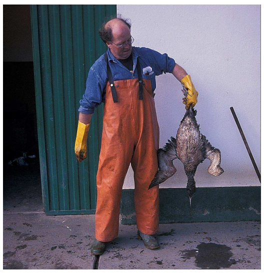
# HANDBOOK ON OIL IMPACT ASSESSMENT

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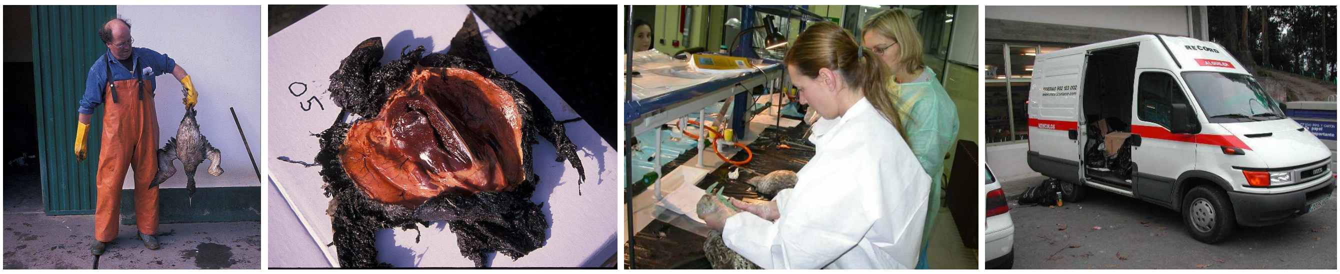
Texel, 2007

NIOZ

HAC LUCE
UNIVERSIDADE DA CORUÑA

SEA ALARM FOUNDATION

# HANDBOOK ON OIL IMPACT ASSESSMENT



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Version 1.0


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Oiled Red-throated Diver on sandy beach (© J.A.P. van Velzen)

THIS DOCUMENT WAS PREPARED WITH THE HELP OF NUMEROUS EXPERTS, INVOLVED IN OILED WILDLIFE RESPONSES AROUND EUROPE. THE HANDBOOK IS MEANT TO STANDARDISE TECHNIQUES AND TO BE OF HELP IN FUTURE EMERGENCY SITUATIONS, WHEN THE BIOLOGICAL IMPACT OF A SPILL NEEDS TO BE ASSESSED.

FUTURE UPDATES, INCLUDING REVISIONS OF JUST RELEASED TEXTS OR ADDITIONAL DOCUMENTS WILL BE RELEASED ON THE INTERNET. TO IMPROVE THE QUALITY OF THIS HANDBOOK, WE WOULD INVITE EXPERTS TO (HELP) REVISE TEXTS, TO PROPOSE NEW MATERIAL OR GUIDANCE AND TO (CO-)AUTHOR PARTS OF THE HANDBOOK

# HANDBOOK ON OIL IMPACT ASSESSMENT

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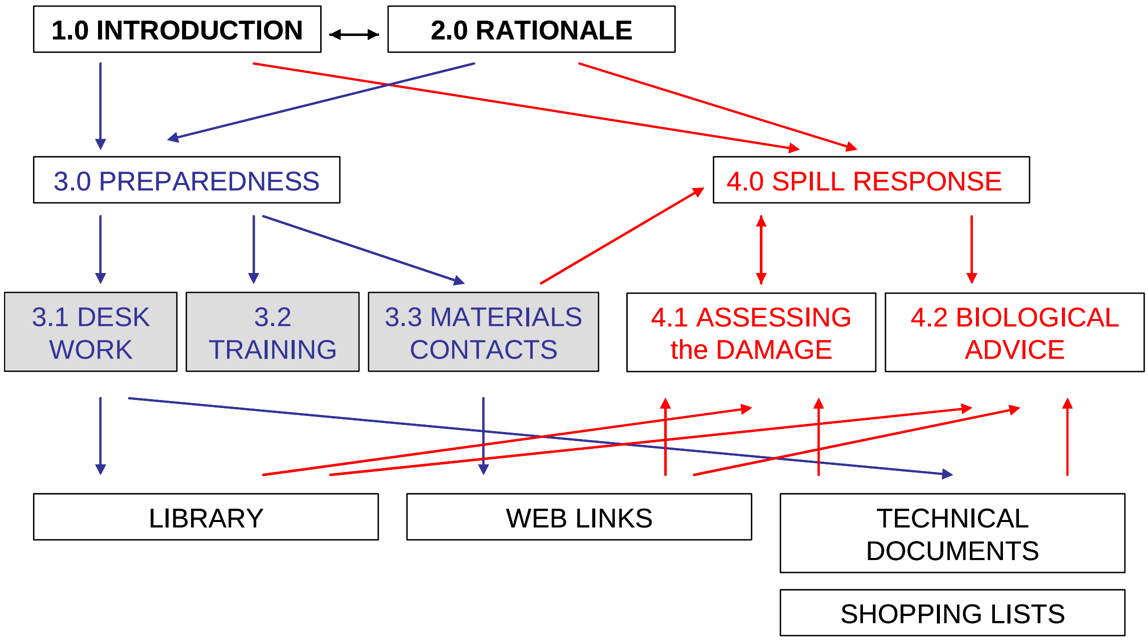
This document is a version 1.0 of the introductory chapters of the Handbook on Oil Impact Assessment, produced in hard copy and as web release (www.oiledwildlife.eu). Future updates of this text will be released on the web only.



Web release only

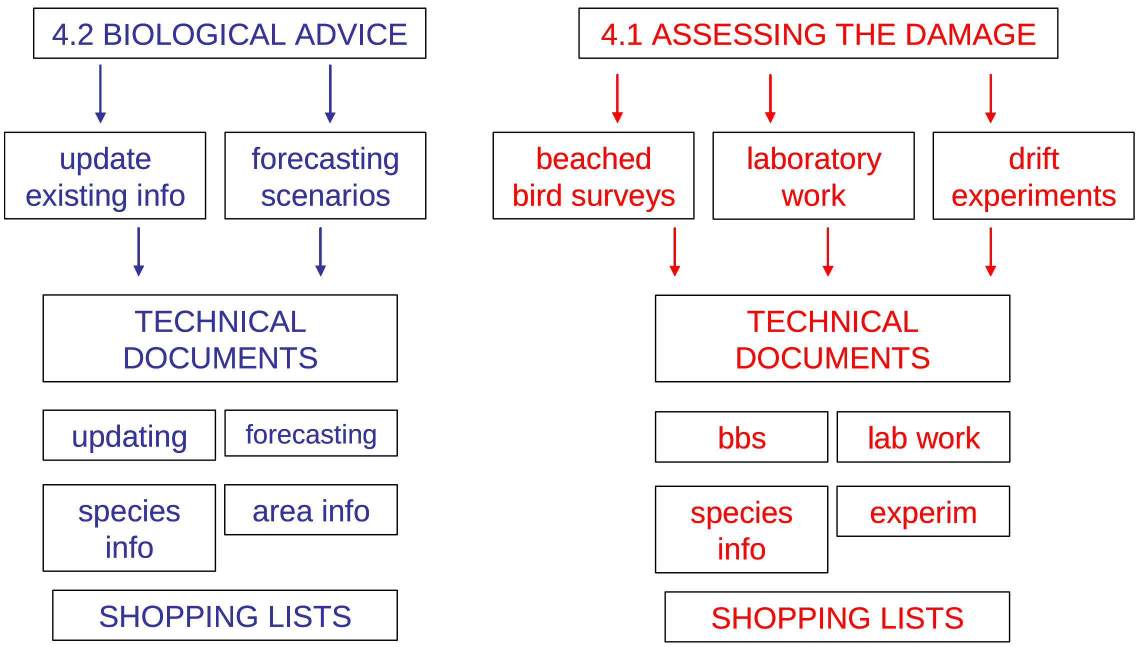
## HANDBOOK ON OIL IMPACT ASSESSMENT → WILDLIFE RESPONSE

### HANDBOOK STRUCTURE




## HANDBOOK ON OIL IMPACT ASSESSMENT → WILDLIFE RESPONSE

### WEB STRUCTURE



# HANDBOOK ON OIL IMPACT ASSESSMENT

## 1.0 INTRODUCTION

There has been a long, world-wide history of oil spills and associated mortality of marine wildlife (Dunnet 1982, Clark 1984, NRC 1985, Clark 2001). Despite recent declines in the amounts of oil released or spilled into the marine environment, chronic oil pollution is still a reason for concern (Camphuysen 2007), and within the European Union, major accidental oil spills (>20 000 tonnes) still occur at irregular intervals (European Environment Agency 2001, 2004).

Oil spills have tended to surprise the responsible authorities and any response has often had to be improvised. Published evaluations of oil spill scenarios have shown that in terms of dealing with wildlife casualties, such responses were often either chaotic, counter-productive, or at best inefficient. Pre-planning for such emergencies can not only enable a more efficient and co-ordinated response, but in many circumstances can help limit environmental damage and the number of animals that suffer the miserable fate of becoming oiled. This handbook is intended to provide wildlife response guidelines for best practice in the event of a spill. Three issues are addressed:

| | |
|---|---|
| (1) being prepared for a spill | Chapter 3.0 |
| (2) assessing the damage during a spill | Chapter 4.1 |
| (3) biological advice to minimise further damage during a spill | Chapter 4.2 |

**Preparedness (Chapter 3.0)** So, if a major oil spill happens on *your* coast, how would you deal with it? Are you prepared? Any oiled wildlife response should be integrated into the overall spill response to ensure cost-efficiency, access to resources, and help minimise further damage. Although there have been significant improvements and successes in the rehabilitation of oiled wildlife, it is much better wherever possible to prevent wildlife becoming oiled, for example by directing initial clean-up operations to the most sensitive areas. Does your coastline have a contingency plan for an oiled wildlife response (including trained wildlife responders)? Where are the most sensitive sea areas for vulnerable wildlife? Which species are most at risk, and at what time of year? Who should be contacted to become involved in the response? These are basic questions that can be answered before a spill occurs, and this manual provides guidelines on matters of preparedness, such as

- Evaluating sea areas in terms of sensitivity to oil pollution ‘beforehand’
- Collating existing data, and where would updated information come from
- Who should be involved in a spill response
- What materials, facilities, and personnel are available

**Impact assessment (Chapter 4.1)** Once an oil spill has taken place, how serious is the impact likely to be, and could there be detectable effects at the population level for particular species? To answer such questions, high quality data must be collected from the very start of the spill, with the help of (preferably local) experts. These data can help prioritise actions during the event, including priorities for rehabilitators, and are crucial for a proper evaluation afterwards. This manual provides guidance on what data are needed and how they should be collected, the difficulties involved in this kind of work, and options for dealing with live and dead oiled birds

In planning for a response, geographic options need to be considered on where to locate the various facilities. In some circumstance, facilities needed for an impact assessment may be integrated with those for the rehabilitation of oiled birds, but it should be recognised that these aspects of the response have very different requirements in terms of personnel, infrastructure, hygiene, and security. In order to meet the management requirements under different scales of incident magnitude, a tiered response system for wildlife response needs consideration. The health and safety of responders should be ensured, and proper and legal waste disposal must be considered. Finally, a financial tracking system is essential, and it should be established at the outset whether the activities are liable for compensation, and if so, who will pay the bills? This manual provides practical guidelines on:

- Organising the response
- Who to contact for specialist expertise
- Establishing a wildlife response centre
- Who should be involved, and in what roles
- Recruiting and managing volunteers
- Health and safety issues
- Planning and conducting beached bird surveys
- Establishing facilities for post-mortem examinations
- Conducting drift experiments
- Disposal of contaminated waste
- Financial aspects of the response, and the potential for compensation
- Assessing the overall impact on affected species

**Biological advice (Chapter 4.2)** When a spill actually takes place, desk study data on species and numbers at risk should be readily available (Preparedness, Chapter 3.0). However, it is likely that this information is outdated. Local experts should therefore be contacted for the most recent data, providing biological advice to responders. This information should confirm that the most biologically sensitive areas are recognised, help plan for changing scenarios in the event of a prolonged spill, and assist in the immediate response as an interface between the technical responders and the scientific and environmental community. This manual provides guidelines on matters of biological advice, such as

- How to re-evaluate a sea area in terms of sensitivity to oil pollution
- What data should be mobilised and analysed
- How to provide updated advice to help minimise further oiling of wildlife
- How to provide updated advice on near-future, worst case scenarios and best practice

## Project Impact of oil spills on seabirds

The key objective of this project, facilitated by a grant from the Community Framework for Cooperation on Accidental and Deliberate Marine Pollution (Grant Agreement no.07.030900/2005/429207/SUB/A5), was to discuss goals and previous experiences with leading experts on an international workshop and to produce that required set of guidelines (this manual) with concrete research recommendations to be of use in future incidents. The project was structured around a central workshop, with a desk study preceding that event and a desk study following the meeting to structure and prepare the discussion and the handbook resulting from the project. While the initial aim was to focus on the impact assessment of any spill, recent experiences in Estonia (2006), a report commissioned by IFAW (International Fund for Animal Welfare) on the scale and impact of chronic oil pollution in Europe (Camphuysen 2007), as well as the discussions during the workshop in A Coruña showed that area assessments deserved equal attention.

**Preparations**

Between 7 and 9 September 2007, 20 delegates; government officials, scientists and NGOs from 11 European countries (10 EU Member States and Norway, see Annex 1) gathered in A Coruña, Spain, to discuss best practices on data collection and analysis for the assessment of impacts of oil spills on seabird populations and the anticipated contents of a handbook. The workshop was organised by Royal NIOZ, the University of A Coruña and Sea Alarm Foundation.

The workshop was convened to agree on protocols to be laid down in a set of guidelines, called **"***The Handbook on Oil Impact Assessment***"** that was to be made available on the internet for future consultation and updates. The manual is intended to guide scientists and other responders in future oil incidents. It will be made available as PDF documents at www.oiledwildlife.eu. The handbook should be easy to use and should describe methods and tools that can be applied even under the most difficult and stressful circumstances.

**Production and access**

Following the workshop, a Version 1.0 of the manual was prepared and distributed for review. The *Handbook on Oil Impact Assessment* is a web publication that consists of numerous documents and web links. Any of these can be updated at any stage, and in the event of a spill, the latest version should be available for download, including highly practical tools such as shopping lists and forms. The entire handbook is available for download at:

**http://www.oiledwildlife.eu/**

**Updates**

Edition 1.0 is the end product of the project "Impact of oil spills on seabirds", whereas major updates will be numbered 2.0, 3.0 etc., and web-posted when completed. Smaller updates will be listed on a separate page {Web updates}, with a date and a brief description of the update. The most recent update will be on top.

## Parallel initiatives

Two parallel projects took place, co-funded by DG Environment of the European Commission, one with a workshop organised in Brest (France) on general aspects of oil spill response and led by Sea Alarm ('European oiled wildlife response planning'), and one on oiled seabird rehabilitation issues with a workshop in Albufeira (Algarve, Portugal) and led by Zoo Marine ('Oiled wildlife rehabilitation').

### European oiled wildlife response planning

Project partners: Sea Alarm (lead), CEDRE, IFAW, ICRAM, SYKE, ITOPF, OSRL

Duration: February 2006 - August 2007

The overall objective of the project is to initiate the exchange of information and experiences between the different Member States regarding oiled wildlife response, to develop a set of tools and a draft international response plan by which Member States, individually and/or jointly, could achieve a higher state of preparedness for oiled wildlife incidents in a rational, cost-efficient way.

### Oiled wildlife rehabilitation

Project partners: ZooMarine (lead), Sea Alarm, IFAW, ICRAM

Duration: February 2006 - February 2007

The objectives are to bring European marine wildlife responders from all coastal Member States, Norway and Ireland together to exchange experiences in the field of sea animal assistance at European level, especially on methodologies and approaches to clean and rehabilitate oiled birds and other animals under the conditions of an oil spill response; and to develop guidance on the collection, cleaning, rehabilitation of oiled sea animals as an integrated part of an oil spill response based on the experiences of the workshop participants, international experts and other internationally available information on the subject.

Together, these projects are meant to provide consistent information to be used while combating and responding to future oil spills in Europe and are aimed to minimize wildlife damage.

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**Version: 1.0** (November 2007)

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 2.0 RATIONALE

Oil spills have the potential to cause considerable environmental damage, and in the marine environment usually involve wildlife casualties, most commonly seabirds. As well as causing individual suffering, mass mortality in oil spills can impact seabirds negatively at the population level. Seabirds and marine mammals are key components of marine ecosystems, but do not respect territorial boundaries and their conservation is a shared responsibility that should be considered on a European, or even Atlantic scale, rather than on a national basis. Many species are protected in most European countries, some of which have established programmes to monitor and conserve their populations, but each country has a duty of care and legal obligation during the part of the year these common resources are in their territory.

Oil spills can happen anywhere and at any time of year, and all national and regional authorities should be prepared to respond promptly and efficiently to limit damage to the environment, including wildlife. However, zones can be identified where particularly vulnerable concentrations of seabirds occur (usually seasonally) in areas with a high risk of marine accidents and oil spillage, whether from oil tanker traffic, general shipping, or oil and gas production. In such areas, where even relatively minor spills can have a disproportionate impact on seabird populations, measures to prevent marine accidents or the illegal discharge of oil should be enforced especially rigorously, and levels of preparedness should be particularly high.

During an oil spill, the priorities and needs of the technical response may differ from wildlife responders, but it is vital that both work together on a crisis team. Rapid and authoritative biological advice can help the technical team to minimize further environmental damage, who in turn can assist the wildlife response with logistical support, liase on clean-up strategy, and provide an interface between clean-up crews and those involved with collecting live and dead oiled wildlife. All involved should be aware that authorities in other countries will be watching the progress of the response, especially in those countries who share the wildlife resource most at risk, and who will want to know what species have been affected, and on what scale. Preparedness, and an efficient, integrated response can provide such an impact assessment.

The **Handbook on Oil Impact Assessment** provides guidelines for two key aspects of a wildlife response: the impact assessment (Chapter 4.1) to evaluate (population level) damage inflicted on marine wildlife and the provision of biological advice (Chapter 4.2) to help guide the response and minimise further damage. This handbook does not provide guidelines on the treatment of oiled wildlife (rehabilitation attempts, or euthanasia). For that, we direct readers to www.oiledwildlife.eu.

The Handbook is meant to ensure that the best practices are adopted and applied throughout Europe by presenting the state of the art in an accessible on-line format. This will enhance the use of good practices in future incidents and training.

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 3.0 PREPAREDNESS

### Introduction

Not all European countries are equally prepared for oiled wildlife incidents. Some countries have developed an integrated oiled wildlife response plan, others are in a process to develop such a plan, but many countries do not have any pre-spill arrangement in place for oiled wildlife. Countries that have an oil spill response plan in place should be able to provide a management structure and strategy guidelines on how to deal with complicated emergencies. Unfortunately most plans are different from each other and there are substantial differences between countries in the way responsibilities are divided between ministries or between national, regional, and communal/local authorities.

Each country has a duty of care and a legal obligation to look after (marine) waters under their jurisdiction and to minimise the effects of oil pollution in these areas. To be able to respond properly to an oil spill, a country needs detailed information about spatial and temporal patterns in the sensitivity to oil pollution of the affected sea areas. Scientifically developed indices of area sensitivity are based on a combination of best available data on species specific oil vulnerability indices (OVIs), on seabird distribution patterns at sea, on breeding seabird populations, and on migratory pathways and timing. High quality information on area sensitivity is essential make sound decisions on the priorities with regard to oil clean-up operations and area protection.

A wildlife response should ideally be set up as part of the general oil spill response plan. Experience from past incidents demonstrates that the best results are achieved through pre-spill planning. Elsewhere, the logistics and rationale of a full-blown oil spill response will be discussed. With respect to pre-planning and preparedness regarding possible wildlife casualties during an oil spill, three main issues are considered within the context of this handbook:

(1) Which are the most sensitive sea areas under my jurisdiction (→ know your area)

(2) Who are the trained experts that should be involved in the response (→ know your experts)

(3) What facilities / material can be made available (→ prepare or select facilities beforehand)

### 3.1 Planning ahead, foreseeing risks

**Know your seabirds** Seabird species differ in their vulnerability to oil spills. Some species are more aerial than others, and shearwaters, storm-petrels, terns and gulls are examples of aerial families that at best plunge in the water to catch their prey. Other species spend most time on the water surface, sleep and rest exclusively at sea, and form large aggregations of individuals in rich feeding areas. Some species roost on land, while others are fully pelagic. In general terms, the truly pelagic and least aerial species are the most vulnerable to oil pollution. Many of those swimming species dive to feed and some, like guillemots descend during foraging to spectacular depths (150m deep and more; Piatt & Nettleship 1985). The pressure exerted on the plumage during a dive is considerable, certainly during dives deeper that 20 or 30m, and thus the plumage needs to be in perfect condition to avoid loss of insulation.

So the scale of vulnerability of seabirds depends not only on numbers present but also on the behavioural and other characteristics of the species involved. Several studies have examined ways of assessing these characteristics and the species-specific sensitivity to oil pollution (Oil Vulnerability Indices, OVI; reviewed by Camphuysen 2007). In most cases, marine species were graded on the basis of various factors that affect their survival. Each of these factors was given a score representing respectively no, low, medium or high relevance of that factor in increasing sensitivity to oil pollution. Several authors noted that scores for several species would alter if sub-species were used instead of species, indicating the importance of choice of taxonomic level.

Different techniques to calculate OVIs led to different outcomes, but Anon. (2002) compared several indices and found significant relationships between OVIs calculated for the same species in different parts of the world. Significant correlations were found between OVIs scored for species common to King & Sanger (1979) and Camphuysen (1989) ($R_S = 0.572$, $P = 0.001$, $n = 32$), between the proportion of beached birds found oiled on Netherlands beaches and OVI scores of Camphuysen (1989) ($R_S = 0.685$, $P = 0.001$, $n = 21$), between OVIs of Camphuysen (1989) and of Williams *et al.* (1995) for the North Sea ($R_S = 0.454$, p = 0.004, n = 37), and between the oil rate of beached birds found in The Netherlands and OVI scores of Williams *et al.* (1995) ($R_S = 0.446$, p = 0.015, n = 29).

Within western Europe, following Camphuysen (1989), the seabird families most sensitive to oil pollution are auks (mean OVI 77.2), divers (66.3), cormorants and shags (66.0), gannets and boobies (65.0), and sea ducks (64.2) (Table 3.1). Moderately sensitive seabirds are petrels and shearwaters (59.2), diving ducks (58.0), grebes (53.3) and storm-petrels (50.3). Species of lower sensitivity are found in the terns (47.9), gulls (45.1), skuas (42.6), and phalaropes (38.0). There are notable exceptions, however, such as the Black-legged Kittiwake, a highly sensitive gull (OVI 66). Phalaropes rank very low, but one should not try to imagine an oil slick in their main wintering areas off the West African coast. Note that phalaropes ranked significantly higher in the King & Sanger (1979) analysis for the North Pacific, an area where phalaropes are common.

Table 3.1 Mean Oil vulnerability index scores of Camphuysen (1989) per family and range for species scored for the North Sea.

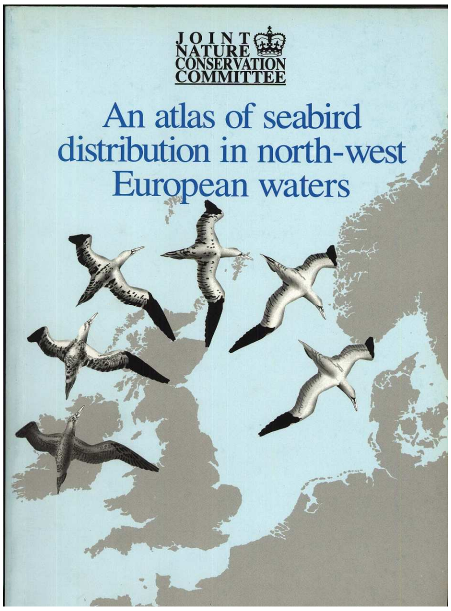
| Family | Mean OVI | Min | | Max |
|---|---|---|---|---|
| auks | 77.2 | 65 | - | 86 |
| divers | 66.3 | 65 | - | 68 |
| cormorants | 66.0 | 59 | - | 73 |
| gannets | 65.0 | 65 | - | 65 |
| sea ducks | 64.2 | 45 | - | 75 |
| petrels and shearwaters | 59.2 | 47 | - | 65 |
| diving ducks | 58.0 | 58 | - | 58 |
| grebes | 53.3 | 46 | - | 58 |
| storm-petrels | 50.3 | 49 | - | 54 |
| terns | 47.9 | 46 | - | 51 |
| gulls | 45.1 | 36 | - | 66 |
| skuas | 42.6 | 36 | - | 58 |
| phalaropes | 38.0 | 37 | - | 39 |

With few exceptions, these species breed at high latitudes in the temperate, subarctic and arctic zones, sometimes deep inland (divers and seaduck), and winter in the Baltic, the North Sea and along the Atlantic seaboard between the Norwegian Sea and NW Africa. In winter, much greater numbers and more species are at risk than in summer, and the distribution of the more vulnerable taxa extends further to the south. It is therefore no surprise that most of the damage done by chronic oil pollution was in winter and that most mass-mortality events were recorded in the areas indicated.

For as far as species-specific oil vulnerability indices have been calculated by Camphuysen (1989) and Williams *et al.* (1995), the OVIs are included in Technical Document {European Seabirds} associated with this chapter. Note that OVI's are not just species specific, but also area specific! Monthly exposure, area usage, behaviour, and habitat characteristics differ and must be considered in a thoughtful way, to obtain a sensible index. Phalaropes, for example, that rank rather low for the North Sea (Table 3.1) would probably be considered highly sensitive in their main wintering areas off the West African coast (Macaronesia). It is quite clear that much work has to be done to finalise this task, and we would like to invite scientists to participate in this work in the near future. Area specific OVI's will need be assessed for all major sea areas within Europe (Table 3.2) in the near future.

**Know your area** There are spatial and temporal patterns in the sensitivity of sea areas for oil pollution, for as far as marine wildlife such as seabirds and marine mammals is concerned. Information on the sensitivity of the various sea areas under the jurisdiction of a responder is essential for a proper oil spill response to take place and there are far too many cases in which a technical response was started, without a proper evaluation of area sensitivity. Prioritising clean-up operations in the most sensitive areas can greatly reduce the number of casualties during a spill.

All of the above purposes require not only species specific OVIs, but also information on the relative occurrence and timing of the seabird species within areas; in other words temporal and spatial information that ideally is presented in the form of maps. King & Sanger (1979) included temporal information as a seasonal (quarterly) exposure factor. In recent work in NW European waters, seabird at sea density information has been collected at sea during standardised surveys from ships and aircraft and information on the relative occurrence of the species within areas can be calculated on a seasonal, or even monthly basis.



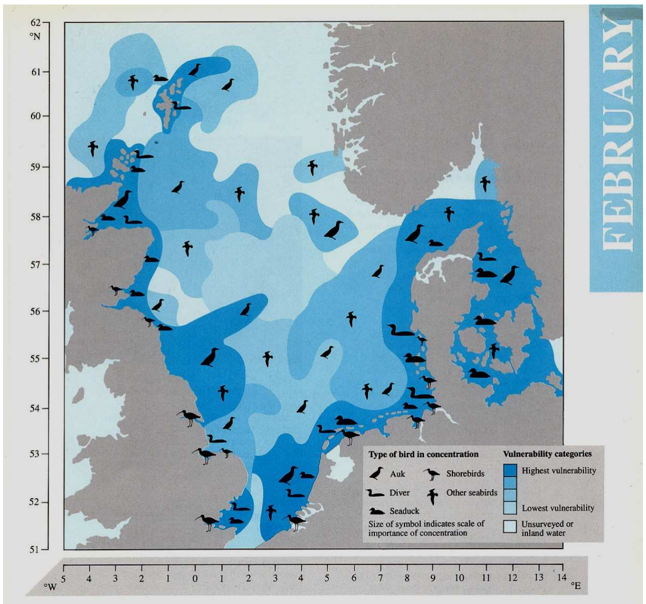




Figure 3.1. Example of a seabird distribution atlas (Stone *et al.* 1995) and a generalised map highlighting sensitive areas with regard to oil pollution within the North Sea after basic distribution data were re-evaluated (from Carter *et al.* 1993).

If seabird species with a high OVI score occur in high densities in a particular sea area, that area would naturally classify as a sensitive area with respect to oil pollution and immediate conservation actions would be required in case of a spill. Much less immediate concern would be necessary in areas holding few and only low scoring species. Distribution atlases are just the first step, while the next step should be the transformation of species specific seabird distribution patterns into generalised oil vulnerability maps. Unfortunately, that step has thus far only seldom been undertaken (examples are Carter *et al.* 1993; Webb *et al.* 1995). Atlases of area vulnerability to oil spills are obviously a much more precise and therefore much needed tool for planning and emergency response.

Data on area specific differences in the sensitivity to oil pollution on the basis of updated seabird information should be collected *before* a possible spill (Chapter 3.0 Preparedness), but must be promptly checked and updated *during* the spill (Chapter 4.2 Biological advice during Spill Response). Migratory movements between areas in winter, spring, summer, and autumn lead to shifts in the seabird community within areas and, hence, in the occurrence of species with high OVI scores. Decision makers in the oil spill response should be aware of the seasonality and take these patterns into account. They should realise that the situation regarding area sensitivity might chance dramatically *during* the event. An essential part of the biological advice they would need is an elaboration of a (worst) case scenario, in which shifts in vulnerable wildlife abundance are forecasted on the basis of local knowledge of migration routes, timing of migration, and stop-over sites.

**Current knowledge of sensitive areas within Europe** Unfortunately, while generalised oil vulnerability atlases have been produced for some areas, these are missing or inadequate for other regions. It is these vulnerability maps that are the most useful tools for technicians responding to a spill, because biological know-how is not needed to understand these maps. While reviewing Europe's sea areas in these respects (Camphuysen 2007), it became clear that

(1) there is substantial recent knowledge on seabird distribution and migration patterns, but with large gaps,

(2) only few areas have been evaluated in terms of their sensitivity to oil pollution on the basis of marine wildlife and species-specific OVIs,

(3) some of the worst recent spills in terms of casualties (i.e. *Erika, Prestige*) occurred in sea areas for which both data sets are lacking or at best incomplete, and

(4) in well covered areas where vulnerability atlases have been produced, the data are currently ageing (risk of outdated information); new surveys may be required as updates

Fifteen major sea areas within Europe have been identified and evaluated in terms of present knowledge (Table 3.2). A review of these sea areas, including an indication of the occurrence of the most sensitive bird families, the availability of high-quality seabirds at sea data, and whether or not a recent evaluation of the sensitivity to oil pollution has been undertaken or would be possible is summarised below (Table 3.3). Technical documents associated with this chapter (15 in all, for all sea areas listed in Table 3.2) are meant to provide further details.

As a next step to improve preparedness, we would strongly recommend a thorough (re-) evaluation of all European seas in terms of their sensitivity to oiling. Systematic offshore surveys studying seabird distribution patterns should be promoted in all data deficient or partly covered sea areas (Table 3.3), while the analysis of available data should be stimulated to assess patterns in area sensitivity as described earlier.

Table 3.2 Major sea areas in Europe and countries potentially involved during oil spill responses in each of these.

| # | Sea area | Countries involved in spill response |
|---|---|---|
| 1 | Greenland Sea and Icelandic waters | Denmark (Greenland), Iceland |
| 2 | Svalbard | Norway |
| 3 | Barents Sea | Norway, Russia |
| 4 | Norwegian Sea | Norway, Denmark (Faeroese waters), United Kingdom (Shetlands) |
| 5 | Faeroese waters | Denmark (Faeroe Islands) |
| 6 | North Sea | Denmark, Germany, The Netherlands, Belgium, United Kingdom, Norway |
| 7 | Baltic Sea | Denmark, Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Poland, Germany |
| 8 | West of Britain, Ireland and Irish Sea | Ireland, United Kingdom |
| 9 | Channel and Celtic Sea | Ireland, United Kingdom, France |
| 10 | Bay of Biscay | Spain, France |
| 11 | Portuguese and Spanish Atlantic coasts | Portugal, Spain |
| 12 | The Azores, Canaries, Madeira, Cape Verde Islands (Macaronesia) | Portugal (Azores, Madeira), Spain (Canaries), Morocco, Mauritania, Cape Verde Islands |
| 13 | Western Mediterranean | United Kingdom (Gibraltar), Spain, France, Italy, Libya, Tunisia, Algeria, Morocco |
| 14 | Eastern Mediterranean | Libya, Egypt, Israel, Palestine, Lebanon, Syria, Cyprus, Turkey, Greece, Albania, Serbia, Croatia, Slovenia, Italy, Malta |
| 15 | Black Sea | Turkey, Bulgaria, Georgia, Romania, Russia, Ukraine |

Table 3.3 Overview of current high-quality knowledge of seabird at sea distribution in Europe and attempts to evaluate species-specific OVIs and area vulnerability to oil pollution.

| Area | Seabirds at sea data | OVI and area sensitivity | Data availability |
|---|---|---|---|
| Greenland/Iceland | anecdotal data, local surveys | not analysed | data deficient |
| Svalbard | surveys in southern part | not analysed | partly covered |
| Barents Sea | summer surveys, some spring | not analysed | partly covered |
| Norwegian Sea | mainly nearshore surveys | not analysed | partly covered |
| Faeroese waters | extensive year-round surveys | vulnerability atlas | well covered, atlas |
| North Sea | extensive year-round surveys | vulnerability atlas | well covered, atlas |
| Baltic | extensive year-round surveys | not analysed | well covered, atlas |
| West of Britain, Irish Sea, Ireland | extensive year-round surveys | vulnerability atlas | well covered, atlas |
| Channel, Celtic Sea | extensive year-round surveys UK | vulnerability atlas UK | partly covered |
| Bay of Biscay | fragmented survey data | not analysed | data deficient |
| Atlantic Portugal and Spain | new studies just commenced | not analysed | data deficient |
| Macaronesia | new studies just commenced | not analysed | data deficient |
| West Mediterranean | new studies just commenced | not analysed | data deficient |
| East Mediterranean | not known | not analysed | data deficient |
| Black Sea | not known | not analysed | data deficient |

**Know your experts** For all sea areas, whether they have been properly studied or are data deficient, address lists should be compiled, to provide immediate access to the experts, institutes or (ornithological) organisations that could provide high quality biological advice *during* a spill. These experts should be able to demonstrate their expertise in this field and they should be directly involved in studies of seabird distribution patterns, migration studies, or wildfowl censuses on a routine basis.

For non-ornithologists or non-biologists, it is quite unclear whom to consider a specialist in oil-spill response. The type of expertise required for an area assessment and for an update of area sensitivity is highly specific. During oil spills, numerous NGOs and ornithological organisations beat the drums, while the most essential people are often unavailable, or difficult to trace down. In each country, the orga nisations or people needed for an area assessment will be different, but as a general guideline: organisations/institutions/persons involved in systematic seabirds at sea surveys, winter waterfowl censuses, systematic counts of coastal (sea-)bird migration, and monitoring programmes of breeding populations will have to be called in. In the Technical Documents associated with this chapter, we will try in guide towards the appropriate organisations for as far as these are known to us. As with the Technical Documents associated with Chapter 4, these texts and lists will be constantly updated. Note, however, that it will be impossible to provide complete and exhaustive address lists and one important step in pre-spill planning and preparedness for each and every country potentially involved in a future spill will be to try and list the experts and expertise beforehand.

## 3.2 Lessons learnt from previous spills

**Identify responders beforehand** Previous spills have shown that numerous people respond to the breaking news that an oil spill has occurred. Responders include the responsible authorities, insurers, experts, NGOs, news media and the general public (as spectators or as volunteers). It is a considerable challenge to steer all those responders in an efficient manner from the onset of the spill. Realising beforehand that such groups are likely to respond is helpful and a plan should be made outlining the responsibilities and the level of involvement for each of them.

**Who are the true experts?** With respect to oiled wildlife, despite a long history of oil spills within Europe, few responders are truly experienced. NGOs may present themselves as experts without being able to demonstrate practical involvement in previous spills. It is important to discuss expertise, train people where needed, and list the genuine and wanted experts/expertise as part of a preparation for a spill. The expertise required varies from the exceptional ornithological skills to identify a badly oiled or rotten bird corpse to a demonstrated experience in assessing patterns in area sensitivity to oil pollution based on survey data and wildfowl counts.

Figure 3.2. On 16 March 1978, the oil tanker Amoco Cadiz, transporting 227,000 tonnes of crude oil, suffered a failure of her steering mechanism, and ran aground on Portsall Rocks, on the Breton coast. The entire cargo spilled out as the breakers split the vessel in two, progressively polluting 360 km of shoreline from Brest to Saint Brieuc. This was the largest oil spill caused by a tanker grounding ever registered in the world. The consequences of this accident were significant, and it caused the French Government to revise its oil response plan (the Polmar Plan), to acquire equipment stocks, and to impose traffic lanes in the Channel. The photo shows the wreck of the Amoco Cadiz while being bombed by a helicopter to release the remaining oil from its holds. © CJ Camphuysen

**Know your area** There are spatial and temporal patterns in the sensitivity of sea areas for oil pollution, for as far as marine wildlife such as seabirds and marine mammals are concerned. Oil vulnerability atlases have been produced for some areas, but are missing or inadequate for other regions. Information on the sensitivity of the various sea areas under the jurisdiction of a responder is essential for a proper oil spill response to take place and there are far too many cases in which a technical response was started, without a proper evaluation of area sensitivity. Prioritising clean-up operations in the most sensitive areas can greatly reduce the number of casualties during a spill.

**Volunteer motivation** Some spills are short-lived and the area is readily cleaned, other oil incidents may take many months before the leakage and associated clean-up operations have stopped. While responders are highly motivated during the onset of a spill, triggered by the news media, it is important to keep up the work for as long as needed. Goodwill is easily spoiled; volunteers should not be overloaded with work.

**Tiered response** Small incidents do not need an extensive mobilisation of responders and volunteers whereas large complicated incidents probably do. A tiered response system provides guidance as to match the size of an incident with the number and qualification of responders that is probably required. The most commonly used system of tiered response recognises three tiers.

**Mechanisms for financial compensation** In the past it was often not clear to wildlife responders who in the end would pay for their expenses. After having done their mostly voluntary work, many organisations and individuals in the end failed to find a party that was willing to reimburse the expenses they had made. In many cases the claims to the ship's insurers were refused for unclear reasons. Nowadays, wildlife response activities, including those for impact assessment, are better recognised by the existing international mechanisms for financial compensation. However, these mechanisms do not always apply in any case of oil pollution. Well developed systems such as the so called Civil Liability Convention and International Oil Pollution Compensation Fund Convention will apply in the case of a spill from an oil tanker in the waters of a Coastal State that has ratified these conventions. For so called bunker spills (oil spills from a non-tanker) a mechanism for compensation has been developed but is not yet in force, pending the ratification in a number of Coastal States. The way in which the existing international compensation mechanisms systems work in wildlife incidents is well explained at http://www.oiledwildlife.eu/drupal-4.7.3/?q=node/7. It should be considered a matter of good practice that wildlife responders (including scientist who aim to carry out an impact assessment) are aware of these systems and seek information in the very early days of their activities in the aftermath of an oil spill through organisations like ITOPF (www.itopf.com) or Sea Alarm (www.sea-alarm.org).

## 3.3 Planning for an oil spill response (summary)

An agreed pre-spill oiled wildlife response plan is the best guarantee for a responsible, cost-efficient approach to an oil spill which involves wildlife. If a pre-spill planning is in place that outlines response coordination, capabilities, and procedures, an oiled wildlife response has the best probability of success. It is imperative that wildlife response plans should be fully integrated into the wider oil spill response plan.

The planning of an effective oiled wildlife response needs serious attention and will require the inputs and cooperation of many stakeholders including administrators, oiled wildlife response experts, oil spill response experts, competent authorities and others. Some guidelines for the planning process and critical issues to be addressed are described at http://www.oiledwildlife.eu/drupal-4.7.3/?q=node/4. Below, a number of issues that specially apply to impact assessment are emphasised..

**General issues** As a matter of basic pre-spill preparedness, key players in the field of impact assessment (authorities, scientists, volunteer coordinators) should be identified and sit together in order to define objectives, methodologies and responsibilities for impact assessment activities. It is recommended that baseline data on year-round seabird occurrence and concentrations of pollution sensitive species are collected and elaborated into seasonal sensitivity maps. The objectives and methodologies should be identified and agreed. Experts who are able to provide high quality biological advice should be identified and included into the telephone list of the existing oil spill response plan. Guidelines for the integration of search and collection activities into the beach monitoring and cleanup activities should be drafted.

**Legal responsibilities, licenses and liabilities** Legal responsibilities, the need for particular licenses (handling protected wildlife), and liability issues should be identified and agreed as good as possible. If licenses for animal (including corpses) handling need to be issued, it is important that pre-spill arrangements are in place so that search and collection can commence immediately after the first stranding of wildlife without having to wait for formalities that may take days or weeks under normal circumstances.

**Logistics and coordination** Pre-spill arrangements should include names and contact details of activity coordinators (who are well integrated into the overall oil spill response management system) and institutes and/or volunteer networks that have agreed to carry out hands-on work in the fields of search and collection and necropsies. Logistic planning (mobilisation of staff and volunteers, vehicles, facilities, equipment) should be ready and stocks of equipment (incl. personal protection equipment) must be available for immediate mobilisation.

**Training** A response plan needs to be trained regularly in order to gain importance. Training may include staff training and mobilisation exercises.

**International assistance**. In case national capacity is insufficient or its mobilisation is delayed, international assistance can be called on. Sea Alarm (Brussels; see contact details below) provides services in identifying and mobilising tailor made assistance of internationally operating wildlife responders.

**Finances** An oiled wildlife response is impossible without financial resources. These resources are best provided by the authorities. In the planning process, financial issues should be well discussed. Authorities may create an emergency fund or there may be an agreement that all involved parties pay their own expenses, pending the submission of a unified claim. In the design of the response activities, a successful claim should be anticipated. This can be done by developing a response plan that includes all elements that are recommended by leading international guidelines such as the Claims Manual of the IOPC Fund or the IPIECA Guide to Oiled Wildlife Response Planning.

**Health and safety** Working in a polluted environment is potentially hazardous for those involved, working along a shore in rough weather is potentially dangerous. Adequate measures should be taken (inc. training) to avoid health problems or loss of human lives during and after a response.

**Waste management, cleaning up** In the wildlife response activities (including impact assessment) it should be avoided to create unnecessary secondary pollution. The production of oiled waste should be minimised at all parts of the response. A waste management plan is best designed in accordance to national laws and regulations.

## Technical documents

| | |
|---|---|
| European contacts.DOC | List of useful contacts and expertise within Europe |
| European seabirds.DOC | List of European seabirds and (current) OVI evaluation |

Technical documents for chapter 4.2 (Descriptions of current knowledge in 15 defined sea areas)

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

### Introduction

The four basic questions to be answered by an impact assessment are (i) what has been killed, (ii) how many, (iii) where did they come from, (iv) can any effect be detected at the population level? Demonstrating any effect on seabird populations of even a major oil spill has not been easy, and few case studies have been able to do so convincingly. Firstly, the different species affected must be identified and the mortality quantified. This normally involves searches of the polluted coastline for oiled victims (beached bird surveys), and these surveys are most effective if they are planned and directed, in co-operation with the teams responsible for cleaning up the oil. Not all birds that become oiled will be found on even the most thorough beached bird surveys, and this proportion will vary depending on factors such as the distance from shore of the point source of the spill, the nature of the coastline, the type and volume of oil, and prevailing winds. A drift experiment, where real or simulated seabird carcasses are marked and dropped in the vicinity of slicks, to be later recovered on beached bird surveys, can help estimate the proportion of the total mortality that was actually found. This is best planned for in advance, and conducted during the early stages of an incident.

Figure 4.1.1 Stranded, slightly oiled Common Guillemot *Uria aalge* © CJ Camphuysen

For many seabird species the only data on population sizes and trends comes from counts at the breeding colonies, but most seabirds are migratory, or at least spend much of the year well away from their breeding sites, whereas most oil spills occur during winter months. A small proportion of seabirds have been ringed (banded) at their colonies, which may indicate breeding origins, but for most species this percentage is either extremely small or heavily biased towards particular well-studied locations. Fortunately, widespread seabird species normally vary in size over their breeding range and careful measurements (biometrics) can help indicate likely breeding origins, and where best to look for population impacts. Seabirds also have a period of immaturity lasting several years before attaining breeding age, with the different age classes having different natural survival rates, and often different winter distributions. It is therefore important to established the age structure of the mortality for each species, since their populations are most likely to be impacted if the victims are mostly breeding adults (with normally high winter survival), rather than birds in their first winter, many of which would have died naturally before the following summer. Finally, it is important to establish the sex ratio of the mortality since male and female seabirds can have different wintering distributions, and an incident could kill adult birds of either sex disproportionately.

These key elements of a wildlife response for impact assessment are generic to any incident: organised beached bird surveys, a drift experiment where feasible, and the recording and examination of the dead birds collected. This needs close co-operation with those involved in the rehabilitation response for live birds, and with the authorities in charge of the overall response. Being prepared should also involve collating data on the numbers and distribution of the wildlife resources at risk in your area. This will not only help guide the overall response, but may itself be part of the impact assessment for species such as arctic waterfowl whose breeding origins, numbers and densities are poorly known, and for which counts in winters following the spill may be the best means of detecting any population effect. This manual provides guidance for wildlife responders during an oil spill, and introduces standard protocols and methodology that aid the impact assessment and help provide comparisons between different incidents.

## 4.1.1 Tasks

If your local, regional or national oil spill contingency plan includes provision for dealing with wildlife casualties, then it should include options for a location from where to organise the wildlife response, and identify the organisations that will provide the management roles that will need to be filled. If not, these are the first tasks to be done. The response centre should be a multi-roomed facility, ideally existing offices, or rooms capable of being adapted quickly to provide normal office facilities such as working desks, power points for computers, photocopier, fax etc., communications, a dedicated meeting room, and basic catering and toilet facilities. Management roles that need to be considered will include (i) planning and directing beached bird surveys and any carcass experiments, (ii) management of volunteers and their needs (equipment, health and safety, transport, food, accommodation), (iii) organisation and/or supervision of post-mortem examinations, (iv) record-keeping and database management, (v) finance and liason with insurance/compensation authorities, (vi) liason with the incident management team. Other tasks such as ensuring safe and legal waste disposal, liason with the scientific community and conservation organisations, and media relations need to be considered, but no two incidents are the same and the number of people required to fulfil these tasks will depend on local circumstances.

The main task during a spill is to establish a reliable count of the casualties, both dead and live, to identify them to species, examine them for characteristics or markers that might indicate their breeding origins, and to age and sex them as far as possible. These procedures should be generic to any major oil spill, they are part of the spill response and are essential to understanding the impact on seabird populations, and should not be considered as academic research. Counting carcasses is not too difficult, but collecting them and keeping an accurate record throughout an incident that might involve many thousands of birds and extend along hundreds of kilometres of coast requires organisation and attention to detail. Beached bird surveys should be planned and directed, and early and serious consideration should be given to estimating the proportion of carcasses not found, either by drift experiments at sea, or by calculating disappearance rates from experimental beaches. The specific identification of dead seabirds, especially those that are very heavily oiled or are incomplete, is less easy than many people who have not participated in beached bird surveys realise, while taking biometrics and conducting internal examinations for age and sex will require expertise that may not be readily at hand.

**Beached bird surveys** Systematic beached bird surveys are best carried out by dedicated volunteers, supported by a core of people experienced in oil spill response {beached bird survey manual}. They should be planned and directed, based on the latest information on the extent of oil, projected slick trajectories, and known concentrations of vulnerable seabirds. Routine beached bird survey schemes already exist in many countries {European contact addresses} and where possible, experienced volunteers from these should be used. An efficient collection and transportation system will need to be organized for both live and dead birds, and beach clean-up teams should also be instructed to collect any oiled birds they encounter, separate them from waste material, and have them labeled and collected at regular intervals. The basic information that should accompany both live and dead birds is the date and location of finding. Members of the public not involved in directed surveys will inevitably encounter oiled birds during casual visits to the coast and should be informed via the local media as to where to bring birds found. Survey teams should be asked to report sightings of live, oiled birds that could not be caught (flocks of oiled waders and gulls tend to be under-reported during large spills). Surveys should cover the geographical extent of the affected coastline and find its limits, as well a concentrating on core areas, and should continue for the duration of the incident. Health and safety issues will vary greatly, depending on the nature of the coastline, season, and prevailing climate, but the health and safety of volunteers should be the paramount concern. Advice should be sought from the responding authorities on the nature and toxicity of the oil, and the degree of personal protective equipment required. Consideration should be given to issuing volunteers with some form of identification (e.g. a printed reflective waistcoat) which can tell the authorities that they are part of the formal spill response.

Figure 4.1.2. In many European countries, beached bird surveys have been organised since the late 1960s to monitor seabird strandings resulting from chronic oil pollution. It is strongly recommended to respect existing schemes during oil incidents and to recruit experts from these organisations to set-up or assist with high quality beached bird surveys during spills. © G Jonker (left), CJ Camphuysen (centre), JE den Ouden (right)

**Species identifications and further examinations** Best practice is to collect all oiled birds at a central location for recording, any further examination, and eventual safe disposal. It should be remembered that oiled seabirds left on or near the shoreline present a toxic threat to scavenging wildlife. Scientific oversight should be established rapidly, to decide the level of examination that is practicable given the resources available, to identify and source relevant expertise, and to determine the fate of the biological material collected. To plan this work properly, it is important to know which species are likely to be involved and how heavily they may be oiled. Accurate identification and ageing and sexing by external characters is generally impossible under field conditions if birds are fully covered in oil, so casualties should be processed in a (simple) laboratory facility.

Figure 4.1.3. Improvised, but adequate laboratory facilities at A Coruña University during the Prestige oil spill (left) and in a geology department warehouse during a mystery spill in Estonia (right). © Hugo Nijkamp (left) and Leho Luigujõe (right).

In situations where species, age and sex is clear (e.g. strandings of partly oiled waterfowl), examinations can be done quickly by experts and the carcasses disposed of immediately. Consult the species/bird families technical documents for ageing/identification issues. However, in most cases, conducting a proper impact assessment means examining birds in laboratory conditions. If this is not done, it is important to check all carcasses thoroughly for leg rings or other markers before disposal, and it should be remembered that scientists increasingly attach (expensive) remote-sensing devices to seabirds for research.

**Laboratory work** Depending on relevant national legislation, authority should be given quickly to the scientific team allowing them to examine corpses, and to have the option of transferring them to other institutions if necessary. One of the key management and scientific decisions to be taken early in an incident is whether to conduct post-mortems concurrently with the field response, or whether to simply confirm and record species, numbers, dates and locations found, and then store carcasses frozen for later examination. Concurrent examination has the advantage of being able to provide more or less instant advice to rehabilitators, scientists and conservationists on the nature of the mortality. Storage of the carcasses may seem more convenient at the time, but can cause some logistic problems, not least with eventually arranging a mass post-mortem, and has the potential for loss of data on date and location of finding. In either situation, scientific advice can determine which species to prioritise.

Figure 4.1.4. Basic, but adequate laboratory facilities at Royal Netherlands Institute for Sea Research, Texel, The Netherlands, with severely oiled Common Guillemots and Razorbills lined up for dissection.

Note that in order to protect the furniture, plastic foil is needed. The oil on carcasses such as these will melt at room temperatures and leak away.



Laboratory facilities needed for standard autopsies may be integrated with those for the rehabilitation of oiled birds, but it should be remembered that these aspects of the response have very different requirements in terms of personnel, infrastructure, hygiene, and security. Facilities can be fairly simple, the key requirements being easy access (sacks of oiled birds are very heavy!), workbenches at standing height, good lighting, hot and cold running water (preferably with an interceptor for oily waste), and (preferably) some ventilation (Figs. 1-2). Cover entrances, walkways and work surfaces with plastic sheeting to avoid unnecessary oil contamination. Deep freezers should be available, the size and number depending on the scale of the incident and the potential scientific value of the biological material. Carcasses should be processed on a daily basis, for as long as the responders can keep up with the numbers found. If numbers exceed capabilities, sub-sampling is one option, but try to spread the sampling geographically and temporally, because during prolonged incidents the species and age structure of the mortality is likely to vary with time, especially at migration seasons. Any frozen carcasses received will need c.24 hours at room temperature to thaw before processing. Ensure a system is in place to receive carcasses of birds that have died at rehabilitation centres, even if they have been autopsied for veterinary purposes, so they can be incorporated into the database. Facilities should be available seven days per week, with at least one person dedicated to supervision of the autopsies, another to logistical tasks such as maintaining equipment and the flow of birds (including their safe and legal disposal), and a third maintaining a database and being responsible for disseminating information. Preliminary analyses of results should be reported regularly during the spill (ideally daily on a dedicated web-site), so that an overview of the potential impact on seabird populations can be accessed by all involved or otherwise interested the event: government agencies, NGO's, journalists, scientists, seabird rescue workers, clean-up teams and others. Such a website could also advertise what biological material is available for purposes such as museum curation or DNA and isotope analyses.

The basic steps involved in post-mortem examination are recording date and place of finding, identification to species, checking for rings and other markers such as satellite transmitters (not always easy in the case of heavily oiled birds), detailing the oiling status of each bird (% oiled), external ageing and sexing where possible, external biometrics to help determine the age and breeding population of origin, and internal examination to determine sex and age. In most situations, up to 100-150 birds can be processed per day in a well-organised facility. In the event of more birds being found, some procedures may have to be curtailed or arrangements may have to be made for freezer storage once the initial logging, specific identification and checking for rings has been completed.

**Drift experiments** Ideally, total estimates of mortality derived from counts of dead birds that wash ashore should be corrected for the numbers lost at sea. If an oil spill occurs far from land or in offshore winds, seabird mortality can be greatly underestimated even with the most thorough beach bird surveys (Threlfall & Piatt 1983, Keijl & Camphuysen 1992, Hlady & Burger 1993). Corpses floating at or near the surface are subject to drift caused by the prevailing wind (Hughes 1954; Matsumura *et al.* 1990), and periods of onshore winds obviously lead to more strandings than prolonged periods of offshore winds. There is a long history of drift experiments around the world, in which marked bird corpses or drift blocks designed to mimic oiled seabirds have been used to calculate a common correction factor for bird strandings (Bibby & Lloyd 1977, Bibby 1981, Stowe, 1982, Keijl & Camphuysen 1992, Hlady & Burger 1993).

Figure 4.1.5. Drift experiment using individually marked carcasses of grebes Podicipedidae and seaduck *Mergus* spp, *Bucephala clangula* drowned in fishing gear of the Dutch coast, February 1991 (© G.O. Keijl).

The results of these experiments have been rather variable and have tended to be location-specific, with coastal features, weather conditions, and the types of tags used leading to different results (Camphuysen & Heubeck 2001, Wiese & Jones 2001). Wind seems to be the predominant factor determining movement over large distances (Hughes 1954), whereas tidal currents can influence deposition on specific beaches (Wiese & Jones 2001). Instead of using an average derived from these previous results, the best option in the event of an oil incident is to set up and perform a drift experiment in the early stages of the spill to evaluate local conditions (cf. Colombé *et al.* 1996, Arcos *et al.* 2004).

### 4.1.2 Health and safety

The health and safety of all participants in any oil spill response, whether professionals or volunteers, should be of paramount concern. Safety issues will vary according to latitude, season, and the nature and remoteness of the affected coastline but some aspects should be generic. If volunteers are being asked to search oiled coastline it should be very clear at the outset whose authority they are operating under, and who has legal liability in the event of an accident or subsequent illness connected to their activities. The lead organisation should have a risk assessment in place beforehand, take prompt advice from the responding authorities on the nature of the oil involved and any particular hazards it poses to health, and arrange safety briefings for volunteers. Participants should be asked about any chronic health problems such as skin or respiratory complaints, which may be exacerbated by exposure to oil and its vapours. For directed beached bird surveys, a log (with contact details) should be maintained of where and when teams are operating, teams should report in at the end of each day, and strict protocols should be in place if boat work is anticipated. Lone working in the field should be discouraged and teams should be aware of weather forecasts and tidal states. Personal protective equipment should be issued to both minimise contact with oil and cope with weather conditions. Oil exposure during field and laboratory work can result in several levels of toxicity (Laffón *et al.* 2006; Pérez-Cadahía *et al.* 2007). Appropriate protective clothing and masks have to be available for all the personnel involved in the different tasks of the impact assessment, and volunteers should be instructed in their use and risks of not using it. Incidents involving shipwrecks can result in hazardous cargo or other objects washing ashore, and a system should be in place for reporting these to the authorities. These and other potential problems and solutions are all best thought out beforehand and dealt with in an oil spill response plan, rather than being hastily considered in an emergency, or worse, after an avoidable accident.

### 4.1.3 Costs

There will be costs involved, which should be met by those responsible for the pollution. These costs include (1) staff time and expenditure for the organisation co-ordinating the response, (2) travel, accommodation and subsistence for any expertise requested to assist, (3) accommodation, subsistence, vehicle hire and fuel for beach teams, (4) any costs involved in arranging laboratory or similar facilities and the disposal of dead oiled birds, (5) basics such as protective clothing, disposable laboratory equipment, and cleaning materials, and (6) analysis of the data and publication of the results. The organising body should work in close conjunction with the local/national government and the relevant insurers in agreeing and tracking this expenditure, providing interim payments where necessary, and eventually processing a claim to the International Oil Pollution Compensation Fund (or whichever body is responsible for compensation). However, it is essential that immediate contact is made between those planning to spend money on assessing the impact of a major spill on seabird populations, and those on the scene who are both advising on, and responsible for refunding costs.

### 4.1.4 Pre-planning

Pre-planning is essential for an effective response, and all countries or regions vulnerable to oil spill events (and some spills may impact more than one country) should identify which organisation is prepared to take the lead role in co-ordinating the systematic beach search effort, identifying facilities where dead birds can be examined, and sourcing the expertise to conduct post-mortems. A questionnaire distributed during the production of this manual has resulted in a list of contacts in numerous European countries, as a first step in pre-planning oiled wildlife response. It is our aim to keep this list updated. {European contacts}

A rapid response should not be constrained by the fear of expenditure, which might be considerable in terms of the assets of that organisation, but will be minimal in terms of the overall costs of response and cleanup. It is worth noting that many of our recommendations above were largely endorsed by the published reports on the environmental impacts of the 1993 *Braer* oil spill in Shetland, Scotland (Ritchie & O'Sullivan 1994) and the 1996 *Sea Empress* oil spill in south-west Wales (SEEEC 1998). Governments, conservation organisations and seabird biologists need to learn the lessons of the past, and not re-invent the wheel each time they are forced to cope with a major oil spill.

