

**Report for OSPAR  
and the German Federal Agency for Nature Conservation (BfN)**

**Fulmar Litter EcoQO Report Germany  
up to 2010**

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### **Remark**

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## Objective & Background

This first national report supplies the information on Fulmar Litter EcoQO research carried out in Germany up to 2010. The German program is part of the international Fulmar Litter EcoQO monitoring coordinated and led by Jan van Franeker from the Institute for Marine Resources and Ecosystem (IMARES) on Texel (The Netherlands). The coordination of the German contribution was initially, from 2002 to 2004, carried out by the National Park Authority (Nationalparkverwaltung) of the Wadden Sea of Schleswig-Holstein in Tönning, Germany. The dissection of Fulmars has been carried out in Germany since 2002 by the Research and Technology Centre (Forschungs- und Technologiezentrum Westküste, FTZ) in Büsum, Germany. From 2005 to 2010 no funding was available for the German contribution. Nonetheless, the FTZ carried on both with the coordination of the national work and the dissections on a purely voluntary basis. Due to these efforts an unbroken dataset could be guaranteed. The stomach analysis of German samples was carried out by IMARES from 2002 onwards based on separate funds. These analyses comprise the majority of samples up to 2009 and thus the majority of data presented in this report. In 2011 funds from the Federal Agency of Nature Conservation (BfN) enabled this first national report and the continuation of the German contribution carried out by the FTZ including the stomach analysis of the more recent German samples. In order to ensure the same standards both in dissection procedures as well as stomach analysis FTZ scientists attended workshops and trainings that were offered by IMARES free of charge. This report aims to inform our partners at IMARES about our recent analyses at the FTZ. Thus, the German dataset can be incorporated into the common Fulmar Litter EcoQO database to enable IMARES a joint reporting to OSPAR. To harmonize data preparation as well as presentation we followed IMARES' lead regarding the calculation of averages, EcoQO performance, structure of figures and tables.

## Results of Fulmar Litter EcoQO research in Germany up to 2010

The metric for discussion of amounts of, and trends in plastics in stomachs of Northern Fulmars (*Fulmarus glacialis*) for the plastic particle EcoQO focuses on the mass of plastics in stomachs, in which the

- **'Annual data'** are provided but should be dealt with carefully as short-term variations, especially for smaller sample sizes, could be misleading. Therefore, it is recommended to consider data not by separate years, but by:
- **'Current situation'** which is described by the average for the last 5-year period (now: 2006-2010) and
- **'Recent trend'** which is defined as trend over the past 10 years (now 2000-2010).
- **'EcoQO performance'** is expressed as the percentage of birds that has more than 0.1 gram of plastic in the stomach. Hence, these birds do **not** meet the recommended target but exceed it.

Over the period of 2000-2010 a total of 484 Fulmar stomachs from German North Sea waters have been examined.

### Annual data

Basic data on incidence, number and mass of plastics in analysed stomachs of Northern Fulmars from Germany are shown in Table 1 and Figure 1. These emphasize considerable annual variation in the amount of plastic ingested, in mass of plastic found and in the proportion of birds exceeding the critical EcoQO level. Single years exhibiting a very small or very large sample size partly have a substantial effect on results. Large sample sizes e.g. due to mass mortalities in the years 2004 and 2009 lead to lower geometric mean values of plastic loads while single years such as 2006 and 2010 that are characterized by low sample sizes exhibit high values of plastic pollution (Figure 1). Incidence of plastic in stomachs of Fulmars however is constantly high, ranging from 94 to 100%.

### Current situation

Averaged over the recent 5-year period (2006-2010), 62% of 219 German Fulmars examined, exceed the critical value of 0.1 gram of plastic in the stomach. Incidence of plastics was high, with 97% of birds having plastic in the stomach, on average 25.8 pieces and plastic mass of 0.39 g per bird (Tables 1 & 2).

