Fulmar Litter EcoQO monitoring in Denmark 2002-2018

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Photo 1 *Cover page photo (*): Stomach content of a fulmar beached in Skagen, with recognizable parts of a food container and a bright red soft airgun bullet.*

(*) All photographs in this report by Jan van Franeker or Susanne Kühn, Wageningen Marine Research.

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Photo 2 *Fulmars do not breed in Denmark, but are abundant in the North Sea and especially frequent visitors of the Skagerrak area and found dead on beaches, albeit in strongly different annual numbers.*

Contents

1. INTRODUCTION

Marine debris has serious economic and ecological consequences. Economic impacts are most severe for coastal communities, tourism, shipping and fisheries. Marine wildlife suffers from entanglement and ingestion of debris, with micro-particles potentially affecting marine food chains up to the level of human consumers (Lusher et al. 2017). In the North Sea, marine litter problems were firmly recognized by its border countries in 2002: North Sea governments assigned the task to OSPAR (Commission for the Protection of the Marine Environment of the North-East Atlantic) to include marine plastic litter in the system of Ecological Quality Objectives (EcoQOs) (North Sea Ministerial Conference 2002). At that time, in the Netherlands, marine litter was already monitored by the abundance of plastic debris in stomachs of a seabird, the Northern Fulmar *Fulmarus glacialis* (Van Franeker & Meijboom 2002).

Fulmars are purely offshore foragers that ingest all sorts of litter from the sea surface and do not regurgitate poorly degradable diet components like plastics. Initial size of ingested debris is usually in the range of millimetres to centimetres, but may be considerably larger for flexible items as for instance threadlike or sheetlike materials. Items must gradually wear down in the muscular stomach to a size small enough for passage to the intestines. During this process, plastics accumulate in the stomach to a level that integrates litter levels encountered in their foraging area for a period of probably up to a few weeks (Van Franeker & Law 2015).

The Dutch monitoring approach using beached fulmars was developed for international implementation by OSPAR as one of its EcoQOs for the North Sea (OSPAR 2008, 2009, 2010a,b; Van Franeker et al. 2011) and the same approach is now also used as an indicator for 'Good Environmental Status (GES)' in the Marine Strategy Framework Directive (MSFD) (EC 2008, 2010, 2017; Galgani et al. 2010; MSFD GES Technical Subgroup on Marine Litter 2011; OSPAR 2015a,b; Werner et al. 2016; OSPAR 2017). OSPAR has set a long-term target for acceptable ecological conditions in the North Sea as:

> *"There should be less than 10% of Northern fulmars (Fulmarus glacialis) having 0.1 gram or more plastic in the stomach in samples of 50-100 beached fulmars from each of 5 different areas of the North Sea over a period of at least 5 years".*

OSPAR has set no date to when this EcoQO target level should be reached. In contrast, the European MSFD does have an overall target date for GES by the year 2020, and different countries may therefore define a short-term MSFD target for ingested plastics differently. For the longer term, it is likely that an MSFD Threshold will be set similar to the OSPAR EcoQO target, potentially with modelled intermediate targets. For marine areas where fulmars do not occur, other species will be used as ingestion indicators, for which methodology and targets are being developed (MSFD GES Technical Subgroup on Marine Litter 2011). Monitoring methods for litter ingestion by marine turtles are in an advanced state (Matiddi et al. 2017). In the North Sea studies of seals (Bravo Rebolledo et al. 2013), Harbour Porpoises (Van Franeker et al. 2018) and fishes (Kühn et al. 2019) have been conducted to evaluate baseline values and potential monitoring methods. In presenting marine plastic pollution as one of the main global environmental concerns, UNEP uses the Fulmar study in the North Sea as an example of valuable long-term monitoring methods (UNEP 2011, 2016)

2. METHODS

The monitoring system uses fulmars found dead on beaches, or accidentally killed as e.g. fisheries bycatch. Data for the Danish monitoring are based on a sampling program of beached fulmars in the Skagen area that was established in 2002 as a part of the EU Interreg Project 'Save the North Sea' which ran to 2004 (Save the North Sea, 2004). The backbone of the surveys in the Skagen area is the clean-up of local beaches by the Skagen council, which runs all 5 workdays in the week, from april to December. Futhermore 8-10 locals from the local bird observatory are on the beach almost daily. The collection and storage of birds is co-ordinated by Jens Pedersen and Poul-Lindhard Hansed. Transport of fulmars to the lab in the Netherlands is irregular on an opportunity basis, but at least once in every two years. In spite of lack of dedicated funding up to 2014, the program has been kept running and is now conducted by assignment from the Danish Environmental Protection Agency.
In a pilot study (Van Franeker & Meijboom 2002) it has been shown that the amount of plastic in stomachs of slowly starved beached animals was not statistically different from that of healthy birds killed in instantaneous accidents. This implies that results from our study material are representative for all fulmars at sea. Standard procedures for dissection and stomach analyses have been documented in a range of manuals, reports and publications (Van Franeker 2004; Van Franeker et al. 2011; OSPAR 2015a,b etc.) and are not repeated here. Different categories of plastic are recorded, with as major types the industrial plastics (the raw granular feedstock for producers) as opposed to user plastics (from all sorts of consumer waste).

Information on abundance of plastics in fulmars may be expressed in different ways, such as by:

- **Percentage frequency of occurrence (%FO).** The percentage of birds in a sample having plastic in the stomach irrespective of the quantity of plastic (also referred to as 'incidence' or 'prevalence').
- **Average ± se.** Averages refer to straightforward arithmetic averages, with standard errors, for either number of particles or mass of plastic for all birds in a sample including the ones without any plastic ('population average').
- **Geometric mean.** Geometric means of plastic mass are calculated using data transformation (natural logarithm) to reduce influence of extreme outliers and to facilitate comparison of smaller samples. To include zero values in the population means, the transformation includes addition of one particle of plastic or 0.001 g plastic mass to each sample, later corrected for in back-calculations.
- **EcoQO performance or EcoQ%**. The percentage of birds in the population having more than a threshold value of 0.1 gram of plastic in the stomach, allowing direct comparison to the OSPAR target, which aims at having less than 10% of such birds. Confidence limits around EcoQ% depend on sample sizes, and 95% Confidence limits may be calculated following (Brown et al. 2001) and *http://epitools.ausvet.com.au/content.php?page=CIProportion*
- **State assessment data pooling.** In fulmar EcoQO reporting, data are frequently pooled over 5-year periods to have a focus on reliable averages and consistent trends rather than on incidental short term fluctuations. The 5-year data are not derived from annual averages or means, but are based on individual data from all birds sampled in these five years. **Graphs** often represent pooled data for 5 years, but shift one year by data point, i.e. running averages. Subsequent data points in the graph thus overlap for 4 years of data. These graphs are only intended to visually illustrate trends over time or geographic patterns and have no statistical

meaning. The 5-year period is also the standard used to report on compliance with policy targets such as defined by OSPAR.

- **Trend analysis statistics.** Statistical analyses investigating time related trends or regional differences are based on the mass of plastic. Tests for significance of trends over time are based on linear regressions of log-transformed data for the mass of plastics in individual birds against year of collection. In OSPAR analyses for trends focus on developments in the most recent 10 years (now: 2009-2018). But longer trends e.g. over all the years in the dataset (now 2002-2018 for Denmark) can also be discussed. An alternative way to look at trends is by a GLM approach (Generalized Linear Modelling), in which annual data for sample size and proportions of birds having over 0.1g of plastic are evaluated in a logistic analysis dedicated for binomial distributions and using logit transformed data. This model has been applied to Dutch data (Van Franeker & Kühn 2019) suggesting that the EcoQO target or MSFD Threshold might be reached in the Netherlands around year 2050. In the process of MSFD Threshold definitions, it is the intention to expand the Dutch work to a North Sea wide data analysis, providing options to consider integrated intermediate targets in the North Sea area.

