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HEBRON PROJECT Seabird Attraction To The Hebron Site Before Installation Of The Production Platform And During The First Year Of Operation (2016–2018) incld Lessons Learned						
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V	VOID (IFV)
ALL	Issued for Information (IFI); can apply to any revision level

Table of Contents

1.0	INTRODUCTION.....	3
2.0	LESSONS LEARNED.....	3
2.1	Deviations in Schedule from Original Survey Plan	3
2.2	Data Collection and Methodology	4
3.0	REFERENCES.....	5
4.0	EXHIBIT A: SEABIRD ATTRACTION STUDY (2016–2018).....	6

1.0 INTRODUCTION

From 2016 to 2018 LGL Limited was engaged by ExxonMobil Canada Properties (“ to study interactions between the Hebron Gravity Base Structure (GBS) and seabirds. The study was conducted to address requirements outlined in Section 9.5.7 of the Hebron Comprehensive Study Report (September, 2011) as stated below.

“In light of current knowledge of bird strikes associated with lighting on offshore platforms, EMCP commits to the development and implementation of a research monitoring program at the Hebron field location. This program will be designed to provide information regarding potential interactions between pelagic seabirds (significant concentrations hosted on the Grand Banks) and the Hebron platform. Information from the Hebron Platform site would provide additional data to allow assessment of risk and mortality regarding potential seabird attraction to offshore structures. The program design would be developed in consultation with Environment Canada’s Canadian Wildlife Service and would be completed prior to platform start-up in 2017. It is anticipated that field testing would begin upon completion of platform start-up and commissioning activities offshore.”

A copy of the report, *Seabird attraction to the Hebron site before installation of the production platform and during the first year of operation (2016-2018)*¹ can be found attached at Exhibit A.

Two primary actionable findings came out of the report with opportunities as lessons learned: deviations in the schedule could be predicted and planned, and increased transparency in methodologies could lead to optimized data collection.

2.0 LESSONS LEARNED

2.1 Deviations in Schedule from Original Survey Plan

It is recognized that plans created for an offshore field program of this duration and nature may not be able to be conducted exactly as written due to unforeseen circumstances associated with operations and weather. The plan for this program was developed in advance of its execution and while all efforts were made to execute per plan to the extent that was practical, several challenges arose. Simultaneous operations onboard the Operator Standby and Support Vessels, as well as several weather-related challenges required occasional schedule interruptions to the field observer’s ability to conduct observations. The requirement to make operational changes is inevitable, but was not covered in the original plan and therefore caused some confusion when final report was developed. For future programs it is recognized that this needs to be taken into consideration and predicted situations that may results in impact and deviations to the schedule should be addressed in the plan.

¹ Mactavish, B.D. and A.L. Lang. 2019. Seabird attraction to the Hebron site before installation of the production platform and during the first year of operation (2016–2018). LGL Rep. SA1190G. Rep. by LGL Limited, St. John’s, NL, for ExxonMobil Canada Properties, St. John’s, NL. 71 p. + appendices.

2.2 Data Collection and Methodology

During review of the report, Environment and Climate Change Canada - Canadian Wildlife Service (ECCC-CWS) identified improvements for the methodology used to capture data over the course of the program. To ensure these concerns are addressed in future programs, proposed collection methods will be included in the program plan such that they can be reviewed and critiqued for optimization. A description of proposed primary and secondary collection methods will be reviewed with ECCC-CWS to ensure alignment.

3.0 REFERENCES

Mactavish, B.D. and A.L. Lang. 2019. Seabird attraction to the Hebron site before installation of the production platform and during the first year of operation (2016–2018). LGL Rep. SA1190G. Rep. by LGL Limited, St. John's, NL, for ExxonMobil Canada Properties, St. John's, NL. 71 p. + appendices.

4.0 EXHIBIT A: SEABIRD ATTRACTION STUDY (2016–2018)



**SEABIRD ATTRACTION TO THE
HEBRON SITE BEFORE INSTALLATION OF THE PRODUCTION PLATFORM AND
DURING THE FIRST YEAR OF OPERATION (2016–2018)**

Submitted by:



Submitted to:

ExxonMobil Canada Properties

October 2019
LGL Report: SA1190G



**SEABIRD ATTRACTION TO THE
HEBRON SITE BEFORE INSTALLATION OF THE PRODUCTION PLATFORM AND
DURING THE FIRST YEAR OF OPERATION (2016–2018)**

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Table of Contents

	Page
List of Figures	iv
List of Tables	v
Acronyms and Abbreviations	vii
Executive Summary	viii
1.0 Introduction	1
1.1 Organization of the Report	1
2.0 Methods	2
2.1 Day-time Surveys	2
2.2 Night-time Surveys	6
2.3 Bird Strandings on the Platform and Survey Vessel	8
3.0 Results	8
3.1 Day-time Surveys	8
3.1.1 Effort	8
3.1.2 All Species	8
3.1.3 Species Accounts	12
3.1.3.1 Seabirds	12
3.1.3.2 Coastal and Terrestrial Bird Species	45
3.1.4 Attraction to the Platform Itself	48
3.1.4.1 Comparison of Seabird Densities within the Study Area Before and After Installation of the Platform	48
3.1.4.2 Comparison of Bird Densities in the Jeanne d'Arc Basin with those in the Study Area	50
3.1.5 Behaviour of Birds Near the Platform	51
3.1.5.1 Leach's Storm-Petrel	52
3.1.5.2 Gulls	52
3.1.5.3 Shearwaters	53
3.1.5.4 Murres	54
3.2 Night-time Surveys	54
3.2.1 Effort	54
3.2.2 Attraction to the Platform Itself	55
3.2.2.1 All Species	55
3.2.2.2 Leach's Storm-Petrel	56
3.2.3 Behaviour of Birds Near the Platform	59
3.2.3.1 Storm-Petrel Event on 27/28 August 2017	59
3.2.3.2 Storm-Petrel Event on the Night of 10/11 September 2017	60
3.2.3.3 Gulls	61
3.2.3.4 Other Bird Species	62
3.2.4 Bird Interactions with the Flare	63
3.3 Bird Strandings on the Platform and Survey Vessel	63
4.0 Summary and Conclusions	63
4.1 Attraction to the Platform Itself	64
4.1.1 Day-time	64

4.1.2	Night-time.....	64
4.2	Behaviour of Birds Near the Platform.....	66
4.2.1	Day-time.....	66
4.2.2	Night-time.....	66
4.3	Bird Interactions with the Flare.....	66
4.4	Bird Strandings on the Platform.....	66
4.5	Conclusions.....	67
5.0	Acknowledgements.....	68
6.0	Literature Cited.....	68
	Appendices.....	71
	Appendix A: Night-time Observation Effort Timing in 2017 and 2018.....	A-1
	Appendix B: Night-time Survey Effort and Number of Birds Observed in 2017 and 2018.....	B-1
	Appendix C: Summary of Leach's Storm-Petrel Strandings.....	C-1

List of Figures

	Page
Figure 1. The <i>Atlantic Osprey</i> was used for the majority of the survey effort around the Hebron platform.....	3
Figure 2. Day-time view of the Hebron production platform with an offshore supply vessel, the <i>Atlantic Heron</i> , alongside for cargo operations (A). For scale, the topsides (superstructure) measure 183 m by 75 m, and the <i>Atlantic Heron</i> is 86 m in length. Night view of the Hebron platform with flare burning (B).....	7
Figure 3. Direction of flight of Leach's Storm-Petrels by percent of total observed during August 2018 in the Study Area.....	28
Figure 4. Direction of flight of Leach's Storm-Petrels by percent of total observed during September 2018 in the Study Area.....	28
Figure 5. Direction of flight of Leach's Storm-Petrels by percent of total observed during October 2018 in the Study Area.....	29
Figure 6. Average number of storm-petrels observed per hour in 2017 during night-time surveys from the standby vessel (left vertical axis), and number of storm-petrels stranded on Hebron or survey vessels (right vertical axis).....	57
Figure 7. Average number of storm-petrels observed per hour in 2018 during night-time surveys from the standby vessel (left vertical axis), and number of storm-petrels stranded on Hebron or standby/supply vessels (right vertical axis).....	58
Figure 8. The average maximum number of Great Black-backed Gulls recorded on night-time surveys per week at the Hebron platform in August–October 2017 and 2018.....	61

List of Tables

	Page
Table 1.	Dates in 2016 when LGL biologists were on-site at the Hebron field before installation of the GBS*..... 4
Table 2.	Dates in 2017 when LGL biologists were on-site at the Hebron field after installation of the GBS but before operation of the flare*..... 4
Table 3.	Dates in 2018 when LGL biologists were on-site at the Hebron field after installation of the GBS but during production and operation of the flare*..... 5
Table 4.	Day-time survey effort at the site of the Hebron GBS during 2016–2018..... 8
Table 5.	Offshore seabird species recorded at the Hebron site during the 2016–2018 study by month..... 9
Table 6.	Coastal and terrestrial bird species recorded at the Hebron site during the 2016–2018 study and which were unlikely to be recorded during Stationary Platform counts..... 10
Table 7.	Average number of birds/km ² (± standard deviation) of all species combined during ten-day blocks from counts conducted in the Study Area..... 11
Table 8.	Average number of Dovekies/km ² (± standard deviation) during ten-day blocks from Stationary Platform counts conducted within the Study Area..... 13
Table 9.	Densities of All Murres (pooled Common, Thick-billed and unidentified murres) within the Study Area averaged over ten-day blocks during the 2016–2018 study period..... 16
Table 10.	The percent of Common Murre and Thick-billed Murre observed in flight and on the water within the Study Area during the Winter observation period (2018)..... 17
Table 11.	Densities of Black-legged Kittiwake within the Study Area averaged over ten-day blocks during the 2016–2018 study period..... 19
Table 12.	Recognizable movements of Leach’s Storm-Petrels noted during daylight observations in the Spring 2016 observation period at the Hebron site..... 23
Table 13.	Flight directions of Leach’s Storm-Petrels during daylight observations from the Hebron site during the Summer 2016 observation period..... 24
Table 14.	Densities of Leach’s Storm-Petrel within the Study Area averaged over ten-day blocks during the 2016 to 2018 observation periods..... 26
Table 15.	Average number of Leach’s Storm-Petrels observed per hour by flight direction during daylight hours in Fall 2017 (August to October) (from Stationary Platform counts and incidental sightings near Hebron GBS)..... 27
Table 16.	Summary of flight direction of all Leach’s Storm-Petrels recorded during the August to October 2018 observation period..... 27
Table 17.	Densities of Northern Fulmar within the Study Area averaged over ten-day blocks during the 2016 to 2018 observation periods..... 30
Table 18.	Densities of Sooty Shearwater within the Study Area averaged over ten-day blocks during the 2016 to 2018 observations periods..... 33
Table 19.	Densities of Great Shearwater within the Study Area averaged over ten-day blocks during the 2016–2018 study period)..... 36
Table 20.	Sightings of Cory’s Shearwaters during the 5–12 August 2016 observation period..... 43
Table 21.	Flight direction of Northern Gannets at the Hebron site during Fall 2018 observation period..... 45

Table 22.	Summary of coastal and terrestrial bird species observations recorded at the Hebron site during the 2016–2018 study.....	46
Table 23.	Spring densities of birds (number of birds/km ²) at the Hebron production site before (2016) and after (2018) the installation of the GBS.....	48
Table 24.	Summer (August) densities of birds (number of birds/km ²) at the Hebron production site before (2016) and after (2018) the installation of the GBS.....	48
Table 25.	Densities of Seabirds in a 1.5°N x 2°W study block centred on the production platforms and within a 5 km radius of the Hebron platform (i.e., Study Area).....	51
Table 26.	Night-time survey effort by month.	54
Table 27.	Average (mean) number of birds sighted per hour of night-time observation by season (2017 and 2018 pooled). Spring: May; Summer: August; Fall: September and October; Winter: January and February.	56
Table 28.	Summary of storm-petrel sightings during night-time surveys at the Hebron GBS.	56

Acronyms and Abbreviations

C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
CWS	Canadian Wildlife Service
E	East
ECCE	Environment and Climate Change Canada
ECSAS	Eastern Canada Seabirds at Sea
ESRF	Environmental Studies Research Fund
FLIR	forward-looking infrared
FPSO	Floating Production Storage and Offloading
GBS	Gravity Base Structure
h	hour(s)
indiv.	individual(s)
km	kilometre(s)
kt	knot(s)
LGL	LGL Limited
m	metre(s)
MBCA	<i>Migratory Birds Convention Act</i>
mm	millimetre(s)
N	North
NE	Northeast
NW	Northwest
S	South
SE	Southeast
SSW	South-Southwest
SW	Southwest
V	Variable
W	West
WNW	West-Northwest
WSW	West-Southwest

Executive Summary

This report presents the findings of the final four study objectives that comprised Hebron Project's commitment to Environment Canada and Climate Change Canada (ECCC) to study interactions between the Hebron Gravity Base Structure (GBS) and seabirds. The overall study of seabird distribution, abundance, and temporal occurrence at the Hebron site had five objectives, namely to study: 1) attraction of birds to the general vicinity of the Hebron site prior to installation of the GBS, the analysis of which was reported in 2017; 2) attraction of birds to the actual platform itself; 3) behaviour of birds around the platform; 4) bird strandings on the platform; and 5) bird interactions with the flare. The study to address objectives two through five began with baseline data collection in spring and summer 2016, the year preceding the Hebron GBS tow-out to its offshore location. Four weeks of field work were conducted in spring 2016 and one week in summer 2016, from vessels that installed subsea infrastructure at the Hebron site. After the GBS was installed in summer 2017, an LGL biologist collected data from standby vessels for eight weeks in September and October. The 2017 fall field work occurred before first oil was produced and prior to operation of the flare. The fall field work covered the period when newly fledged Leach's Storm-Petrels (*Hydrobates leucorhous* [*Oceanodroma leucorhoa*]) and their parents were abandoning their nest burrows and flying out to sea. In 2018, seabird observations were made during three periods: winter (24 January to 27 February), spring (3–20 May), and summer (4–31 August) and fall (1 September to 31 October).

Seabird surveys were conducted using the ECCC-Canadian Wildlife Service standardized Eastern Canada Seabirds at Sea (ECSAS) protocol. A total of 4544 ECSAS Stationary Platform counts were conducted during daylight hours in the Study Area (i.e., the area within a 5 km radius of the Hebron site) on 200 survey days during 2016–2018. In total, 293.45 hours of night-time surveys were conducted at the Hebron site on 106 nights in 2017 and 2018. Overall, 25 species of pelagic seabirds and 42 species of coastal and terrestrial birds were observed. The data confirmed that bird populations in the immediate area around the Hebron site were typical of the larger regional area. There was nothing unique about the Hebron site.

The majority of individuals observed during the study were Alcids (the two murre species and Dovekie), gulls (Black-legged Kittiwake and Great Black-backed Gull), shearwaters (Great and Sooty), Leach's Storm-Petrel and Northern Fulmar. In winter (January and February), Thick-billed Murre, Common Murre, Dovekie, Northern Fulmar and Black-legged Kittiwake were the dominant species. In spring (March–May), Thick-billed Murre and Common Murre combined to make up the majority of the birds present, along with lower densities of Leach's Storm-Petrel, Black-legged Kittiwake, Dovekie and Northern Fulmar. In summer (June–August), the diversity of species increased. Great Shearwater and Leach's Storm-Petrel were the most numerous species. Increased numbers of Great Shearwater and Leach's Storm-Petrel continued into the fall period (September and October). Great Black-backed Gulls started showing up in late-August and numbers increased through September and peaked in October. Murres and Dovekies began to return in numbers during October prior to the onset of winter.

Comparison of densities of birds during day-time in the Study Area before and after the installation of the platform showed a slight increase in the number of gulls after the installation. During daylight hours, bird attraction to the platform was low except for gulls. Great Black-backed Gulls occurred in flocks on the water downwind from the platform in September and October during both day and night-time periods. Black-legged Kittiwakes sporadically occurred in small day-time flocks downwind from the platform mainly during the fall. Shearwaters, Northern Fulmar, Leach's Storm-Petrel and murres showed no

day-time attraction to the platform. Seabirds were rarely observed feeding within the Study Area during the daylight at any season. Birds generally were flying through the area.

During night-time surveys, very few birds were observed around the platform in winter and spring. In late summer and fall (August–October), Leach’s Storm-Petrels and Great Black-backed Gulls were active at night in the lighted areas on the water around the platform. During September and October, Great Black-backed Gulls were regularly observed catching small silver coloured fish thought to be Atlantic saury (*Scomberesox saurus*). Leach’s Storm-Petrels were observed at night on 34 out of 106 survey nights during August–October in 2017 and 2018 combined. These observations usually consisted of fewer than five birds per watch. Storm-petrels were observed flying closer to the platform at night than during the day. Most sightings of storm-petrels were of single birds flying rapidly and directly low over the water past the GBS without stopping. Direct interaction with the platform was rarely observed during night-time surveys. There was one instance of a nocturnal circulation of a few hundred storm-petrels around the GBS cement shaft on a foggy night. Another instance of a large number of storm-petrels involved a steady movement past the platform without direct interaction with the platform. Direct contact by storm-petrels with the platform during night-time surveys was limited to four instances of single birds, three of which occurred on the night of the nocturnal circulation event. Only one instance appeared to result in mortality (a single bird). One or more storm-petrels were sighted during 50% of watches with fog or rain whereas only 27% of watches with unlimited visibility had one or more sightings.

During 2017 and 2018, a total of 89 Leach’s Storm-Petrels stranded on the Hebron platform and the survey vessels. Most of these birds (78 individuals) stranded in 2017. These strandings are well within the range of the number of strandings per year reported from the other three production facilities in Jeanne d’Arc Basin. The largest stranding events, consisting of 11 individuals each, occurred on three nights during the first half of October 2017. Strandings in both years occurred during the usual nesting colony abandonment period. The only other species which stranded was a Common Murre found on a supply vessel during cargo operations alongside the platform.

Storm-petrel sightings in the vicinity of the flare were also rare. No birds were observed flying into the flare. Four birds were observed flying near the flare on the night of 30 September/1 October 2018. One bird passed under the flare at an estimated distance <10 m and another at approximately 20 m below the flare. Two others appeared to pass close to the flare, but the distance could not be estimated. On the night of 5/6 October 2018, two single Leach’s Storm-Petrels were observed flying at a higher altitude than the flare but not near the flare.

1.0 Introduction

LGL Limited (LGL) developed a research program to satisfy a commitment made by the Hebron Project in its Comprehensive Study Report (Hebron 2011) to develop and implement a seabird monitoring program at the Hebron field location. The overall purpose of the research program was to examine potential interactions between pelagic seabirds and the Hebron Gravity-based Structure (GBS). This arose, in part, from the known susceptibility of Leach's Storm-Petrel (*Hydrobates leucorhous* [*Oceanodroma leucorhoa*]) to strand related to electrical lighting on vessels and coastal lighting (Montevicchi et al. 1999; Ronconi et al. 2015), and the declining numbers of this species nesting at some colonies in Atlantic Canada (Wilhelm et al. 2015, 2019). The specific objectives of the study were developed in consultation with Environment and Climate Change Canada-Canadian Wildlife Service (ECCC-CWS) and Hebron project staff.

The proposed research program was designed to be a full annual study (LGL 2017a). It was intended to address: 1) attraction of birds to the general vicinity of the production platform; 2) attraction of birds to the actual platform itself; 3) behaviour of birds around the platform; 4) bird strandings on the platform; and 5) bird interactions with the flare. Objective 1 was addressed in an analysis of baseline seabird distribution and abundance from data collected by LGL during seabird and marine mammal monitoring of seismic exploration programs from 2004–2016 and those collected by ECCC-CWS from 2006–2009 for the Eastern Canada Seabirds at Sea program (ECSAS) (LGL 2017b). Analysis of those data demonstrated that bird populations in the area around the Hebron site did not differ from the surrounding areas of the eastern Grand Banks (LGL 2017b). It also showed that large gull species and Black-legged Kittiwake were more common around the three production facilities that were operational at the time. The present study addresses objectives two through five through data collected at the Hebron site.

The study began with baseline data collection in spring and summer 2016, the year preceding the Hebron GBS tow-out to its offshore location in the summer of 2017. In 2016, four weeks of field work were conducted in spring and one week was conducted in summer (Mactavish 2016a,b). After the GBS was installed, eight weeks of fall field work were conducted in September and October 2017 before first oil was produced and the flare was operational (Mactavish and Lang 2018a). The latter work covered the period when newly fledged Leach's Storm-Petrel young and their parents were abandoning their nest burrows and flying out to sea. In 2018, there was a winter study from 24 January to 27 February (Mactavish and Lang 2018b), a spring study from 3–20 May (Mactavish 2018), and summer and fall combined study 4 August to 31 October (Mactavish and Lang 2019). Tables 1–3 show the dates when observers were at the Hebron production site. This report presents the results of the 2016, 2017 and 2018 field observation periods.

1.1 Organization of the Report

This report begins with a description of the Study Area and the methods for the three main study components: 1) day-time surveys, 2) night-time surveys, and 3) birds stranded on the Hebron platform and survey vessel. The results of the day-time surveys are broken into study effort and accounts for each species presenting seasonal occurrence and densities in each season in the Study Area, behaviour and movements near the platform, any interactions with the platform, a comparison of seabird densities observed during the present study in the Study Area before and after installation of the GBS, and a comparison of seabird densities in Jeanne d'Arc Basin with seabird densities in the Study Area. The results of night-time surveys are presented in four subsections describing study effort, bird attraction to the platform, behaviour of birds near the platform, and interactions with the flare. A summary of records of birds stranded on both the

survey vessel and platform is presented in the last section of the results. Summary and conclusion sections discuss the results of all three components of the study. This is followed by acknowledgements, and a list of the references cited in the report. The report ends with three appendices detailing: 1) night-time study effort, 2) night-time bird observation data, and 3) stranded bird data.