## Technical documents

Associated technical documents with the impact assessment part of an oil spill response are arranged in four separate lists:

| | | |
|---|---|---|
| BBS manuals | • Setting up beached bird surveys<br>• Drift experiments | Suggestions on how to design and set up beached bird surveys and drift experiments in case of an oil spill, with reference to earlier studies and existing monitoring schemes |
| Lab manuals | • External examinations<br>• Standard autopsy manual<br>• Ageing and sexing manual<br>• Condition manual<br>• Diet study manual<br>• Disposal of contaminated birds | Practical manuals describing standard techniques for collecting biometrical data of stranded seabirds (with reference to bird family descriptions that provide more species-specific information), to perform a standard autopsy, on assessing age and sex following internal characteristics, on assessing physical condition and organ health of the casualties, and finally suggestions for practical diet studies. |
| Bird families | • European seabirds (list)<br>• Gaviidae<br>• Podicipedidae<br>• Procellariidae<br>• Hydrobatidae<br>• Sulidae<br>• Phalacrocoracidae<br>• Phaethontidae<br>• Anatidae<br>• Phalaropodinae<br>• Stercorariidae<br>• Laridae<br>• Sternidae<br>• Alcidae | Species specific information, arranged per family, focusing on general distribution patterns, geographical variation, biometrics, and identification guidelines (including sex and age from external characteristics).<br><br>**Note:** The citations of the literature used in these technical documents will not and cannot replace the original sources! The technical documents are meant for quick reference only, they will be constantly updated and advice to improve these texts and tables will be greatly appreciated! |
| Shopping lists | • BBS materials<br>• Drift experiment materials<br>• External examination materials<br>• Standard autopsy materials<br>• Diet study materials | Lists with illustrated examples of basic materials needed for any of the work described earlier |
| Extra's | • European contacts | List of contact addresses in European countries, and the type of advice provided. |

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

### Introduction

Under the assumption that an oil spill occurs in a well-studied part of Europe (see 3.0 Preparedness and issues regarding the evaluation of area sensitivity), detailed information is about spatial and temporal patterns in the sensitivity to oil pollution of the affected sea areas should be readily available. This information shall then be mobilised and used to help protect the most sensitive areas and where advice need be provided when oil clean-up operations are to be organised (focusing on the most sensitive areas at the expense of areas of less concern whenever possible). While area assessments include aspects of preparedness (recent knowledge of areas prior to spills ready at hand, for example as ‘vulnerability atlases’), it also includes aspects of immediate action. It is very likely that the material at hand is outdated, and quick updates with more recent data, including unpublished material collected by local experts, are important.

For oil spills that occur in areas that are either data deficient, or where the appropriate analyses have not been conducted on data collected in the recent past, immediate action is required to inform the technical responders with the best possible information regarding spatial patterns in area sensitivity.

Figure 4.2.1 Concentrations of auks at sea, such as Common Guillemots and Razorbills as shown here, are highly vulnerable to oil pollution. The biological advice provided during an oil spill should allow oil spill responders to distinguish highly sensitive sea areas from areas of less concern. © CJ Camphuysen

In both cases, to help minimize further damage caused by the oil spill, expert biological advice must be called in immediately: either to interpret the material at hand or to provide any further information that could be useful to evaluate the affected area. Because the information on the area sensitivity collected beforehand is likely to be outdated, updates must be prepared as soon as possible, using all possible sources of data. The experts attracted to the oil spill response should be either holding all such data sets, or they should have the relevant contacts needed to produce updated information at short notice.

An important and often overlooked aspect is high-quality advice, not only regarding the sensitivity of the affected area exactly *during* the spill, or when the oil is released, but also of the affected area and surrounding waters in weeks and months to come given migration patterns and seasonal shifts in wildlife abundance. Clean-up operations may be prioritised using this information, and dangerous operations may either be postponed, skipped entirely, or hastened, when expected temporal variations in the sensitivity of the affected area would call for such measures.

Three issues are discussed under this chapter:

- How to evaluate a sea area in terms of sensitivity to oil pollution
- How to provide updated advice to help minimise further oiling of wildlife
- How to provide updated advice on near-future, worst case scenarios and best practice

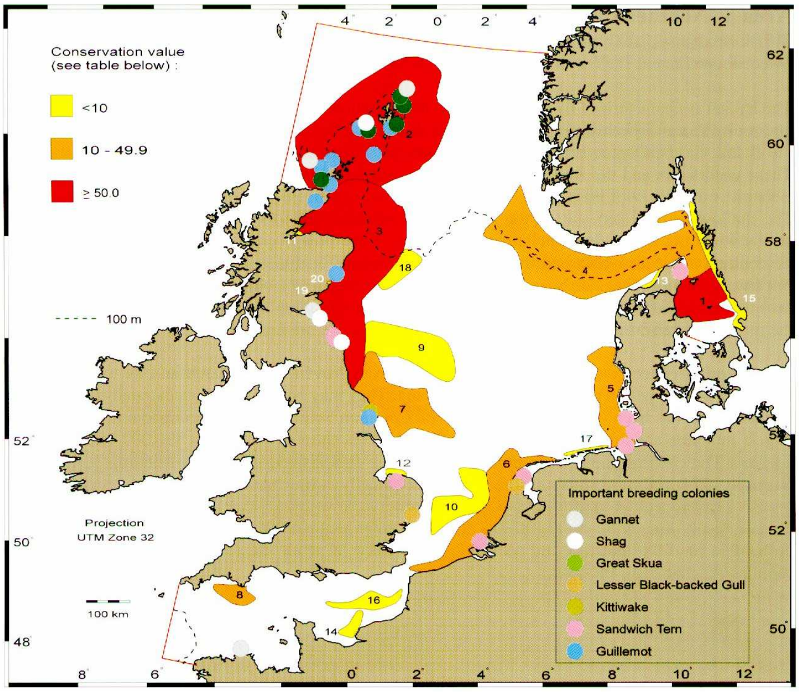


Figure 4.2.2 Previous studies within the North Sea have resulted in seabirds at sea distribution atlases, which were in turn used to draft maps highlighting areas of international importance for seabirds. The illustrated case is a summary of results produced in the late 20th century, showing the location and extent of 20 selected areas and breeding colonies of international importance for seabirds in the North Sea, the Channel and the Kattegat (from Skov *et al.* 1995).

Although highly valuable in itself, the scale of this information is insufficiently small to be of much use for oil spill responders. Moreover, seasonal aspects make that the sensitivity of sea areas for oil pollution will vary through the year.

## 4.2.1 Area sensitivity

There are spatial and temporal patterns in the sensitivity of sea areas for oil pollution, for as far as marine wildlife such as seabirds and marine mammals is concerned (Chapter 3.0 Preparedness). If seabird species with a high OVI score (see Chapter 3.0 Preparedness) occur in high densities in a particular sea area, that area would naturally classify as being sensitive to oil pollution and immediate conservation actions would be required in case of a spill. Data on area specific differences in the sensitivity must be promptly checked and updated *during* the spill, by contacting the persons, institutions or organisations that collected the data beforehand as their part in oil spill preparedness or otherwise. Common sense is needed to swiftly answer the most pressing question during an oil incident:

| |
|---|
| Where are the highest densities of vulnerable seabird species located today? |

As a short cut, in most European seas, the most vulnerable seabirds, likely to be affected in large numbers, would be (not necessarily in this order) auks (Alcidae), divers (Gaviidae), cormorants and shags (Phalacrocoracidae), gannets and boobies (Sulidae), and seaduck (Anatidae) (Camphuysen 1989, Chapter 3.0 Preparedness, Table 3.1). Auks and seaduck are particularly important, given the often large numbers affected by spills.

Generally speaking, some of these are inshore species (Gaviidae, Phalacrocoracidae, Anatidae), while others are offshore species (Alcidae, Sulidae). Since technical oil spill responders have a tendency to prioritise oil clean up such that shorelines are protected to become oil-contaminated, the importance of offshore areas should be evaluated first. Nearshore and offshore bird concentrations should be evaluated in nearly every spill, and the data required for a proper evaluation are rather different. Seabird populations are studied and monitored in very different ways.

Seabird colonies are usually fixed, their locations don't change much, and even if population censuses themselves may be outdated, the breeding locations are probably well known (e.g. Lloyd *et al.* 1991, Thibault 1993, Mitchell *et al*. 2004, Anker Nilssen *et al.* 2006). Wildfowl winter counts are organised in well known roosting/feeding areas and the characteristics of these areas are also rather fixed, even if numbers may widely fluctuate between years, seasons or even days (Meltofte *et al.* 1994, Gilissen *et al.* 2002). The locations of high tide roosts are usually fairly well known and again, the locations of the most sensitive roosts will not change much over time (Butler *et al.* 2001). The 'offshore' distribution of seabirds and waterfowl at sea or in large estuaries and lakes is subject to much more variation, and even if rather robust distribution patterns may have been found during monitoring, these patterns are subject to change (e.g. Arcos & Oro 1996, Vaitkus 1999, Speckman *et al.* 2000, Pelagic Working Group 2002, Schwemmer & Garthe 2006). Yet, (tidal) fronts, gulf stream eddies, river mouths, sand banks and other shallows may have been identified as important bird areas during previous studies (e.g. Bourne 1981, Richner 1988, Harrison *et al.* 1990, Schneider 1990, Haney 1991, Hunt *et al.* 1999, Daunt *et al.* 2006) and in the absence of other (better) data, such areas may need to be highlighted first during an oil spill response.

While the monitoring of seabird colonies and wintering wildfowl concentrations is usually organised on a regional or national scale (irrespective aspects of international co-operation), the distribution of pelagic seabirds at sea is not normally assessed within the framework of national boundaries. Even where countries focus on waters under their jurisdiction, an early initiative to conduct the work according to standard protocols using ships of opportunity led to the foundation of the European Seabirds at Sea database (ESAS database), a partnership of institutions and organisations from countries around the North Sea. It is sensible to contact the database manager of ESAS during a spill to obtain an updated overview of seabird distribution in the affected area. The group has recently been expanded to include institutions and organisations working off NW Africa, in Macaronesia, and within the Mediterranean. Even if data may not yet have been submitted to ESAS, the database manager should be able to redirect a data request to the most appropriate organisation(s) within the affected area[1].

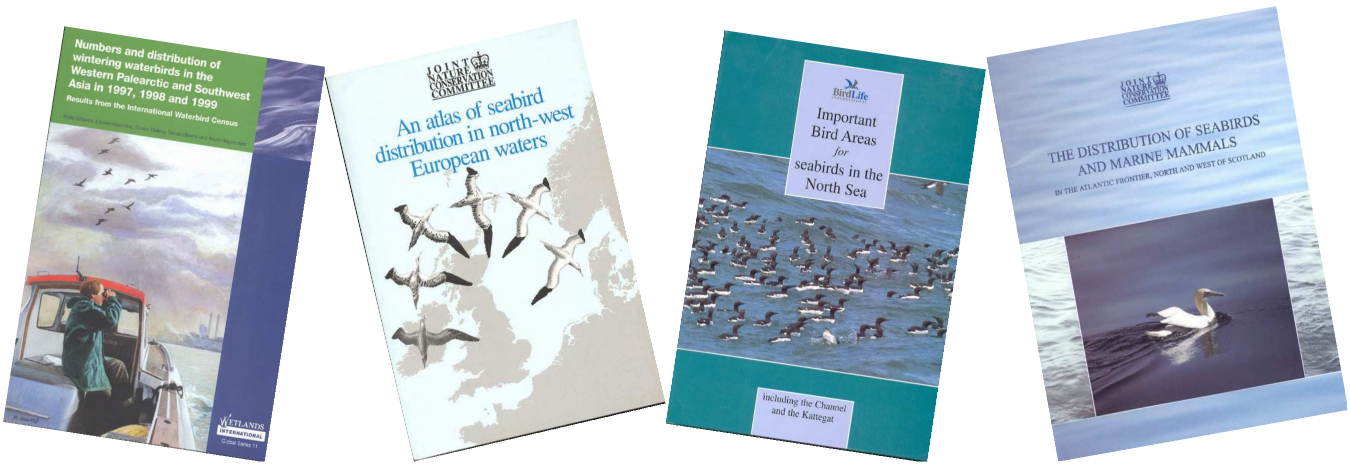


Figure 4.2.2 Examples of recently published distribution atlases of waterfowl and seabirds in Europe based on waterbird counts (left Gilissen *et al.* 2002) and seabirds at sea surveys (second left to far right Stone *et al.* 1995, Skov *et al.* 1995, and Pollock *et al.* 2000). These studies are essential baseline data providing high quality information of spatial patterns in seabird and waterbird distribution. Note however that published (printed) reports are soon ageing and in need of updates with more recent material. Do contact Wetlands International and European At Sea database for contact addresses in case of a spill to update any published material listed in this handbook.

### 4.2.2 Providing a data update

Prioritising clean-up operations in the most sensitive areas can greatly reduce the number of casualties during a spill. To update existing data, or to provide information in areas that have been identified as data deficient:

(1) Contact the European Seabirds at Sea database manager to provide data updates[1]

(2) Contact national/regional offshore surveyors (if available) to provide data updates[1]

(3) Contact Wetlands International or local wildfowl surveyors to provide data updates[1]

(4) Contact anyone, any organisation that is likely to be able to provide recent counts of waterfowl in the area; consult recent publications and reports

(5) Swiftly re-survey/inspect the area to confirm that the available data is correct

A swift survey (using an aircraft or a ship) may not always be possible, either because of bad weather, or because there is simply no observation platform available. Do realise, however, that even the most recently collected data may not predict the most sensitive concentrations precisely. The data update should be done by an ornithological expert. However, a data update is fully pointless and a waste of time if the material is not translated into concrete advice for the oil spill responders. A data format that is to be understood by a more general audience (i.e. non-ornithologists) is similar to the formats used in vulnerability atlases (Carter *et al.* 1993, Webb *et al.* 1995ab):

- generalised distribution patterns of highly sensitive groups (not on species level)
- emphasis on the top three most sensitive areas
- clear suggestions for an oil clean-up strategy from the wildlife point of view

Produce maps (or clear indications on existing maps) rather than tables and texts, and make the report as short and to the point as possible. Be prepared to produce the data in a powerpoint presentation, so that oil spill responders can pick up the data and discuss the advice with you.

Figure 4.2.3 Estonian oil spill, February 2006. Oil Mute Swans *Cygnus olor* on ice near Tallinn. The oil released during the spill disappeared under ice and the situation in terms of area sensitivity in spring needed consideration. © CJ Camphuysen

[1] Addresses provided, for as far as known, in European Contacts.DOC, a Technical document associated with this handbook. Do update address information where needed, to keep this website and handbook up to date!

### 4.2.3 Producing worst case scenarios on the spot

Migratory movements between areas in winter, spring, summer, and autumn lead to shifts in the seabird community within areas and, hence, in the occurrence of species with high OVI scores. Oil spill responders should take the seasonality of these patterns into account and realise that the situation might chance *during* an event. An essential part of the biological advice to be provided to oil spill responders is the drafting of a (worst) case scenario, while forecasting shifts in abundance on the basis of local knowledge of migration routes, timing of migration, and stop-over sites.

Common sense is needed to consider the next most pressing question during an oil incident:

Given the highest densities of vulnerable seabird species located today, how about the near future?

If the area is swiftly and completely cleaned from oil, forecasting future scenarios may not be needed. However, given that oil spill can take many months or even years before the area can be considered clean, shifts in distribution patterns of sensitive wildlife need to be considered. Areas that rank as fairly unimportant during the spill may in fact be very important as staging areas or stopover sites for vulnerable species at other times of the year.

A classic example is the recent spill in Estonia (generally referred to as ‘the mystery spill’), that took place in winter in an area very rich in waterfowl near Tallinn. With the spilled oil disappearing under ice, the scenario needed to be broadcasted that a re-appearance in spring could potentially lead to a much worse effect on waterfowl, given the knowledge that literally millions of migratory waterfowl would use certain Estonian waters as stop-over sites. Even although there was substantial damage caused immediately following the spill, the risk for further mortality several months after the event was considerable.

It depends on the type of spill and the amount of oil released what forecasters should take into account. In large incidents, such as the accidents with tankers as the *Prestige* and the *Erika*, oil continuous to be released from the wrecks in many months following the incident. It is therefore important to forecast major changes in the wildlife community in the near future, so that certain potentially risky activities during the oil spill response (possibly causing further outflows of oil) can be planned in accordance with wildlife interests.

Important sources of data could be: offshore surveys, seawatching results and other systematic counts of waterbird migration, and waterfowl censuses through the year. The timing of breeding seasons will have to be considered while forecasting for example the likely return of breeding populations in winter or spring. Do evaluate the affected area in terms of the utilisation as a stop-over site or temporary foraging ground for migratory waterfowl wintering to the south or west and breeding to the north or east of the affected area.


Figure 4.2.4 Ship-based offshore surveys are an important technique to map the distribution of seabirds at sea. Standard protocols have been introduced in the late 1970s in the North Sea, following the example of workers in Canadian waters. The data have been stored into a joint database, the European Seabirds At Sea database, available for consultation during oil spills from the central address in Aberdeen © M. Schaap (left) and CJ Camphuysen (right)

### 4.2.4 Participation in the oil response team

To be of use, the biological advice provided should at least be considered and hopefully used by oil spill responders during an emergency. Do realise, however, that oil spill responders may have other priorities such as safeguarding human life during an incident. In many cases, however, carefully drafted and presented biological advice could minimise (further) losses of vulnerable wildlife, if it would be given serious consideration during a response. If decisions must or can be made regarding the exact location of the sinking or grounding of a ship in trouble, clear cut biological advice regarding the differences in sensitivity to oil pollution of potential sites can be very useful. When potentially dangerous operations must be planned (risking for example further releases of oil into the sea), the exact timing of these may be considered with forecasted changes in wildlife abundance in the affected area in mind. When clean-up operations are scheduled, priority may be given to the most sensitive areas at the expense of areas of less concern.

The most useful suggestion would be to have the expert biologist participating in daily meetings of the response team, so that any biological advice can be modified according to direct demands, and so that the technical responders become fully aware of alternatives for any planned actions after being confronted with spatial and temporal patterns in vulnerable wildlife distribution. A fruitful dialogue is possible only on the basis of mutual respect, and the active participation in the crisis team is an important step in the process.

Figure 4.2.5 Seawatchers are seldom involved in oil spill reponses, but their data can be highly valuable to forecast temporal shifts in nearshore seabird abundance and to describe predictable migration patterns. In most countries, waterfowl and waders are counted at regular intervals in standard areas and often as national or international joint efforts, potentially providing high quality data on nearshore waterfowl concentrations including roosts and foraging grounds © CJ Camphuysen

## Technical documents

European contacts.DOC List of useful contacts and expertise within Europe

European seabirds.DOC List of European seabirds and (current) OVI evaluation

Descriptions of current knowledge in 15 defined sea areas

- Greenland Sea and Icelandic waters
- Svalbard
- Barents Sea
- Norwegian Sea
- Faeroese waters
- North Sea

- Baltic Sea
- West of Britain, Ireland and Irish Sea
- Channel and Celtic Sea
- Bay of Biscay
- Portuguese and Spanish Atlantic coasts
- The Azores, Canaries, Madeira, Cape Verde Islands (Macaronesia)
- Western Mediterranean
- Eastern Mediterranean
- Black Sea

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 6.0 WEB LINKS

**General links**

| | |
|---|---|
| www.oiledwildlife.eu | Information in Oiled Wildlife Incidents, Effects of oil on wildlife, Impact Assesments, Oiled Wildlife Care and Rehabilitation, Response, Planning, Compensation, Mobile Equipment, Industry and more |

**Royal Netherlands Institute for Sea Research**

| | |
|---|---|
| www.nioz.nl | Front page institute's website |

**Sea Alarm website**

| | |
|---|---|
| http://www.sea-alarm.org/ | Front page organisation's website |

**Universidade A Coruña / University of La Coruña**

| | |
|---|---|
| http://www.udc.es/principal/ga/ | Front page university website |

**ITOPF Web addresses and documents**

| | |
|---|---|
| www.itopf.com | ITOPF Handbook 2006/2007 |
| www.iopcfund.org | Claims manual |
| www.ipieca.org | A guide to oiled wildlife response planning IPIECA |

**DG Environment, European Commission**

| | |
|---|---|
| http://ec.europa.eu/dgs/environment/index_en.htm | Home page, mission statement |
| http://ec.europa.eu/environment/strategic_objectives/index.htm | European Commission's Strategic Objectives, Annual Policy Strategy and Work Programme |
| http://www.aduhme.org/trumpet/websit/dge.htm | DG Environment websites |

**Joint Research Centre, European Commission**

| | |
|---|---|
| http://serac.jrc.it/ | Home page |
| http://serac.jrc.it/midiv/maps/med/1999_2000_2001_2002_oilspills.pdf | Oil spills in the Mediterranean 1999-2002 |
| http://serac.jrc.it/midiv/maps/med/1999_2000_2001_2002_oilspill_density.pdf | Oil spills in the Mediterranean 1999-2002, normalised density |
| http://serac.jrc.it/midiv/maps/baltic/oilspill_helcom_1998_2004.pdf | Oil spills in the Baltic Sea 1998-2004 |
| http://serac.jrc.it/midiv/maps/baltic/density_oil_helcom_1998_2004.pdf | Oil spills in the Baltic Sea 1998-2004, normalised density |
| http://serac.jrc.it/midiv/maps/northsea/aerial/oilspill_bonn_1998_2004.pdf | Oil spills in the North Sea 1998-2004 |
| http://serac.jrc.it/midiv/maps/northsea/aerial/density_oil_bonn_1998_2004.pdf | Oil spills in the North Sea 1998-2004, normalised density |
| http://serac.jrc.it/midiv/maps/blacksea/2000_2001_2002_oilspills.pdf | Oil spills in the Black Sea 2000-2002 |

**International Fund for Animal Welfare**

| | |
|---|---|
| http://www.ifaw.org/ifaw/general/default.aspx | Home page |
| http://www.ifaw.org/ifaw/dimages/custom/2_Publications/ER/chronicOil_8_5_07.pdf | Camphuysen C.J. 2007. Chronic oil pollution in Europe, a status report. Report Royal Netherlands |

Institute for Sea Research, commissioned by International Fund for Animal Welfare, Brussels, 85pp. c. 2MB PDF

**Centre de Documentation, de Recherche et d'Expérimentations sur les Pollutions Accidentelles des Eaux**

| | |
|---|---|
| http://www.cedre.fr/ | Front page organisation's website |

**European Environment Agency**

| | |
|---|---|
| http://themes.eea.europa.eu | Front page organisation's website |
| | Accidental and illegal discharges of oil at sea. Are we reducing oil discharges from marine shipping? EEA 2001, 2004 |

http://themes.eea.europa.eu/Sectors_and_activities/transport/indicators/consequences/TERM10,2001/Oil_spills_TERM_2001.doc.pdf
http://themes.eea.europa.eu/Specific_media/water/indicators/WHS11%2C2004.05/WHS11_OilSpillsAccidental_250504.pdf

**Oil Spill Response and East Asia Response Ltd**

| | |
|---|---|
| http://www.osrlearl.com/ | Front page organisation's website |
| http://www.osrlearl.com/prepared_consult_wildlife.html | Wildlife response facilities |
| http://www.osrlearl.com/activate_fee.html | Equipment and fees for activating a response |

**US Environmental Protection Agency, Oil Program**

| | |
|---|---|
| http://www.epa.gov/oilspill/pdfbook.htm | The purpose of this brochure is to provide information about oil spills. It outlines what oil spills are, their potential effects on the environment, how they are cleaned up, and how various agencies prepare for spills before they happen. Details about several oil spills and the resulting cleanup operations are provided to offer examples of the complexities involved in oil spill cleanup activities. Individual chapters of the *Understanding Oil Spills and Oil Spill Response* booklet are available for download in Portable Document Format (PDF) below. Click on a section title to download it. |
| http://www.epa.gov/oilspill/pdfs/chap5.pdf | Wildlife and oil spills in the US |

**Environment Canada**

| | |
|---|---|
| http://www.atl.ec.gc.ca/reports/osrp.html | The Oil Spill Response plan specifies actions to be taken by CWS Atlantic Region in the event of an oil spill or the presence of oiled migratory birds. Both large and small events are addressed, with no attempt to concentrate on the "mega-spill". This plan does not replace any element of the REET Atlantic Region Contingency Plan (1999), but elaborates and complements those parts of it which pertain to migratory birds. |

**Reducing the Impact of Oil Spills (RIOS project)**

| | |
|---|---|
| http://www.nordeconsult.com/RIOS/index.htm | Home page |
| http://www.nordeconsult.com/RIOS/consortium.htm | Consortium and associated experts |
| http://www.nordeconsult.com/RIOS/project.htm | Project description |

**European Union**

| | |
|---|---|
| European Union Online | Home page |
| European Maritime Affairs | Europe is surrounded by seas and oceans; they are our past, present and future. The European Union needs an integrated maritime policy to benefit from the full potential of our seas and oceans |
| http://www.ec.europa.eu/maritimeaffairs/policy_en.html | On 7 June 2006, the European Commission adopted a Green Paper on a Future Maritime Policy for the European Union. The Green Paper is accompanied by a number of background documents which have been produced by European Commission Working Groups and by the Maritime Policy Task Force which oversaw the drafting of the Green Paper. |

# HANDBOOK ON OIL IMPACT ASSESSMENT

## EUROPEAN SEABIRDS

European seabirds and waterbirds, their breeding (B) wintering (W) distribution and their status as passage migrants (P) in Arctic waters, in the temperate zone of NW Europe, in the Mediterranean, the Black Sea and Macaronesia, and OVIs indicated by Camphuysen (1989)[1] and by Williams et al. (1995)[2]. Taxonomic conventions following AERC TAC Checklist of bird taxa occurring in Western Palearctic region 15th Draft (Association of European Records and Rarities Committees, 2007). Rare birds are in boxes shaded grey, extinct species in black. Birds printer in red are globalle threatened species, listed in Stattersfield & Capper 2000, “Threatened Birds of the World” as either (Critically) Endangered, or Vulnerable.

| English name | Scientific name | Artic | Temp | Medit | Bl. Sea | Macar | OVI1 | OVI2 |
|---|---|---|---|---|---|---|---|---|
| Common Pochard | *Aythya ferina* | | B W | B W | B W | | | |
| Redhead | *Aythya americana* | | | | | | | |
| Canvasback | *Aythya valisineria* | | | | | | | |
| Ring-necked Duck | *Aythya collaris* | | | | | | | |
| Ferruginous Duck | *Aythya nyroca* | | B W | B W | B W | | | |
| Tufted Duck | *Aythya fuligula* | | B W | W | W | | | |
| Greater Scaup | *Aythya marila marila* | | B W | W | W | | 58 | 20 |
| Lesser Scaup | *Aythya affinis* | | | | | | | |
| Common Eider | *Somateria mollissima mollissima* | | B W | W | rare | | 75 | 16 |
| | *Somateria mollissima faeroeensis* | | B W | | | | | |
| | *Somateria mollissima borealis* | B W | W | | | | | |
| King Eider | *Somateria spectabilis* | B W | W | | | | | |
| Spectacled Eider | *Somateria fischeri* | | | | | | | |
| Steller's Eider | *Polysticta stelleri* | B W | W | | | | | |
| Harlequin Duck | *Histrionicus histrionicus* | B | B W | | | | | |
| Long-tailed Duck | *Clangula hyemalis* | B | B W | W | | | 55 | 17 |
| Common Scoter | *Melanitta nigra nigra* | | B W | W | | W | 66 | 19 |
| | *Melanitta nigra americana* | | | | | | | |
| Surf Scoter | *Melanitta perspicillata* | | | | | | | |
| Velvet Scoter | *Melanitta fusca fusca* | | B W | W | W | | 65 | 21 |
| | *Melanitta fusca deglandi* | | | | | | | |
| | *Melanitta fusca stejnegeri* | | | | | | | |
| Bufflehead | *Bucephala albeola* | | | | | | | |
| Barrow's Goldeneye | *Bucephala islandica* | | B W | | | | | |
| Common Goldeneye | *Bucephala clangula clangula* | | B W | W | W | | 50 | 16 |
| Hooded Merganser | *Mergus cucullatus* | | | | | | | |
| Smew | *Mergus albellus* | | B W | W | W | | | |
| Red-breasted Merganser | *Mergus serrator* | | B W | W | B W | | 58 | 21 |
| Goosander | *Mergus merganser merganser* | | B W | W | W | | 45 | 0 |
| Ruddy Duck | *Oxyura jamaicensis jamaicensis* | | | | | | | |
| White-headed Duck | *Oxyura leucocephala* | | | | | | | |
| Red-throated Diver | *Gavia stellata* | B | B W | W | W | | 68 | 29 |
| Black-throated Diver | *Gavia arctica arctica* | | B W | W | W | | 65 | 29 |
| Great Northern Diver | *Gavia immer* | B | B W | W | | | 67 | 29 |
| Yellow-billed Diver | *Gavia adamsii* | B W | W | | | | | |
| **PODICIPEDIDAE** | | | | | | | | |
| Pied-billed Grebe | *Podilymbus podiceps podiceps* | | | | | | | |
| Little Grebe | *Tachybaptus ruficollis ruficollis* | | B W | B W | B W | | | |
| | *Tachybaptus ruficollis capensis* | | | | | | | |
| | *Tachybaptus ruficollis iraquensis* | | | | | | | |
| Great Crested Grebe | *Podiceps cristatus cristatus* | | B W | B W | B W | | 58 | 23 |
| Red-necked Grebe | *Tachybaptus ruficollis grisegena* | | B W | W | B W | | 54 | 26 |
| | *Tachybaptus ruficollis holboellii* | | | | | | | |

| English name | Scientific name | Artic | Temp | Medit | Bl. Sea | Macar | OVI1 | OVI2 |
|---|---|---|---|---|---|---|---|---|
| Horned Grebe | *Podiceps auritus* | | B W | W | W | | 46 | |
| Black-necked Grebe | *Tachybaptus ruficollis nigricollis* | | B W | B W | B W | | | |
| **DIOMEDEIDAE** | | | | | | | | |
| Black-browed Albatross | *Thalassarche melanophris melanophris* | | | | | | | |
| Yellow-nosed Albatross | *Thalassarche chlororhynchos chlororhynchos* | | | | | | | |
| Shy Albatross | *Thalassarche cauta cauta* | | | | | | | |
| Wandering Albatross | *Diomedea exulans* | | | | | | | |
| **PROCELLARIIDAE** | | | | | | | | |
| Southern Giant Petrel | *Macronectes giganteus* | | | | | | | |
| Northern Fulmar | *Fulmarus glacialis glacialis* | B | B W | | | | 65 | 18 |
| Cape Petrel | *Daption capense capense* | | | | | | | |
| Herald Petrel | *Pterodroma arminjoniana arminjoniana* | | | | | | | |
| Zino's Petrel | *Pterodroma madeira* | | | | | B | | |
| Fea's Petrel | *Pterodroma feae feae* | | | | | B | | |
| | *Pterodroma feae deserta* | | | | | | | |
| Atlantic Petrel | *Pterodroma incerta* | | | | | | | |
| Bermuda Petrel | *Pterodroma cahow* | | | | | | | |
| Black-capped Petrel | *Pterodroma hasitata* | | | | | | | |
| Bulwer's Petrel | *Bulweria bulwerii* | | | | | B | | |
| Cory's Shearwater | *Calonectris diomedea borealis* | | B | | | B | | |
| | *Calonectris diomedea diomedea* | | | B | | W | | |
| | *Calonectris diomedea edwardsii* | | | | | B | | |
| Streaked Shearwater | *Calonectris leucomelas* | | | | | | | |
| Wedge-tailed Shearwater | *Puffinus pacificus* | | | | | | | |
| Flesh-footed Shearwater | *Puffinus carneipes* | | | | | | | |
| Great Shearwater | *Puffinus gravis* | | P | | | P | | |
| Sooty Shearwater | *Puffinus griseus* | | P | | | P | 47 | 19 |
| Manx Shearwater | *Puffinus puffinus* | | B | | | B W | 54 | 23 |
| Balearic Shearwater | *Puffinus mauretanicus* | | W | B W | | W | | |
| Yelkouan Shearwater | *Puffinus yelkouan* | | | B W | W | | | |
| Little Shearwater | *Puffinus assimilis boydi* | | | | | B | | |
| | *Puffinus assimilis baroli* | | | | | B | | |
| Audubon's Shearwater | *Puffinus lherminieri persicus* | | | | | | | |
| | *Puffinus lherminieri bailloni* | | | | | | | |
| **HYDROBATIDAE** | *Puffinus lherminieri* | | | | | | | |
| Wilson's Storm-Petrel | *Oceanites oceanicus oceanicus* | | | | | W | | |
| | *Oceanites oceanicus exasperatus* | | | | | | | |
| White-faced Storm-Petrel | *Pelagodroma marina eadesi* | | | | | B | | |
| | *Pelagodroma marina hypoleuca* | | | | | B | | |
| White-bellied Storm-Petrel | *Fregetta grallaria* | | | | | | | |
| European Storm-Petrel | *Hydrobates pelagicus* | | B | B | | B W | 54 | 18 |
| Leach's Storm-Petrel | *Oceanodroma leucorhoa leucorhoa* | | B | | | W | 49 | |
| Swinhoe's Storm-Petrel | *Oceanodroma monorhis* | | rare | | | rare | | |
| Madeiran Storm-Petrel | *Oceanodroma castro* | | B | | | B W | | |
| **PHAETHONTIDAE** | | | | | | | | |
| Red-billed Tropicbird | *Phaethon aethereus mesonauta* | | | | | B | | |
| | *Phaethon aethereus indicus* | | | | | | | |
| White-tailed Tropicbird | *Phaethon lepturus* | | | | | | | |
| **SULIDAE** | | | | | | | | |
| Red-footed Booby | *Sula sula sula* | | | | | | | |
| Masked Booby | *Sula dactylatra dactylatra* | | | | | | | |
| | *Sula dactylatra melanops* | | | | | | | |
| Brown Booby | *Sula leucogaster leucogaster* | | | | | B W | | |
| | *Sula leucogaster plotus* | | | | | | | |
| Northern Gannet | *Morus bassanus* | P | B W | W | | W | 65 | 22 |
| Cape Gannet | *Morus capensis* | | | | | | | |
| **PHALACROCORACIDAE** | | | | | | | | |
| Great Cormorant | *Phalacrocorax carbo maroccanus* | | | B W | | B W | | |
| | *Phalacrocorax carbo carbo* | B | B W | W | | | | |
| | *Phalacrocorax carbo sinensis* | | B W | B W | B W | | 59 | 20 |
| | *Phalacrocorax carbo lucidus* | | | | | B W | | |
| Double-crested Cormorant | *Phalacrocorax auritus* | | | | | | | |
| European Shag | *Phalacrocorax aristotelis riggenbachi* | | | | | B W | | |
| | *Phalacrocorax aristotelis desmarestii* | | | B W | B W | | | |
| | *Phalacrocorax aristotelis aristotelis* | | B W | | | | 73 | 24 |
| Socotra Cormorant | *Phalacrocorax nigrogularis* | | | | | | | |
| Pygmy Cormorant | *Phalacrocorax pygmeus* | | | B W | | | | |
| Long-tailed Cormorant | *Phalacrocorax africanus africanus* | | | | | rare | | |
| **ANHINGIDAE** | | | | | | | | |

| English name | Scientific name | Artic | Temp | Medit | Bl. Sea | Macar | OVI1 | OVI2 |
|---|---|---|---|---|---|---|---|---|
| African Darter | *Anhinga melanogaster rufa* | | | | | B | | |
| **PELECANIDAE** | | | | | | | | |
| Great White Pelican | *Pelecanus onocrotalus* | | | B W | B W | B W | | |
| Dalmatian Pelican | *Pelecanus crispus* | | | B W | B W | | | |
| Pink-backed Pelican | *Pelecanus rufescens* | | | | | | | |
| **FREGATIDAE** | | | | | | | | |
| Magnificent Frigatebird | *Fregata magnificens* | | | | | B | | |
| Ascension Frigatebird | *Fregata aquila* | | | | | | | |
| Lesser Frigatebird | *Fregata ariel* | | | | | | | |
| **PHALAROPODINAE** | | | | | | | | |
| Wilson's Phalarope | *Phalaropus tricolor* | | | | | | | |
| Red-necked Phalarope | *Phalaropus lobatus* | B | B | | P | | 37 | 0 |
| Red Phalarope | *Phalaropus fulicarius* | B | P | | | W | 39 | 0 |
| **STERCORARIIDAE** | | | | | | | | |
| Pomarine Skua | *Stercorarius pomarinus* | B | P | P | P | W | 40 | 0 |
| Arctic Skua | *Stercorarius parasiticus* | B | B P | P W | P | W | 43 | 24 |
| Long-tailed Skua | *Stercorarius longicaudus longicaudus* | | B P | | | W | 36 | 0 |
| | *Stercorarius longicaudus pallescens* | B | P | | | W | | |
| Great Skua | *Stercorarius skua skua* | B | B W | P W | | W | 58 | 25 |
| South Polar Skua | *Stercorarius skua maccormicki* | | | | | | | |
| **LARIDAE** | | | | | | | | |
| Sooty Gull | *Larus hemprichii* | | | | | | | |
| White-eyed Gull | *Larus leucophthalmus* | | | | | | | |
| Pallas's Gull | *Larus ichthyaetus* | | | P | B W | | | |
| Mediterranean Gull | *Larus melanocephalus* | | B W | B W | B W | W | | |
| Laughing Gull | *Larus atricilla megalopterus* | | | | | | | |
| Franklin's Gull | *Larus pipixcan* | | | | | | | |
| Little Gull | *Larus minutus* | | B P W | P W | B W | W | 58 | 24 |
| Sabine's Gull | *Larus sabini* | B | P | | | P | 41 | |
| Bonaparte's Gull | *Larus philadelphia* | | | | | | | |
| Black-headed Gull | *Larus ridibundus* | | B W | B W | B W | W | 44 | 11 |
| Grey-headed Gull | *Larus cirrocephalus poiocephalus* | | | | | B W | | |
| Slender-billed Gull | *Larus genei* | | | B W | B W | | | |
| Audouin's Gull | *Larus audouinii* | | | B W | | W | | |
| Ring-billed Gull | *Larus delawarensis* | | | | | | | |
| Mew Gull | *Larus canus canus* | | B W | W | | | 46 | 13 |
| | *Larus canus heinei* | | W | | W | | | |
| Lesser Black-backed Gull | *Larus fuscus graellsii* | | B W | P W | W | W | 50 | 19 |
| | *Larus fuscus intermedius* | | | | | | | |
| | *Larus fuscus fuscus* | | B | P | P | | | |
| | *Larus fuscus heuglini* | | | | | | | |
| Kelp Gull | *Larus dominicanus vetula* | | | | | rare | | |
| Herring Gull | *Larus argentatus argenteus* | | B W | | | | 47 | 15 |
| | *Larus argentatus argentatus* | | | | | | | |
| American Herring Gull | *Larus smithsonianus* | | | | | | | |
| Yellow-legged Gull | *Larus michahellis atlantis* | | | | | B W | | |
| | *Larus michahellis lusitanius* | | | | | | | |
| | *Larus michahellis michahellis* | | B W | B W | | W | | |
| Caspian Gull | *Larus cachinnans* | | | W | B W | | | |
| Armenian Gull | *Larus armenicus* | | | W | | | | |
| Glaucous-winged Gull | *Larus glaucescens* | | | | | | | |
| Thayer's Gull | *Larus thayeri* | | | | | | | |
| Iceland Gull | *Larus glaucoides glaucoides* | | | | | | | |
| | *Larus glaucoides kumlieni* | | | | | | | |
| Glaucous Gull | *Larus hyperboreus hyperboreus* | B W | B W | | | | 36 | |
| Greater Black-backed Gull | *Larus marinus* | B W | B W | P | | | 57 | 21 |
| Ross's Gull | *Rhodostethia rosea* | | | | | | | |
| Black-legged Kittiwake | *Rissa tridactyla tridactyla* | B W | B W | P W | | W | 66 | 17 |
| Ivory Gull | *Pagophila eburnea* | B W | | | | | | |
| **STERNIDAE** | | | | | | | | |
| Gull-billed Tern | *Sterna nilotica nilotica* | | B P | B P | B W | B W | | |
| Caspian Tern | *Sterna caspia* | | B | B P W | B W | B W | | |
| Royal Tern | *Sterna maxima albididorsalis* | | | | | B W | | |
| | *Sterna maxima maxima* | | | | | | | |
| Greater Crested Tern | *Sterna bergii velox* | | | | | | | |
| Lesser Crested Tern | *Sterna bengalensis torresii* | | | B W | | W | | |
| | *Sterna bengalensis bengalensis* | | | | | | | |
| Sandwich Tern | *Sterna sandvicensis sandvicensis* | | B W | B P W | B W | W | 51 | 20 |
| | *Sterna sandvicensis acuflavida* | | | | | | | |

| English name | Scientific name | Artic | Temp | Medit | Bl. Sea | Macar | OVI1 | OVI2 |
|---|---|---|---|---|---|---|---|---|
| Elegant Tern | *Sterna elegans* | | | | | | | |
| Roseate Tern | *Sterna dougallii dougallii* | | B | | | B W | | |
| | *Sterna dougallii bangsi* | | | | | | | |
| Common Tern | *Sterna hirundo hirundo* | | B | B W | B W | B W | 46 | 20 |
| | *Sterna hirundo minussensis* | | | | | | | |
| | *Sterna hirundo tibetana* | | | | | | | |
| Arctic Tern | *Sterna paradisaea* | B | B P | P | | P W | 46 | 16 |
| White-cheeked Tern | *Sterna repressa* | | | | | | | |
| Forster's Tern | *Sterna forsteri* | | | | | | | |
| Aleutian Tern | *Sterna aleutica* | | | | | | | |
| Bridled Tern | *Sterna anaethetus melanoptera* | | | | | B W | | |
| | *Sterna anaethetus antarctica* | | | | | | | |
| Sooty Tern | *Sterna fuscata fuscata* | | | | | B W | | |
| | *Sterna fuscata nubilosa* | | | | | | | |
| Little Tern | *Sterna albifrons albifrons* | | B | B P | B | W | 49 | 19 |
| | *Sterna albifrons guineae* | | | | | | | |
| | *Sterna albifrons sinensis* | | | | | | | |
| Saunders's Tern | *Sterna saundersi* | | | | | | | |
| Whiskered Tern | *Chlidonias hybrida hybrida* | | B | B P W | | P | | |
| Black Tern | *Chlidonias niger niger* | | B | B P | | P | | |
| | *Chlidonias niger surinamensis* | | | | | | | |
| White-winged Tern | *Chlidonias leucopterus* | | B | B P | | P | | |
| Brown Noddy | *Anous stolidus stolidus* | | | | | | | |
| African Skimmer | *Rynchops flavirostris* | | | | | B W | | |
| **ALCIDAE** | | | | | | | | |
| Common Guillemot | *Uria aalge albionis* | | B W | P | | | | |
| | *Uria aalge aalge* | | B W | | | | 82 | 22 |
| | *Uria aalge hyperborea* | B | B W | | | | | |
| Brünnich's Guillemot | *Uria lomvia lomvia* | B | B W | | | | | |
| Razorbill | *Alca torda islandica* | | B W | P W | | | 86 | 24 |
| | *Alca torda torda* | B | B W | | | | | |
| Great Auk | *Pinguinus impennis* | | | | | | | |
| Black Guillemot | *Cepphus grylle arcticus* | | B W | | | | 72 | 29 |
| | *Cepphus grylle grylle* | | B W | | | | | |
| | *Cepphus grylle faeroeensis* | | B W | | | | | |
| | *Cepphus grylle islandicus* | | B W | | | | | |
| | *Cepphus grylle mandtii* | B W | | | | | | |
| Long-billed Murrelet | *Brachyramphus perdix* | | | | | | | |
| Little Auk | *Alle alle alle* | B | W | | | W | 65 | 22 |
| | *Alle alle polaris* | B | W | | | | | |
| Crested Auklet | *Aethia cristatella* | | | | | | | |
| Parakeet Auklet | *Aethia psittacula* | | | | | | | |
| Ancient Murrelet | *Synthliboramphus antiquus* | | | | | | | |
| Atlantic Puffin | *Fratercula arctica grabae* | | B | P W | | W | 80 | 21 |
| | *Fratercula arctica arctica* | B | B W | | | | | |
| | *Fratercula arctica naumanni* | B | | | | | | |
| Tufted Puffin | *Lunda cirrhata* | | | | | | | |

Author: CJ Camphuysen, 2007; Modified March 2007, following input from the International workshop and manual preparation *"Impact of oil spills on seabirds"*, CEIDA, Castela de Santa Cruz (A Coruña, Spain), 7-9 September 2006.

Camphuysen C.J. 1989. Beached Bird Surveys in the Netherlands 1915-1988; Seabird Mortality in the southern North Sea since the early days of Oil Pollution. Techn. Rapport Vogelbescherming 1, Werkgroep Noordzee, Amsterdam 322pp.

Stattersfield A.J. & Capper D.R. (eds) 2000. Threatened birds of the world. Lynx editions, Barcelona.

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

## List of countries with established beached bird survey schemes and contact addresses for expert advice on (stranded) seabird identifications and seabirds-at-sea area assessments during oil spills

### Beached bird surveys

Systematic counts of stranded (oiled) seabirds are called 'Beached Bird Surveys'. In many countries, volunteer networks exist that monitor seabird strandings. Established schemes and contact addresses are listed below (indicated under 'BBS').

### Expert advice on species identification

The identification and ageing of stranded, oiled seabirds requires particular expertise. In case of an oil spill, expert advice may be obtained from institutes or individual experts listed below (indicated under 'ID').

### Area assessments

For biological advice, area assessments have to be made using the most recently updated information, summarising data on seabirds at sea distribution and the location of particularly vulnerable sea aeras. Information is most likely to be obtained from data-holders or organisations appointed to have access to seabirds at sea data, waterfowl censuses, etcetera. Advice may be obtained from institutes or individual experts below (indicated under 'Area'). Partners in the European Seabirds at Sea database (the largest single and frequently updated database on seabird distribution patterns in Europe) are highlighted with 'ESAS'.

| Country | Contact address | BBS | ID | Area |
|---|---|---|---|---|
| Belgium | RESEARCH INSTITUTE FOR NATURE AND FOREST (Instituut voor Natuur- en Bosonderzoek); Contact: Dr. E.W.M. Stienen, Kliniekstraat 25, B-1070 Brussels, Belgium; email: eric.stienen@inbo.be, tel: +32(0)2.558.18.28; http://www.inbo.be | yes | yes | ESAS |
| | ROYAL BELGIAN INSTITUTE OF NATURAL SCIENCES (RBINS), Dept. Management Unit of the North Sea Mathematical Models (MUMM); Contact: Jan Haelters, 3e en 23e Linieregimentsplein, B-8400 Ostend, Belgium; email: j.haelters@mumm.ac.be, tel: +32(0)59.70.01.31; http://www.mumm.ac.be [*Responsible for scientific follow-up of the environmental impact during incidents with large numbers of birds*] | | | yes |
| Denmark | UNIV. OF AARHUS, NATIONAL ENVIRONMENTAL RESEARCH INST, Dept. of Wildlife Ecology and Biodiversity, Grenaavej 12, DK-8410 Rønde, Denmark. Contact: Ib Krag Petersen; email: ikp@dmu.dk, tel: +45 89201518; http://www.dmu.dk | yes | yes | yes |

| | | | | |
|---|---|---|---|---|
| | BirdLife Denmark, Vesterbrogade 140, DK-1620 Copenhagen V, Denmark. Contact: Jørn Lennart Larsen; email: jornllarsen@get2net.dk, tel: +33 283800; http://www.dof.dk | yes | | yes |
| Estonia | Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences Contact: Leho Luigujõe, Riia 181, 51014 Tartu, Estonia, leho.luigujoe@gmail.com, leho@zbi.ee. | no | yes | yes |
| Europe | European Seabirds at Sea Database, Contact: Andy Webb database manager c/o Joint Nature Conservation Committee, Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ Scotland, tel: +44 1224 655705, fax: +44 1224 621488, e-mail: andy.webb@jncc.gov.uk, | | | ESAS |
| France | **Normandy** Groupe ornithologique Normand, 181 rue d'Auge 14000 Caen, Tel +33231435256 Contact : Gilles Le Guillou gillesleguillou@wanadoo.fr | yes | yes | |
| | **Nord - Pas-de-Calais** - Groupe ornithologique et naturaliste du Nord - Pas-de-Calais (GON), 23 rue Gosselet, F-59000 LILLE, tel./fax : +33 320 53 26 50 / E-mail: gon.5962@free.fr | yes | yes | |
| | **Brittany** - Bretagne Vivante - SEPNB, 186 rue Anatole France, BP 63121, F-29231 BREST cedex 3, Contact: Bernard Cadiou, Tel.: +33 298 49 07 18 / Fax: +33 298 49 95 80 / E-mail: conservation@bretagne-vivante.asso.fr | yes | yes | |
| | **Pays de la Loire** - LPO Loire-Atlantique, 1 rue André Gide, F-44300 Nantes, Tel.: +33 251 82 02 97 / E-mail: loire-atlantique@lpo.fr | yes | yes | |
| | **France** - GISOM (French Seabird Group), c/o Bretagne Vivante - SEPNB, 186 rue Anatole France, BP 63121, F-29231 BREST cedex 3, Contact: Bernard Cadiou (Secretary), Tel.: +33 298 49 07 18 / Fax: +33 298 49 95 80 / E-mail: conservation@bretagne-vivante.asso.fr | yes | yes | |
| Germany | **Schleswig-Holstein -** Landesamt für den Nationalpark Schleswig-Holsteinisches Wattenmeer, Contact D.M. Fleet, Schlossgarten 1, D-25832 Tönning, Germany, Tel 04861 616-43, Fax 04861 616-69, david.fleet@nationalparkamt.de, www.wattenmeer-nationalpark.de | yes | yes | |
| | **Niedersachsen** - Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN), Contact M. Schulze Dieckhoff, Jahnstraße1, 26506 Norden, Germany, Tel. +49 (0)4931 947 147, Fax. +49 (0)4931 947 125, Martin.SchulzeDieckhoff@nlwkn-nor.niedersachsen.de, www.nlwkn.de | yes | yes | |
| | **Germany, North Sea** & **Baltic** Forschungs- und Technologiezentrum Westküste (FTZ) Universität Kiel, Contact Dr S. Garthe, Hafentörn, 25761 Büsum, Germany, Tel. +49 4834 604 116, Fax. +49 4834 604 199, sgarthe@ftz-west.uni-kiel.de | | | ESAS |
| Ireland | National Parks & Wildlife Service, Contact: David Lyons, 7 East Gate, Little Island, Co. Cork, http://www.npws.ie/en/ | | | |
| Italy | Istituto Nazionale per la Fauna Selvatica, Nicola Baccetti, via ca' Fornacetta, 9, I-40064 Ozzano Emilia BO Italy phone +39 051 6512219, fax +39 051 796628, nicola.baccetti@infs.it http://www.infs-acquatici.it/#MUS | yes | yes | |
| Netherlands | Royal Netherlands Institute for Sea Research (Royal NIOZ), Contact: C.J. Camphuysen, , P.O. Box 59, 1790 AB Den Burg, Texel, The Netherlands, + 31 222 349688, camphuys@nioz.nl, http://home.planet.nl/~camphuys/NZGNSO.html. | yes | yes | ESAS |
| | Wageningen IMARES Contact: M.F. Leopold, P.O. Box 167, 1790 AD Den Burg, Texel, The Netherlands, + 31 222 369744, mardik.leopold@wur.nl, Alternative contact: Dr J.A. van Franeker, + 31 222 396724, | | yes | ESAS |
| Norway | **Skagerrak and Norwegian Sea -** Norwegian Institute for Nature Research (NINA), T. Anker-Nilssen / S.-H. Lorentsen, NO-7485 Trondheim, Norway, +47 73801400, tycho@nina.no / shl@nina.no , http://www.nina.no | no | yes | ESAS |
| | **North Sea-** County Governor of Hordaland, Dept. of Environmental Affairs, S. Byrkjeland, P.O. Box 7310, NO-5020 Bergen, Norway, stein.byrkjeland@fmho.no , +47 55572000, http://www.fylkesmannen.no/hordaland | no | yes | |
| | Norwegian Nature Information - Seabird section (NNI). Arnold Håland. Paradisleitet 14, 5232 Paradis, Bergen, Norway. post@nni.no +47 55947600/+47 55913117 http://www.nni.no | no | yes | |

| | | | | |
|---|---|---|---|---|
| | **Southern Barents Sea -** Zoology Dept. Tromsø University Museum, R.T. Barrett, NO-9037, Tromsø, Norway, +47 77645013, robb@tmu.uit.no, http://uit.no/tmu/ | no | yes | |
| | **Svalbard -** Norwegian Polar Institute, H. Strøm, Polar Environmental Centre, NO-9296, Tromsø, Norway, +47 77750500 hallvard.strom@npolar.no, http://npweb.npolar.no | no | yes | yes |
| Portugal | **Continental Portugal**: Sociedade Portuguesa Para o Estudo das Aves, SPEA. Marine Programme. Iván Ramírez, email: ivan.ramirez@spea.pt , +351 213220430, www.spea.pt | yes | yes | ESAS |
| | Instituto da Conservação da Natureza e da Biodiversidade (ICNB), António Teixeira, I.P. Rua de Santa Marta 55, 1150-294 Lisboa, Portugal; tel: +351213507900; fax: +351213507984; teixeiraa@icnb.pt | | yes | |
| | Iberian Seabird Group (GIAM) Contact: Iván Ramírez/ Pedro Geraldes ivan.ramirez@spea.pt / pedro.geraldes@spea.pt , +351 213220430, www.spea.pt | | yes | Dias RAM |
| | Universidade de Lisboa Jose Pedro Granadeiro,; jpgranadeiro@fc.ul.pt , +351 213921850 | | yes | |
| | Instituto Veterinário do Porto Contact: Carla Monteiro, , +351 916127915, carlac.monteiro@gmail.com | | yes | |
| | Centro de Recuperação de Monsanto Contact: Pedro Melo -, +351 919463271 | | yes | |
| | **Açores**: Departamento de Oceanografia e Pescas dos Açores (DOP) Joel Bried, joelbried@yahoo.com ; +351 292 200400 | | yes | |
| | **Madeira**: SPEA-Madeira; Contact: Isabel Fagundes; madeira@spea.pt , +351 291241210 | | yes | |
| | Parque Natural da Madeira; Contact: Paulo Oliveira/Dilia Menezes; +351 291 214 360; pnm@icn.pt | | yes | |
| Spain | Iberian Seabird Group (GIAM). Contact: Xulio Valeiras, coordinadorgiam@gmail.com , http://www.seo.org/?GIAM | | yes | |
| Sweden | Ekologiska institutionen, Lunds Universitet Contact: Leif Nilsson, Ekologihuset S-223 62 Lund, Sweden Leif.nilsson@zooekol.lu.se | | | ESAS |
| United Kingdom | **Orkney -** Royal Society for the Protection of Birds, Contact: Eric Meek 12/14 North End Rd., Stromness, Orkney KW16 3AG. Tel.: 01856-850176. Fax: 01856-851311, Eric.Meek@rspb.org.uk | yes | yes | yes |
| | **Shetland -** Shetland Oil Terminal Advisory Group, Contact: Martin Heubeck, c/o East House Sumburgh Lighthouse, Virkie, Shetland ZE3 9JN, + 44 1950460760, fax + 44 1950460760, martinheubeck@btinternet.com ; Alternatives: Paul Harvey (Shetland Biological Records Centre) 44 1595 694688, sbrc@zetnet.co.uk or Simon Smith (Scottish Natural Heritage) 44 1595 693345 Simon.Smith@snh.gov.uk, northern_isles@snh.gov.uk | yes | yes | yes |
| | **UK -** Joint Nature Conservation Committee, Contact: Zoë Crutchfield tel: +44 1224 655716, zoe.crutchfield@jncc.gov.uk or Mark Tasker, Head of Marine Advice, Dunnet House, 7 Thistle Place, Aberdeen AB10 1UZ Scotland, tel: +44 1224 655701, fax: +44 1224 621488, Mob: +44 7971 078441, Skype: mltasker, e-mail: mark.tasker@jncc.gov.uk, www.jncc.gov.uk | | | ESAS |
| | **UK** British Trust for Ornithology, Ringing Unit, Contact Mark Grantham, The Nunnery, Thetford, Norfolk IP24 2PU, UK. Tel: (44) 1842 750050 Email: mark.grantham@bto.org or ringing@bto.org Web: www.bto.org/ringing | | yes | |
| | **UK** Royal Society for the Protection of Birds, Contact: Kate Tanner, The Lodge, Sandy, Bedfordshire, SG19 2DL. Tel: 01767 680551. Fax: 01767 692365, kate.tanner@rspb.org.uk | yes | | |

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

### Standard autopsy: post-mortem examination of stranded seabirds

An autopsy will normally follow a session in which the carcass is examined from the outside and where the biometrical data are collected. A standard autopsy in case of an oil spill is primarily meant to assess age and sex of casualties where external characteristics are unclear. At the same time, however, the physical condition of the casualties can be evaluated. In spills where a large quantity of oil is involved and birds die very quickly, many casualties may be in excellent condition (fat stores, muscle profile, organ condition), whereas in spill where casualties are lightly oiled, the physical condition of the birds when they eventually died is often very poor (fat stores depleted, atrophy, organs affected). Finally, when a standard autopsy is performed, it is easy to collect and store (deep freezer) stomachs and guts for subsequent diet studies. This is not part of an impact assessment, but the results are very valuable in the absence of other, more direct means to study the ecology of seabirds at sea away from the breeding grounds. In order of priority and relevance:

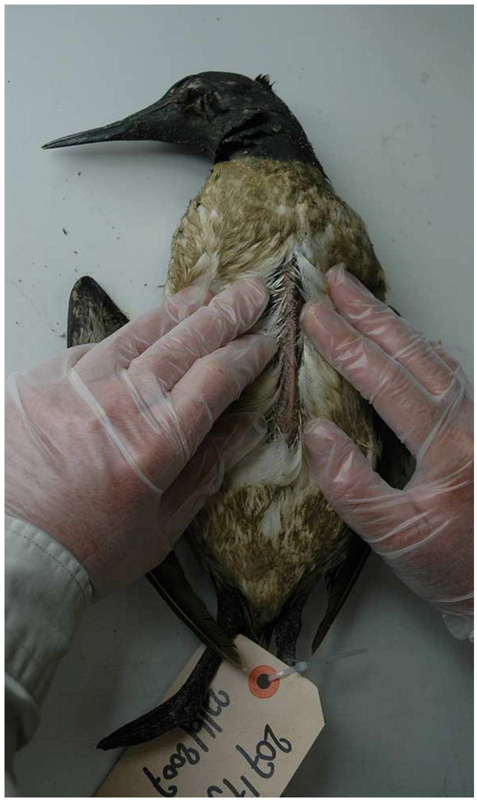
| topic | relevance impact assessment | ecological study |
|---|---|---|
| age characteristics | high | high |
| sex | high | high |
| physical condition | high | moderate |
| condition of vital organs | moderate | low |
| diet | none | high |

**Ageing**
For all birds in which plumage characteristics are either non-existent, unclear, or covered by oil, a rapid check of the gonadal development and the presence/absence (size) of the bursa Fabricii is required. A combination of the two factors will separate adult birds from juveniles, while immatures (non-breeding birds) can be separated with some degree of certainty. For the impact assessment it is vital to obtain an estimate of the proportion of adult birds affected (potential breeding birds in the forthcoming season).

