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Save the North Sea Fulmar-Litter-EcoQO Manual
Part 1: Collection and dissection procedures

J.A. van Franeker




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Save the North Sea Fulmar-Litter-EcoQO Manual Part 1: Collection and dissection procedures

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Save the North Sea Fulmar-Litter-EcoQO Manual Part 1: Collection and dissection procedures

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ABSTRACT

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This manual describes standard procedures for the collection and dissection of beachwashed Fulmars used in the ***Save the North Sea*** (SNS)'-Fulmar study. ***Save the North Sea*** is an international project which aims to reduce marine litter through increased awareness. Fulmars ingest marine litter and accumulate rubbish such as plastics in the stomachs. Therefore, Fulmars are used as the symbol of the SNS campaign. At the same time, litter in stomach contents of Fulmars is being developed as an international monitoring tool to measure changes in levels of litter. It is one of the ***Ecological Quality Objectives for the North Sea (EcoQOs')*** which OSPAR has to implement at the request of the Ministers of North Sea countries (NSC Bergen Declaration, March 2002). This report describes standard methods for handling bird corpses in the intended Fulmar-Litter-EcoQO.

Keywords: BBS; beached-bird-surveys; dissection-methods; Ecological-Quality-Objective EcoQO; Fulmar; Fulmarus-glacialis; Interreg-IIIB; marine-litter; monitoring; North-Sea; OSPAR

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Figure 1 Save the North Sea logo

1 Introduction

In March 2002, ministers of the North Sea countries adopted a system of ***Ecological Quality Objectives for the North Sea*** **(EcoQOs')**. The purpose of the EcoQO approach is to provide quantitative systems to measure major human impacts on the North Sea environment and ecosystem. Such monitoring systems should include clearly defined target values to which ecological quality should be restored.

OSPAR has been given the task to implement the system of EcoQOs'. One of the quality objectives that has been identified, concerns the marine litter situation. The proposed measurement tool to evaluate the marine litter situation is a seabird, the Northern Fulmar (*Fulmarus glacialis*) .The Fulmar is a common seabird within and beyond the North Sea and has the unfortunate habit of ingesting litter which it encounters at sea. Such litter, especially plastic waste, accumulates in the birds' stomachs.

A pilot-study in the Netherlands based on stomach contents of beachwashed Fulmars over the period 1982-2000 demonstrated that Fulmars can be used as a suitable monitor of levels of marine litter pollution (Van Franeker & Meijboom 2002). Monitoring updates were provided in Van Franeker & Meijboom (2003) and Van Franeker *et al.* (2004). All three studies were based on Fulmars found in the Netherlands.

Committees of ICES and OSPAR involved in the implementation of ***the Fulmar-Litter-EcoQO*** have expressed the need for additional research. In particular it was requested to expand the study to the wider North Sea to validate the methods with regard to regional variability, and to advise on an efficient long term monitoring system, its metrics and target values.

Such additional research has become possible thanks to the **'Save the North Sea (SNS)'** project. The Save the North Sea initiative aims to reduce marine litter in the North Sea region by increasing awareness among target groups of users of the North Sea such as the shipping, fisheries, offshore and recreational sectors. The SNS project is co-funded by the EU Interreg IIIB program for the North Sea. The current project runs from 2002 to 2004 and uses the Fulmar as a symbol to demonstrate the need to change attitudes and behaviour towards marine littering.

In the Save the North Sea project, the research of stomach contents of Fulmars has been expanded to participating groups in all countries bordering the North Sea. Details of aims of the SNS Fulmar study and its links to the Dutch research and EcoQO development have been described in Van Franeker & Meijboom (2003).

The SNS Fulmar project and the development of the Fulmar-Litter-EcoQO require a clearly described and fully standardized methodology. This first manual for the Fulmar-Litter-EcoQO describes the initial phases of data-collection: the sampling of

birds, dissection procedures and codes for recording external and anatomical details on standard forms. Standardization in seabird dissection methods in the North Sea was initiated by UK and Dutch Seabird Groups (Hope Jones *et al.* 1982; Van Franeker 1983). Much of that methodology is maintained in this Fulmar manual, drafts of which were used during the SNS-Fulmar-Study workshops held at Alterra Texel in 2002, 2003, and 2004. Based on experiences of the participants of the workshops, the dissection-forms and the descriptions of procedures were gradually improved. Procedures for analysing contents of stomachs will be dealt with separately in a later report.

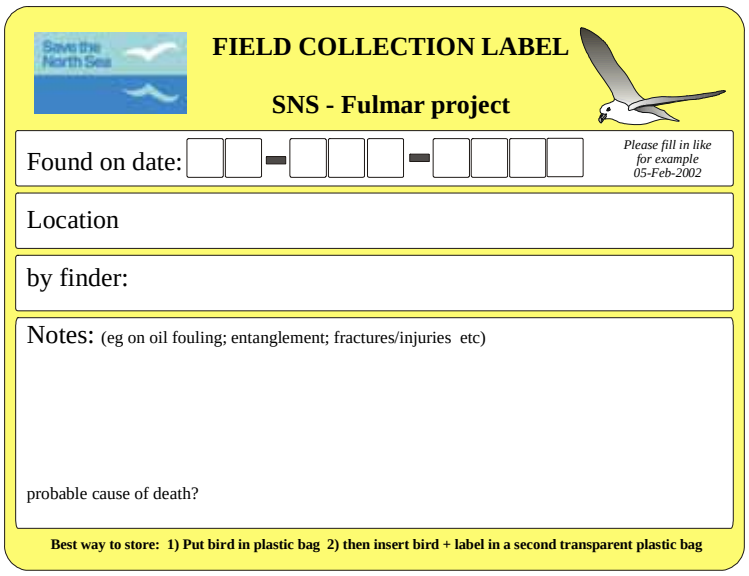


Figure 2 Standard Collection Label

2 Collecting and handling of dead Fulmars

2.1 Frequency of searches for Fulmars

Searches for beachwashed Fulmars can be conducted as a part of regular Beached Bird Survey (BBS) programmes, or as a part of more local beach inspections for different reasons. In either system it may be important to rely not only on the standard schedule of full surveys (e.g. monthly), but to attempt to have a less formal but more frequent partial survey that would detect increased numbers of corpses. Fulmars often wash ashore in irregular pulses or wrecks related to conditions of weather, food, disease or pollution incidents. Bird corpses that are left in the tideline for prolonged periods of time do not only suffer decay, but are frequently scavenged by other birds or mammals. Coordinators may ask their contacts to keep an eye open all the time, and to be informed on any apparent increase in beachwashed birds. When such happens, temporarily increased search effort in surrounding areas can assist in obtaining adequate sample sizes of beachwashed Fulmars.

2.2 Sample size

Results from the Dutch pilot study indicate that about 40 Fulmar stomachs are an adequate sample size to provide a reliable figure for the litter situation at a particular location and point in time. Ideally, the different regions or countries would thus aim to collect 40 or more beachwashed or other dead Fulmars per year. For some regions this will definitely be a difficult task due to the length or type of coastline, prevailing winds, removal of corpses by scavenging mammals, or scarcity of Fulmars offshore. In the SNS study however we can deal with suboptimal local sample sizes by combining regions (e.g. different locations around Skagerak) or if necessary years (e.g. 2002-2004).

2.3 Sample quality

With regard to adequate sample sizes it is important to note that there is no need to restrict collection to ‘fresh’ specimens. Even fairly decayed or partly scavenged corpses can be used, as long as the stomach is intact. For analyses of relations between stomach contents and variables such as sex, age, cause of death or condition it is not necessary that all variables are known for all samples. In a regional comparison, also non-sexed or aged birds can be used.

2.4 Labelling, packaging and storage of corpses

Already at the beach, especially if birds are fouled by oil or other contaminants, corpses should be individually packed to avoid transfer of fouling from one bird to

the other. It is important that collected corpses are immediately individually labelled with information on location, date, finder and any possible relevant information (for example if the bird was entangled in a net or other indicators for cause of death). Preferably the standard SNS collection label is used (Fig.2). Corpses should be stored deep-frozen (-16°C or below) in a well sealed plastic bag, and then with the label in a second plastic transparent bag, again well sealed. The 'double bag' procedure prevents fouling or wettening of the label (which could become unreadable) and at the same time prevents the corpse from drying out in the freezer.