This result is slightly higher than respective values of the preceding 5-year period from Germany (Table 1) as well as from the Netherlands. In the Netherlands, the critical value of 0.1 gram of plastic in the stomach was exceeded by 58% of the 227 Fulmars analysed from 2005-2009. Plastic was found in 95% of the Dutch birds, mean number of plastic particles found amounted to 27 items and mean mass rated at 0.29 g (van Franeker & The SNS Fulmar Study Group 2011). At the level of the entire North Sea region, 60% of all Fulmars found in 2005-2009 at the coasts of the North Sea exceeded the critical 0.1 g EcoQO target value. Incidence of plastic in all 916 birds amounted to 95% with an average of 30 particles per stomach and a mean mass of 0.33 g. Fulmars found in Germany in the respective period contained a slightly lower number of plastic particles (Table 1). However, values of those factors that are of a higher importance for the assessment of trends in marine litter (incidence and overall mass of plastic found as well as proportion of birds exceeding the critical level) are in line with the average values of the entire North Sea region. Plastic loads of Fulmars found in Germany thus match mean values of plastic found in Fulmars in the entire North Sea. In comparison, plastic loads of Fulmars found in the Netherlands apparently are somewhat lower (compare Table 1 and results of van Franeker & The SNS Fulmar Study Group 2011).

Table 1. Annual details for plastic abundance in beached Northern Fulmars from Germany. For separate and 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 (arithmetic mean) per bird in grams. The column on the far right indicates 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. The bottom line of the table shows the 'current' situation as the average over the past 5 years. Note sample sizes (n) to be low for particular years implying low reliability of the annual averages for such years, not to be used as separate figures. Also note high variability in age proportions of birds in samples, where age is known to influence amount of litter in the stomach.

Year	n	% adult	INDUSTRIAL PLASTICS			USER PLASTICS			ALL PLASTICS (industrial + user)			EcoQO > 0.1 g
			%	n	g	%	n	g	%	n	g	
1994	1	0%	100%	2	0.043	100%	31.0	0.512	100%	33.0	0.555	100%
1995												
1996												
1997												
1998	1	100%	100%	2	0.022	100%	35.0	0.194	100%	37.0	0.216	100%
1999												
2000	1	0%	100%	4	0.103	100%	26.0	0.158	100%	30.0	0.261	100%
2001	2	100%	50%	2	0.034	100%	15.5	0.049	100%	17.5	0.082	50%
2002	4	50%	0%	0	0.000	100%	6.5	0.051	100%	6.5	0.051	25%
2003	32	22%	81%	3.9	0.087	94%	24.1	0.356	94%	28.0	0.443	78%
2004	155	74%	56%	2.9	0.058	93%	25.7	0.238	94%	29.0	0.296	54%
2005	71	61%	66%	2.3	0.051	94%	17.5	0.191	94%	20.0	0.242	52%
2006	10	40%	50%	2.5	0.051	100%	29.7	0.299	100%	32.2	0.350	70%
2007	66	24%	75%	4.2	0.101	95%	25.1	0.478	95%	29.3	0.579	72%
2008	50	44%	58%	2.6	0.062	94%	30.0	0.479	94%	32.6	0.541	66%
2009	85	52%	43%	1.2	0.027	100%	17.4	0.152	100%	18.6	0.179	50%
2010	8	50%	75%	1.4	0.031	100%	21.3	0.169	100%	21.3	0.169	63%
2005-2009	282	46%	60%	2.5	0.058	96%	21.9	0.301	96%	24.4	0.359	60%
2006-2010	219	41%	58%	2.5	0.059	97%	23.3	0.332	97%	25.8	0.391	62%

\* Five-year data were averaged over all individual birds in the five year period ( not from annual averages).