3. RESULTS

3.1 The 5-year EcoQO assessment

Following the first report that provided an integrated comprehensive data analysis for the fulmar EcoQO monitoring in Denmark over the period 2002-2014 (Van Franeker et al. 2015), this report represents the fourth annual update. Data are based on a sampling program of fulmars beached in the Skagen area. This program was established in 2002 as a part of the EU Interreg Project 'Save the North Sea' which ran from 2002 to 2004. The program was continued thanks to the support of many volunteers and the municipality of Skagen. Since 2015, sample analyses and reporting is funded by the Danish authorities. Unfortunately it has been impossible to find beached fulmars in 2018.
Nevertheless, it was considered necessary to produce a report, as average plastic abundance and trends are based on specific multi-year periods, which thus change, even when in a specific year no new data can be added.

Overall, over the 2002-2018 period, 181 fulmars have been collected around the Skagen area. Beached fulmars were abundant in 2003 and 2004, but in most other years the number of beached birds has been lower and has varied from 1 to 15 per year. The number of beached birds over the 5-year assessment periods has ranged from 12 to 130 birds. Van Franeker & Meijboom (2002) found that a sample size of around 40 birds provided a reliable location- and time specific arithmetic averages. Smaller numbers are not a problem for trend calculations, but do reduce statistical certainty in the short term. Variability in abundance of live and dead fulmars in a region is influenced by many factors, mainly in relation to food availability and weather conditions. Years of low sample size are one of the reasons to recommend pooled 5-year data to consider the 'current' situation. The Danish sample for the 5-year period 2014-2018 is 12 fulmars, as no new birds could be added in 2018. Low numbers of beached fulmars was an issue in many countries in recent years. In the Netherlands in 2017 numbers increased again (36 birds found), were low in 2018 (12 birds) but were higher in 2019 (so far, over 40 fulmars). The most recent 5-year assessment are summarized in *Table 1,* with full details provided in the appendix. Raw data formatted according to the OSPAR Guidelines (OSPAR 2015b) for 2002-2014 (n=174) were provided as a separate file with the report by Van Franeker et al. (2015), and since then are annually updated in combination with the annual reports.

The current EcoQO assessment for the fulmars in Denmark (5-year period 2014 to 2018; 12 fulmars) is that the threshold of 0.1 gram plastic was exceeded by 58% of the birds whereas OSPAR has the long-term target that this percentage should be reduced to under 10%. In the current assessment period, 100% of fulmars had plastic in the stomach with on average 27 particles with a mass of 0.17 gram per stomach.

Table 1 **Data summary for study year added to the existing monitoring series and the most recent 5-year EcoQO assessment period.** *The table presents year or period of sampling with sample size (n), and for each of main plastic categories and total plastic the Frequency of Occurrence (%FO), the average number of particles (n) and the associated average mass per bird in gram (g). The final column gives EcoQO performance, that is the percentage of birds that exceeds 0.1 g of plastic mass in the stomach. NB no added data available for year 2018; also note that averages for the 5-year sample are based on a small sample size of only 12 birds, and thus has limited reliability, with 95% confidence limits from 31 to 82%.*

		INDUSTRIAL PLASTICS			USER PLASTICS			ALL PLASTICS (ind+user)			
Year	*n*	%FO	n	**g**	%FO	n	**g**	%FO	n	**g**	%EcoQ
2018 period	*0*										
2014_18	*12*	58%	2.4	**0.05**	100%	24.6	**0.12**	100%	27.0	**0.17**	58%

The 2014-18 EcoQO performance shows that 58% of Danish birds having more than 0.1g of plastic in the stomach is far above the long-term OSPAR EcoQO target (<10% of such birds). But the small sample size of only 12 birds for this period does not allow high accuracy. The 95% Confidence limits of this EcoQ% of 58%, actually has wide 95% confidence limits between 31% to 82%. In terms of average number of particles per bird, the Danish situation (27 particles) is slightly worse than in the Netherands (24 particles), but in the more important figure for mass of plastics, the Danish birds (0.17g of plastic) continue to be lower than those in the Netherlands (0.26g per bird in the 2014-2018 period). The figures also continue to indicate somewhat cleaner waters near Denmark than in the overall North Sea (Van Franeker et al. 2011; Van Franeker & the SNS Fulmar Study Group 2013; OSPAR 2017).

3.2 Trends

Trends to evaluate whether environmental conditions are improving or not, and in what speed, use the most recent 10 years of data. The agreed method (OSPAR 2015a) to conduct the trend analysis is by linear regression of log transformed mass of plastics in individual bird stomachs against years of sampling. In addition to the recent 10-year analysis, long-term trends may be viewed.
Long-term and recent 10-year trends are specified in *Table 2*. Over the longer term, the results show a significant drop in mass of ingested industrial plastics, but not in the mass of user plastics or the combined plastic mass. Within the recent 10-year period no significant changes for any category of plastic were observed. The slope is downward for user plastics and total plastic but far from significant, and even slightly upwards for industrial plastic but with very high standard error. In the Netherlands (Van Franeker & Kühn 2019), recent annual reports have shown a modest, but significant decrease in the mass of plastics ingested by fulmars. Over the whole of the North Sea over the 2007-2016 period, 4 out of 5 subregions show downward regression slopes. None of these is statistically significant, but combined for all North Sea data (OSPAR in press), the downward trend in ingested platic is significant ($p<0.001$). The Danish data do contribute to that overall trend, but by themselves are not significant because of the small Danish sample sizes in recent years.
Changes in abundance of plastics in fulmars beached in the Skagen area as tested in *Table 2* have been visualized for EcoQO performance in *Fig.1* and for average mass in *Fig.2*. Both graphs show data as running 5-year averages. The main message from the

EcoQO graph is that throughout the period of observation, ecological quality has not been in compliance with the OSPAR EcoQO target. The EcoQO performance over 5-year periods has varied between 39% and 58% with broad confidence limits, whereas the target is that it should be below 10%. *Fig.1* provides EcoQO data and could suggest a recent increase in plastic ingestion. However, the changes in this metric are minor, only caused by dropping birds from 2013, without adding new ones for 2018, and are not supported by the statistical tests (Table 2) and actual mass data in *Fig.2*. . GLM tests of annual EcoQO performance in Denmark indicate no significant trends in either long-term analysis (since 2002) or for the recent 2009-2018 period.

Table 2 ***Linear regression analysis of trends in plastic ingestion in Danish fulmars*** *for (A) long-term and (B) recent 10-year data series. Trends in plastic mass evaluated by ln-transformed individual mass values against year. EcoQO performance is evaluated by regression of simple numerical score for above or below the critical 0.1 gram level (0 below; 1 above). The regression line ('trend') is described by y = Constant + estimate*x in which y is the calculated value of the regression-line for year x. When the t-value of a regression is negative it indicates a decreasing trend in the tested litter-category; a positive t-value indicates increase. A trend is considered significant when the probability (p) of misjudgement of data is less than 5% (p<0.05). Significant trends are labelled with positive signs in case of increase (+) or negative signs in case of decrease (-). Significance at the 5% level (p<0.05) is labelled as - or + ; at the 1% level (p<0.01) as -- or ++; and at the 0.1% level (p<0.001) as --- or +++.*

A. LONG TERM TRENDS 2002 - 2018

FOR PLASTICS IN FULMAR STOMACHS DENMARK

	n	constant	slope	se	t	p	
Industrial Plastics (lnGIND)	*181*	186.0	-0.0950	0.0422	-2.25	0.026	-
User Plastics (lnGUSE)	*181*	-34.8	0.0159	0.0362	0.44	0.662	*n.s.*
All plastics combined (lnGPLA)	*181*	15.3	-0.0089	0.0374	-0.24	0.812	*n.s.*

B. RECENT TRENDS 2009 - 2018

FOR PLASTICS IN FULMAR STOMACHS DENMARK

	n	constant	slope	se	t	p	
Industrial Plastics (lnGIND)	*48*	-477.0	0.2350	0.1330	1.77	0.084	*n.s.*
User Plastics (lnGUSE)	*48*	-38.0	0.0180	0.1270	0.14	0.890	*n.s.*
All plastics combined (lnGPLA)	*48*	-81.0	0.0390	0.1330	0.29	0.773	*n.s.*