2.0 Methods

All observations were conducted from vessels working in a Study Area consisting of the area within a 5 km radius of the Hebron platform site. The construction support vessel *Calamity Jane* was used during the spring 2016 surveys and the pipe laying vessel *Seven Waves* was used during the summer 2016 surveys before the installation of the GBS. For seabird surveys in 2017 and 2018 various vessels owned by Atlantic Towing, most notably the *Atlantic Raven* and *Atlantic Osprey*, but also the *Atlantic Heron*, *Atlantic Griffon* and *Paul A. Sacuta* were used for standby duty at the Hebron GBS (Figure 1). In all, there were 200 survey days at the Hebron platform during the 2016–2018 study period. In 2016, before the platform was installed, a total of 34 survey days were spent during spring and summer at the Hebron platform site (Table 1). In August 2017, just after the Hebron GBS was installed at the drill site but before production began and the start-up of the flare, an observer was present on a standby vessel for 49 dates in late summer and early fall (Table 2). During the 2018 observation periods, observers were present on a standby vessel on site for a total of 117 days, of which 24 were in winter, 16 were in spring and 71 were in a combined late summer and fall effort (Table 3). Throughout the study period, surveys were conducted whenever weather and critical vessel or platform operations permitted, so there were relatively few interruptions in the survey schedule. Three LGL biologists conducted the surveys: Bruce Mactavish was present for 128 days, Tony Lang for 46 days and Colin Jones for 26 days. An additional 31 days were involved in transiting between St. John's and the Hebron site. These transits often took place during darkness. Moving platform seabird surveys following CWS protocols were conducted during parts of the transits. Communication and cooperation between the onboard observer and the ship's captain and crew were deemed excellent throughout the survey effort. During active observations, the onboard seabird observer would advise the vessel captain on preferred viewing locations. For the purposes of this report the seasons are identified as Winter (December to February); Spring (March to May); Summer (June to August) and Fall (September to November).

2.1 Day-time Surveys

To derive seabird densities during daylight hours, systematic, quantitative seabird surveys were conducted, and general observations of seabirds were recorded. Seabird surveys were conducted using the ECCC-CWS standardized Eastern Canada Seabirds at Sea (ECSAS) protocol for Stationary Platform counts (Gjerdrum et al. 2012). A survey consisted of a series of near-instantaneous counts with the unaided eye of the birds within a semi-circle with a radius of 500 m in diameter conducted at a point on the vessel with a good view of the water and sky. Each count took a few seconds and documented all birds present within 500 m of the observer. Binoculars were used only to confirm the species identification of birds, not to initially detect birds. The counts were performed once every ten minutes during a survey period, which ranged from one to three hours throughout the day. To determine the distance of a bird from the observer a rangefinder (i.e., a clear plastic ruler on which distances were marked from a mathematical equation as outlined in Gjerdrum et al. [2012]) was used. The bird information recorded with each count included

species, number of individuals, activity, distance, flight direction, and other categories as outlined in Gjerdrum et al. (2012). If bird densities within 500 m were low, the number of birds outside the 500 m radius were also counted but could not be used in the calculation of bird densities. The distance of birds from the observer was recorded by dividing the survey area into distance bands of 0–50, 100–200, 200–300, 300–500 and >500 m. A data sheet was devised with the appropriate headings for efficient recording of data and later entry into a digital database. Figure 2A shows Hebron during daylight with a supply vessel.

Because the area of the 500 m diameter semi-circular survey area is known (0.39 km²) bird densities (numbers of birds per square kilometre) were calculated. Distance sampling, i.e., correction for an observer's declining ability to sight a bird with increasing distance of that bird from the survey platform, was not applied, so densities are slightly underestimated. Then the average (mean) densities and corresponding standard deviations for each period of ten consecutive days were calculated. Standard deviation is a measure of the variation in the numbers recorded during the counts. A low standard deviation indicates that the numbers tend to be close to the average, whereas a high standard deviation indicates that the numbers are spread over a wider range.



FIGURE 1. The *Atlantic Osprey* was used for the majority of the survey effort around the Hebron platform.

TABLE 1. Dates in 2016 when LGL biologists were on-site at the Hebron field before installation of the GBS*.

2016	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Jan																															
Feb																															
Mar																															
Apr																															
May																															
Jun																															
Jul																															
Aug																															
Sep																															
Oct																															
Nov																															
Dec																															

* Dark blue shading represents date when an observer was at the Hebron site. Pale blue shading represents transit to and from Hebron site.

TABLE 2. Dates in 2017 when LGL biologists were on-site at the Hebron field after installation of the GBS but before operation of the flare*.

2017	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Jan																															
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Oct																															
Nov																															
Dec																															

* Dark blue shading represents date when an observer was at the Hebron site. Pale blue shading represents transit to and from Hebron site.

TABLE 3. Dates in 2018 when LGL biologists were on-site at the Hebron field after installation of the GBS but during production and operation of the flare*.

2018	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31							
Jan																																						
Feb																																						
Mar																																						
Apr																																						
May																																						
Jun																																						
Jul																																						
Aug																																						
Sep																																						
Oct																																						
Nov																																						
Dec																																						

* Dark blue shading represents date when an observer was at the Hebron site. Pale blue shading represents transit to and from Hebron site.

2.2 Night-time Surveys

Night-time observations were conducted to document bird activity around the Hebron GBS during the hours of darkness. Figure 2B shows Hebron at night with its electrical lighting, flare and the reflection of that light off the sea surface. The illuminated area in which seabirds were visible without the aid of infrared devices extended about 150 m from the platform. Hebron's flare was small (Figure 2B) and consistent in size for the duration of the 2018 observation periods.

Observations at night were made using forward-looking infrared (FLIR) bi-oculars and standard optical binoculars. To detect small species around the platform the observer on the supply vessel needed to be within 150 m of the GBS. Operation of a supply vessel inside the 500 m safety zone around an oil producing platform requires special safety protocols. These protocols are routinely used when the supply vessels approach the platform to unload/offload cargo, drilling mud, etc. During the surveys, the supply vessel was positioned slightly off to the side from the location of the GBS so that the observer could see around the area, looking up at an angle of $<45^\circ$. This reduced neck strain on the observer but was still near enough for the observer to see small birds through optics. Opportunistic observations were also conducted at various times in the night when cargo was being exchanged between the supply vessel and the Hebron platform. At those times, the supply vessel was positioned about 20 m from the base of the platform.

Because the horizon is usually not visible at night, it was not possible for the observer to measure distance from the observer at small scales and therefore a protocol for surveying a known area, like the ECSAS protocols, could not be used. Instead, the observer used a FLIR™ BTS-X Pro thermal bi-ocular (resolution: 320 x 240 pixels) equipped with a 65 mm, fixed focal length lens (field of view $7^\circ \times 5^\circ$) and conventional binoculars as the primary tools to search for birds. Every five to ten minutes the observer made two systematic scans around the outer edge of the GBS. The inner scan followed the outer contour of the GBS, and the outer scan contoured the outer edge of the field of view of the inner scan. A third systematic scan was conducted of the area around the base of the GBS that was illuminated by electric lighting on the platform. These scans took about 1 minute to perform, or longer if birds were detected, in order for the observer to follow the birds to observe their behaviour in relation to the GBS and to attempt species identification.

In between scans around the GBS with the FLIR, there were visual searches with good quality binoculars of the illuminated areas of the platform itself and the water at the base of the platform. Information recorded on field data sheets included environmental conditions, distance of observer from the platform, plus the number and species of birds observed. Behavioural observations of birds, such as a bird approaching the platform, colliding with the platform, falling onto a horizontal surface, flying erratically among components of the platform, continuously circling the platform (known as "nocturnal circulation" or "holding effect"), loafing, foraging, and sleeping were also recorded and later entered into a digital database.

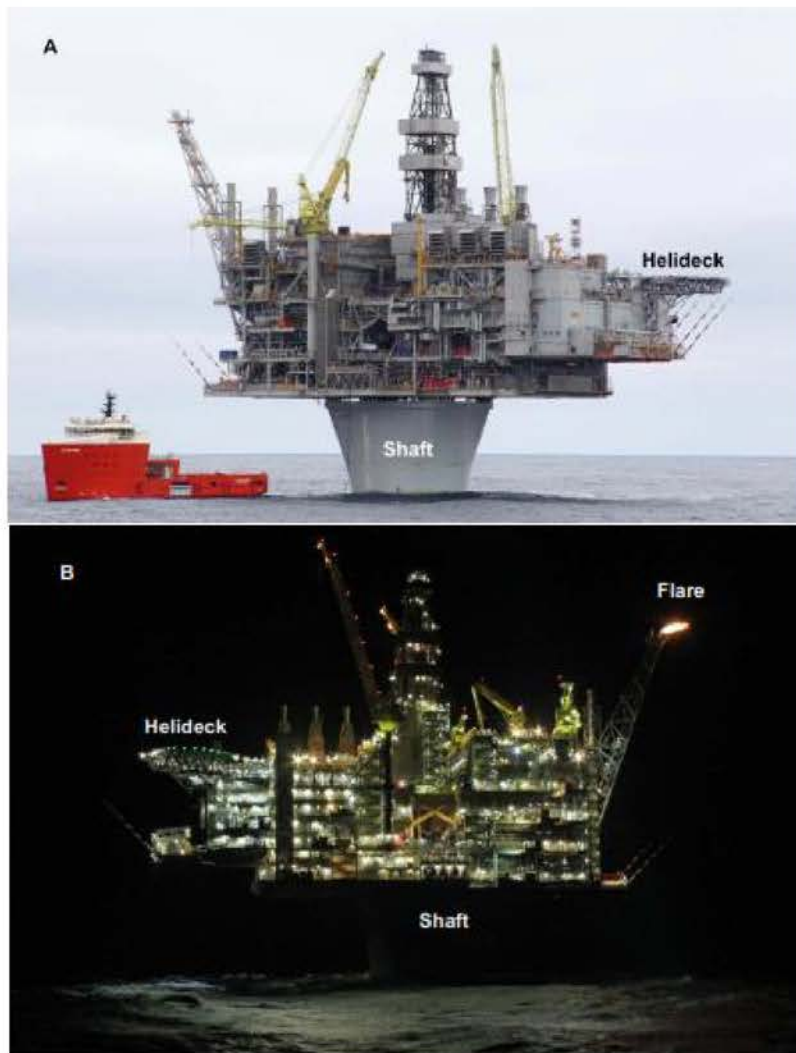


FIGURE 2. Day-time view of the Hebron production platform with an offshore supply vessel, the *Atlantic Heron*, alongside for cargo operations (A). For scale, the topsides (superstructure) measure 183 m by 75 m, and the *Atlantic Heron* is 86 m in length. Night view of the Hebron platform with flare burning (B).

2.3 Bird Strandings on the Platform and Survey Vessel

In compliance with ECCC-CWS best practices for stranded bird species protected by the federal *Migratory Birds Convention Act* (MBCA), Hebron platform personnel search for, recover, and document birds that strand on the platform (Environment Canada 2015). These best practices also include procedures to be implemented once birds are recovered, whether deceased or alive. Documentation of bird strandings is submitted annually to ECCC-CWS, consisting of date, bird species, number of birds, condition of the bird(s) when found, action taken, and the fate of the bird(s), in addition to latitude and longitude if a platform is mobile. Starting in 2018, occurrence of fog or rain is also recorded. For the present study stranding data were compiled from documentation of birds stranded on the Hebron platform in 2017 and 2018.

3.0 Results

3.1 Day-time Surveys

3.1.1 Effort

A total of 4544 ECSAS Stationary Platform counts were conducted within the Study Area on 200 survey days over three years (2016–2018) (Table 4).

TABLE 4. Day-time survey effort at the site of the Hebron GBS during 2016–2018.

Year	First and Last Survey Date of Survey Period	No. of Survey Days	No. of Systematic Stationary Counts
2016	19 April to 13 May	25	690
	5–13 August	9	249
2017	26 August to 19 October	49	890
2018	24 January to 27 February	30	689
	2–20 May	16	469
	4 August to 31 October	71	1557
Total		200	4544

3.1.2 All Species

A total of 77 species of birds were recorded during the study. Twenty-five species were classified as seabirds (i.e., birds that include the open ocean as part of their natural habitat) (Table 5). The other 42 species were birds considered to be land-based (terrestrial) birds or coastal waterbirds that do not normally live at sea far from land but may migrate over the open ocean or have strayed offshore (Table 6).

Densities of birds within the Study Area varied throughout the year. To get a clearer impression of differences, the densities of birds were averaged for ten-day blocks over the survey periods (Table 7). Densities ranged from a low of 0.15 (± 0.60) birds/km² during 21–31 October 2018 to a high of 20.62 (± 192.21) birds/km² during 21–30 September 2018. Eighteen out of the 25 ten-day blocks showed average densities ranging from 0.35 (± 1.86) to 1.98 (± 4.45) birds/km². Densities were, on average, highest during August and September and lowest in April and May (Table 7). The most numerous species throughout the study were Northern Fulmar, Great Shearwater, Sooty Shearwater, Leach's Storm-Petrel, Black-legged Kittiwake, Common and Thick-billed Murre and Dovekie. Gulls, particularly the Great

TABLE 5. Offshore seabird species recorded at the Hebron site during the 2016–2018 study by month. Squares with dark blue shading represent months with species recorded in the 500 m diameter semi-circle of the Stationary Platform instantaneous counts. Pale blue squares represent months with species recorded incidentally but not on Stationary Platform counts. White squares represent months when the species was not recorded at all.

Common Name	Scientific Name	2016			2017			2018					
		Apr	May	Aug	Aug	Sep	Oct	Jan	Feb	May	Aug	Sep	Oct
Red Phalarope	<i>Phalaropus fulicarius</i>												
Great Skua	<i>Stercorarius skua</i>												
South Polar Skua	<i>S. macconnicki</i>												
Pomarine Jaeger	<i>S. pomarinus</i>												
Long-tailed Jaeger	<i>S. longicaudus</i>												
Dovekie	<i>Alle</i>												
Common Murre	<i>Uria aalge</i>												
Thick-billed Murre	<i>U. lomvia</i>												
Razorbill	<i>Alca forda</i>												
Atlantic Puffin	<i>Fratercula arctica</i>												
Black-legged Kittiwake	<i>Rissa tridactyla</i>												
Herring Gull	<i>Larus argentatus</i>												
Iceland Gull	<i>L. glaucoides</i>												
Lesser Black-backed Gull	<i>L. fuscus</i>												
Glaucous Gull	<i>L. hyperboreus</i>												
Great Black-backed Gull	<i>L. marinus</i>												
Arctic Tern	<i>Sterna paradisaea</i>												
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>												
Leach's Storm-Petrel	<i>Hydrobates leucorhous</i>												
Northern Fulmar	<i>Fulmarus glacialis</i>												
Cory's Shearwater	<i>Calonectris diomedea</i>												
Sooty Shearwater	<i>Ardenna grisea</i>												
Great Shearwater	<i>A. gravis</i>												
Manx Shearwater	<i>Puffinus</i>												
Northern Gannet	<i>Morus bassanus</i>												

TABLE 6. Coastal and terrestrial bird species recorded at the Hebron site during the 2016–2018 study and which were unlikely to be recorded during Stationary Platform counts. The check marks indicate presence, i.e., one or more sightings, during that month.

Common Name	Scientific Name	2016			2017			2018					
		Apr	May	Aug	Aug	Sep	Oct	Jan	Feb	May	Aug	Sep	Oct
Ring-necked Duck	<i>Aythya collaris</i>									✓			
Surf Scoter	<i>Melanitta perspicillata</i>						✓						
Long-tailed Duck	<i>Clangula hyemalis</i>							✓					
Red-breasted Merganser	<i>Mergus serrator</i>							✓					
Mourning Dove	<i>Zenaidura macroura</i>												✓
American Golden-Plover	<i>Pluvialis dominica</i>					✓							
Red Knot	<i>Calidris canutus</i>										✓		
Sanderling	<i>C. alba</i>										✓		
White-rumped Sandpiper	<i>C. ascirocolis</i>						✓						✓
Buff-breasted Sandpiper	<i>C. subruficollis</i>					✓							
Semipalmated Sandpiper	<i>C. pusilla</i>												
Wilson's Phalarope	<i>Phalaropus tricolor</i>					✓							
Black-headed Gull	<i>Chroicocephalus ridibundus</i>	✓											
Ring-billed Gull	<i>Larus delawarensis</i>										✓		
Common Tern	<i>Sterna hirundo</i>										✓		
Common Loon	<i>Gavia immer</i>							✓	✓				
Gray Heron	<i>Ardea cinerea</i>												✓
Snowy Owl	<i>Bubo scandiaca</i>								✓				
Gyr Falcon	<i>Falco rusticolus</i>								✓				
Peregrine Falcon	<i>F. peregrinus</i>						✓	✓					✓
Red-eyed Vireo	<i>Vireo olivaceus</i>						✓						
Barn Swallow	<i>Hirundo rustica</i>		✓		✓								
Red-breasted Nuthatch	<i>Sitta canadensis</i>												✓
Ruby-crowned Kinglet	<i>Regulus calendula</i>												✓
Hermit Thrush	<i>Catharus guttatus</i>										✓		
American Robin	<i>Turdus migratorius</i>										✓		
American Pipit	<i>Anthus rubescens</i>						✓						
Lapland Longspur	<i>Calcarius lapponicus</i>												✓
Snow Bunting	<i>Plectrophenax nivalis</i>							✓					
Savannah Sparrow	<i>Passerculus sandwichensis</i>										✓		
White-throated Sparrow	<i>Zonotrichia albicollis</i>		✓								✓		✓
Dark-eyed Junco	<i>Junco hyemalis</i>										✓		
Bobolink	<i>Dolichonyx oryzivorus</i>						✓						
Baltimore Oriole	<i>Icterus galbula</i>							✓					
Hairy Woodpecker	<i>Euphagus carolinus</i>										✓		
Black-and-white Warbler	<i>Mniotilta vana</i>										✓		
Common Yellowthroat	<i>Geothlypis trichas</i>												✓
American Redstart	<i>Setophaga ruticilla</i>												✓
Yellow Warbler	<i>S. petechia</i>						✓						
Palm Warbler	<i>S. palmarum</i>										✓		
Yellow-rumped Warbler	<i>S. coronata</i>										✓		
Rose-breasted Grosbeak	<i>Pheucticus ludovicianus</i>		✓										

TABLE 7. Average number of birds/km² (\pm standard deviation) of all species combined during ten-day blocks from counts conducted in the Study Area (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	1.98 (± 4.45) n=358	0.44 (± 1.33) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	1.29 (± 2.18) n=164	1.86 (± 3.08) n=224	1.18 (± 2.50) n=175	1.38 (± 3.54) n=98	-	-	-	-	-	-	0.40 (± 1.89) n=273	0.18 (± 1.58) n=196	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	1.97 (± 3.26) n=173	2.96 (± 3.28) n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	1.24 (± 2.27) n=148	0.88 (± 1.77) n=159	0.51 (± 1.46) n=109	0.36 (± 1.11) n=148	0.35 (± 1.86) n=151	1.79 (± 3.65) n=175	-	-	-	-	-	-	-
2018	-	-	-	4.28 (± 10.58) n=122	6.84 (± 48.07) n=203	1.52 (± 9.38) n=220	1.19 (± 2.48) n=320	2.61 (± 6.20) n=234	20.62 (± 192.21) n=203	0.36 (± 1.21) n=98	1.29 (± 2.76) n=105	0.15 (± 0.60) n=52	-	-	-	-	-	-

Black-backed Gull, were attracted to the Hebron platform, i.e., they tended to gather on the sea surface downwind of the platform and foraged under the platform lights at night. It was not possible to calculate unbiased densities for gulls for this reason.

The species accounts give distribution and abundance throughout the year according to the study results. Comparisons with bird abundance before and after the installation of the Hebron platform are also discussed. An annotated list of land-based birds observed landing on the survey vessel or around the Hebron platform follows the seabird section.

3.1.3 Species Accounts

The species accounts are divided into two sections 1) Seabirds and 2) Coastal and Terrestrial Birds. The nomenclature and sequence of species within these sections follows that of the American Ornithological Society (Chesser et al. 2019). The seabird section is further divided into regularly occurring species and sporadically occurring species.

3.1.3.1 Seabirds

3.1.3.1.1 Regularly Occurring Seabird Species

This section includes Dovekie, Thick-billed Murre, Common Murre, Black-legged Kittiwake, Great Black-backed Gull, Leach's Storm-Petrel, Northern Fulmar, Sooty Shearwater and Great Shearwater. These species made up of the majority of seabirds observed over the 2016–2018 study period.

Dovekie

Dovekies were recorded mainly during the non-breeding season, i.e., mid-October to early-May (Table 8). This is expected as Dovekies nest at high latitudes mainly in Greenland but also in Baffin Island, Canada, and northern Norway and Russia. They returned to the Study Area in mid-October.

Winter

- Dovekies were observed on 12 of the 29 days during this observation period.
- Densities ranged from 0.03 (± 0.26) birds/km² to 0.26 (± 1.04) birds/km² in ten-day blocks during 21 January to 28 February 2018 (Table 8). An average density of 0.11 (± 0.08) birds/km² was recorded for the overall period.
- Small numbers of Dovekies were observed on the water diving, indicating they were feeding.
- A small movement of Dovekies was noted on 28 January with about 50 individuals flying northeast with a 30 knot SW wind over three hours during the morning.
- On 25 January, three Dovekies were observed being captured and eaten by Glaucous Gulls, two during the day-time observations and one during night-time observations. The three incidents of predation are described below in Sections 3.1.5.2 and 3.2.3.3.

TABLE 8. Average number of Dovekies/km² (\pm standard deviation) during ten-day blocks from Stationary Platform counts conducted within the Study Area (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	0.05 (± 0.59) n=328	0 (± 0.77) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0.26 (± 1.04) n=164	0.07 (± 0.41) n=224	0.06 (± 0.54) n=173	0.03 (± 0.26) n=98	-	-	-	-	-	-	0.05 (± 0.77) n=273	0 (± 0.77) n=190	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	0 n=173	0 n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0 n=148	0 n=109	0 n=109	0 n=148	0 n=151	0.61 (± 2.52) n=175	-	-	-	-	-	-	
2018	-	-	-	0 n=122	0.01 (± 0.16) n=203	0 n=220	0 n=320	0 n=234	0.01 (± 0.16) n=203	0 n=98	0.10 (± 0.78) n=105	0.05 (± 0.35) n=32	-	-	-	-	-	

Spring

2016

- A total of 43 Dovekies were recorded during Stationary Platform counts and during general observations between counts in the observation period.
- The average density was 0.05 (± 0.59) birds/km² for the 21–30 April 10-day block.
- There were none observed in May, indicating the birds seen in April were the last of the overwintering birds to migrate northward.
- Nearly all Dovekies observed were in flight. All birds seen well enough were in breeding plumage except for one that was still in full winter plumage. However, being mid-spring, it is assumed these were sub-adult Dovekies as the adults should have been at or near their breeding sites in Arctic Canada, Greenland or northern Russia.