**Sexing**
In many areas, away from the breeding grounds, the sexratio is significantly different from even. A strong bias towards one sex will have disproportionate effects on the population level and this information (obtained during ageing) is therefore highly relevant.

Precisely how to age and sex birds, or how to evaluate the physical condition of the birds is described in separate manuals (hyperlinks provided), while the illustrations below show how a standard autopsy can be performed. The standard autopsy is not an exhaustive pathological study of individual causes of death.

(1) Place the corpse on its back, feet towards you, head folded to one side.

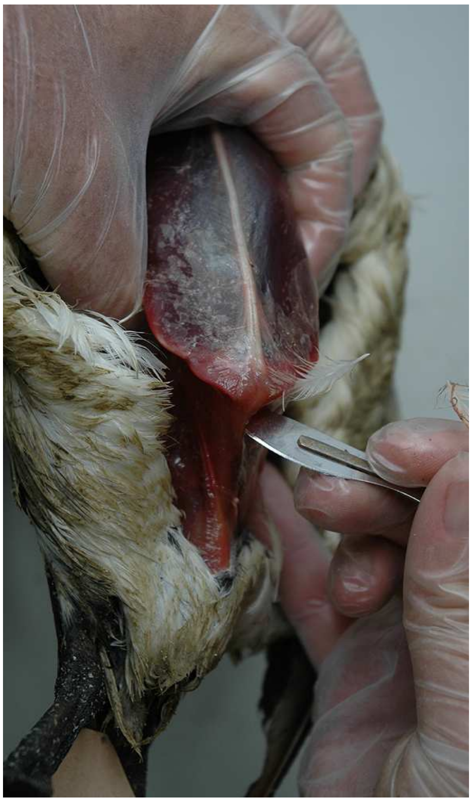


(2) Gently fold feathers away to expose the centre of the breast and belly. The keel of the sternum can be felt and sometimes even seen as in the picture; this is where the feathers should be folded away to either side.

(3) Gently cut the skin following the keel of the sternum down, without cutting into the muscle.

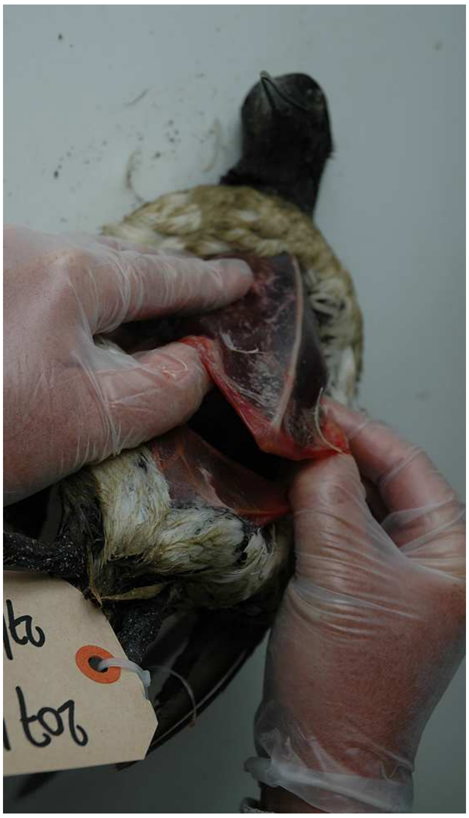
(4) All the way down, stop just above the cloaca. In Common Guillemots, as the example, the sternum is very long, in other species the keel of the sternum will run till half way down; work down in a straight line, without damaging the intestines.

(5) Loosen the skin with the fat (if present) from the flesh, without tearing away any tissue. Expose the inside of the skin and fold away to score subcutaneous fat deposits and evaluate the condition of the breast muscle. {Condition manual}



(6) Lift the sternum and cut the stretched membrane as shown with a small puncture. Make sure neither the intestines, nor the liver are punctured.

(7) Just a small hole will do, put away the knife.



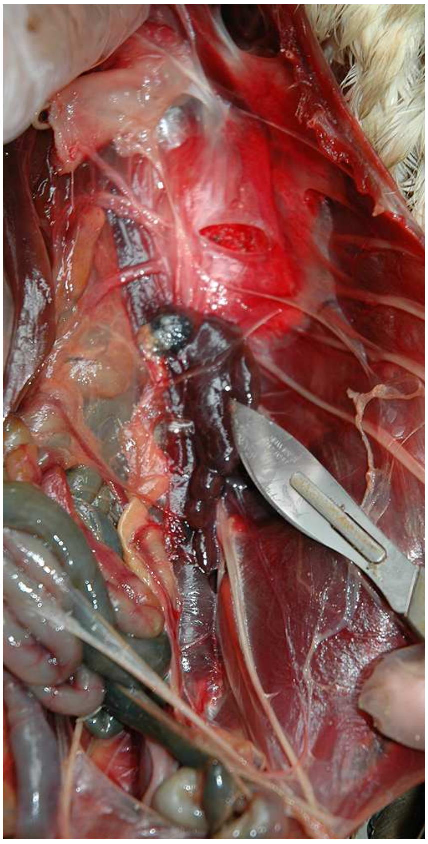
(8) Two thumbs can be used to spread the hole without damaging any of the underlying organs. Open a wide gap by stretching the membrane to either side.

(9) Use some force to open the body cavity by holding the carcass down while lifting the sternum. On either side, the ribs and the membrane between the ribs will stretch. Some (bone-)breaking sound is normal, but don't overdo this.

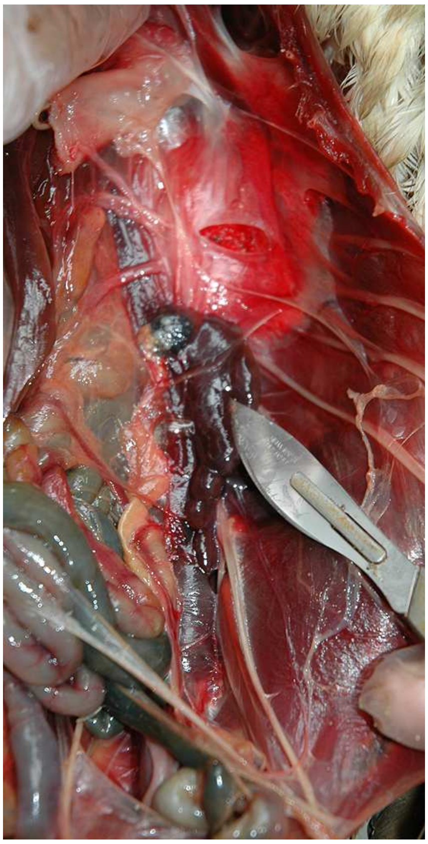
(10) Cut the ribs on the right side, parallel to the sternum.

(11) Similarly, cut the ribs on the left side to allow the body cavity to be opened entirely.

(13) Check the lungs, cutting the membrane if unclear. Check the {Condition manual} for further details



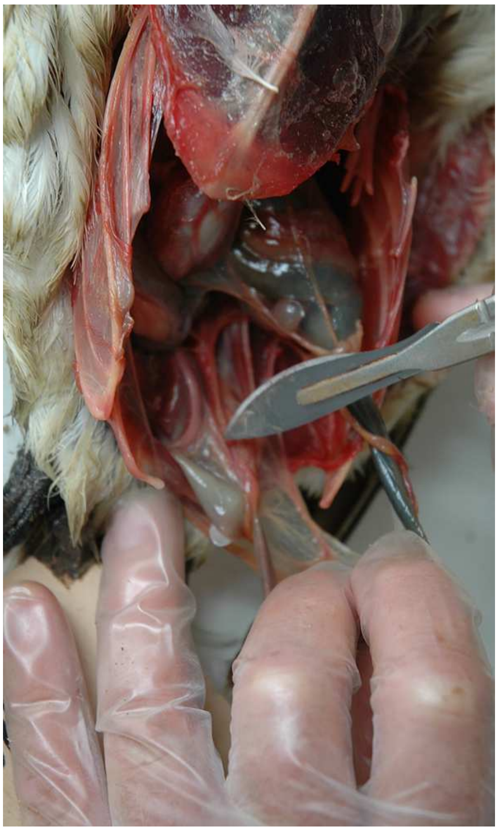
(14) Sex the bird {Ageing manual.



(15) ) Check the kidney {Condition manual}

(16) Check the liver for colour and shape; an early step in corpse decomposition is the liver turning green or greenish. {Condition manual}

(17) Check the intestines; healthy guts should be stiff and pink with clearly visible veins. Do not forget to score deposited fat {Condition manual}



(18) Check the presence (and if so the size) of a bursa Fabricii by folding the gut towards you. {Ageing manual} The bursa should be positioned between the two ureters. (Absent in this example)

(19) In case of a diet study, pull out the stomach (make sure not to press, for food remains may be pressed upwards and 'escape' in that case), and try to clip the proventriculus as high as possible.

(20) Stomach cut loose and ready for storage (deep freeze) or immediate processing. {Diet manual}

**Instruments needed**

Instruments needed for a standard autopsy are a set of scalpels with plenty spare knifes (non-sterile), pairs of scissors, callipers, disposable vinyl or latex protective gloves, protective clothing and perhaps mouth caps (to avoid inhaling hydrocarbons or pathogens), A4 clip-boards, datasheets, pens, plastic bags for stomach collections, glass or plastic containers to store any other samples. There should be easy access to a tap with clean fresh water, and nearby deep-freezing facilities are strongly recommended. A shopping list is provided {autopsy shopping list}

**References, further reading**


Bao R., D. Bigas, J. Castelló, L. García, M. Dopico, M. Fernández Boán, A. Ramos & C. J. Camphuysen 2005. Edad, sexo y origen de los Frailecillos Atlánticos (Fratercula arctica) afectados por la marea negra del Prestige en A Coruña. Oral presentation VI Congreso Galego de Ornitoloxía e V Jornadas Ornitológicas Cantábricas, in Viveiro, Lugo (Spain), 29th-31st October, 2005.

Camphuysen C.J. 1987. Problems with age-determination of seabirds due to heating of the corpses. Sula 1(1): 13-14.

Dorrestein G.M. & M. van der Hage 1997. Marine bird necropsy findings. In: Jauniaux T., Bouquegneau J.-M. & Coignoul F. (eds) Marine mammals, seabirds and pollution of marine systems: 151-166. Presses Fac. Médecine Vét. Univ. Liège, Liège.

The pattern of diseases found upon the necropsy of marine birds will be different depending on the origin of the bird (the wild or rehabilitation centre). The ratio of oiled/non-oiled birds and therefore the necropsy results will vary with the time of year and the species involved (coastal, estuarine or pelagic species). At necropsy one should be familiar with the anatomical peculiarities of the different marine species. The main reasons for a necropsy are to get valid information about the mortality cause and biological information about the species, to confirm a diagnosis, to checking an unsuccessful therapy, to enlarge knowledge, or simply to find out what is going on. The main problems/diseases/necropsies seen in marine birds at beach surveys are: acute and chronic oil pollution, chemical pollution, food shortage, entanglement, plastic ingestion, and infectious diseases (esp. parasites). In rehabilitation centres the main medical problems are related to management, dehydration, cloacal impaction, gizzard impaction, ulcers and bumblefood, corpora aliena, stress, viral infections (e.g. duck plague), bacterial infection (e.g. avian cholera, tuberculosis), fungal infections (e.g. aspergillosis), and parasitic infestation (worms and protozoans). The necropsies and the diagnoses will be discussed

Forbes W.A. 1877. On the bursa Fabricii in birds. Proc. Zool. Soc. Lond. 1877: 304-318.

Forrester D.J., Davidson W.R., Lange R.E., Stroud R.K. & Alexander L.L. Franson-JC; Haseltine-SD; Littell-RC; Nesbitt-SA 1997. Winter mortality of common loons in Florida coastal waters. J. Wildl. Disease 33(4): 833-847.

Diagnostic findings are presented for 434 common loons (*Gavia immer*) found sick or dead on Florida beaches from 1970 through 1994, primarily during the months of December to April. The most commonly recognized problem was an emaciation syndrome (66%), followed by oiling (18%), aspergillosis (7%), trauma (5%) and miscellaneous disease entities (1%). The cause-of-death for 3% of the birds was not determined. Many of the carcasses examined (n 173) were obtained during an epizootic which occurred from January to March of 1983 in which more than 13,000 loons were estimated to have died. An emaciation syndrome, characterized by severe atrophy of pectoral muscles, loss of body fat and hemorrhagic enteritis, was the primary finding in this epizootic. It was postulated to have a complex etiologic basis involving synergistic effects and energy costs of migration, molting and replacement of flight feathers, food resource changes, salt-loading, intestinal parasitism, environmental contaminants, and inclement weather.

Franeker J.A. van 1983. Inwendig onderzoek aan zeevogels. Nieuwsbr. NSO 4(4/5): 144-167.

Franeker J.A. van 2004. Save the North Sea Fulmar-Litter-EcoQO Manual Part 1: Collection and dissection procedures. Alterra-rapport 672, Alterra Groen Ruimte, Texel. {0675.PDF}

Glick B. 1983. Bursa of Fabricius. D.S. Farner, J.R. King & K.C. Parkes (Eds). Avian Biology Vol. VII, pp. 443-500.

Gower W.C. 1939. The use of the bursa of Fabricius as an indicator of age in gamebirds. Trans. N. Amer. Wildl. Conf. 4: 426-430.

Heubeck M. 1986. A Report to the Shetland Oil Terminal Environmental Advisory group on the Beached Bird Survey scheme in Shetland March 1985 to February 1986. Report to SOTEAG, Lerwick 39pp.

Jones P.H. 1985. Determination of age, sex and origin of guillemots and razorbills killed in oilspills and other incidents. M. Sc. Thesis, Open University.

Heubeck M., Camphuysen C.J., Bao R., Humple D., Sandoval A., Cadiou B., Bräger S. & Thomas T. 2003. Assessing the impact of major oil spills on seabird populations. Mar. Poll. Bull. 46: 900-902.

Jauniaux T., Brosens L., Farnir F., Manteca C., Losson B., Tavernier J., Vindevogel H. & Coignoul F. 1996. Mortalité des oiseaux marins lors de l'hiver 1992-1993 le long du littoral belge. Ann. Méd. Vét. 140: 149-159.

During the 1992-1993 winter, 133 seabirds found on Belgian beaches were necropsied. Most frequent species were the guillemot (*Uria aalge*), the oystercatcher (*Haematopus ostralegus*), the kittiwake (*Rissa tridactyla*), the razorbill (*Alca torda*) and the herring gull (*Larus argentatus*). The three main observations were, in decreasing order, cachexia, acute and hemorrhagic gastro-enteritis, and oil contamination of plumage and intestinal tract. The pelagic origin of seabirds was associated with all 3 observations oil contamination was associated with acute gastro-enteritis and cachexia and, finally, the immature character was associated with cachexia. A hypothetical mechanism of death would be oiled pelagic seabirds that become cachectic and die of acute gastro-enteritis. It is unlikely that seabirds act as a reservoir for bacteria, that were only occasionally identified in our material. Therefore, it appears that infectious agents play a minor role in seabirds stranding.

Jauniaux T., Brosens L., Meire P., Offringa H. & Coignoul F. 1998. Pathological investigations on guillemots (Uria aalge) stranded on the Belgian coast during the winter of 1993-94. Vet. Record 143: 387-390.

Klima M. 1956. Die Entwicklung der Bursa Fabricii und ihre Benützung zur Altersbestimmung der Vögel. (Auszug).. Sborník Prednásek. Vortráge der 1. Konferenz der Tschechoslowakischen ornithologen in Prag, im Oktober 1956.

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**Citation**

C.J. Camphuysen[1] 2007. Standard autopsy: post-mortem examinations of stranded seabirds. Technical documents 4.1, Handbook on Oil Impact Assessment, version 1.0. Online edition, www.oiledwildlife.eu

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE 4.1 Assessing the damage

### Shopping list

### Standard autopsy: post-mortem examination of stranded seabirds

Note! Any brands or types depicted are suggestions, no prescriptions

Instruments needed for a standard autopsy are a set of scalpels with plenty spare knifes (non-sterile), pairs of scissors, callipers, disposable vinyl or latex protective gloves, protective clothing and perhaps mouth caps (to avoid inhaling hydrocarbons or pathogens), A4 clip-boards, datasheets, pens, plastic bags for stomach collections, glass or plastic containers to store any other samples. Suggestions are shown below

**Instruments and disposables needed**

**Dissection scalpel** (handle and disposable blades).

Expect individual blades to become blunt and useless after 10-25 birds

**Scissors**

Shown is a pair with a plastic handle. Make sure to use a strong type, for handles on cheap scissor easily break. Some force is required during autopsies.

**Callipers**

Electronic callipers are nice to work with, but they have a tendency to give up and note that batteries are typically empty and need replacement


**Protective gloves**

L size are suitable for most hands, some people are allergic for latex gloves, vinyl gloves tend to be stronger and are not so easily punctured. One pair per 5 birds minimum.

**Clipboard and datasheets**

The provided datasheets with this handbook are A4 size

**Zipper-bags or valve bags**

Plastic bags to collect stomachs and intestines.

## Optional instruments and disposables

**Water bottles**

Water bottles for rinsing blood and other liquids away from the

**Sampling containers**

Glass (snap-cap) or plastic containers for tissue-samples.

**Mouth caps**

The provided datasheets with this handbook are A4 size

**Protective clothing**

Disposable protective clothing may be recommended in certain conditions.

Version 1.0

**Shopping list associated with:**

C.J. Camphuysen[1] 2007. Standard autopsy: post-mortem examinations of stranded seabirds. Technical documents 4.1, Handbook on Oil Impact Assessment, version 1.0. Online edition, www.oiledwildlife.eu

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage
**Technical document**

### Ageing and sexing manual for stranded seabirds

This technical document provides guidelines for ageing seabirds during autopsies. For external characteristics of sex and age, do consult the specific technical documents for each of the seabird families or general field guides.

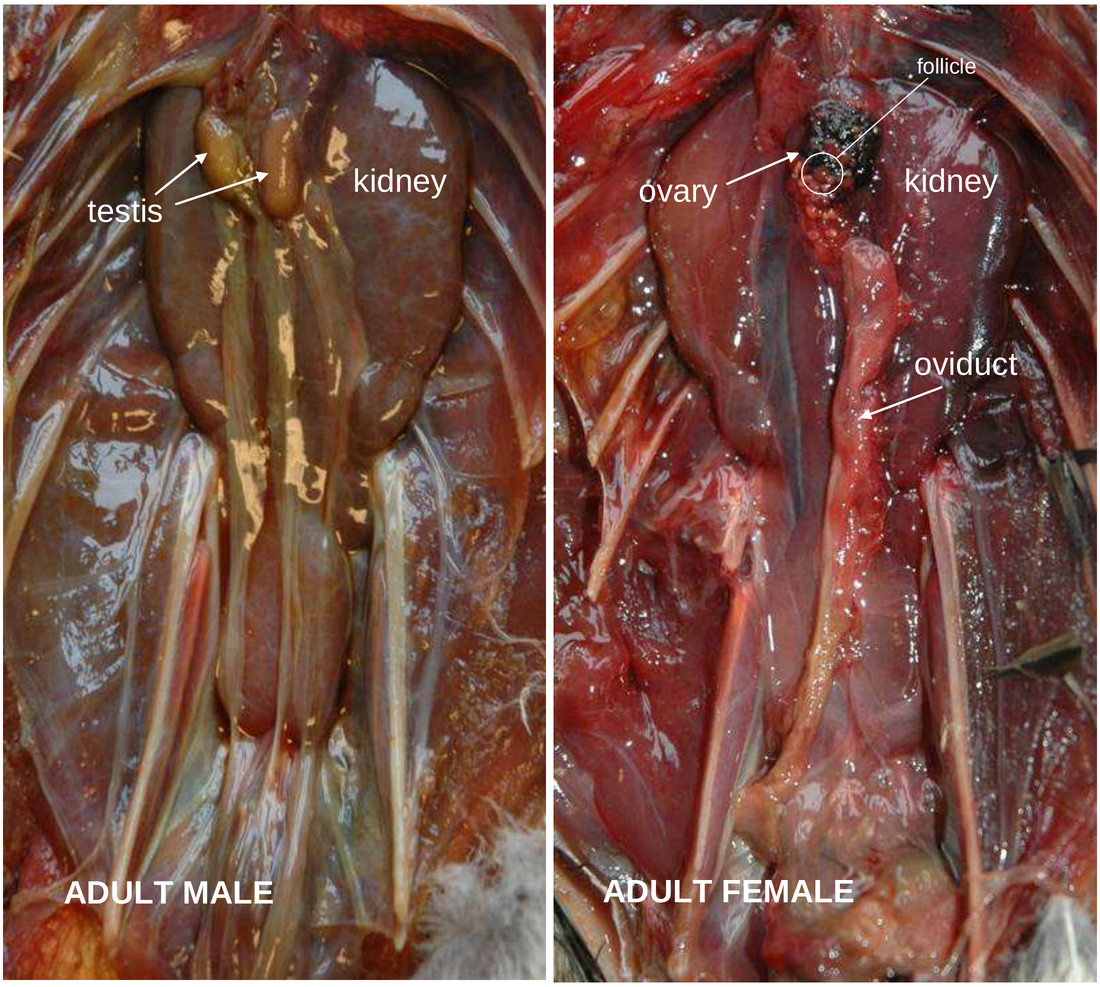



Figure 1. Urogenital system of (a) adult male and (b) adult female Common Guillemot *Uria aalge* in the non-breeding season. In males, length and width (0.1mm) of the largest (left) testis is measured. For orientation, while looking into the abdominal cavity, the left testis is seen on the right side! In females, the diameter of the largest visible follicle is measured, while the shape and development of the oviduct is described (Fig. 3).

**Sexing birds** Male birds have paired testes within the abdominal cavity, anterior and ventral to the lobes of the kidneys (Fig. 1a), while the reproductive system in female birds is reduced to a left ovary and oviduct, just anterior and medial to the left kidney (Fig. 1b). For orientation, while looking into the abdominal cavity during a standard autopsy, the left testis is seen on the right side. Similarly, ovary and oviduct are seen on the right.

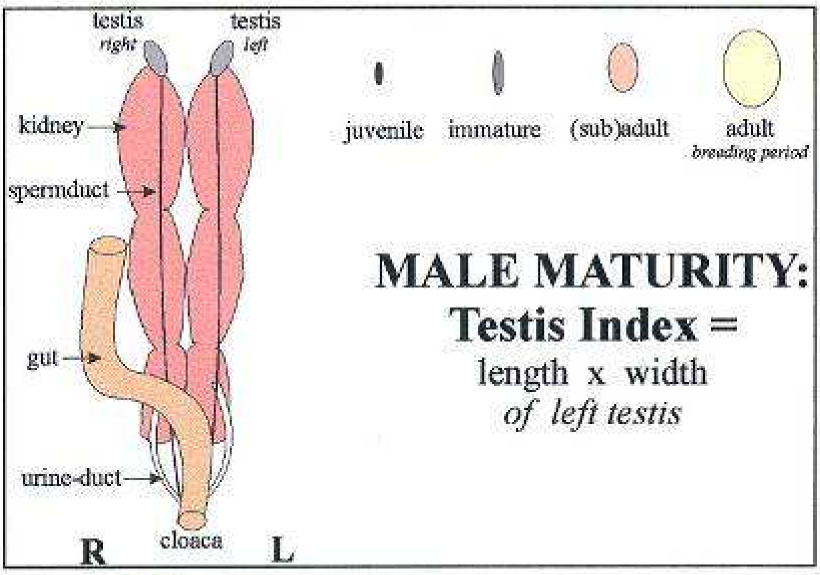



Figure 2. Testis index suggested by Van Franeker (2004) based on Northern Fulmar *Fulmarus glacialis* dissections.

Juveniles have an often dark, short and thin testis, mature birds have rounded testis, considerably swollen in the breeding season.

In other seabirds, testis shapes may be slightly different, but the general plan of development is the same as in the illustrated case. In guillemots, for example, juvenile testis are rather long and thin (often 12x0.5 mm or similar), often bicoloured, and sometimes with a clear nick in the top. As in fulmars, the adult male preparing for breeding will develop a white-bean type testis as illustrated.

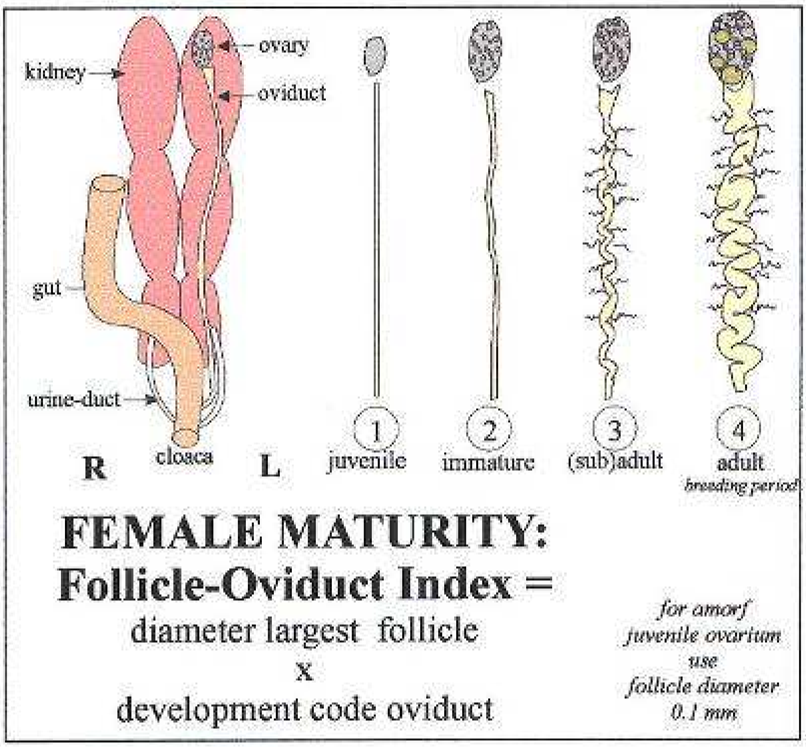



Figure 3. Follicle-Oviduct index suggested by Van Franeker (2004) based on Northern Fulmar dissections.

The ovary of juveniles has no structure (amorf). Small grains (tiny follicles) are visible in young immature birds, whereas older birds develop clearly visible follicles of different sizes. All the examples drawn here are outside the breeding season, or just prior to nesting. During egg-laying, some follicles will greatly increase in size (finally reaching the actual egg size), and the oviduct is greatly enlarged.

Oviduct development four-point scale:

1. thin and straight
2. thicker, straight
3. thicker still, slightly twisted
4. swollen and twisted

**Male birds** The (paired) testis develop with age, but there is seasonal growth as well. It is impossible to age a seabird with certainty solely on the basis of testis size, but a testis index (length x width; Fig. 2) is surely indicative of age. Testis size and exact shape are species specific, but the general plan of growth as illustrated in Fig. 2 holds for all species. Sausage-shaped, yellowish or whitish testis (Fig. 1a) are typical for adult males in the non-breeding season; a (white) bean shape is often seen immediately prior to or during breeding. Juvenile testis are thin (and can be long), often dark or bi-coloured. Juvenile testis can be very difficult to spot, particularly in smaller species. When in doubt between an ovary and a testis, note that testis are paired, even although the other one may be hidden in membrane, blood or other liquids. So, blot dry and thoroughly search the abdominal cavity for a second one.

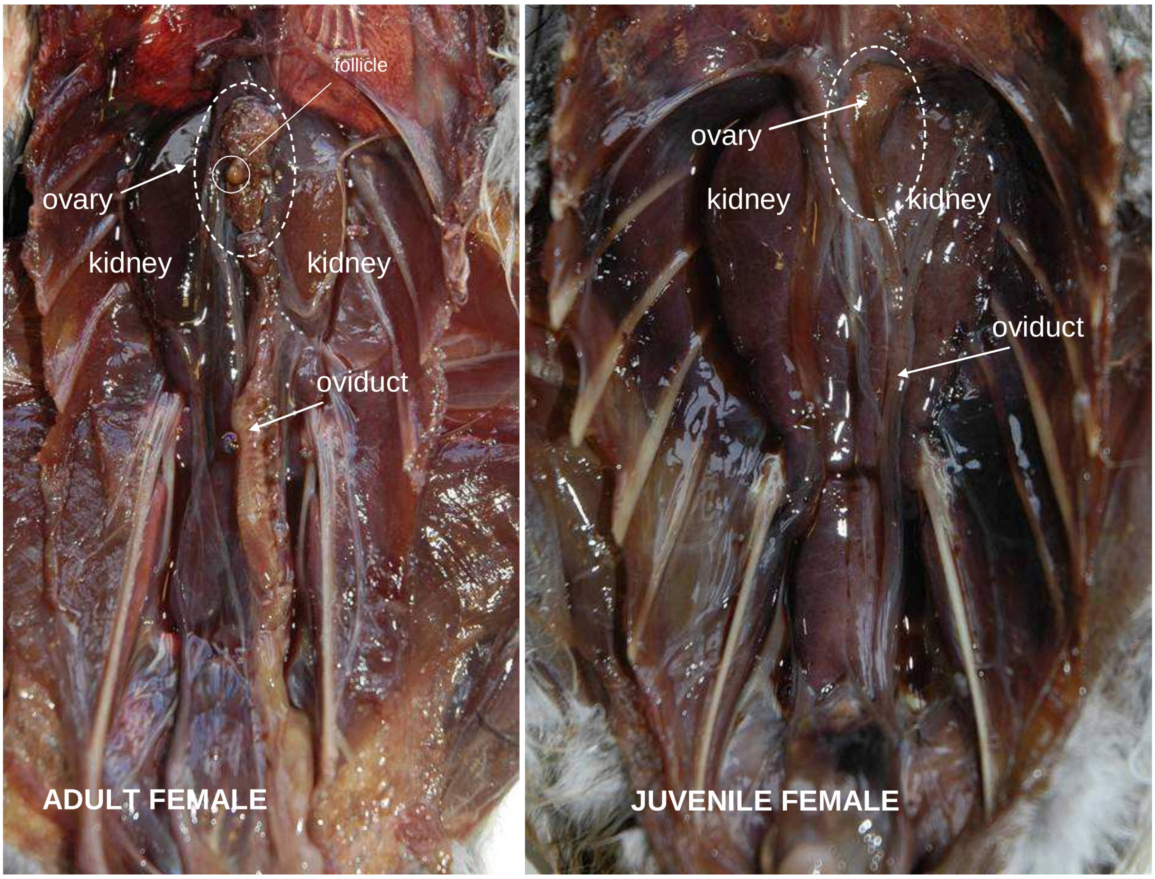



Figure 4. Urogenital system of (a) adult female Common Guillemot and (b) juvenile female Razorbill *Alca torda*. In older females, the diameter of the largest visible follicle is measured, while the shape and development of the oviduct is described as straight, swollen and straight, twisted, or swollen and twisted (Fig. 3). In juveniles, the amorf ovary is often difficult to detect, can be simply described as 'not structured' (i.e. no visible follicles), while the oviduct is thin and straight and very hard to distinguish from the ureters running from each of the kidneys to the cloaca.

**Female birds** In developing or adult females, the normally yellowish coloured ovary resembles a bunch of grapes with its many round follicles (Fig. 1b, 4a). The tubular structure running posteriorly from ovary to cloaca is the oviduct, which begins next to the ovary in a funnel-shaped structure called the *ostium*. The follicles differ in size and usually there are a few large (mature) follicles visible, next to a large number of very small follicles. We suggest to measure the diameter of the largest follicle seen during the autopsy, to evaluate the development of the oviduct on a four-point scale (thin and straight (1), slightly swollen and straight (2), slightly swollen and slightly twisted (3), swollen and twisted (4)), and to calculate a *'Follicle-Oviduct index'* as suggested by Van Franeker (2004; Fig. 3). In juvenile birds, there will not be visible follicles, the oviduct is typically thin and straight (1). The ovary development will simply be recorded as 'not structured' in these cases, use 0.1 as a score to calculate the 'Follicle-Oviduct index' (cf. Van Franeker 2004).

**Bursa Fabricii** While the gonadal development gives an idea of the age of the bird, more foothold can be obtained by assessing the presence or absence of the bursa Fabricii, one of the glands in the endocrine system of birds. The bursa Fabricii (or Bursa of Fabricius) is visible as a pouch on the outer wall of the cloaca, and it is only found in very young birds, while it atrophies in sub-adults and is absent in mature birds. From frequent comparisons of the presence/absence and the size of the bursa with known age (ringing results) of individual birds, we are certain that all juvenile seabirds have a large bursa, young immatures (2$^{nd}$ year) may have a much reduced bursa, while old immatures (>3$^{rd}$ year) and adults normally have not a trace of a bursa. Hence, the presence of a large bursa in combination with non-developed gonads is a fine indication that the bird in question is a juvenile.

The bursa is involved with forming and stimulating cells of the immune system and it is assumed to secrete hormones that stimulate the production of antibodies to infections and the production of lymphocytes (a type of white blood cell) (Proctor & Lynch 1993).

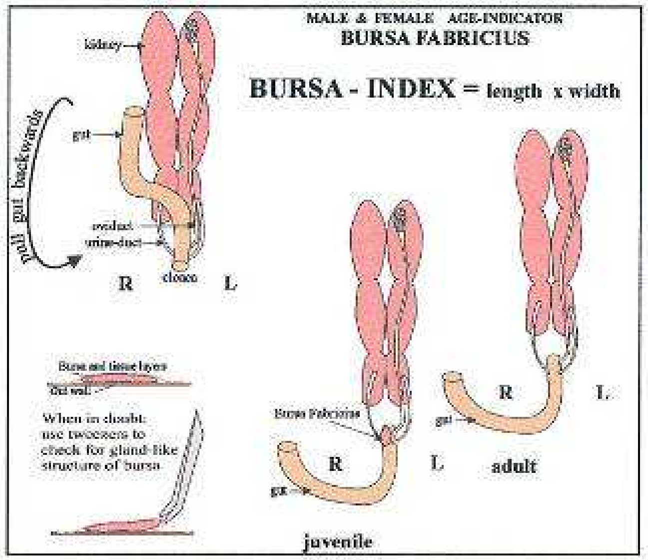



Figure 5. Bursa index suggested by Van Franeker (2004) based on Northern Fulmar *Fulmarus glacialis* dissections.

The bursa is most easily found when the large intestine (gut) is folded down during a standard autopsy, to inspect the region closest to the cloaca, and between the two ureters. In juvenile birds, the bursa is so large, that folding down the gut is not needed (Fig 6a), even although the presence will become more clear (Fig. 6b). To measure the size, however, the other organs should be moved' out of the way'. In immature birds, small bursa's might be easily overlooked if the gut is not folded down.

Note that in some species the bursa does not stand out as a clear pouch, because a strong membrane holds it tight against the outer wall of the cloaca. There is usually a colour difference between bursa and intestine, and tweezers may have to be used in case of doubt.

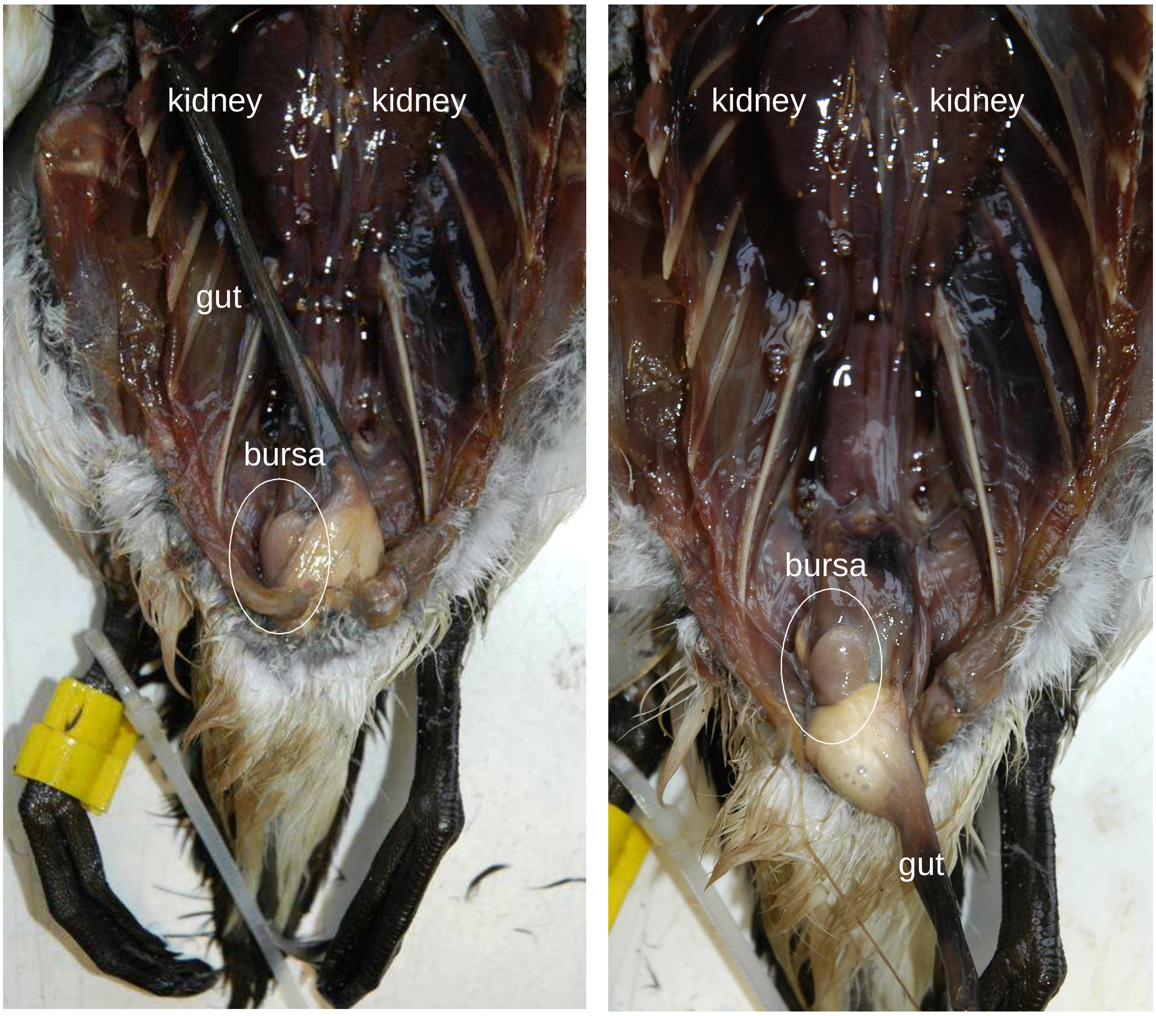
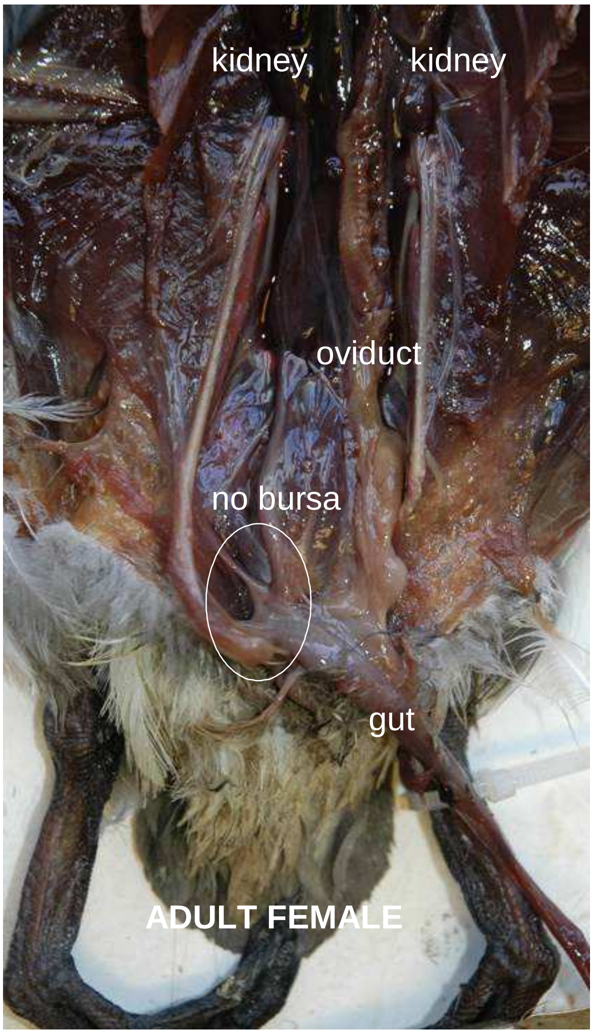



Figure 6. Urogenital system of juvenile female Razorbill *Alca torda* showing the position of the bursa Fabricii, (a) just visible slightly to the side of the cloacal exit of the large intestine, and (b) more clearly visible with the gut folded down. Note that the whitish, swollen appearance of the intestine is caused by excrements filling up the organ. This swelling should not be confused with a bursa (see also Fig. 7).

The bursa is shown in Figs 6 and 7. Note that assessing the presence is more easy than assessing the absence of this organ. Small bursa's may be hard to find and the large intestine must be manipulated such that the absence can be seen very clearly, such as in Fig. 7a. Length (base to top) and width of the bursa is measured (0.5 mm) without squeezing or stretching the organ.



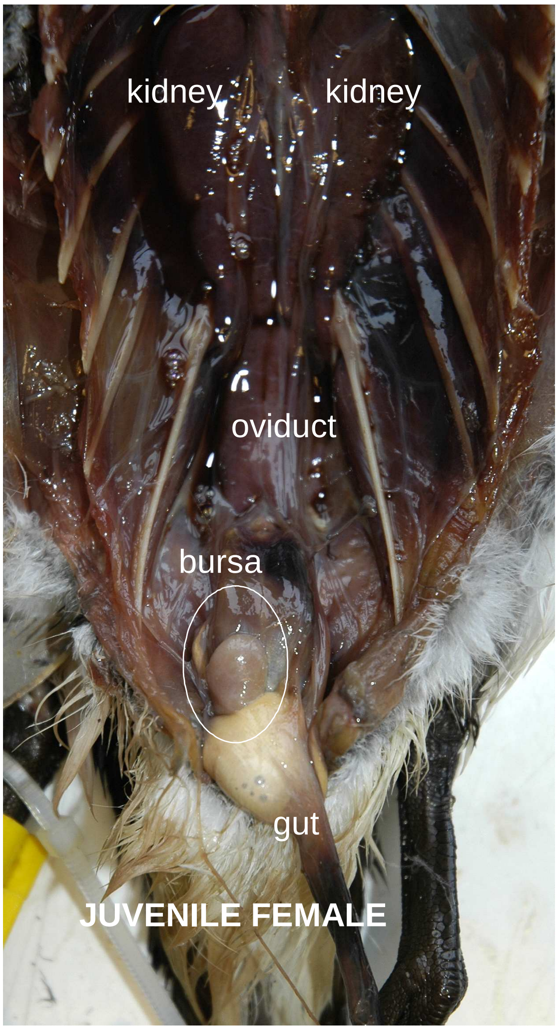




Figure 7. Urogenital system of (a) adult female Common Guillemot and (b) juvenile female Razorbill showing the position of the bursa Fabricii. The absence of a bursa can only be properly checked by folding down the large intestine. The hockeystick-shape structure in Fig, 7a is a rib, while one of the ureters is clearly visible. Any (tiny) bursa present should be visible as a pouch. Note the difference between an empty gut and the swollen appearance of a cloaca filled with excrements, just below the clearly visible bursa in the young Razorbill (Fig. 7b).

**Logging data** Autopsy forms supplied with this handbook were designed such that all data can be logged easily (Fig. 8). For testis in male birds, length and width can be entered, or a brief description (measurements are preferred), for females, the development of the oviduct can be described scoring 1, 2, 3, or 4 as described earlier, while an entry for the diameter of the largest follicle can be made if the ovary is indeed structured. And finally, the bursa can be coded as ‘present’ (+), ‘absent’ (-) or ‘unknown’ (?), plus an entry of the organ size or a brief description (again, measurements are preferred). Note that it is important to log bursa absence specifically, don’t simply leave the box blank in case you checked but didn’t locate the organ! Checking and confirming absence is different from *not* checking for the presence absence of the organ, and in later analysis there should not be any doubt.

| | |
|---|---|
| **SEX AND AGE:** | ♂ testis: × mm descr.: *long thin / long thick / short round //* |
| gonadal development: | ♀ oviduct: *1* *2* *3* *4* foll. max: mm ø / not structured (juv) |
| bursa Fabricii: | + - *?* size: × mm descr.: *large / mod. / small* |

Figure 8. Detail of proposed autopsy form where data on gonadal development and presence / absence of the bursa Fabricii can be entered according to the ageing and sexing protocol in this manual. All autopsy forms associated with this handbook will have these or very similar boxes included. Accurate measurements are preferred over descriptions such as ‘long thin’ and ‘large’, ‘moderate’, and ‘small’, also because organ size is species specific.

**Checking data entries** During a routine autopsy, information on the age of birds may be derived from external characteristics (e.g. Northern Gannet *Morus bassanus*, gulls Laridae, auks), internal characteristics (e.g. petrels, shearwaters and storm-petrels), or a combination of both. Heavily polluted seabirds may have no external (plumage) characteristics available for inspection, or an incomplete subset only. When working on a bird, it is useful to check and cross-check entries *during* the actual work, to avoid surprises afterwards. Mistakes are easily made, age-characteristics are variable, and the size of flexible organs is nothing to fully rely on. When a bird shows clear juvenile plumage characteristics, while a bursa cannot be found, do check again (both). If true, do highlight an extraordinary entry on the datasheet with an exclamation mark. Similarly, fully developed ovaries, or bean shape testis but also a large bursa (or the reverse, juvenile-looking gonads but no bursa found): step back, check again, something may have gone wrong. Finally, and very importantly, the system needs further validation. *Any* ringed bird should be very carefully checked according to this protocol and the outcome should be compared with the ringing data. The authors would be very grateful if the outcome of such checks could be reported (contact address below).

**Expected size range** Judging the size of a flexible organ like a bursa Fabricii by eye is hard and one has to realise that a large bursa for a juvenile Little Auk *Alle alle* would be a very small bursa for a Common Guillemot *Uria aalge* (Fig. 9). Table 1 offers some guidance while listing measurements of a selection of immature and juvenile seabirds collected in winter. Camphuysen (1987) reported that slightly decomposed, severely oiled seabirds collected after a couple of days baking in the sun had swollen organs (intestines, gonads and bursa), making exact measurements pointless. Be aware of decomposition effects: fluffy organs cannot be measured. A bursa Fabricii in good condition is a fairly stiff pouch, flexible, but certainly not fluffy.

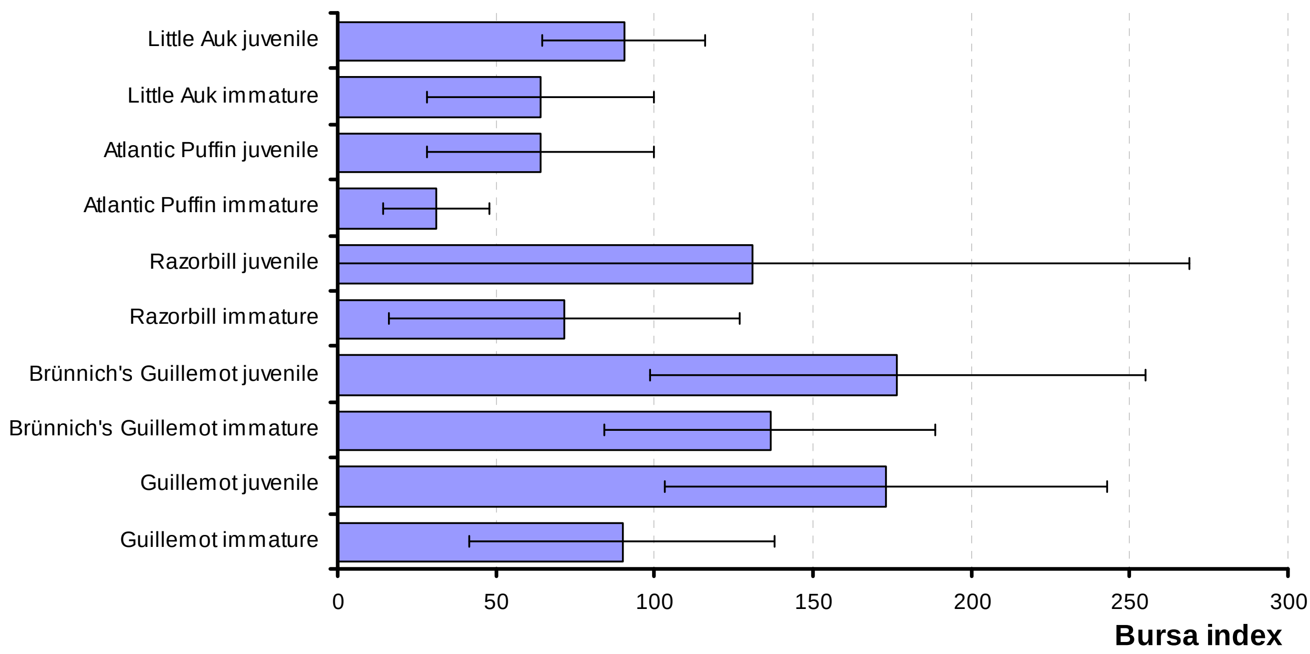



Figure 9. Bursa index (±SD) in immature and juvenile Atlantic Alcidae based on measurements at stranded, wintering seabirds (Nov-Mar) in the Southern North Sea and in Newfoundland (CJ Camphuysen unpubl. data). Note that the age (I for immature, J for juvenile) is based on interpretations during dissections following the standard ageing protocol described in this manual. Only a fraction of these birds could be confirmed with true age from ringing data!

Table 2 will offer some guidance by listing testis size of seabirds wintering in de southern North Sea. In all reported cases, only the left testis was measured (visible on the right side during the standard autopsy). Follicle size is so variable, that there is little point in producing a list of measured examples.

Testis size varies between species and is roughly correlated with structural body size. Outside the breeding season, testis indices in auks vary between 6 (*Alle alle*) and 40 (*Uria aalge*), representing testis length variations between 5.5 and 12mm, and testis widt of less than 1 and 3.6mm. Some February or March auks may prepare for breeding, and a testis index of 300 (30x10) can be found in a large auks like the Common Guillemot. Non-breeding testis indices seldom exceed 100, even in large species like Northern Gannets *Morus bassanus*. The bean shape is typical for all studied seabirds preparing for breeding, and is typical for mature individuals. Since adult males are difficult to evaluate in terms of age, do cross-check for size and presence of bursa Fabricii!

Table 1. Size indications of bursa Fabricii based on measurements at stranded, wintering seabirds (Nov-Mar) in the Southern North Sea (CJ Camphuysen unpubl. data; cormorant data courtesy MF Leopold). Note that the age (I for immature, J for juvenile) is based on interpretations during dissections following the standard ageing protocol described in this manual. Only a fraction of these birds could be confirmed with true age from ringing data!

| **Species** | | **Age** | **Length** | SD | Min | Max | **Width** | SD | Min | Max | **Index** | SD | **Sample** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Great Northern Diver | *Gavia immer* | I | 15.0 | | 15 | 15 | 10.0 | | 10 | 10 | 150.0 | | 1 |
| Little Grebe | *Tachybaptus ruficollis* | J | 10.0 | | 10 | 10 | 5.0 | | 5 | 5 | 50.0 | | 1 |
| Great Crested Grebe | *Podiceps cristatus* | J | 15.1 | 3.4 | 11 | 21 | 9.0 | 3.7 | 5 | 17 | 142.6 | 84.1 | 8 |
| Slavonian Grebe | *Podiceps auritus* | J | 5.0 | | 5 | 5 | 4.0 | | 4 | 4 | 20.0 | | 1 |
| Northern Fulmar | *Fulmarus glacialis* | J | 15.4 | 4.2 | 10 | 21 | 10.9 | 2.5 | 7 | 15 | 169.9 | 68.0 | 11 |
| Northern Gannet | *Morus bassanus* | I | 12.0 | | 12 | 12 | 8.0 | | 8 | 8 | 96.0 | | 1 |
| Great Cormorant | *Phalacrocorax carbo sinensis* | J | 28.6 | 7.1 | 20 | 42 | 13.3 | 3.7 | 7 | 21 | 383.9 | 147.8 | 9 |
| European Shag | *Phalacrocorax aristotelis* | I | 14.5 | | 13 | 16 | 7.5 | | 7 | 8 | 108.8 | | 2 |
| | | J | 18.0 | | 18 | 18 | 9.0 | | 9 | 9 | 162.0 | | 1 |
| Common Eider | *Somateria mollissima* | I | 20.0 | | 20 | 20 | 10.5 | | 10 | 11 | 210.0 | | 2 |
| | | J | 16.0 | | 16 | 16 | 6.0 | | 6 | 6 | 96.0 | | 1 |
| Common Scoter | *Melanitta nigra* | I | 22.0 | | 22 | 22 | 9.0 | | 9 | 9 | 198.0 | | 1 |
| | | J | 24.2 | 5.2 | 19 | 32 | 10.0 | 4.6 | 7 | 18 | 255.6 | 180.0 | 5 |
| Pomarine Skua | *Stercorarius pomarinus* | I | 6.5 | | 5 | 8 | 5.0 | | 5 | 5 | 32.5 | | 2 |
| | | J | 15.7 | 3.2 | 12 | 22 | 8.0 | 1.5 | 7 | 11 | 128.6 | 51.7 | 7 |
| Great Skua | *Stercorarius skua* | J | 23.0 | | 18 | 28 | 12.0 | | 9 | 15 | 276.0 | | 2 |
| Black-headed Gull | *Larus ridibundus* | J | 10.0 | | 10 | 10 | 10.0 | | 10 | 10 | 100.0 | | 1 |
| Common Gull | *Larus canus* | I | 5.0 | | 5 | 5 | 6.0 | | 6 | 6 | 30.0 | | 1 |
| Iceland Gull | *Larus glaucoides* | J | 14.0 | | 14 | 14 | 6.0 | | 6 | 6 | 84.0 | | 1 |
| Glaucous Gull | *Larus hyperboreus* | I | 9.0 | | 9 | 9 | 6.0 | | 6 | 6 | 54.0 | | 1 |
| Great Black-backed Gull | *Larus marinus* | J | 12.7 | | 11 | 15 | 10.3 | | 7 | 15 | 130.9 | | 3 |
| Black-legged Kittiwake | *Rissa tridactyla* | I | 9.0 | 2.6 | 7 | 12 | 6.0 | 2.0 | 4 | 8 | 56.7 | 34.4 | 3 |
| | | J | 10.6 | 2.4 | 7 | 15 | 6.3 | 1.2 | 4 | 9 | 66.8 | 17.9 | 18 |
| Common Guillemot | *Uria aalge* | I | 12.4 | 3.8 | 4 | 20 | 6.8 | 2.6 | 1 | 16 | 89.8 | 48.3 | 57 |
| | | J | 17.9 | 3.6 | 10 | 31 | 9.4 | 2.1 | 5 | 65 | 172.9 | 69.9 | 97 |
| Brünnich's Guillemot | *Uria lomvia* | I | 16.5 | 3.7 | 10 | 20 | 8.0 | 1.6 | 6 | 10 | 136.5 | 52.1 | 8 |
| | | J | 19.4 | 2.2 | 15 | 25 | 9.0 | 3.3 | 1 | 15 | 176.8 | 78.2 | 21 |
| Razorbill | *Alca torda* | I | 10.7 | 3.7 | 3 | 26 | 6.1 | 2.2 | 2 | 16 | 71.7 | 55.4 | 66 |
| | | J | 14.5 | 3.0 | 10 | 22 | 8.8 | 8.9 | 3 | 69 | 130.8 | 138.0 | 50 |
| Little Auk | *Alle alle* | I | 7.0 | 2.3 | 4 | 9 | 4.2 | 1.3 | 3 | 6 | 31.2 | 16.8 | 5 |
| | | J | 10.9 | 9.9 | 6 | 75 | 6.3 | 3.1 | 3 | 25 | 64.1 | 35.8 | 45 |
| Atlantic Puffin | *Fratercula arctica* | I | 9.6 | 2.3 | 7 | 13 | 4.8 | 0.4 | 4 | 5 | 64.1 | 35.8 | 5 |
| | | J | 12.7 | 2.8 | 6 | 18 | 7.0 | 1.1 | 4 | 9 | 90.3 | 25.7 | 27 |

Table 2. Size indications (L= length, W = width, Index = LxW) of left testis based on measurements in stranded, wintering seabirds (Nov-Mar) in the Southern North Sea (CJ Camphuysen unpubl. data; cormorant data courtesy MF Leopold). Note that the age (A for adult, I for immature, J for juvenile) is based on interpretations during dissections following the standard ageing protocol described in this manual. Only a fraction of these birds could be confirmed with true age from ringing data!

| Species | | Lft | Mean L | SD | Min | Max | Mean W | SD | Min | Max | Index | SD | Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Red-throated Diver | *Gavia stellata* | A | 11.8 | 2.2 | 9.0 | 14.0 | 4.6 | 1.0 | 3.8 | 6.0 | 52.2 | 3.4 | 4 |
| Great Crested Grebe | *Podiceps cristatus* | A | 12.8 | 3.4 | 6.0 | 19.0 | 3.8 | 1.2 | 1.2 | 6.0 | 50.0 | 21.7 | 15 |
| | | J | 11.8 | 1.8 | 9.0 | 14.0 | 3.1 | 0.8 | 2.0 | 4.0 | 36.5 | 8.9 | 9 |
| Northern Fulmar | *Fulmarus glacialis* | A | 7.2 | 1.6 | 6.0 | 9.0 | 3.0 | 1.0 | 2.0 | 4.0 | 21.7 | 8.4 | 3 |
| | | J | 4.6 | 0.4 | 4.0 | 5.0 | 1.5 | 0.7 | 0.5 | 2.5 | 6.9 | 3.6 | 5 |
| Northern Gannet | *Sula bassana* | A | 12.0 | 0.2 | 12.0 | 12.0 | 8.0 | 1.5 | 6.5 | 9.5 | 96.0 | 19.0 | 3 |
| Great Cormorant | *Phalacrocorax carbo sinensis* | J | 22.8 | 3.6 | 19.4 | 27.3 | 3.9 | 0.7 | 3.3 | 5.0 | 88.6 | 19.5 | 5 |
| Common Eider | *Somateria mollissima* | A | 12.0 | 2.0 | 8.0 | 16.4 | 5.1 | 1.1 | 3.0 | 8.1 | 62.6 | 18.9 | 65 |
| | | I | 10.7 | 1.8 | 7.1 | 14.4 | 3.9 | 1.3 | 1.8 | 7.2 | 43.1 | 18.8 | 50 |
| | | J | 9.4 | 1.6 | 3.0 | 13.0 | 2.6 | 1.1 | 1.0 | 9.0 | 23.7 | 8.2 | 122 |
| Pomarine Skua | *Stercorarius pomarinus* | J | 6.5 | 0.5 | 6.0 | 7.0 | 1.3 | 0.3 | 1.0 | 1.5 | 8.3 | 2.3 | 3 |
| Black-legged Kittiwake | *Rissa tridactyla* | A | 5.7 | 1.1 | 4.5 | 7.0 | 2.3 | 0.5 | 1.8 | 3.0 | 13.3 | 5.6 | 4 |
| | | I | 5.0 | 1.0 | 4.0 | 6.0 | 1.5 | 0.9 | 0.5 | 2.0 | 7.5 | 4.8 | 3 |
| | | J | 4.1 | 1.7 | 3.0 | 7.0 | 1.1 | 0.2 | 1.0 | 1.5 | 4.7 | 2.2 | 5 |
| Common Guillemot | *Uria aalge* | A | 11.6 | 2.3 | 2.8 | 30.0 | 3.6 | 1.3 | 1.0 | 10.0 | 41.6 | 17.2 | 315 |
| | | I | 10.6 | 1.8 | 6.0 | 14.0 | 1.9 | 1.0 | 0.5 | 7.0 | 20.6 | 12.0 | 94 |
| | | J | 10.6 | 2.2 | 6.0 | 17.0 | 1.5 | 1.0 | 0.5 | 8.0 | 15.8 | 12.4 | 131 |
| Brünnich's Guillemot | *Uria lomvia* | A | 10.8 | 1.1 | 10.0 | 12.0 | 2.6 | 1.3 | 1.5 | 4.0 | 27.4 | 11.9 | 5 |
| | | J | 11.7 | 2.3 | 8.0 | 15.0 | 1.0 | 0.2 | 0.8 | 1.5 | 12.0 | 2.8 | 9 |
| Razorbill | *Alca torda* | A | 9.0 | 1.6 | 5.0 | 14.0 | 3.1 | 1.1 | 1.0 | 6.0 | 28.6 | 11.9 | 155 |
| | | I | 8.4 | 2.1 | 3.0 | 12.0 | 1.7 | 0.7 | 0.5 | 4.0 | 14.1 | 6.4 | 33 |
| | | J | 7.3 | 2.3 | 3.8 | 12.0 | 1.4 | 0.5 | 1.0 | 2.5 | 9.7 | 4.5 | 17 |
| Little Auk | *Alle alle* | A | 5.5 | 1.3 | 4.0 | 8.0 | 2.1 | 0.7 | 0.9 | 3.0 | 11.7 | 5.4 | 13 |
| | | J | 5.8 | 1.7 | 3.5 | 8.0 | 1.1 | 0.2 | 0.5 | 1.5 | 6.3 | 2.7 | 16 |
| Atlantic Puffin | *Fratercula arctica* | A | 7.4 | 2.6 | 5.0 | 12.0 | 3.5 | 1.0 | 2.0 | 5.0 | 27.5 | 17.0 | 7 |
| | | I | 8.0 | 2.0 | 6.0 | 10.0 | 2.6 | 0.7 | 1.8 | 3.0 | 21.6 | 9.8 | 3 |
| | | J | 6.5 | 2.3 | 4.0 | 10.0 | 1.6 | 0.6 | 1.0 | 3.0 | 10.9 | 5.8 | 11 |

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**Citation**

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.1 Assessing the damage

**Technical document**

### Condition manual: the physical condition of stranded seabirds

Like other homoeothermic ("warm-blooded") aquatic animals, such as seals and cetaceans, many seabirds have a thick layer of subcutaneous fat to help insulate them from the cold sea water. The primary barrier to cold, however, is the almost impervious layer of outer contour feathers that overlays a thick layer of extremely dense down feathers in species like divers, grebes, seaduck and auks. Oil ruins the structure of these feathers and water will leak through. Typically, slightly oiled seabirds will start preening and, by doing so, damage their plumage even more. The time spent on feather care comes at the expense of foraging time, and diving seabirds will refrain from going under water (i.e. cannot forage), since the water will penetrate the plumage, reach the skin and ultimately cause hypothermia. Severely oiled seabirds are promptly immobilised, may suffocate in the oil, and die virtually immediately. During the standard autopsy, an impression can be obtained of the physical condition of the seabirds affected, as an aid in describing the type of mortality (immediate, or delayed). This technical document provides guidelines for assessing the physical condition and the condition of some vital organs of seabirds.

