



1996 - 2021  
**25**  
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YEARS



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# **ACCOBAMS training on necropsies**

***Part I - Online, 28 - 29 June 2021***

# Necropsy: a tool for the identification of the causes of death and threats

Dabin W., Levy E., Quievy A., Jauniaux T.

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:

- Belgian coastline: 2013: 180 stranded marine mammals

Highest density in the world (/km coastline)

2020 different unusual stranding (Belgique/France):

- Jan. : 1 Sowerby beaked whale (*Mesoplodon bidens*)
- Sept. : 1 fin whale , 1 Bryde's whale and 1 tropical whale (*B. edeni*): fis stranding in Europe
- Oct.: 3 fin whales
- Dec.: : 1 Sowerby beaked whale

2020 Belgian coastline : 94 marine mammals dead stranded

## Different “options” for stranded cetaceans (lead by local priorities)

Calais (France): Nov. 2015: 10 pilot whales (*Globicephala melas*): immediate necropsy



Yoff- Dakar (Senegal): May 2008: 34 pilot whales: 32 « disappeared as « marine bushmeat »; 2 were necropsied



## Collision between a ship and a whale (ship strike): reason of post-mortem investigations?





Sperm whales Unusual Mortality Event: links with human activities?

## SPERM WHALE STRANDINGS 2016



Narwhal: Arctic species

One individual stranded in Belgium (2016): link with global changes?



Narwhal: 11 strandings recorded in the North Sea between 1588 and 1949!!!

**To understand cetaceans' strandings, causes of death,  
main threats:**

**OONE TOOL:**

**NECROPSY (gross lesions and histopathology) and  
complementary investigations (microbiology,  
parasitology...), toxicology,....**



## Introduction: the North Sea situation

Where is the North Sea?

What marine mammal species are present?

Why and how to study marine mammals?

How many strandings?

What are the main causes of death?

The continental coastline of the southern North Sea:

Causes of death of small cetaceans: the harbour porpoise

Causes of death of large cetaceans

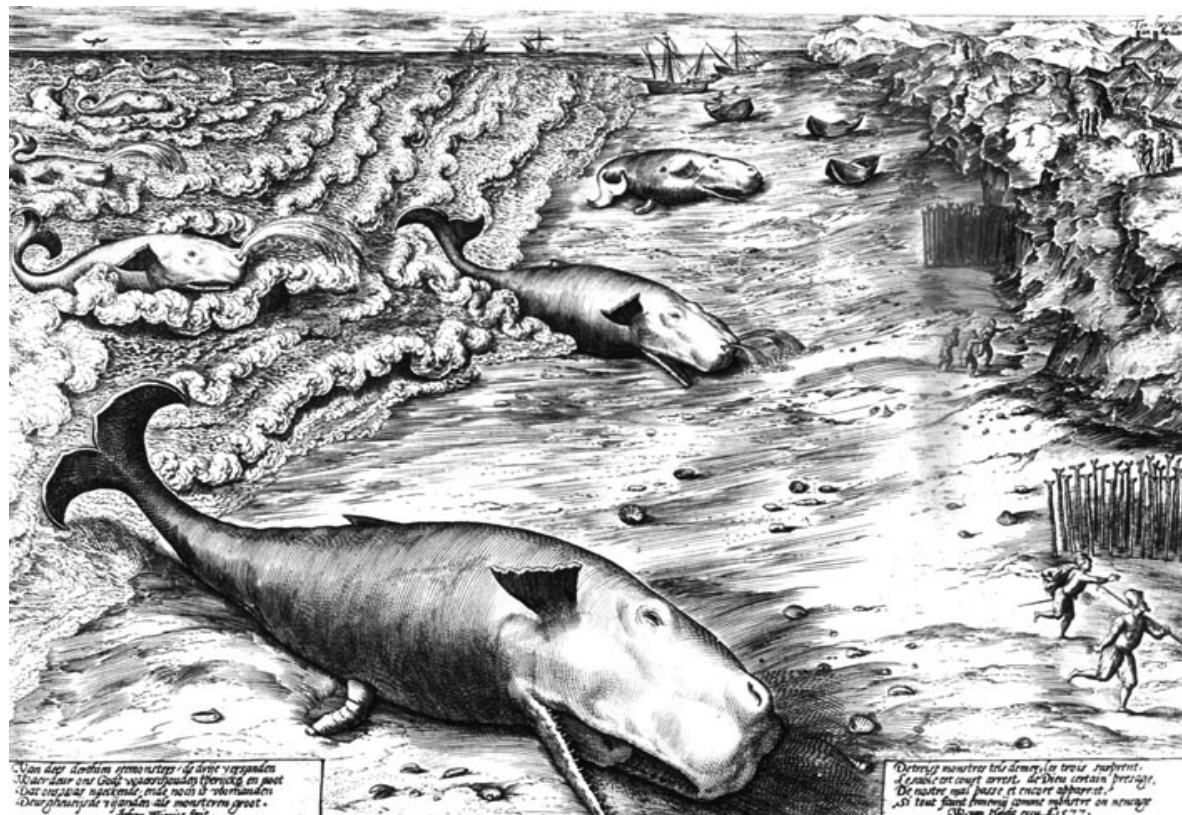
*« ... cet animal appartenait à l'embranchement des vertébrés, à la classe des mammifères, au groupe des pisciformes, et finalement à l'ordre des cétacés. Quant à la famille dans laquelle il prenait rang, baleine, cachalot ou dauphin, quant au genre dont il faisait partie, quant à l'espèce dans laquelle il convenait de le ranger, c'était une question à élucider ultérieurement.*

*Pour la résoudre, il fallait disséquer ce monstre inconnu,... »*

**To solve the enigma, it is necessary to dissect such unknown monster**

Jules Vernes,

*Vingt mille lieues sous les mers*



## Introduction: the North Sea situation

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Causes of death of small cetaceans: the harbour porpoise

Causes of death of large cetaceans: sperm whale and fin whale

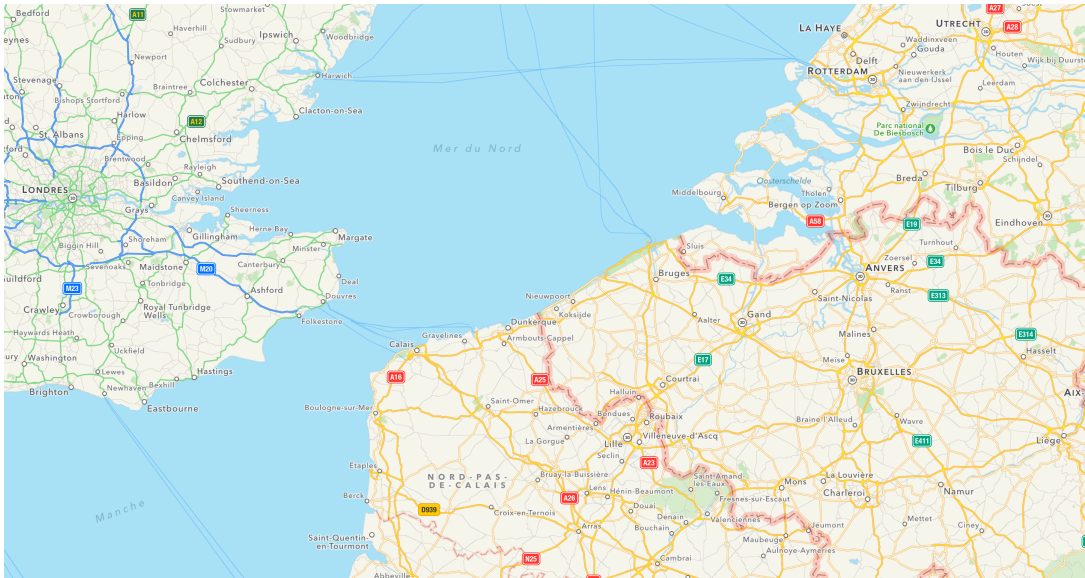


Different agreements for the conservation and protection of marine mammal species

- International : Convention on International Trade in Endangered Species (CITES),  
Convention on Migratory Species
- European: Habitat directives
- Regional: (1) Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea (ASCOBANS),  
(2) Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAM), OSPAR
- national: federal laws

## PROTECTED SPECIES

Where is the North Sea?



## What marine mammal species are present?

### Cetaceans in the southern North Sea

#### *Odontoceti*

Harbour porpoise  
White-beaked dolphin  
Atlantic white-sided dolphin  
Striped dolphin  
Common dolphin  
Bottlenose dolphin  
Sperm whale

#### *Mysticeti*

Minke whale  
Fin whale  
Humpback whale





Harbour porpoise



Sperm whale



Fin whale



Minke whale



Humpback whale

© MUMM | BMM | UGMM



Striped dolphin



Bottlenose dolphin



## Why to study marine mammals?

### Bioindicators

Long life span  
Mammals (homeothermic)  
Contaminated environment  
Top predator



Accumulation of lipophilic contaminants in  
marine food web  
Bioaccumulation: concentration ratio between  
predator and prey

Marine mammals will indicate early alteration associated with contaminant exposure

High concentration of contaminant in tissues of stranded marine mammals: BUT

High concentration responsible for diseases/lesions?

or

Diseases/lesions responsible for contaminant increasing in tissues

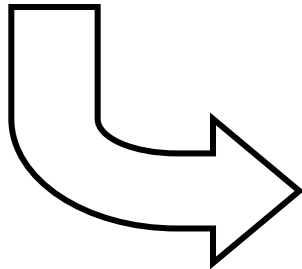
NEED: multidisciplinary approach of the cause of marine mammals death, from the individual to evaluate the population health status

Stranding network:

MARIN aims:

Identification of lesions and causes of death of cetaceans and pinnipeds- stranded on the continental coastline of the southern North Sea by:

- Systematic necropsy using specific protocol;
- Complete samplings and tissues banking;
- Database with all results;
- Detailed description of lesions and their origin;
- Highlighting main mortality processes.



