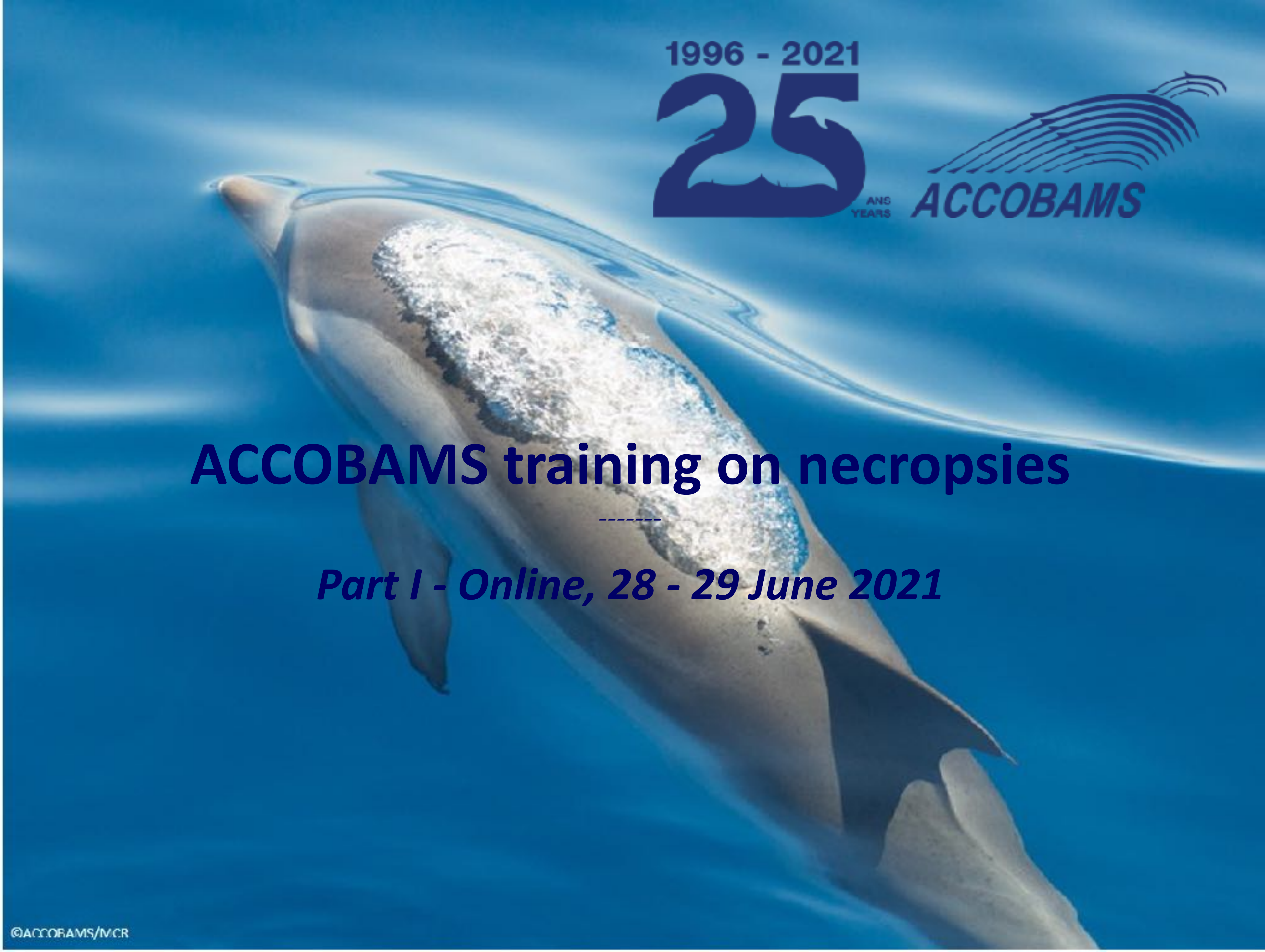
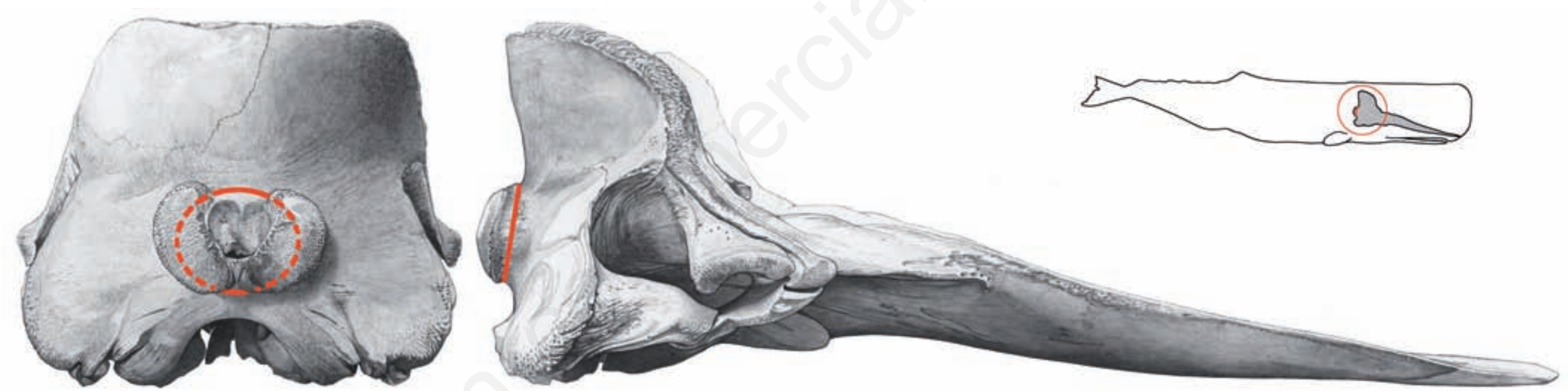


1996 - 2021
25 ANS YEARS
ACCOBAMS

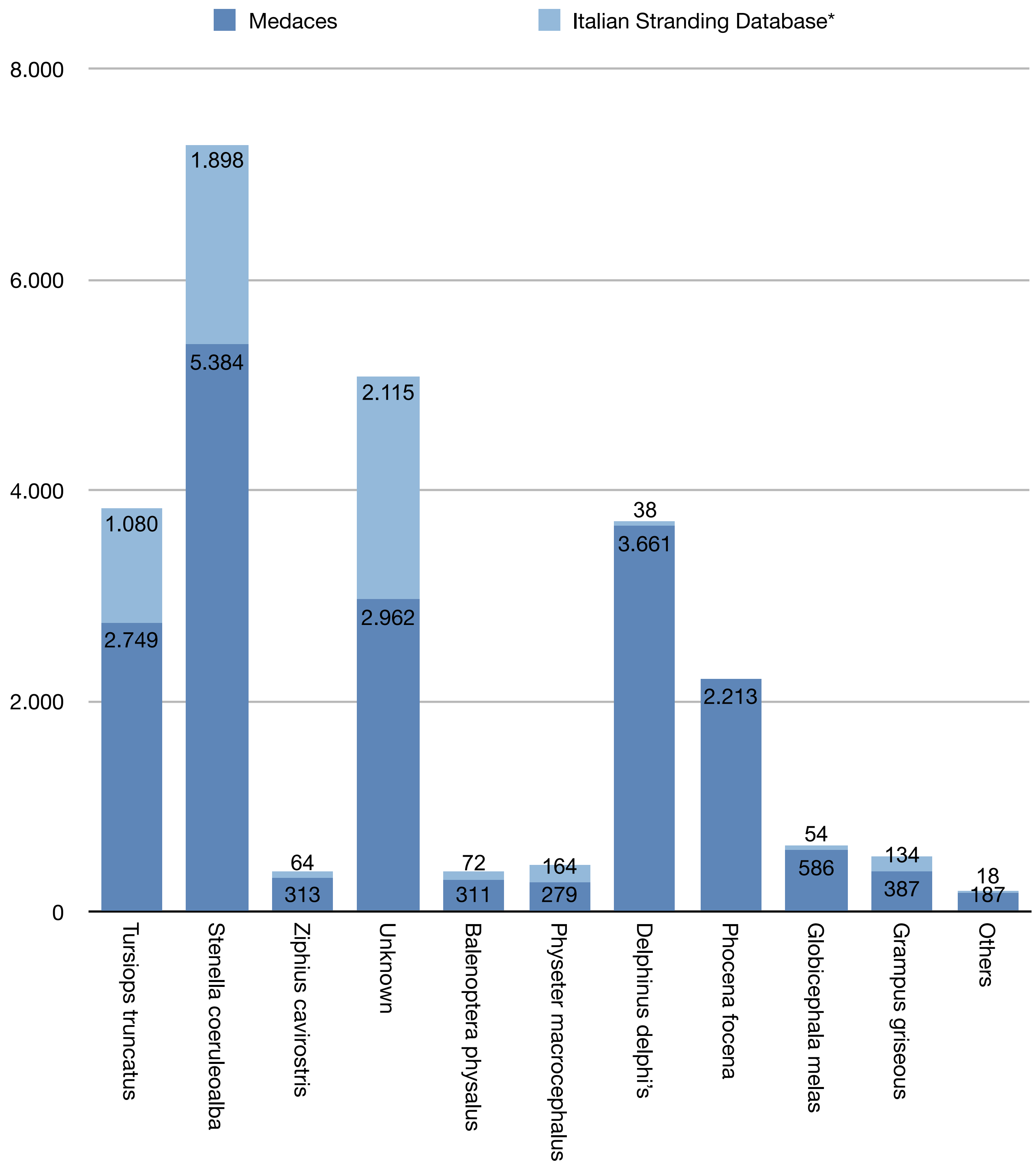
ACCOBAMS training on necropsies

Part I - Online, 28 - 29 June 2021

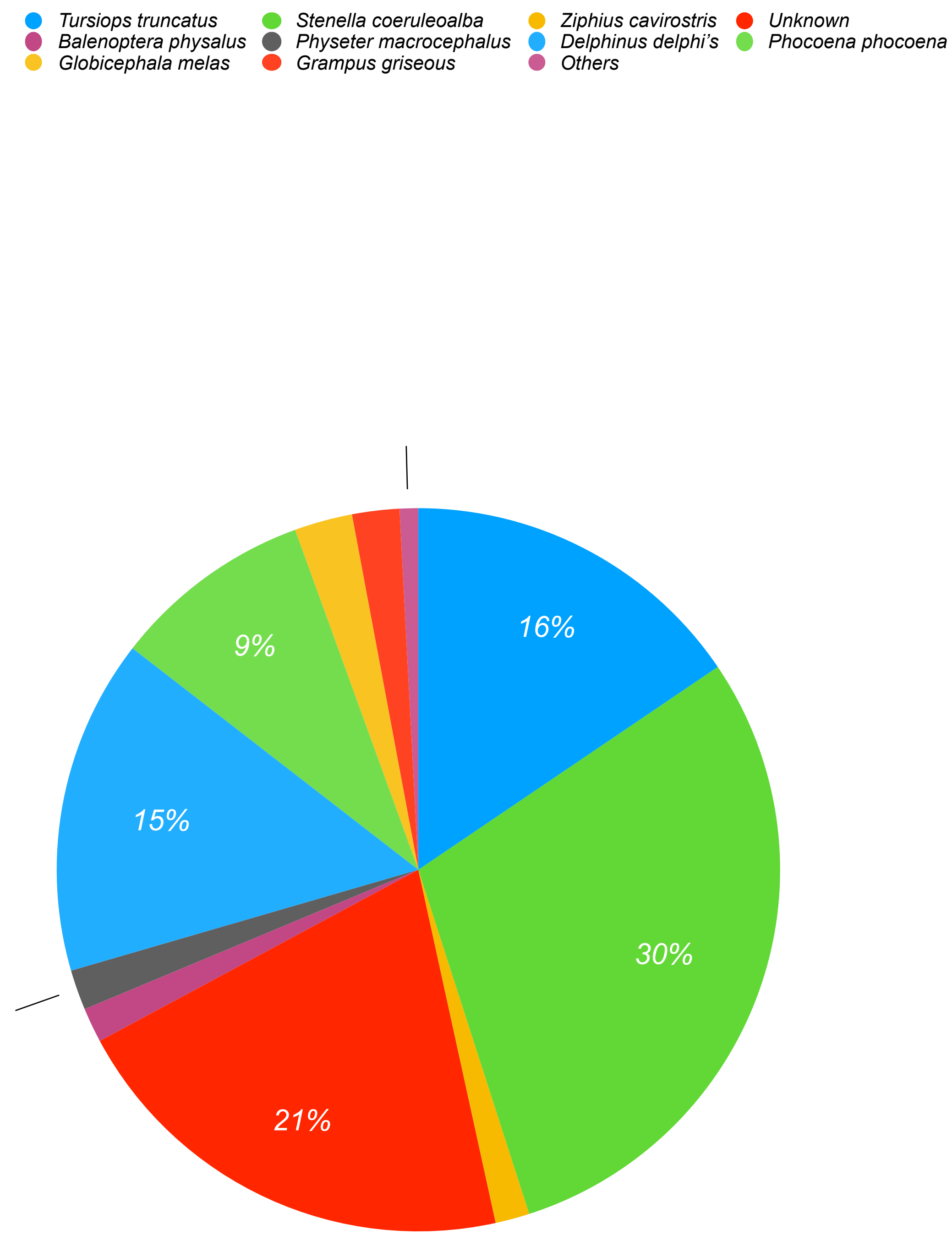
Main causes of death and threats for cetaceans: postmortem findings interpretation, sampling and diagnosis



Sandro Mazzariol - University of Padova



Medaces
Italian Stranding Database*
8.000
6.000
4.000
2.000
0
1.080
2.749
1.898
5.384
64
313
2.115
2.962
72
311
164
279
38
3.661
2.213
54
586
134
387
18
187
Tursiops truncatus
Stenella coeruleoalba
Ziphius cavirostris
Unknown
Balenoptera physalus
Physeter macrocephalus
Delphinus delphi's
Phocena focena
Globicephala melas
Grampus griseous
Others