2018

- A total of 26 Dovekies were observed during Stationary Platform counts and between counts. Eighteen of these occurred on 6 May during a two-hour observation period (07:30–09:30 h) with a 35-knot WSW wind. The Dovekies were all flying south. There was a similar movement of Leach's Storm-Petrels at the same time.
- An average density of 0.03 (± 0.59) birds/km² was derived from the Stationary Platform counts over the entire observation period.
- The latest sighting was of two individuals on 18 May. All the Dovekies were in flight.

Summer

- No Dovekies were observed in 2016 or 2017.
- In 2018, single unseasonal Dovekies were observed resting on the water on 10 and 19 August.

Fall

2017

- The first Dovekie of the Fall season was observed on 1 October. This species was observed on only seven days in 2017.
- An overall density of 0.33 (± 1.86) birds/km² was recorded for this observation period. Upon its arrival in the Hebron area, this species' average density in the 11–20 October 10-day block was 0.61 (± 2.52) birds/km² (Table 8).
- A few Dovekies were seen on the water and diving during October.
- Small southward movements of Dovekies were noted on 14, 15 and 19 October, consisting of occasional groups of five to ten birds flying south or east.

2018

- The first sighting of a Dovekie considered to be a fall migrant was one individual on 22 September. Dovekies remained very scarce until mid-October when they were observed almost daily.
- Upon the arrival of the first migrant, densities ranged from 0.10 (± 0.78) birds/km² (11–20 October) to 0.05 (± 0.35)/km² (21–31 October) (Table 8).

Thick-billed and Common Murres

The Thick-billed Murre is the more northern breeder of the two murre species and breeds mainly north of insular Newfoundland. In contrast, the centre of breeding abundance for Common Murre in Atlantic North America is insular Newfoundland. Both species overwinter in Newfoundland waters. The two species of murre are very similar looking and often indistinguishable at sea due to distance or lighting conditions and share similar habitat preferences and diets. Those indistinguishable birds and those identified to species are grouped together here as All Murres for density calculations (Table 9). All Murres were most numerous in Winter and Spring (Table 9). The Thick-billed Murre was the most frequently identified murre during the Winter and Spring seasons. Common Murres outnumbered Thick-billed Murres in the Fall. Murres were less common during the Summer months.

Winter

- Murres (identified and unidentified) were regularly observed resting on the water and diving, indicating feeding, within the Study Area.
- The average density of All Murres over the entire Winter observation period was 0.57 (± 1.50) birds/km².
- A total of 203 murres (identified and unidentified), both on- and off-transect, were identified to species on 689 Stationary Platform counts. There were 126 Thick-billed Murres and 77 Common Murres identified. Although the Thick-billed Murre was the more numerous species, a higher percentage of the Common Murres (66.2%) were present on the water than Thick-billed Murres (50.8%) (Table 10).
- Thick-billed Murres were identified on 22 of 29 days. The maximum number recorded on any one day was 25 individuals on 25 January. Typical totals per day ranged from three to ten individuals. Most of these were observed in flight. The average density of Thick-billed Murres over the observation period was 0.30 (± 0.21) birds/km².
- Common Murres were a little less numerous than Thick-billed Murres and were recorded on 23 of 29 days with observations. The density of Common Murres averaged over the observation period was 0.18 (± 0.13) birds/km².
- A deceased Thick-billed Murre was seen floating on the water at mid-day on 25 January. It was floating ventral side up on the water about 200 m from the platform. The bird looked recently deceased, being buoyant and relatively dry. There was no sign of oil on the breast or injury anywhere on the bird. Two Glaucous Gulls were picking at the carcass. Twenty minutes later there were six Glaucous Gulls around the carcass, and they had ripped a hole into the belly skin.

Spring

2016

- A total of 260 murres (identified and unidentified) were recorded during dedicated seabird surveys and general observations during this observation period. Murres were rarely seen on the water. Most were flying north or east. The 60+ murres observed on 27 April were flying north with a near gale force southeast tail wind.
- The average density of All Murres observed was 0.23 (± 1.10) birds/km² over the Spring observation period.

TABLE 9. Densities of All Murres (pooled Common, Thick-billed and unidentified murres) within the Study Area averaged over ten-day blocks during the 2016–2018 study period (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	0.36 (±1.43) n=358	0.10 (±0.53) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0.62 (±1.50) n=164	0.82 (±1.75) n=224	0.38 (±1.34) n=175	0.23 (±0.97) n=98	-	-	-	-	-	-	-	0.40 (±1.89) n=273	0.18 (±1.58) n=195	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	0 n=173	0 n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0.03 (±0.29) n=148	0.02 (±0.20) n=159	0.09 (±0.96) n=109	0.07 (±0.59) n=148	0.03 (±0.41) n=151	0.20 (±0.96) n=175	-	-	-	-	-	-	-
2018	-	-	-	0.02 (±0.23) n=122	0 n=203	0 n=220	0.02 (±0.25) n=320	0.02 (±0.23) n=234	0.93 (±7.43) n=203	0.05 (±0.51) n=98	0.02 (±0.25) n=105	0 n=52	-	-	-	-	-	-

TABLE 10. The percent of Common Murre and Thick-billed Murre observed in flight and on the water within the Study Area during the Winter observation period (2018).

Species	Total No.	Percent Flying	Percent on Water
Thick-billed Murre	126	49.2	50.8
Common Murre	77	33.8	66.2
Total	203		

- Only 20.4% murre were identified to species (on- and off-transect).
- Thick-billed Murres comprised 94% of these identified birds.
- The average density of Thick-billed Murres during this observation period was 0.06 (± 0.56) birds/km² and the density of unidentified murre was 0.17 (± 0.95) birds/km².
- Common Murres comprised 6% of murre recorded on- and off-transect. However, no Common Murres were identified on-transect.
- A number of the Thick-billed Murres exhibited white throats, thus were not in breeding plumage. Adult murre should be in breeding plumage by late-April. Therefore, the majority of the murre observed were probably non-breeding, sub-adult Thick-billed Murres. Breeding age Thick-billed Murres should be near or at the breeding colonies, which are mainly north of 60°N, by the time of the Spring observation period.

2018

- A total of 219 All Murres were observed on-transect, off-transect and between surveys in this observation period.
- The average density of All Murres over the entire Spring observation period was 0.31 (± 1.77) birds/km². The maximum density was 0.40 (± 1.89) bird/ km² (1-10 May) (Table 9).
- Thick-billed Murres comprised 35% of the murre recorded on-transect, off-transect and between counts. Thick-billed Murres were recorded in an average density of 0.21 (± 1.35) birds/km². Of the 77 Thick-billed Murres recorded, 31 were on the water and 46 were flying. Most of those in flight were headed north. Most of the Thick-billed Murres observed closely were still in winter plumage with white feathering in the throat area indicating they were sub-adults. Adults should be in breeding plumage in May.
- Common Murres comprised 8% of the murre recorded on-transect, off-transect and between counts. Common Murres averaged 0.07 (± 0.91) birds/km². Half of the 18 Common Murres were observed on the water.
- Unidentified murre averaged 0.03 (± 0.41) birds/km² over the whole observation period. The 124 unidentified murre included 13 on the water and 111 in flight. Flight direction, when recorded, showed 51, 10, 12 and 26 flying north, east, west, and south, respectively.
- All Murres made up about 60% of the density of all bird species for this observation period.
- Some of both murre species were observed diving, indicating they were foraging in the area.

Summer

2016

- There were five sightings of single murre in flight during this survey period. None were close enough to identify to species.

2017

- Three murres were observed during this time period. Two were individual Thick-billed Murres on the water. Both were considered sub-adult non-breeding birds because of the white throat and dull white line on the bill.
- One Common Murre in full breeding plumage flew by the survey vessel.

2018

- A total of 13 murres were observed during this observation period at the Hebron site. All were seen between standard surveys. Only three were identified to species, which were all Common Murres.

Fall

2017

- The density of All Murres was consistently low over the observation period, ranging from 0.02 to 0.09 birds/km², with the exception of 11–20 October, when the density was 0.20 (± 0.96) birds/km² (Table 9). The average density of All Murres was 0.08 (± 0.64) birds/km² over the entire Fall observation period.
- Only 11 Thick-billed Murres were observed during the entire observation period. The highest one-day total of Common Murres was four on 19 October and the density averaged over this observation period was 0.02 (± 0.22) birds/km².
- Common Murres were a little more numerous on average during the observation period than Thick-billed Murres. The highest one-day count of Common Murres was 10 individuals on 19 October. The average density over the whole observation period was 0.04 (± 0.46) birds/km². Most of the Common Murre sightings were of birds on the water.
- Unidentified murres had an average density of 0.02 (± 0.38) birds/km² during this period.

2018

- The average density of All Murres was 0.21 (± 3.34) birds/km² over this whole observation period.
- Observations were infrequent throughout the observation period and were typically singles or small groups sitting on the water. The exception was on 26 September when a high total of 22 Common Murres and 26 unidentified murres were observed on the water.
- Only two Thick-billed Murres were identified during the observation period. They were individuals seen on 13 and 14 September.
- Most of the murres were recorded in September. In October only six murres (two Common Murres and four unidentified murres) were observed.

Black-legged Kittiwake

The Black-legged Kittiwake was the most common species during the Winter, Spring, and during October surveys (Table 11). Most observations were of birds flying directly and purposely through the area without deviation or stopping to feed. Sometimes flocks congregated on the water downwind from the Hebron platform or the survey vessel. In Winter, about 90% of the birds were adults and in Spring 90% were one-year old birds. Kittiwakes were absent during August and up to the third week of September. An unusual event occurred at first light on 9 February when 150–200 Black-legged Kittiwakes were observed circulating low over the water around the shaft of the Hebron platform (discussed in more detail below in Section 3.1.5.2).

TABLE 11. Densities of Black-legged Kittiwake within the Study Area averaged over ten-day blocks during the 2016–2018 study period (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1–10	11–20	21–31	1–10	11–20	21–28	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31	1–10	11–20	21–30
2016	-	-	-	-	-	-	-	-	-	-	-	0.78 (±2.77) n=358	0.03 (±0.28) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0.23 (±0.93) n=154	0.48 (±2.03) n=224	0.44 (±1.67) n=175	0.44 (±1.55) n=98	-	-	-	-	-	-	0.05 (±0.51) n=273	0.06 (±0.65) n=196	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1–10	11–20	21–31	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31
2016	-	-	-	0 n=173	0 n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0 n=148	0 n=159	0 n=109	0 n=148	0.17 (±1.68) n=151	0.71 (±2.42) n=175	-	-	-	-	-	-	
2018	-	-	-	0 n=122	0 n=203	0 n=220	0 n=320	0 n=234	0.06 (±0.74) n=203	0.08 (±0.77) n=98	0.51 (±1.95) n=105	0 n=52	-	-	-	-	-	

Winter

2018

- The Black-legged Kittiwake was the most numerous species recorded during the Winter observation period and was recorded almost daily.
- The average density over the whole observation period was 0.4 (± 0.28) birds/km².
- Most birds were flying past in direct flight heading in various directions. Only twice did large flocks of kittiwakes concentrate on the water downwind from the GBS (discussed below in Section 3.1.5.2). Overall, there was an average of 95% adults and 5% first-winter immature birds.

Spring

2016

- The Black-legged Kittiwake was marginally the most numerous species observed during the Spring observation period at the Hebron site.
- There were sharp peaks in density of 1.20 (± 3.19) birds/km² recorded during 19 to 22 April and 1.07 (± 3.64) birds/km² during 23–26 April. Densities were much lower from 1 to 10 May (0.03 (± 0.28) birds/km²) (Table 11).
- There was a significant steady eastward movement of Black-legged Kittiwakes throughout 22 and 23 April. Total numbers observed were in the low hundreds. An estimated 90% of the kittiwakes were one-year old birds and the rest were in adult plumage. It is unknown where these sub-adult kittiwakes would have been heading. During a storm on 3 May, a flock of 150 Black-legged Kittiwakes rested on the water downwind from the vessel. As with the 22 and 23 April kittiwake flight, 90% of the birds were yearling birds.

2018

- Black-legged Kittiwakes were observed almost daily on systematic surveys and on general observations between surveys during this observation period. Daily totals exceeded 10 birds on only two dates when there were 15 on 9 May and 35 on 12 May.
- A density of 0.05 birds/km² was derived from the ECSAS surveys averaged over this observation period.
- Forty-four individuals whose age could be determined consisted of 24 adults and 20 one-year old birds.
- Kittiwakes were generally observed in flight, travelling through the area without stopping. An exception was a flock of 25 that collected on the water within 500 m of the GBS late in the day on 12 May.

Summer

- No Black-legged Kittiwakes were observed during any of the Summer observations periods (2016, 2017, and 2018).

Fall

2017

- The first Black-legged Kittiwakes observed during this time period were two individuals on 22 September. This species was observed in small numbers and occurred less than daily during the first week of October. Kittiwakes were fairly common and seen daily during 13–19 October. Daily totals derived from combining Stationary Platform counts and incidental sightings ranged from 25–75, with 20–40% being young-of-the-year birds. They were flying in various directions, with very few seen on the water.
- This species had a density of 0.46 (± 2.12) birds/km² averaged over the October portion of the observation period.
- The only concentration of kittiwakes at the platform was a large group of 600 (25% young-of-the-year) that collected downwind from the structure during the afternoon of 18 October.

2018

- During this September and October observation period, Black-legged Kittiwake was first recorded on 21 September when one adult and four immatures (young-of-the-year) were observed. From late-September to the end of October, flocks of kittiwakes were frequently observed resting on the water near the platform, usually on the downwind side. Flock size ranged from 24 individuals on 27 September to 125 individuals on 17 October.
- Densities of kittiwakes ranged from 0.06 (± 0.74) birds/km² during 21–30 September to 0.51 (± 1.95) birds/km² during 11–20 October (Table 11).

Great Black-backed Gull

The Great Black-backed Gull was by far the most numerous of the five species of *Larus* gulls (non-kittiwakes) observed at the Hebron platform. Densities were not calculated for this species because individuals gathered in flocks near the platform, thus biasing densities. This species was most numerous in September and October. In 2017 and 2018, the first Great Black-backed Gulls arrived during the last week of August with numbers building up to 50 resting on the water beside the platform through September, then increasing in October with day-time flocks at times reaching the low hundreds. The gulls were resting on the water downwind from the platform by day-time but at night were observed actively hunting for fish thought to be Atlantic saury (*Scorpaenopsis saurus*) that may have been attracted to the water surface by light. Great Black-backed Gulls were present in low numbers during the Winter and Spring and absent in Summer.

Winter

- The Great Black-backed Gull was uncommon during this observation period. It was observed on 19 of 29 days in which observers were at the Hebron site. Maximum one-day counts from incidental and systematic surveys were 15 individuals on both 25 January and 7 February.
- An average density of 0.08 (± 0.06) birds/km² was recorded over the whole observation period.
- Great Black-backed Gulls were not observed feeding around the platform during the day or night during this period, but sometimes rested on the water downwind from the platform. Adults were slightly more numerous than immature birds.

Spring

2016

- Great Black-backed Gulls were scarce during this observation period. A total of 14 individuals were tallied, which includes 12 birds recorded during 2–5 May around the platform. Only two adults were observed, with the rest being sub-adults.

2018

- There were only three Great Black-backed Gulls observed during this observation period. There were single adults on 9 and 20 May and one sub-adult on 19 May.

Summer

2016

- One sub-adult Great Black-backed Gull that flew past the vessel on 11 August was the only observation of this species.

2017

- There were three individuals on 28 August and one on 30 August.

2018

- The first observations of the late Summer season were five on 26 August and one on 29 August after which the species was regularly observed in September.

Fall

2017

- The Great Black-backed Gull was consistently the most numerous species around the Hebron platform during Fall 2017.
- There were 20 on the water around the base of the platform on 2 September. Numbers gradually increased through September, with concentrations of up to 50 late in the month. Great Black-backed Gulls became more numerous during October. Groups of usually less than 50 but occasionally up to 200 individuals collected on the water downwind from the GBS on most days from 1–19 October.
- Great Black-backed Gulls were more numerous during the night-time observations than day-time.
- About 80% of the Great Black-backed Gulls were adults.

2018

- Great Black-backed Gulls were observed almost daily during this observation period.
- This species was typically associated with the platform. During the day-time, a group usually rested on the water downwind from the platform.
- The day-time flock increased from up to 25 per day during the first three weeks of September, then 40–60 individuals were routinely present during late-September to mid-October, with higher counts in the 100–400 range during the last half of October.

- A sample of 301 birds aged over the period show that 83% were adult and 17% were immature birds, with all but one of the latter birds being young-of-the-year.
- At night they were observed foraging over the illuminated waters around the platform. They were seen to catch long slender silver coloured fish. Some of these fish could be identified as Atlantic saury and may have all been this species. The gulls were not actively feeding every night.

Leach's Storm-Petrel

The Leach's Storm-Petrel was among the three most numerous species recorded during the Stationary Platform counts in Spring, Summer and Fall. It was not observed in the Winter, as was expected since the species is known to overwinter well south of Newfoundland. They typically were flying swiftly and directly through the Study Area, which was rarely used for feeding. There was a strong east-west orientation to the flight direction during all three seasons. For the purposes of discussing the Leach's Storm-Petrel data from Summer and Fall, the Summer (August) observations are discussed with the Fall (September and October) observations. Leach's Storm-Petrels were also observed during night-time studies (details are presented in Section 3.2.2.2 below).

Winter

- No Leach's Storm-Petrels were observed during the Winter observation period.

Spring

2016

- A total of 387 Leach's Storm-Petrels were recorded during dedicated seabird surveys and general observations between surveys. The species was not observed daily but was present throughout this observation period.
- Average density was 0.22 (± 0.95) birds/km² over the Spring period.
- Generally, they were moving through the Study Area without stopping.
- Recognizable eastward movements of Leach's Storm-Petrels were noted on several occasions (Table 12).

TABLE 12. Recognizable movements of Leach's Storm-Petrels noted during daylight observations in the Spring 2016 observation period at the Hebron site.

Date	No. of Birds	Comments on Flight Direction
19 April	35	Mostly flying east during the afternoon.
20 April	15	Mostly flying south throughout the day.
22 April	25	Mostly flying east throughout the day.
28 April	25	Equal numbers flying east and west throughout day.
4 May	15	Mostly flying east throughout the day.
10 May	30	A distinct movement within one hour, all flying east.
11 May	45	A distinct movement that started and ended suddenly and lasted for two hours – all moving east.
12 May	120	A distinct movement that started, lasted for two hours and ended suddenly in late morning – all moving east.

2018

- Leach's Storm-Petrel were relatively scarce during this period, but still had the second highest density of any species recorded: 0.11 (± 0.69) birds/km² averaged over this observation period.
- Leach's Storm-Petrels were typically travelling purposely in one direction without stopping or slowing down. For example, the 25 Leach's Storm-Petrels observed on 6 May were all flying south during a 35-knot WSW wind within a two-hour period from 07:30–09:30 h. On 18 May, a total of 18 Leach's Storm-Petrels were observed over three hours during the morning travelling east with a 25-knot N wind. In the afternoon of the same day only three were observed during two hours of observations, all flying west with a 15-knot N wind.

Summer

2016

- The density of this species averaged over the observation period was 1.11 (± 2.22) birds/km². Storm-petrels were observed daily but in highly variable numbers. There were distinct periods of movement with birds travelling mostly in one direction; either east or west (Table 13).
- Leach's Storm-Petrels were slightly more numerous than Great Shearwaters during the 2016 observation period.

2017

- See Fall results.

2018

- See Fall results.

TABLE 13. Flight directions of Leach's Storm-Petrels during daylight observations from the Hebron site during the Summer 2016 observation period.

Date	No. of Stationary Platform Counts	Flight Direction of Individual Birds during Stationary Platform Counts				Comments on Birds Observed Outside of ECSAS Counts
		North	East	South	West	
5 August	23	0	11	0	4	About 75 observed throughout the day.
6 August	36	0	19	0	2	About 200 observed throughout the day with majority flying east.
7 August	50	0	1	0	0	About 12 observed throughout the day.
8 August	29	0	0	0	0	Only 2 observed throughout the day.
9 August	32	0	6	0	1	About 35 observed throughout the day with majority flying east.
10 August	3	0	0	0	0	Poor visibility most of the day due to fog. Only 3 observed through the day.
11 August	44	0	14	2	3	About 225 observed throughout the day with most flying east.
12 August	32	0	11	0	14	About 200 observed throughout the day with birds moving generally west during the morning and east during the afternoon.
Totals	249	0	62	2	24	

Fall

2017

- The Leach's Storm-Petrel was the most numerous species recorded during the August to October Stationary Platform counts.
- This species had a density of 0.26 (± 0.89) birds/km² averaged over the Fall 2017 observation period. The average density decreased during the observation period from 0.50 (± 1.18) birds/km² during 21–31 August to 0.06 (± 0.47) birds/km² during 11–20 October (Table 14).
- Most of these birds were observed flying directly through the Study Area and rarely stopped to forage or meander through the area, as is typically observed during foraging. During 42.3 hours of day-time observations over an 11-day period from 27 August to 6 September, the flight directions were recorded for most of the 347 Leach's Storm-Petrels observed both during systematic counts and incidentally between counts. Of this number, 49.9% were flying east, 32.1% were flying west, 12.1% flying south, 0.8% were flying north, 1.0% had a meandering flight, and direction was not recorded for 4.1%. (Table 15). Of the birds with known flight direction, a combined total of 82.0% were flying either east or west.

2018

- The Leach's Storm-Petrel was the second most numerous species after the Great Shearwater over the August to October observation period, with an overall average of 0.81 (± 1.87) birds/km². Ten-day averages from early-August to the third week of September ranged from a low of 0.54 (± 1.39) birds/km² to a high of 1.42 (± 2.34) birds/km² (Table 14). Average ten-day block densities dropped during the period from 21 September to 20 October, ranging from 0.03 (± 0.26) birds/km² to 0.24 (± 0.9) birds/km².
- The latest date for a Leach's Storm-Petrel sighting was 17 October, with a total of 34 tallied during and between Stationary Platform counts.

As mentioned above, Leach's Storm-Petrels were rarely observed foraging in the Study Area. An estimated 2.1% of the total birds were observed in a variable flight direction that may have been a foraging activity (Table 16).

