Outer Dowsing Offshore Wind

19.11 Lead-in periods for kittiwake breeding on Artificial Nesting Structures

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Acronyms & Definitions

Abbreviations / Acronyms

Abbreviation / Acronym	Description
AEoI	Adverse Effect on Integrity
ANS	Artificial Nesting Structure
AON	Apparently Occupied Nest
CIMP	Compensation Implementation and Monitoring Plan
CRM	Collision Risk Modelling
DCO	Development Consent Order
FFC	Flamborough and Filey Coast
HRA	Habitats Regulations Assessment
KSCP	Kittiwake Strategic Compensation Plan
NMC	Non Material Change
ODOW	Outer Dowsing Offshore Wind
ORBA	Offshore Restricted Build Area
ORCP	Offshore Reactive Compensation Platform
RIAA	Report to Inform Appropriate Assessment
SoS	Secretary of State
SPA	Special Protection Area
UCI	Upper Confidence Interval
UK	United Kingdom
WTG	Wind Turbine Generator

Terminology

Term	Definition
The Applicant	GTR4 Limited (a joint venture between Corio Generation (and its affiliates), TotalEnergies and Gulf Energy Development), trading as Outer Dowsing Offshore Wind~~GT R4 Ltd. The Applicant making the application for a DCO.~~ ~~The Applicant is GT R4 Limited (a joint venture between Corio Generation, Total Energies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The Project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company), TotalEnergies and GULF.~~
Compensation	Measures secured by the appropriate authority and taken to ensure that the overall coherence of the National Site Network is protected, following a finding of AEoI by a project on a particular qualifying feature of a European site and a derogation case.
Compensation debt	As colonisation of ANS, for example, or success of a compensation measure is likely to be gradual, a compensation debt may develop when the impact is occurring at a greater rate than the rate of compensation being delivered. Compensation debt must be offset

Term	Definition
	over the lifetime of a project in order for compensation to be delivered effectively.
Compensation requirement	The amount of compensation needed, usually expressed in numbers of breeding pairs.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Ecological lead-in period	The time required for the birds fledging from an ANS's first breeding season to attain adulthood.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the sensitivity of the receptor, in accordance with defined significance criteria.
Export Cables	High voltage cables which transmit power from the Offshore Substations (OSS) to the Onshore Substation (OnSS) via an Offshore Reactive Compensation Platform (ORCP) if required, which may include one or more auxiliary cables (normally fibre optic cables).
Habitats Regulations Assessment (HRA)	A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Landfall	The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore.
Lead-in period	The period between delivery of the ANS and commencement of operations.
Offshore Reactive Compensation Platform (ORCP)	A structure attached to the seabed by means of a foundation, with one or more decks and a helicopter platform (including bird deterrents) housing electrical reactors and switchgear for the purpose of the efficient transfer of power in the course of HVAC transmission by providing reactive compensation
Onshore Infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection.
Offshore Restricted Build Area (ORBA)	The area within the array area, where no wind turbine generator, offshore transformer substation or offshore accommodation platform shall be erected.
Outer Dowsing Offshore Wind (ODOW)	The Project
The Project	Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure.
Strategic Compensation	Collaborative approach by developers and/or government departments to secure compensation for adverse effects on the conservation objectives of a Marine Protected Area.

Term	Definition
Wind Turbine Generator (WTG)	A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems, fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation

Reference Documentation

Document Number	Title
19.08	Levels of precaution in the assessment and confidence calculations for offshore ornithology
19.09	SNCB guidance and bioseasons for guillemot
19.10	Rates of displacement in guillemot and razorbill

Executive Summary

Following completion of the Report to Inform Appropriate Assessment for this Project (RIAA; AS1-095), the potential for an Adverse Effect on Integrity (AEoI) to the kittiwake feature of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) due to mortality from collisions with the wind turbine generators (WTG) in combination with other plans or projects cannot be ruled out. A full derogation case (APP-242) for kittiwake (from in-combination effects) has therefore been developed alongside appropriate compensation measures (APP – 249, APP-250, APP-256).

The draft Development Consent Order (DCO) provides for the construction of up to two offshore Artificial Nesting Structures (ANS) as part of the proposed compensation measures for the predicted effects on kittiwake. The use of offshore ANS as a compensation measure is being developed to compensate for the effects of the Project and aligns with The Crown Estate's Kittiwake Strategic Compensation Plan (KSCP, APP-260). ANS would be constructed to increase the annual recruitment of kittiwake into the regional population of the southern North Sea and therefore compensate for any losses at the FFC SPA.

The Applicant had proposed at paragraph 4(a)(iii) and 5 of Part 1 of Schedule 22 of the draft DCO (PD1-024) that, where an ANS is proposed as compensation for kittiwake, the Project's Kittiwake Compensation Implementation and Monitoring Plan (CIMP) must include an implementation timetable for the delivery of the ANS that ensures that the structure is in place to allow for at least three full kittiwake breeding seasons prior to the operation of any turbine.

The Applicant considers that there is sufficient evidence to justify the reduction in the proposed time between implementation of the ANS and operation of any turbine to two full kittiwake breeding seasons. That evidence is set out in this Report. Paragraphs 3(d) and 4 of Part 2 of Schedule 16 of the Hornsea Four Offshore Wind Farm Development Consent Order 2023 were recently amended to reduce the length of time ANS need to be in place before operation from four full breeding seasons to two full breeding seasons. This reduction was agreed with Natural England as part of the Offshore Ornithological Engagement Group. The Applicant considers that a similar approach applies equally to the Project.

In Natural England's Relevant Representation (RR-045), Natural England advised that the "*proposed lead in times to deliver…compensation to a level where it is providing the required ecological function are unlikely to be sufficient."* This Report sets out the Applicant's evidence to support the timings proposed for delivery of compensation to be delivered through the construction of the ANS.

The draft UK Government guidance (*Best practice guidance for developing compensatory measures in relation to Marine Protected Areas, 22 July 2021, Defra)* states that compensation measures should ideally be in place and effective prior to the negative effect on a European site occurring, thereby protecting the overall coherence of the National Site Network. To date, Natural England has generally advised lead-in periods for ANS of 4 years based on the time required for the birds fledging from the first breeding season at the ANS to attain adulthood. The draft guidance also recognises that, in some cases, it may take several years for measures to be in place and fully functioning prior to the impact taking place and that therefore this may not be feasible.

At its core, the compensation provisions of the Habitats Regulations require that the Secretary of State secures that any necessary compensatory measures are taken to ensure that the overall coherence of the National Site Network is protected. Put another way, the impact on the relevant species predicted to arise from the Project must be offset by the end of the Project's operational life.

Whilst a longer lead-in period between the construction of the ANS and the operation of the Project will have the effect of reducing the predicted mortality which takes place in the early years of the Project's operation, the more important consideration is whether or not that mortality is offset throughout the Project's operational lifetime. This Report provides the evidence that the difference made by an additional lead in period of one or two years will be negligible in terms of the compensation delivered over the lifetime of the Project. The relevance of the precise lead-in period is reduced further still when the lifetime of the ANS is considered. Paragraph 7 of Part 1 and Part 2 of Schedule 22 of the DCO provides that the ANS must not be decommissioned without written approval of the Secretary of the State in consultation with Natural England and that, unless otherwise agreed, the ANS must be maintained beyond the operational lifetime of the development if it is colonised.

A more appropriate approach to delivering compensation is to design ANS that will deliver sufficient extra compensation over the lifetime of the project to offset the compensation debt built up as the colony develops. As such, delivery of Project scale compensation is best met through designing measures to over-compensate for predicted impacts over the lifetime of the Project and thus account for any compensation debt accrued, rather than through the implementation of a lead-in period.

Section 3 details, through the use of a realistic scenario growth model (in terms of ANS design and colonisation rates), how the cumulative output from ANS will reach the point of exceeding the cumulative requirement (covering scenarios based on the mean impact value prediction, with compensation at a 1:1 ratio calculated using the Hornsea Four method (the Applicant's approach) to the Upper Confidence Interval (UCI) impact value, calculated using the Hornsea Three stage two approach at a 3:1 ratio, the anticipated Natural England approach). Using the Applicant's approach on an ANS with 300 Apparently Occupied Nests (AONs) exceedance occurs at 13 years with no lead in time, at 9 years with a lead-in period of two years, at three years with a lead-in period of three years and at zero years (ie the commencement of operation) with a lead-in period of four years. Using Natural England's approach, exceedance occurs at 35 years with a two-year lead-in period, at 31 years with a three year lead-in period and at 29 years with a four year lead-in period. In the case of the Applicant's approach with an ANS with 300 AONs, the growth model shows that, over the anticipated 35-year lifetime of the Project, the compensation provided would outweigh the cumulative requirement by over 800 birds.

This document has been updated to provide further detail and clarity on the points raised by Natural England in their consultation response provided on 23rd January 2025 to the Change Notification (REP2-064) submitted at Deadline 2. The Change Notification was submitted in order to propose an amendment to the Development Consent Order (DCO) to reduce the length of time the proposed artificial nesting structure(s) for kittiwake needs to be in place before operation of the project from three full breeding seasons to two full breeding seasons in order to afford more flexibility to project delivery timelines. The updates provided do not affect the overall conclusions made in the original document (REP2-060). The scenarios considered without the Offshore Restricted Build Area (ORBA) have been deleted from the document following the acceptance of the ORBA on 3rd December 2024 and consequential update to the RIAA.

1 Introduction

1.1 Project Background

1. GT R4 Limited (trading as Outer Dowsing Offshore Wind (ODOW)) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (the Project). The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm) approximately 54km from the Lincolnshire coastline in the southern North Sea, export cables to landfall, Offshore Reactive Compensation Platforms (ORCPs), onshore cables, connection to the electricity transmission network, ancillary and associated development and areas for the delivery of up to two Artificial Nesting Structures (ANS) and the creation of a biogenic reef (see Volume 1, Chapter 3: Project Description (APP-058) for full details).

1.2 Document Purpose

2. Following completion of the Report to Inform Appropriate Assessment (RIAA) (AS1-095), the potential for an Adverse Effect on Integrity (AEoI) to the kittiwake feature of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) due to mortality from collisions with the wind turbine generators (WTG) in combination with other plans or projects cannot be ruled out. A full derogation case (APP-242) for kittiwake (from in-combination effects) has therefore been developed alongside appropriate compensation measures (APP-249, APP-250, APP-256).
3. The draft Development Consent Order (DCO) provides for the construction of up to two offshore ANS as part of the proposed compensation measures for the predicted effects on kittiwake. The use of offshore ANS as a compensation measure is being developed to compensate for the effects of the Project and aligns with The Crown Estate's Kittiwake Strategic Compensation Plan (KSCP, APP-260). ANS would be constructed to increase the annual recruitment of kittiwake into the regional population of the southern North Sea and therefore compensate for any losses at the FFC SPA.
4. The Applicant had proposed at paragraph 4(a)(iii) of Part 1 of Schedule 22 of the draft DCO (PD1-024) that, where an ANS is proposed as compensation for kittiwake, the Project's Kittiwake Compensation Implementation and Monitoring Plan (CIMP) must include an implementation timetable for the delivery of the ANS that ensures that the structure is in place to allow for at least three full kittiwake breeding seasons prior to the operation of any turbine.
5. The Applicant considers that there is sufficient evidence to justify the reduction in the proposed time between implementation of ANS and operation of any turbine to two full kittiwake breeding seasons. That evidence is set out in this Report. For Hornsea Four, paragraphs 3(d) and 4 of Part 2 of Schedule 16 of the Order were amended to substitute the relevant lead in period for the ANS from 4 full breeding seasons to two full breeding seasons. For Hornsea Three, Paragraphs 3(c) and 4 of Part 2 of Schedule 14 of the DCO have been amended on two occasions since the Order was first made. The effect of the two Non Material Change (NMC) requests was a reduction in the lead in period to 3 full kittiwake breeding seasons in respect of 3 ANSs and no lead in period for the final ANS.

6. These reductions were agreed with Natural England as part of the respective Offshore Ornithological Engagement Group and were accepted by the Secretary of State (SoS) in July 2024 (Hornsea Four[2]) and May 2024 (Hornsea Three)[1]. The Applicant considers that a similar approach can be justified in relation to the Project.

7. The Applicant ~~has~~ submitted a Change Notification ~~[~~(REP2-064~~1-038]~~) ~~at this deadline~~ to amend the Order to reduce the length of time the proposed artificial nesting structure(s) for kittiwake needs to be in place before operation of the project from three full breeding seasons to two full breeding seasons. This document provides the ornithological justification for the proposed change. The Applicant also refers to its response to the ExA's First Written Questions, Q1 HRA 2.4 (REP2-051~~[Document 19.2]~~) .

8. Following the consultation of the proposed change on 20th December 2024, Natural England provided a written response on 23rd January 2025 highlighting where further information and clarity was required in relation to the change. These points were also raised during a meeting between Natural England and the Applicant on January 17th 2025. Accordingly, the Applicant has updated this document to include:

   - Minor corrections and edits as highlighted by Natural England in their consultation response;
   - Clarity on the term 'compensation requirement' and how this has been calculated;
   - Clarity on the parameters used to inform growth modelling;
   - The inclusion of additional models using different colony starting sizes and colony growth scenarios; the graphs provided show where a growth model returns an overall output that exceeds the overall requirement within the lifetime of the Project (Annex 2).

9. The RSPB also provided a detailed consultation response to the proposed change on 22nd January 2025; the points raised were overarching ones, i.e. the response did not include requests for specific corrections or methodological updates.

[1] EN010080-003697-H3 non material change decision letter final.pdf

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-002385-Hornsea%20Four%20Non-Material%20Change%20-%20Decision%20Letter%20%5bsigned%5d%20-%2017%20July%202024.pdf

~~7.~~10. With the aim of ensuring that ANS would provide adequate output prior to the adverse effect occurring, Natural England has requested a lead in period (the time prior to the effect occurring when compensation measures should be in place and effective) to allow young birds, fledged from the ANS, time to mature to breeding age; for kittiwake, the time to mature is on average four years (Horswill and Robinson, 2015). The draft DCO for the Project (submitted with the Application) states that the ANS measure must be implemented three full kittiwake breeding seasons prior to the operation of any turbine. However further recent precedent indicates that a period of two breeding seasons is appropriate. This is now the Applicant's position and the evidence for this position is set out in this Report.

11. A more appropriate approach to delivering compensation is to design ANS that will deliver sufficient extra compensation over the lifetime of the project to offset the compensation debt built up as the colony develops. As such, delivery of Project scale compensation is best met through designing measures to over-compensate for predicted impacts over the lifetime of the Project and thus account for any compensation debt accrued, rather than through the implementation of a lead-in period. In their response to the Change Notification Consultation (20th December 2024), Natural England expressed concerns regarding additional risk to the FFC SPA during the period in which the population of the SPA is depressed, due to outputs from the measure not yet meeting requirements~~,~~ through compensation debt accrued during the period of colony growth. The Applicant notes that the measure seeks to address a precautionary impact of 15.5 birds per year to a colony of 79,306 individuals, with an approximate annual increase on baseline mortality of 0.12%. While recognising its responsibility to address impacts from the Project, the Applicant does not consider that an additional two year period where some of this minor impact is not being fully addressed would lead to any meaningful depression of the colony or make it more prone to impacts of environmental change in any measurable way. The Applicant therefore considers that the coherence of the network would be maintained.

~~8.~~12. Section 3 details, through a realistic scenario growth model (in terms of ANS design and colonisation rates), how the cumulative output from an ANS will reach the point of exceeding the cumulative requirement based on a range of scenarios covering the Applicant's approach and the anticipated Natural England approach. This growth model shows that over the anticipated 35-year lifetime of the Project, the compensation debt accrued as a result of predicted kittiwake collisions from the turbines can be exceeded through the provision of ANS within the design envelope of the project.

It should also be noted that the method used to assess the impacts of the Project to kittiwake and the way these impacts are apportioned to the FFC SPA, is precautionary and likely to result in over-compensation (Document 19.8 Levels of Precaution in the assessment and confidence calculations for Offshore Ornithology).

2 Colonisation of Artificial Structures and the Use of Lead-in Periods

~~9.~~13. Predicting the growth rate of a kittiwake colony on a new artificial site is challenging due to a lack of data on colonisation of remote, specifically designed artificial structures. However, growth patterns for kittiwakes at man-made sites appear to follow those seen at natural sites and therefore growth patterns at natural sites have been used in the analysis presented in this document.

2.1 Kittiwake

~~10.~~14. For kittiwake, new colonies are usually formed by 3-20 young birds and, for the first few years', colony growth will be rapid, doubling in size each year during the first 2 to 4 years (Coulson, 2011). Following these initial years, colony growth will slow to a rate of approximately 10-20% per annum (Coulson, 2011; Kidlaw, 2005).

~~11.~~15. A tower with a capacity for over 140 nests constructed in Gateshead during the winter of 1997/98 was colonised by 18 apparently occupied nests (AON) during its first breeding season, rising to 131 AON in the third breeding season (Turner, 2010). A colony that established on a warehouse in North Shields, Tyne and Wear was started by 4 AON in 1949. This had risen to approximately 40 AON by 1958, and grew to approximately 105 AON by 1965, where it peaked (Coulson and Thomas, 1985).

~~12.~~16. For offshore ANS in areas where there are existing colonised offshore structures, as is the case for the ANS sites proposed by the Applicant, colonisation may be even more rapid as birds that have bred on, or were raised on, such structures are likely to encounter the ANS and may associate the habitat provided with that upon which they were reared.

~~13.~~17. Early growth of the colony is highly dependent on successfully attracting immigrants and prospective breeders. Since a relatively small proportion of young kittiwake (as few as 11%) remain at their natal sites (Coulson and Coulson, 2008), it is likely that strategic placement of an artificial structure would create high potential for the development of a new colony from dispersing individuals.

~~14.~~18. To date, lead-in periods have been expressed as a number of years, related to the maturation period of the species in question. Natural England have advised a lead-in period of more than three years for kittiwake (RR-045). It should be noted that, for example, an ecological lead-in period of less than four years for kittiwake (i.e. less than 48 months) can still cover 4 breeding seasons, and therefore still address the aim of mature birds being generated prior to commencement of the operational phase. Kittiwake colonies are occupied in May and young will begin to fledge in July. As such, an ecological lead-in period beginning in May of year 1 and ending in July of year 4 will cover four full breeding seasons but only cover 39 months. The four-year ecological lead-in period as advised by Natural England is therefore defined as four breeding seasons rather than four full years. The Applicant also notes that approximately 27% of kittiwake recruitment involves birds of three years old, compared to 35% of recruitment involving birds of four years old (Coulson, 2011).

~~15.~~19. The rationale for having a lead in period of four years that generates the required number of adult kittiwakes prior to the commencement of operations is reliant on the ANS being colonised to the required level in the first breeding season that the ANS is available. Colonisation rates at existing ANS suggest that this is unlikely.

~~16.~~20. Natural England's advice is that a lead in period of more than three years is preferred (RR-045)). If a four-year period is considered to be acceptable to secure the overall coherence of the National Site Network, and the difference with a two-year period is minimal in terms of the overall effectiveness of the measure when considering the predicted colony growth pathways, then a two-year period should also be acceptable.

~~17.~~21. This is particularly pertinent given that recruitment ages vary in kittiwake and a proportion of birds recruit before the age of four (26.5%, Coulson, 2011).

3 Over-compensating over the Lifetime of the Project

3.1 Compensation Debt

~~18.~~22. Compensation requirements are quantified as the number of adult birds that are needed to form enough breeding pairs to redress the reduced population at the impacted colony. As colonisation is likely to be gradual (see Section 2.2), a compensation debt may develop when the impact is occurring at a greater rate than the rate of compensation being delivered. The compensation debt can be defined as the cumulative annual shortfall of required adults generated by the ANS. The compensation debt is calculated by summing the annual compensation requirement over a given number of years and then subtracting the contribution. The contribution is calculated by noting the number of AONs (in this case the spaces available) on the structure, calculating the number of young to be generated by these AONs (either through direct monitoring of breeding success, or through application of published productivity rates), and then applying survival rates to the number of offspring that fledge to calculate a number of birds that survive to adulthood per year. This is then summed over the same period for which the annual compensation debt was summed. Compensation debt must be offset over the lifetime of a project in order for compensation to be delivered effectively.

3.2 Compensation Scale

23. In this document, the term 'compensation requirement' refers to the predicted mortality impact, i.e. the requirement is the number of adults needed to address losses at the impacted colony. The term 'compensation quanta' refers to the number of nests calculated to address impacts using one of two compensation calculation methods.

24. The compensation quanta~~required~~ using the Applicant's approach (i.e., the mean impact value and the method used to calculate compensation for Hornsea Four [2]at a 1:1 ratio) is 41 breeding pairs. The compensation quanta using the Natural England Approach (i.e., the Upper Confidence Interval (UCI) impact value and the Hornsea Three Stage 2' method used to calculate compensation for Hornsea Three[3] at a 3:1 ratio) is 813 breeding pairs This is based upon a UCI impact of 41.0 birds. The Applicant notes that the compensation quanta using the Natural England approach has increased from the 801 previously stated within REP2-060; this is due to the addition of the ORBA and the use of adult proportions in accordance with Natural England advice (see the Applicant's response to the Offshore and Intertidal Risk and Issues Log (Document Reference 21.3).

25. Calculating compensation using the Hornsea 3 stage 2 method involves three stages.

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[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010098/EN010098-001040-Hornsea%20Project%20Four%20-%20G1.41%20Calculation%20Methods%20of%20Hornsea%20Fours%20Proposed%20Compensation%20Measures%20for%20Features%20of%20the%20FFC%20SPA.pdf

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003246-HOW03-30Sep_Appendix%202%20Kittiwake%20Compensation%20Plan%20(06543754_A).pdf

26. Stage one is a simple calculation of the number of breeding pairs required to deliver a cohort of juveniles that will survive to adulthood in sufficient number to address the impact. For an impact of 41.0 breeding pairs, the compensation quanta calculated is 130.4 breeding pairs.

27. The second stage is to consider philopatry, ~~–~~ i.e. the proportion of juveniles that will disperse from the measure. As kittiwake have high levels of juvenile dispersal (0.89, Horswill and Robinson 2015), this increases the number of breeding pairs required to 146.6.

28. The final stage of the calculation is to consider the effect that the measure will have on the impacted colony. At the measure there will be a certain amount of natural wastage each year through mortality and adult dispersal. The Hornsea Three Stage 2 method assumes that all of this natural wastage will be addressed by birds arriving from the impacted colony. Therefore, the measure has an annual effect on the impacted colony. At a colony of 146 pairs (and therefore 292 birds) annual losses, based on an adult survival rate of 0.854 and an adult dispersal rate of 0.016, mean that each year 46.3 additional birds need to be compensated for. This adds a requirement of 124.2 nests. As such a (rounded up) total of 271 nests is required, which, at a 3:1 compensation ratio, gives a requirement of 813 breeding pairs.

29. The compensation requirement for the growth curve graphs (Figures 1 to 10) has been calculated by summing the annual impact values. Using the mean impact value, this would give an cumulative impact of 542.5 birds over a 35 year project lifetime. Outputs from AONs have been calculated using published rates for colony growth, survival across all age classes, and productivity (Horswill and Robinson, 2015); this approach aligns with that used to define colony growth within the Hornsea Three and Hornsea Four documentation[4,5], but the ODOW approach uses a very precautionary colony starting size (three pairs) (after Kildaw *et al.*, 2005) and colony growth rate (doubling for four years and then 15% after the first four years of growth). The colony growth rate and starting size are considered particularly precautionary given the proximity of the ANS to existing structures with well-established breeding colonies. The productivity rate used (1 bird per AON) is low compared to the median rate used by Hornsea Three (1.025 birds per AON) and very low compared with the productivity rate for birds not breeding for the first time as published in Horswill and Robinson (1.379 birds per AON). As such the Applicant considers the approach used to be suitably precautionary.

~~19.~~30. To address uncertainty regarding the rates of colony growth and colony start size, a range of scenarios has been presented. These scenarios cover colony growth at the upper and lower ends of the 10 – 20% growth rate presented by Coulson (2011) (i.e. growth at 10% and 20%, as well as the 15% already presented) and additional colony start sizes of 20 pairs (as per Coulson 2011) and a precautionary starting size of one pair.

4 https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-003691-Covering%20Letter%20and%20Application%20Document.pdf

5 [redacted]

3.3 Provision of Over-compensation

~~20.~~31. The Applicant aims to ensure that over-compensation will occur over the lifetime of the Project, and that any compensation debt accrued at the beginning of the operational phase of the Project will be repaid. Most ANS compensation measures are designed to over-compensate and, over the lifetime of the Project, more adults will be generated than the number required for compensation. If suitable habitat exists near to an ANS, birds from a thriving colony may 'overspill' into other areas, allowing the colony to grow beyond the scale of the ANS and, as such, deliver compensation at an even higher rate than that required, and beyond the operational lifespan of the project.