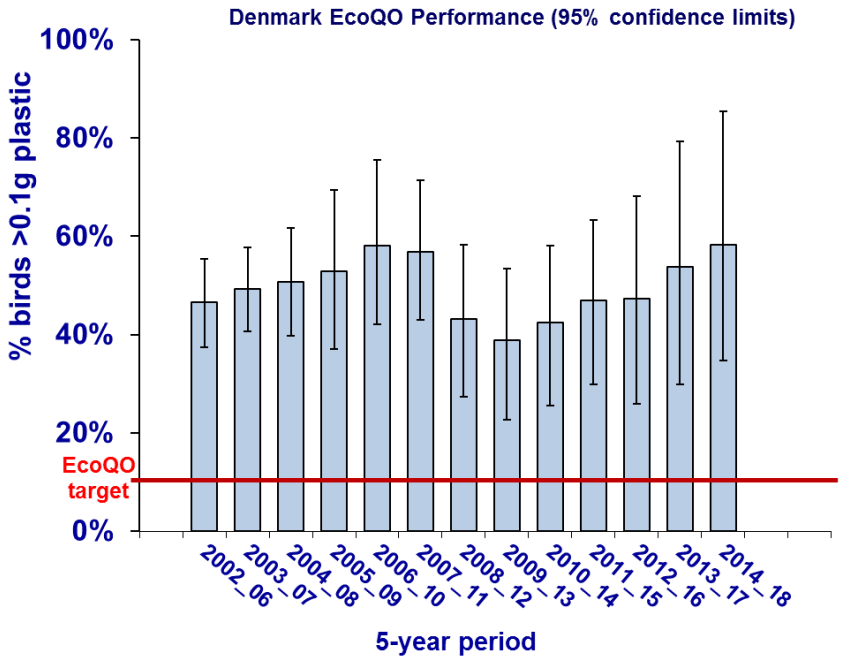


Figure 1 ***EcoQO performance among fulmars from Denmark 2002-2018.*** *Data for the proportion of birds having more than 0.1 gram of plastic with 95% confidence interval, illustrating the distance to the 10% target as defined by OSPAR (red line); data are shown by annually updated 5 year performances (i.e. data points shift one year ahead at a time). These graphic visualizations do not represent a statistical trend analysis.The suggestion of an increase in the most recent period is misleading: no new stomachs were added, only those of 2013 dropped from the calculated average. The change is statistically insignificant (note the large standard error ranges).*

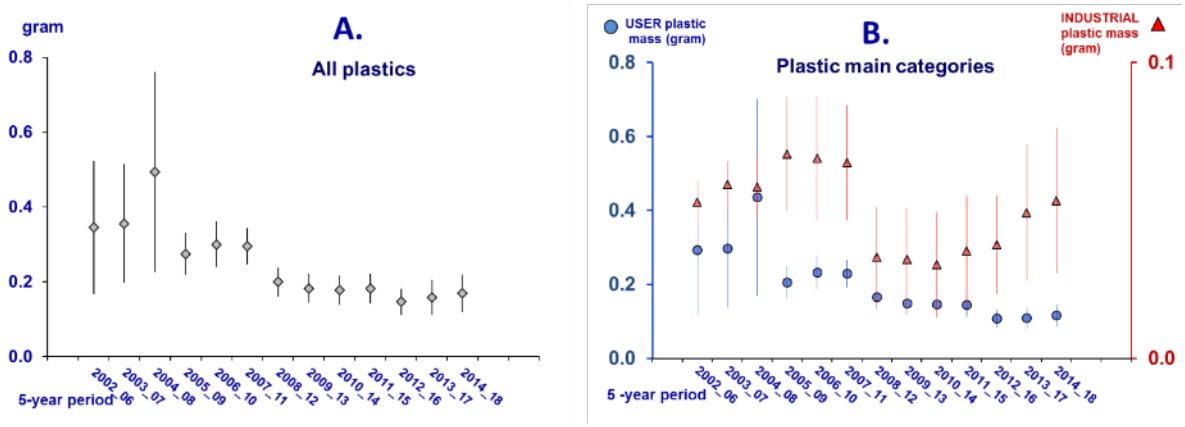


Figure 2 ***Plastic mass in stomachs of fulmars from Denmark 2002-2018.*** *A: all plastics combined (grey diamonds) and B: user plastic (blue circles, left y-axis) and industrial plastic (red triangles, right y-axis). Data are shown by arithmetic average ± standard error for mass for running 5-year averages (i.e. data points shift one year ahead at a time) where sample size was over 10 birds. These graphic visualizations do not represent a statistical trend analysis.*

4. DISCUSSION

It is not fully clear which sources are the main contributors to plastics found in fulmar stomachs. Industrial granules may be lost during marine transports between producing and processing factories, but also at the land-based plants from where they may make their way to the oceans through rivers and unfiltered sewage discharges. Losses of industrial granules represent economic loss and have been addressed by the industry since the 1980s leading to globally reduced marine abundance (Van Franeker & Law 2015). The downward trend continues at a slower rate in recent years.

In the southern North Sea, larger objects of consumer debris can be traced to mainly marine sources: a detailed beach study on Texel in the Netherlands in 2005 showed that most debris along the Dutch coast had its origin in or near the North Sea itself and was primarily linked to seabased sources such as merchant shipping and fisheries, but also offshore industry and mariculture (Van Franeker 2005; Van Franeker & Meijboom 2006). A similar conclusion with an emphasis on the role of fisheries was reached by Fleet (2003) and Unger & Harrison (2016). On Texel, among plastic wastes, by weight 57% were fishing nets and ropes and the major part of the remainder consisted of jerrycans, fishboxes, and other large items clearly linked to seabased activities. In the North Pacific Garbage Patch, a similar predominance of litter from marine sources has been observed (Lebreton et al. 2018). On Texel, using various other details of beached items, seabased sources were considered to be responsible for about 90% of the mass of coastal debris found (Van Franeker 2005; Van Franeker & Meijboom 2006). Large objects degrade to smaller debris, but possibly smaller particles also originate from riverine sources and unfiltered discharges from urban drainage systems and sewage discharges.

So far, no evident impacts from specific policy measures have emerged from the monitoring results. The current patterns appears to reflect stability or a very slow rate of gradual improvement. But for example the implementation of the EU Directive 2000/59/EC on Port Reception Facilities (since 2004) and the recent change in MARPOL Annex V regulations in 2013 (MEPC 2011: switch from 'discharges allowed unless…' to 'NO discharges unless') have not created sharp detectable improvements.

As yet, at local scale, it is maybe too early to expect significant reductions in marine debris in relation to recent developments. Public and stakeholder awareness has strongly increased in recent years following media attention for garbage patches in the open ocean. International legislation for waste disposal by ships under MARPOL Annex V and developments for implementation of the European Marine Strategy Directive (2008/56/EC) and its requirements towards Good Environmental Status may only gradually take effect. In the Netherlands, based on substantially larger sample sizes a slow but statistically significant improvement has been observed (Van Franeker & Kühn 2019). A similar trend in Danish material will go undetected for some time due to low sample sizes, but will contribute to OSPAR assessments for the North Sea as a whole or the Skagerrak sub-region which holds a mix of Danish and Norwegian data.

The slow rate of improvement in the marine litter situation indicates that additional policies may be needed to achieve a more rapid change towards the OSPAR EcoQO target or EU MSFD Threshold. It should be noted that the OSPAR EcoQO target of less than 10% of birds exceeding the 0.1g level of plastic in the stomach, represents an undated long-term policy objective by OSPAR for the North Sea. Targets to be achieved by the year 2020 within the perspective European Marine Strategy Directive may be defined differently in intermediate Threshold levels.

5. VOLUNTEER SUPPORT – FUTURE WORK

The low number, and in 2018 even absence' of beached fulmars in the Skagen area has been of concern, and efforts have been made to increase future support. Our dossier page on this in late 2018 (see appendix and https://www.wur.nl/en/Research-Results/Research-Institutes/marine-research/show-marine/Fulmar-plastic-monitoring-in-Denmark.htm) and data from the previous report were used within Denmark to promote volunteer support. This resulted in a number of messages from Danish authorities, bird organisation and media, over the course of 2019, e.g.:

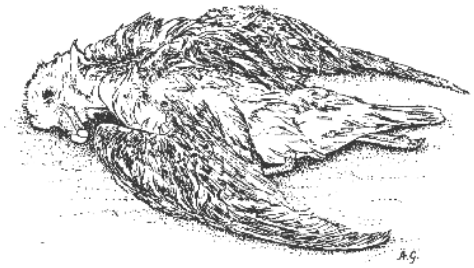
https://mst.dk/service/nyheder/nyhedsarkiv/2019/jul/miljoestyrelsen-efterlyser-doede-dyr/

https://www.dr.dk/nyheder/viden/natur/frivillige-finder-dode-havfugle-fyldt-med-plastik

https://www.dof.dk/om-dof/nyheder?nyhed_id=1755

https://gylle.dk/havfugle-med-25-stykker-plastik-i-maven/

At this stage (Nov 2019) this has resulted in 4 volunteers that contacted the Danish coordinator John Pedersen, one of which already collected a fulmar for the project, and another was found in the original Skagen area. We hope for a gradually growing network in years to come, with higher numbers of fulmars brought in for the monitoring program with continued support from the Danish Environmental Protection Agency.