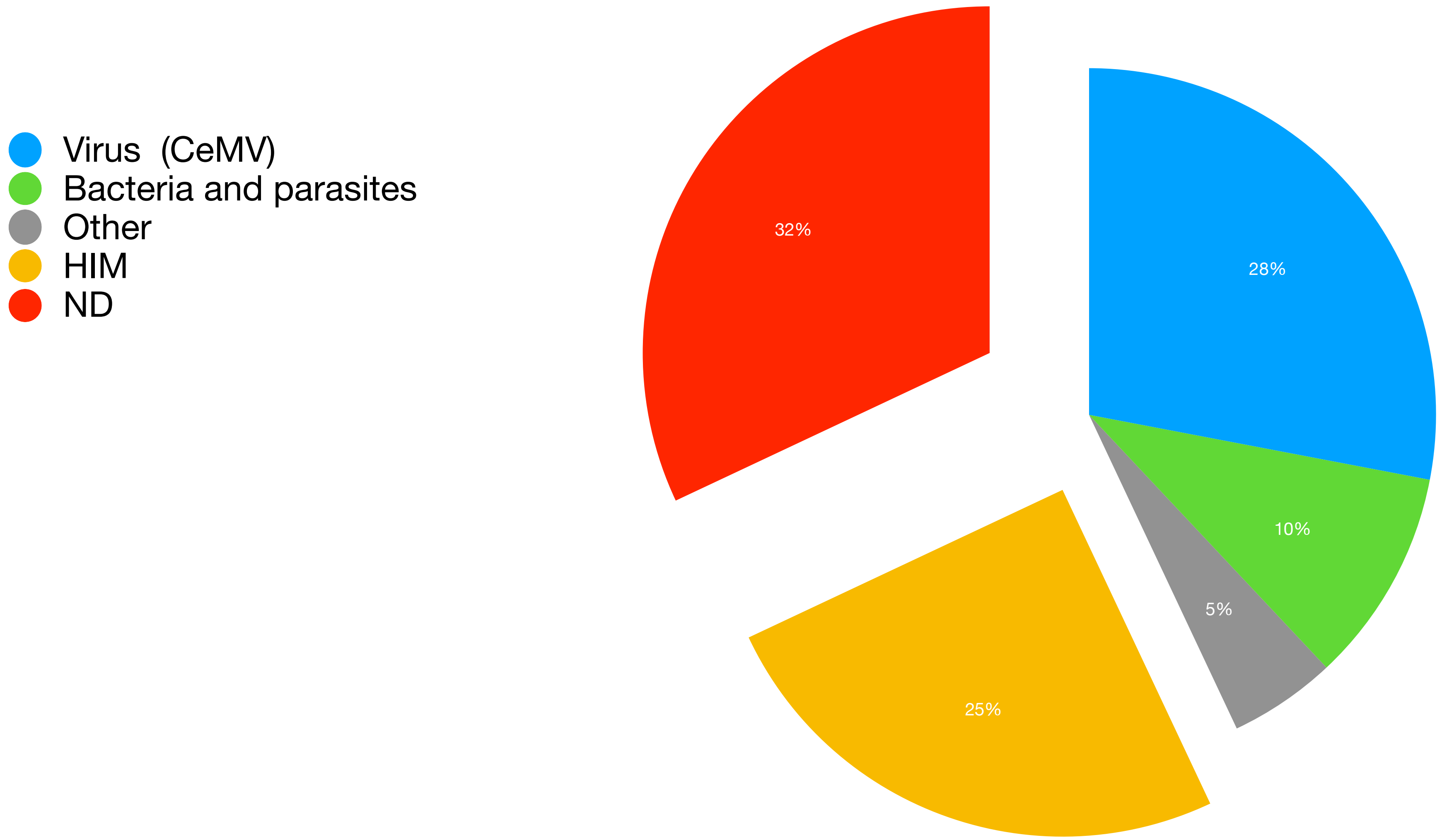


Tursiops truncatus
Stenella coeruleoalba
Ziphius cavirostris
Unknown
Balenoptera physalus
Physeter macrocephalus
Delphinus delphi's
Phocoena phocoena
Globicephala melas
Grampus griseous
Others
16%
30%
21%
15%
9%

Italy -data 2015-2019

- 160 strandings/year (85-240)
- 45% examined animals (39-50)
- 56% M vs 44% F
- 75.5% no food in the stomach
- Good NCC 29.4% vs Poor NCC 35.5%
- Cause of death determined in 65% of examined animals

Cause of DEATH OF CETACEANS - ITALY 2015-2019



GLOSSARY

CAUSE OF DEATH: The disease, injury or abnormality that alone or in combination with other factors (environmental, other concurrent diseases, age, etc.) is responsible for initiating the sequence of functional disturbances that resulted in live stranding and death. During this procedure the following may be further defined:

a) *Immediate cause of death: final disease or condition resulting in death;*

b) *Underlying cause of death: the disease or injury that initiated the chain of morbid events that led directly and inevitably to death;*

c) *Contributing factors: other significant diseases, conditions, or injuries/impacts/influences that may have contributed to death but which did not constitute an underlying cause of death.*

MECHANISM OF DEATH: The immediate physiologic derangement resulting in death. A particular mechanism of death can be produced by a variety of different causes of death.

MANNER OF DEATH: How death came about; in the case of wildlife and, specifically, in cetaceans, we can distinguish:

a) *Natural, due mainly to natural disease or toxic processes;*

b) *Anthropic/anthropogenic, accidental like ship strikes, bycatch, or non-accidental due to a volitional act or direct killing;*

c) *Undetermined, inadequate information regarding the circumstances of death in order to determine the manner.*

Causation: criteria

a. Certain;

b. Probable;

c. Do not exist;

d. Not Determined.

Certain/Pathognomonic (only in carcasses with code of decomposition 1 and 2)	The fishery interaction is confirmed + absence of other severe pathologies + the mechanism of death is assessed
Probable (only in carcasses with code of decomposition 1 and 2)	The fishery interaction is confirmed or suspected + absence of other pathologies
Suspected/Possible (if the carcass present a decomposition code higher than 2)	The fishery interaction is confirmed + absence of other pathologies
Fishery interaction as a consequence of underlying pathologies	The fishery interaction is confirmed + neurological, systemic and other severe pathologies that could have predisposed the animal to the fishery interaction

DIAGNOSTIC FRAMEWORKS

-Infectious diseases

- Fishery interaction

- Marine litter ingestion and evaluation

- Ship strikes

- Noise impacts

- Others causes of death

DIAGNOSTIC FRAMEWORKS

-**Infectious diseases**

- Fishery interaction

- Marine litter ingestion and evaluation

- Ship strikes

- Noise impacts

- Others causes of death

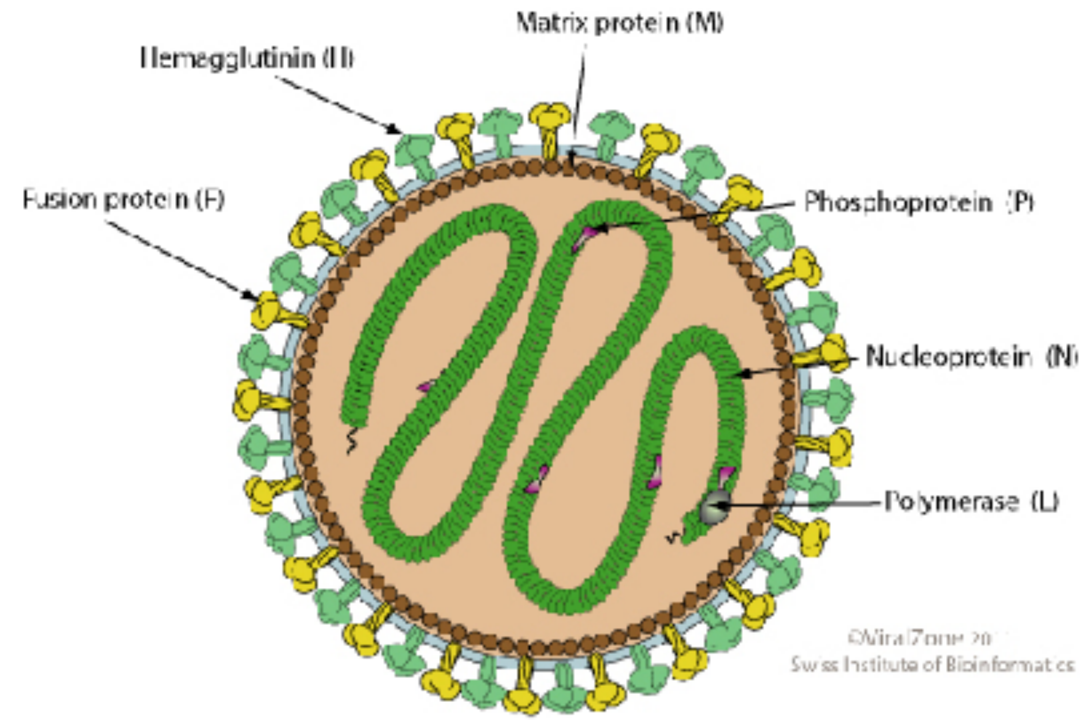
Cetacean morbillivirus

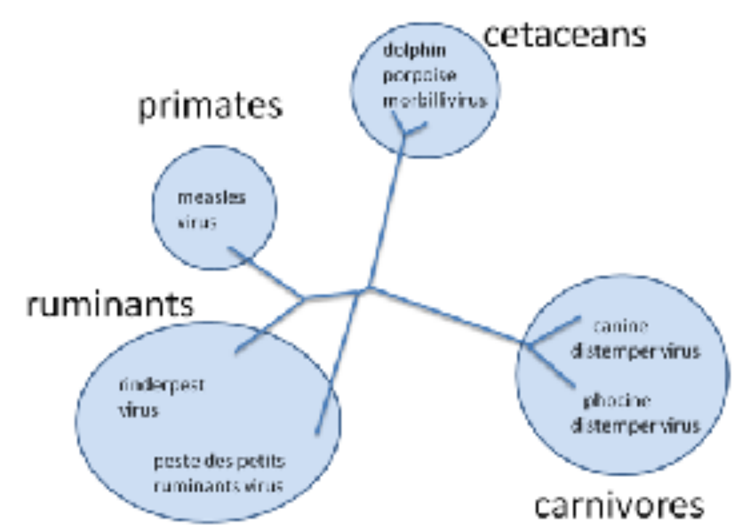
- Paramyxovirus - RNA virus with envelope

- Cetacean Morbillivirus (DMV, PMV and PWMV)

- Tropism for leucocytes, epithelium (respiratory, urinary and GI) and nervous tissue (neurons, glial cells)

- Main findings: necrotizing broncho-interstitial pneumonia, non purulent meningo-encephalitis with demyelination, lymphoid depletion with inflammation and multi-nucleated giant cells; secondary infections (*T. gondii*, *Herpesvirus*, *P. damselae*)







viruses

MDPI

Review

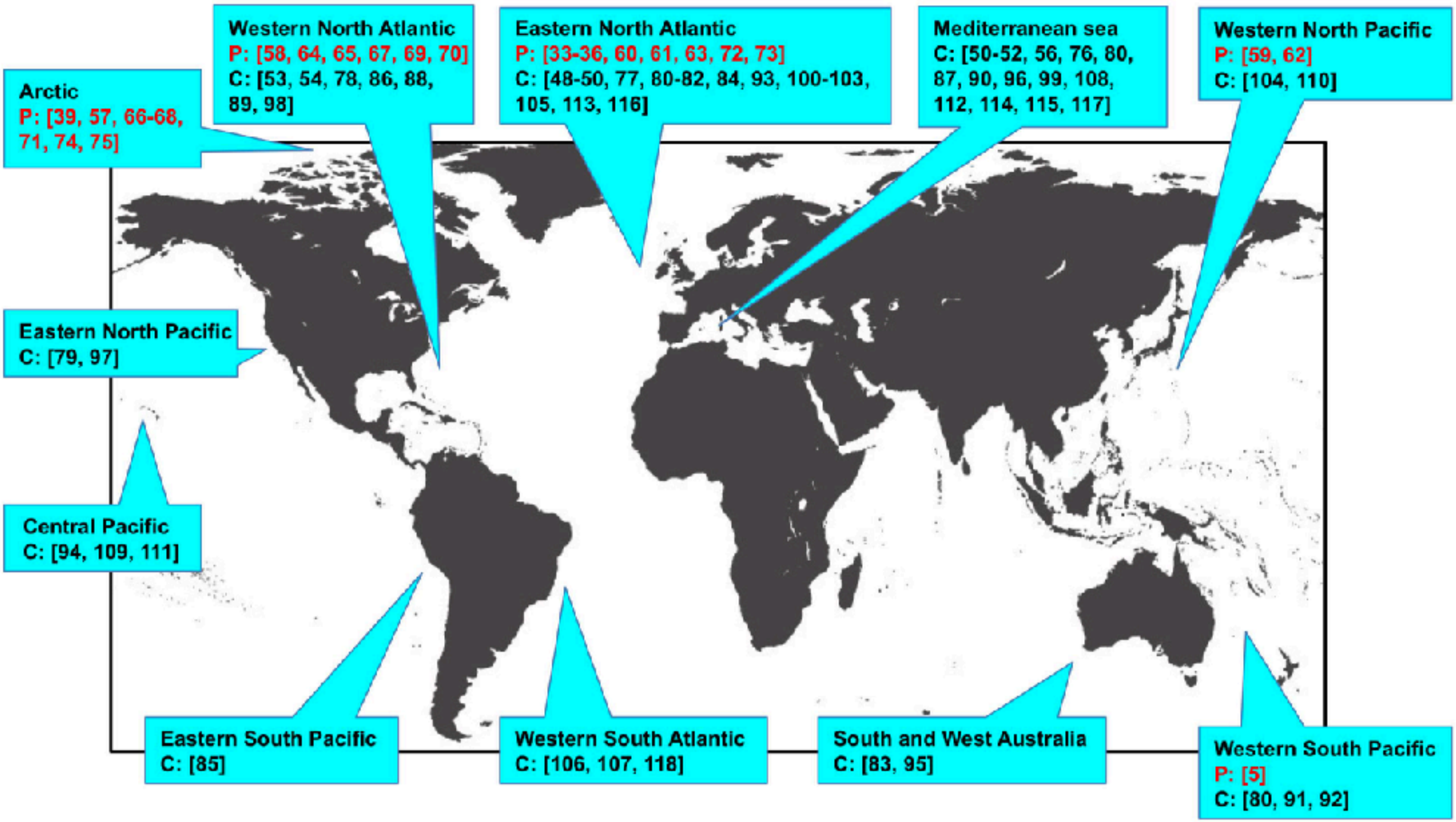
Marine Morbilliviruses: Diversity and Interaction with Signaling Lymphocyte Activation Molecules