1. Creation of specific theories for stranding;
2. Evolution of the causes of death;
3. Impacts of human activities;
4. From the individuals to the population

One health, multidisciplinary, holistic approach

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# Strandings from 1990 to 2016 : Harbor porpoise

1996 - 2021

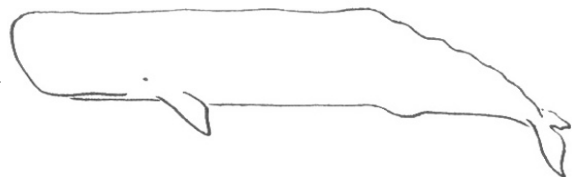
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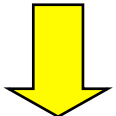


[http://www.mumm.ac.be/FR/Management/Nature/search\\_strandings.php](http://www.mumm.ac.be/FR/Management/Nature/search_strandings.php)





STRANDINGS



ALARM

BELGIUM

OD Nature

(Royal Institute of  
Natural Sciences of Belgium)

France

Pelagis

(University of La Rochelle)

ULiege

INTERVENTION

Alive

Dead

*Rehabilitation center*

Necropsy

Necropsy room  
Uliece, Pelagis

Compulsory

*No solution in  
southern North Sea*

Beach



*“A pod of almost 48 Sperm Whales have stranded two days ago on a sand bar at Perkins Island near Smithton, on Tasmania's north-west coast. During these two days Australian rescuers have tried to save 12 of them that were still alive, but the sperm whales are simply too big and heavy to be moved and when the sun's out the animals just heat up incredibly quickly, the blubber, which is a real asset to them in the deep cold waters, just really makes them heat up quickly, on top of that the site of the stranding can only be reached with boats and during the high tide making everything more difficult”*

<http://seawayblog.blogspot.be/2009/01/slow-death-of-sperm-whales-pod.html>

|                              | Repro | HP. | Viro. | Bact.   | Parasi   | ML   | POPs | Alim | Genet   |
|------------------------------|-------|-----|-------|---------|----------|------|------|------|---------|
| Peau                         |       |     |       |         |          |      |      |      | alcool  |
| Glande mammaire G/D          |       |     |       |         |          | lait | lait | lait |         |
| Dents                        |       |     |       |         |          | 3    |      |      | 5:-20°C |
| Graisse                      |       |     |       |         |          |      |      |      |         |
| Muscle                       |       |     |       |         |          |      |      |      |         |
| Foie                         |       |     |       |         | parasite |      |      |      |         |
| Surrénale                    |       |     |       |         |          |      |      |      |         |
| Ganglion mésentérique        |       |     |       |         |          |      |      |      |         |
| Rate                         |       |     |       |         |          |      |      |      |         |
| Gonade                       |       |     |       |         |          |      |      |      |         |
| Tractus reproducteur complet |       |     |       |         |          |      |      |      |         |
| Prostate G/D                 |       |     |       |         |          |      |      |      |         |
| Estomac                      |       |     |       |         | parasite |      |      |      |         |
| Restes alimentaires          |       |     |       |         |          |      |      |      |         |
| Intestin                     |       |     |       |         |          |      |      |      |         |
| Rein                         |       |     |       |         |          |      |      |      | alcool  |
| Vessie                       |       |     |       |         |          |      |      |      |         |
| Pancreas                     |       |     |       |         |          |      |      |      |         |
| Poumon                       |       |     |       |         | parasite |      |      |      |         |
| Ganglion bronchique          |       |     |       |         |          |      |      |      |         |
| Coeur G/D                    |       |     |       | sang    |          |      |      |      |         |
| Aorte                        |       |     |       |         |          |      |      |      |         |
| Oesophage                    |       |     |       | +ulcère |          |      |      |      |         |
| Thymus                       |       |     |       |         |          |      |      |      |         |
| Thyroïde                     |       |     |       |         |          |      |      |      |         |
| Système nerveux central      |       |     |       |         |          |      |      |      |         |
| Hypophyse                    |       |     |       |         |          |      |      |      |         |
| Sang                         |       |     |       |         |          |      |      |      |         |
| Placenta, cordon, membrane   |       |     |       |         |          |      |      |      |         |
| Conduit auditif              |       |     |       |         |          |      |      |      |         |
| Oeil                         |       |     |       |         |          |      |      |      |         |
| Squelette/einture pelvienne  |       |     |       |         |          |      |      |      |         |
| Lésions                      |       |     |       |         |          |      |      |      |         |



Histopathology : 10% buffered formol

Virology : samples stored -80°C ou -20°C (no formol no ethanol)

Bacteriology: samples stored 4°C (no formol no ethanol)

Parasitology : parasites stored in 70 % ethanol with 5% glycerin

Toxicology:

Heavy metals (>50 g.): samples stored in plastic bags -20°C

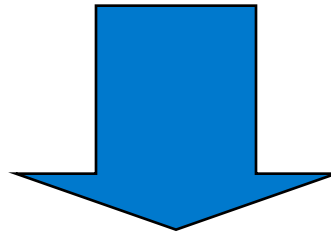
Persistent Organic Pollutants (>50 g.): : samples stored in aluminium -20°C

Stomach content (prey investigation): samples stored -20°C

Genetic : samples stored in 70 % ethanol

## Necropsy of marine mammals

1. Report of all observed lesions
2. Collection of samples for complementary investigations  
(histopathology, toxicology, bacteriology virology, parasitology, mycology,...)
3. Complementary investigations analyses and results



One health, multidisciplinary, holistic  
approach of the causes of death and  
identification of major threats

## Marine mammal necropsies:

→ scientific, political, mediatic and sanitary reasons

Team composed of veterinarian (vet. Pathologist), with assistants (or volunteers such as veterinary and biologist students)

Specific procedures and protocols (Join ASCOBANS-ACCOBANS protocol)

Equipment

Necropsy of all stranded animals whatever the size (0,8 m to 20 m) or the conservation code (1 very fresh to 5 severe putrefaction)

→ Cetaceans necropsy in the context of ACCOBAMS (also ASCOBANS and other agreements)

- Identification of lesions and causes of death, categorization of main threats
- Tool for elaboration of strategies for conservation and protection concepts

## Major threats for marine mammals in the North Atlantic

Net capture

Viral infection

Parasites infestation

Bacterial infection

Contaminants/Pollutants

Miscellaneous





Main threats and causes of death of marine mammals in the southern North Sea

1. Net entrapment (by catch) :

- First cause of porpoises death
- Removal rate > population growth rate (2 - 4%)
- Porpoise population estimated : 350.000 (2% : 7.000)

1.1. Evaluation by observers on fishing vessels (number of porpoises)

| Country       | Fishing area          | Period    | Annual rate | Reference                     |
|---------------|-----------------------|-----------|-------------|-------------------------------|
| Denmark       | North Sea             | 1993-1994 | 7000 ☠☠     | Vinther, 1996                 |
| Great-Britain | Irish Sea             | 1993-1994 | 2200 ☠      | Tregenza <i>et al.</i> , 1997 |
| Denmark       | Baltic and North Seas | 1994-1998 | 6785 ☠☠     | Vinther, 1999                 |

☠☠ threat for North Sea population

☠ threat for local population



## 1.2. Evaluation by necropsy on stranded porpoises

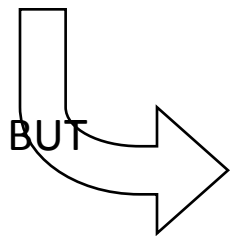
... most of by-caught animals being thrown back into water after capture

| Location        | Porpoise | Period    | Reference                    |
|-----------------|----------|-----------|------------------------------|
| British islands | 24%      | 1989-1991 | Baker & Martin, 1992         |
| British islands | 34%      | 1990-1996 | Jepson, 2000                 |
| German coasts   | 51%      | 1991-1993 | Benke, 1998                  |
| German coasts   | 47%      | 1991-1996 | Siebert <i>et al.</i> , 2001 |

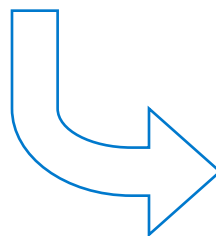
The Netherlands, Belgium (2008): 50%)

Post-mortem diagnosis based on:

- evidence of capture : skin lacerations, hematomas
- evidence of release from net: flipper amputation, eventration
- good health: absence of disease, good nutritional status
- evidence of hypoxia: lung congestion and edema, petechia



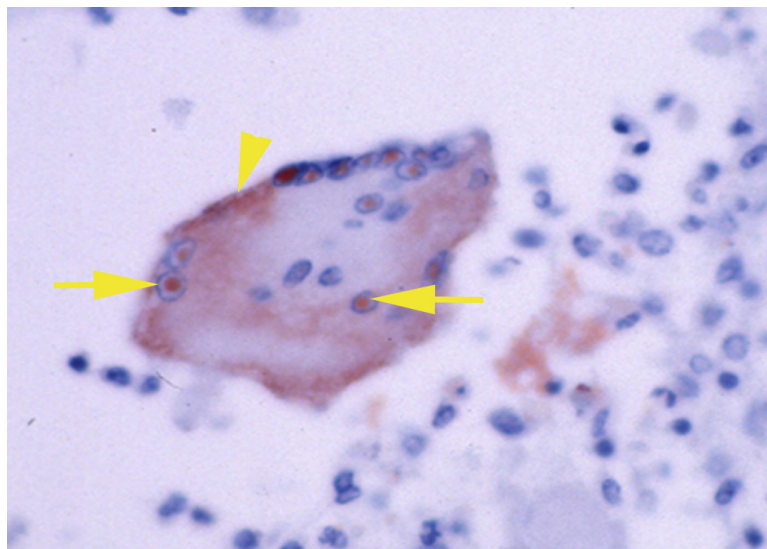
lesions not always present  
and non-pathognomonic,  
and no diagnostic test



Estimation of by-caught only  
by necropsy underestimated  
the impact on population

## 2. Viral disease : Morbillivirus (similarity with Distemper, measles, rinderpest)

*See Sandro's presentation*



*Multinucleate cell, Immunohistochemistry staining  
Morbillivirus +, lymph node, Balaenoptera physalus*



### 3. Parasites infestation

Respiratory nematodiasis with secondary bacterial/fungal infection: first infectious cause of death

Harbour porpoise : high prevalence of nematodes infestations in lung (tract, pulmonary arteries), heart, stomach, middle ear.

Also trematodes infestation in biliary ducts, stomach.