~~21.~~32. With the requirement that any ANS remain in place once the need for compensation has passed (Paragraph 7 of Part 1 and Part 2 of Schedule 22 of the DCO provides that the ANS must not be decommissioned without written approval of the SoS in consultation with Natural England and that, unless otherwise agreed, the ANS must be maintained beyond the operational lifetime of the development if it is colonised), the ANS colony will continue to generate new adults available for recruitment at the colony requiring compensation. Therefore, the ANS will continue to supplement colonies even after the Project has ceased to operate.

~~22.~~33. Figure 1 provides modelled growth based on an ANS limited to 300 AONs and shows that the cumulative output would exceed the cumulative requirement over the lifetime of the Project. Based on an annual impact of 15.5 adult birds (using the Applicant's approach including a mean impact value) and using published productivity (0.819), survival 0.790 for juveniles, 0.854 for other age classes) and dispersal rates (0.11 for juveniles) to calculate the number of birds contributed, the compensation requirement and output can be compared. Note that 15.5 adult birds would require 41 breeding pairs using the Hornsea Four 1:1 approach (see paragraph 19). The model assumes a colony that grows in line with the basic colony growth parameters as laid out in Section 2.113~~10~~ (i.e., assuming a minimum colonisation of three AONs, doubling for three years and a median growth rate of 15% after four years. This is a more precautionary approach (in terms of colony growth) than that used by Hornsea Three and Hornsea Four, and is considered a precautionary starting size due to the proximity of the ANS area to established offshore breeding colonies). Figure 1 shows that the cumulative requirement is surpassed by the cumulative output across all scenarios. Table 1 gives the specific year after construction at which the cumulative requirement is surpassed by the cumulative output.

Table 1. Years after construction at which the cumulative requirement is surpassed by the cumulative output under different lead-in and compensation ratio scenarios based on a structure hosting 300 AONs, using the Applicant's approach.

	Lead in Period			
Ratio	0	2	3	4
1:1	13	9	3	0
1:2	20	17	15	13
1:3	24	21	20	18

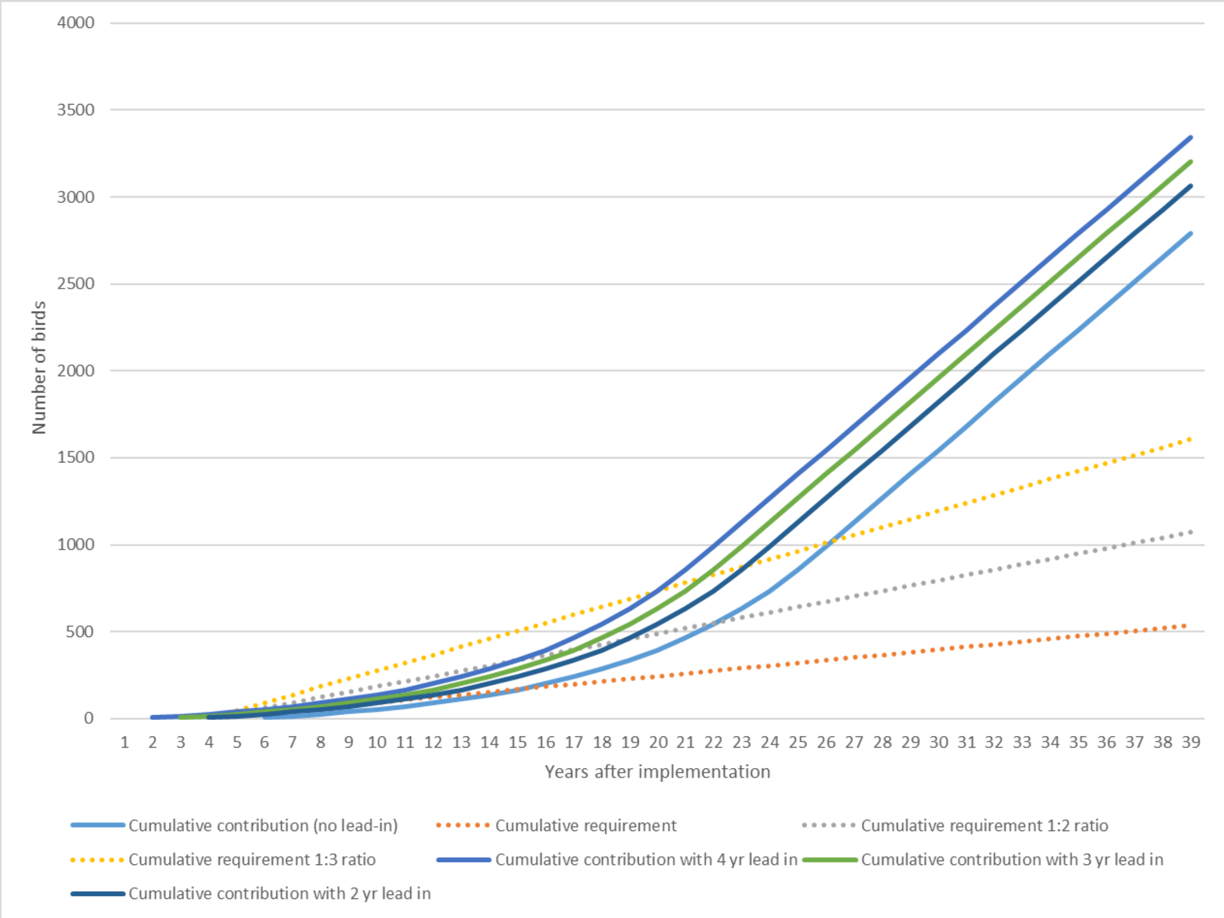


Figure 1. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios

~~23.~~34. For kittiwake, compensation debt can be calculated per year by subtracting the compensation requirement (i.e. the number of impacted adults) from the amount of compensation delivered (i.e. the number of adults that the ANS generates). Summing the compensation debt over the lifetime of the Project informs whether, and over what time period, this debt has been addressed. If the cumulative debt at the project end is a negative number, then the debt has been compensated. In this case (with no lead-in, and with compensation at a 3:1 ratio (shown as a grey line in Figure2)), by year 15, a debt of 382.2 birds has built up (based on the Applicant's approach and the growth scenarios discussed in paragraph 24). However, from year 16 to 35, a surplus of 1254.8 is generated, leaving an overall surplus of 872.4 birds. This will be supplemented every year for the duration that the ANS exists beyond the 35 years modelled here.

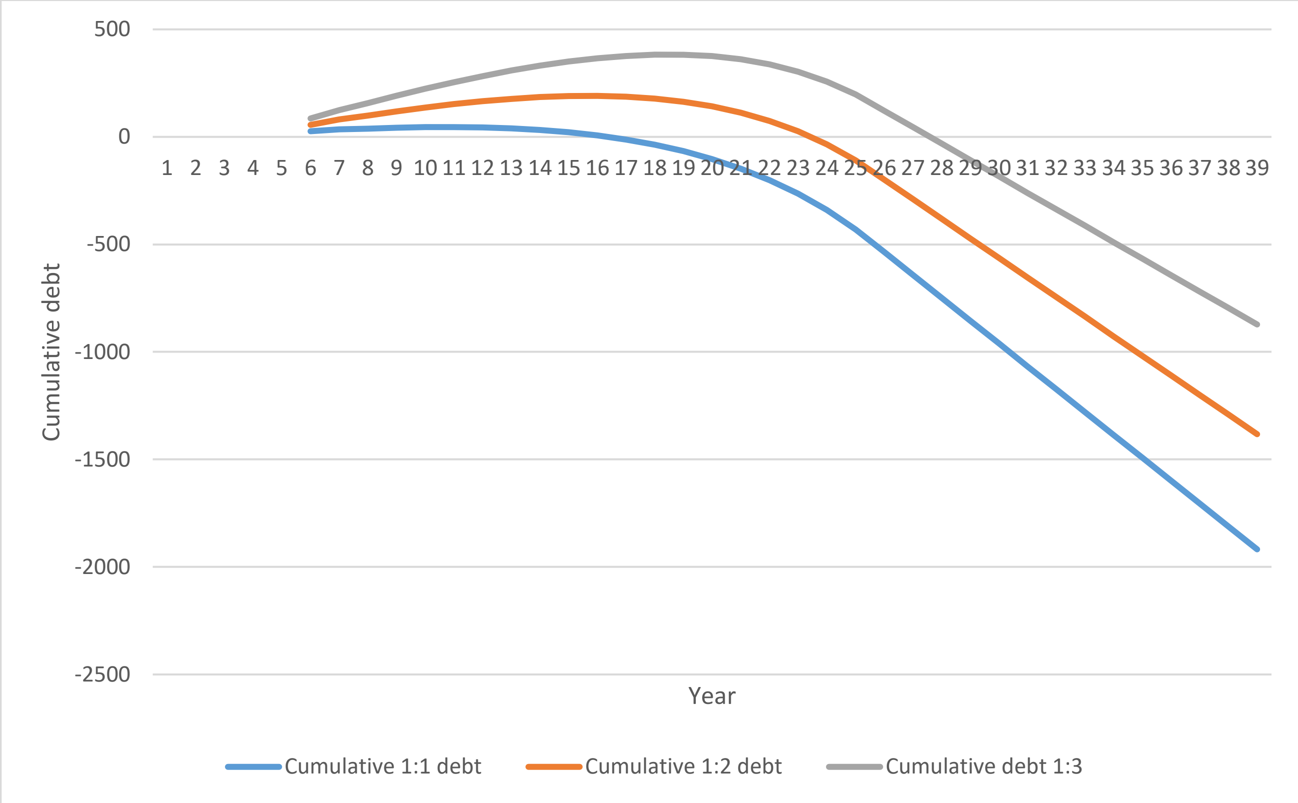
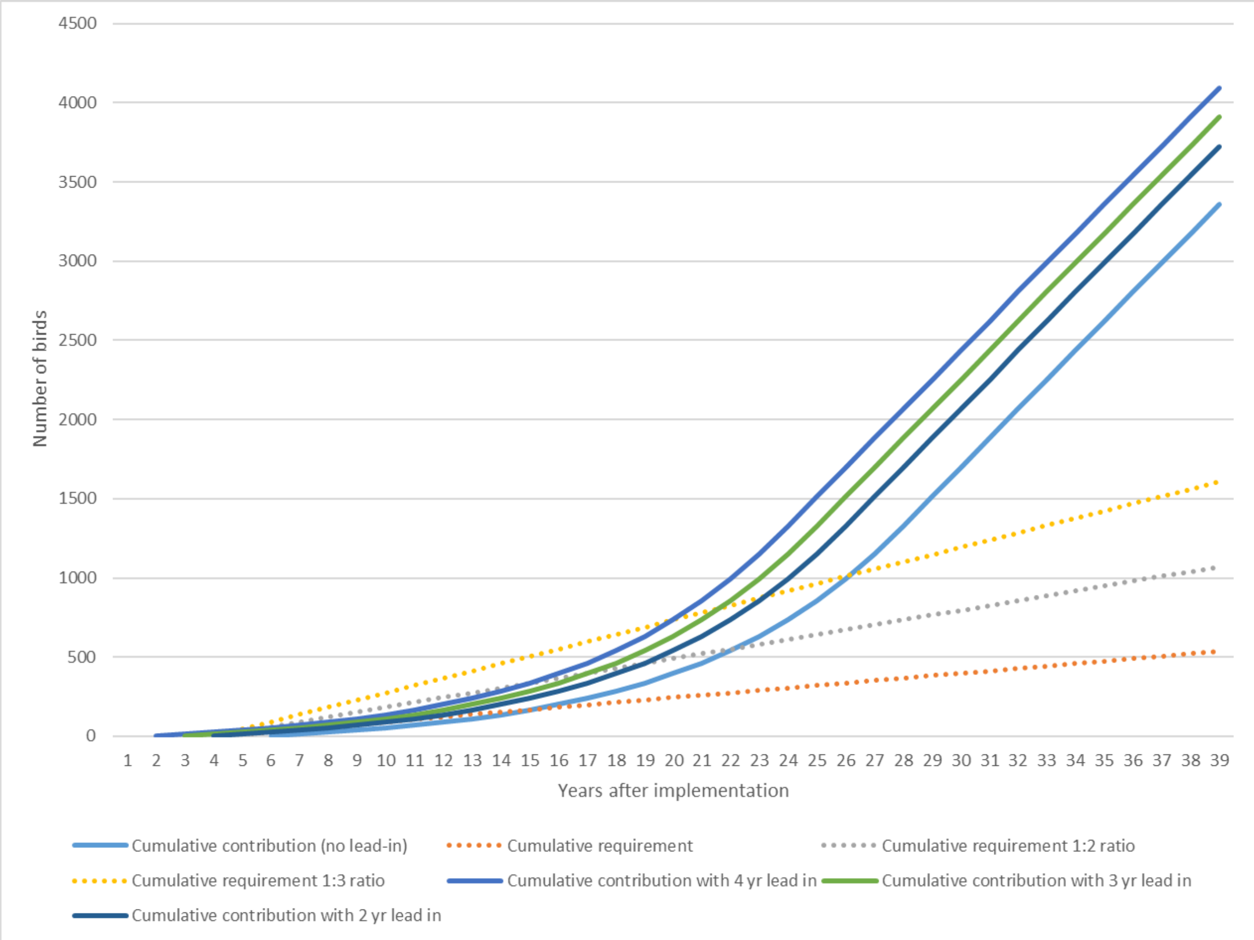


Figure 2. Cumulative compensation debt over the lifetime of the Project for kittiwake at an ANS with 300 spaces and at a 1:1,2:1~~1:2~~ and 3:1~~1:3~~ compensation ratio.



35.

Figure 3~~Figure 3~~ to

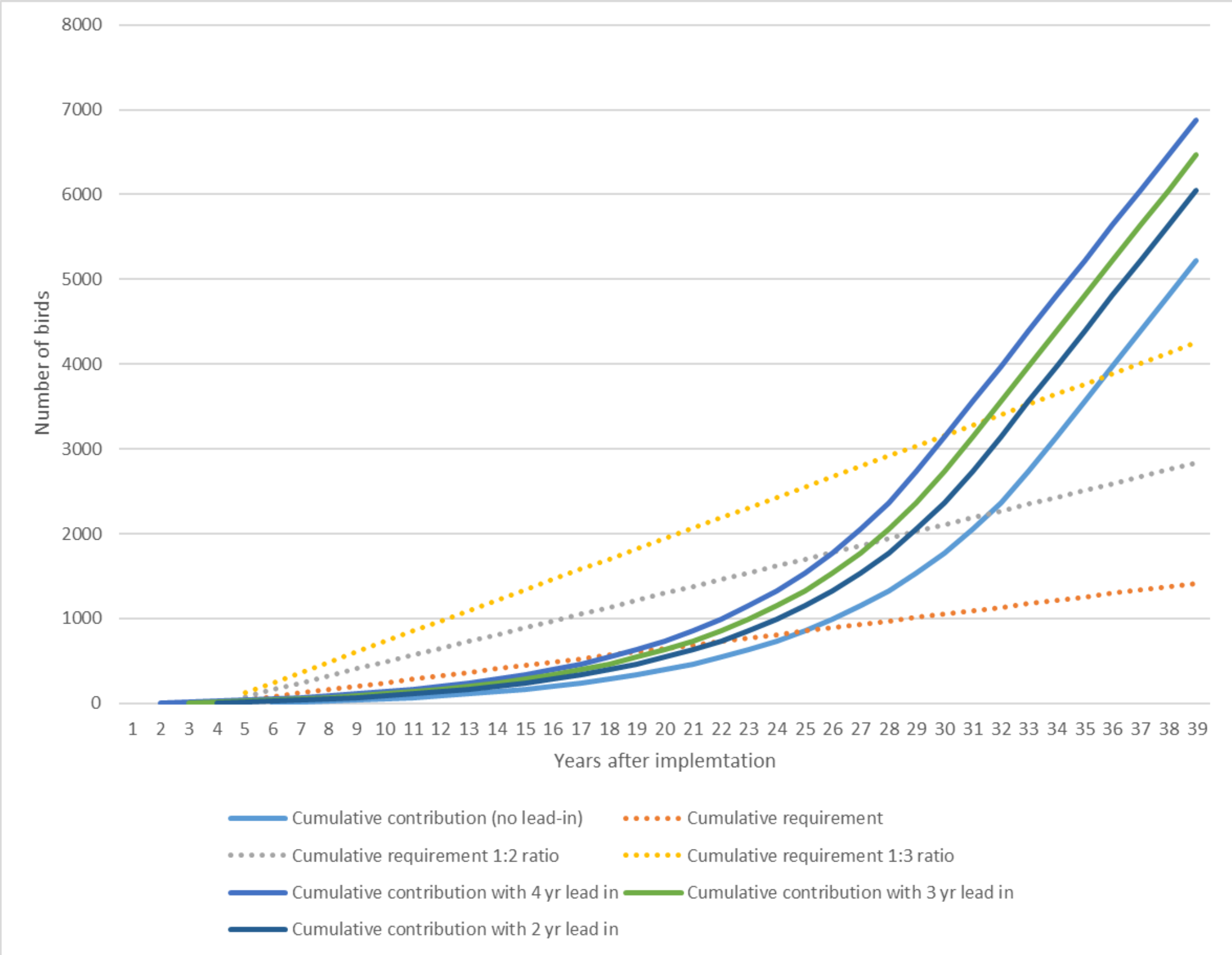


Figure 10~~Figure 10~~ provide growth curves for kittiwake on ANS using a range of scenarios. Figure 3 to Figure 5 show growth curves assuming mean impact values and ANS with 400, 500 and 600 AONs; Figure 6 to Figure 10 show growth curves assuming UCI impact values and ANS with 300, 400, 500, 600 and 900 AONs (UCI impact values have been modelled in response to Natural England’s Relevant Representation (RR-045). The growth curves show that using the mean impact value, under all compensation ratio and lead-in scenarios, the cumulative output comfortably surpasses the cumulative debt for ANS with 300 AONs or more. Under the UCI impact scenarios, the compensation requirement at a 3:1~~1:3~~ ratio is met within the lifetime of the project with a two year lead-in period on a colony that supports 500 AONs (

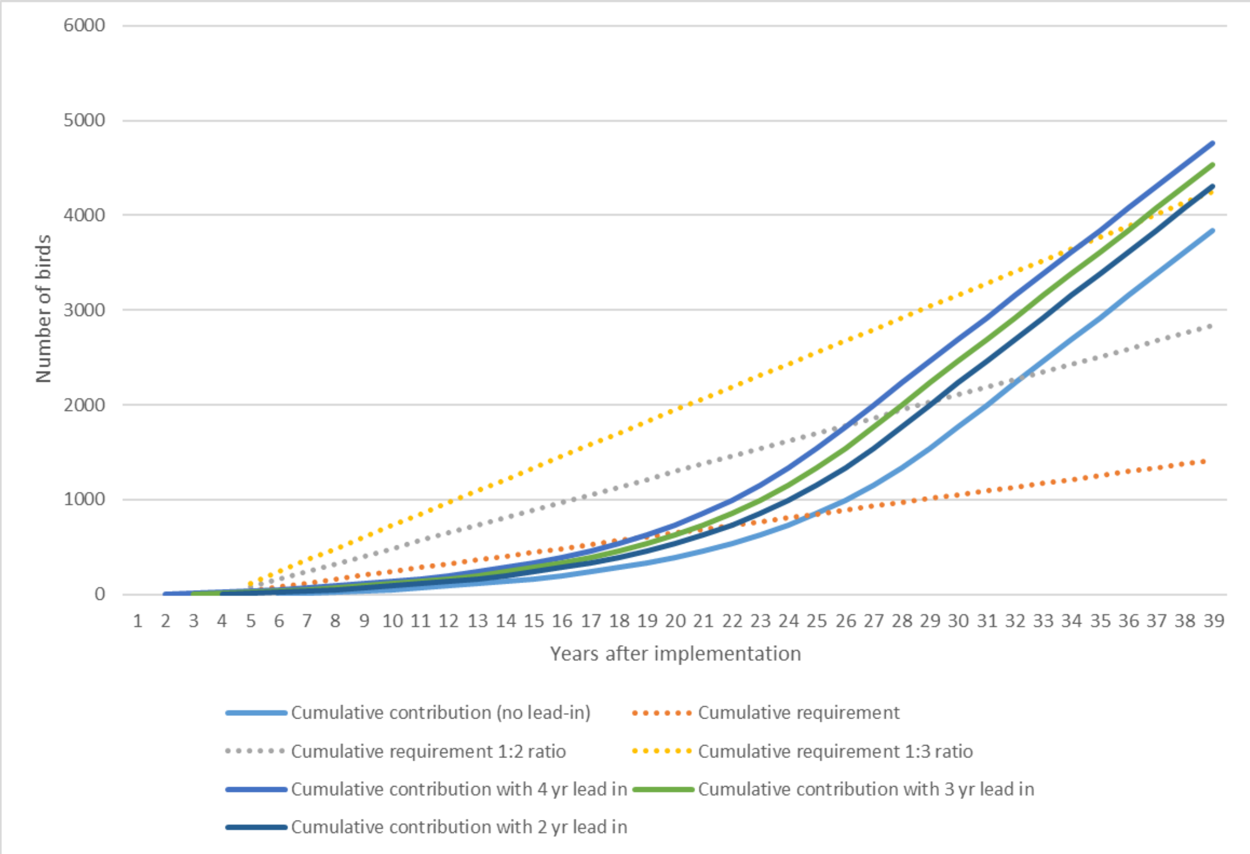


Figure 8~~Figure 8~~) and is comfortably surpassed on a colony that supports 900 AONs (

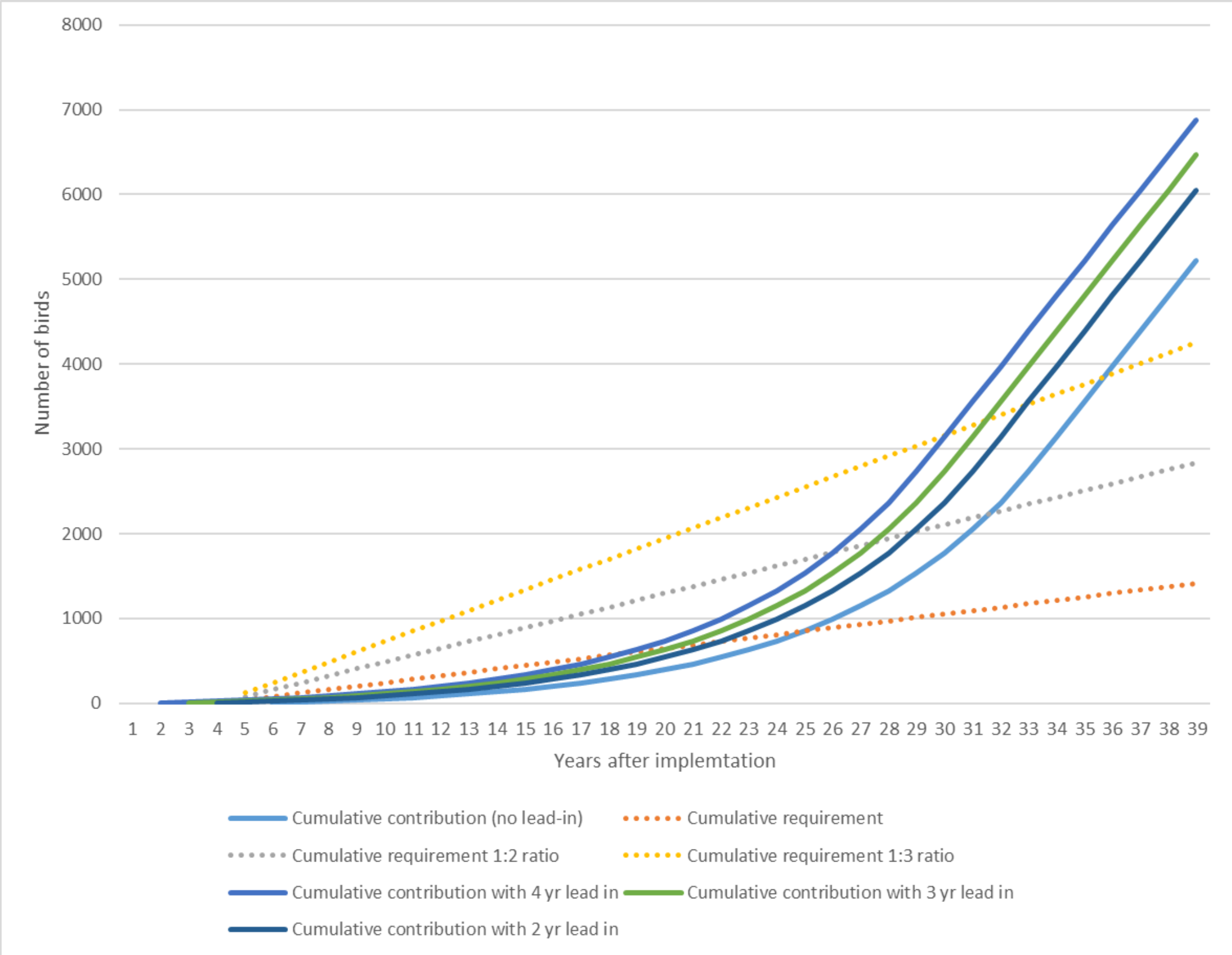


Figure 10~~Figure 10~~), although the Applicant notes that this represents a highly precautionary scenario.