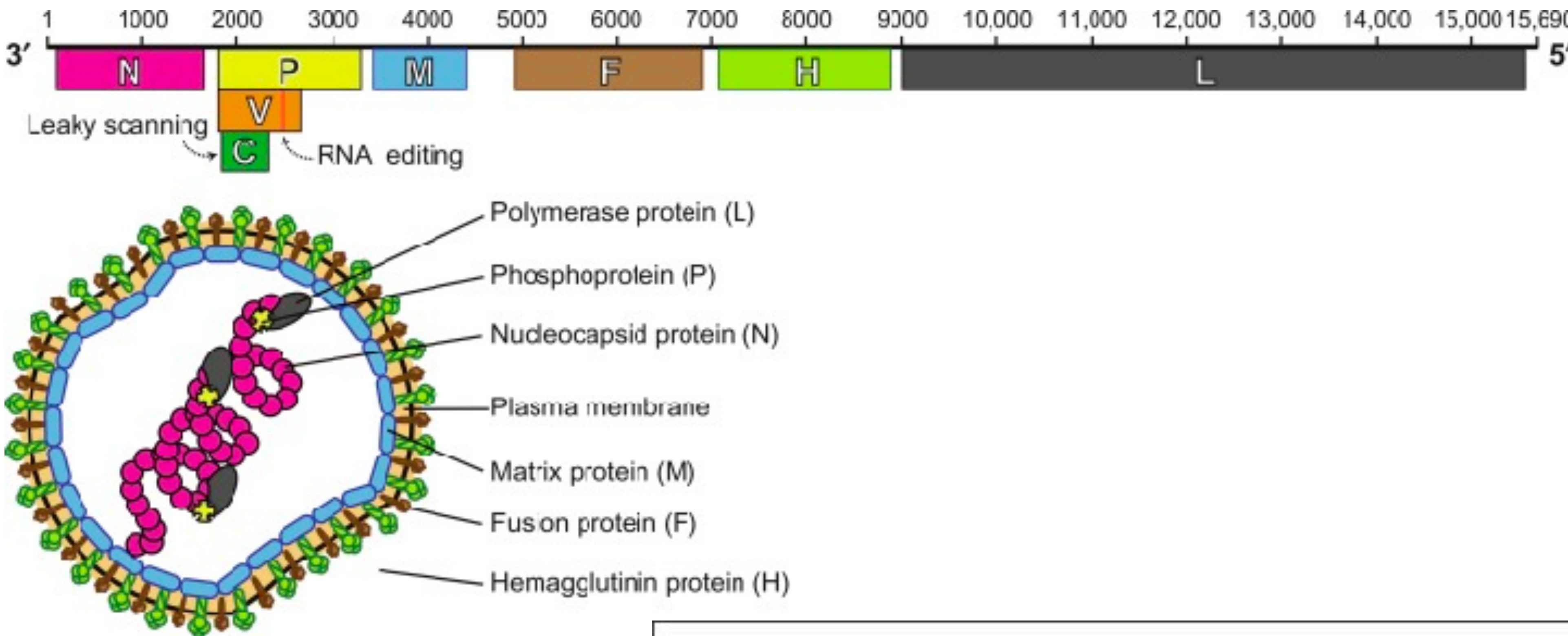
Kazue Ohishi [1,*], Tadashi Maruyama [2], Fumio Seki [3] and Makoto Takeda [3]

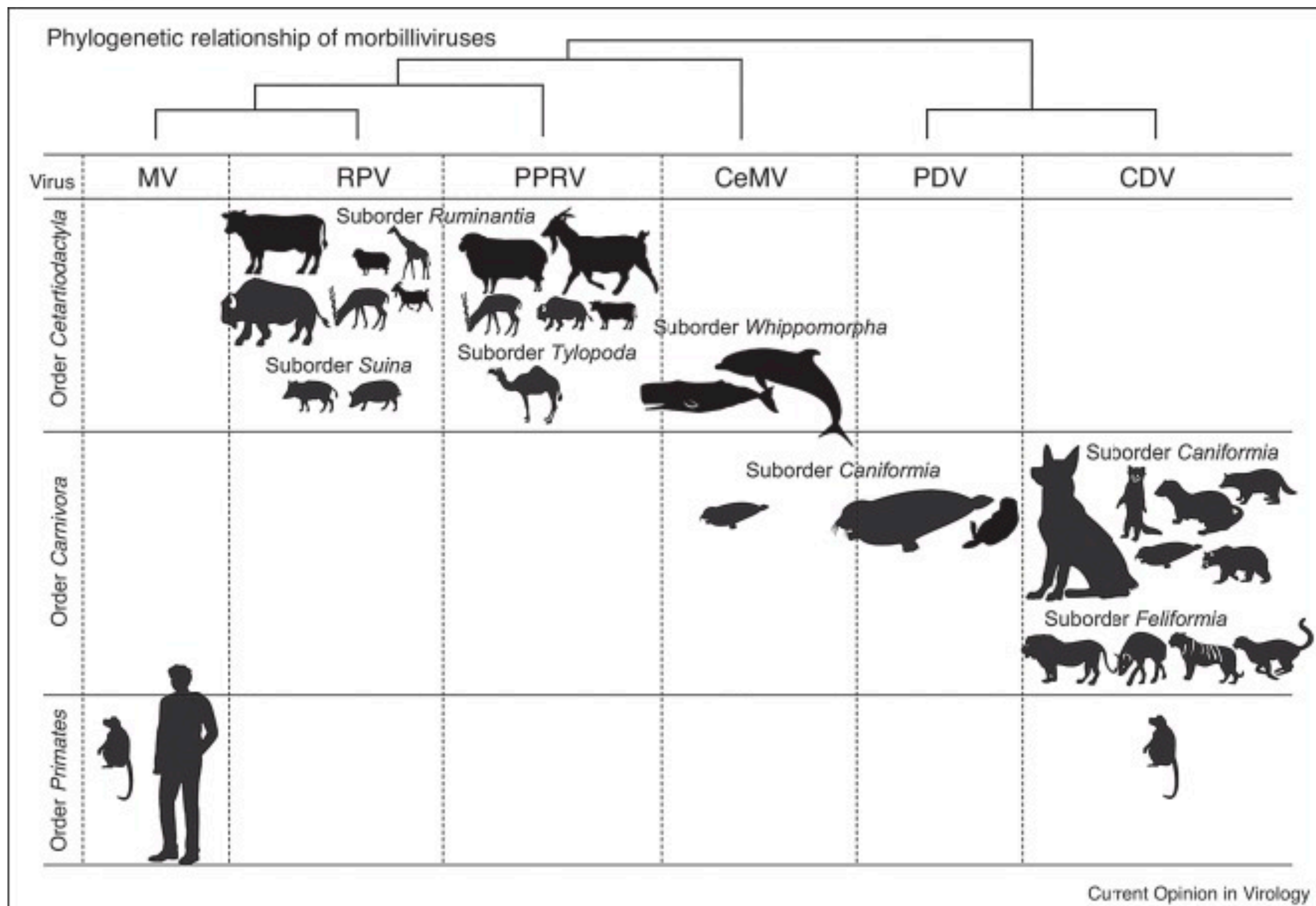
1 Faculty of Engineering, Tokyo Polytechnic University, 1583, Iiyama, Atsugi, Kanagawa 243-0297, Japan
2 School of Marine Biosciences, Kitasato University, 1-15-1, Kitasato, Minami, Sagamihara, Kanagawa 252-0373, Japan
3 Department of Virology III, National Institute of Infectious Diseases, 4-7-1, Gakuen, Musashimurayama, Tokyo 208-0011, Japan
* Correspondence: ofa20910@syd.odn.ne.jp; Tel.: +81-45-568-4659

check for updates

Received: 23 May 2019; Accepted: 29 June 2019; Published: 3 July 2019




1 1000 2000 3000 4000 5000 6000 7000 8000 9000 10,000 11,000 12,000 13,000 14,000 15,000 15,690
3′
5′
N
P
M
F
H
L
V
C
Leaky scanning
RNA editing
Polymerase protein (L)
Phosphoprotein (P)
Nucleocapsid protein (N)
Plasma membrane
Matrix protein (M)
Fusion protein (F)
Hemagglutinin protein (H)

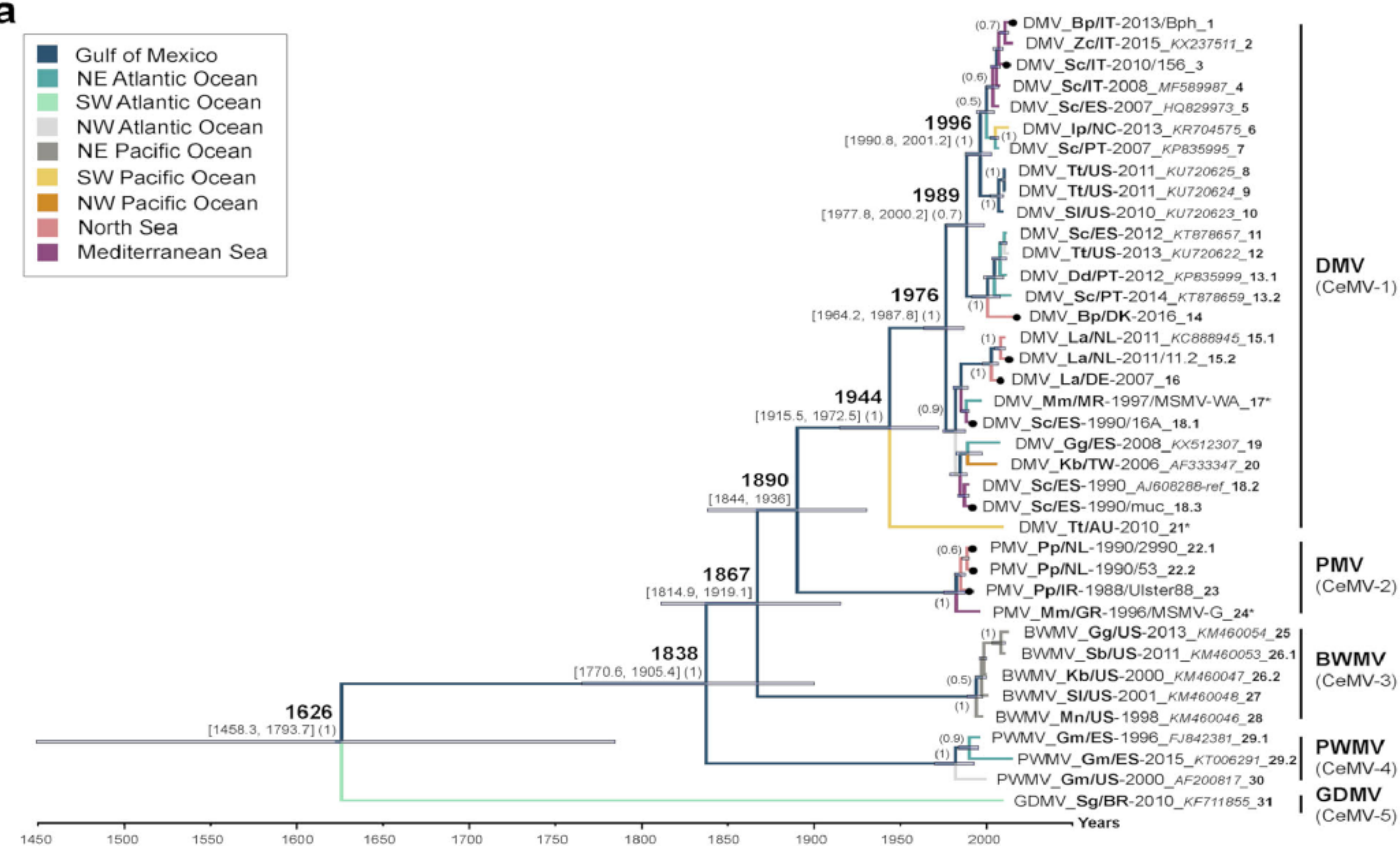

Phylogenetic relationship of morbilliviruses
Virus
MV
RPV
PPRV
CeMV
PDV
CDV
Order Cetartiodactyla
Suborder Ruminantia
Suborder Suina
Suborder Tylopoda
Suborder Whippomorpha
Order Carnivora
Suborder Caniformia
Suborder Caniformia
Suborder Feliformia
Order Primates
Current Opinion in Virology

