

Scottish Marine and Freshwater Science

Volume 5 Number 8

**EMEC Billia Croo Wave Test Site:
Wildlife Observations Project
Annual Report**

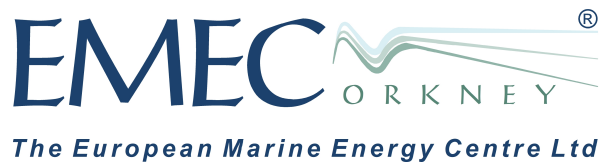
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EMEC Billia Croo Wave Test Site: Wildlife Observations Project

Annual Report



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This report presents the results of marine and freshwater scientific work carried out for Marine Scotland under external commission.

Copies of this report are available from the Marine Scotland website at www.scotland.gov.uk/marinescotland

EMEC Billia Croo Wave Test Site: Wildlife Observations Project Annual Report

May 2014

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Revision History

Version	Date	Description	Originated by	Approved by
0.1	29/04/14	Initial draft report issued to the Scottish Govt.	CB	DC
1.0	10/06/14	Final version incorporating Scottish Govt. revisions.	CB	DC

1. Executive Summary

A key concern expressed by policy makers, regulators and environmental stakeholders about deployment of marine energy devices in open waters relates to the possibility of negative impacts they may have on marine mammals and diving birds. The potential for direct collision with such devices, or harmful effects caused by their presence, including the potential for displacement of marine wildlife from habitual waters, are issues which need to be addressed. In order to get as accurate a picture as possible about the presence and behaviour of marine wildlife in the vicinity of operating devices, data needs to be collected both underwater and at the sea surface. The current wildlife observation programme underway at the European Marine Energy Centre (EMEC) in Orkney gathers surface-visible wildlife information across EMEC's grid-connected and nursery test sites, and the data gathered can be used to inform regulatory decision-making, as well as in guiding developers' device-specific wildlife monitoring programmes.

Activities of the wildlife observation programme underway at EMEC are overseen by the EMEC Monitoring Advisory Group (MAG), whose membership includes representatives from Marine Scotland Science, Marine Scotland Licencing Operations Team, Marine Scotland Compliance, Scottish Natural Heritage, Scottish Government, and the Sea Mammal Research Unit at the University of St Andrews.

The Billia Croo wildlife observation project commenced in July 2005, with the Scottish Government funding the current contract. During the period 1 April 2013 to 31 March 2014, a total of 886 hours of observations were completed. Observations at the site for this reporting period have shown seasonal peaks in grey and harbour seal abundances corresponding with pupping seasons, which is mirrored in the data collected to date at the site. During this reporting period the majority of cetacean sightings have been of White-beaked Dolphin, whereas typically the most sighted cetacean is Harbour Porpoise. A typically diverse range of marine birds has also been observed, although for several species, numbers in April and May 2013 fell below the mean. This could be due to the enduring winter of 2012/2013 and resultant late spring experienced in Orkney as was the case for the rest of the UK.

Detailed analysis of the data collected is out-with the scope of this project; however a separate project, funded by Marine Scotland and Scottish Natural Heritage, has been established to carry out an in-depth analysis of the data.

2. Introduction

The potential displacement of key wildlife species (e.g. marine mammals and marine birds) from their normal range of habitats is a key factor which needs to be addressed by developers in order for the marine renewable energy industry to progress. It is recognised that assessing marine species' usage of particular areas of ocean is an extremely challenging task. The European Marine Energy Centre (EMEC) has received research funding from the Scottish Government to carry out land-based vantage point surface wildlife observations at its tidal test site at Billia Croo, Mainland, Orkney Islands in order to aid informing the solution to this industry-wide concern.

Activities of the wildlife observation programme underway at EMEC are overseen by the EMEC Monitoring Advisory Group (MAG), whose membership includes representatives from Marine Scotland Science (MSS), Marine Scotland Licencing Operations Team (MS-LOT), Marine Scotland Compliance, Scottish Natural Heritage (SNH), Scottish Government, and the Sea Mammal Research Unit at St Andrews University (SMRU). The objectives of this group include: translation of policy requirements into practical monitoring effort; overseeing the production of relevant monitoring tools and best practice techniques at the EMEC test sites whilst ensuring monitoring effort and methods of data stewardship are compatible with relevant methodologies; and exchanging knowledge and information relating to similar initiatives so as to avoid duplication and establish links with other relevant research programmes at national and international level. The terms of reference for the EMEC MAG are provided as Annex A of this document.

Land-based wildlife observations using a bespoke methodology initially developed with input from SMRU have been carried out at the site since July 2005. These observations provide baseline data which can be used to look at the distribution and behaviour of marine mammals, diving birds and other wildlife across the test site area.

The main objective of the project is to provide site description species data which can later be used to establish whether the installation, presence and operation of marine energy converter devices causes displacement of surface-visible wildlife from habitual waters, and to identify any discernible changes to wildlife behaviour.

Detailed analysis of the data collected is out-with the scope of the project. A first-stage analysis of the data up until June 2010 has been carried out by SNH (Robbins, 2011) and a separate project funded by Marine Scotland, SNH and EMEC has been established to perform an in-depth analysis of the data. The EMEC Wildlife Data Analysis project commenced in August 2013, and will analyse all wildlife data collected at the EMEC grid-connected test sites from July 2005 to March 2015. Initial results are expected in summer 2015, with final results due to be reported in November 2015. EMEC has subcontracted the Centre for Research into Ecological and Environmental Modelling (CREEM) of the University of St Andrews to provide expert statistical input and training for this project.

Outputs from the wildlife observation project will be made available to all relevant parties, including marine energy technology developers and other marine renewables environmental projects. The data collected by the project is publically available via the Marine Scotland Interactive website¹.

This report provides details of project progress for the period 1 April 2013 to 31 March 2014.

¹ <http://www.scotland.gov.uk/Topics/marine/science/MSInteractive/Themes/EMEC-Wildlife>

3. Methodology

In September 2009, EMEC commissioned SMRU Ltd to develop a methodology for carrying out wildlife observations at its wave test site at Billia Croo. As well as documenting the methodology, SMRU Ltd provided initial training for the wildlife observers who carry out the observations. The methodology is available to download from the Marine Scotland Interactive website².

Due to the featureless nature of the Billia Croo test site area, a grid-based recording system as used at the other sites within the EMEC wildlife observation programme was deemed unsuitable for this project. Instead the survey area is defined as a hemispherical shape extending offshore from the observation point. This area encompasses the whole of the Billia Croo test site and its surrounding area, extending to approximately 5km from shore (this is around the sighting limit for small cetaceans from a cliff-top at the height of the observation point).

The angle of declination and horizontal angle from the viewing tripod are used, together with information on tidal height, to estimate the geographical location of species sighted.

Following the establishment of the methodology and subsequent training of the wildlife observers, a boat based calibration was undertaken to validate the angle measurements.

3.1 Observations

Fully trained observers carry out observations from an ex-coastguard lookout station situated on a cliff-top approximately 90m above sea level overlooking the Billia Croo wave test site. Observations are made using a pair of 25x power binoculars ('Big Eyes') fix-mounted on a robust tripod with horizontal and declination angle boards to allow estimates of the geographical locations of wildlife to be made. The horizontal and declination angles are checked each day and realigned if necessary using pre-defined reference points.

Observing the area with the Big Eyes is carried out in a consistent manner from left to right at a series of distances from land ensuring the whole study area is covered. The study area is fully covered with two sweeps using the Big Eyes (a near sweep covering 800m - 1400m from shore and a far sweep covering 1400m - 5000m from shore) and a sweep of the near-shore area using hand-held binoculars. Figure 1 below shows the survey area with respect to the EMEC test berths and cables. Wildlife spotted is identified to species level using this method.

² <http://www.scotland.gov.uk/Topics/marine/science/MSInteractive/Themes/EMEC-Wildlife/Billia-Croo>

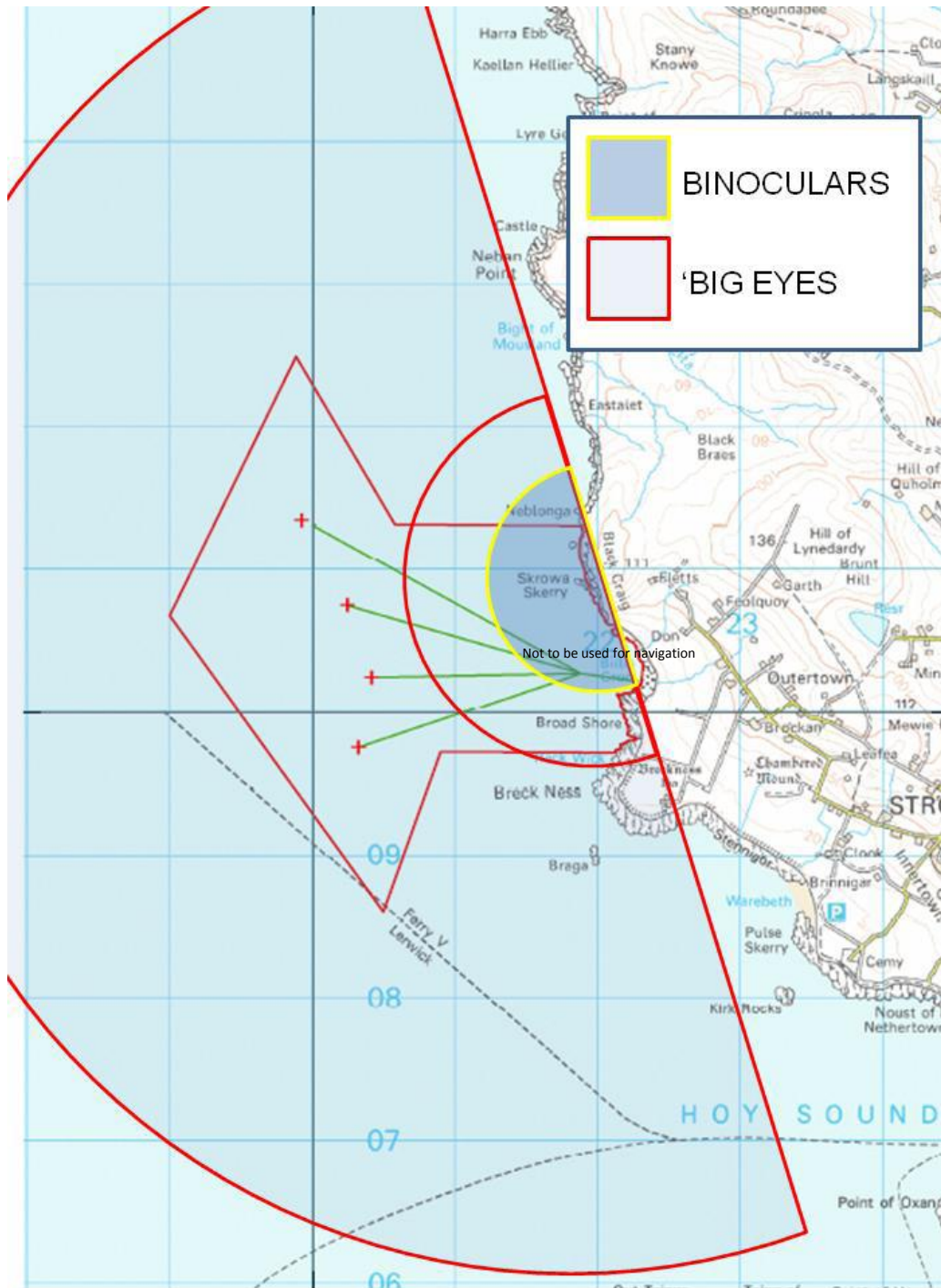


Figure 1: Survey area for EMEC's Billia Croo wave test site

3.2 Survey Effort

Data is collected for 20 hours per week, split over five 4 hour watch periods (based on five working days per week). The observers record wildlife sightings during daily watches by making regular scans of the study area as described above. Watches are carried out throughout the year during daylight hours, covering the period from 04:00hrs to 20:00hrs during summertime, and 09:00hrs to 15:00hrs in winter. It

takes approximately 20 minutes to complete a single sweep of the survey area. This timing has been designed to maximise the probability of sighting wildlife whilst minimising observer fatigue. A rest period of 10 minutes is taken between scans in order to further reduce observer fatigue, making it possible to complete 2 sweeps per hour (i.e. 8 sweeps per four hour watch).

A total of 886 hours of observations were completed for the period 01 April 2013 to 31 March 2014.

A watch rota, designed to ensure relatively uniform coverage across diurnal and tidal cycles, was created for each month. This rota is adhered to as far as possible, subject to weather conditions. If a watch is not carried out on a particular day, there is scope to transfer that particular watch to a day on the following weekend.

3.3 Data Recording

The observers record wildlife sightings during daily watches by making regular scans of the study area in a consistent manner. The details of any sightings made are recorded on paper field forms by the observer. This information is later transcribed into a bespoke Microsoft Access database. In addition to sighting data, the observer also records effort (date, start/end time), environmental conditions (tide state, meteorological conditions), and details of any shipping observed in the area during the watch. An updated database is submitted to EMEC each month.

Sightings are only recorded for any birds or marine mammals sighted in or on the surface of the sea. Details recorded include grid location, numbers, and behavioural details (e.g feeding, diving, swimming, stationary). Birds are recorded as sightings if they are on the water or hovering directly above the surface (within a few metres). Any birds flying higher than this or birds that are clearly transiting through the survey area are not recorded.

4. Project Summary

4.1 Site Activity

A number of developers have completed various stages of device installation at the test site during the period 01 April 2013 to 31 March 2014. Table 1 below summarises work in progress during this period.

EMEC Berth	Developer	Activity
1	E.ON	No activity
2	Scottish Power Renewables	Device testing
3	<i>Vacant</i>	No activity
4	Seatricity	Installation activity
5	Wello Oy	Installation activity
Shallow water	Aquamarine Power Ltd	Device testing

Table 1: Developer site activity at the EMEC Billia Croo test site 1st April 2013 to 31st March 2014

Installed devices may or may not be operational at any given time. Additional activity at the test site may include periodic complete removal/re-installation of devices for maintenance, maintenance visits by developers, deployment of Acoustic Doppler Current Profilers to measure resource, and acoustic surveys.

