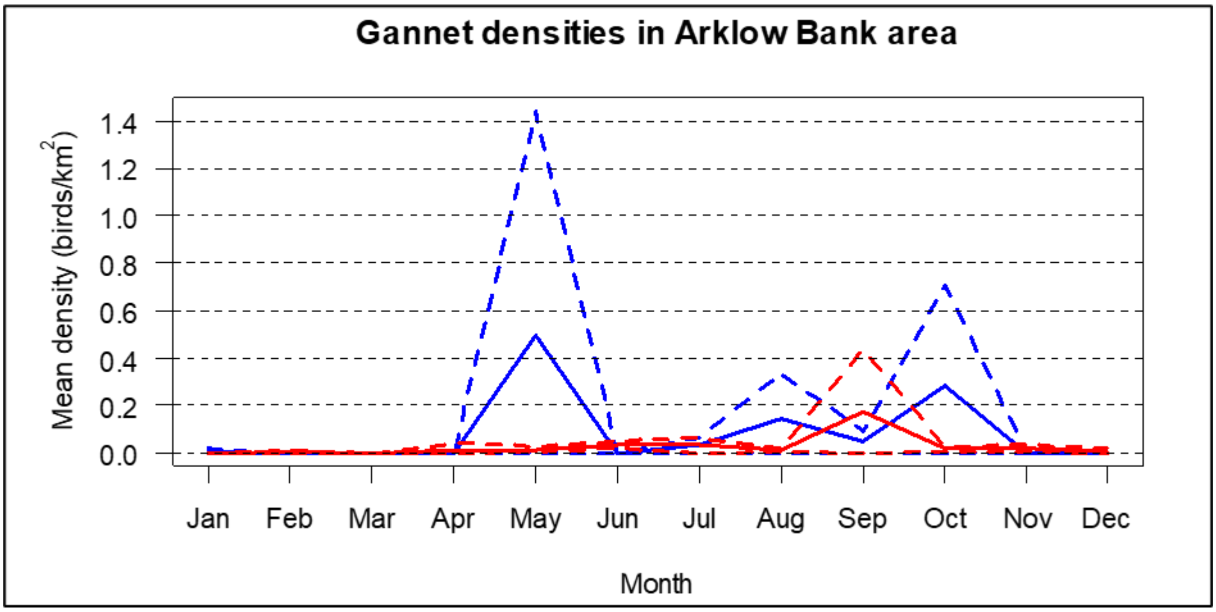

Figure 12.9.16: Gannet densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.8 Gannets were present in generally low numbers between May and November with peaks in May and also between August and October. There was no clear trend in the before and after densities, but numbers may have decreased post-construction in the Arklow Bank area.

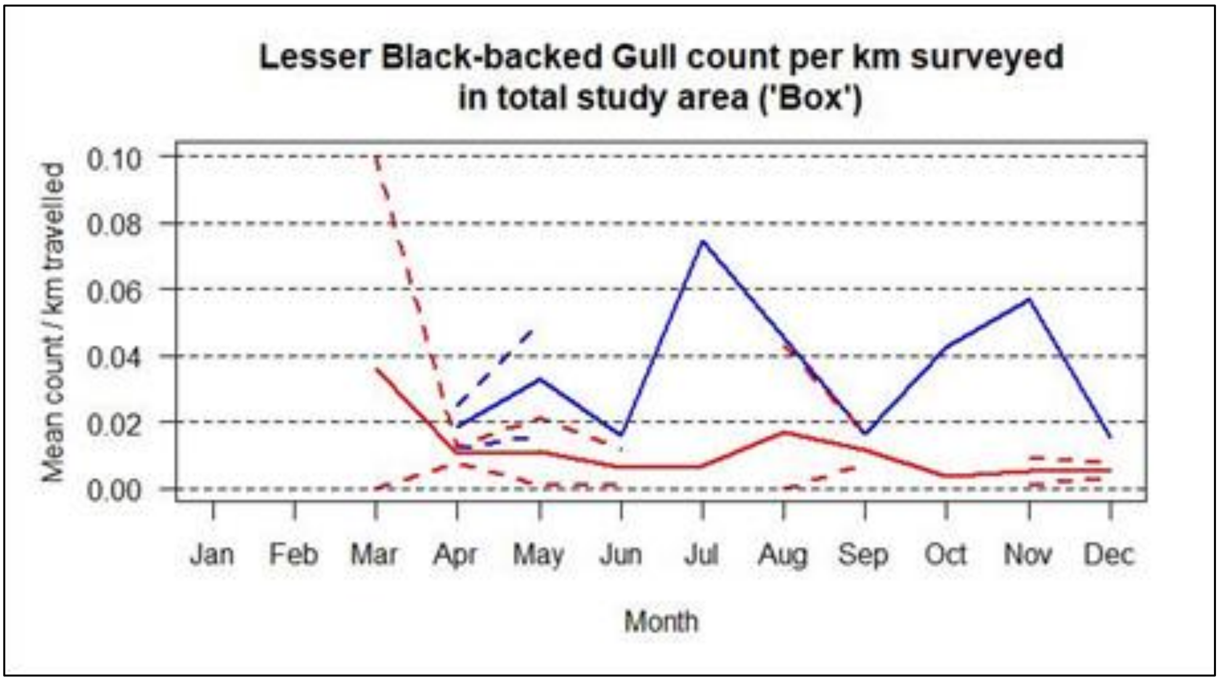

Figure 12.9.17: Great black-backed gull monthly counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

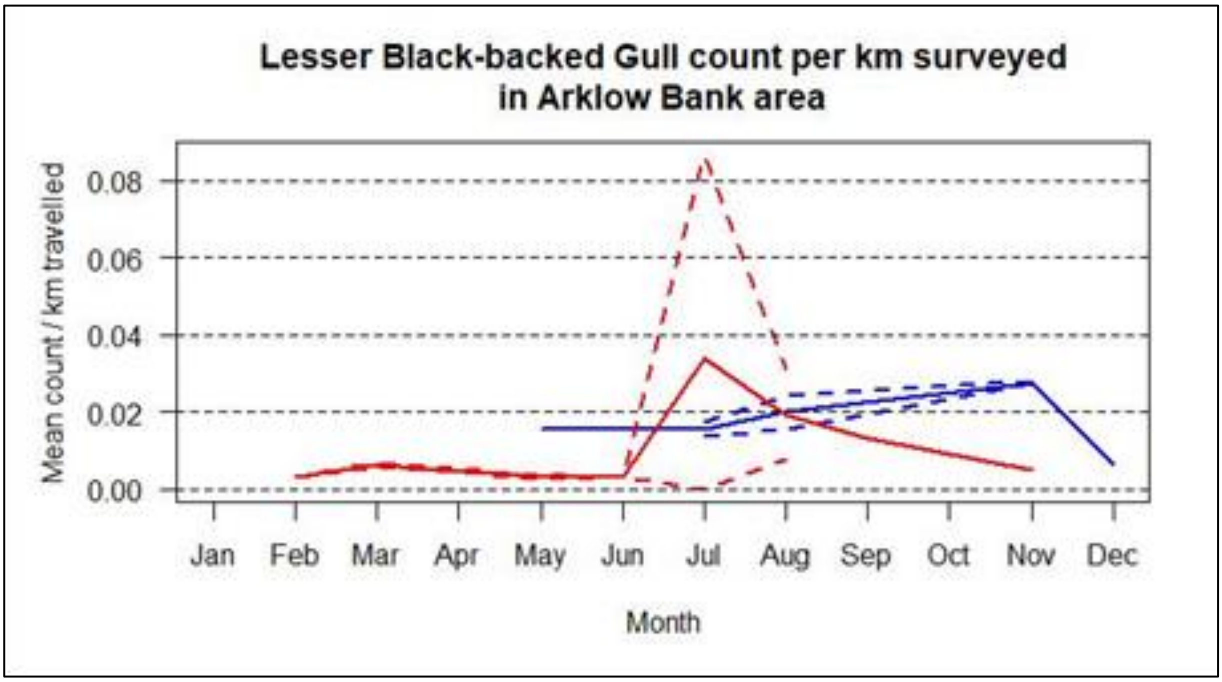

Figure 12.9.18: Great black-backed gull monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.9 Great black-backed gulls were recorded in low but variable numbers in most months, with lowest numbers during the breeding season and highest during spring and autumn. In the wider area, densities were consistently higher before construction, however the low number of records for this period limits the extent to which this can be considered a real effect. No clear before-after pattern was evident on the Bank.

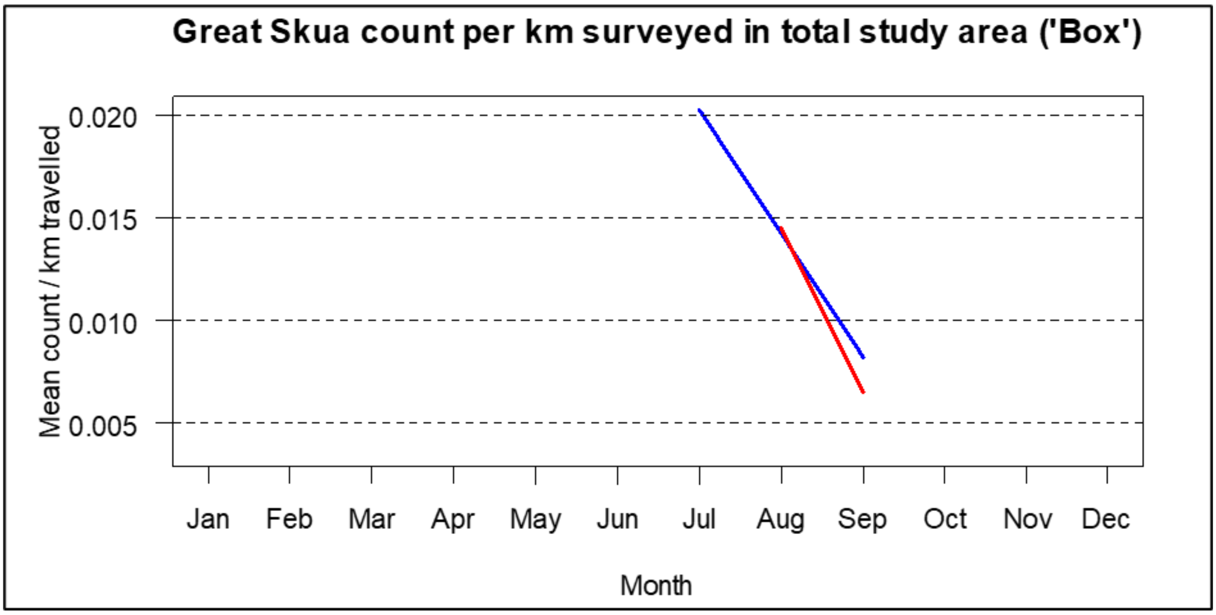

Figure 12.9.19: Great skua monthly counts per kilometre travelled in the total study area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