Also cestodes infestation in intestine

Nematodes: suspected to play a role for transmission of *Brucella* or morbillivirus

### 4. Bacterial infection

Most opportunistic germ secondary parasites or viral infection leading to pneumonia, septicaemia

Risk of zoonosis:

*Erysipelothrix rhusiopathiae*: skin lesion, septicemia, endocarditis,

*Brucella* sp: 4 human cases reported of neurobrucellosis and osteomyelitis (*B.ceti*)

### 5. Fungal infection

Opportunistic, secondary to parasites: *Aspergillus fumigatus*, *Candida* sp.



Marine mammals *Brucella* sp.infection:

- For cetaceans: *Brucella ceti*:

High zoonotic risk (4 cases reported)

1 case of profesional exposition

low consequences: fever, tiredness

3 other cases: unknown origin (no link with marine mammals)

BUT raw fish and crustacean consumers (sushi eater)

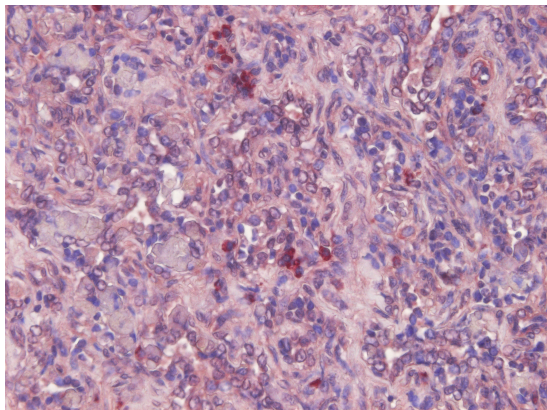
Severe consequence: encephalitis



- For seals: *Brucella pinnipedialis*

Zoonotic risk :? (no case reported)

Seal meat consumption by nordic people



## 6. Contaminants

Immunosuppression : suspicion in morbillivirus diseases emergence but epizootics of rinderpest and measles before presence of such contaminants



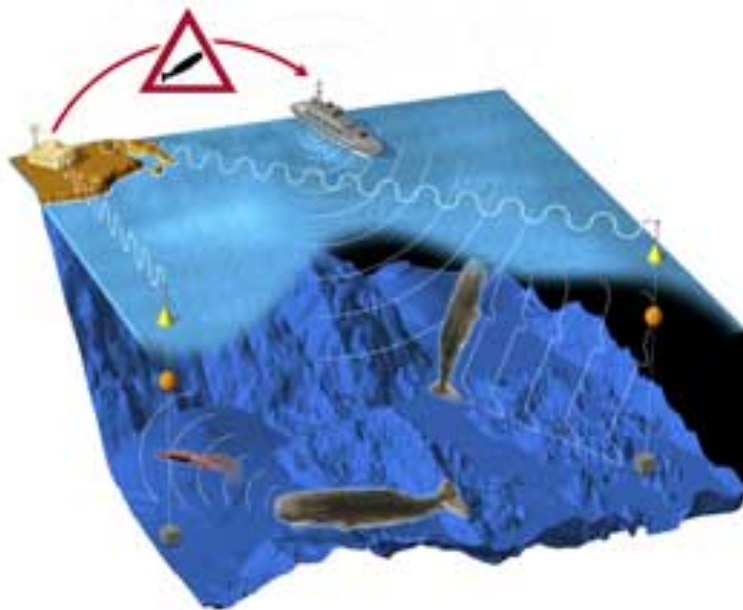
Alteration of reproduction and endocrine disruptor:  
uterine stenosis, reduction of reproduction

Tumor induction:

St-Laurent beluga whale, the highest prevalence of tumor compared with other species linked with high concentration of B(a)P

*Collision or ship strike: area with high density of traffic or with high speed:*

- Tankers: no specific location
- Jet sky
- Fast ferry: between islands (Canaries) or between continent and island (Corsica, Baleares)  
specific location: anti-collision system



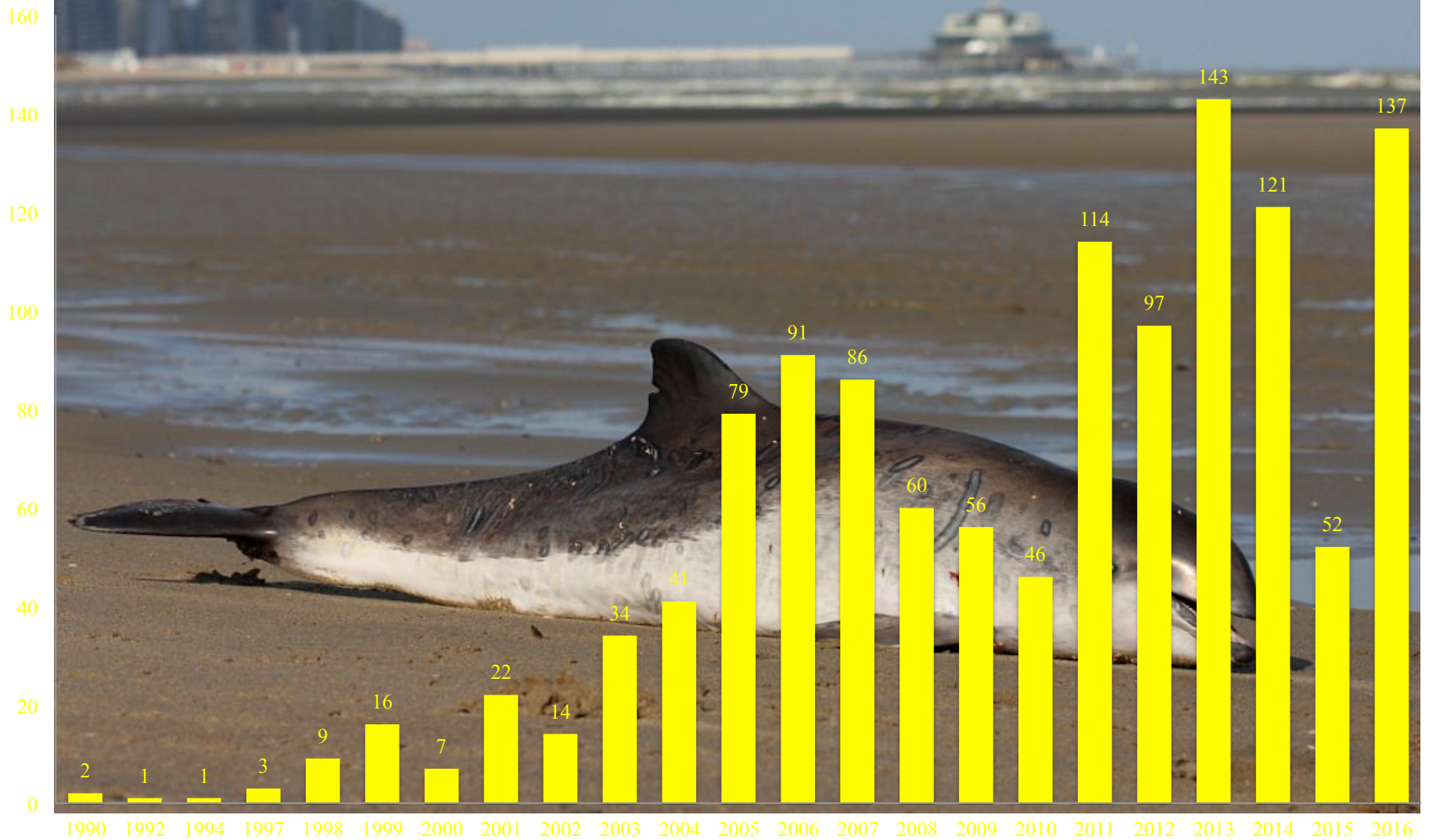
<http://rolexawards.com/en/the-laureates/michelandre-home.jsp>

Introduction: the North Sea situation

The continental coastline of the southern North Sea:

Causes of death of small cetaceans: the harbour porpoise

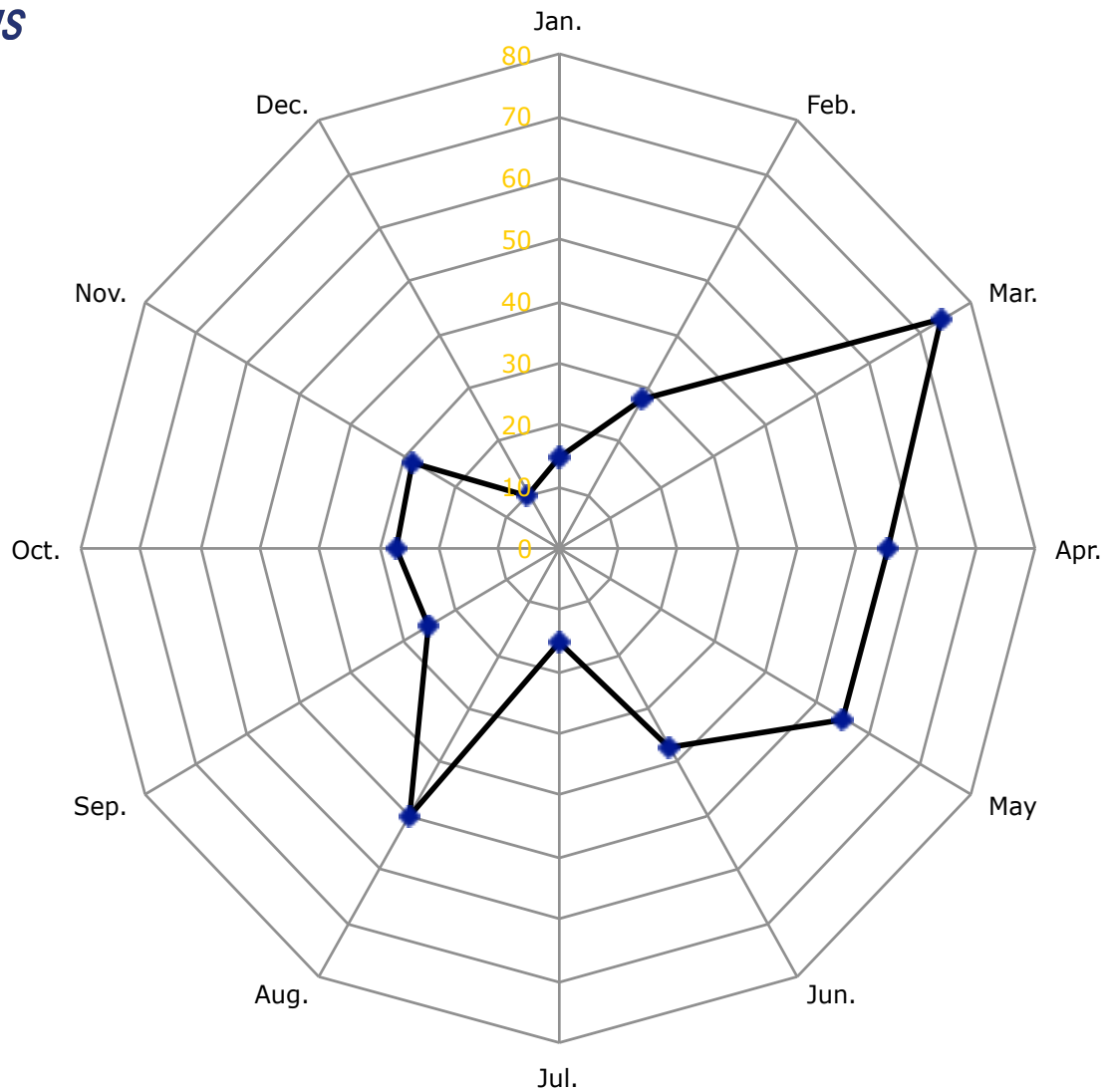
Causes of death of large cetaceans: sperm whale and fin whale