2.5 Caution

Most Beached Bird Survey participants will be well aware of risks of searching beaches and picking up birds. Toxic substances may wash ashore and may have fouled birds. Also, birds may carry diseases (psittacosis/ornithosis; avian tuberculosis; histoplasmosis; cryptococcus; puffinosis) that could be transmitted to man. Transmission of bird-disease is infrequent, and is usually limited to people with already lowered immunity and to situations where large concentrations of live animals are kept in confined spaces (rehabilitation centres, aviaries, pigeon sheds etc). Disease may be transmitted in particular by aerial particles and by dry faeces. Symptoms of psittacosis/ornithosis are that of flu with fever and pneumonia, about 4 to14 days after infection. Treatment is possible, but no prior vaccination. Transfer of disease from wild birds to humans has been known to occur on the Faeroe Islands among persons involved in the hunting and processing of live wild birds for consumption, including Fulmars. Specific information on risks from picking up or handling dead birds from beaches is not available. However, the potential contact with toxic chemicals and diseases urges a number of common sense procedures during beach surveys and laboratory investigations. Unneccessary contact may be avoided by packing birds in proper plastic bags and by wearing surgical gloves. Do not eat or smoke or wipe eyes or nose with unwashed hands. In the lab one may wear a dust-mask and ensure proper air-removal and cleaning procedures. Although the effect of deep-freezing on the infection risk from various diseases seems unknown, it may be recommended to deep-freeze samples prior to the laboratory work. Risks from handling birds can never be totally excluded and it remains a personal decision whether or not to participate in BBSs' and to pick up or handle dead seabirds. Much information for an independent decision is available through the internet (search eg for bird disease, or ornithosis).

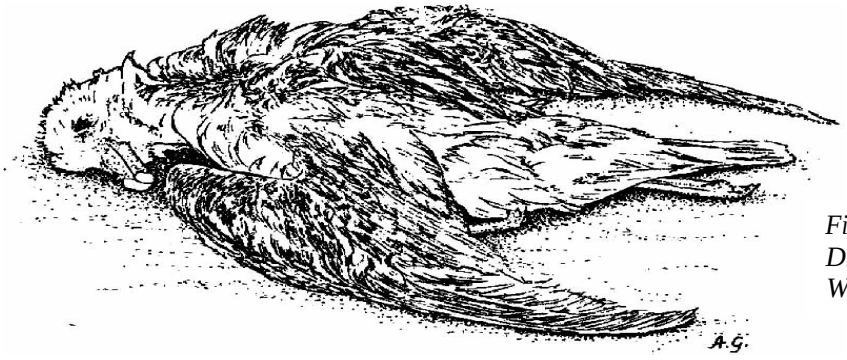


Figure 3 Beachwashed Fulmar. Drawing by Arnold Gronert, Windbreke

3 The standard dissection form

Texts in this manual are written to be used in association with the form as depicted in Figs. 4 and 5. The standard forms can be obtained from the author (pdf file).

Species		Collection number	-	-			Dissected by:				
Find-Date (dd-mon-yyyy)	-	-		Finder:							
country		location									
Corpse - condition	freshness	FFF	FF	F	O	OO	OOO	oil %	%	entanglement ?	no yes
	completeness	CC	C	I	II			other ext fouling %	%	fractures/wounds?	no yes
											notes
Plumage	colour-phase	LL	L	D	DD			primary moult L (p10 *to* p1)		*or*	no yes *score*
		W	Coloured					primary moult R (p10 *to* p1)		*or*	no yes
								Tail moult …..	-	….. *or*	no yes
Secondary moult	no yes	Body feather moult *external*	no yes	Body feather moult *internal*	no yes	Incubation patch present?	no yes				
Measurements	CulmenLength	.	BillDepth	.	HeadLength		TarsusLength	.			
	WingLength		WeighT	-	=						
Condition	breast muscle	0 1 2 3	Subcutaneous fat	0 1 2 3	Intestinal fat	0 1 2 3	Overall Condition INDEX				
sex *(circle male or female)*	MALE	testis colour *(descr)*		FEMALE	oviduct code	1 2 3 4	male sex INDEX				
		length x width *(mm)*	x		max follicle *(mm)*	.	female sex INDEX				
bursa fabricius present?	no yes	bursa length x width *(mm)*	x				=bursa INDEX				
organ health	stomach	0 1 2 3	liver	0 1 2 3	gut	0 1 2 3	kidney	0 1 2 3	lung	0 1 2 3	
Notes/conclusions on likely cause of death											
parts collected:											
notes											

Figure 4 Standard SNS Fulmar dissection form, front side

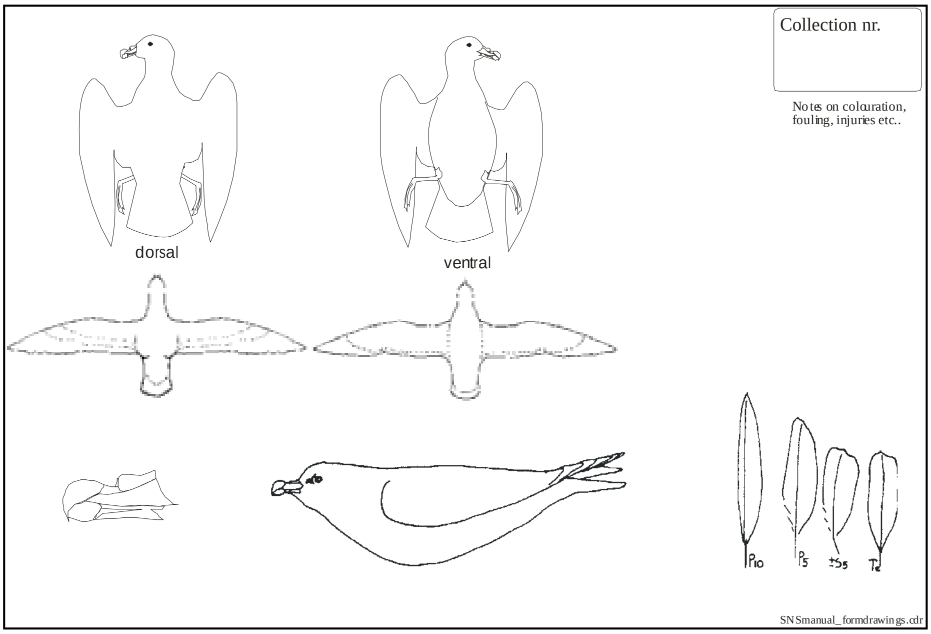


Figure 5 Standard SNS Fulmar dissection form: rear side

4 Identifiers and find details

4.1 Species

Northern Fulmar / *Fulmarus glacialis* (species code **FGLA**)

4.2 Collection number

On the beach, there is no need for collectors to number birds, as long as finding date, location, finder and further details are given with each bird, preferably using the standard collection label (Fig.2). At dissection however, bird corpses should receive a clear and unique collection number to identify all further steps in the research. Such collection numbers are best issued by the person responsible for dissections in a particular region or country at the moment of dissection. Within the SNS project, the following standard approach for numbering has been adopted: the collection number is composed of:

- **region-prefix** 3 letters (standard code as proposed in table 1)
- **year of finding** 4 digits (e.g. 2004)
- **sequence number per year** 3 digits (e.g. 001)

See Table 1 for current set of region prefixes. The three components of the collection number are separated by hypens. For example: the collection number of the first bird from the Shetland Islands in the SNS project was : **SHE-2002-001.**

4.3 Dissected by:

Please fill in name(s) or known abbreviation code(s) for person(s) responsible for the collection number and dissection data (e.g. as in Table 1). If different persons have done the external (measurements) and internal (sex, age etc) parts of the job please give details. These data are recorded because for some applications high details in for example measurements are required. In such work even minor personal differences in measuring have to be considered in the analysis of data.