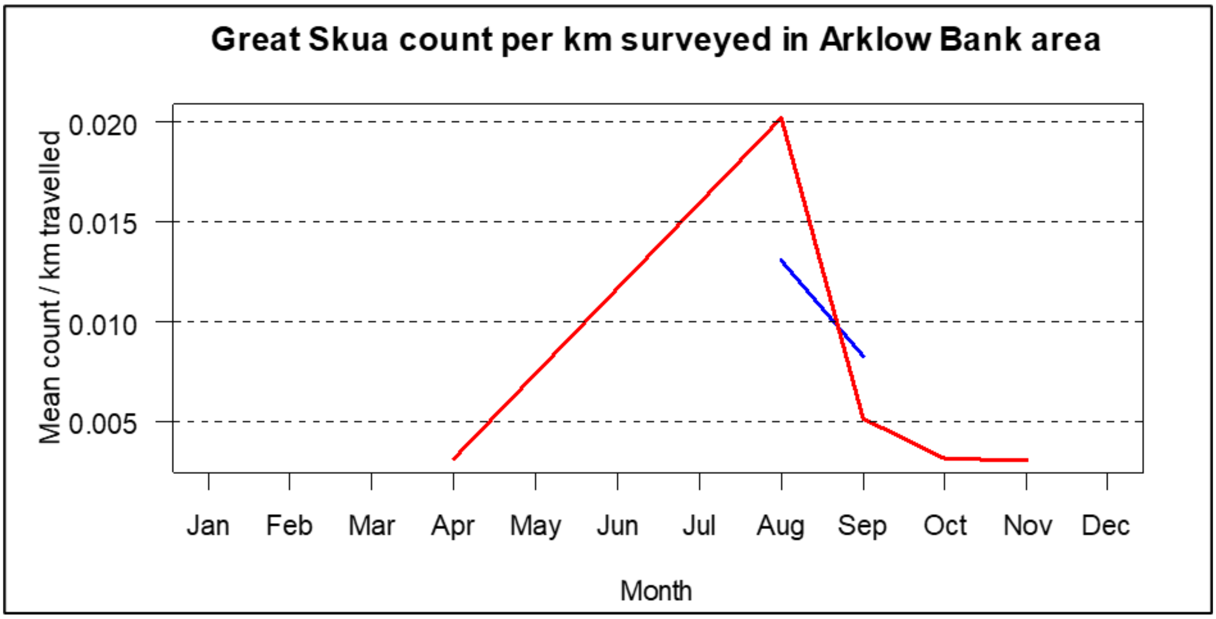

Figure 12.9.20: Great skua monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.10 Great skuas were only recorded between July and November, in very low numbers. This is consistent with post-breeding dispersal movements through the Irish Sea. There were too few observations to permit any before-after comparisons to be made, but patterns look similar before and after construction.

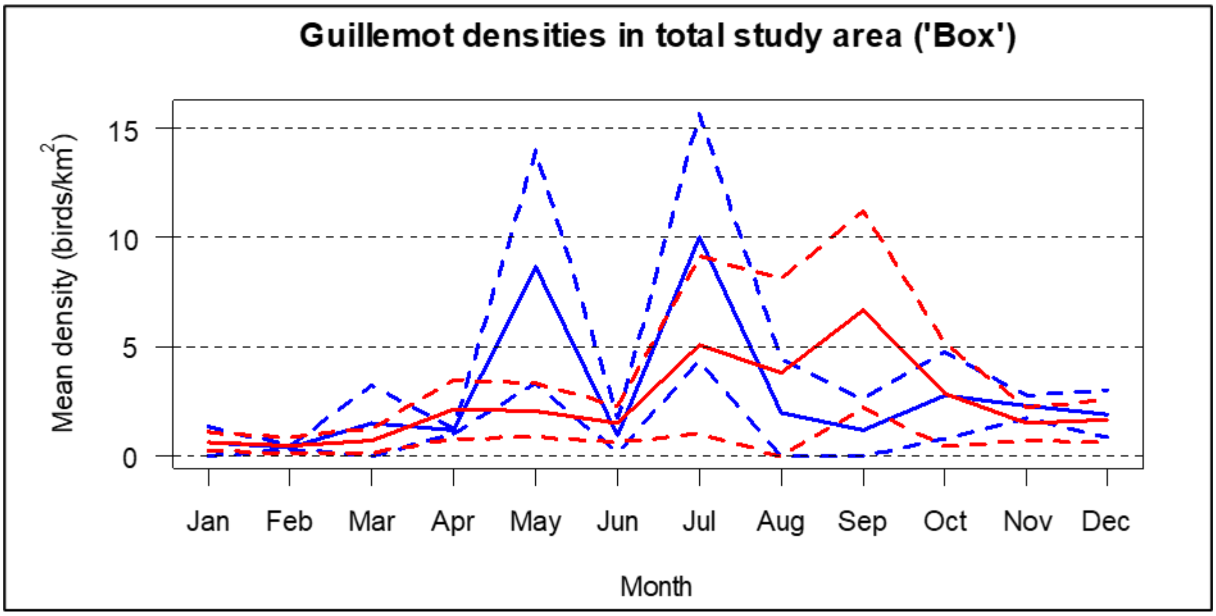

Figure 12.9.21: Guillemot densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

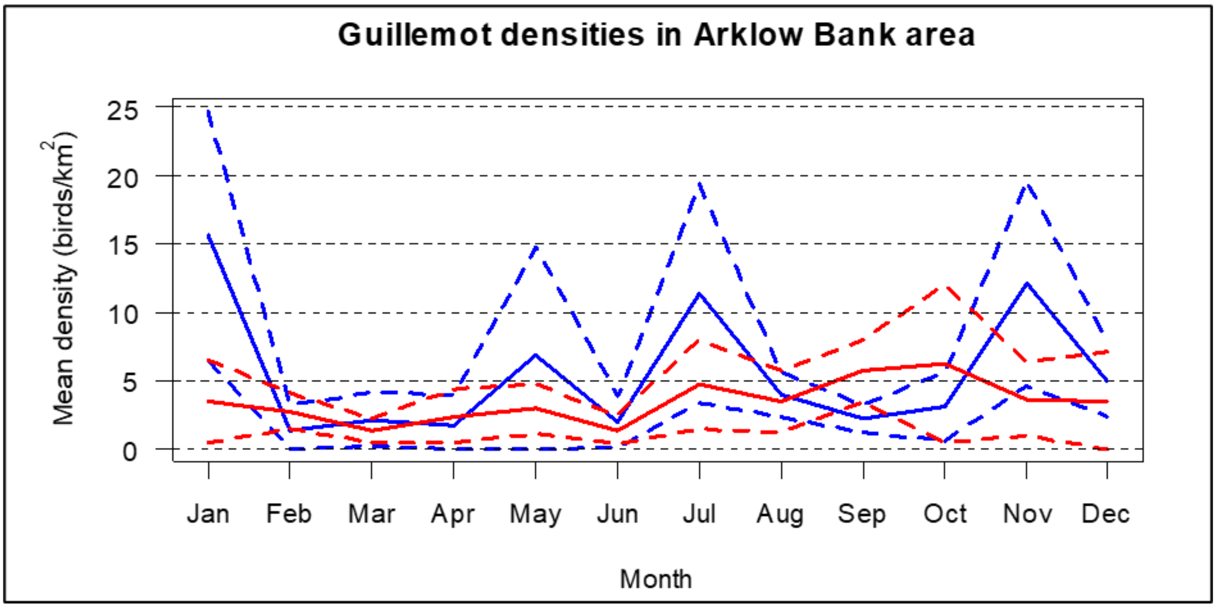

Figure 12.9.22: Guillemot densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.11 Guillemots were recorded in moderate to high numbers in all months, with peaks in May and July both in the wider area and also on the Arklow Bank. In addition, higher densities were also recorded on the Bank between September and January. There were higher peak densities prior to construction both on the Bank and in the wider area. While the pattern on the Bank could indicate avoidance of the ABWP1 wind turbines, the similar pattern in the wider area suggests this was part of a wider trend.

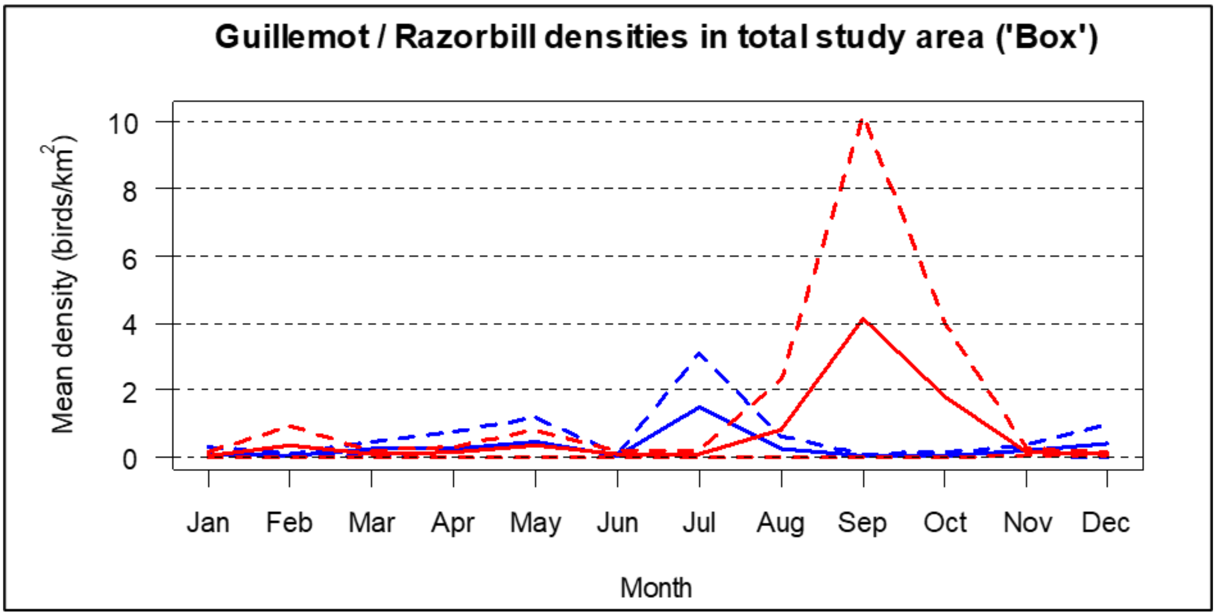

Figure 12.9.23: Unidentified guillemot/razorbill densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