The direction of flight was noted with most observations of Leach's Storm-Petrel both on- and off-transect and between counts during the August to October 2018 observation period. During the 1557 Stationary Platform counts, 1499 Leach's Storm-Petrels (493 on-transect, 1006 off-transect or between counts) were recorded with flight direction details. The grand total divided by flight direction is shown in Table 16. Approximately two-thirds of all birds were flying west or east (Figures 3 to 5). An almost equal number of birds were flying east as were flying west. Northerly compass points (NW, N, NE) accounted for the direction taken by 9.1% of total birds over the period. The strong west-east flight direction is consistent with recently published research showing that Leach's Storm-Petrels from the nesting colonies in Atlantic Canada, including the Witless Bay Ecological Reserve and Baccalieu Island, fly to deep water beyond the continental shelf edge to forage for several days then return to the nesting colony (Hedd et al. 2018). Among the easterly movements of birds during August to October 2018 there was a shift from most birds heading due east in August to most birds heading southeast in October. None of the 557 birds were detected flying southeast in August, 19% of 894 birds in September were heading southeast, and 62.5% of 48 birds in October were flying southeast (Figures 3 to 5). It is likely that these were birds migrating toward wintering grounds off West Africa (Pollet et al. 2014, 2019a).

TABLE 14. Densities of Leach's Storm-Petrel within the Study Area averaged over ten-day blocks during the 2016 to 2018 observation periods (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	0.16 (±0.75) n=358	0.30 (±1.14) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0 n=104	0 n=224	0 n=175	0 n=98	-	-	-	-	-	-	0.13 (±0.78) n=273	0.09 (±0.54) n=195	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	0.68 (±1.89) n=173	2.11 (±2.89) n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0.50 (±1.18) n=148	0.53 (±1.25) n=159	0.19 (±0.67) n=109	0.22 (±0.78) n=148	0.08 (±0.54) n=151	0.06 (±0.47) n=175	-	-	-	-	-	-	-
2018	-	-	-	1.42 (±2.34) n=122	1.19 (±2.05) n=203	0.54 (±1.39) n=220	0.93 (±2.25) n=320	1.50 (±2.35) n=234	0.23 (±0.85) n=203	0.03 (±0.26) n=98	0.24 (±0.90) n=105	0 n=52	-	-	-	-	-	-

TABLE 15. Average number of Leach's Storm-Petrels observed per hour by flight direction during daylight hours in Fall 2017 (August to October) (from Stationary Platform counts and incidental sightings near Hebron GBS).

Date	Direction of Flight					
	North	East	West	South	Variable	Not Recorded
27-Aug	0.0	1.5	1.5	0.0	0.0	0.0
28-Aug	0.3	4.1	1.3	0.6	0.0	2.8
29-Aug	0.2	6.4	6.7	0.0	0.0	0.0
30-Aug	0.0	4.5	2.8	0.0	0.0	0.0
31-Aug	0.2	4.2	1.4	0.0	0.0	0.4
01-Sep	0.0	2.6	2.4	0.5	0.0	0.0
02-Sep	0.0	6.1	5.8	5.5	0.0	0.0
03-Sep	0.0	3.3	3.1	0.0	0.9	0.0
04-Sep	0.0	0.5	0.5	0.0	0.0	0.3
05-Sep	0.0	5.4	0.4	4.3	0.0	0.0
06-Sep	0.0	6.3	3.1	0.0	0.0	0.2
Overall average	0.1	4.1	2.6	1.0	0.1	0.3
Percent	0.8	49.9	32.1	12.1	1.0	4.1

TABLE 16. Summary of flight direction of all Leach's Storm-Petrels recorded during the August to October 2018 observation period.

Direction of Flight	Percent of Total Flying this Direction (n=1499)	Number
East	34.1	511
West	33.0	495
South East	13.3	200
South	7.9	119
North	5.8	87
North West	2.8	42
North East	0.5	7
South West	0.4	6
Variable	2.1	32

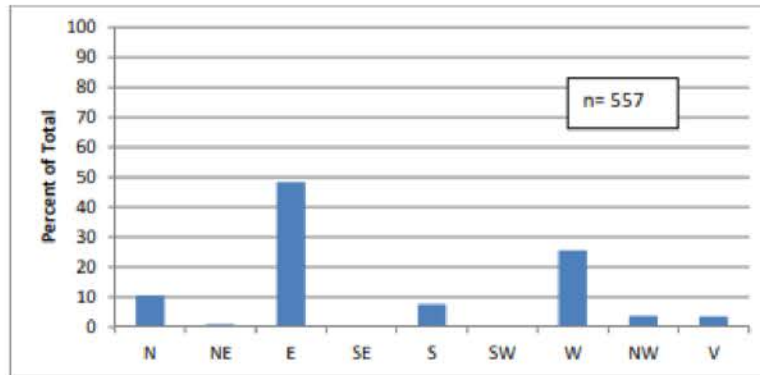


FIGURE 3. Direction of flight of Leach's Storm-Petrels by percent of total observed during August 2018 in the Study Area (n = total number of birds; V= variable).

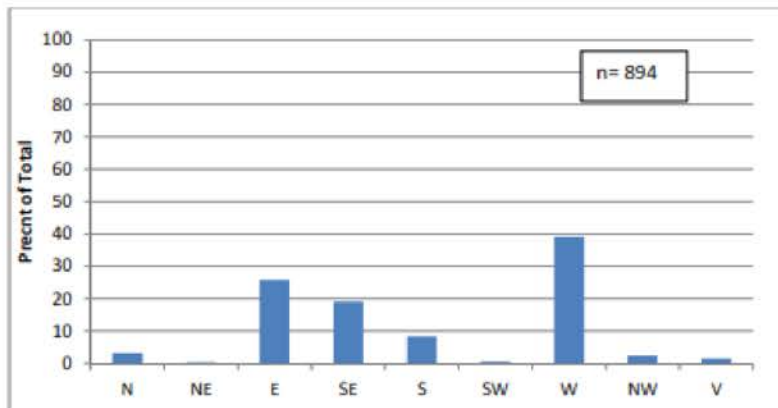


FIGURE 4. Direction of flight of Leach's Storm-Petrels by percent of total observed during September 2018 in the Study Area (n = total number of birds; V= variable).

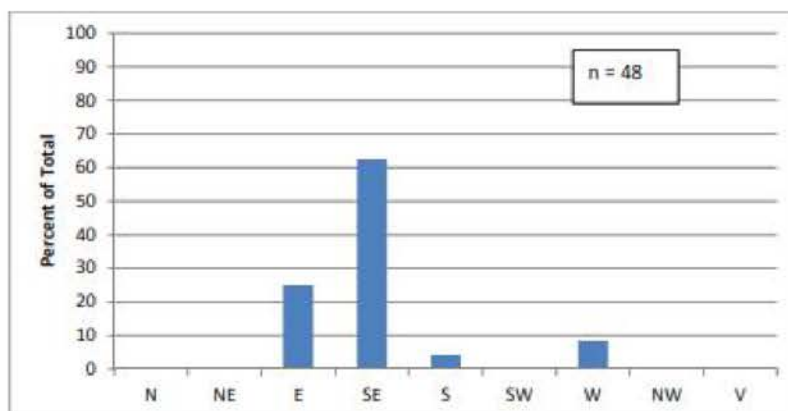


FIGURE 5. Direction of flight of Leach's Storm-Petrels by percent of total observed during October 2018 in the Study Area (n = total number of birds; V= variable).

Northern Fulmar

The Northern Fulmar was a scarce but regular species in Winter, Spring and Fall. It was very scarce in Summer. Birds generally flew through the Study Area without lingering. Occasional feeding on jellyfish was noted.

Winter

- The Northern Fulmar was uncommon during the Winter observation period. It was observed on just 16 of the 29 days of observations within the Study Area.
- This species had an average density of 0.03 (± 0.02) birds/km² over the whole observation period.
- Days with the highest overall numbers were associated with gale force winds. The three days with the highest totals of birds seen on Stationary Platform counts and general observations between counts were: 25 individuals on 28 January during 35-knot SW winds, 17 individuals on 17 February during 40-knot NW winds, and 78 individuals on 19 February during 35-knot NE winds.
- Northern Fulmars did not appear to feed in the Hebron area.

Spring

2016

- A peak density of 0.53 (± 1.96) birds/km² was recorded during the 21–30 April time period followed by a drop to 0.02 (± 0.20) birds/km² during the 1–10 May period (Table 17).
- The Northern Fulmar was a close second behind Black-legged Kittiwake as the most numerous bird present during this observation period.
- On 19 April, flocks totalling 150 fulmars collected on the water on the downwind side of the observation vessel during a 40-knot NE wind.

TABLE 17. Densities of Northern Fulmar within the Study Area averaged over ten-day blocks during the 2016 to 2018 observation periods (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	0.53 (±1.96) n=356	0.02 (±0.20) n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0.03 (±0.40) n=154	0.01 (±0.17) n=224	0.04 (±0.33) n=175	0.03 (±0.26) n=98	-	-	-	-	-	-	0.01 (±0.15) n=273	0 n=196	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	0.01 (±0.19) n=173	0 n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0 n=148	0 n=159	0.05 (±0.34) n=109	0.05 (±0.36) n=148	0 n=151	0.03 (±0.27) n=175	-	-	-	-	-	-	-
2018	-	-	-	0 n=122	0 n=203	0.01 (±0.17) n=220	0.02 (±0.32) n=320	0.03 (±0.29) n=234	0.50 (±2.38) n=203	0.05 (±0.36) n=98	0.19 (±0.98) n=105	0.10 (±0.49) n=52	-	-	-	-	-	-

- On 22 April, there was a distinct southward movement of fulmars through the area. There was a 20-knot NW wind blowing at the time. More than 200 Northern Fulmars were observed throughout the day moving southward. Similar numbers of Black-legged Kittiwakes were flying east at the same time.
- Dark morph birds comprised 2–5% of the total fulmars observed.

2018

- Northern Fulmars were observed on most days within this observation period but no more than ten were seen on any one day.
- An average density of 0.01 (± 0.12) birds/km² over the whole observation period was recorded.
- Two out of the total of 36 Northern Fulmars observed during the period were dark morph and the rest were light morph birds.

Summer

2016

- The Northern Fulmar was scarce during this observation period, with 1–5 seen per day, mostly during incidental observations between surveys.
- An average density of 0.01 (± 0.16) birds/km² was over the whole observation period recorded.

2017

- The Northern Fulmar was not recorded on 148 Stationary Platform counts during this period.

2018

- The Northern Fulmar was very scarce throughout this observation period, with a total of just 13 individuals observed on- and off-transect.

Fall

2017

- Northern Fulmars were scarce during this period. Ten-day average densities ranged from no birds recorded to 0.05 (± 0.27) birds/km² (Table 17).
- The highest daily totals were ten individuals on 14 October and 15 individuals on 19 October.

2018

- The Northern Fulmar was scarce throughout this observation period.
- Ten-day average densities ranged from 0.02 (± 0.32) birds/km² to 0.50 (± 0.36) birds/km² (Table 17).
- Light morph birds greatly outnumbered dark morph birds, with 176 light to 6 dark morphs out of those sightings where colour morph was noted.
- Fulmars moved randomly through the Study Area with no particular direction of travel. Some were observed resting on the water.
- One was observed eating a jellyfish at the surface.

Sooty Shearwater

Sooty Shearwaters were present in moderate densities in the Summer and Fall observation periods. This species was usually outnumbered by the Great Shearwater with which it often associated. Densities by ten-day blocks peaked at 0.52 (± 1.50) birds/km² during Summer 2017 and 0.90 (± 4.93) birds/km² during Fall 2018 (Table 18). Sooty Shearwaters usually flew through the Study Area without stopping, but at times resting on the water in small flocks with Great Shearwaters.

Winter

- Sooty Shearwaters were not recorded during this observation period. The species is nesting in the Southern Hemisphere at this time of year.

Spring

2016

- This species was very scarce during this observation period. A total of 38 individuals were recorded during dedicated seabird surveys and general observations between surveys.
- All of the Sooty Shearwaters were seen in April.
- There were 19 individuals on 20 April, the day after a northeast gale. They were all flying south and were perhaps correcting their preferred route after being blown off course. Another ten were observed on 22 April also flying south in a general southward movement of Northern Fulmars and Black-legged Kittiwakes.

2018

- Sooty Shearwaters were not observed during this Spring observation period.

Summer

2016

- A total of 57 Sooty Shearwaters were tallied during the Stationary Platform counts and through incidental sightings.
- This species had an average density of 0.05 (± 0.42) birds/km² over the whole observation period.
- Nearly all individuals were in flight.
- There was no favoured direction of movement.

2017

- The Sooty Shearwater was fairly common during this observation period and continued to be so during the following Fall observation period (see Fall 2017).
- The average density for this observation period was 0.52 (± 1.50) birds/km².

2018

- Sooty Shearwater was present in low numbers throughout this time period.
- This species' density was 0.07 (± 0.44) birds/km² during this observation period.

TABLE 18. Densities of Sooty Shearwater within the Study Area averaged over ten-day blocks during the 2016 to 2018 observations periods (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-28	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30
2016	-	-	-	-	-	-	-	-	-	-	-	0.04 (±0.30) n=358	0 n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0 n=164	0 n=224	0 n=175	0 n=98	-	-	-	-	-	-	0 n=273	0 n=196	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31
2016	-	-	-	0.04 (±0.33) n=173	0.07 (±0.58) n=76	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0.52 (±1.50) n=148	0.22 (±1.01) n=109	0.09 (±0.48) n=109	0 n=148	0 n=151	0.15 (±0.71) n=175	-	-	-	-	-	-	-
2018	-	-	-	0.04 (±0.32) n=122	0.06 (±0.43) n=203	0.06 (±0.51) n=220	0.10 (±0.64) n=320	0.61 (±3.45) n=234	0.90 (±4.93) n=203	0.13 (±0.67) n=98	0.05 (±0.50) n=105	0 n=52	-	-	-	-	-	-

Fall

2017

- The Sooty Shearwater was the most numerous shearwater species over the 1 September to 19 October observation period.
- Average densities during ten-day blocks ranged from 0 to 0.22 (± 1.01) birds/km² (Table 18).
- On the last day of observations on 19 October a total of 15 Sooty Shearwaters was observed incidentally.
- Like the Great Shearwater, Sooty Shearwaters did not stop in the Study Area but were typically flying purposely and directly through the area. They did not rest on the water near the Hebron platform.

2018

- Sooty Shearwaters were fairly common during this period.
- Ten-day block densities peaked at 0.61 (± 3.45) birds/km² during 11–20 September and 0.90 (± 4.93) birds/km² during 21–30 September (Table 18).
- Generally, they were flying through the Study Area without stopping and little apparent feeding activity.
- On 21 September, a large flock of 1000 Greater Shearwaters and 75 Sooty Shearwaters collected on the water to rest near the survey vessel. Sooty Shearwaters were present until the end of October with 11 individuals observed off-transect on 28 October.

Great Shearwater

The Great Shearwater was among the five most numerous species recorded overall during the 2016 to 2018 survey program. This species was not observed during the Winter or Spring surveys. It was most numerous during August and September. There was evidence of an eastward and southward migration during September. Flocks of shearwaters in flight and sometimes resting on the water were observed. Great Shearwaters showed no sign of feeding in the area. They were not obviously attracted to the Hebron platform or the survey vessel.

Winter

- None were recorded during this observation period, which was expected because the species nests in the Southern Hemisphere at this time.

Spring

- None were recorded during this observation period.

Summer

2016

- A total of 768 Great Shearwaters were tallied during this observation period during Stationary Platform counts and incidental sightings.

- The average density over the 249 Stationary Platform counts during the whole observation period was 0.98 birds (± 2.41)/km².
- This species typically flew through the Study Area without stopping or showing any signs of feeding.

2017

- See Fall 2017.

2018

- Some of the highest densities for any species of bird were recorded for the Great Shearwater during August 2018. There were densities of 2.69 (± 9.79)/km² for 1–10 August and 5.54 (± 48.16)/km² for 11–20 August (Table 19).
- There were distinct eastward movements of Great Shearwaters on 5, 6, and 9 August.
- Generally, Great Shearwaters were observed in flight passing through the Study Area during this observation period. There was no obvious sign of feeding.

Fall

2017

- Great Shearwaters were observed daily and was most numerous during the first two weeks of this observation period.
- This species had a density of 0.14 (± 0.78) birds/km² averaged over the observation period.
- During a northwest wind event on 3 September, there was steady eastward movement of Great Shearwaters involving a few hundred individuals, including about 600 between 10:30 h and 12:00 h. The largest number of Great Shearwaters observed during any day after 3 September was only two individuals, with the last one sighted on 4 October. Throughout this observation period, Great Shearwaters were generally observed flying through the Hebron area without resting on the water or showing any signs of feeding.

2018

- The Great Shearwater was sporadically numerous in September. Small numbers of Great Shearwater were noted in October, but none were recorded on the Stationary Platform counts. The last sighting was of two birds on 31 October. September densities were influenced by some large flocks observed resting on the water.
- There was a sharp peak of 17.45 (± 182.65) birds/km² during 21–30 September. A distinct wave of migrating Great Shearwaters was noted on 21–24 September. Winds were generally from the North and East during this time. Flocks of 20–40 Great Shearwaters in tight knit groups were observed flying southward. Sometimes the flocks collected on the water, building to groups of up to 1000 individuals on 21 September. The survey vessel was located 1800 m from the Hebron platform at the time. The birds may have been attracted to the presence of the survey vessel. The flock dispersed by mid-day.
- Other day totals of Great Shearwaters reached 200 on 22 September, 385 on 23 September and 200 on 24 September. Most of these birds were flying southward.

TABLE 19. Densities of Great Shearwater within the Study Area averaged over ten-day blocks during the 2016–2018 study period (n = number of Stationary Platform counts, 500 m radius).

Year	January			February			March			April			May			June		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1–10	11–20	21–31	1–10	11–20	21–28	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31	1–10	11–20	21–30
2016	-	-	-	-	-	-	-	-	-	-	-	0 n=358	0 n=332	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	0 n=164	0 n=224	0 n=175	0 n=98	-	-	-	-	-	-	0 n=273	0 n=196	-	-	-	-

Year	July			August			September			October			November			December		
	10-day block			10-day block			10-day block			10-day block			10-day block			10-day block		
	1–10	11–20	21–31	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31	1–10	11–20	21–30	1–10	11–20	21–31
2016	-	-	-	1.17 (±2.74) n=173	0.57 (±1.35) n=78	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	0.19 (±0.99) n=148	0.10 (±0.56) n=159	0.07 (±0.54) n=109	0 n=148	0.02 (±0.21) n=151	0 n=175	-	-	-	-	-	-	-
2018	-	-	-	2.69 (±9.79) n=122	5.54 (±48.16) n=203	0.87 (±9.29) n=220	0.10 (±0.68) n=320	0.41 (±3.26) n=234	17.45 (±182.65) n=203	0 n=88	0 n=105	0 n=52	-	-	-	-	-	-

3.1.3.1.2 Sporadically Occurring Seabird Species - Charadriiformes

Red Phalarope

One Red Phalarope was identified on 21 September 2018 and two unidentified phalaropes were observed together on 26 September 2018. All three phalaropes were observed on the water.

Great Skua

Winter

- There were two sightings of single Great Skuas during this observation period. One was observed on 25 January and the other on 28 January. Both birds occurred after strong southerly winds. There were southeast winds gusting to 55 knots during the night preceding the 25 January sighting. The Great Skua observed on 28 January occurred during 35-knot SW winds. These birds may have been displaced from the southern Flemish Cap or southern Grand Banks where the Great Skua has been shown to overwinter. Transmitters placed on Great Skuas that nest in Iceland show a large percentage of them overwinter in the southern Flemish Cap and southern Grand Banks area and farther south (Magnusdottir et al. 2012). The Great Skua observed on 28 January was flying low and fast over the waves when it changed direction slightly to pursue a Dovekie in flight. It chased the Dovekie for 15–20 seconds at close range. The chase ended when the Dovekie escaped by diving from the air into the water and disappearing beneath the surface.

Spring

- Two Great Skuas flew west past the survey vessel during a northeast gale on 19 April 2016.

Fall

- Three individuals were identified in late-September 2018. One on 20 September was observed harassing a small flock of Great Black-backed Gulls. One on 21 September was flying north without stopping and another on 26 September was flying south at a steady speed.

South Polar Skua

Seven single South Polar Skuas were identified in August and September 2018. One was observed eating a deceased bird of unknown species on the water on 13 September. A total of eight South Polar Skuas were observed during the Summer 2016 observation period. Two were seen during a Stationary Platform count and the rest occurred in between surveys. Three of the birds landed on the water near the survey vessel.

Not all skuas were identified to species. For example, a total of seven unidentified skuas were observed between 5 August and 8 October 2018.

Pomarine Jaeger

A total of 18 adult Pomarine Jaegers were observed between 25 April and 12 May 2016. Four were dark morph and 14 were light morph. Generally, they all were flying north, presumably in passage migration.

The Pomarine Jaeger was scarce during Fall migration, with two adults on 14 October being the only ones observed during the Summer and Fall 2017 observation period. Only five Pomarine Jaegers were observed during the Summer and Fall 2018 observation period, with two on 18 September and singles on 19 and 20 September and one on 27 October. Like the Spring movement, all the Pomarine Jaegers were adults.

Long-tailed Jaeger

There were two sightings of Long-tailed Jaeger during the 2016–2018 study. Both were adults, with one flying north on 7 May 2018 and one flying south on 7 September 2018.

Razorbill

A single Razorbill in full breeding plumage flew once around the survey vessel at close range on 21 April 2016. The Razorbill is a fairly common nester at several seabird colonies on the Avalon Peninsula but does not commonly range as far offshore as the eastern Grand Banks.

Atlantic Puffin

Atlantic Puffin was very scarce but was recorded in all seasons. There were totals of 16 in Winter, nine in spring, one in Summer and four in Fall.

Winter

A total of 16 Atlantic Puffins (six on the water, ten in flight) were observed during systematic surveys, between surveys or incidentally within the Study Area during the 24 January to 27 February 2018 observation period. A density of 0.03 (± 0.02) birds/km² was estimated. There were no puffins sighted later than 12 February.

Spring

There were four sightings of Atlantic Puffins throughout the Spring 2016 observation period. The sightings were as follows: one adult on 20 April, one sub-adult (dark bill and face) on 28 April, one adult on 29 April, and two adults on 11 May. All puffins were observed in flight. In 2018 the only sightings were a single in flight on 3 May and four in flight on 20 May.

Summer

One adult Atlantic Puffin flew by the vessel on 12 August 2016.