Table 1 Codes for regions and persons currently participating in the SNS Fulmar study (see chpt.11 for full address information)

Location	country	location prefix	persons involved	name code
Shetland Islands, **Scotland**	**UK**	**SHE**	M Heubeck, M.Mellor	HEU, MME
Orkney Islands, **Scotland**	**UK**	**ORK**	K Fairclough, E.Meek	KFA, EME
Northeast **England**	**UK**	**NEE**	D Turner	DTU
Southeast **England**	**UK**	**SEE**	M Grantham, S.Newson	MGA, SNE
Belgium	**BE**	**BEL**	E Stienen, W Courtens, M vd Walle	EST, WCO, MWA
The Netherlands	**NL**	**NET**	JA v Franeker, A Meijboom	JAF, AMB
Germany	**DE**	**GER**	N Guse, D Fleet	NGU, DFL
Skagen, **Denmark**	**DK**	**SKA**	J Pedersen, PL Hansen	JPE, PLH
Lista, **Norway**	**NO**	**LIS**	KO Olsen	KOO
Sotenas, **Sweden**	**SW**	**SWE**	PJ Andersson	PJA
Faroe Islands	**FO**	**FAE**	B Olsen, J-K Jensen, J Danielsen	BOL, JKJ, JDA

4.4 Find-date

Please fill in as '***Day*** *(2 digits)* - ***month*** *(3 letters)* - ***year*** *(4 digits)*' like for example for the 9th of September 2002 as **09-Sep-2002.** Use lettering for month as **Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec.** The letter description for 'month' is used, because there are many international differences in date formats. We want to avoid the frequent data errors resulting from such formats.

4.5 Finder

Please provide the name of the person and/or organisation that collected the bird from the beach. This can be of importance for later queries, but also allows the return of research data to persons who collected the birds. Such feedback is highly appreciated by volunteers in these programmes and promotes continued involvement.

4.6 Country/location

Please provide: country (e.g. UK) and further 'stepwise' specification for the location like for example in Shetland, Mainland, Sumburgh Head, near lighthouse. Information should be easy to trace for people unfamiliar with your area.

5 Corpse condition

5.1 Freshness

Freshness of corpses is recorded for several reasons. Firstly, it indicates whether the date of collection is representative for the actual date that the bird died. Secondly, freshness can explain why particular fields in the dissection form are left blank. Decay complicates the determination of sex, age and health issues. The six categories in table 2 conform to categories as used in the Dutch Beached Bird Survey.

Table 2 Categories of freshness (CIRCLE ONE of the codes on the form)

very fresh	**FFF**	eyes bright and shiny
fresh	**FF**	eyes dull and bit shrunken, but tissue eg in mouth looks fresh
rather fresh	**F**	shrunken eyes, tissue in mouth starts discolouring
rather old	**O**	shrunken eyes, discoloured tissue, feathers becoming loose
old	**OO**	feathers easily pulled out
very old	**OOO**	mummified or strongly decaying eg bill-cornea easily falls off

5.2 Completeness

Like freshness, completeness may explain blank fields or uncertainties on the form. For example, the percentage of the body covered by mineral oil is only valid for later quantitative calculations when the plumage of the corpse was more or less complete. The Dutch BBS uses a simple categorization (complete or incomplete) that was expanded in the fulmar study.

Table 3 Categories of completeness (CIRCLE ONE of the codes on the form)

complete	CC	body & plumage fully intact; no scavenger marks
near complete	C	lightly damaged or scavenged, but all major feather areas present
incomplete	I	seriously damaged or scavenged, with feather areas incomplete
parts only	I I	whole body parts missing, e.g. only wings + breastbone

5.3 Oil percentage

Oil refers to remains of 'dark mineral oil'. If the corpse is complete or near complete (C or CC), give **percentage of oil-fouling of body**, and use drawings on the back of the form to illustrate where this oil was on the body. For clean birds fill in as 0%; and for tiny bits and pieces of oil use 0.1% In other cases give the estimated percentage fouling. Fig. 6 can assist in determining the proportion of the body fouled with oil.

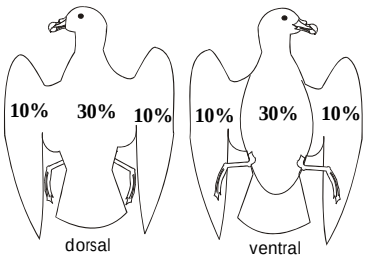


Figure 6 Proportions of body parts for fouling records

For incomplete corpses (I or II), do NOT give a percentage, but note '**oil ? (+)**' when oil was present on the incomplete remains or '**oil ? (-)**' if absent.

5.4 Other external fouling percentage

Sometimes birds have their plumage fouled with other substances than mineral oil. These can be lumps of paraffine like materials, glue-like sticky substances, palm-oil, paint or other. Many beachwashed corpses have dirty or wet plumages but do NOT record those as external fouling. Quantify fouling as for mineral oil, and give details under ‘notes’

5.5 Entanglement

Please **circle ‘yes’ or ‘no’** on the form. If yes, describe details under notes or on the back of the form. Entanglement may be concluded from the notes on label/bag from the person that picked up the bird (he/she may have removed net remains!), or from remains of entanglement on the corpse at dissection. Fishing-hook and line in the bill or throat are also recorded as ‘entanglement’.

5.6 Fractures and wounds

Before dissecting a bird, check for broken bones or other injuries that might indicate the death-cause of the bird. **Circle ‘yes’ or ‘no’** and if yes, describe shortly under notes or in more detail on the back of the form. Fractures or wounds that are suspected to be ‘secondary’, eg caused by scavenging animals or from transport, should NOT be listed here. Only circle ‘Yes’ if injuries seem directly or indirectly related to the death of the bird.