4.2 Project Activity

Overall, this contract period has seen a very high completion rate of planned watches, with an average watch achievement rate of 92%.

The third quarter of the contract suffered a reduced rate of data collection due to the exceptionally heavy storms which were a persistent feature of the UK and Orkney weather pattern in winter 2013/14. The reduced daylight hours experienced in Orkney during the winter months afford less flexibility in the schedule. Nevertheless, watch achievement rates remained above 75% for all months (see Table 2 below).

Month	Percentage (%)	Actual/Potential Hours	Comments
April 2013	100	80/80	
May 2013	100	80/80	
June 2013	95	76/80	Bad weather
July 2013	100	80/80	
August 2013	100	80/80	
September 2013	100	80/80	
October 2013	100	80/80	
November 2013	80	64/80	Bad weather
December 2013	75	60/80	Bad weather

January 2014	85	68/80	Bad weather
February 2014	75	60/80	Bad weather
March 2014	98	78/80	Bad weather

Table 2: Achievement of watches expressed as a percentage and actual contractual hours per month.

A new set of “Big Eyes” binoculars, with exactly the same specification as the previous set, were installed at the end of March 2014. This was required as the current set were showing significant signs of wear. The possibility of sourcing a unit with a better inclination angle measurement system and a built-in range finding system was explored, but there is currently nothing available that would meet this requirement.

4.3 Wildlife Observations Summary

Detailed analysis of the data collected is out-with the scope of this project. The entire set of raw wildlife observation data collected for the period 1 April 2013 to 31 March 2014 will be available to download from the Marine Scotland Interactive website.

The monthly wildlife sighting counts are presented in Table 3 and Table 4 below. Note these sightings are total sightings per month, and have not been corrected for effort (number of hours observed per month). The high number of unidentified seals sighted in August 2013 is due to increased seal sightings further offshore during that month. Seasonal graphs showing sighting counts per mean summer month and per mean winter month are also provided (Figures 2 to 4).

Monthly wildlife sighting counts with respect to monthly means (calculated from the entire EMEC Wildlife Observations Programme Billia Croo dataset) are presented graphically in Annex B.

Species	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14
Arctic Skua	0	1	6	26	3	0	0	0	0	0	0	0
Arctic tern	0	4	64	75	0	0	0	0	0	0	0	0
Black guillemot	374	136	145	157	66	10	94	11	5	49	138	270
Black-headed Gull	0	0	0	0	0	0	0	0	0	0	0	0
Black scoter	0	0	0	0	0	0	0	0	0	0	0	0
Black throated Diver	0	0	0	0	0	0	0	0	0	0	0	0
Common Gull	0	0	0	0	1	0	8	42	0	0	0	10
Common guillemot	378	337	314	1478	8	21	70	31	37	88	135	176
Common scoter	0	0	0	0	0	0	0	9	0	0	0	0
Cormorant	0	0	0	0	0	0	0	0	0	0	0	0
Diver Sp.	0	0	0	0	0	0	0	0	0	0	0	0
Eider Duck	142	18	9	37	63	48	42	99	86	144	185	86
Fulmar	2049	821	1224	1954	1562	1970	271	469	715	2108	535	1759
Gannet	258	358	101	72	390	283	249	103	26	22	20	14
Glaucous Gull	0	0	0	0	0	0	0	0	0	0	0	0
Goldeneye	0	0	0	0	0	0	0	0	0	0	0	0
Goosander	0	0	0	0	0	0	0	0	0	0	0	0
Greater Black-backed Gull	24	10	16	5	12	5	30	80	102	68	78	39
Great Northern Diver	1	1	1	0	0	0	0	0	0	10	20	15
Great Skua	13	144	151	90	103	41	14	0	0	0	0	0
Grey Phalarope	0	0	0	0	0	3	3	0	0	0	0	0
Greylag Goose	0	0	0	0	0	0	0	0	0	0	0	0
Herring Gull	40	2	5	14	9	3	92	35	61	25	35	32
Iceland Gull	0	0	0	0	0	0	0	5	1	0	2	0
Kittiwake	14	83	322	70	0	0	14	20	3	4	1	18
Leach's Petrel	0	0	1	0	0	0	0	0	0	0	0	0
Lesser Black-backed Gull	0	0	0	0	0	0	0	0	0	0	0	0
Little Auk	0	0	0	0	0	0	3	1	0	4	4	2
Long Tailed Duck	0	0	0	0	0	0	4	1	2	2	0	4
Mallard	0	0	0	0	0	0	0	0	0	0	0	0
Manx Shearwater	0	9	6	33	0	5	0	0	0	0	0	0
Mew Gull	0	0	0	0	0	0	0	0	0	0	0	0

Northern Shoveler	0	0	0	0	0	0	0	0	0	0	0	0
Phalacrocorax spp	0	0	0	0	0	0	0	0	0	0	0	0
Puffin	45	91	191	438	15	0	0	0	0	0	2	13
Razorbill	23	70	34	98	0	0	0	0	0	0	3	15
Red Breasted Merganser	0	0	0	0	0	0	0	0	0	0	0	0
Red Throated Diver	3	4	3	0	0	0	0	2	0	2	0	0
Sabine's Gull	0	0	0	0	0	0	0	0	0	0	0	0
Sandwich Tern	0	0	0	0	0	0	0	0	0	0	0	0
Scaup	0	0	0	0	0	0	0	0	0	0	0	0
Shag	747	492	534	658	865	1021	1069	695	306	434	401	457
Shelduck	0	0	0	0	0	0	0	0	0	0	0	0
Slavonian Grebe	0	0	0	0	0	0	0	0	0	0	0	0
Storm Petrel	0	1	6	3	1	3	0	0	0	0	0	0
Surf scoter	0	0	0	0	0	0	0	0	0	0	0	0
Teal	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Auk	122	264	242	795	57	9	32	17	13	32	94	119
Unidentified Duck	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Goose	0	0	0	0	0	0	0	0	0	0	0	0
Unidentified Gull	0	0	0	0	0	0	0	0	0	0	5	0
Unidentified Tern	34	103	169	197	0	0	0	0	0	0	0	0
Unidentified Bird	0	0	0	0	0	0	0	0	0	0	0	0
Velvet scoter	0	0	0	0	0	0	8	0	0	0	0	0
Wigeon	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL BIRDS	4267	2949	3544	6200	3155	3422	2003	1620	1357	2992	1658	3029

Table 3: Monthly sighting counts for bird species for period April 2013 to March 2014 at the EMEC Billia Croo wave test site.

Species	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14
Harbour seal	1	0	0	4	0	0	0	0	1	1	0	0
Grey seal	5	5	20	189	22	18	40	10	9	2	2	8
Unidentified seal	2	1	0	0	33	6	19	2	7	4	2	1
TOTAL SEALS	8	6	20	193	55	24	59	12	17	7	4	9
Harbour porpoise	12	10	6	28	22	7	12	5	3	3	4	4
Humpback whale	0	0	0	0	0	1	0	0	0	0	0	0
Minke whale	0	5	7	2	3	3	2	0	0	0	0	1
Unidentified cetacean	8	9	0	0	22	3	2	1	0	4	1	4
Bottlenose dolphin	4	0	0	0	0	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0
White-sided dolphin	6	2	0	0	2	0	7	0	0	0	0	0
Risso's Dolphin	4	4	6	7	0	10	6	0	3	8	4	0
Short-beaked Common dolphin	0	0	0	0	0	0	0	0	0	0	0	0
Long-finned pilot whale	0	0	27	0	0	0	0	0	0	0	0	0
Pilot whale	0	0	0	0	0	0	0	0	0	0	0	0
Orca	0	12	11	0	16	0	0	0	0	0	0	0
TOTAL CETACEANS	34	42	57	37	65	24	29	6	6	15	9	9
Basking shark	0	4	1	1	0	1	0	0	0	0	0	0
Otter	0	1	0	0	0	0	0	0	0	0	0	0

Table 4: Monthly sighting counts for seals, cetaceans and other species for period April 2013 to March 2014 at the EMEC Billia Croo tidal test site.

Figures 2 to 4 below summarise the species of birds, cetaceans and seals observed at the Billia Croo tidal test site during summer (April to September) and winter (October to March) months. Values shown are mean summer month (red) and mean winter month (blue). Any inter-seasonal comparisons drawn from figures 2 to 4 should be made with caution as the data represents only one year of observations.

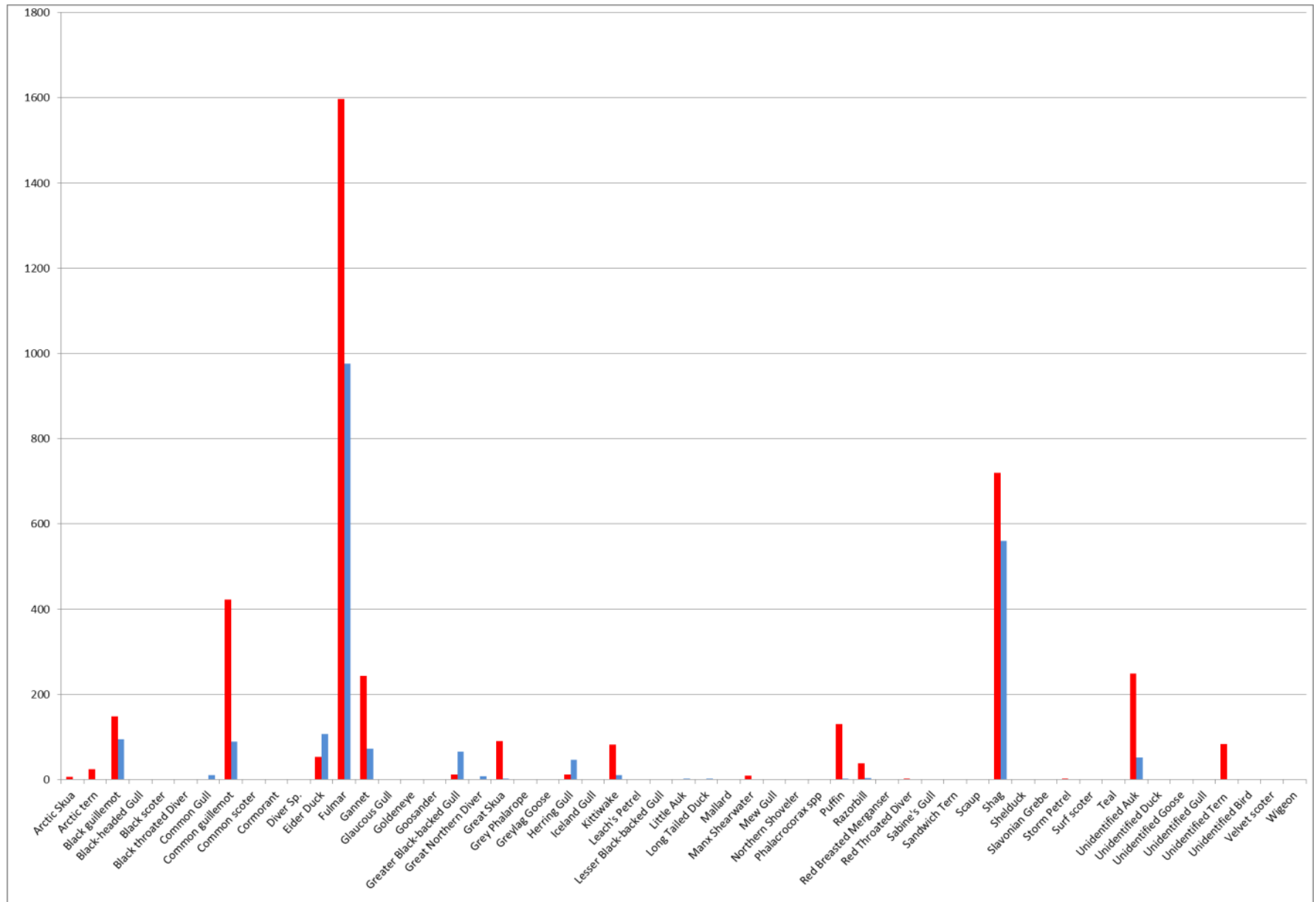


Figure 2: Mean summer month (red) and mean winter month (blue) bird species sightings at the Billia Croo for period April 2013 to March 2014.

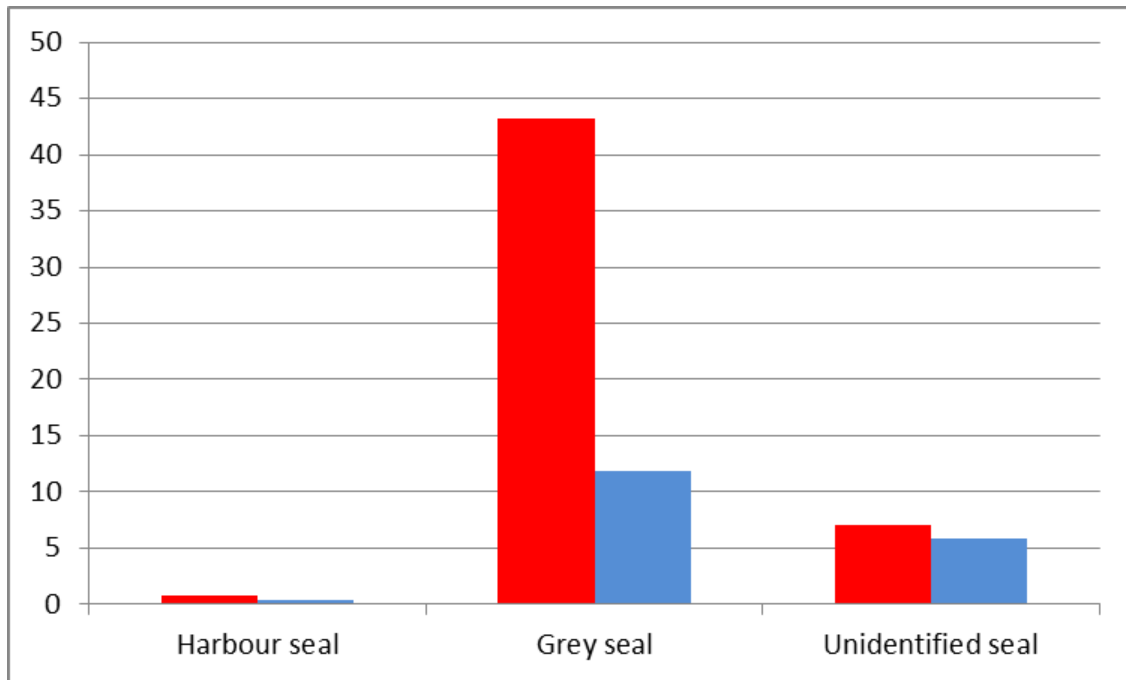


Figure 3: Mean summer month (red) and mean winter month (blue) seal species sightings at the Billia Croo for period April 2013 to March 2014.