Beached fulmar (line-drawing by Arnold Gronert)

6. ABSTRACT - CONCLUSIONS

1. In the OSPAR Ecological Quality Objective (EcoQO), North Sea governments have agreed to a long-term target for marine litter in which less than 10% of fulmars exceed a threshold of 0.1 gram plastic in the stomach. Target definition under the more time restricted EU Marine Strategy Framework Directive will likely use the same as its ultimate threshold, but intermediate targets may be defined.

2. Currently over the 5 year period 2014-2018 in Denmark, 58% of beached fulmars exceed the threshold of 0.1 gram (95% confidence limits 31%-82%; sample of 12 fulmars: all birds contained some plastic, on average 27 particles per stomach, weighing 0.17 gram). Comparison to the earlier 2013-2017 details is misleading because no new birds were added in 2018, and 2013 results were dropped from the calculation.

3. Compared to the southern North Sea, Danish waters seem somewhat cleaner (e.g. in the Netherlands, fulmars have an average mass of 0.26 gram of plastic in the stomach, but detailed comparisons are hampered by small samples from the Danish coast in recent years).

4. Over the past 10 years, Danish monitoring shows no statistical changes for marine plastic litter in fulmar stomachs. The only significant change seen is a reduction in industrial plastics since the start of the project in 2002. Danish data do contribute to North Sea wide assessments by OSPAR and MSFD.

5. Efforts to increase volunteer participation in collection of beached fulmars show first results but need continuous attention.

Photo 3 ***An international problem.*** *Dutch debris is quite common on Danish beaches, here a Dutch fishbox. The Danish coast is downstream of the Netherlands in residual currents in the North Sea. Also, various marine industries from the Netherlands operate near the Danish coast. Danish debris likely goes to Swedish and Norwegian waters. Finger pointing is useless. All are part of the problem, and all will need to contribute to solutions.*

7. Acknowledgements

The origin of an EcoQO based on the abundance of plastics in seabird stomachs was initiated by the ICES Working Group on Seabird Ecology and guided in several workgroups within ICES and OSPAR. Fulmar monitoring in Denmark was started with support of the EU Interreg IIB project 'Save the North Sea' running from 2002 to 2004, with major efforts by the municipality of Skagen, the Skagen Uddannelsescenter, and the Naturhistorisk Museum Skagen.
From 2004 onwards the work was continued and has temporarily been funded by the NYK Group Europe Ltd and Chevron Upstream Europe. The Netherlands Ministry of Infrastructure and the Environment (I&M) has intermittently supported part of data analyses. As of 2015, the Danish Nature Agency through its department on 'Water Planning and Marine Environment' is funding continuation of the project from its background in both OSPAR and EU MSFD.
But all of this, now and in future, is only possible thanks to the enormous efforts by a range of volunteers, either searching beaches or otherwise active. In the Skagen area, we should at least thank:
Anders Clausen, Arve Jensen, Einar Thorsen, Helle Schultz, Henrik Pedersen, Jens Pedersen, Kathleen Pedersen, Kai Jacobsen, Lars Mortensen, Lars Pedersen, Leif Madsen, Liselotte Sorensen, Ole Skrubbeltrang, Peter Breyen, Rolf Christensen, Sven Age Pedersen and Tina Mortensen, with sincere apologies to anyone not specifically named!
In the Netherlands major efforts have been contributed by Elisa Bravo Rebolledo, Martin de Jong and André Meijboom.

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9. APPENDIX -RESULT DETAILS

In addition to the details provided in the next pages of this appendix, these annual reports are normally accompanied by a file with data summary as required by OSPAR. However, in this case, as no birds were added in 2018, the file is empty. It is recommended to nevertheless submit it to the OSPAR secretariat, to avoid later queries on missing data from Denmark.
OSPARsourcedataRawData_2018_DNK.csv/xlsx

APPENDIX TABLE 1 Summary of sample characteristics and stomach contents of fulmars collected for Danish marine litter monitoring *in* ***A)*** *the year 2018(*) and* ***B)*** *the current 5-year period 2014-2018. The top line in each table shows sample composition in terms of age, sex, origin (by colourphase; darker phases are of distant Arctic origin), death cause oil, and the average condition-index (which ranges from emaciated condition=0 to very good condition=9). For each litter-(sub)category the table lists: Incidence, representing the proportion of birds with one or more items of the litter category present; average number of plastic items per bird stomach ± standard error; average mass of plastic ± standard error per bird stomach; and the maximum mass observed in a single stomach. The final column shows the geometric mean mass, which is calculated from ln-transformed values as used in trend-analyses.*

A. Details of stomach contents in Fulmars beached in Denmark 2018

No table; no birds collected during year 2018

B: Details of stomach contents in Fulmars beached in Denmark 2014 to 2018

	Skagen, Denmark	nr of birds	adult	male	LL colour	death oil	avg condition	
	2014_18	12	50%	42%	92%	0%	2.3	
		incidence	average number of items (n/bird) ± se		average mass of litter (g/bird) ± se		max. mass recorded	geometric mean mass (g/bird)
1.0	**ALL PLASTICS**	**100%**	**27.0**	**± 11.1**	**0.170**	**± 0.051**	**0.5**	**0.0737**
1.1	**INDUSTRIAL PLASTIC**	**58%**	**2.4**	**± 1.1**	**0.053**	**± 0.025**	**0.2**	**0.0083**
1.2	**USER PLASTIC**	**100%**	**24.6**	**± 10.2**	**0.116**	**± 0.029**	**0.3**	**0.0603**
1.2.1	sheets	50%	6.4	± 3.7	0.006	± 0.003	0.0	0.0022
1.2.2	threads	50%	4.5	± 3.8	0.011	± 0.006	0.1	0.0020
1.2.3	foamed	33%	1.6	± 0.9	0.001	± 0.000	0.0	0.0004
1.2.4	fragments	92%	12.1	± 3.8	0.099	± 0.026	0.2	0.0447
1.2.5	other plastic	0%	0.0	± 0.0	0.000	± 0.000	0.0	0.0000
2.0	**OTHER RUBBISH**	**0%**	**0.0**	**± 0.0**	**0.000**	**± 0.000**	**0.0**	**0.0000**
2.1	paper	0%	0.0	± 0.0	0.000	± 0.000	0.0	0.0000
2.2	kitchenwaste (food)	0%	0.0	± 0.0	0.000	± 0.000	0.0	0.0000
2.3	rubbish various	0%	0.0	± 0.0	0.000	± 0.000	0.0	0.0000
2.4	fishhook	0%	0.0	± 0.0	0.000	± 0.000	0.0	0.0000

APPENDIX TABLE 2 Running averages by 5-year period for plastic abundance in fulmars from Skagen, Denmark. *For **A.** separate and **B.** combined plastic categories: incidence (%) represents the proportion of birds with one or more items of that litter present; number (n) abundance by average number of items per bird; and mass (g) abundance by average mass per bird in grams. Mass data for total plastics are also shown in terms of geometric mean mass (for comparative purposes reducing the influence of outliers) and as level of performance in relation to the OSPAR EcoQO, viz. the percentage of birds having more than the critical level of 0.1 gram of plastic in the stomach. Results not shown where sample size was 10 stomachs or less.*

Table 2A.