1. >3000 porpoises stranded between 1990 and 2017
2. >1000 necropsied and sampled
3. Identification of relevant lesions and causes of death
4. Samples for histology, microbiology, toxicology, age determination, preys identification, stable isotopes, ...





## End of winter and August peaks

Causes of death (when the cause of death is determined!)

net capture

-External observations : 30%

skin lacerations, net marks, amputation

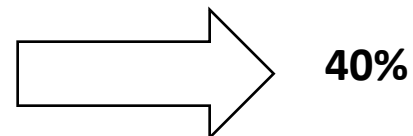
- Other observations :

subcutaneous hemorrhages

lung edema and congestion

recent feeding

good nutritional status



**40%**

!!! BUT (severe) diseases also on by-caught porpoises (then not a “control” population de facto without necropsy)

infectious diseases and emaciation

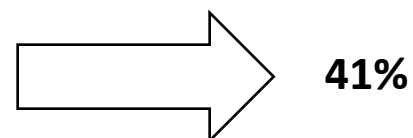
emaciation

parasitosis

acute pneumonia

severe gastritis

no evidence of recent feeding



**41%**

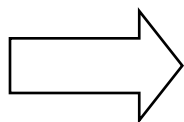
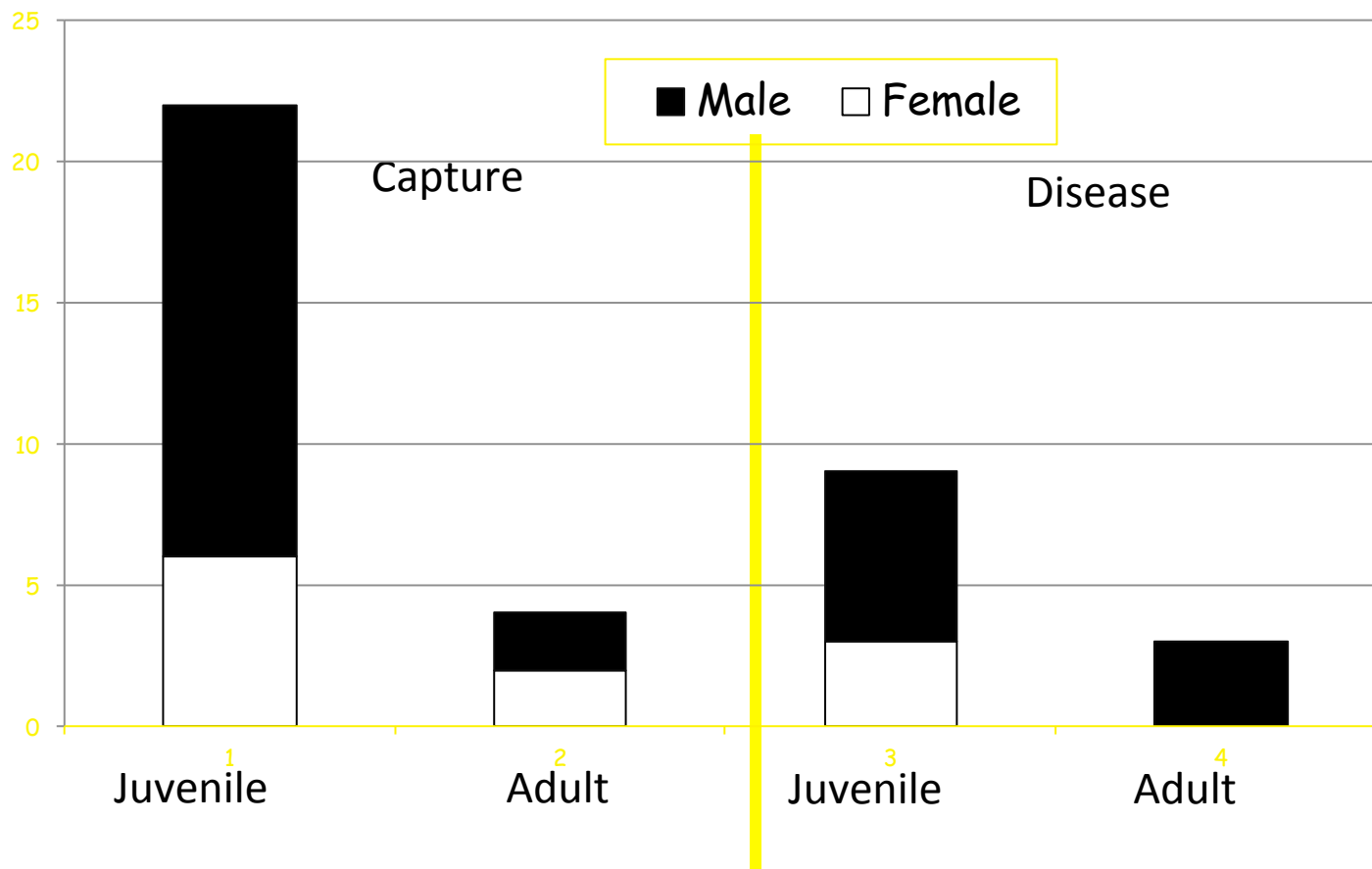
Captures linked with recreational fishing activities -beach set gillnet;

Frequently other lesions on by-caught porpoises, some being potentially fatal (severe emaciation, acute pneumonia)

Lesions related to net-entrapment: not always present (skin marks,..) and not specific: underestimation of net capture

To evaluate health status of stranded animals: Needs of complete necropsy by pathologist of all animals including animals with clear evidence of net-entrapment

## Sex and age



- ✓ More males than females
- ✓ More juveniles
- ✓ Predisposition for capture amongst juveniles



## Most common external observations frequently associated with by-catch





Most common external observations frequently associated  
with by-catch



Hypohema: blood in the  
anterior chamber of the eye




France: Bay of Biscay situation:  
Every winter, hundreds of dolphins  
stranded with evidences of capture

**Libération** Sur la côte Atlantique, les dépouilles ...

**BIODIVERSITE**

# Sur la côte Atlantique, les dépouilles de dauphins s'échouent en masse

Par Florian Bardou — 7 avril 2017 à 12:11



liberation.fr » dans un nouvel onglet

**f PARTAGER** **TWEETER**

**Le Monde**

Consulter le journal

ACTUALITES ÉCONOMIE VIDÉOS OPINIONS CULTURE M LE MAG SERVICES

## PLANÈTE - BIODIVERSITÉ


### Echouage massif de dauphins sur les côtes françaises

Plus de 600 cétacés ont été retrouvés sur les plages françaises depuis décembre, dont 95 % portent des traces d'accidents de pêche.

Par Martine Valo - Publié le 22 février 2020 à 09h56 - Mis à jour le 24 février 2020 à 07h29

Lecture 4 min.

Article réservé aux abonnés



PUBLICITÉ

CONTENUS SPONSORISÉS PAR OUTDOOR+>

MICROBIOMES 3D  
Cet appareil super relâche les tensions cervicales

RED PICTURES  
Profitez d'offres exceptionnelles sur la New Peugeot 208

Safari Fichier Édition Présentation Historique Signets Fenêtre Aide

lexpress.fr

Environnement Les océans en danger La sécheresse en France Energies renouvelables Pêche en eaux profondes Vidéo Environnement

## France

### Échouage massif de dauphins en France : la pêche intensive dans le viseur des ONG

Plus de 600 cétacés se sont échoués sur les côtes françaises depuis début 2020. Un phénomène massif qui s'explique par des accidents provoqués par les chalutiers.