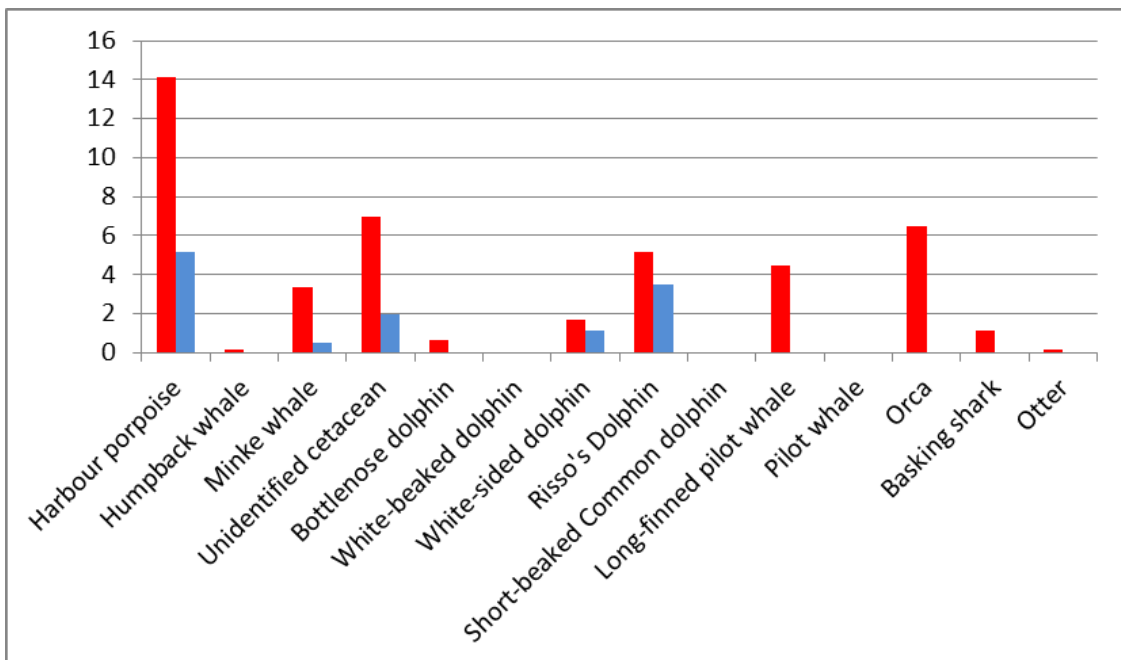


Figure 4: Mean summer month (red) and mean winter month (blue) cetacean, basking shark and otter species sightings at the Billia Croo for period April 2013 to March 2014.

4.4 Issues & Concerns

Under a separate project funded by Marine Scotland and SNH, EMEC will undertake detailed analysis of the data gathered through this project. Within the data analysis project, EMEC has sought expert input from the Centre for Research into Ecological and Environmental Modelling (CREEM) who have identified a limitation with the data in that there is insufficient data to construct 'detection functions' for the test sites.

To address this limitation, EMEC has developed a proposal for a boat-based calibration exercise to collect additional wildlife observation data at the test sites. This would provide information about the detectability rates for a range of distances from the observation points. The steering group for the data analysis project (which comprises Marine Scotland, SNH and EMEC) agree that the construction of site-specific detection functions, which will enable modelling of absolute changes in surface-visible wildlife presence, is an important output of the analysis project.

5. Recommendations

5.1 It is recommended that work should be undertaken to carry out calibration of the land-based wildlife observations. The objective of this calibration exercise will be to evaluate how accurately the observers at the land-based vantage points are able to detect, identify and locate wildlife species within and at the outermost limits of the observation area, and thus derive a site-specific 'detection function' that can be applied to the analysis of the wildlife data

6. References

Robbins, A. 2012. Analysis of Bird and Marine Mammal Data for Billia Croo Wave Test Site, Orkney. *Scottish Natural Heritage Commissioned Report No. 592.*

Terms of Reference

EMEC has close links with a range of different developers and types of marine energy devices – both wave and tidal – as well as academic institutions and regulatory bodies, whilst maintaining independence from any one body. This gives EMEC a unique and crucial position within the regulatory and research frameworks.

The range of possible impacts of the wave and tidal energy industries is wide and offers the potential for a series of projects and research partnerships between EMEC, developers, academia and other expert bodies. This requires EMEC to work with appropriate experts and regulators to establish and encourage best practice monitoring methods to be associated with devices as they are deployed at the wave and tidal test sites.

Outputs of monitoring projects will initially serve developers who deploy at EMEC, but in the longer term they are expected to serve as an essential resource for both developers and regulators in the licensing of future installations as the industries develop into commercial stages.

In repeated communications between EMEC, key regulators and environmental stakeholder groups (especially Scottish Natural Heritage), the emphasis has been on the unrepeatable opportunity for early research and monitoring associated with these industries, coordinated through EMEC. If the responsibility for device monitoring were to lie with individual developers and/or their different consultants, then there is a high risk that a suite of inconsistent approaches would be adopted, which would not necessarily employ the best available methods, and would risk a piecemeal approach to monitoring becoming the norm.

The EMEC Monitoring Advisory Group EMEC is a vehicle to formally extend and coordinate the ongoing monitoring discussions it has had with regulators and their consultees. Advisors are asked to contribute on specific methods in relation to the devices deployed at EMEC, including both device-specific and generic issues, and taking full account of the scale of deployment at these test sites. The group also provides an ongoing feedback vehicle as monitoring processes are put in place.

The group plans to meet at least three times per year with the following objectives

1. Translate policy requirements into practical monitoring effort to ensure that the EMEC facility is optimised to meet existing and future monitoring and assessment needs for wave and tidal energy converters.
2. Oversee the production of relevant monitoring tools and best practice techniques at the EMEC test sites whilst ensuring monitoring effort and methods of data stewardship are compatible with relevant methodologies.
3. Exchange knowledge and information relating to similar initiatives so as to avoid duplication and establish links with other relevant research programmes at national and international level.

4. Maintain an overview of emerging research and technology and identify new requirements.
5. Identify sources of funding available for research and supporting studies.
6. Undertake an annual assessment of the strategy and goals for monitoring undertaken at the EMEC test sites.
7. Undertake systematic review and QA of project specific Impact Monitoring reports submitted by developers at EMEC to Marine Scotland, and assess the wider implications and relevance of the methods pursued and results obtained to the Marine Renewables sector in Scotland.

Core parties:

EMEC, Marine Scotland (Science), Marine Scotland (Licensing Operations Team), Marine Scotland (Compliance), Scottish Natural Heritage, Sea Mammal Research Unit, Scottish Government, and the Department for Energy and Climate Change.

Attendees shall be nominated by their respective organisations. No decisions taken at the meetings shall be regarded as binding upon the organisation; however attendees are encouraged to champion actions where possible.

Other key stakeholders (e.g. particular developers or specialist experts) will be invited to contribute on specific issues as and when required.

Chair: EMEC Research Director

Billia Croo Wildlife Observations Project

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ANNEX B: Graphs of Monthly Wildlife Sighting Counts with Respect to Monthly Means

This annex presents graphs of the monthly wildlife sighting counts with respect to monthly means (calculated from the entire EMEC Wildlife Observations Programmes Billia Croo dataset). The vertical axes on each graph are logarithmic (base 10), and the diamond markers show the monthly mean per species.