Emerging Microbes & Infections

ARTICLE Open Access

Evolutionary evidence for multi-host transmission of cetacean morbillivirus

a



b

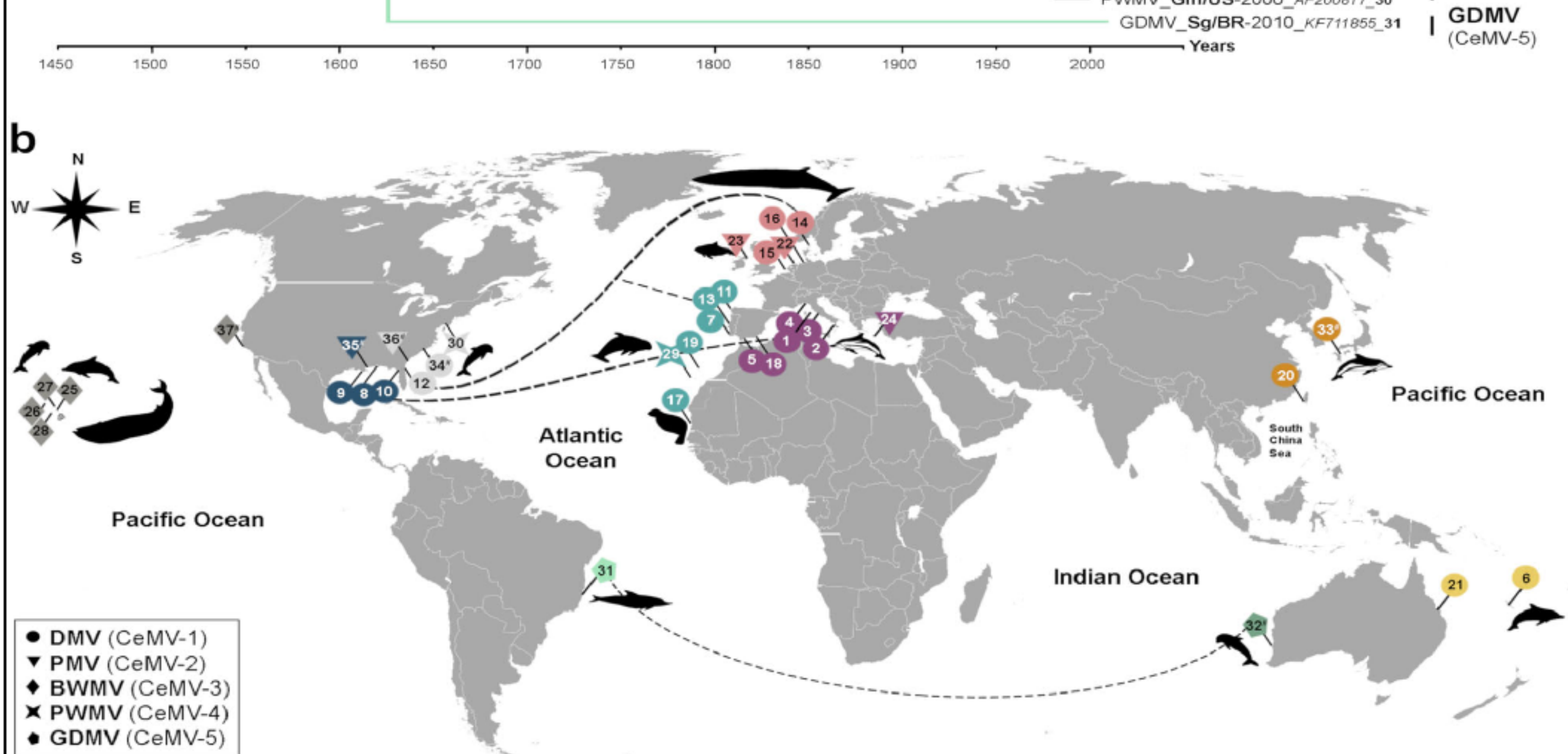
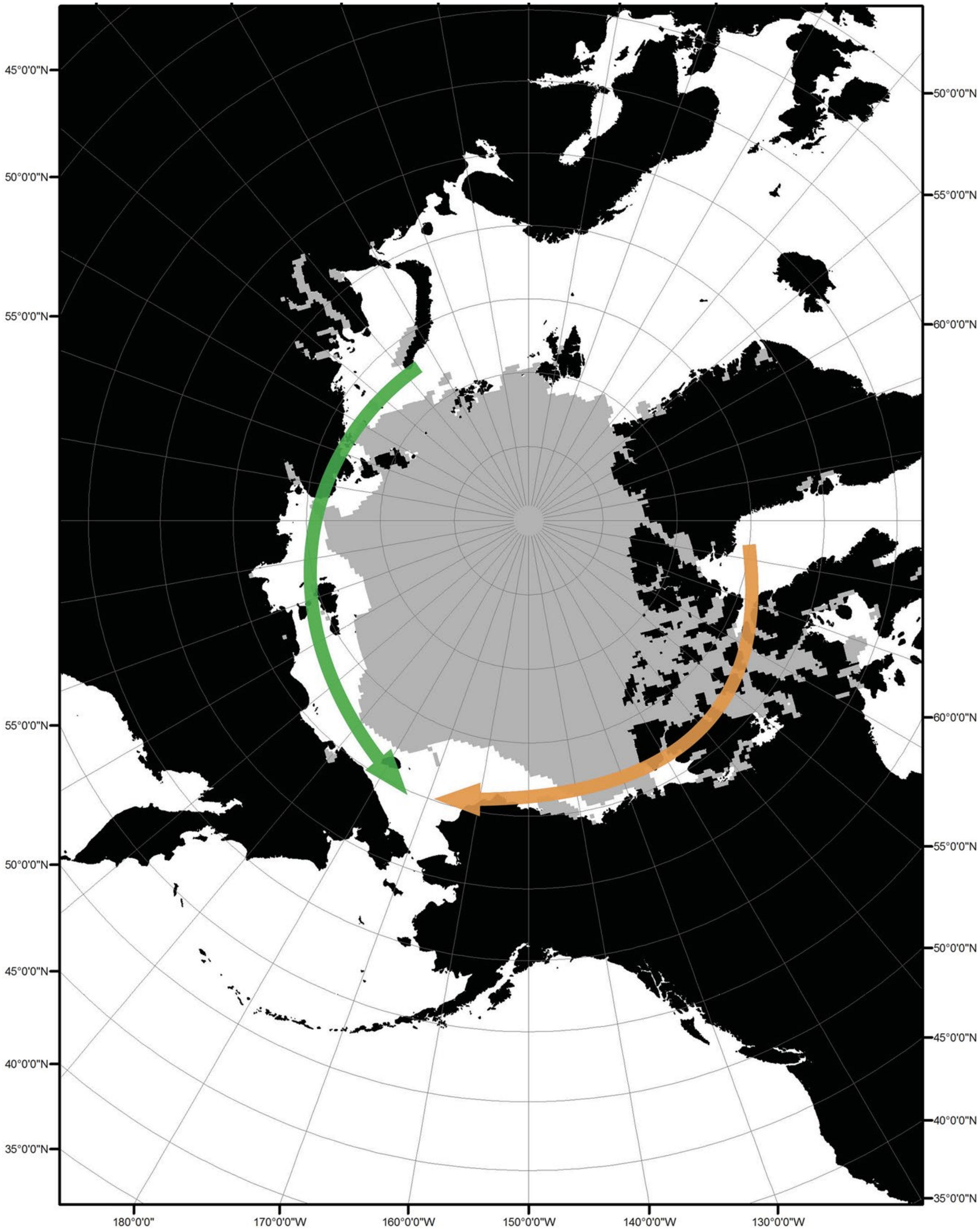


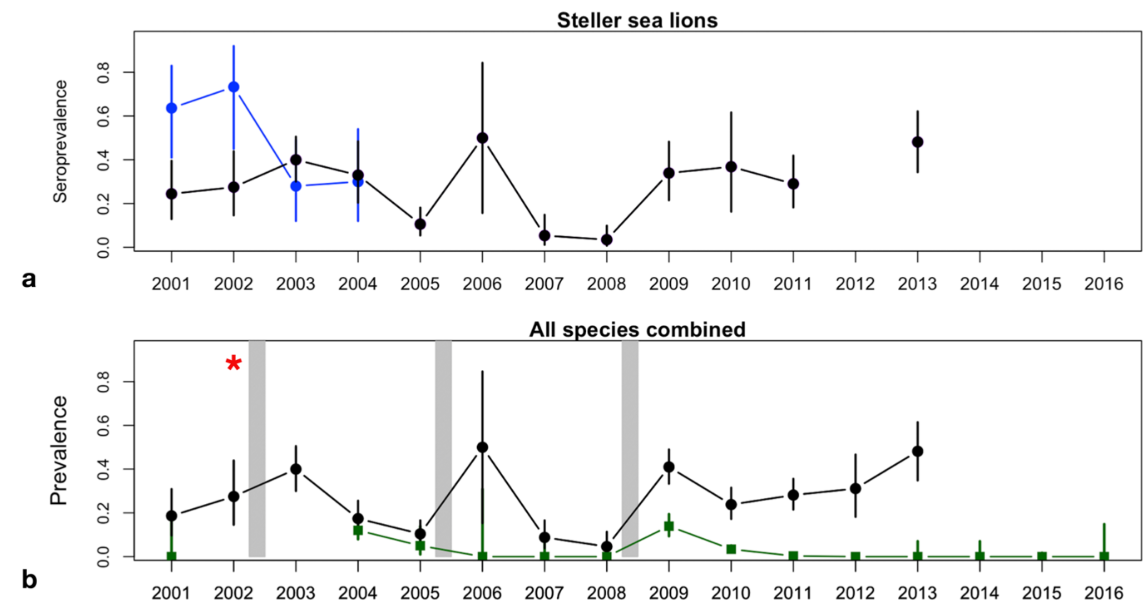
Fig. 3 Phylogeography of CeMV. a Bayesian phylogenetic analysis of partial P genes (400 bp). Most common recent ancestor ages are presented at the nodes in cursive with 95% highest posterior density interval values in brackets and as gray horizontal bars. Posterior values > 0.5 are shown in parenthesis. CeMV genomes in this study are presented with black circles at the tips. Each branch is color-coded according to the ocean/sea in which the cetaceans were found. The taxon names are presented as virus_host/Country-year of collection/variant_*GenBank accession number*_ID for **b**. Sequences 17* and 24* were extracted from a published paper[22]. Sequence 21* was kindly provided by Dr. Stone and Jianning Wang. Host abbreviations: Bp *Balaenoptera physalus*, Dd *Delphinus delphis*, Gg *Grampus griseus*, Gm *Globicephala melas*, Ip *Indopacetus pacificus*, Kb *Kogia breviceps*, La *Lagenorhynchus albirostris*, Mm *Monachus monachus*, Mn *Megaptera novaeangliae*, Pp *Phocoena phocoena*, Sb *Steno bredanensis*, Sc *Stenella coeruleoalba*, Sg *Sotalia guianensis*, Sl *Stenella longirostris*, Tt *Tursiops truncatus*, and Zc *Ziphius cavirostris*. **b** A world map of CeMV migration using sequences from **a**. Locations of viruses in the map are relative and were obtained from the publications in which the sequences were published. The hashtag (#) indicates no sequence availability (No. 32: CeMV-5 from AU/2010 and No. 33: CeMV-1_JP/1999). Proposed virus migratory routes (dashed lines) were based on sequence clades from the phylogenetic tree in **a**

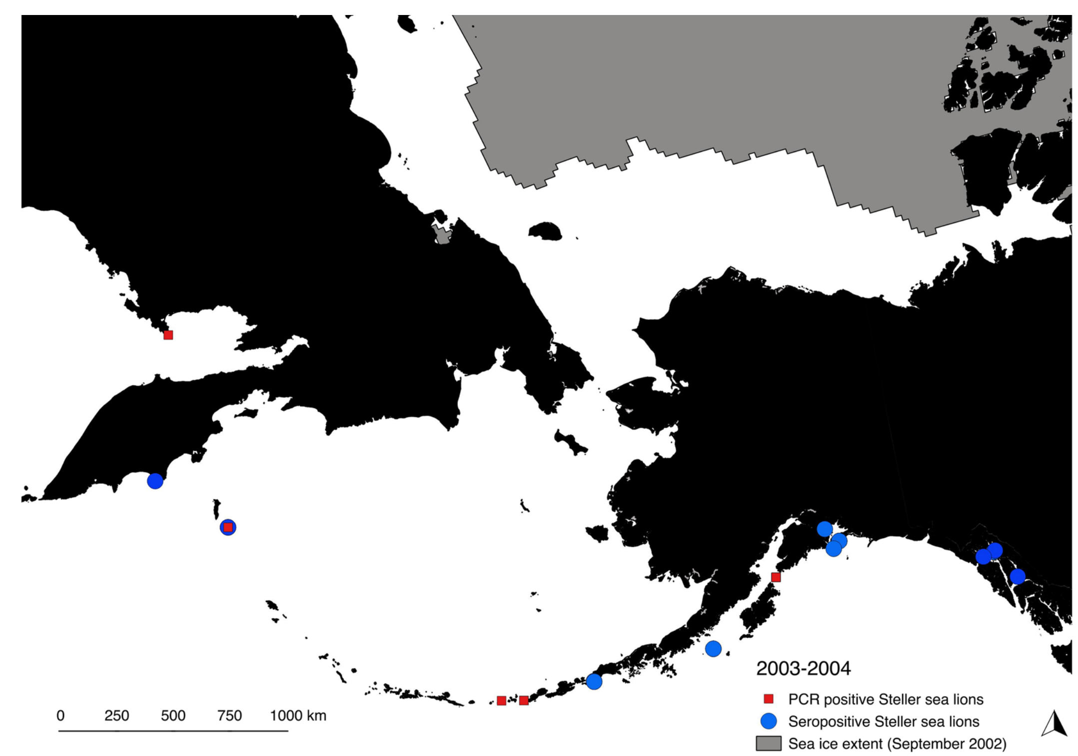
SCIENTIFIC REPORTS
natureresearch



Viral emergence in marine mammals in the North Pacific may be linked to Arctic sea ice reduction

E. VanWormer[1,2], J. A. K. Mazet[1], A. Hall[3], V. A. Gill[4,5], P. L. Boveng[6], J. M. London[6], T. Gelatt[6], B. S. Fadely[6], M. E. Lander[6], J. Sterling[6], V. N. Burkanov[6], R. R. Ream[6], P. M. Brock[7], L. D. Rea[8,9], B. R. Smith[1], A. Jeffers[10], M. Henstock[11], M. J. Rehberg[8], K. A. Burek-Huntington[12], S. L. Cosby[10], J. A. Hammond[11] & T. Goldstein[1*]





viruses MDPI

Review

Marine Morbilliviruses: Diversity and Interaction with Signaling Lymphocyte Activation Molecules

Kazue Ohishi [1,*], Tadashi Maruyama [2], Fumio Seki [3] and Makoto Takeda [3]

1 Faculty of Engineering, Tokyo Polytechnic University, 1583, Iiyama, Atsugi, Kanagawa 243-0297, Japan
2 School of Marine Biosciences, Kitasato University, 1-15-1, Kitazato, Minami, Sagamihara, Kanagawa 252-0373, Japan
3 Department of Virology III, National Institute of Infectious Diseases, 4-7-1, Gakuen, Musashimurayama, Tokyo 208-0011, Japan
* Correspondence: cie20910@syd.odn.ne.jp; Tel.: +81-45-568-4659

Table 2. Cetacean species infected with cetacean morbillivirus.