Fall

During the Summer and Fall 2017 observation period, no Atlantic Puffins were observed in the Study Area. In 2018, only four Atlantic Puffins were observed during the entire 3 August to 1 November observation period. They were all birds in flight seen on 20 September, 28 September, 6 October, and 8 October.

Herring Gull

The Herring Gull was a very uncommon visitor to the Hebron site in Winter and Fall and was not recorded in the Summer. Herring Gulls were present almost daily during the Spring surveys in low numbers except for a sudden influx on 3 May. When present Herring Gulls gathered near the survey vessel and platform.

Winter

- Only three Herring Gulls were observed during the Winter observation period. There were single adults on 25 January and 7 February and a second-winter immature bird on 4 February.

Spring

2016

- Herring Gulls were present nearly daily around the vessel during the Spring 2016 observation period. Typically, they rested on the water in a flock on the downwind side of the vessel.
- Peak daily counts were 21 individuals on 21 April, 120 individuals on 3 May, and 35 individuals on 5 May. The sudden appearance of 120 Herring Gulls on 3 May followed a day with strong northwest winds that may have pushed the birds away from the coast. Daily totals were usually much lower and ranged from 0–5 on 14 dates in Spring 2016.
- Overall about 95% of the Herring Gulls were adults.

2018

- Herring Gulls were observed on 12 of 14 dates of observation within the Spring 2018 observation period. Day-time totals observed on Stationary Platform counts and between counts were typically one to three individuals. Exceptions were nine individuals on 9 May and 20 individuals on 20 May. Herring Gulls were usually observed visiting the survey vessel or flying near the Hebron platform. An influx of 30 gulls on 20 May included 20 Herring Gulls, most of which collected on the water on the lee side of the platform. About 58% of a sample of 48 Herring Gulls aged were adults.

Summer

- None were observed in the Summer.

Fall

2017

- During the Fall 2017 observation period, there were 11 Herring Gulls observed with nine of those in the period 12–18 October.

2018

- During the Fall 2018 observation period, the only Herring Gulls were two adults on 13 October, an immature (bird-of-the-year) on 15 October, and another adult on 28 October. All of these birds were close to the platform.

Iceland Gull

Like other large gulls, the Iceland Gulls were attracted to the platform and the survey vessel. They flew around the structures and rested on the water near them. They were very uncommon, with most sightings occurring in Winter and Spring.

Winter

- A total of 16 Iceland Gulls were observed over the course of the Winter observation period at the Hebron site. None were recorded on ECSAS Stationary Platform counts. There were four adults, eight immatures and four of unidentified age.

Spring

2016

- The only observation during the Spring 2016 observation period was of seven sub-adults that appeared around the vessel the day after a northerly gale.

2018

- During the Spring 2018, observation period about ten different Iceland Gulls were observed. There were singles on 4, 9 and 10 May plus two on 19 May. The influx of gulls on 20 May included five Iceland Gulls. All were sub-adults except for an adult on 20 May.

Summer

- None were observed in the Summer.

Fall

- Single young-of-the-year Iceland Gulls observed on 22 September and 14 October 2017 were the only individuals observed during the Fall 2017 and Fall 2018 observation period.

Lesser Black-backed Gull

Small numbers of Lesser Black-backed Gulls were observed during Spring and Fall migration. Most of the Fall birds were young-of-the-year.

Winter

- None were observed in Winter.

Spring

2016

- Four Lesser Black-backed Gulls were observed during the Spring 2016 observation period. There were two adults and a sub-adult (4th year) sitting on the water around the vessel all day on 19 April and another sub-adult (3rd year) around the vessel on 22 April.

2018

- During the Spring 2018 survey, the only sighting of Lesser Black-backed Gull was three sub-adults during an influx of gulls on 20 May.

Summer

2016

- One sub-adult (2nd year) Lesser Black-backed Gull visited the survey vessel briefly on 6 August 2016.

Fall

2017

- During the Fall 2017 observation period there were five Lesser Black-backed Gulls observed between 31 August and 12 September, all of them birds-of-the-year.

2018

- There were 18 Lesser Black-backed Gulls, about two-thirds birds-of-the-year, observed between 30 August and 8 October during the Summer and Fall 2018 observation periods.

Glaucous Gull

Glaucous Gull was observed primarily during the Winter observation period. It was sighted almost daily but in low densities. A few individuals were seen during Spring and Fall migration.

Winter

- The Glaucous Gull was uncommon during the Winter observation period with an overall average density of 0.12 (± 0.08) birds/km² calculated from the 689 Stationary Platform counts.
- This species was slightly more numerous than the Great Black-backed Gull, having been recorded on 23 out of the 29 days.
- The maximum one-day totals derived from Stationary Platform counts and incidental sightings were 15 individuals on 25 January and ten individuals on both 10 and 27 February. Immature birds outnumbered adults.

Spring

2016

- Two Glaucous Gulls were observed during the Spring 2016 observation period. A one-year old sub-adult was seen on 3 May and an adult was seen on 4–5 May. Both birds stayed around the vessel for a few hours.

2018

- The only sighting during this observation period was a sub-adult on 19 May that approached the survey vessel.

Summer

- None were observed in Summer.

Fall

- The only Glaucous Gull observed during the two Fall observation periods was one young-of-the-year on 25 September 2017.

Arctic Tern

The only Arctic Terns observed during the 2016–2018 study program were southward flying birds in late Summer and early Fall. The sightings were one adult on 6 August, two adults on 11 August, one adult on 2 September, and a group of three immatures on 18 September.

3.1.3.1.3 Sporadically Occurring Seabird Species - Procellariiformes

Wilson's Storm-Petrel

Wilson's Storm-Petrel is similar in appearance to the Leach's Storm-Petrel but with experience is easily identified by its distinctive shape and manner of flight. A total of just six were observed during the entire 2016–2018 study. All of them were observed in feeding behaviour, which consists of pattering of their feet on the surface of the water while flying slowly over the water. Sightings consisted of singles on 8 August, 28 August, 15 September, and 27 September, with two on 12 September.

Cory's Shearwater

Small numbers of Cory's Shearwater were recorded in each of the three years during late Summer. The Cory's Shearwater is a warm-water species with a range, reaching the southern extremities of Newfoundland waters during the period in late Summer, when water temperatures are at the warmest for the year.

The largest numbers were recorded in 2016 when a total of 62 were recorded during 5–12 August. All were moving slowly and steadily eastward (Table 20).

TABLE 20. Sightings of Cory's Shearwaters during the 5–12 August 2016 observation period.

Date	No. of Cory's Shearwaters
5 Aug	0
6 Aug	0
7 Aug	11
8 Aug	3
9 Aug	3
10 Aug	0
11 Aug	31
12 Aug	14
Total	62

In 2017, the only sightings were two individuals on 27 August and one on 28 August; all were flying south. In 2018, there were six individuals observed. The dates of sightings were singles on 11 and 13 of August, two on 20 August, and singles on 1 and 15 September. The Cory's Shearwater on 13 August was following a school of Atlantic white-sided dolphins (*Lagenorhynchus acutus*). The others were flying leisurely southward.

Manx Shearwater

Winter

- None were observed in the Winter.

Spring

- There were just three Spring observations of Manx Shearwater. There was one sighting on 21 April 2016. An individual stopped briefly off the bow of the vessel and appeared to be eating something in the water before flying away. In 2018, there were two sightings of Manx Shearwater: one on 5 May and two together on 12 May. Both sightings involved birds circling through the area appearing to be looking for food.

Summer

- August was the month of greatest abundance of Manx Shearwaters. There were 13 Manx Shearwaters during the 5–12 August 2016 observation period. There were 29 Manx Shearwaters observed in the period 4–31 August 2018 and four during 27–31 August 2017. The birds were generally observed in flight only and were sometimes briefly attracted to the vessel as shown by repeated close flybys past the bow.

Fall

- The latest dates for Manx Shearwater in 2017 and 2018 were 2 September and 3 September, respectively.

3.1.3.1.4 Sporadically Occurring Seabird Species - Suliformes

Northern Gannet

Northern Gannets occurred in low numbers regularly during Spring, Summer and Fall surveys. Birds were generally not feeding. In late Summer and Fall 2018, there was a prominent southeastern direction of flight noted that could have been birds in migration to known wintering grounds off West Africa (Fifield et al. 2014).

Winter

- The Northern Gannet was not seen during the Winter observation period. This species is not expected in Newfoundland waters during the Winter.

Spring

2016

- During the Spring 2016 observation period, a total of 26 Northern Gannets were recorded during Stationary Platform counts and general observations between counts.

2018

- Thirteen Northern Gannets were observed on Stationary Platform counts and general observations between surveys within this observation period. All Spring gannets were adults. All but one was in flight. There was no particular direction of flight. None of the birds were observed diving or feeding. There was a high one-day count of 15 gannets on 30 April 2016 the day after 30-knot WSW winds that may have shifted these birds farther offshore than normal.

Summer and Fall

2016

- A total of seven Northern Gannets were observed from 5 to 12 August 2016. They were all sub-adults that flew past the location of the vessel without lingering.

2017

- During this observation period Northern Gannets were recorded on 29 days in numbers ranging from one to four per day. Most were adults and did not linger in the area. No juvenile gannets were observed.

2018

- The Northern Gannet was a scarce bird near the Hebron GBS but was observed regularly, though on fewer than half of the survey days during the Fall 2018 observation period. Birds were typically singles flying steadily through the area, keeping on a direct course. Of the 49 individuals observed with direction of flight recorded, 32 individuals or 65.3 %, were flying East, Southeast or South (Table 21). These were potentially migrants in passage headed for the known wintering area off West Africa (Fifield et al. 2014). Of 31 gannets assigned an age group, 25 were adults and six were subadults. No juvenile gannets were observed. Gannets rarely appeared to be foraging in the Study Area. Two individuals each executed a single dive. It could not be seen if any prey was captured.

TABLE 21. Flight direction of Northern Gannets at the Hebron site during Fall 2018 observation period.

	Direction								
	N	NE	E	SE	S	SW	W	NW	Variable
No. of Birds	3	0	18	7	7	1	7	1	5

3.1.3.2 Coastal and Terrestrial Bird Species

Coastal and terrestrial birds are out of their element when seen as far offshore as Jeanne d'Arc Basin. Terrestrial birds on passage migration sometimes drift offshore east of the island of Newfoundland and their normal migration route. Those birds are sometimes attracted to vessels and platforms at sea as a place to rest. Typically, they do not stay long since there is no food or fresh water available. Of the 42 species listed in Table 22, the most unusual offshore visitor was a Gray Heron from Europe. The Gray Heron is a European species. It is very rare in North America but there are three previous records for Newfoundland. A tropical depression stalled between the Grand Banks and southern Europe had been generating winds from Europe to the Grand Banks for the previous three days. This was considered the most likely cause of the Gray Heron reaching the Hebron site.

Table 22. Summary of coastal and terrestrial bird species observations recorded at the Hebron site during the 2016–2018 study.

Group/Species	Observation(s)
Anseriformes	
Ring-necked Duck	One female present near Hebron platform for two hours on 3 May 2018.
Surf Scoter	One present on water around survey vessel for an hour on 14 Oct 2017 before flying eastward.
Long-tailed Duck	One present on water at base of Hebron platform during night-time observations (19:45–21:40 h) on 29 Jan 2018 and again on 15 Feb during daylight and was diving next to the base of the platform.
Red-breasted Merganser	Female observed flying southwest past Hebron platform on 28 Jan 2018.
Columbiformes	
Mourning Dove	One flew around survey vessel once and then headed toward Hebron platform on 14 Sep 2018.
Charadriiformes	
American Golden-Plover	One landed on survey vessel on 25 Sep 2017 but found deceased on 26 Sep; no cause of death obvious.
Red Knot	One adult still in breeding plumage landed on stern of survey vessel on 5 Aug 2018. After resting for an hour, flew off strongly.
Sanderling	One landed on back deck of survey vessel for a brief period on 18 Aug 2018.
White-rumped Sandpiper	One flew around survey vessel on 18 Sep 2017 but did not land. Another landed briefly on survey vessel on 1 Oct 2018.
Buff-breasted Sandpiper	One flushed off back deck of survey vessel and flew away on 2 Sep 2017.
Semipalmated Sandpiper	One rested briefly on back deck of survey vessel and then flew off on 9 Sep 2017.
Wilson's Phalarope	One landed on back deck of survey vessel on 2 Sep 2017. This species is a rare but annual fall migrant in Atlantic Canada.
Black-headed Gull	One adult circled survey vessel and flew north on 26 Apr 2016.
Ring-billed Gull	One adult near survey vessel and Hebron platform for part of the day on 20 May 2018.
Common Tern	One adult flew around survey vessel several times on 19 May 2018. There had been strong offshore winds during previous day which may have blown bird away from coastal nesting sites.
Gaviiformes	
Common Loon	One observed on 29 Jan ~ 1 km from Hebron platform and on 7 Feb 2018 750 m from platform. Observed diving, as is normal for feeding; assumed to be same individual.
Pelecaniformes	
Gray Heron	One landed on stern of survey vessel at 10:30 h on 30 Sep and remained aboard until dark and was not seen again.
Strigiformes	
Snowy Owl	One observed at 20:22 h on 24 Feb 2018; flew around survey vessel once in the darkness and not seen again.
Falconiformes	
Gyrfalcon	On 18 Feb 2018, a dark-morph observed flying around survey vessel and then toward Hebron platform where it was thought to have landed. Seen again at night-time in flight after a platform drill alarm sounded on the GBS.
Peregrine Falcon	Seven individuals observed during Fall 2017 (2 on 25 Sep, 1 on 12 Oct) and 2018 (indiv. seen on 15, 21 Sep and 14 and 17 Oct). Typically, observed flying to platform to rest or ride updrafts created by wind colliding with one side of platform. The indiv. on 17 Oct ate a Dovekie on deck of survey vessel.
Passeriformes	
Red-eyed Vireo	One found deceased on back deck of survey vessel on 16 Sep; cause of death was unknown and specimen was fresh.
Barn Swallow	One flew around survey vessel on 11 May 2016 as did another on 26 Aug 2017.
Red-breasted Nuthatch	One present on survey vessel on 6 and 7 Oct 2018.
Ruby-crowned Kinglet	Indiv. present briefly on survey vessel on 3 May 2018 and 26 Sep 2018.
Hermit Thrush	One landed briefly on back deck of survey vessel on 3 May 2018.
American Robin	One landed briefly on back deck of survey vessel on 3 May 2018.
American Pipit	In 2017, one flew around survey vessel on 3 Sep and two more were present briefly on 22 Sep.

Group/Species	Observation(s)
Lapland Longspur	In 2018, one visited survey vessel on 5 Sep and four visited briefly on 6 Sep.
Snow Bunting	Indiv. observed flying around survey vessel without landing on 1 and 14 Oct 2017.
Savannah Sparrow	One present on survey vessel on 3 and 4 May 2018.
White-throated Sparrow	Most common passerine found on survey vessels. In 2016, different indiv. present for one day on 3, 10, 11, and 12 May. In 2018, three arrived on afternoon of 3 May and were still present early next morning but then disappeared. There were also two on 9 May, three on 12 May, and one on 7 Oct. 2018.
Dark-eyed Junco	One present for a short while on back deck of survey vessel on 12 May 2018.
Bobolink	One present on back deck of survey vessel for several hours on 11 Sep 2017.
Baltimore Oriole	One present on back deck of survey vessel on 13 Oct 2018.
Rusty Blackbird	Female present on back deck of survey vessel for several hours on 3 May 2018.
Black-and-white Warbler	One present on survey vessel for ten min before flying off toward Hebron platform on 20 May 2018. Another visited survey vessel briefly on 5 Sep 2018.
Common Yellowthroat	One observed late afternoon on 16 Sep 2018 on survey vessel and was still present early next morning before disappearing.
American Redstart	One present on survey vessel for an hour on 17 Sep 2018.
Yellow Warbler	One present briefly on back deck of survey vessel on 31 Aug 2017.
Palm Warbler	One spent two hours on back deck of survey vessel on 12 May 2018.
Yellow-rumped Warbler	Two males present on survey vessel on 9 May 2018 for most of afternoon; another was observed on 20 May.
Rose-breasted Grosbeak	One male on survey vessel for an hour on 11 May 2016 before observed flying away in a westward direction.

3.1.4 Attraction to the Platform Itself

3.1.4.1 Comparison of Seabird Densities within the Study Area Before and After Installation of the Platform

There were 34 days of surveying within 5 km of the future site of the Hebron platform during 2016 before the platform was installed: 19 April to 13 May (i.e., Spring) and 5–13 August (Summer). The only dates in common with surveys conducted after installation of the platform were 2–13 May (Table 23) and 5–13 August in 2018 (Table 24).

TABLE 23. Spring densities of birds (number of birds/km²) at the Hebron production site before (2016) and after (2018) the installation of the GBS.

Species	Before Platform 2–13 May 2016 (No. of Stationary Counts - 249)	Platform Present 2–13 May 2018 (No. of Stationary Counts - 186)
Dovekie	0	0.04 (±0.72)
All Murres	0.10 (±0.54)	0.36 (±1.78)
Black-legged Kittiwake	0.03 (±0.29)	0.08 (±0.71)
Northern Fulmar	0.02 (±0.21)	0.01 (±0.14)
Leach's Storm-Petrel	0.32 (±1.18)	0.13 (±0.74)
Combined Density	0.47 (±1.37)	0.63 (±2.26)

TABLE 24. Summer (August) densities of birds (number of birds/km²) at the Hebron production site before (2016) and after (2018) the installation of the GBS.

Species	Before Platform 5–13 August 2016 (No. of Stationary Counts - 249)	Platform Present 5–13 August 2018 (No. of Stationary Counts - 186)
Northern Fulmar	0.01 (±0.16)	0
Great Shearwater	0.96 (±2.41)	1.82 (±8.02)
Cory's Shearwater	0.06 (±0.39)	0
Sooty Shearwater	0.05 (±0.42)	0.03 (±0.26)
Manx Shearwater	0.01 (±0.16)	0.04 (±0.42)
Leach's Storm-Petrel	1.11 (±2.22)	1.14 (±2.03)
Northern Gannet	0	0.01 (±0.19)
South Polar Skua	0.02 (±0.23)	0.01 (±0.19)
All Murres	0	0.01 (±0.19)
Combined Density	2.27 (±3.29)	3.07 (±8.74)

During Spring (May) surveys, the densities of the murres and Black-legged Kittiwake were slightly higher in 2018 than in 2016, and densities of Northern Fulmar and Leach's Storm-Petrel were slightly lower in 2018 (Table 23). Dovekies were present in a very low density with the platform present and were not recorded during the Stationary Platform counts before the platform installation. The overall density of 0.47 (±1.37) birds/km² during the pre-installation time is lower than that with the platform in place (0.63 (±2.26) birds/km²). However, given the overlap in variation in bird numbers, as demonstrated by the standard deviations, these differences are not considered significant. The species diversity was very similar during the pre-platform and platform present surveys.

The Summer (August) surveys before and after the presence of the platform show more similarities than differences (Table 24). In both years Great Shearwater and Leach's Storm-Petrel combined to make more than 90% of the overall bird density. The other species, Northern Fulmar, Cory's Shearwater, Sooty Shearwater, Manx Shearwater, Northern Gannet, South Polar Skua and murres were in extremely low densities (Table 24). The Leach's Storm-Petrel showed a very similar density of 1.11 (±2.22) birds/km² in

2016 and 1.14 (± 2.03) birds/km² in 2018. Great Shearwater showed a density of 0.98 (± 2.41) birds/km² in the pre-platform year compared to 1.82 (± 8.02) birds/km² with the platform present. The Great Shearwater regularly occurs in large flocks. When flocks are recorded on a Stationary Platform count the density can rise significantly. The high standard deviation of ± 8.02 birds indicated this is what happened in 2018. The higher density of Great Shearwaters in 2018 accounts for the higher density of all birds combined in 2018 of 3.07 (± 8.74) birds/km² compared to all birds combined of 2.27 (± 3.29) birds/km² in 2016.

Gulls, except for some Black-legged Kittiwakes, were not included in the density calculations because gulls in general are attracted to platforms and vessels at sea. This attraction biases the density calculations. Gull numbers were summarized separately. Some kittiwakes deemed to be present in the Study Area but not attracted to the vessel or platform were included in the density calculations. During counts from 5 to 13 August surveys in 2016 and 2018 there were only two individuals observed, both during 2016. Gulls were more numerous during the Spring observation periods in both years. Herring Gulls and Black-legged Kittiwakes were the two most numerous species. Strong northwest winds on 2 May 2016 was responsible for carrying the 120 Herring Gulls present in the vicinity of the two vessels working at the Hebron site on 3 May with 35 still present on 5 May. Otherwise typical daily totals of Herring Gull for the Spring 2016 observation period ranged from 0 to 5 individuals. The strong offshore winds were likely responsible for shifting these Herring Gulls into the offshore zone. While at the Hebron site the Herring Gulls rested on the water in one flock downwind from the vessels working at the site. During the Spring 2018 observation period, there were no similar storms. Herring Gull numbers were typically one to three birds per day with an exception of nine on 9 May. Small numbers of Iceland, Lesser Black-backed, Glaucous and Great Black-backed Gulls were observed in both years.

Black-legged Kittiwakes were present in small numbers on most days during the Spring 2016 observation. The storm that caused a concentration of Herring Gulls at the Hebron site on 3 May 2016 was also the reason 150 kittiwakes rested on the water downwind from the two construction vessels working on site. When the winds subsided, the flock dispersed and only five kittiwakes were observed on 4 May. During the Spring 2018 observation period kittiwakes were observed almost daily flying through the Study Area but on 12 May a flock of 25 kittiwakes rested on the water downwind from the platform.

In summary, Herring Gulls were attracted to the construction vessels working at the Hebron site before the platform was present and were also attracted to the standby vessel and the Hebron platform after the latter's installation. During an unusual event when large numbers of Herring Gulls were pushed offshore the construction vessels on site became a point of refuge from the wind. The same action would likely take place with the presence of the platform. Black-legged Kittiwakes also used the presence of a construction vessel present during a storm for refuge from strong winds and showed some attraction to the platform even when wind conditions were not a factor. Outside of a weather-related event there was little difference in the abundance of gulls before or after the installation of the platform, but the presence of any kind of vessel or platform can attract gulls.

Overall there was little difference detected in the bird abundance before and after the installation of the Hebron platform based on the limited overlapping survey dates.

