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SEABIRD DATA COLLECTED BY THE GRAND BANKS OFFSHORE HYDROCARBON INDUSTRY 1999-2002: RESULTS, LIMITATIONS AND SUGGESTIONS FOR IMPROVEMENT

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Abstract

Pelagic seabirds were counted by oil industry personnel from eight offshore oil and gas exploration, construction and production sites on the Grand Banks of Newfoundland, Canada from 1997 to 2002. This report is a summary and evaluation of that data.

We found that seabirds were more numerous around glory hole construction and long-term oil production sites than other installations. Of 27 species, Greater Shearwater and Black-legged Kittiwake numbers were the most common with a relative abundance of 55 and 27%, respectively, of total seabirds seen at the sites. Other species, forming 12% of birds present at sometime during the year, in rank order, were Northern Fulmar, Great Black-backed Gulls, Common Murres, Herring Gulls and Thick-billed Murres. The patterns of attendance generally reflected known migration periods. Greater Shearwater and Northern Fulmar numbers increased significantly from year to year, though causal mechanisms remain unclear. Anomalous sightings of Thick-billed Murres in summer and high number's of Cory's Shearwater appear to be an artifact of observer training. Thirty-four non-seabird species of birds and 6 species of marine mammals were recorded.

The majority of birds found stranded on platforms were Leach's Storm-Petrels (97%). Strandings occurred mainly in October (52%), September (32%) and August (15%). Overall, 74% of stranded birds were released, 3% died and only 3% were found with oil on their feathers. The fate of 23% of the stranded birds remains unclear as they were not recorded as dead or released.

The sheer volume of the data collected allowed us to use aggressive data filters to calculate mean and relative abundance estimates for seabirds at sea. However, we identified three general problem areas, namely study design, observer training, and inconsistencies in data management that reduced the power of the findings in this report. In terms of study design, seabird density estimates could not be calculated due to unlimited radius observations, attraction could not be assessed as behaviour of birds was not consistently recorded, and the fate of all birds were not recorded once they were found stranded. Further, the logic of using timed counts from fixed platforms is flawed as an instantaneous count of all birds in a known area is the relevant measure needed to calculate seabird densities. Records of species not expected at certain times of year, an increase in density over the time period of the study and lack of information recorded on ages and plumages suggest some issues related to observer quality and training. Data management issues included the non-recording of days in which birds were not seen, inconsistencies in the format of the data, lack of detailed information on stranded bird encounters and data transcription errors.

We recommend that a standardized seabird monitoring and observer training program for the offshore operations in the Grand Banks region be implemented. Observer training, in-field evaluations and program assessment by seabird experts should be a fundamental part of this program. We have suggested guidelines and data management design that will overcome the major problems and data bias found in this study. If these improvements are implemented, an assessment of the possible attraction of seabirds to the platforms, better estimates of numbers of seabirds at risk around platforms, and the success of the stranded bird encounter program should be possible.

Résumé

De 1997 à 2002, des employés de l'industrie pétrolière ont dénombré les oiseaux de mer pélagiques à partir de huit sites d'exploration, de construction et de production pétrolières et gazières extracôtières se trouvant sur les bancs de Terre-Neuve, au Canada. Le présent rapport est un résumé et une évaluation des données recueillies.

Nous avons constaté que les oiseaux de mer étaient plus nombreux autour des sites de construction d'entonnoirs sous-marins et des sites de production pétrolière à long terme qu'autour d'autres installations. Sur 27 espèces, le Puffin majeur et la Mouette tridactyle étaient les espèces les plus communes, avec une abondance relative de 55 % et de 27 %, respectivement. Les autres espèces, représentant 12 % des oiseaux présents à certaines périodes de l'année, étaient, par ordre décroissant d'abondance, le Fulmar boréal, le Goéland marin, le Guillemot marmette, le Goéland argenté et le Guillemot de Brünnich. Les patrons de présence reflétaient généralement les périodes de migration connues. Les effectifs du Puffin majeur et du Fulmar boréal ont significativement augmenté d'année en année. Les causes de cette augmentation ne sont toutefois pas claires. Les mentions inhabituelles de Guillemots de Brünnich au cours de l'été et les observations d'un nombre élevé de Puffins cendrés semblent être dues à la mauvaise formation des observateurs. Par ailleurs, trente-quatre individus qui ne sont pas des oiseaux de mer et six espèces de mammifères marins ont aussi été mentionnés.

La majorité des oiseaux échoués sur des plates-formes étaient des Océanites cul-blanc (97 %). Les échouages ont surtout été observés en octobre (52 %), en septembre (32 %) et en août (15 %). Au total, 74 % des oiseaux échoués ont été libérés, 3 % sont morts et seulement 3 % avaient du pétrole sur leurs plumes. Le sort de 23 % des oiseaux échoués reste nébuleux; on n'a pas noté s'ils étaient morts ou s'ils avaient été libérés.

À elles seules, les données recueillies nous ont permis d'utiliser des filtres de données serrés pour estimer les abondances moyenne et relative des oiseaux de mer pélagiques. Toutefois, nous avons repéré trois problèmes généraux : conception de l'étude, formation des observateurs et irrégularités dans la gestion des données. Ces trois problèmes ont réduit la fiabilité des constats du rapport. En termes de conception de l'étude, la densité estimative des oiseaux de mer n'a pas pu être calculée à cause de la portée limitée des observations, l'attirance des oiseaux pour les plates-formes n'a pas pu être évalué, le comportement des oiseaux n'ayant pas toujours été noté, et le sort de tous les oiseaux échoués n'a pas été consigné. En outre, les dénombrements minutés à partir de plates-formes fixes comportent des lacunes puisque, pour le calcul de la densité des oiseaux de mer, il est préférable d'effectuer un comptage instantané de tous les oiseaux dans une zone donnée. Les mentions d'espèces qu'on ne s'attendait pas à voir à certaines périodes de l'année, une augmentation de la densité au cours de l'étude et l'insuffisance des données recueillies sur l'âge et le plumage laissent douter des compétences et de la formation des observateurs. Parmi les problèmes de gestion des données figurent la non-consignation des jours où aucun oiseau n'a été observé, les irrégularités liées au format des données, le manque d'information détaillée sur les oiseaux échoués trouvés et les erreurs de transcription des données.

Nous recommandons la mise en œuvre d'un programme normalisé de surveillance des oiseaux de mer et de formation des observateurs dans les exploitations extracôtières de la région des bancs de Terre-Neuve. Une formation des observateurs, des évaluations de terrain et un examen du programme par des experts des oiseaux de mer doivent faire partie intégrante du programme. Nous avons proposé des directives et un cadre de gestion des données, qui résoudront les problèmes majeurs et les biais des

données observés dans la présente étude. Si ces améliorations sont adoptées, une évaluation de l’attirance possible des oiseaux de mer pour les plates-formes, de meilleures estimations du nombre d’oiseaux de mer en danger autour de ces plates-formes et le succès du programme de surveillance des oiseaux échoués devraient être possibles.

1. INTRODUCTION

Offshore oil and gas exploration on the Gr and Banks began in the early 1980s. In November of 1997, the Hibernia fixed platform was the first to produce oil. In January of 2002, the Terra Nova Floating Production Storage and Offloading vessel (FPSO) achieved first oil for the Terra Nova Development Corporation. Future oil and gas production is scheduled to begin in late 2005 or early 2006 on the White Rose field by Husky Energy (http://www. huskywhiterose.com). The Grand Banks oil industry continues to grow as seismic surveys continue to be conducted and licenses for oil and gas exploration programs are purchased by oil companies as far out as the Flemish Pass in water up to 3000 m deep (Fig. 1).

Oil operations may attract and concentrate migratory seabirds by means of artificially enhanced food supply and lights (Tasker et al. 1986, Baird 1990, Wolfson et al. 1979, Wiese et al. 2001). Northern Fulmars *Fulmarus glacialis*, Shearwaters *Puffinus* spp. and Leach's Storm-Petrels *Oceanodroma leucorhoa* are naturally attracted to light, and especially storm-petrels, collide with light producing stationary or moving structures (Huntingdon et al. 1996). To understand the relative vulnerability of seabirds near offshore oil industrial activities, the degree of association of seabirds with these sites needs to be known (Wiese et al. 2001). Between 1997 and 2002, almost 30,000 litres of crude oil and synthetic based drilling fluid were reported spilled from Grand Banks exploration drilling, development drilling and production oil operations. Most of these spills occurred in the winter (http://www.cnopb.nfnet.com) when numbers of seabirds on the Grand Banks are highest and species especially vulnerable to oil pollution, such as Thick-billed Murres *Uria lomvia* and Dovekies *Alle alle*, are abundant (Lock et al. 1994, Wiese and Ryan 2003). It is also the time of year when recovery of oil on the ocean surface is most difficult.

The Canada-Newfoundland Atlantic Accord Implementation Act was formed in 1987 to "implement an agreement between the Government of Canada and the Government of Newfoundland and Labrador on offshore petroleum resource management" (http://laws.justice.gc.ca/en/C-7.5/25258.html). This joint federal and provincial operation established the Canadian-New foundland Offshore Petroleum Board (C-NOPB) with the mandate to foment hydrocarbon exploration on the Grand Banks and at the same time to coordinate most environmental legislations, emergency measures and coast guard regulations related to hydrocarbon development within 500 m of these installations. On the federal level, however, the *Migratory Birds Convention Act* (MBCA) and *Species at Risk Act* (SARA) and associated policies are mandates of the Canadian Wildlife Service (CWS) of Environment Canada. According to the National Policy on Oiled Birds and Oiled Species at Risk, CWS has legal responsibility "to assess the threat to migratory birds based on ... number of birds affected, presence of species at risk and the timing and location of these species" (Lock 2000). In order to assess the long-term impacts of offshore hydrocarbon developments on bird populations and their ecosystems, CWS aims to play an active role in supporting and evaluating offshore petroleum industry seabird monitoring programs.

The Terra Nova Development Corporation has operated a seabird monitoring and Leach's Storm-Petrel mitigation program as recommended by the Environmental Assessment Panel for the Terra Nova Project. Husky Energy also began to monitor seabirds using a protocol similar to that of Terra Nova. These surveys were conducted at various phases of oil operations including exploratory drilling operations, glory hole construction, well abandonment operations and at oil producing platforms.

This report is an evaluation of the current Grand Banks offshore oil and gas development seabird monitoring programs and deals mainly with seabird monitoring on fixed-platforms. The goal of this report was to assess the scientific quality of seabird-related industry programs and activities by compiling and summarizing all available spatial and temporal seabird abundance data and deck stranded birds associated with Grand Banks offshore oil platforms during 1997 – 2002. Where necessary, deficiencies in the current offshore monitoring program are identified and guidelines for improvement are provided.

2. METHODS

2.1 Study sites

Data on seabird distribution at sea (SAS) and stranded bird encounters (SBE) were collected from 8 offshore hydrocarbon sites on the northeastern Grand Banks, Newfoundland during 1997 to 2002 (Fig. 1, Table 1).

2.2 Study design

2.2.1 SAS surveys

Data were collected from the Henry Goodrich between the spring of 2000 and the end of 2002 (Table 2). Surveys from several oil and gas development operations of Husky Energy were conducted upon commencement of operations in late summer of 2002. Data were collected from the Hibernia production platform in 1997 and 1998 as required by Canadian-Newfoundland Offshore Petroleum Board (C-NOPB) environmental assessment process; no seabird data has been collected at Hibernia since. For simplification we refer to all relatively fixed construction vessels as 'platforms'.

Seabird observations were made from inside the main steering bridge (Terra Nova) or outside on the wing bridges (Husky Energy) of the oil and gas platforms. Platform personnel whose regular occupations onboard were medical technicians (Terra Nova), weather/ice observers, or dynamic positioning operators (Husky Energy) performed the surveys. Wherever possible observers with interest or experience in seabird or marine mammal observation were used. Observers were trained by Jacques Whitford Environment Ltd. St. John's NL. Typical training sessions were 3 to 4 hours long and included protocols, observation technique (Knox and Williams 1999) and seabird identification, which was taught using bird field books (Harrison 1983) and a manual designed by Jacques Whitford for the Terra Nova Seabird Monitoring Program (Knox and Williams 1999).

Counts were to be conducted during day-light hours in 20-minute periods, 3 times per day. Surveys focused on seabirds although other bird species and marine mammal sightings were noted. At all sites, survey field of view was 180º with an unlimited observation radius. All observations were made with the naked eye, however binoculars and spotting scopes were provided for verification of identification in some cases. Seabird behaviour, the presence of oil and the occurrence of dead birds were recorded in the 'Comments' section of datasheets. Observers were asked to record environmental conditions such as sea state, wave height, wind force, visibility and precipitation.

2.2.2 Stranded bird encounters

Observers were asked to perform walkabouts to look out for Leach's Storm-Petrels stranded on deck. Other bird species were recorded opportunistically during the daytime. Live petrels found were released at night by dropping them into the sea following methods developed by Terra Nova and the Canadian Wildlife Service (Williams and Chardine 1999) or in Husky Energy's case a similar protocol developed by Husky Energy in consultation with W. Montevecchi and reviewed by CWS. Birds that could not be released immediately due to injury or time of day were held for recovery for a minimum of 15-20 minutes in small boxes. These birds were subsequently released upon sufficient recovery. Birds with extensive injuries were sent to Environment Canada for euthanization.

2.3 Data management

Observers recorded survey information on data sheets in the field. The data sheets were faxed from ship to shore to the respective oil company environmental directors on a weekly (Terra Nova) or monthly (Husky Energy) basis. The data was then entered into MS Excel worksheets. Photocopies of raw field data sheets from the 1999 Queen of the Netherlands (Terra Nova) surveys were made available to CWS. Data for all years and platforms were compiled into one Excel file. Data were recorded and reported using a variety of data fields, formats, units and species naming conventions, all of which had to be standardized in order to query the data set and perform analyses. Where the species was not obvious, it was changed to unknown. We converted all species names to American Ornithological Union (AOU) codes, and used derived codes when exact species was not known. The final dataset comprised 4191 records collected over 5 years from 7 platforms.

2.4 Data analysis

2.4.1 SAS detection

2.4.1.1 Detectability

Detectability of seabirds is the degree to which a bird can be seen and whether its identification is reliable (Montevecchi et al. 1999). We examined the influence of environmental factors on seabird observations with scatterplots of seabird counts against time of day, sea state, wind force and visibility estimates. We determined the point at which seabird numbers decreased noticeably through visual inspection of the scatterplots and removed from the analysis any records that fell above or below these threshold values (Table 3).