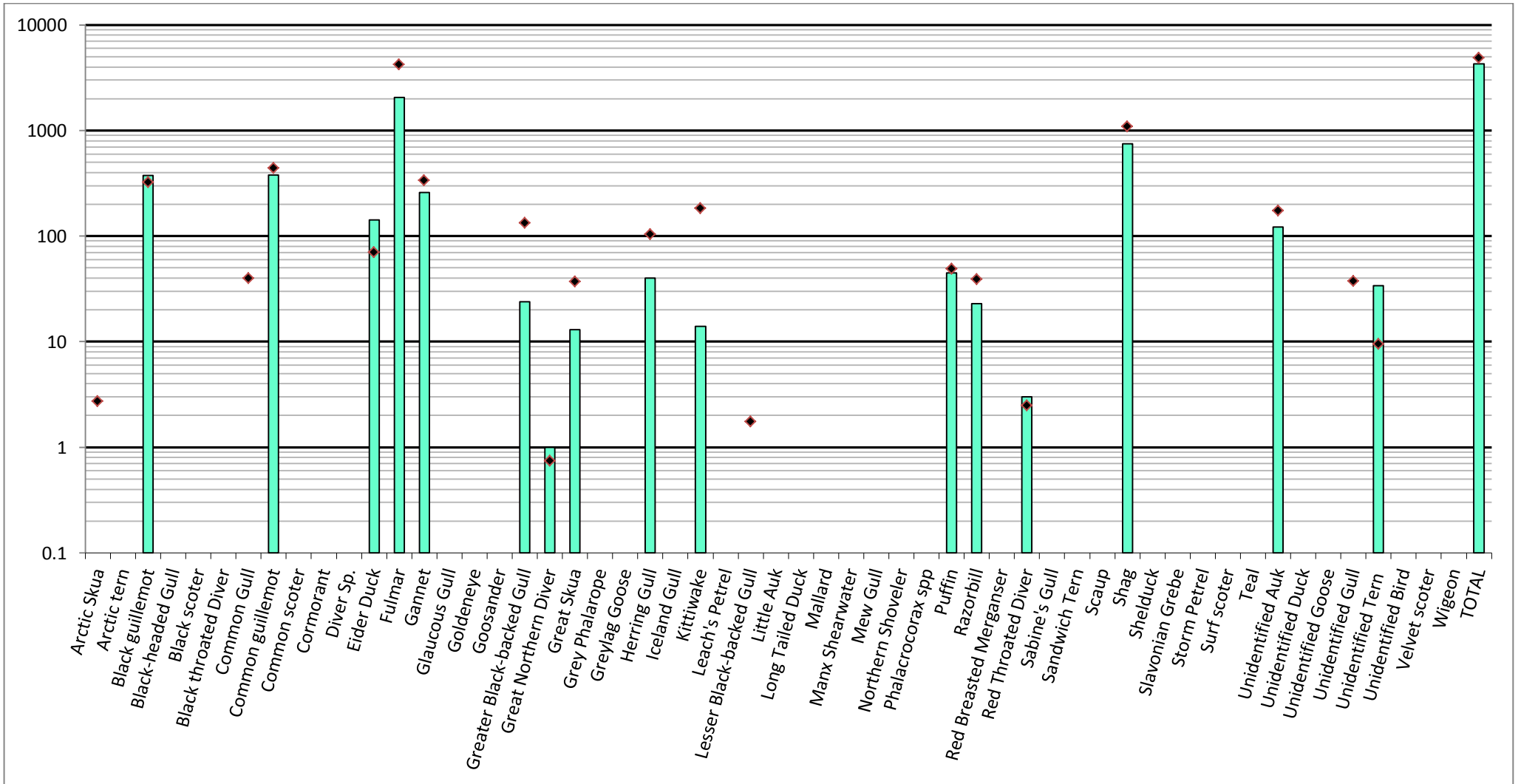


Figure 1: Bird species sighted at EMEC Billia Croo test site April 2013

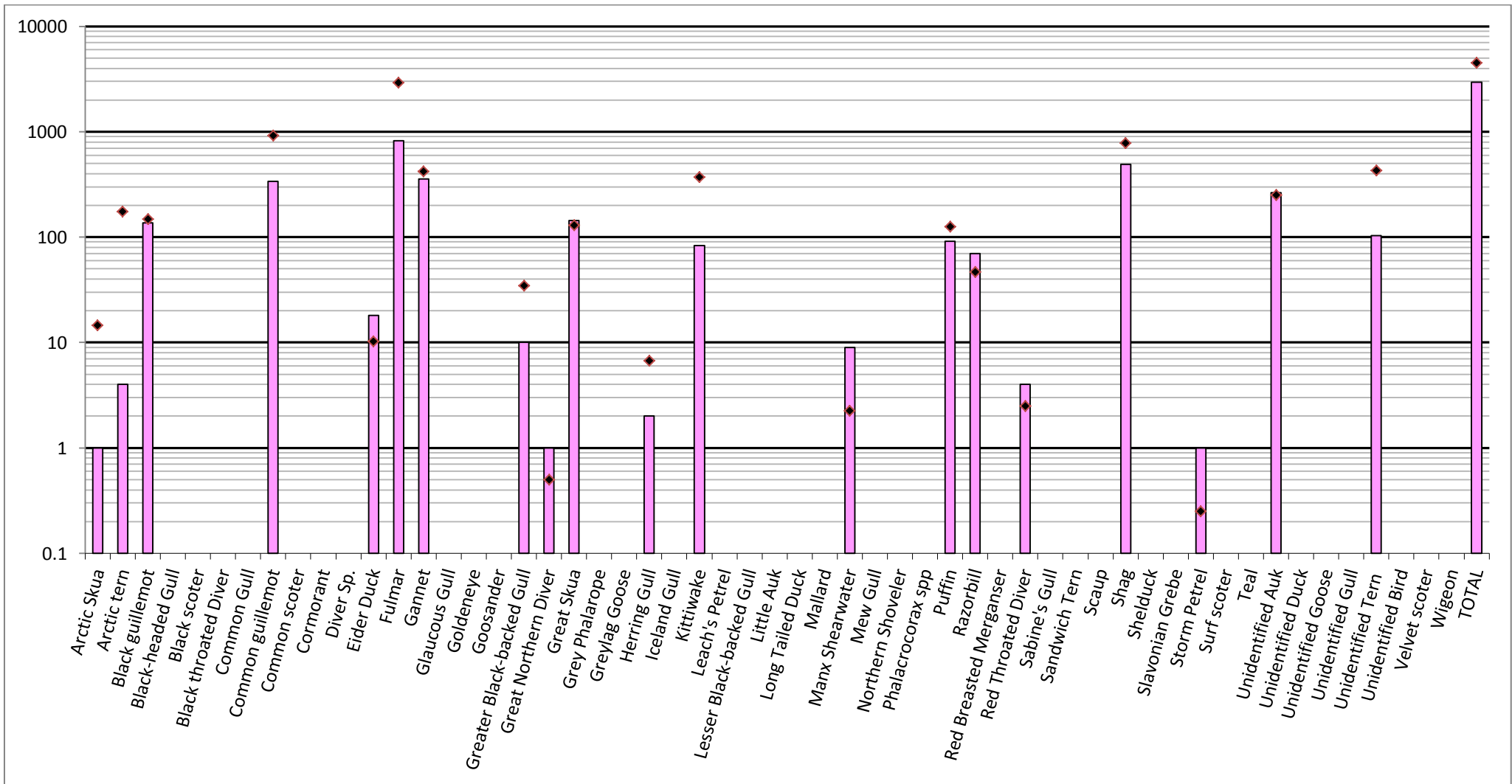


Figure 2: Bird species sighted at EMEC Billia Croo test site May 2013

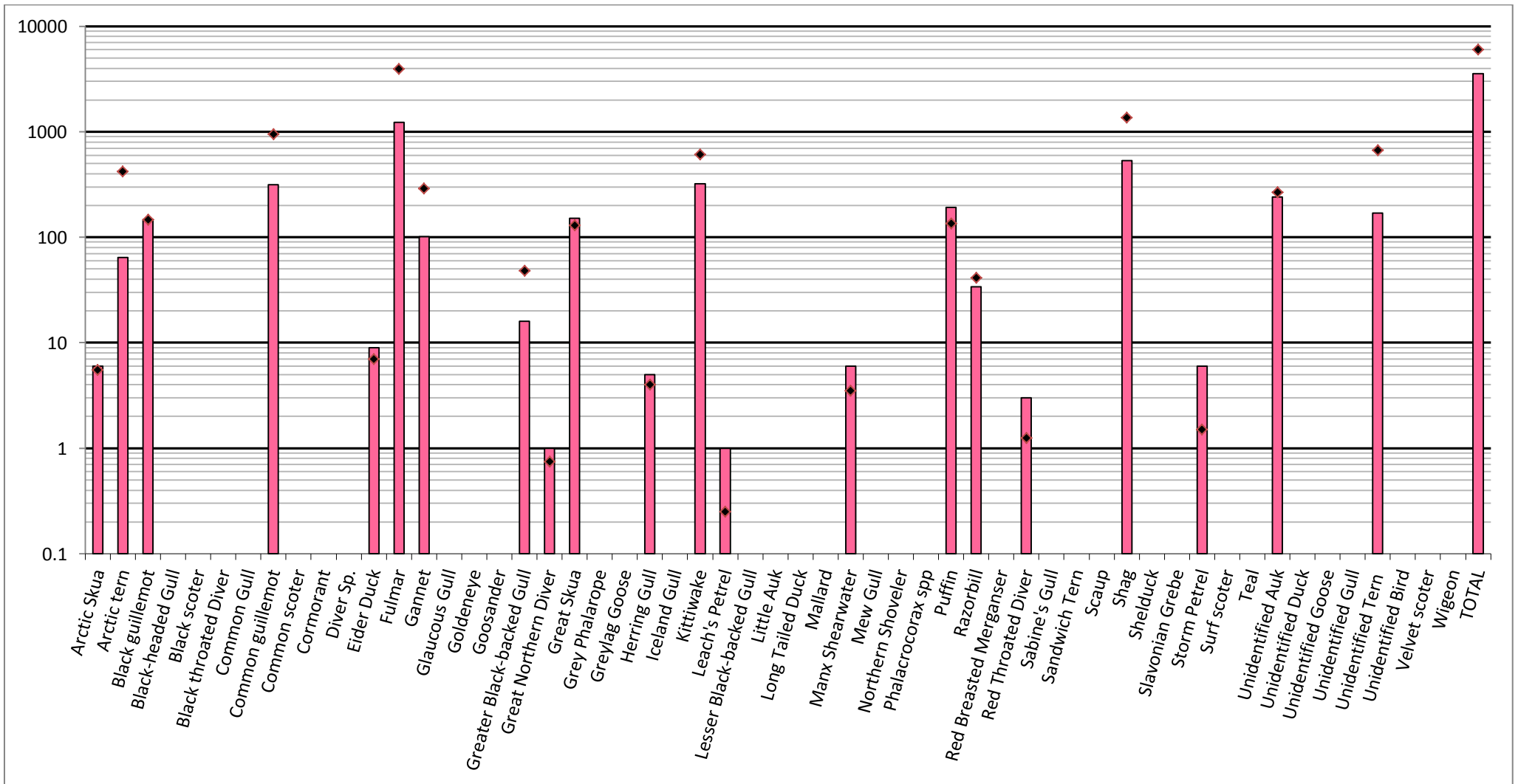


Figure 3: Bird species sighted at EMEC Billia Croo test site June 2013

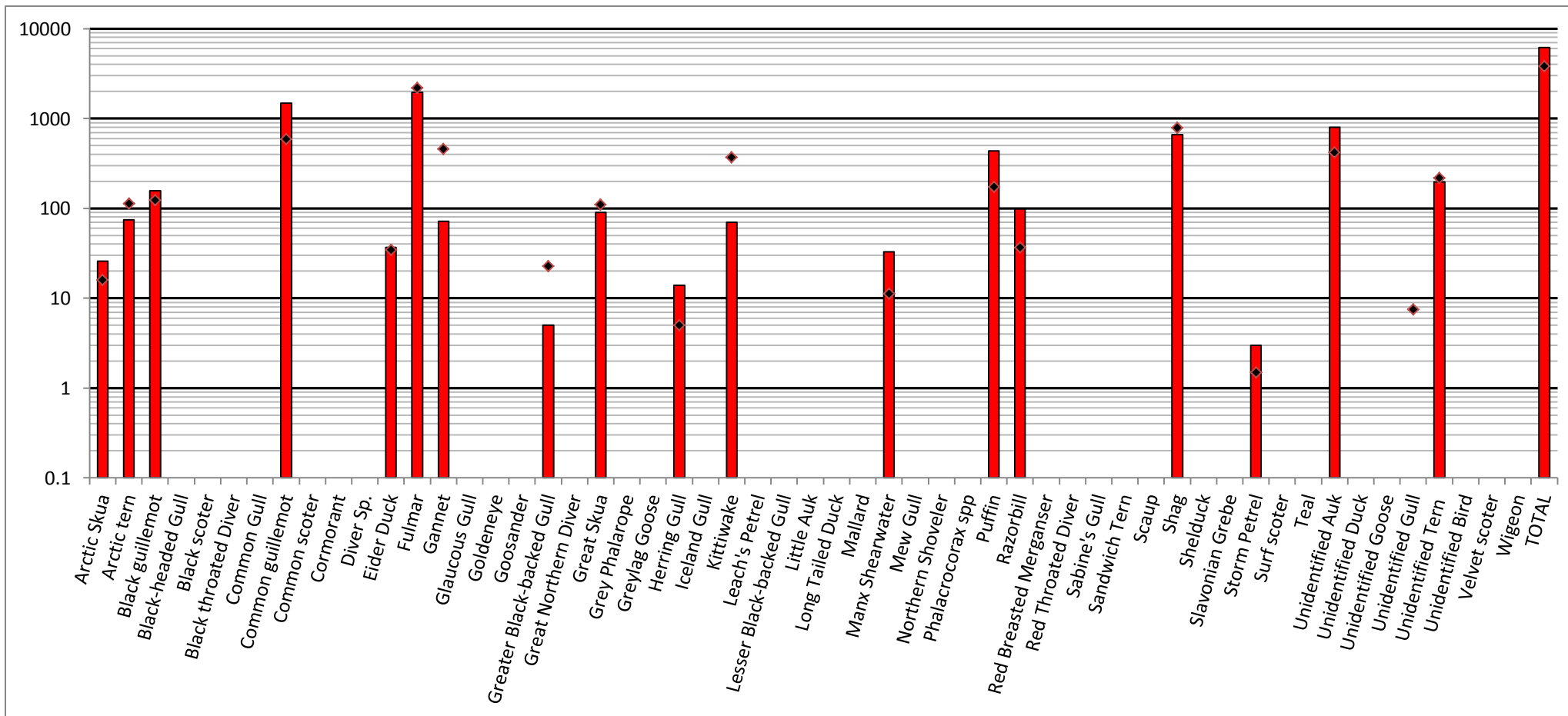


Figure 4: Bird species sighted at EMEC Billia Croo test site July 2013

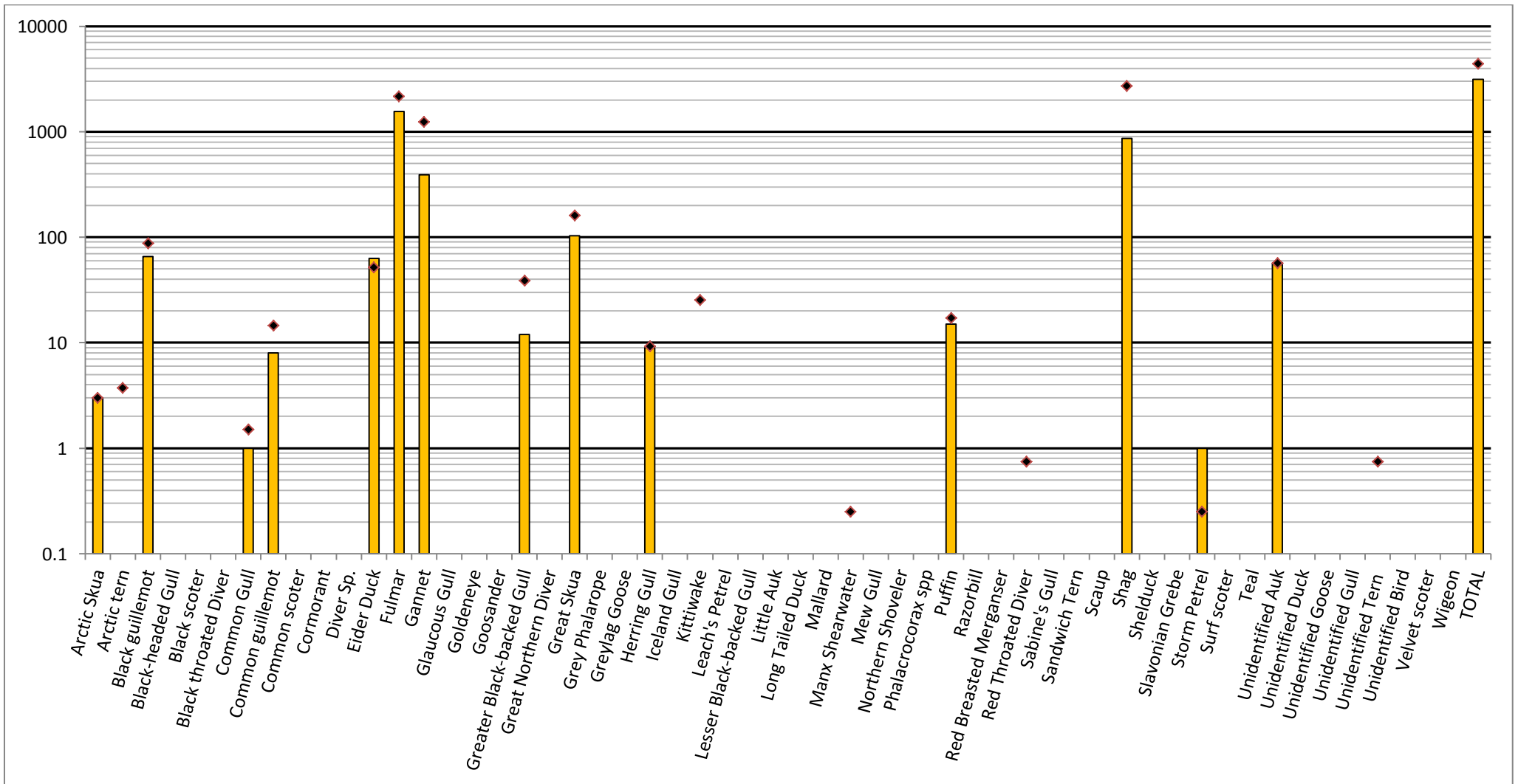