Family	Species	References
Odontoceti		
Delphinidae	Common dolphin (*Delphinus delphis*)	[76–78], [79] *, [80], [81–83] *, [84]
	Long-beaked common dolphin (*Delphinus capensis*)	[85]
	Bottlenose dolphin (*Tursiops truncatus*)	[53], [54] *, [80], [83] *, [85–87], [88] *, [89], [90–94] *
	Indo-Ocean bottlenose dolphin (*Tursiops aduncus*)	[83,92,95] *
	Striped dolphin (*Stenella coeruleoalba*)	[51,52] *, [76,78,80], [81,82,90,94,96,97] *
	Atlantic spotted dolphin (*Stenella frontalis*)	[78]
	Long-finned pilot whale (*Globicephala melas*)	[80], [88,90] *, [98], [99,100] *
	Short-finned pilot whale (*Globicephala macrorhynchus*)	[81,98], [100,101] *
	White-beaked dolphin (*Lagenorhynchus albirostris*	[50,77], [102,103] *
	Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	[78]
	Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	[104]
	Dusky dolphin (*Lagenorhynchus obscurus*)	[85]
	Rough-toothed dolphin (*Steno bredanensis*)	[94] *
	Spotted dolphin (*Stenella attenuata*)	[94] *
	Spinner dolphin (*Stenella longirostris*)	[94] *
	Fraser's dolphin (*Lagenodelphis hosei*)	[78,80,92]
	Risso's dolphin (*Grampus griseus*)	[80], [94,105] *
	False killer whale (*Pseudorca crassidens*)	[78]
	Melon-headed whale (*Peponocephala electra*)	[92]
	Pygmy killer whale (*Feresa attenuata*)	[78]
	Guiana dolphin (*Sotalia guianensis*)	[106,107] *
Phocoenidae	Harbor porpoise (*Phocoena phocoena*)	[48–50] *, [77,78,80]
Ziphiidae	Cuvier's beaked whale (*Ziphius cavirostris*)	[94,108] *
	Longman's beaked whale (*Indopacetus pacificus*)	[94,109] *
	Blainville's beaked whale (*Mesoplodon densirostris*)	[94] *
Kogiidae	Pygmy sperm whale (*Kogia breviceps*)	[78], [94,110] *
Physeteridae	Sperm whale (*Physeter macrocephalus*)	[94,111,112] *
Mysticeti		
Balaenopteridae	Fin whale (*Balaenoptera physalus*)	[56] *, [113], [114–116] *
	Common minke whale (*Balaenoptera acutorostrata*)	[117]
	Bryde's whale (*Balaenoptera edeni*)	[92]
	Humpback whale (*Megaptera novaeangliae*)	[94] *
Balaenidae	Southern right whale (*Eubalaena australis*)	[118] *

* Virus isolation and/or polymerase chain reaction analysis.

J. Comp. Path. 2020, Vol. 181, 26–32

Available online at www.sciencedirect.com

ScienceDirect

ELSEVIER

www.elsevier.com/locate/jcpa

DISEASE IN WILDLIFE OR EXOTIC SPECIES

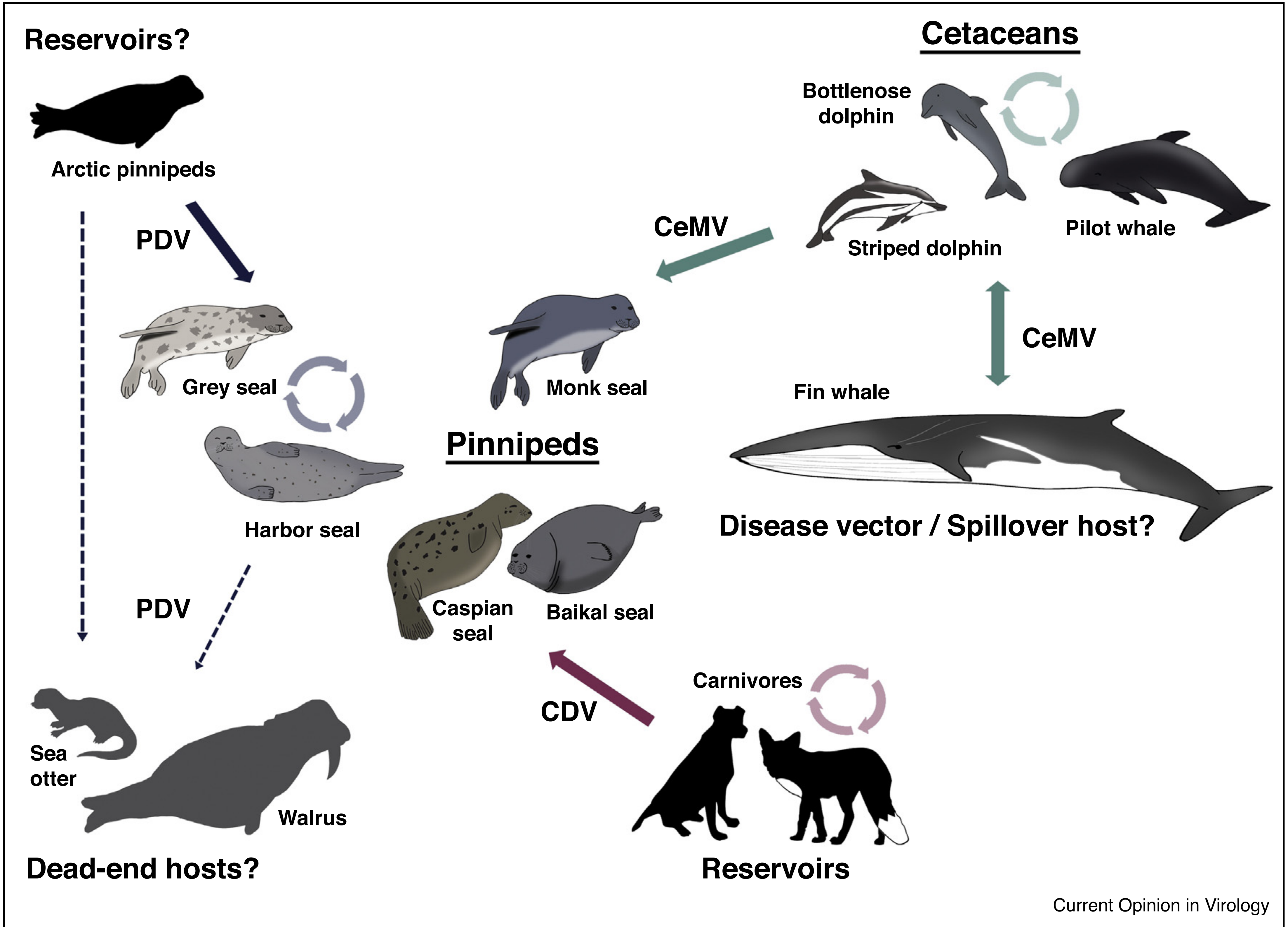
Cetacean Morbillivirus Infection in a Killer Whale (*Orcinus orca*) from Brazil

Kátia R Groch[*], Hassan Jerdy[†], Milton CC Marcondes[‡], Lupércio A Barbosa[§], Hernani GC Ramos[‡], Larissa Pavanelli[‖], Luz Alba MG Fornells[¶], Marina B Silva[†], Giliane S Souza[†], Milton M Kanashiro[†], Pollyana Bussad[†], Leonardo S Silveira[†], Samira Costa-Silva[*], Dominique J Wiener[#], Carlos EPF Travassos[†], José L Catão-Dias[*] and Josué Díaz-Delgado[*]

Available online at www.sciencedirect.com
ScienceDirect
Current Opinion in Virology

Transmission of morbilliviruses within and among marine mammal species

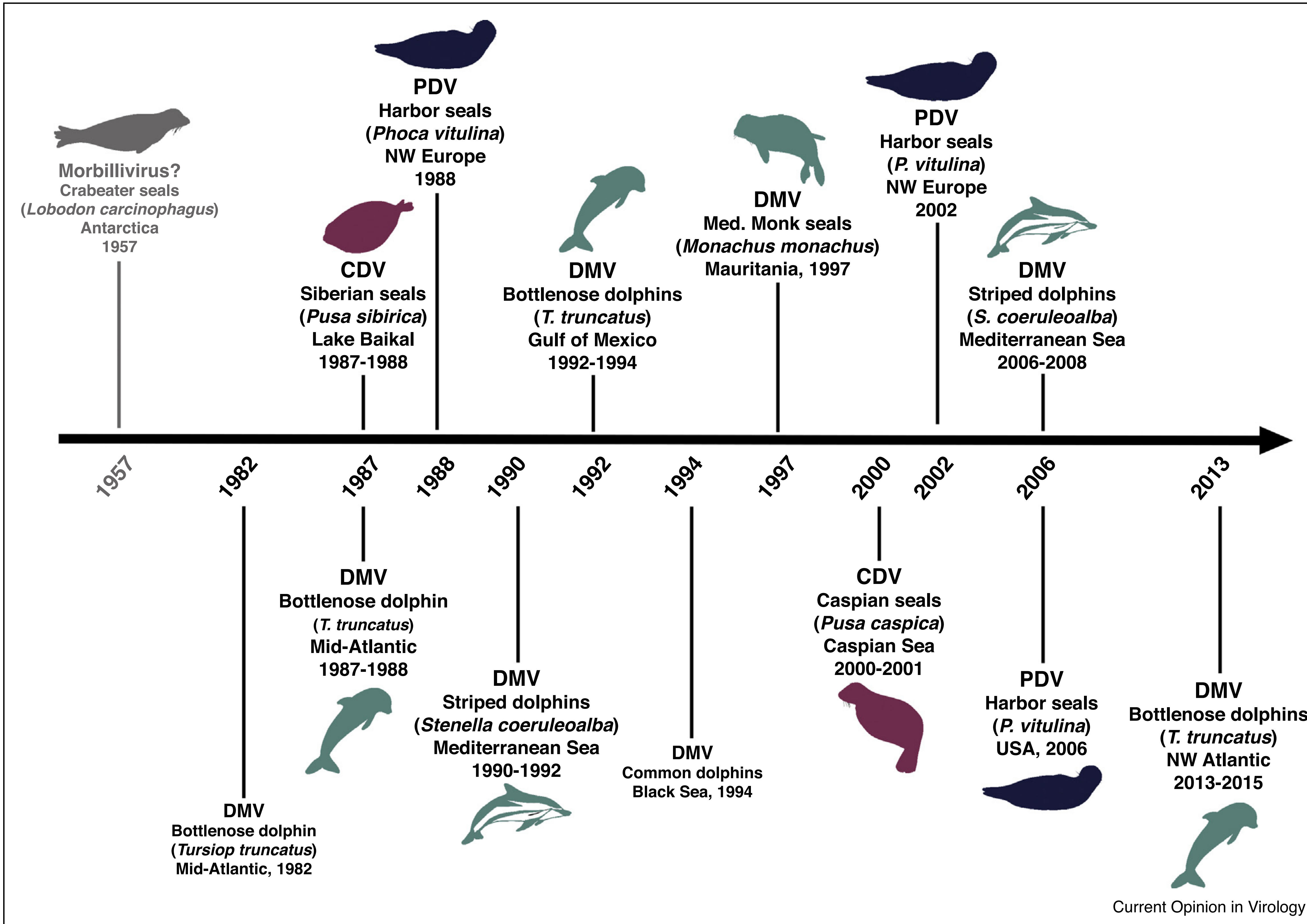
Wendy K Jo, Albert DME Osterhaus and Martin Ludlow



Available online at www.sciencedirect.com
ScienceDirect
Current Opinion in Virology

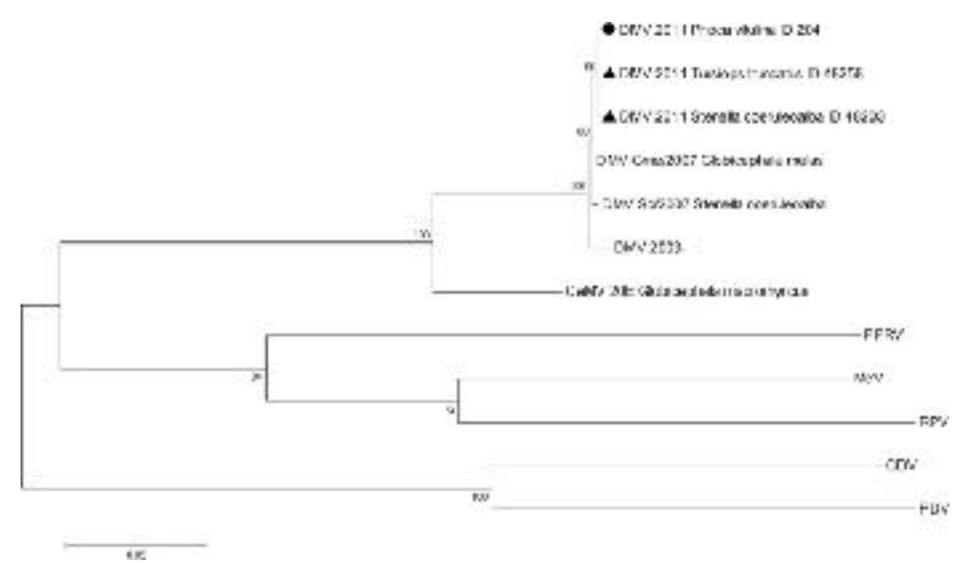
Transmission of morbilliviruses within and among marine mammal species

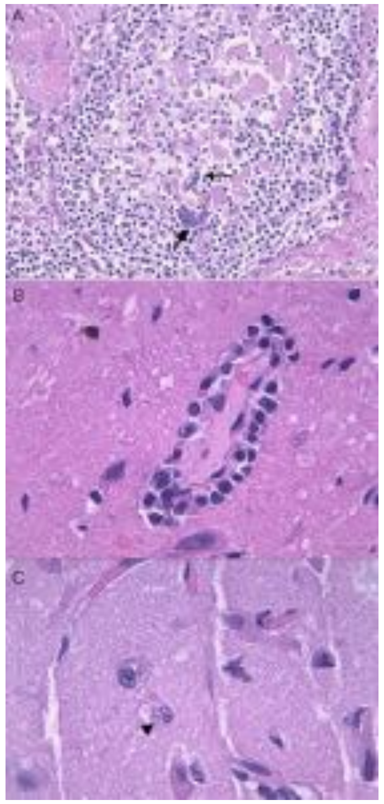
Wendy K Jo, Albert DME Osterhaus and Martin Ludlow



CeMV in *pinnipeds*

- Specimen under human care
- Cetaceans - pinnipeds transmission
- Mauritania, 1997 - previous CeMV epidemic





Mazzariol *et al*., 2013

Osterhaus *et al*., 1997

Dolphin Morbillivirus in Eurasian Otters, Italy

Iolanda Padalino, Giovanni Di Guardo, Antonio Carbone, Pasquale Troiano, Antonio Parisi, Domenico Galante, Maria Assunta Cafiero, Marta Caruso, Lucia Palazzo, Laura Guarino, Laura De Riso, Cinzia Centelleghe, Sandro Mazzariol, Antonio Petrella

DOI: https://doi.org/10.3201/eid2502.180256

Author affiliations: Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata, Foggia, Italy (I. Padalino, A. Carbone, P. Troiano, A. Parisi, D. Galante, M.A. Cafiero, A. Petrella);

the park aimed at assessing the health and conservation status of the otter population.