Skagen, Denmark		Industrial granules			User plastics		
PERIOD	*sample n*	Inc. %	avg number n ± se	avg mass g ± se	Inc. %	avg number n ± se	avg mass g ± se
2002_06	*116*	60%	2.4 ± 0.3	0.05 ± 0.01	94%	33.9 ± 8.5	0.29 ± 0.18
2003_07	*130*	64%	2.8 ± 0.4	0.06 ± 0.01	95%	46.2 ± 11.3	0.30 ± 0.16
2004_08	*77*	64%	2.8 ± 0.6	0.06 ± 0.01	94%	64.7 ± 18.8	0.44 ± 0.27
2005_09	*34*	65%	3.6 ± 1.2	0.07 ± 0.02	94%	69.5 ± 32.3	0.21 ± 0.04
2006_10	*31*	58%	3.6 ± 1.3	0.07 ± 0.02	97%	75.4 ± 35.2	0.23 ± 0.04
2007_11	*44*	52%	3.3 ± 1.0	0.07 ± 0.02	89%	58.0 ± 25.1	0.23 ± 0.04
2008_12	*37*	27%	1.5 ± 0.7	0.03 ± 0.02	84%	16.9 ± 3.2	0.17 ± 0.03
2009_13	*36*	22%	1.4 ± 0.7	0.03 ± 0.02	83%	16.2 ± 3.2	0.15 ± 0.03
2010_14	*33*	27%	1.3 ± 0.7	0.03 ± 0.02	85%	14.1 ± 3.1	0.15 ± 0.03
2011_15	*32*	38%	1.6 ± 0.8	0.04 ± 0.02	84%	15.2 ± 3.3	0.15 ± 0.03
2012_16	*19*	42%	1.7 ± 0.7	0.04 ± 0.02	95%	22.7 ± 6.8	0.11 ± 0.02
2013_17	*13*	54%	2.2 ± 1.0	0.05 ± 0.02	100%	23.0 ± 9.5	0.11 ± 0.03
2014_18	*12*	58%	2.4 ± 1.1	0.05 ± 0.02	100%	24.6 ± 10.2	0.12 ± 0.03

Table 2B.

Skagen, Denmark		Total plastics				
PERIOD	*sample n*	Incidence %	average number n ± se	average mass g ± se	Geometric mean mass	EcoQO % *(over 0.1g)*
2002_06	*116*	94%	36.3 ± 8.6	0.35 ± 0.18	0.064	47%
2003_07	*130*	95%	49.1 ± 11.6	0.36 ± 0.16	0.074	49%
2004_08	*77*	94%	67.5 ± 19.2	0.49 ± 0.27	0.078	51%
2005_09	*34*	94%	73.1 ± 33.4	0.27 ± 0.06	0.097	53%
2006_10	*31*	97%	79.0 ± 36.4	0.30 ± 0.06	0.129	58%
2007_11	*44*	89%	61.3 ± 26.0	0.30 ± 0.05	0.103	57%
2008_12	*37*	84%	18.4 ± 3.6	0.20 ± 0.04	0.058	43%
2009_13	*36*	83%	17.6 ± 3.6	0.18 ± 0.04	0.051	39%
2010_14	*33*	85%	15.4 ± 3.5	0.18 ± 0.04	0.052	42%
2011_15	*32*	84%	16.7 ± 3.7	0.18 ± 0.04	0.051	47%
2012_16	*19*	95%	24.5 ± 7.4	0.15 ± 0.04	0.064	47%
2013_17	*13*	100%	25.2 ± 10.4	0.16 ± 0.05	0.067	54%
2014_18	*12*	100%	27.0 ± 11.1	0.17 ± 0.05	0.074	58%

Relevant website with dossier on plastic research in relation to marine wildlife:

OUTREACH *In the Fulmar monitoring project, we aim to disseminate knowledge widely and promote participation. Through a web-dossier www.wur.eu/plastics-fulmars we inform general public, policy makers, scientific colleagues and volunteers involved in the program on our achievements and important developments.*

Message end 2018 on the dossier, to promote volunteer support for the project

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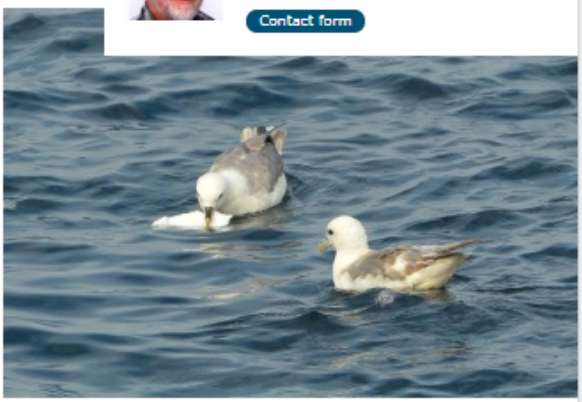
News

Fulmar-plastic monitoring in Denmark

December 28, 2018

In October 2018 a report was published for the Danish Environmental Protection Agency on results of the national monitoring program of plastics in stomachs of Northern Fulmars beached in Denmark. Wageningen Marine Research in Den Helder, The Netherlands, coordinates the same type of research in Denmark as done for the Netherlands national program. Results of research from all countries around the North Sea are ultimately joined for the purpose of policies under the EU Marine Strategy Framework Directive (MSFD).

Ask your question about plastic litter to our expert:
dr. JA (Jan Andries) van Franeker
Contact form



Results

The new report shows that in Denmark, during the current 5-year evaluation period (2013-2017; 13 birds) all birds had some plastic in the stomach. The averages were 25 plastic particles with a plastic mass of 0.16 gram per bird stomach. The level of 0.1 gram plastic in the stomach was exceeded by 54% of the birds. OSPAR has a long term target aiming to reduce this percentage to under 10%. The standard analyses in this program look at statistically relevant time series over the most recent 10 years. For Denmark, the 10 year time series indicates no relevant increase or decrease. However, over the longer period since the start of the program in 2002, a significant decrease has occurred in industrial plastic granules in the stomachs.

Help needed!

From the start of the monitoring program, Danish fulmars have been collected around the locality of Skagen, in the north. Unfortunately in recent years few fulmars are found beached in this region, reducing the statistical strength of the national Danish monitoring. Smaller national samples do represent a valuable contribution to the North Sea wide combined monitoring program. However, to increase the strength of the Danish program, we are looking for volunteers that would like to contribute to the sampling program along other sectors of the Danish North Sea coastline. By doing so, one makes an important contribution to reducing plastic debris in our oceans, because your work forms the basis for important policy decisions! For information about the fulmar project and contact information, please check our dossier.

Download the report:
Van Franeker, J.A., Kühn, S., Pedersen, J. & Hansen, P.L. (2018) Fulmar Litter EcoQO monitoring in Denmark 2002-2017. Report for the Danish Environmental Protection Agency. Wageningen Marine Research Den Helder, The Netherlands. 25pp.

Read more in our dossier

Plastic waste and marine wildlife

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10. APPENDIX SOURCE DATA 2002-2018

Table showing all collected Danish fulmars since the start of the *Save the North Sea* project in 2002, using OSPAR Raw data table format.

NIND	number of industrial plastic pellets in the stomach
GIND	mass of industrial plastics in the stomach (gram)
NUSE	number of user plastic particles in the stomach
GUSE	mass of user plastics in the stomach (gram)
NPLA	total number of plastic items in the stomach
GPLA	total mass of plastics in the stomach