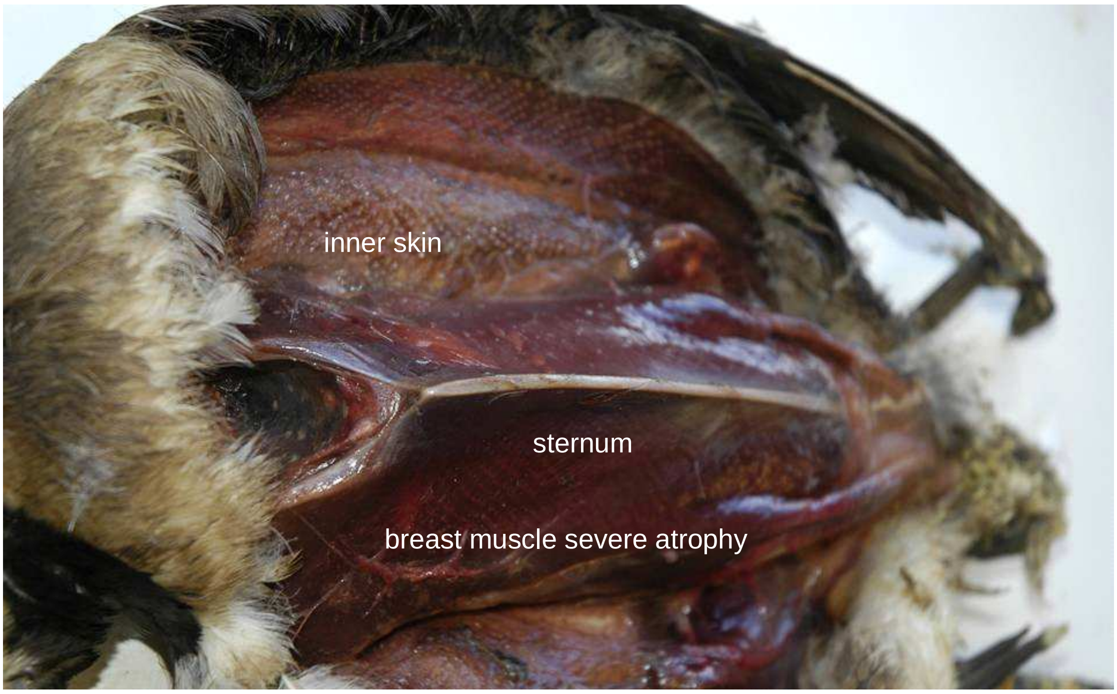


Figure 1. Sternum and breast muscle of a severely emaciated, partly oiled Common Guillemot *Uria aalge*.

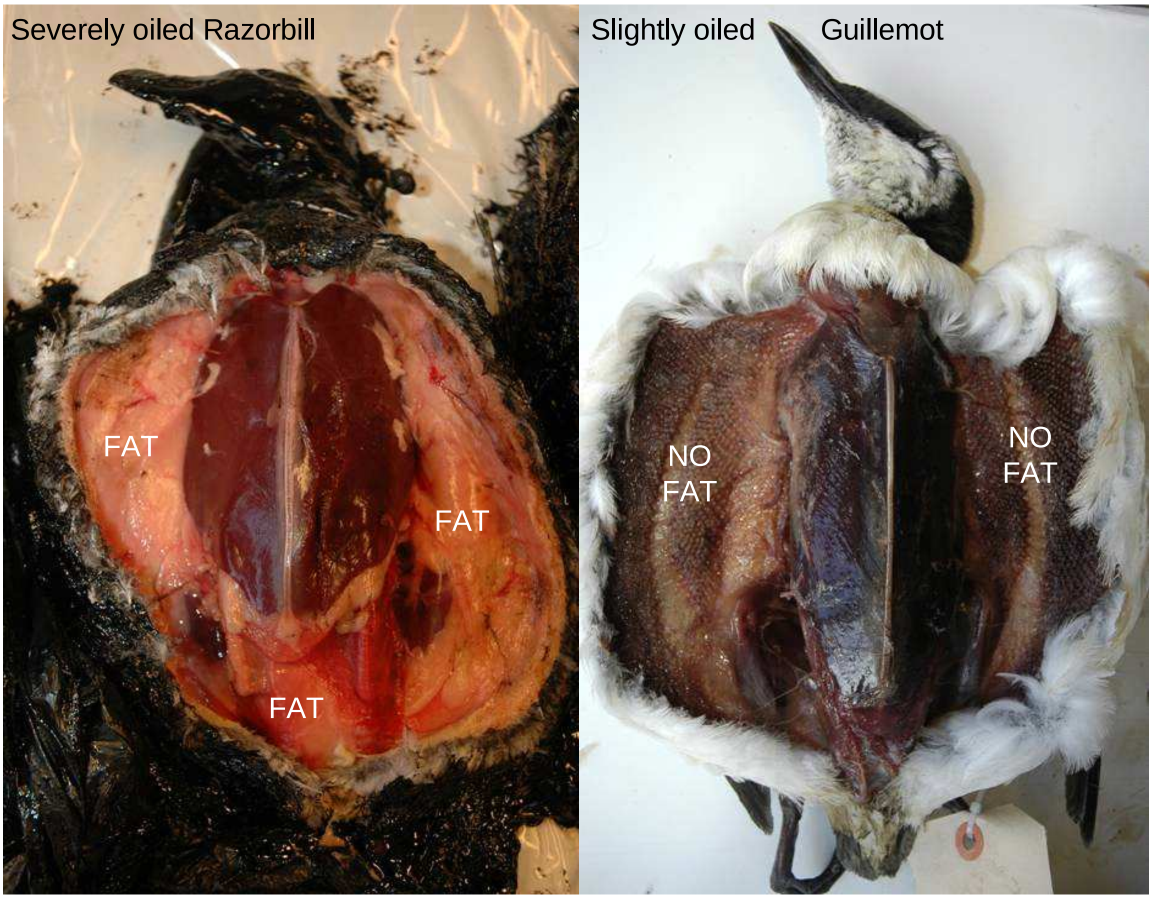


Figure 2. Subcutaneous fat stores, sternum and breast muscle of (a) a severely oiled and very fat (i.e. good condition) Razorbill *Alca* torda and (b) a partly oiled, severely emaciated (i.e. starved) Common Guillemot *Uria aalge*.

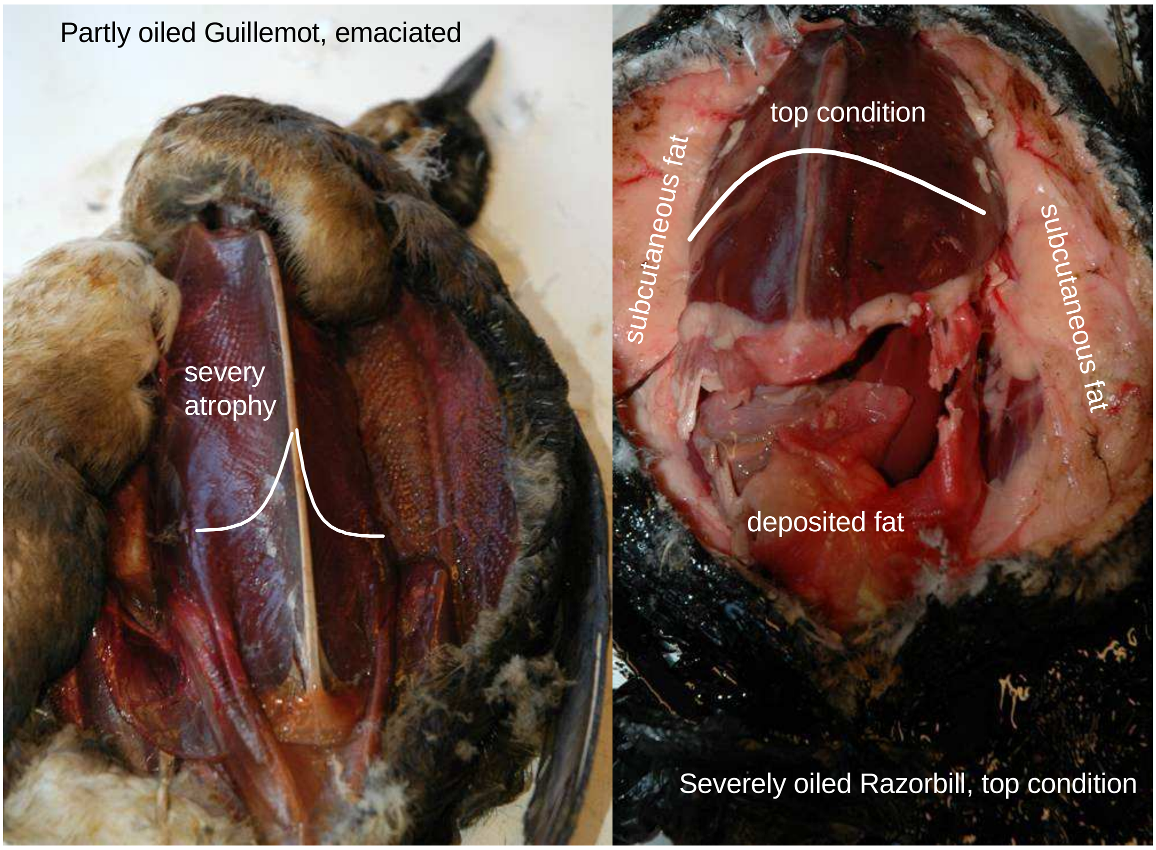


Figure 3. Breast muscle profiles of (a) a severely emaciated (i.e. starved) Common Guillemot *Uria aalge* and (b) a very fat (i.e. good condition) Razorbill *Alca* torda and (b).

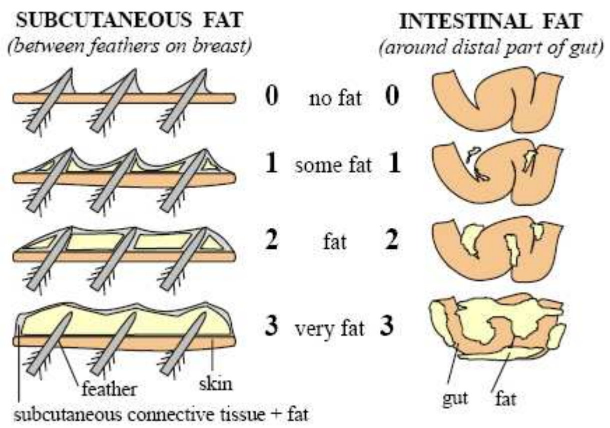


Figure 4. Fat deposit in stranded seabirds, scored according to a four-point scale (from Van Franeker 1983, 2004).

0 – no fat, feather quills clearly visible when the skin is opened during a standard autopsy (belly and breast skin are inspected), not a trace of fat between the intestines. See Fig. 2b for a clear example.

1 – some fat between the feather quills, scattered traces of fat in membranes between the intestines

2 – fat, feather quill tops just visible as little humps in the subcutaneous fat, intestines clearly visible but extensive fat stores between the loops

3 – very fat, feather quills invisible, intestines hidden in thick layers of fat. See Fig. 3b for a clear example.

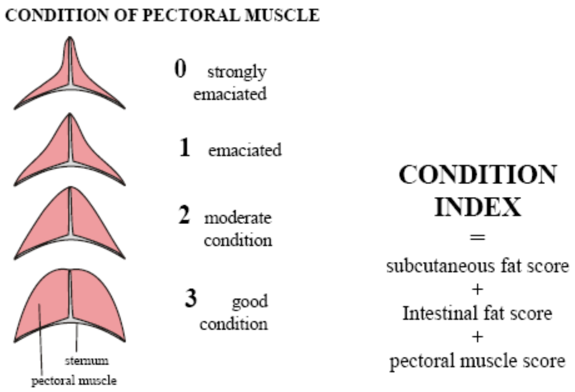


Figure 5. Breast muscle profiles and a suggested condition index based on fat score and pectoral muscle score (from Van Franeker 1983, 2004).

0 – breast muscle mostly gone. Sternum keel as a razor. See Fig. 3a for a clear example.

1 – breast muscle clearly concave

2 – breast muscle thick, but tip of sternum keel sticks out

3 – breast muscle very thick, sternum keel as a depression in the centre. See Fig. 3b for an example.

**Fat score and condition index** 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). Figs. 4-5 illustrate how to score the various characters on a four-point scale (0-3) and how to calculate the overall condition index; examples of extreme cases are shown in Figs. 1-3. The condition index is based on the sum of scores of fat stores and breast muscles (0-9): score 0-1 = mortally emaciated; 2-3 critically emaciated; 4-6 moderate body condition; and 7-9 good body condition.

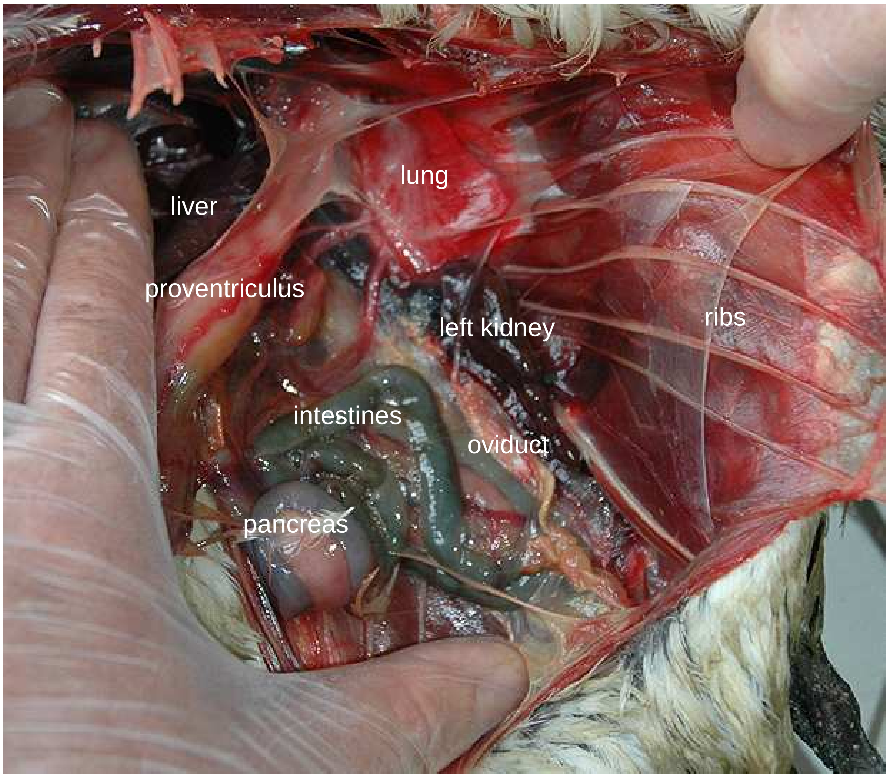


Fig. 6. Visual inspection of vital organs in the thoracic cavity by lifting the sternum (see methods of standard autopsy) and while pushing the stomach and liver to the left side.

- The pancreas should not be confused with deposited fat between the intestines.
- The illustrated intestines have a proper shape but are mal-arranged and greenish (inflammation).
- The illustrated lungs are reddish, suggesting some degree of pneumonia
- Kidney colour is fine, the organ is probably healthy
- Liver colour (barely visible) is fine, the organ is probably healthy

In this badly emaciated example, there is not a trace of fat deposited between the intestines.

**Other organs** Some animals found in oil spills are critically ill, and the oil may not have contributed much to their fate. On the other hand, pneumonia is often diagnosed in (slightly) oil contaminated seabirds that suffered from hypothermia. We suggest to record organ health from visual inspections using a simple four-point scoring system ranging from 0 for extremely poor health to 3 for good condition. Decay of corpses will complicate judgment of organ health: attempt to give a judgment 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. Note that this simple methodology is indicative only, and useful when large numbers of casualties are to be dealt with within a short time-span; this method can never replace a proper assessment of the physical condition by a veterinarian or pathologist.

While lifting the sternum during a standard autopsy (Fig. 6), assessing the presence of deposited fat is the first observation (see Fig. 4 for coding system). The colour and condition of the **intestines** (or **gut**) can be evaluated at the same time. Healthy birds will show neatly arranged, pink intestines that are fairly firm when touched. Blood veins are visible as thin red lines, but there should not be any bleedings (red, purple or blackish areas). Do not confuse the *pancreas* (pinkish or greyish) with the presence of fat (yellowish; Fig. 6).

Normally, one will have to push aside the liver to get a proper look into the thoracic cavity. Examine the liver for whitish, reddish or blackish spots, the organ should be large, bi-lobed, supple and dark red all over. Decomposition of the corpse will quickly affect liver colour! Greenish livers are often associated with smelly carcasses.

Kidney lobes will be visible when the bird is sexed. As in the liver, dark red is the appropriate colour of the kidneys (uniform fleshy colour). Spotted, pale reddish, greyish or yellowish kidneys are indicative for disease.

Lateral and dorsal of the heart, the lungs can be seen. Healthy lungs are dry and bright pink. Bleedings will make the lungs reddish or even dark red. Oil may have filled the lungs and made them blackish. Foamy water should not be visible in the lungs, and parasite worms should either be absent or sparsely present.

Table 1. Four-point scales of organ health (0-3, ranging from poor condition to pristine), for visual inspections

| | | |
|---|---|---|
| **Intestines (Guts)** | | |
| **0** | Heavily infected | nearly black, shriveled |
| **1** | Infected | dark green, loose, empty |
| **2** | Slightly or partly infected | (partly) greenish, loose |
| **3** | Pristine | nice pink with blood veins visible, neatly arranged, equally filled |
| **Kidneys** | | |
| **0** | Degenerated, crumbly | hard structures in the organ, colour variable |
| **1** | Heavily spotted | white, red, or dark spots |
| **2** | Slightly spotted | white, red, or dark spots |
| **3** | Pristine | uniform fleshy colour |
| **Liver** | | |
| **0** | Cancers or other hard parts | hard structures in the organ, colour variable |
| **1** | Heavily spotted | white, red, or dark spots |
| **2** | Slightly spotted | white, red, or dark spots |
| **3** | Pristine | uniform fleshy colour[1] |
| **Lungs** | | |
| **0** | Heavily infected, filled with blood or oil | black or dark red |
| **1** | Infected | completely bright red, watery |
| **2** | Slightly or partly infected | partly red or reddish, watery |
| **3** | Pristine | completely pink and "dry" |

*!! [1]Corpses that are not fresh have their organs coloured greenish or blackish, despite the fact that they may have been OK when the bird died. In particular the liver gets a blackish wash all over at an early stage in the degeneration of the corpse. In case of great stink: do not try to record condition of liver from visual observations only.*

**Notes on (possible) cause of death** Under notes, please specify what may have caused the death of the bird (proximate cause of death), integrating all aspects thus far recorded, plus aspects that may not have been covered in the descriptions on the record form. In many cases you will not be able to say more than 'killed in oil' or 'died from starvation' without a clear clue as to what triggered the deteriorating condition. However, in other cases you may suspect that for example 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 descriptions, Van Franeker (2004) proposed a series of standard categories, listed below. Note that the category-listing is preliminary and not exhaustive.

Table 2. Suggested coding to log possible (proximate) causes of death in stranded seabirds (from Van Franeker 2004, modified)

| Code | Proximate cause of death | Description |
|---|---|---|
| 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 |
| EXT | other external contaminant | likely to have contributed directly or indirectly to the death of the bird |
| SHO | wounded by shot | evidenced indirectly by damage to feathers or tissue or directly by shot in the bird |
| DRO | drowned | suspected in 'healthy birds' from: excellent plumage and condition, all organs healthy except for some fresh blood and or water in the lungs |
| ENT | entanglement | (not immediately drowned); entanglement as recorded by finder or still present on corpse. Broken limbs may be indicative for birds having been extracted from netting by force. |
| EUT | euthanised | bird euthanised in a rehabilitation center, or by the finder on the shoreline |
| HOO | hook | fishing hook with or without line fragment hooked into body, beak, or throat |
| COL | collision | as evidenced by for example fractures or internal bleedings |
| CEM | cement-cloaca | a hard stony ball may form in the cloacal area; these may grow to several cm 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 a proportion likely to have contributed to death. Measure length and width of cancer tissue in mm |
| PLU | plumage problems | extreme wear to bare shafts of feathers following delayed or arrested moult; deformed feathers; absence of down; ……. |
| STA | starvation without clear cause | many birds are emaciated but show no clear evidence of anything that triggered the start of the emaciation process |

**Logging data** Autopsy forms supplied with this handbook were designed such that all data can be logged easily (Fig. 7). The fat scores and the condition of the breast muscle together should result in a condition index (avoid missing values in this set). Four organs can be described according to suggested coding, or by brief descriptions. A quick way of data logging is simply encircling the 0-3 codes for either entry, and the manual described what is meant with each of the codes used. For most necropsies, after some practice, there will be little doubt what to highlight and what to ignore. The main pitfall will be the assessment of organ health in decomposed carcasses. The liver will be among the first organs that cannot be reliably judged through a simple visible inspection. Be alert for internal bleedings, other than the ones described, for example caused by a collision or hard blows on the body (amateuristic euthanasia, windturbine collisions, etc.), parasitic infections, ulcers or cancers. All these extras may be recorded under 'Notes' (Fig. 7).

| **INTERNAL STUDY:** | *Simply encircle the condition score according to the manual, and/or describe* | | | | | |
|---|---|---|---|---|---|---|
| subcutaneous fat: | *0* | *1* | *2* | *3* | remarks: | |
| deposited fat: | *0* | *1* | *2* | *3* | remarks: | |
| breast muscle: | *0* | *1* | *2* | *3* | remarks: | |
| guts: | *0* | *1* | *2* | *3* | colour: | remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: | remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: | remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: | remarks: |
| Notes: | | | | | | |
| | | | | | Proximate cause of death: | |

Figure 7. Detail of proposed autopsy form where data physical condition and state of some vital organs can be entered according protocols in this manual. All autopsy forms associated with this handbook will have these or very similar boxes included. Accurate descriptions can be added to the basic scores.

**Instruments needed**

Instruments needed are similar to those required for a standard autopsy. A shopping list is provided {autopsy shopping list}

**Further reading**


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**Abstract:** The pattern of diseases found upon the necropsy of marine birds will be different depending on the origin of the bird (the wild or rehabilitation centre). The ratio of oiled/non-oiled birds and therefore the necropsy results will vary with the time of year and the species involved (coastal, estuarine or pelagic species). At necropsy one should be familiar with the anatomical peculiarities of the different marine species. The main reasons for a necropsy are to get valid information about the mortality cause and biological information about the species, to confirm a diagnosis, to check for an unsuccessful therapy, to enlarge knowledge, or simply to find out what is going on. The main problems/diseases/necropsies seen in marine birds at beach surveys are: acute and chronic oil pollution, chemical pollution, food shortage, entanglement, plastic ingestion, and infectious diseases (esp. parasites). In rehabilitation centres the main medical problems are related to management, dehydration, cloacal impaction, gizzard impaction, ulcers and bumblefood, corpora aliena, stress, viral infections (e.g. duck plague), bacterial infection (e.g. avian cholera, tuberculosis), fungal infections (e.g. aspergillosis), and parasitic infestation (worms and protozoans). The necropsies and the diagnoses are discussed.

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

### Diet study manual for stranded seabirds

This technical document provides guidelines for sampling stomach contents of seabirds during standard autopsies. Diet studies are a lower priority in the actual impact assessment of the oil spill (4.1, Introduction), but they are strongly recommended, time permitting, because valuable ecological data can be collected with little effort or extra cost. Many mass mortalities during oil spills occurred away from the breeding grounds in wintering areas, and our knowledge of dietary preferences and staple foods in these areas is extremely limited.

Sampling stomachs and intestines during standard autopsies is easy and freezer capacity needed to store hundreds of properly labelled and packed samples is trivial. The analysis of stomach contents can be postponed to a later date.

Figure 1. Sampling digestive system: (a) stomach plus intestines from a Red-throated Diver *Gavia stellata*, (b) stomach only (i.e. proventriculus and gizzard) from a Common Guillemot *Uria aalge*.

**Sampling**

The stomach (gizzard and proventriculus) can be collected during the standard autopsy (see description {Standard autopsy}). In some studies, the intestines are also checked for food remains, and it would be the choice of the researcher whether also the intestines should be kept. Studies on divers Gaviidae indicated that as many as 50% of the 'useful' food remains (hard parts needed for identification) may be found in the gut rather than in the stomach.

Intestines of birds that eject indigestible prey remains via regurgitated pellets (e.g. cormorants Phalacrocoracidae) will, in all likelihood contain few hard prey remains; species that are known to eject prey hard parts via their faeces, such as gulls Laridae (Ambrose 1986), terns Sternidae (Veen *et al.* 2002; Vincx *et al*. 2007), waders Charadriidae (Dekinga & Piersma 1993; Scheiffarth 2001); or seaduck Anatidae (Nehls & Ketzenberg 2002; Rodway & Cook 2002; Leopold et al. 2007) are likely to have identifiable prey remains in their intestines.

Stomach (and gut) should be put in a strong, sealed plastic bag, clearly labelled (collection number of the carcass, referring to stranding details, species name and date), and stored in a freezer. Sampled stomachs and intestines should not be given the chance to dry, for processing will be complicated if this occurred. Also, stomach contents should not, or only very shortly, be kept in formalin as this fixative will dissolve fish otoliths. Deep freezing is by far the most convenient method, and when sealed in individual plastic bags (Fig. 2), the sample will not dry.

Fig. 2. Suggestions for plastic bags with zip-locks or valves for stomach sampling.

**Warning!** Stomach and intestines combined normally require no more than a small plastic bag per sample (i.e. 7x11 or 15x22 cm for ziplock bags or valve bags; Fig. 2). However, seabirds killed while feeding may have surprisingly full stomachs, and when handling such Northern Gannets *Morus bassanus*, Great Cormorants *Phalacrocorax carbo* or Common Eiders *Somateria mollissima* during necropsies, rather large sampling bags may be required to store the entire digestive tract (Figs. 3-4)!

Fig. 3. Exceptionally large stomach sample: a 920g gizzard and proventriculus taken from a Northern Gannet that had drowned in a trawl net during feeding.

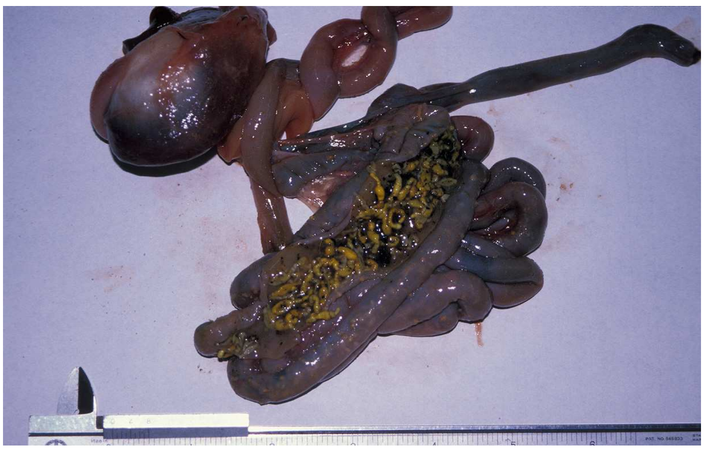


Fig. 4. Muscular gizzard (top left) and intestines (infected with Acanthocephalan parasites) of a Common Eider *Somateria mollissima*.

**Analysis (1): retrieving prey items from stomachs**


Fig. 5. Frozen stomachs in sampling bags

A diet study will start with defrosting the collected stomachs and intestines (Fig. 5, 6A). Stomach samples comprise the proventriculus and the gizzard in one piece. After defrosting, these should be opened with a pair of scissors (Fig. 6B-C). First, pick out any more or less intact prey that can be identified and measured. Rinse the remaining stomach contents in clean water (Fig. 6D) while making sure that everything is collected in a sufficiently large container. Most hard prey items will sink (Fig. 6E), dirty samples can be stirred for a while and then left for hard prey items to sink (Fig. 6F). Check the container for any relevant items that float, pick those out, and gently pour excess water into a sink (Fig. 6G), while ensuring that prey items cannot 'escape' in the flow. If the sample is too dirty for this procedure, for instance if lots of partly digested prey are present, these may be dissolved by adding Biotex or 1 N NaOH (let sample dissolve for several hours or overnight; these detergents do not dissolve fish bones or otoliths, but will dissolve soft parts). Detergent and partly digested soft tissue can be get rid of by placing the container under a gently running tap and making it overflow. Heavy hard parts will remain on the bottom of the jar, unwanted light, soft parts will flow over the rim. If there is uncertainty about the loss of valuable parts, place the overflowing container into a fine-messed sieve. When the water in the container is clear, pour the sample with some remaining water in a petri dish, and sort out prey items under a binocular microscope (Fig. 6H). Prey items should be left to dry for later identification, measuring and storage (Fig. 6I).

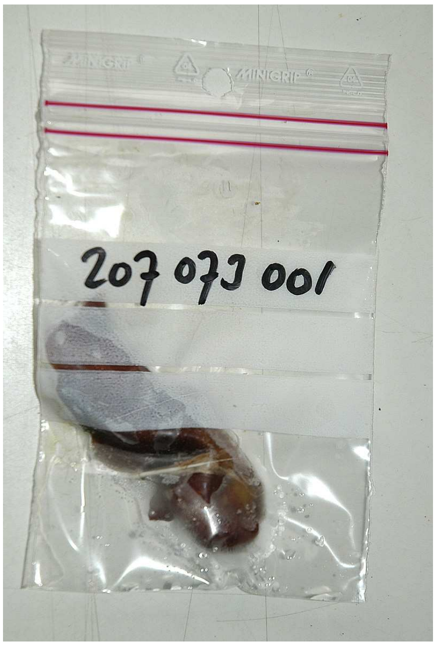
**Analysis (2): retrieving prey items from intestines**

Retrieving prey from intestines follows the same procedure as in stomach analysis. Unfold the intestines by cutting loose all curls from adhering membranes. Cut the intestine open lengthwise and rinse contents with clear water into a sufficiently large container. Let hard parts sink, check for floating parts that will help identify prey and put the jar under a gently running tap, making it overflow. Detergents will not normally be necessary when dealing with intestine contents. Decant, put remaining debris into a petri dish and sort under a microscope.

**Analysis (3): type of prey items to select, sort and measure**

Many seabirds are piscivorous (fish eating), and the most likely and at the same time useful items to be encountered in a seabird stomach are otoliths, vertebrae, operculae, and premaxillae. Some species have scales or bony plates or dermal scutes on their skin that are useful, some (Clupeidae) have cartilaginous bullae in their skulls (Blaxter & Hunter 1982), some (e.g. sticklebacks) have readily identifiable spines. Birds that eat fresh water fish retain pharyncheal teeth and chewing pads (Veldkamp 1995a,b; Lekuona et al. 1998). Birds that eat squid or polychaete worms cannot digest the chitineous jaws of these animals (Clarke 1986; Leopold & van Damme 2003); birds that eat insects (gulls, terns, Mauco & Favero 2005) retain their exoskeletons. Seaducks that eat whole bivalve or gastropod molluscs crush the shells in the stomachs, leaving fragments that can be used for identification and back-calculation of original prey size (Dekinga & Piersma 1993; Nehls & Ketzenberg 2002; Leopold et al. 2007). Crustaceans may leave pincers or claws (crustaceans; Enckell 1980, Doornbos 1984, Adema 1991). Stomachs of birds that eat small prey may contain complete prey items (Zydelis 2000; Rodway & Cook 2002; Kraan et al. 2006); pteropods and arrow worms tend to be found only because of their fleshy remains. In bullet points:

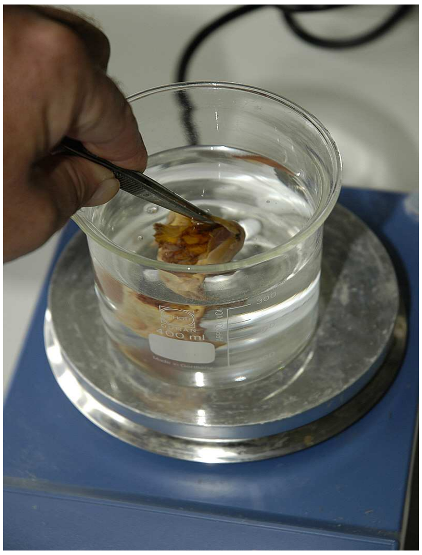
| | | | |
|---|---|---|---|
| Marine fish | • Otoliths | Crustaceans | • Carapax |
| | • Bullae | | • Claws, pincers |
| | • Vertebrae | | • Swimming paddles |
| | • Operculae, premaxillae | Molluscs | • Shells |
| | • Dermal scutes, scales, spines | | • Slot fragments |
| | • Other remarkable hard parts | Squids | • Beaks |
| Freshwater fish | • Pharyncheal teeth | Insects | • Any larger parts exoskeleton |
| | • Chewing pads | Arrow worms | • All tissue |
| Polychaetes | • Jaws | Worms | • Setae, jaws |
| Pteropods | • All tissue | Jellyfish | • All tissue |




A. Defrost samples

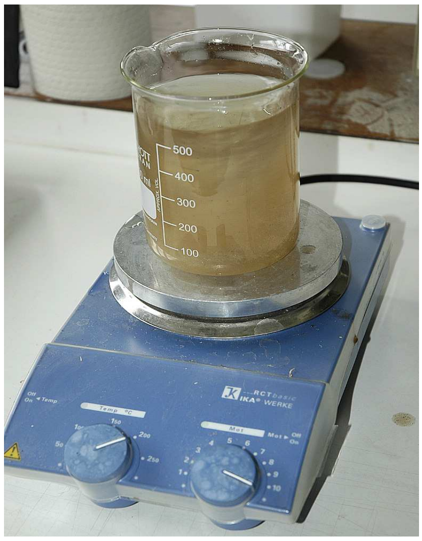
B. Place proventriculus opening down

C. Clip open (gizzard visible on top)



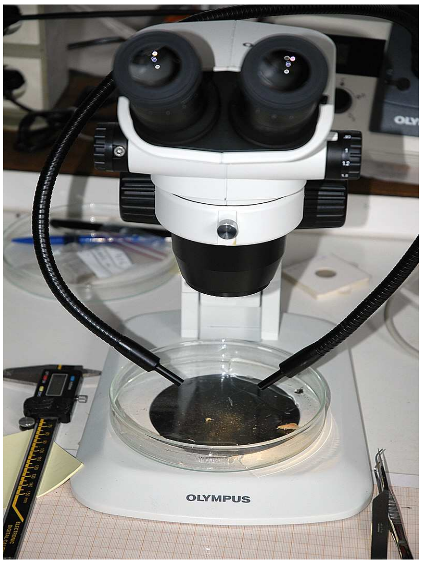
D. Rinse stomach in clean water


E. Let prey items sink



F. Stir if needed, most prey will sink later

G. Get rid of excess water




H. Pick out prey items

I. Leave prey items to dry for identification

Fig. 6. Recommended procedure to retrieve prey items from proventriculus and gizzard (see text).

**Analysis (4): sorting, identification, measuring**

Once the sorted items are dry and clean, they should be compared with a reference collection. For fish otoliths and bones published references exist and the same holds for squid beaks (see: Further reading). For other items, but in fact also for fish and squid remains, you will probably have to build up your own reference collection to facilitate identifications.

For paired items such as otoliths or jaws, matching left and right items (or upper and lower in squid beaks) should be put together if possible. This can be done by direct, visual inspection or by taking measurements. For prey that leave more than two (paired items) such as fish that may not only leave otoliths but also jaws and other bones, if possible the items belonging to the same fish should be put together but in samples that contain many similar prey this will often not be possible. Estimating the number of prey represented by the collected hard parts than becomes a matter of expert judgement. One way out of this is determining the minimum number of prey present, as the highest number of unique structures (e.g. left otoliths). If at least part of the sample may be paired, a better estimate of number of prey is possible, as the number of pairs, plus the number of remaining parts that cannot be paired and that each represent another prey.

Prey items for which regression equations are available that allow for an estimate of prey size, should be measured. This can be done by using callipers or under a microscope fitted with an reticule eyepiece. A complication is that many retrieved hard parts will have been worn down by the grinding action of the stomach and by the stomach acid. This results in a reduced size and thus in an underestimation of prey size if this wear is not corrected for. One way to deal with this is to only use “pristine” hard parts for estimating prey size but this will often greatly reduce sample size. Alternatively, the size worn items may be corrected: see Tollit *et al*. (2004) and Grellier & Hammond (2006) for appropriate methods. If more items from one prey are available, and/or if more measurements per item can be used to estimate prey size, the average of all estimates should be used to estimate prey size.

**Key publications for the identification of fish prey**

For NW European waters, a selected number of strongly recommended identification guides would be:

- Breiby A. 1985. Otolitter fra Saltvannsfisker i Nord-Norge. Naturvit. nr. 45, Univ. Tromsø, Tromsø 30pp.
- Clarke M.R., 1986. A handbook for the identification of cephalopod beaks. Oxford Sc. Publ., Clarendon Press, Oxford, 273 pp.
- Enckell P.H. 1980. Kräftdjur. Signum, Lund pp 1-685.
- Härkönen T. 1986. Guide to the Otoliths of the Bony Fishes of the Northeast Atlantic. Danbiu ApS, Biol. Consultants, Hellerup 256pp.
- Leopold M.F., Damme C.J.G. van, Philippart C.J.M. & Winter C.J.N. 2001. Otoliths of North Sea fish - Fish identification key by means of otoliths and other hard parts, version 1.0. World Biodiversity Database, CD Rom Series, ETI/NIOZ/Alterra, Biodiversity Center of ETI, Univ. of Amsterdam, Amsterdam.
- Watt J., Pierce G.J. & Boyle P.R. 1997. Guide to the identification of North Sea fish using premaxillae and vertebrae. ICES Coop. Res. Rep. No. 220, International Council for the Exploration of the Sea, Copenhagen, 231pp.

**Reporting data**

Data can be summarised in various ways and it is best to use several, as they all provide a different perspective. Relative importance of different prey in the diet of a given predator can be assessed in different ways. The first is to calculate, for each prey species found, the frequency of occurrence (percentage of stomachs that contain prey, in which a particular prey species was found). This overestimates the importance of rare prey: one item found in a stomach will count as much as one hundred found in another stomach. This is taken care of by calculating the relative abundance of prey (total number of a particular prey species relative to all prey found). This however, overestimates the importance of small, numerous prey. If all prey can be converted to prey mass, it is also possible to calculate relative biomass of each prey. Finally, specific biomasses may be converted to energy contents (that may greatly differ between various prey species). Other complications involve different probabilities that hard parts of different species are retained in stomachs and guts. Thus, prey with very hardy parts may be overestimated (squid beaks, for instance, may be kept in stomachs for weeks after ingestion) and species that have no, or very small hard parts may be underestimated. Several methods have been devised to deal with this problem (in part) such as constructing indices of relative prey importance that incorporate several of the indices mentioned above (see e.g. Amundsen *et al*. 1996; Bugoni & Vooren 2004; Ringelstein et al. 2006; Tollit *et al*. 2007).

**Materials needed for the work**

Instruments and disposables needed for sampling and studying seabird diets include plastic bags to collect stomachs in a deep freezer callipers, permanent markers, A4 clip-boards, datasheets, pens, scissors, callipers, 400-600ml glass jars, water bottles with spout, petri discs for sorting and drying/storing, a microscope and pincers, Eppendorf cups and/or other glass or plastic containers for storage. Optional magnetic stirrer(s) for processing samples. Suggestions are shown in the shopping list for diet studies, associated with this manual. {Shopping list diet studies}

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

### External observations including biometrics of stranded seabirds

A carcass is first thoroughly examined from the outside and relevant biometrical data are collected when possible. If a standard autopsy can be avoided, that is if age, sex and possible origin can be deduced from external observations, this would save time and costs. In spills where large quantities of oil are found on carcasses, external observations are seriously hindered. Bill and feet may have to be localised 'by touching' and it should be realised that whatever observations are done, a thorough check for the presence of rings (legs, neck), wing tags (forewing) or electronic devices (leg, back) is of the greatest importance.

Standard procedure: carcasses of ringed or tagged birds should be kept aside for later inspection, not matter how incomplete the carcass may be. Ringed or tagged birds, particularly those where the exact age is known (ringed as chicks) are very important to further develop these protocols and to check biometrics and ageing characteristics used in these manuals. As a general rule: birds with a somehow known history are of vital importance for the calibration of ageing techniques and as checks for the analysis of breeding origin. These carcasses should therefore be treated with care.

**Identification**

The identification of bird carcasses is very different from the identification of birds in field situations. Good birders obviously do not necessarily make good pathologists, but even their ordinary identification skills will be challenged when carcasses are oiled, rotten, partly scavenged, or simply when birds are held dead in the hand rather than in pristine condition some metres distance away. Field guides do not necessarily provide the most relevant characteristics for lab conditions, although it is important to have some copies at hand for consultation. Carcasses can be heavily oiled or utterly incomplete, and vital characteristics may simply not be available for inspection. Field guides do not generally provide basic biometrics that could be helpful to make decisions on the specific identity of a bird in the hand, and hand books are not always readily available.

Technical documents have been provided with this handbook, summarising important information from a variety of sources. Species specific information is provided, arranged per family, focusing on general distribution patterns, geographical variation, biometrics, and identification guidelines (including sex and age from external characteristics). Many of these texts lean heavily on the standard handbooks:


- Cramp S. & Simmons K.E.L. (eds) 1977. The Birds of the Western Palearctic, 1. Oxford Univ. Press, Oxford.
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but also on numerous papers, other books and unpublished material. Note that the citations of the literature used in these technical documents **will not and cannot replace the original sources**! The technical documents are meant for quick reference only, they will be constantly updated and advice to improve these texts and tables will be greatly appreciated! The following bird families have been described, or are currently under preparation.

Bird families

- Gaviidae
- Podicipedidae
- Procellariidae
- Hydrobatidae
- Sulidae
- Phalacrocoracidae
- Phaethontidae
- Anatidae
- Phalaropodinae
- Stercorariidae
- Laridae
- Sternidae
- Alcidae

Potential co-authors are invited to improve these texts, or contribute to them by adding or replacing chapters, data or illustrations, so that we would end up with the best possible quick-reference information for the most important taxa in case of an oil spill, anywhere in Europe.

**Ageing**
For all birds in which the age can be deduced from plumage characteristics, autopsies may not be needed. The technical documents on bird families summarise information on external ageing characteristics.

**Sexing**
For all birds in which the sex can be deduced from plumage characteristics or biometrics, autopsies may not be needed. The technical documents on bird families summarise information on external sexing characteristics.

**Biometrics**
Different species may have different body parts to measure, but conventional measurements are used and even preferred whenever possible. The standard handbooks normally provide us with bill length, wing length, tarsus length and body mass. Each of these should be measured according to internationally accepted protocols and deviations should be very clearly indicated.

Other common measurements include bill depth, head length, tail-length, and sternum length. Each of these would need an explanation. Even more specific measurements are for example bill width, cutting edge of mandible length, tube length, nail length, toe length, tail streamer length, etcetera. For species-specific measurements, see the technical documents on bird families. The most common measurements are explained here:

**Key measurements: bill length, wing length and tarsus**


Figure 1. Bill length, tip to feathers, measured in a Red-throated Diver. Exactly where the feathers starts is easy in most species, but hard to judge in some. Avoid measuring wide areas of naked skin around the mandible horn.

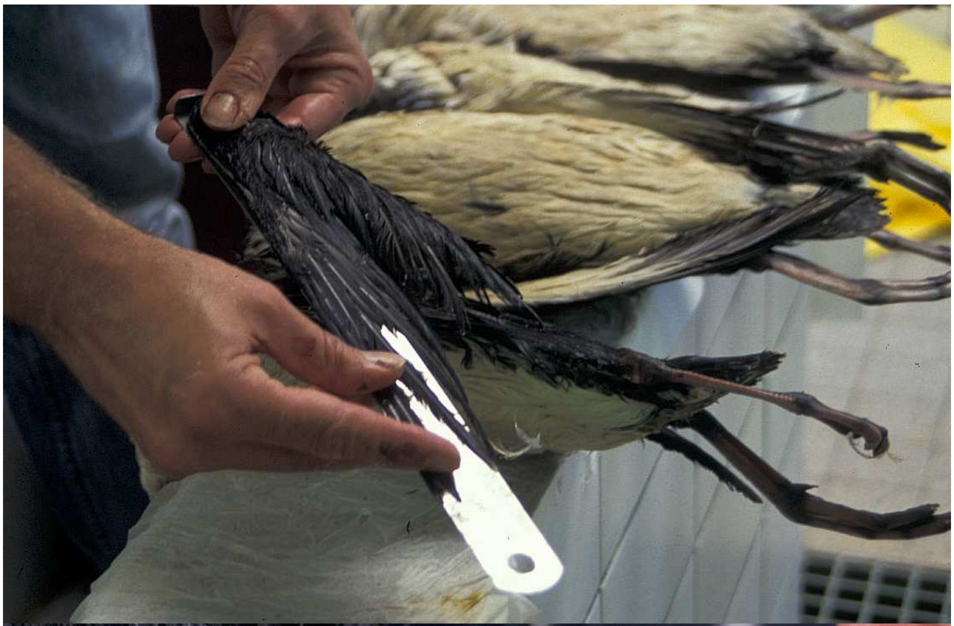

Figure 2. Wing length, flattened chord, measured in a Red-throated Diver. A ruler with a stop is required for proper measurements, find out which feather(s) should be the longest (see 'Structure' in the Technical documents on bird families) to confirm that the wing is 'fit' to be measured, stretch and flatten the primaries as shown (this method is also referred to as 'wing length max').

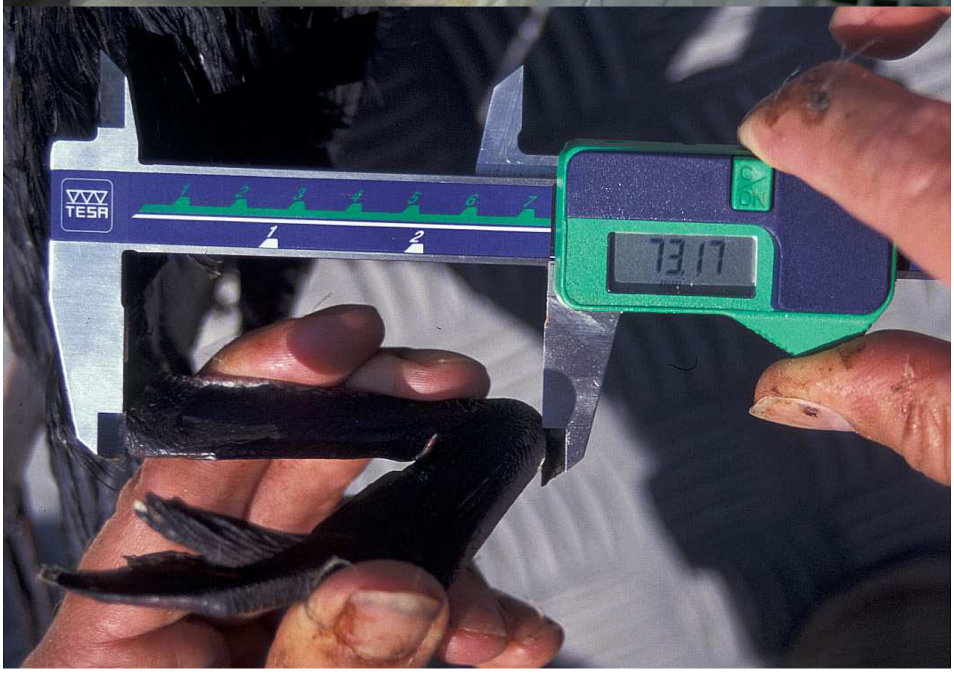


Figure 3. Tarsus length, measured in a Red-throated Diver. Measure from the notch at the back of the intertarsal joint to the distal edge of the last large complete scale at the front of the foot, just before the toes deverge. The foot is gently bent down at right angles to the tarsus to expose the last large scale.

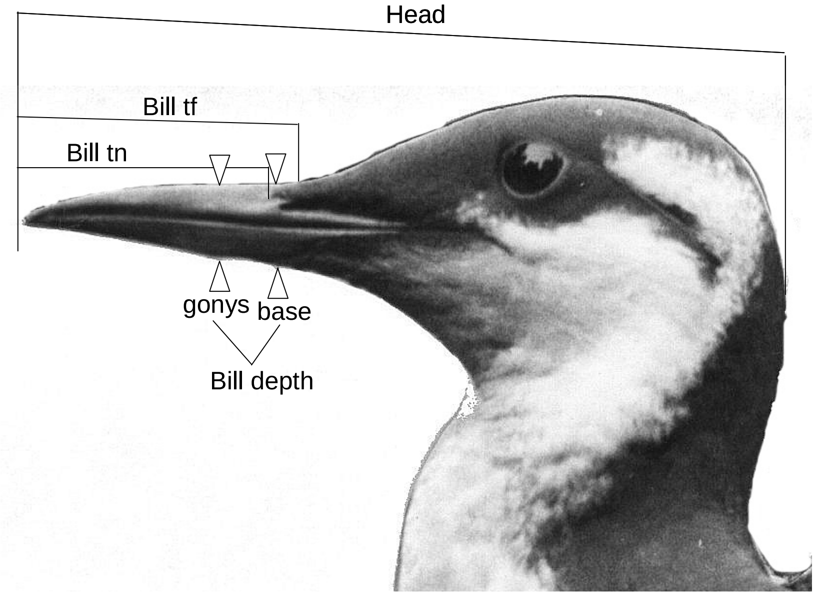


Figure 4. Further common measurements include total head (Head), bill from tip to nostril, bill depth at base, and bill depth at gonys, here illustrated on a Common Guillemot. Callipers are required for each of these, but it should be noted that in Norther Gannets, ordinary callipers may be difficult to use when the total head needs to be measured. Some species do not have a clear gonys, in which case that measurement should be skipped.

For total head (Head), bend the head as illustrated and firmly hold the callipers against the back of the head.

For bill depth (bill gonys and base), make sure the beak is empty (no sand, no dried blood to influence the result).

For nostril to tip (Bill tn), hook the callipers into the nostril and stretch to find the bill tip.

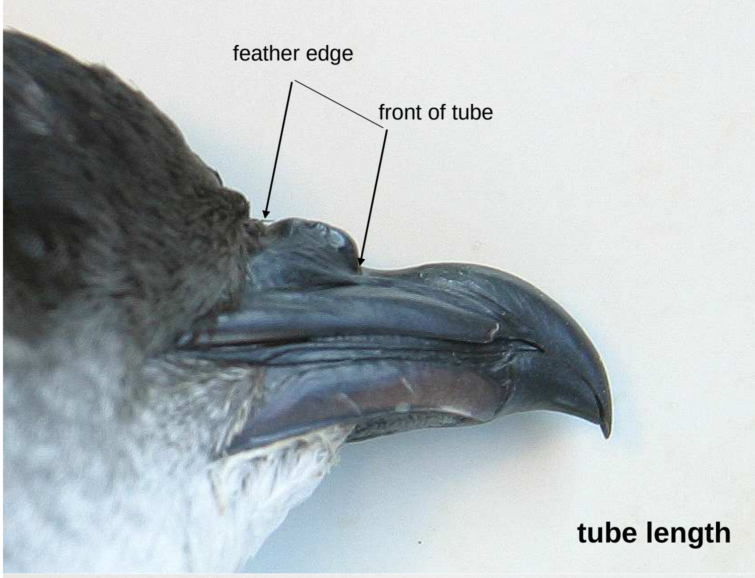


Figure 5. Tube length is a measurement that is commonly used in Procellariidae and Hydrobatidae.

(Measurements are shown on the bill of a Common Diving Petrel *Pelecanoides urinatrix*)

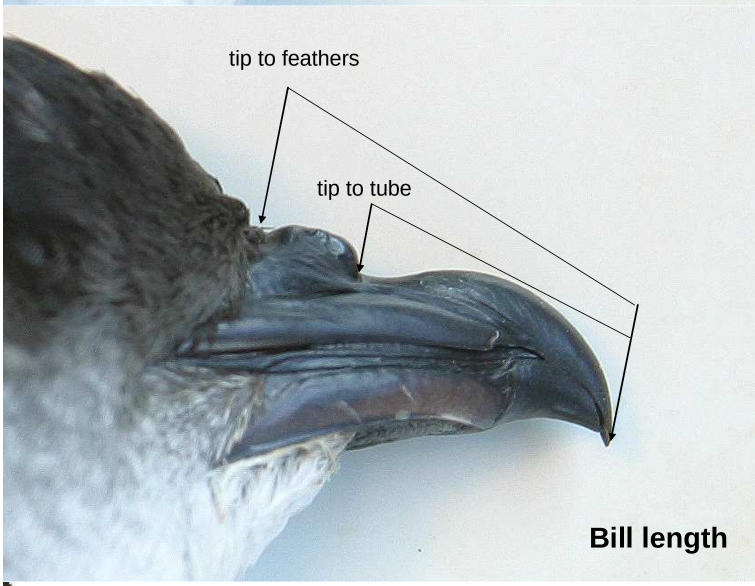


Figure 6. Other common measurements in Procellariidae and Hydrobatidae, from which tube length may in fact be calculated, are bill length tip to feathers (bill tf) and bill length tip to tube.