2.4.1.2 Abundance

Each species was tallied using the maximum number of birds seen per day (DMAX) based on the three daily observation periods. This approach treats each day as the analysis sample, rather than each observation period, as counts within days can be highly correlated by counting the same birds all day. Mean abundance (MA) and relative abundance (RA) for each species was calculated from DMAX (Tasker et al. 1986):

$$MA(species) = \frac{\sum DMAX(day)}{n}$$

$$RA(species) = \frac{MA(species)*100}{\sum MA(species)}$$

where *n* is the number of sample days per month

We calculated MA for each species by month and RA by season: winter (Dec – Feb), spring (Mar – May), summer (Jun – Aug) and autumn (Sep – Nov). Broad trends on DMAX for each species over years were assessed using General Linear Models (GLM) with month as a categorical factor to account for seasonal differences in migratory populations. Values are reported as means ± 1 SE.

3. Results

3.1 Survey effort

With the exception of Hibernia, survey effort (number of surveys per day) was consistent among platforms and years during periods of operation, averaging 2.1 to 2.9 counts/day (Table 2). Surveys were conducted during daylight hours, with roughly one survey during the morning, at noon and in the early evening at all sites. The only exception was at the Hibernia B-44 site (Husky Energy observers), where no surveys were conducted during mornings. Data from Hibernia platform surveys in 1997 and 1998 were not available and are thus not included in this report.

3.2 SAS abundance estimates

The use of data filters for sea state, wind scale and visibility filters resulted in the elimination of 47% of observation records (Table 3). A total of 27 seabird species were recorded by observers on the Grand Banks during 1999-2002. Greater Shearwaters *Puffinus gravis* and Black-legged Kittiwakes *Rissa tridactyla* dominated the assemblage and the 12 least abundant species comprised less than 1% of total seabird numbers (Table 4). Daily maximum counts for the total of all species at the Henry Goodrich increased significantly between 2000 and 2002 ($F_{1,1325} = 38.4$, $P < 0.001$), from approximately 27.8 ± 5.3 (n = 184) in 2000, to 48.0 ± 6.2 (n = 243) in 2001 and 84.2 ± 12.8 (n = 207) birds/day during 2002 (Fig. 2). This increase was due to changes in Greater Shearwaters and Black-legged Kittiwakes and was not apparent when these two species were excluded ($r^2 = 0.002$, $F_{1,792} = 1.6$, $P = 0.2$). Total numbers of seabirds were highest around the Henry Goodrich platform in winter and lowest in summer, although species composition varied significantly among seasons (Fig. 2, see Section 3.4 below).

3.2.1 Greater Shearwaters

Greater Shearwaters were observed from June to November in high numbers at all platforms and were most abundant at the Henry Goodrich. The number of Greater shearwaters increased gradually throughout the summer, peaked in September, and then decreased rapidly (Fig. 3). At the Henry Goodrich, numbers of shearwaters increased significantly each year ($F_{1,621} = 24.5$, $P < 0.001$) with annual DMAX means of

13.0 ± 4.4 (n = 184), 16.7 ± 3.4 (n = 243) and 52.8 ± 10.7 (n = 207) birds/day and peaks of 46.2 ± 37.9 (n = 21), 53.5 ± 17.2 (n = 25) and 196.3 ± 62.5 (n = 23) birds/day in the early autumn months during 2000, 2001 and 2002, respectively (Fig. 3). Median flock size was usually less than 50, with sporadic flocks of up to 1200 birds at the Seahorse, and typically persisted for less than a day. However, at the Henry Goodrich in 2002, high shearwater flock counts occurred daily and generally persisted for a week. At the other platforms in 2002, peaks of approximately 70 (Trepassey J-91) to 146 (Seahorse) birds/day in any given month were observed. In 1999, the highest monthly mean flock size recorded from the Queen of the Netherlands was 26.8 ± 20.1 birds/day.

3.2.2 Black-legged Kittiwakes

Black-legged Kittiwakes were present from October to May and most prevalent during early winter at the Henry Goodrich during 2000-2002, with peaks of 103.2 ± 38.5 (n = 21) to 116.5 ± 43.5 (n = 8) birds/day in November or December and flocks of up to 700 birds (Fig. 4). Mean abundance during 2000, 2001 and 2002 was 8.2 ± 2.6 (n = 84), 23.2 ± 4.9 (n = 243) and 23.5 ± 5.4 (n = 207) birds/day, respectively. This increase in abundance was significant over the three years ($F_{1,621}$ = 4.9, P = 0.03). Median flock size was usually less than 10 birds yet flock counts of up to 600 birds (Henry Goodrich) persisted for several days when present. At the Seahorse, the monthly average abundance reached 45 birds/day and a maximum flock of 160 birds was observed in October. Kittiwake estimates ranged from approximately 1 bird/day in July to 12 birds/day in June 1999 at the Queen of the Netherlands. During the post-breeding season at White Rose, Hibernia B-44 and Trepassey J-91 sites, kittiwake numbers were lowest ranging from 0.3 – 6 birds/day. No Black-legged Kittwakes were reported to occur at Gros Morne C-17.

3.2.3 Northern Fulmar

At the Henry Goodrich, Northern Fulmars were generally present year round with numbers higher in spring and autumn and very low numbers during January, however these patterns varied annually (Fig. 5). In some years numbers were higher in spring than autumn, with peaks of no more than 3-7 birds/day. During late 2002, other survey platforms had similar abundance estimates to those at the Henry Goodrich. However, an anomalous spike occurred at the Hibernia B-44 site, where 23.4 ± 9.4 (n = 24) birds/day occurred when large flocks of fulmars from 90 to 200 birds persisted throughout mid-October. At the Henry Goodrich, fulmar numbers increased significantly ($F_{1,621}$ = 4.5, P = 0.03), with annual averages from 0.9 ± 0.3 (n = 184) to 2.0 ± 0.8 (n = 243) to 2.9 ± 0.8 (n = 207) birds/day during 2000, 2001 and 2002, respectively. No fulmars were observed at the beginning of the Henry Goodrich monitoring program in spring 2000, and may reflect observer inexperience as they are easily confused as gulls.

3.2.4 Great Black-backed Gull

Great Black-backed Gulls *Larus marinus* were common from September to February in most years at the Henry Goodrich and were almost completely absent from March through August (Fig. 6). A striking decrease occurred in the autumn/winter peaks from 28.9 ± 11.8 (n = 8), 15.5 ± 8 (n = 15), to 6.5 ± 2.3 (n = 23) birds/day during 2000, 2001 and 2002, respectively. The annual averages of 1.9 ± 0.7 (n = 184), 2.4 ± 0.8 (n = 243) and 1.2 ± 0.3 (n = 207) birds/day during 2000, 2001 and 2002, respectively, show an almost 40% reduction from 2000 to 2002, but this apparent decrease was not significant ($F_{1,621}$ = 1.4, P = 0.2). During the autumn of 2002, the other platform sites reported peak numbers of only 2-4 birds/day in any given month. Great Black-backed Gulls were only present at the Hibernia B-44, Gros Morne and Henry Goodrich sites.

3.2.5 Herring Gull

Herring Gulls *Larus argentatus* were present year round at the Henry Goodrich and exhibited variable attendance patterns (Fig. 7). At the Henry Goodrich, these gulls were most prevalent during spring and fall with monthly peaks of less than 3 birds/day. Numbers were consistently low during August and January. An anomalous spike, 7.6 ± 17.9 (n = 17) birds/day, occurred in April 2001 when a large flock of 75 birds appeared for one day. We found no significant change in Herring Gulls throughout the years ($F_{1,621}$ = 0.01, P = 0.9) and annual averages in DMAX were 0.6 ± 0.1 (n = 184), 1.6 ± 0.4 (n = 243) and 0.8 ± 0.1 (n = 207) birds/day during 2000, 2001 and 2002, respectively. At platforms other than the Henry Goodrich, Herring Gulls occurred in sporadic groups of lower numbers.

3.2.6 Common Murre

Common Murres *Uria aalge* were most prevalent during May-June and November at the Henry Goodrich, White Rose and Hibernia B-44 sites, with 1-3 birds/day recorded during those months. At the Henry Goodrich, the annual average for maximum daily abundance was 0.9 ± 0.2 (n = 184), 0.9 ± 0.2 (n = 243) and 0.5 ± 0.2 (n = 207) birds/day during 2000, 2001 and 2002, respectively and no significant trend in abundance was detected ($F_{1,621}$ = 1.4, P = 0.2) (Fig. 8). In 2000 at the Henry Goodrich, unlike in 2001 or 2002, Common Murres were reported to have persisted in steady numbers throughout the winter. A peak of 27.3 birds/day occurred at Hibernia B-44 in November 2002 as the result of one flock of 200 birds sighted on one day. At the White Rose sites, Common Murres were sighted on only 2 of 10 sampling days during September of 2002. Almost no murres were sighted around the Queen of the Netherlands, Seahorse or Gros Morne platforms, probably because sample dates did not overlap with timing of migration.

3.2.7 Thick-billed Murre

Thick-billed Murres were not recorded from any site other than the Henry Goodrich and were virtually absent from observations until 2002. Birds were observed from November to April in low numbers (Fig. 9). The number of Thick-billed Murres counted per year increased from 0.05 ± 0.02 (n = 184), 0.2 ± 0.1 (n = 243) and 1.9 ± 1.2 (n = 207) birds/day during 2000, 2001 and 2002, respectively ($F_{1,621}$ = 4.8, P = 0.03). Coinciding with the expected mass migration (Huettman and Diamond 2000), a flock of 250 Thick-billed Murres were sighted in mid-November of 2002. This flock constituted over half of the numbers recorded over a 4-year period. Sightings typically ranged from an average of approximately 5-15 birds/month when present. This species was apparently present in July of both 2001 (0.2 birds/day) and 2002 (5.1 birds/day) outside of its expected date range. During early spring, peaks of approximately 0.5 and 2.5 birds/day were sighted during 2001 and 2002, respectively.

3.2.8 Leach's Storm-Petrel

Leach's Storm-Petrels were present during spring and autumn in low numbers with peaks of 0.7 birds/day during August in any given year at the Henry Goodrich (Fig. 10). Petrels typically were absent from the Grand Banks sites from October to April. From the Queen of the Netherlands in 1999, an anomalous spike of 5.5 birds/day (n = 20) in July was reported when a flock of 101 birds occurred in contrast to the typical groups of 1-3 birds. In 2002, storm-petrels occurred at almost all platforms operating before October, but in very low numbers (usually < 0.3 birds/day for any given month).

3.2.9 Cory's Shearwater

Sightings of Cory's Shearwaters *Calonectus diomedea* were erratic and reported from only two platforms, the Henry Goodrich and the Seahorse. At the Henry Goodrich, birds were seen from September to November with peaks of 1.9 and 0.8 birds/day during 2000 and 2001, respectively, and were absent in 2002 (Fig. 11). However, at the Seahorse, 8.3 birds/day (n = 12) in September of 2002 were recorded due to a large flock of 100 individuals on one day. These numbers of Cory's Shearwaters seem high, given that Sooty Shearwaters, a far more abundant bird, were seen in lesser numbers (see below).

3.2.10 Sooty Shearwater

Sooty Shearwaters *Puffinus griseus* were seen more frequently than Cory's Shearwater yet in lower overall numbers. From November to April, Sooty Shearwaters were absent from the platforms. During 2000 and 2001 at the Henry Goodrich, birds were observed in May and June (approximately 0.6 birds/day) and in higher numbers between August and October (approximately 2.5 birds/day; Fig. 12). Mean abundance was much lower in 2002 and no birds were sighted at the Queen of the Netherlands in 1999, even though surveys coincided with their migration period. This species was also reported in low numbers from the Trepassey (July) and Seahorse (September) in 2002.

3.2.11 Dovekies

Few Dovekies were observed on the Grand Banks oil fields. The majority of birds were sighted from the Henry Goodrich in 2000-2002 between October and February (Fig. 13). Dovekies were also seen from the glory hole construction platforms, Queen of the Netherlands in 1999 and the Seahorse in 2002. When present, mean abundance was less than 1.0 birds/day. However, 54 birds were sighted in 4 days during November 2000 with an average of 2.6 birds/day (n = 21) for the month. In 2001, 3 birds were sighted later than usual in April and May.

3.3 Diurnal attendance patterns

Combining data from all platforms, there is no evidence that the number of birds seen were different in the morning (before 1100h), afternoon (between 1100h and 1600h) or evening (after 1600h) ($F_{2,1317}$ = 0.27, P = 0.76).

3.4 Relative abundance at the Henry Goodrich 2000-2002

Greater Shearwaters dominated seabird assemblages at the Henry Goodrich during summers (88-96%, Fig. 14). In contrast, Black-legged Kittiwakes were the most abundant species in winter (78-86%). Despite significant increases in numbers, the relative abundance of Northern Fulmars in spring decreased threefold between 2000 and 2002 from 25 to 8%. This decrease was due to parallel annual increases in Greater Shearwaters and kittiwakes. The relative abundance of Greater Black-backed Gulls also decreased from 7 to 1%. On the other hand, Herring Gull abundance fluctuated with no clear pattern except that they were most common during the spring when they made up 10-30 % of the seabird assemblage. The relative abundance of murres (Common and Thick-billed Murres) was similar through the seasons at approximately 5%. Other seabirds such as Leach's Storm-Petrels, Cory's Shearwater and Dovekies, had annual relative abundance estimates of < 1%.

3.5 Differences among platforms in summer and autumn 2002

The two sites with information from summer 2002, the Henry Goodrich and Trepassey J-91, had a similar volume of birds, at 60 and 71 birds/day, respectively (Fig. 15). There were considerably less birds near the platforms during summer than autumn. In autumn, the Henry Goodrich hosted the most birds with 190 birds/day (Fig. 16). Seabird abundance estimates were similar between the Seahorse and Gros Morne sites, 140 and 117 birds/day, respectively. The White Rose and Hibernia B-44 platforms had the lowest numbers of birds in autumn at 93 and 81 birds/day, respectively.

Greater Shearwaters comprised 96 and 92% of seabirds near the Henry Goodrich and Trepassey platforms in summer, respectively (Fig. 15). Similarly, during autumn, this species dominated with 98, 93, 80 and 72% relative abundance at the Gros Morne, White Rose, Seahorse and Henry Goodrich. The Hibernia B-44 platform saw the lowest proportions of Greater Shearwaters with 58% of total abundance (Fig. 16).

Of the other species seen in summer, murres and kittiwakes were present at the Henry Goodrich, while fulmars, Sooty Shearwaters and Black-legged Kittiwakes were seen at the Trepassey platform (Fig. 15). Of the other species seen in autumn, Northern Fulmars were relatively common at the Hibernia B-44 site, and seen at the Henry Goodrich, Seahorse and White Rose (Fig. 16). Great Black-backed Gulls were the only other species seen in any number at the Gros Morne site. Black-legged Kittiwakes were the most abundant bird (after Greater Shearwaters) at the Henry Goodrich and the Seahorse. Murres were seen from the White Rose, Hibernia B-44 and Henry Goodrich.