~~24.~~36. Growth curves that show growth under different colony start size and colony growth scenarios are presented in Annex 2. In all of these figures, the year at which compensation contribution has surpassed the cumulative (35 year) requirement can be derived by reading across from the right hand end of the cumulative requirement line to where it meets the relevant cumulative contribution line. This allows for a theoretical colonisation delay to be considered. In a scenario where the compensation contribution surpasses the cumulative (35 year) requirement at 20 years, in theory a 15 year delay in colonisation is tolerable in terms of still providing adequate compensation within the lifetime of the project.

~~25.~~37. The compensation requirements presented in the main document are based upon the impacts calculated following the introduction of the Offshore Restricted Build Area (ORBA). A set of growth curves using the impacts predicted within the RIAA (ie prior to the introduction of the ORBA) are presented in Annex 1. Similarly, these show that the cumulative output of the ANS passes the cumulative requirement for all scenarios modelled (ie 300, 400 and 500 AONs) when the mean impact value is used, and for ANS with greater than 500 AONs when the UCI impact value is used.

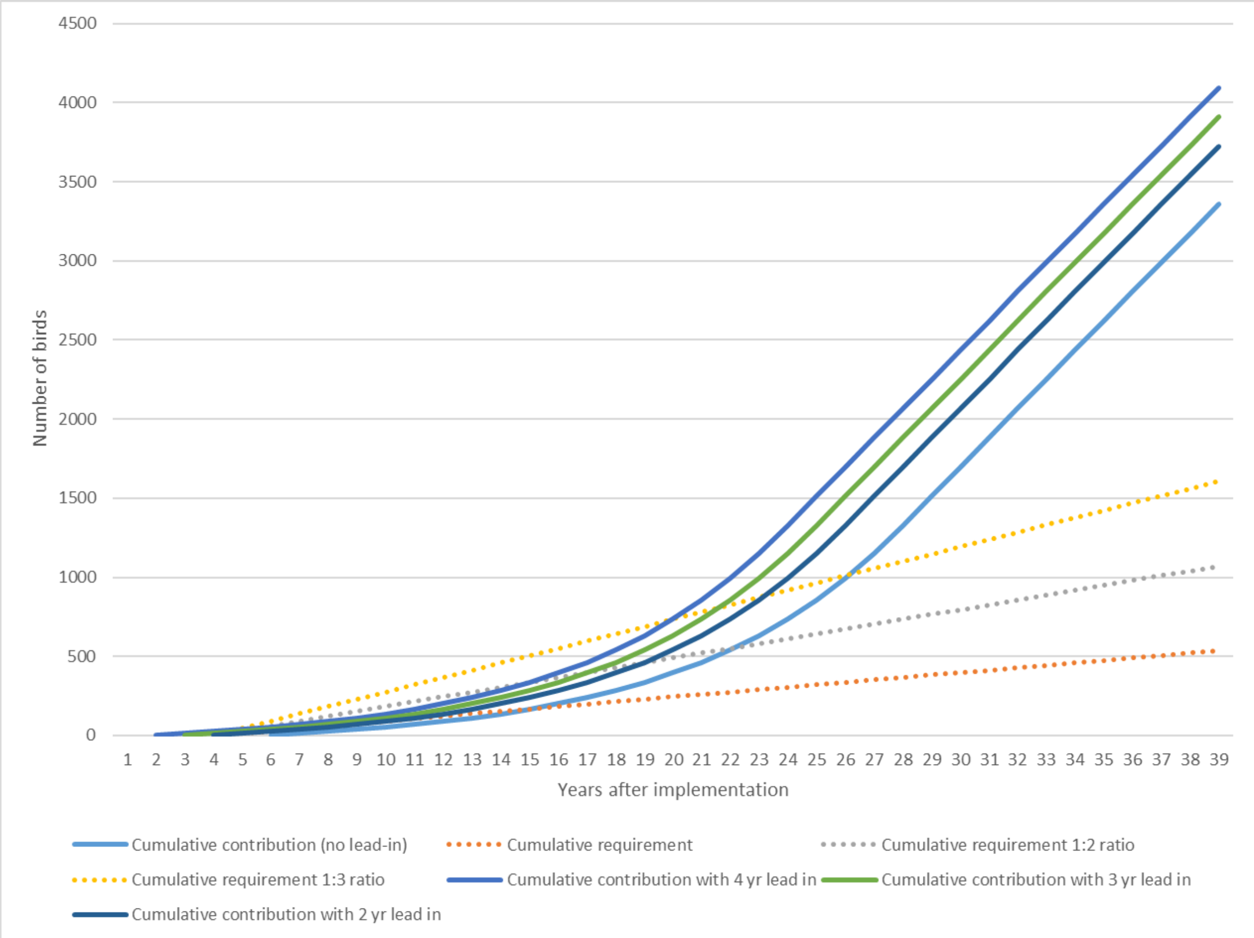


Figure 3. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

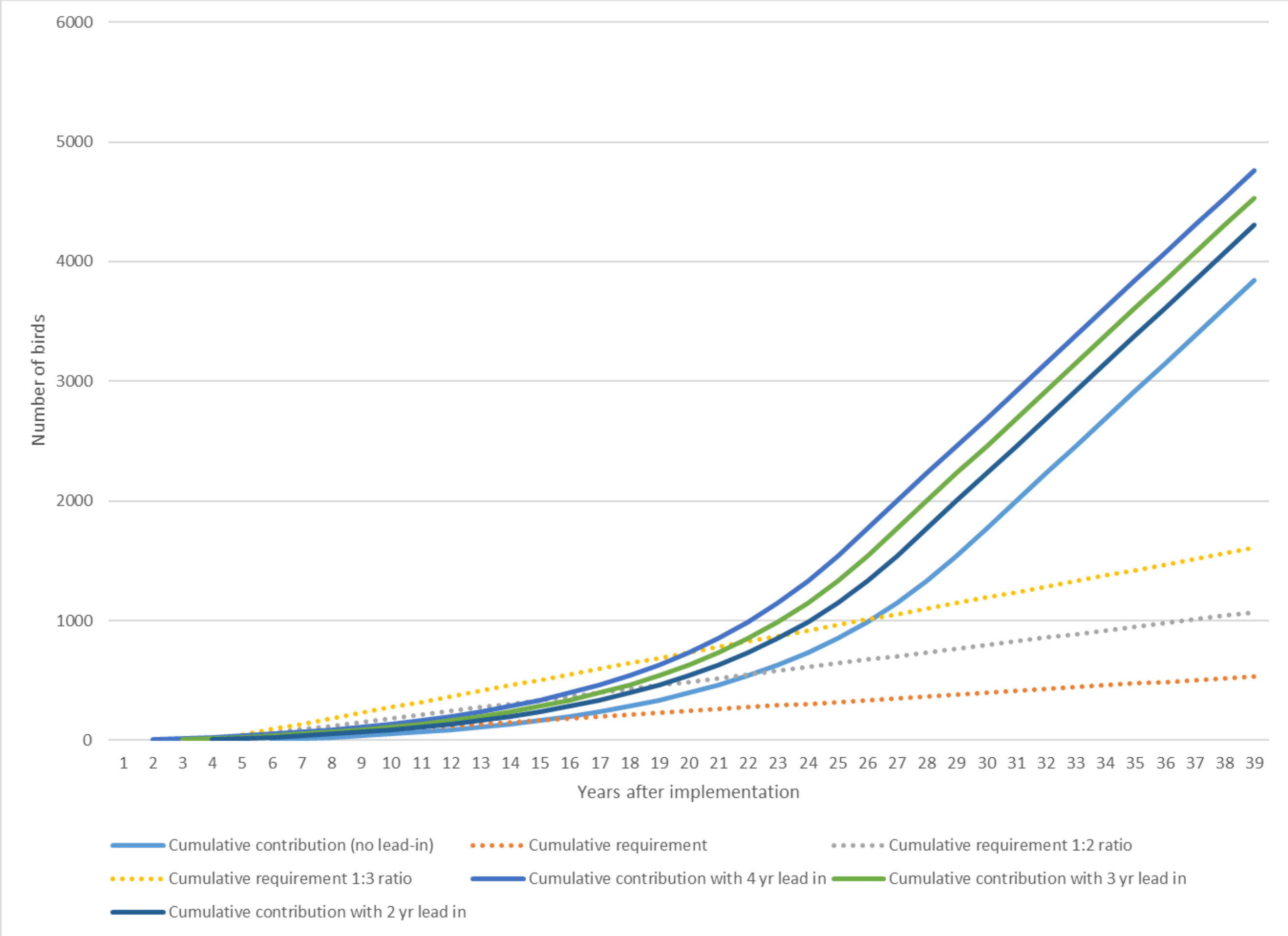


Figure 44. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value (following the introduction of the ORBA) expressed at 1:1, 2:1 and 3:1 ratios.