OSPARsourcedata_upto2014_DNK.CSV															
SampleCode	**Species Name**	**Sample Date**	**Country**	**Location Description**	**AreaCode**	**Latitude**	**Longitude**	**Sex**	**AgeGr**	**NIND**	**GIND**	**NUSE**	**GUSE**	**NPLA**	**GPLA**
SKA-2002-001	Fulmarus glacialis	20020723	Denmark	Skagen; 500m S Kandestederne	DNK3130	57.6411	10.3286	M	ADULT	7	0.2175	2	0.0207	9	0.2382
SKA-2003-001	Fulmarus glacialis	20030402	Denmark	Skagen; Skawbanke	DNK3130	57.6411	10.3286	F	NONAD	2	0.0453	8	0.0295	10	0.0748
SKA-2003-002	Fulmarus glacialis	20030331	Denmark	Skagen; 2km S Kandestederne	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	25	0.1370	25	0.1370
SKA-2003-003	Fulmarus glacialis	20030402	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	F	NONAD	1	0.0072	11	0.1683	12	0.1755
SKA-2003-004	Fulmarus glacialis	20030331	Denmark	Skagen; 2km S Kandestederne	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	9	0.0633	9	0.0633
SKA-2003-005	Fulmarus glacialis	20030407	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	5	0.0095	5	0.0095
SKA-2003-006	Fulmarus glacialis	20030407	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	M	NONAD	1	0.0205	9	0.0628	10	0.0833
SKA-2003-007	Fulmarus glacialis	20030618	Denmark	Skagen; Buttervej	DNK3130	57.6411	10.3286	UNK	NOAGE	18	0.3946	35	0.2194	53	0.6140
SKA-2003-008	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	UNK	NOAGE	8	0.1454	51	0.2371	59	0.3825
SKA-2003-009	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	10	0.2701	57	0.2696	67	0.5397
SKA-2003-010	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0146	9	0.0327	10	0.0473
SKA-2003-011	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	2	0.0442	7	0.0708	9	0.1150
SKA-2003-012	Fulmarus glacialis	20030615	Denmark	Skagen; Batterivej	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	7	0.0445	7	0.0445
SKA-2003-014	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0138	2	0.0025	3	0.0163
SKA-2003-015	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	2	0.0548	30	0.4408	32	0.4956
SKA-2003-016	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0183	7	0.0994	8	0.1177
SKA-2003-017	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	10	0.2117	73	0.3808	83	0.5925
SKA-2003-018	Fulmarus glacialis	20030615	Denmark	Skagen; Batterivej	DNK3130	57.6411	10.3286	M	ADULT	9	0.1635	54	0.1396	63	0.3031
SKA-2003-019	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	3	0.0478	37	0.0771	40	0.1249
SKA-2003-020	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	3	0.0033	37	0.0240	40	0.0273
SKA-2003-021	Fulmarus glacialis	20030615	Denmark	Skagen; Kandestederne	DNK3130	57.6411	10.3286	M	ADULT	12	0.2173	100	0.7065	112	0.9238

SKA-2003-022	Fulmarus glacialis	20030822	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	10	0.0383	10	0.0383
SKA-2003-023	Fulmarus glacialis	20030616	Denmark	Skagen; Skivern	DNK3130	57.6411	10.3286	M	NONAD	2	0.0290	5	0.0361	7	0.0651
SKA-2003-024	Fulmarus glacialis	20030623	Denmark	Skagen; Kandestederne	DNK3130	57.6411	10.3286	UNK	NOAGE	1	0.0240	12	0.0548	13	0.0788
SKA-2003-025	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0033	1	0.0033
SKA-2003-026	Fulmarus glacialis	20030615	Denmark	Skagen; Batterivej	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	14	0.0799	14	0.0799
SKA-2003-027	Fulmarus glacialis	20030822	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	3	0.0068	3	0.0068
SKA-2003-028	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	7	0.0994	55	0.2443	62	0.3437
SKA-2003-029	Fulmarus glacialis	20030615	Denmark	Skagen; Kandestederne	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	5	0.0136	5	0.0136
SKA-2003-030	Fulmarus glacialis	20030610	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	F	ADULT	7	0.1772	19	0.1430	26	0.3202
SKA-2003-031	Fulmarus glacialis	20030615	Denmark	Skagen; Buttervej	DNK3130	57.6411	10.3286	F	ADULT	2	0.0404	25	0.0842	27	0.1246
SKA-2003-033	Fulmarus glacialis	20030615	Denmark	Skagen; Skivern	DNK3130	57.6411	10.3286	M	ADULT	1	0.0018	11	0.0540	12	0.0558
SKA-2003-034	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2003-035	Fulmarus glacialis	20030610	Denmark	Skagen; Kandestederne	DNK3130	57.6411	10.3286	F	ADULT	5	0.1830	17	0.0516	22	0.2346
SKA-2003-036	Fulmarus glacialis	20030615	Denmark	Skagen; Buttervej	DNK3130	57.6411	10.3286	F	ADULT	6	0.1348	28	0.1259	34	0.2607
SKA-2003-037	Fulmarus glacialis	20030615	Denmark	Skagen; Kandestederne	DNK3130	57.6411	10.3286	M	ADULT	7	0.1971	22	0.1461	29	0.3432
SKA-2003-039	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0255	90	0.2494	91	0.2749
SKA-2003-040	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.0975	6	0.0480	10	0.1455
SKA-2003-041	Fulmarus glacialis	20030615	Denmark	Skagen; Skivern	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	1	0.0267	1	0.0267
SKA-2003-042	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2003-043	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0107	5	0.0410	6	0.0517
SKA-2003-044	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0183	14	0.0377	15	0.0560
SKA-2003-045	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0491	7	0.1308	8	0.1799
SKA-2003-046	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	F	ADULT	7	0.1218	44	0.1571	51	0.2789

SKA-2003-047	Fulmarus glacialis	20030615	Denmark	Skagen; Skivern	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	11	0.0405	11	0.0405
SKA-2003-048	Fulmarus glacialis	20030615	Denmark	Skagen; GL Skagen	DNK3130	57.6411	10.3286	M	ADULT	4	0.0431	11	0.0852	15	0.1283
SKA-2003-049	Fulmarus glacialis	20031208	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	12	0.0346	12	0.0346
SKA-2003-050	Fulmarus glacialis	20031216	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	3	0.0165	3	0.0165
SKA-2003-051	Fulmarus glacialis	20031215	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	2	0.0038	2	0.0038
SKA-2003-052	Fulmarus glacialis	20031215	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	8	0.0167	8	0.0167
SKA-2003-053	Fulmarus glacialis	20031215	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	14	0.2551	14	0.2551
SKA-2003-054	Fulmarus glacialis	20031215	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	ADULT	4	0.0942	12	0.0235	16	0.1177
SKA-2003-055	Fulmarus glacialis	20031216	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	M	NONAD	1	0.0279	7	0.0158	8	0.0437
SKA-2003-056	Fulmarus glacialis	20031216	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.0678	9	0.0438	13	0.1116
SKA-2003-057	Fulmarus glacialis	20031215	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	NONAD	4	0.1286	13	0.3333	17	0.4619
SKA-2003-058	Fulmarus glacialis	20031215	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	9	0.0225	9	0.0225
SKA-2004-001	Fulmarus glacialis	20040103	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0342	16	0.1074	17	0.1416
SKA-2004-002	Fulmarus glacialis	20040103	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	9	0.2365	9	0.2365
SKA-2004-003	Fulmarus glacialis	20040103	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0076	69	0.9874	70	0.9950
SKA-2004-004	Fulmarus glacialis	20040524	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	3	0.0084	3	0.0084
SKA-2004-005	Fulmarus glacialis	20040525	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0001	1	0.0001
SKA-2004-006	Fulmarus glacialis	20040308	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0232	606	20.5691	607	20.5923
SKA-2004-007	Fulmarus glacialis	20040311	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.0635	22	0.1435	26	0.2070
SKA-2004-008	Fulmarus glacialis	20040310	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	5	0.0901	5	0.0901
SKA-2004-009	Fulmarus glacialis	20040308	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	5	0.0423	5	0.0423
SKA-2004-010	Fulmarus glacialis	20040227	Denmark	Hirtshals	DNK3120	57.2257	9.5376	M	ADULT	1	0.0262	4	0.0183	5	0.0445
SKA-2004-011	Fulmarus glacialis	20040228	Denmark	Lonstrup	DNK3120	57.2257	9.5376	F	ADULT	0	0.0000	41	0.0571	41	0.0571