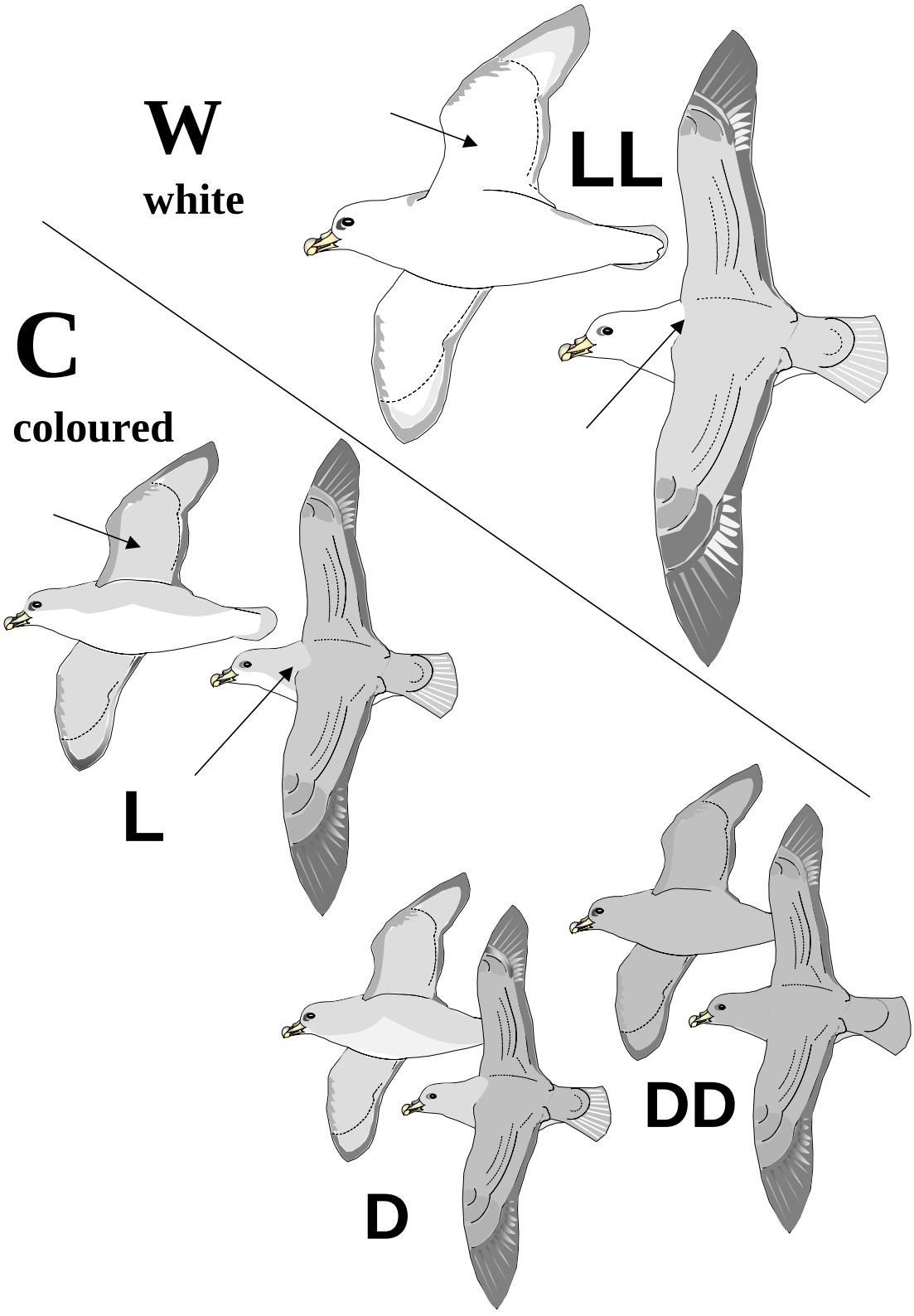


Figure 7 Plumage colour phases of Atlantic Fulmars

6 Plumage (colour, moult etc.)

6.1 Colour phase

Colour phase is recorded because it may be indicative of the origin of a bird. ***Coloured individuals*** (colour phases Light L; Dark D: and Double Dark DD) are virtually limited to arctic populations (subspecies *F.g.glacialis*). ***Double Light (LL or 'White') individuals*** make up near 100% of the southern subspecies populations (*F.g.auduboni*) and a variable proportion of arctic populations. Colour phase can be determined using Fig.7 and Table 4.

In fairly clean birds you may be able to use the four colour phase system, but in dirty, fouled, wet or older corpses this is often not easy, and it may be more convenient to use the white versus coloured distinction (which for our purposes provides the same information). The best distinguishing character to split coloured birds (L+D+DD) from white ones (LL), even in old dirty corpses, is the coloration of the small feathers on the underwing. In white birds, the underwing may have variable shades of grey around the edges, and sometimes a small partial grey inner area, but the main central underwing surface is white. In **all** coloured fulmars, the underwing is wholly grey. This underwing character is more easy to use than the presence/absence of colour difference between head/neck and mantle, which is often obscure. Coloured birds often have darker bills with more extensive black spots; however, apart from being of initial value as an indicator, the bill-colouration is an unreliable character.

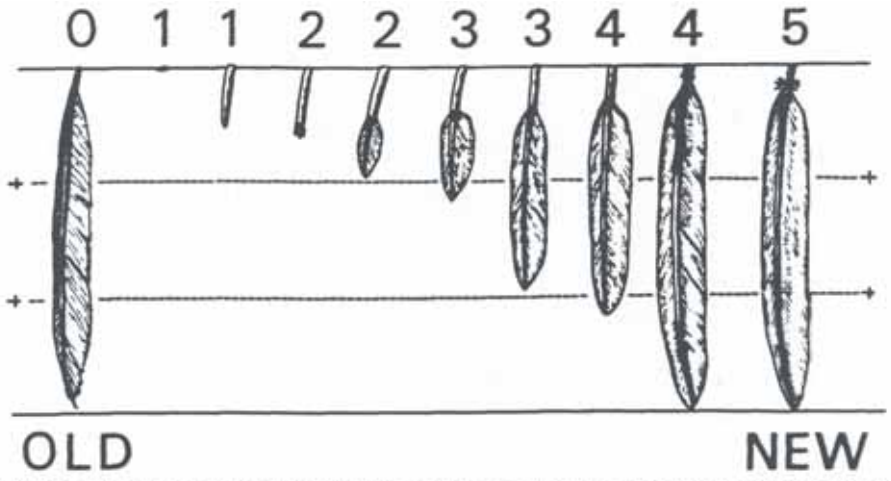
Table 4 Colour coding for plumages of Northern Fulmars

LL	Double Light	head and neck white, with fairly sharp demarcation between mantle and neck in all body positions; underbody and **main underwing surface white**	**W**
L	Light	variable grey on upper head, neck, and flanks; no clear distinction between colour of mantle and lower neck (in flight position); breast/belly white or whitish, **but underwing grey, distinctively different from belly/breast.**	**COLOURED**
D	Dark	as L, but with more extensive grey on head and underparts; only breast/belly may be light grey	
DD	Double Dark	unmistakably grey on all body parts	

6.2 Primary moult

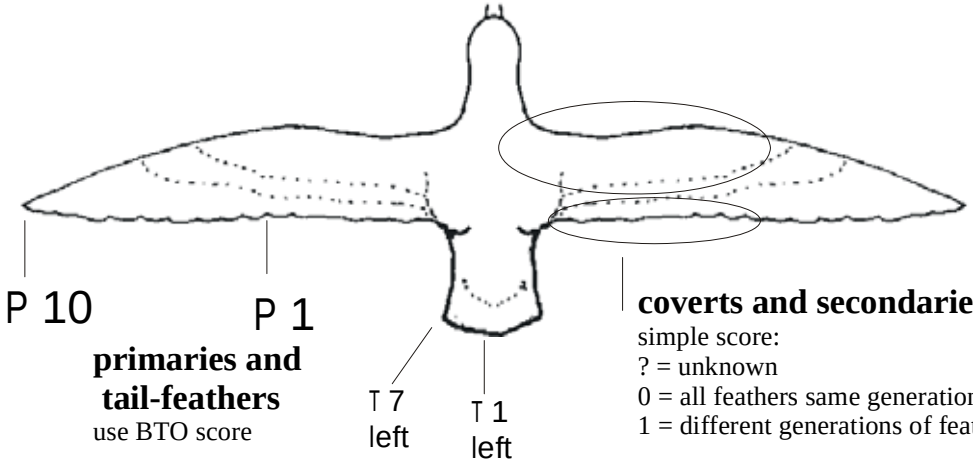
Moult and feather condition may be indicative for age, breeding status and death cause. Birds in trouble often slow down the moulting of wing and/or tail-feathers or totally stop doing so (arrested moult). Primary moult is recorded for at least one of the wings but preferably for both. Use the BTO moult score for individual feathers as shown in Fig.8. A birds' primary moult score is calculated as the sum of BTO scores for all primaries of both wings (the overall score may thus range from 0 to 100).

BTO standard for scores of moulting feathers



The feather scoring system. The dashed horizontal lines represent one third and two thirds growth. The numerical scoring system is:

0 Old feather remaining.
1 Old feather missing or new feather completely in pin.
2 New feather just emerging from the sheath up to one third grown.
3 New feather between one and two thirds grown.
4 New feather more than two thirds grown and with remains of waxy sheath at its base.
5 New feather fully developed with no trace of waxy sheath remaining at base.



primaries and tail-feathers
use BTO score

coverts and secondaries
simple score:
? = unknown
0 = all feathers same generation
1 = different generations of feathers

incubation or brood-patch
simple score
? = unknown
0 = no bare patch (covered with down)
1 = present (bare skin or clearly developing or disappearing)
NB! in somewhat decayed specimens down easily disappears

Figure 8 Explanations and codes for moult records

Primary moult starts with the inner primaries by a near simultaneous shedding of p1 to p4. In this group p1 is not necessarily shedded first. Further stages are usually moulted sequentially but not at a constant rate. Note that in a full-grown stage, Fulmars have a p10 (outermost primary) that is at least as long as p9. If it is not possible to specify primary moult in detail, please at least fill in the simple final box by circling no or yes:

no - outermost primary longest **and** no apparent age-differences or gaps between feathers

yes - outermost primary not longest **or** clear age or size differences or gaps.