Durée : 9 min | Article réservé aux abonnés



**— Les plus lus —**

- 1 Enquête. Eric Zemmour, la tentation présidentielle
- 2 Yuval Noah Harari : Les

Soutenez la rédaction. Abonnez-vous. 2 MOIS POUR 1 € | [Je m'abonne sans engagement](#)

Annually, end of winter around 800-1,000 stranded dolphins on French coastline of bay of Biscay

Model estimation: 5-8 % offshore capture

Cause of death: mostly capture

Final evaluation: 10.000 à 16.000 by-caught dolphins

⇒ Significant local treath

BUT post-mortem investigations done by non-veterinarians and post-mortem conclusions invalidate by advocates

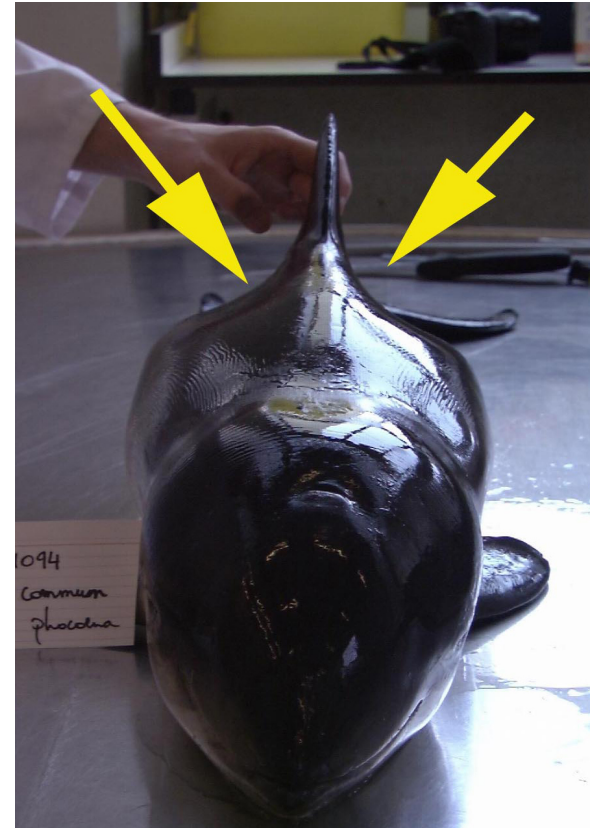
Strong need of veterinary expoerts to validate post-mortem investigations



## Diseases & emaciation



Good nutritional status



Poor nutritional status (severe emaciation)

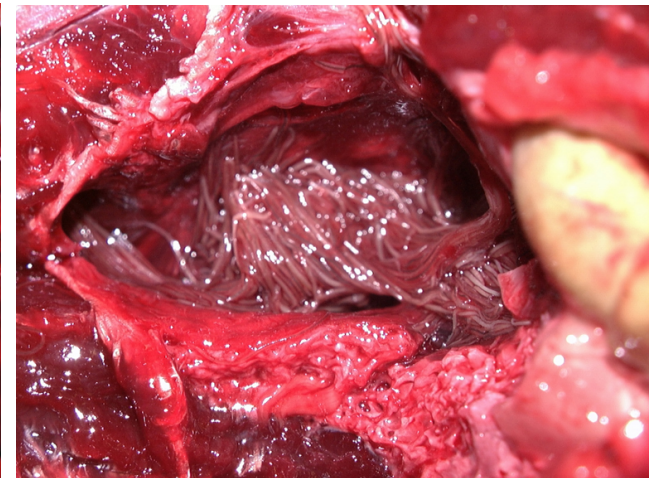
Parasitism (presence of parasites) vs parasitosis (disease associated with parasites)