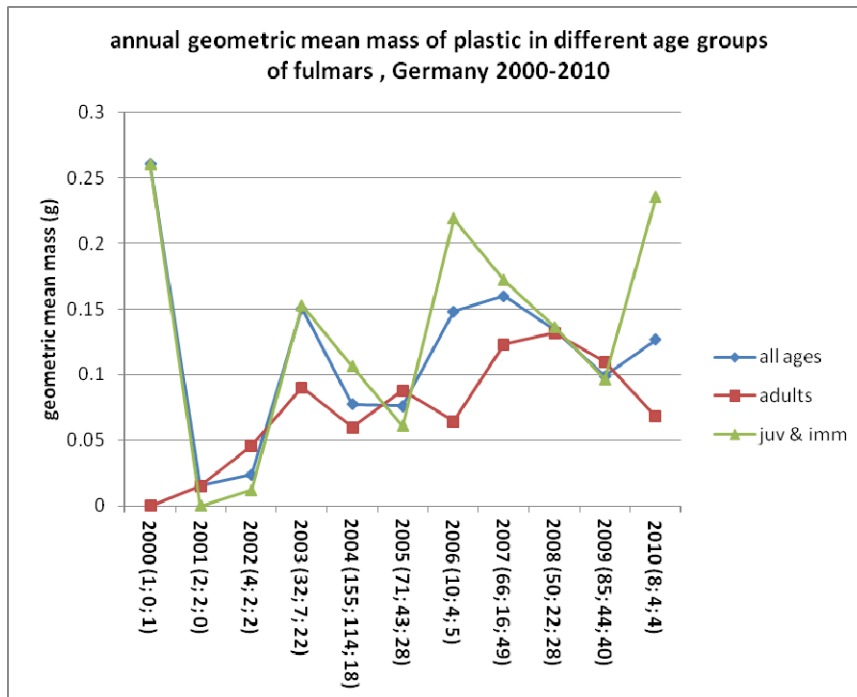


Figure 1. Annual geometric means for mass of plastics in stomachs of beached Fulmars from Germany 2000-2010 for all age groups combined (including birds of unknown age), adult birds and non-adults, with sample sizes in brackets in the x-axis labels. NB watch small sample sizes in initial years (2000 to 2002) shown in x-axis with further details in Table 1.

Table 2. Summary of sample characteristics and stomach contents of Northern Fulmars collected for German marine litter monitoring over the 5-year period 2006-2010. The top line shows sample composition in terms of age, sex, origin (by colourphase, darker phase individuals are of distant Arctic origin), death cause oil, and the average condition-index (which ranges from emaciated condition=0 to very good condition=9). Currently, only age is known to affect the amount of litter in stomachs. 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 items per bird stomach, average mass 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.

	Year	nr of birds	adult	male	unsexed	LL colour	death oil	avg condition
	2006-2010	219	41%	49%	3%	72%	4%	1.1
		incidence	average number of items (n/bird) ± se	average mass of litter (g/bird) ± se	max. mass recorded	geometric mean mass (g/bird)		
1	<b>ALL PLASTICS</b>	<b>97%</b>	<b>25.8 ± 2.566</b>	<b>0.391 ± 0.064</b>	<b>9.4</b>	<b>0.1261</b>		
1.1	<b>INDUSTRIAL PLASTICS</b>	<b>58%</b>	<b>2.5 ± 0.341</b>	<b>0.059 ± 0.009</b>	<b>1.3</b>	<b>0.0095</b>		
1.2	<b>USER PLASTIC</b>	<b>97%</b>	<b>23.3 ± 2.429</b>	<b>0.332 ± 0.063</b>	<b>9.4</b>	<b>0.0964</b>		
1.2.1	sheets	55%	3.0 ± 0.625	0.026 ± 0.009	1.4	0.0023		
1.2.2	threads	42%	1.2 ± 0.154	0.011 ± 0.003	0.5	0.0014		
1.2.3	foamed	62%	6.7 ± 1.325	0.052 ± 0.019	3.6	0.0039		
1.2.4	fragments	92%	12.0 ± 1.362	0.209 ± 0.050	9.0	0.0547		
1.2.5	other plastics	22%	0.4 ± 0.083	0.035 ± 0.009	1.4	0.0015		
2	<b>OTHER RUBBISH</b>	<b>31%</b>	<b>1.5 ± 0.276</b>	<b>0.131 ± 0.033</b>	<b>5.0</b>	<b>0.0029</b>		
2.1	paper	2%	0.3 ± 0.154	0.003 ± 0.002	0.4	0.0001		
2.2	kitchenwaste (food)	26%	1.1 ± 0.201	0.119 ± 0.033	5.0	0.0023		
2.3	rubbish various	5%	0.1 ± 0.033	0.009 ± 0.005	1.1	0.0002		
2.4	fishhook	0%	0.0 ± 0.000	0.000 ± 0.000	0.0	0.0000		