April 1 = Reset date in the Fulmar moult score system.

When all primaries and tail-feathers are full-grown, it becomes an arbitrary decision to score these as new (5) or old (0). Some time after completion of the moult (scores 5), the scoring system needs a reset to scores 0 before the start of the next moult cycle. The question then is at which point in time to make this reset. Primary moult in young and immature Fulmars may start in May/June. Sub-adults and breeders moult later. Succesfull breeders have to postpone much of their moult until after completion of the breeding and some of them may only complete moult in the early months of the next calendar year.
Therefore, in Fulmars, we have set the date in which an 'new' plumage becomes an 'old' one at the 1st of April. So, a bird with full grown primaries and tail feathers collected on or before March 31 has all feathers scored at BTO score 5 (new, full grown) whereas the same bird found on the next day (April 1) or after would be scored as 0 (old) for all primaries and tail feathers.

6.3 Tail feather moult

For general guidelines on scoring moult in tail feathers, see the instructions for primaries in section 6.2, (incl. Fig. 8; and the text-block on 'reset-date'.). Fulmars normally have 14 tail feathers (Total BTO score ranging from 0 to 70). However, aberrant numbers between 12 to 16 tail feathers do occur! On the Fulmar dissection form light shaded additional blocks are provided to left and right of the tail diagram. Please make clear notes on aberrant numbers of tail-feathers. The tail-moult-score of such aberrant birds is recalculated as if they had only 14 tailfeathers, with a maximum score of 70.

Tail moult records are of considerable interest for a variety of research purposes, but not crucial to the SNS-Fulmar project. Tail moult is fairly labour intensive to assess properly. If necessary the moult scores for individual feathers can be omitted, but in that case please have at least a superficial look and circle the simple '**no** or **yes'** box:

no - no apparent age or size differences, and no gaps between feathers;

yes - apparent age or size differences or gaps present.

6.4 Moult of secondaries and coverts

Recording the moult of secondaries and coverts assists in the distinction between 1st year birds and older ones. First year birds have a plumage in which all feathers are from a single generation. After their first moult virtually all birds show different

generations of secondaries and/or coverts. 'Previous generation feathers' usually become somewhat brownish (even when not showing wear), whereas the new generation feathers are truly grey. So, if not immediately apparent from active moult or extreme wear in some feathers, look for colour-differences between feathers among the secondaries and the coverts (upper wing most easily inspected; Fig.8). Circle **'no'** (all feathers same generation) or **'yes'** (feathers of different generations present). For body feathers a second box for an internal score after dissection is given. On the inside of the skin, moulting feathers show strongly thickened, soft whitish feather shafts that differ strongly from the 'hard pins' of non moulting feathers. Inner moult may be checked on breast-feather fields immediately after the start of dissection. Please circle 'no' (no moulting shafts) or 'yes' (moulting shafts present) after dissection.

6.5 Incubation patch

Shortly before laying, adult breeders (probably also birds hormonally 'close' to breeding) loose the down from their belly and develop a bare and well-blooded skin area for incubating the egg (Fig.8). This occurs in males as well as females. In the late egg phase and early chick-phase down regrows on this patch, but a former 'incubation' status may still be visible from the uniform short length of the new down. Presence of the incubation patch can be recorded by circling 'no' (normal long down present) or 'yes' (incubation patch present or developing/disappearing). Do not circle any of the two if you are uncertain. In older decaying corpses, the belly down may become very loose and can be brushed off by a single wipe with your finger (or a similar event before you checked the bird).

A check of the incubation patch area is usefull also in non-breeding seasons. Some birds suffer from plumage problems in the sense that they have hardly any down feathers, or no down at all below their normal feathers. Lack of down will mean a huge increase in heat-losses and thus a factor directly or indirectly causing death. By making it a routine to check for the incubation patch, it is ensured that all birds are also checked for down plumage problems. Lack of down is described under notes, and in more severe cases may be listed as cause of death (PLU Plumage problems (chpt. 8.5).

7 Measurements

Four measurements are crucial to assist in determining sex or origin. Males are larger than females, and most Arctic populations are smaller sized than the more southern ones. The four most important measurements (Fig.9) are.

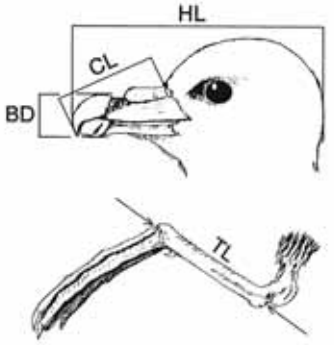
- **Bill(Culmen)-length** from first feather-base to tip of bill;
- **Bill-depth** straight up from gonys;
- **Head-length** from front of bill to back of skull, and
- **Tarsus-length**.(between indents in joints; see arrows in Fig.9)

The combination of these four measurements can be used in a formula for bird-size.
Less important (and not always possible) are:

Wing-length should be taken only if outer primary p10 is full grown, that is BTO score 0 or 5. If p10 is not full grown, 'incomplete' wing length may be given under notes.

Weight (body mass): should be measured only if the bird is complete (stages CC and C above), AND clean and dry. To make totally sure that the weight given is of the bird only (and not including a bag or box in which it was weighed), please fill in as grams weighed *minus* grams of container **=** net bird weight. If no bag or container was used, complete the data fields in the form as for example 710g - 0g = 710g. This will prevent any later doubts.

FULMAR MEASUREMENTS



CL = culmen length *(0.1mm)* from tip of bill to first feathers
BD = bill depth *(0.1mm)* at gonys
HL = total head-length *(mm)*
TL = tarsus length *(0.5mm)*
and
WL = winglength flattened and straightened along ruler *(mm)*
only for birds in which P10 is full grown (BTO score 0 or 5)
WT = mass (g) ***only*** for dry, clean and complete specimens

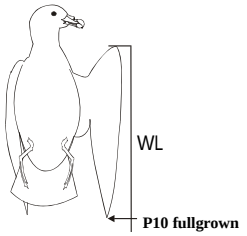


Figure 9 Instructions and codes for taking standard measurements

8 Dissection methods and anatomical records

8.1 Start of dissection

Following external investigations of the corpse, plumage, moult and measurements, the dissection of the bird may start by making a long lengthwise ventral section just through the skin over the breastbone and belly to near the cloaca (Fig. 10).

At this stage, one should attempt to **keep the tissue-lining around the intestinal cavity intact**. The thin-walled and large glandular stomach (proventriculus) lies immediately below and can be easily damaged if you cut too deep. Things may not only get messy, but part of stomach contents may get lost, and we want to inspect 'complete stomach contents'.

Open the bird by 'peeling off' the skin to both sides. Keep the fat layer attached to the skin. You can now check breast-muscle condition , subcutaneous fat, and internal signs of moult of the coverts on the breast.

Now carefully cut the lining around stomach/intestines to start inspecting intestinal fat and various organs for e.g. sex determination. See the next pages for various details. **Do NOT remove the stomach until you have completed ALL the items from the dissection form.** Earlier removal of the stomach will certainly reduce the potential for sexing the bird correctly. The soft tiny organs in juvenile birds are easily damaged, especially so in more decayed specimens. Just move intestines gently to one side (usually the right side of the bird) while searching for the left-side sexual organs, which are positioned 'deep down' in close association with the kidneys, which are more or less attached to the back-bone.