3.1.4.2 Comparison of Bird Densities in the Jeanne d'Arc Basin with those in the Study Area

As part of the present study, previously collected data from surveys of seabirds at-sea in Jeanne d'Arc Basin were compiled and analysed. The results were published in a report for ExxonMobil in May 2017 (LGL 2017b). The data came from two sources. LGL conducted at-sea seabird surveys from seismic exploration and other oil industry support vessels from 2004–2016 as part of marine mammal and seabird monitoring programs required by the Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) in Newfoundland and Labrador waters. LGL supplied the environmental observers on 52 voyages totalling 2541 days at sea during this 13-year period. Survey protocols followed the survey methods that were recommended by CWS at the time of each of the seismic programs. The other source was the CWS, which conducted seabird surveys at-sea under a program called ECSAS funded in part by the Environmental Studies Research Fund (ESRF) from 2006–2009 (Fifield et al. 2009). Raw data from 2006–2009 surveys were provided to LGL and pooled with data from the LGL seabird surveys from 2004–2016.

The data were summarized for an area 1.5°N x 2°W centred on the production platforms present before the installation of the Hebron platform. This area was divided into 108 10' x 10' blocks. Densities of seabirds were calculated for each block for which there was five or more kilometres of survey effort (LGL 2017b). The Study Area used during the present study was a circle with a 5 km radius centred on the Hebron site. The densities of birds found in this 5 km radius during years 2017 and 2018 when the platform was present are compared with the average baseline densities of the 10' x 10' blocks in the 1.5°N x 2°W block.

Except for Black-legged Kittiwake, gulls were excluded from density calculations because of the attraction to the platform in 2017 and 2018. Black-legged Kittiwakes showed only a mild attraction to the platform. Individuals suspected of being attracted to the platform were excluded from density calculations. The most numerous species are compared. For convenience, all Thick-billed Murre, Common Murres and unidentified murres are pooled together as All Murres. Great, Sooty, Cory's and Manx Shearwater are pooled as All Shearwaters. For the purposes of this comparison the seasons defined by ECSAS in 2006–2015 were used. That is Winter = November–February, Spring = March and April, Summer = May–August, and Fall = September and October. There were not enough data collected during the March–April Hebron survey to make meaningful comparisons. The Winter, Summer and Fall seasons are compared in Table 25.

There was a greater density of nearly all species and species groups in the 1.5°N x 2°W block than within the Study Area during Winter, Summer and Fall (Table 25). The differences were greatest in the Winter, with Dovekie, All Murres, Black-legged Kittiwake and Northern Fulmar before installation all more than 10 times the densities of after installation. In Summer the densities were closer. Storm-petrels were nearly identical at 0.61 birds/km² and 0.57 birds/km² respectively. Other comparisons between densities within the 1.5°N x 2°W block and the Study Area for All Murres was 0.45 birds/km² versus 0.13 birds/km², for Northern Fulmar was 0.41 birds/km² versus 0.01 birds/km², and for All Shearwaters was 7.35 birds/km² versus 1.93 birds/km², respectively (Table 25). In the Fall, there were also significantly greater densities in the 1.5°N x 2°W block than in the Study Area. The greatest differences were with Black-legged Kittiwake (2.67 birds/km² versus 0.13 birds/km²) and Northern Fulmar (3.01 birds/km² versus 0.09 birds/km²).

TABLE 25. Densities of Seabirds in a 1.5°N x 2°W study block centred on the production platforms and within a 5 km radius of the Hebron platform (i.e., Study Area).

Season		Dovekie (birds/km ²)	All Murres (birds/km ²)	Black- legged Kittiwake (birds/km ²)	Storm- Petrels (birds/km ²)	Northern Fulmar (birds/km ²)	All Shearwaters (birds/km ²)
Winter	1.5°N x 2°W block	1.40	2.34	11.45	0.01	2.03	0.06
	Study Area	0.11	0.23	0.40	0	0.03	0
Summer	1.5°N x 2°W block	0.03	0.45	0.02	0.61	0.41	7.35
	Study Area	0.01	0.13	0.03	0.57	0.01	1.93
Fall	1.5°N x 2°W block	0.50	1.88	2.67	1.03	3.01	3.82
	Study Area	0.13	0.16	0.13	0.50	0.09	2.36

General observations of seabirds in the Study Area during the 2016–2018 field study revealed that birds rarely stopped to feed in the area. Most birds were flying directly through the Study Area without stopping, showing little or no sign they were even searching for food. The higher density of birds in the 1.5°N x 2°W block perhaps reflects better feeding conditions elsewhere in the block than the Study Area.

3.1.5 Behaviour of Birds Near the Platform

The presence of a large structure on the open sea in the offshore zone 300 km from the nearest land is a conspicuous feature. However, the conspicuousness of the Hebron platform is somewhat diluted by the presence of other operations in the general area. Other drill platforms in the area as well as various supply vessels servicing the assets constantly in the area add to the presence of structures on the naturally open and unobstructed horizon in the Hebron platform area.

Observation of the behaviour of seabirds during the 200 days of field work over the three years (2016–2018) within the Study Area give some insight into its potential to attract birds. Birds with the most obvious attraction to the Hebron platform were gulls. Great Black-backed Gull, Herring Gull and Black-legged Kittiwake were the main species attracted in descending order of abundance. Smaller numbers of Iceland Gull, Glaucous Gull and Lesser Black-backed Gull were present in season. Single Ring-billed Gull and Black-headed Gull were out of habitat and rare for the area. Occasionally flocks of shearwaters, mainly Great Shearwater with smaller numbers of Sooty Shearwater mixed in, rested in flocks in the vicinity of the Hebron platform. Unlike gulls, they did not show a strong preference for resting downwind from the platform.

Birds were rarely observed feeding in the vicinity of the Hebron platform during the day-time. In the Winter, murres were sometimes observed diving close to the cement shaft of the Hebron platform. A Long-tailed Duck, rare offshore, was observed repeatedly diving close to the platform shaft during the Winter survey.

3.1.5.1 Leach's Storm-Petrel

At dawn on 12 September 2017, after five days of fog, visibility improved and 25–30 storm-petrels could be seen circling the survey vessel, which was about 1 km from Hebron, occasionally stopping to pick up small, gelatinous prey (Mactavish and Lang 2018a). As the vessel approached Hebron, about 200 Leach's Storm-Petrels were feeding within about 300 m of Hebron. As the visibility further improved the birds began drifting away and most had dispersed by 10:00 h.

Another notable exception to the general observation that most birds were transiting through the Study Area was a feeding event near the base of the Hebron platform on 5 August 2018. The upwelling of water from the base of the Hebron platform sometimes produces a calmer water, or surface expression, that trails downwind or down current from the platform base. Typically, birds ignore this surface expression, showing no sign of avoidance or attraction. However, at 08:00 h on 5 August the vessel, *Atlantic Raven*, was on helicopter standby mode, positioned 1 km from the platform. At this time the observer on duty noticed a concentration of Leach's Storm-Petrel activity near the platform shaft's water line. Thirty to fifty birds were pattering their feet along the surface while fluttering their wings, sometimes dropping momentarily to the water as if collecting food items over the surface expression trailing off from the base. There was also a clockwise flight of Leach's Storm-Petrels around the platform base. By 09:00 h the number of birds was reduced to 20 individuals fluttering back and forth over the calmer water. At 09:30 h there were still 20 Leach's Storm-Petrel flying back and forth over the surface expression and two Great Shearwaters were on the water within the calm area. At this time the *Atlantic Raven* finished helicopter standby duties and moved away from the platform, becoming too far to continue observations. There was nothing different about the appearance of the surface expression on this day or any other obvious reason why the Leach's Storm-Petrels found an attraction to it on this day and not any other day during the 4 August to 31 October observation period. Leach's Storm-Petrels and other procellariiform species use olfaction during foraging to guide them to their prey (Nevitt and Haberman 2003).

3.1.5.2 Gulls

Gulls showed attraction to the Hebron platform. The large gull species (all gulls other than Black-legged Kittiwake) are treated separately from Black-legged Kittiwake here. The majority of large gulls live year-round near or on land. Relatively small numbers of large gulls spend part of non-breeding season on the Grand Banks.

The Great Black-backed Gull was the most numerous of the large gulls observed at the Hebron platform. The pattern of occurrence was very similar in both 2017 and 2018. They began arriving at the Hebron platform in the last week of August. Numbers built up gradually through September, with maximum day counts reaching up to 60 individuals during the last week of September. Numbers peaked through October with some days reaching more than 100. Numbers of gulls counted during the day-time were highly variable due in part because the survey vessel was not always in the best position to count gulls resting near the platform. A gull flock resting on the water could drift more than a kilometer downwind from the platform while the survey vessel could have been on the opposite side of the platform. On some occasions when working in close to the platform there appeared to be no gulls present.

The Great Black-backed Gull was more numerous than all the other large gull species except during the month of May when it was outnumbered by Herring Gull. The Herring Gulls may have been migrants in

passage that drifted offshore due to winds rather than being at sea by choice for foraging. The sudden appearance of 120 Herring Gulls on 3 May 2016 followed a day with strong northwest winds. During the Spring 2018 observation period, Herring Gulls were seen 86% of the survey days with an average of 1–3 per day while there were only three Great Black-backed Gulls observed during that entire observation period. During the May 2016 and 2018 no gulls were observed feeding in the area.

Glaucous Gulls preyed on Dovekies during day-time on two occasions. On the first occasion, two Glaucous Gulls were initially seen fighting in the air over a Dovekie. They settled on the water, each struggling to gain control of the Dovekie. Then, a Great Black-backed Gull flew in, seized the Dovekie, and swallowed it whole. On the second occasion, an immature Glaucous Gull swam toward two Dovekies sitting on the water. It kept a very low profile with head and neck down at the surface of the water. Using this stalking behaviour, the gull swam right up and grabbed a Dovekie, which was seemingly unaware of the threat. The Glaucous Gull carried the dovekie into the air while being chased by another Glaucous Gull. The two gulls struggled for the Dovekie in mid-air and came down to the water still fighting for the bird. One of the gulls flew off with the Dovekie and swallowed it whole.

Black-legged Kittiwakes were rarely observed at night but occasionally collected in substantial flocks in daylight near the Hebron platform in Winter, Spring and late Fall. On 7 February 2018, a flock of 750 kittiwakes assembled 1300 m downwind from the platform. On 20 February, a flock of 200 was on the water 600 m from the platform. During a storm on 3 May, 150 Black-legged Kittiwakes collected on the water in a flock downwind from the vessel. In Fall 2017, kittiwakes were frequently observed on the water in flock sizes ranging from 24 on 27 September to 125 on 17 October. In Fall 2018, very few kittiwakes were observed on the water but a large group of 600 collected in a flock downwind from the platform on the afternoon of 18 October. Black-legged Kittiwakes did not exhibit any sign of feeding in the area.

On 9 February, there was an unusual event with Black-legged Kittiwakes observed circling the Hebron GBS. From 08:00–08:15 h there were 150–200 kittiwakes flying clockwise around the shaft of Hebron platform in a band extending from close to the shaft to 100 m away from the shaft. They were flying rapidly. By 08:30 h, the number circling the GBS was reduced to 75 kittiwakes. At 08:40 h a helicopter landing on the GBS caused most of the kittiwakes to fly away from the GBS to the north. When the helicopter departed at 08:55 h there were still 12 kittiwakes circling the GBS. The behaviour of the kittiwakes was similar to that called nocturnal circulation where birds fly around lighted structures at night (Bourne 1979; Wiese et al. 2001). It had been foggy all night but by dawn (07:00 h) visibility was 1 km and by 08:00 h visibility was 5 km. Sunrise was 06:59 h but bird observations were not started until 08:00 h. It is speculated that the kittiwakes had been circling the GBS in the fog during the hours of darkness before dawn and continued to do so during the first two hours of daylight.

3.1.5.3 Shearwaters

Great and Sooty Shearwaters are common birds on the Grand Banks from June–October. Shearwaters generally flew through the 5 km survey diameter around the Hebron platform. Very little feeding activity was noted. The shearwaters rarely rested on the water. In late-September, tight knit flocks of Great Shearwaters flying rapidly southward were thought to be in active migration. During this period, small flocks of shearwaters were sometimes observed resting on the water but without an obvious association with the Hebron platform. On 21 September 2018 a flock of 1000 Great Shearwaters with a few Sooty

Shearwaters mixed in rested on the water for several hours in late morning. The flock was located 1800 m downwind from the platform. There did not seem to be a correlation between the presence of the platform and this flock of birds.

3.1.5.4 Murres

Murres were present in low densities within the Study Area but this was the only group of birds observed regularly foraging. Diving was considered indicative of foraging. Occasionally an individual murre was observed diving next to the shaft of the platform for several consecutive dives before moving on. Generally, individual murres were observed diving once or twice within sight of the survey vessel and then were not seen again.

3.2 Night-time Surveys

3.2.1 Effort

Night-time surveys began in the latter half of Summer of 2017 after the Hebron GBS was installed on location; observations continued into the Fall. In 2017, observations were conducted on 33 nights beginning on the night of 26/27 August and continuing to 19/20 October. Four of these nights were in August, 18 nights were in September, and 11 nights were in October (Table 25). In 2018, night-time surveys were carried out for a portion of each of Winter, Spring, Summer, and Fall. The Winter surveys took place on 15 nights between 24/25 January and 26/27 February. These surveys were conducted on three nights in January and on 12 nights in February (Table 26). Spring surveys were carried out on eight nights between 3/4 and 19/20 May 2018 (Table 26). During 2018, Summer and Fall surveys were conducted on 40 nights from 4/5 August to 31 October/1 November. A total of 16 nights of surveys were conducted during August, 19 nights during September, and 15 nights during October (Table 25). Over the course of the two years, night-time surveys were conducted on 106 nights for a total of 293.45 hours, averaging 2.8 hours per night (Table 26). The times and hours of night-time surveys are shown in Appendix A. During night-time surveys the vessel was positioned about 150 m from the GBS on most nights, however the vessel was about 20 m from the GBS on some nights when the vessel was engaged in cargo transfer operations. Because the vessel's master acted as the second dynamic positioning officer necessary in the wheelhouse for the vessel to enter the 500 m safety zone around the GBS, and because the master was most often available for this activity during the first half of the night, most night-time surveys took place in the first half of the night.

Table 26. Night-time survey effort by month.

Year	Season	Month	No. Observation Nights	Total No. Observation Hours	Average No. Observation Hours/Night
2017	Summer	August	4	10.6	2.7
	Fall	September	18	50.0	2.8
		October	11	31.1	2.8
	Total		33	91.9	2.8
2018	Winter	January	3	9.75	3.3
		February	12	26.75	2.2
	Spring	May	8	20.0	2.5
	Summer	August	16	44.5	2.8
	Fall	September	19	57.75	3.0
		October	15	43.0	2.9
	Total		73	201.75	2.8
	Grand Total		106	293.45	2.8

3.2.2 Attraction to the Platform Itself

As discussed in the Methods (Section 2.2) above, the lack of a visible horizon precluded the use of a survey protocol that enabled the calculation of bird densities. In addition, each series of FLIR scans around the GBS and the binocular scans of the illuminated area took a few minutes in total, and monitoring with the unaided eye took place in between the aided-eye scans. Consequently, the results are given in numbers of birds sighted per hour of observation effort rather than the number of birds per square kilometre.

Birds were attracted to the Hebron at night for different reasons than in day-time. The lights on the Hebron platform apparently attracted fish to the surface of the water at night that, during Fall, the Great Black-backed Gulls searched for and caught with some success. This feeding activity did not occur during the daylight hours. The Leach's Storm-Petrel is well known for being attracted to lights on stationary or slow-moving fishing vessels, oil exploration ships and lighthouses at night and stranding around those lights (Montevocchi et al. 1999; Ronconi et al. 2015). Despite the relatively small volume of airspace that could be surveyed in darkness compared with that during daylight, Leach's Storm-Petrels were observed on 34 of the 106 nights (32%) with night-time surveys (see Table 28 later). They were observed flying closer to the platform at night than during the daylight hours. However, they typically flew low over the water through the lighted area around the platform, but there were exceptions on some nights (see Section 3.2.3). Other species of birds were occasionally attracted to the platform at night. In Summer and Fall, Great Shearwaters sometimes flew through the lighted area around the platform but did not linger. Northern Fulmars sometimes circled around low over the water in the lighted area but did not stay long. A few land-bird species were seen on the well-lit back deck of the standby vessel during the night-time hours. Often these birds had been present during the day before it got dark. Detailed totals of birds observed during each night-time survey in 2017 and 2018 can be found in Appendix B.

3.2.2.1 All Species

A total of 17 bird species were recorded during night-time surveys in 2017 and 2018 (Table 27). With the exception of Leach's Storm-Petrel and Great Black-backed Gull, all species were recorded in very low numbers (average ≤ 0.1 bird per hour) (Table 27). During Spring (May) only Northern Fulmar and Savannah Sparrow, the latter a species of land-bird, were recorded at night. Leach's Storm-Petrels were not sighted during Spring. During Summer (August) eight species were recorded, of which only Leach's Storm-Petrel was common. Storm-petrels were recorded on 12 of the 20 nights sampled in August of 2017 and of 2018, with an average of 8.6 birds per hour. This average was heavily influenced by the night of 27/28 August 2017, during which 25 scans over a 3.3-hour period resulted in an average of 11.9 birds per scan with a maximum of 20 in a single scan (discussed below). When that night is removed, the average number of storm-petrels is 3.5 birds per hour during Summer observations. During Fall (September and October), eight species were recorded of which only Great Black-backed Gull and Leach's Storm-Petrel were common. The former species averaged 15.7 birds per hour during night-time surveys in Fall. Leach's Storm-Petrels were recorded on 22 of the 63 (35%) nights sampled in September and October of 2017 and 2018, with an average of 1.4 birds per hour. During Winter (January and February 2018), 11 species were recorded, of which Great Black-backed and Glaucous Gulls were the most common, recorded an average of 0.4 and 0.3 birds per hour, respectively. The Leach's Storm-Petrel was not sighted in the Winter observation period.

TABLE 27. Average (mean) number of birds sighted per hour of night-time observation by season (2017 and 2018 pooled). Spring: May; Summer: August; Fall: September and October; Winter: January and February.

Species	Season			
	Spring	Summer	Fall	Winter
Long-tailed Duck	0	0	0	0.03
Unidentified Shorebird	0	0.1	0	0
Black-legged Kittiwake	0	0	0.01	0
Iceland Gull	0	0	0	0.03
Lesser Black-backed Gull	0	0.03	0	0
Glaucous Gull	0	0	0	0.3
Great Black-backed Gull	0	0.1	15.7	0.4
Dovekie	0	0	0.01	0.1
Common Murre	0	0	0	0.1
Unidentified Murre	0	0	0.03	0.03
Unidentified Alcid	0	0	0	0.04
Leach's Storm-Petrel	0	7.1	1.4	0
Northern Fulmar	0.2	0.02	0.1	0.03
Sooty Shearwater	0	0.02	0	0
Great Shearwater	0	0.4	0	0
Unidentified Shearwater	0	0.02	0	0
Gyrfalcon	0	0	0	0.03
Snowy Owl	0	0	0	0.03
American Pipit	0	0	0.01	0
Savannah Sparrow	0.1	0	0	0
Unidentified Bird	0	0	0.01	0

3.2.2.2 Leach's Storm-Petrel

Leach's Storm-Petrels were seen near the Hebron platform on 30% of the 33 observation nights in 2017, all before there was an operational flare (Table 28, Figure 6). In 2018, storm-petrels were seen on 41% of observation nights, all during time with an operational flare (Table 28, Figure 7). However, the 2017 observations were conducted only from the nights of 26/27 August to 19/20 October, whereas the 2018 observations were conducted on 73 nights spread over all four seasons. As a result, a summary of all 2018 data pooled is not directly comparable with the 2017 data. When the 2018 observations only from 26/27 August to 19/20 October are examined, storm-petrels were observed on 39%, of those nights (Table 28). During 2017 the average (mean) number of storm-petrels per hour of night-time surveys was 4.0 birds per hour, despite storm-petrels having been recorded on fewer than one-third of nights (Table 28, Figure 6). This average number of birds per hour was heavily influenced by the event on the night of 27/28 August (Figure 6; discussed below). Another spike in numbers occurred on the night of 10/11 September (Figure 6). During all of 2018, the average number of storm-petrels per hour was 1.4 (Table 28, Figure 7). From 26–27 August to 19/20 October 2018 it was only slightly higher: 1.7 birds per hour, despite being observed on 39% of nights. No Leach's Storm-Petrels were observed at night during the Winter and Spring surveys.

TABLE 28. Summary of storm-petrel sightings during night-time surveys at the Hebron GBS.

	2017		2018		All	Total
	26/27 Aug – 19/20 Oct	25/26 Jan – 25/26 Aug	26/27 Aug – 19/20 Oct	27/28 Oct – 31 Oct/1 Nov		
No. of Nights with Night-time Surveys	33	35	33	5	73	106
No. of Nights Storm-petrels Observed	10	8	13	3	24	34
Percentage of Nights Storm-petrels Observed	30	23	39	60	41	32
Average No. Storm-petrels/Hour	4.0	1.3	1.7	0.6	1.4	1.1

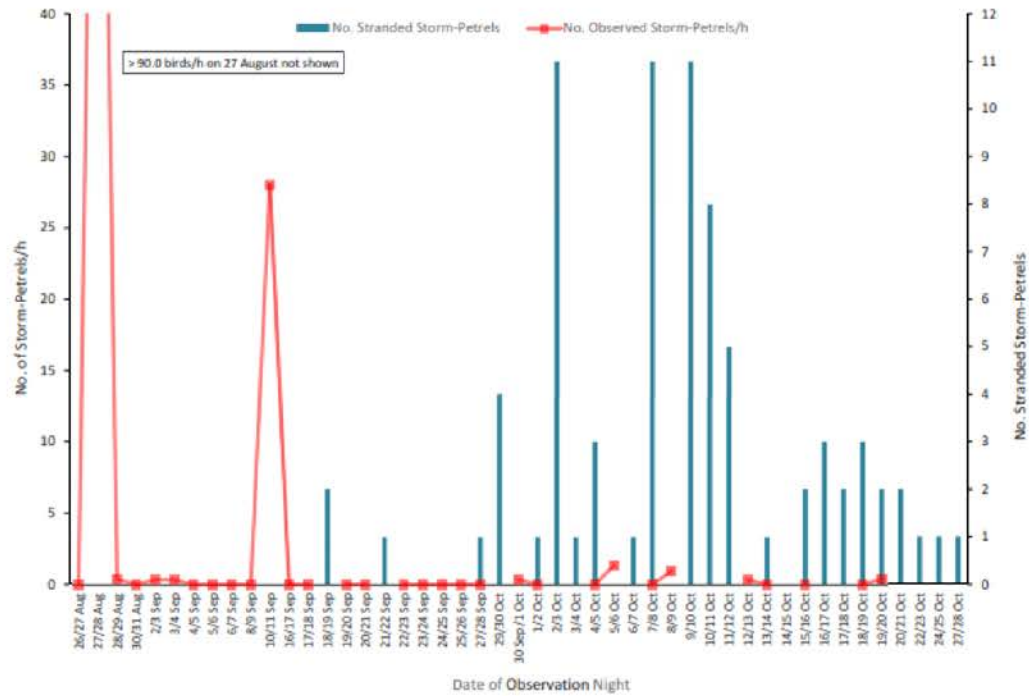


FIGURE 6. Average number of storm-petrels observed per hour in 2017 during night-time surveys from the standby vessel (left vertical axis), and number of storm-petrels stranded on Hebron or survey vessels (right vertical axis). The number of storm-petrels per hour observed on 27 August (> 90.0 birds/h) is not shown. Only dates with night-time surveys or strandings are shown. Strandings are discussed in Section 3.3 below.