In a comparison of seabirds associated with glory hole construction sites and the long term oil production site we found that the Queen of the Netherlands (42.4 birds/day, N = 98 d) had 2.6 times the total number of birds from May to September in 1999 than did the Henry Goodrich in 2000 (16.4 birds/day, n = 118 d) at the same geographic location. Similarly, the Seahorse (140 birds/day, n = 20) had much higher numbers than the Henry Goodrich in 2000 (22.7 birds/day, n = 40) and 2001 (51.4 birds/day, n = 38), although the Henry Goodrich surpassed the number of seabirds associated with the Seahorse for the same time period in 2002, with an average of 175 birds/day (n = 38).

3.6 Stranded bird encounters (SBE)

A total of 469 stranded birds from 11 different species were reported for all Grand Banks offshore oil platforms over a 6-year period (Table 5). The majority of stranded species recorded were Leach's Storm-Petrels (97%), although this was expected as it was the priority species during these surveys. Bird strandings on deck occurred mainly in October (52%), September (32%) and August (15%). The maximum number of birds found in any given day was 52 Leach's Storm-Petrels. Overall, 74% of all birds were reported to have been released and 3% died. Only 3% were found with oil on their feathers. Because the fate of individual birds was not distinguished on days where more than one bird was encountered, we could not discern the proportion of oiled birds that died. The fate of 23% of birds is unknown because they were not recorded as dead or released.

3.7 Birds other than seabirds

Thirty-four species of birds other than seabirds, seaducks, terns and gulls were seen on the Grand Banks during hydrocarbon operations from 1999-2002. Of the birds that were identified to species, included were 4 raptor, 7 warbler, 6 sparrow, and 3 flycatcher species (Appendix A).

3.8 Marine mammals and turtles

Six species of marine mammals were identified during routine seabird surveys (Appendix B). A group of 17 Orcas were seen from the Seahorse on 4 September 2002. Also, a leatherback sea turtle was seen on 28 September 2002 from the Henry Goodrich.

4. DISCUSSION

4.1 Seabird attendance at offshore platforms

4.1.1 Greater Shearwaters

Greater Shearwaters near the Grand Banks oil platforms typically comprised 80 to 98% of the total bird numbers at any platform in summer and autumn. It is thought that the entire southern hemisphere Greater Shearwater population, breeders and non-breeders alike, concentrate during our summer in North Atlantic waters (Huettmann and Diamond 2000). Greater Shearwaters show a steady increase in numbers through each summer and a peak in September. Breeding shearwaters arrive on their colonies in August and September, so many of the birds present in the North Atlantic at this time are likely to be non-breeders (Huettmann and Diamond 2000).

The significant annual increases of shearwaters at the Grand Banks oil platforms during 2000-2002 could be related to a number of factors. Oil platforms are known to provide artificial reef environments (Wolfson et al. 1979). Brown et al. (1981) showed that Greater Shearwater numbers fluctuated from year to year and suggested that these birds follow seasonal peaks in local food sources. This may help explain sporadic movements of large flocks through the oil fields. Because novice observers tend to underestimate flock sizes (Komdeur et al. 1992), it is also possible that observed annual increases in abundance reflect increasing observer ability. Currently, it is not possible to discern whether the observed increases represent a real change in annual/spatial distribution or is due to random variation.

4.1.2 Black-legged Kittiwakes

Black-legged Kittiwakes were the second most abundant seabird after Greater Shearwaters and the most abundant species in winter. During the post-breeding migration in autumn, Canadian east coast kittiwake populations are known to congregate on the Grand Banks (Baird 1994). The data presented support the premise that large numbers of kittiwakes also over-winter on the Grand Banks (Brown et al. 1975, 1986). Similar to the findings from surveys conducted under the Programme Intégré des Recherches sur les Oiseaux Pélagiques (PIROP 1966-1992), kittiwakes associated with the Henry Goodrich were most prevalent from November to January during 2000-2002 on the Grand Banks (Lock et al. 1994). After January, numbers at the oil fields declined and then resurged again in March and May. However, breeders typically return to their nest sites at Newfoundland colonies in early February to April (Baird 1994). The short spikes around the oil fields in May likely comprise concentrations of juvenile kittiwakes that lag behind breeders that are migrating from the Grand Banks to south Greenland (Huettmann and Diamond 2000). Juvenile kittiwake plumage is highly distinct from the adult plumage and is retained for the first year. Unfortunately, no observations on age or plumage characteristics were recorded.

4.1.3 Northern Fulmar

Northern Fulmars are arctic/sub-arctic breeding Procellariformes and in accordance with observations made during PIROP, generally concur on the Grand Banks during migration periods in April-May and October-November (Lock et al. 1994, Hatch and Nettleship 1998). Huettmann and Diamond (2000) reported a large peak in molting birds during July, mainly on the Labrador Banks, whereas fulmar presence at the oil rigs in July varied from year to year. Fulmars arrive near the Grand Banks oil rigs from northern Canada, Greenland and Europe after their post-breeding molt in October (Hatch and Nettleship 1998, Huettmann and Diamond 2000). Northern Fulmars are known to over-winter in large numbers from December - March off New England (Hatch and Nettleship 1998). The PIROP dataset (Lock et al. 1994) showed that fulmars were absent from the eastern Grand Banks by December (1966-1992) yet they persisted until January at the Henry Goodrich in 2000-2002. This delayed departure occurred in all study years and may be attributed to an attraction source provided by the man-made structures. A significant increase in fulmars through time at the platforms and the fact that they were common throughout the entire study area support the notion of fulmars being attracted to platforms. However, without further study on behaviour, oceanographic and other environmental conditions, no definite causal relationship can be determined.

4.1.4 Large Gulls

Great Black-backed Gulls were only present near the Grand Bank platforms in winter (November-January). Great Black-backed Gulls in Newfoundland leave the breeding colonies in late August and generally move 50-100 km offshore, where they remain until April (Good 1998). Although they are also known to winter in coastal areas, freshwater lakes and landfill sites (Good 1998), it is becoming increasingly apparent that offshore areas are important wintering sites for this species. Huettmann and Diamond (2000) surmise that Great Black-backed Gull winter numbers on the Grand Banks may comprise post-breeding adults from west Greenland and northern Newfoundland and Labrador. Two recent CWS band returns suggest that a trans-Atlantic winter migration is possible, as one juvenile banded in Newfoundland was reported in Spain 2½ years later (killed in the *Prestige* oil spill) and another was resighted in Portugal in October of the year it was banded (unpublished data, CWS St. John's). The high monthly peak averages were the result of sporadic flocks of moderate numbers of birds, for example: 2 of 6 sample days in December of 2000 comprised 70% of gulls counted for the month; 1 of 17 sample days in Nov of 2001 comprised 57% of gulls; in 2002 a total of only 34 gulls were seen over 15 sample days.

Non-breeding Great Black-backed Gulls typically remain on the wintering grounds during summer (Good 1998). Huettmann and Diamond (2000) found that immature Great Black-backed Gulls (1-4 years old) were on the Grand Banks during the pre-breeding season, and their distributions differed from those of adults. However, very few Great Black-backed Gulls were sighted in spring and summer from the Grand Banks oil platforms in this study. Information on age was not consistently collected so age-specific patterns and the relative proportion of juveniles to adults could not be extracted from the data.

Unlike Great Black-backed Gulls, Herring Gull numbers fluctuated within and among years, and averaged less than 3 birds/day in any given month. Bird numbers were highest during pre- and post- breeding seasons with occasional flocks of 10 to 20 birds. The data support the notion that breeders and immatures move away from the area during winter and stay near the coast during summer (Brown 1968, Huettmann and Diamond 2000).

4.1.5 Murres

There are over ½ million breeding pairs of Common Murres in eastern Canada and over 2 million breeding pairs of Thick-billed Murres in the Canadian High Arctic and western Greenland (Lock et al. 1994; Gaston and Hipfner 2000; Ainley et al. 2002). For many of these birds, the Grand Banks is an important over-wintering and molting area though timing of migration differs among the two species (Lock et al. 1994, Huettmann and Diamond 2000, Ainley et al. 2002). The auks are the most vulnerable taxa to oiling at the platforms as they spend a large amount of time on the water surface, especially during molt when they are temporarily flightless (Lock et al. 1994; Montevecchi et al. 1999). The Grand Banks have been confirmed as a wintering (November-December) and molting ground for Thick-billed Murres (Huettmann and Diamond 2000), but oddly, no Common or Thick-billed Murres were seen at this time from the Queen of the Netherlands in 1999 and very few Thick-billed Murres were seen from the Henry Goodrich until 2002.

Common Murres are known to exhibit a random dispersal to the continental shelf from breeding colonies and tend to arrive on the Grand Banks in August/September (Tuck 1961, Ainley et al. 2002). Young Thick-billed Murres do not arrive on the Grand Banks until October/November and the adults generally arrive one to two month after that (Gaston and Hipfner 2000). By March/April Thick-billed Murres leave again to migrate north while Common Murres head east to their breeding colonies (Tuck 1961). It thus seems unlikely that the spikes of murres observed in April and July were Thick-billed Murres. It is difficult to distinguish Common and Thick-billed Murres (and Razorbills) from a distance (Lock et al. 1994; Ainley et al. 2002) and they are easily missed altogether in high seas or poor lighting conditions. Abundance patterns and distinctions made between these two species in the present study are thus somewhat questionable.

4.1.6 Leach's Storm-Petrels

Leach's Storm-Petrels are one of the most numerous seabird species encountered during transect surveys from St. John's to the Hibernia oil fields (Burke et al. 2005). However, storm-petrels were one of the least numerous birds observed from the platforms in this study and were only sighted sporadically during spring and fall when millions migrate through to the area (Sklepkovych and Montevecchi 1989). Their small size, dark colour and the fact that observers were standing high above the water level all make it likely that many petrels were simply not seen. One nearby colony, Baccalieu Island, supports 4 million breeding pairs of petrels (Sklepkovych and Montevecchi 1989) that leave their nests to forage offshore for several days before returning to their chicks or eggs (Huntingdon et al. 1996). Storm-Petrels are planktivorous nocturnal feeders that are attracted to the luminescence of prey that rise in the water column at night (Huntingdon et al. 1996). As a result, they are known to concentrate at artificial and natural light sources (Huntingdon et al. 1996). Efforts to survey birds at night with infrared night-vision binoculars or radar, at least on an experimental basis, may prove useful.

4.1.7 Dovekies

Dovekie numbers around Grand Banks oil platforms were low when present at all. Both the PIROP and this dataset show that Dovekies are most prevalent from November to January, resurge again in May, but are completely absent from June to September. Dovekies, as well as Thick-billed Murres are of concern to CWS because they are among the most common casualties of oil pollution found on beached bird surveys in southeastern Newfoundland (Wiese and Ryan 2003). The Grand Banks are the chief wintering area for the tens of millions of breeding pairs of Dovekies from the Canadian Arctic and west Greenland (Lock et al. 1994, Montevecchi and Stenhouse 2002). Dovekies are known to concentrate around the east slope of the Grand Banks (Montevecchi and Stenhouse 2002) but were also the most abundant species observed from offshore oil supply vessel surveys during winter within the oil fields (Burke et al. 2005). In contrast, little over 100 Dovekies were seen from oil platforms over the 3-year period. Although it is possible that Dovekies were simply not there, it seems more likely, based on all the other sources of data, that platform observers overlooked them due to their small size, or an insufficient sampling regime.

4.1.8 Differences among platforms

It is apparent that despite their close proximity, platforms on the Grand Banks support different assemblages of birds. Seabirds were monitored from oil production and exploration platforms, well abandonment sites and glory hole construction. Most factors known to contribute to the attraction and vulnerability of seabirds such as oil spills, lights, human waste and fouling (Wolfson et al. 1979; Baird 1990; Wiese et al. 2001), vary among these sites and thus differences in seabird abundance and species composition between them is not surprising.

Glory hole construction sites, such as the Queen of the Netherlands in 1999 and Seahorse in 2002, appear to attract more birds than well abandonment operations and exploration platforms, but less than long-term oil production sites. The glory hole sites for the Henry Goodrich were dug by the Queen of the Netherlands in 1999 from May to September. Greater Shearwaters and Black-legged Kittiwakes appeared to increase in numbers between 2000 and 2002 at the Henry Goodrich. Both species appear to over-winter near the platforms and are probably attracted to the more predictable food sources (Brown et al. 1981, Baird 1994, Wiese et al. 2001). Although flocks of hundreds of Black-legged Kittiwakes visited the Henry Goodrich and the Seahorse in the autumn of 2002, numbers were significantly lower at all other platforms.

The Gros Morne site had the lowest diversity of birds, an artifact sometimes attributed to poor observer training (Van der Meer and Camphuysen 1996). Similarly, virtually no Thick-billed Murres were seen from any vessel, including the Henry Goodrich until 2002, an unusual result given their expected presence in winter. The degree to which observer skill varies among platforms is unknown, but it is quite possible that observed patterns may not reflect real differences among platforms.

4.2. Limitations of the data and areas for improvement

Inconsistencies in data collection effort and protocols among locations and years were evident. We classify these problems into three main areas: 1) study design, 2) observer training and 3) data management.

4.2.1 Study design

4.2.1.1 SAS surveys

Although the collected data generally allow the determination of general migration patterns and a broad overview of the species present near platforms, no information on possible attraction of seabirds to platforms could be extracted. For densities of seabirds to be calculated and hence compared to ship based surveys, observers should determine the area being observed by giving a direction and radius in which birds are being documented. In addition, behavioural data should be collected in a rigorous fashion so that true platform associates can be distinguished from birds simply flying by. Such information could also give insight on why birds are present and their main activities around platforms.

Oceanographic regimes influence the distribution and abundance of seabirds and their prey (Mehlum et al. 1996, Ostrand et al. 1998). Basic information such as water temperature, salinity and speed of currents was likely recorded by the platform computer system (D. Taylor and U. Williams, pers. comm.). Integrating this information with the seabird data would thus be a beneficial undertaking. Likewise, disturbances such as helicopters, proximity of fishing vessels, effluent dumps, cutting plumes or oil spills may influence spatio-temporal abundance patterns and seabird assemblage composition, and could easily be collected during seabird surveys.

As noted earlier, the age, sex and plumage of birds was generally not recorded in this study. However, birds of different ages, sexes and plumage categories (such as fulmars) within a species exhibit different movements and distributions (Huettmann and Diamond 2000). By recording such information it would thus be possible to distinguish between these population segments and gain an understanding of the relative vulnerability to these population components (Montevecchi et al. 1999).