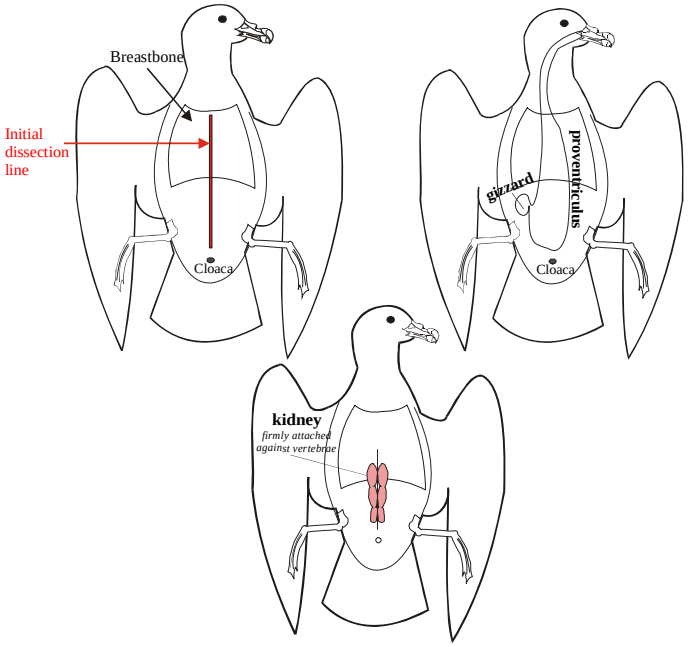
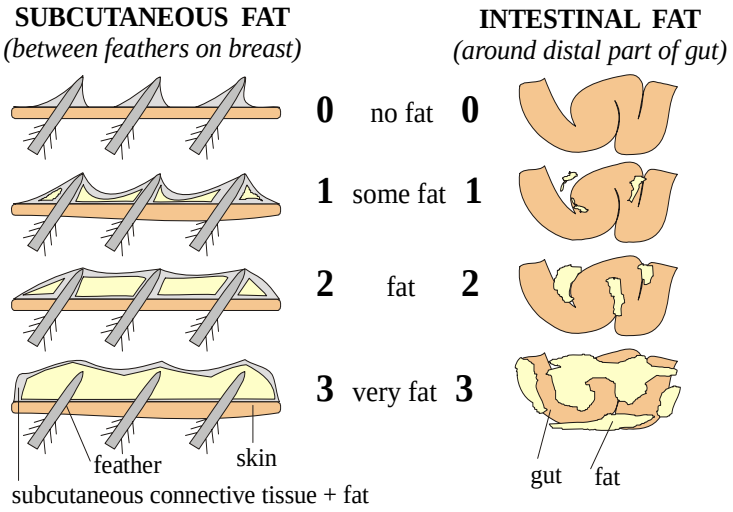


Figure 10 Dissection: first skin-incision, position of stomach, and position of kidneys

8.2 Condition

It is important to record condition because of its relevance to the cause of death and/or the duration of the process of dying (both of which could correlate to stomach contents, including litter). Birds in deteriorating body condition usually deplete their fat reserves first (subcutaneous and intestinal fat deposits disappear) and then start using proteins from muscles like the pectoral flight muscles (breast muscles). Fig.11 illustrates how to score the various characters and the overall condition index. To describe groups in the overall condition index it is suggested to use: score 0-1 = mortally emaciated; 2-3 critically emaciated; 4-6 moderate body condition; and 7-9 good body condition.



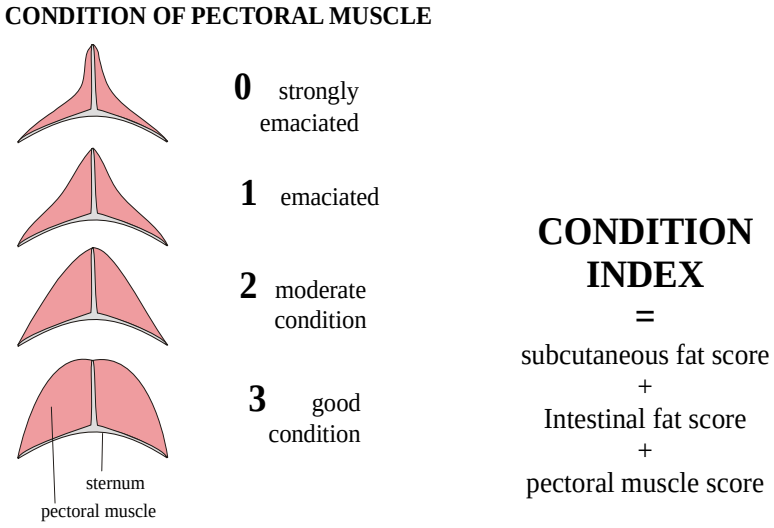


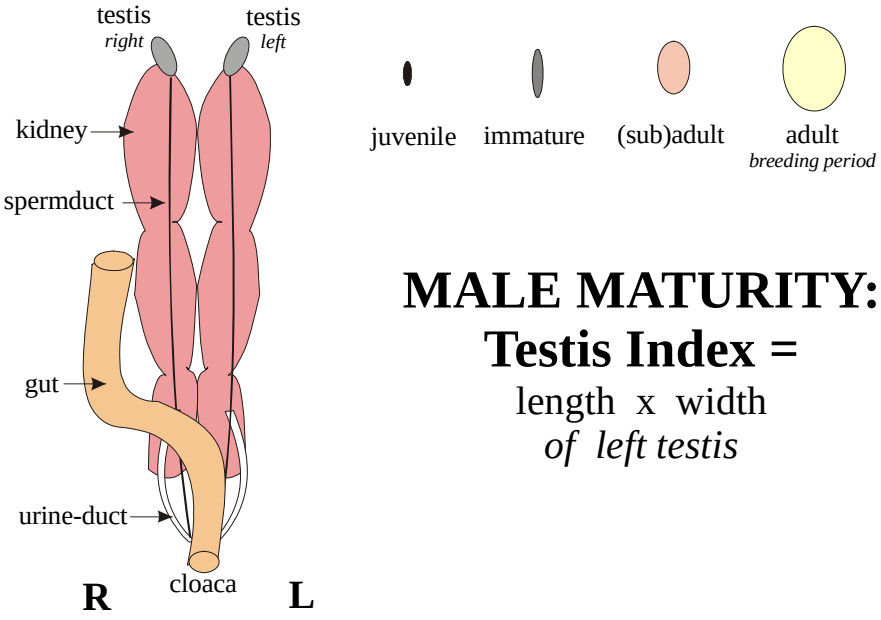
Figure 11 Standard codes for scoring condition parameters

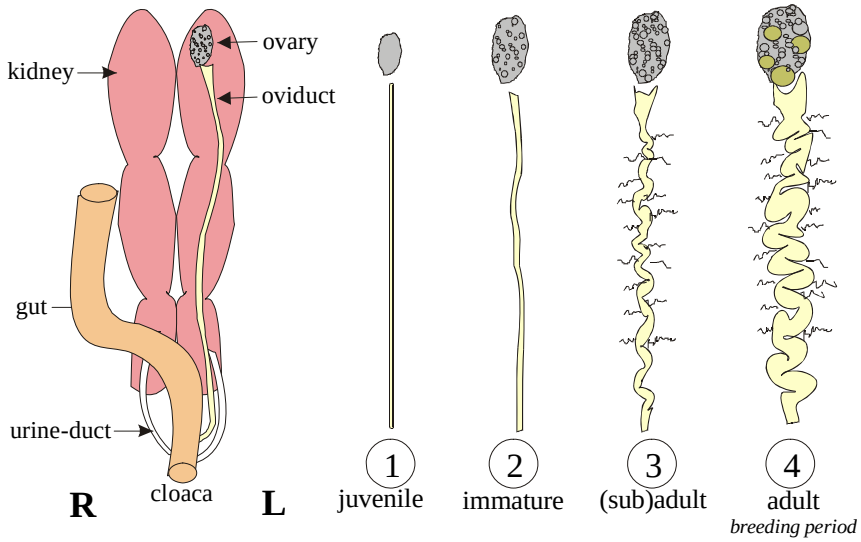
8.3 Sex and Bursa Fabricius (sexual maturity & age)

Sexual organs are situated close to the kidneys and can thus only be found by pushing the overlying organs (mainly stomach and intestines) gently to the side. Initially look for the sexual organs at the LEFT side, because female birds develop sexual organs (ovarium and oviduct) only at the left side of their body. Males have testes on both sides. See Fig. 12.