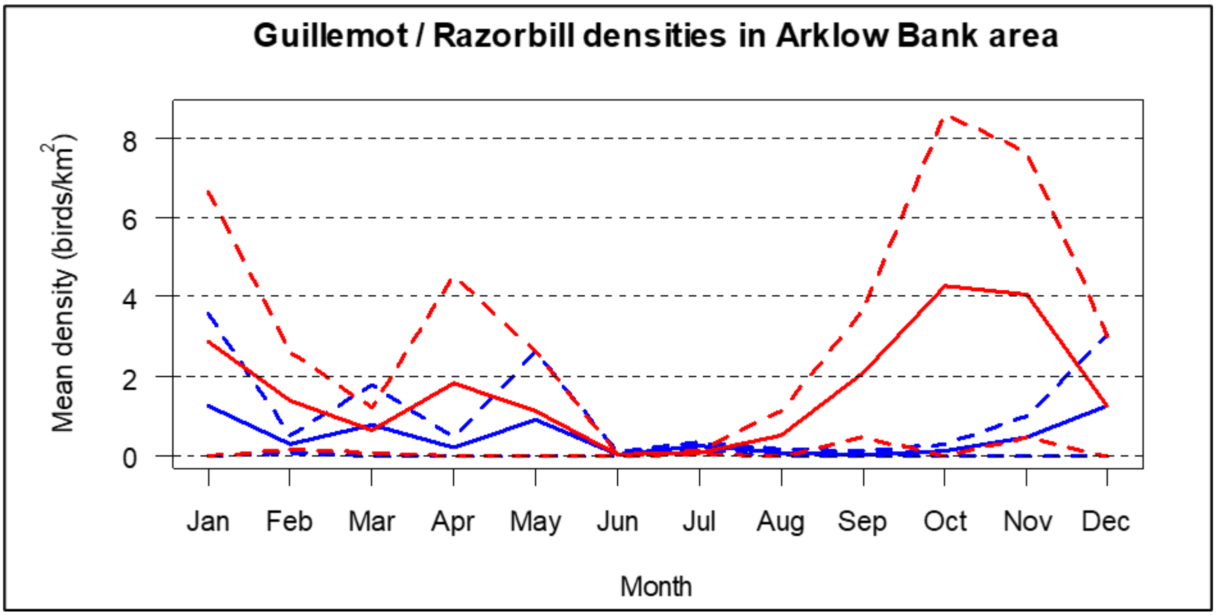

Figure 12.9.24: Unidentified guillemot/razorbill densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.12 The main peak for auks (which could only be identified as either guillemots or razorbills) was during the early mid-winter period (September to November), although as with guillemots there were moderate numbers present on the Arklow Bank throughout the winter. There were higher peaks recorded following construction, however overall, there is no clear before-after trend.

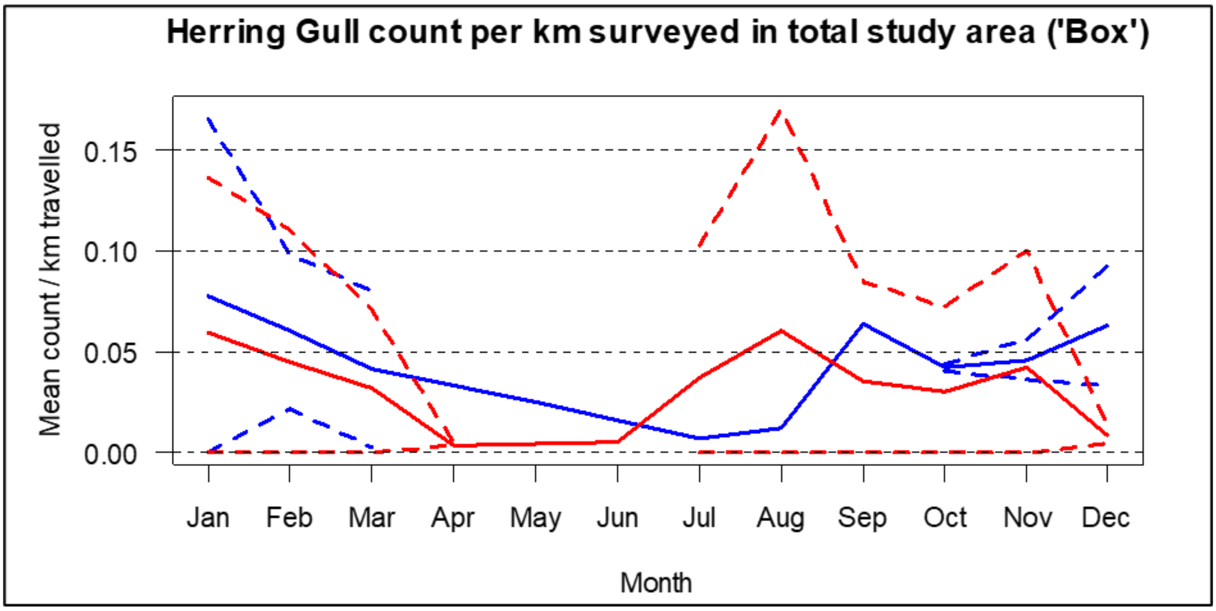

Figure 12.9.25: Herring gull monthly counts per kilometre travelled in the total study area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

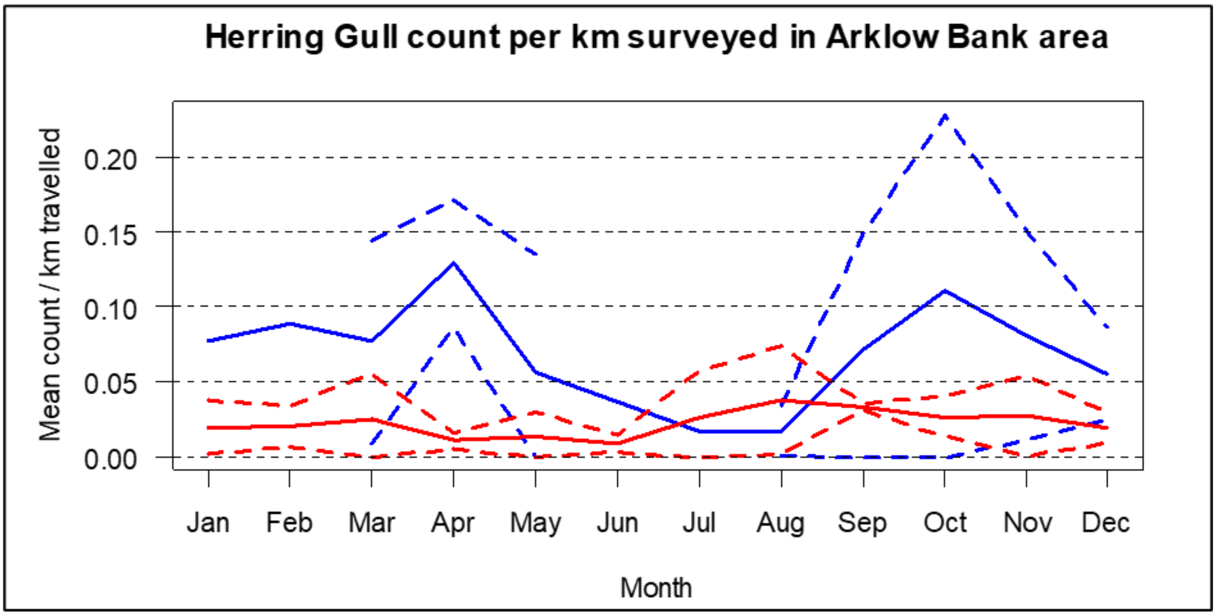

Figure 12.9.26: Herring gull monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.13 Herring gulls were recorded in all months in variable but low numbers. There is some indication of higher abundance outside the breeding season, especially prior to construction.

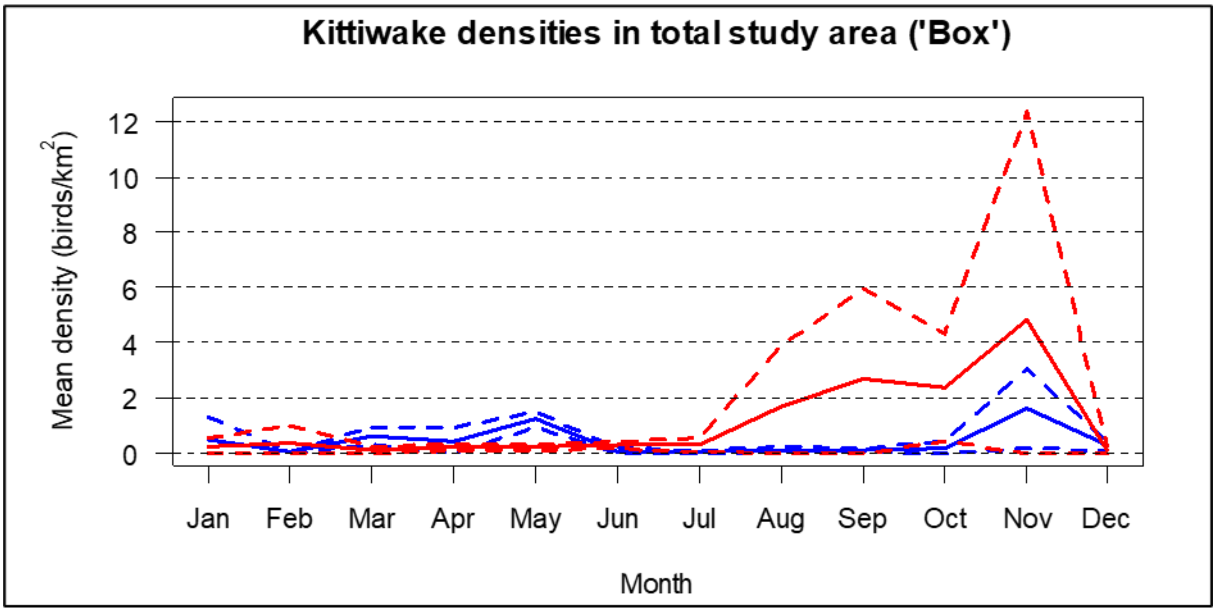

Figure 12.9.27: Kittiwake densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