Finally, it is possible that numbers of birds observed during the three 20-minute counts per day are not entirely representative of what was actually present throughout a day. A sample design, such as that suggested by Montevecchi et al. (1999), in which observations are made continuously for one week per month, could also be informative in understanding daily patterns of seabird distribution around platforms, especially if there are species such as Dovekies that may move through the area in large numbers but not reside at the platforms very long. A sampling regime that is sensitive to the attendance patterns of most species would be desirable.

4.2.1.2 SBE surveys

We identified a number of issues related to the collection of stranded bird data. Number of survey days was not recorded, nor whether 'zero' birds were found on some nights. On days when more than one bird was held for recovery, the fate of individuals was not followed (i.e. not recorded as released or dead). We could therefore not ascertain whether or not birds recorded as oiled had died. The Seahorse was the only platform in which the fate of all birds was accounted for. No information was provided on where walkabouts were conducted or whether observers used a predetermined route. We were thus limited to broadly summarizing the information provided and it is most probable that the recorded numbers do not accurately reflect the actual numbers of stranded birds. Although a good stranded bird mitigation protocol was implemented, analyses on timing of stranding events, frequency or cause of mortality, abundance estimates or comparisons between platforms could not be conducted.

4.2.2 Observer training

To allow comparisons of data across time and space, it is important that observer quality be as high and as standardized as possible. At the very least, observer name or certainty of identification should be recorded so that data can be interpreted in the best way possible. Data bias can occur in subtle ways, especially in a project where there is little continuity among the people who designed the study, the observers in the field, data managers and data analysts. Correctly identifying seabirds to species and age classes is difficult even for trained observers. In a study in the North Sea, different experienced teams recorded bird densities that varied by an order of magnitude (Van der Meer and Camphuysen 1996). The inconsistent results with regard to murres (i.e. seeing Thick-billed Murres in summer) and the high number of Cory's Shearwaters seen could be attributed to a lack of experience on the part of observers. It is also important that observers be ready to positively identify rare species that may be at-risk, such as the Ivory Gull (*Pagophila eburnea*).

4.2.3 Data management

Several of the problems, inconsistencies and errors that occurred were related to data management and a lack of coordination or standardization in observer protocols. For example, 'start time' was recorded variously as '500', '0500', '05:00' or '5:00'. Sea state was recorded as wave height in metres (m) or by the sea disturbance scale (a relative scale of 1 – 9 that combines Beaufort Scale and wave height) or no units were indicated at all. Visibility was recorded in nautical miles (nm) and kilometers (km) or by the words 'poor', 'fair' and 'good' or no units were given. Likewise, species names should be recorded in a standardized fashion to avoid confusion later.

To calculate and compare seabird abundance in time and space it is necessary to have a measure of effort. For this report, we had to make the assumption that days with 'zero' birds were days in which no survey was conducted as there was no indication whether no birds were recorded due to fog, the survey was not conducted, or there were actually no birds present. As a result, it is possible that the abundance estimates presented here may be overestimates if 'zero' days were actually days where no birds were seen.

As mentioned above, it is essential that behavioural information be collected in a standardized way. When recorded, observations were written in the comments section and then mostly lumped, i.e. a count of Black-legged Kittiwakes was 4, yet the 'Comments' section showed that 2 of these birds were flying and 2 were on the water. In addition, this section sometimes contained information on age and sex, oiling, and death, but in an unordered fashion, so that it could not be attributed to specific birds. For example, one record was "8 Great Black-backed Gulls: 2 adults, 5 first or second winter, 1 juvenile. Flying up to 50 m, hovering, gliding", or another was "11 Great Black-backed Gulls: 7 on water. 1 adult, remainder are juvenile or first winter. 4 flying 30 - 40 m high. Juvenile colours". Although it is positive that such observations were recorded, it is unfortunate that it cannot be used in any analysis because of the format in which is was recorded.

Finally, the effects of observer height, sea state, ship speed, and visibility on counts have been documented in several studies (Diamond et al. 1986; Tasker et al. 1986; Wiese et al. 2001). Despite the importance of this information, it was not always collected and/or reported, or it was recorded in field datasheets but not transcribed to data files. As before, the lack of such information makes data interpretation difficult and comparisons questionable.

These inconsistencies necessitated visual inspection of every record and almost complete recoding of the data. Several instances of simple data entry error were noted, i.e. time of day on data sheets did not correspond with the submitted Excel file summary. A certain amount of human error in this regard is to be expected and can be reduced by having the observers enter the data in the field either during or shortly after the survey. Fixing these problems related to data management are relatively simple and would greatly speed-up future analyses.

4.3 Recommendations for seabird monitoring

Based on the above protocol and other relevant observation protocols currently in existence in Canada and elsewhere (Tasker et al. 1984; Komdeur et al 1992), we outline some guidelines toward a scientifically sound seabird monitoring program.

4.3.1 Study design

4.3.1.1 SAS surveys

To assess the degree to which seabirds are attracted to platforms, platform-based and ship-based surveys should be conducted simultaneously (Montevecchi et al. 1999). Fixed platform surveys should be conducted as recommended in Montevecchi et al. (1999) and Wiese et al. (2001) as these surveys are almost continuous and permit estimation of turnover rates yet allow the observer a break for a half an hour every hour. The recommended monitoring design requires specialized and dedicated seabird observers. Implementing such a design would allow spatio-temporal comparisons of seabird abundance and reduce the probability of misidentification or missing birds. At the very least, the number of surveys per day could be increased and spread throughout the day so that turnover of birds around platforms can be assessed. Such a regime would also provide an advantage in bad weather, especially in winter months when 50% of samples may be removed from the dataset to standardize visibility conditions. In addition, having only a maximum of three counts per day may not result in appropriate abundance estimates, as they are calculated using daily maximum counts per species (Tasker et al. 1986; Montevecchi et al. 1999). Based on data collected so far, it will be possible to design an optimal sampling using a predictive attendance model and/or power analysis (see Gerrodette 1987).

The current regime of 3 counts per day of 20 minutes each does provide a gross level picture of the relative distribution of some species and times when they are present in numbers. However, the logic of using timed counts from a fixed platform needs to be questioned. Timed counts are used in moving vessel surveys, as time is equivalent to distance, and hence area of sea surveyed. For fixed platform surveys, timed counts of birds are not relevant. Of more importance is making sure that all birds on the water are counted, and the exact area of sea examined is recorded. Ideally, flying birds should be counted in this survey area in an instantaneous snap shot, or at least as quickly as possible. Otherwise, bird flux becomes a problem as birds move through the survey area. We recommend that a new observation regime be employed in collaboration with seabird scientists so that more accurate information on seabird species composition and abundance, turnover rates, frequency and persistence of large flocks, migration chronology and diurnal attendance patterns of birds associated with platforms can be collected.

Seabird behaviour. Information collected on seabird behaviour serves two purposes. First, it defines the birds' mobility regime and allows one to determine the detectability for each species. Some bird species are more visibly mobile and most likely seen flying in the air, such as shearwaters and petrels. Other species, such as alcids, spend most of their time on the water surface making them difficult to sea in dark, high swell or rough sea conditions. These differences can be taken into consideration when calculating abundance estimates. Second, seabird behaviour at offshore oil operations can help explain why they are there and whether or not they are flying by or are associated with the platform. A basic method for recording bird behaviour, based on Webb and Durinck (1992), is widely used in Atlantic Canada pelagic surveys. Two fields should be provided for behaviour. One is filled in according to whether the bird was on the water 'SEA' or in the air 'FLY' and the second is a further modification by describing the action of the bird (feeding, resting, flying by or circling).

Survey radius. As mentioned above it is important to record or standardize survey radius in order to obtain seabird density estimates (birds/km^2) that can then be compared in space and time. It is recommended that observers focus on counting all the birds within 300 m of the field-of-view and try to record those they see beyond 300 metres (> 300 m) as separate records. One method suggested by Webb and Durinck (1992) and used by pelagic experts throughout the North Sea requires observers to record sightings within 300 m as follows:

code	distance
A	0 - 50 m
B	50 - 100 m
C	100 - 200 m
D	200 - 300 m
E	> 300 m

This will also aid in assessing the observers' efficiency in detecting birds on the water and remove potentially unreliable identifications made at long range. For ship-based surveys on the Grand Banks, Davoren (2001) and Burke et al. (2005) simply count birds within and beyond 300 m. However, Montevecchi et al. (1999) recommend assigning a distance to all birds without the use of band distances because variable fog conditions may limit the full range of a band, especially if surveys cannot be carried out on a daily basis. Further, observing only to 300 m may not capture all of the birds associated with a platform. All of these methods have merit, however one method must be used as a standard throughout the study region, and a count of all birds within 300 m using the band distance method of Webb and Durinck (1992) is recommended. Any birds observed beyond 300 m can be recorded, but should be noted as such (i.e., code E).

Age, sex and plumage. It is strongly recommend that information on the bird's age, plumage and sex be recorded for each species where possible. In most cases observers can determine at least one of the age, sex or plumage of a bird at sea. The difference between winter (basic) and breeding (alternate) plumage in alcids is distinct and should be recorded. Ages can be easily distinguished in birds such as the gulls and Black-legged Kittiwakes and provides important information about each component of the population.

Environmental conditions. Climate information, such as wind force and direction, sea state and visibility, is essential to the calculation of reliable and valid seabird abundance estimates recorded under variable conditions. Information on oceanographic conditions can help explain why the birds are in the vicinity.

Sources of disturbance. The presence of fishing boats within the survey area should be recorded, as it may affect the behaviour of the birds. Birds associated with floating material or discoloured patches in the water should be described consistently during surveys. Observers should record any oil patches, their size, distance from ship and proximity to birds on the water in the comments section. It is also recommended that observers record the activity of vessels or platforms, e.g. drilling, steaming, on standby, deploying streamers, shooting a line, etc.

4.3.1.2 SBE survey design

The stranded bird encounters should be documented in a systematic way in order to define mechanisms of attraction and to ensure appropriate mitigation procedures are being used. One entry on the "Storm-Petrel Recovery and Release" form should be filled out for every day, regardless of whether stranded birds are seen or not. As many personnel as needed/interested should participate in Storm-Petrel mitigation procedures, however, it is strongly recommended that only one person be in charge of compiling information on stranded bird encounters to ensure consistent and proper data collection.

A systematic approach to stranded bird mitigation will help determine the conditions which correlate to episodic petrel crashes. Petrel walkabouts should start well after dark and observers should be asked to provide:

- the times they started and stopped a walk-about
- where walk-about was conducted
- number of petrels/birds encountered
- number released immediately
- number held for recovery and later released
- number that died or were sent to shore for rehabilitation

The fate of all encountered birds should be recorded. As outlined in Montevecchi et al. (1999) experiments could be done to determine which species and to which degree they are attracted to the rigs because of ship lights, the flare, and/or effluents, so that preventative measures can be take and implemented where practicable.

4.3.2 Observer Training

Variation in estimates of pelagic seabirds have been documented to vary among observers due to differences in ability, training, fatigue, visual acuity and sickness (Kepler and Scott 1981, Tasker et al. 1984, Van de Meer and Camphuysen 1996, Montevecchi et al. 2000). However, a good training and observer evaluation program can help reduce some of these effects. An adequate training course should be 1-2 weeks, especially for the complete novice, and involve classroom, laboratory and field sessions (Kepler and Scott 1981). The classroom sessions should use materials such as field guides, video footage of birds at sea, and pop quizzes that increase in diversity of species and levels of difficulty. Study skins showing plumage variation in species, age and moult could be used in the lab. Trainees should have in-field training sessions where observations are conducted simultaneous to the instructor's and tallies are compared to assess competence level and observer-specific detection correction factors. Such tests can be repeated in certain time intervals and proficiency ratings of individual observers updated. In this study, skilled and novice observers with minimal training alike contributed to the data set and we had no means to account for their differences in species detectibility. Periodic in-field audits of observers would increase the confidence in observer quality and therefore, the quality of the data.

4.3.3 Data management

Designing a database that is easy to access, use, update and modify is advantageous to any long-term monitoring program with large quantities of data collected, in this case, on a daily basis from several platforms for several years. The use of MS Excel software is not recommended due to its limited data management capabilities. A relational database, in which all variables in a record are related because they reside in the same row or "flat", is recommended (Chardine and Howell 1999). Relational databases are useful to reduce duplication and file space, as different tables or files can be linked through a common field and queried accordingly (i.e. seabird count table, stranded bird data table, observer effort table, location table, oceanographic and weather parameter). In addition, the use of database software such as File Maker Pro or MS Access, which only accepts prescribed codes, formulas or character lengths can reduce many data entry errors.

To avoid data bias, observers should always adhere to their observation protocol and when in doubt:

- note, but not include, interesting sightings, that occur outside of the survey time
- start the survey regardless of whether birds are present or not
- document if no birds were seen throughout the survey
- always fill out the "environmental conditions" form for each observation period, regardless of whether marine birds/mammals were seen or not

Finally, a set of random records (1-5% of total) should be selected and checked for entry errors.

4.3.3.1 Environmental conditions

When recording information, such as wind force, wind direction, sea state, visibility and oceanographic conditions, units must be standardized among all observers and sites. If the observer arrives on site and it is too foggy, then the observer should enter the number of birds as 'NA' (and not '0'), then fill in the 'environmental conditions' and 'location and effort' forms of the database. We suggest the following unit scheme:

- wind force should be on the Beaufort scale (1-12)
- sea state should be recorded as a Sea Disturbance Number (1-9)
- swell height should be recorded in metres up to 5 m, anything over 5 m can be recorded as > 5 m
- visibility should be recorded in kilometres from 0.01 (which is 10 m) to 20 kilometres and these estimates should be made even on foggy days

4.3.3.2 Location and effort data

This information should be recorded whether a survey is conducted or not. Observers will need to note the number of daylight hours over which a watch for marine birds and mammals was kept. The radius of the observation (normally 180º) and the general bearing of the observation should be recorded.

4.3.3.3 Species names

To avoid inconsistencies in naming conventions, we recommend the use of standardized naming codes devised by the American Ornithologist's Union (AOU). The AOU code list can be found at (http://www.pwrc.usgs.gov/bbl/manual/bandsize.htm).

The advantages of these codes are that they are short and recognizable and are constructed using standardized rules from the official AOU English name for the species. Unknown species codes are provided according to species group, e.g. alcids = ALCI, unknown murre = UNMU, unknown bird = UNKN (see Appendix C). The 'UNKN' designation is valid for overall bird abundance estimates and can be expected occasionally considering variable glare and visibility conditions. However, an attempt to identify species to at least order or family should always be made.

For each seabird or group of seabirds observed, it is very important that observers rate the certainty of their seabird or mammal identification as 1 = Definite, 2 = Probable or 3 = Possible, 4 = Unsure. This information will be factored into seabird abundance estimates and can indicate potential problem areas that can be addressed in observer training refresher sessions. Novice or untrained observers will often record the name of a species without being absolutely sure. However, factors such as observer fatigue, sun glare, fog, can always interfere with the quality of the observation.