### Recent trend

While data from the Netherlands are available since 1979 and thus provide distinct long-term trends, Germany has a continuous dataset back to the year 2000. However results of the first years up to 2002 have to be treated with caution due to very low sample sizes (see Table 1). Still, running 5 year averages point at stable to slightly increasing amounts of plastic in Northern Fulmars from German North Sea waters (Figures 2 & 3). These results are underlined by a comparison of recent results with an earlier study investigating 92 Fulmars found from 2002-2004 at the German North Sea coast (Guse et al. 2005). Plastic was found in the stomachs of 95% of these birds, consisting on average of 39.1 items and a mean overall mass of 0.36 g. With the exception of the less important number of items found, plastic loads of birds found recently (2006-2010) have slightly increased by incidence (97%) and by mean mass (0.39 g). The amount of industrial plastics was very stable over the study period in the range of 0.06 g while user plastics showed a slight increase (Figure 2). The latter is responsible for the main plastic loads of Fulmars and shows – in contrast to amounts of industrial plastics – higher fluctuations. These range from 0.23 g (2001-2005) up to 0.33 g (2006-2010) per bird. This fluctuating and slightly rising tendency of user plastics is reflected in the EcoQO performance. While 52 to 60% of Northern Fulmars exceeded the critical value in former years, in the recent 5-year period 2006-2010 62% of the birds lie above the threshold.

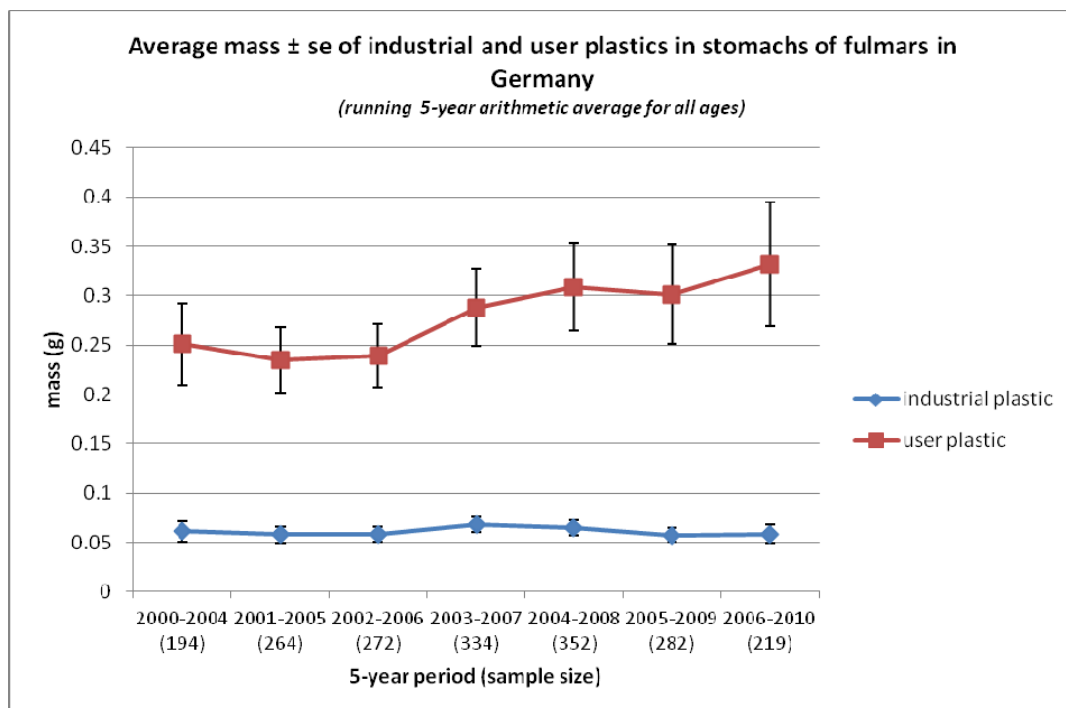


Figure 2. Trends in plastic mass in stomachs of Northern Fulmars from Germany between 2000 and 2010. Data is split into user plastic (red) and industrial plastic (blue). Data are shown by arithmetic averages ± standard errors for mass in running 5-year averages from the year 2000 onwards (i.e. data points shift one year ahead at a time). Sample size is given in brackets.