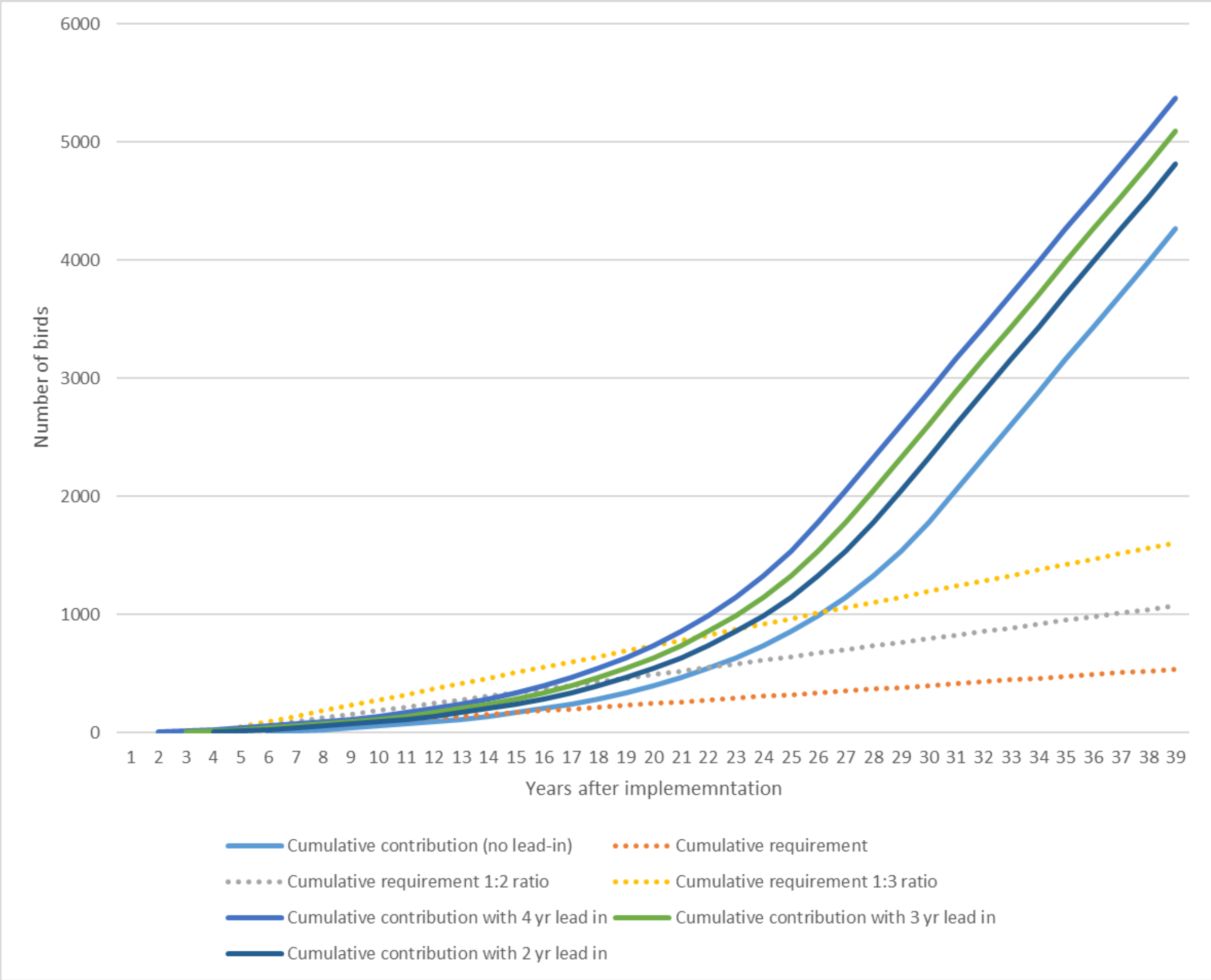


Figure 5~~5~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

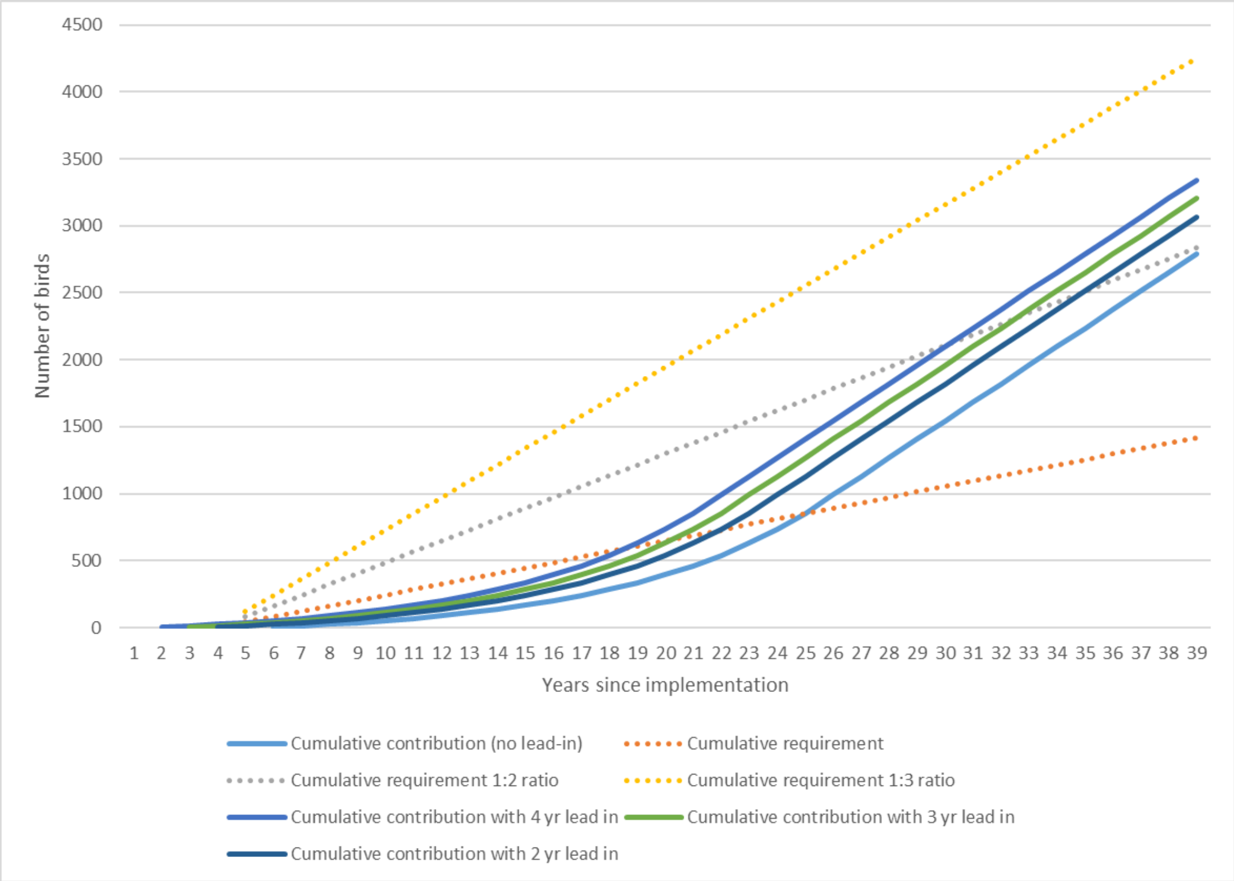


Figure 6~~6~~. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

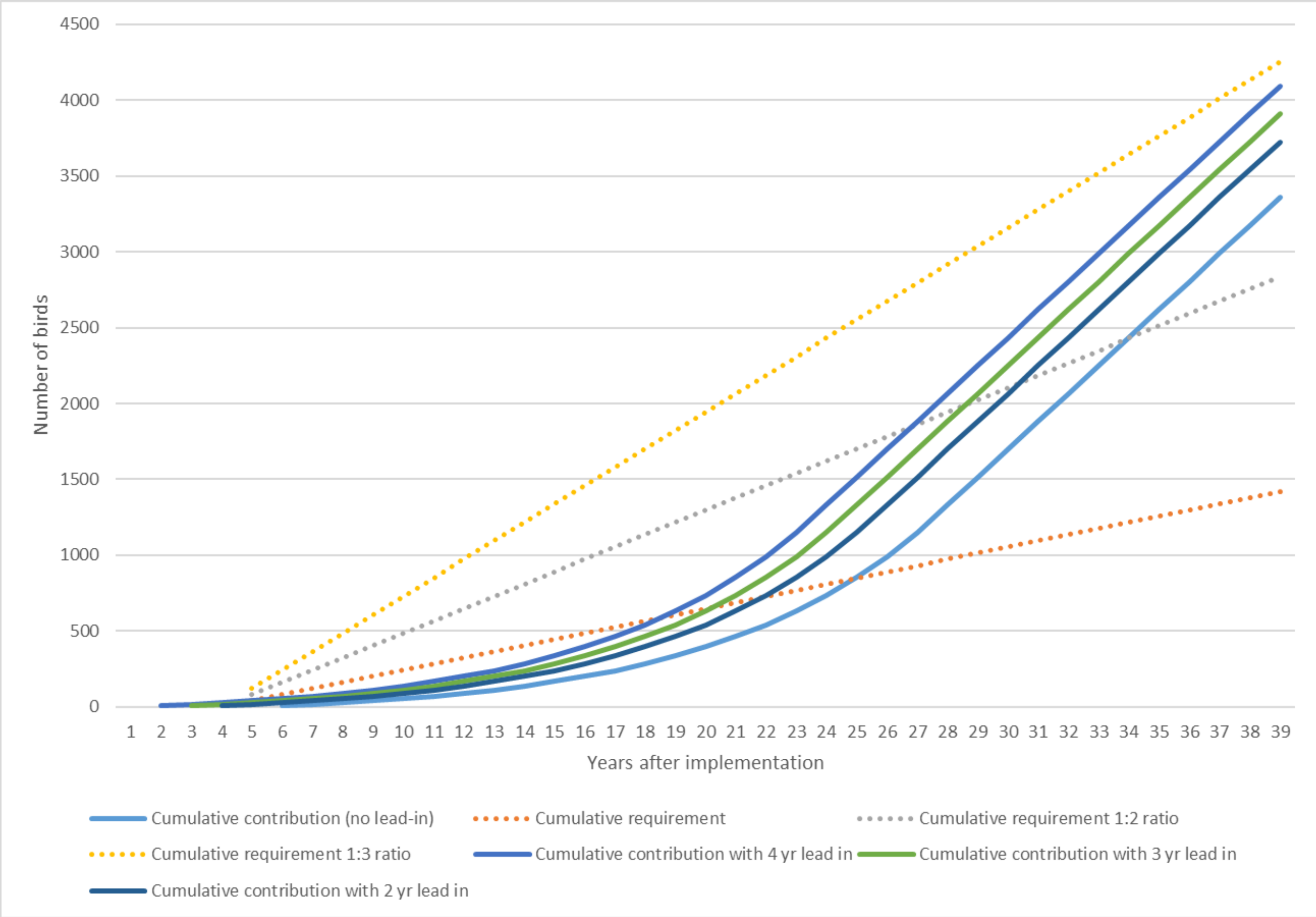


Figure 7~~7~~. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

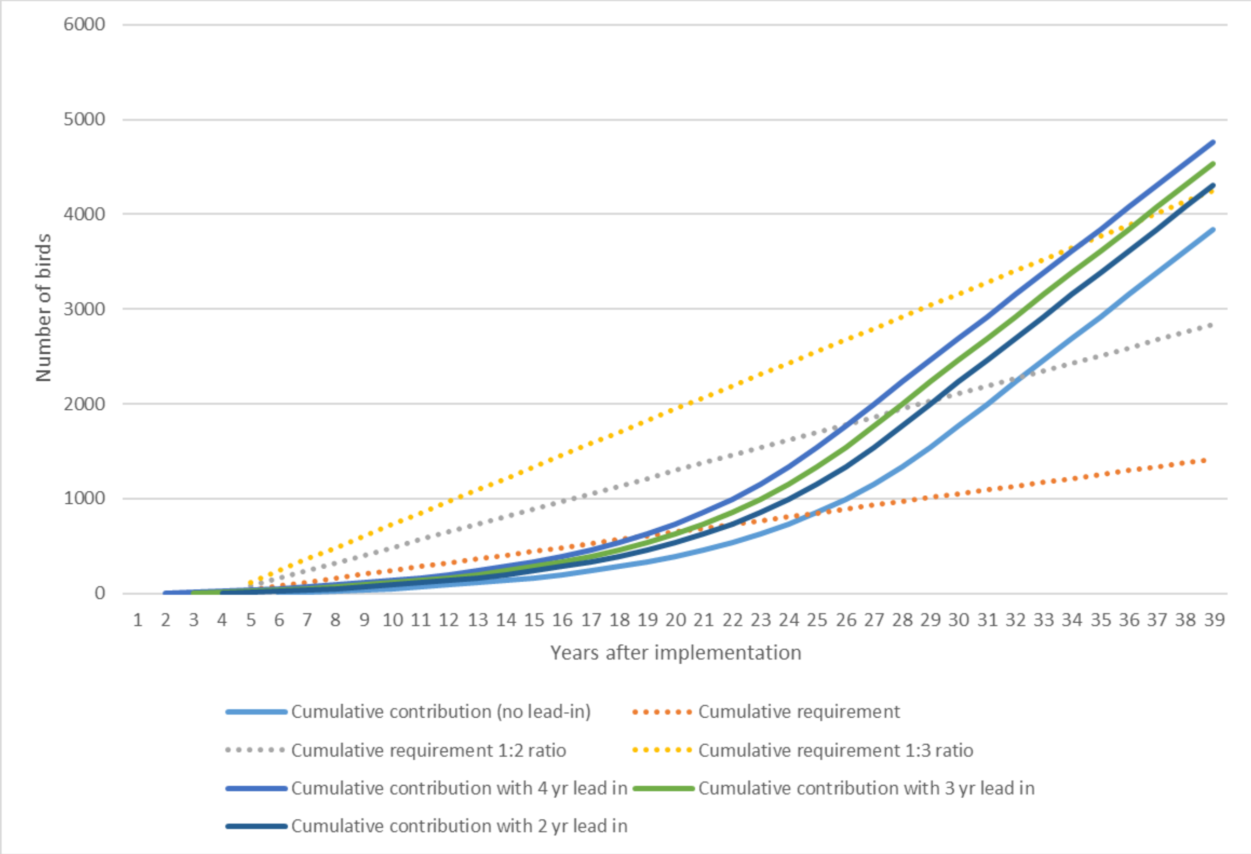


Figure 8~~8~~. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

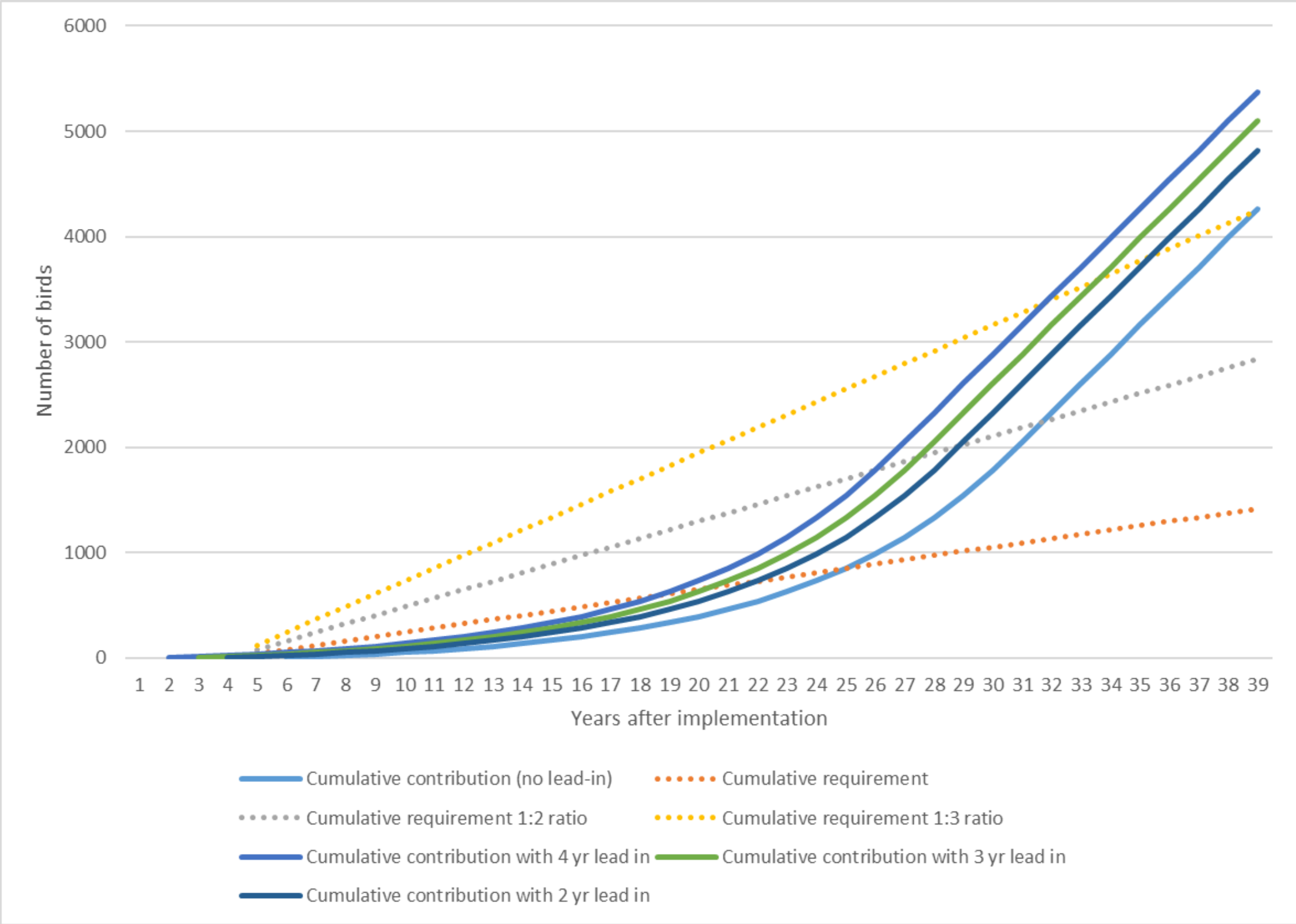


Figure 9~~9~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

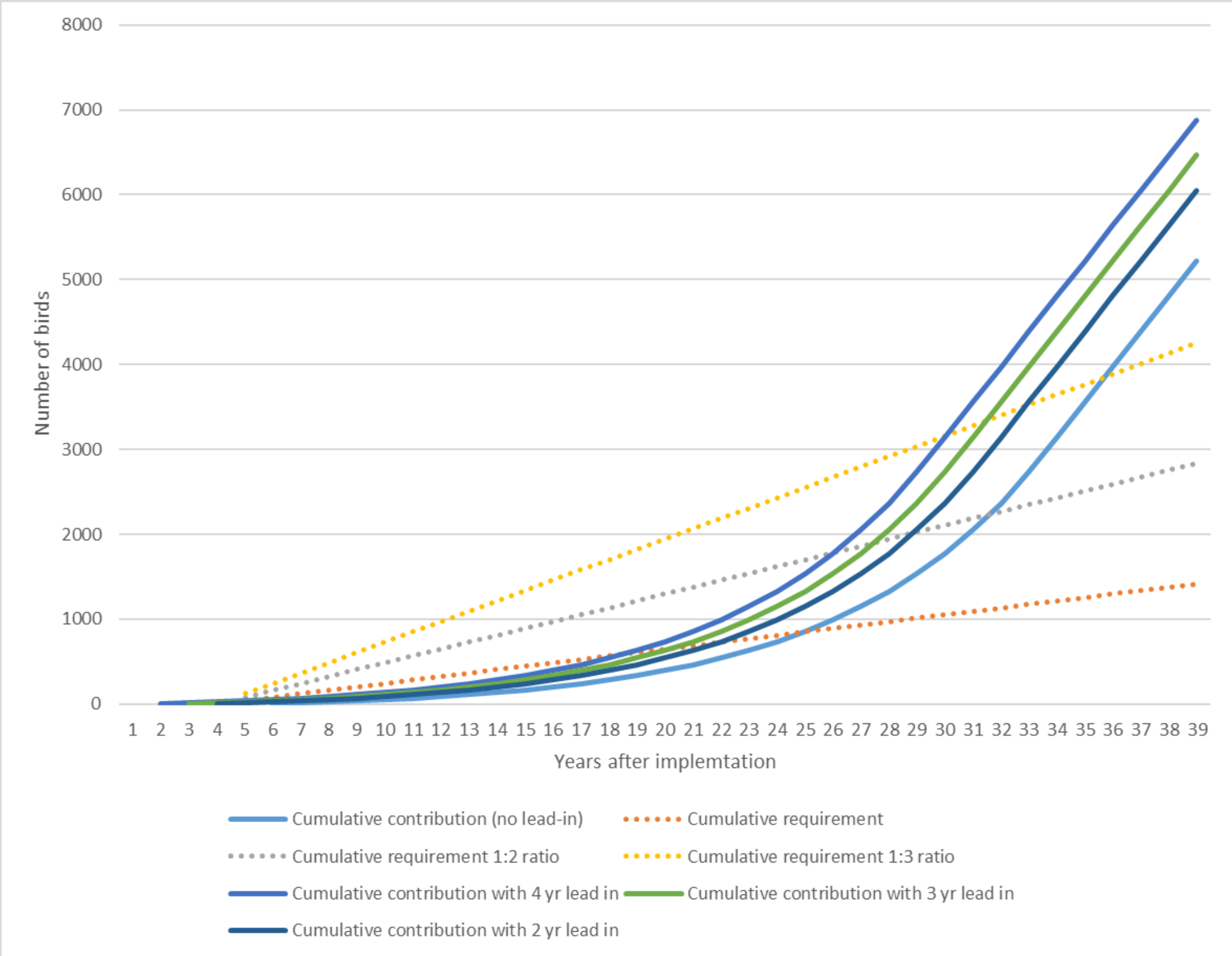


Figure 10~~10~~. Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (following the introduction of the ORBA) expressed at 1:1, 2:1~~1:2~~ and 3:1~~1:3~~ ratios.

~~26.~~38. Calculating the scale of longer-term benefits is limited by the undetermined lifetime of the ANS (Paragraph 7 of Part 1 and Part 2 of Schedule 22 of the DCO provides that the ANS must not be decommissioned without written approval of the SoS in consultation with Natural England and that, unless otherwise agreed, the ANS must be maintained beyond the operational lifetime of the development if it is colonised). Should ANS remain at capacity, they will continue to deliver adults at the required rate annually and beyond the lifespan of the Project.

3.4 Over-compensation due to Precautionary Assessments

Compensating based on the impact value defined using the Applicant’s approach (for kittiwake, the impact has been predicted as 15.5 birds per year) will result in over-compensation due to the elements of precaution that are introduced within the impact assessment, including precautionary inputs into Collision Risk Modelling (CRM), precautionary adult apportioning and precautionary proportioning of offshore breeders (~~see~~ REP2-057). The use of Natural England’s approach adds further precaution through the use of UCI outputs from CRM leading to even greater levels of over-compensation. Further details regarding levels of precaution used in the impact assessment can be found in (Document 19.8 Levels of precaution in the assessment and confidence calculations for offshore ornithology)

4 Precedent for a Reduced Lead in Time from Natural England's Advised Four Years

~~27.~~39. Other projects impacting kittiwake populations breeding at FFC SPA have had ANS compensation measures accepted that utilise lead in periods which are less than four years.

~~28.~~40. As discussed in Section 1, both Hornsea Three and Hornsea Four have successfully made non-material changes to their respective DCOs with regard to the lead-in period required for an ANS. In both cases the SoS has agreed to allow the reduction of the lead in period required. In the case of Hornsea Four, a reduction from four to two breeding seasons was granted. Two non-material changes were made to the Hornsea Three DCO, resulting in a total reduction from four full breeding seasons for all four required ANSs to three full breeding seasons for three of the ANSs and no lead-in period for the final ANS.

~~29.~~41. The rationale for the reduction in both cases was to ensure that project timelines were met, meaning delivery and operation of both windfarms were kept to schedule, and that both projects incurred no delay.

~~30.~~42. Both Hornsea Three and Hornsea Four presented evidence that making this change would not impact the overall delivery of compensation for kittiwake from ANS at the required rate, over the lifetime of the projects. Both projects presented this case alongside evidence that no additional land rights were required, and that the alteration to the required lead-in period had no material effect on Habitats Regulations Assessment (HRA) conclusions and resulted in no materially different environmental effects.

~~31.~~43. Part 2, Schedule 17 of the Sheringham Shoal and Dudgeon Extensions Offshore Wind Farm Order 2024 provides for three full breeding seasons to have passed before the operation of turbines[6].

~~32.~~44. The Applicant notes that, during the Examination for the Sheringham Shoal and Dudgeon Extension DCO, Natural England stressed that lead in times for compensatory measures should be considered on a case-by-case basis.

~~33.~~45. There is no ecological justification for alignment with a four year lead in time when: a) there have now been several departures from that position which have been agreed by Natural England; and b) the Applicant has presented the evidence base which supports the inclusion of the lead in period of 2 breeding seasons, as set out in Part 1, Schedule 22 of the draft DCO and in this document.

[6] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-002343-SADEP%20DCO%20DESNZ%20170424.pdf

~~34.~~46. The Applicant considers that this position would also apply to the Project given that the compensation measures proposed will substantially overcompensate for negative effects over the lifetime of the Project, regardless of the lead in period. As such, in order to avoid potential delays to the overall timeline of delivery for the Project, a reduction in lead-in time for ANS from four years to two breeding seasons is proposed.

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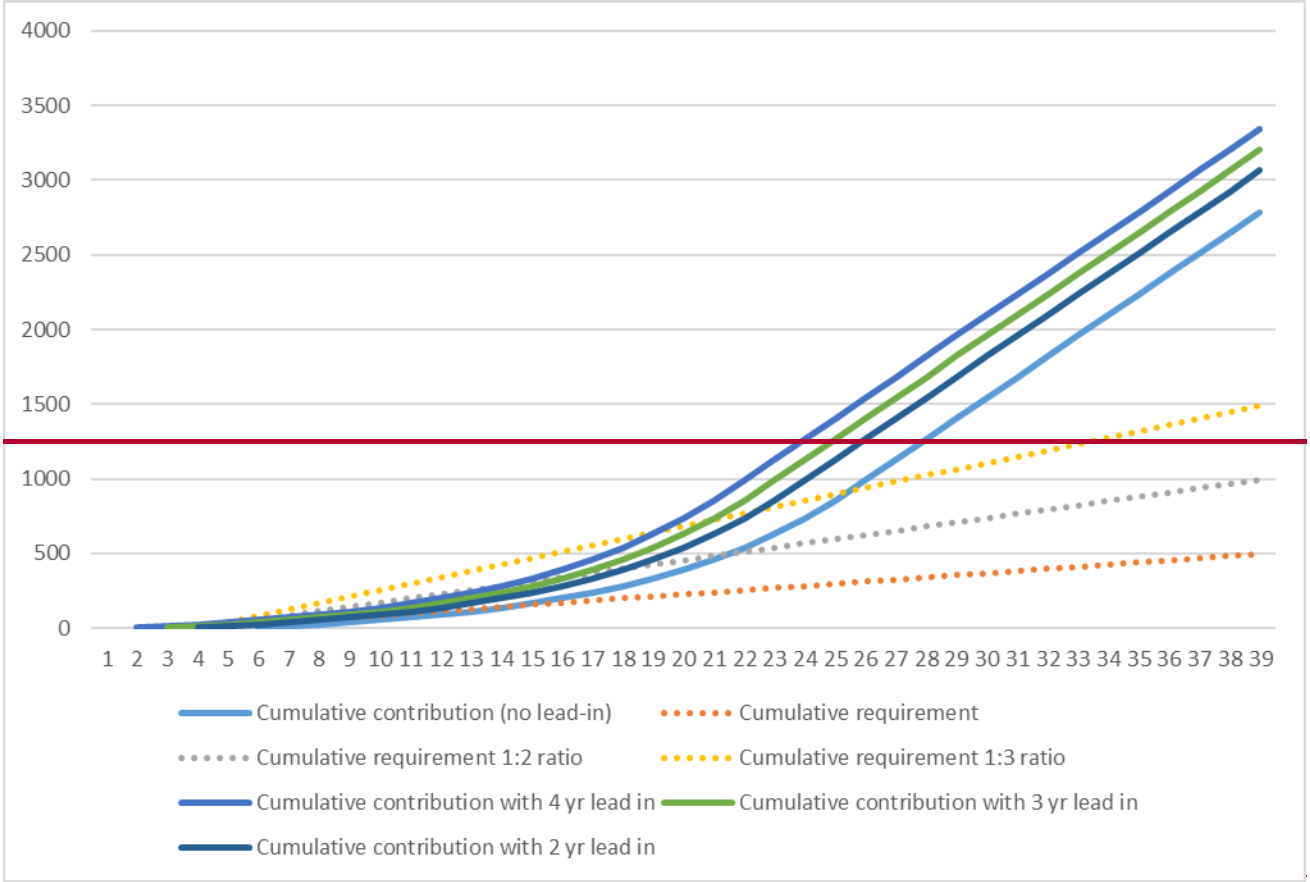
~~Annex 1~~

~~Cumulative outputs from ANS compared to cumulative requirements for kittiwake based on impacts predicted in the RIAA.~~



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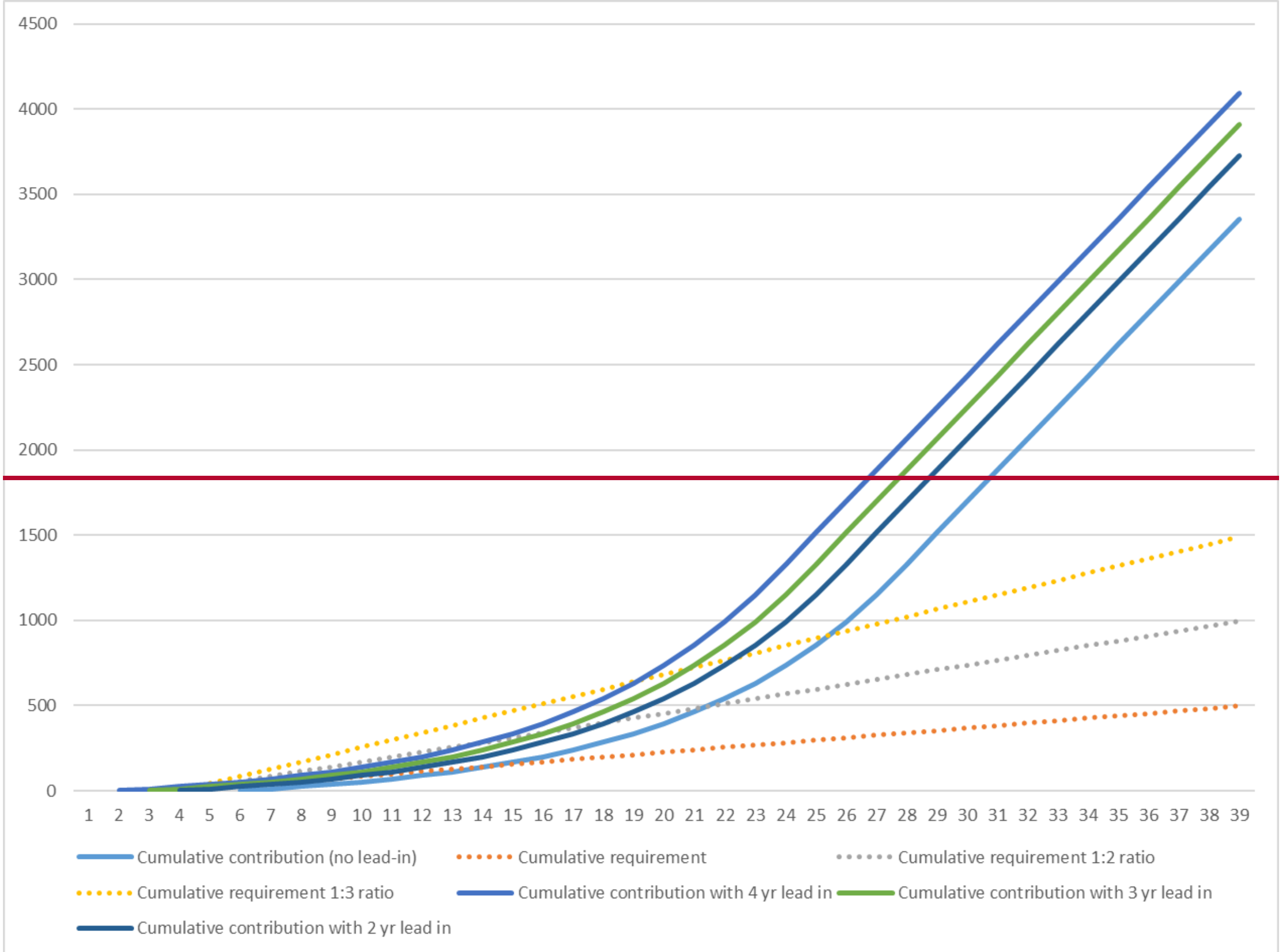

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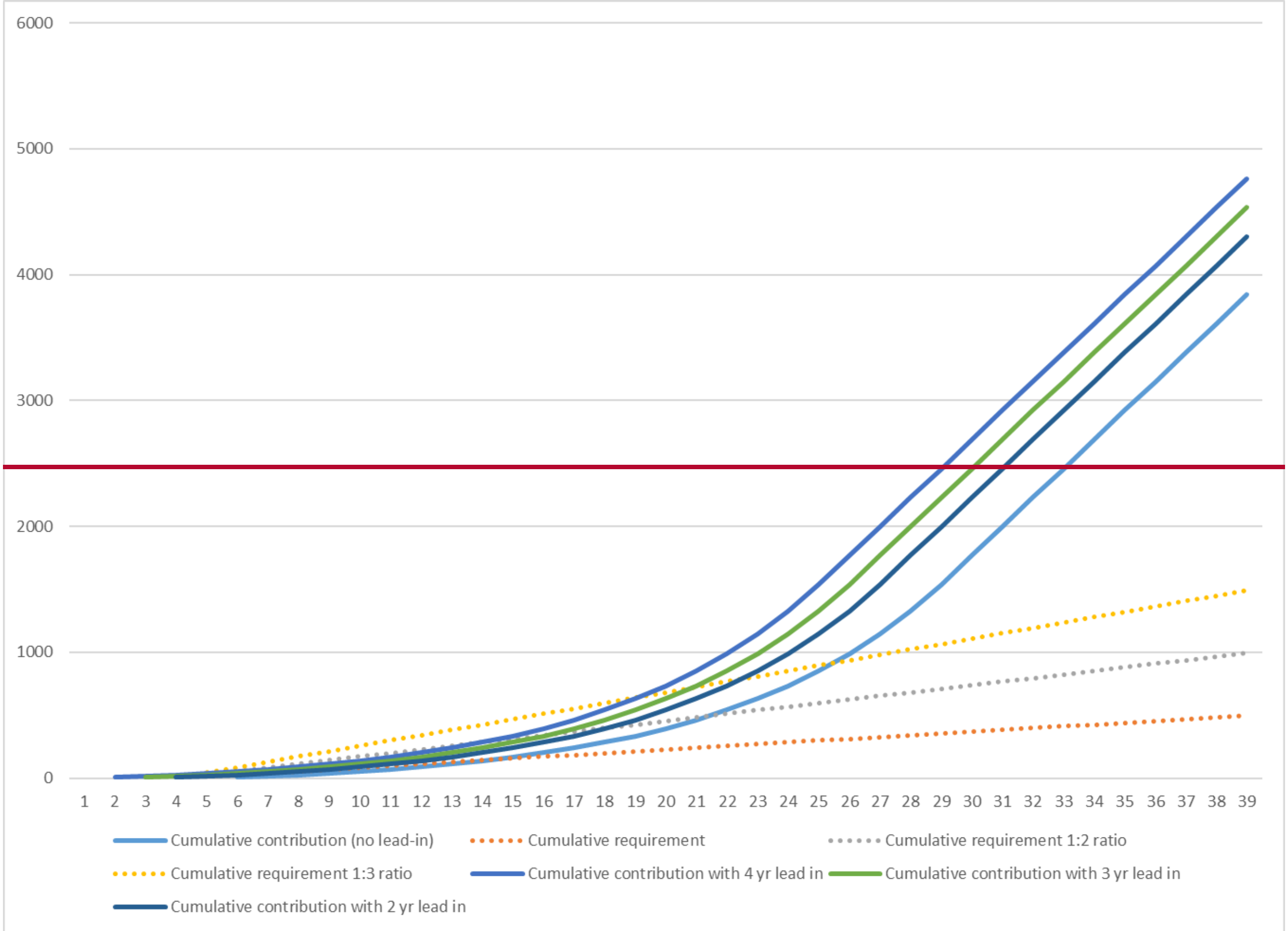