SKA-2004-012	Fulmarus glacialis	20040227	Denmark	Tornby Strand	DNK3120	57.2257	9.5376	F	ADULT	0	0.0000	4	0.2042	4	0.2042
SKA-2004-013	Fulmarus glacialis	20040227	Denmark	Hirtshals	DNK3120	57.2257	9.5376	F	ADULT	7	0.1916	120	0.2808	127	0.4724
SKA-2004-014	Fulmarus glacialis	20040221	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	5	0.1415	39	0.2532	44	0.3947
SKA-2004-015	Fulmarus glacialis	20040209	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	NONAD	3	0.0996	57	0.1036	60	0.2032
SKA-2004-016	Fulmarus glacialis	20040524	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	F	NONAD	21	0.4425	120	0.5607	141	1.0032
SKA-2004-017	Fulmarus glacialis	20040524	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	4	0.0828	33	0.1026	37	0.1854
SKA-2004-019	Fulmarus glacialis	20040525	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	NONAD	10	0.2272	37	0.1408	47	0.3680
SKA-2004-020	Fulmarus glacialis	20040525	Denmark	Stranden 2; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	6	0.0308	6	0.0308
SKA-2004-021	Fulmarus glacialis	20040525	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0159	1	0.0159
SKA-2004-022	Fulmarus glacialis	20040525	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2004-023	Fulmarus glacialis	20040629	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	UNK	NOAGE	1	0.0416	7	0.0089	8	0.0505
SKA-2004-024	Fulmarus glacialis	20040630	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	6	0.1231	78	0.3922	84	0.5153
SKA-2004-025	Fulmarus glacialis	20040614	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0037	1	0.0037
SKA-2004-026	Fulmarus glacialis	20040614	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0003	1	0.0003
SKA-2004-027	Fulmarus glacialis	20040616	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	NONAD	1	0.0161	20	0.0339	21	0.0500
SKA-2004-028	Fulmarus glacialis	20040616	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	2	0.0684	3	0.0035	5	0.0719
SKA-2004-029	Fulmarus glacialis	20040616	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	2	0.0699	10	0.0961	12	0.1660
SKA-2004-030	Fulmarus glacialis	20040614	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	0	0.0000	0	0.0000
SKA-2004-031	Fulmarus glacialis	20040617	Denmark	Stranden 2; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2004-032	Fulmarus glacialis	20040616	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0113	10	0.0473	11	0.0586
SKA-2004-033	Fulmarus glacialis	20040616	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0204	30	0.0678	31	0.0882
SKA-2004-034	Fulmarus glacialis	20040616	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	2	0.0455	9	0.0472	11	0.0927
SKA-2004-035	Fulmarus glacialis	20040616	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	8	0.1153	80	0.2631	88	0.3784

SKA-2004-036	Fulmarus glacialis	20040614	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.0453	136	0.3905	140	0.4358
SKA-2004-037	Fulmarus glacialis	20040614	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	ADULT	3	0.0585	107	0.1480	110	0.2065
SKA-2004-038	Fulmarus glacialis	20040610	Denmark	Hosen Fyr; Buttervej; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	18	0.0113	18	0.0113
SKA-2004-039	Fulmarus glacialis	20040610	Denmark	Sonderstrand; Skagen	DNK3130	57.6411	10.3286	M	ADULT	3	0.0506	758	0.7050	761	0.7556
SKA-2004-040	Fulmarus glacialis	20040614	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	142	0.1077	142	0.1077
SKA-2004-041	Fulmarus glacialis	20040616	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	1	0.0007	1	0.0007
SKA-2004-042	Fulmarus glacialis	20040714	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	2	0.0249	2	0.0249
SKA-2004-043	Fulmarus glacialis	20040714	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.0552	5	0.0296	9	0.0848
SKA-2004-044	Fulmarus glacialis	20040708	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2004-045	Fulmarus glacialis	20040802	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	4	0.0836	49	0.5790	53	0.6626
SKA-2004-046	Fulmarus glacialis	20040727	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	7	0.0292	7	0.0292
SKA-2004-047	Fulmarus glacialis	20040802	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	4	0.1439	30	0.1337	34	0.2776
SKA-2004-048	Fulmarus glacialis	20040802	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	2	0.0109	2	0.0109
SKA-2004-049	Fulmarus glacialis	20040714	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	F	NONAD	1	0.0056	26	0.1781	27	0.1837
SKA-2004-050	Fulmarus glacialis	20040727	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	26	0.1219	26	0.1219
SKA-2004-051	Fulmarus glacialis	20040830	Denmark	Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	1	0.0073	1	0.0073
SKA-2004-052	Fulmarus glacialis	20041116	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	F	ADULT	1	0.0408	4	0.0130	5	0.0538
SKA-2005-001	Fulmarus glacialis	20050124	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0300	10	0.0225	11	0.0525
SKA-2005-002	Fulmarus glacialis	20050201	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	6	0.0061	6	0.0061
SKA-2005-003	Fulmarus glacialis	20050201	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	25	0.1977	25	0.1977
SKA-2005-004	Fulmarus glacialis	20050201	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	0	0.0000	0	0.0000
SKA-2005-005	Fulmarus glacialis	20050324	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	F	NONAD	6	0.1460	22	0.1943	28	0.3403
SKA-2005-006	Fulmarus glacialis	20050324	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	UNK	NOAGE	3	0.0504	12	0.0287	15	0.0791

SKA-2005-007	Fulmarus glacialis	20050509	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0265	4	0.0069	5	0.0334
SKA-2006-001	Fulmarus glacialis	20060629	Denmark	2km south of Gl.Skagen; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	3	0.0003	3	0.0003
SKA-2006-002	Fulmarus glacialis	20060903	Denmark	Nordstrand-Grenen; Skagen	DNK3130	57.6411	10.3286	M	NONAD	2	0.0650	13	0.2331	15	0.2981
SKA-2007-002	Fulmarus glacialis	20070211	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	F	NONAD	12	0.2628	105	0.4134	117	0.6762
SKA-2007-003	Fulmarus glacialis	20070509	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	M	ADULT	2	0.0586	31	0.2895	33	0.3481
SKA-2007-004	Fulmarus glacialis	20070510	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	ADULT	2	0.0334	27	0.0795	29	0.1129
SKA-2007-006	Fulmarus glacialis	20070510	Denmark	Skagen Gl	DNK3130	57.6411	10.3286	F	ADULT	8	0.1495	185	0.5116	193	0.6611
SKA-2007-007	Fulmarus glacialis	20070510	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	NONAD	37	0.5226	1086	1.0480	1123	1.5706
SKA-2007-008	Fulmarus glacialis	20070510	Denmark	Skagen Gl	DNK3130	57.6411	10.3286	M	ADULT	7	0.1315	70	0.1447	77	0.2762
SKA-2007-009	Fulmarus glacialis	20070510	Denmark	Skagen Gl	DNK3130	57.6411	10.3286	F	ADULT	3	0.0436	113	0.2244	116	0.2680
SKA-2007-010	Fulmarus glacialis	20070510	Denmark	Skagen Gl	DNK3130	57.6411	10.3286	M	NONAD	6	0.1117	221	0.4173	227	0.5290
SKA-2007-011	Fulmarus glacialis	20070510	Denmark	Skagen Gl	DNK3130	57.6411	10.3286	F	NONAD	1	0.0076	27	0.3002	28	0.3078
SKA-2007-012	Fulmarus glacialis	20070830	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	M	NONAD	1	0.0213	3	0.0048	4	0.0261
SKA-2007-013	Fulmarus glacialis	20070918	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	21	0.8625	21	0.8625
SKA-2007-014	Fulmarus glacialis	20070919	Denmark	Skiveren; Skagen	DNK3130	57.6411	10.3286	F	NONAD	2	0.0261	6	0.0342	8	0.0603
SKA-2007-015	Fulmarus glacialis	20070930	Denmark	unspecified Skagen	DNK3130	57.6411	10.3286	M	NONAD	11	0.2829	168	0.2913	179	0.5742
SKA-2007-016	Fulmarus glacialis	20071011	Denmark	Nordstrand; Skagen	DNK3130	57.6411	10.3286	M	ADULT	2	0.0332	3	0.0199	5	0.0531
SKA-2007-017	Fulmarus glacialis	20071208	Denmark	Nordstrand-Grenen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0564	10	0.0061	11	0.0625
SKA-2008-001	Fulmarus glacialis	20080526	Denmark	Skagen Harbour Damsted	DNK3210	57.5519	10.4368	F	ADULT	3	0.0335	42	0.5090	45	0.5425
SKA-2008-002	Fulmarus glacialis	20080618	Denmark	Kandestederne; Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0241	5	0.2826	6	0.3067
SKA-2009-001	Fulmarus glacialis	20090305	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2009-002	Fulmarus glacialis	20090313	Denmark	Skagen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	5	0.0182	5	0.0182
SKA-2009-004	Fulmarus glacialis	20090604	Denmark	Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	15	0.0649	15	0.0649