(Measurements are shown on the bill of a Common Diving Petrel *Pelecanoides urinatrix*)

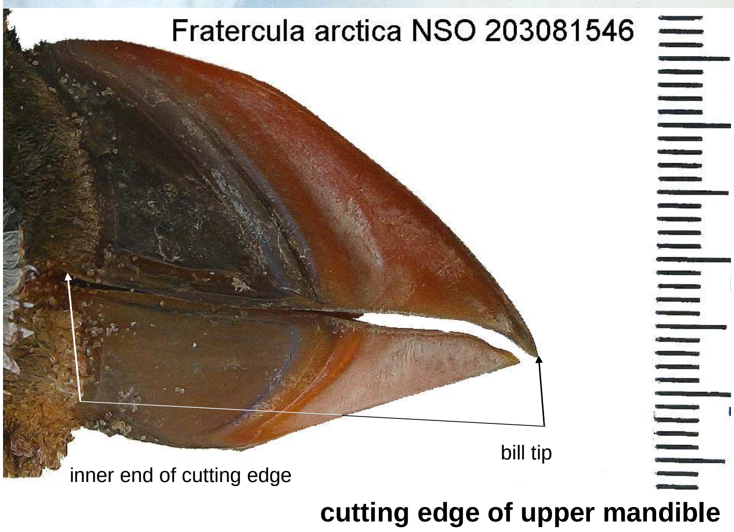


Figure 7. Atlantic Puffins have complicated bills and a rather different bill morphology in winter than in summer.

One of the standard measurements for puffins is the length of the cutting edge of the upper mandible, as shown in this photo, from the inner end of the cutting edge to the bill tip.

**Instruments needed**

Instruments needed external observations are a few callipers, wing rulers, a balance, disposable vinyl or latex protective gloves, protective clothing and perhaps mouth caps (to avoid inhaling hydrocarbons or pathogens), A4 clip-boards, datasheets, pens, plastic bags for the collection of particular carcasses. Nearby deep-freezing facilities are strongly recommended. An illustrated shopping list is provided {external observation shopping list}, in bullet points the following pieces of equipment are essential:

- Wing rulers of 30 cm and a 50 cm length with a stop at 0 cm should both be available. Note that wing rulers of >50cm are required in spills affecting Northern Gannets!
- A balance (electronic or otherwise), should be capable of weighing up to 5 kg with an accuracy of at least 5g. An additional, smaller balance (up to 2 kg, accuracy 2g) would be welcome.
- Electronic callipers are nice to work with, but they have a tendency to give up without prior notice (batteries run typically empty) and don't work when wet or dirty.
- Strong cardboard or plastic labels, with string or tie rips to attach labels to carcasses, permanent marker.
- Plastic bags for storage of carcasses that need to be kept in the deep freezer
- Protective gloves and clothing
- Data sheets and pens

**References**

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**Citation**

C.J. Camphuysen[1] 2007. External observations including biometrics of stranded seabirds. Technical documents 4.1, Handbook on Oil Impact Assessment, version 1.0. Online edition, www.oiledwildlife.eu

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# HANDBOOK ON OIL IMPACT ASSESSMENT

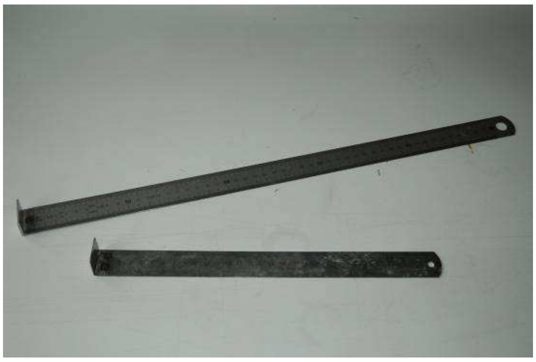
## 4.0 SPILL RESPONSE 4.1 Assessing the damage

### Shopping list
### Biometrical examination of stranded seabirds

Note! Any brands or types depicted are suggestions, no prescriptions

Instruments needed for an external examination of stranded seabirds include callipers, wing rulers, a balance, A4 clip-boards, datasheets, pens, disposable vinyl or latex protective gloves, and plastic bags to collect carcasses in a deep freezer. Optional protective clothing and mouth caps (to avoid inhaling hydrocarbons or pathogens). Suggestions are shown below

**Instruments and disposables needed**



**Wing ruler**

A 30 cm and a 50 cm ruler with a stop at 0 cm.

**Balance**

A balance (electronic or otherwise), including at least one capable of weighing up to 5 kg with an accuracy of at least 5g.

**Callipers**

Electronic callipers are nice to work with, but they have a tendency to give up and note that batteries are typically empty and need replacement


**Protective gloves**

L size are suitable for most hands, some people are allergic for latex gloves, vinyl gloves tend to be stronger and are not so easily punctured. One pair per 5 birds minimum.

**Clipboard and datasheets**

The provided datasheets with this handbook are A4 size, plenty pens for writing.

**Strong labels and waterproof pens**

Strong cardboard or plastic labels, with string or tierips to attach labels to carcasses, permanent marker.

**Plastic bags for corpse storage**

Plastic bags to collect entire carcasses for deep freezing.

## Optional instruments and disposables

**Mouth caps**

The provided datasheets with this handbook are A4 size


**Protective clothing**

Disposable protective clothing may be recommended in certain conditions.

Version 1.0

**Shopping list associated with:**

C.J. Camphuysen[1] 2007. Collection biometrical data: post-mortem examinations of stranded seabirds. Technical documents 4.1, Handbook on Oil Impact Assessment, version 1.0. Online edition, www.oiledwildlife.eu

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# HANDBOOK ON OIL IMPACT ASSESSMENT

Version 1.1

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

### **Alcidae** Auks

Circumpolar, exclusively marine, neritic and pelagic, 11 genera, 22 species, 45 taxa (del Hoyo *et al.* 1996)

Auks are small to moderately large, highly aquatic, diving, marine seabirds, most abundant in the European arctic, subarctic and temperate zones, wintering in coastal and offshore waters around Europe, excluding the eastern Mediterranean and Black Sea. Auks are highly vulnerable to oil pollution and casualties were prominently represented in most of the major European oil spills. Six species regularly occur within Europe. Identification of auks is easy, but ageing requires specialists' input. Biometrical data are useful because of geographical variations (clines) in body size. Subspecies are subject of taxonomic debate.

| Euring | Species* | Distribution, status in Europe |
|---|---|---|
| 6470 | **Little Auk** *Alle alle* | E Baffin Isl through Greenland (and Iceland) to Jan Mayen, Spitsbergen, Bear Island and Novaya Zemlya (*alle),* Franz Josefland and Severnaya Zemlya east to Bering Sea(*polaris*); European status: **secure** |
| 6340 | **Guillemot** *Uria aalge* | E North America, Greenland and Iceland, through Faeroes and Scotland to S Norway and Baltic Sea (*aalge)*, Ireland and S Britain through Brittany to W Iberia and Helgoland (*albionis),* Svalbard, Jan Mayen through N Norway and Murmansk to Novaya Zemlya (*hyperborea*); European status: **secure** |
| 6350 | **Brünnich's Guillemot** *Uria lomvia* | NE Canada to Gulf St Larwence, Greenland east to Franz Josefland (*lomvia*), E Taymyr Peninsula to New Siberian Islands (*eleonorae*). European status: **vulnerable** |
| 6360 | **Razorbill** *Alca torda* | E North America, Greenland and east to Bear Island, Norway, Denmark, Baltic Sea region, Murmansk and White Sea (*torda*), Iceland, Faeroes, Britain, Ireland east to Helgoland, Channel Isl and NW France (*islandica*). European status: **secure** |
| 6380 | **Black Guillemot** *Cepphus grylle* | Arctic E North America south to Labrador and N Newfoundland, Greenland W and E, Jan Mayen and Svalbard, through E Siberia to N Alaska (*mandtii*); North America (south of *mandtii*) and S Greenland to British Isl, Norway, SW Sweden, Denmark, Murmansk and White Sea (*arcticus*); Iceland (*islandicus*); Faeroes (*faeroeensis*); Baltic Sea (*grylle*). European status: **depleted** |
| 6540 | **Atlantic Puffin** | NE Canada and NW and E Greenland to Jan Mayen, Svalbard and Novaya Zemlya (*naumanni*), SE Baffin and Hudson Bay south to Maine and east through S Greenland and Iceland to Bear Island and C & N Norway, Kola Peninsula and S Novaya Zemlya (*arctica*), Faeroes, S Norway and SW Sweden, south though British Isles to Channel Is and NW France (*grabae*). Europea status: **depleted** |

*Other taxa on AERC TAC Checklist of bird taxa occurring in Western Palearctic region: *Brachyramphus perdix* (Kamchatka and Sea of Okhotsk), *Aethia cristatella* (Bering Sea), *Aethia psittacula* (Bering Sea), *Synthliboramphus antiquus* (Bering Sea), and *Lunda cirrhata* (N Pacific).

Common Guillemot, Razorbill, Atlantic Puffin and Little Auk, as a demonstration of differences in size

**External features:**

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| **Age** | adult,<br>immature,<br>juvenile | Bill and or plumage characteristics; does require expertise in most cases | A<br>I<br>J |
| **Plumage** | winter<br>transitional<br>summer (breeding) | Plumage characteristics, head pattern and or bill, all body in *Cepphus* | W<br>T<br>B |
| **Morph** | bridled<br>not bridled | Bridled morph in *Uria aalge* | bridled<br>not bridled |
| **Sex** | male<br>female | Sexes alike, males generally slightly larger | M<br>F |
| **Colour phase** | | *none* | |
| **Biometrics** | Bill length 1 | Bill tip to feathers (0.1 mm) | Bill tf |
| | Bill length 2 | Bill tip to nostril (0.1 mm) | Bill tn |
| | Bill depth 1 | Bill depth at base (0.1 mm) | Bill base |
| | Bill depth 2 | Bill depth at gonys (difficult in *Fratercula*, important in *Alca)* (0.1 mm) | Bill gonys |
| | Mandible | Typical for Puffins, measure the lower (cutting) edge of the upper mandible from the bill tip to the anterior edge of the cere (0.1mm) | Mandible |
| | Head length | (mm) | Head |
| | Wing length | (mm) | Wing |
| | Tarsus length | (mm) Can be difficult in guillemots | Tarsus |
| **Priority** | Bill tf – Bill base – Bill gonys/Mandible - Head - Wing | | |

| Structure | Primaries | Longest primary | Tail feathers | Shape of tail |
|---|---|---|---|---|
| *Alle alle* | 10 + 1m | P10 | 12 | short, rounded |
| *Uria aalge* | 10 + 1m | P10 | 12 | short, rounded |
| *Uria lomvia* | 10 + 1m | P10 | 12 | short, rounded |
| *Alca torda* | 10 + 1m | P10 | 12 | pointed |
| *Cepphus grylle* | 10 + 1m | P10 | 12 (13-14) | long, rounded |
| *Fratercula arctica* | 10 + 1m | P10 (≥P9) | (14-)16 | rounded |

**General characteristics** (from BWP*i* 2006): Small to moderately large seabirds, exclusively marine. Bodies elongated; depending on shape of thorax and length of sternum and particularly of pelvis which is most elongated in *Uria*. Sexes similar in size. Necks short, wings short and narrow. 11 primaries but p11 minute. 16–21 secondaries. Tails mostly short, rounded to wedge-shaped; 12–16 feathers. Bills highly variable: short and stubby in *Alle*; long and pointed in *Cepphus* and *Uria*; long and laterally compressed in *Alca*; deep, laterally compressed in *Fratercula*. Tarsi rather short, laterally flattened. Toes strong, 3 front ones fully webbed; hind toe absent or vestigial. Plumages typically dark (brown or black) above and white or whitish below. *Cepphus* largely dark in breeding plumage, predominantly white in non-breeding. Sexes alike. Feathers dense with numerous feather tracts and down covering whole body. Bare-part colours variable, bills black, but sometimes brightly coloured. Post-breeding moult complete, flight-feathers simultaneous; pre-breeding moult slight, involving small feathers only and often restricted to head, neck, and chest. Juvenile plumages resemble adult breeding in general colour pattern. Adult plumage acquired at 3–15 months.

**Basic biometrics** (summarised)

| Species | sex | Bill tf | Wing | Tarsus | depth |
|---|---|---|---|---|---|
| *Alle alle alle* | ♂ | 15-17 | 116-127 | 19-22 | |
| | ♀ | 13-17 | 116-125 | 19-22 | |
| *Alle alle polaris* | ♂ | 15-17.5 | 124-138 | 20-23 | |
| | ♀ | | 129-137 | | |
| *Uria aalge aalge* | ♂ | 44-51 | 194-209 | 36-41 | 12-14[1] |
| | ♀ | 43-51 | 198-218 | 36-42 | 12-14[1] |
| *Uria aalge albionis* | ♂ | 44-50 | 191-203 | 37-38 | 12-14[1] |
| | ♀ | 44-48 | 190-200 | 37-39 | 12-14[1] |
| *Uria aalge hyperborea* | ♂ | 46-52 | 208-219 | 39-43 | 13-15[1] |
| | ♀ | 43-50 | 210-225 | 39-42 | 13-15[1] |
| *Uria lomvia* | ♂ | 36-44 | 205-229 | 35-40 | 21-23[1] |
| | ♀ | 35-42 | 202-227 | 36-40 | 20-23[1] |
| *Alca torda torda* | ♂ | 32-39 | 201-216 | | 23-27[1] |
| | ♀ | 32-37 | 201-216 | | 22-25[1] |
| *Alca torda islandica* | ♂ | 31-39 | 187-200 | 28-33 | 19-22[1] |
| | ♀ | 31-34 | 194-200 | 27-31 | 19-21[1] |
| *C. grylle grylle* | ♂ | 30-35 | 169-180 | | 11-12[2] |
| | ♀ | 32-35 | 169-182 | | 10-12[2] |
| *C. grylle mandtii* | ♂ | 30-36 | 168-177 | 29-32 | 9-11[2] |
| | ♀ | 29-34 | 164-174 | 28-32 | 9-10[2] |
| *C. grylle arcticus* | ♂ | 30-35 | 157-171 | 30-33 | 10-12[2] |
| | ♀ | 29-34 | 159-166 | 29-32 | 10-11[2] |
| *C. grylle faeroeensis* | ♂ | 29-34 | 153-162 | 30-33 | 10-11[2] |
| | ♀ | 27-35 | 155-162 | 30-33 | 9-11[2] |
| *C. grylle islandicus* | ♂ | 28-32 | 152-168 | 29-33 | 9-11[2] |
| | ♀ | 26-31 | 153-165 | 30-32 | 8-11[2] |
| *Fraterc. a. naumanni* | ♂ | 45-57[3] | 159-193 | | 35-48[2] |
| | ♀ | 43-60[3] | 156-191 | | 35-49[2] |
| *Fratercula a. arctica* | ♂ | 41-52[4] | 159-178 | 26-29 | 35-42[2] |
| | ♀ | 40-50[4] | 154-175 | 25-29 | 32-40[2] |
| *Fratercula a. grabae* | ♂ | 41-51[4] | 140-174 | | 31-41[2] |
| | ♀ | 38-48[4] | 146-168 | | 27-38[2] |

[1]depth at gonys; [2]depth at base, [3]incl. horny rim at base, [4] excl. horny rim

**Geographical variation**

Indications of subspecies for convenience only; in most cases, subspecies are poorly differentiated, differences being part of irregular variation or clinal, conservative view followed here.

Common Guillemot (from BWP*i* 2006): Polytypic. Nominate *aalge* eastern Canada, Greenland, Iceland, Faeroes, Scotland north of c. 55°38′N, Baltic, and Norway north to c. 69°N; *albionis* Britain south of c. 55°38′N, Ireland, Helgoland, Brittany, and western Iberia; *hyperborea* Norway north of c. 69°N, coast of Murmansk, Bear I sland, Jan Mayen, Spitsbergen, Novaya Zemlya. Extralimital: *californica* California; *inornata* North Pacific.

Bridled morph confined to Atlantic and arctic populations, percentage increasing gradually from south to north: western Iberia 0%, England 1–5%, Scotland 6–17%, Iceland 7–53%, southern Norway 12.5%, northern Norway 19–25%, Bear Island 57%, Novaya Zemlya 36–50%. Colour variation of upperparts, head, and neck more or less clinal. *U. a. albionis* paler, less blackish, than nominate *aalge*; Bear Island and Jan Mayen birds dark. Birds from Bear Island, Jan Mayen, Faeroes, and Shetland mostly heavily streaked on flanks, those of Baltic and southern Britain with few streaks, birds from Iceland and Scotland intermediate. Heavy spotting on under wing-coverts in birds from Bear Island, Jan Mayen, Faeroes, and Shetland, intermediate in Scotland and Iceland, few or none in rest of Britain, Baltic, Iberia; variable in Norway. Variation in size more or less clinal, wing length increases with latitude. Variation in average bill length irregular. Bill depth and length of middle toe show no distinct trend; in Atlantic. Races poorly differentiated, differences being part of clinal or irregular variation.

Brünnich's Guillemot (from BWP*i* 2006): Polytypic. Nominate *lomvia* arctic North Atlantic from eastern Canada east to Franz Josef Land and Novaya Zemlya. Extralimital: *eleonorae*, eastern Taymyr peninsula, east to Novosibirskiye Ostrova; *heckeri* Wrangel and Herald Islands; *arra* North Pacific. Colour variation difficult to evaluate. *U. l. eleonorae* and *heckeri* said to average paler and arra darker than nominate *lomvia*. Variation in length of wing, culmen, and tarsus and depth of bill more or less clinal, with larger averages occurring in eastern part of range (see Glutz and Bauer 1982). *U. l. heckeri* and *eleonorae* also poorly differentiated on size and probably better assigned to *arra*.

Razorbill (from BWP*i* 2006): Polytypic. Nominate *torda* North America, Greenland, Bear Island, Denmark, Norway, Murmansk to White Sea, and Baltic region; *islandica* Iceland, Faeroes, Britain, Ireland, and Brittany. Nominate *torda* larger than *islandica*). *A. t. pica*, sometimes recognized, comprising breeding birds of coast of Norway, Murmansk, western Greenland, and eastern Canada; based on presence of 3rd uncoloured furrow in more than half of the number of adult specimens, but feature less common than that and because of overlap with other races recognition not warranted.

Black Guillemot (from BWP*i* 2006): Polytypic. Nominate *grylle* Baltic Sea; *mandtii* arctic North America, Canada, Newfoundland, western Greenland south to c.72°N, eastern Greenland south to c.69°N, Jan Mayen, Bear Island, and Spitsbergen, east to eastern Siberia and northern Alaska; *arcticus* North America, southern Greenland (south of *mandtii*), Britain, Ireland, western Sweden, Denmark, Norway, Murmansk, and White Sea; *faeroeensis* Faeroes; *islandicus* Iceland.

Complex; widely differing opinions concerning subspecific assignment of local populations. In adult non-breeding plumage, *arcticus* and nominate *grylle* have much less white on upperparts than *mandtii.* In juveniles of nominate *grylle*, *arcticus*, *faeroeensis*, and *islandicus*, upperparts entirely black or with some mottling on neck and rump. Compared with other populations, birds from Iceland and Faeroes are shortwinged, those from Baltic long-winged. In high Arctic (north of 70°N), weak clinal increase in wing length from west to east. Birds from Baltic, however, on average have even longer wings than those from Wrangel Island (eastern Siberia). In western Greenland, cline of increasing wing length from north to south. Large mean bill length in Baltic, rather short in Iceland. Variation in bill depth (at base) slight and irregular; averages rather small in Canada, eastern Greenland, and Spitsbergen, largest in Baltic. Tarsus increases clinally from northern Baffin Island to Maine; increases from north to south in western Greenland; largest in Baltic. Variation exists in amount of white on greater wing-coverts in wing-patch and extent of white on inner web of primaries. Birds from high Arctic having no or almost no black at base of feathers. In Iceland, black base of greater coverts is rather large and extends along margin of outer web as thin streak. Of other populations, birds from Faeroes show greatest extension of black. Also variation in non-breeding and juvenile plumage, birds from high Arctic in both plumages being whiter on upperparts than birds from south. Thus, geographical variation probably best expressed by recognition of 5 races: *C. g. grylle, mandtii, arcticus, faeroeensis*, and *islandicus*.

Little Auk (from BWP*i* 2006): Polytypic. Nominate *alle* Ellesmere Island (Canada), Greenland, Grimsey (Iceland), Jan Mayen, Bear Island, Spitsbergen, and Novaya Zemlya; *polaris* Franz Josef Land. Not certainly known which race breeds on Severnaya Zemlya and in North Pacific. Geographical variation involves size only. Measurements of birds from Severnaya Zemlya and North Pacific unknown, hence subspecific status undecided.

Atlantic Puffin (from BWP*i* 2006): Polytypic. Nominate *arctica* Iceland, central and northern Norway, Bear Island, southern Novaya Zemlya, south-west Greenland, and eastern North America; *grabae* Britain, Ireland, Faeroes, Channel Islands, France, and southern Norway; *naumanni* north-west and eastern Greenland, Spitsbergen, and northern Novaya Zemlya. Involves size only. Traditional division into races followed here but size increases clinally from south to north, making delimitation arbitrary because adjacent populations show much overlap.

Variation in Norway clinal: in southern Norway, average wing 162.7 mm (from skins), in Finnmark (nominate *arctica*), wing 173.7mm. Birds of Murmansk coast considered intermediate between nominate *arctica* and *naumanni* (Salomonsen 1944, Vaurie 1965). Jan Mayen birds considered *naumanni* (Camphuysen 1990) Delimitation of races further complicated by birds from northern Iceland being significantly larger than those from southern Iceland (Petersen 1976b); Harris (1979) reported significant differences in size between birds from north-west and south-east Scotland.

**Specific biometrics**

**European cline in wing length of Common Guillemots *Uria aalge***

| Subspec | | Min | Max | Mean | SD | Sample | Origin | * |
|---|---|---|---|---|---|---|---|---|
| *albionis* | | 188 | 201 | 195.5 | 4.3 | 12 | Berlengas, Portugal | 1 |
| *albionis* | | 185 | 210 | 197.6 | 4.8 | 84 | Skomer, 52°N Wales | 2 |
| *albionis* | | 194 | 209 | 199.5 | 3.7 | 35 | Gt Saltee, 52°N Ireland | 2 |
| *aalge* | | 192 | 212 | 200.9 | 4.8 | 351 | Isle of May, 56°N Scotland | 2 |
| *aalge* | | 193 | 210 | 201.2 | 4.4 | 46 | Graesholm, 55°N Baltic | 2 |
| *aalge* | ♂ | 187 | 218 | 202.8 | | 245 | NL winter material | 3 |
| *aalge* | ♀ | 188 | 221 | 203.3 | | 205 | NL winter material | 3 |
| *aalge* | | 191 | 215 | 203.6 | 4.2 | 104 | Caithness, Scotl Jun-Jul | 4 |
| *aalge* | | 193 | 210 | 203.6 | | 15 | NL winter material, (53°N) | 3 |
| *aalge* | | 195 | 210 | 203.6 | 3.6 | 39 | Troup Hd 57°N Scotland | 2 |
| *aalge* | | 193 | 215 | 203.8 | 4.8 | 91 | Canna, 57°N Scotland | 2 |
| *aalge* | | 196 | 219 | 206.6 | 4.3 | 252 | Fair Isle, 59°N Shetland | 2 |
| *aalge* | | 200 | 212 | 207.0 | 3.0 | 19 | Esturoy, 62°N Faeroe | 2 |
| *aalge* | | 199 | 216 | 207.2 | 3.5 | 60 | Grimsey, 67°N Iceland | 2 |

| Subspec | Min | Max | Mean | SD | Sample | Origin | * |
|---|---|---|---|---|---|---|---|
| *aalge* | 196 | 217 | 207.3 | 4.7 | 65 | Noss, 60°N Shetland | 2 |
| *aalge* | 198 | 214 | 207.3 | 4.0 | 38 | Foula, 60°N Shetland | 2 |
| *aalge* | 202 | 223 | 209.6 | 5.2 | 68 | Røst, 68°N Norway | 2 |
| *hyperborea* | 199 | 223 | 210.5 | 5.5 | 95 | Vardø, 70°N Norway | 2 |
| *hyperborea* | 203 | 219 | 212.1 | 5.6 | 7 | Jan Mayen ad breeding | 5 |

***Source** [1]Hope Jones 1984; [2]Hope Jones 1988; [3]CJ Camphuysen NZG/NSO; [4]Mudge & Aspinall 1985; [5]Camphuysen 1990

**Wing length Atlantic Puffin**

| Puffin subsp | Min | Max | Mean | SE | Sample | Origin | * |
|---|---|---|---|---|---|---|---|
| *grabae* | 152 | 162 | 157.9 | 1.6 | 12 | Channel Islands, 49.5°N | 11 |
| *grabae* | 144 | 170 | 158.2 | 0.2 | 495 | St Kilda, 57.8°N | 11 |
| *grabae* | 146 | 170 | 158.3 | 0.5 | 158 | Skomer, 52°N Wales | 2 |
| *grabae* | 148 | 170 | 158.6 | 0.4 | 129 | Shiant Isles, 57.83°N | 11 |
| *grabae* | 153 | 168 | 159 | 0.7 | 31 | Sule Skerry, 59.1°N | 11 |
| *grabae* | 148 | 166 | 159.1 | 0.4 | 81 | Flannan Isles, 58.25°N | 11 |
| *grabae* | 152 | 171 | 159.3 | 0.2 | 209 | Skomer, 52°N Wales | 1 |
| *grabae* | 154 | 167 | 160 | 0.5 | 61 | Fair Isle, 59°N Shetland | 11 |
| *grabae* | 156 | 166 | 160.1 | 0.6 | 29 | Faeroe Isl, 62°N | 6 |
| *grabae* | 151 | 173 | 161.4 | 0.3 | 197 | Hermaness, 60.8°N Shetl | 11 |
| *grabae* | 149 | 176 | 161.8 | 0.1 | 1615 | Isle of May, 56°N Scotland | 11 |
| *arctica* | 154 | 172 | 162.6 | 0.8 | 21 | WestmIsl Iceland, 63.4°N | 6 |
| *grabae* | 158 | 168 | 162.6 | 0.5 | 31 | Farne Isl. 55.6°N England | 11 |
| *grabae* | 158 | 173 | 162.7 | 1.0 | 16 | Rott-Begla, 58°N Norway | 7 |
| *grabae* | | | 163.5 | 1.3 | 38 | Kjor, 58.1°N Norway | 11 |
| *grabae* | 160 | 175 | 167.4 | 0.9 | 22 | Runde, 62.4°N Norway | 7 |
| *grabae* | 160 | 175 | 167.4 | 0.6 | 41 | Runde, 62.4°N Norway | 11 |
| *arctica* | 162 | 177 | 167.5 | | 6 | Bear Island, 74.5°N | 9 |
| *arctica* | 158 | 178 | 167.7 | 0.3 | 190 | Lovunden, 66°35'N Norw | 4 |
| *arctica* | 159 | 173 | 168.3 | 1.3 | 13 | Baer, 65.3°N Iceland | 6 |
| *arctica* | 160 | 180 | 168.5 | 0.5 | 84 | Lofoten, 68°N Norway | 7 |
| *arctica* | 169 | 173 | 170.8 | 0.9 | 4 | Grimsey, 67°N Iceland | 11 |
| *naumanni* | 161 | 182 | 171.4 | 0.31 | 225 | Newfoundland, 48°N | 5 |
| *arctica* | 165 | 178 | 173.4 | 1.2 | 12 | Troms, 68.5°N Norway | 7 |
| *arctica* | 150 | 190 | 173.7 | | 38 | Murmansk, 69.5°N Russia | 3 |
| *arctica* | 168 | 184 | 175 | 0.7 | 33 | Gjesvaer, 71°N Norway | 11 |
| *naumanni* | 164 | 181 | 175.2 | | 7 | Jan Mayen, 71°N | 9 |
| *arctica* | 162 | 188 | 175.6 | | 14 | Novaya Zemlya, 73°N | 3 |
| *naumanni* | 175 | 194 | 183 | | 14 | NW Greenland, 78°N | 8 |
| *naumanni* | 175 | 195 | 183.8 | | 48 | Svalbard, 78°N | 9 |
| *naumanni* | 178 | 187 | 184 | 1.0 | 14 | Svalbard, 78°N | 11 |
| *naumanni* | 177 | 195 | 184.2 | 6.8 | 5 | Jan Mayen ad breeding | 10 |
| *naumanni* | 180 | 194 | 185.4 | | 9 | Svalbard, 78°N | 7 |

***Source** [1]Ashcroft 1976; [2]Corkhill 1972; [3]Dement'ev 1951; [4]Myrberget 1963; [5]Nettleship 1972; [6]Petersen 1976; [7]Pethon 1967; [8]Salomonsen 1950; [9]Vaurie 1965; [10]Camphuysen 1989; [11]Harris 1984

***Alle alle alle* versus *Alle alle polaris*** (adult breeding)

| Subspecies | | Min | Max | Mean | | SD | n= | Origin |
|---|---|---|---|---|---|---|---|---|
| *Alle alle alle* | Bill base | 5.4 | 7.3 | 6.4 | ± | 0.55 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Bill tf | 12.4 | 15.3 | 14.1 | ± | 0.76 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Bill tf | 13.0 | 17.5 | 15.3 | ± | 0.82 | 217 | Bear Island[2] |
| *Alle alle alle* | Bill tf | 14.0 | 17.5 | 15.9 | ± | 0.71 | 88 | Svalbard[2] |
| *A. a. polaris* | Bill tf | 14.7 | 19.5 | 17.4 | ± | 1.19 | 57 | Fr Josef Land[2] |
| *Alle alle alle* | Bill tn | 10.1 | 12.5 | 11.2 | ± | 0.72 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Head | 49 | 54 | 51.5 | ± | 1.43 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Mass | 120 | 175 | 146 | ± | 13.2 | 18 | Jan Mayen[1] |
| *Alle alle alle* | Mass | 133 | 196 | 157.8 | ± | 10.53 | 212 | Bear Island[2] |
| *Alle alle alle* | Mass | 134 | 192 | 163 | ± | 11.35 | 94 | Svalbard[2] |
| *A. a. polaris* | Mass | 174 | 230 | 202.3 | ± | 12.48 | 56 | Fr Josef Land[2] |
| *Alle alle alle* | Tarsus | 16.5 | 23.5 | 21.4 | ± | 0.86 | 214 | Bear Island[2] |
| *Alle alle alle* | Tarsus | 19.0 | 22.0 | 20.2 | ± | 1.01 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Tarsus | 20.0 | 23.5 | 21.8 | ± | 0.81 | 94 | Svalbard[2] |
| *A. a. polaris* | Tarsus | 21.4 | 25.5 | 23.1 | ± | 0.84 | 51 | Fr Josef Land[2] |
| *Alle alle alle* | Wing | 112 | 124 | 118.4 | ± | 3.69 | 20 | Jan Mayen[1] |
| *Alle alle alle* | Wing | 118 | 134 | 124.8 | ± | 2.64 | 217 | Bear Island[2] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Alle alle alle* | Wing | 121 | 127 | 124.6 | ± | 2.51 | 5 | Svalbard[2] |
| *A. a. polaris* | Wing | 122 | 141 | 133.3 | ± | 3.73 | 59 | Fr Josef Land[2] |

**Source:** [1]Camphuysen 1990; [2]Stempniewicz *et al.* 1996

***Alle alle alle***, winter birds, The Netherlands (CJ Camphuysen unpubl).

| Little Auk | | | Min | Max | Mean | n= |
|---|---|---|---|---|---|---|
| male | Bill tf | mm | 13.8 | 15.4 | 14.5 | 8 |
| female | | mm | 13.6 | 15.8 | 14.5 | 9 |
| male | Bill tn | mm | 10.0 | 12.0 | 10.9 | 7 |
| female | | mm | 10.3 | 12.0 | 11.2 | 6 |
| male | Head | mm | 52 | 54 | 53.3 | 6 |
| female | | mm | 52 | 54 | 53.2 | 5 |
| male | Mass | g | 105 | 147 | 123.8 | 7 |
| female | | g | 105 | 130 | 117.8 | 7 |
| male | Tarsus | mm | 21 | 22 | 21.5 | 8 |
| female | | mm | 20 | 22 | 21.3 | 7 |
| male | Wing | mm | 122 | 130 | 126.4 | 9 |
| female | Wing | mm | 121 | 129 | 124.1 | 9 |

***Alca torda islandica***,mass in winter birds, The Netherlands. [1]For (bill) age characteristics, see later in document.

| Age[1] | Sex | Min | Max | Mean | | n= | |
|---|---|---|---|---|---|---|---|
| 0+0 | F | 575 | 575 | 575 | g | 3 | Fat (2/3) winter birds, NL |
| W+2 | F | 510 | 510 | 510 | g | 1 | Fat (2/3) winter birds, NL |
| W+2 | M | 445 | 585 | 515 | g | 3 | Fat (2/3) winter birds, NL |
| 0+0 | F | 380 | 415 | 397 | g | 11 | Lean (0/1) winter birds, NL |
| 0+0 | M | 348 | 625 | 459 | g | 5 | Lean (0/1) winter birds, NL |
| W+0 | F | 350 | 490 | 405 | g | 8 | Lean (0/1) winter birds, NL |
| W+0 | M | 385 | 445 | 418 | g | 3 | Lean (0/1) winter birds, NL |
| W+1 | F | 406 | 520 | 452 | g | 9 | Lean (0/1) winter birds, NL |
| W+1 | M | 425 | 520 | 477 | g | 12 | Lean (0/1) winter birds, NL |
| W+2 | F | 370 | 660 | 451 | g | 22 | Lean (0/1) winter birds, NL |
| W+2 | M | 380 | 655 | 463 | g | 15 | Lean (0/1) winter birds, NL |
| W+3 | F | 365 | 540 | 458 | g | 8 | Lean (0/1) winter birds, NL |
| W+3 | M | 345 | 550 | 450 | g | 7 | Lean (0/1) winter birds, NL |

CJ Camphuysen unpubl.

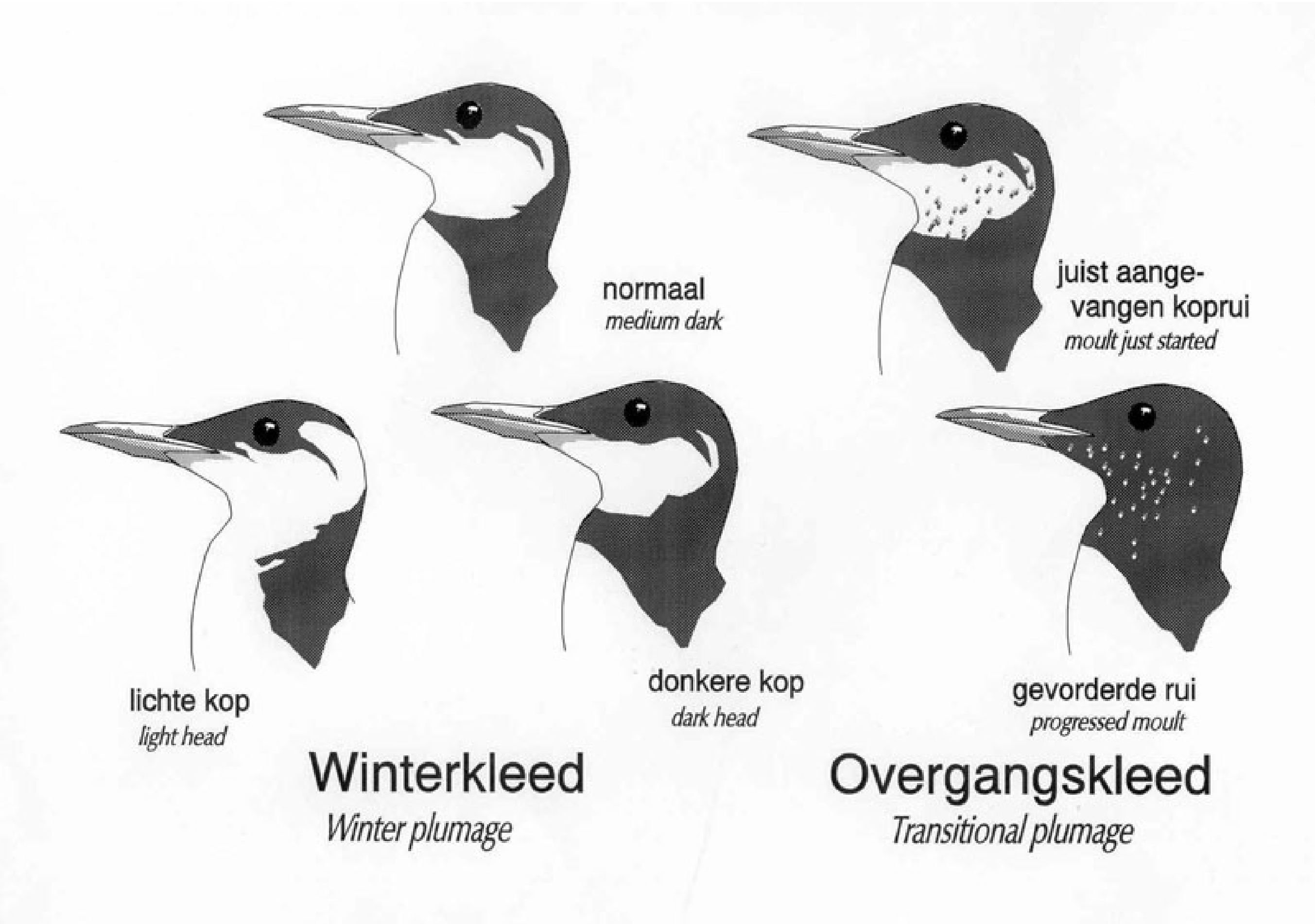
***Alca torda islandica***, biometrics winter birds, The Netherlands

| Razorbill | | | Min | Max | Mean | ± SD | n= |
|---|---|---|---|---|---|---|---|
| A | F | Bill base | 16.9 | 22.8 | 19.5 | 1.2 | 43 |
| A | M | | 18.7 | 22.4 | 20.0 | 0.8 | 40 |
| I | F | | 16.5 | 18.7 | 17.3 | 0.7 | 9 |
| I | M | | 16.3 | 18.8 | 17.9 | 0.9 | 5 |
| J | F | | 13.3 | 19.7 | 15.5 | 1.6 | 14 |
| J | M | | 13.2 | 15.6 | 14.5 | 1.0 | 5 |
| A | F | Bill gonys | 16.4 | 21.1 | 18.5 | 1.4 | 12 |
| A | M | | 16.3 | 20.4 | 18.8 | 1.3 | 12 |
| I | F | | 15.8 | 18.1 | 17.0 | 1.2 | 3 |
| I | M | | 15.8 | 17.3 | 16.6 | 1.1 | 2 |
| J | F | | 14.6 | 16.0 | 15.1 | 0.6 | 6 |
| J | M | | 16.0 | 16.0 | 16.0 | | 1 |
| A | F | Bill tf | 29.0 | 35.4 | 32.1 | 1.6 | 43 |
| A | M | | 31.0 | 36.0 | 33.5 | 1.2 | 40 |
| I | F | | 30.2 | 34.2 | 32.0 | 1.1 | 9 |
| I | M | | 30.7 | 34.5 | 32.2 | 1.4 | 5 |
| J | F | | 28.3 | 35.1 | 31.9 | 1.6 | 14 |
| J | M | | 31.0 | 33.7 | 32.5 | 1 | 5 |
| A | F | Bill tn | 19.3 | 21.6 | 20.6 | 0.7 | 13 |
| A | M | | 19.8 | 22.6 | 21.2 | 1 | 13 |
| I | F | | 19.3 | 21.1 | 20.1 | 0.9 | 3 |
| I | M | | 21.5 | 22.1 | 21.8 | 0.4 | 2 |
| J | F | | 18.9 | 22.0 | 19.8 | 1 | 8 |
| J | M | | 20.3 | 20.3 | 20.3 | | 1 |
| A | F | Head | 85 | 93 | 89.8 | 2.4 | 18 |
| A | M | | 88 | 94 | 91.8 | 1.7 | 16 |
| I | F | | 88 | 91 | 89.3 | 1.5 | 3 |
| I | M | | 88 | 88 | 88.0 | | 1 |

| Razorbill | | | Min | Max | Mean | ± SD | n= |
|---|---|---|---|---|---|---|---|
| J | F | | 85 | 94 | 88.7 | 2.3 | 8 |
| J | M | | 91 | 91 | 91.0 | | 1 |
| A | F | Wing | 184 | 209 | 199.6 | 5 | 42 |
| A | M | | 190 | 210 | 198.0 | 4.7 | 40 |
| I | F | | 191 | 205 | 195.3 | 4.3 | 9 |
| I | M | | 187 | 203 | 194.0 | 6.1 | 5 |
| J | F | | 184 | 196 | 189.5 | 4 | 14 |
| J | M | | 188 | 194 | 190.6 | 2.6 | 5 |

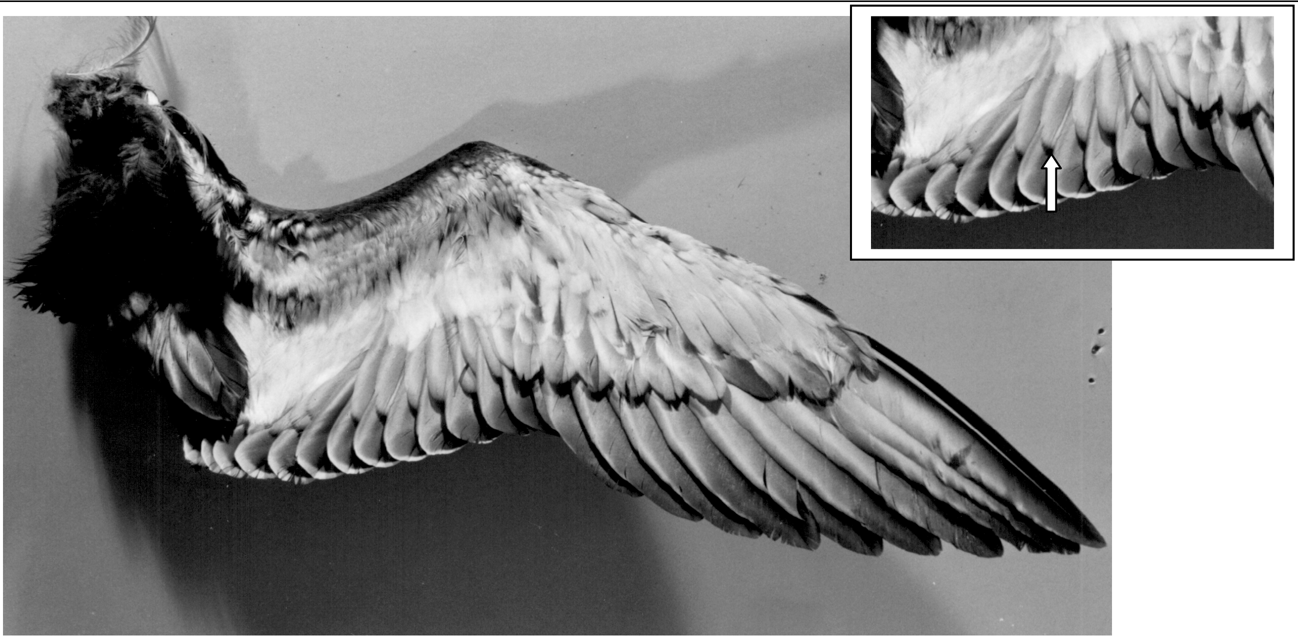
CJ Camphuysen unpubl.

## Plumage characteristics (1) winter and summer plumage




Common Guillemots, Brünnich's Guillemots, Little Auks and Razorbills all have rather similar summer plumages and winter plumages, that is, all have a fully dark head in summer, and a white chin and cheeks in winter. See field guides for details. The following types are recognised:

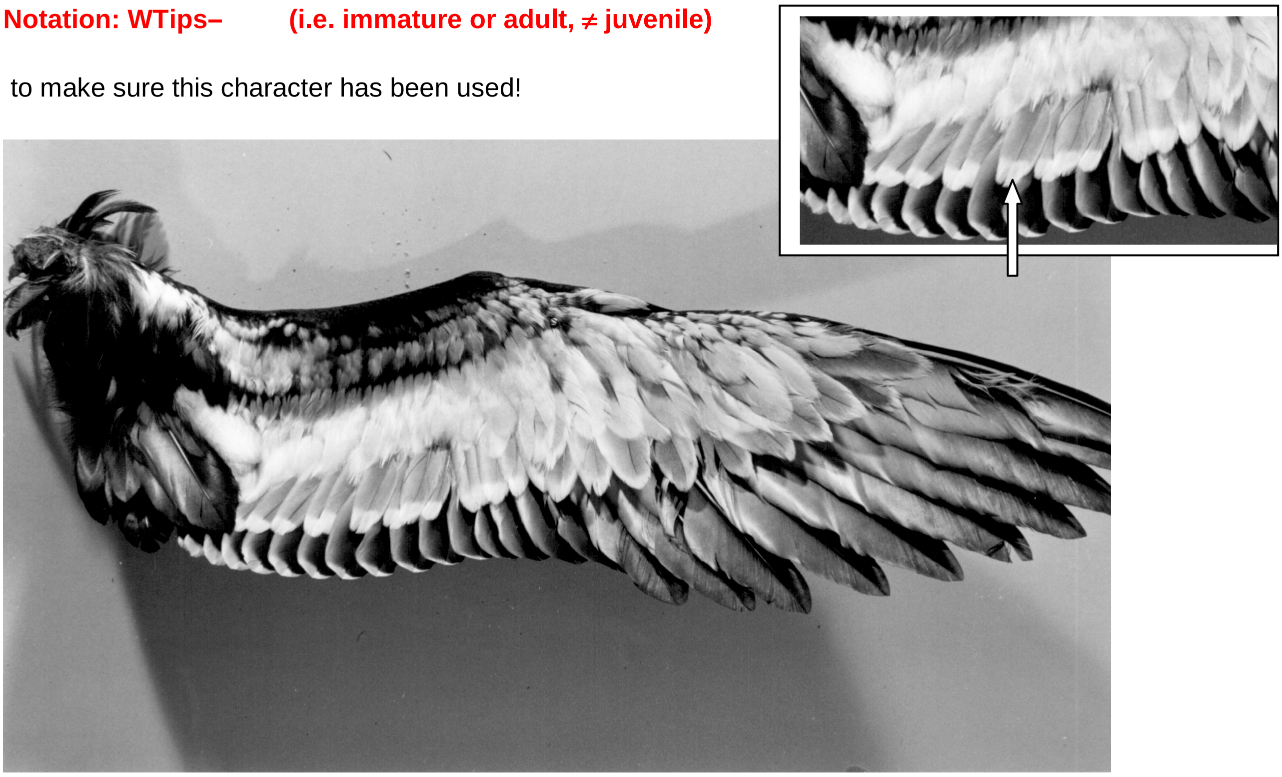
- W full winter plumage
- W/T winter plumage, some summer plumage feathers on chin or cheeks (blackish specks)
- T transitional plumage (exactly half way)
- T/B near summer plumage (progressed moult), some white specks on otherwise blackish head
- B full breeding plumage



**Non-juvenile Common Guillemot *Uria aalge*** have all grey greater underwing coverts, without white tips. This aspect needs to be checked in the underarm. In the inset, greater secondary coverts are partly hidden under the secondaries (arrow). Nearly all clean or largely clean corpses of Common Guillemots can be aged, because the under wings are often clean. Dirty, heavily oiled birds need to be dissected (check of gonads and presence of a bursa). Some adult summer plumage individuals have silvery tips on these greater secondary coverts.

**Notation: WTips–** **(i.e. immature or adult, ≠ juvenile)**

to make sure this character has been used!



**Juvenile Common Guillemots *Uria aalge*** have white tips on the greater secondary coverts at the underwing (secondaries). At the inset, these coverts are clearly visible and the white tips produce a white wing bar (arrow). Not all juveniles have such clear tips (smaller), and dirty feathers should be examined with care. White tips on the tips of the primary coverts (see photographs) should not be used for ageing.

**Notation: WTips+** **(i.e. juvenile)** to make sure this character has been used!

## Ageing Common Guillemots using white tips of greater coverts

## Ageing Razorbills using number of bill grooves

0+0 winter

W+0 winter

W+1 winter

W+1.5 summer

W+2 winter

W+2.5 winter

Razorbills develop a white vertical groove in the second winter. The absence of a white groove is written as 0+0. In front of the white groove, furrows will develop in later years (a maximum of three furrows). Complete furrows run over the upper and lower mandible. If only in the upper mandible, score as ½. Adult Razorbills tend to have at least 1 vertical furrow in front of the white groove.

Instead of recording a guessed age, just record the number of grooves and furrows as indicated above. 0+0 = no grooves, W+0 = only white groove, W+1 = white groove and complete furrow, W+1½ = white groove and two furrows in upper, one in lower mandible, etc. The record form is designed to provide entries such as these.

## Ageing Atlantic Puffins using number of bill grooves

no grooves

faint groove

1 groove

1.5 grooves

2 grooves

3 grooves

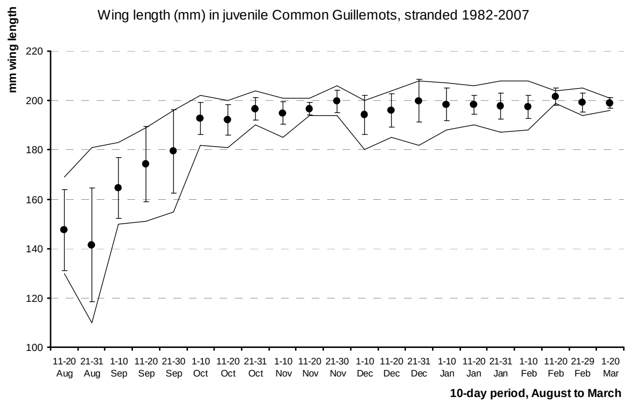
Atlantic develop a larger bill and an increasing number of vertical grooves in later years. The absence of any grooves on a dull, brownish to reddish bill would indicate a first-year individual ('no grooves'), while adults would have at least 1½ vertical grooves and a large, bright orange bill.

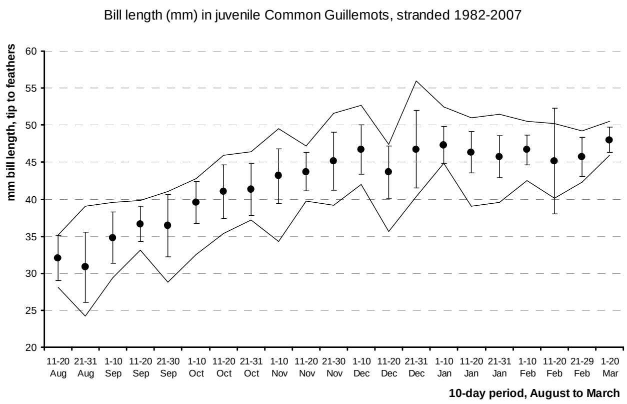
In stead of logging an interpretation of the age, do count and record vertical grooves as indicated above. The Atlantic Puffin record form is designed to provide entries such as these.

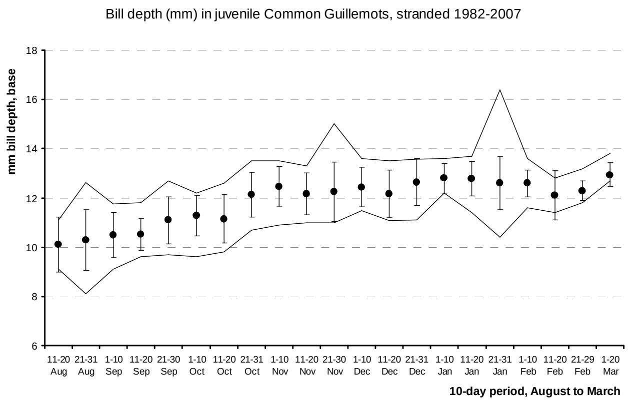
**Biometrics of juveniles, caution**

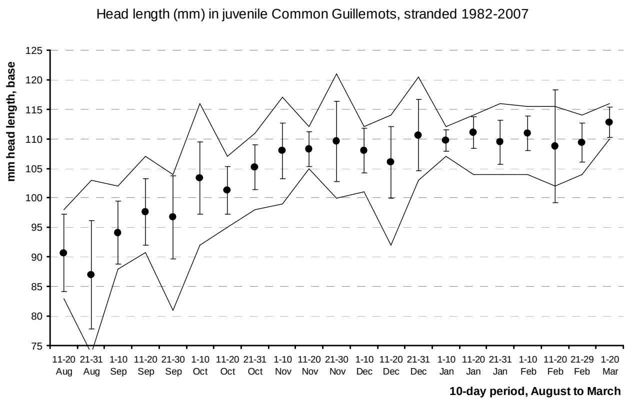
Several auk species fledge while not yet fully grown, in fact they fledge as downy young (Harris *et al.* 1992, Ydenberg *et al.* 1995). Juveniles are generally smaller than adult birds, but exactly when downy young have reached juvenile size while at sea is not clearly described in the literature (Harris *et al.* 1991). From measurements of *c.* 300 chicks and juveniles found stranded in the southern North Sea between 1982 and 2007 (originating most probably from colonies in Scotland) it is clear that biometrics of juveniles, at least between August and November, should be treated with care. Head and bill are not 'fully grown' before December (Figs. below). Wing length and bill depth (base) cease to increase by November. Only juveniles found stranded in January or later may be assumed to have reached full (juvenile) size.

Biometrics of juveniles are generally of little use when studying the origin of birds from body size characteristics. Juveniles are smaller than adults and from breeding colonies, only data of adult breeding birds are available for comparison. This point further emphasises the need for a proper ageing protocol when working on stranded seabirds. There is no point mixing biometric data from adults, immatures and juveniles, or of males and females in species with a strong sexual dimorphy**.**

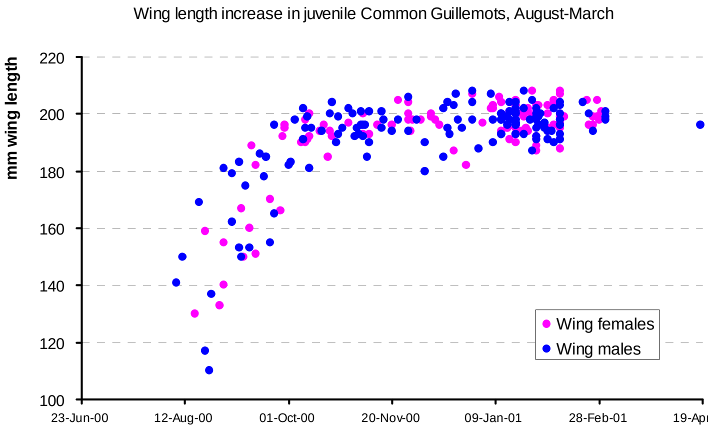



Key biometrics (mean ± SD, min and max range indicated) of juvenile Common Guillemots found stranded between mid August and mid March (10-day periods), 1982-2007, illustrating a rapid increase in wing length (flattened chord) until November, a gradual increase in head length and bill length (tip to feathers) until December, and a gradual increase in bill depth (base) until November, each followed by a stabilisation in later months (CJ Camphuysen *unpubl. data*). Note that the sex of the birds has been ignored in these graphs.




Wing length increase in male and female juvenile Common Guillemots, August-March, from stranded individuals found in The Netherlands, 1982-2007 (CJ Camphuysen *unpubl. data*).

### Ageing Little Auks *Alle alle*

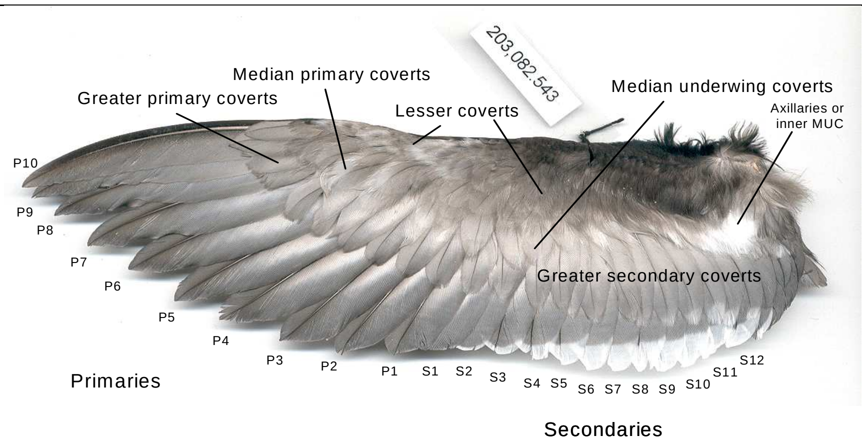
Biometrics and plumage characteristics of Little Auks have been evaluated to assess possibilities for the external ageing of individual birds (Camphuysen 2006). Standard biometrics included bill length (feathers to tip), distance from nostril to tip, bill depth, head, wing (max, flat), and tarsus length, and body mass. The presence or absence of white or white-tipped feathers was checked in seven feather groups of the (grey) underwing. Bill depth and wing length were the most useful measurements to separate adult and juvenile Little Auks (when combined, classification accuracy 83%). In combination with body mass (only emaciated birds were used), the aged was assigned correctly in 88% of the examined birds. White or white-tipped feathers in the lesser primary coverts (LPC) occurred more frequently in juveniles than in adults, while the reverse was true for the greater secondary coverts (GPC). Only 74% of the Little Auks were properly aged on the basis of a combination of LPC and GPC pigmentation. With body mass being a `difficult' measurement (an assessment of physical condition is required and incomplete corpses cannot be weighed), the combination of bill depth, wing length and white in LPC and GPC was evaluated (87% correctly assigned).

It is recommended to use bill depth and wing length for ageing in combination with pigmentation patterns of LPC and GPC in future studies of wrecked or stranded Little Auks. For comparisons with breeding populations, bill length and wing length are the most widely available and therefore useful measurements.