4.4 Summary of recommendations

4.4.1 Study design and protocol

4.4.1.1 SAS surveys

1) all data should be collected with the goal of calculating seabird densities:
   a) survey radius must be standardized, or, at the very least, recorded (i.e. when visibility is reduced)
   b) for baseline surveys, timed counts should be abandoned, and instantaneous counts of birds in a known area should be used instead. Timed counts may be used for secondary and more detailed surveys to assess bird flux around platforms.

2) a scientifically valid optimal sampling regime should be designed using a seabird attendance/movement model or power analysis based on current knowledge (or best assumptions) of seabird distributions at platforms
3) consult Montevecchi et al. (1999) and follow recommendations on survey design and experiments where practical
4) platform- and fixed vessel-based surveys should be conducted simultaneously to assess seabird attraction to platforms
5) seabird behaviour, especially whether a bird is 'flying', 'on water' or 'feeding' are essential to assess detection rates and determine if birds are attracted to the platforms
6) collect age and plumage data to provide information on population segments attending platforms
7) record observer location, effort and survey conditions
8) record sources of pollution, effluent and disturbance
9) collect oceanographic information to help understand why birds are present

4.4.1.2 SBE surveys

10) use a systematic design geared to define mechanisms of attraction
11) refer to Montevecchi et al. (1999) for guidance on experimental approaches
12) have only one person compile information from all those who collect and handle birds
13) ensure the fate of every bird handled is recorded

4.4.2 Observer training

14) for an excellent resource for designing the observer training program see Kepler and Scott (1981)
15) observer training should be carried out by seabird and marine ecology experts who understand and have experience in collection of such data in the field
16) the training course should last a minimum of 1-2 weeks and be comprised of lecture, laboratory and field elements with testing
17) contact with observers should be maintained and their contact details stored in the database
18) observers should be contacted regarding 1999-2002 surveys to assess observer quality, if that data is to be retained in the database
19) periodic on-site audits of observers should be undertaken

4.4.3 Data management

20) a relational database program (not MS Excel) should be used for a data management system that enables acquisition, storage, retrieval and updating of observations and database
21) enter observations into this database directly on laptop computer aboard ship, or as soon as possible after completion of the survey on platforms
22) if a survey is cancelled due to fog, then 'NA' should be recorded for number of birds
23) standardize units among observers and locations
24) use 4 digit AOU bird codes to record species names
25) information on oceanographic conditions, collected by the ship computer, could be realtime-linked to the seabird observers computer (as well as a GPS-link for moving vessels)

26) if the 1999 to 2002 dataset is to be retained with the future dataset, managers should consider re-entering the data from original data sheets filled out by observers
27) blank datasheets should be kept on hand in the field in the event of a computer malfunction

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Table 1. Location of offshore oil and gas operations on the eastern Grand Banks from which birds were sampled.

Company	Platform	Location	Operation
Terra Nova 1999	Queen of the Netherlands	46° 43.1'N 48° 27.6'W	glory hole construction
		46° 29.3'N 48° 27.6'W	
Terra Nova 2000-2002	Henry Goodrich	46° 29.4'N 48° 27.6'W	oil production 2002
		46° 28.1'N 48° 25.0'W	oil production 2001-2
		46° 24.0'N 48° 29.5'W	oil production 2001
		46° 27.4'N 48° 29.5'W	oil production 2000
		46° 29.2'N 48° 27.4'W	oil production 2000
Husky Energy 2002	Trepassey J-91	46° 40.3'N 47° 58.6'W	exploration well
	Gros Morne C-17	46° 36.2'N 48° 02.4'W	exploration well
	White Rose E-09	46° 48.4N 48° 01.4'W	well abandonment
	White Rose A-17	46° 46.1'N 48° 01.7'W	well abandonment
	White Rose L-08	46° 47.5'N 48° 01.3'W	well abandonment
	White Rose N-30	46° 49.8'N 48° 03.8'W	well abandonment
	Hibernia B-44	46° 43.1'N 48° 03.8'W	Hibernia drilling ops.
	Seahorse	46° 46.2'N 48° 00.6'W	glory hole construction

Table 2. Timing and effort of seabird-at-sea surveys by industry observers on fixed platforms in Grand Banks, 1997-2002.

Vessel or site	Year	Start date	End date	No. Survey days	Surveys per day (N)
Hibernia Platform	1997	15 Nov	19 Nov	3	?
Hibernia Platform	1998	16 Jan	28 Aug	21	1 (21)
Queen of Netherlands	1999	10 May	21 Sep	121	2.6 (309)
Henry Goodrich	2000	5 Mar	31 Dec	258	2.5 (655)
Henry Goodrich	2001	1 Jan	31 Dec	308	2.2 (676)
Henry Goodrich	2002	1 Jan	31 Dec	339	2.6 (887)
GGB Trepassey	2002	25 Jul	28 Aug	33	2.9 (96)
Seahorse	2002	26 Aug	11 Oct	59	2.8 (166)
GGB Gros Morne	2002	29 Aug	30 Sep	33	2.6 (85)
GGB White Rose	2002	19 Sep	30 Sep	12	2.7 (32)
Hibernia B-44	2002	01 Oct	30 Nov	20	2.1 (42)

Table 3. Data filters used to eliminate questionable pelagic seabi rd data collected by fixed platforms on the Grand Banks, 1999-2002.

Platform	visibility (m)	sea state (scale 1-9)	wind scale (Beaufort)	Percentage of records removed by filters (N)
Qu. Netherlands	> 300 m	< 3	< 7	55 % (413)
Henry Goodrich	> 300 m	< 5	< 7	36 % (1924)
Seahorse	> 300 m	< 5	< 7	0 % (68)
Hibernia B-44	> 300 m	< 3	< 7	41 % (143)
Trepassey	> 300 m	< 3	< 7	6 % (62)
White Rose	> 300 m	< 3	< 7	7 % (27)
Gros Morne	> 300 m	< 3	< 7	42 % (38)
TOTAL				53 % (2675)

Table 4. Seabird species recorded by industry observers from fixed platforms on the Grand Banks, 1999-2002.

Common name	Latin names	No. birds	%
Greater Shearwater	*Puffinus gravis*	26432	55
Black-legged Kittiwake	*Rissa tridactyla*	12808	27
Northern Fulmar	*Fulmarus glacialis*	2206	5
Great Black-backed Gull	*Larus marinus*	1329	3
Common Murre	*Uria aalge*	863	2
Herring Gull	*Larus argentatus*	703	2
Thick-billed Murre	*Uria lomvia*	447	1
Leach's Storm Petrel	*Oceandroma leucorhoa*	219	0.5
Cory's Shearwaters	*Puffinus diomedia*	212	0.4
Sooty Shearwater	*Puffinus griseus*	179	0.4
Dovekie	*Alle alle*	116	0.2
Wilson's Storm Petrel	*Oceanites oceanicus*	81	0.2
Northern Gannet	*Morus bassanus*	63	0.1
Great Skua	*Catharacta skua*	62	0.1
Glaucous Gull	*Larus hyperboreus*	56	0.1
Manx Shearwater	*Puffinus puffinus*	39	0.1
Lesser Black-backed Gull	*Larus fuscus*	26	0.1
Ivory Gull	*Pagophila eburnea*	21	0.04
Pomarine Jaeger	*Stercorarius pomarinus*	17	0.04
Iceland Gull	*Larus glaucoides*	7	0.01
Common Tern	*Sterna hirundo*	4	0.01
Parasitic Jaeger	*Stercorarius parasiticus*	4	0.01
Ring-billed Gull	*Larus delawarensis*	3	0.01
Atlantic Puffin	*Fratercula arctica*	1	0.00
Black-browed Albatross	*Diomedea melanophris*	1	0.00
Black-headed Gull	*Larus ridibundus*	1	0.00
Sabine's Gull	*Xema sabini*	1	0.00
Unknown birds		2135	4

Table 5. Monthly summary of stranded bird encounter data reported on Grand Banks offshore hydrocarbon platforms from 1998 to 2002.

		AOU	count	held	oiled	died	released
Sea Sorceress							
1998	August	LHSP	58	0	0	0	58
Queen of the Netherlands							
1999	May	SPAR	1	0	0	1	0
	June	LHSP	2	2	0	0	2
	August	LHSP	1	0	0	1	0
	September	LHSP	23	4	2	3	11
		UNK	1	0	1	0	0
		TOTAL	**28**	**6**	**3**	**5**	**13**
Henry Goodrich							
2000	August	WISP	1	0	0	1	0
	September	LHSP	61	30	5	1	11
	October	LHSP	67	31	0	0	52
2001	January	COMU	2	0	0	0	2
	February	COMU	1	0	0	1	0
	March	COMU	2	0	0	0	2
	August	RUTU	1	1	1	1	0
	September	LHSP	16	12	0	1	3
	October	LHSP	112	99	1	2	98
		NOPA	1	1	0	1	0
2002	January	GLGU	1	0	1	0	0
	October	LHSP	48	46	0	1	45
	November	LHSP	1	0	0	0	0
		TOTAL	**314**	**220**	**8**	**9**	**213**
Seahorse							
2002	August	LHSP	2	1	0	0	1
	September	LHSP	49	42	1	1	48
	October	LHSP	2	0	0	1	1
		ATPU	9	9	1	0	8
		TOTAL	**62**	**52**	**2**	**2**	**58**
Trepassey J-91 Well							
2002	August	LHSP	5	5	0	0	2
Gros Morne C-17 Well							
2002	September	LHSP	1	1	0	0	0
Hibernia B-44 Drill Site							
2002	October	LHSP	1	1	0	0	0
		TOTAL	**7**	**7**	**0**	**0**	**2**
		GRAND TOTAL	469	285	13	16	344

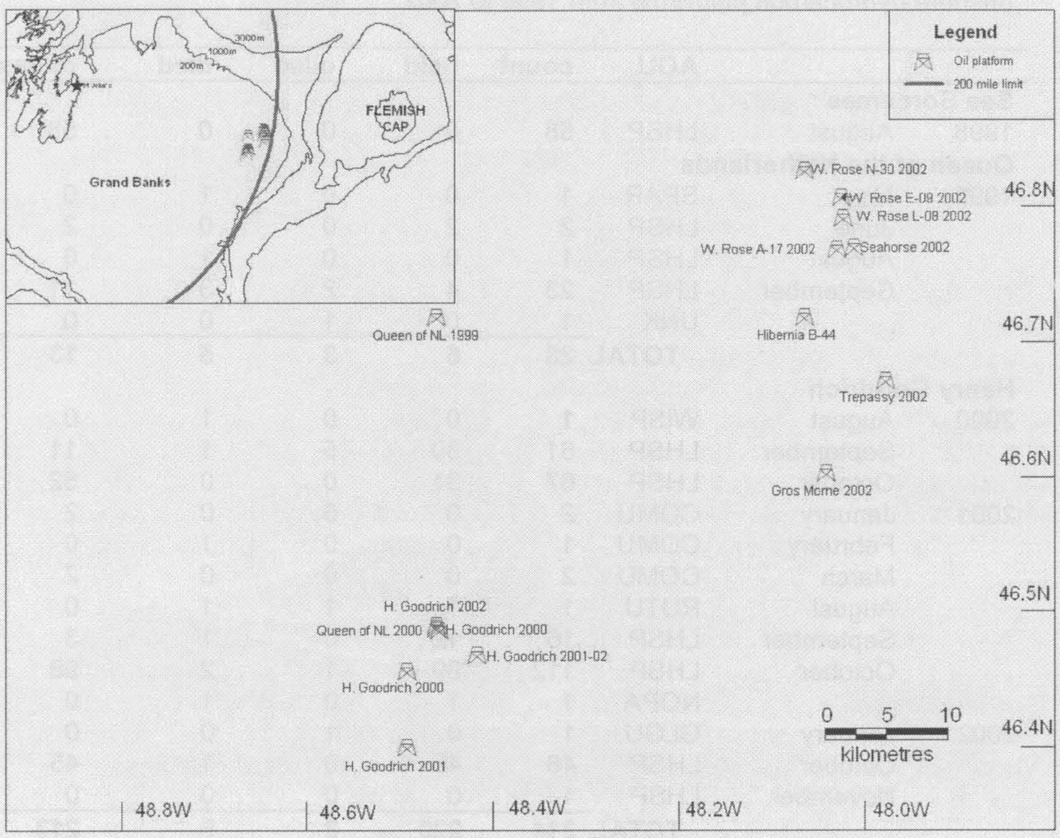

Figure 1. Map showing survey platform locations on the Grand Banks oil field 1999-2002.

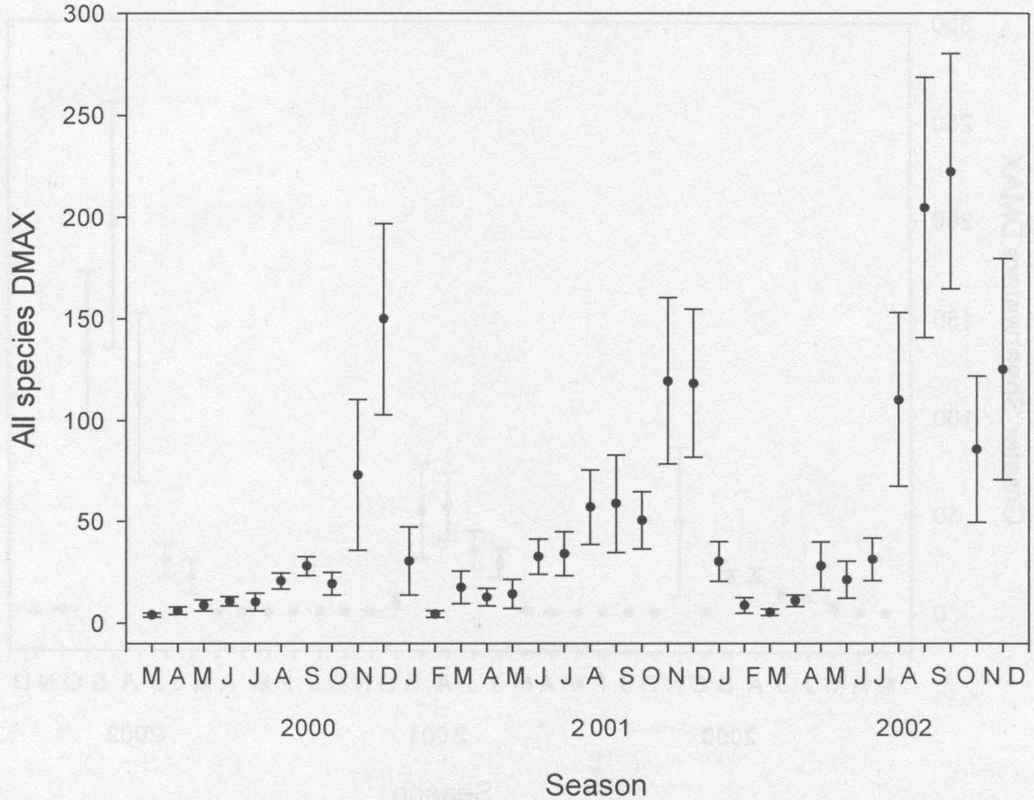

Figure 2. Mean abundance for all species seen from the Henry Goodrich, 2000-2002.