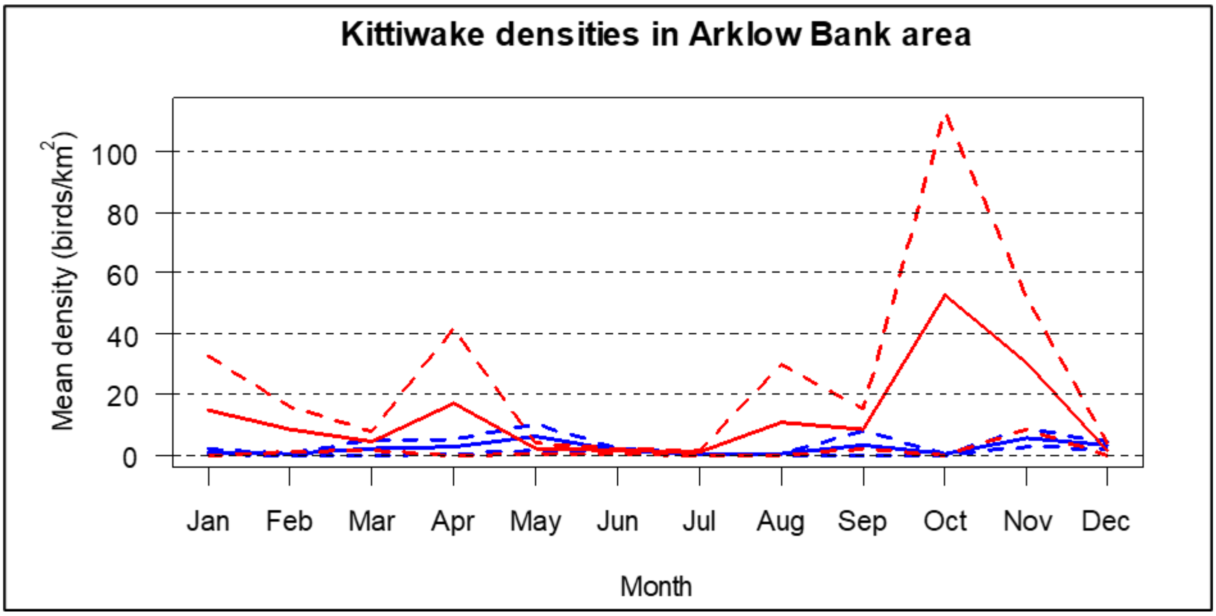

Figure 12.9.28: Kittiwake densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.14 Kittiwakes were the most abundant species, especially on the Arklow Bank, with high numbers recorded in the early winter period (October and November). Low to moderate numbers were also recorded during the remainder of the year, with a pre-breeding peak.

Higher densities were recorded following construction both in the wider area and on the Bank during the nonbreeding periods.

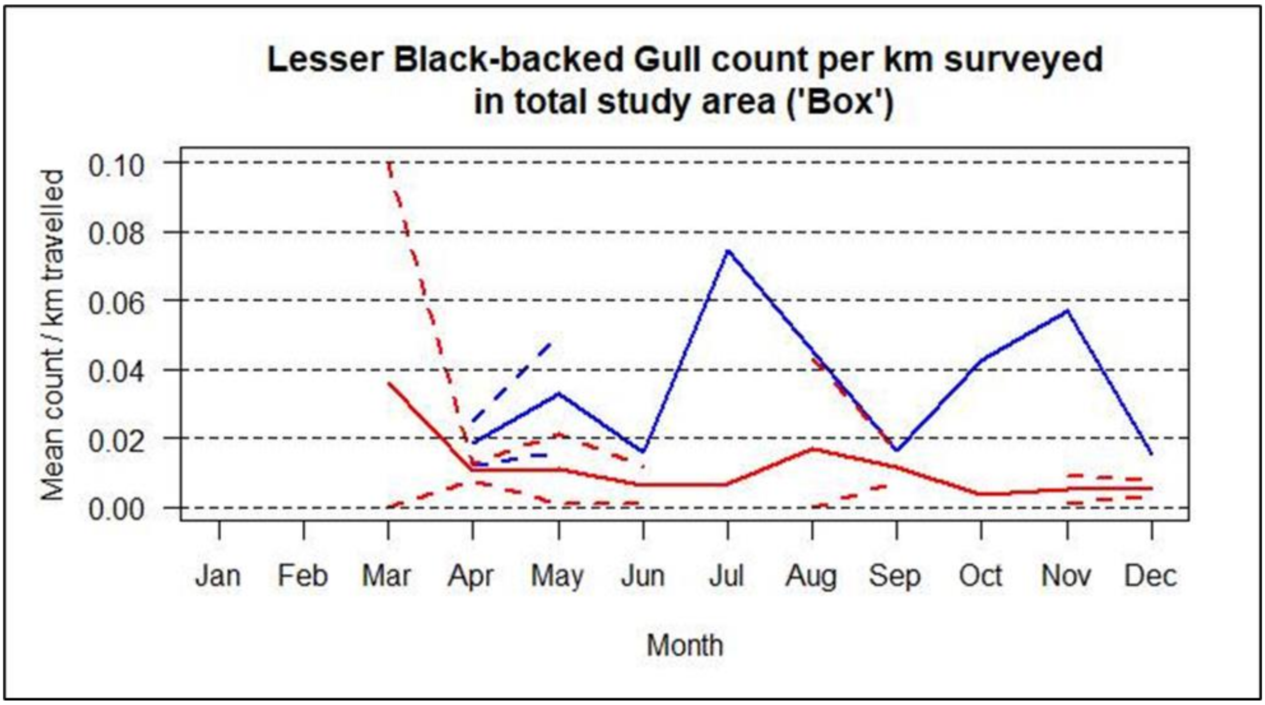

Figure 12.9.29: Lesser black-backed gull monthly counts per kilometre travelled in the total study area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

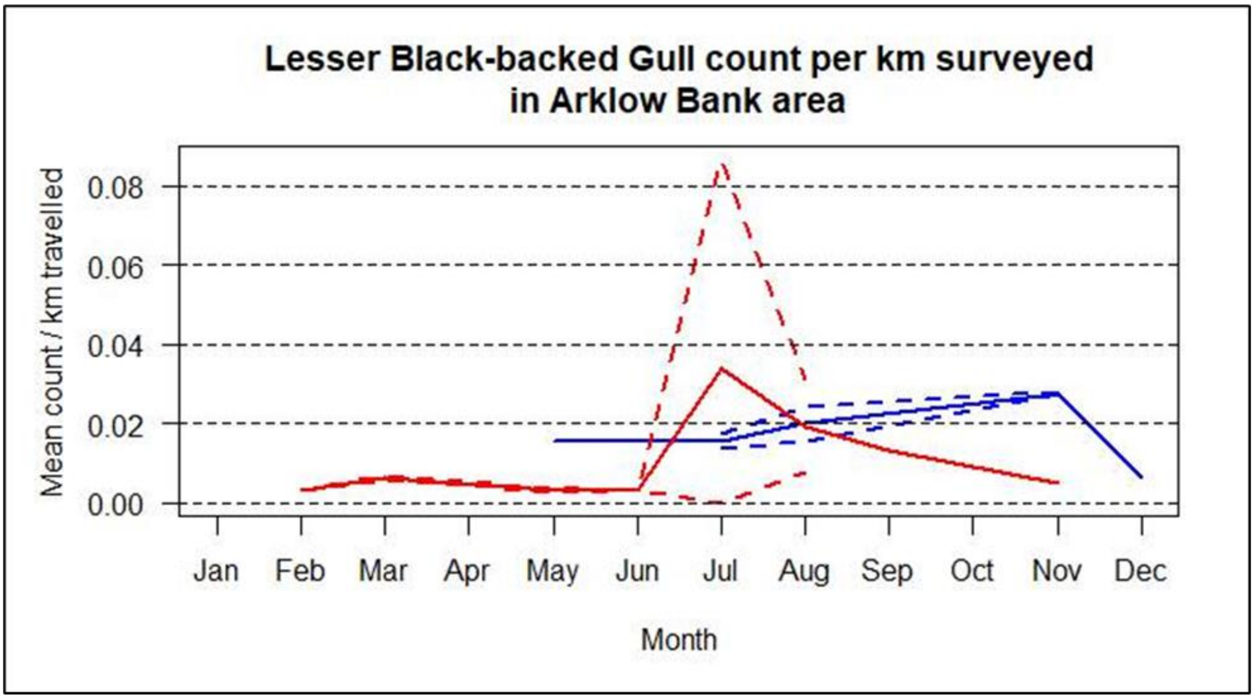

Figure 12.9.30: Lesser black-backed gull monthly counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.15 Lesser black-backed gulls were recorded in variable but low numbers in almost all months (but not in January). No clear seasonal patterns or differences between data collected before and after construction were evident.

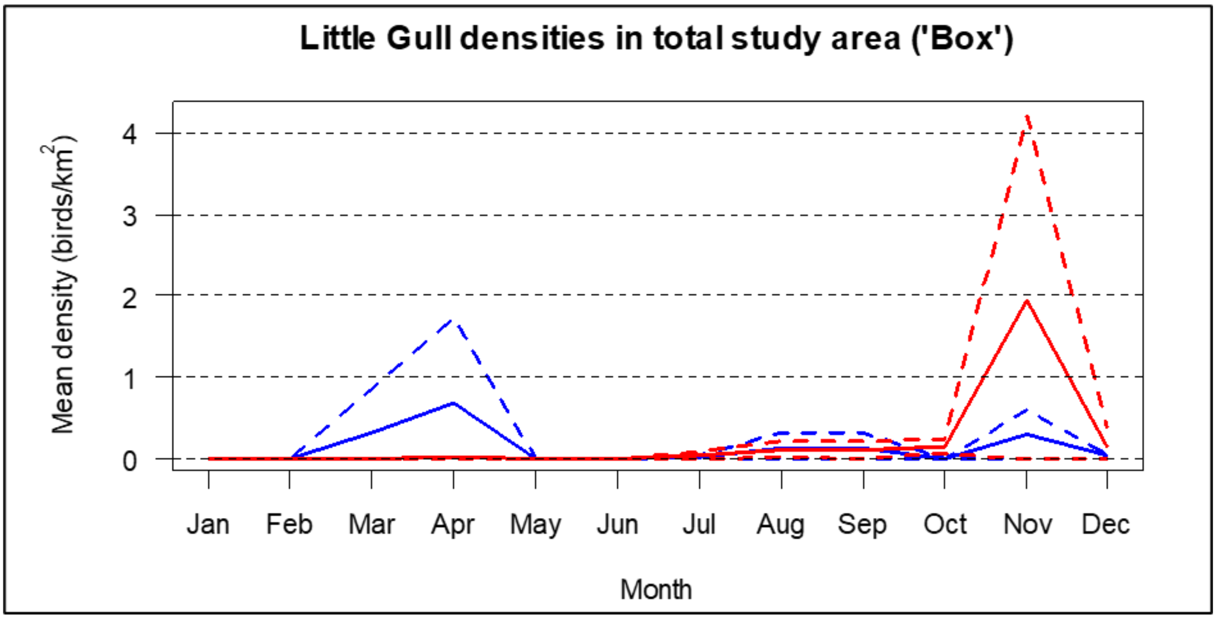

Figure 12.9.31: Little gull densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