Gastric nematodes

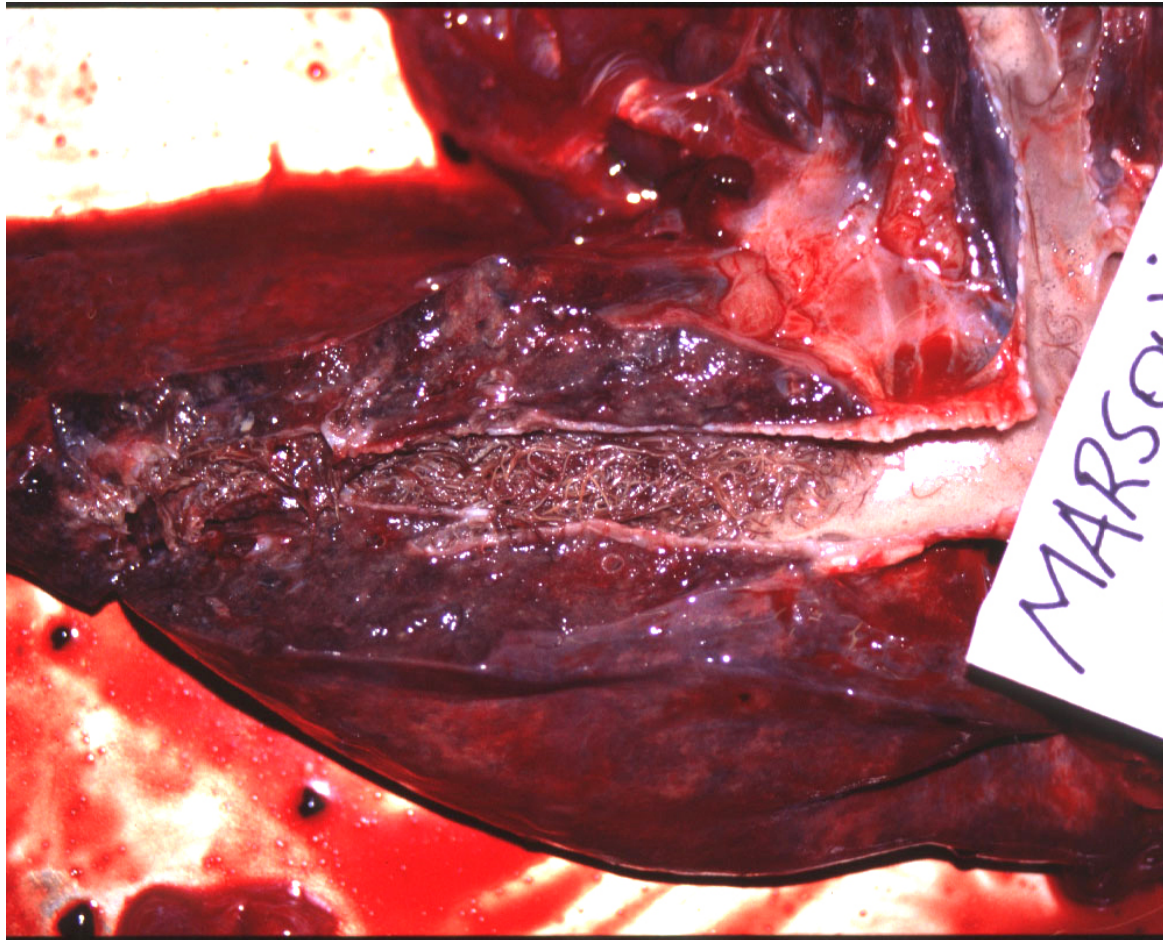


Airways nematodes



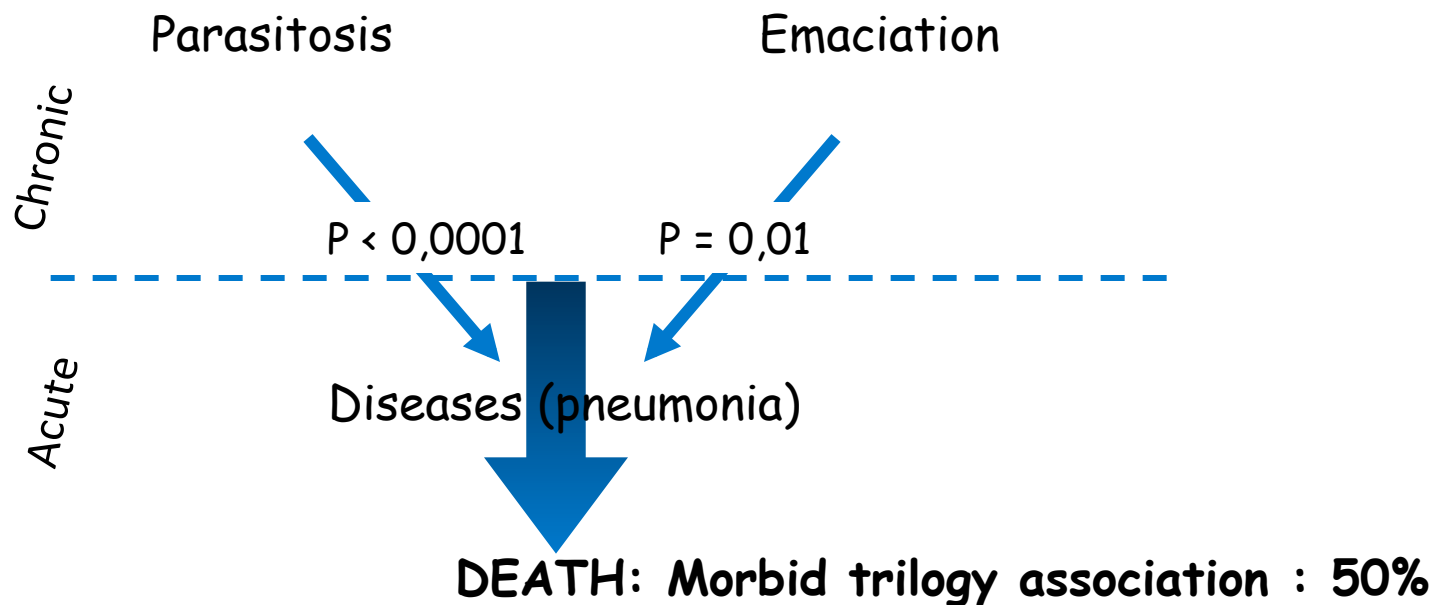
Peritympanic nematodes



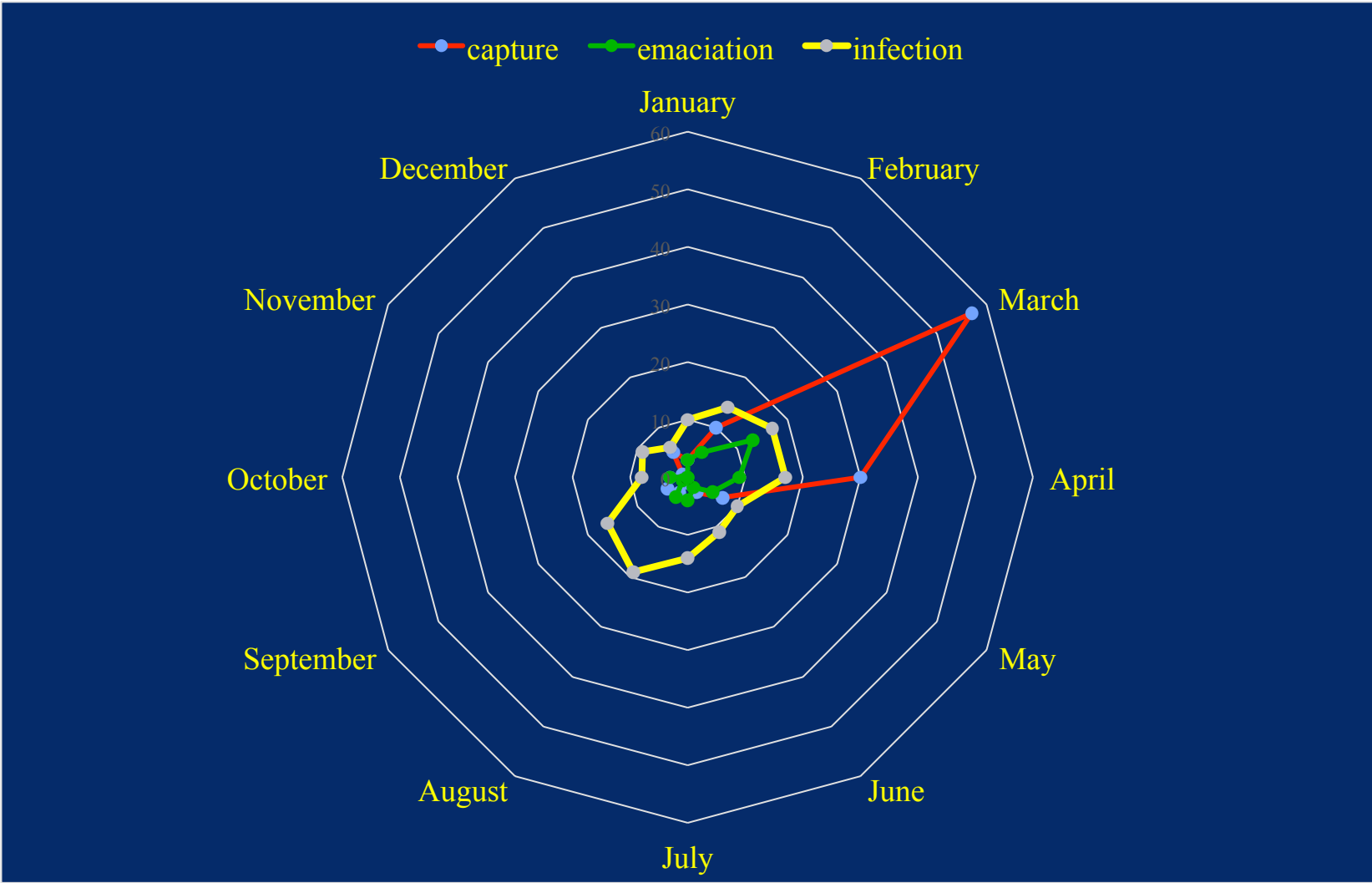


Acute purulent bronchopneumonia with nematodes in airways

## Causes of death



Human activities: accidental net capture 40%



## Why such porpoises strandings increase on the continental coastline of the southern North Sea

### 1. Southern shift of the porpoises population

porpoise population estimated : 350.000

SCANS 1 : 1994: northern North Sea

SCANS 2 : 2005: southern North Sea

### 2. Increase of capture

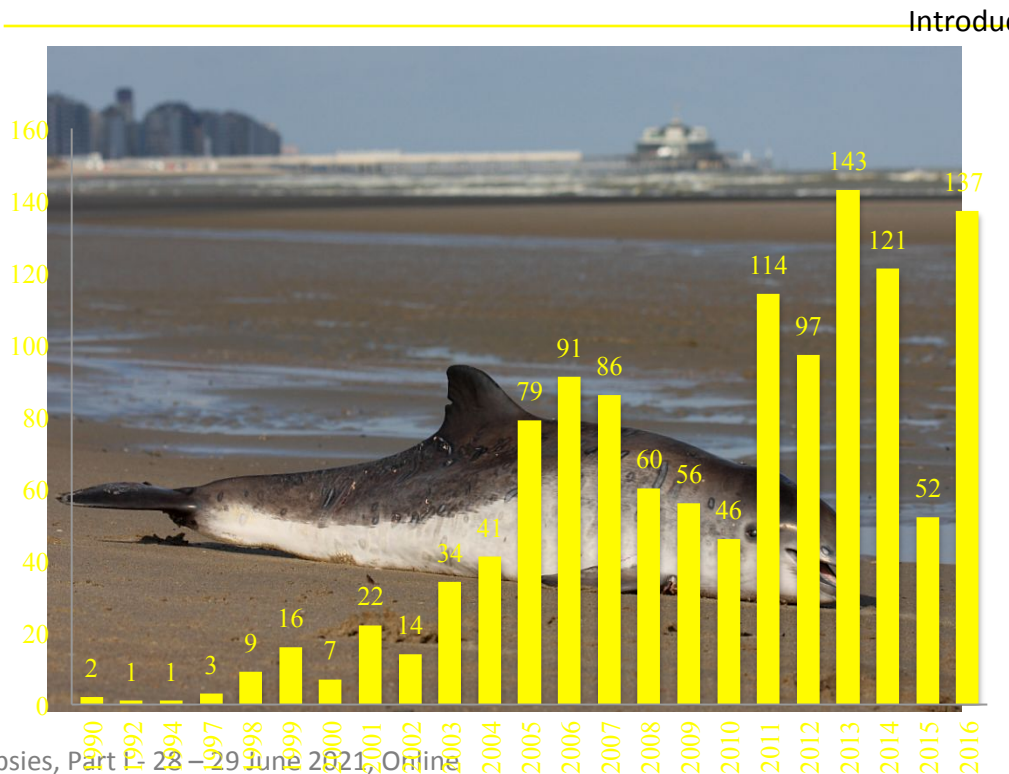
1990-2000: 20%

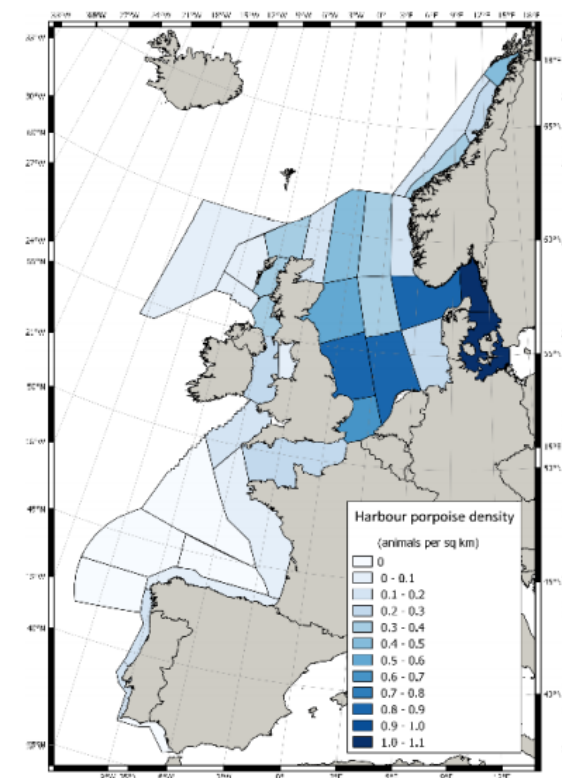
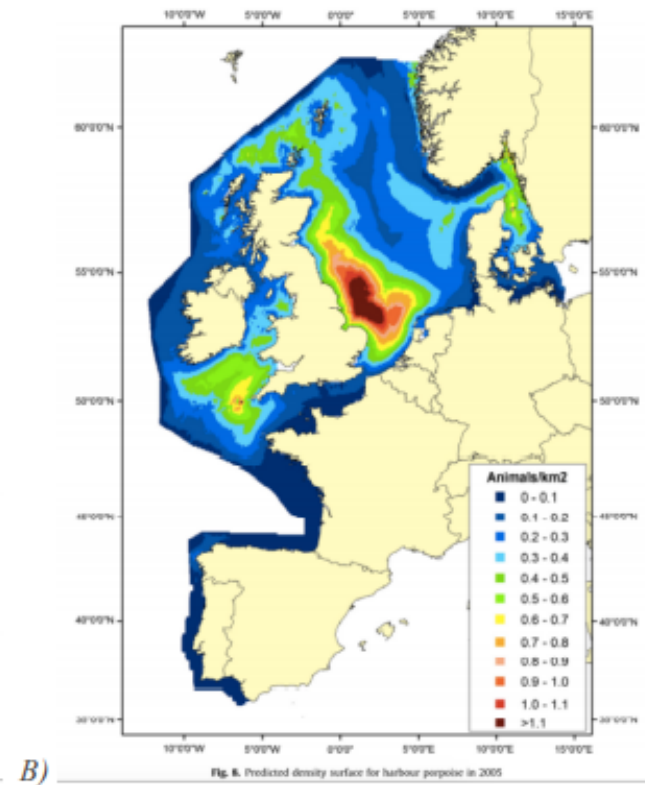
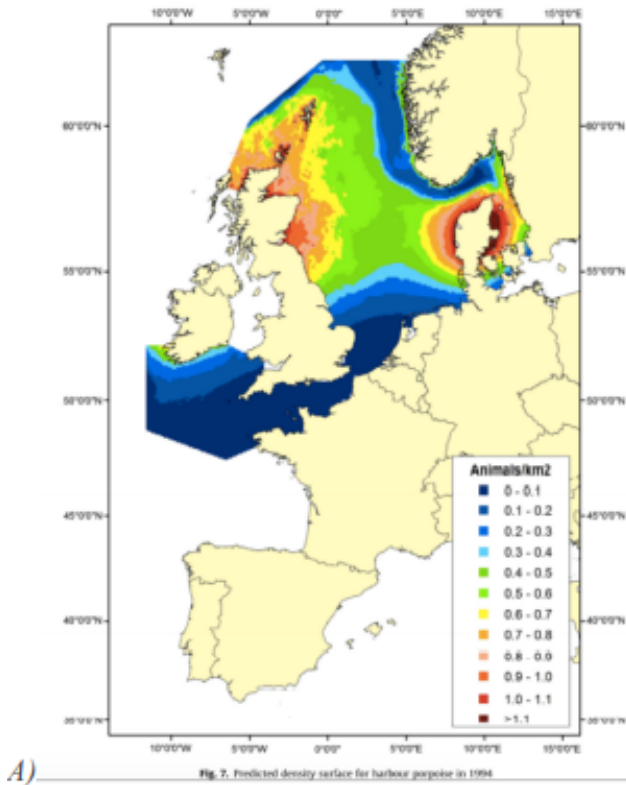
2001-2013: >40%

recreational fishing activities  
(beach set gillnet)