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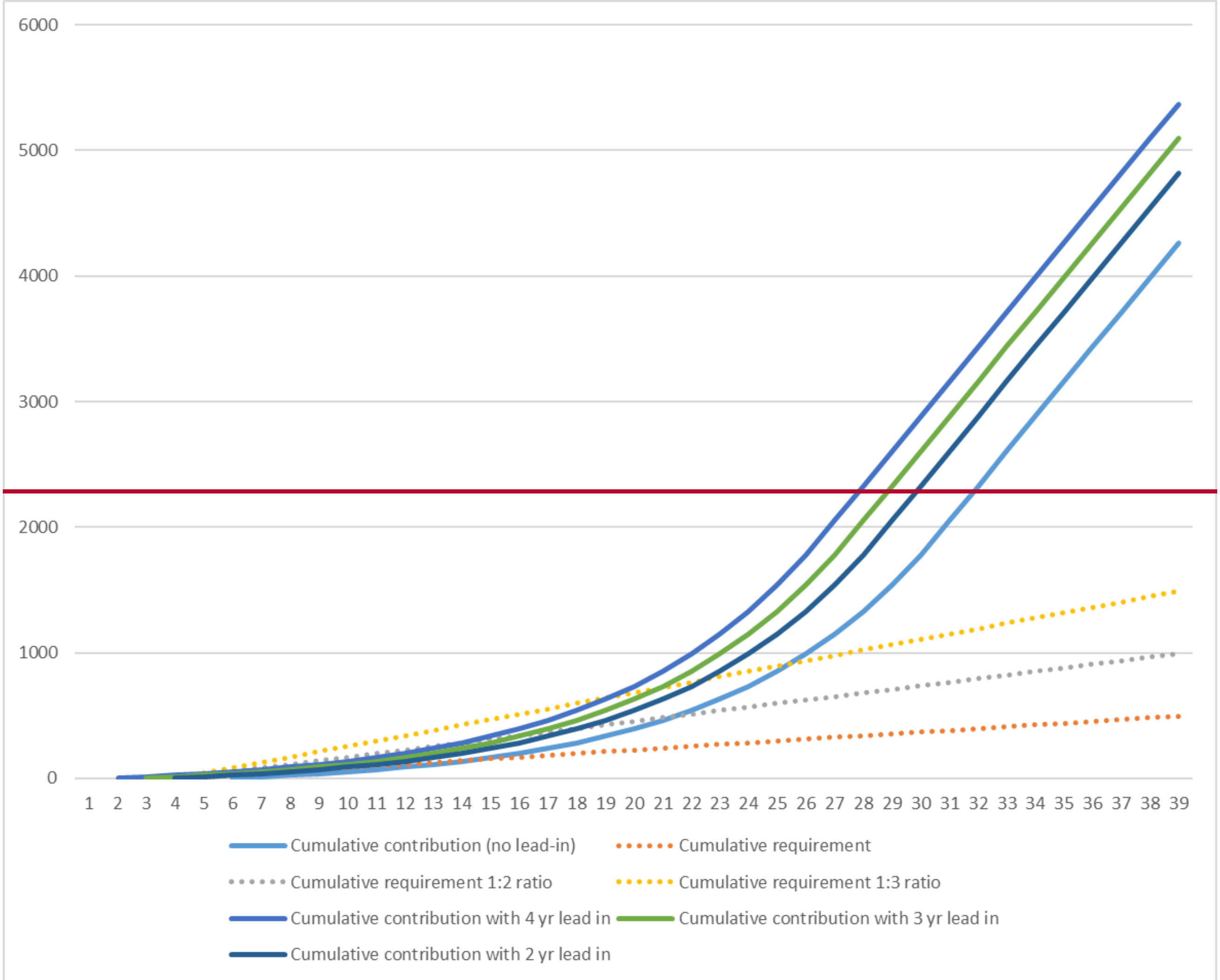
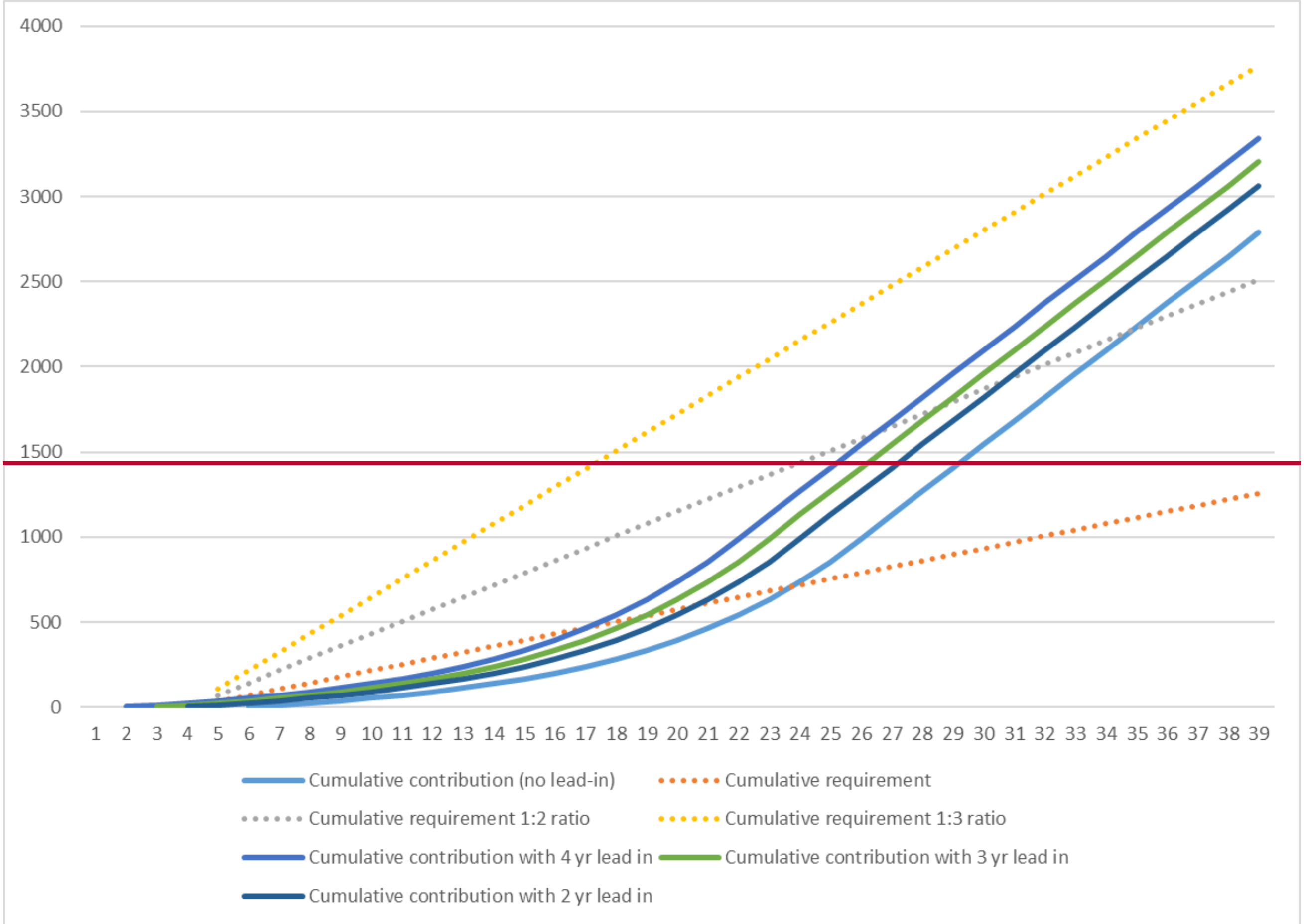


~~Figure . Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value (as provided in the RIAA) expressed at 1:1, 1:2 and 1:3 ratios~~



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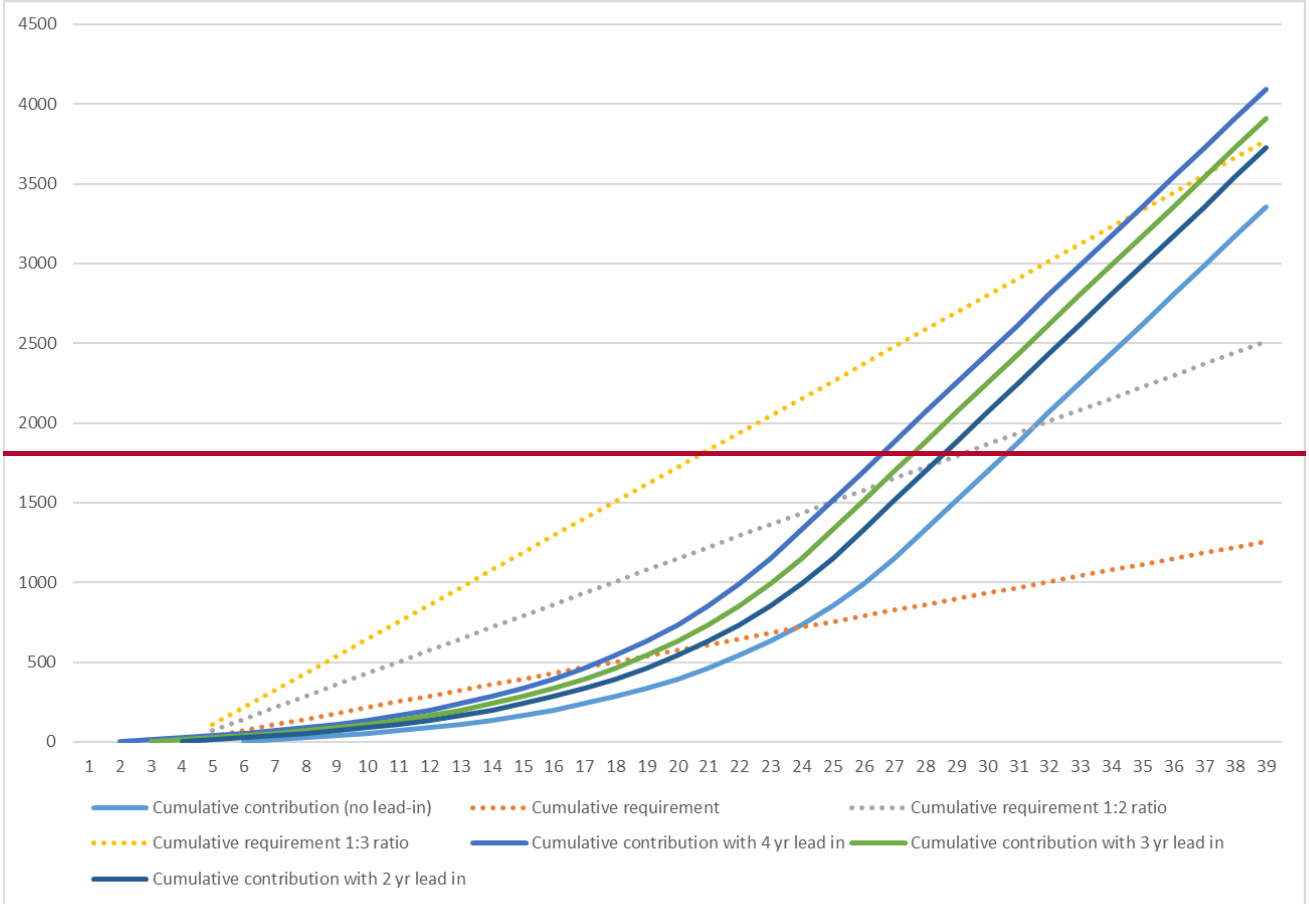
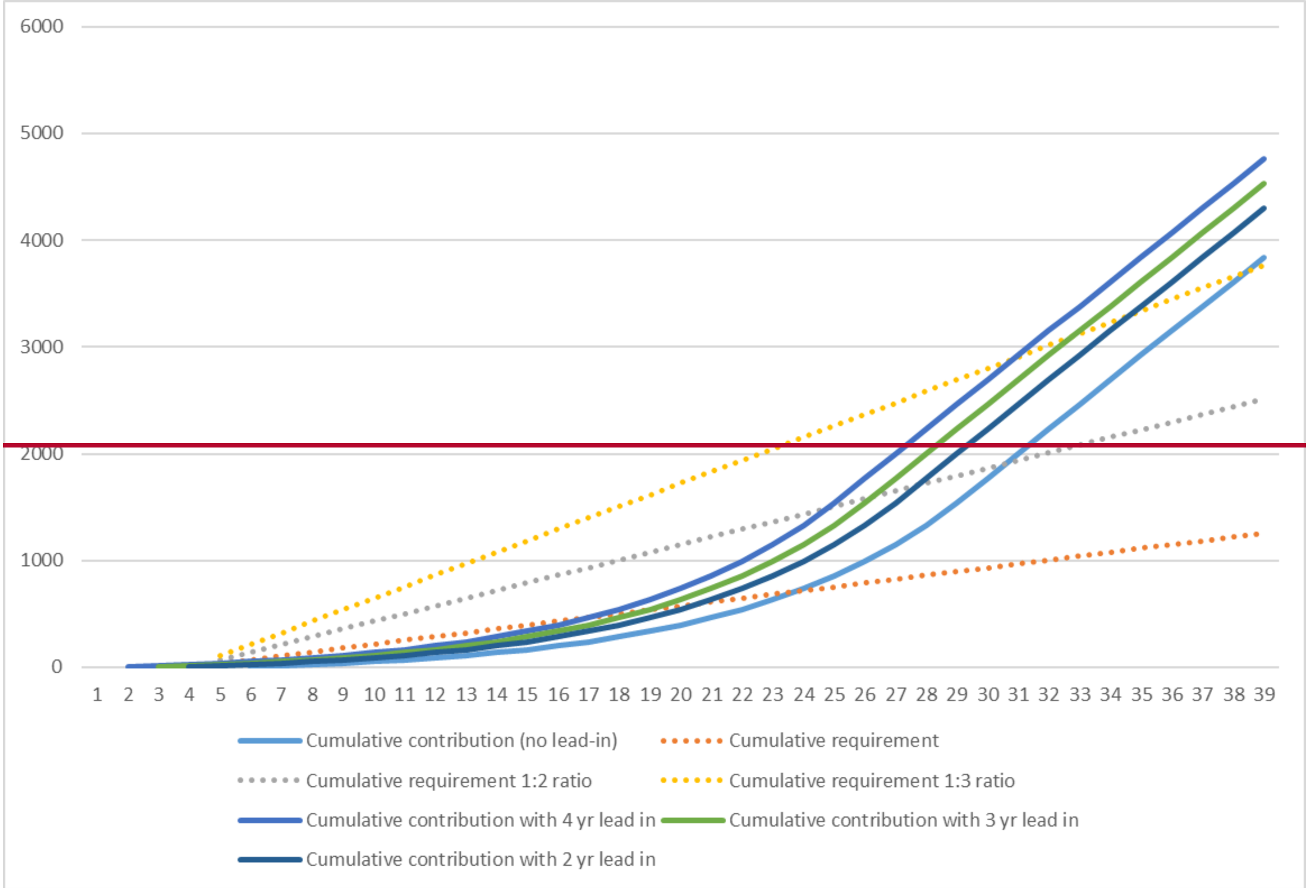
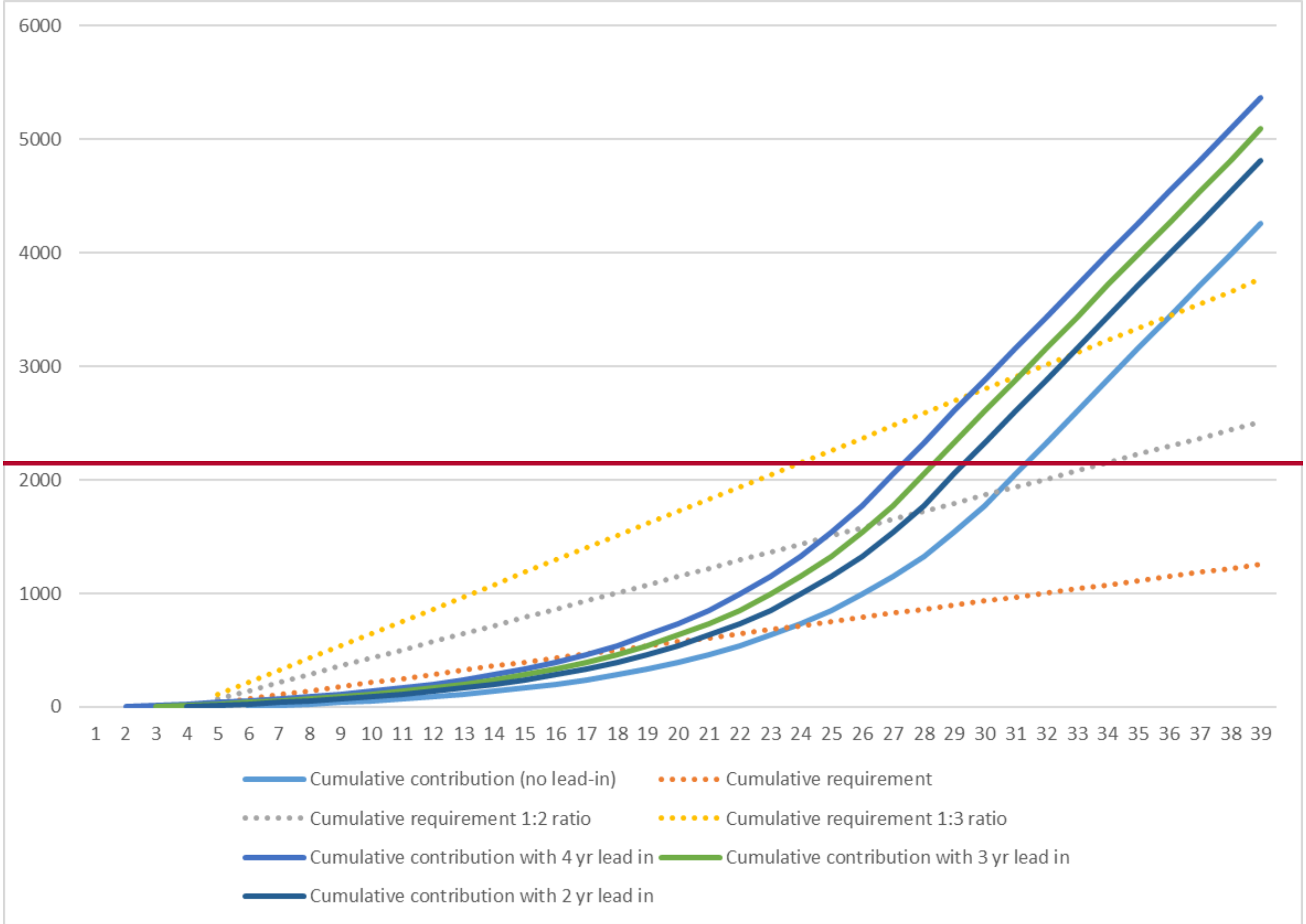


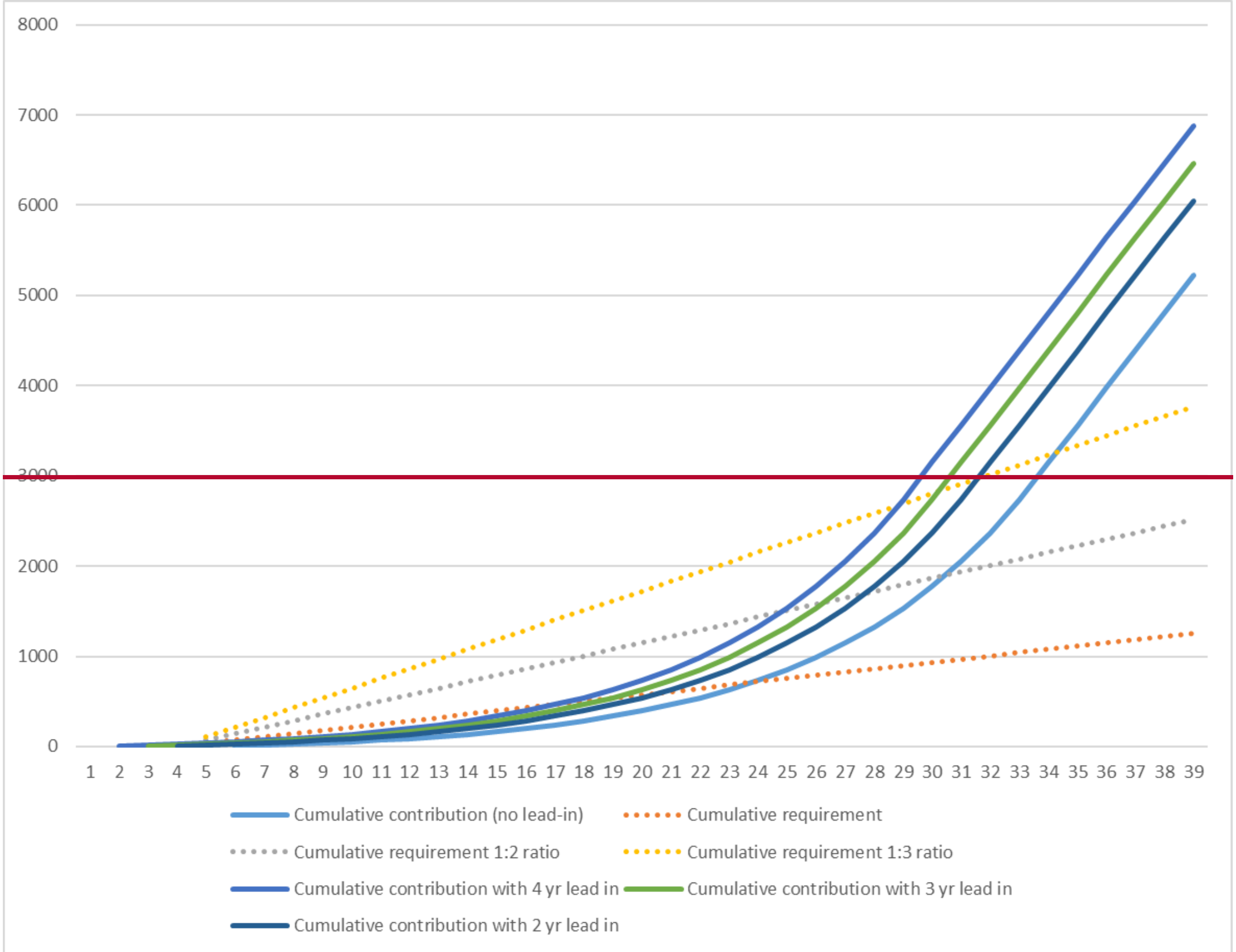
~~Figure . Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (using UCI outputs from CRM carried out at RIAA) expressed at 1:1, 1:2 and 1:3 ratios~~



~~Figure . Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (using UCI outputs from CRM carried out at RIAA) expressed at 1:1, 1:2 and 1:3 ratios~~



~~Figure . Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (using UCI outputs from CRM carried out at RIAA) expressed at 1:1, 1:2 and 1:3 ratios~~



~~Figure . Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the UCI impact value (using UCI outputs from CRM carried out at RIAA) expressed at 1:1, 1:2 and 1:3 ratios~~

Annex 1

47. Cumulative outputs from ANS compared to cumulative requirements for kittiwake based on mean impact values, modelled with a range of colony start size and colony growth variables. In addition to the colony start size of 3 AONs and a colony growth rate of 15% annually, additional scenarios based on colony start sizes of one and 20 AONs, and colony growth rates of 10 and 20%, as per Coulson (2011), are presented.
48. In a scenario with an ANS with 300 AONs, even using the most precautionary growth rate (10%) and the most precautionary colony start size (one AON), the ANS overcompensates over the lifetime of the project when considering impacts at a 1:1 ratio. With a two-year lead in time, overcompensation will be delivered at approximately year 30 in the Projects lifetime. As such in this scenario a delay in colonisation of five years is tolerable. In all other scenarios (i.e. any scenario other than the most precautionary) with an ANS of 300 AONs, the cumulative compensation requirement is comfortably surpassed at a 3:1 ratio, at the latest, 25 years into the lifetime of the project. As such, even at a 3:1 ratio a substantial delay in colonisation is tolerable.
49. This is also the case for all other ANS sizes modelled here (400, 500, 600 and 900 AONs), i.e. in any scenario apart from the most precautionary, the cumulative compensation requirement is comfortably surpassed at a 3:1 ratio.
50. Across the most precautionary scenario at the 400, 500, 600, and 900 AON models, with a two year lead in period, the cumulative compensation requirement is comfortably surpassed at a 1:1 ratio. At the latest this happens at around 25 years into the lifetime of the Project on a 400 AON ANS.

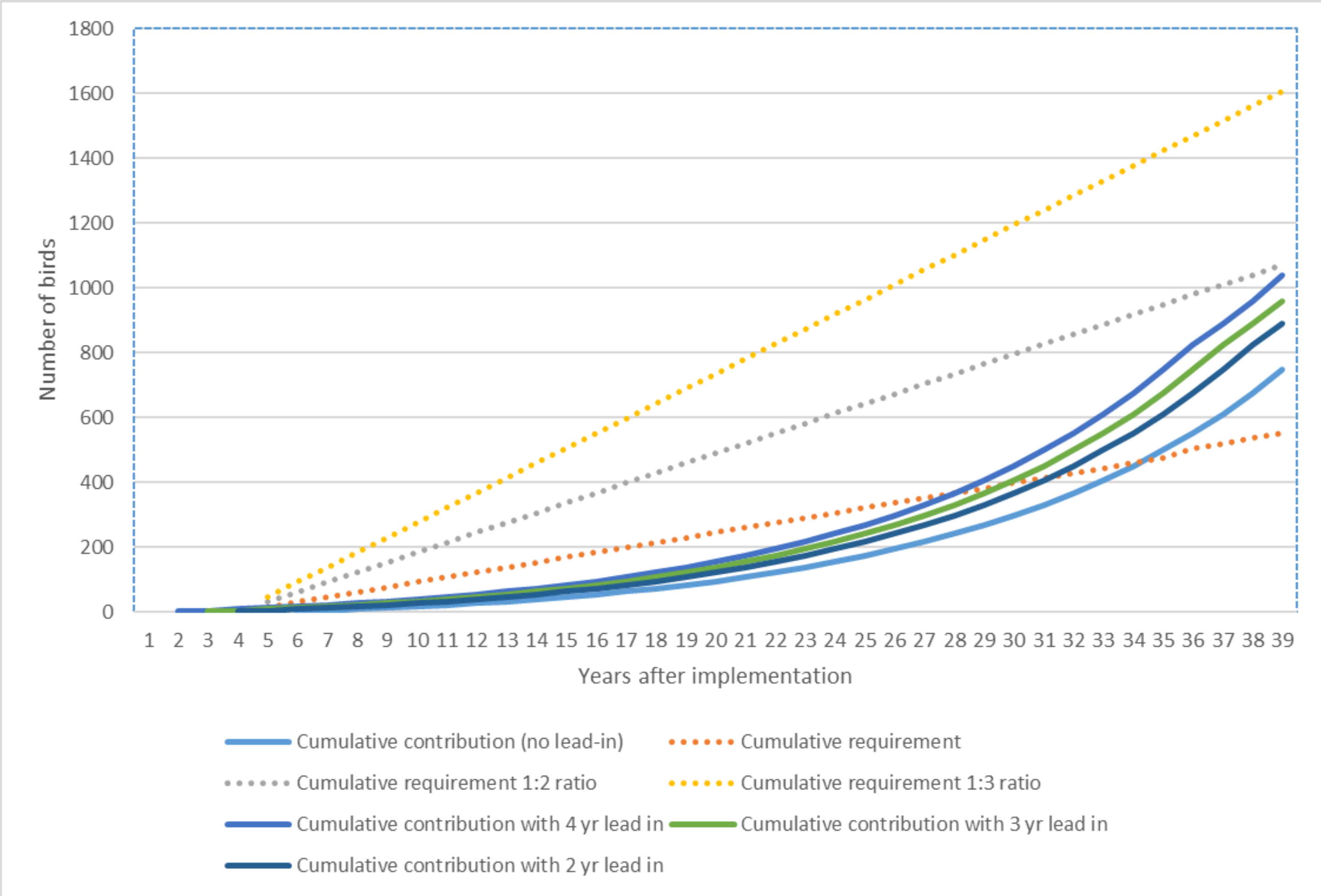


Figure 11~~20~~. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 1 AON.