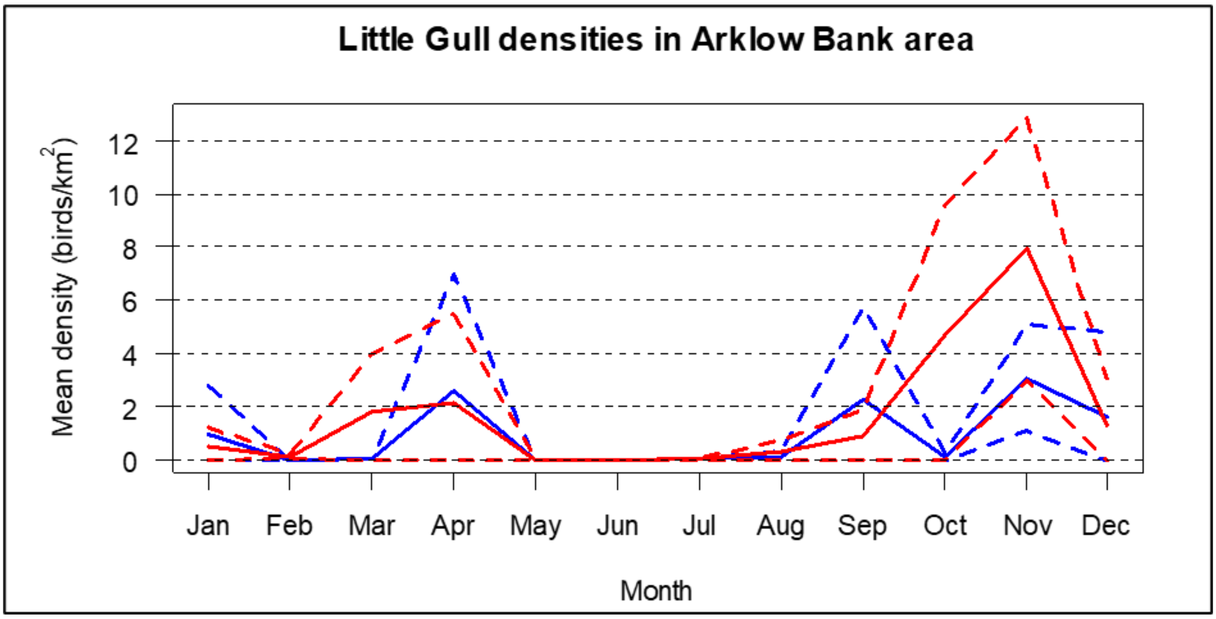

Figure 12.9.32: Little gull densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.16 Little gulls were recorded with two distinct peaks either side of the breeding season, the higher one in November, the lower in April, consistent with passage movements. The higher densities were recorded on the Arklow Bank. There was no clear trend in observations before or after construction.

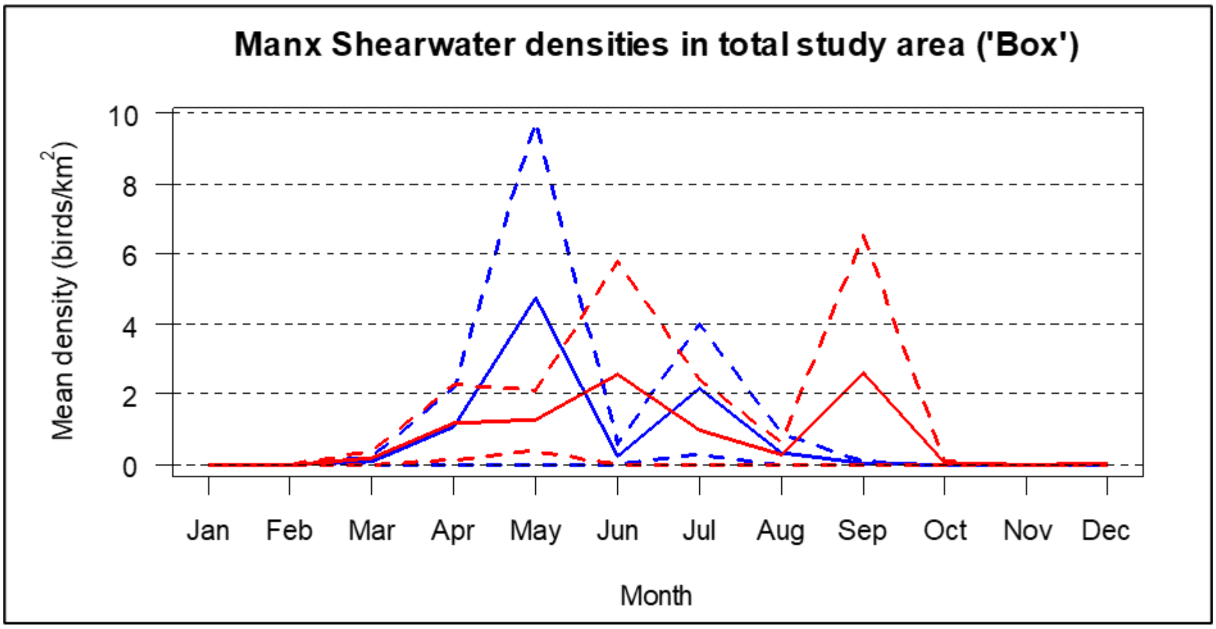

Figure 12.9.33: Manx shearwater densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

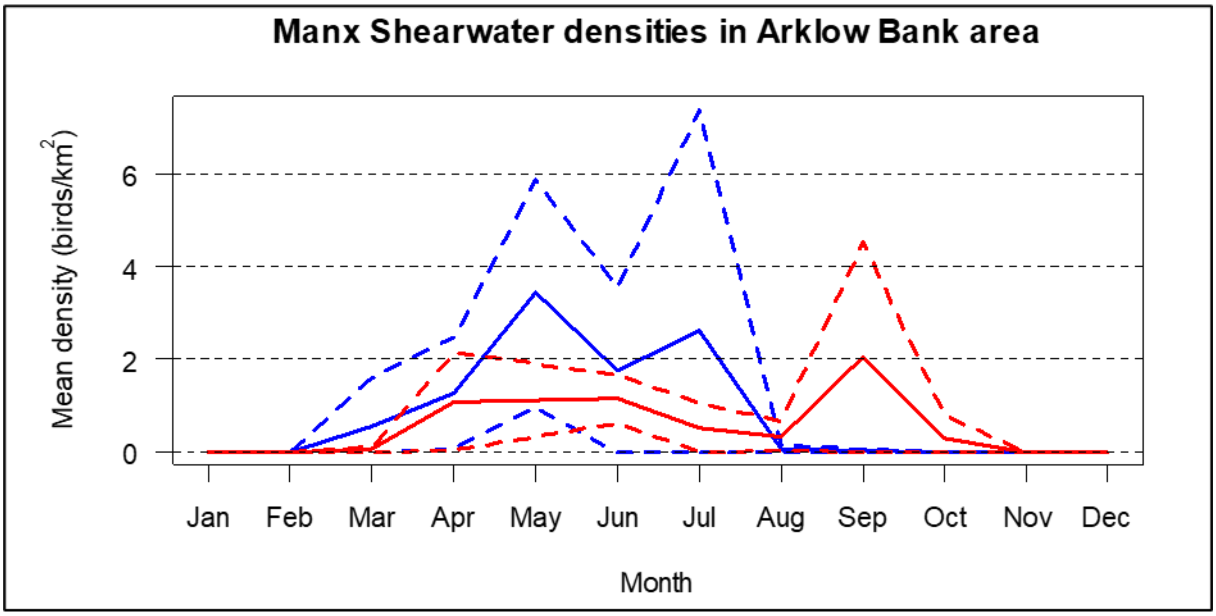

Figure 12.9.34: Manx shearwater densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.17 Manx shearwaters were recorded between March and October in moderate numbers, peaking in May and September. There were no apparent trends in the presence before or after construction.