Especially juvenile birds may pose problems for less experienced observers.
In ***juvenile females*** the ovarium has not yet developed follicles. The organ is not much more than a light brownish, sometimes almost transparent flat organ pressed against the upper kidney. The oviduct in such birds is still very thin and straight, embedded in the transparent thin tissue-layers that separate subcompartments in the intestinal cavity (so the oviduct is not 'attached' to the kidney, as might be the suggestion from drawings but 'hangs' from the back).
In **older 'mature' females** periodic development oviduct-tissue during the breeding season and egg formation/passage have created a wider and curved oviduct with evident 'stretch-markings' in the surrounding tissue. Female sexual maturity index is based on the developmental stage of the oviduct and the diameter of the largest follicle in the ovary in mm. For juvenile females with undeveloped ovary, use follicle-size 0.1 mm. Oviduct code 4 is restricted to adult breeding females, when the oviduct strongly enlarges and the tissue becomes fleshy.
In ***juvenile males*** the testes are very small, blackish and elongated (looking like a small 'mouse-dropping'). They are sometimes hard to find, situated in tissue-strings going from the upper side of the kidney into the linings that separate the intestinal and breast-cavity (lung/heart). In difficult birds, definitely check also the right side of the body (males having testes on both sides) to see if you find a similar structure.
In **older males** the testes gradually become larger and are more 'bean'shaped and sized, usually with a variable fleshy or creamy colour. Only during the mating season do they swell up to a really large size with a creamy colour. In that condition, also the otherwise inconspicuous sperm ducts are easily seen because they are filled with whitish sperm. Male maturity index is calculated as length x width of the left testis (mm).

A useful age-character is the **Bursa of Fabricius**, a gland-like organ involved in development of 'immunities' (Fig. 13). This bursa is large in Fulmar chicks, disappears mostly within the first year but persists into the second year of life in some individuals.
To find the bursa, the intestines have to be pulled backwards. Since this destroys the various tissue layers in which oviducts and sperm-ducts are situated, only do this after you have completed the 'sex-section'. Search for the bursa on the dorsal side of the gut close to the cloaca. It is situated in the area where also the urine-ducts and oviduct or spermducts enter the cloacal area. Especially in fat birds or decaying specimens, the bursa may not be easy to find. It may be not much more that a rather flat organ pressed against the gut. Use tweezers to 'loosen' it along the edges to confirm it is indeed a gland-like organ that you are looking at (sometimes, the cloaca





FEMALE MATURITY:
Follicle-Oviduct Index =
diameter largest follicle
x
development code oviduct

for amorf juvenile ovarium use follicle diameter 0.1 mm

Figure 12 Standards for scoring male (top) and female (bottom) characters for sex and age; note that view is from ventral side (nb left L versus right R)

'shining' through the wall of the gut gives a colour-difference suggesting something like a bursa!).
Bursa-index is product of length x width of the bursa (mm). If the bursa is absent, record length and width as zero, leading to bursa-index being zero. If presense of bursa was not checked, write 'X' in the index-box. If a check on presence was conducted, but with uncertain result, write '?' in the box. .

See diagrams in Figs. 12 and 13 for details on sex and age.

MALE & FEMALE AGE-INDICATOR

BURSA FABRICIUS

The Bursa Fabricius may be found on the dorsal side of the gut, near the cloaca, where also urine-ducts and sperm-ducts or oviduct open into the cloacal area. The bursa is large in chicks but gradually disappears during juvenile/young life-stages and is lacking in subadults and adults

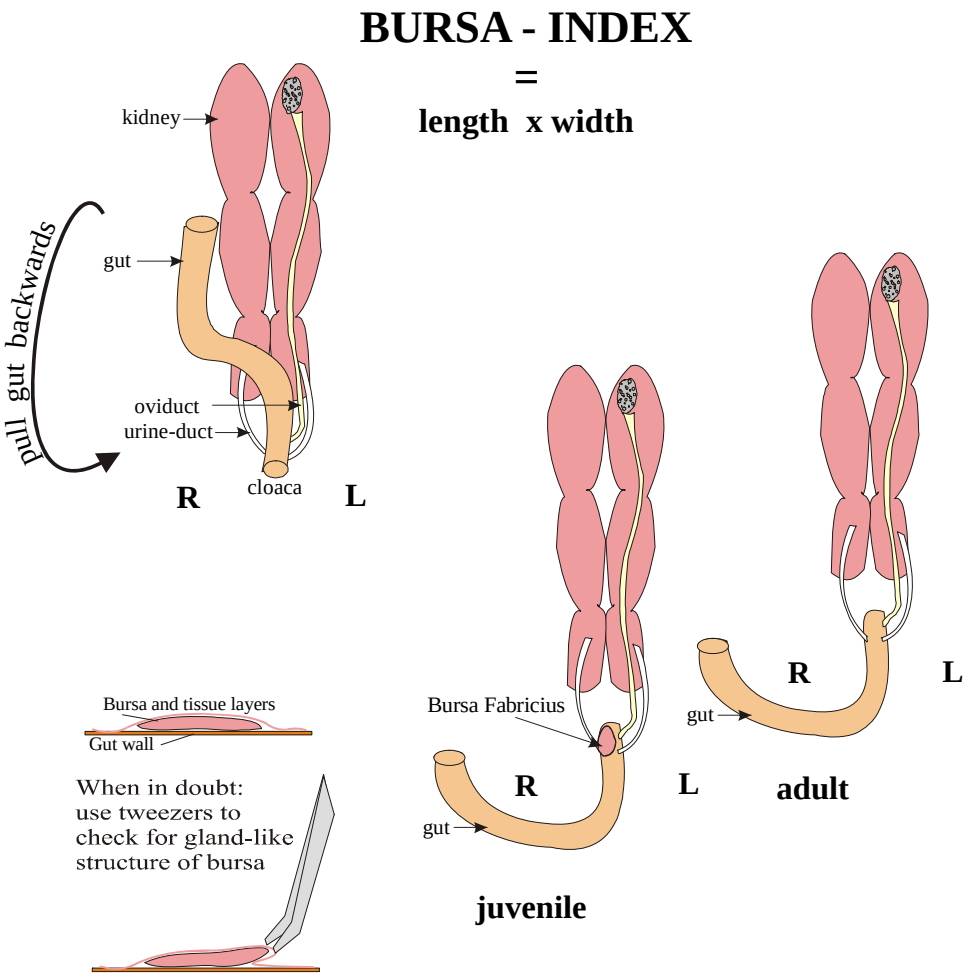


Figure 13 Instructions for finding Bursa Fabricius

8.4 Organ health

Organ health is recorded in a simple scoring system ranging from zero for extremely poor health to score 3 for good health. Decay of corpses will complicate judgement of organ health: please attempt to give a judgement as if the bird was 'fresh'. Health scores for different organs may assist in defining the cause of death or the duration of the dying process. They are not meant to describe the state of decay of the corpse. Descriptions here can not be exhaustive. Please use notes to describe situations not properly covered in table 5.

Table 5 Codes and descriptions for organ health

STOMACH

Code	description
0	severe or multiple wounds, ulcerations or cancers in or around stomach walls
1	affected with wounds, ulcerations or cancers in or around stomach walls
2	slight or minor affected stomach wall
3	unaffected, healthy looking stomach wall

LIVER

Code	description
0	heavily infected, damaged or with degenerated tissues or cancer
1	infections, damage, tissue-degeneration or cancer in moderate forms
2	infections, damage, tissue-degeneration or cancer in light forms
3	unaffected, healthy looking uniform liver tissue

GUT

Code	description
0	heavily affected, full length blackish from bleeding and completely shrivelled or: excessively swollen with accumulated gut material
1	affected, considerable parts of gut blackish and shrivelled, or partly swollen
2	somewhat affected, but largely normal 'fleshy or pink' colours and filled
3	unaffected, healthy coloured and normally filled gut

KIDNEY

Code	description
0	heavily affected, degenerated crumbly kidney tissue
1	affected, kidney spotted in white, red or dark
2	somewhat affected, only slightly spotted
3	unaffected, healthy looking uniform dark red kidney tissue

LUNG

Code	description
0	heavily affected, totally blackish or dark red from bleeding
1	affected, largely blackish or red from bleeding
2	somewhat affected, but with some blood or wet
3	unaffected, healthy looking dry pink lung tissue

8.5 Notes on cause of death

Under notes on cause of death please specify your thoughts on what may have caused the death of the bird, integrating all that you have written down and maybe things not easy to describe in the standard fields of the form. In many cases you will not be able to say more than 'died from starvation' without a clear clue as to what triggered the deteriorating condition. However, in other cases you may suspect that e.g a small amount of oil fouling, an injury, or internal problem is likely to have triggered death directly or indirectly. In apparently healthy birds there may be indications of drowning, collision or other causes.