Within a multidisciplinary approach framework, we conducted in-depth histopathologic, microbiologic, parasitologic, and ecotoxicologic analyses on the 7 otters, along with biomolecular (reverse transcription PCR [RT-PCR]) and immunohistochemical (IHC) investigations for *Morbillivirus* spp. After using a technique amplifying a highly conserved fragment of the *Morbillivirus* nucleoprotein (NP) gene (*4*), we applied 2 additional methods aimed at detecting DMV-specific hemagglutinin (HA) (*5*) and NP gene sequences (*6*) for more detailed analysis. To increase the biomolecular results' reliability, we performed all the extraction, amplification, and sequencing steps in 3 different laboratories. We also conducted the histopathological and IHC analyses in 3 different

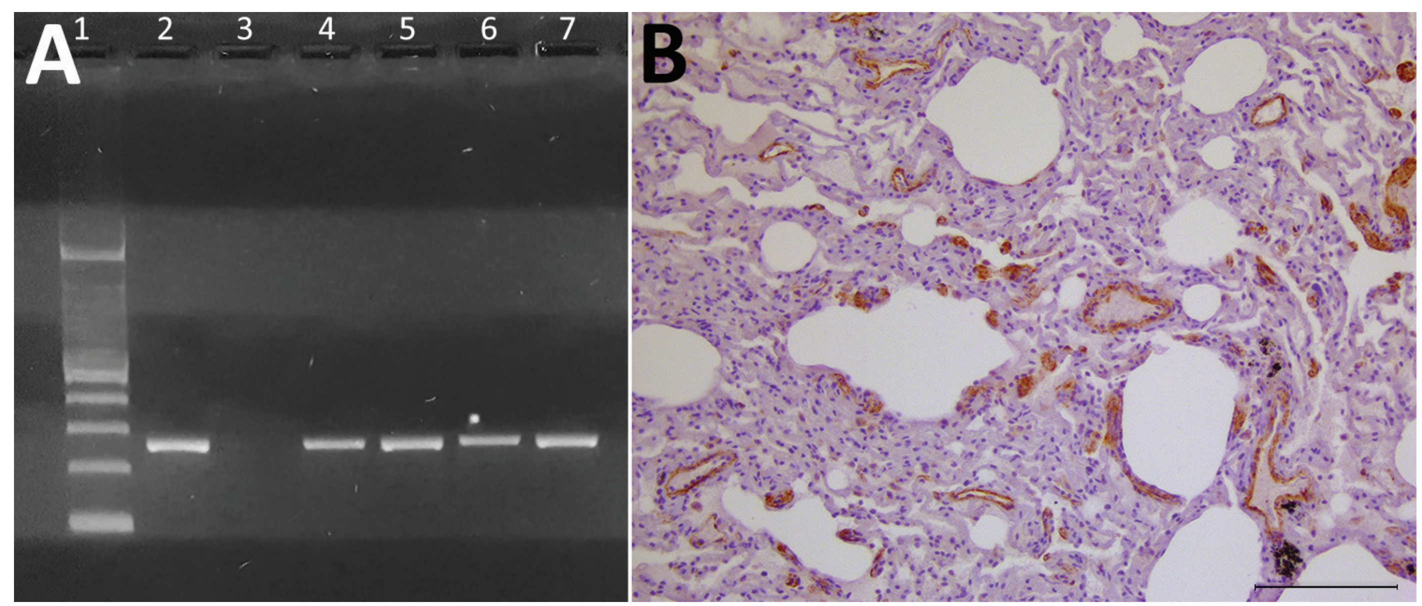


Figure. Evidence of dolphin morbillivirus infection in Eurasian otters (*Lutra lutra*), southwestern Italy. A) Comparison of nucleoprotein gene amplification products from infected otters, obtained by reverse transcription PCR. A specific band at the expected molecular weight of 287 bp is shown. Lane 1, molecular weight marker (TrackIt 100bp DNA Ladder; Invitrogen, http://www.thermofisher.com); lane 2, positive control (lung tissue from an infected striped dolphin, *Stenella coeruleoalba*); lane 3, negative control (distilled water); lanes 4–7, samples from morbillivirus-positive Eurasian otters: LL-290, lung (lane 4); LL-291, kidney (lane 5); LL-3380, lung (lane 6); LL-7318, lung (lane 7). B) Mayer's hematoxylin counterstain of lung tissue shows marked and widespread immunohistochemical labeling for morbillivirus antigen (dark areas), particularly evident at the level of vascular walls and endothelial cells and, to a lesser extent, of alveolar epithelial cells (morphologically consistent, or not, with hyperplastic type II pneumocytes) as well as of thickened alveolar septa. Scale bar indicates 100 µm.

CeMV variants

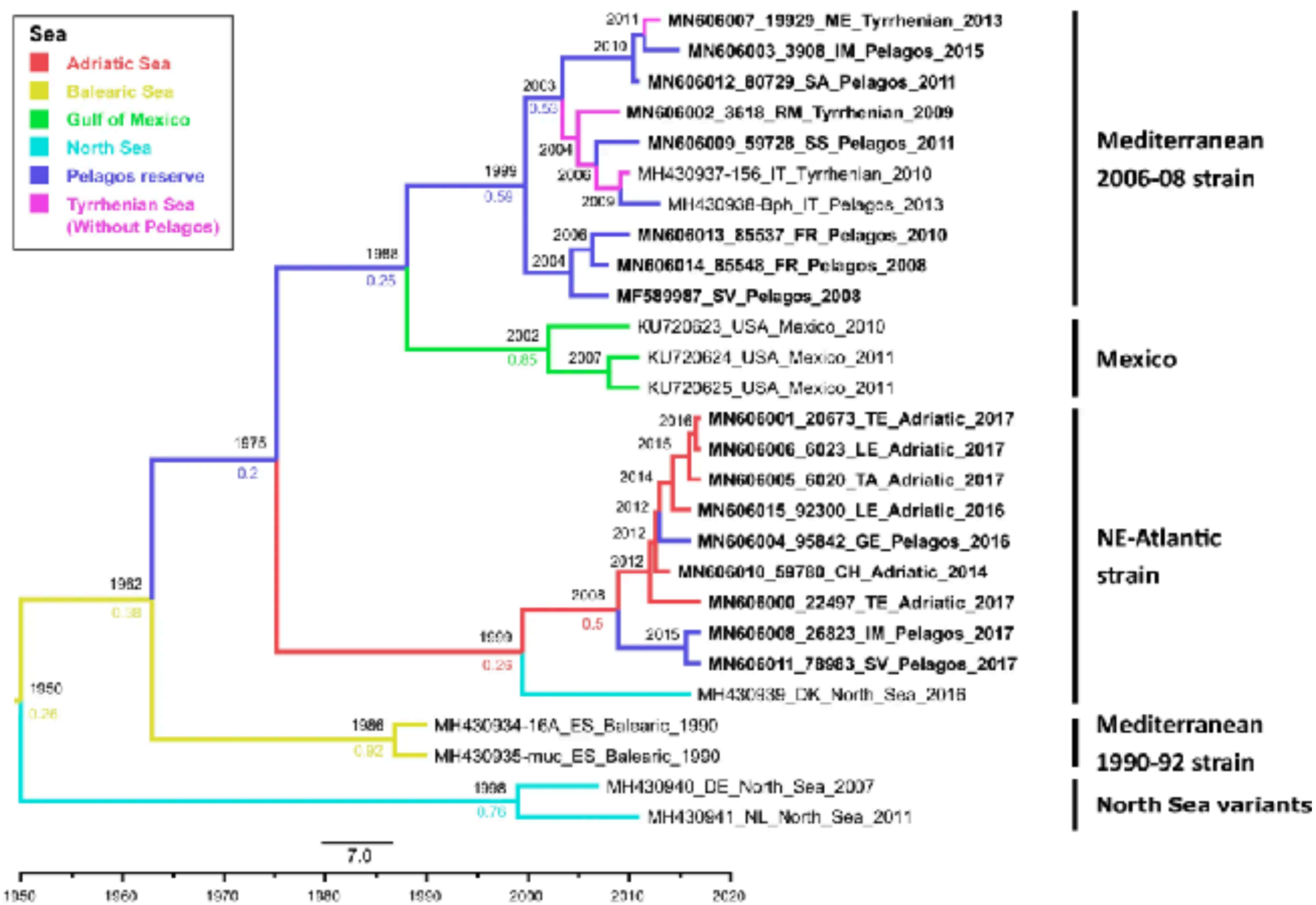
scientific reports

OPEN

Specific capture and whole-genome phylogeography of Dolphin morbillivirus

Francesco Cerutti[1], Federica Giorda[1,2], Carla Grattarola[1], Walter Mignone[1], Chiara Beltramo[1], Nicolas Keck[3], Alessio Lorusso[4], Gabriella Di Francesco[4], Ludovica Di Renzo[4], Giovanni Di Guardo[5], Mariella Goria[1], Loretta Masoero[1], Pier Luigi Acutis[1], Cristina Casalone[1] & Simone Peletto[1]✉

- **Atlantic**
- **Mediterranean**
- North sea
- Mexico



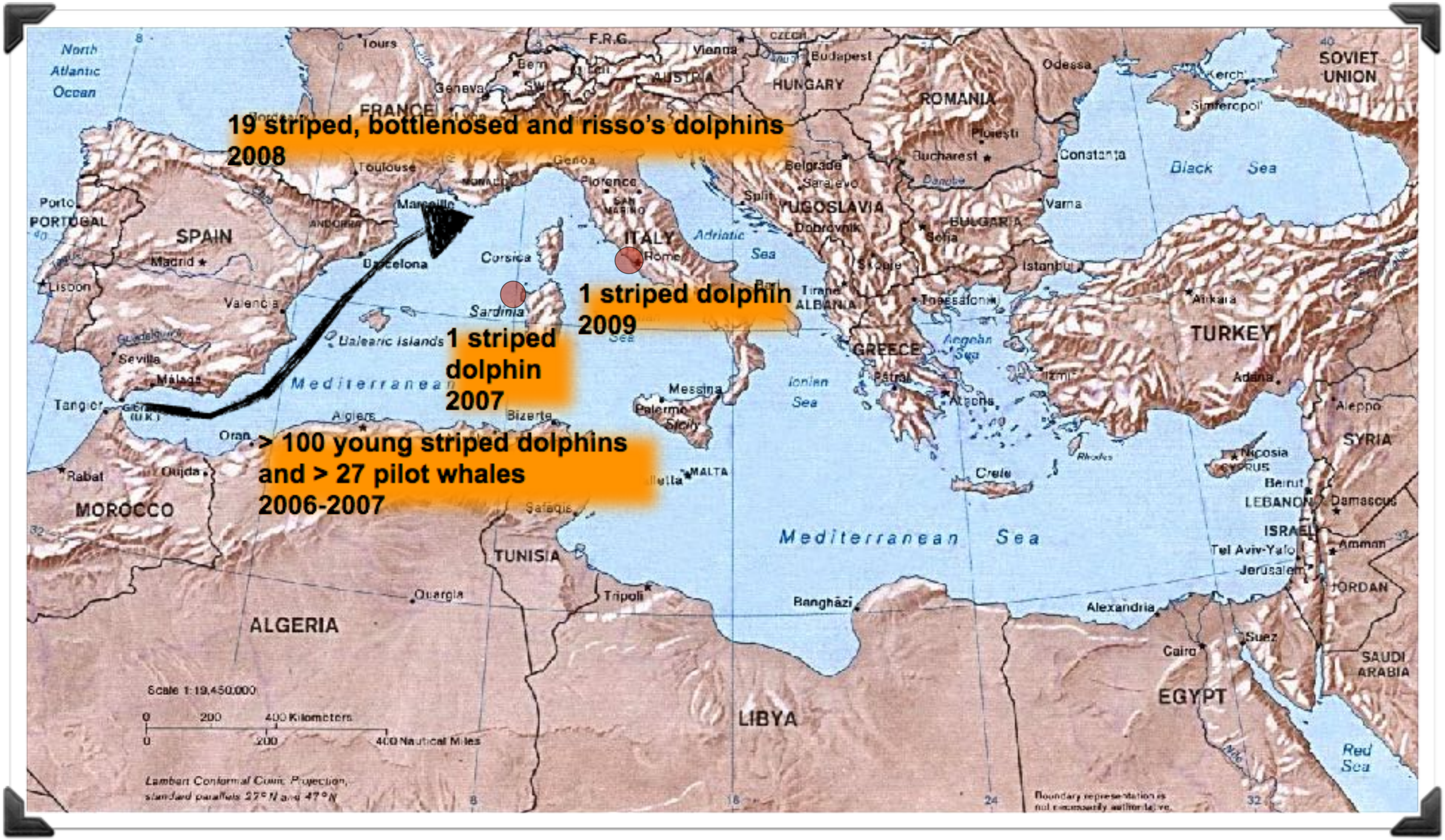
Morbillivirus infection in a striped dolphin (*Stenella coeruleoalba*) from the coast of Italy

G. Di Guardo, U. Agrimi, D. Amaddeo,
M. McAliskey, S. Kennedy

Veterinary Record (1992) 130, 579-580

DMV epidemic 1990-1992 in the Mediterranean

DMV epidemic 2006-2008



Contents lists available at SciVerse ScienceDirect

Research in Veterinary Science

journal homepage: www.elsevier.com/locate/rvsc

Morbillivirus infection in cetaceans stranded along the Italian coastline: Pathological, immunohistochemical and biomolecular findings

Giovanni Di Guardo [a,*], Cristina Esmeralda Di Francesco [a], Claudia Eleni [b], Cristiano Cocumelli [b], Francesco Scholl [b], Cristina Casalone [c], Simone Peletto [c], Walter Mignone [d], Cristiana Tittarelli [d], Fabio Di Nocera [e], Leonardo Leonardi [f], Antonio Fernández [g], Federica Marcer [h], Sandro Mazzariol [i]