Figure 5: Bird species sighted at EMEC Billia Croo test site August 2013

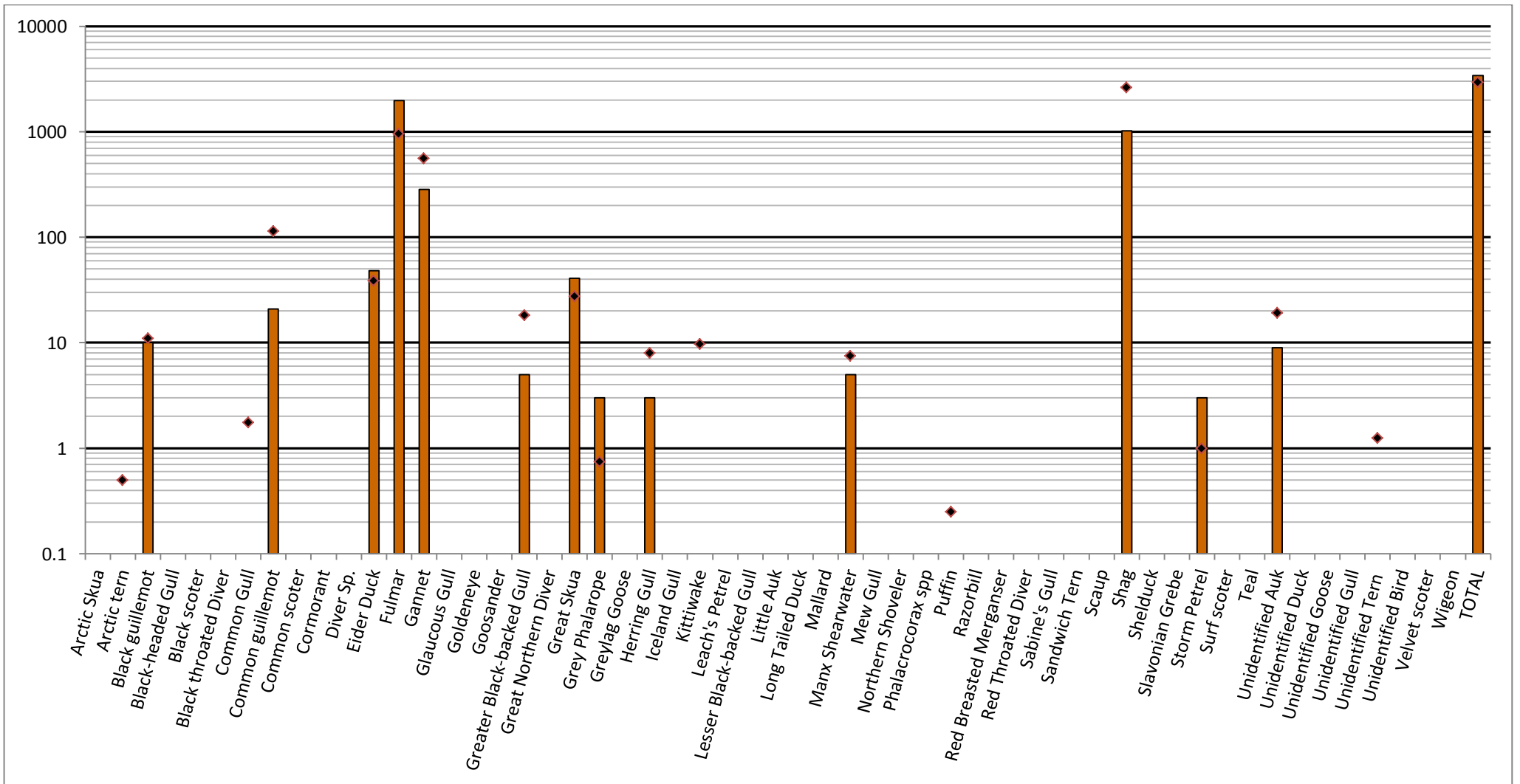


Figure 6: Bird species sighted at EMEC Billia Croo test site September 2013

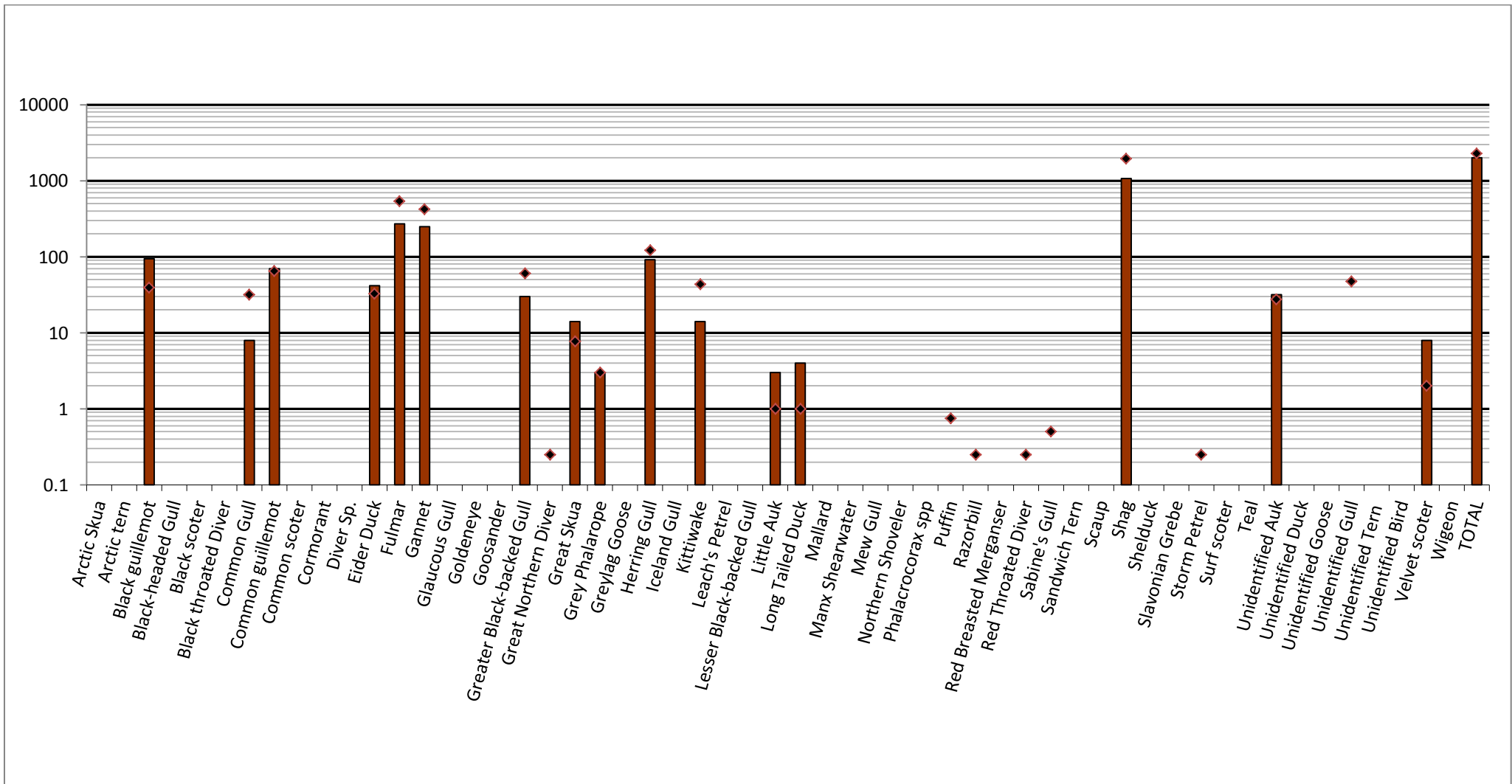


Figure 7: Bird species sighted at EMEC Billia Croo test site October 2013

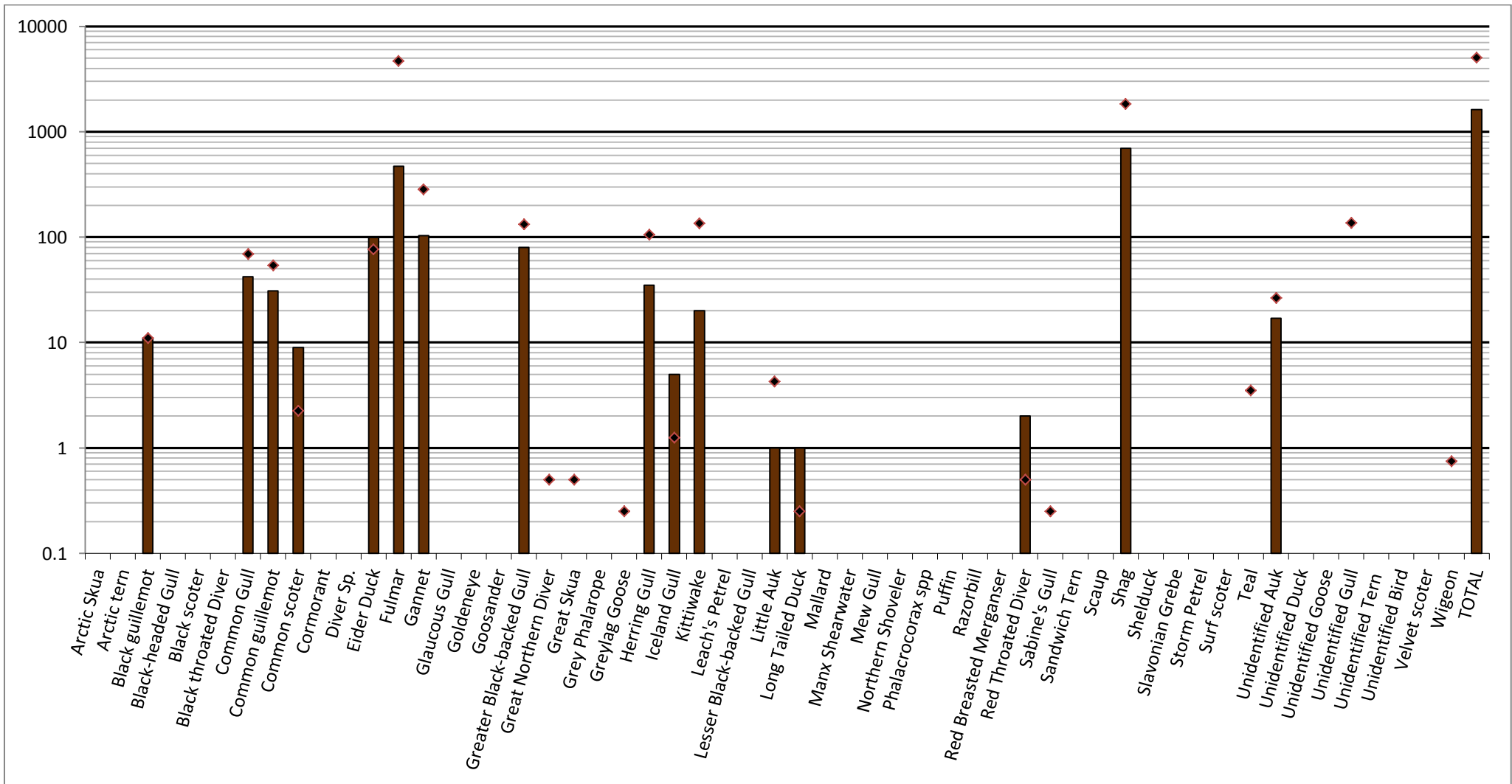


Figure 8: Bird species sighted at EMEC Billia Croo test site November 2013

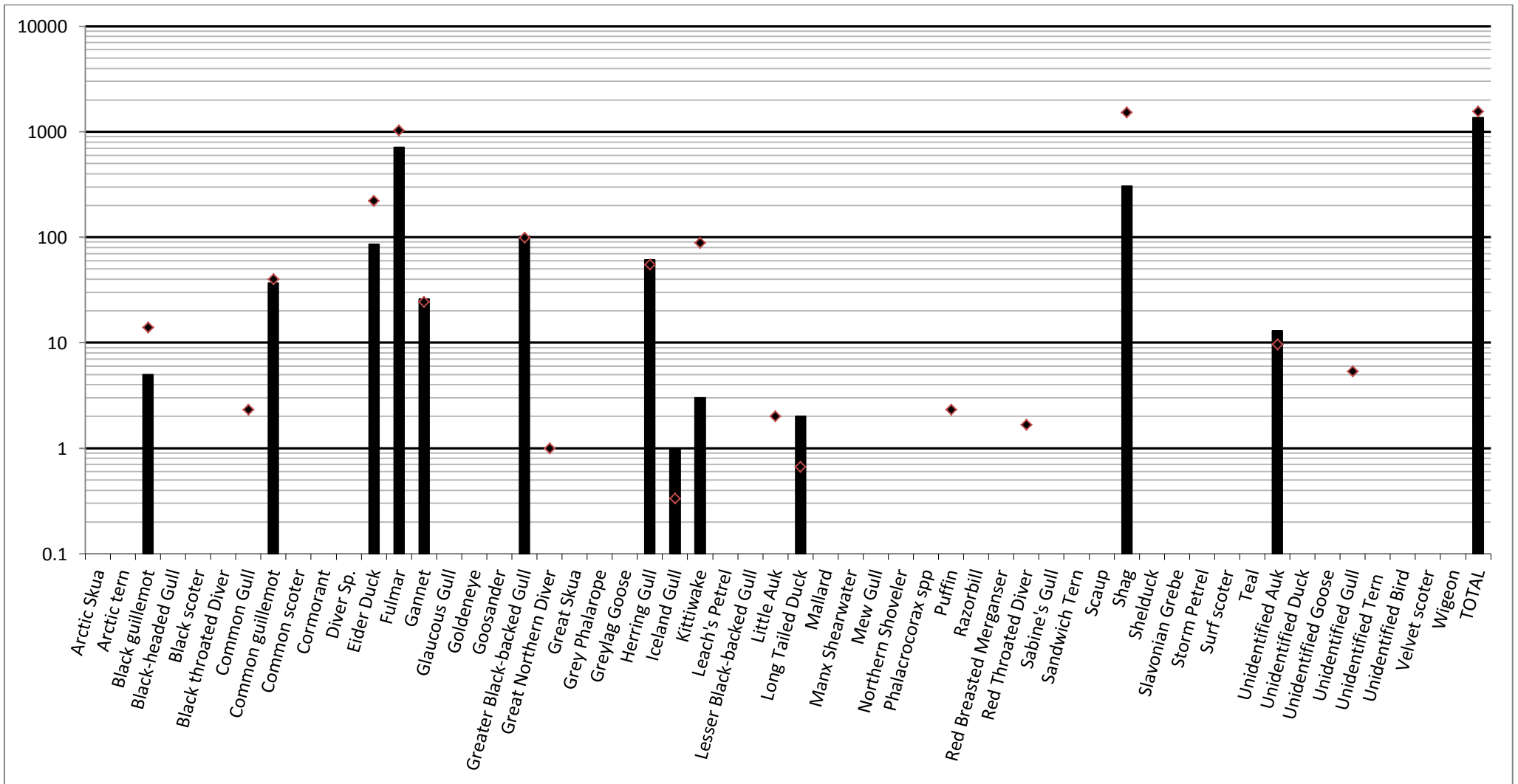


Figure 9: Bird species sighted at EMEC Billia Croo test site December 2013