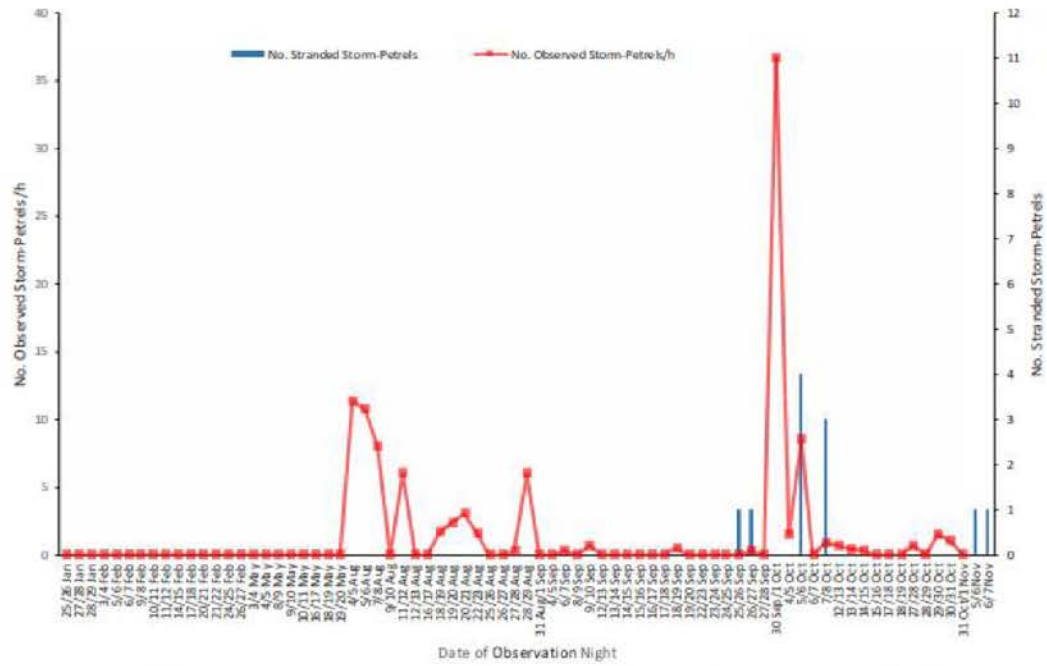


FIGURE 7. Average number of storm-petrels observed per hour in 2018 during night-time surveys from the standby vessel (left vertical axis), and number of storm-petrels stranded on Hebron or standby/supply vessels (right vertical axis). Only dates with night-time surveys or strandings are shown. Strandings are discussed in Section 3.3 below.

3.2.2.2.1 Environmental Conditions and Presence of Storm-Petrels

Some studies of attraction to artificial lighting by petrels and related species have found correlations between light attraction and natural lighting levels, i.e., moonless nights, or with certain atmospheric conditions, i.e., fog or precipitation. In the present study, observers aboard the standby vessel recorded the presence of a visible moon and its phase, fog, and precipitation while conducting bird observations.

Presence of a Visible Moon

To examine the influence of illumination by the moon on storm-petrel presence near Hebron, data from watches during which night-time surveys were conducted were divided into watches with a visible moon and watches during which the moon was obscured by an overcast sky, fog, or the earth's shadow (new moon), or was below the horizon. Each of these two groups were divided into watches with storm-petrel sightings and those without. If celestial or atmospheric conditions changed during a night-time survey to reveal the moon or to cover the moon, each of these two intervals was treated as a separate watch. During 22 watches there was a visible moon whereas during 95 watches the moon was obscured. Storm-petrels were observed on 39 watches and were not observed on 78 watches. One or more storm-petrels were observed near Hebron during 23% of watches with a visible moon compared with 36% of watches when the moon was obscured. This difference was not statistically significant ($\chi^2 = 1.4$, $df = 1$, $p = 0.24$).

Visibility: Fog and Precipitation

To examine the influence of fog or precipitation on storm-petrel presence on or near Hebron, data collected during night-time surveys were divided into watches with fog or rain and those without. Each of these two groups were divided into watches with one or more storm-petrel sightings and those without. If weather conditions changed during a night-time survey, each of those periods were treated as a separate watch. Visibility was restricted by fog or rain during 34 watches and was unrestricted during 83 watches. Storm-petrels were sighted during 39 watches and were absent during 78 watches. One or more storm-petrels were observed during 50% of watches with fog or rain whereas storm-petrels were sighted during only 27% of watches with unrestricted visibility. The difference is statistically significant ($\chi^2 = 5.9$, $df = 1$, $p = 0.01$).

3.2.3 Behaviour of Birds Near the Platform

With few exceptions, Leach's Storm-Petrels observed at night were travelling directly and purposely low over water through the area illuminated by the lights on the platform. Most were flying in one direction, usually into the wind, on a given night. The exceptions are discussed below.

3.2.3.1 Storm-Petrel Event on 27/28 August 2017

On the night of 27/28 August 2017, several months before the flare was activated, an indeterminate number of storm-petrels, but probably totalling at least 300, as observed around the Hebron platform. The birds were generally flying just above the water, circling around the platform. This pattern of continuous circling of the platform is known as "nocturnal circulation" and is believed to represent attraction of the birds to artificial lighting (Russell 2005). The watch was 3.3 hours in length occurring from 23:40–02:55 h. Numbers were greater in the latter half of this watch. From 23:40–00:45 h, storm-petrels were observed on

9 of the 14 scheduled scans at five-minute intervals, with numbers ranging from 1 to 4. From 00:50–02:55 h, storm-petrels were recorded on all 25 scans with an average of 11.9 individuals per scan, with maximum scan totals of 18, 19 and 20. The birds were flying rapidly, low over the water around the base of the GBS in both directions. The stern of the *Atlantic Raven* was positioned about 30 m from the base of the GBS for cargo transfers with the Hebron platform for the entire duration of the 3.3 h watch. Most of the storm-petrels flew around the *Atlantic Raven* instead of flying over the stern or between the stern and platform base during their circuit of the platform. They were flying swiftly, generally without stopping. There were four exceptions to this generalization. See the list below.

- 1) One bird appeared to be feeding on the water, i.e., pattering its feet in the water with very high wing strokes. This was the only bird observed foraging during the 3.3 hours.
- 2) One storm-petrel flew up to the underside of the lowest deck of the GBS. Reflection of the superstructure lighting off of the sea surface gave sufficient illumination of the underside of the deck to identify this bird. It fluttered “like a moth” against the cement surface of the platform column before flying back out to sea into the darkness and out of sight.
- 3) One storm-petrel flew repeatedly into the cement shaft of the GBS about 10 m above sea level, striking it each time. It then fluttered down to the surface of the sea where it rested briefly before fluttering against the cement column repeatedly and then flew out to sea and out of sight.
- 4) One storm-petrel flew into the cement shaft of the platform near where the *Atlantic Raven's* spotlight was shining and fell down to the water below. It floated on the surface of the water with the tail held upwards at an unusually high angle and the wings spread out on the water. It remained motionless in that position and drifted with the wind and current into the darkness and out of sight several minutes later. The bird appeared injured or possibly deceased.

There were no gulls present around the platform during this watch. There was nothing remarkable about the weather. The sky was overcast but the visibility was unrestricted horizontally by fog or rain. The winds were very light at 4–6 knots from the north. The seas were between 0.5 and 1.2 m in height.

3.2.3.2 Storm-Petrel Event on the Night of 10/11 September 2017

During the 2.5-hour night watch on 10/11 September 2017, several months before the flare was activated, there was a steady movement of storm-petrels through the lighted area beneath the platform. A total of 71 storm-petrels were counted during the watch, which was conducted from 20:45–23:15 h. All individuals observed, including those between the five-minute standardized times for survey scans, are included in this total. A total of 61 storm-petrels flew south into the wind. They flew low and swiftly over the water while maintaining a southward heading. Three individuals stopped briefly to patter on the surface of the water in a feeding-type action. It could not be seen what, if anything, they were feeding on. In one incident a second bird was drawn in to investigate the action of a bird dabbling at the surface. Five individuals flew north and two flew erratically and briefly over the back deck of the *Atlantic Raven* and then disappeared into the darkness. This flight behaviour and the time of year suggest that this event was post-breeding, southward migration. The wind was Beaufort Force 5 (17–21 knots) from the south west. There was light rain and fog for the entire count period. The fog ceiling came down to the upper decks and helipad of the platform. Visibility was better closer to sea level. The lights of the Terra Nova Floating Production Storage and Offloading (FPSO) vessel were dimly visible, 9 km away. No other species of birds were observed during this watch.

3.2.3.3 Gulls

Gulls were most common around the Hebron platform during September and October and scarce or absent at other times. Black-legged Kittiwakes and Great Black-backed Gulls were the most numerous gull species. Kittiwakes were rarely observed at night. The Great Black-backed Gull was usually more numerous at night than during the day-time. The lights of the platform illuminated the surface of the water surrounding the platform. The gulls hunted for fish in the lighted areas within a 50–100 m radius of the base of the platform. Fishing activity of the gulls was sporadic. On some nights the gulls rested on the water with no fishing activity and on other nights no gulls were present at all. When fishing, the gulls flew slowly and low over the water with their beak pointing downward. Occasionally a gull would drop to the water and grab a long, silver fish with its beak. Some of the fish were identifiable as Atlantic saury and may all have been this species. It was thought the fish may have been attracted to the surface by light from the platform. Gulls did not engage in this activity during the day-time. Except for the general increase in gulls through September there was little correlation between the number of gulls visible during the day-time with the number observed at night. The maximum count of gulls present on a single sweep during the nighttime surveys from August–October in 2017 and 2018 are shown in Figure 8. Great Black-backed Gulls were not observed pursuing Leach’s Storm-Petrels at night around the Hebron platform during the present study. During the Winter surveys only 25 gulls of three species (Great Black-backed, Glaucous and Iceland) were observed during all of the 15 nights of survey time. They were either resting on the water near platform or flying through the lighted area but no night-time feeding or searching for fish was observed. However, during the hours of darkness (18:10 h) on 25 January, a Glaucous Gull swam toward a Dovekie sitting on the water <50 m from the cement shaft of the GBS, i.e., within the area illuminated by the lights on the GBS. The Glaucous Gull grabbed the Dovekie. It manipulated the dovekie in its beak for five minutes, then swallowed it whole. No gulls were observed during the night-time watches around the Hebron platform in the Spring 2018 observation period.

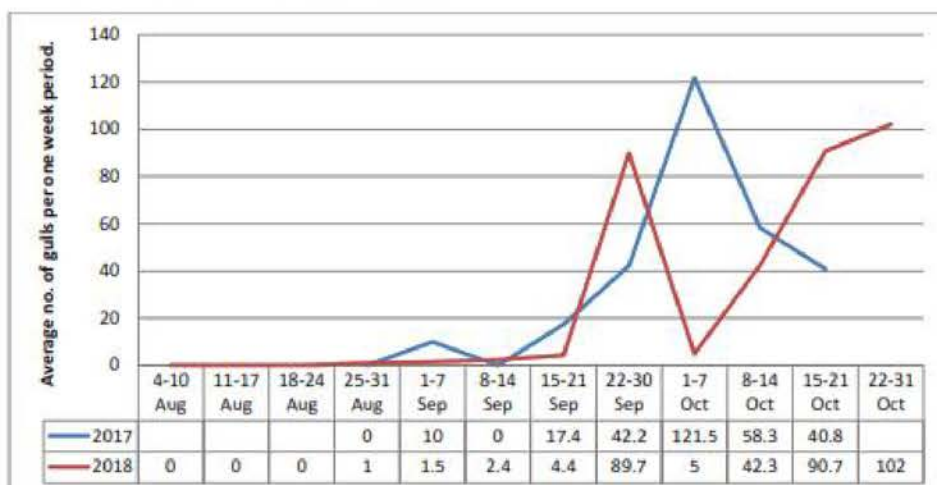


FIGURE 8. The average maximum number of Great Black-backed Gulls recorded on night-time surveys per week at the Hebron platform in August–October 2017 and 2018.

3.2.3.4 Other Bird Species

There were very few sightings of bird species other than Leach's Storm-Petrel or Great Black-backed Gull during the night-time observations.

3.2.3.4.1 Winter

Alcids made up 33.3% of the total number of individual birds observed during the 15 nights of observations. There were totals of six Dovekies, six Common Murres, one unidentified murre, and one unidentified alcid. All six Dovekies were seen during the first 15 minutes of the 25/26 January night-time survey. They were resting in the lighted area under the GBS. As discussed above, one was captured and eaten by a Glaucous Gull. The other five drifted off into the darkness and were not seen again. There were six Common Murres observed on four survey nights. Single Common Murres were observed actively foraging by putting the head into the water and then diving on the nights of 25/26 January and 29/30 January. The other Common Murres, one on 10/11 February and three on 11/12 February, appeared to be sleeping. They were resting with head hunched down against their body without looking from side to side. Two other alcids not identified to species were observed on the water on 20/21 February and 21/22 February and also appeared to be resting.

There were four additional species observed on the Winter night-time surveys. A Northern Fulmar flew through the lighted area under the GBS without stopping on the night of 18/19 February. A Long-tailed Duck was observed on the water near the base of the platform on the night of 29/30 January. It was thought to be the same individual observed during daylight hours near the base of the platform on 15 February. A Gyrfalcon was flushed from Hebron when a platform alarm sounded on 18/19 February. It circled around the sides and above the platform for a few minutes and was thought to return to the structure when the alarm was turned off. The bird had been seen during daylight hours on the 18 February. A Snowy Owl was observed at 20:22 h on 24 February. It flew around the *Atlantic Raven* once in the darkness and was not seen again.

3.2.3.4.2 Spring 2018

Birds were almost completely absent during the Spring night-time watches. On 8 May there was one Northern Fulmar observed flying at 21:12 and again five minutes later. One Savannah Sparrow was observed briefly on the back deck of the *Atlantic Raven* on 3 May at 21:36; it was thought to have been the same individual present on the vessel during the previous afternoon.

3.2.3.4.3 Late Summer and Fall 2017

There were four sightings of single Northern Fulmars on different dates flying through the lighted area beneath the platform without stopping. Two Black-legged Kittiwakes flew through the lighted area together on the night of 13/14 October. An unidentified murre observed on the water over three consecutive nights (16–19 September) might have been the same individual. A flock of six shorebirds, which may have been phalaropes, flew together through the lighted area on the night of 27/28 August. An American Pipit was observed briefly over the back deck of the *Atlantic Raven* at 20:39 h on 12 October. An unidentified bird was detected briefly with the FLIR optics high above the platform at 02:59 h on 20 October.

3.2.3.4.4 Late Summer and Fall 2018

Totals of 35 Great Shearwaters and 24 Northern Fulmars were observed over the 50 night-time surveys during this period. The Great Shearwaters were mostly flying through the lighted area under the platform, with some resting on the water. The Northern Fulmars flew low over the water around the lighted area under the platform before exiting the lighted area. Sometimes they lingered and may have been foraging. There were single sightings of Sooty Shearwater, Lesser Black-backed Gull, Dovekie, unidentified murre and at least one unidentified passerine.

3.2.4 Bird Interactions with the Flare

Four Leach's Storm-Petrels were observed flying near the flare on the night of 30 September/1 October 2018. One bird passed under the flare at an estimated <10 m and another at approximately 20 m. Two other individuals passed apparently close to flare, but distances could not be estimated. On the night of 5/6 October two single Leach's Storm-Petrels were observed flying higher than the height of the flare but not near it. On the same night storm-petrels stranded on the GBS (see following section).

3.3 Bird Strandings on the Platform and Survey Vessel

In 2017, Leach's Storm-Petrels were reported stranded on the Hebron platform by that facility's personnel on 23 nights, from the night of 18/19 September to the night of 27/28 October (Figure 6). A total of 78 storm-petrels stranded on those 23 nights. The number of birds stranding per night in 2017 peaked on three nights from 2/3 October to 9/10 October, with 11 stranded storm-petrels stranded on each of those nights (Figure 6). Weather was not recorded in stranded bird documentation during 2017. None of these 2017 strandings coincided with the large numbers of storm-petrels observed near the Hebron platform on the night of 27/28 August or the night of 10/11 September. A list of strandings in 2017 and 2018 and associated data are presented in Appendix C. During 2018, fog was noted on 11 November but there was no fog or precipitation on the other 2018 dates that had strandings. A "strong" wind was noted on 8 October. In contrast to 2017, storm-petrels stranded on only six nights in 2018 (Figure 7). Strandings were reported from 25/26 September to 7/8 November. The largest stranding event on the platform in 2018 consisted of four birds on the night of 5/6 October and coincided with storm-petrel interactions with the flare (see preceding section). Two Leach's Storm-Petrels stranded on the survey vessel, both on the night of 5/6 October. One was released immediately while the other landed in a place not easily accessible but flew away on its own after ten minutes. All but 14 of the 89 stranded birds in 2017 and 2018 were recovered alive and released alive or were able to leave the platform or vessel under their own power. The only other species reported stranded was one Common Murre on the *Atlantic Heron* discovered during cargo operations on 4 December 2018. Light drizzle was noted on this date.

4.0 Summary and Conclusions

A total of 4544 ECSAS Stationary Platform counts were conducted during day-time within a 5 km radius of the Hebron GBS on 200 survey days over three years (2016–2018). Twenty-five species of seabirds were recorded during the study. The bulk of individuals observed during the study were Alcids (the two murre species and Dovekie), gulls (Black-legged Kittiwake and Great Black-backed Gull), shearwaters (Great and Sooty), Leach's Storm-Petrel and Northern Fulmar. In Winter (January and February),

Thick-billed Murre, Common Murre, Dovekie, Northern Fulmar and Black-legged Kittiwake were the dominant species. In Spring (May), Thick-billed Murre and Common Murre combined to make up the majority of the birds present, with lower numbers of Leach's Storm-Petrel, Black-legged Kittiwake, Dovekie and Northern Fulmar also present. In Summer (August), the diversity of species increased. Great Shearwater and Leach's Storm-Petrel were the most numerous species. The abundance of Great Shearwater and Leach's Storm-Petrel continued into the Fall season (September and October). Great Black-backed Gulls started showing up in late-August, increased through September, and peaked in October. Murres and Dovekies began to return in numbers during October.

A total of 293.45 hours of night-time surveys were conducted at the Hebron platform on 106 nights in 2017 and 2018. Seventeen species were observed during night-time surveys, all of which were recorded in very low numbers with the exception of Leach's Storm-Petrel and Great Black-backed Gull during Fall. All of these species were pelagic seabirds except six species of out-of-range coastal or terrestrial species.

4.1 Attraction to the Platform Itself

4.1.1 Day-time

Direct comparisons of densities of birds in the Study Area were limited to May and August 2016 before the installation of the platform and after the installation in May and August 2018. A slight increase in bird densities was detected after the installation of the platform. There was no obvious attraction to the platform shown by seabirds other than gulls during the day-time.

Bird attraction to the platform was low in day-time. Small numbers of Great Black-backed Gulls regularly collected downwind from the platform during daylight in the Fall. Occasionally Black-legged Kittiwakes also rested on the water downwind from the platform.

Higher densities of gulls near Hebron are consistent with the findings of the analysis of previously collected data that showed higher gull densities near the three pre-existing production platforms than elsewhere in Jeanne d'Arc Basin (LGL 2017b).

4.1.2 Night-time

During night-time surveys in Winter, the number of species was the highest of any of the seasons (11 species), but the numbers of individuals of each of those species were low. The only species that were consistently observed near the platform were two large species of gull, Glaucous and Great Black-backed. Leach's Storm-Petrel was not seen during Winter because this species winters primarily in tropical waters (Pollet et al. 2014, 2019a,b).

During Spring (May) night-time surveys, only two species were observed, one of which was a vagrant land-bird species. The only seabird, Northern Fulmar, was seen in low numbers. Leach's Storm-Petrels were not detected during Spring nocturnal observations. Although this species begins visiting its Northwest Atlantic nesting colonies in April and May, there is a pre-laying exodus by females, followed eventually by their return in late-May to begin laying eggs (Pollet et al. 2019b). The earliest published egg-laying date at Great Island in Witless Bay, Newfoundland, is 26 May (Pollet et al. 2019b). The whereabouts of individuals of this species between the pre-laying exodus and egg-laying are unknown. However, Leach's

Storm-Petrels feed primarily in the deep waters off the continental shelf (Steele and Montevecchi 1994; Hedd et al. 2009), so perhaps most individuals remain in deep water rather than commuting through the Jeanne d'Arc Basin oilfields between those waters and nesting colonies, as they do after incubation begins (Hedd et al. 2018).

During night-time surveys in late Summer (August) all but one of the eight species (Leach's Storm-Petrel) seen were very uncommon. Leach's Storm-Petrel was seen near Hebron on most August nights in 2017 and 2018, with more than five storm-petrels per hour seen on six of those nights, and more than 90 per hour seen on one of those nights. During the Summer, when the single egg is incubated and the nestling is fed, both sexes participate in parental care (Pollet et al. 2019b), requiring each parent in turn to commute every few days from the nesting colony to the feeding ground (Hedd et al. 2018). A portion of nesting populations from Gull Island in Witless Bay and Baccalieu Island, two of the largest colonies in the Atlantic, pass through Jeanne d'Arc Basin on their way to the deep waters (Hedd et al. 2018).