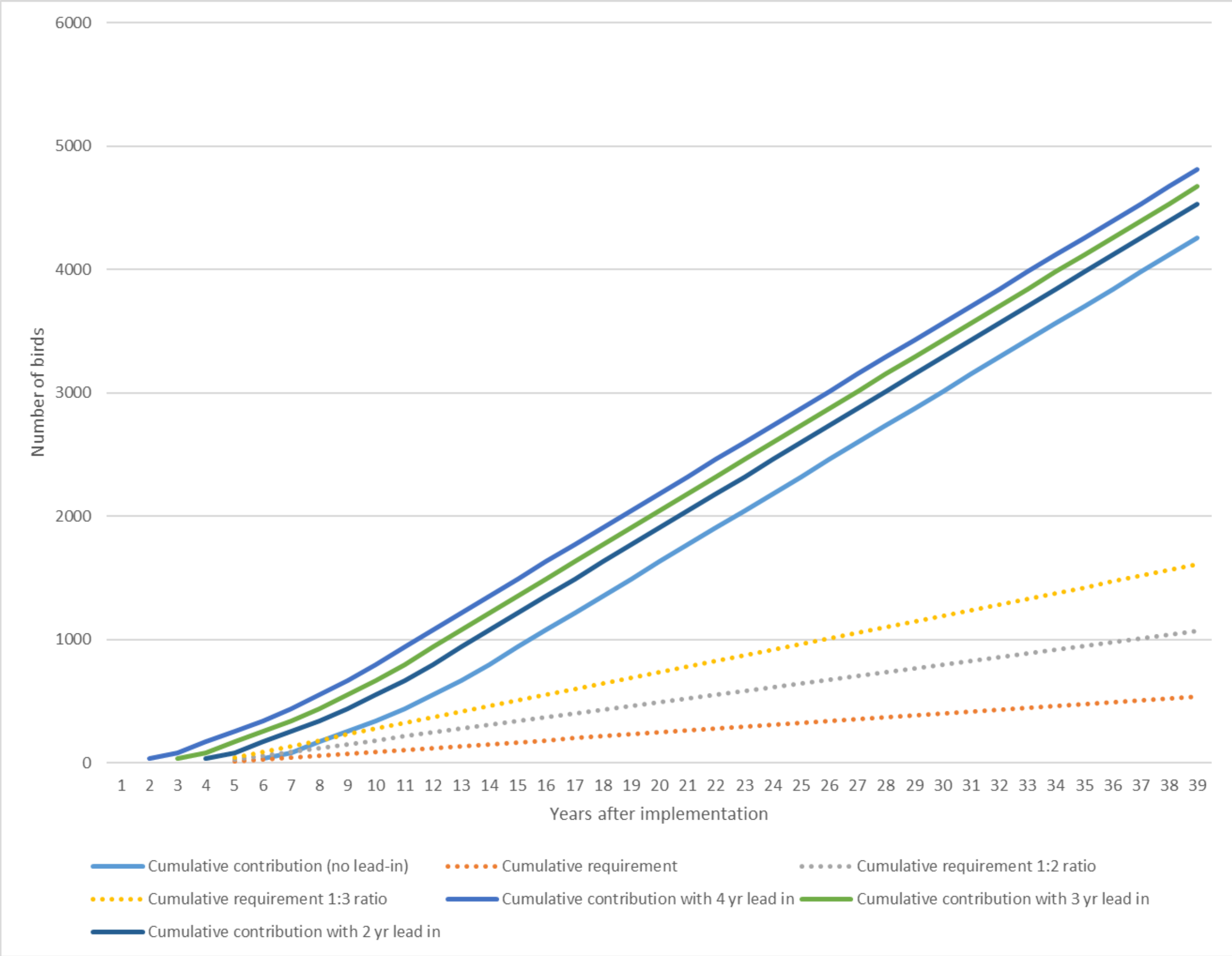


Figure 12~~21~~. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 20 AONs.

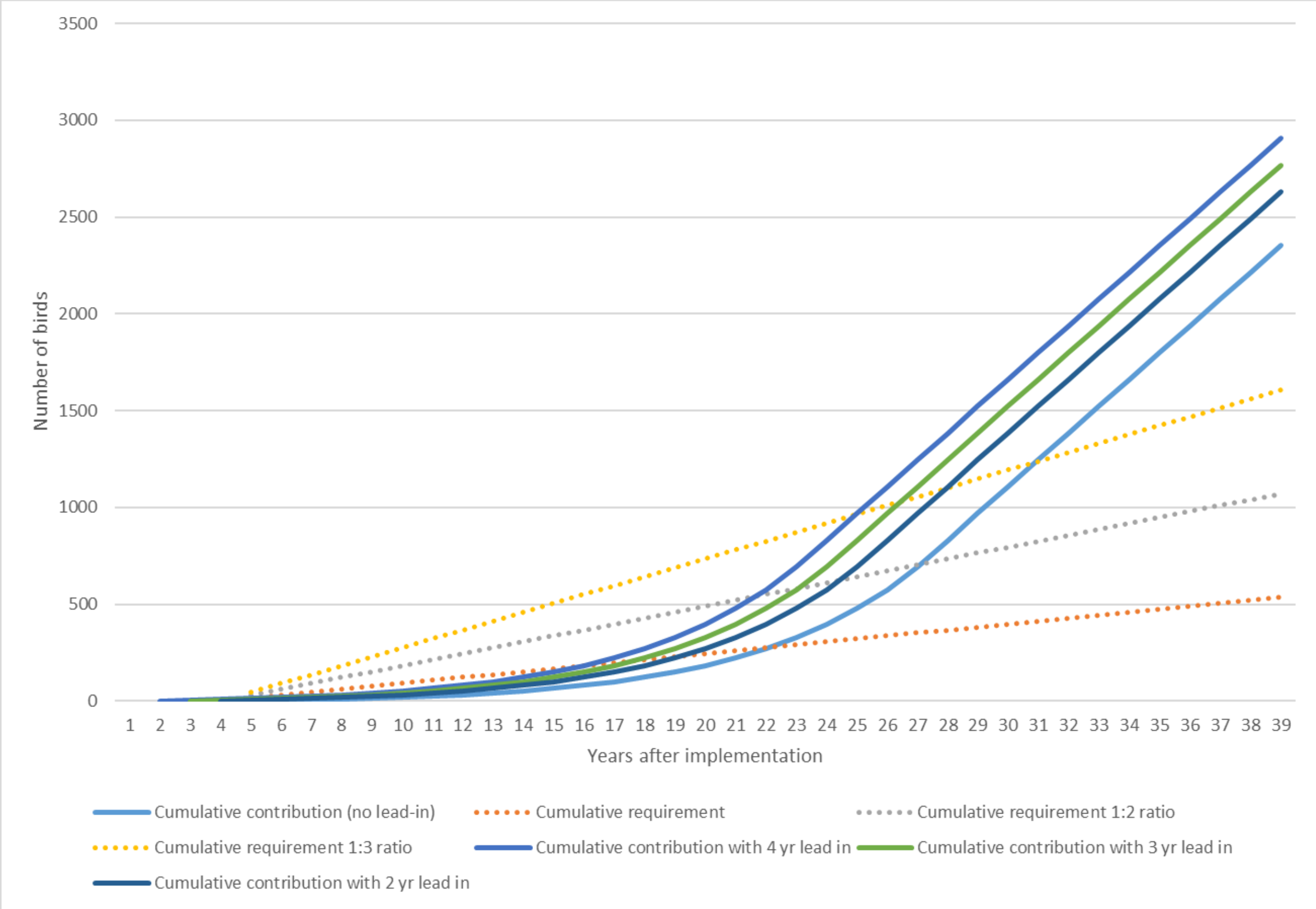


Figure 13~~22~~. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 1 AON.

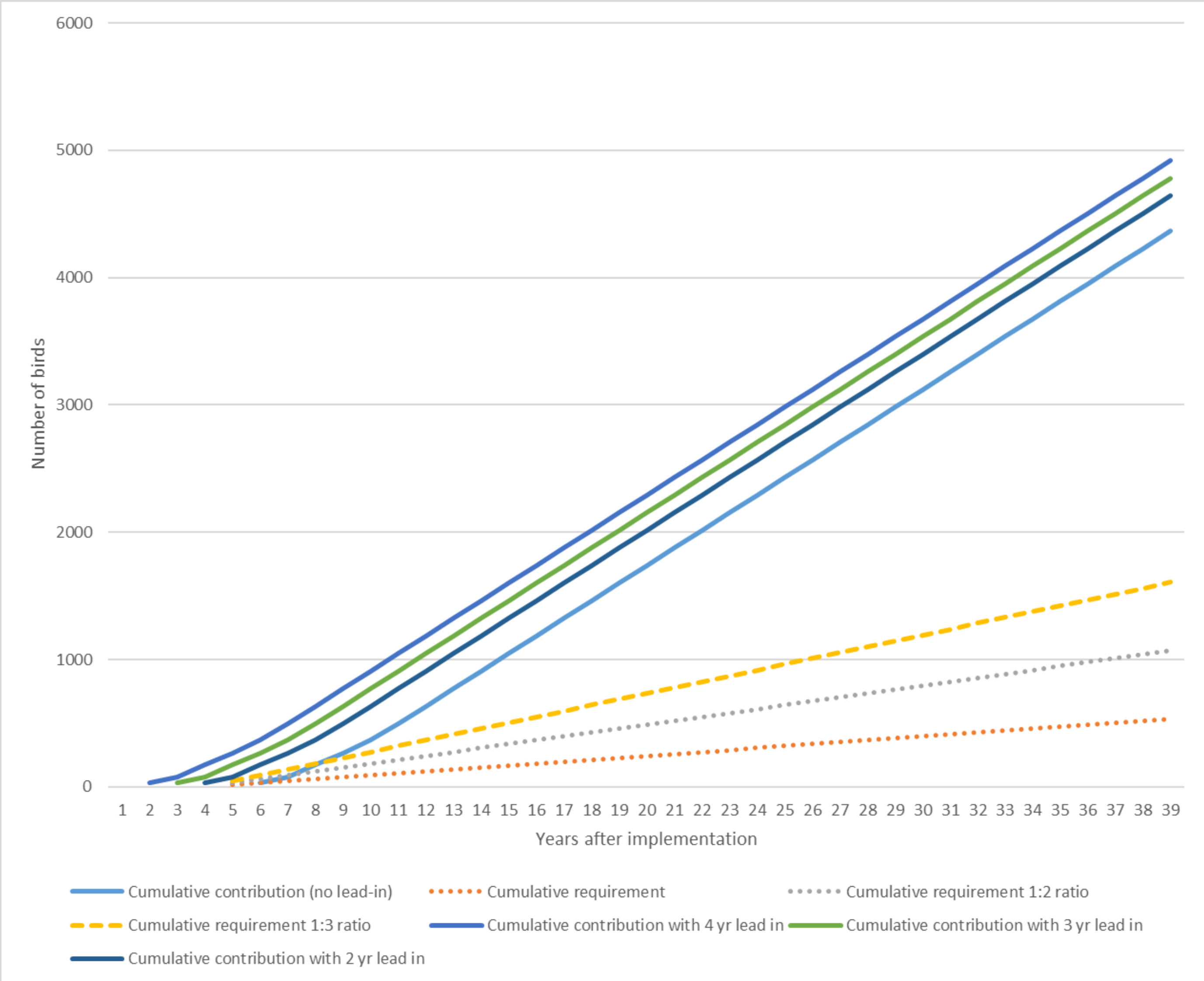


Figure 14~~23~~. Cumulative outputs from an ANS with 300 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 20 AON.

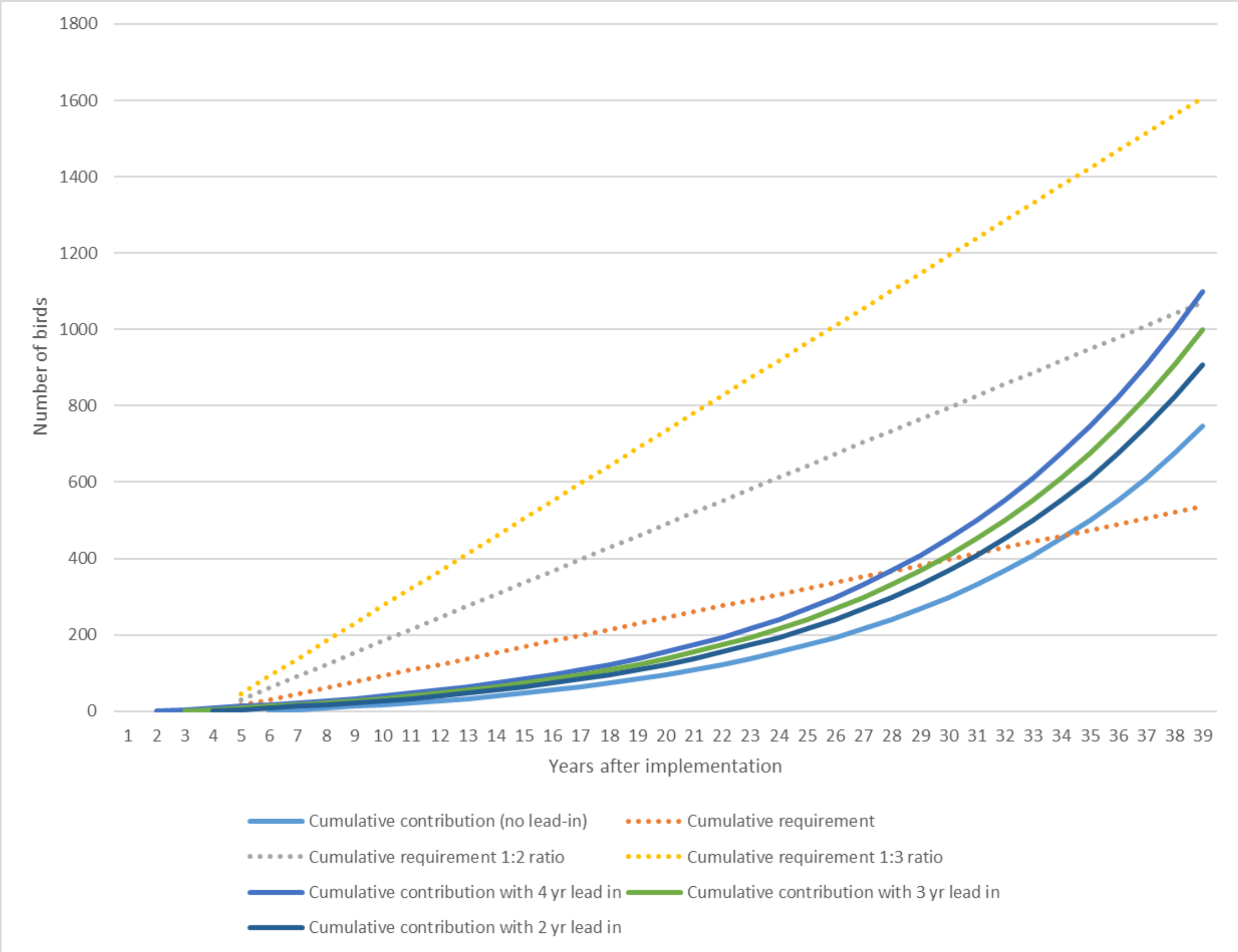


Figure 15~~24~~. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 1 AON.

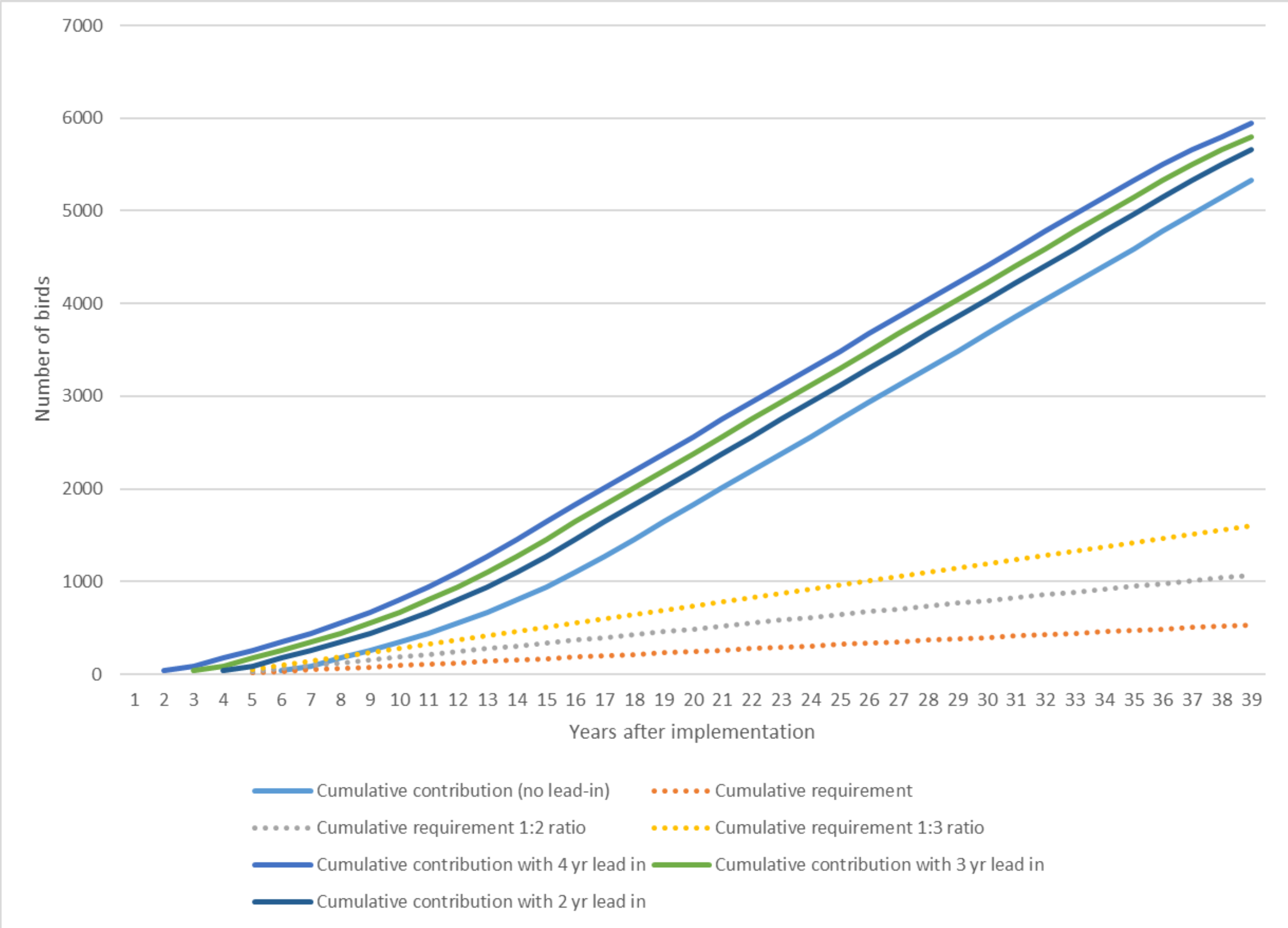


Figure 16~~25~~. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 20 AON.

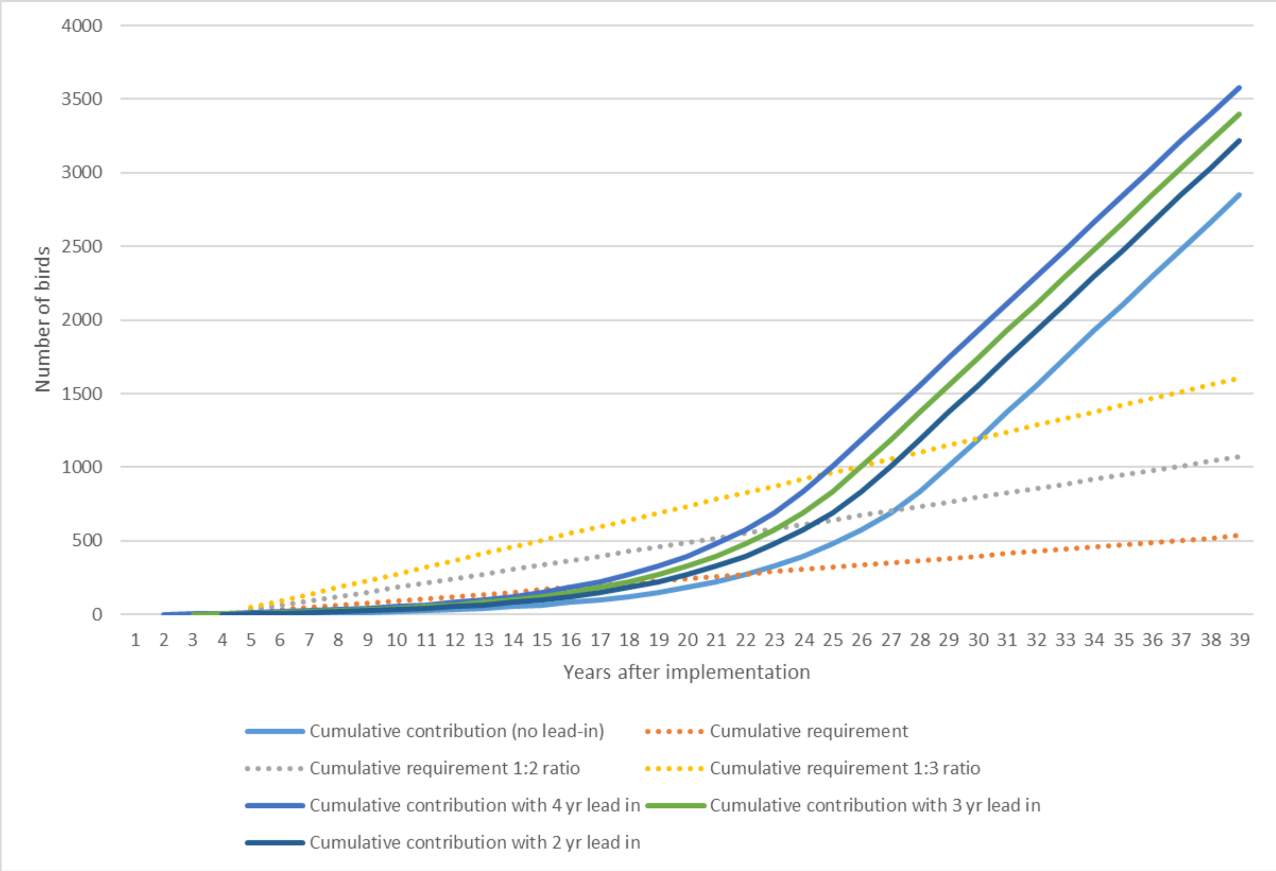


Figure 17~~26~~. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 1 AON.