SKA-2009-005	Fulmarus glacialis	20090621	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	7	0.0432	7	0.0432
SKA-2009-006	Fulmarus glacialis	20090615	Denmark	Skagen Kandesterne	DNK3130	57.6411	10.3286	M	NONAD	10	0.2327	65	0.3810	75	0.6137
SKA-2009-007	Fulmarus glacialis	20090702	Denmark	Skagen Kandesterne	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	5	0.0133	5	0.0133
SKA-2009-008	Fulmarus glacialis	20090706	Denmark	Skagen Kandesterne	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	31	0.0966	31	0.0966
SKA-2009-009	Fulmarus glacialis	20090728	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	17	0.2499	17	0.2499
SKA-2010-001	Fulmarus glacialis	20100518	Denmark	Skagen Skiveren	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	19	0.0940	19	0.0940
SKA-2010-002	Fulmarus glacialis	20100602	Denmark	Skagen Skiveren	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	17	0.1976	17	0.1976
SKA-2010-003	Fulmarus glacialis	20100603	Denmark	Skagen Grenen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	15	0.3042	15	0.3042
SKA-2010-004	Fulmarus glacialis	20100802	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	3	0.0709	3	0.0709
SKA-2011-001	Fulmarus glacialis	20110811	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2011-002	Fulmarus glacialis	20110812	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	6	0.0227	6	0.0227
SKA-2011-003	Fulmarus glacialis	20110811	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2011-004	Fulmarus glacialis	20110812	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	15	0.5653	15	0.5653
SKA-2011-005	Fulmarus glacialis	20110811	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	ADULT	1	0.0432	6	0.0335	7	0.0767
SKA-2011-006	Fulmarus glacialis	20110811	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	NONAD	1	0.0187	35	0.4450	36	0.4637
SKA-2011-008	Fulmarus glacialis	20110811	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	4	0.1907	4	0.1907
SKA-2011-009	Fulmarus glacialis	20110619	Denmark	Buttarij; Skagen	DNK3130	57.6411	10.3286	M	NONAD	1	0.0235	10	0.0975	11	0.1210
SKA-2011-010	Fulmarus glacialis	20110616	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	F	ADULT	10	0.2052	88	0.4990	98	0.7042
SKA-2011-011	Fulmarus glacialis	20110801	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	5	0.0560	5	0.0560
SKA-2011-012	Fulmarus glacialis	20110412	Denmark	Gammle Skagen beach	DNK3130	57.6411	10.3286	F	NONAD	1	0.0314	13	0.3274	14	0.3588
SKA-2011-013	Fulmarus glacialis	20110518	Denmark	Kandesterne; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	22	0.6536	22	0.6536
SKA-2011-014	Fulmarus glacialis	20110616	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	0	0.0000	0	0.0000
SKA-2011-015	Fulmarus glacialis	20110616	Denmark	Grenen; Skagen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	0	0.0000	0	0.0000

SKA-2011-016	Fulmarus glacialis	20110423	Denmark	Hirtshals; 50km SW of Skagen	DNK3120	57.2257	9.5376	M	NONAD	22	0.5602	24	0.2335	46	0.7937
SKA-2012-001	Fulmarus glacialis	20120108	Denmark	Skagen; unspecified	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	4	0.0348	4	0.0348
SKA-2012-002	Fulmarus glacialis	20120111	Denmark	Skagen; Hoje	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	2	0.0111	2	0.0111
SKA-2012-003	Fulmarus glacialis	20120113	Denmark	Skagen; Grenen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	42	0.0576	42	0.0576
SKA-2012-004	Fulmarus glacialis	20120116	Denmark	Skagen; Grenen	DNK3130	57.6411	10.3286	M	NONAD	0	0.0000	0	0.0000	0	0.0000
SKA-2012-005	Fulmarus glacialis	20120209	Denmark	Hirtshals beach	DNK3130	57.6411	10.3286	M	NONAD	4	0.0913	25	0.0970	29	0.1883
SKA-2012-006	Fulmarus glacialis	20120302	Denmark	Skagen; Nordstrand	DNK3130	57.6411	10.3286	M	ADULT	0	0.0000	31	0.0840	31	0.0840
SKA-2012-007	Fulmarus glacialis	20120529	Denmark	Skagen; Grenen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	7	0.0419	7	0.0419
SKA-2012-008	Fulmarus glacialis	20120619	Denmark	Skagen; unspecified	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	40	0.3464	40	0.3464
SKA-2013-001	Fulmarus glacialis	20130823	Denmark	Skagen; unspecified	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	4	0.0231	4	0.0231
SKA-2014-001	Fulmarus glacialis	20140101	Denmark	Stavagen 7km inland Skagen	DNK3130	57.6411	10.3286	F	ADULT	1	0.0263	9	0.0821	10	0.1084
SKA-2014-002	Fulmarus glacialis	20140807	Denmark	Nordstrand Skagen	DNK3130	57.6411	10.3286	F	NONAD	0	0.0000	4	0.0414	4	0.0414
SKA-2014-003	Fulmarus glacialis	20140825	Denmark	Skiverer Skagen	DNK3130	57.6411	10.3286	F	NONAD	1	0.0453	8	0.1742	9	0.2195
SKA-2014-004	Fulmarus glacialis	20140825	Denmark	Skiverer Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	1	0.0030	1	0.0030
SKA-2014-005	Fulmarus glacialis	20140826	Denmark	Skagen	DNK3130	57.6411	10.3286	F	ADULT	0	0.0000	7	0.0266	7	0.0266
OSPARsourcedata_2015_DNK.CSV addition															
SampleCode	**Species Name**	**Sample Date**	**Country**	**LocationDescription**	**AreaCode**	**Latitude**	**Longitude**	**Sex**	**AgeGr**	**NIND**	**GIND**	**NUSE**	**GUSE**	**NPLA**	**GPLA**
SKA-2015-001	Fulmarus glacialis	20150318	Denmark	Skagen	DNK3130	57.6411	10.3286	M	NONAD	1	0.0028	42	0.2431	43	0.2459
SKA-2015-002	Fulmarus glacialis	20150417	Denmark	Nordstrand Skagen	DNK3130	57.6411	10.3286	M	ADULT	1	0.0170	6	0.0971	7	0.1141
SKA-2015-003	**Fulmarus glacialis**	**20150622**	**Denmark**	**Nordstrand Skagen**	**DNK3130**	**57.6411**	**10.3286**	**M**	**NONAD**	**6**	**0.0976**	**25**	**0.1643**	**31**	**0.2619**
OSPARsourcedata_2016_DNK.CSV addition															
SampleCode	**Species Name**	**Sample Date**	**Country**	**LocationDescription**	**AreaCode**	**Latitude**	**Longitude**	**Sex**	**AgeGr**	**NIND**	**GIND**	**NUSE**	**GUSE**	**NPLA**	**GPLA**
SKA-2016-001	Fulmarus glacialis	20160520	Denmark	Gl. Skagen Skagen	DNK3130	57.6411	10.3286	F	NONAD	10	0.2214	125	0.2688	135	0.4902
SKA-2016-002	Fulmarus glacialis	20160706	Denmark	Kandesterne Skagen	DNK3130	57.6411	10.3286	F	ADULT	9	0.2292	50	0.2585	59	0.4877

OSPARsourcedataRawData_2017_DNK.csv/xlsx															
SampleCode	**SpeciesName**	**SampleDate**	**Country**	**LocationDescription**	**AreaCode**	**Latitude**	**Longitude**	**Sex**	**AgeGr**	**NIND**	**GIND**	**NUSE**	**GUSE**	**NPLA**	**GPLA**
SKA-2017-001	Fulmarus glacialis	20170622	Denmark	Skagen	DNK3210	57.5519	10.4368	M	ADULT	0	0.0000	15	0.0335	15	0.0335
SKA-2017-002	Fulmarus glacialis	20170814	Denmark	Skagen; Skiveren	DNK3210	57.5519	10.4368	M	NONAD	0	0.0000	3	0.0033	3	0.0033
OSPARsourcedataRawData_2017_DNK.csv/xlsx															
SKA-2018 no data (no birds collected)															