**Underwing pigmentation scores**:

| | |
|---|---|
| All grey | score 1 |
| Grey, partly with faint white edges | score 2 |
| Faint white tips | score 3 |
| All or mostly faint white | score 4 |
| Clear white tips | score 5 |
| All or mostly bright white | score 6 |

GPC - Greater primary coverts
MPC - Median primary coverts
LPC - Lesser primary coverts
GSC - Greater secondary coverts
MSC - Median secondary coverts
LSC - Lesser secondary coverts
Axil - Axillaries




| Underwing pigments | GPC* | MPC | LPC* | GSC | MSC | LSC | Axil |
|---|---|---|---|---|---|---|---|
| scores: | | | | | | | |

**Basic biometrics for Little Auks collected in winter in The Netherlands and Belgium, 1975-2003**

| | | Mean | SD | SE | 95% C.I. | Min | Max | Sample |
|---|---|---|---|---|---|---|---|---|
| Bill length | Ad | 14.4 | 0.9 | 0.1 | 0.3 | 12.1 | 15.8 | 41 |
| | Juv | 14.2 | 0.8 | 0.1 | 0.2 | 12.4 | 15.9 | 47 |
| Nostril to tip | Ad | 11.0 | 0.6 | 0.1 | 0.2 | 9.9 | 12.1 | 27 |
| | Juv | 10.8 | 0.6 | 0.1 | 0.2 | 9.5 | 12.0 | 42 |
| Bill depth | Ad | 8.1 | 0.7 | 0.1 | 0.3 | 6.6 | 9.7 | 26 |
| | Juv | 7.6 | 0.7 | 0.1 | 0.2 | 5.8 | 9.5 | 41 |
| Head | Ad | 52.4 | 1.7 | 0.3 | 0.6 | 48 | 56 | 36 |
| | Juv | 52.1 | 1.7 | 0.3 | 0.5 | 48 | 55 | 45 |
| Tarsus | Ad | 20.8 | 0.8 | 0.1 | 0.3 | 19 | 22 | 27 |
| | Juv | 21.0 | 0.9 | 0.1 | 0.3 | 19 | 23 | 43 |
| Wing | Ad | 125.5 | 4.2 | 0.6 | 1.3 | 116 | 135 | 41 |
| | Juv | 121.2 | 3.5 | 0.5 | 1.0 | 114 | 130 | 50 |
| Mass | Ad | 117.2 | 9.8 | 2.0 | 3.8 | 105 | 138 | 25 |
| | Juv | 115.7 | 11.1 | 1.9 | 3.6 | 90 | 135 | 36 |

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**Citation**

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Read and commented by:MFL, MH, RB

Further suggestions:

Problems of moult with winglength, and implications for checking white tips etc. September Guillemots can be a nuisance and difficult to age. Same for March Puffins.

Secondly, leg colour? Headless Puffin in November with bright orange legs need not be scored as unaged. Similarly one with blue/grey legs can be pretty reliably assigned as first-winter.

A photo comparing underwings of Brunnich's, Common Guillemot, and Razorbill, and one comparing Brunnich's with first-winter Razorbill.

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.1 Assessing the damage

**Technical document**

## **Gaviidae** Divers or loons

Circumpolar in Holarctic, 1 genus, 4 species, 6 taxa (del Hoyo *et al.* 1992) or 1 genus, 5 species, 6 taxa (Sibley & Monroe 1990)

Divers are large swimming birds, breeding in arctic and subarctic (to temperate) inland lakes and wintering in nearshore waters around Europe. Divers are highly vulnerable to oil pollution and are easily disturbed by shipping activities. Four taxa regularly occur within Europe. Identification and ageing of divers in winter plumage is not easy and this will require specialists' input. In the absence of data on geographical variations in body size, ringing data are essential to assess the breeding origin of oiled casualties, but only few divers have been ringed.

| Euring | Species | Distribution, status in Europe |
|---|---|---|
| 20 | **Red-throated Diver** *Gavia stellata* | Holarctic, generally north of 50°N and far into high arctic, wintering coasts N Atlantic and N Pacific, also Great Lakes, Black, Caspian and Mediterranean Seas; European status: **depleted** |
| | **Pacific Diver** *Gavia [arctica] pacifica* | Extreme N and NW Nearctic, wintering Pacific coast N America |
| 30 | **Black-throated Diver** *Gavia arctica arctica* | W Palearctic eastwards to river Lena; Europe, wintering coasts NW Europe, also Black, Caspian and Mediterranean Seas; European status: **vulnerable** |
| | **Green-throated Diver** *Gavia arctica viridigularis* | E Palearctic, east of river Lena, wintering NW Pacific |
| 40 | **Great Northern Diver** *Gavia immer* | Mainly Nearctic, also Greenland, Iceland, occasionally Bear Island and perhaps Jan Mayen, very occasionally Scotland (hybridisation), winters mainly N Atlantic and NE Pacific; European status: **secure** |
| 50 | **White-billed Diver** *Gavia adamsii* | Holarctic, breeding mainly Arctic Ocean coasts up to 78°N, winters in coastal waters NW and NE Pacific and also off NW Norway; European status: **secure** |

**General characteristics** (from BWP*i* 2006): Body elongated, legs set far back, neck short. Wings narrow, relatively small, and strongly pointed. 11 primaries (p11 minute), attenuated towards tip; p10 longest. At least 23 secondaries. Tail short, 16–20 feathers, largely hidden by tail-coverts. Bill long, straight, and pointed; nostrils narrow and slit-like. Tarsus laterally flattened, 3 front toes connected by webs; hind toe small and elevated; nails small. Sexes similar in plumage, ♂ averaging larger. Breeding plumage strikingly patterned; non-breeding dull, grey and white. Plumage dense and compact, generally harsher than in grebes Podicipedidae, less downy; soft and velvety on head and neck. 2 moults per year; flight-feathers shed simultaneously.

**External features:**

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| **Age** | adult,<br>immature,<br>juvenile | Plumage characteristics (patterns); not easy, particularly not if feathers are dirty or wet. Specialists' job | A<br>I<br>J |
| **Plumage** | winter<br>transitional<br>summer (breeding) | Plumage characteristics (colour in neck and throat, mantle, scapulars and back) | W<br>T<br>B |
| **Sex** | male<br>female | Only *Gavia stellata*, using sex discriminant based on wing, tarsus and Bill tf | M<br>F |
| **Colour phase** | | - | |
| **Biometrics** | Bill length 1 | Bill tip to feathers (0.1 mm) | Bill tf |
| | Bill length 2 | Bill tip to nostril (0.1 mm) | Bill tn |
| | Nostril / feathers<br>(x-z)<br>(x-y)<br>(see guidelines below) | Only for ID assistance *Gavia immer/adamsii*<br>Ratio between nostril length (x-z) and distance from nostril to end feathers over nostril (x-y)<br>→ (x-y)/(x-z) >0.05 = *adamsii*, < 0.05 = *immer* | Nostril xz<br>Nostril xy |
| | Bill depth 1 | Bill depth at base (priority over Bd 2) | Bill base |
| | Bill depth 2 | Bill depth at gonys *(often difficult in smaller species)* | Bill gonys |
| | Head length | (mm) | Head |
| | Wing length | (mm) | Wing |
| | Tarsus length | (mm) | Tarsus |
| **Priority** | Bill tf – Wing – Tarsus | For sex discriminant *Gavia stellata* | |

| Structure | Primaries | Longest primary | Tail feathers | Shape of tail |
|---|---|---|---|---|
| *G. stellata* | 10 (11 minute) | P10 or P9 | 18 | Short, rounded |
| *G. arctica* | 10 (11 minute) | P10 | 16-18 | Short, rounded |
| *G. immer* | 10 (11 minute) | P10 | 20 | Short, rounded |
| *G. adamsii* | 10 (11 minute) | P10 | 18 | Short, rounded |

**Biometrics** (handbooks summarised)

| Species | sex | Bill tf | Bill tn | Wing | Tarsus |
|---|---|---|---|---|---|
| *G. stellata* | ♂ | 48-61 | 36-46 | 264-320 | 66-84 |
| | ♀ | 46-61 | 33-44 | 248-308 | 64-77 |
| *G. arctica* | ♂ | 52-68 | 40-50 | 294-343 | 72-89 |
| | ♀ | 52-68 | 33-43 | 282-337 | 71-87 |
| *G. immer* | ♂ | 72-91 | 58-70 | 343-392 | 76-117 |
| | ♀ | 68-85 | 53-67 | 335-365 | 83-109 |
| *G. adamsii* | ♂ | 81-97 | 60-76 | 366-395 | 88-99 |
| | ♀ | 80-96 | 67-75 | 361-388 | 85-96 |

**Specific biometrics** Red-throated Diver (non-juveniles), southern North Sea, winter birds

| *Gavia stellata* | min | max | *n =* |
|---|---|---|---|
| ♂ Bill tf | 48.0 | 61.0 | 113 |
| ♀ Bill tf | 46.0 | 61.0 | 116 |
| ♂ Bill tn | 36.1 | 46.0 | 72 |
| ♀ Bill tn | 33.0 | 44.0 | 72 |
| ♂ Bill base | 10.9 | 16.9 | 76 |
| ♀ Bill base | 11.7 | 16.8 | 82 |
| ♂ Bill gonys | 9.8 | 10.9 | 4 |
| ♀ Bill gonys | 8.5 | 11.9 | 8 |
| ♂ Head | 124 | 132 | 4 |
| ♀ Head | 118 | 131 | 7 |

| *Gavia stellata* | min | max | *n =* |
|---|---|---|---|
| ♂ Mass | 1030 | 2460 | 90 |
| ♀ Mass | 840 | 2255 | 108 |
| ♂ Tail | 42 | 57 | 10 |
| ♀ Tail | 47 | 54 | 10 |
| ♂ Tarsus | 66 | 82 | 108 |
| ♀ Tarsus | 64 | 77 | 118 |
| ♂ Wing | 264 | 320 | 158 |
| ♀ Wing | 248 | 308 | 167 |

**Specific biometrics** Great Northern Diver and White-billed Diver (non-juveniles)

| *Gavia immer* | | **min** | **max** | ***n* =** |
|---|---|---|---|---|
| ♂ | Bill tf | 72.5 | 91.0 | 88 |
| ♀ | Bill tf | 68 | 85.1 | 95 |
| ♂ | Mass | 2520 | 6130 | 26 |
| ♀ | Mass | 1620 | 4650 | 28 |
| ♂ | Tarsus | 76 | 117 | 91 |
| ♀ | Tarsus | 83 | 109 | 76 |
| ♂ | Wing | 343 | 392 | 8 |
| ♀ | Wing | 335 | 365 | 9 |

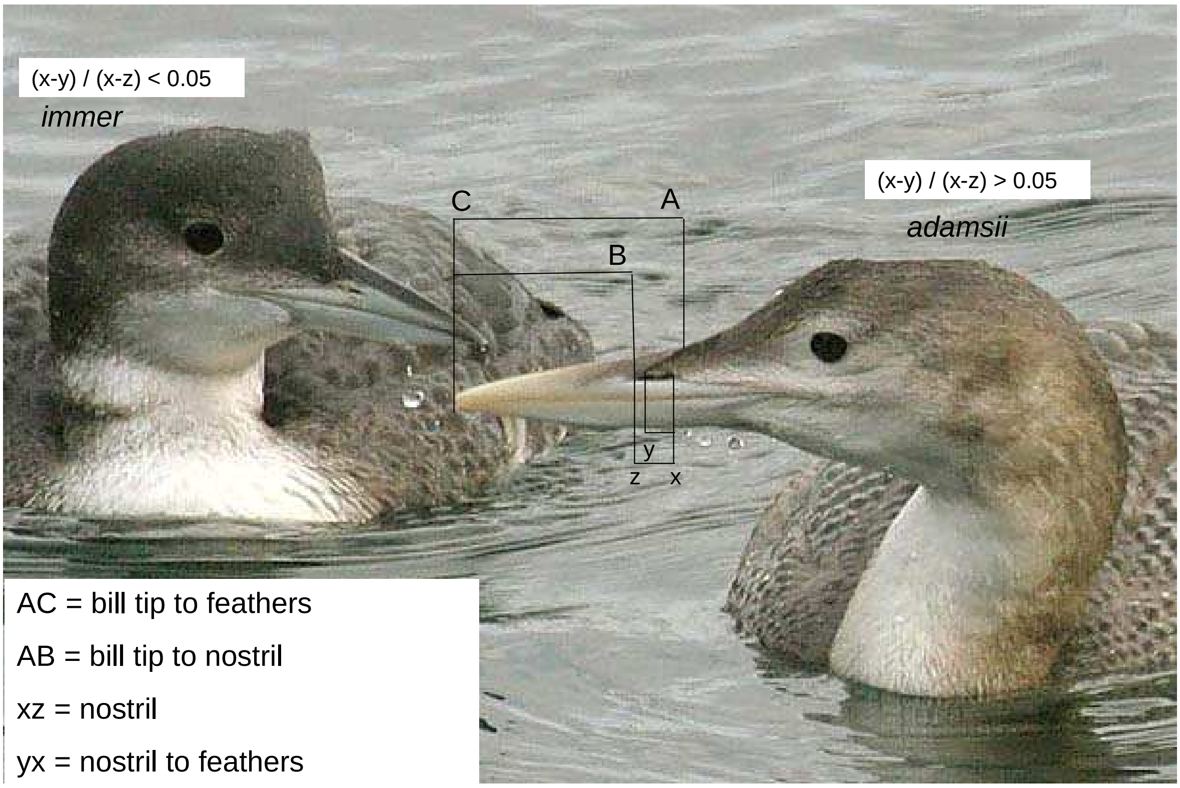
| *Gavia adamsii* | | **min** | **max** | ***n* =** |
|---|---|---|---|---|
| ♂ | Bill tf | 81.0 | 97.0 | 23 |
| ♀ | Bill tf | 80.4 | 96.5 | 15 |
| ♂ | Mass | 4000 | 5800 | 14 |
| ♀ | Mass | 4025 | 6400 | 13 |
| ♂ | Tarsus | 88.5 | 97.8 | 26 |
| ♀ | Tarsus | 85 | 96 | 21 |
| ♂ | Wing | 366 | 395 | 28 |
| ♀ | Wing | 361 | 388 | 21 |

**Geographical variation**

- *Gavia stellata*: Birds from Spitsbergen and Franz Josef Land said to differ from other populations in having greyish edges to mantle feathers in breeding plumage, but character variable and does not warrant recognition of subspecies (BWP*i* 2006).
- *Gavia arctica:* Great individual variation. *G. a. viridigularis* averages slightly larger, especially bill and foot, and with green gloss on throat in breeding plumage; *G. a. pacifica* smaller with pale grey nape and hindneck and purple gloss on throat. Winter plumage indistinguishable (Godfrey 1966, BWP*i* 2006).

## Identification assistance (1) Great Northern versus White-billed Diver

Important differences between Great Northern and White-billed Divers are the number of tail feathers (20 in Great Northern, 18 in White-billed), the gonys (smooth in Great Northern, distinct bump in White billed; move the tip of your finger from the throat-feathers towards the tip of the bill and a small bump at the gonys cannot be missed), the amount of feathers on the bill (figure 1): (x-y)/( x-z) < 0.05 in Great Northern Diver, (x-y)/( x-z) >0.05 in White-billed Diver (Fig. 1). The colour of the bill is quite unreliable, although a summer plumage individual with a huge, banana shape and -colour bill is obviously a White-billed Diver.

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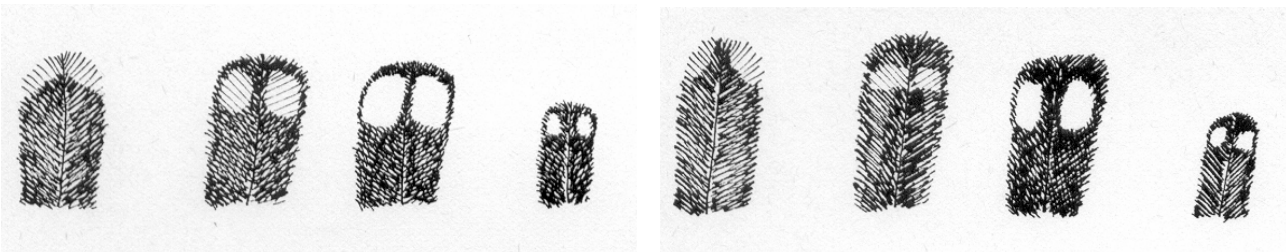
http://www.birdinfo.com/A_Images_C/CommonLoon_image.html

Figure 1. The feathered part of the head (x-y in the picture) protrudes further over the nostril in White-billed Divers than in Great Northern Divers. To measure exactly, use the bill feather index: a ratio between nostril length (x-z) and distance from nostril (front) to end of feathers along mandible (x-y) as (x-y)/(x-z) → (x-y)/(x-z) >0.05 = *adamsii*, < 0.05 = *immer*.

Camphuysen (1995) listed the following differences in bullet points:

| | Great Northern Diver (*immer*) | White-billed Diver (*adamsii*) |
|---|---|---|
| All plumages | | |
| • Bill A-C (tip to feathers) | 69-89 mm | 83-96 mm |
| • Bill B-C (nostril to tip) ♂ | 58-70 mm | 60-76 mm |
| • Bill B-C (nostril to tip) ♀ | 53-67 mm | 67-75 mm |
| • Wing | 331-400 mm | 376-402 mm |
| • Tarsus | 83-100 mm | 89-97 mm |
| • Feathered part on upper mandible | protrudes less far over the nostril in Gr Northern Divers → (x-y)/(x-z) <0.05 | protrudes further over the nostril in White-billed Divers → (x-y)/(x-z) >0.05 |
| • Number of tail feathers | 20 | 18 |
| • Lower mandible | smooth at gonys | distinct bump at gonys |
| Winter plumage | | |
| • Bill | grey | yellowish white |
| • Upper mandible | bend (downward) | straight |
| • Mantle feathers | dark brown with faint light spots | brown with clear light spots |
| • Cheeks and ear region | largely dark | cloudy, greyish |
| • Primary shafts | dark brown or blackish | light brown or whitish |
| Juvenile plumage | | |
| • Bill | greyish or whitish | yellowish white |
| • Mantle feathers | light terminal fringes | broad light terminal fringes |
| • Cheeks and ear region | largely dark | cloudy, greyish |
| • Primary shafts | dark brown or blackish | light brown or whitish |



A B C D E F G H
juvenile adult winter adult summer juvenile adult winter adult summer
White-billed Diver (A-D) Great Northern Diver (E-H)

Figure 2. Mantle feathers and wing coverts (D and H) of White-billed Diver and Great Northern Divers.

### Identification assistance (2) Red-throated versus Black-throated Diver

Important differences between Red- and Black-throated Divers are the presence of a white area in the inner vane of the secondaries in Black-throated Divers (all plumages), regular white spotting of the upperparts in RtD (winter- and juvenile plumage), dark upper parts with light edges on the feathers in juveniles or with some remains of summer plumage in adults in BtD. Old corpses of winter or juvenile plumage (small) divers should be examined on the rump (never white specks in BtD, always white specks in RtD). If feathers are dirty and wet, a sample should be collected for examination after drying and cleaning (Camphuysen 1995). Black-throated Diver is on average larger than Red-throated, but there is a considerable overlap in size. Adult winter plumage Red-throated Diver has extensively white-spotted upperparts (white drops), but this may be hard to see in oiled or very dirty and wet specimens. Adult winter plumage Black-throated Diver upperparts blackish, but some summer plumage feathers (white spots, or white squares) may be present. Juvenile (winter) plumage Red-throated Diver has extensively white-spotted upperparts (white stripes), whereas juvenile Black-throated Divers have dull grey mantle feathers with lighter tips. Secondaries with white inner vane in Black-throated Diver, secondaries all grey in Red-throated Diver (or perhaps with a narrow whitish fringe along the inner vane). In case of doubt, check the rump: white spots in Red-throated Diver, never any white spots in Black-throated Diver.


Figure 3. Red-throated Divers (left) and Black-throated Divers (right) differ in overall size, but there is a considerable overlap and the species may be hard to distinguish in winter plumage.

Camphuysen (1995) listed the following differences in bullet points:

| | Red-throated Diver (*stellata*) | Black-throated Diver (*arctica*) |
|---|---|---|
| All plumages | | |
| • Bill A-C (tip to feathers) ♂ | 48-61 mm | 52-68 mm |
| • Bill A-C (tip to feathers) ♀ | 46-55 mm | 52-68 mm |
| • Bill B-C (nostril to tip) ♂ | 38-46 mm | 40-50 mm |
| • Bill B-C (nostril to tip) ♀ | 33-44 mm | 33-43 mm |
| • Wing ♂ | 265-310 mm | 294-343 mm |
| • Wing ♀ | 257-308 mm | 282-337 mm |
| • Tarsus ♂ | 66-82 mm | 72-89 mm |
| • Tarsus ♀ | 65-77 mm | 71-87 mm |
| • Inner vane secondaries | all grey | white window |
| Adult winter plumage | | |
| • Mantle | speckled white | dark brown all over (summer feathers?) |
| • Rump | speckled white | always blackish, never speckled |
| • Neck | only hind neck greyish, clear cut | hind neck blackish, broad, clear cut |
| Juvenile plumage | | |
| • Mantle feathers | speckled white | dark brown, lighter fringes |
| • Rump | speckled white | dark brown, never speckled |

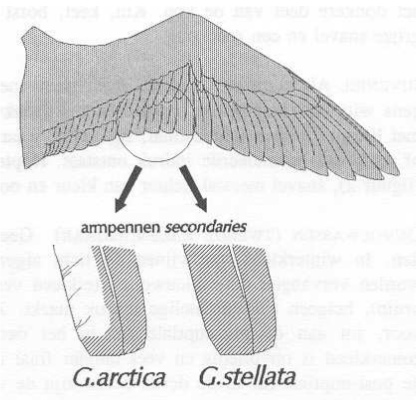
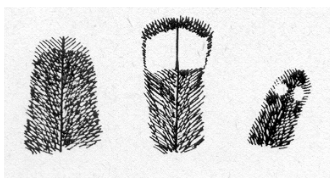



Figure 4. Inner vanes of secondaries have a white window in Black-throated Diver (left), whereas they are all grey in Red-throated Divers (right).



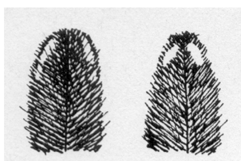




Figure 5. Mantle feathers (A-B) and wing coverts (C) of Black-throated Diver and Red-throated Divers (D-E). Note juvenile mantle feathers of Black-throated diver (A) dark with lighter fringes as in Great Northern Diver, white subterminal specks in Red-throated Diver in juvenile (D) and adult winter plumage (E). Individual summer plumage feathers may be present as 'left-overs' in winter plumage Black-throated Diver (B-C).

**Identification assistance** (3) Great Northern versus Black-throated Diver

Clear differences between Black-throated and Great Northern Diver (all plumages) are bill length and the presence or absence of a dark streak over the greater underwing coverts. The rump may show remains (white specks) of summer plumage in Great Northern Divers, but never in Black-throated Divers. The pattern of the feathers of the upperparts in both adults and immatures are quite different. Great Northern Divers are obviously a lot larger in overall size, with goose-like dimensions, but note that some ♀♀ are very small and that some ♂ Black-throated Divers can be exceptionally large, so that confusion may arise; Camphuysen (1995). Great Northern Diver bill tip to feathers > 69 mm, Black-throated Diver <69 mm; wing usually >350 in Great Northern Diver, <350 in Black-throated, but note overlap.

Camphuysen (1995) listed the following differences in bullet points (biometrics not repeated):

| | Black-throated Diver (*arctica*) | Great Northern Diver (*immer*) |
|---|---|---|
| All plumages | | |
| • Under wing coverts | all white | dark streak around shaft |
| Adult winter plumage | | |
| • Rump | never speckled white | may be speckled (summer feathers) |
| • Mantle feathers | dark brown | dark brown, light spots |
| • Head and neck | lighter than mantle feathers | darker than mantle feathers |
| • Cheeks and ear region | mostly white, clear cut | largely dark brownish |
| Juvenile | | |
| • Mantle feathers | faint lighter fringes | clear lighter fringes |

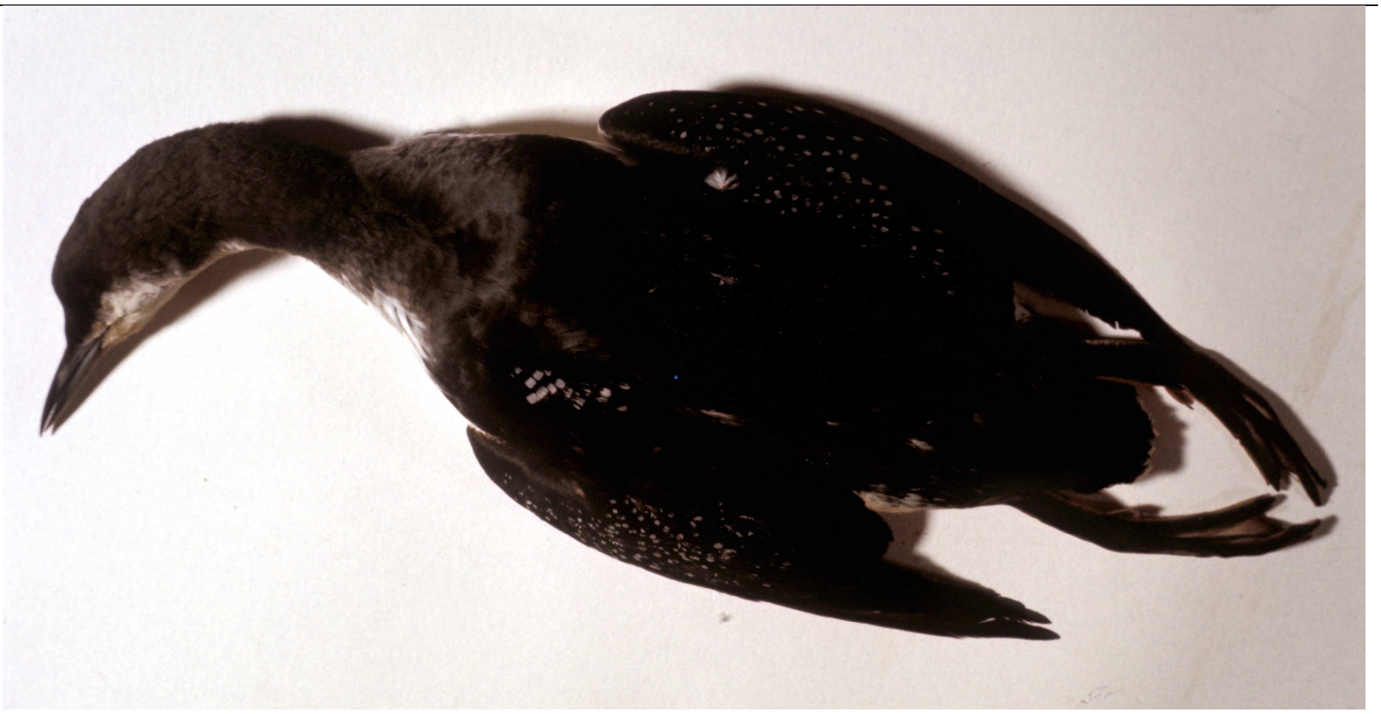


Figure 6. Black-throated Divers in winter plumage may retain summer plumage feathers in patches such as in this individual. Note summer plumage feathers in the shoulder region and on the wings. © CJ Camphuysen

Figure 7. Great Northern Divers have clear dark streaks around the shaft of the greater underwing coverts, whereas Black-throated Divers have all white greater underwing coverts (Camphuysen 1995)

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**Sexing Red-throated Divers using biometrics:**

*Gavia stellata*: sex differences significant. Bill tf ♂ 55.1 ± 2.98, ♀ 51.3 ± 1.16; Wing ♂ 292 ± 10.1, ♀ 281 ± 4.6; Tarsus ♂ 75.1 ± 4.15, ♀ 70.8 ± 3.29 (Cramp & Simmons 1977).

*Gavia stellata*: Shetland population (0.167 x Wing) – (0.133 x Bill tf) + (1.39 x Tarsus) → predicted sex (♂ if score > 144.7, ♀ if score < 144.7) (Baker 1993)

Figure 8. Divers moult primaries and secondaries simultaneously. Shortly after shedding, diver wings look quite spectacular. Shown is the left wing of a Red-throated Diver in full wing moult (newly grown primaries just emerging). © CJ Camphuysen

Figure 9. Great Northern Divers are very large birds, with almost goose-like proportions. Shown is a casualty of the *Prestige* oil spill in La Coruña, NW Spain. © M Heubeck

Figure 10. Juvenile White-billed Diver, with the bill shape not quite characteristic yet. © MF Leopold

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

### **Phalacrocoracidae** – Cormorants and shags

Cosmopolitan with greatest diversity in tropical and temperate zones, 1 genus, 39 species, 57 taxa (del Hoyo *et al.* 1992)

Cormorants are medium-sized to large, pursuit-diving seabirds, typical for coastal stretches of open water, estuarine areas, river mouths and inland bodies of water. Cormorants and shags are highly vulnerable to oil pollution and were often involved in spill along the Western European seaboard. Only the Great Cormorant and the European Shag are common in Europe. Identification is fairly easy, ageing can be difficult and this will require expert input. There is considerable geographical variation in morphology in both species (subspecies), but ringing data are very valuable to assess the exact breeding origin of oiled casualties.

| Euring | Species* | Distribution, status in Europe |
|---|---|---|
| **720** | **Great Cormorant** *Phalacrocorax carbo carbo* | E Canada, Greenland, Iceland, Norway and British Isles. European status: **secure** |
| **720** | **Great Cormorant** *Phalacrocorax carbo sinensis* | C and S Europe, east to India and China. European status: **secure** (no subspecific evaluation) |
| **800** | **European Shag** *Phalacrocorax aristotelis aristotelis* | Iceland and N Scandinavia to Iberian Peninsula. European status: **secure** |
| **800** | **Mediterranean Shag** *Phalacrocorax aristotelis desmarestii* | C Mediterranean to Black Sea. European status: **secure** (no subspecific evaluation) |
| **820** | **Pygmy Cormorant** *Phalacrocorax* pygmeus | Discont. SE Europe to Aral Sea. European status: **secure** |

*Other taxa on AERC TAC Checklist of bird taxa occurring in Western Palearctic region: *Phalacrocorax carbo maroccanus* (NW Africa), *Phalacrocorax carbo lucidus* (W & S Africa, inland E Africa), *Phalacrocorax auritus* (North America, Canada), *Phalacrocorax aristotelis riggenbachi* (Morocco), *Phalacrocorax nigrogularis* (Persian Gulf, Oman), *Phalacrocorax africanus africanus* (Africa, S of Sahara).

**External features:**

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| **Age** | adult,<br>immature,<br>juvenile | Plumage characteristics (patterns); fairly easy, not if feathers are dirty or wet. Still a specialists' job. | A<br>I<br>J |
| **Plumage** | breeding<br>winter | | B<br>W |
| **Sex** | | Predictions from specific biometrics | M |

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| | | | F |
| **Colour phase** | | - | |
| **Biometrics** | Bill length 1 | Bill tip to feathers (0.1 mm) | Bill tf |
| | Bill length 2 | Bill tip to nostril (0.1 mm) | Bill tn |
| | Bill depth 1 | Bill depth at base (0.1 mm) | Bill base |
| | Bill depth 2 | Bill depth at gonys (0.1 mm) | Bill gonys |
| | Bill depth minimum | Bill depth just posterior of gonys (0.1 mm) | Bill min |
| | Head length | (mm) | Head |
| | Wing length | (mm) | Wing |
| | Tarsus length | (mm) | Tarsus |
| **Priority** | Bill tf – Bill base – Bill min – Head – Wing – Tarsus | | |

| Structure | Primaries | Longest Primary | Tail feathers | Shape of tail |
|---|---|---|---|---|
| *P.c. carbo* | 10 + 1m | P9/P8 | 14 | rounded |
| *P.c. sinensis* | 10 + 1m | P9/P8 | 14 | rounded |
| *P. aristotelis* | 10 + 1m | P9/P8 | 12 | rounded |
| *P. pygmeus* | 10 + 1m | P8 (≥P8) | 12 | wedge, long |

**General characteristics** (from BWP*i* 2006): Medium-sized to large aquatic birds. Body elongated, neck rather long. ♂ larger than ♀. Wings with long inner portion and short tip. 11 primaries, p8 and p9 longest; 17–23 secondaries. Tail long and strongly wedge-shaped, 12–14 pointed feathers. Bill strong, of medium length, laterally compressed, culmen rounded; hooked at tip; nostrils closed. Gular skin bare. Tarsus heavy; toes long, outer longest, nail of middle toe medially with comb. Tibia feathered. Legs set far back. Plumage black, often with metallic sheen. Sexes similar. Breeding plumage different from non-breeding, often by increase of white filoplumes. 2 moults per cycle, pre-breeding involving relatively few feathers; primaries replaced in serially descendant order. Juveniles differ from adult by being duller or paler; reach adult plumage in 3rd-4th calendar year.

**Basic biometrics** (summarised)

| Species | sex | Bill tf | Bill min | Wing | Tarsus |
|---|---|---|---|---|---|
| *Phalacrocorax carbo carbo* | ♂ | 66-86 | 16-18 | 330-370 | 67-82 |
| | ♀ | 59-77 | 13-15 | 318-365 | |
| *Phal. carbo sinensis* | ♂ | 55-75 | 13-16 | 323-382 | 63-78 |
| | ♀ | 50-72 | 11-13 | 310-360 | 62-71 |
| *Phalacrocorax aristotelis* | ♂ | 50-71 | 9.3-14.2 | 263-289 | 62-70 |
| | ♀ | 57-69 | 7.6-12.5 | 252-281 | 58-65 |
| *Phalacrocorax pygmeus* | ♂ | 29-33 | | 195-217 | 37-40 |
| | ♀ | 27-31 | | 193-208 | 36-39 |

**Geographical variation**

Great Cormorant (from BWP*i* 2006): Three races recognized in west Palearctic. *P. c. sinensis* (most of Europe) smaller than nominate *carbo* (Atlantic coast), especially bill; plumage glossed blue-green rather than blue-purple, but variable and some *carbo* have green-glossed chest, some west European *sinensis* slight purple gloss. *P. c. sinensis* has more white plumes on head and neck, but number dependent on age, and, rarely, old carbo have as many as typical sinensis. *P. c. maroccanus* (North Africa) intermediate between *sinensis* and tropical African race *lucidus*: throat and upper chest white.

Shag (from BWP*i* 2006): Slight in north-west Europe; see Measurements. Mediterranean subspecies *P. a desmarestii* slightly smaller than nominate *aristotelis*, but bill longer and more slender; bare skin at base of lower mandible in adult more extensive, paler yellow; bill usually yellow except black culmen and tip; foot brown with yellow webs; crest on average shorter, sometimes absent. Juvenile with much white on underparts; throat, breast, and belly at least white, sometimes chin to under tail-coverts (but not flanks). North-west African *P. a. riggenbachi* combines body size and colour of bare parts of *P. a. desmarestii* with bill dimensions of nominate *aristotelis* (Hartert 1921).

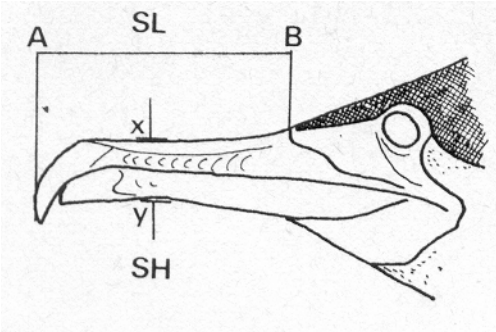


Figure 1. Key measurements in cormorants and shags: bill length tip to feathers (Bill tf; A-B) and *minimum* bill depth, just behind the gonys (Bill min; x-y). From Camphuysen 1998. Minimum bill depth is used to predict sex ratios (Calvo & Bolton 1997) and for species identification.

Ratio bill tf / bill min (i.e. A-B / x-y)

| | |
|---|---|
| Great Cormorant | ± 4.5 |
| European Shag | ± 5.5 |

### Identification assistance: Great Cormorants versus European Shags

Both species are large, blackish waterbirds with a long neck, a long tail, a hooked bill and rounded wing tips. Adults are almost entirely black (green metallic, blue metallic or purple metallic gloss in fresh and clean specimens). A diagnostic difference between cormorants and shags is the wing length: >310 mm in cormorants and <280 mm in shags. The bare gular skin is more extensive in cormorants than in shags (Figs. 2-3) and the bill in cormorants is heavier. Finally, cormorants have 14 tail feathers, shags only 12 (do check for completeness).

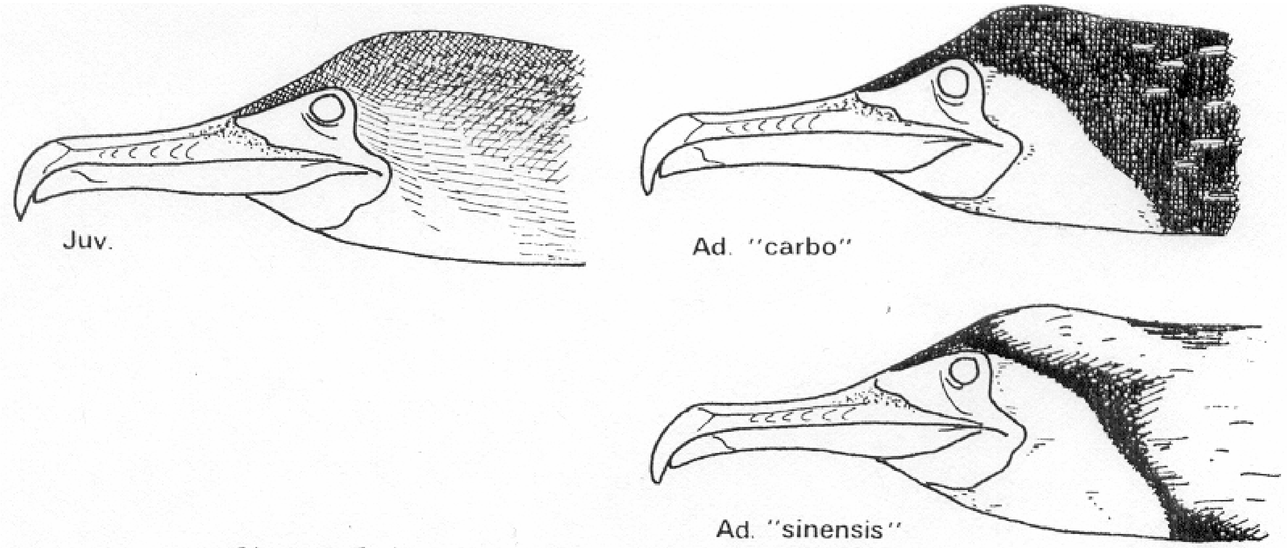


Figure 2. Head patterns of juvenile and adult (breeding) Great Cormorants. Note the more extensive bare gular skin area in cormorants than in shags (Fig. 3). From Camphuysen 1998.

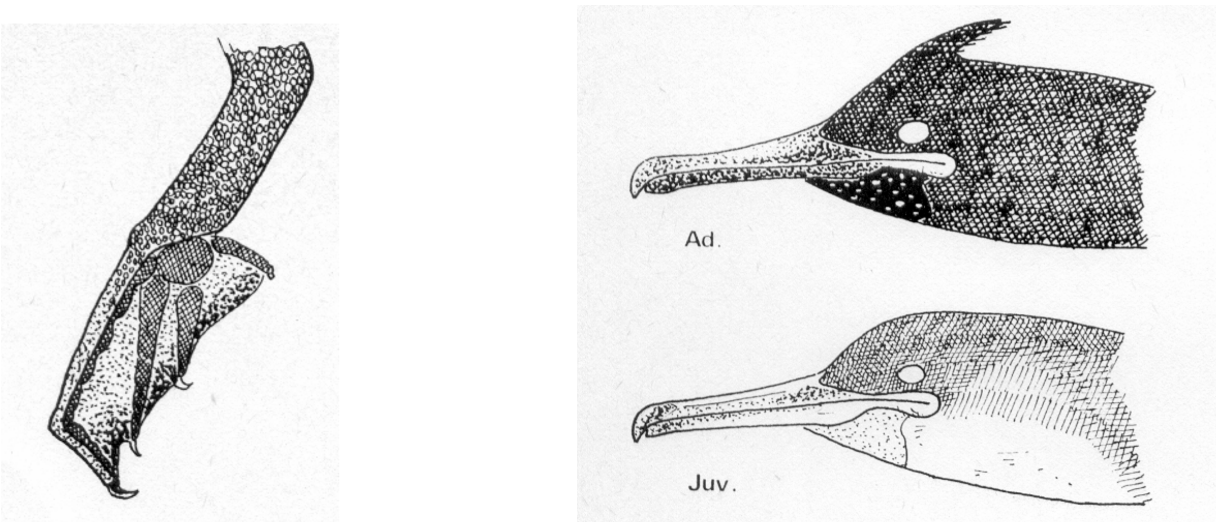


Figure 3. Leg (left) and head patterns (right) of juvenile and adult (breeding) Eurpean Shags. Note the less extensive bare gular skin area in cormorants than in cormorants (Fig. 2). In stranded specimens, crest feathers are normally not very obvious, and crests are only a prominent feature in the early breeding season. From Camphuysen 1998.

**Ageing Great Cormorants and European Shags**


Figure 4. Tips of secondaries (A) and primaries (B) in juvenile and adult cormorants.

Blunt or rounded in adults, sharply pointed or sharp tipped in juveniles.

Secondaries and primaries of juvenile cormorants are pointed, or have a sharp tip (Fig. 4), whereas primaries and secondaries of mature birds are generally rounded and worn. Primaries are replaced in serially descendant order, similar as in Northern Gannets, and an active moult centre can be seen in mature birds or immatures >1cy of age. The presence of wing moult points at a non-juvenile bird.

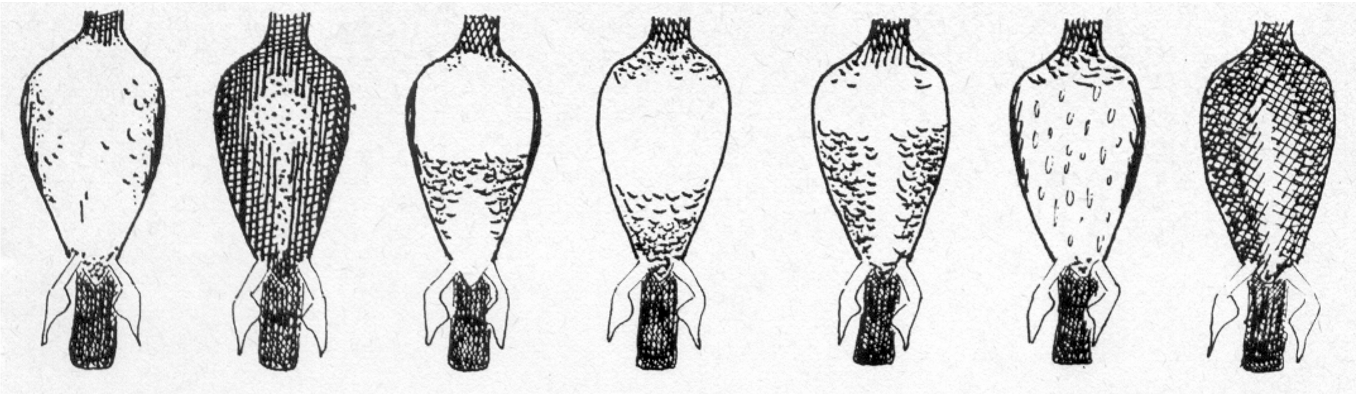

Figure 5. Variability in pattern of underparts in Great Cormorants (Camphuysen 1998). See also Bauer & Glutz von Blotzheim (1966).

Juveniles and immatures do not have fully black underparts. In juvenile Great Cormorants, the underparts are largely or partly whitish (but highly variable; Fig. 5). Underparts of juvenile European Shags are light brown to nearly whitish (darker evenly brown in immature birds). Both species have a fine scaled appearance of mantle and upperwing, but the feathers of juveniles and adults are very different. Immature birds (non-juveniles) are likely to have a mix of adult and juvenile feathers, and a less shining metallic gloss of so-called ‘adult’ countour feathers.

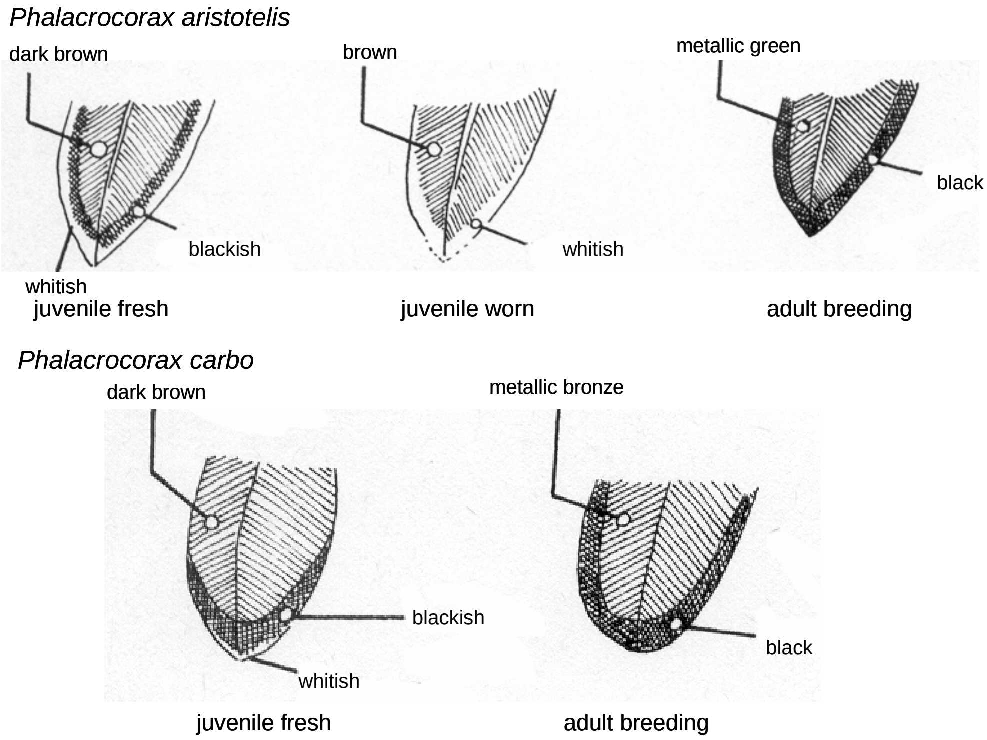


Figure 6. Mantle feathers and upperwing coverts of European Shag and Great Cormorant (after Camphuysen 1998).

Juvenile European Shags have whitish fringes on these feathers with a dark subterminal band. Worn feathers have even broader whitish fringes, but the subterminal band is vague or even absent. Adult birds have green glossy feathers with clear-cut black edges, giving the characteristic scaled appearance. The feather tips are V-shaped rather than rounded.

In juvenile Great Cormorants, the whitish tip of these feathers is narrow, easily wears off, leaving a rather wide brown terminal band over dark brown feathers. Adult birds have mostly rounded mantle feathers with a broad black band and a metallic bronze centre.

**Sexing European Shags *Phalacrocorax aristotelis***

External measurements can be used to predict the sex of adult European Shags, as could be demonstrated with discriminant analysis by Calvo & Bolton (1997) from Shetland material, colleted during the *Braer* oil spill in 1993. Key measurements are wing length (Wing) and minimum bill depth (Bill min). Based on a combination of measurements, over 95% of females would be properly identified, whereas 91% of males were sexed correctly, using discriminant scores (*D*, where *D* < *0* ♀♀ and *D* > 0 ♂♂):

*D* = (1.421 x Bill min) + (0.095 x Wing) – 39.647 (♀ 96.4% correct, ♂ 91.3% correct)

From single measurements, especially from bill depth (Bill min), the predictions were still often correct:

*D* = (1.796 x Bill min) – 17.925 (♂♀ 92.8% correct)

*D* = (0.201 x Wing) – 53.978 (♂♀ 85.1% correct)

**Sexing Great Cormorants *Phalacrocorax carbo sinensis***

Koffijberg & Van Eerden (1995) obtained a sample of 116 Great Cormorants consisting birds which had drowned in gill nets and fykes in the IJsselmeer (The Netherlands). Discriminant analysis applied on total body length (L), wing length (wing), sternum length (sternum), bill length (bill tf), and bill depth (bill base) separately showed that 71.4% and 87.4% (adults and immatures combined) could be sexed accurately. Bill depth was the best single parameter allowing for segragation between males and females:

*D* = 0.71 x (bill base) – 14.35 (♂♀ 87.4% correct)

A slightly lower classification rate was calculated when using wing length (wing):

*D* = 0.09 x (wing) – 31.63

and all individuals with a wing length >336.6 mm could safely be assumed being males. The best prediction (96.1% correct overall ) was made by a combination of measurements, including total body length (L), wing length (wing), and bill depth (bill base).

*D* = 0.09 (L) + 0.06 (wing) + 0.44 (bill base) – 35.53 (♂ 100% correct, ♀ 92% correct)

It should be noted that using sternum length to predict sex is useful only in case of scavenged carcasses, with gonads being eaten away. Sternum length can be measured only during a standard autopsy, and it is more direct and accurate to assess the sex and age from internal inspection rather than from sternum length.

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

**Technical document**

## **Procellariidae** Petrels and Shearwaters

Cosmopolitan, in all oceans, greatest diversity in Southern Hemisphere, 12 genera, 70 species, 109 taxa (del Hoyo *et al.* 1992) or 24 genera, 115 species (Sibley & Monroe 1990)

Petrels and shearwaters are pelagic seabirds, with a compact build, long narrow wings and a ‘tube nose’. 26 taxa occur within the Western Palearctic, 12 of which are very rare. Foraging concentrations may be vulnerable to oil pollution, but otherwise, these wide-ranging largely aerial seabirds usually stay largely clear of major spills. Identification of petrels and shearwaters is relatively easy in the hand, for as long as the birds are fresh and more or less intact. There are no clear external characteristics for either sex (but ♂ usually larger than ♀) or age and standard autopsies are usually required to assess those variables with certainty. In the absence of data on geographical variations in body size in most species, ringing data are essential to assess the breeding origin of oiled casualties. Arctic populations of Northern Fulmars (smaller birds, often dark phase) can be separated from boreal populations (larger, mostly light phase).

| Euring | Species* | Distribution, status in Europe |
|---|---|---|
| | **Zino’s Petrel** *Pterodroma madeira* | Madeira, 30-40 pairs. European status: **critically endangered** |
| | **Fea’s Petrel** *Pterodroma feae* | Desertas (Maderia, *deserta*) and Cape Verde Islands (*feae*). In Europe 170-260 pairs. European status: **vulnerable** |
| **220** | **Northern Fulmar** *Fulmarus glacialis* | North Atlantic Ocean, high arctic *glacialis*, low arctic and boreal zones *auduboni*. > 2.8 million pairs, following large increase and expansion. European status: **secure** |
| **340** | **Bulwer's Petrel** *Bulweria bulwerii* | Pantropical E Atlantic from Azores to Cape Verde Isl, in Pacific from E China and Bonin isl to Hawaii, Phoenix and Marquesas isl. Europe: 7000-9000 pairs. European status: **rare** |
| **360** | **Scopoli's Shearwater** *Calonectris [d] diomedea* | Mediterranean islands, Bay of Biscay; 30.000-42.500 pairs. European status: **vulnerable** |
| **365** | **Cory's Shearwater** *Calonectris [d] borealis* | Berlengas (Portugal), W to Azores and S to Canary Islands; 235.000-245.000 pairs, European status: **vulnerable** |

| | | |
|---|---|---|
| 400 | **Great Shearwater** *Puffinus gravis* | Nightingale and Inaccessible Island (Tristan da Cunha), Falkland Islands. European status: **not evaluated** |
| 430 | **Sooty Shearwater** *Puffinus griseus* | S Chile and Falkland Islands, SE Australia and New Zealand area. European status: **not evaluated** |
| 460 | **Manx Shearwater** *Puffinus puffinus* | N Atlantic. Newfoundland, S Iceland, Faeroes, British Isles, Ireland and NW France, Azores, Madeira and Desertas to Canary Islands. In Europe 350.000-390.000 pairs. European status: **localised** |
| 462 | **Balearic Shearwater** *Puffinus mauretanicus* | Balearic Isl (W Mediterranean), 1650-2050 pairs. European status: **endangered** |
| | **Yelkouan Shearwater** *Puffinus yelkouan* | Mediterranean Islands, 13.000-33.000 pairs. European status: **secure**. |
| 480 | **Little Shearwater** *Puffinus assimilis* subsp. | Azores to Canary Islands (*baroli*), Cape Verde Islands (*boydi*) European status: **rare**. |

*Other taxa on AERC TAC Checklist of bird taxa occurring in Western Palearctic region: *Macronectes giganteus* (Southern Oceans), *Daption capense capense* (Southern Oceans), *Pterodroma arminjoniana arminjoniana* (S Atlantic, Indian Ocean), *Pterodroma incerta* (S Atlantic), *Pterodroma cahow* (Bermuda), *Pterodroma hasitata* (Carribean), *Calonectris leucomelas* (Japan, Taiwan, China, Korea), *Puffinus pacificus* (tropical Indian Ocean, Pacific), *Puffinus carneipes* (Indian Ocean, Pacific), *Puffinus lherminieri persicus* (Arabian Sea), *Puffinus lherminieri bailloni* (Mascarene Islands)

**General characteristics** (from BWP*i* 2006): Medium-sized pelagic seabirds, 6 species breeding in west Palearctic, others (regular) migrants or accidental. Body ovate, more elongated in shearwaters. Wings long and narrow. 11 primaries: p10 longest, p11 minute. 20–29 secondaries; short. Tail short; 12-14 feathers (14 in *Fulmarus*). Bill heavy, more slender in shearwaters, hooked at tip; horny sheath divided in plates; nostrils in dorsal tubes of varying length. Legs set far back, tarsus laterally flattened, round in gadfly-petrels; lower part of tibia bare. 3 anterior toes webbed, hind toe rudimentary, elevated; nails sharp and curved. Peculiar musky odour. Sexes similar in plumage, ♂ usually larger than ♀. Some species occur in light and dark morphs. 1 moult per year, primaries moulting descendantly. Juvenile like adult.

**External features:**

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| **Age** | adult,<br>juvenile | Generally impossible from plumage characteristics.<br>Standard autopsy required for confirmation. | A<br>J |
| **Plumage** | | No difference between, summer or winter. | |
| **Sex** | male<br>female | Generally impossible from plumage characteristics; sex discriminant in some species. Otherwise standard autopsy required for sexing. | M<br>F |
| **Colour phase** | white phase<br>coloured phase | Northern Fulmars only, indicating high arctic (coloured) or boreal (white) origin | **Col** (L, D, or DD)<br>**W** (LL) |
| **Biometrics** | Bill length 1 | Bill tip to feathers (0.1 mm) | Bill tf |
| | Bill length 2 | Bill tip to tube (0.1 mm) | Bill tub |
| | Bill depth 1 | Bill depth at base (0.1 mm) | Bill base |
| | Bill depth 2 | Bill depth at gonys (0.1 mm) | Bill gonys |
| | Bill width 1 and 2 | Bill width at base and gonys (0.1mm) (see below) | Bill width |
| | Tube | Tube length from feathers (0.1 mm) | Tube |
| | Head length | (mm) | Head |
| | Wing length | (mm) | Wing |
| | Tarsus length | (mm) | Tarsus |
| **Priority** | Bill tf – Bill base - Bill gonys – Tube – Head - Wing – Tarsus | | |

| Structure | Primaries | Longest Primary | Tail feathers | Shape tail |
|---|---|---|---|---|
| *P. madeira* | 10 + 1m | P10 (≥ P9) | 12 | wedge |
| *P. feae* | 10 + 1m | P10 (≥ P9) | 12 | wedge |
| *F. glacialis* | 10 + 1m | P10 | 14 | rounded |
| *B. bulwerii* | 10 + 1m | P10 (≥ P9) | 12 | wedge |
| *C. diomedea* | 10 + 1m | P10 (≥ P9) | 12 | rounded |

| Structure | Primaries | Longest Primary | Tail feathers | Shape tail |
|---|---|---|---|---|
| *C. borealis* | 10 + 1m | P10 (≥ P9) | 12 | rounded |
| *P. gravis* | 10 + 1m | P10 | 12 | rounded |
| *P. griseus* | 10 + 1m | P10 | 12 | rounded |
| *P. puffinus* | 10 + 1m | P10 (≥ P9) | 12 | rounded |
| *P. mauretanicus* | 10 + 1m | P10 (≥ P9) | 12 | rounded |
| *P. assimilis* | 10 + 1m | P10 (≥ P9) | 12 | rounded |

**Geographical variation commoner species**

Northern Fulmar (from BWP*i* 2006, modified): Proportion of coloured birds in population and size of bill vary, but variation not correlated. In many high-arctic localities (Baffin Island, north-east Greenland, Spitsbergen), coloured morphs form great majority of population. On Bear Island, dark morph birds slightly less predominant than in Spitsbergen, with white phase birds 10% of population. In west Greenland and at Jan Mayen, 99% of breeding birds white morph. Populations of southern, boreal part of Atlantic range overwhelmingly white phase. Small bills found in Baffin and Devon Islands (♂♂, average 36.2). Data for Greenland scattered and conflicting, but generally bills slightly longer than in north Canada. At Spitsbergen, bill longer (♂♂, average 37.5) than in Baffin Island. Again, larger bills found at Bear Island (38.8), Jan Mayen (39.2), and Iceland, Faeroes, and British Isles (40.8). Salomonsen (1965) divided Atlantic Fulmar into two subspecies: *glacialis* comprising high-arctic, coloured, short-billed populations and *auduboni*, comprising all white populations (mainly boreal). Division between light and dark morphs not rigid, however, as grade imperceptibly into one another. Spitsbergen birds intermediate between those from Baffin Island and west Europe, considerable overlap among populations. Range of mainly coloured birds split by white populations in west Greenland and Jan Mayen. Differences described by Salomonsen (1965) represent general trends, but not sufficient for acceptance of subspecies.

Manx, Balearic and Yelkouan Shearwaters (from BWP*i* 2006, modified): Manx Shearwater previously considered polytypic, with nominate *puffinus*, east temperate North Atlantic; *mauretanicus*, *yelkouan* other Mediterranean islands, and 5 extralimital in Pacific. At present considered separate species.

Balearic Shearwater *Puffinus mauretanicus* slightly larger than Manx Shearwater *puffinus*; Yelkouan Shearwater *P. yelkouan* about as large as *puffinus*, but tail shorter; *mauretanicus* also relatively short-tailed. In contrast to *puffinus*, both Mediterranean races have upperparts tinged brown. Otherwise, *yelkouan* similar to *puffinus*, but normally more dusky on axillaries and under tail-coverts. White crescent on side of neck often absent, but sometimes well-developed. Brown tinge of upperparts only diagnostic character in such birds, but occasionally upperside black with slight tinge of brown-grey approaching nominate *puffinus* still more. *P. mauretanicus* has underparts variably tinged brown-grey; in some only throat, sides of breast, flanks, lower belly, and under tail-coverts, in others whole underside. No white crescent on side of neck, no sharp contrast between brown and white on side of head, axillaries entirely grey.

Cory's Shearwater (from BWP*i* 2006, modified) nominate *diomedea* smaller than *borealis*; bill less massive; head and mantle paler; chin and throat less marked grey; prominent white wedge on inner web of primaries, projecting well beyond under wing-coverts. The former subspecies *edwardsii, Cape Verde Islands, is now regarded as a full species.* Much smaller; bill more slender, black instead of yellow; tail relatively longer, (t1–t6 in 2 ♂♂ 34 and 40, in 2 ♀♀ 29 and 39); crown and neck darker brown; sides of head more contrasting; mantle darker, but lighter than lower back, latter as dark as upper wing-coverts; no white on distal part of primaries.