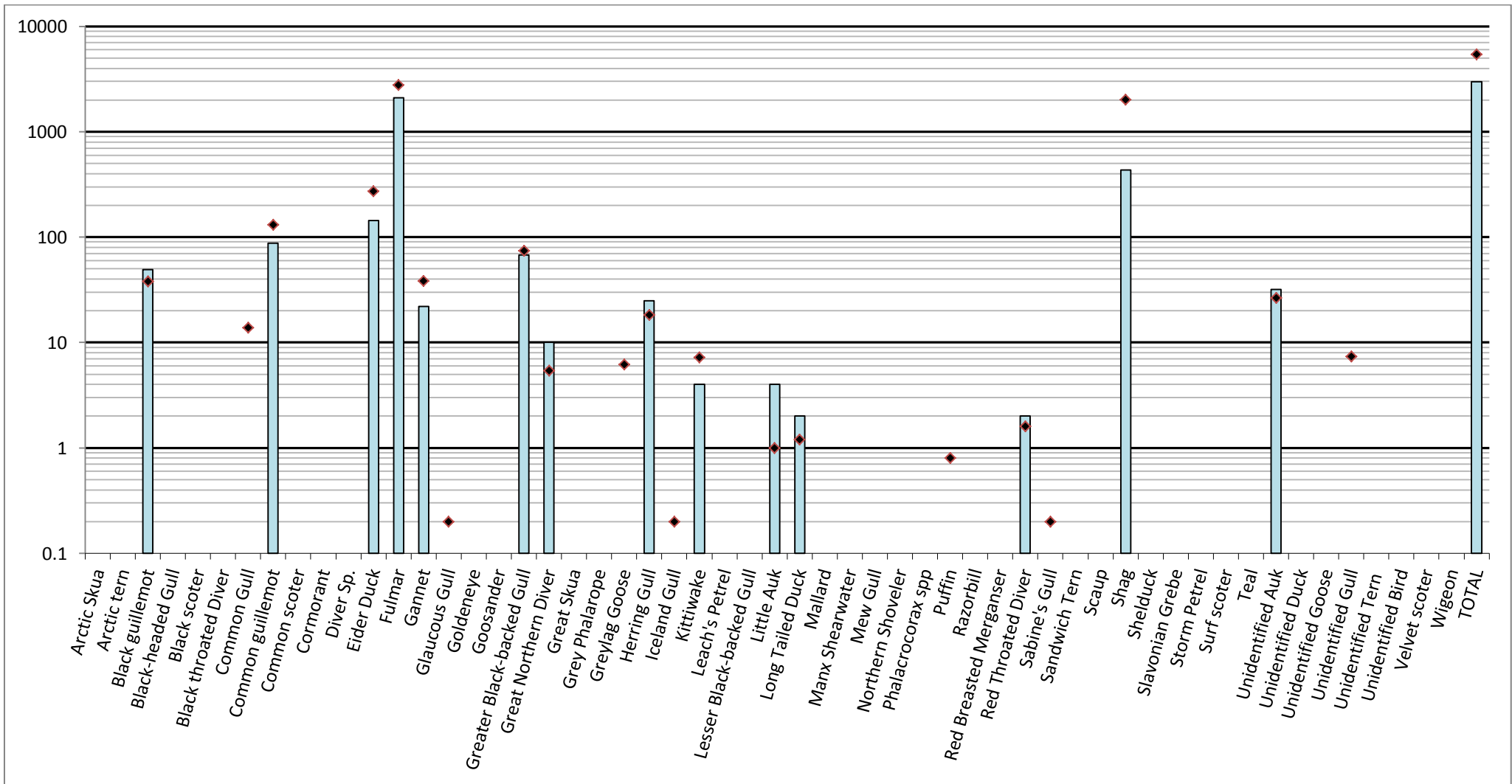


Figure 10: Bird species sighted at EMEC Billia Croo test site January 2014

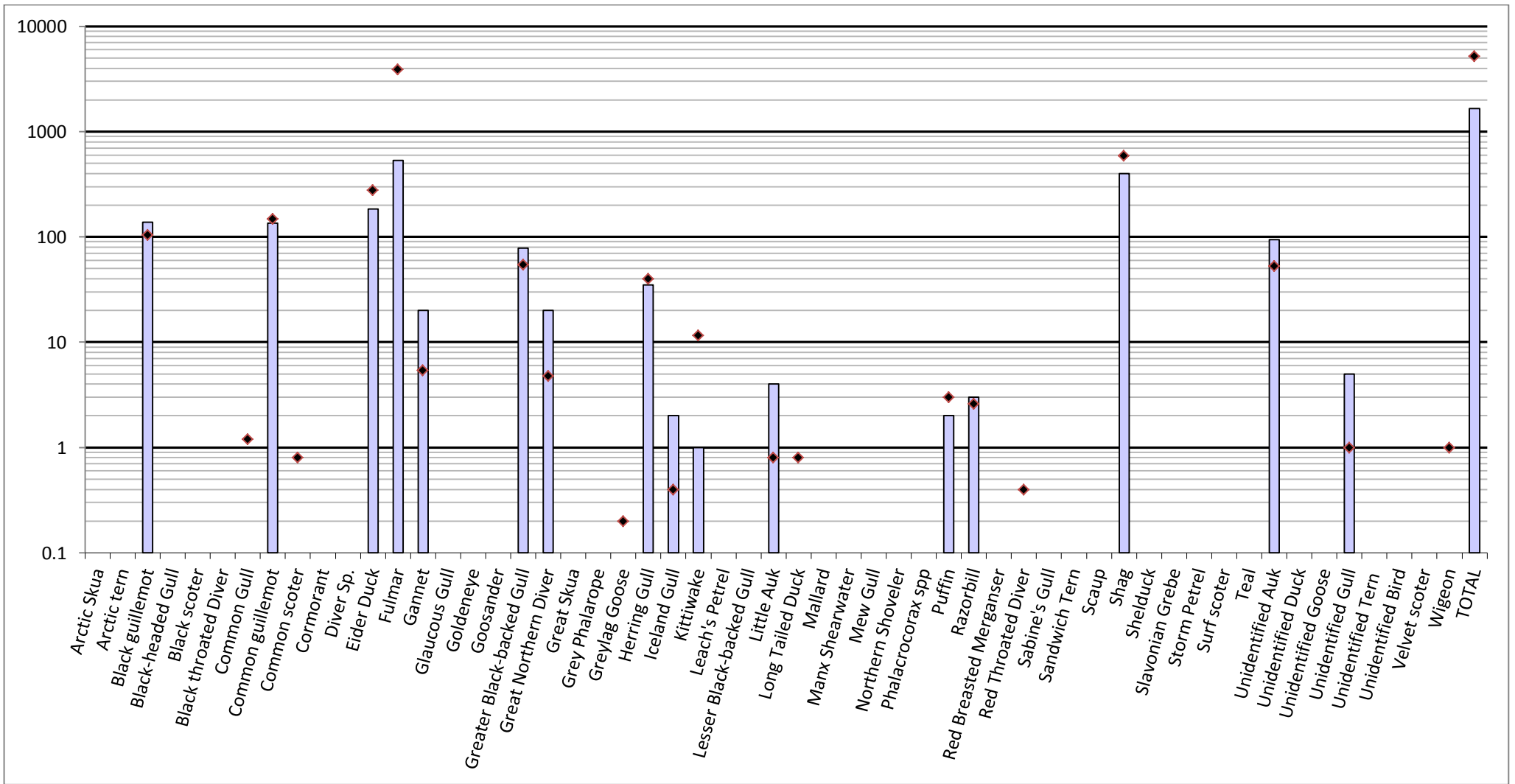


Figure 11: Bird species sighted at EMEC Billia Croo test site February 2014

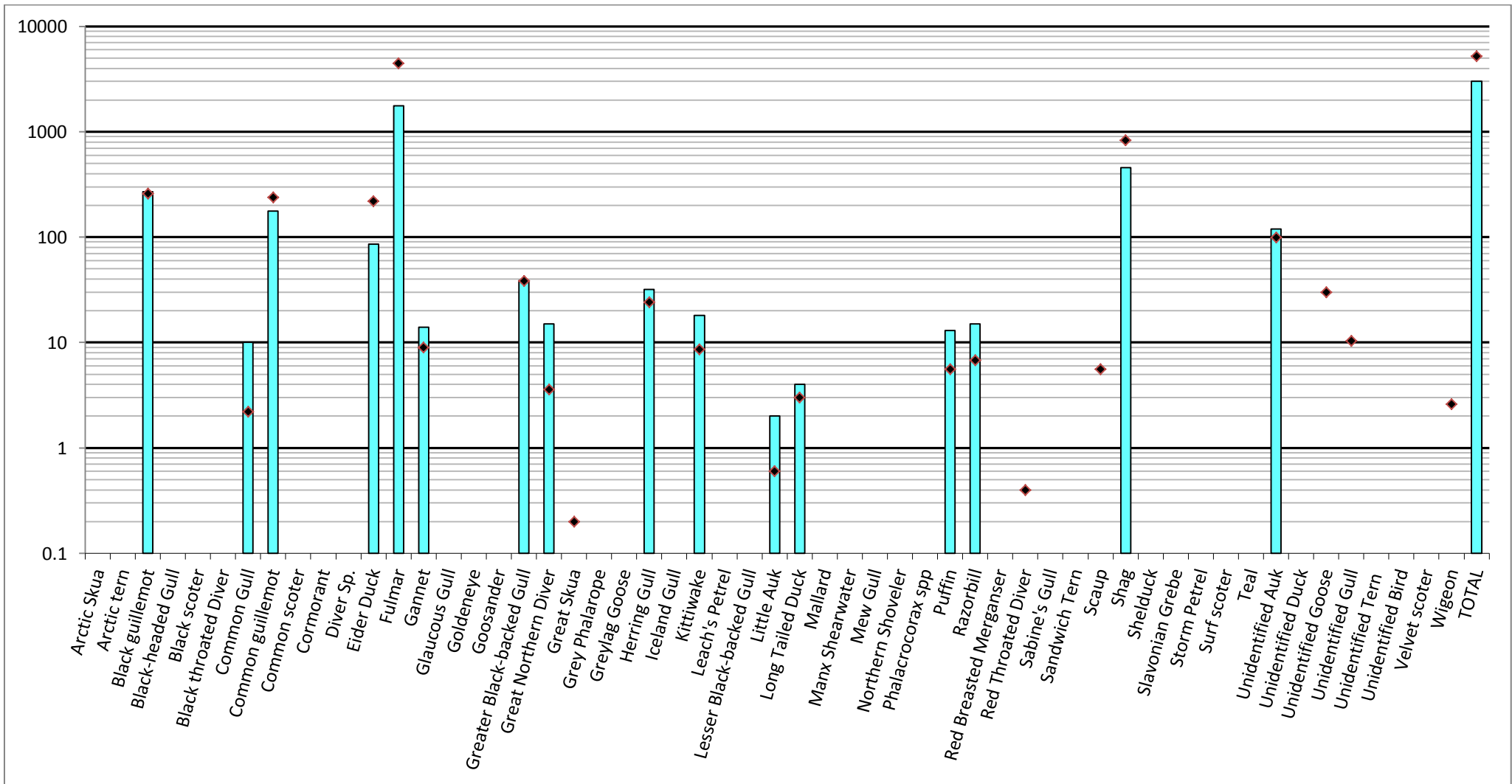


Figure 12: Bird species sighted at EMEC Billia Croo test site March 2014

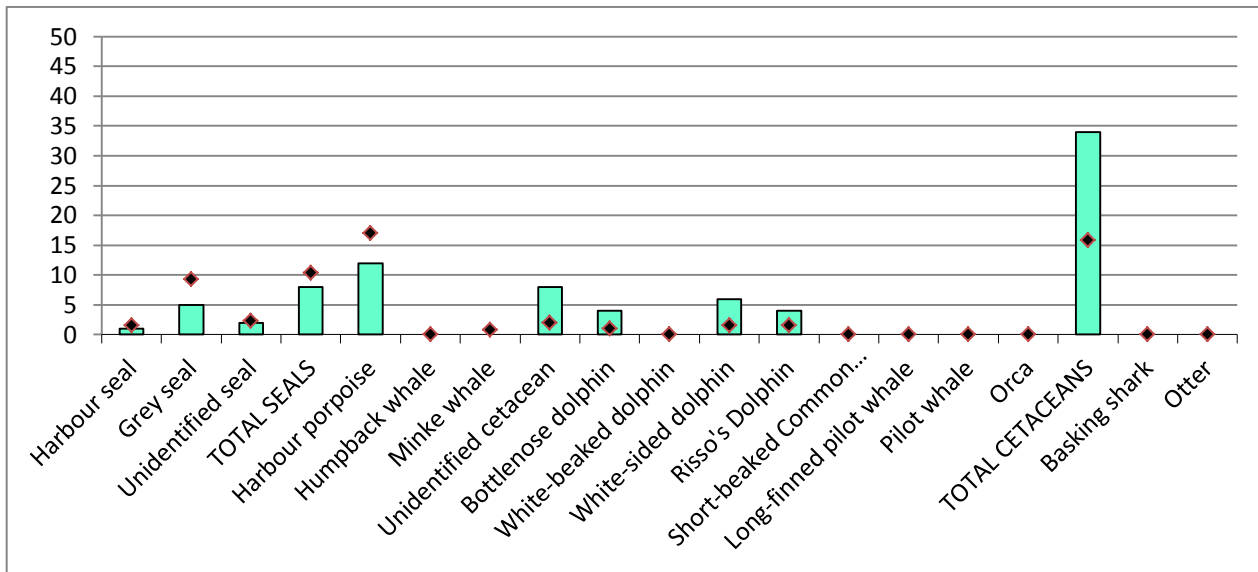


Figure 13: Cetacean, seal and other species sighted at EMEC Billia Croo test site April 2013