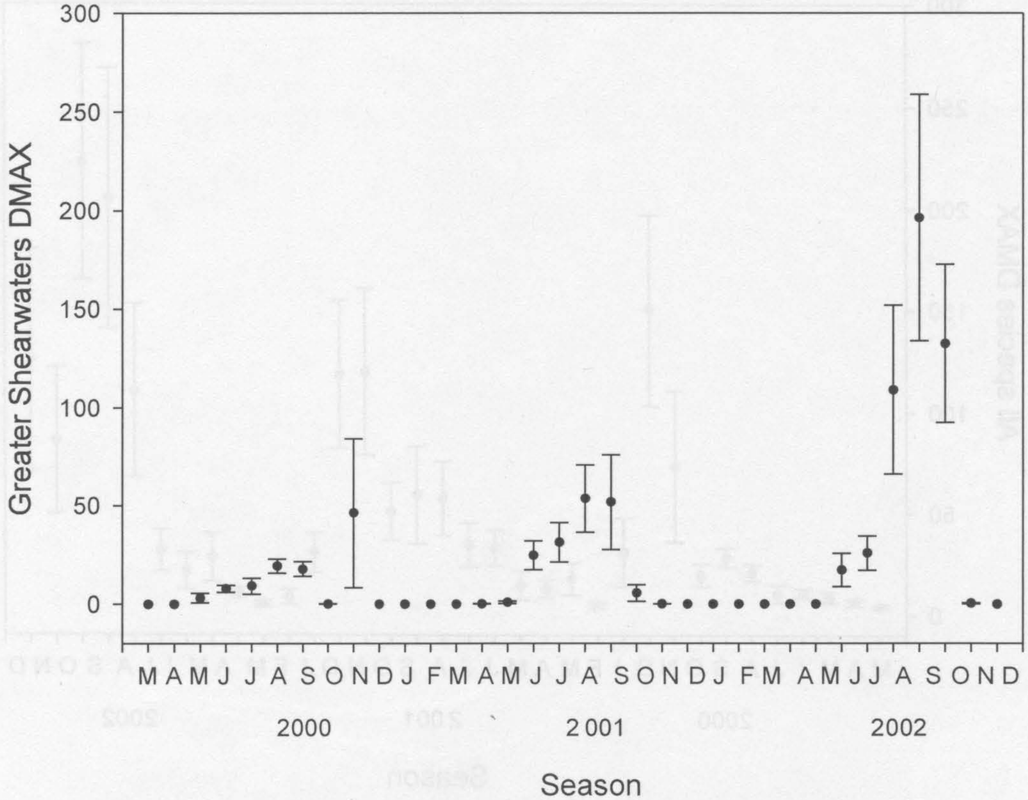

Figure 3. Mean abundance (based on average of daily maximum [DMAX] counts) of Greater Shearwaters at the Henry Goodrich, 2000-2002.

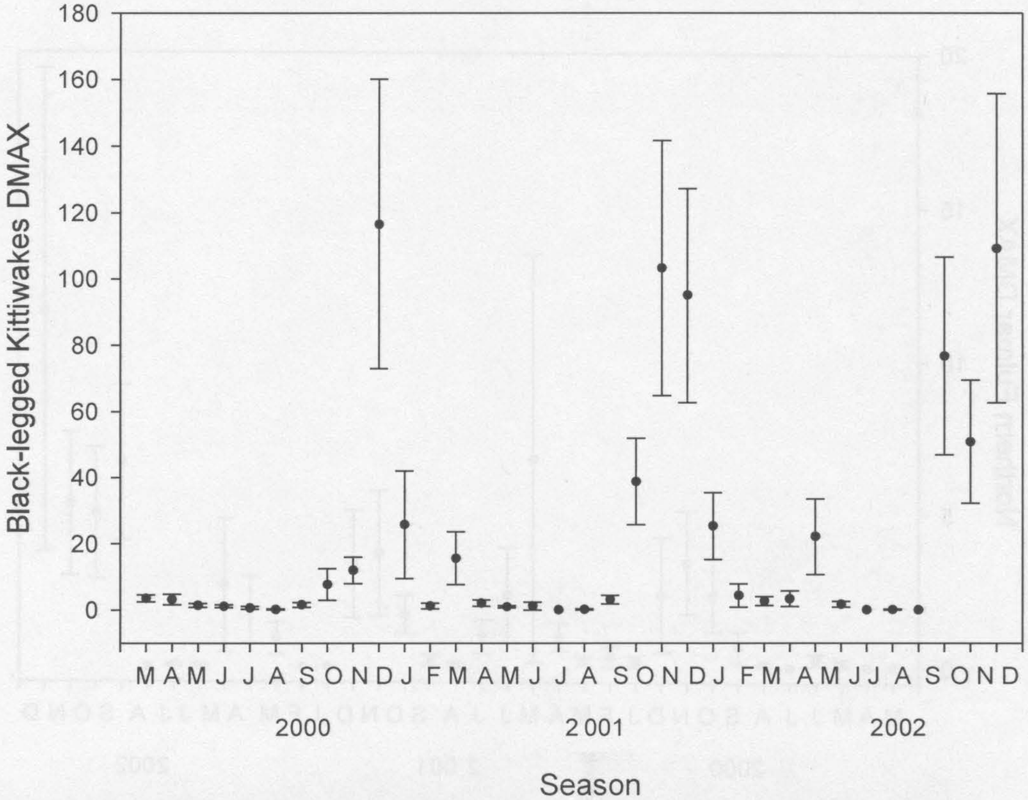

Figure 4. Mean abundance (based on average of daily maximum [DMAX] counts) of Black-legged Kittiwakes at the Henry Goodrich, 2000-2002.

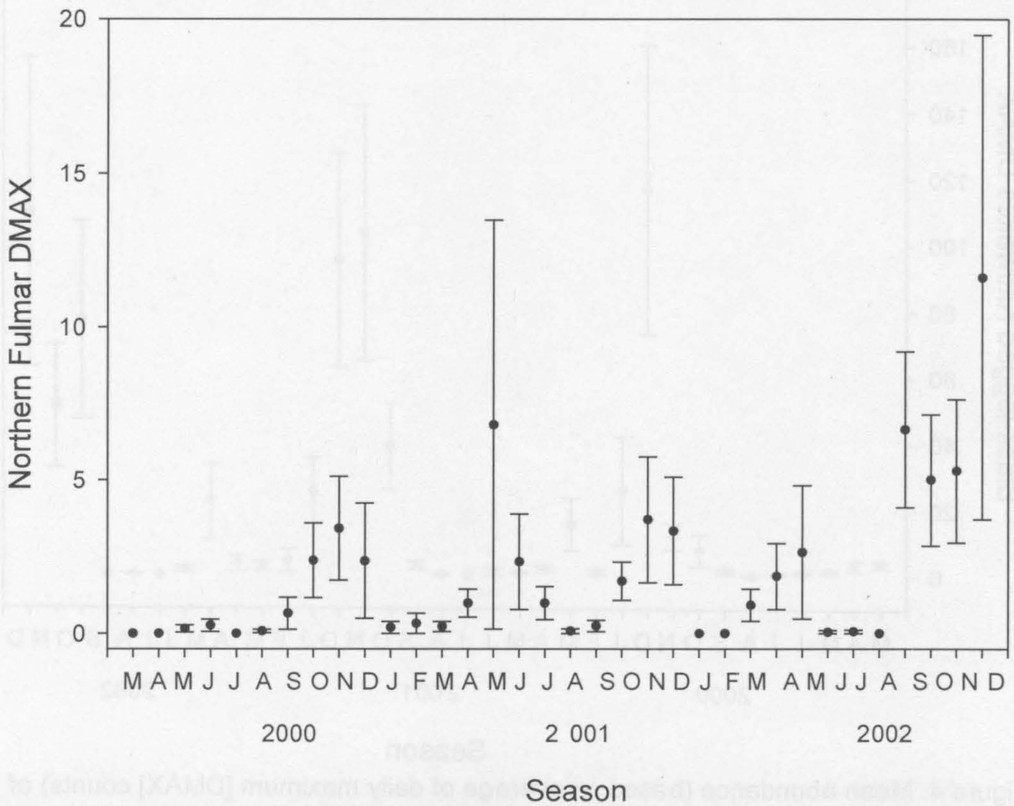

Figure 5. Mean abundance (based on average of daily maximum [DMAX] counts) of Northern Fulmar at the Henry Goodrich, 2000-2002.

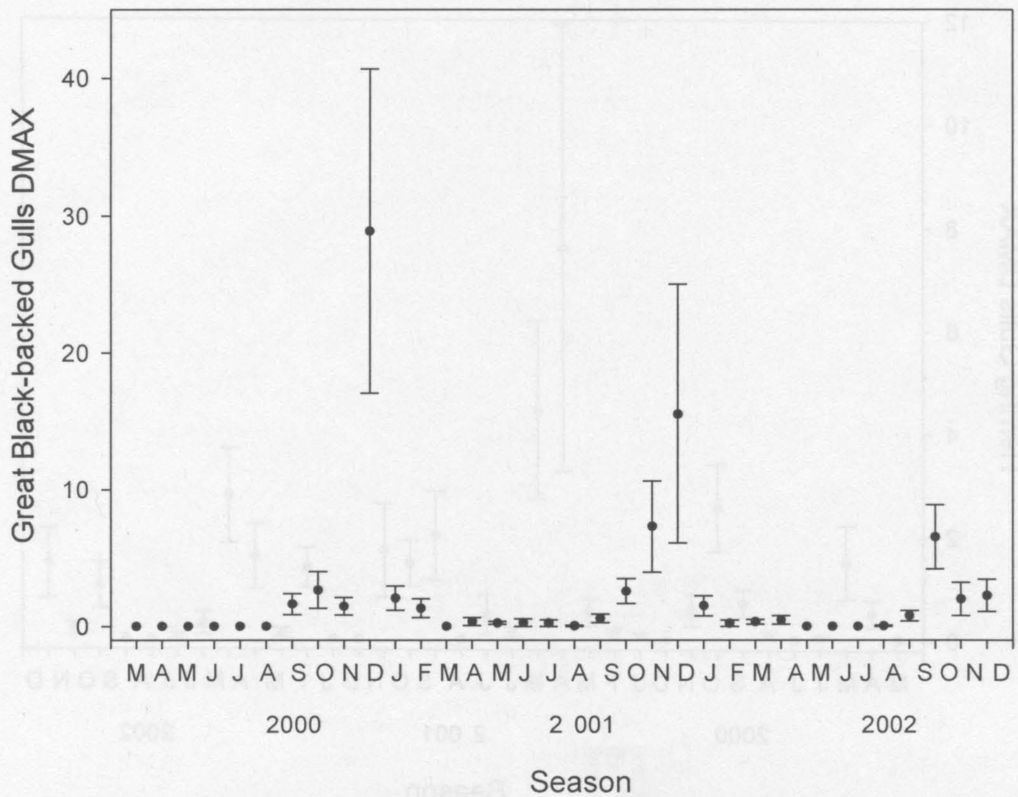

Figure 6. Mean abundance (based on average of daily maximum [DMAX] counts) of Great Black-backed Gulls at the Henry Goodrich, 2000-2002.

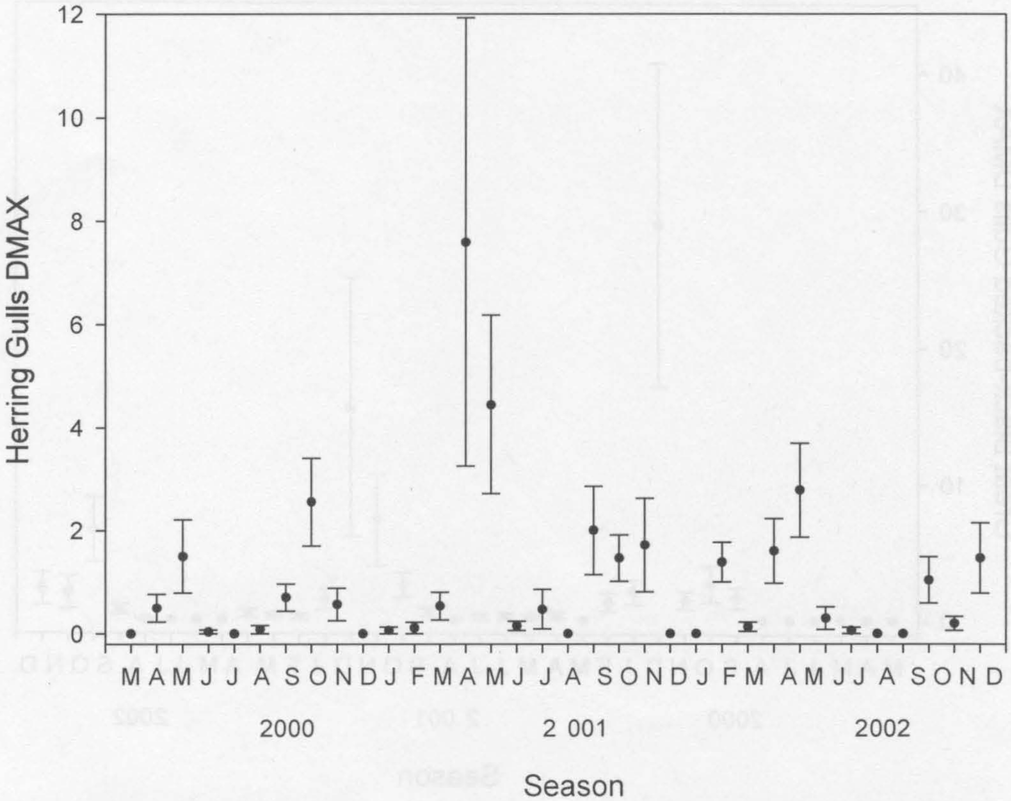

Figure 7. Mean abundance (based on average of daily maximum [DMAX] counts) of Herring Gulls at the Henry Goodrich, 2000-2002.