**Basic biometrics** (summarised)

| Species | sex | Bill tf | Wing | Tarsus |
|---|---|---|---|---|
| *Pterodroma madeira* | ♂♀ | ♂ 24.7, 24.8, ♀ 25.1, 25.4 | 241-254 | 30-31 |
| *Pterodroma feae* | ♂♀ | 26-30 | 255-272 | 32-38 |
| *F. glacialis (glacialis)* | ♂ | 36-41 | 325-356 | 51-55 |
| | ♀ | 33-39 | 312-337 | 49-52 |
| *F. glacialis (auduboni)* | ♂ | 38-44 | 324-355 | |
| | ♀ | 36-39 | 309-336 | |
| *B. bulwerii* | ♂ | 19-23 | 191-207 | 24-29 |
| | ♀ | 20-22 | 193-209 | 25-30 |
| *C. [d] diomedea* | ♂ | 49-55 | 331-360 | |
| | ♀ | 45-53 | 317-355 | 51-57 |
| *C. [d] borealis* | ♂ | 51-59 | 350-378 | 54-59 |
| | ♀ | 49-57 | 335-368 | 51-57 |
| *P. gravis* | ♂ | 43-50 | 317-348 | |
| | ♀ | 41-47 | 301-337 | |

| Species | sex | Bill tf | Wing | Tarsus |
|---|---|---|---|---|
| *P. griseus* | ♂ | 39-46 | 270-322 | 52-60 |
| | ♀ | 38-44 | | |
| *P. puffinus* | ♂ | 32-39 | 224-244 | 42-48 |
| | ♀ | 31-36 | 225-242 | |
| *P. mauretanicus* | ♂ | 36-42 | 234-256 | 44-51 |
| | ♀ | | | |
| *P. assimilis* | ♂ | 24-28 | 170-190 | 36-39 |
| | ♀ | 24-26 | 170-185 | |

## Colour phase in Northern Fulmar *Fulmarus glacialis*

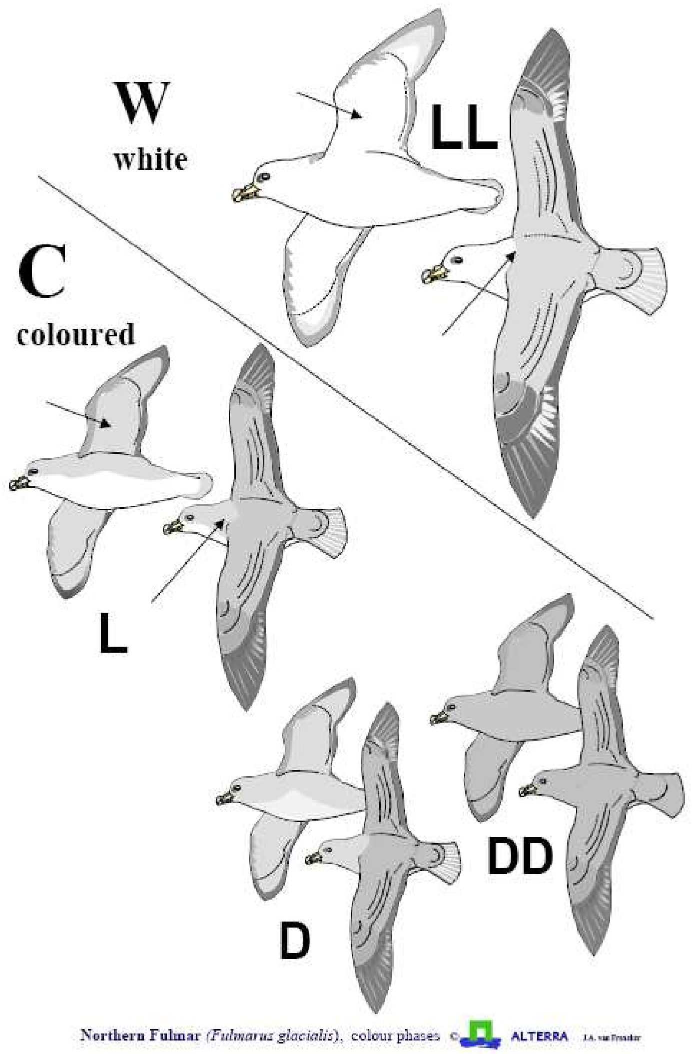


Figure 1. Colour phases of Northern Fulmars *Fulmarus glacialis* may be coded in detail as LL (double light), L (light), D (dark), and DD (double dark).(Fisher 1952; Van Franeker & Wattel 1982). Today, a more simple and meaningful split is made between the 'coloured' morphs (L, D, and DD) and the double light or 'white' morph (LL=W) (From Van Franeker 2004a).

Arctic colonies have a mixture of 'coloured' individuals, whereas colonies in the temperate zones have almost exclusively 'double light' (white) populations. The main characteristic is the presence of grey under wing coverts in all but the lightest variety of this species. On the head, birds coded as L-phase birds may only have such a faint greyish that they are easily misidentified. The grey under wing is the most reliable characteristic.

After Van Franeker 1995 and 2004a.


Misleading plumage: a light phase bird, unoiled plumage, appeared to be impregnated with particles of soot.
© JA van Franeker

## Sex discriminant in Northern Fulmar *Fulmarus glacialis* (Van Franeker & Ter Braak 1993)

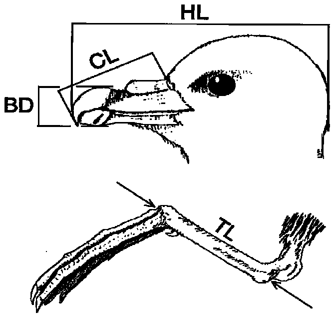


Figure 2. Northern Fulmar main measurements as used by Van Franeker & Ter Braak (1993). Head length is particularly important both in studies of geographical variation and sexual dimorphy. Tube length is normally measured from feathers to the end of the tube.

Van Franeker & Ter Braak (1993) developed a range of discriminant functions for beached Northern Fulmars from the Netherlands. Although the bulk of this material concerns the boreal subspecies *F.g. auduboni*, in the order of 10 to 20% of birds has high arctic origins. In addition, the material included juvenile individuals with not full-grown bills. In spite of such strong origin related and age related variability, the discriminants perform well.

Using additional material from other Northern Fulmars and from four southern hemisphere species of fulmarines, a similar set of ‘generalized discriminants’ was developed, of which the one using the four main characters is recommended for usage in poorly known populations or species of tubenoses. Cut points separating the sexes need to be calculated from the sample itself (Van Franeker & Ter Braak 1993).

Many older studies lack head length. A simple discriminant for Dutch Northern Fulmars using just bill length and depth was calculated as: Bill tf + 2.5291 Bill gonys, with cut point at discriminant score 81.44. However, this function reliably separated only 93.1% of the individuals, considerably below functions using head length:

| | | | |
|---|---|---|---|
| Function NL1 | Head | ♂ > 95.2 > ♀ | (95% correct) |
| Function NL2 | Head + 0.919 Bill gonys | ♂ > 110.6 > ♀ | (97% correct) |
| Function NL3 | Head + 1.057 Bill gonys + 0.428 Tarsus | ♂ > 136.0 > ♀ | (97% correct) |
| Function NL4 | Head + 0.935 Bill gonys + 0.365 Tarsus – 0.4 Bill tf | ♂ > 114.9 > ♀ | (98% correct) |
| Generalised | Head + 2.38 Bill gonys + 0.41 Tarsus – 0.21 Bill tf | cut-point has to be based on sample | |

## Fulmar wrecks

Figure 3. Wing moult and excessively worn secondaries in a stranded Northern Fulmar, September 2007 © CJ Camphuysen

Procellariiform seabirds are prone to ‘wrecks’ (Joensen 1961, Crockett & Reed 1976, Bourne 1981, Teixeira 1987, Van Franeker 2004b). Wrecks involve mass strandings of severely emaciated individuals and the proximate cause of these events is food related (stock, availability, or quality). The exact mechanism of these wrecks is not well understood, but one of the symptoms often observed is excessive wear of feathers, suggesting arrested moult prior to the mortality. The illustrated example was part of a mass stranding in early autumn, with virtually all Northern Fulmars involved in ‘active’ wing moult (i.e. not juvenile), and mostly with ragged secondaries and primaries.

## Identification assistance (1) Manx, Sooty, Great and Cory’s Shearwaters

The identification of commoner shearwaters should not be too problematic. Shown are some characteristics that would of help with the identification of incomplete carcasses, or with the (sub-)specific identification of for example Manx/Balearic Shearwaters and Great/Cory’s Shearwaters and subspecies of Cory’s Shearwaters. Rarer species, such as Little Shearwaters or gadfly petrels *Pterodroma* spp. should always be collected for later reference and museum collections.

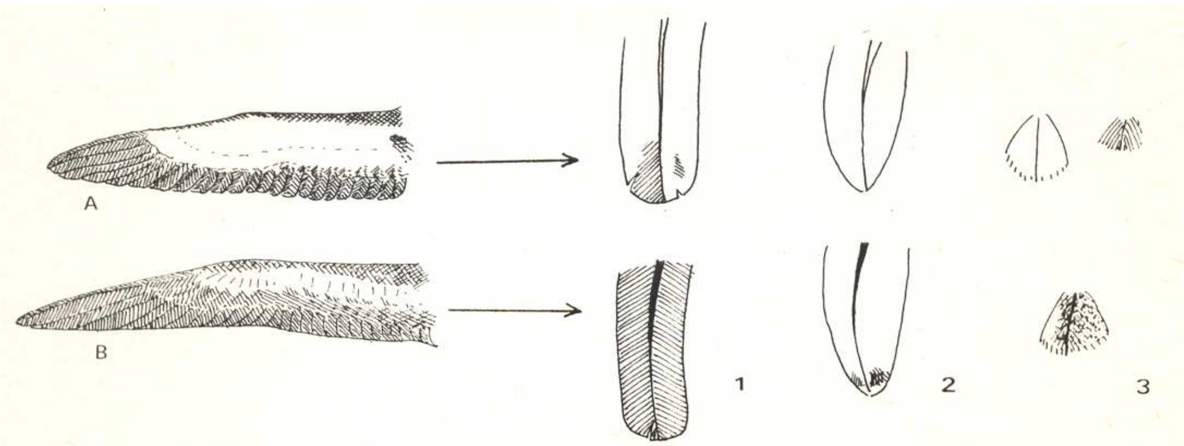


Figure 4. Underwing patterns of (A) Manx Shearwater *Puffinus puffinus* and (B) Sooty Shearwater *Puffinus griseus,* plus (1) greater under wing coverts, (2) central under wing coverts, and (3) lesser under wing coverts of either species.

Figure 5. Manx Shearwater under wing (top) and upper wing pattern (bottom). © CJ Camphuysen

Figure 6. Manx Shearwater with typical black-and-white overall appearance and bright white undertail coverts. Stranded birds are often soaked with water and subtle colour differences or ageing characters such as the exact shape of primary tips (see below) can be difficult to judge on wet carcasses. © Arnold Gronert

Figure 7. Balearic Shearwater *Puffinus mauretanicus* with browner upperparts, dusky underside (can be whitish!), duskier axillaries and undertail-coverts (not shown here), often extending up the side of the body to beneath the wing. © Ricard Gutiérez

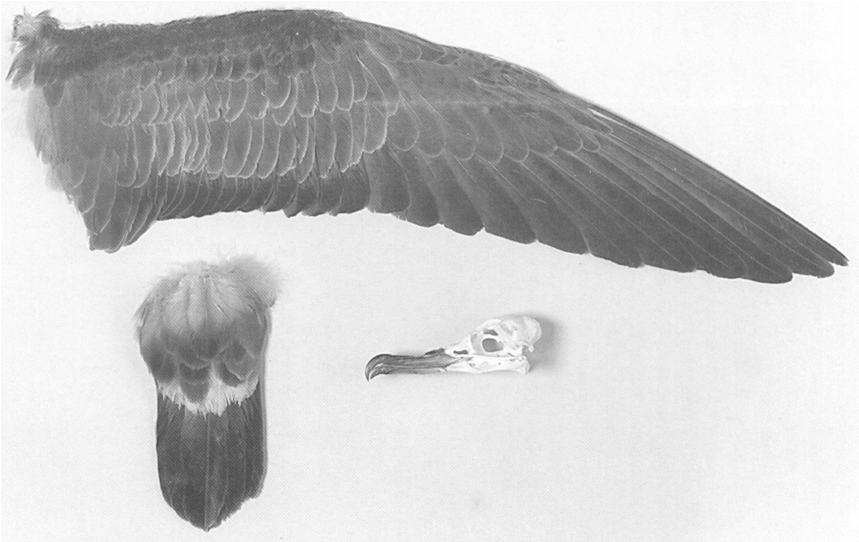

Figure 8. Upperwing patterns, upper tail and skull of Great Shearwater *Puffinus gravis* (Prins & Coster 1997)

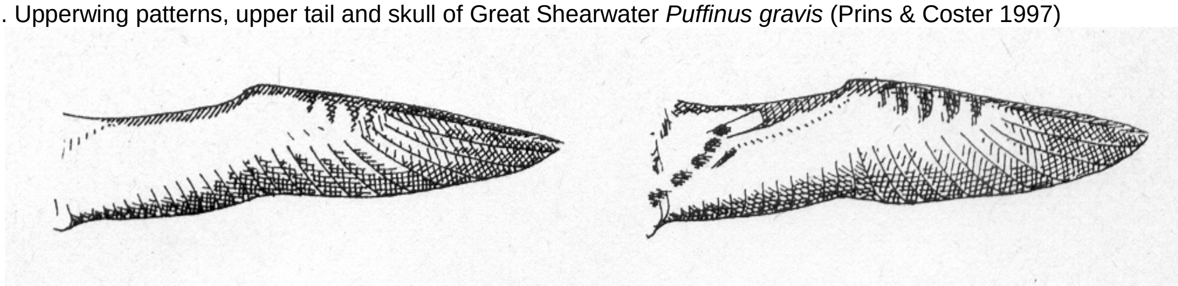

Figure 9. Underwing patterns of (left) Cory's Shearwater and (right) Great Shearwater.

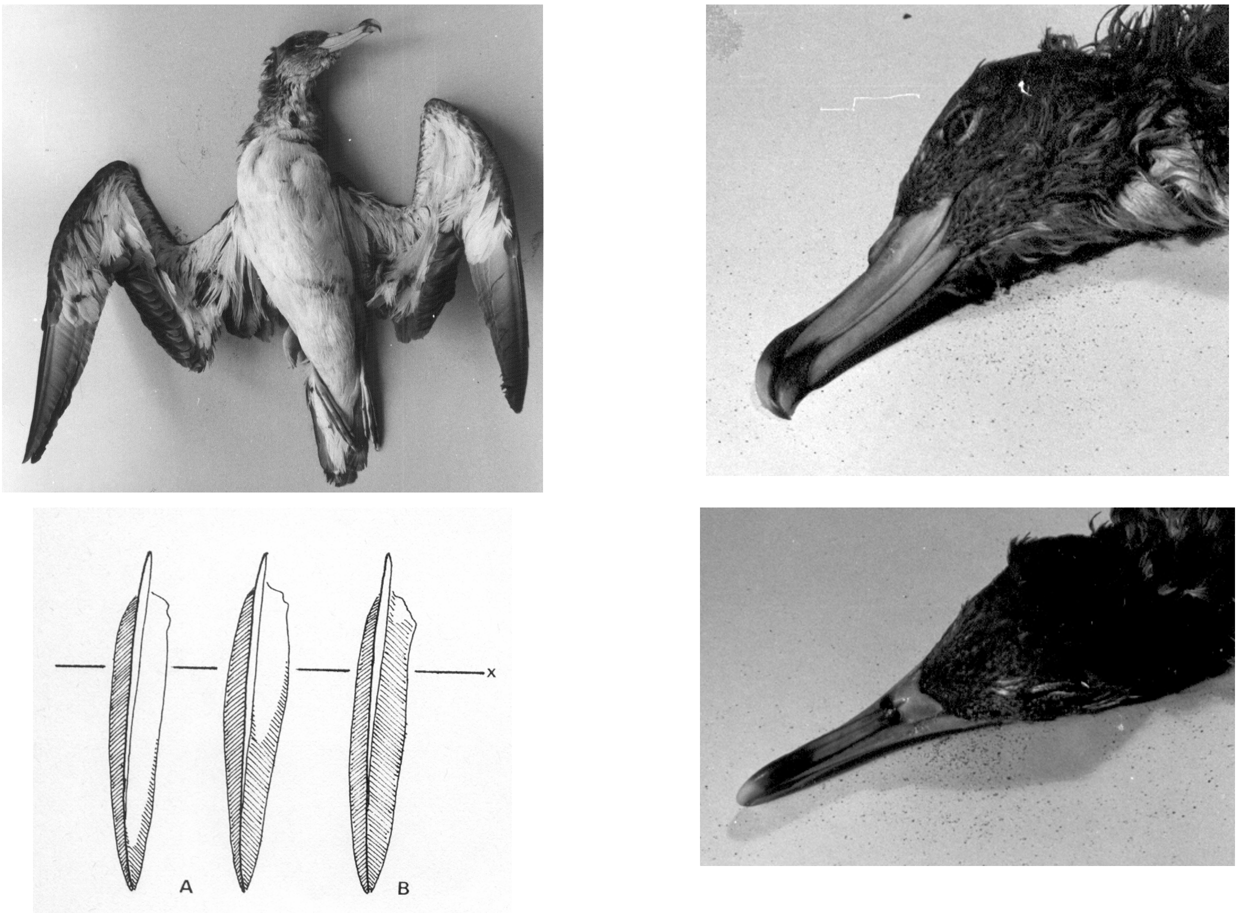


Figure 10. Cory's Shearwater *Calonectris [d.] borealis*, freshly dead corpse. Note light and heavy bill, grey head and whitish chin. Primaries of Cory's Shearwater *Calonectris [d.] diomedea (A) have a whitish panel of variable size at the inner vane, whereas primaries of C.[d.] borealis (B) are all grey.* © CJ Camphuysen.

### Sexual dimorphism of Cory's Shearwater *Calonectris [d.] diomedea* (after Ristow & Wink 1980)

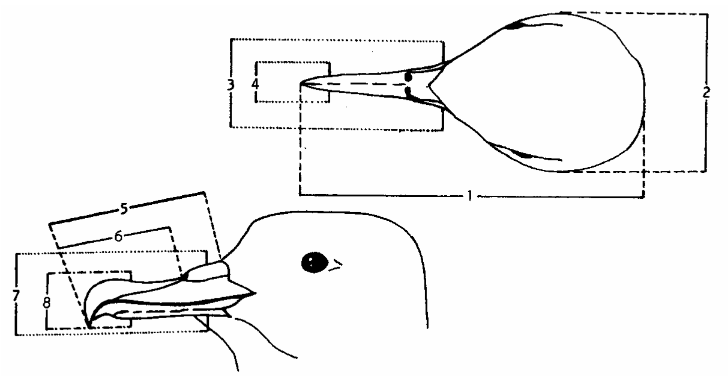


Figure 11. Eight measurements of head and bill of Cory's Shearwater, used to sex individuals without the need to perform an autopsy. All differences statistically significant (P< 0.01).

| | ♂ | ♀ |
|---|---|---|
| (1) Total head | 105.9 | 101.2 |
| (2) Width of head at cheeks | 34.5 | 32.7 |
| (3) Width of bill at base | 19.7 | 19.1 |
| (4) Width of bill at gonys | 6.7 | 6.1 |
| (5) Bill length tip to feathers | 49.5 | 46.2 |
| (6) Bill length tip to tube | 38.6 | 36.5 |
| (7) Bill depth base | 18.6 | 16.6 |
| (8) Bill depth gonys | 12.9 | 11.6 |

Biometrical data obtained from Cory's Shearwaters in the Aegean Sea were used to study morphological differences between the sexes. Males were significantly larger than females and a bi-modal pattern was produced by multiplying bill length (measurement# 5, Fig. 11) and bill depth (#7), suggesting that of all 76 individuals with a known sexual identity, the overlap in size was minimal

♂♂ → Bill tf x Bill base > 840
♀♀ → Bill tf x Bill base < 820

The results suggest that only standard measurements are required for a fairly reliable prediction of sex, so that the excessive amount of 8 head measurements could be avoided. It is likely that a similar approach in the Atlantic race of Cory's Shearwater, or indeed in other shearwaters would be similarly useful.

### Ageing shearwaters

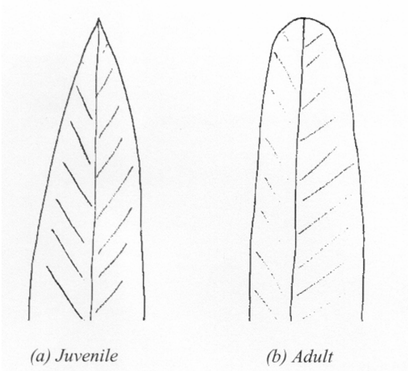


Figure 12. Juvenile shearwaters (autumn and early winter) generally have fresh and pointed outer primaries, whereas adult birds show more rounded and often abraded feather tips (from Baker 1993, Leonard & McKee 2005).

Outer primary shape is a useful external character for most shearwaters shortly after fledging. The example shown here was based on Manx Shearwater studies.

Leonard & McKee (2005) have summarised the ageing characteristics for Manx Shearwater as follows:

| | Juvenile | Adult |
|---|---|---|
| Outer primary shape | Pointed and fresh | Rounded and worn |
| Inner primary shape | Blunt-ended with hooked inner edge; fresh | Rounded and worn |
| Mantle feathers | Black with pale grey edges | Uniform brown and worn |
| Feather colour | Sooty black | Brown |
| Axillaries | Pointed, much black on feather | Rounded, no or small amounts of black |

The **shape of the primaries** of juvenile birds differs dramatically from that of adults. In juveniles, the outer two or three primaries are very pointed (Figure 12). Primaries 4 to 8 are blunt-ended, the end of the feathers appearing to have been cut off across the shaft. On the inner edge of these primaries there is a distinctive hooked point at 90° to the shaft. All these feathers are sooty black in colour. The edges of the feathers are fresh and unworn; the shafts of the feathers are black. The inner edges of the fresh unused primaries are often 'crumpled' giving them a waved, undulating appearance. In adults, all the old un-moulted primaries are rounded in shape. The outer few feathers can be pointed to some degree, but rarely. However, the edges of all the feathers are worn and frayed, often with nicks on the edge. The feather shafts are brown.

The **ground colour** of the **main feather tracts** is one of the main differentiating features between adults and juvenile birds. As suggested by Baker (1993), the ground colour of juvenile birds is black. All the major feather tracts are the same sooty black colour, fresh and unworn - remiges, rectrices, scapulars, mantle, nape and head. The moult schedule of Manx shearwaters is not definitely known but it must occur during the winter (Cramp and Simons 1977). Adults returning to colonies in March have fresh black feathers, but by early September their feathers are 6-10 months old and are consequently heavily worn. The ground colour of the mantle, scapulars, remiges and rectrices is a dark muddy brown. This contrast with juveniles is usually clear-cut and obvious.

Juvenile **axilliaries** were found to be pointed in shape with large amounts of black across the tip of the feather. Adult axilliaries were rounded with the great majority of birds having white feathers with no black markings. Leonard & McKee (2005) considered axilliary pattern a fine indicator of shearwater age.

### Identification assistance (2) Fea's Petrel *Pterodroma* feae and Zino's Petrel *Pterodroma madeira*

Identification of the 'soft-plumaged petrel' group is problematic, and separation of Fea's Petrel from the extremely similar Zino's Petrel represents one of the most difficult identification challenges. Diagnostic differences: bill measurements of the two species do not overlap, but there is as little as 1 mm difference between bills of the largest Zino's and the smallest Fea's Petrels. Both species are so rare, that any specimen encountered during a spill should be labelled, wrapped up and stored in a deep freezer for subsequent identification and analysis.

From Snow & Perrins (1998): Zino's Petrel of similar appearance to Fea's Petrel but up to 10% smaller and much lighter, with slimmer bill on smaller head, slimmer body and shorter outer wing with blunter tip. Plumage similar to Fea's Petrel, with proven differences restricted to more mottled flanks and more clouded pale patch on underwing (by shoulder), but probably also showing more solid, dusky-black hood, rather darker mantle and wings, and darker ends to central tail feathers. In Zino's Petrel, P1 141–150 shorter than P10, bill much more slender.

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Read and commented by:

## Appendix

### Specific biometrics Northern Fulmars

| | Bill length (tf) | | | Head length (Head) | | |
|---|---|---|---|---|---|---|
| | n | avg ±sd | min max | n | avg ±sd | min max |
| **ALL** | **808** | **38.7 ± 2.2** | **(32.8 - 44.6)** | **710** | **94.3 ± 4.1** | **(85.0 - 106.0)** |
| **FEMALES** | **432** | **37.5 ± 1.6** | **(33.0 - 41.4)** | **401** | **91.6 ± 2.4** | **(85.0 - 99.0)** |
| LL non juv | 316 | 37.8 ± 1.4 | (34.4 - 41.2) | 294 | 92.1 ± 2.2 | (86.0 - 99.0) |
| coloured non juv | 64 | 37.3 ± 1.5 | (33.5 - 41.4) | 60 | 91.0 ± 2.2 | (87.0 - 96.0) |
| LL juv | 24 | 35.7 ± 1.1 | (33.0 - 37.7) | 22 | 89.0 ± 2.0 | (86.0 - 93.0) |
| Col juv | 21 | 35.9 ± 1.8 | (33.4 - 39.7) | 19 | 89.8 ± 3.8 | (85.0 - 99.0) |
| **MALES** | **293** | **40.6 ± 1.6** | **(36.0 - 44.6)** | **271** | **98.3 ± 2.4** | **(90.0 - 106.0)** |
| LL non juv | 218 | 40.8 ± 1.5 | (36.5 - 44.6) | 200 | 98.7 ± 2.2 | (92.0 - 106.0) |
| coloured non juv | 50 | 40.2 ± 1.3 | (36.9 - 43.9) | 48 | 97.5 ± 2.7 | (90.0 - 102.0) |
| LL juv | 8 | 39.2 ± 1.4 | (37.5 - 41.7) | 8 | 95.9 ± 2.2 | (93.0 - 99.0) |
| Col juv | 13 | 39.0 ± 1.5 | (36.6 - 41.2) | 12 | 96.8 ± 2.3 | (92.0 - 100.0) |
| all , moult ignored | 1019 | 38.637 2.2659 | 32.8 45.1 | 900 | 94.239 4.1469 | 84 106 |

| | Bill depth at gonys | | |
|---|---|---|---|
| | n | avg ±sd | min max |
| **ALL** | **701** | **16.5 ± 1.1** | **(13.7 - 19.8)** |
| **FEMALES** | **400** | **15.9 ± 0.7** | **(13.7 - 18.3)** |
| LL non juv | 293 | 16.1 ± 0.6 | (14.3 - 18.3) |
| coloured non juv | 60 | 15.6 ± 0.7 | (14.4 - 17.5) |
| LL juv | 22 | 15.1 ± 0.5 | (14.2 - 16.7) |
| Col juv | 19 | 15.1 ± 0.7 | (13.9 - 16.9) |
| **MALES** | **268** | **17.5 ± 0.8** | **(14.6 - 19.8)** |
| LL non juv | 197 | 17.6 ± 0.8 | (14.6 - 19.8) |
| coloured non juv | 48 | 17.2 ± 0.8 | (15.7 - 18.6) |
| LL juv | 8 | 16.9 ± 0.6 | (15.9 - 17.7) |
| Col juv | 12 | 16.5 ± 0.8 | (14.9 - 17.8) |
| all , moult ignored | 891 | 16.448 1.1133 | 13.4 19.8 |

| | Tarsus length | | | Wing length | | |
|---|---|---|---|---|---|---|
| | n | avg ±sd | min max | n | avg ±sd | min max |
| **ALL** | **889** | **53.5 ± 2.5** | **(43.0 - 61.0)** | **891** | **331 ± 11** | **(289 - 365)** |
| **FEMALES** | **449** | **52.1 ± 1.7** | **(43.0 - 57.9)** | **442** | **326 ± 9** | **(295 - 347)** |
| LL non juv | 330 | 52.3 ± 1.7 | (43.0 - 57.9) | 329 | 327 ± 9 | (295 - 347) |
| coloured non juv | 65 | 51.6 ± 1.7 | (45.5 - 55.5) | 61 | 321 ± 10 | (300 - 338) |
| LL juv | 25 | 51.1 ± 1.5 | (48.0 - 53.5) | 24 | 324 ± 8 | (302 - 341) |
| Col juv | 22 | 51.7 ± 2.1 | (48.0 - 55.0) | 21 | 327 ± 8 | (314 - 344) |
| **MALES** | **311** | **55.7 ± 1.9** | **(50.4 - 61.0)** | **303** | **338 ± 10** | **(295 - 365)** |
| LL non juv | 233 | 55.9 ± 1.7 | (51.0 - 61.0) | 227 | 339 ± 10 | (295 - 365) |
| coloured non juv | 53 | 55.2 ± 2.2 | (50.4 - 59.4) | 51 | 331 ± 11 | (311 - 360) |
| LL juv | 8 | 54.9 ± 2.1 | (51.0 - 58.0) | 8 | 341 ± 8 | (334 - 361) |
| Col juv | 13 | 55.7 ± 1.9 | (53.0 - 58.5) | 13 | 335 ± 7 | (325 - 353) |
| all , moult ignored | 1134 | 53.442 2.5274 | 43 61 | 1003 | 329.03 12.644 | 269 365 |

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.1 Assessing the damage

### Technical document

### **Sulidae** Gannets and boobies

Tropical, subtropical and temperate seabirds, 1 genus, 9 species, 19 taxa (del Hoyo *et al.* 1992)

Gannets and boobies are large, plunge-diving seabirds, breeding on tropical to temperate islands in all oceans. Gannets are vulnerable to oil pollution and were often involved in spill along the Western European seaboard. Only the Northern Gannet is common in Europe. Identification and ageing of Northern Gannets is very easy. In the absence of data on geographical variations in body size, ringing data are essential to assess the breeding origin of oiled casualties.

| Euring | Species* | Distribution, status in Europe |
|---|---|---|
| **700** | **Brown Booby** *Sula leucogaster* | Caribbean and tropical Atlantic (*leucogaster*), Red Sea and W Indian Ocean (*plotus*) |
| **710** | **Northern Gannet** *Morus bassanus* | North Atlantic, Newfoundland, Channel Islands to N Norway in east, accidentally breeding Mediterranean. 300.000-310.000 pairs in Europe. European status: **secure** |

*Other taxa on AERC TAC Checklist of bird taxa occurring in Western Palearctic region: *Sula sula sula* (Caribbean, SW Atlantic), *Sula dactylatra dactylatra* (Caribbean, SW Atlantic), *Sula dactylatra melanops* (W Indian Ocean), *Morus capensis* (South Africa, Namibia).

**External features:**

| Assessing | Categories | Characteristics | Database coding |
|---|---|---|---|
| **Age** | adult,<br>immature,<br>juvenile | Plumage characteristics (patterns); very easy in clean specimens. Plumage types 1, 2, 3, 4, and 5 roughly correlated with true age, see decriptions. | A<br>I (2-5)<br>J (1) |
| **Plumage** | | Slight difference summer and winter plumage | |
| **Sex** | | - | |
| **Colour phase** | | - | |
| **Biometrics** | Bill length 1<br>Bill depth 1<br>Head length<br>Wing length<br>Tarsus length | Bill tip to feathers (0.1 mm)<br>Bill depth at base (0.1 mm)<br>(mm) **Note**: difficult with ordinary callipers<br>(mm) **Note**: often requires >50cm ruler<br>(mm) | Bill tf<br>Bill base<br>Head<br>Wing<br>Tarsus |
| **Priority** | Bill tf – Bill base –Head – Wing – Tarsus | | |

| **Structure** | **Primaries** | **Longest Primary** | **Tail feathers** | **Shape of tail** |
|---|---|---|---|---|
| M. bassanus | 10 + 1m | P10/P9 | 12 | wedge, pointed |
| S. leucogaster | 10 + 1m | P10 | 14 | long strongly wedge-shaped |

**General characteristics** (from BWP*i* 2006): Large seabirds, elongated body, thick neck of medium length, head large, bill long and stout, gradually tapering towards curved nail at tip, without visible nostrils. Gular and facial skin bare. ♂ and ♀ equally large in Northern Gannets, similar in plumage, in Brown Booby ♀ larger than ♂. Wings long, narrow, and pointed. 11 primaries: p9 or p10 longest, 11 minute, *ca.* 28 short secondaries. Tail long, strongly wedge shaped; 12–16 pointed feathers. Leg short and stout, four toes connected by web. Plumage predominantly white, black tipped wings (Northern Gannet), or brown with white belly (Brown Booby). Juveniles and older immatures differ from adults, with less white in plumage. Reach full adult plumage in 2–5 years. One moult per cycle; primaries replaced in serially descendant order, often >1 active moult centres.

**Basic biometrics** (summarised)

| **Species** | **sex** | **Bill tf** | **Wing** | **Tarsus** |
|---|---|---|---|---|
| *Morus bassanus* | ♂ | 92-110 | 460-535 | 48-65 |
| | ♀ | 92-105 | 460-523 | 47-64 |
| *Sula leucogaster* | ♂ | 92-105 | 383-417 | 43-48 |
| | ♀ | 89-111 | 393-431 | 44-50 |

**Geographical variation**

<u>Northern Gannet</u> (from BWP*i* 2006): None in North Atlantic area. Close relatives in South Africa (*M. capensis*) and Bass Strait area and New Zealand (*M. serrator*) differ in pattern of black in wings and tail, in size, and in ecology. Sometimes considered conspecific.

<u>Brown Booby</u> (from BWP*i* 2006): Involves colour of bare parts and of plumage. Data on size not consistent, difference between sexes apparently greater in Indo-Pacific populations. *S. l. plotus* differs from nominate in being uniformly dark brown above, not paler on lower mantle, back, and tail. In east Pacific subspecies, ♂ conspicuously pale headed.

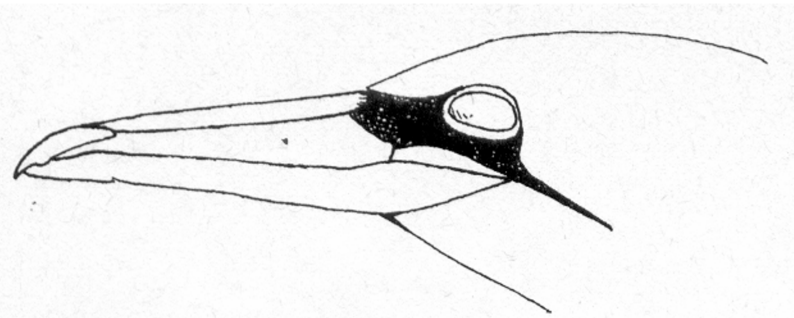

Figure 1. The Northern Gannet bill is long and stout, gradually tapering towards a curved nail at the tip. Cutting edges serrated. The nostrils are closed and bill measurements usually include only tip-to feathers bill length and base depth.

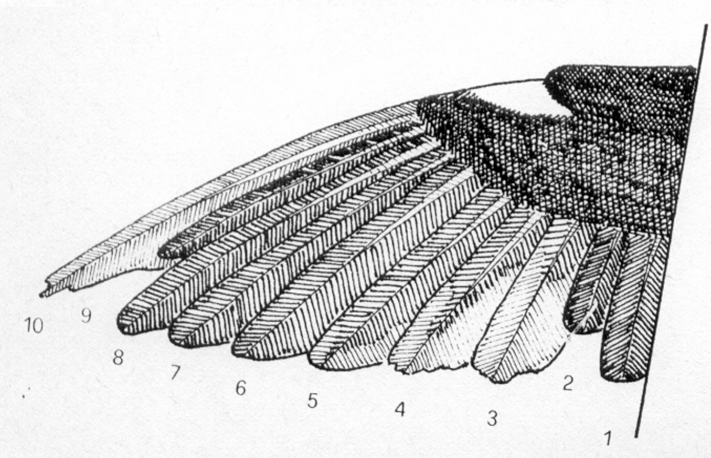


Figure 2. Primaries are replaced in serially descendant order, and in many (older) specimens, two moult centres may be visible as illustrated. A score of the primary moult can be helpful when ageing younger immature Northern Gannets, some of which retain brown heads for over a year. Active primary moult would indicate that a brown-hooded Northern Gannet is at least one year old.

The identification of Northern Gannets is normally very easy and straightforward. Plumage characteristics will reveal the age of stranded individuals, but seriously oiled specimens may require a standard autopsy to examine internal age characteristics.

**Caution** Unusual in Northern Gannets is the location of subcutaneous fat stores. Fit, fat adult birds can be a lot heavier than reported in the literature (3100-4700 g), and subcutaneous fat scores measured at the belly and breast may call for a fat score 0 or 1 even in the most healthy specimens (see Condition manual for details). Fat are considerable between the intestines (deposited fat), but also subcutaneous in the shoulder region and at the back of these animals (CJ Camphuysen *unpublished*).

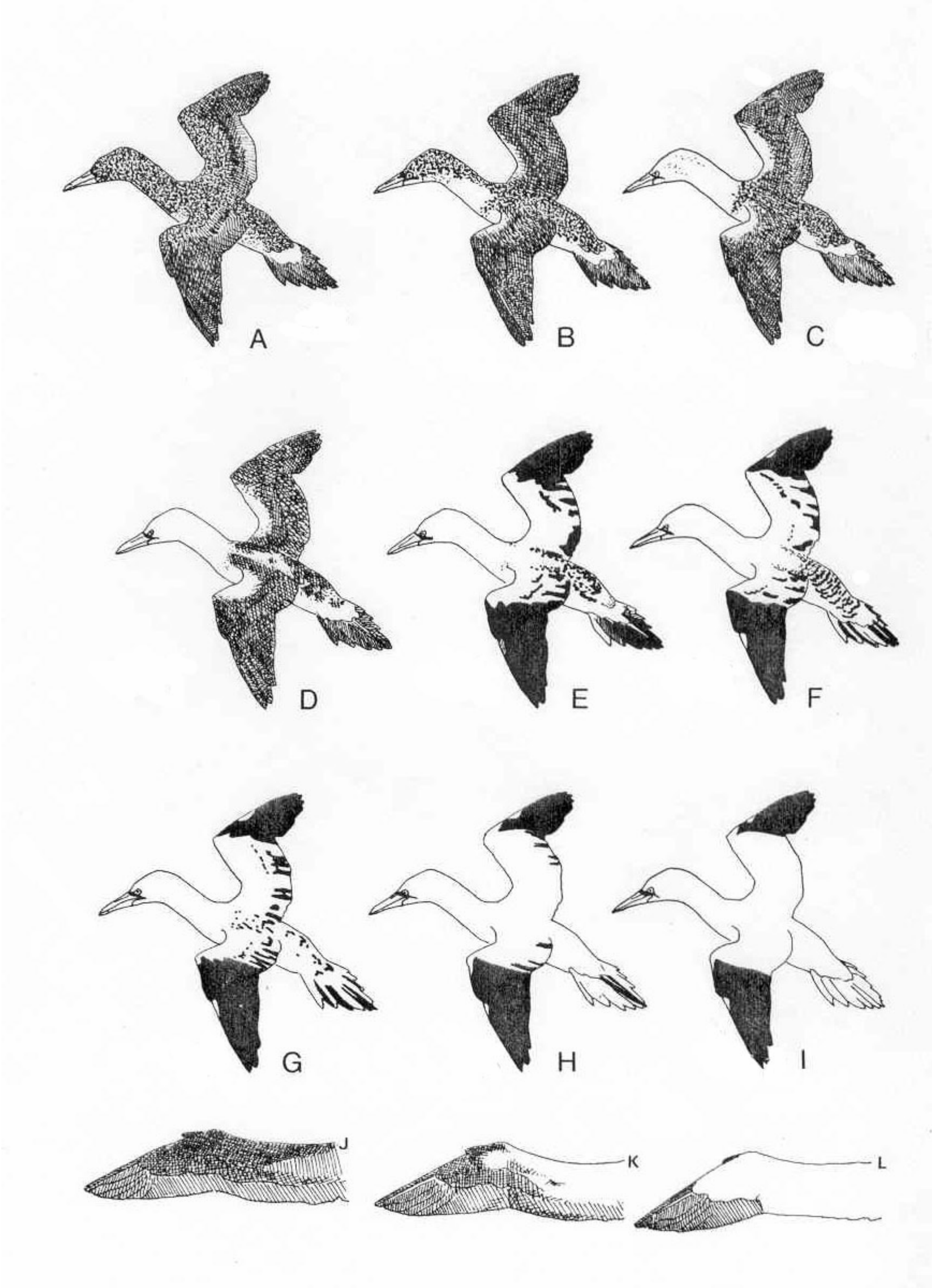


**Figure 3 Gannet plumage types with age** (from Nelson 1978b, modified)

| | |
|---|---|
| Type 1 (A) | Juvenile plumage, dark brown sprinkled white, greyish underparts |
| Type 1 (B) | Immature first year, dark head, whitish underparts |
| Type 2 (C-D) | Immature second year, white head, whitish forewing only, back mostly dark brown |
| Type 3 (E-F) | Immature third year, white or yellowish head, progressively more white on back and wings, most secondaries blackish |
| Type 4 (G) | Immature fourth year, secondaries “as piano keys”, several blackish tail feathers remaining |
| Type 5 (H) | Immature fifth year, one or two blackish secondaries, only central tail feathers blackish |
| Adult (I) | White secondaries and upper wing, white tail |

See Table 1. for expectation of occurrence

**Figure 4. Gannet plumage types with age** © CJ Camphuysen

Northern Gannet plumage types are highly variable and intermediate stages can be expected. Fresh juvenile plumage (Type 1A; top left) can be expected throughout the first autumn and into the winter (Aug-Feb). The next stage (Type 1B, top right) can be expected in the first spring, but may be encountered even in the second autumn (Feb-Nov). A yellowish head may develop in Type 2 (center left), but the colour is usually not that bright. Type 2 Northern Gannets can be expected from June or July in the first summer until November of the third year! Borderlines between Type 2 (center left) and Type 3 (center right) are not always that clear, and neither are the borderlines between Types 3 and Type 4 (bottom left). In Type 5 (bottom right), the secondaries are mostly white, while the central tail feathers are usually blackish. The illustrated individual is a clear exception to that rule.

| | |
|---|---|
| Type 1 | Juvenile plumage, dark brown sprinkled white, greyish underparts (top left) |
| Type 1 | Immature first year, dark head, whitish underparts (top right) |
| Type 2 | Immature second year, white head, whitish forewing only, back mostly dark brown (center left) |
| Type 3 | Immature third year, white or yellowish head, progressively more white on back and wings, most secondaries blackish (center right) |
| Type 4 | Immature fourth year, secondaries increasingly white, several blackish tail feathers (bottom left) |
| Type 5 | Immature fifth year, few blackish secondaries, central tail feathers normally black (bottom right) |

**Table 1. Expected plumage types in Northern Gannets**

With reference to Figures 3 and 4, Northern Gannet plumage Types 1-5 the expected and adult can be expected in the following seasons. Exceptions may occur.

| Type 1-3 | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | A | A | A | A | A | A | A | | | | | | D | D | D | D | D | D | D | D | D | | |
| | | | | | | | B | B | B | B | B | B | B | B | B | | | | E | E | E | E | E | E |
| | | | | | | | | | | | | C | C | C | C | C | C | C | C | C | | | | |
| | First year | | | | | | | | | | | | Second year | | | | | | | | | | | |

| Type 3-5 | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | E | E | E | | | G | G | G | G | G | G | G | G | G | G | G | | | | | | I | I | I |
| | | F | F | F | F | F | F | F | | | | | H | H | H | H | H | H | H | H | H | H | H | H |
| | Third year | | | | | | | | | | | | Fourth year | | | | | | | | | | | |

| Type 5-Adult | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I | I |
| | H | H | H | H | H | | | | | | | | | | | | | | | | | | | |
| | Fifth year | | | | | | | | | | | | Adult | | | | | | | | | | | |

Key characteristics:

Type 1 = brown head (illustrations A-B in Fig. 3)
Type 2 = white head, perhaps white ‘shoulders’ (forewing) (illustrations C-D in Fig. 3)
Type 3 = gradually more white on mantle and back (illustrations E-F in Fig. 3)
Type 4 = secondaries half black, half white, tail feathers partly white (illustration G in Fig. 3)
Type 5 = all white as adult, except a small number of black secondaries and 1-2 tail feathers (illustration H in Fig. 3)
Adult = all white (illustration I in Fig. 3, Fig. 5)

Figure 5. Adult Northern Gannet, white tail and white secondaries © CJ Camphuysen

Figure 6. Wings of Type 3 (top) and Adult Northern Gannet © CJ Camphuysen

Figure 7. Tail of Type 3 (top) Northern Gannet. Note highly variable pattern of feathers © CJ Camphuysen

Figure 8. Left foot of Northern Gannet © CJ Camphuysen

Tail patterns in immature Northern Gannets are highly complicated, with a mixture of fully white, fully blackish and black-and-white feathers (Fig. 7). Feathers are replaced irregularly and a mixture of worn (old) and pristine (freshly moulted) feathers are found in most specimens. Some textbooks refer to the colour of the lines over the toes of Northern Gannets for sexing (bluish or greenish; Fig. 8), but the colour of soft parts in dead birds is not reliable and this characteristic should not be used.

**Sexing Northern Gannets**

There is little difference in the body size or external appearance of adult male and female Northern Gannets (Redman *et al.* 2002). Some morphological characteristics differ on average between sexes, but autopsies will be required to obtain an accurate sex ratio (see Ageing and sexing manual).

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**Citation**

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# General seabird form – Dissections and biometrics

| Species: | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|
| Date: \| \| \| 200…. | Where found: | | |
| Sex: ♂ / ♀ / ? | Plumage: □ Adult □ Immature □ Juvenile | | |
| Condition corpse: | □ *Very Fresh* – □ *Fresh* – □ *Rather Fresh* – □ *Rather Old* – □ *Old* – □ *Very Old* | | |
| Oiled: yes / no / unclear | % covered, oiled parts: | | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers | tip-nostril | 0.1mm |
| Bill depth: | base | gonys | 0.1mm |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm |
| Tail length: | | mm distance from feather implant to tip of T1 | |
| | | | |
| Clean mass: | | g | |
| Sternum: | | mm | |
| | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| tail: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| mantle feathers: | |
| breeding patch: | □ present, □ absent, notes: |
| remarks: | |

| **internal study** | | | | | | |
|---|---|---|---|---|---|---|
| subcutaneous fat: | *0* | *1* | *2* | *3* | remarks: | |
| deposited fat: | *0* | *1* | *2* | *3* | remarks: | |
| breast muscle: | *0* | *1* | *2* | *3* | remarks: | |
| guts: | *0* | *1* | *2* | *3* | colour: | remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: | remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: | remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: | remarks: |

| | | |
|---|---|---|
| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* |
| | ♀ oviduct: *1 2 3 4* | foll. max: mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm descr: *large / mod. / small* |
| stomach | colour gizzard: | worms: *yes / no* |
| | colour proventr: | remarks: |
| stomach contents: | | |
| | | bl: *yes / no* |

Notes:

Proximate cause of death:

# Razorbill *Alca torda* - Dissections and biometrics

| Species: **Razorbill** **06360** | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| Date: | | | 200 | Location: | |
|---|---|---|---|---|---|

| Plumage: | Winter/summer: ◻ W ◻ W/T ◻ T ◻ T/B ◻ B | Bill grooves: ◻ 0+0 ◻ W+0 ◻ W+½ ◻ W+1 ◻ W+1½ ◻ W+2 ◻ W+2½ ◻ W+3 |
|---|---|---|

| Condition corpse: | ◻ *VeryFresh* ◻ *Fresh* ◻ *RatherFresh* ◻ *RatherOld* ◻ *Old* ◻ *VeryOld* / ◻ *Incomplete* |
|---|---|

| Oiled: | yes / no / ? | % covered, oiled parts: | |
|---|---|---|---|
| Remarks: | | | |

## biometrics

| biometrics | | | accuracy |
|---|---|---|---|
| Billlength: | tip-feathers | tip-nostril | 0.1mm |
| Bill height: | base | gonys | 0.1mm |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm, P10 should be longest |
| Clean mass: | | gram | ◻ wet & sandy / ◻ wet / ◻ sandy / ◻ dry and clean / |
| | | measured by: | |

## moultscore

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tail: | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | Σ 12 tail feathers |

| | |
|---|---|
| contourfeathers: | |
| breeding patch: | |
| remarks: | |

## internal study

| | | | | | | |
|---|---|---|---|---|---|---|
| subcutaneous fat: | *0* | *1* | *2* | *3* | remarks: | |
| deposited fat: | *0* | *1* | *2* | *3* | remarks: | |
| breast muscle: | *0* | *1* | *2* | *3* | remarks: | |
| guts: | *0* | *1* | *2* | *3* | colour: | remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: | remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: | remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: | remarks: |

| **sex and age:** | (♂) testis: × mm | descr.: *long thin / long thick / short round //* |
|---|---|---|
| sex: ◻ ♂ ◻ ♀ | (♀) oviduct: *1 2 3 4* | foll. max: mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm descr: *large / mod. / small* |

| | | | |
|---|---|---|---|
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| plastics: | | | bl: *yes / no* |
| remarks: | | | |

Proximate cause of death:

# Little Auk *Alle alle* – Dissections and biometrics

| Species: **Little Auk** **06470** | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| Date: | | | 200…. | Where found: | |
|---|---|---|---|---|---|

Plumage: ◻ Winter ◻ Transitional ◻ Breeding

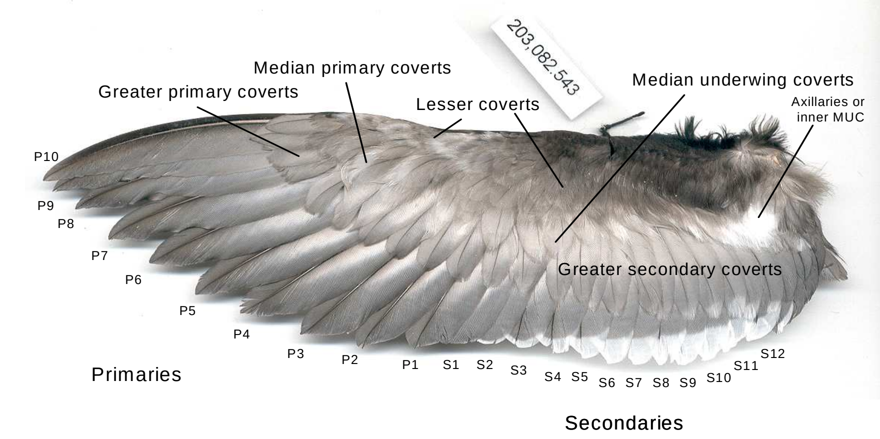
Condition corpse: ◻ *VeryFresh* – ◻ *Fresh* – ◻ *RatherFresh* – ◻ *RatherOld* – ◻ *Old* – ◻ *VeryOld* / ◻ *Incomplete*

Oiled: yes / no / unclear % covered, oiled parts:

## Underwing pigmentation scores:

| | |
|---|---|
| All grey | score 1 |
| Grey, partly with faint white edges | score 2 |
| Faint white tips | score 3 |
| All or mostly faint white | score 4 |
| Clear white tips | score 5 |
| All or mostly bright white | score 6 |

| | | |
|---|---|---|
| GPC | - | Greater primary coverts |
| MPC | - | Median primary coverts |
| LPC | - | Lesser primary coverts |
| GSC | - | Greater secondary coverts |
| MSC | - | Median secondary coverts |
| LSC | - | Lesser secondary coverts |
| Axil | - | Axillaries |




## biometrics

| | | | accuracy |
|---|---|---|---|
| Billlength: | tip-feathers | tip-nostril | 0.1mm |
| Bill depth: | * base | | 0.1mm |
| Head length: | | | mm |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | * L | * R | mm, P10 should be longest |

| Clean mass: | | gram | ◻ wet & sandy / ◻ wet / ◻ sandy / ◻ dry and clean / |
|---|---|---|---|

## moultscore

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Primaries L | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Primaries R | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Secondaries | | | | | | | | | | |

| Underwing pigments | GPC* | MPC | LPC* | GSC | MSC | LSC | Axil |
|---|---|---|---|---|---|---|---|
| scores: | | | | | | | |

## internal study

| | | | | | |
|---|---|---|---|---|---|
| subcutaneous fat *): | *0* | *1* | *2* | *3* | remarks: |
| deposited fat *): | *0* | *1* | *2* | *3* | remarks: |
| breast muscle *): | *0* | *1* | *2* | *3* | remarks: |
| guts: | *0* | *1* | *2* | *3* | colour: remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: remarks: |

## sex and age

♂ testis: × mm descr.: *long thin / long thick / short round //*

Sex: ◻ ♂ ◻ ♀ ♀ oviduct: *1 2 3 4* foll. max: mm Ø / not structured

bursa Fabricii: + - ? size: × mm descr.: *large / mod. / small*

## stomach

colour gizzard: worms: *yes / no*

colour proventr: remarks:

stomach contents:

bl: *yes / no*

## remarks

Proximate cause of death:

*) *priorities for measurements and observations:* GPC / LPC / bill depth base / wing length / mass / emaciation

# Atlantic Puffin *Fratercula arctica* - Dissections and biometrics

| | | | |
|---|---|---|---|
| Species: **Atlantic Puffin** **06540** | Coll number: | Collected parts: | Collected by: |

| | | | | | |
|---|---|---|---|---|---|
| Date: | | | **200** | Location: | |

| | | | |
|---|---|---|---|
| Plumage: | Age: □ Ad □ imm □ juv | Winter/summer: □ W □ T □ B | Bill grooves: □ none □ vague □ 1 □ 1½ □ 2 □ 2½ □ 3 / |
| Condition corpse: | *□ VeryFresh □ Fresh □ RatherFresh □ RatherOld □ Old □ VeryOld / □ Incomplete* | | |
| Oiled: | yes / no / ? | % covered, oiled parts: | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Billlength: | tip-feathers | tip-nostril | 0.1mm |
| Bill depth: | base | gonys | 0.1mm (gonys = difficult) |
| Mandible length: | | 0.1mm, typical for Puffins, measure the lower (cutting) edge of the upper mandible from the bill tip to the anterior edge of the cere | |
| Head+bill length: | | mm | See Harris 1981 British Birds 74: 246-256 |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | Mm, P10 should be longest |
| Clean mass: | | gram | wet & sandy / wet / sandy / dry and clean / |
| | | measured by: | |

| **moultscore** | outermost | | | | | | | | | innermost |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| tail: | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | Σ 12 tail feathers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| contour feathers: | |
| breeding patch: | (lateral) present, bare / present, feathers growing / absent |
| remarks: | |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |

| | | | |
|---|---|---|---|
| **sex and age:** | (♂) testis: × mm | descry.: *long thin / long thick / short round //* | |
| sex: □ ♂ □ ♀ | (♀) oviduct: *1 2 3 4* | foll. max: | mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| plastics: | | | bl: *yes / no* |
| remarks: | | | |
| | | Proximate cause of death: | |

# Diver GAVIIDAE – Dissections and biometrics

| Diver species: **Rthr** / **Bl-thr** / **GrN** / **WBill** 0020 0030 0040 0050 | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|
| Date: | | 200…. | Where found: |
| Sex: ♂ / ♀ / ? | Plumage: | ad – imm - juv W – W/T – T – T/B – B | feathers adult / mix / juvenile |
| Condition corpse: | □ *Very Fresh* – □ *Fresh* – □ *Rather Fresh* – □ *Rather Old* – □ *Old* – □ *Very Old* | | |
| Oiled | yes / no / unclear | % covered, oiled parts: | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers A-C | tip-nostril B-C | 0.1mm |
| Bill depth: | base | gonys | 0.1mm |
| Nostril – feathers[1]: | x-y | y-z | 0.1mm see manual for details |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm |
| Tail length: | | mm | |
| Clean mass: | | g | |
| | | | |
| Sternum: | | mm | |
| [1]Only Great Northern Diver & White-billed Diver | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| tail: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| contourfeathers: | |
| breeding patch: | □ present, □ absent, notes: |
| remarks: | |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |

| **sex and age:** | | | |
|---|---|---|---|
| | ♂ testis: × mm | descr.: *long thin / long thick / short round //* | |
| | ♀ oviduct: *1 2 3 4* | foll. max: | mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| gut contents: | | | |
| # gastoliths: | | | bl: *yes / no* |

Notes:

Proximate cause of death:

# LARIDAE– Dissections and biometrics

| Species: | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Date: | | | 200…. | Where found: | |
| Sex: | ♂ / ♀ / ? | Plumage: | □ Adult □ Immature □ Juvenile □ Pullus / □ Summer □ Winter *(tick)*<br>Estimated age: 1cy 2cy 3cy 4cy / | | |
| Condition corpse: | *□ Very Fresh – □ Fresh – □ Rather Fresh – □ Rather Old – □ Old – □ Very Old* | | | | |
| Oiled: | yes / no / unclear | % covered, oiled parts: | | | |
| Remarks: | | | | | |

| biometrics | | | accuracy |
|---|---|---|---|
| Bill length: | tip-feathers | tip-nostril | 0.1mm |
| Bill depth: | base | gonys | 0.1mm |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm |
| Tail length: | | mm distance from feather implant to tip of T1 | |
| | | | |
| Clean mass: | | g | |
| Sternum: | | mm | |
| | | measured by: | |

| moultscore | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| tail | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| mantle feathers: | |
| breeding patch: | □ present, □ absent, notes: |
| remarks: | |

| internal study | | | | | | |
|---|---|---|---|---|---|---|
| subcutaneous fat: | *0* | *1* | *2* | *3* | remarks: | |
| deposited fat: | *0* | *1* | *2* | *3* | remarks: | |
| breast muscle: | *0* | *1* | *2* | *3* | remarks: | |
| guts: | *0* | *1* | *2* | *3* | colour: | remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: | remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: | remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: | remarks: |

| | | | |
|---|---|---|---|
| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* | |
| | ♀ oviduct: *1 2 3 4* | foll. max: | mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| | | | bl: *yes / no* |

Notes:

Proximate cause of death:

# Cormorants PHALACROCORACIDAE– Dissections and biometrics

| Species: SHAG / GR CORMORANT / 0800 0720 | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Date: | 200…. | Where found: | |
| Sex: ♂ / ♀ / ? | Plumage: | | |
| Condition corpse: | □ *Very Fresh* – □ *Fresh* – □ *Rather Fresh* – □ *Rather Old* – □ *Old* – □ *Very Old* | | |
| Oiled: | yes / no / unclear | % covered, oiled parts: | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers | 0.1mm | |
| Bill depth: | base | min* | gonys |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L* | R* | mm |
| Tail length: | | mm | |
| Clean mass: | | g | |
| Total length | | mm Introduced by Koffijberg & Van Eerden for *sinensis* sex discrimant | |
| Sternum: | | mm | |
| | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| | | |
|---|---|---|
| secondaries: | left | right |

| tail: (Shag 12, Gr Cormorant 14) | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| contour feathers: | |
| breeding patch: | □ present, □ absent, notes: |
| remarks: | |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |

| | | | |
|---|---|---|---|
| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* | |
| | ♀ oviduct: *1 2 3 4* | foll. max: | mm Ø / not structured |
| bursa Fabricii: | + - ? | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| | | | bl: *yes / no* |

Notes:

Proximate cause of death:

| | |
|---|---|
| For sex discriminant European Shag | → wing and bill depth minimum (*cf.* Calvo & Bolton 1997) |
| For sex discriminant Great Cormorant *sinensis* | → total length, wing, bill depth at base (*cf.* Koffijberg & Van Eerden 1995) |

# PROCELLARIIDAE– Dissections and biometrics

| Species: | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Date: | | | 200…. | Where found: | |
| Sex: | ♂ / ♀ / ? | Plumage: | Fulmar only: ◻ Light phase (LL) ◻ Dark phase (◻ L, ◻ D, ◻ DD) *(tick)* | | |
| Condition corpse: | *◻ Very Fresh – ◻ Fresh – ◻ Rather Fresh – ◻ Rather Old – ◻ Old – ◻ Very Old* | | | | |
| Oiled: | yes / no / unclear | % covered, oiled parts: | | | |
| Remarks: | | | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers | tip-tube | 0.1mm |
| Bill depth: | base | gonys | 0.1mm |
| Bill width: *Calonectris* only | base | gonys | 0.1mm See manual for explanation |
| Tube | | 0.1mm (= bill length tip to feathers minus bill length tip to tube) | |
| Head length: | | mm Optional: Head width in *Calonectris*, see manual for explanation | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm |
| Tail length: | | mm | |
| Clean mass: | | g | |
| Sternum: | | mm | |
| | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | | | | | right |

| tail: (expect 14 in Fulmar, 12 in shearwaters) | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| mantle feathers: | ◻ all pristine, fresh, ◻ some worn or ragged (moult?), ◻ otherwise: |
| breeding patch: | ◻ present, ◻ absent, notes: |
| remarks: | Primaries ◻ fresh, pointed (suggesting juv) ◻ worn or rounded (suggesting older) |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |

| | | | |
|---|---|---|---|
| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* | |
| | ♀ oviduct: *1 2 3 4* | foll. max: mm Ø / not structured | |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| | | | bl: *yes / no* |

Notes:

Proximate cause of death:

# STERCORARIIDAE– Dissections and biometrics

| Species: | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|
| Date: | 200…. | Where found: | |
| Sex: ♂ / ♀ / ? | Plumage: | ◻ Light phase (LL) ◻ Dark phase ◻ Barred (juv) *(tick)* ◻ Adult ◻ Immature ◻ Juvenile ◻ Summer ◻ Winter | |
| Condition corpse: | ◻ *Very Fresh* – ◻ *Fresh* – ◻ *Rather Fresh* – ◻ *Rather Old* – ◻ *Old* – ◻ *Very Old* | | |
| Oiled: yes / no / unclear | % covered, oiled parts: | | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers | 0.1mm | |
| Bill depth: | base | gonys | 0.1mm |
| Nail length: | | 0.1mm Specific measurement for skuas: length of nail at bill tip | |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm |
| Tail length: | | mm distance from feather implant to tip of T1 | |
| Streamers protruding: | | mm length of central tail feather beyond T2 | |
| Clean mass: | | g | |
| Sternum: | | mm | |
| | | measured by: | |

| **moultscore** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | | |
| secondaries: | left | | | | | right | | | | | | |
| tail | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 |
| mantle feathers: | | | | | | | | | | | | |
| breeding patch: | ◻ present, ◻ absent, notes: | | | | | | | | | | | |
| remarks: | | | | | | | | | | | | |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |
| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* | |
| | ♀ oviduct: *1 2 3 4* | foll. max: mm Ø / not structured | |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| | | | bl: *yes / no* |

Notes:

Proximate cause of death:

# Gannets and boobies SULIDAE– Dissections and biometrics

| Species: **Br Booby** / **Northern Gannet** 0700 0710 | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|

| Date: | | | 200…. | Where found: | |
|---|---|---|---|---|---|
| Sex: | ♂ / ♀ / ? | Plumage: | Plumage type: (1) – (2) – (3) – (4) – (5) – Adult | | |
| Condition corpse: | □ *Very Fresh* – □ *Fresh* – □ *Rather Fresh* – □ *Rather Old* – □ *Old* – □ *Very Old* | | | | |
| Oiled: | yes / no / unclear | % covered, oiled parts: | | | |
| Remarks: | | | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Bill length: | tip-feathers | 0.1mm | |
| Bill depth: | base | 0.1mm | |
| Head length: | | mm | Skip if difficult, callipers may be too short |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm Note: >50cm long ruler may be needed |
| Tail length: | | mm | |
| Clean mass: | | g | |
| | | | |
| Sternum: | | mm | |
| | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| secondaries: | left | | | | | right | | | | |

| tail: | | | | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| contour feathers: | |
| breeding patch: | □ present, □ absent, notes: |
| remarks: | |

| **internal study** | | | | | |
|---|---|---|---|---|---|
| subcutaneous fat: | *0* | *1* | *2* | *3* | NOTE! Fat stores should be examined at shoulder & back |
| deposited fat: | *0* | *1* | *2* | *3* | remarks: |
| breast muscle: | *0* | *1* | *2* | *3* | remarks: |
| guts: | *0* | *1* | *2* | *3* | colour: remarks: |
| kidneys: | *0* | *1* | *2* | *3* | colour: remarks: |
| liver: | *0* | *1* | *2* | *3* | colour: remarks: |
| lungs: | *0* | *1* | *2* | *3* | colour: remarks: |

| **sex and age:** | ♂ testis: × mm | descr.: *long thin / long thick / short round //* |
|---|---|---|
| | ♀ oviduct: *1* *2* *3* *4* | foll. max: mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm descr: *large / mod. / small* |

| stomach | colour gizzard: | | worms: *yes / no* |
|---|---|---|---|
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| | | | bl: *yes / no* |

Notes:

Proximate cause of death:

# Common Guillemot *Uria aalge* - Dissections and biometrics

| Species: **Common Guillemot** **06340** | Coll number: | Collected parts: | Collected by: |
|---|---|---|---|
| Date: | 200 | Location: | |
| Plumage: | White tips wing coverts WTips + / - | Winter/summer: ◻ W ◻ W/T ◻ T ◻ T/B ◻ B | Bridled ◻ Bridled ◻ Non-Bridled |
| Condition corpse: | ◻ *VeryFresh* ◻ *Fresh* ◻ *RatherFresh* ◻ *RatherOld* ◻ *Old* ◻ *VeryOld* / ◻ *Incomplete* | | |
| Oiled: | yes / no / ? | % covered, oiled parts: | |
| Remarks: | | | |

| **biometrics** | | | **accuracy** |
|---|---|---|---|
| Billlength: | tip-feathers | tip-nostril | 0.1mm |
| Bill height: | base | gonys | 0.1mm |
| Head length: | | mm | |
| Tarsus length: | L | R | 0.5mm |
| Wing length: | L | R | mm, P10 should be longest |
| Clean mass: | | gram | ◻ wet & sandy / ◻ wet / ◻ sandy / ◻ dry and clean / |
| | | measured by: | |

| **moultscore** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| primaries L: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| primaries R: | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| | | |
|---|---|---|
| secondaries: | left | right |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tail: | 6 | 5 | 4 | 3 | 2 | 1 | 1 | 2 | 3 | 4 | 5 | 6 | Σ 12 tail feathers |

| | |
|---|---|
| contourfeathers: | |
| breeding patch: | |
| remarks: | |

| **internal study** | | | |
|---|---|---|---|
| subcutaneous fat: | *0 1 2 3* | remarks: | |
| deposited fat: | *0 1 2 3* | remarks: | |
| breast muscle: | *0 1 2 3* | remarks: | |
| guts: | *0 1 2 3* | colour: | remarks: |
| kidneys: | *0 1 2 3* | colour: | remarks: |
| liver: | *0 1 2 3* | colour: | remarks: |
| lungs: | *0 1 2 3* | colour: | remarks: |

| **sex and age:** | (♂) testis: × mm | descry.: *long thin / long thick / short round //* | |
|---|---|---|---|
| sex: ◻ ♂ ◻ ♀ | (♀) oviduct: *1 2 3 4* | foll. max: | mm Ø / not structured |
| bursa Fabricii: | + - *?* | size: × mm | descr: *large / mod. / small* |

| | | | |
|---|---|---|---|
| stomach | colour gizzard: | | worms: *yes / no* |
| | colour proventr: | | remarks: |
| stomach contents: | | | |
| plastics: | | | bl: *yes / no* |
| remarks: | | | |
| | | Proximate cause of death: | |

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.2 Biological advice

**Technical document**

### Greenland Sea and Icelandic waters

→ data deficient

- Seabirds in the area: internationally important breeding populations of divers (inland), auks, gannets and seaduck, some breeding cormorants. Wintering auks (pelagic and coastal) and cormorants (coastal).
- Species of particular conservation concern: Manx Shearwater, European Storm-petrel, Leach's Storm-petrel
- Breeding distribution data:
- Waterfowl censuses in coastal areas:
- Standardised studies of seabirds at sea: anectdotal information and local surveys (e.g. Meltofte 1972; Camphuysen 1993; Petersen *et al.* 1994); no overview data at hand on seabird distribution at sea, published or within any substantial database.
- Seabird migration studies:
- Beached bird monitoring programmes:
- (Marine) Important Bird data: (e.g.…birdlife atlases)
- OVI evaluation and area sensitivity: analysis never undertaken
- Anticipated sensitivity to chronic oil pollution: very high, certainly in summer; from ringing results there is some information on migratory routes and winter staging areas available (Lyngs 2003).
- Contact points for data updates: *no data*

Species of particular conservation concern:

**Manx Shearwater** *Puffinus puffinus* This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be at least 1,000,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007a). Within Europe, the major part of the breeding population is concentrated at a few sites, including 7000-10,000p on Iceland; SPEC Category 2, status (Localised); Brooke & Tasker 1994)

**European Storm-petrel** *Hydrobates pelagicus* has a large global population estimated to be 840,000 individuals (Fishpool and Evans 2001). About 90% of the known breeding population is concentrated in the Faroe Islands (**Denmark**) (150,000-400,000 pairs), **United Kingdom** (20,000-150,000 pairs), **Ireland** (50,000-100,000 pairs) and **Iceland** (50,000-100,000 pairs), with smaller colonies elsewhere. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It nests on remote islands that are largely free of mammalian predators. Despite evidence of population declines in some areas, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007b).

**Leach's Storm-petrel** *Oceanodroma leucorhoa*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 8,000,000 individuals. Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007c). Within Europe there are only a few colonies, all on remote islands close to oceanic feeding grounds. An estimated 80,000-150,000p breed in Iceland (SPEC Category 3, status (Localised); Tasker 1994, Mitchell 2004)

## References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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Svalbard

→ partly covered, incomplete data

- <u>Seabirds in the area:</u> internationally important breeding populations of divers (inland), auks, and seaduck. Wintering seabirds?
- <u>Standardised studies of seabirds at sea:</u> survey data biased to Barents Sea and southwestern approaches, exclusively in summer (e.g. Mehlum 1989, Fauchald & Erikstad 1995, Isaksen 1995, Mehlum & Isaksen 1995), including more anecdotal information (Voisin 1970, Byrkjedal *et al.* 1976, Camphuysen 1993, Joiris 1996).
- <u>OVI evaluation and area sensitivity:</u> analysis not specifically undertaken, available data would make analysis possible but likely with gaps in knowledge
- <u>Anticipated sensitivity to chronic oil pollution:</u> very high, at least in summer

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.2 Biological advice

**Technical document**

### Barents Sea

→ partly covered, incomplete data

- Seabirds in the area: internationally important breeding populations of divers (inland), auks, and seaduck, breeding cormorants and gannets. Wintering auks (pelagic and coastal) and cormorants (coastal).
- Standardised studies of seabirds at sea: recent summer survey data, including some of the Russian parts of the area (Borkin *et al.* 1992, Bakken 1990, Isaksen & Bakken 1995, Mehlum *et al.* 1998, Fauchald *et al.* 2005), some winter and spring information (Hunt *et al.* 1996)
- OVI evaluation and area sensitivity: analysis not specifically undertaken, could be undertaken from recent survey data (Fauchald *et al.* 2005). Quarterly overview data from Fauchald need broken down for regional and fine-scale temporal assessment
- Anticipated sensitivity to chronic oil pollution: very high, in summer and in winter

**References**

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Norwegian Sea

→ partly covered, incomplete data

- Seabirds in the area: internationally important breeding populations of divers (inland), auks, cormorants and seaduck, some breeding gannets. Wintering auks (pelagic and coastal), seaduck, divers and cormorants (all coastal).
- Species of particular conservation concern:
- Standardised studies of seabirds at sea: recent summer survey data, but small and fragmented data sets for pelagic seabirds only (Fauchald *et al.* 2005), comprehensive data for wintering, nearshore waterfowl (Frantzen 1985, Nygård *et al.* 1988, Bergstrøm 1990, Anker-Nilssen *et al.* 1996)
- OVI evaluation and area sensitivity: analysis not specifically undertaken, could be undertaken from recent survey data, but likely to contain gaps due to fragmented character of datasets
- Anticipated sensitivity to chronic oil pollution: at least regionally very high through the year

**References**

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Faeroese waters

→ recently well covered, vulnerability atlas available

- Seabirds in the area: internationally important breeding populations of auks, some breeding cormorants, seaduck, divers and gannets. Wintering auks (pelagic and coastal), seaduck and cormorants (all coastal).
- Species of particular conservation concern: Faeroese Eider [?]
- Standardised studies of seabirds at sea: extensive seabird surveys in recent years completed and reported; winter data set relatively small and fragmented (Danielsen *et al.* 1990, Taylor & Reid 2001, Skov *et al.* 2002)
- OVI evaluation and area sensitivity: vulnerability atlases produced, using species specific OVI analysis and seabird abundance data on a monthly basis (Skov *et al.* 2002)
- Anticipated sensitivity to chronic oil pollution: locally very high; clearly identified seasonal and spatial patterns in sensitivity published (Skov *et al.* 2002)

Species of particular conservation concern:

**Manx Shearwater** *Puffinus puffinus* This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be at least 1,000,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007a). Within Europe, the major part of the breeding population is concentrated at a few sites, including 15,000-30,000p on the Faroe Islands; SPEC Category 2, status (Localised); Brooke & Tasker 1994)

**Leach's Storm-petrel** *Oceanodroma leucorhoa*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 8,000,000 individuals. Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007b). Within Europe there are only a few colonies, all on remote islands close to oceanic feeding grounds. Small numbers breed on the Faroe Islands (SPEC Category 3, status (Localised); Tasker 1994).

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.2 Biological advice

**Technical document**

### North Sea

→ recently well covered, vulnerability atlas available

- Countries involved: Denmark, Germany, The Netherlands, Belgium, United Kingdom, Norway
- Seabirds in the area: internationally important breeding populations of auks, gannets, and cormorants. Small numbers of inland breeding seaduck and divers. Internationally important pathway for numerous species of migratory seabirds. Internationally important wintering areas of auks, divers, seaduck, some wintering Gannets.
- Species of particular conservation concern:
- Standardised studies of seabirds at sea: extensive seabird surveys in recent years completed and reported; winter data set relatively small and fragmented. Published material and data sets include area overviews (Blake *et al.* 1984, Tasker *et al.* 1987, Stone *et al.* 1995) as wel as regional studies (Camphuysen & Leopold 1994, Garthe *et al.* 1995, Offringa *et al.* 1995, Mitschke *et al.* 2001, Diederichs *et al.* 2002 Garthe 2003ab, Garthe *et al.* 2004). Monitoring ongoing on national level and as joint international research project (European Seabirds at Sea database; Reid & Camphuysen 1998).
- OVI evaluation and area sensitivity: vulnerability atlases produced, using species specific OVI analysis and seabird abundance data on a monthly basis (Tasker & Pienkowski 1987, Skov *et al.* 1992, Carter *et al.* 1993). Marine Important Bird Area (IBA) atlases have been produced (Skov *et al.* 1995, Maes *et al.* 2000, Seys *et al.* 2001).
- Anticipated sensitivity to chronic oil pollution: locally very high; clearly identified seasonal and spatial patterns in sensitivity published (Tasker & Pienkowski 1987, Skov & Durinck 1992, Carter *et al.* 1993)
- Special work: Sensitivity maps, covering all biota, have been developed for German North Sea coasts since a feasibility study during 1983-87 and have been updated for the German North Sea coast and Baltic coastal areas. As part of the German Contingency Planning for Marine Pollution Control, these maps will be extended to cover German offshore areas in the (near) future (van Bernam *et al.* 1994).

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.2 Biological advice

**Technical document**

### Baltic

→ recently well covered, requires vulnerability assessment

- Seabirds in the area: internationally important breeding populations of divers (inland), and seaduck, breeding cormorants and auks. Internationally important wintering concentrations of auks (Kattegat) and seaduck (pelagic and inshore), internationally important stop-over sites of divers.
- Species of particular conservation concern: Steller's Eider, Baltic Guillemot, Black Guillemot [90% of Europ pop Long-tailed Duck population]
- Standardised studies of seabirds at sea: extensive seabird surveys in recent years completed and reported (Durinck *et al.* 1993, Pihl *et al.* 1995, Garthe 2003ab, Garthe *et al.* 2003, Sonntag *et al.* 2004); winter waterfowl counts in coastal areas and during aerial surveys in most of the area (e.g. Raudonikis 1989ab, Shergalin 1990, Nilsson 2005).
- OVI evaluation and area sensitivity: analysis not specifically undertaken, could be undertaken from (recent) survey data. Marine IBA atlases have been produced (Durinck *et al.* 1994, Skov *et al.* 2000).
- Anticipated sensitivity to chronic oil pollution: very high in winter, with offshore seaduck concentrations, in summer locally high

**References**

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

### 4.2 Biological advice

**Technical document**

### West of Britain, Ireland and Irish Sea

→ recently well covered, vulnerability atlas available

- Seabirds in the area: internationally important breeding populations of auks, cormorants and gannets. Some breeding seaduck. Internationally important pathway for numerous species of migratory seabirds. Wintering auks (pelagic and coastal), divers, seaduck, cormorants (all coastal) and some gannets (pelagic).
- Species of particular conservation concern: Manx Shearwater, European Storm-petrel, Leach's Storm Petrel
- Standardised studies of seabirds at sea: extensive studies of seabirds at sea (Webb *et al.* 1995a, Pollock *et al.* 1997), continued in recent years (Mackey *et al.* 2004); information on wintering coastal seabird and waterfowl concentrations (Lack 1986).
- OVI evaluation and area sensitivity: vulnerability atlas produced, using species specific OVI analysis and seabird abundance data on a monthly basis (Webb *et al.* 1995b).
- Anticipated sensitivity to chronic oil pollution: locally very high; clearly identified seasonal and spatial patterns in sensitivity published (Webb *et al.* 1995b).

Species of particular conservation concern:

**Manx Shearwater** *Puffinus puffinus* This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 $km^2$. It has a large global population estimated to be at least 1,000,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007a). Within Europe, the major part of the breeding population is concentrated at a few sites, some of the largest being in Ireland (29,000-49,000p) and especially in Scotland (220,000-250,000p; SPEC Category 2, status (Localised); Brooke & Tasker 1994)

**European Storm-petrel** *Hydrobates pelagicus* has a large global population estimated to be 840,000 individuals (Fishpool and Evans 2001). About 90% of the known breeding population is concentrated in the Faroe Islands (**Denmark**) (150,000-400,000 pairs), **United Kingdom** (20,000-150,000 pairs), **Ireland** (50,000-100,000 pairs) and **Iceland** (50,000-100,000 pairs), with smaller colonies elsewhere. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 $km^2$. It nests on remote islands that are largely free of mammalian predators. Despite evidence of population declines in some areas, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007b).

**Leach's Storm-petrel** *Oceanodroma leucorhoa*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km². It has a large global population estimated to be 8,000,000 individuals. Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007c). Within Europe there are only a few colonies, all on remote islands close to oceanic feeding grounds. An estimated 50,000p breed in the United Kingdom (SPEC Category 3, status (Localised); Tasker 1994, Mitchell 2004)

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Channel and Celtic Sea

→ at least locally data deficient, UK part recently well covered, vulnerability atlas available

- Seabirds in the area: internationally important breeding populations of cormorants and gannets. Some breeding auks. Internationally important pathway for numerous species of migratory seabirds. Internationally important wintering area for auks (pelagic and coastal), divers, cormorants (coastal) and some gannets and seaduck.
- Species of particular conservation concern: ?
- Standardised studies of seabirds at sea: extensive studies of seabirds at sea (White & Webb 1995, Webb *et al.* 1995a), much less comprehensive data on seabird numbers at sea in French waters (some anecdotal data: Creswell & Walker 2001, Mustoe 2001, Walker *et al.* 2004)
- OVI evaluation and area sensitivity: vulnerability atlas produced, using species specific OVI analysis and seabird abundance data on a monthly basis (Webb *et al.* 1995b)
- Anticipated sensitivity to chronic oil pollution: locally very high; clearly identified seasonal and spatial patterns in sensitivity published for UK waters (Webb *et al.* 1995b); very high at least in winter in French part; localised around major breeding colonies in summer

**References**

# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Bay of Biscay

→ data deficient

- Seabirds in the area: breeding cormorants. Internationally important wintering areas for auks (pelagic and coastal), gannets, cormorants (?). Internationally important pathway for numerous species of migratory seabirds. Wintering divers and locally some seauck (all coastal).
- Species of particular conservation concern: Balearic Shearwater
- Standardised studies of seabirds at sea: non-integrated ship-based and aerial surveys in recent years, partly in response to the *Erika* oil spill, methodology different per project (Bretagnolle *et al.* 2004, Castège *et al.* 2004, Valeiras *et* al 2005, ESAS *unpublished data*), some additional anecdotal data: (Creswell & Walker 2001, Mustoe 2001, Walker *et al.* 2004).
- OVI evaluation and area sensitivity: In the bay of Biscay, an OVI evaluation has been made only for a small well studied area in the south-east of Brittany (47°34'-46°40'N / 3°18'-1°57'W; Recorbet 1998, 2001). Otherwise, an analysis has never been undertaken; difficult at present with available material and certainly with major gaps in knowledge
- Anticipated sensitivity to chronic oil pollution: at least locally very high in winter, as demonstrated in recent major oil spills; unknown in summer

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Portuguese and Spanish Atlantic coasts

→ data deficient

- Countries involved: Portugal, Spain
- Seabirds in the area: breeding auks, and cormorants. Internationally important pathway for numerous species of migratory seabirds. Wintering auks (pelagic and coastal), gannets, divers, seaduck and cormorants (coastal) in insufficiently known numbers.
- Species of particular conservation concern: Balearic Shearwater, Iberian Guillemot
- Standardised studies of seabirds at sea: seaduck monitoring, including aerial surveys, in coastal waters (Rufino & Neves 1990), recent studies of the offshore distribution of seabirds currently under way (SEO and SPEA, data loggers, aerial surveys and ship-based surveys; no results published yet)
- OVI evaluation and area sensitivity: analysis never undertaken
- Anticipated sensitivity to chronic oil pollution: at least locally very high in winter, as demonstrated in recent major oil spills; unknown, but probably lower, in summer

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## The Azores, Madeira, Canaries, Cape Verde Islands (Macaronesia)

→ data deficient

- Countries involved: Portugal (Azores, Madeira), Spain (Canaries), Morocco, Mauritania, Cape Verde Islands
- Seabirds in the area: no breeding species of the highest sensitivity, wintering seabirds such as auks and gannets relatively dispersed (?)
- Species of particular conservation concern: Fea's Petrel, Zino's Petrel, Little Shearwater, Cape Verde Shearwater, Cory's Shearwater, Bulwer's Petrel, White-faced Storm-petrel, Madeiran Storm-petrel, Westafrican Royal Tern, Roseate Tern
- Standardised studies of seabirds at sea: Recent studies of the offshore distribution of seabirds currently under way (SEO and SPEA, data loggers, aerial surveys and ship-based surveys; no results published yet); anecdotic data in published papers and grey literature.
- OVI evaluation and area sensitivity: analysis never undertaken
- Anticipated sensitivity to chronic oil pollution: several rarer species of seabirds probably in lower oil vulnerability (OVI) categories in the area, offshore distribution patterns not clear; OVI analysis urgently required

### Globally threatened species:

**Zino's Petrel** *Pterodroma madeira* [Endangerd] This species has been downlisted from Critical to Endangered because its breeding population, which is increasing slowly, is now believed to number 65-80p breeding on six cliff ledges in the central mountain massif of Madeira. However, the population is still extremely small, and as such it qualifies as endangered (Zino *et al.* 1994e; BirdLife International 2007a).

**Further species of particular conservation concern:**

**Fea's Petrel** *Pterodroma feae* breeds on four islands of **Cape Verde** (*P. f. feae*), Fogo (minimum 80 pairs), Santo Antão (>200p), São Nicolau (c.30p) and small numbers on Santiago. It also breeds on Bugio in the Desertas off Madeira, **Portugal** (*P. f. deserta*), and breeding is likely on the Azores. An estimated 500-1000p breed in Cape Verde, although this must be regarded as an absolute minimum as further colonies probably exist on Fogo and Santa Antão and individuals have also been observed breeding in the central moutain range of Santiago island. A further 150-200p breed on Bugio where the population appears stable. It was previously regarded as Vulnerable and any evidence of a population decline would result in a return to globally threatened status. In addition, if a revision of taxonomic status indicates that *P. f. feae* and *P. f. deserta* should be given specific status, their threat status would then need to be assessed. Birds may occur at considerable distances from the Cape Verde islands, even during the breeding season, with some birds moving south after breeding and others remaining in the region throughout the year (BirdLife International 2007a).

**Bulwer's Petrel** *Bulweria bulwerii*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 500,000 - 1,000,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007c). Within Europe, it is quite rare with the Madeira archipelago holding the majority of the population, plus smaller but declining numbers on the Canaries and Azores (SPEC Category 3, status Vulnerable; Zino *et al.* 1994b).

**Cory's Shearwater** *Calonectris [diomedea] borealis*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 600,000 individuals (Brooke 2004). Global population trends have not been quantified, but the shearwater has been extensively harvested in the past. However, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007e). Within Europe, however, although numerous, the species has declined, sometimes considerably, in a substantial number of colonies within the area (SPEC Category 2, status (Vulnerable); del Nevo 1994b).

**Manx Shearwater** *Puffinus puffinus* This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be at least 1,000,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007f). Within Europe, the major part of the breeding population is concentrated at a few sites, with small numbers at Madeira and in the Azores (SPEC Category 2, status (Localised); Brooke & Tasker 1994)

**Little Shearwater** *Puffinus assimilis*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be more than 900,000 individuals (Brooke 2004). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007d). Within Europe, *Puffinus assimilis* breeds in the Azores, Madeira and the Canary Islands, which together account for less than a quarter of its global breeding range. Its European breeding population is small (as few as 5,200 pairs), and underwent a moderate decline between 1970–1990. Although the trend in the Canary Islands during 1990–2000 was unknown, the species was stable in the Azores and its stronghold Madeira, and was stable overall. Nevertheless, its population size renders it susceptible to the risks affecting small populations, and consequently it is provisionally evaluated as Rare (Zino *et al.* 1994c, Burfield & Van Bommel 2004).

**White-faced Storm-petrel** *Pelagodroma marina*. Breeds on the Selvagens (in the Madeiran archipelago) and on islets off Lanzarote (in the Canary Islands), with Europe accounting for less than a quarter of its global breeding range. Its European breeding population is relatively small (c.61,000 pairs), but was stable between 1970–1990. Although the species remained stable overall during 1990–2000, the entire European breeding population is confined to fewer than six locations, with >99% of birds breeding in an area smaller than 3 km$^2$ on the Selvagens. Consequently, it is evaluated as Vulnerable (Burfield & van Bommel 2004).

**Madeiran Storm-petrel** *Oceanodroma castro*. This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 20,000-200,000 individuals (Fishpool and Evans 2001). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007g). Zino *et al.* (1994a) described the population within Europe as poorly known, with few data available on population sizes and trends. The population is believed to be small, and declining on the Azores (SPEC Category 3, status Vulnerable). Madeiran storm petrels breed on three small islets in the Azores: Vila, off Santa Maria, and Praia and Baixo, off Graciosa. Analysis of data on brood patch, incubation periods, chick body size and recaptures of adults provides evidence of the existence of two distinct populations (hot- and cool-season) breeding annually on Baixo and Praia, out of phase by four to five months and overlapping in colony attendance during August and early September; on Vila only the cool-season population is present. Analyses of adult morphology indicate highly significant phenotypic differentiation between the sympatric hot- and cool-season breeders, whereas an almost complete phenotypic uniformity characterizes allopatric breeders within the same season. The hypothesis is given that the hot-season population has evolved from the cool-season population owing to density-dependent constraints on crowded colonies, forcing birds to time-share nest sites. These populations may represent a case of sympatric speciation through temporal partitioning of reproduction and may be better treated as sibling species (from Monteiro & Furness 1998).

**European Storm-petrel** *Hydrobates pelagicus* has a large global population estimated to be 840,000 individuals (Fishpool and Evans 2001). About 90% of the known breeding population is concentrated in the Faroe Islands (**Denmark**) (150,000-400,000 pairs), **United Kingdom** (20,000-150,000 pairs), **Ireland** (50,000-100,000 pairs) and **Iceland** (50,000-100,000 pairs), with smaller colonies in **France** (400-600 pairs), **Greece** (10-30 pairs), **Italy** (1,500-2,000 pairs), **Malta** (5,000 pairs), **Norway** (1,000-10,000 pairs), **Spain** (1,700-2,000 pairs) and a further 1,000 pairs on the Canary Islands (Spain). This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 $km^2$. It nests on remote islands that are largely free of mammalian predators. The accidental introduction of such predators is the main threat to this species, particularly in southern Europe and the Mediterranean. In some areas, increases in numbers of skuas and large gulls appear to have increased the rate of predation. There may be some risk from eating contaminated food items or taking indisgestible matter but, by feeding in flight, the species is less vulnerable to oil spills than some other seabirds (Newbury *et al*. 1998, Tucker and Heath 1994). The species winters off western and southern Africa. Although global population trends have not been quantified, there have been small population declines in Malta, Spain and France, with more significant declines on Guernsey and the Canary Islands, but trend information is poor. Despite the evidence of a population decline (Newbury *et al*. 1998, Tucker and Heath 1994), the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007h).

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Western Mediterranean

→ data deficient

- Countries involved: United Kingdom (Gibraltar), Spain, France, Italy, Libya, Tunisia, Algeria, Morocco
- Seabirds in the area: breeding Shag and gulls (e.g. Audouin's Gull) and shearwaters (e.g. Balearic Shearwater), important numbers of gulls, wintering auks, cormorants, gannets; precise numbers and distribution patterns known for some.
- Species of particular conservation concern: Audouin's Gull, Balearic Shearwater, Yelkouan Shearwater, Mediterranean Shag, Mediterranean Storm Petrel, Cory's Shearwater
- Standardised studies of seabirds at sea: Recent studies of the offshore distribution of seabirds currently under way (SEO, data loggers, aerial surveys and ship-based surveys; no results published yet), some distributional data from observations at offshore stations and from ecological seabird studies (Arcos & Oro 1996, Abelló & Oro 1998)
- OVI evaluation and area sensitivity: analysis never undertaken
- Anticipated sensitivity to chronic oil pollution: several rarer species of seabirds in lower vulnerability categories in the area, offshore distribution patterns not clear

**Globally threatened species:**

**Marbled Teal** *Marmaronetta angustirostris* [Vulnerable]. This species appears to have suffered a rapid population decline, evidenced in its core wintering range, as a result of widespread and extensive habitat destruction. It therefore qualifies as Vulnerable. However, data are scarce and some birds may have relocated to alternative wintering sites. Apparent increases in the western Mediterranean population probably reflect improved observer coverage rather than genuine changes. This population has suffered a long-term decline and widespread loss of habitat. Has a fragmented distribution in the western Mediterranean (Spain, Morocco, Algeria, Tunisia, wintering in north and sub-Saharan west Africa). Prior to 1991, the estimated world population was 34,000-40,000 birds. Although count data are poor, a more recent estimate of 14,000-26,000 birds indicates a rapid population decline. Estimates of a wintering population of 3000 birds in 1997 and a count of 4250 in Tunisia in 1999, suggest the western Mediterranean population is larger than previously thought (BirdLife International 2007a).

**Balearic Shearwater** *Puffinus mauretanicus* [Critically endangered]. This species has a tiny breeding range and a small population that is undergoing an extremely rapid population decline due to a number of threats, in particular predation at breeding colonies by introduced cats, and by-catch of foraging birds by long-line fisheries. Population models predict a decline of 98% within 54 years (three generations). It qualifies as Critically Endangered because of the very severe nature of these declines (BirdLife International 2007b).

Breeding range (<100 km²) confined to the Balearic Islands (Spain; as few as 1650 pairs; Burfield & Van Bommel 2004).

**Species of particular conservation concern:**

**Cory's Shearwater** *Calonectris [diomedea] diomedea*. This subspecies is endemic for the Mediterranean region, but the species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It has a large global population estimated to be 600,000 individuals (Brooke 2004a). Global population trends have not been quantified, but the shearwater has been extensively harvested in the past. However, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007c). Within Europe, the subspecies has declined in a number of colonies (SPEC Category 2, status (Vulnerable); del Nevo 1994b, Burfield & Van Bommel 2004).

**European Storm-petrel** *Hydrobates pelagicus* has a large global population estimated to be 840,000 individuals (Fishpool & Evans 2001). About 90% of the known breeding population is concentrated in NW Europe, with smaller colonies elsewhere including Italy (1500-2000p) and Malta (5000p), Spain (1700-2000p). This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 km$^2$. It nests on remote islands that are largely free of mammalian predators. The accidental introduction of such predators is the main threat to this species in southern Europe and the Mediterranean. The species winters off western and southern Africa. Although global population trends have not been quantified, there have been small population declines in Malta, Spain and France, but trend information is poor. Despite the evidence of a population decline, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007d).

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Eastern Mediterranean

→ data deficient

- Countries involved: Libya, Egypt, Israel, Palestine, Lebanon, Syria, Cyprus, Turkey, Greece, Albania, Serbia, Croatia, Slovenia, Italy, Malta
- Seabirds in the area: breeding and wintering cormorants, wintering divers; precise numbers and distribution patterns unknown.
- Species of particular conservation concern: *Puffinus yelkouan*, Pygmy Cormorant, Dalmatian Pelican, Great White Pelican, Lesser Crested Tern
- Standardised studies of seabirds at sea: not known
- OVI evaluation and area sensitivity: analysis never undertaken and no material to study area sensitivity at hand
- Anticipated sensitivity to chronic oil pollution: several rarer species of seabirds in lower vulnerability categories in the area, offshore distribution patterns not clear

Globally threatened species:

**Dalmatian Pelican** *Pelecanus crispus* [Vulnerable] Conservation measures have resulted in a population increase in Europe, particularly at the species' largest colony, at Lake Mikri Prespa in Greece. However, rapid population declines in the remainder of its range are inferred to be continuing and therefore the species is listed as vulnerable; BirdLife International 2007a). Dalmatian Pelican is now very rare in Europe and while the population can be considered stable or increasing overall, colonies are locally expanding or shrinking (SPEC Category 1, status Vulnerable; Crivelli 1994a). European breeders winter in the eastern Mediterranean countries. It occurs mainly at inland, freshwater wetlands but also at coastal lagoons and river deltas, where it breeds in colonies on islands in large reedbeds or in the open. Former declines were primarily caused by wetland drainage, shooting and persecution by fishers. Continuing threats include disturbance from tourists and fishers, wetland alteration and destruction, water pollution, collision with overhead power-lines and over-exploitation of fish stocks.

Species of particular conservation concern:

**European Storm-petrel** *Hydrobates pelagicus* has a large global population estimated to be 840,000 individuals (Fishpool and Evans 2001). About 90% of the known breeding population is concentrated in NW Europe, with smaller colonies in Greece (10-30p), Italy (1500-2000p), and Malta (5000p). This species has a large range, with an estimated global breeding Extent of Occurrence of 50,000-100,000 $km^2$. It nests on remote islands that are largely free of mammalian predators. The accidental introduction of such predators is the main threat to this species, particularly in southern Europe and the Mediterranean. Although global population trends have not been quantified, there have been small population declines in Malta, but trend information is poor. Despite the evidence of a population decline, the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007b).

**Pygmy Cormorant** *Phalacrocorax pygmaeus*. The species is rare in Europe, where it is restricted to the south-east of the region. Numbers have declined during the 20$^{th}$ century due to habitat loss and direct persecution. The species and its main breeding colonies urgently require legislative protection (SPEC Category 2, status Vulnerable; Weber 1994).

**Great White Pelican** *Pelecanus onocrotalus* This species has a large range, with an estimated global Extent of Occurrence of 100,000-1,000,000 km². It has a large global population estimated to be 270,000-290,000 individuals (Wetlands International 2002). Global population trends have not been quantified, but the species is not believed to approach the thresholds for the population decline criterion of the IUCN Red List (i.e. declining more than 30% in ten years or three generations). For these reasons, the species is evaluated as Least Concern (BirdLife International 2007c). The European population underwent a considerable decline during the 20$^{th}$ century, mainly because of wetland drainage. Like the Dalmatian Pelican, all breeding colonies need protection and measures should be taken to reduce mortality on breeding, passage and wintering grounds (SPEC Category 3, Status Rare; Crivelli 1994b).

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# HANDBOOK ON OIL IMPACT ASSESSMENT

## 4.0 SPILL RESPONSE

## 4.2 Biological advice

**Technical document**

## Black Sea

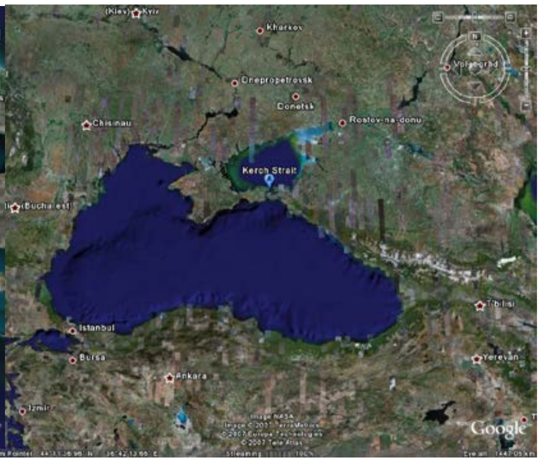
→ data deficient

- Countries involved: Turkey, Bulgaria, Georgia, Romania, Russia, Ukraine
- Seabirds in the area: breeding and wintering cormorants, wintering divers and seaduck; numbers and distribution patterns incompletely known.
- Species of particular conservation concern: White-headed Duck *Oxyura leucocephala*
- Standardised studies of seabirds at sea: not known
- OVI evaluation and area sensitivity: analysis never undertaken an no material to study area sensitivity at hand
- Anticipated sensitivity to chronic oil pollution: wintering concentrations of divers, grebes, cormorants and waterfowl may lead to vulnerable concentrations of birds

### 1,300 tonnes of oil spill from Russian tanker, 11 November 2007

Posted http://www.abc.net.au/news/stories/2007/11/11/2087630.htm

A Russian oil tanker has broken in half during a storm, spilling about 1300 tonnes of oil in the Kerch Strait between the Black Sea and the Sea of Azov. Russia's Transport Ministry says the stern and rear of the tanker tore apart in heavy winds in the area, which is divided between Russia and Ukraine. "Tanker Volga-Neft, carrying some 4000 tonnes of black oil on board, broke in half during a storm at a stop south of Port Kavkaz," a spokesman said. A ministry spokeswoman says rescue efforts are being hampered by the harsh weather conditions. But she says the 13 crew stranded in the rear end of the ship are not in danger. Russian authorities have opened a crisis centre to coordinate rescue efforts and prosecutors are investigating possible criminal charges on pollution and security breaches. The tanker was reportedly carrying fuel oil from the southern Russian city of Samara on the Volga River to a port in Ukraine. - **AFP**



Kerch Strait – general considerations: The marine areas (Black Sea and Azov Sea included), are data deficient and there have been no offshore surveys conducted in recent years for as far as known. Black-throated Divers *Gavia arctica* and Red-throated Divers *Gavia stellata* are highly vulnerable species that may be abundant as migrants and wintering birds (Schüz 1954, 1074; Cramp & Simmons 1977). The timing of autumn migration is largely ice-dependent, but arrivals may be expected from October through December (Cramp & Simmons 1977). Little Grebes *Tachybaptus ruficollis*, Great Crested Grebes *Podiceps cristatus*, Red-necked Grebes *P. grisegena*, and Black-necked Grebes *P. nigricollis* breed and winter in the affected area, Slavonian Grebes *P. auritus* are winter visitors. Black-necked Grebes may be abundant as migrants. The Kerch Strait is right at the heart of the flyway of several species of waterfowl from Siberian breeding areas, including vulnerable seaduck such as Velvet Scoter *Melanitta fusca*, Common Goldeneye *Bucephala clangula*, Smew *Mergellus albellus*, Red-breasted Merganser *Mergus serrator*, and Goosander *M. merganser* (Scott & Rose 2003).

The north coast of the Black Sea and the coasts of the Azov Sea are known for breeding colonies of various species of gulls and terns (*c.* 200,000 pairs in the late 1960s; 450,000 pairs in the early 1990s; Chernichko 1993). A spill in winter (November) is unlikely to affect any of the terns, for most will have left the area and the breeding is over so that colonies are not impacted. High numbers of gulls and some terns may remain in the affected area, however, including Mediterranean Gulls *Larus melanocephalus* and Great Black-headed Gulls *Larus ichthyaetus* (Chernichko 1993, Siokhin 1993).

The north coast of the Black Sea has a resident population of European Shag *Phalacrocorax aristotelis*, the the main concentrations are situated well west of the affected area (Beskaravayny & Kostin 1998; Nelson 2003). Breeding and wintering areas of Great Cormorants *Phalacrocorax carbo* should also be mostly west of the Kerch Strait area (Cramp & Simmons 1977; Nelson 2003).

Common Eiders *Somateria mollissima* have established a small resident population in the Black Sea region (Yaremchenko & Rybachuk 1999), with 1600 pairs nesting on the Dolgiy and Krugliy islands, and 220 nests at the Orlov, New, Egyptian islands in the Tendrovskiy and Yagorlitskiy bays, all at some distance of the impacted area. There is no information on the possible presence of wintering Eiders in the affected area.

The east coast of the Azov Sea is listed as a stop-over and wintering site for White-headed Duck *Oxyura leucocephala*, 2 species of swans, 5 species of geese, 7 species of dabbling ducks and 4 species of diving ducks (no seaduck mentioned), with an importance code “10” (i.e. less than five counts available and less than three counts exceeding 1% of the population, but the average of all counts exceeds 1% of population size; Scott & Rose 1996). Few species are particularly vulnerable to oil pollution, mainly because of their habitat choice. Swans and diving ducks utilising marine areas may be affected, however.

Ukrainian Important Bird Areas Kerch Strait: none of immediate relevance. Uzunlarskoe Lake (IBA# 101) and Bagerova (IBA# 102) are steppe areas and agricultural areas on the Kerch peninsula of the Crimea and near the town of Bagerovo. The only waterfowl listed for these IBAs are Ruddy Shelduck *Tadorna ferruginea* (Mikityuk 2000).

Russian Important Bird Areas Kerch Strait: to the north east of the impacted area, the eastern coast of the Sea of Azov (IBA# 151), important numbers of Dalmatian Pelicans *Pelecanus crispus*, Glossy Ibis *Plegadis falcinellus,* Spoonbill *Platalea leucorodia*, Whooper Swan *Cygnus Cygnus*, White-headed Duck *Oxyura leucocephala*, waders, and Great Black-headed Gulls *Larus ichthyaetus* are listed for the lower reaches and delta of the Kuban river, as well as adjacent coastal shallows of the Sea of Azov, including both open and closed bays and lagoons (salt-lakes). The habitat is described as wetland, including coastal lagoon, standing fresh water, standing brackish water and salt water (including marine areas) (Sviridova 2000).

Slightly to the east, Kiziltash limans (IBA #152) is a closed bay with shallow water, islands and coastal inlets where a variety of waders, gulls and terns is found breeding. Listed species include Great Cormorant *Phalacrocorax carbo*, Greylag Goose *Anser anser*, Black-winged Stilt *Himantopus himantopus*, Avocet *Recurvirostra avosetta*, Great Black-headed Gull *Larus ichthyaetus*, Mediterranean Gull *Larus melanocephalus*, Yellow-legged Gull *Larus cachinnans*, and five tern species (Sviridova 2000).

The Akhtarski and Sladki Liman Temporary Reserve (118 340 ha) comprises vast lowlands along the southeast Azov Sea coast. These are shallow salty lakes connected by a dense network of canals overgrown with vegetation. The lakes are eutrophic due to effluent from nearby animal farms. Seabirds in the reserve are represented by colonies of Dalmatian Pelicans (up to 45 pairs), Common Terns (1600) and Little Terns (500 pairs). The importance of the reserve increases during seasonal flights when thousands of gulls and terns and tens of grebes and divers visit (Nankinov 1996).

Globally threatened species: White-headed Duck *Oxyura leucocephala* (Endangered; Stattersfield & Capper 2000)

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Beskaravayny M.M. & S.Yu. Kostin 1998. Distribution, numbers and some peculiarities of the breeding ecology of the Shag and the Herring Gull in the South-Eastern Crimea. Berkut 7(1-2): 25-29. *The Shag and the Herring Gull inhabit rocky coast precipices and small rocky islands of the Southern Crimea coast. Seven areas of nesting of the Shag have been found (170-180 pairs): the largest one at the Karadag Nature Reserve. Address: M.M. Beskaravayny, Karadag Nature Reserve, 334876 PO Kurortnoye, Feodosiya, the Crimea, Ukraine.*

Black Sea Commission 2002. State of the environment of the Black Sea: Pressures and trends, 1996 -2000. Istanbul 2002, http://www.blacksea-commission.org/Publications/Reports_SOE.htm. *The purpose of this report is to provide policy and decision makers with a brief summary on major regional threats and changes to the Black Sea ecosystem and the environment as whole. The policy measures and management tools for further progress are analyzed in the `Report on The Implementation of the Black Sea Strategic Action Plan' that presents a clear focus on coordinated regional actions. Annexes to the "Report on the Implementation of the Black Sea Strategic Action Plan' present the national answers to a set of questions related to the BSSAP implementation on the national level. In order to achieve the main objectives of the Convention on the Protection of the Black Sea Against Pollution, the BSSAP requests from the Contracting Parties a set of coordinated policies and measures that are to be implemented in order to preserve, protect and rehabilitate of the Black Sea ecosystem from further pollution and degradation. The structure of this report was based on the needs of the decision makers and requirements of the Strategic Action Plan for Rehabilitation and Protection of the Black Sea. This Report is complimentary to the Black Sea Commission Report of the Implementation of the BSSAP for the period 1996-2000. The Report describes in brief the major trends in reduction of pollution inputs with particular attention to the high priority sources of pollution, discharges of the wastewaters that are not in full compliance with national environmental norms, and oil pollution. It also expresses some trends in biodiversity. The lack of agreed indicators and reporting formats resulted in many omissions and some not well justified conclusions. To the extent possible, these omissions are redressed during consultations with the Black Sea coastal states. A comprehensive scientific assessment of the state of the environment of the Black Sea is provisioned in the GEF Ecosystem Recovery Project, 2002-2004. Along with data of national monitoring programs, this assessment will form a basis for the State of the Environment of the Black Sea Report in 2006. The draft Report was circulated, amended and agreed by the Contracting Parties prior to the final publication.*

*Currently overall decreasing trends are reported for oil related pollution in marine waters of all Black Sea coastal states. Only in harbors of Constanta port and near the petrochemical plant in Romania are pollution levels higher. In the coastal waters of the Russian Federation oil product contents do not exceed the national water quality standards and in 1999 were lower than detection limits. Decreasing trends were also reported for Turkish and Ukrainian coastal waters. However oil pollution is a concern for the Black Sea environment in particular due to increasing risk of accidental spills that may result from the expected twofold increase of oil transit by tankers. The freight flow of this oil resource from Middle Asia and Azerbaijan via Georgia gradually increases. Over 20 million tones of oil and petroleum products are supposed to be transported via these terminals in Georgia to the west through the Black Sea (east-west). It should also be noted that an increase of oil transportation from Georgia would proportionally enhance the uncontrolled flow of isolated ballast into the central part of the sea, thus bringing a threat of different exotic species and pathogenic organisms to the Black Sea ecosystem, and probably additional pollution. According to approximate estimations the volume of such ballast in Georgian ports is 5 million tones per year.*

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Nankinov D.N. 1996. Coastal parks and reserves along the Black Sea and their importance for seabirds. Marine Ornithology 24(1-2): 29-34. The coastal line of the Black Sea is 4090 km long. Twenty-two parks and reserves, the total area of which is 907 357 ha, are located on the coast. The largest in area is the Danube Delta and Razelm–Sinoie complex in Romania with an area of 442 000 ha, which is 49% of the total area of the coastal parks and reserves along the Black Sea. The reserves of the Ukraine (six in number) with total area of 227 712 ha (25%), Turkey (three) with total area of 110 100 ha (12%), Russia (one reserve) – 118 340 ha (13%), Bulgaria (six) – 4944 ha (1%) and Georgia (two) – 4261 ha (<1%), follow. A total of 41 species of seabirds, 24 of which breed, have been recorded in the coastal parks and reserves along the Black Sea. The most numerous breeding species are the Mediterranean Gull *Larus melanocephalus* (over 90% of the world population), Common Tern *Sterna hirundo*, Sandwich Tern *S. sandvicensis*, Slender-billed Gull *L. genei* and Yellow-legged Gull *L. cachinnans*. The greatest numbers of seabirds breed in the Chernomorski Biosphere Reserve , the Danube Delta and Azovo-Sivash Reserve. With the exception of the Danube Delta, the other two reserves are included in the Ramsar Convention. On the coasts of the Black Sea and the Sea of Azov there are also other areas, which are neither coastal parks nor reserves, that play an important role for the breeding, migration and wintering of seabirds.

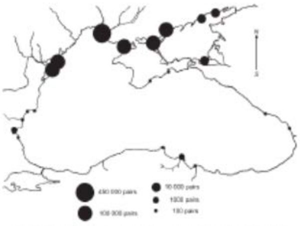

Fig. 2. Breeding seabird concentrations in the coastal parks and reserves of the Black Sea.

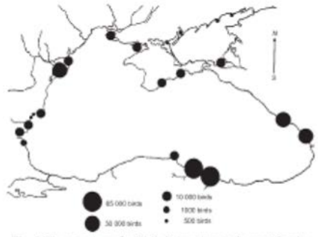

Fig. 4. Concentrations of seabirds during winter in the coastal parks and reserves of the Black Sea.

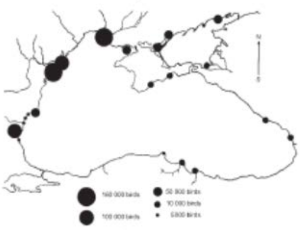

Fig. 3. Concentrations of seabirds during migration in the coastal parks and reserves of the Black Sea.

Main concentrations of breeding seabirds in the coastal parks and reserves of the Black Sea, concentrations of migratory birds, and concentrations of wintering birds (Nankinov 1996)

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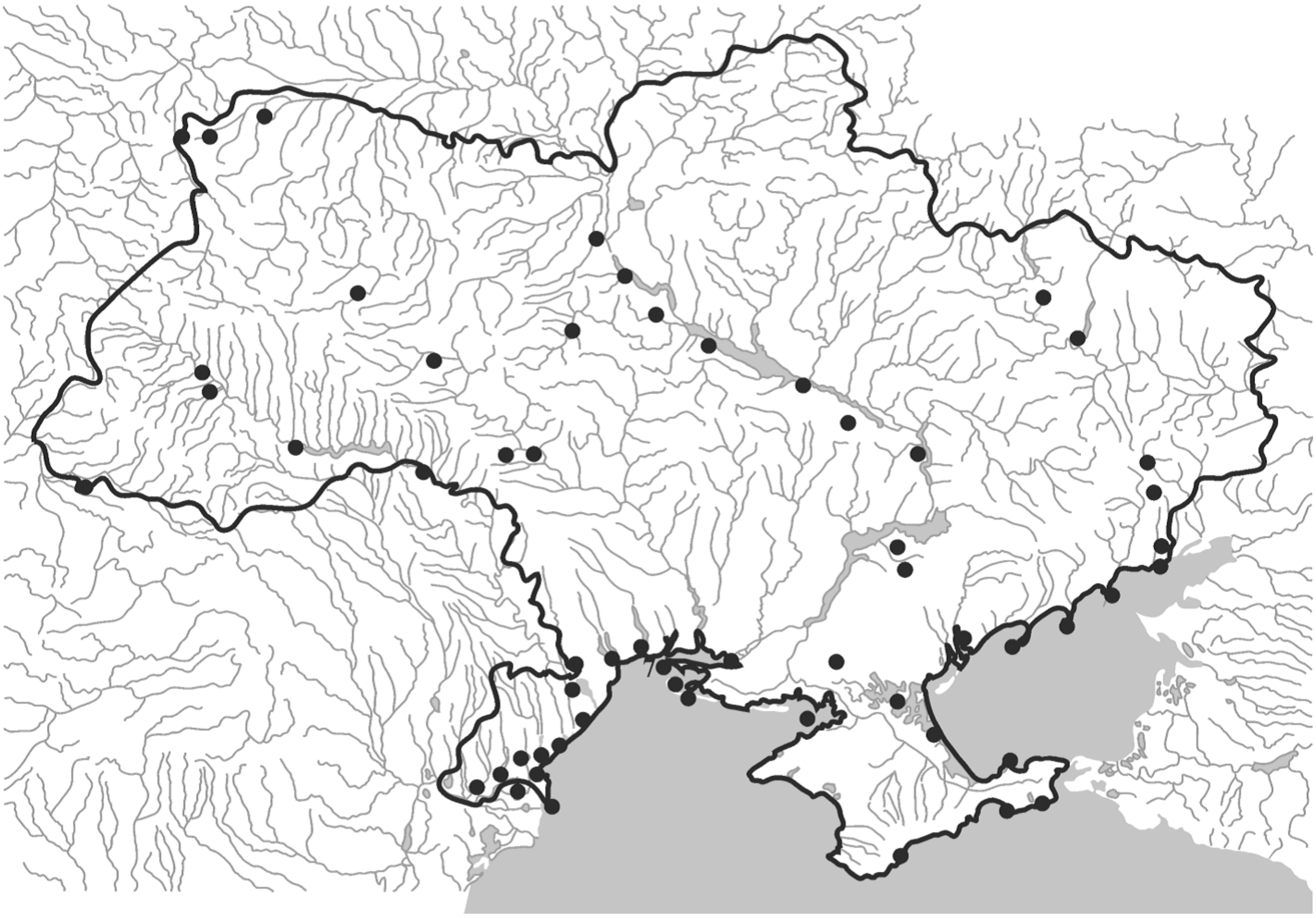
The status, distribution, and numbers of 27 wintering waterfowl species are reviewed for the last 50-year period in Ukraine. The main shifts that occurred are discussed along with hydrological and global climate changes. - Great Crested Grebe (*Podiceps cristatus*). Based on counts of the last winter, numbers of wintering birds on inland water bodies can be estimated at 400 individuals. Slavonian Grebe (*Podiceps auritus*). After the construction of Dniprodzerzhynsk reservoir (Dnipropetrovsk region), the species appeared on migrations (Bulakhov, 1968). Soon after it disappeared from the - faunal structure of flood land ecosystems (Miasoedova, 1984) and now it is a rarity (Bulakhov & Gubkin, 1996). - Cormorant (*Phalacrocorax carbo*). During several last years numbers of wintering birds at the Azov-Black Sea coast varied between 7,000.9,000 individuals, and on inland water bodies there were no more than 200 birds. - Pygmy Cormorant (*Phalacrocorax pygmaeus*). The birds are wintering annually at the seacoast zone, in reedbeds, and in the Danube delta, making some 100.120 individuals (Koshelev et al., 1991). There is a slight tendency of an increase in numbers of breeding and wintering birds. - Eider (*Somateria mollissima*). During the last years the wintering area of Eiders extended. The species is observed not only on the Black Sea reserve, but also on Dzharylgatskaya Bay. Recent estimate of wintering birds makes some 4,000.6,000 individuals. - Pochard (*Aythya ferina*). Based on available data, there is a minimum of 75,000 wintering Pochards. There are some reasons to consider that in some years (due to a possible undercount) there were about 200,000 wintering birds. - Tufted Duck (*Aythya fuligula*). A total amount of wintering birds at the Azov-Black Sea coast in some years can be estimated at a minimum of 10,000.15,000 and at a maximum of 150,000.300,000. - Scaup (*Aythya marila*). On inland water bodies, about 14,000 birds were wintering recently. On the Black Sea and the Azov Sea from 160,000 to 240,000 birds are wintering and migrating. - Goldeneye (*Bucephala clangula*). During the last years the total number of wintering birds was 6,500. It is quite possible that their real number does not exceed 8,000. Taking into account an expansion of the breeding area of the species in the north of Ukraine and the warming climate, numbers of wintering birds could be expected to grow. - Smew (*Mergus albellus*). At present, there are about 6,500 wintering individuals, but based on the results of the last winter census this estimate can be increased to 15,000 (this is probably because migrating birds were also taken into account). - Red-Breasted Merganser (*Mergus serrator*). During the latest counts 50 birds were recorded on their wintering grounds on inland water bodies. Taking into account sea wintering areas, a total number of wintering birds could be up to 1,000. - Goosander (*Mergus merganser*). At present, the number of wintering Goosanders on inland water bodies can be estimated at 250 birds, but on coastal waters of Ukraine, obviously, up to 1,000 birds could be wintering. - Coot (*Fulica atra*). Based on bird winter counts of last years, more and more Coots stay in large numbers on inland water bodies for winter. There can be some 4,500 birds. Taking into consideration the data of the counts performed in the coastal regions of the Black and Azov Seas, there were as many as 480,000.550,000 wintering Coots in different years throughout Ukraine.



Main Ukrainian wintering sites (from Serebryakov 2001)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