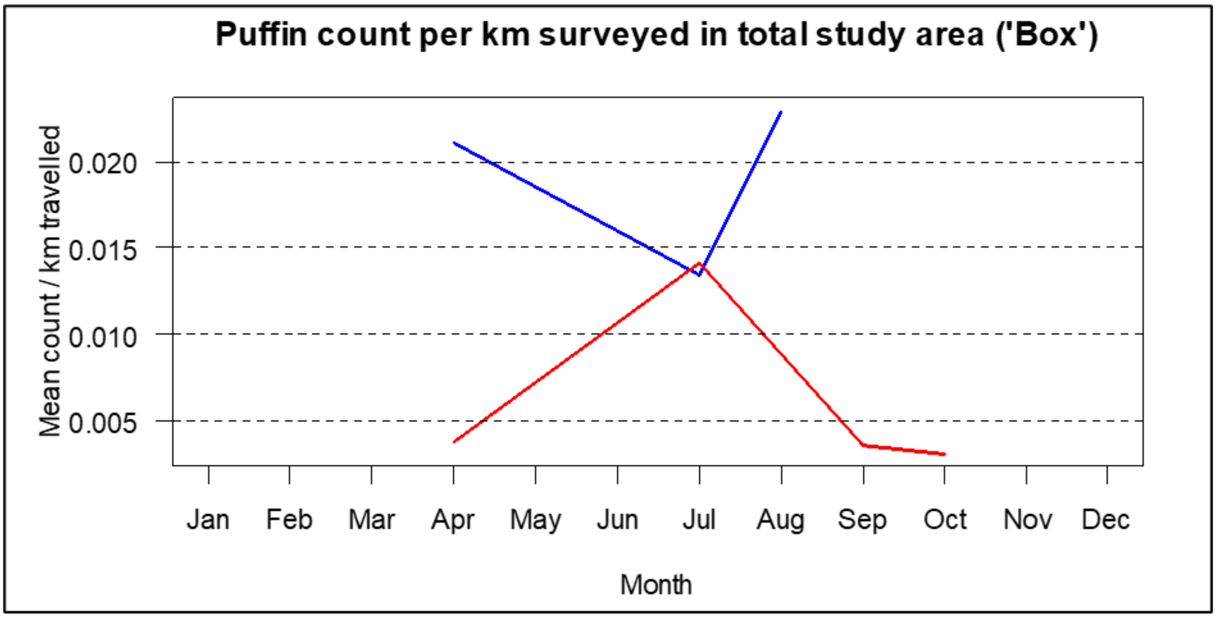

Figure 12.9.35: Puffin counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

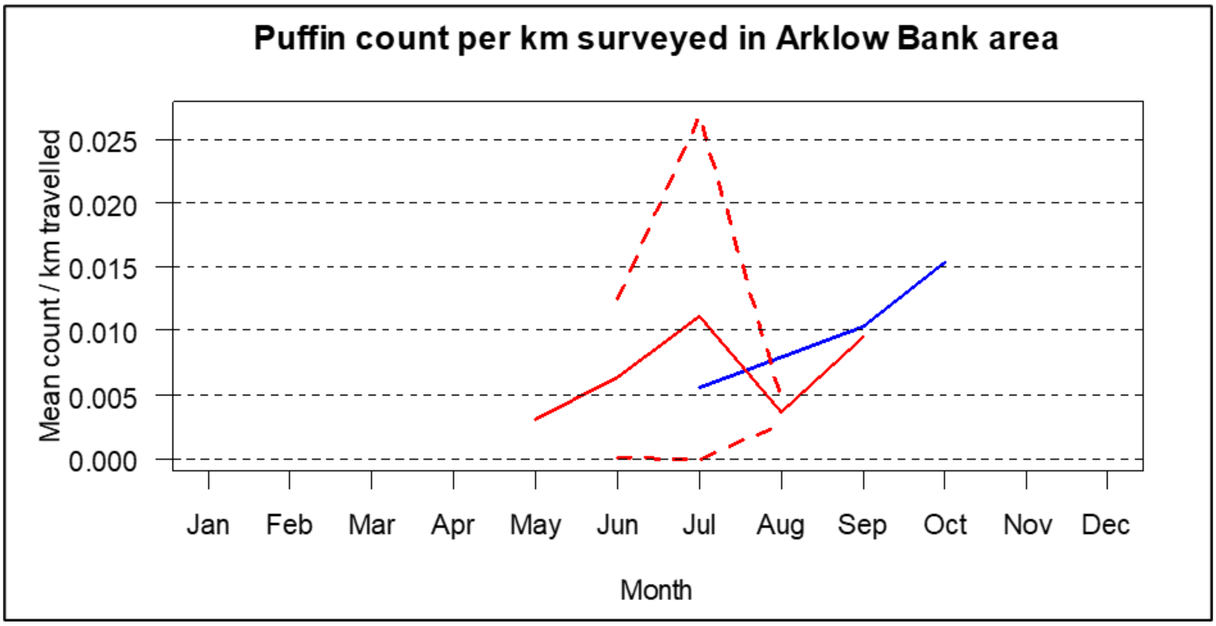

Figure 12.9.36: Puffin counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.18 Puffins were recorded in low and variable numbers between April and October and were otherwise absent from the surveyed areas. The very low number of records prevents robust comparison of before and after densities.

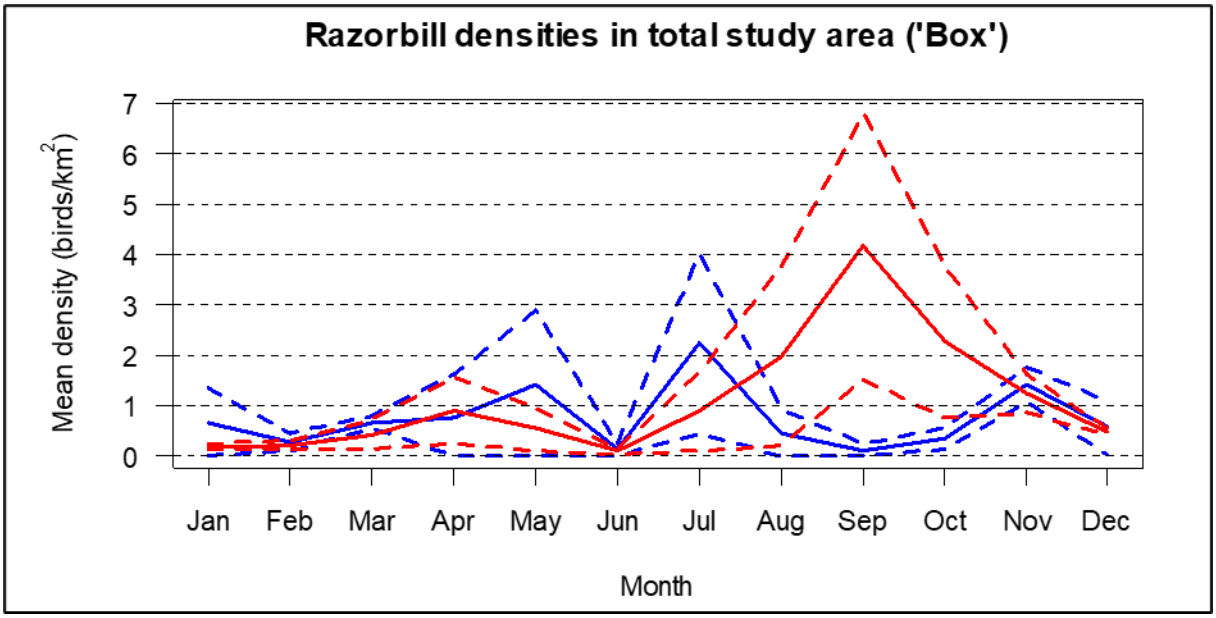

Figure 12.9.37: Razorbill densities in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

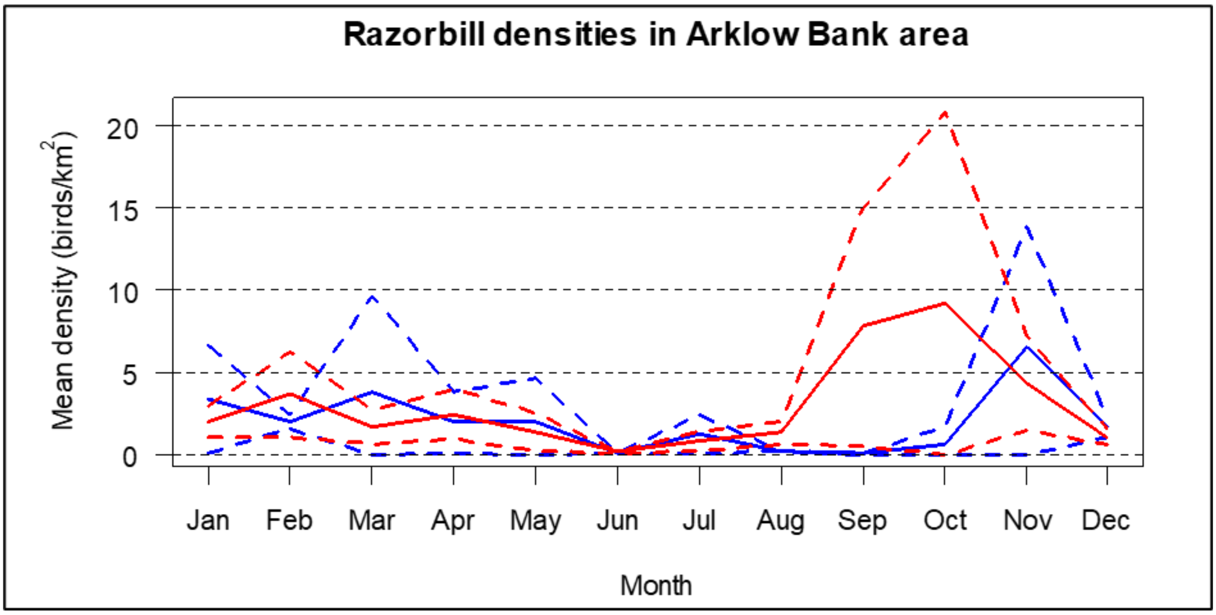

Figure 12.9.38: Razorbill densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.19 Razorbills were recorded in moderate densities in almost all months, with the lowest abundance in June and a peak in the early mid-winter (September to November). Peak densities were higher following construction, however there was no clear pattern across the year in either the wider area or the Bank.

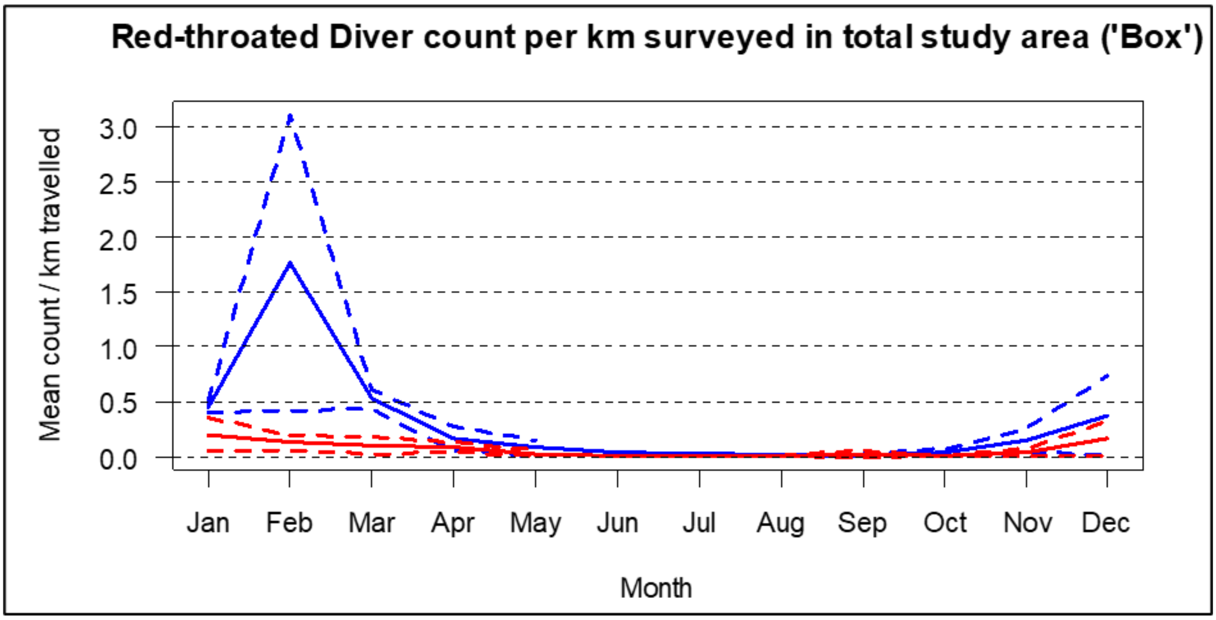

Figure 12.9.39: Red-throated diver counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