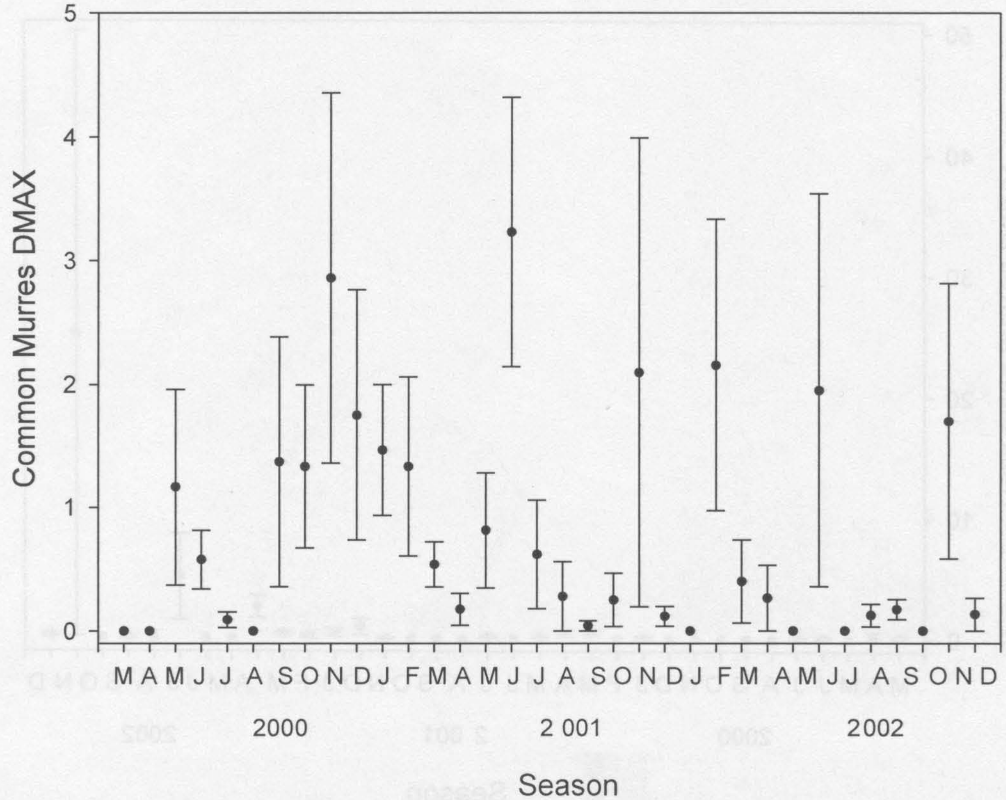

Figure 8. Mean abundance of Common Murres (based on average of daily maximum [DMAX] counts) at the Henry Goodrich, 2000-2002.

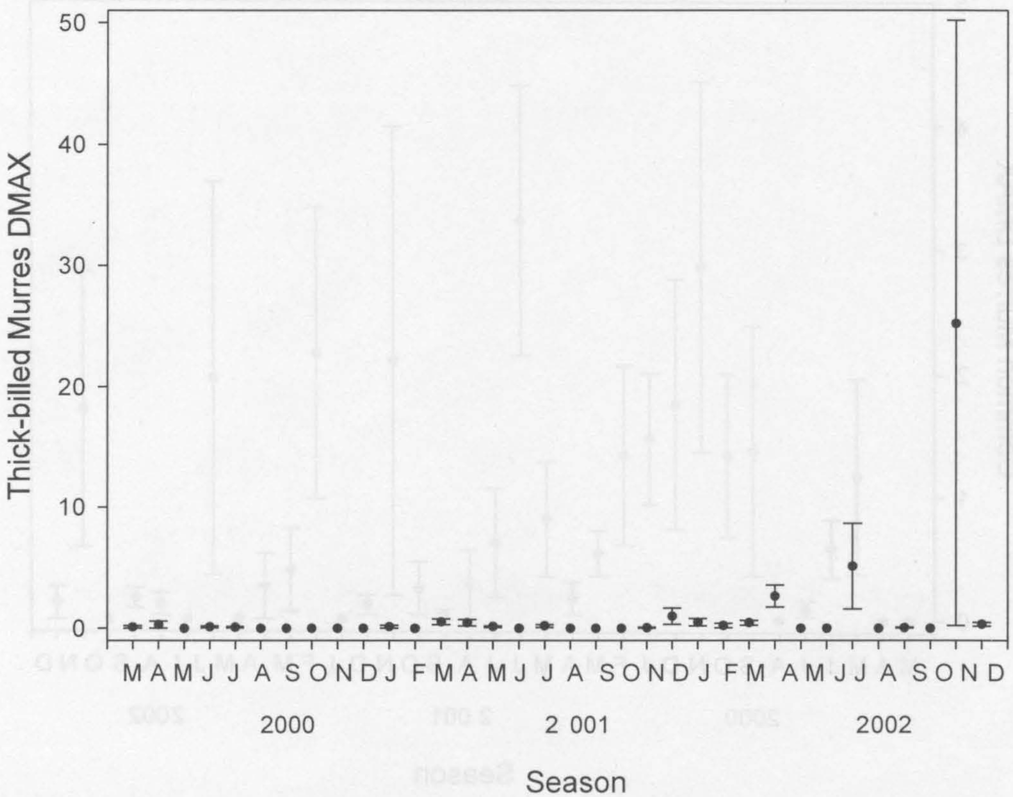

Figure 9. Mean abundance (based on average of daily maximum [DMAX] counts) of Thick-billed Murres at the Henry Goodrich, 2000-2002.

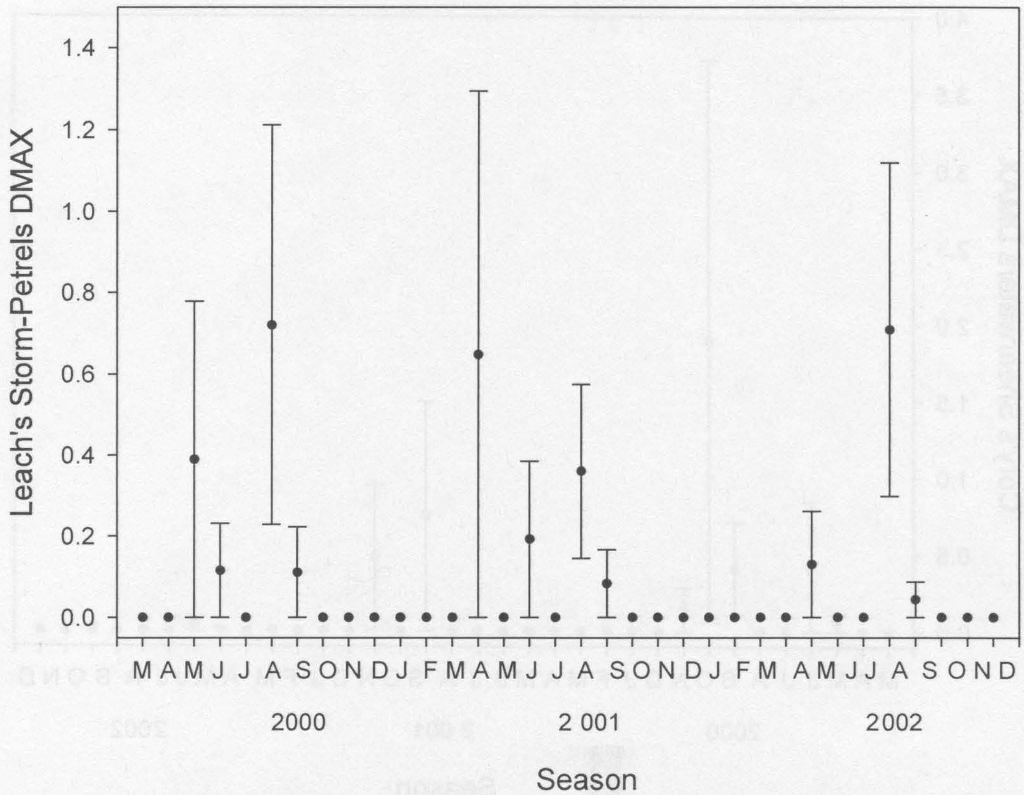

Figure 10. Mean abundance of Leach's Storm-Petrels at the Henry Goodrich, 2000-2002.

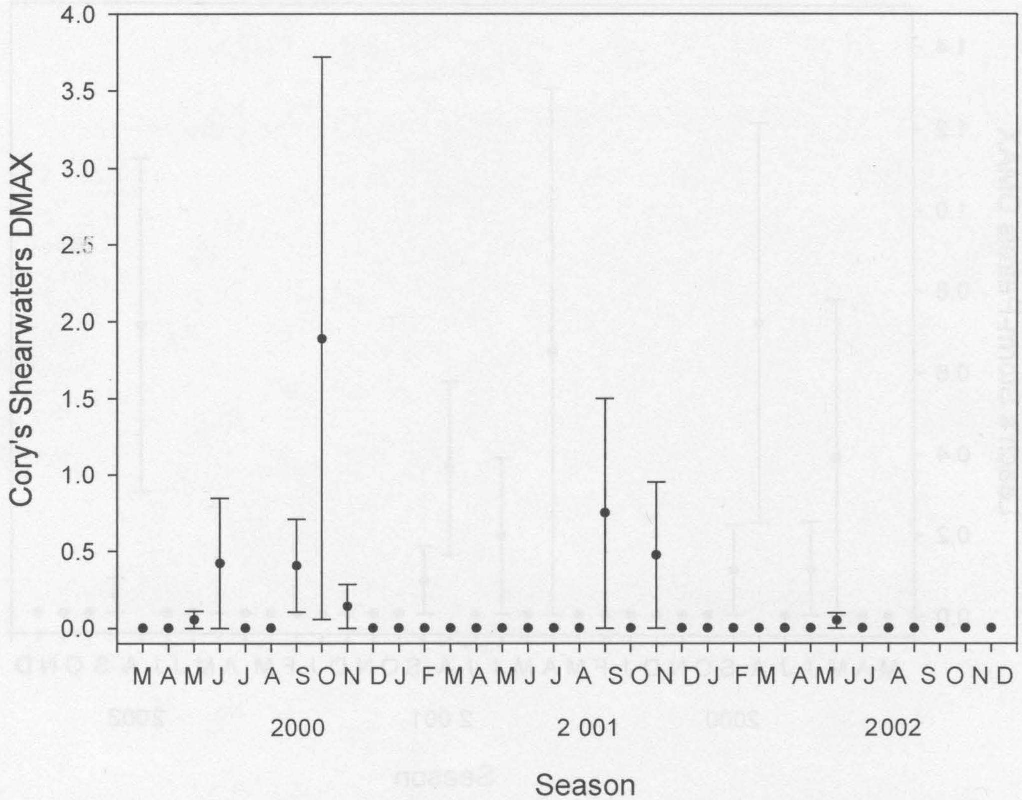

Figure 11. Mean abundance (based on average of daily maximum [DMAX] counts) of Cory's Shearwaters at the Henry Goodrich, 2000-2002.

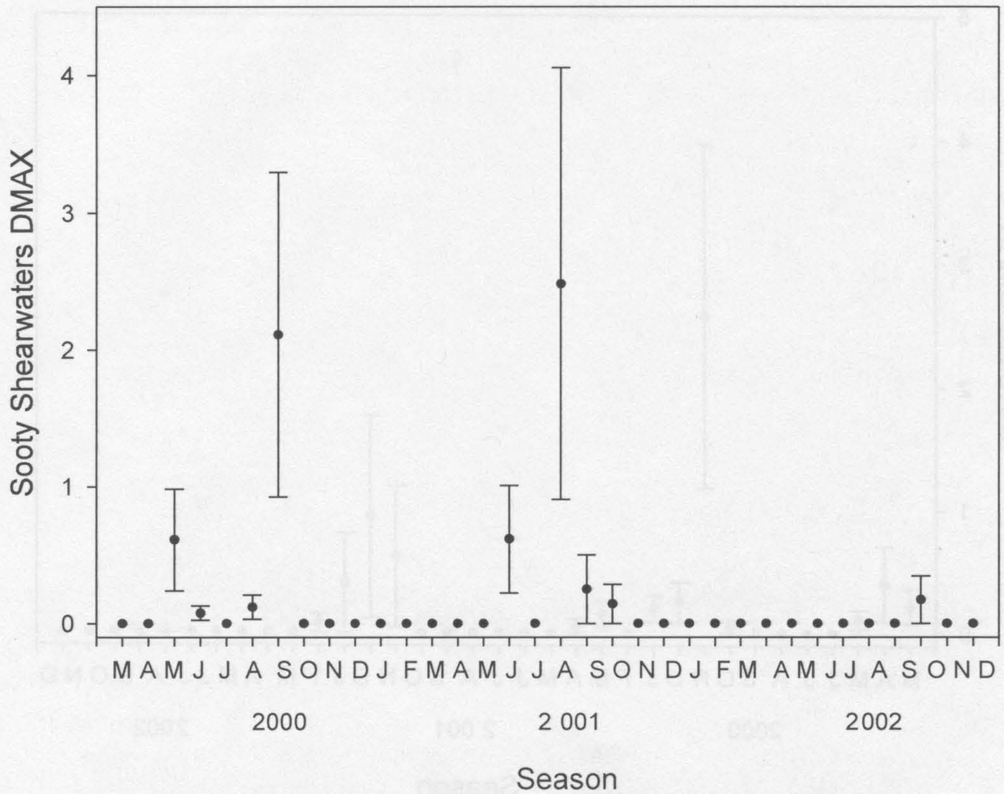

Figure 12. Mean abundance (based on average of daily maximum [DMAX] counts) of Sooty Shearwaters at the Henry Goodrich, 2000-2002.