[a] University of Teramo, Faculty of Veterinary Medicine, Teramo, Italy
[b] Istituto Zooprofilattico Sperimentale (IZS) delle Regioni Lazio e Toscana, Rome, Italy
[c] IZS del Piemonte, Liguria e Valle d'Aosta Turin, Italy
[d] IZS del Piemonte, Liguria e Valle d'Aosta, Imperia, Italy
[e] IZS del Mezzogiorno, Salerno, Italy
[f] University of Perugia, Faculty of Veterinary Medicine, Perugia, Italy
[g] University of Las Palmas, Gran Canaria, Canary Islands, Spain
[h] University of Padua, Department of Animal Medicine, Production and Health, Padua, Italy
[i] University of Padua, Department of Comparative Biomedicine and Food Science, Padua, Italy

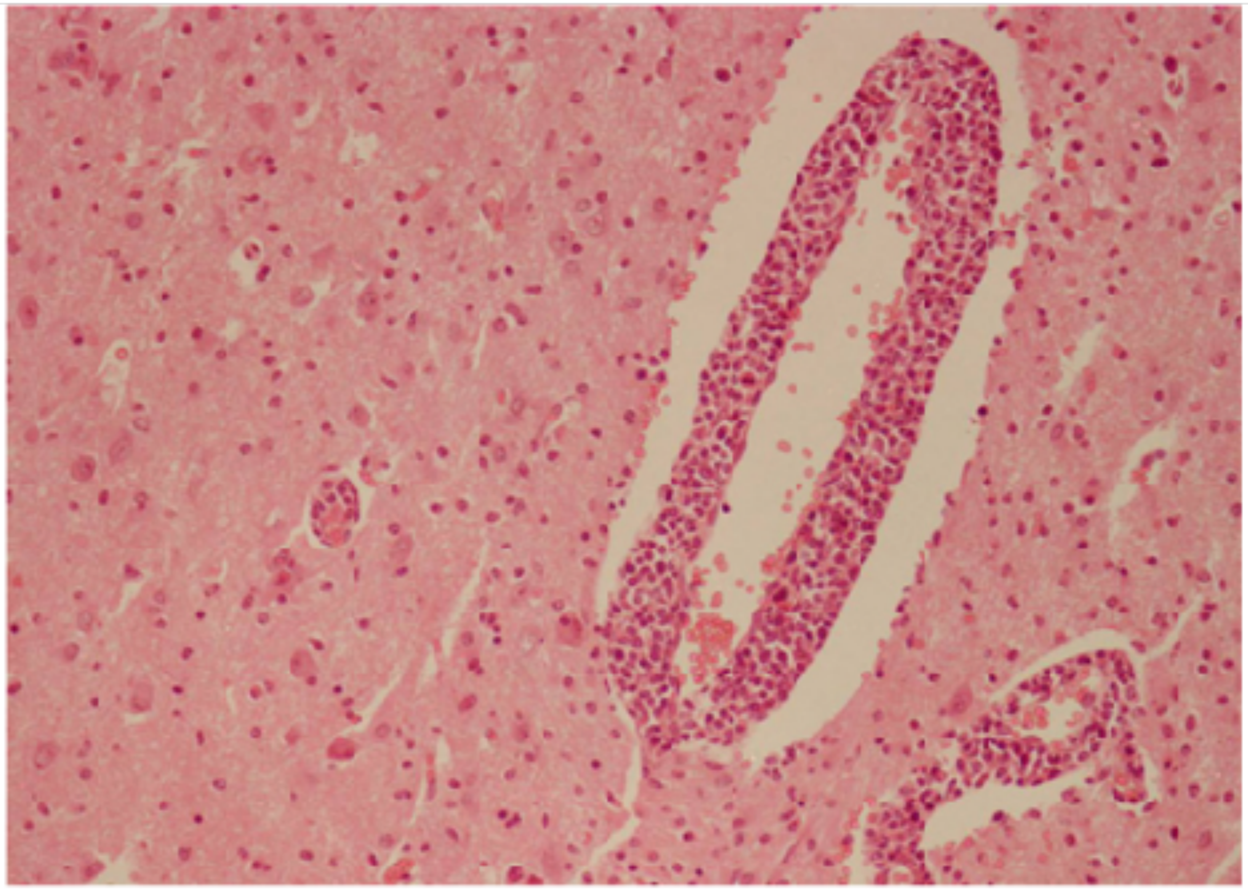


Fig. 1. Striped dolphin (*Stenella coeruleoalba*). Brain. Morbilliviral encephalitis. Mononuclear inflammatory cell cuffing is shown around subcortical blood vessels. Haematoxylin and eosin. Final magnification 250×.

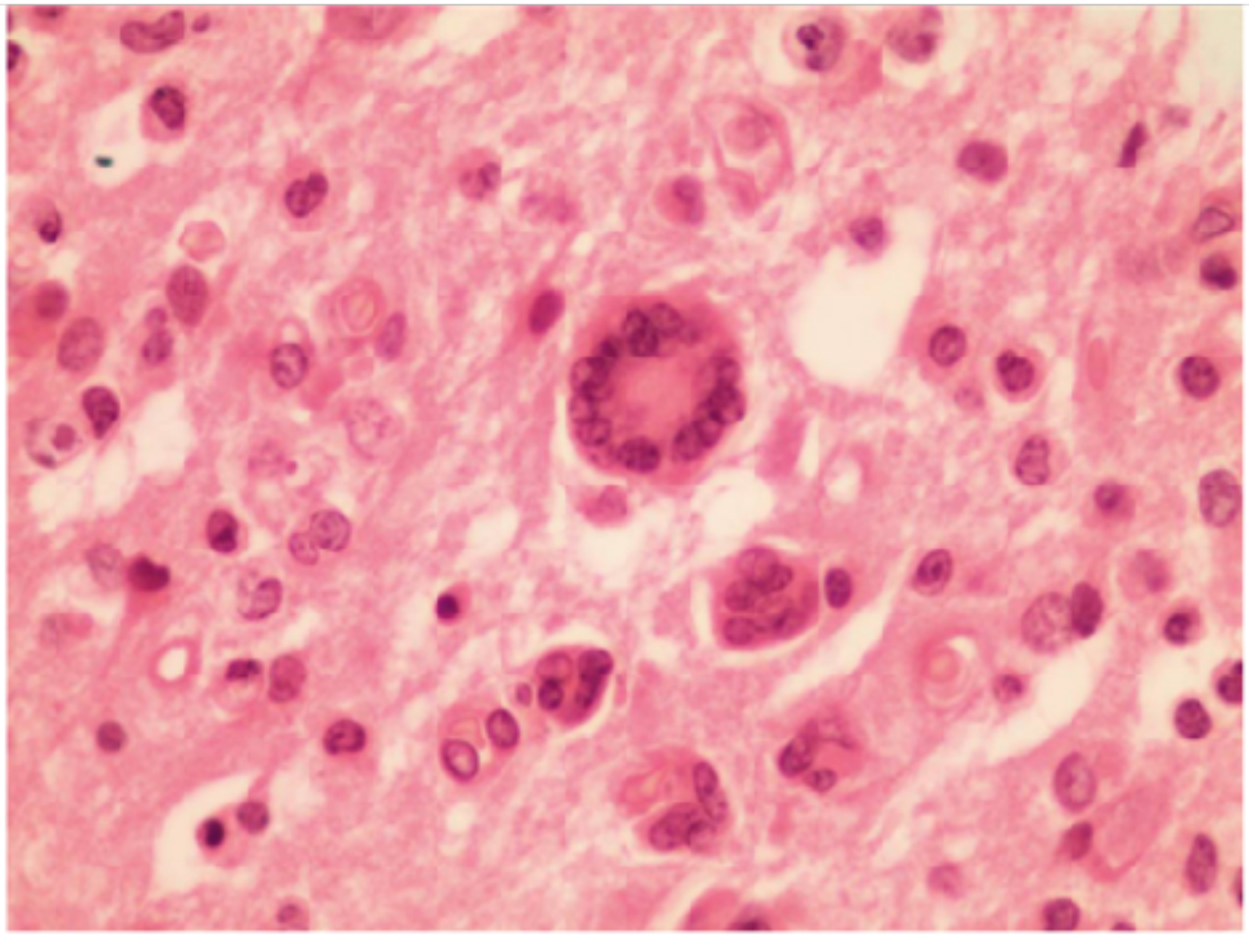
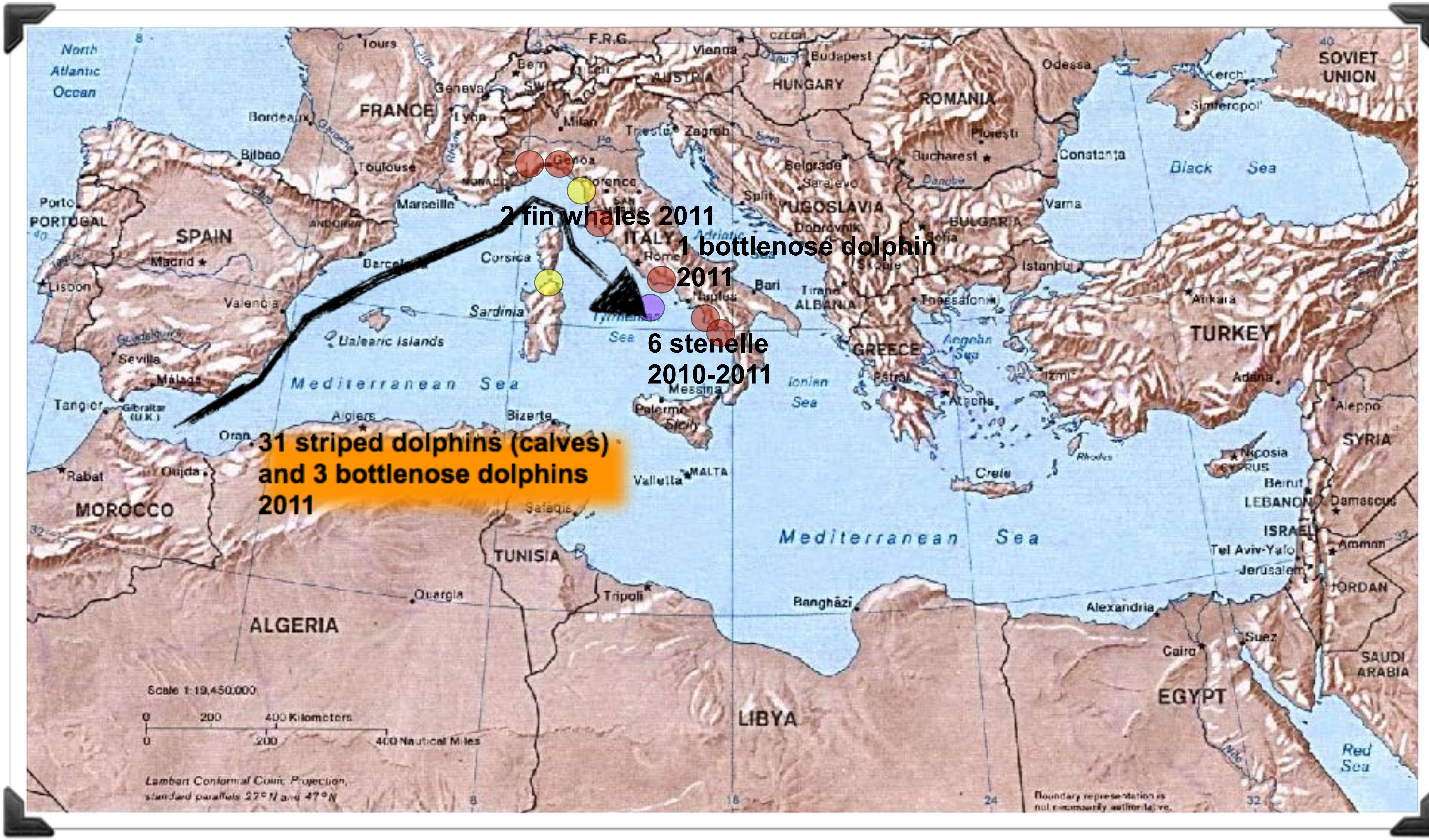


Fig. 3. Striped dolphin (*S. coeruleoalba*). Brain. Morbilliviral encephalitis (same animal as in Fig. 1). Evidence of multinucleate syncytia scattered throughout the inflamed cerebral parenchyma. Haematoxylin and eosin. Final magnification 500×.