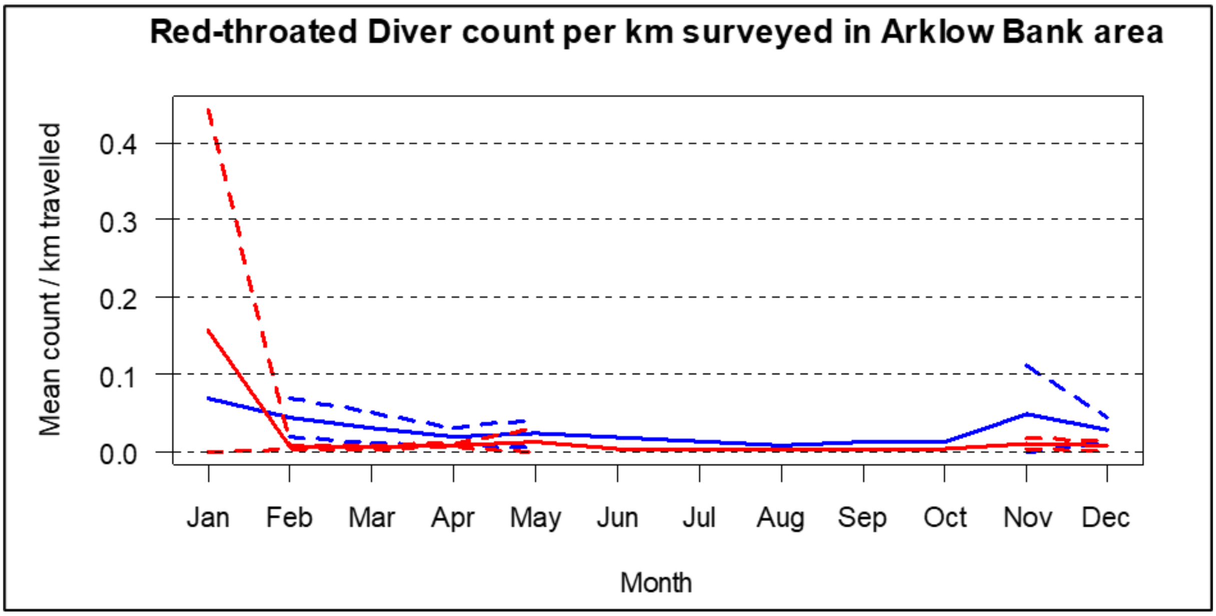

Figure 12.9.40: Red-throated diver counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.20 Red-throated divers were recorded in all months, albeit in very low numbers outside of a mid-winter peak period from December to February. With the exception of a mean January peak on the Bank, densities in all months were higher before construction than after. This may indicate avoidance of the ABWP1 wind turbines.

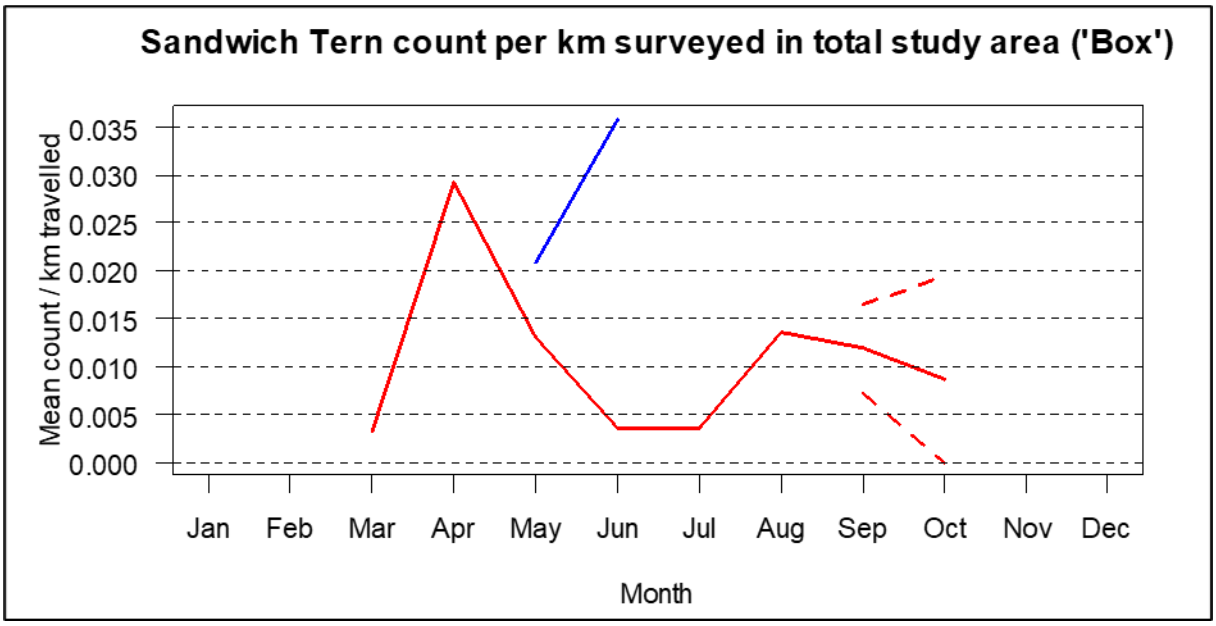

Figure 12.9.41: Sandwich tern counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

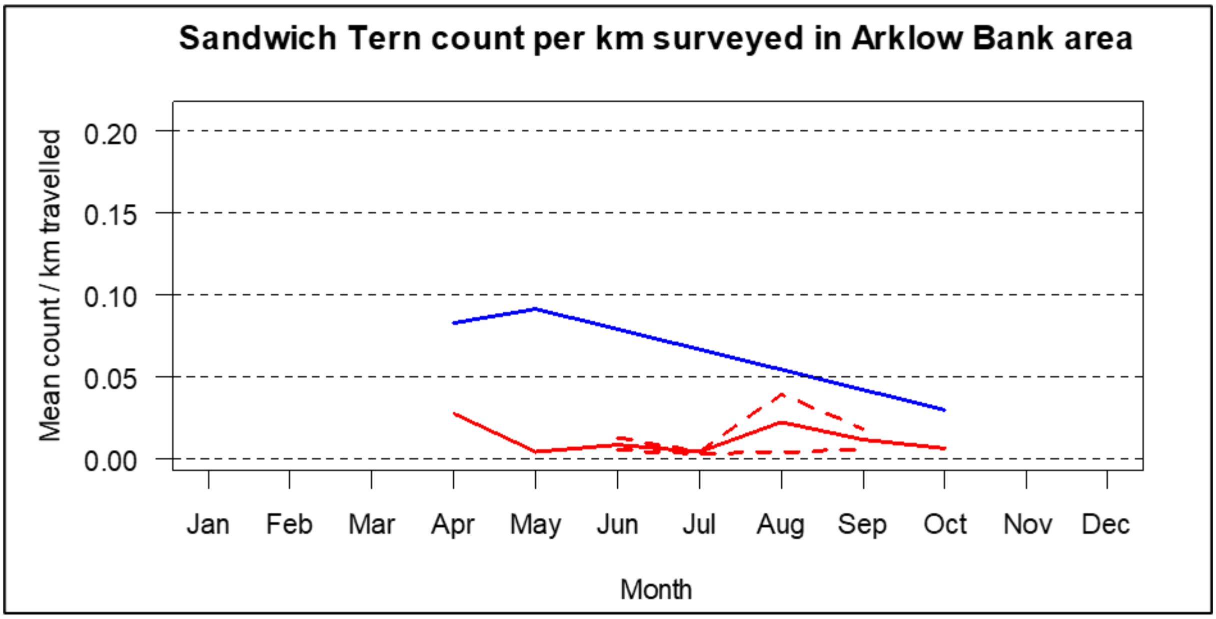

Figure 12.9.42: Sandwich tern counts per kilometre travelled in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.21 Sandwich terns were recorded in low and variable numbers between March and October, with highest numbers in April-May. There were too few observations to permit robust comparison of densities before and after construction.

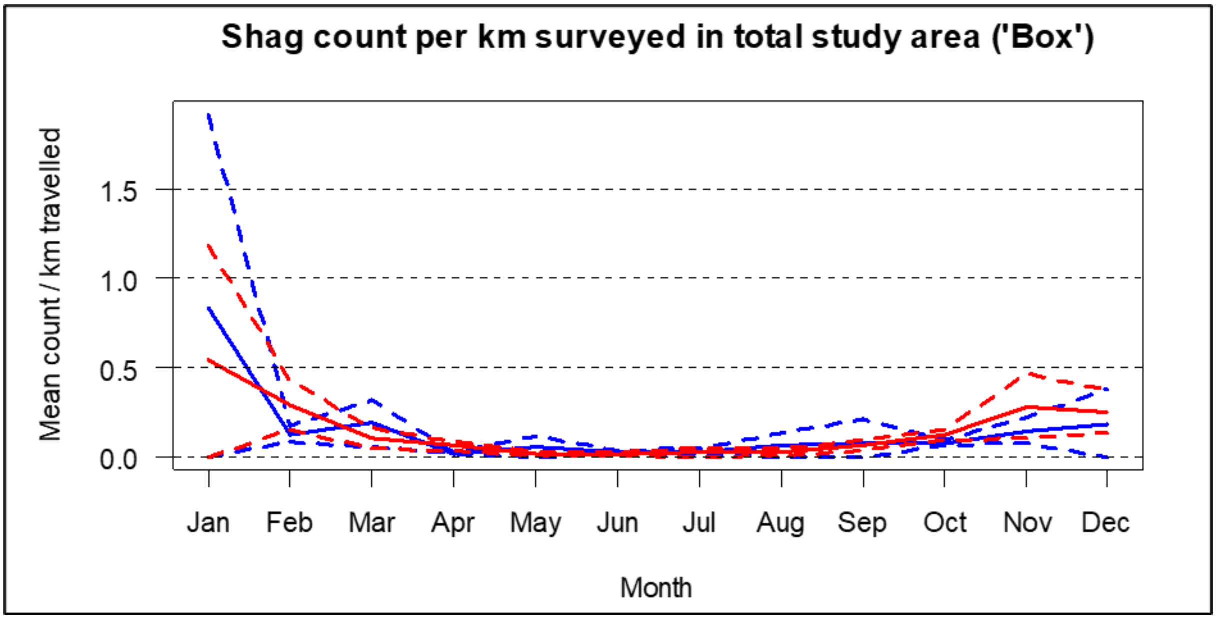

Figure 12.9.43: Shag counts per kilometre travelled in the total study area, not including the Arklow Bank (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