During night-time surveys in Fall (September and October), Great Black-backed Gull and Leach's Storm-Petrel were the only common species. The Great Black-backed Gull was the more common of the two species on average. This species habitually gathers around offshore platforms in Fall, often apparently feeding on fish attracted to the surface at night by artificial light from the platforms (Ronconi et al. 2015; LGL 2017a). Leach's Storm-Petrels were seen during over one-third of September and October nights in 2017 and 2018, during two of which large numbers of storm-petrels were observed. One of these nights, 10/11 September 2017, coincides with the earliest published date of young Leach's Storm-Petrels fledging from the nesting colony at Great Island (Pollet et al. 2019b). The other night, 30 September/1 October 2018 is within the fledging period. The majority of fledging on Great Island takes place from mid-September to late-October (Pollet et al. 2019b). The parents are thought to abandon the nesting colony upon the departure of the fledglings. The attraction of both Great Black-backed Gulls and Leach's Storm-Petrels to offshore installations in Fall, especially during the nesting colony abandonment period, is of potential concern because the former species occasionally preys on the latter around offshore platforms (Montevecchi et al. 1999; LGL 2017a).

One or more Leach's Storm-Petrels were seen near Hebron during 50% of foggy or rainy night-time watches, whereas they were seen during only 27% of watches with unrestricted visibility. This is consistent with findings for other species of procellariiform seabirds (Wallis 1981; Black 2005; Poot et al. 2008). However, the absence of moonlight during watches was not associated with the greater numbers of storm-petrels in the present study, as has been reported for some species of light-attracted shearwaters in other parts of the world (Telfer et al. 1987; Rodríguez and Rodríguez 2009; Miles et al. 2010).

The percentage of nights with storm-petrel sightings near Hebron was slightly greater in the year following the start-up of the flare, i.e., 2018. However, the average number of storm-petrels per hour was much greater in 2017 due to one night (27/28 August) during which a few hundred individuals circled the GBS. This illustrates the episodic nature of nocturnal bird attraction to artificial lighting seen in Leach's Storm-Petrel and other bird species. This episodic nature is likely due to a combination of factors that has not yet been identified (Ronconi et al. 2015). Typically, the flare was relatively small and not noticeably brighter than a subset of the electrical lighting on the platform (Figure 2B).

4.2 Behaviour of Birds Near the Platform

4.2.1 Day-time

Interactions between birds and the Hebron platform during daylight were limited mostly to Great Black-backed Gulls and Black-legged Kittiwakes that appeared to use the presence of the platform as slight wind block for resting on the water. This was most prevalent in September and October but also occurred in Winter and Spring. Small numbers of Iceland Gulls, Glaucous Gulls and Lesser Black-backed Gulls were sometimes present among the Great Black-backed Gulls. No gulls were observed resting on the platform but on windy days Great Black-backed Gulls sometimes rode the updrafts created by the wind deflecting upward from the platform. A Long-tailed Duck, rare offshore, was observed repeatedly diving close to the platform column during the Winter observation period. In the Summer and Fall small flocks of shearwaters occasionally built up on the water within 0.5–5 km from the platform but did not show obvious signs of attraction to the platform.

4.2.2 Night-time

Direct, obvious interactions between birds and the Hebron platform during night-time surveys were rare. The behaviour during the large majority of storm-petrel observations at night consisted of the birds passing the GBS in flight, in a consistent direction, while remaining close to the water's surface. Whether or not passing within 150 m of the platform in this manner represents convergence on the platform from a greater distance cannot be determined without individually tagging and remotely tracking storm-petrels. One instance of direct interaction with the platform was an event on the night of 27/28 August 2017 during which a few hundred Leach's Storm-Petrels circled the shaft just above the water's surface. Another event, on the night of 10/11 September 2017, consisted of a large southward movement of storm-petrels past Hebron. However, none of these birds made contact with the platform or even circled the shaft. In only four instances did storm-petrels make contact with the platform, i.e., three of the storm-petrels involved in the event of 27/28 August 2017 and one on 19/20 October 2017. Only one of these interactions appeared to result in mortality (a single storm-petrel). Interactions with the platform's flare are summarized below.

4.3 Bird Interactions with the Flare

A total of six Leach's Storm-Petrels were seen on two instances in the vicinity of the flare during night-time surveys. None of these individuals flew into the flare or otherwise suffered mortality. Four of these individuals were seen on the night of 30 September/1 October 2018, i.e., the same night as the 2018 peak in number of storm-petrels observed per hour in night-time surveys. The distance of two of these birds from the flare was estimated: one of them at less than 10 m and the other at 20 m. The other instance occurred on the night of 5/6 October 2018, the same night as a minor peak in storm-petrels per hour. This consisted of two storm-petrels seen high above the flare and coincided with the stranding of four storm-petrels on Hebron and two individuals on the survey vessel.

4.4 Bird Strandings on the Platform

A total of 89 Leach's Storm-Petrels stranded on Hebron and the survey vessel (two individuals) during 2017 and 2018. Most of these birds stranded in 2017 (78 individuals). All occurred after the earliest published fledging date of this species in Witless Bay, i.e., during the usual nesting colony abandonment

period. It is thus likely that a significant proportion of these individuals were naïve juveniles. The largest stranding events, consisting of eleven individuals each, were on three nights during the first half of October 2017, almost two weeks after the peak in the number of storm-petrels observed per hour during night-time surveys (27/28 August 2017). The largest stranding event during 2018 comprised five individuals in early-October, shortly after the peak in night-time survey number of storm-petrels per hour. Averaged over the two years, this represents 45 storm-petrels stranded per year which is comparable to annual strandings on other assets in the basin. The only other species stranded was Common Murre (one individual) found on a supply vessel during cargo transfer on 4 December 2018.

It is not clear why there were more nights with strandings, and more individuals stranded in 2017 than in 2018. Weather at the time of stranding or weather events at the nesting colonies during the days preceding the strandings may play a role in the arrival of storm-petrels on the Jeanne d'Arc Basin oil fields. In both years strandings took place on or after the earliest published date of young fledging from nests on Great Island, Witless Bay, so strandings in both years were roughly synchronous with the usual annual nesting colony abandonment by young and adults (Pollet et al. 2019b). As Ronconi et al. (2015) noted, seabird attraction to artificial lighting is likely governed by a particular combination of factors, which is presently unknown for most species.

4.5 Conclusions

This report presents the findings of the final four study objectives that comprised Hebron Project's commitment to ECCC to study interactions between the Hebron GBS and seabirds. The overall study of seabird distribution, abundance, and temporal occurrence at the Hebron site had five objectives, namely to study: 1) attraction of birds to the general vicinity of the Hebron site prior to installation of the GBS, the analysis of which was reported in 2017; 2) attraction of birds to the actual platform itself; 3) behaviour of birds around the platform; 4) bird strandings on the platform; and 5) bird interactions with the flare. The present study addresses objectives two through five.

The results of the field study conducted from 2016–2018 and presented here showed that two groups of seabirds were attracted to the Hebron platform. The first group, large gull species and to a lesser extent Black-legged Kittiwake, were present during day-time surveys and night-time surveys during Fall. Densities of the large gull species were higher during night-time than day-time surveys. The second group, consisting solely of Leach's Storm-Petrel, was recorded during night-time and day-time surveys in Summer and Fall. Gull behaviour near Hebron consisted of loafing downwind of the platform during both the day and at night, and of feeding on vertically migrating fish during the night. Leach's Storm-Petrel attraction was inferred from three sources: 1) this species occurred closer to the platform at night than during daylight observations, 2) there were two instances of many storm-petrels near the shaft of the GBS but none during day-time, and 3) several storm-petrels stranded on the Hebron platform in 2017 and 2018. However, behaviour displayed during the majority of storm-petrel observations consisted of individuals flying close to the water past Hebron's cement shaft without changing direction, suggesting that attraction to the platform rarely resulted in stranding, collision, or nocturnal circulation around the platform. During night-time surveys over two autumns, there was only one instance of nocturnal circulation around Hebron's shaft, and only four instances of individuals making contact with the platform, one of which resulted in mortality. Storm-petrels were sighted during 50% of night-time watches with fog or rain compared with only 27% of watches with unrestricted visibility. A total of 89 Leach's Storm-Petrels stranded on the Hebron platform and the survey vessel. The number of strandings per year is well within the range of those

reported from the other three production platforms in Jeanne d'Arc Basin over a period of 12 years. Storm-petrel interactions with the flare were also rare. During night-time surveys a total of six storm-petrels were observed in the vicinity of the flare, but no mortality was observed. During day-time observations, Leach's Storm-Petrels typically flew directly and rapidly through the 5 km radius Study Area, exhibiting no attraction to the Hebron platform.

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Appendices

Appendix A: Night-time Observation Effort Timing in 2017 and 2018

Appendix B: Night-time Survey Effort and Number of Birds Observed in 2017 and 2018

Appendix C: Summary of Leach's Storm-Petrel Strandings

Appendix A: Night-time Observation Effort Timing in 2017 and 2018

TABLE A-1. Dates and time periods of night-time watches of the Hebron platform, 26 August to 20 October 2017 (fall).

Survey Night ^a	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
August												
26/27												
27/28												
28/29												
29/30												
30/31												
31/1												
September												
1/2												
2/3												
3/4												
4/5												
5/6												
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												
19/20												

Survey Night*	Time of Night [†]											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
20/21												
21/22												
22/23												
23/24												
24/25												
25/26												
26/27												
27/28												
28/29												
29/30												
30/1												
October												
1/2												
2/3												
3/4												
4/5												
5/6												
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												

Survey Night*	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
19/20												

TABLE A-2. Dates and time periods of night-time watches of the Hebron platform, 24 January to 27 February 2018 (Winter).

Survey Night*	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
January												
24/25												
25/26												
26/27												
27/28												
28/29												
29/30												
30/31												
February												
1/2												
2/3												
3/4												
4/5												
5/6												
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												
19/20												
20/21												

Survey Night ^a	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
21/22	█	█	█	█	█							
22/23												
23/24												
24/25	█	█	█	█	█	█						
26/27	█	█	█	█	█							

^a Filled cells (pale shading) show when an observer was present on a supply vessel at the Hebron GBS.
^b Filled cells (dark shading) indicate the time periods of night-time monitoring.

TABLE A-3. Dates and time periods of night-time watches of the Hebron platform, 3–20 May 2018 (Spring).

Survey Night ^a	Time of Night ^b									
	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
May										
2/3										
3/4	█	█	█	█						
4/5	█	█	█	█	█					
5/6										
6/7										
7/8										
8/9	█	█	█	█	█					
9/10	█	█	█	█	█					
10/11										
11/12										
12/13										
13/14										
14/15										
15/16										
16/17				█	█	█	█	█		
17/18										
18/19				█	█	█	█			
19/20	█	█	█	█	█					

^a Filled cells (pale shading) show when an observer was present on a supply vessel at the Hebron GBS.
^b Filled cells (dark shading) indicate the time periods of night-time monitoring.

TABLE A-4. Dates and time periods of night-time watches of the Hebron platform, 4 August to 1 November 2018 (summer and fall).

Survey Night ^a	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
August												
4/5												
5/6												
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												
19/20												
20/21												
21/22												
22/23												
23/24												
24/25												
25/26												
26/27												
27/28												
28/29												
29/30												
30/31												
31/1												
September												
1/2												
2/3												
3/4												
4/5												
5/6												

Survey Night*	Time of Night*											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												
19/20												
20/21												
21/22												
22/23												
23/24												
24/25												
25/26												
26/27												
27/28												
28/29												
29/30												
30/1												
October												
1/2												
2/3												
3/4												
4/5												
5/6												
6/7												
7/8												
8/9												
9/10												
10/11												
11/12												

Survey Night ^a	Time of Night ^b											
	18:00	19:00	20:00	21:00	22:00	23:00	24:00	1:00	2:00	3:00	4:00	5:00
12/13												
13/14												
14/15												
15/16												
16/17												
17/18												
18/19												
19/20												
20/21												
21/22												
22/23												
23/24												
24/25												
26/27												
27/28												
28/29												
29/30												
30/31												
31/1												

^a Filled cells (pale shading) show dates when an observer was present on a supply vessel at the Hebron GBS.

^b Filled cells (dark shading) indicate the time periods of night-time monitoring.

Appendix B: Night-time Survey Effort and Number of Birds Observed in 2017 and 2018

TABLE B-1. Dates, survey effort, and number of individuals by species observed during night-time observations of the Hebron platform, 26 August to 20 October 2017 (Fall).

Survey Night	Number of Hours	Number of Individuals		
		Leach's Storm-Petrel	Great Black-backed Gull*	Other Species
26/27 Aug	2.3	0	0	0
27/28 Aug	3.3	> 300 and <1000	0	6 shorebirds
28/29 Aug	2.8	1	0	0
31 Aug / 1 Sep	2.2	0	0	0
2/3 Sep	3.0	1	15	1 Northern Fulmar
3/4 Sep	3.0	1	25	0
4/5 Sep	3.0	0	1	0
5/6 Sep	3.0	0	0	0
6/7 Sep	3.0	0	0	0
8/9 Sep	3.0	0	0	0
10/11 Sep	2.5	about 70	0	0
16/17 Sep	2.5	0	7	1 unidentified murre
17/18 Sep	2.2	0	11	1 unidentified murre
18/19 Sep	3.0	0	11	1 unidentified murre
19/20 Sep	3.0	0	39	0
20/21 Sep	3.2	0	19	0
22/23 Sep	2.8	0	57	0
23/24 Sep	3.0	0	42	0
24/25 Sep	3.0	0	24	0
25/26 Sep	2.0	0	50	0
27/28 Sep	1.8	0	43	0
30 Sep – 1 Oct	3.0	1	37	1 unidentified bird
1/2 Oct	3.0	0	70	1 Northern Fulmar
4/5 Oct	3.0	0	71	0
5/6 Oct	3.0	4	115	0
7/8 Oct	2.8	0	230	1 Northern Fulmar
8/9 Oct	3.0	3	75	0
12/13 Oct	3.0	1	60	1 American Pipit
13/14 Oct	2.2	0	40	2 Black-legged Kittiwakes
15/16 Oct	3.2	0	60	0
17/18 Oct	3.0	0	75	0
18/19 Oct	2.2	0	23	1 Northern Fulmar, 1 unidentified bird
19/20 Oct	2.7	1	5	1 unidentified bird

* Maximum number during one scan.

TABLE B-2. Dates, survey effort, and number of individuals by species observed during night-time observations of the Hebron platform, 24 January to 27 February 2018 (Winter).

Survey Night	Number of Hours	Number of Individuals		
		Gulls	Alcids	Other Species
25/26 Jan	3.0	1 Glaucous Gull	1 Common Murre, 6 Dovekies	0
27/28 Jan	2.0	5 Glaucous Gulls	0	0
29/30 Jan	2.5	1 Glaucous Gull	1 Common Murre	1 Long-tailed Duck
4/5 Feb	1.8	0	0	0
5/6 Feb	2.0	0	0	0
6/7 Feb	3.0	0	0	0
9/10 Feb	2.0	3 Glaucous Gulls	0	0
10/11 Feb	2.0	2 Great Black-backed Gull	1 Common Murre	0
11/12 Feb	3.2	0	3 Common Murres	0
14/15 Feb	2.0	0	0	0
18/19 Feb	2.3	10 Great Black-backed Gulls, 1 Iceland Gull	0	1 Northern Fulmar, 1 Gyrfalcon
20/21 Feb	1.9	0	1 unidentified alcid	0
21/22 Feb	2.0	0	1 murre	0
24/25 Feb	2.0	0	0	1 Snowy Owl
26/27 Feb	1.7	2 Great Black-backed Gull	0	0

TABLE B-3. Dates, survey effort, and number of individuals by species observed during night-time observations of the Hebron platform, 3–20 May 2018 (Spring).

Survey Night	Number of Hours	Number of Individuals		
		Gulls	Alcids	Other Species
3/4 May	1.3	0	0	1 Savannah Sparrow
4/5 May	2.5	0	0	0
8/9 May	2.8	0	0	1 Northern Fulmar
9/10 May	2.8	0	0	0
10/11 May	2.8	0	0	0
16/17 May	3.0	0	0	0
18/19 May	1.2	0	0	0
19/20 May	3.2	0	0	0

TABLE B-4. Dates, survey effort, and number of individuals by species observed during night-time observations of the Hebron platform, 3 August to 1 November 2018 (Summer and Fall).

Survey Night	Number of Hours	Number of Individuals		
		Leach's Storm-Petrel	Gulls	Other Species
4/5 Aug	3.0	34	0	2 Great Shearwater
5/6 Aug	2.8	30	0	1 Sooty Shearwater, 1 shearwater not identified to species
7/8 Aug	2.0	16	0	0
9/10 Aug	3.0	0	0	1 Great Shearwater
11/12 Aug	2.5	16	0	0
12/13 Aug	2.5	0	0	0
16/17 Aug	1.0	0	0	0
18/19 Aug	3.0	5	0	2 Great Shearwaters
19/20 Aug	3.8	41	0	15 Great Shearwaters
20/21 Aug	3.3	10	0	9 Great Shearwater
22/23 Aug	2.5	4	0	5 Great Shearwater
25/28 Aug	3.0	0	0	0
26/27 Aug	3.0	0	5 Great Black-backed Gull	1 Great Shearwater
27/28 Aug	3.3	1	0	0
28/29 Aug	4.0	18	1 Great Black-backed Gull	1 Northern Fulmar
30/31 Aug	2.0	0	1 Lesser Black-backed Gull	0
4/5 Sep	2.5	0	2 Great Black-backed Gull	0
6/7 Sep	3.0	1	1 Great Black-backed Gull	0
8/9 Sep	3.0	0	0	1 Northern Fulmar
9/10 Sep	3.0	2	1 Great Black-backed Gull	1 Northern Fulmar 1 unidentified small bird
12/13 Sep	2.0	0	2 Great Black-backed Gull	0
13/14 Sep	3.0	0	4 Great Black-backed Gull	0
14/15 Sep	3.0	0	5 Great Black-backed Gull	0
15/16 Sep	3.0	0	3 Great Black-backed Gull	0
16/17 Sep	3.0	0	0	0
17/18 Sep	3.0	0	12 Great Black-backed Gull	0
18/19 Sep	4.0	2	1 Great Black-backed Gull	0
19/20 Sep	3.8	0	6 Great Black-backed Gull	0
22/23 Sep	3.3	0	30 Great Black-backed Gull	0
23/24 Sep	3.0	0	170 Great Black-backed Gull	3 Northern Fulmar
24/25 Sep	3.0	0	140 Great Black-backed Gull	3 Northern Fulmar
25/26 Sep	2.3	0	80 Great Black-backed Gull	2 Northern Fulmar
26/27 Sep	3.0	1	165 Great Black-backed Gull	1 Northern Fulmar
27/28 Sep	3.0	0	18 Great Black-backed Gull	3 Northern Fulmar

Survey Night	Number of Hours	Number of Individuals		
		Leach's Storm-Petrel	Gulls	Other Species
30 Sep/1 Oct	3.0	110	25 Great Black-backed Gull	2 Northern Fulmar
4/5 Oct	3.3	5	6 Great Black-backed Gull	0
5/6 Oct	2.0	17	1 Great Black-backed Gull	0
6/7 Oct	3.0	0	25 Great Black-backed Gull	0
7/8 Oct	2.3	2	56 Great Black-backed Gull	0
12/13 Oct	3.0	2	102 Great Black-backed Gull	4 Northern Fulmar
13/14 Oct	2.5	1	6 Great Black-backed Gull	1 Northern Fulmar
14/15 Oct	3.3	1	19 Great Black-backed Gull	0
15/16 Oct	3.3	0	115 Great Black-backed Gull	1 passerine
17/18 Oct	2.0	0	7 Great Black-backed Gull	1 Northern Fulmar
18/19 Oct	3.0	0	150 Great Black-backed Gull	0
27/28 Oct	3.0	2	45 Great Black-backed Gull	0
28/29 Oct	3.3	0	75 Great Black-backed Gull	0
29/30 Oct	3.3	5	50 Great Black-backed Gull	1 murre, 1 Dovekie
30/31 Oct	3.0	3	190 Great Black-backed Gull	0
31 Oct/1 Nov	3.0	0	150 Great Black-backed Gull	1 Northern Fulmar 1 bird

Appendix C: Summary of Leach's Storm-Petrel Strandings

TABLE C-1. Summary of Leach's Storm-Petrel strandings on the Hebron platform in 2017 and 2018.

Year	Night	No. Storm-Petrels Stranded	Visibility	Sky, Precipitation, Wind	Comments
2017	18/19 Sept.	2	N/A*	N/A*	1 released
	21/22 Sept.	1	N/A	N/A	0 released
	27/28 Sept.	1	N/A	N/A	All released
	29/30 Sept.	4	N/A	N/A	All released
	1/2 Oct.	1	N/A	N/A	Returned to sea under its own power
	2/3 Oct.	11	N/A	Wind 70+ kt.	7 released
	3/4 Oct.	1	N/A	N/A	All released
	4/5 Oct.	3	N/A	N/A	1 released, 2 flew off under their own power
	6/7 Oct.	1	N/A	N/A	0 released
	7/8 Oct.	11	Low	Wind 44 kt. SSW	All released
	9/10 Oct.	11	Low	Wind 50 kt. WNW	All released
	10/11 Oct.	8	N/A	N/A	All released
	11/12 Oct.	5	N/A	N/A	All released
	13/14 Oct.	1	N/A	N/A	All released
	15/16 Oct.	2	N/A	N/A	All released
	16/17 Oct.	3	N/A	N/A	All released
	17/18 Oct.	2	N/A	N/A	1 released
	18/19 Oct.	3	N/A	N/A	All released
	19/20 Oct.	2	N/A	N/A	1 released
	20/21 Oct.	2	N/A	N/A	1 released
22/23 Oct.	1	N/A	N/A	0 released	
24/25 Oct.	1	N/A	N/A	All released	
27/28 Oct.	1	N/A	N/A	0 released	
Total		78			66 released
2018	25/26 Sept.	1	Clear	No rain	All released
	26/27 Sept.	1	Clear	No rain	All released
	5/6 Oct.	4	Clear	No rain	All released
	7/8 Oct.	3	Clear	No rain, strong wind	All released
	5/6 Nov.	1	Clear	No rain	All released
	6/7 Nov.	1	Fog	No rain	All released
Total		11			11 released
Grand Total		89			77 released

* Not reported.