### 3. Oceanographic (currents)

Predisposition for Belgium

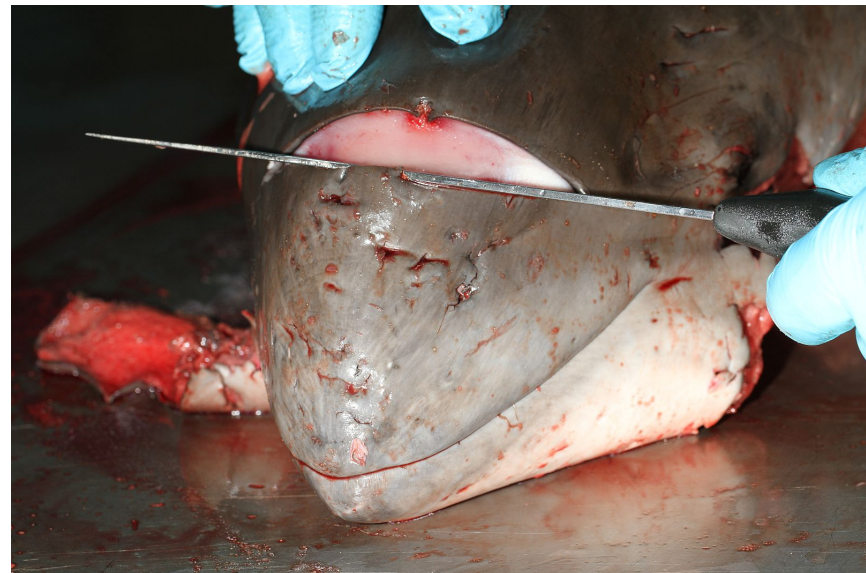


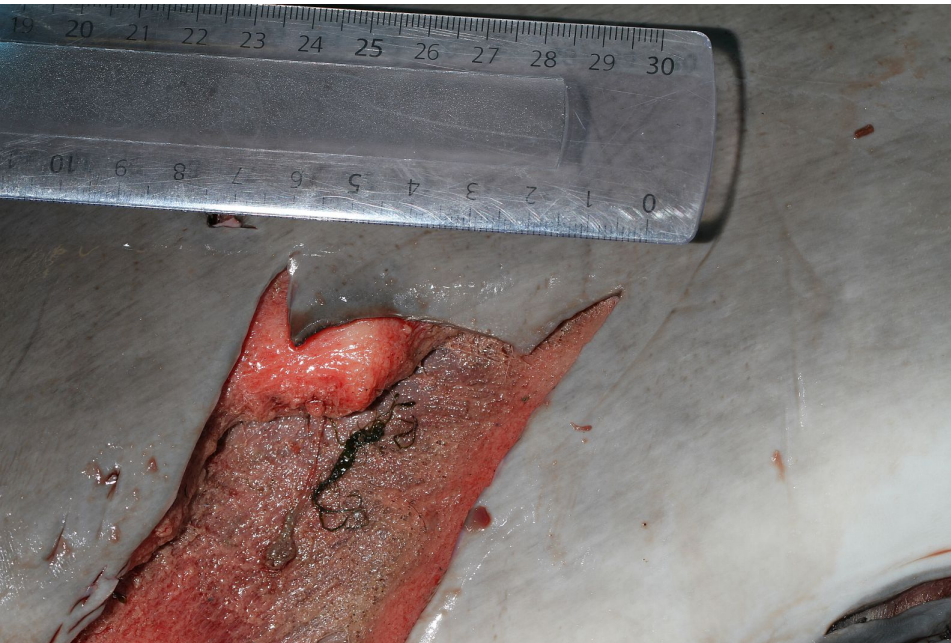


*Distribution of harbour porpoises A) SCANS-I (1994) B) SCANS-II (2005) C) SCANS-III (2016) (Source : Hammond et al. 2013 et Hammond et al. 2017)*



Since 2011, porpoises with severe skin lacerations



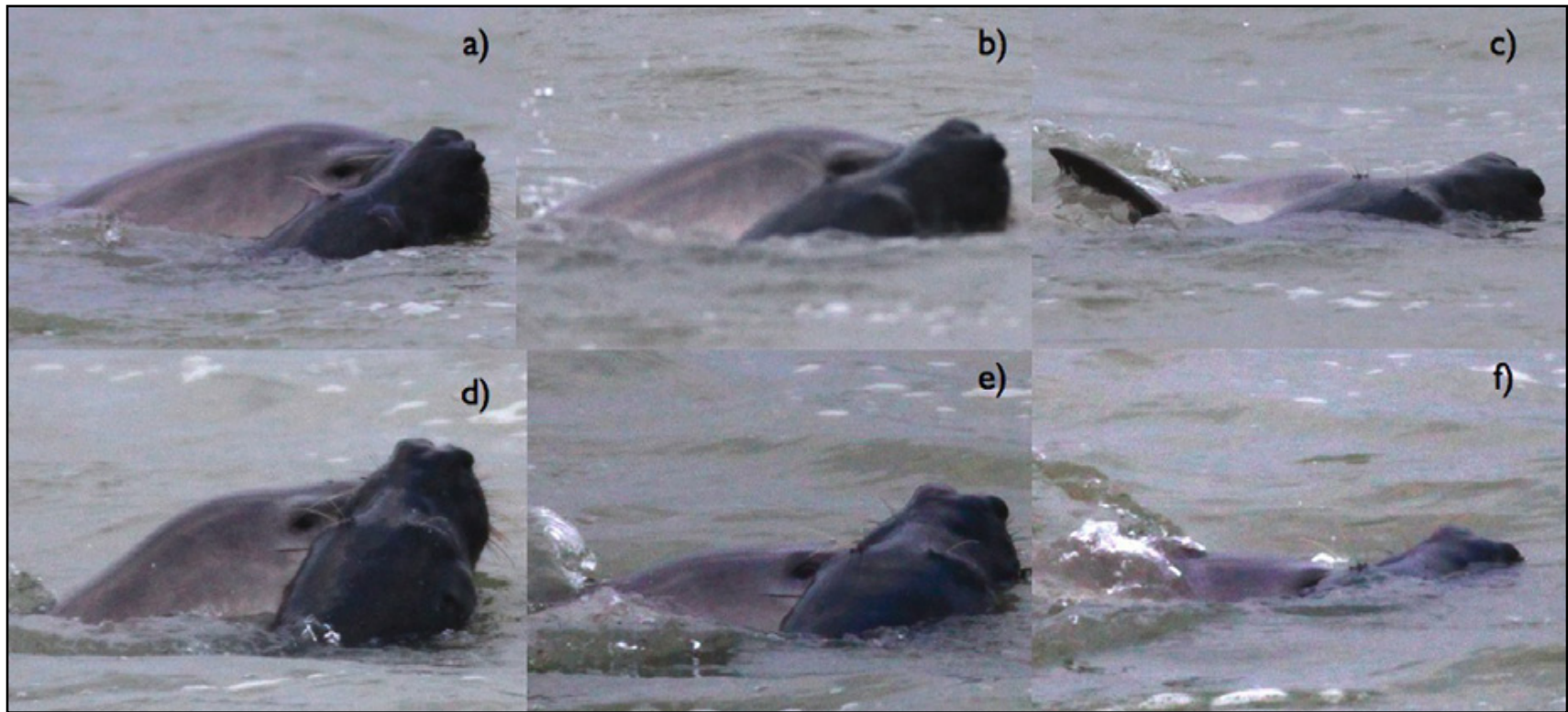


1. Hemorrhagic lesions: ante-mortem
2. Edges of lesion: regular but finely serrated  
 BUT not done by a knife
3. Parallel edge AND punctiform lesion  
 = Bite: marine predator
4. Space between edges of lesion: 6 cm

Candidates : Common seal and grey seal  
 Space between inter-canine teeth:  
 Common seal (n= 52): 1,4 à 4,8 cm

Grey seal (n= 87): 1,9 à 7, 1 cm





## The final proof: demonstration of seal's DNA in porpoise's lesion: the forensic pathology method





**Jauniaux T.**, Garigliany M.-M. , Loos P., Bourgain J.-L., Bouveroux T. , Coignoul F. , Haelters J., Karpouzopoulos J., Pezeril S., Desmecht D., Bite Injuries of Grey Seals (*Halichoerus grypus*) on Harbour Porpoises (*Phocoena phocoena*), PLoS ONE 9(12): e108993. doi: 10.1371/journal.pone.0108993