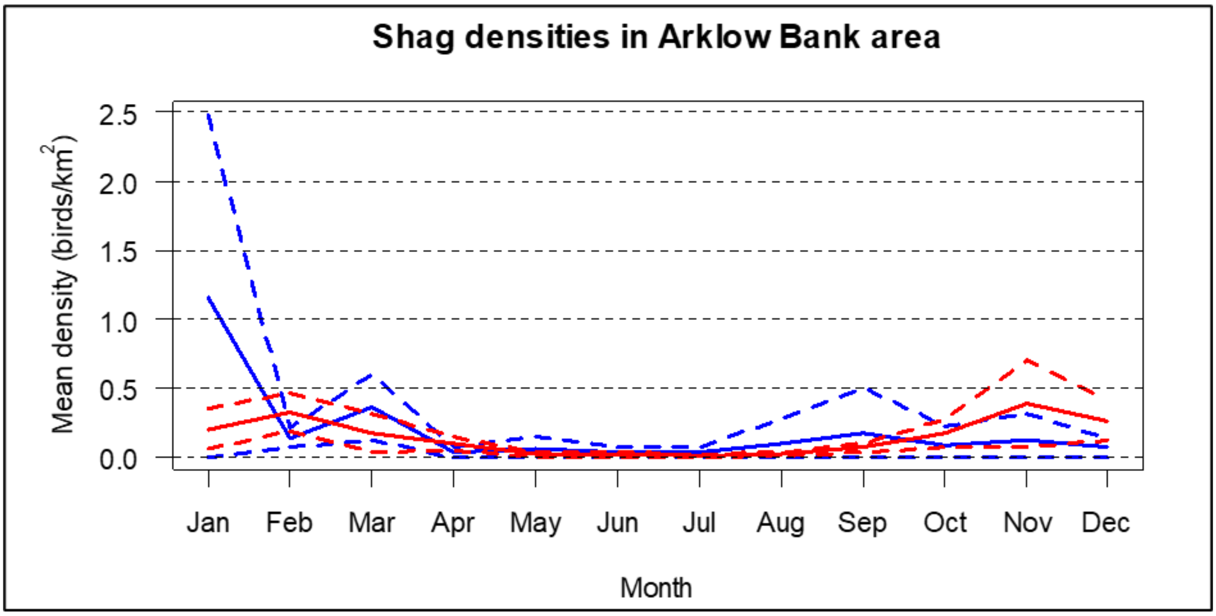

Figure 12.9.44: Shag densities in the Arklow Bank area (blue lines = before construction, red lines = after construction, solid lines = mean, dashed lines = 95% confidence intervals).

1.3.1.22 Shags were recorded in generally low numbers in all months, with highest abundance between November and February. There was no clear pattern of change in densities after construction.

1.3.2 Colony counts

1.3.2.1 All the species monitored at Wicklow Head increased in numbers between 2001 and 2010 (Figure 12.9.45), with mean annual rates of growth between 2.3% (razorbill) and 11.2% (fulmar). There were no relationships identified between the colony counts for these species and their respective mean or maximum densities recorded during the breeding season (defined here as May to July) in either the whole study region or the Bank.

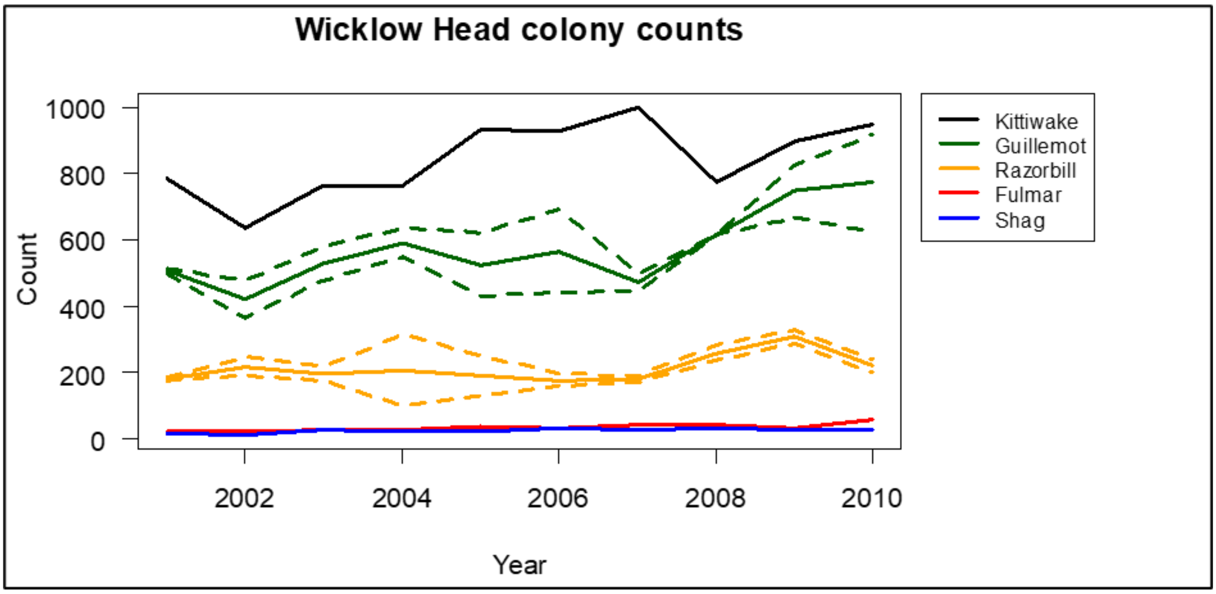

Figure 12.9.45: Wicklow Head colony counts 2001 to 2010. Guillemot and razorbill plots include estimates of the standard deviation (as provided in the colony counts (section 1.2.3).

1.3.2.2 Kittiwake productivity (section 1.2.3) varied between years during the period from 2001 to 2010, with a mean of 0.74 chicks per pair (range 0.38 to 1.1). Across the period monitored there was a suggestion of an overall increase in productivity, but this trend was not significant (p=0.26; Figure 12.9.46).

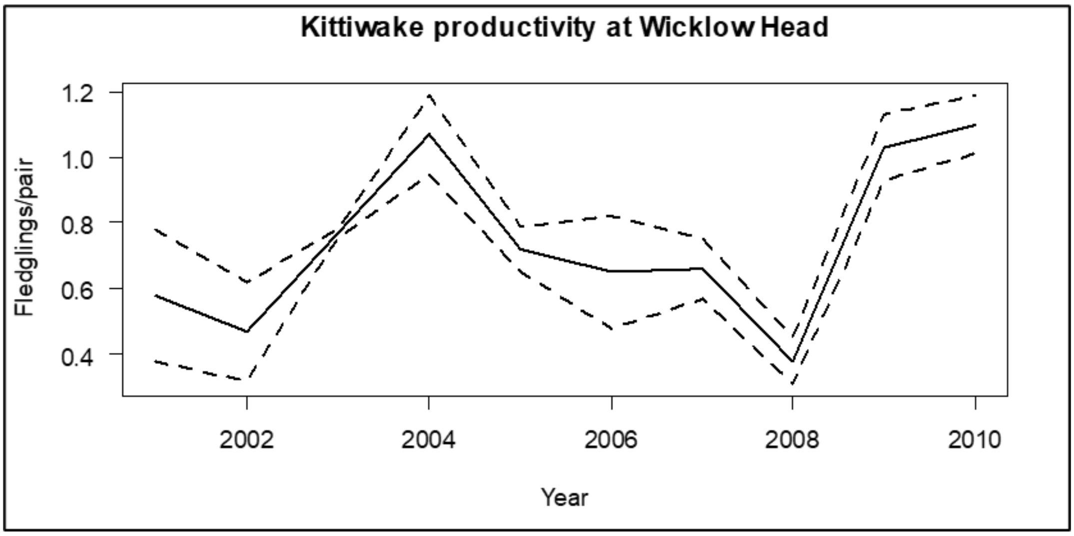

Figure 12.9.46: Kittiwake productivity (fledglings per pair) at Wicklow Head between 2001 and 2010, for birds monitored in sample plots.

1.4 Results

1.4.1 Survey results

1.4.1.1 This Technical Report has focussed on those species typically considered to be at risk of potential offshore wind farm effects. These tend to be the more abundant species (e.g. guillemot and kittiwake) and also those for which there is a developing evidence base indicating their sensitivity to disturbance from the presence of turbines (e.g. red-throated diver, Dierschke *et al*., 2017) and those for which behavioural aspects, such as flying at rotor swept heights, may put them at greater risk (e.g. gannet and large gull species).

1.4.1.2 Although offshore wind farms can affect seabirds during construction (e.g. disturbance and displacement), the primary concerns relate to operational impacts, of which the key ones are collision risk with rotating turbines and displacement due to the presence of the turbines (i.e. unrelated to maintenance vessels etc.). Seabird species tend to be at risk of one or the other of these two, rather than both, due to features of their behaviour and ecology. Hence, auk and diver species, which have low collision risks since they fly below rotor height the majority of the time, are considered as the primary species at risk of displacement effects. In contrast, gannet, kittiwake and the large gull species spend higher proportions of their time in flight at rotor heights and are considered as the main species at risk of collisions. Other species, including smaller gull species (e.g. common gull, black-headed gull, little gull) and tern species tend to have more localised distributions or seasonally constrained movements. Consequently, they are at lower risk of wind farm impacts at a wider scale, but may be locally at high risk, for example if a wind farm is installed within foraging range of a breeding colony.

1.4.1.3 A key aim for post-construction monitoring of operational wind farms should be collection of data to validate the assessment methods (e.g. parameter estimates and assumptions) on which the predictions within the Environmental Impact Assessment are based. On the basis of the monitoring data collected for ABWP1, there is little to indicate that the presence of the turbines has affected the distribution or abundance of any species, although there are suggestions that some species, such as red-throated diver, may be present in lower densities in the vicinity of the turbines following installation. However, the spatial resolution of the monitoring data is too coarse for this to be investigated in greater detail.

1.4.2 Conclusion

1.4.2.1 Analysis of the seabird monitoring data collected at ABWP1 found very little evidence to indicate that the seven wind turbines have had any effect on the seabirds present. However, this lack of evidence may in part be due to the limitations of the boat-based survey methodology used for these surveys.

1.5 References

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