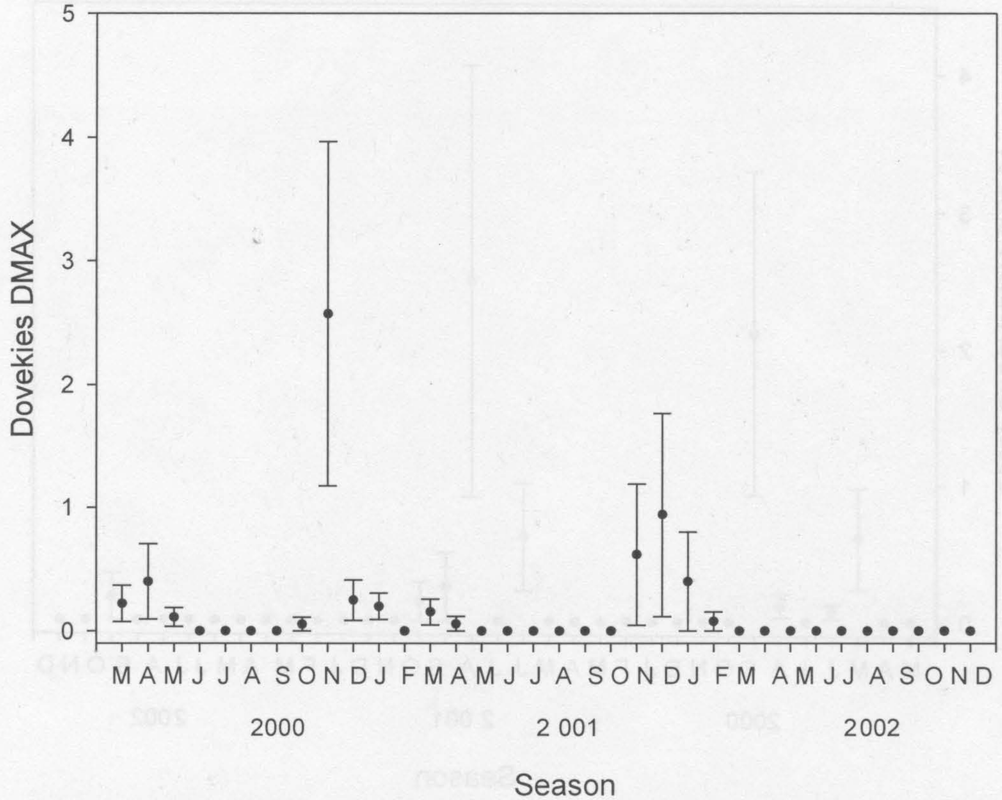

Figure 13. Mean abundance (based on average of daily maximum [DMAX] counts) of Dovekies at the Henry Goodrich, 2000-2002.

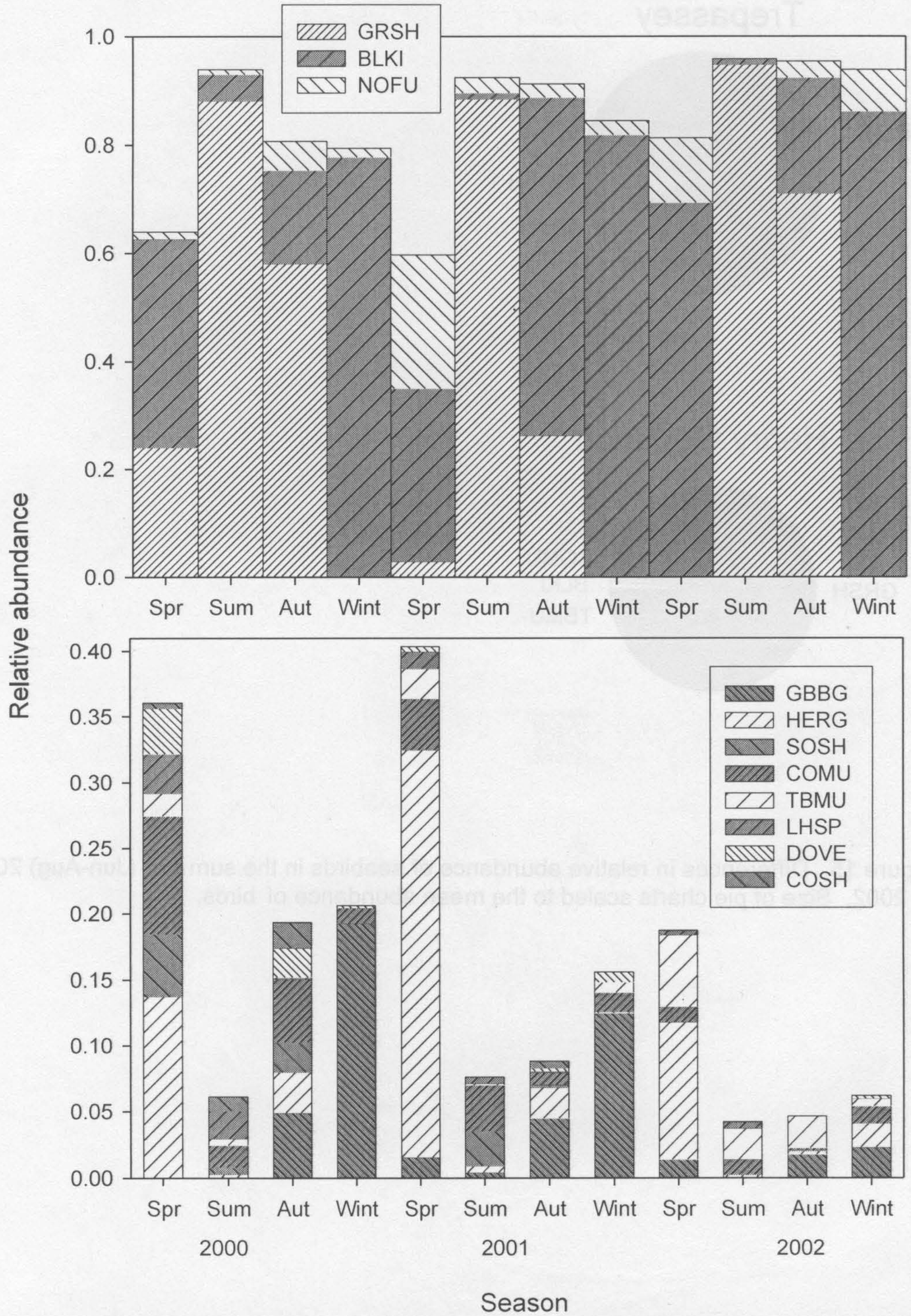

Fig. 14. Relative abundance of seabirds at the Henry Goodrich 2000-2002, top panel includes the three most common species, while the lower panel shows an expanded scale of the rarer species.

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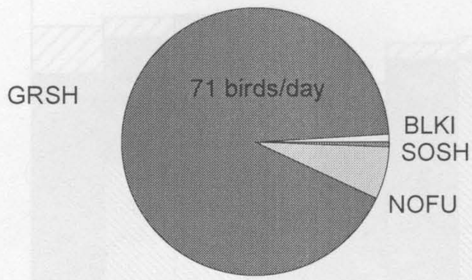

Henry Goodrich

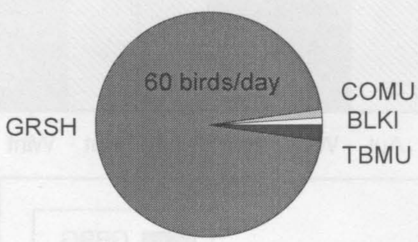

Figure 15. Differences in relative abundance of seabirds in the summer (Jun-Aug) 2002 of 2002. Size of pie charts scaled to the mean abundance of birds.

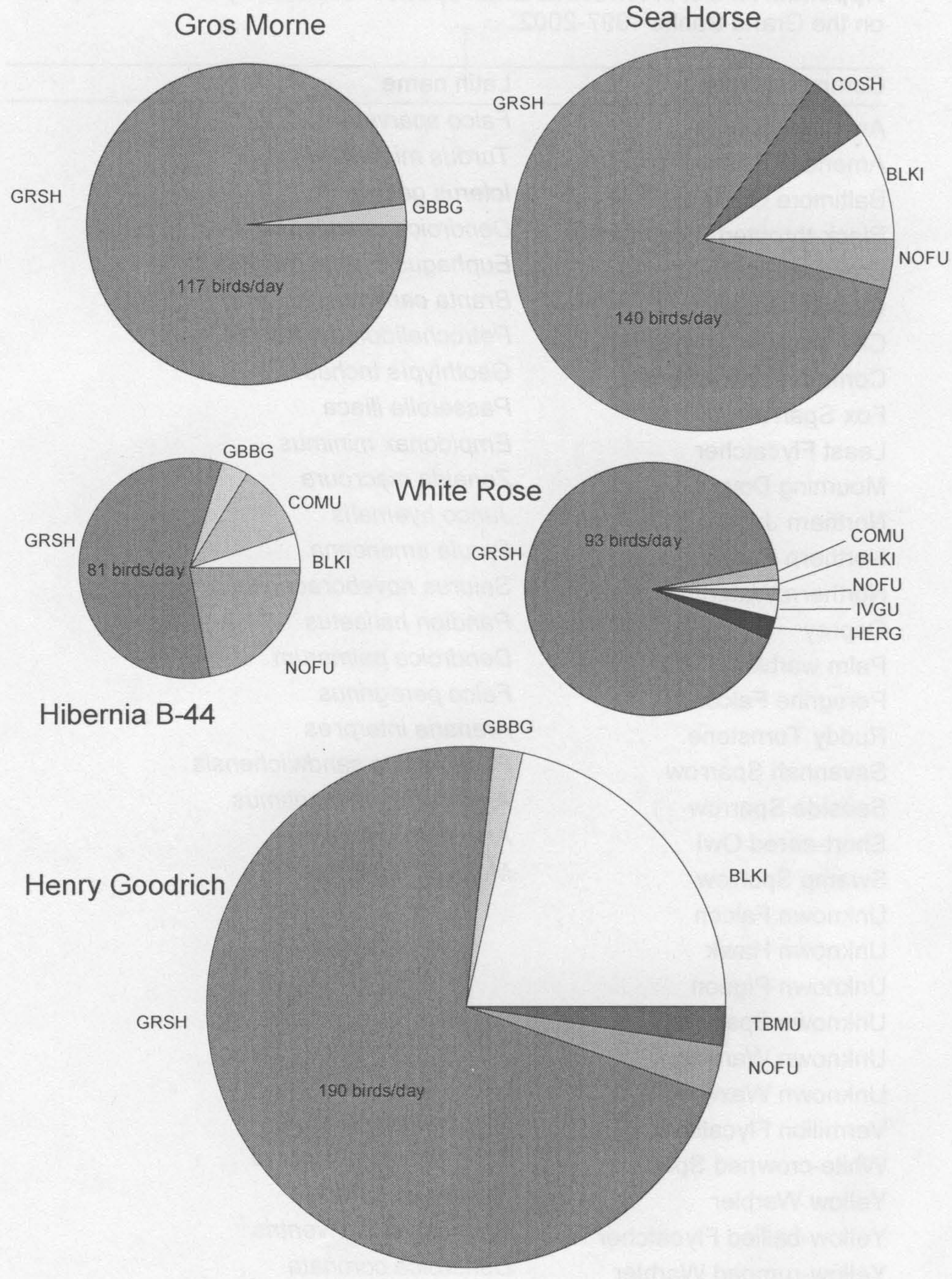

Figure 16. Differences in relative abundance of seabirds in the autumn (September-November) of 2002. Size of pie charts scaled to the mean abundance of birds.

Appendix A. List of terrestrial avian species recorded by offshore oil platform observers on the Grand Banks 1997-2002.

Common Name	Latin name
American Kestrel	*Falco sparverius*
American Robin	*Turdus migratorius*
Baltimore Oriole	*Icterus galbula*
Black-throated Blue Warbler	*Dendroica caerulescens*
Brewers Blackbird	*Euphagus cyanocephalus*
Canada Goose	*Branta canadensis*
Cliff swallow	*Petrochelidon pyrrhonota*
Common Yellowthroat	*Geothlypis trichas*
Fox Sparrow	*Passerella iliaca*
Least Flycatcher	*Empidonax minimus*
Mourning Dove	*Zenaida macroura*
Northern Junco	*Junco hyemalis*
Northern Parula	*Parula americana*
Northern Waterthrush	*Seiurus noveboracensis*
Osprey	*Pandion haliaetus*
Palm warbler	*Dendroica palmarum*
Peregrine Falcon	*Falco peregrinus*
Ruddy Turnstone	*Arenaria interpres*
Savannah Sparrow	*Passerculus sandwichensis*
Seaside Sparrow	*Ammodramus maritimus*
Short-eared Owl	*Asio flammeus*
Swamp Sparrow	*Melospiza georgiana*
Unknown Falcon	
Unknown Hawk	
Unknown Pigeon	
Unknown Sparrow	
Unknown Warbler	
Unknown Waxwing	
Vermilion Flycatcher	*Pyrocephalus rubinus*
White-crowned Sparrow	*Zonotrichia leucophrys*
Yellow Warbler	*Dendroica petechia*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Yellow-rumped Warbler	*Dendroica coronata*

Appendix B. List of marine mammal species recorded by offshore oil platform observers on the Grand Banks 1997-2002.

Common Name	Latin name
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Minke whale	*Balaenoptera acutorostrata*
Orca	*Orcinus orca*
Sei whale	*Balaenoptera borealis*
Grey Seal	*Halichoerus grypus*

Appendix C. AOU codes for common bird species observed on the Grand Banks, includes a list of rarely seen species and our own codes for unknown species.

Common Name	AOU Code	Latin name
COMMONLY SEEN BIRDS		
Atlantic puffin	ATPU	*Fratercula arctica*
Black-headed Gull	BHGU	*Larus ribindus*
Black-legged Kittiwake	BLKI	*Rissa tridactyla*
Common Murre	COMU	*Uria aalge*
Cory's Shearwater	COSH	*Calonectus diomedea*
Dovekie	DOVE	*Alle alle*
Great Black-backed Gull	GBBG	*Larus marinus*
Glaucous Gull	GLGU	*Larus hyperboreus*
Greater Shearwater	GRSH	*Puffinus gravis*
Great Skua	GRSK	*Stercorarius skua*
Herring Gull	HERG	*Larus argentatus*
Iceland Gull	ICGU	*Larus glaucoides*
Lesser Black-backed Gull	LBBG	*Larus fuscus*
Leach's Storm Petrel	LHSP	*Oceanodroma leucorhoa*
Long-Tailed Jaeger	LTJA	*Stercorarius longicaudis*
Manx Shearwater	MXSH	*Puffinus puffinus*
Northern Fulmar	NOFU	*Fulmarus glacialis*
Northern Gannet	NOGA	*Morus bassanus*
Parasitic Jaeger	PAJA	*Stercorarius parasiticus*
Pomarine Jaeger	POJA	*Stercorarius pomarinus*
Ring-billed Gull	RBGU	*Larus delawarensis*
Sooty Shearwater	SOSH	*Puffinus griseus*
Thick-billed Murre	TBMU	*Uria lomvia*
UNKNOWN BIRD CODES		
Unknown Alcid	ALCI	
Unknown Gull	UNGU	
Unknown Jaeger	UNJA	
Unknown Kittiwake	UNKI	
Unknown	UNKN	
Unknown Murre	UNMU	
Unknown Shearwater	UNSH	
Unknown Storm Petrel	UNSP	
Unknown Tern	UNTE	
RARELY SEEN BIRDS* AND POTENTIAL BIRDS		
Black-browed Albatross	BBAL	*Diomedea melanophris*
Common Eider	COEI	*Somateria mollissima*
Common Tern	COTE	*Sterna hirundo*
Ivory Gull	IVGU	*Pagophila eburnea*
Long-tailed Duck	LTDU	*Clangula hyemalis*
Ruddy Turnstone	RUTU	*Arenaria interpres*
Sabine's Gull	SAGU	*Xema sabini*
Wilson's Storm Petrel	WISP	*Oceanites oceanicus*