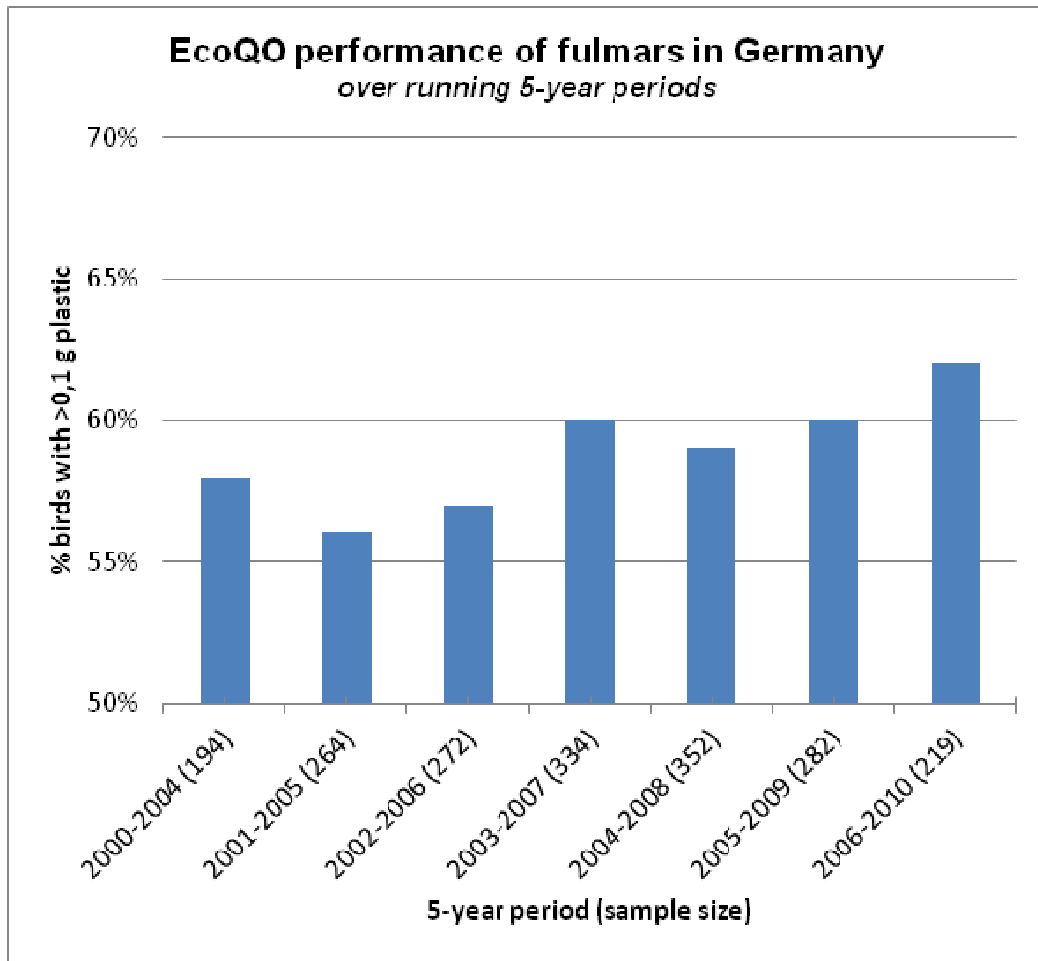


Figure. 3. Changes in EcoQO performance of Northern Fulmars from Germany in 2000-2010. Running 5-year averages for the percentage of beached Fulmars having more than 0.1g of plastic in the stomach. Samples sizes are given in brackets below the x-axis labels. Note that y-axis scale is zoomed in on a restricted range of percentages well above the 10% OSPAR EcoQO target.

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