Introduction: the North Sea situation

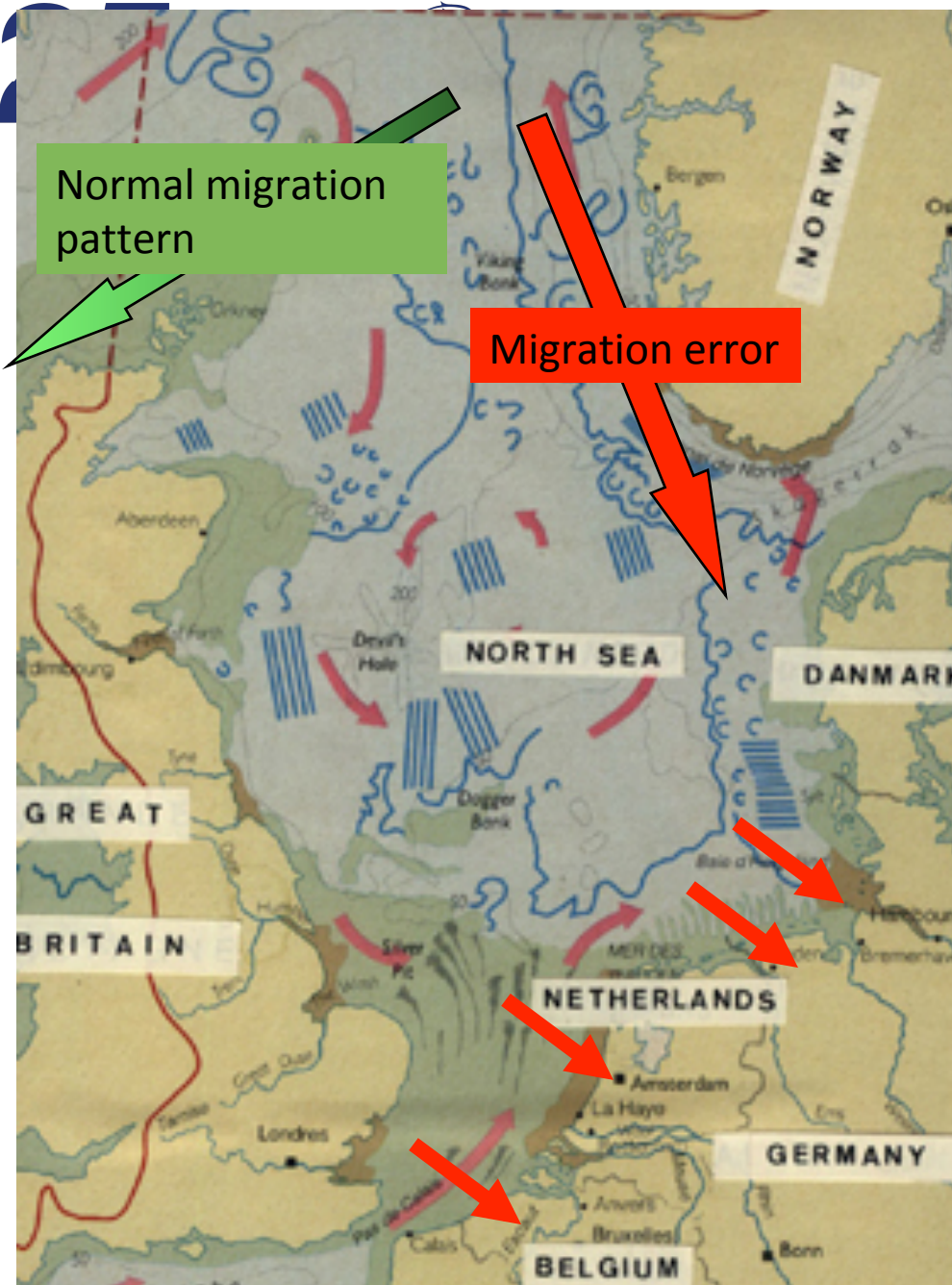
The continental coastline of the southern North Sea:  
Causes of death of small cetaceans: the harbour porpoise

Causes of death of large cetaceans

Van deze dierken zijn nu nog in de zee gevonden.  
 Maar door een Gode verzuurde lucht en het  
 Gode verzuurde water, zijn nu in de zee  
 Overblijfselen van de nu overleden groot.

Orong mantra bidt om, te twee, zulken.  
 Enkele en twee, de twee, zulken.  
 De water, nu, twee, en twee, zulken.  
 En twee, nu, twee, en twee, zulken.

ACCOBAMS Training on necropsies, Part I - 28 – 29 June 2021, Online



Sperm whale

Sperm whales stranding: « navigation error »

Death: cardiovascular failure secondary to the stranding

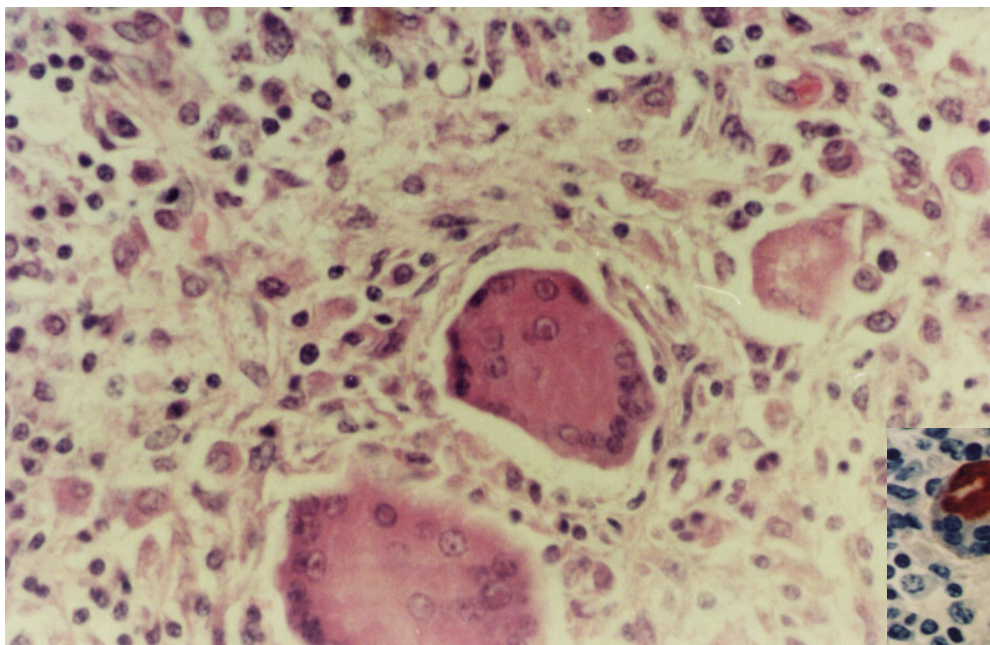


## Fin whales (*Balaenoptera physalus*)

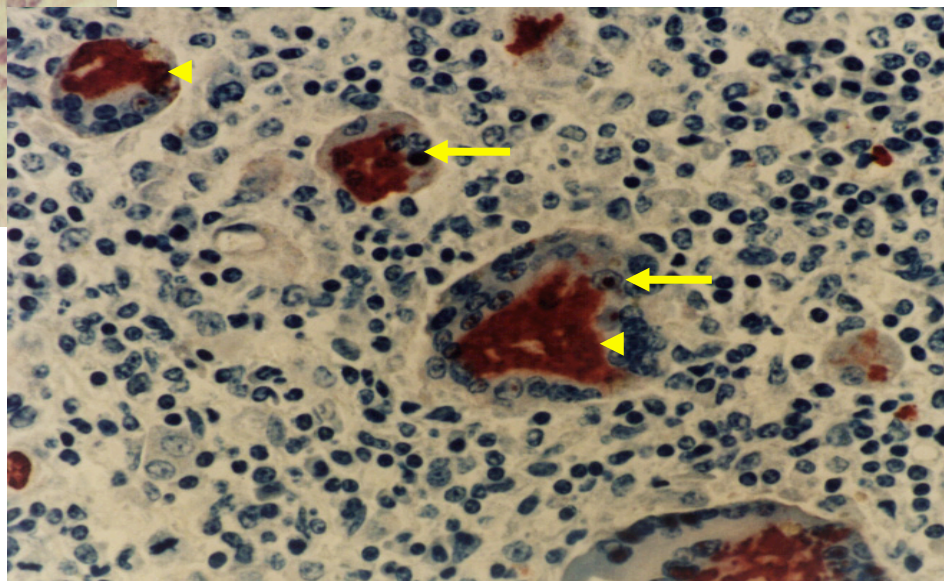


Gross findings: emaciation, severe parasitosis

First cases of morbilliviral infection in  
fin whales (sse Sandro's cases)



Multinucleated syncytial cells with  
eosinophilic intranuclear inclusion body  
(arrow). Lymph node



Intranuclear (arrowhead) and  
intracytoplasmic (arrow) using MoAb against  
PDV. Lymph node



## Humpback whale







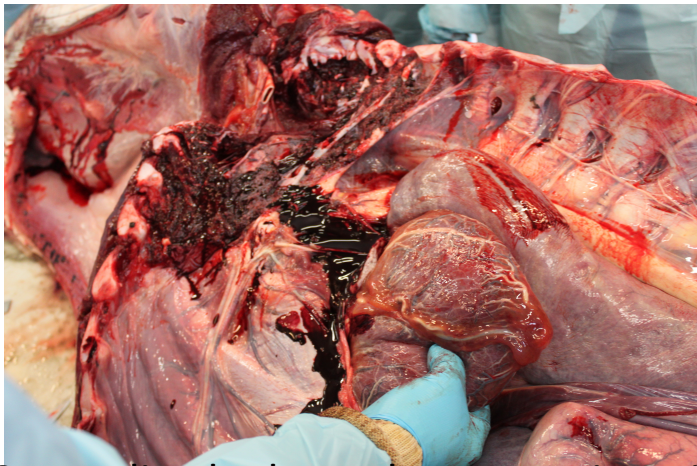
Minke whale (*Balaenoptera acutorostrata*)



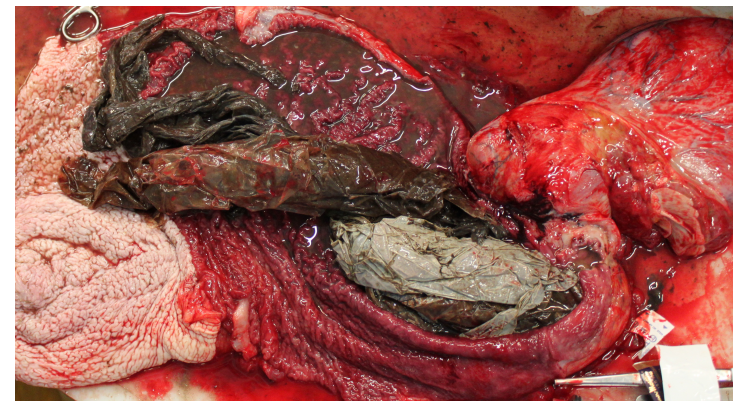
Severe emaciation



Generalized edema, hypoproteinemia



Generalized edema, hypoproteinemia

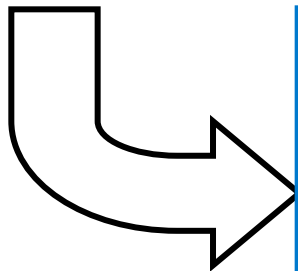


Plastic impaction in stomach

### Stranding network aims with veterinarian support:

#### Identification of lesions and causes of death of cetaceans:

- Systematic necropsy using specific protocol;
- Complete samplings and tissues banking;
- Database with all results;
- Detailed description of lesions and their origin;
- Highlighting main mortality processes.



1. Creation of specific theories for stranding;
2. Evolution of the causes of death;
3. Impacts of human activities;
4. From the individuals to the population
5. Identification of main threats