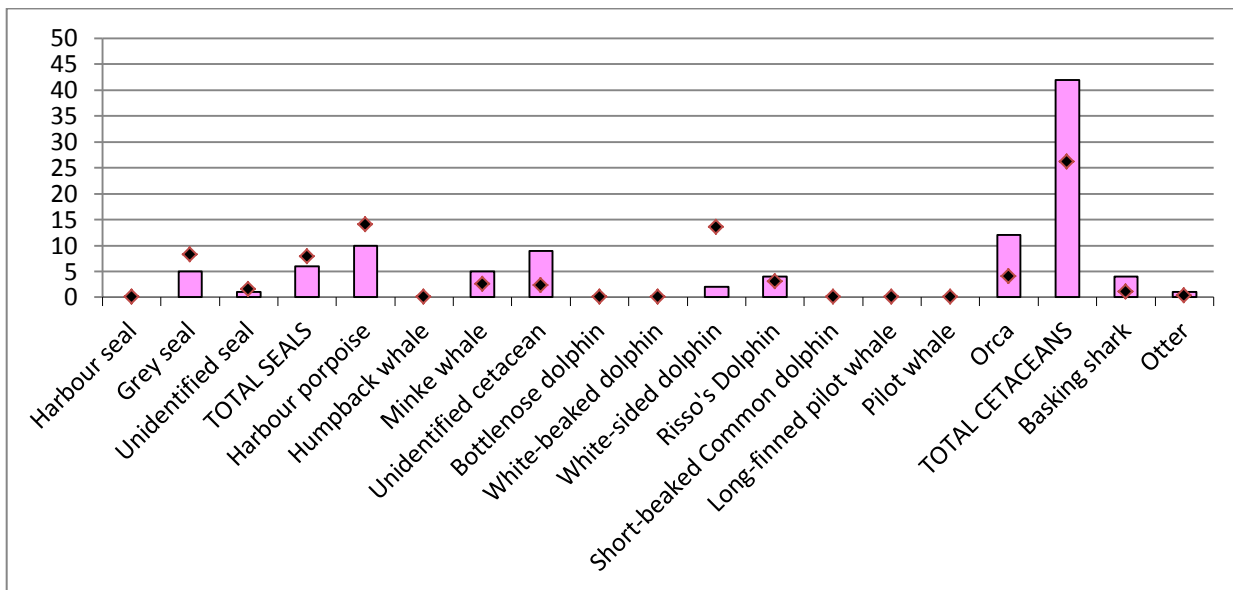


Figure 14: Cetacean, seal and other species sighted at EMEC Billia Croo test site May 2013

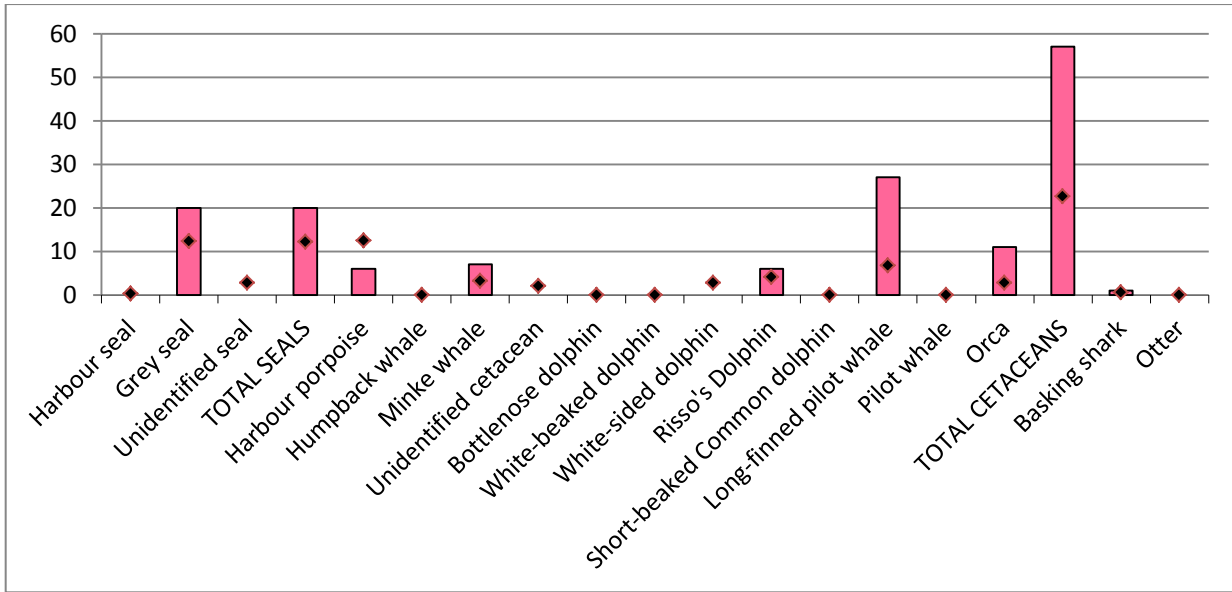


Figure 15: Cetacean, seal and other species sighted at EMEC Billia Croo test site June 2013

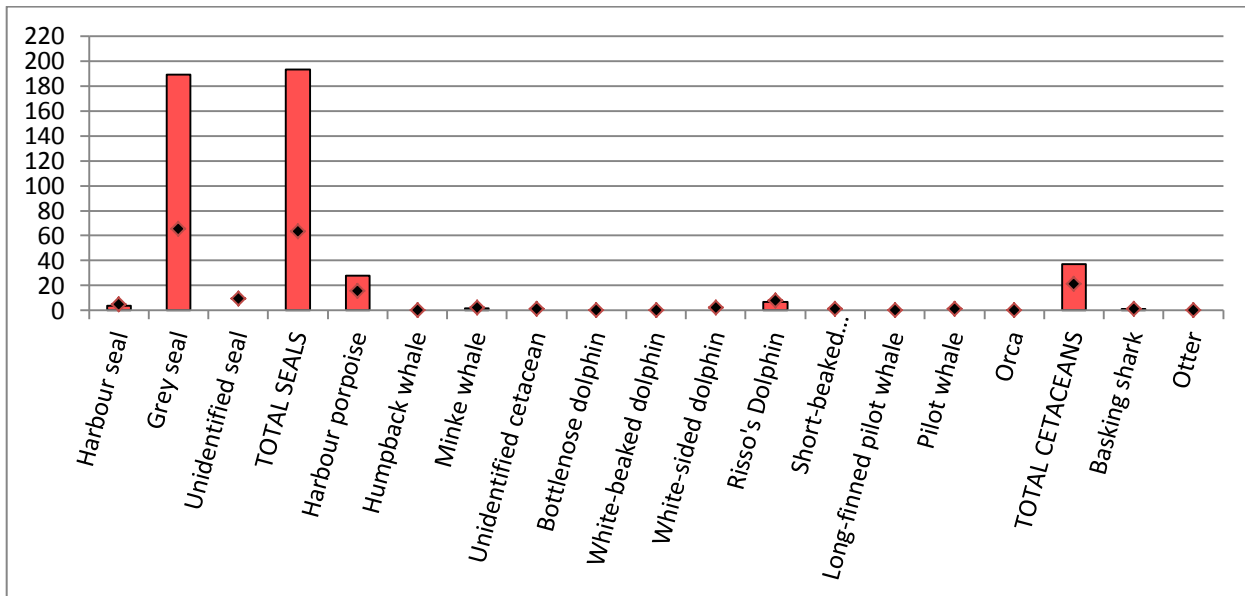


Figure 16: Cetacean, seal and other species sighted at EMEC Billia Croo test site July 2013

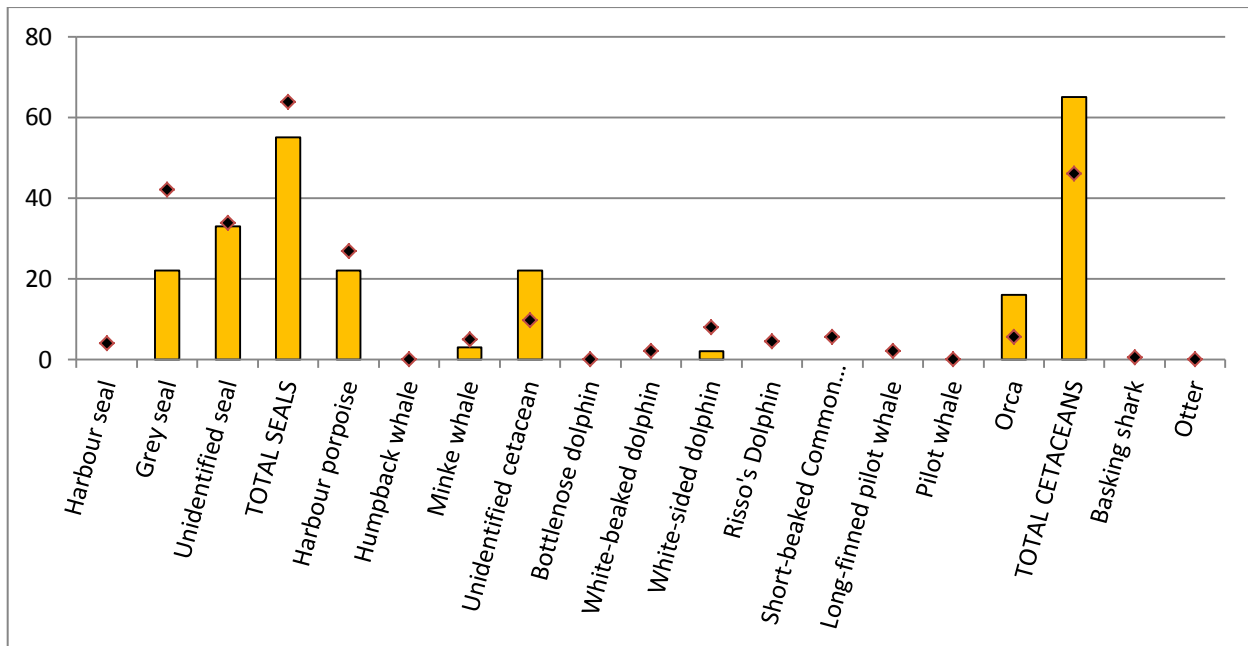


Figure 17: Cetacean, seal and other species sighted at EMEC Billia Croo test site August 2013

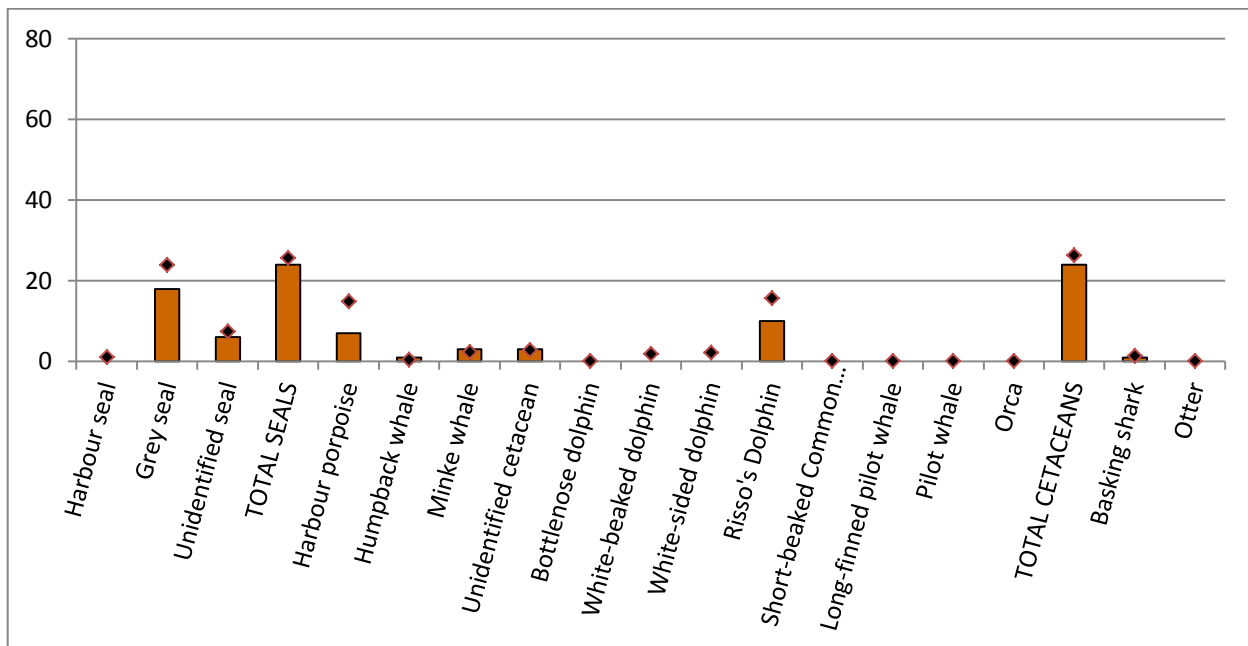


Figure 18: Cetacean, seal and other species sighted at EMEC Billia Croo test site September 2013

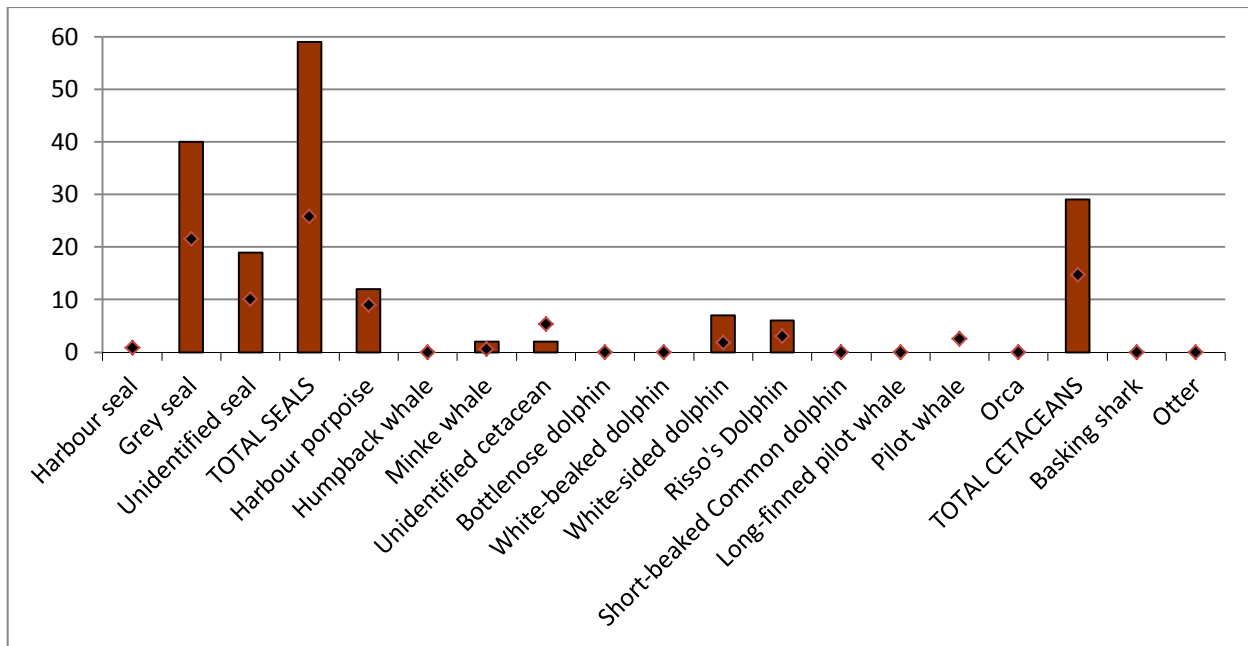


Figure 19: Cetacean, seal and other species sighted at EMEC Billia Croo test site October 2013