In addition to your description, you can add one of the standard categories of the following list in the box to the right of these notes. But please do give the written description, as the category-listing is preliminary and not exhaustive.

Table 6 Preliminary codes for inferred death causes

OIL	**oil** (dark, mineral) in a quantity that you suspect to be directly or indirectly (via gradual loss of condition) related to the death of the bird. Presence of some oil in the feathers does not necessarily lead to death-category OIL.
EXT	**other external contaminant** in quantity likely to have contributed directly or indirectly to the death of the bird
SHO	**wounded by shot**, as evidenced indirectly by damage to feathers or tissue or directly by shot in the bird.
DRO	**drowned** eg suspected in 'healthy birds' in excellent plumage and condition, and all organs healthy except for some fresh blood in lungs.
ENT	**entanglement** (not immediately drowned); entanglement as recorded by finder or still present on corpse
HOO	**hook** fishing hook with or without line fragment hooked into body, beak, or throat
COL	**collision** as evidenced by for example fractures
CEM	**cement-cloaca** In Fulmars, a hard stony ball may form in the cloacal area; these may grow to several cms' diameter; please measure length and width in mm.
GUT	**other intestinal problems** e.g. extremely swollen gut (but no CEM); or holes in stomach-wall;…
CAN	**cancer** to proportion likely to have contributed to death. Please measure length and width of cancer tissue in mm.
PLU	**plumage problems** eg. lacking down; extreme wear to bare shafts following delayed or arrested moult; deformed feathers; ……
STA	**starvation without clear cause** Many birds are emaciated but show no clear evidence of anything that triggered the start of the emaciation process.
ME13	collected healthy (eg for scientific purposes, or as bycatch in longline or net fisheries or hunted)

8.6 Notes general

At the bottom of the form and on the rear side of the form there is ample space for any notes, comments and additions to the information that was supplied in the standard fields. The drawings allow you to indicate position of injuries or extent of fouling, or aberrant types of plumage colouration. For example, in case a bird has a

clearly deformed bill affecting particular measurements, one should leave blank the standard fields for these measurements, but describe or draw the deformation under notes. Also, many fields in the form offer a no / yes option, but sometimes it will not be possible to circle either one: in such a case, please describe the problem under notes. If you use the back of the form, do repeat the collection number in the top right box, as later copies of the form may not be ‘double-sided’.

9 Collection of Subsamples

In our programme at least the stomach is collected for later processing. However, other parts or the whole bird may be kept for various purposes. For example, with **banded birds**, please keep the whole corpse for further study at Alterra, for detailed investigations that may teach us more about age characters. Remains of banded birds are forwarded to the Zoological Museum of the University of Amsterdam or other institutes that guarantee optimal use and storage in well kept collections. The request to collect remains of banded birds concerns all species and includes decayed or scavenged corpses.

9.1 Taking out the stomach

After the dissection form has been completed the stomach can be removed from the corpse. Start with cutting loose the intestine where it leaves the gizzard. Using blunt tools or your fingers, loosen the proventriculus in the breast-cavity and higher up. Take care not to push stomach contents up while doing this, but ensure that all contents remain in the lower part. When thus loosened one can pull out even part of the oesophagus from the throat. Cut the oesophagus as high up as you can (Fig. 14). If there are fluid-like contents in the stomach, please use a bit of wire or elastic band to close the opening. Put stomach in sealable plastic bag (labelling inside and outside!), and store in freezer for later transport/analysis.

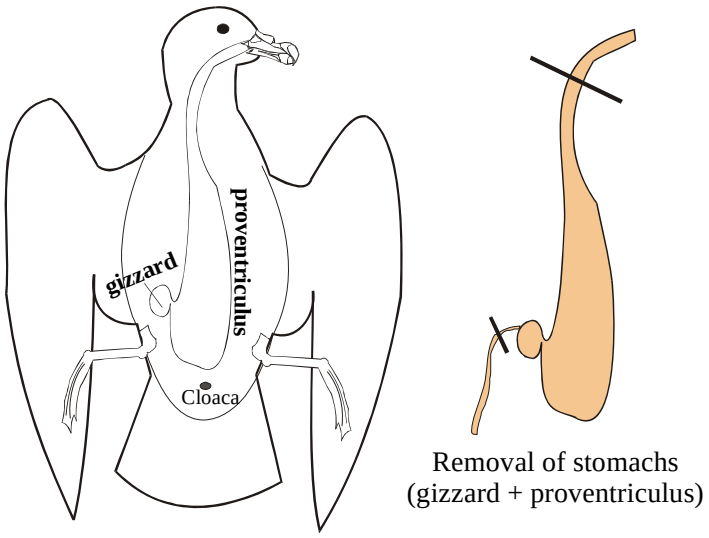


Figure 14 Procedure for taking out the stomach

9.2 Labelling and packaging subsamples

Please write down on the dissection form what parts of the bird have been collected for futher work (plus storage location and/or destination). In our Fulmar study this will be at least the stomach. If the stomach was missing, make a note (eg missing because of decay or scavenging). Clearly label any collected parts of the birds with the **'COLLECTION Number'** of the bird. Preferably use the standard blue dissection label (Fig. 15) and fill this out with clear pencil or indian ink. Insert the label with the collected item inside the bag or sample jar, and repeat the collection number with a permanent waterproof marker on the outside of bag/container. Or even better, use the 'double bag' procedure in which the sample bag plus the label is inserted in a second plastic bag, which is then marked on the outside with the collection number. This may seem a bit of an 'overkill' but experience is that labels regularly become unreadable, so it is better to make sure that no mistakes or losses of data occur. Also, if possible, add the original yellow collection bird-label with notes from the finder.
Keep subsamples frozen at -16°C or below until transport to Alterra for further analyses.

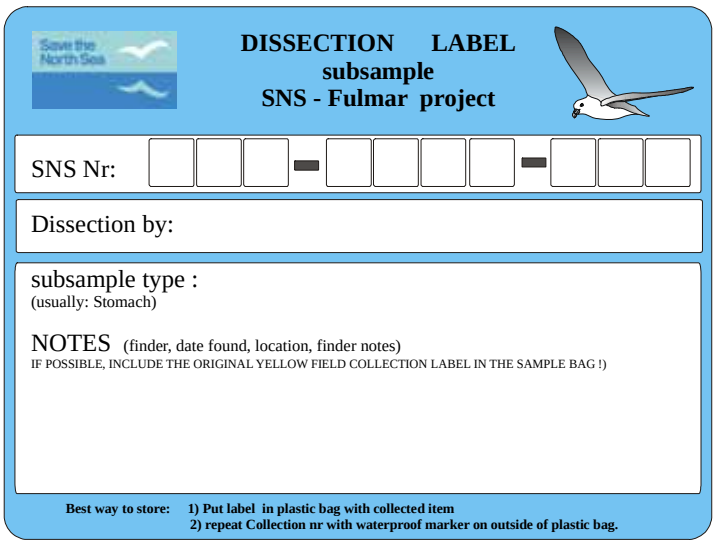


Figure 15 Dissection label for subsamples like stomach

9.3 Forwarding forms with subsamples

When stomach subsamples are forwarded to Alterra, ensure that clear prints of the completed dissection forms are included. To avoid loss of data, first copy the original form and keep one set for your own administration and back-up. If possible, use doublesided copying, but if you can make one-sided copies only, ensure that the collection number has been repeated on the back-side of your forms!

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Van Franeker, J.A., Meijboom, A. & De Jong, M.L. 2004. Marine litter monitoring by Northern Fulmars in the Netherlands 1982-2003. Alterra -rapport 1093. (Alterra, Wageningen)

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