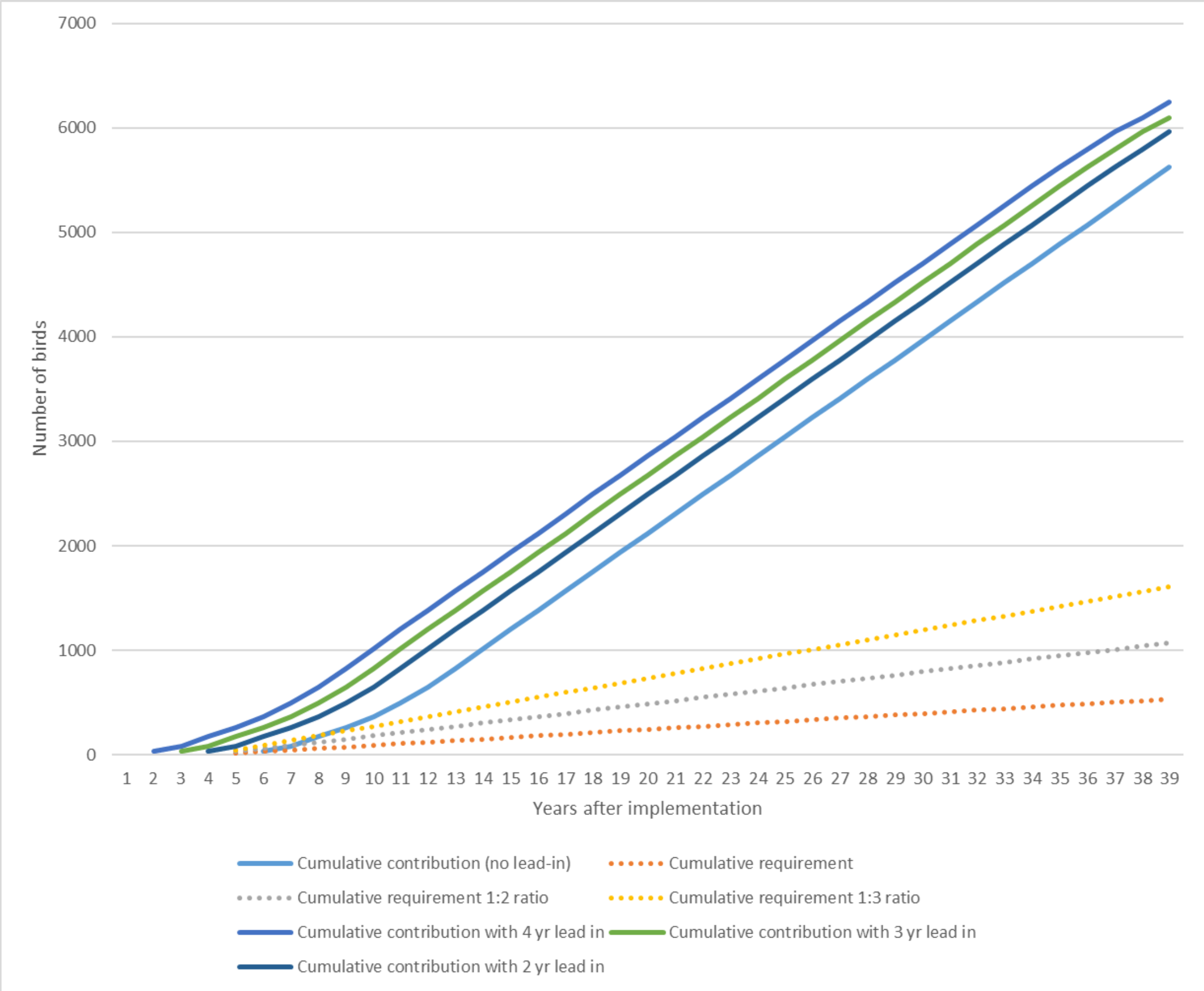


Figure 18~~27~~. Cumulative outputs from an ANS with 400 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 20 AON.

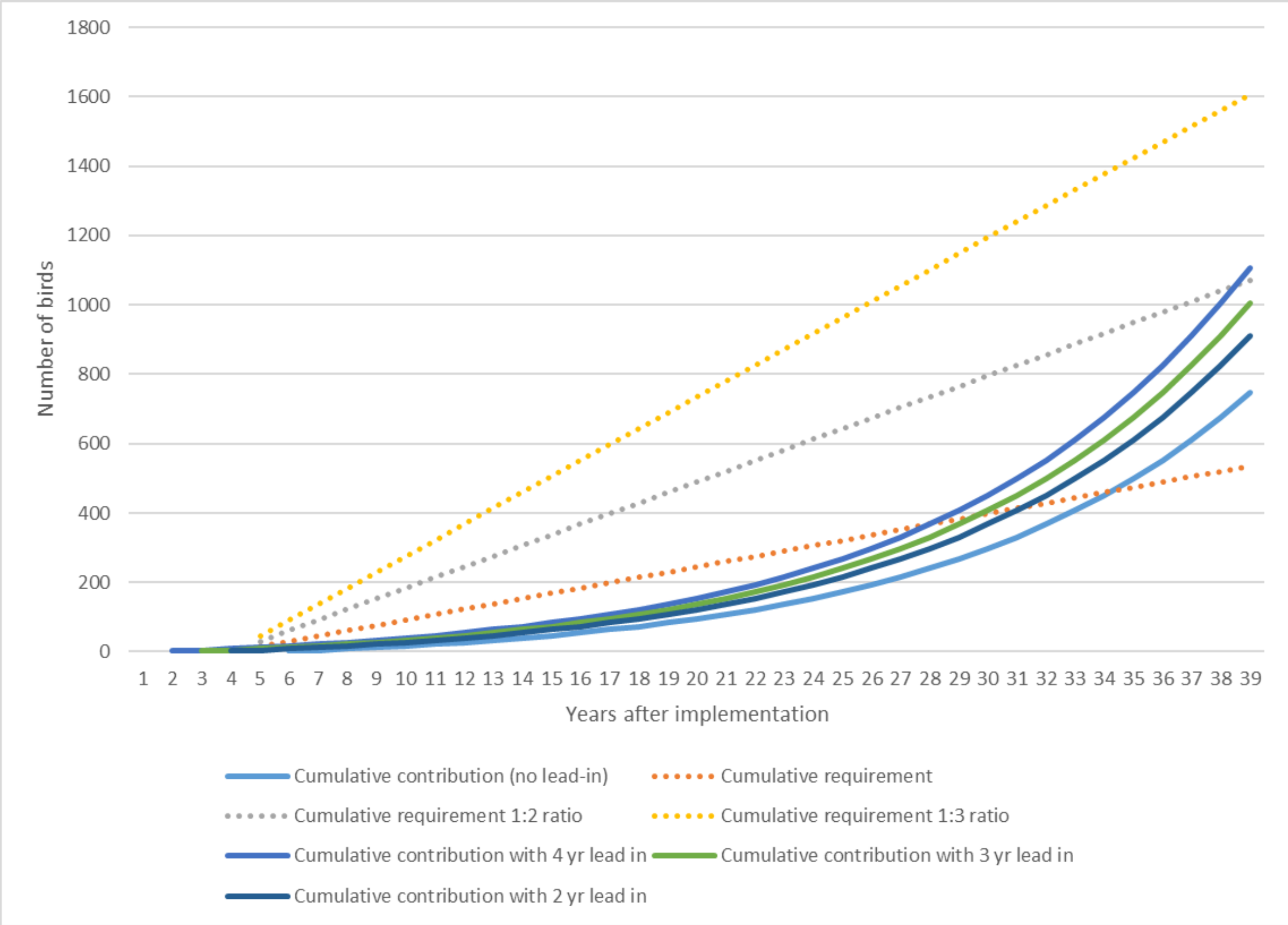


Figure 19~~28~~. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 1 AON.

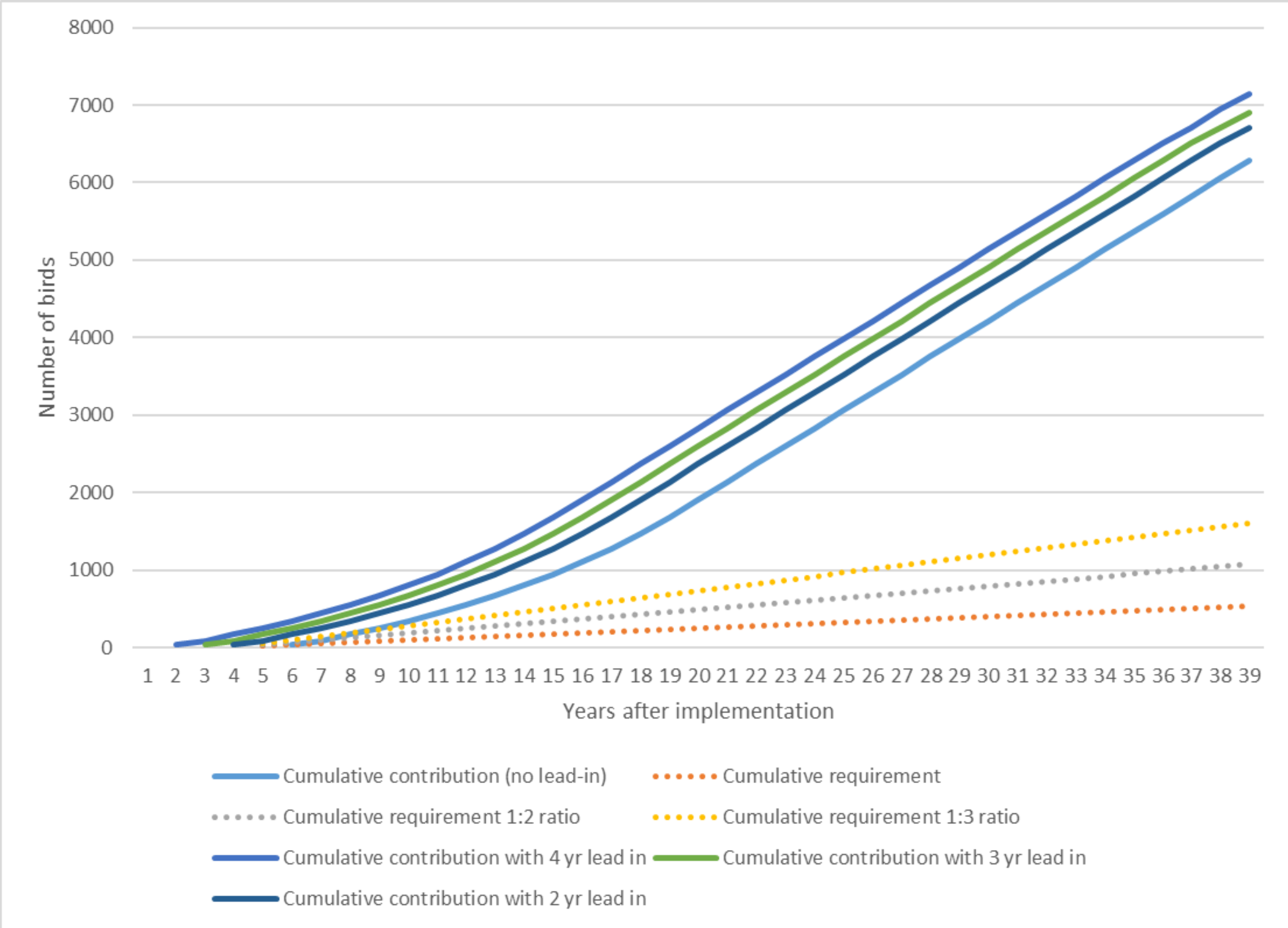


Figure 20~~29~~. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 20 AON.

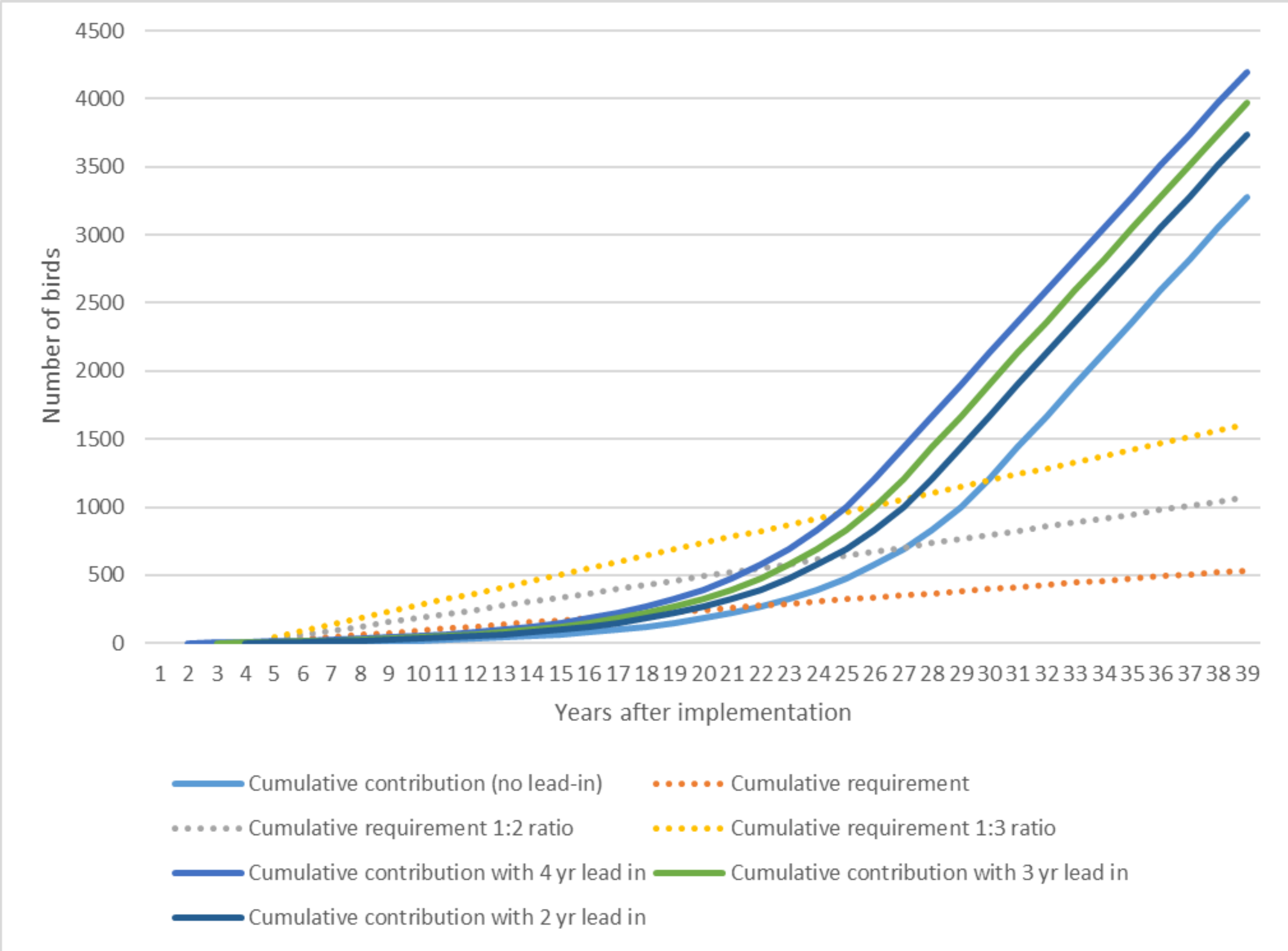


Figure 21~~30~~. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 1 AON.

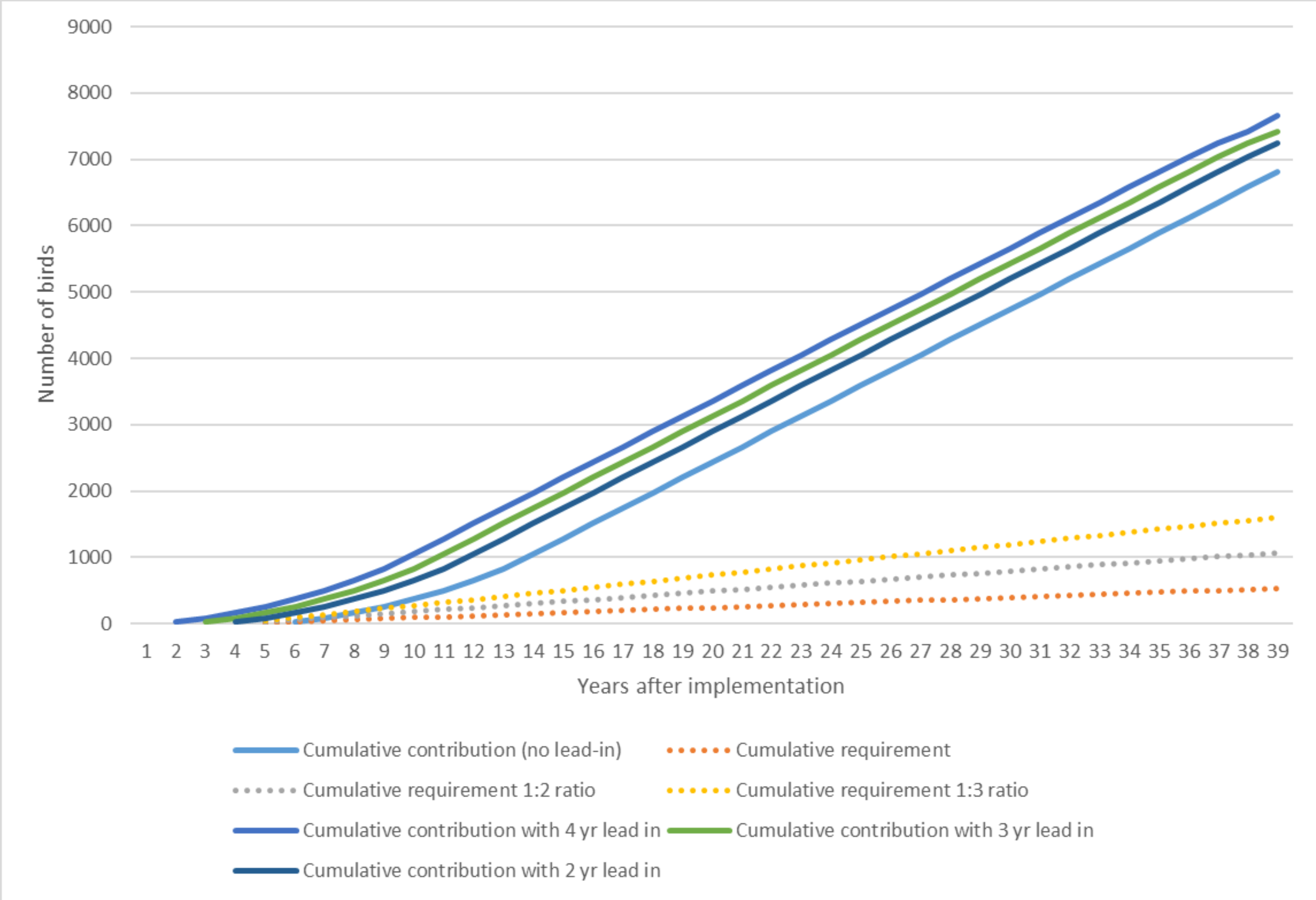


Figure 22~~31~~. Cumulative outputs from an ANS with 500 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 20 AON.

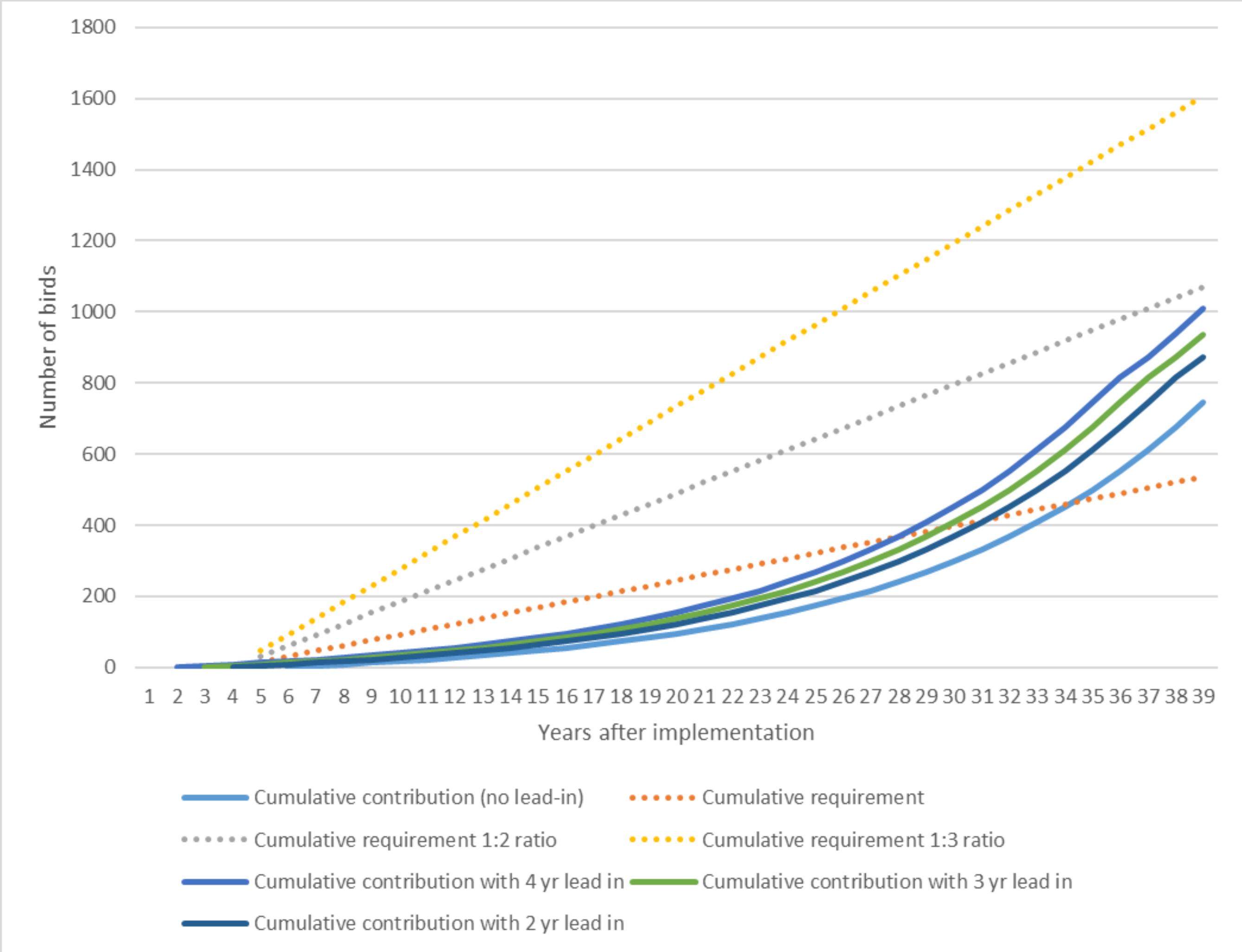


Figure 23~~32~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 1 AON.

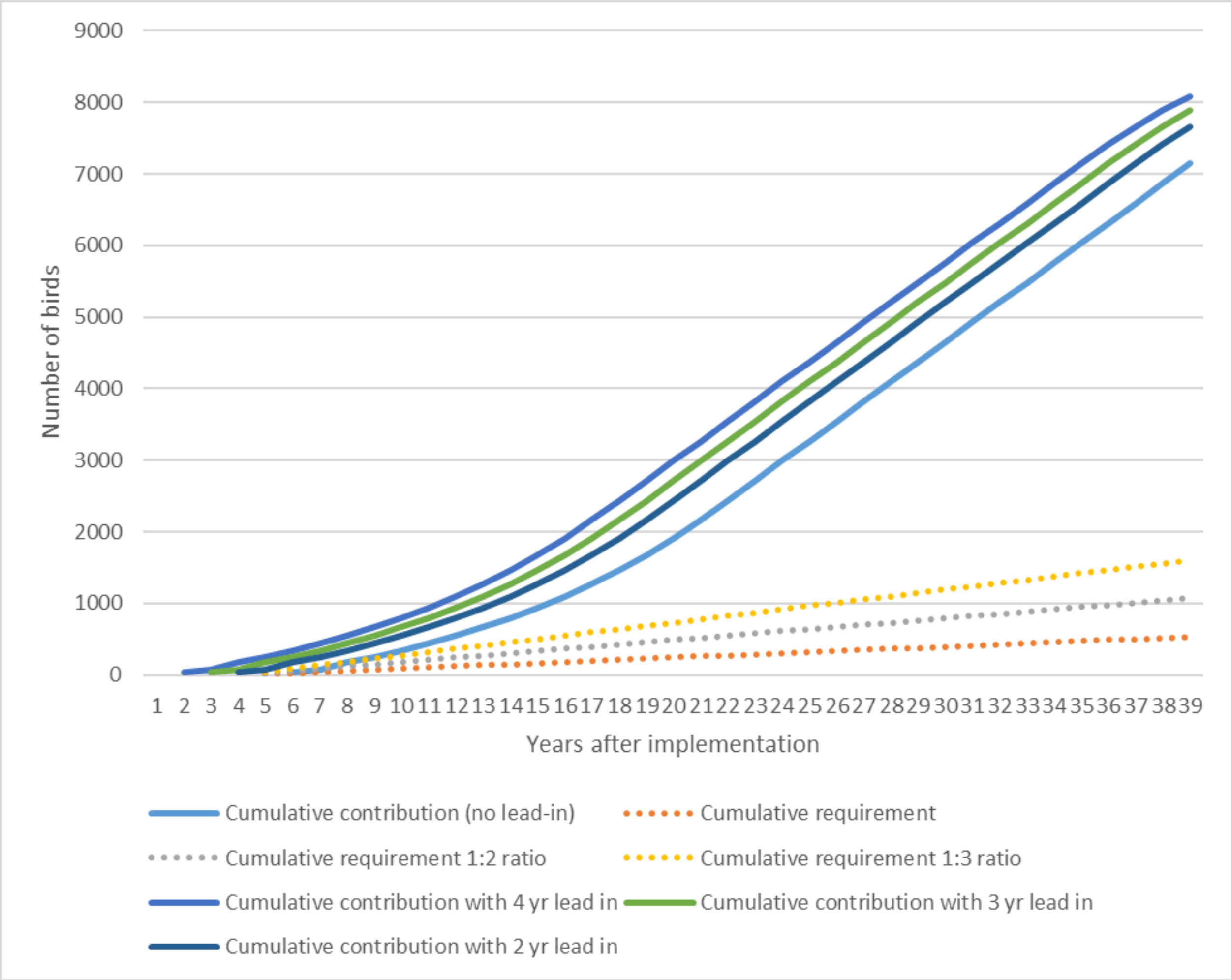


Figure 24~~33~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 20 AON.