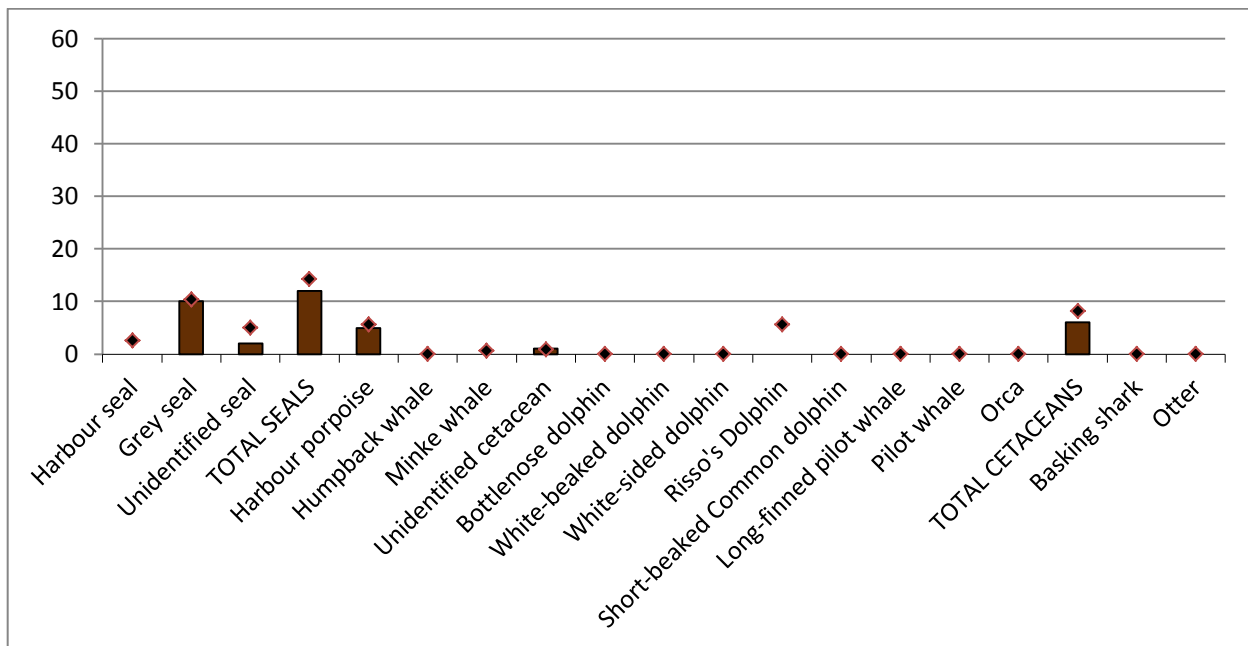


Figure 20: Cetacean, seal and other species sighted at EMEC Billia Croo test site November 2013

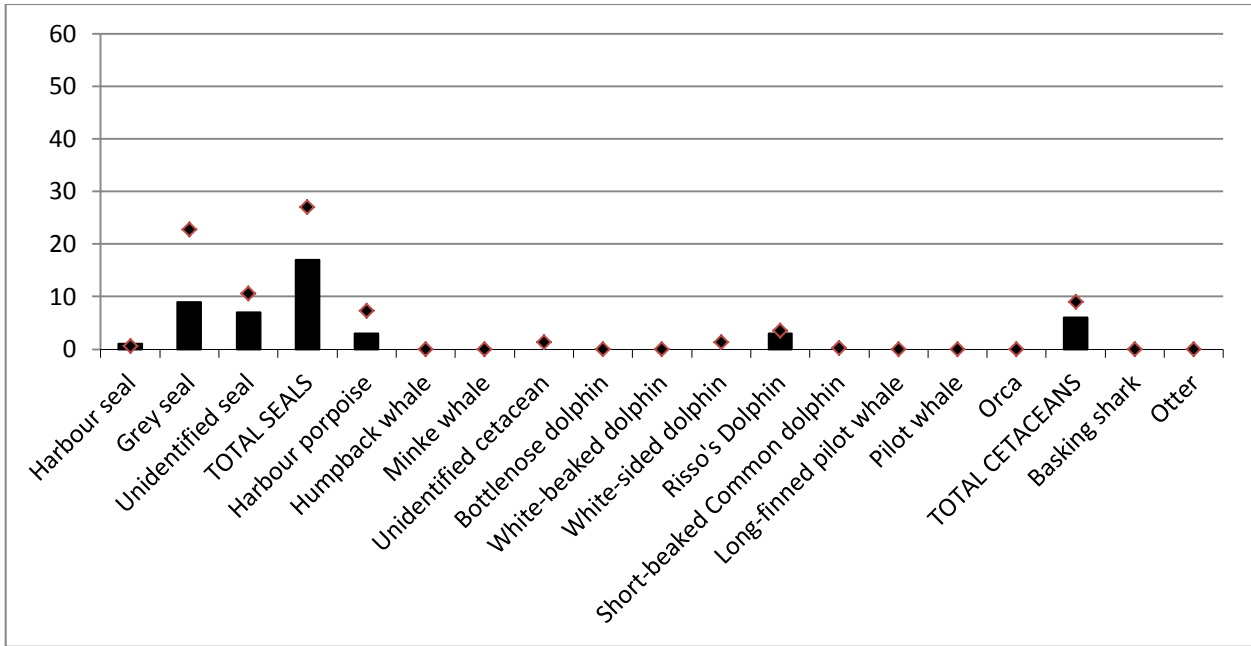


Figure 21: Cetacean, seal and other species sighted at EMEC Billia Croo test site December 2013

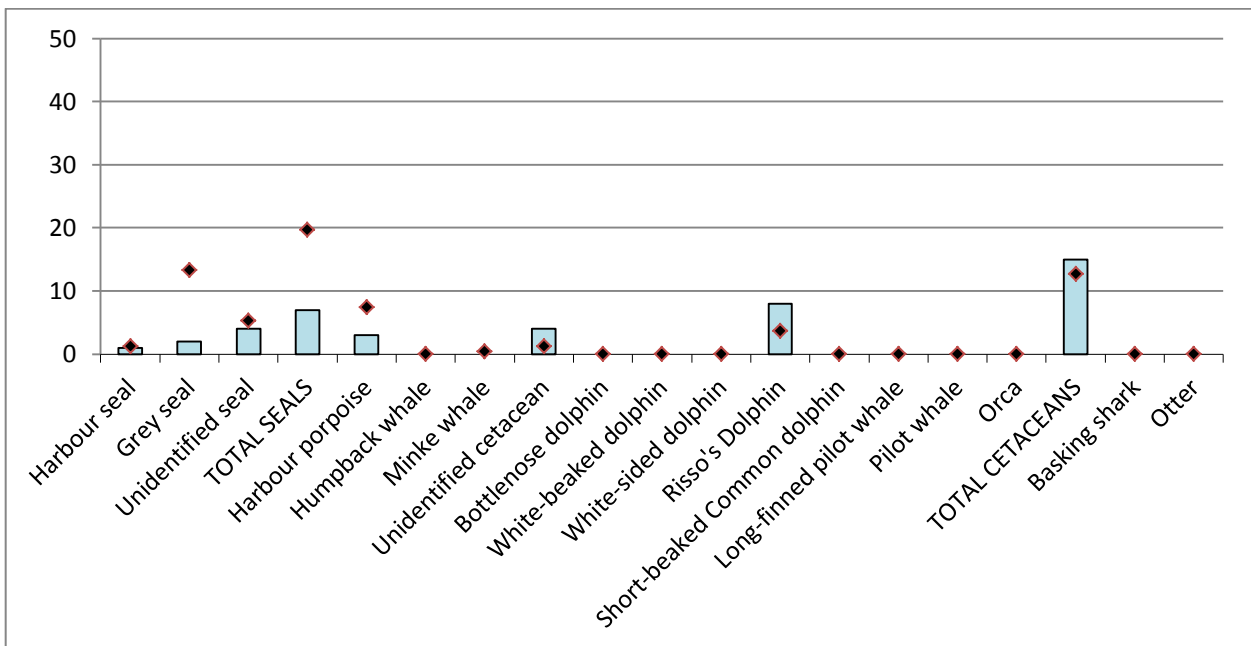


Figure 22: Cetacean, seal and other species sighted at EMEC Billia Croo test site January 2014

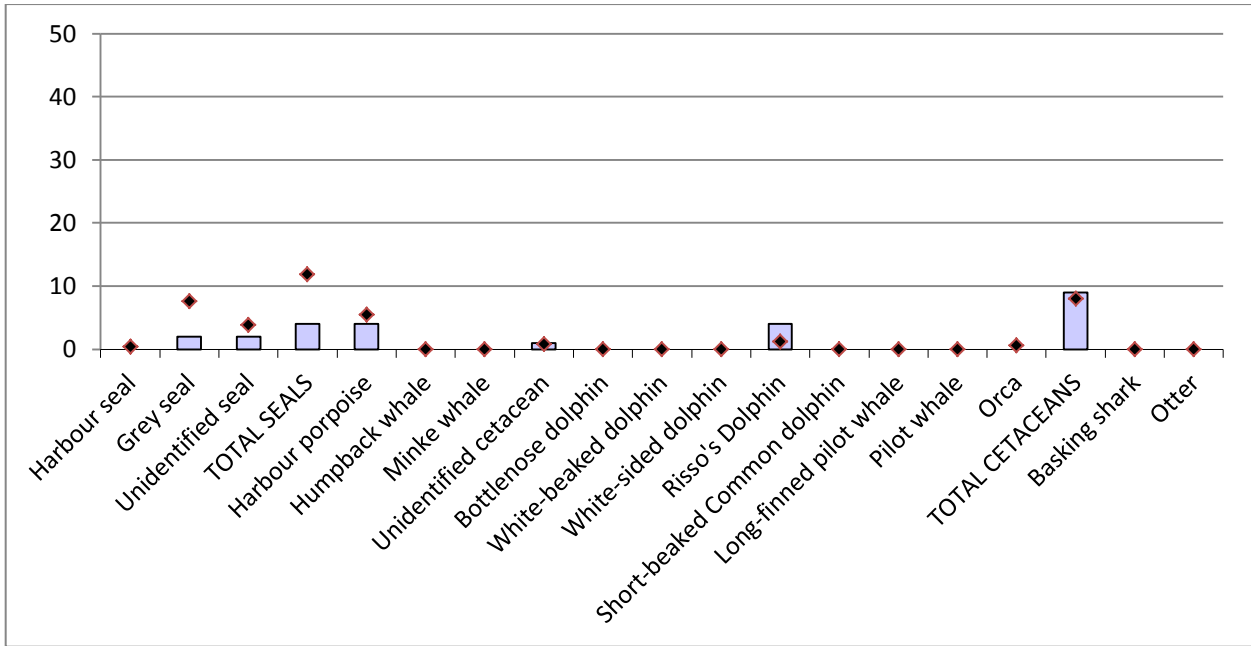


Figure 23: Cetacean, seal and other species sighted at EMEC Billia Croo test site February 2014

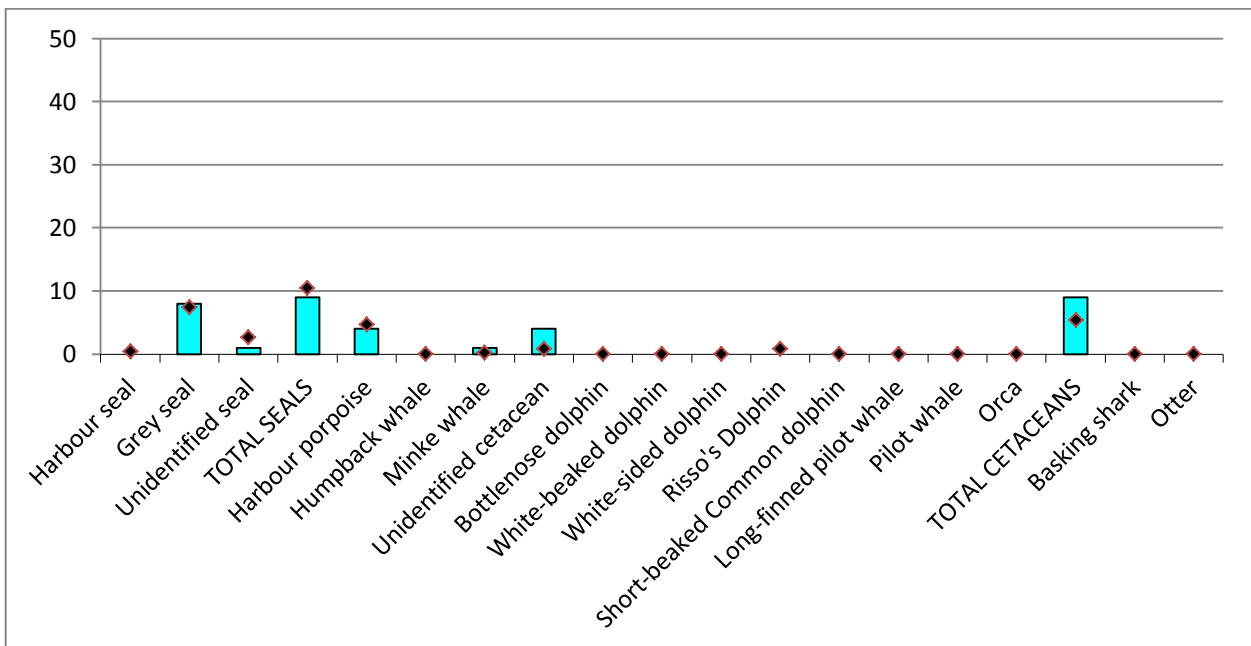


Figure 24: Cetacean, seal and other species sighted at EMEC Billia Croo test site March 2014

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