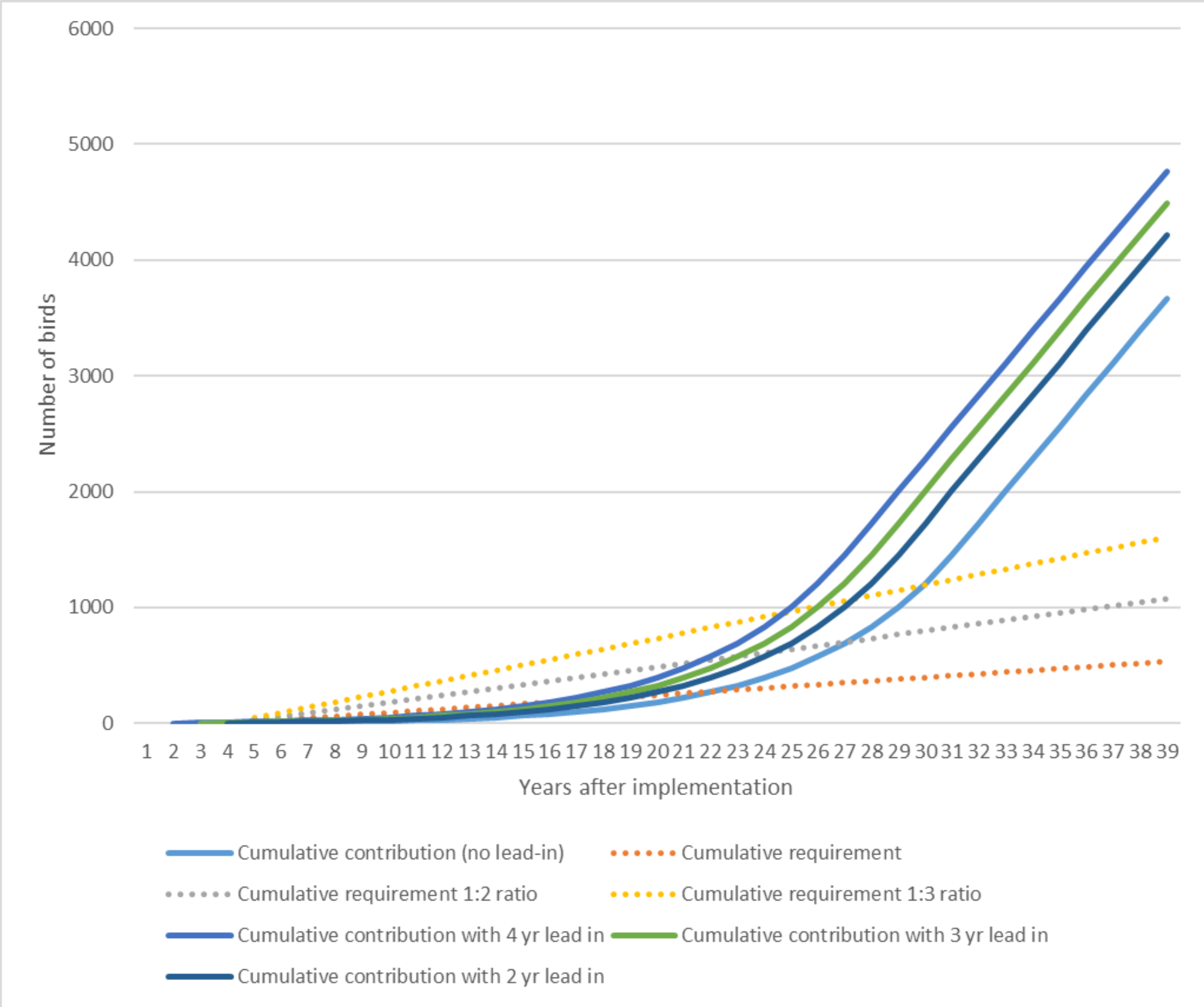


Figure 25~~34~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 1 AON.

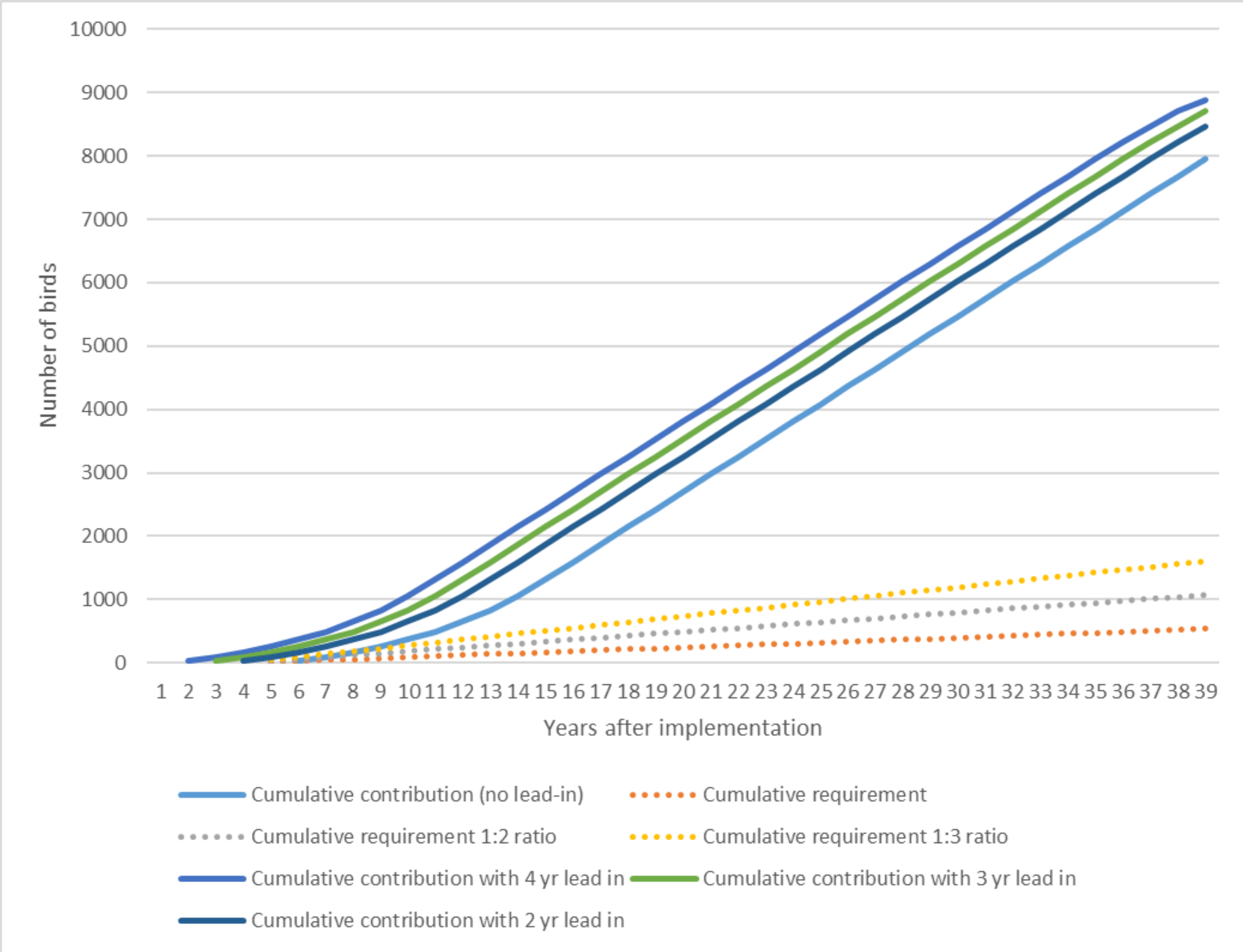


Figure 26~~35~~. Cumulative outputs from an ANS with 600 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 20 AON.

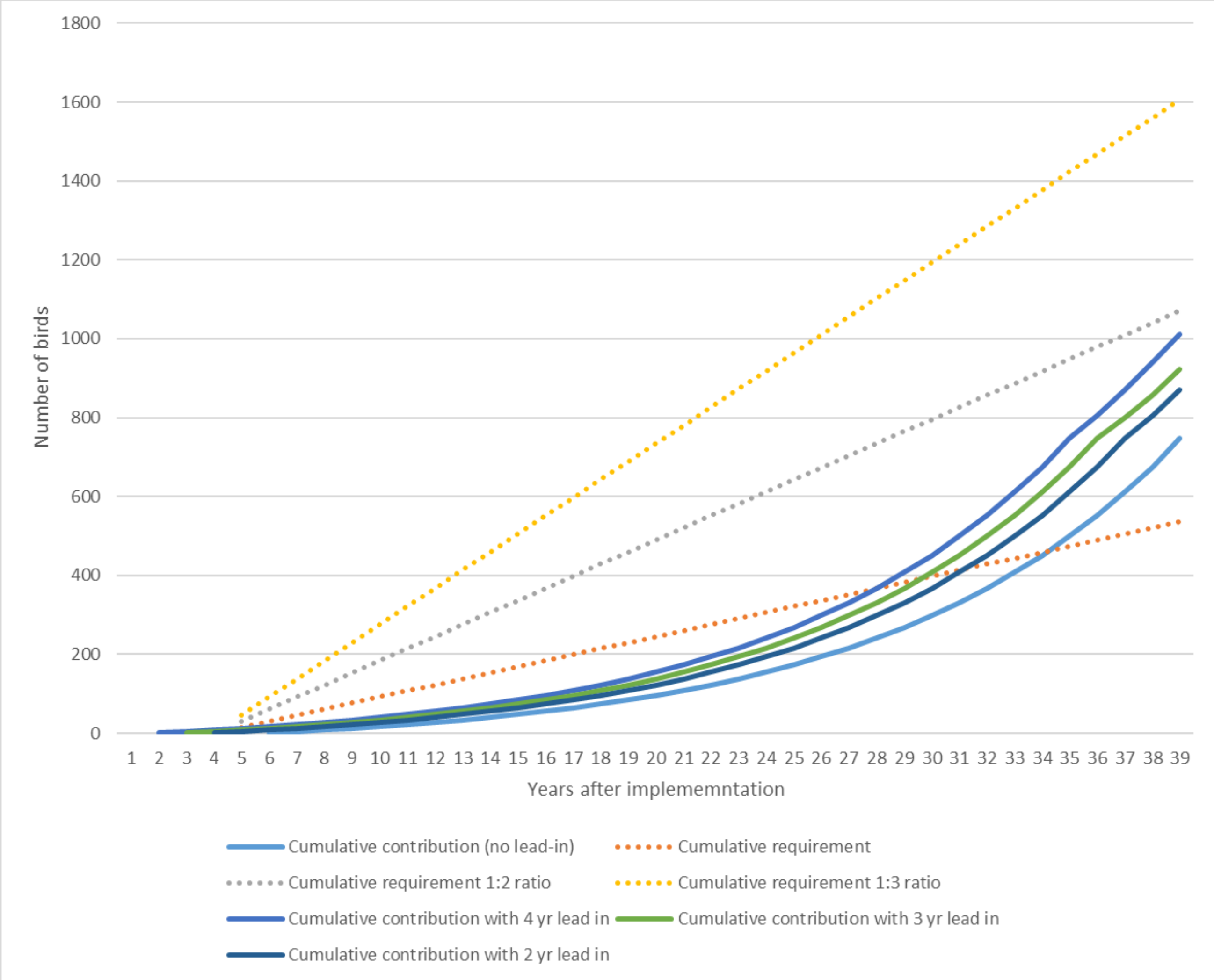


Figure 27. Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 1 AON.

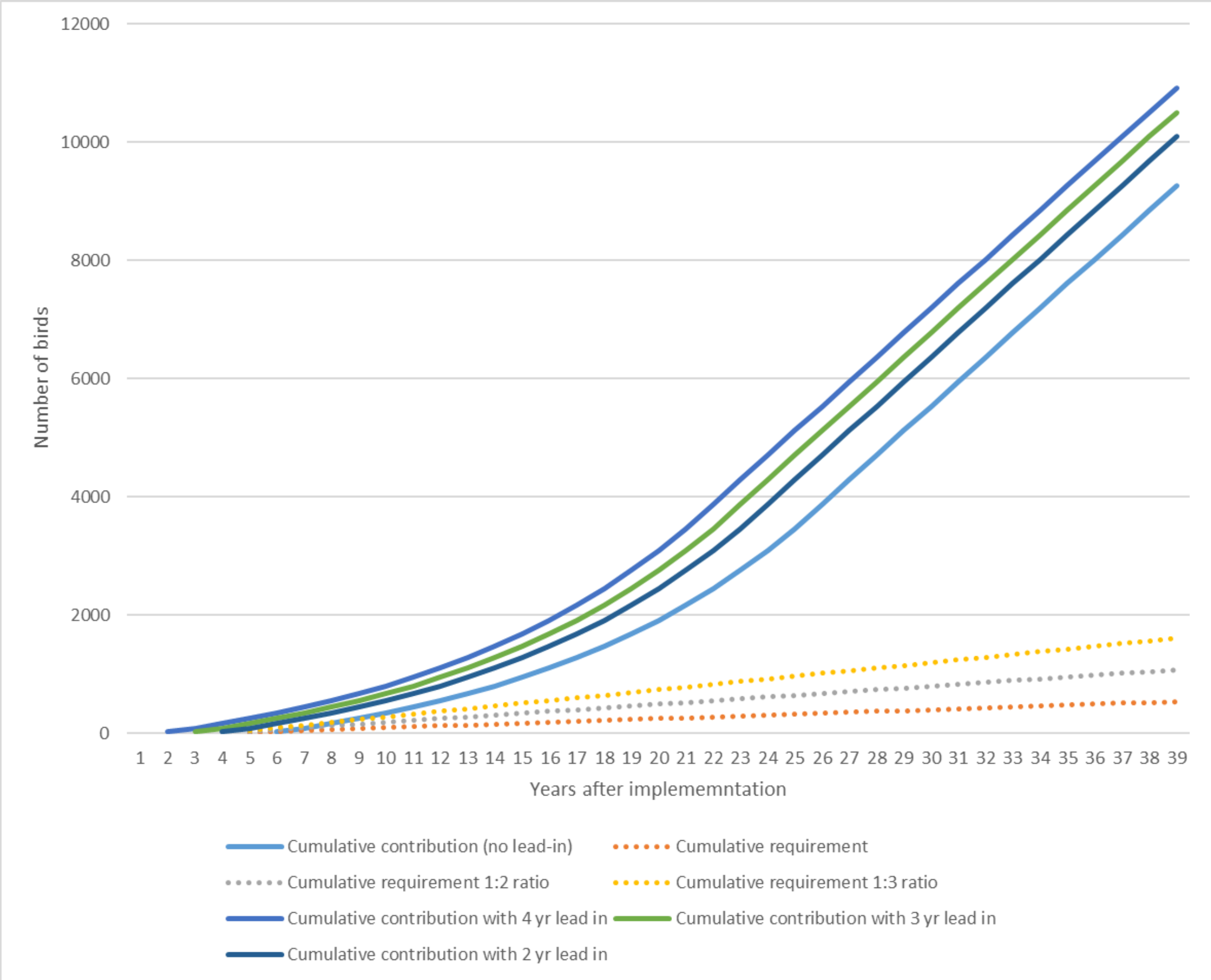


Figure 28. Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 10% and a colony start size of 20 AON.

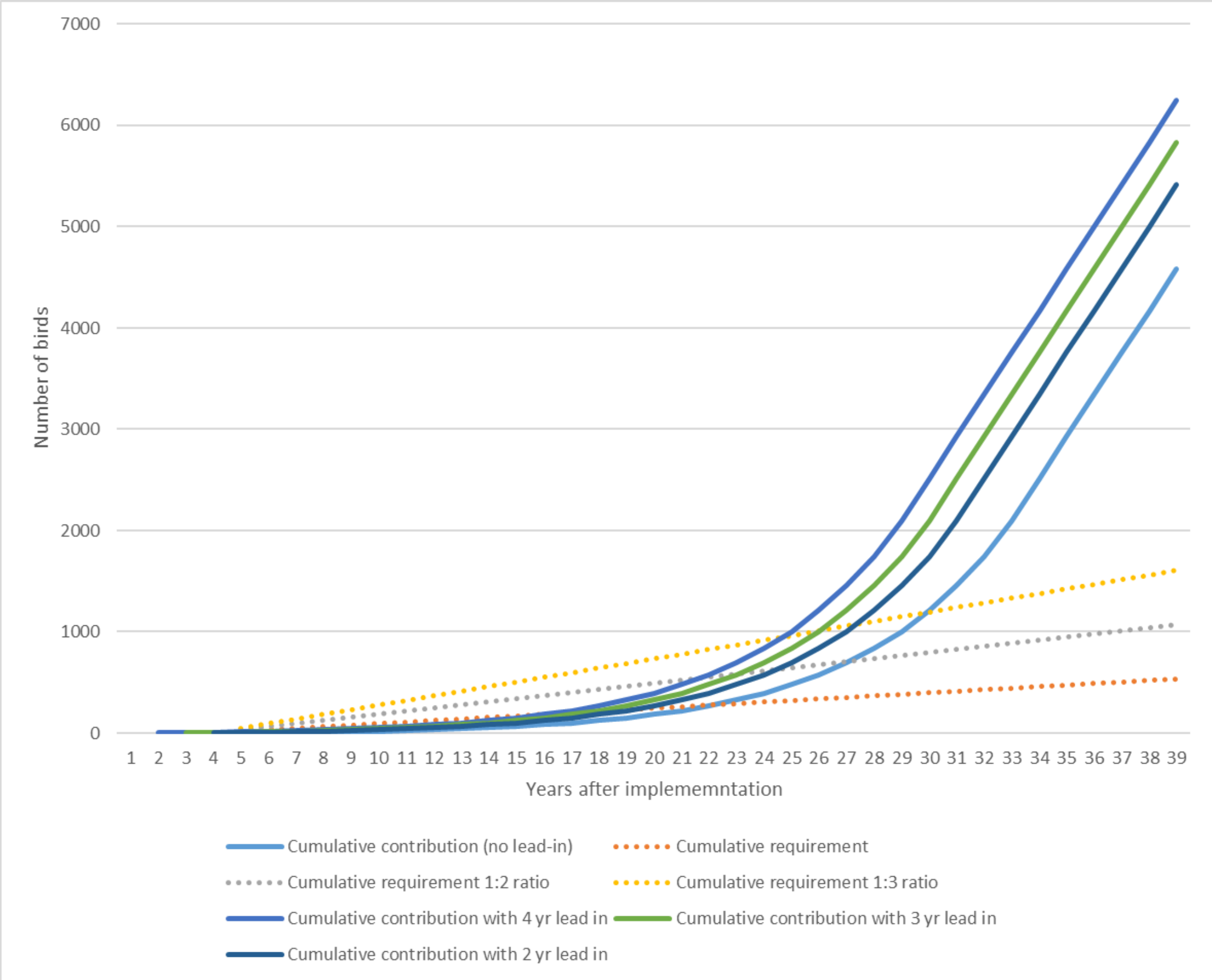


Figure 29. Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 1 AON.

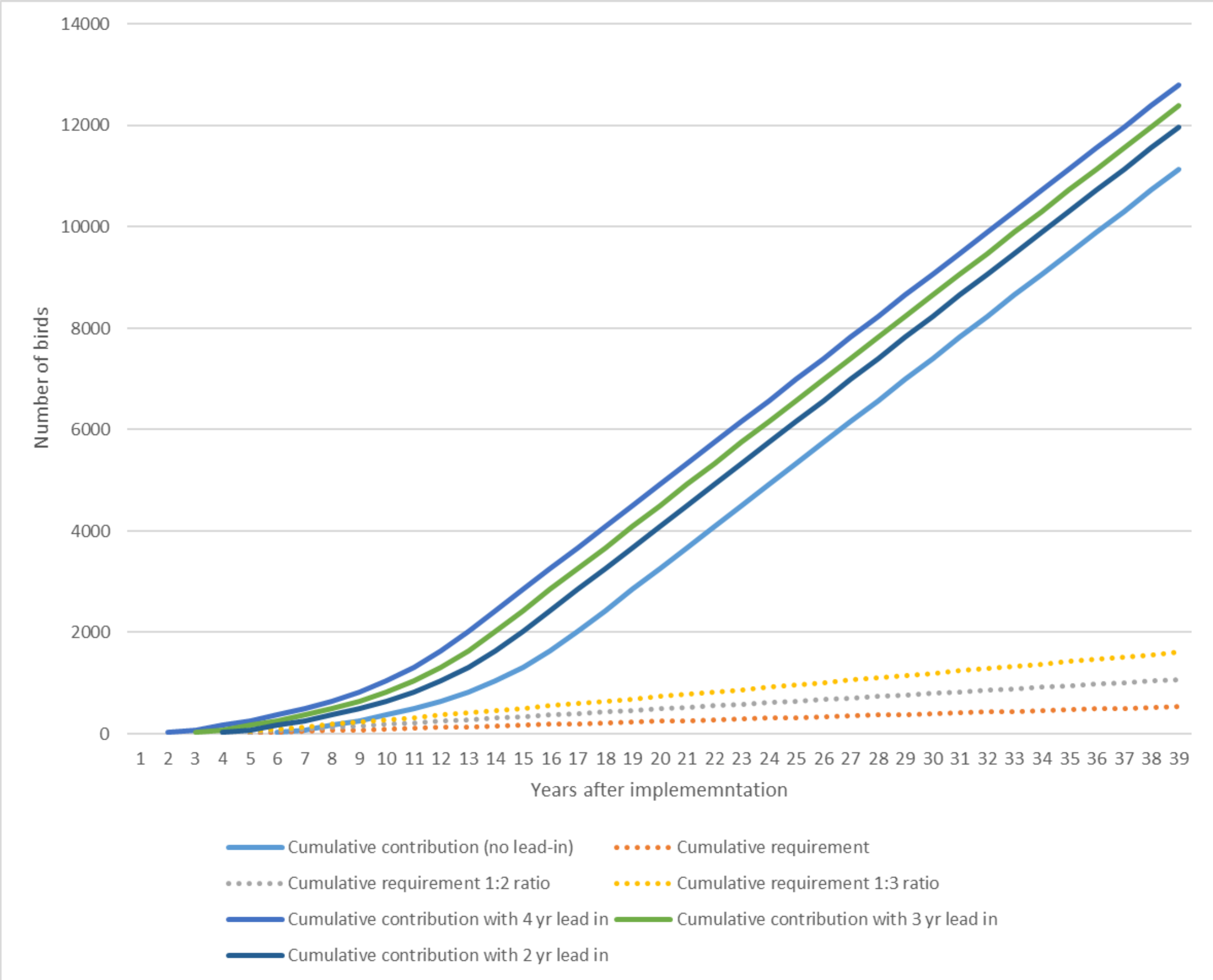


Figure 30. Cumulative outputs from an ANS with 900 AONs with 0, 2, 3 and 4 year lead in, and without lead in time, compared to cumulative requirement for kittiwake using the mean impact value expressed at 1:1, 2:1 and 3:1 ratios. Outputs are modelled using a growth rate of 20% and a colony start size of 20 AON.