DMV 2010-2011



Rubio-Guerri et al. BMC Veterinary Research 2013, 9:106
http://www.biomedcentral.com/1746-6148/9/106

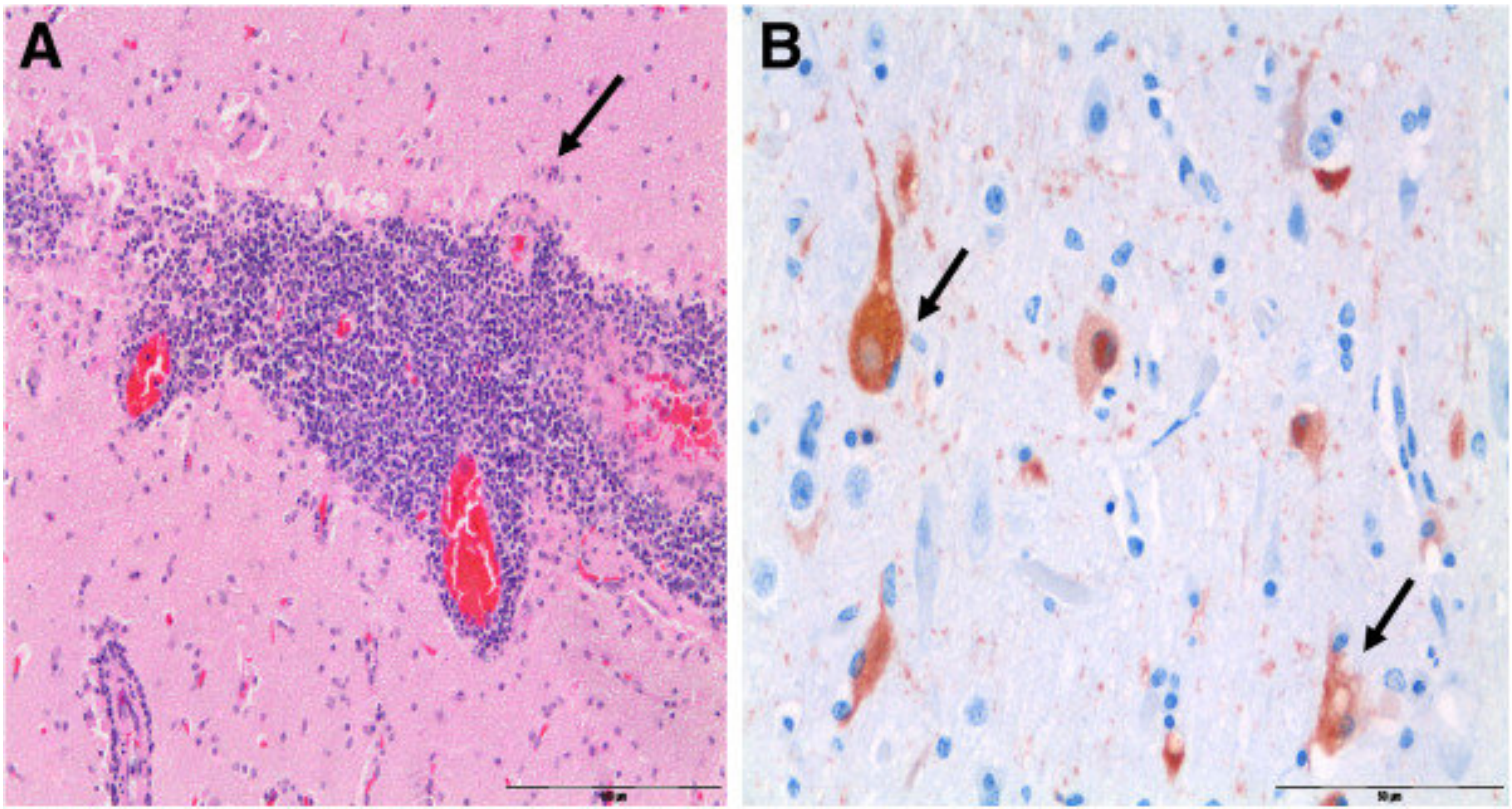
BMC Veterinary Research

CASE REPORT Open Access

Unusual striped dolphin mass mortality episode related to cetacean morbillivirus in the Spanish Mediterranean sea

Consuelo Rubio-Guerri[1*†], Mar Melero[1†], Fernando Esperón[2], Edwige Nina Bellière[2], Manuel Arbelo[3], Jose Luis Crespo[4], Eva Sierra[3], Daniel García-Párraga[4] and Jose Manuel Sánchez-Vizcaíno[1]

Encephalitis 3/9 (33.3%)



DMV 2010-11
PHOCA VITULINA

- After 1 month from TT stranding an harbor seal died in the zoo
- Clinical signs: anorexia, tremors, abdominal pain, polyuria,
- Hypothermia and vomiting before death.
- Necropsy after 12 hrs

DMV Mediterranean outbreak 2013

Vol. 109: 81–86, 2014
doi: 10.3354/dao02726

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

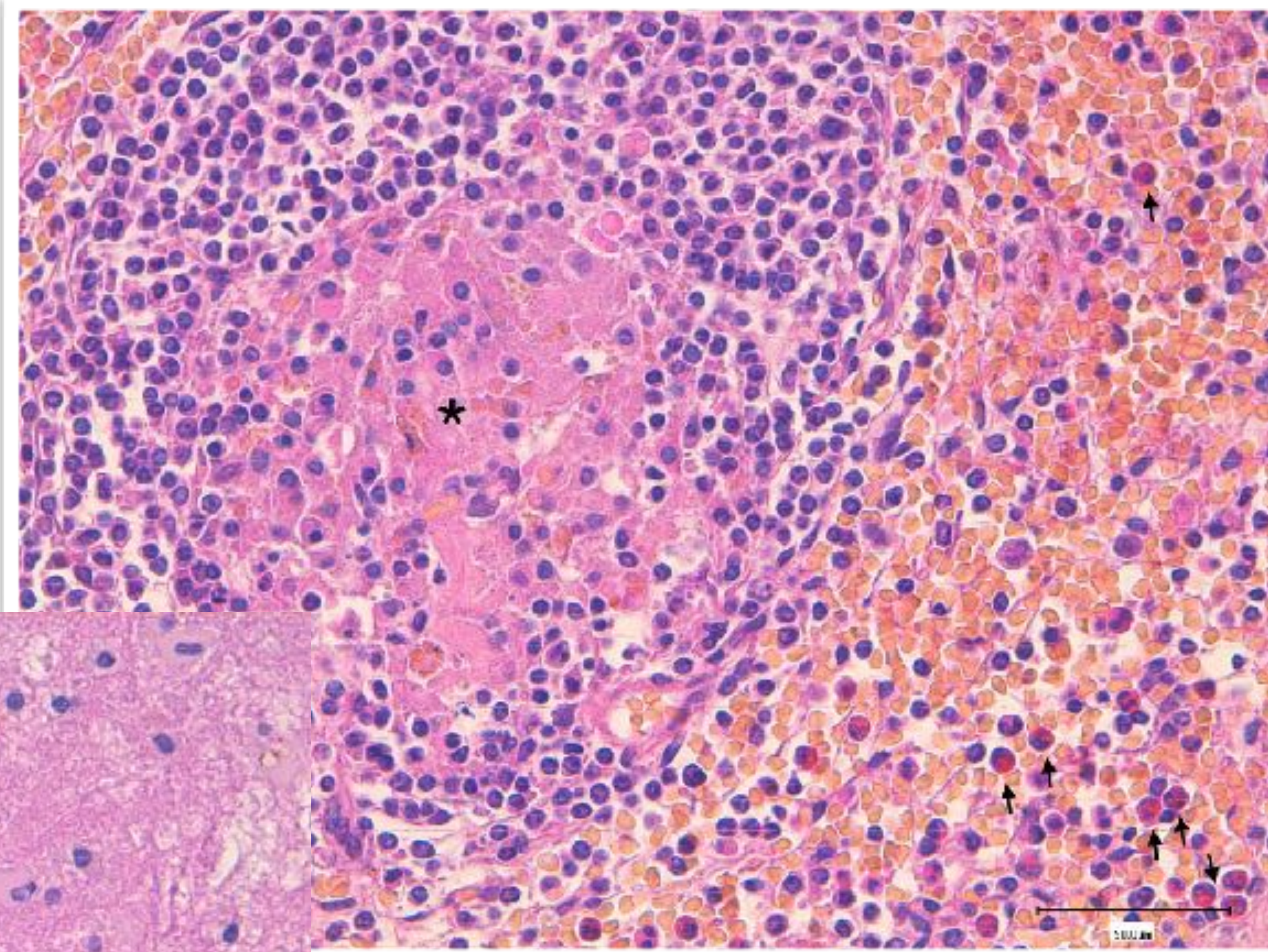
Published April 23

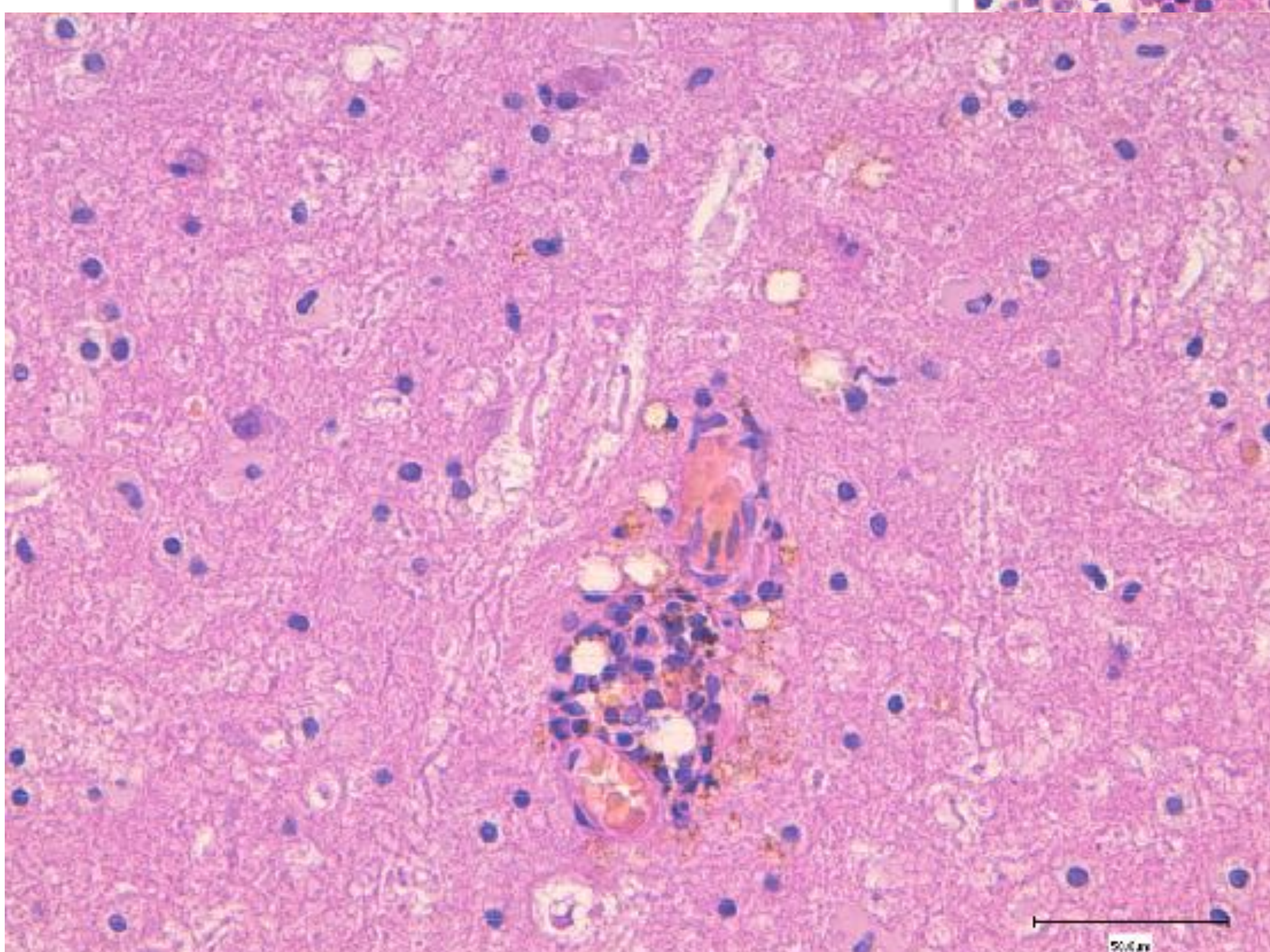
NOTE

Cetacean strandings in Italy: an unusual mortality event along the Tyrrhenian Sea coast in 2013

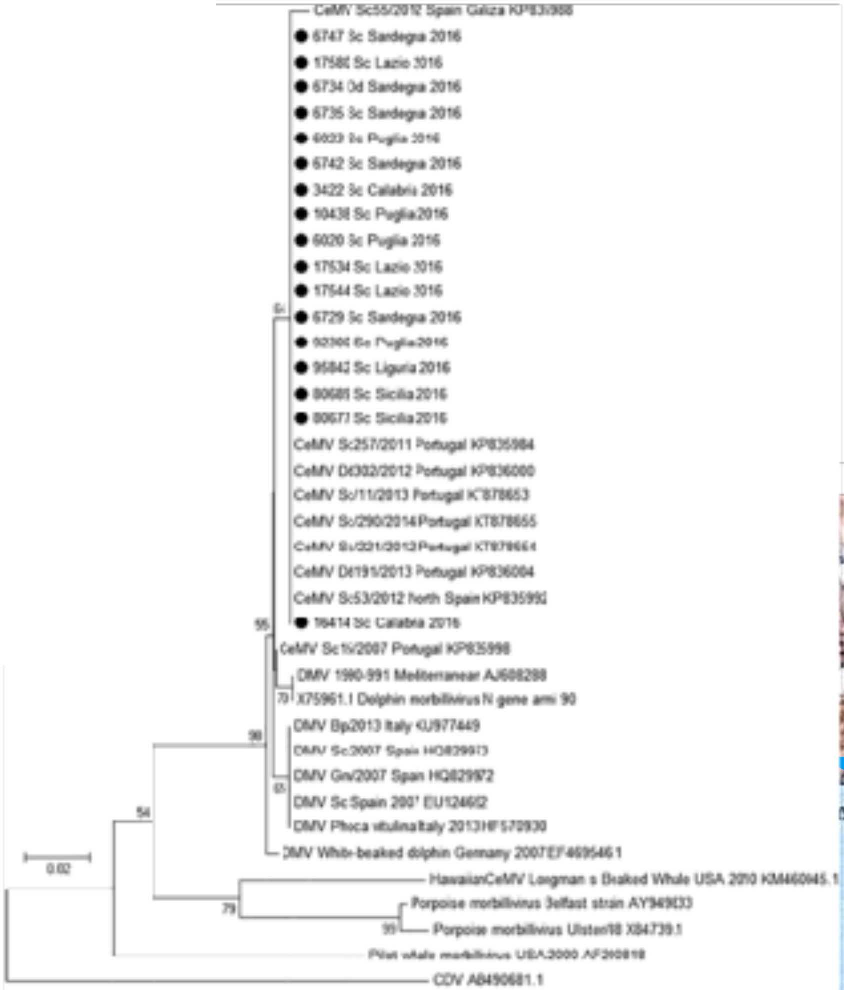
Cristina Casalone[1,*], Sandro Mazzariol[2], Alessandra Pautasso[1], Giovanni Di Guardo[3], Fabio Di Nocera[4], Giuseppe Lucifora[4], Ciriaco Ligios[5], Alessia Franco[6], Gianluca Fichi[6], Cristiano Cocumelli[6], Antonella Cersini[6], Annalisa Guercio[7], Roberto Puleio[7], Maria Goria[1], Michela Podestà[8], Letizia Marsili[9], Gianni Pavan[10], Antonio Pintore[5], Esterina De Carlo[4], Claudia Eleni[6], Santo Caracappa[7]

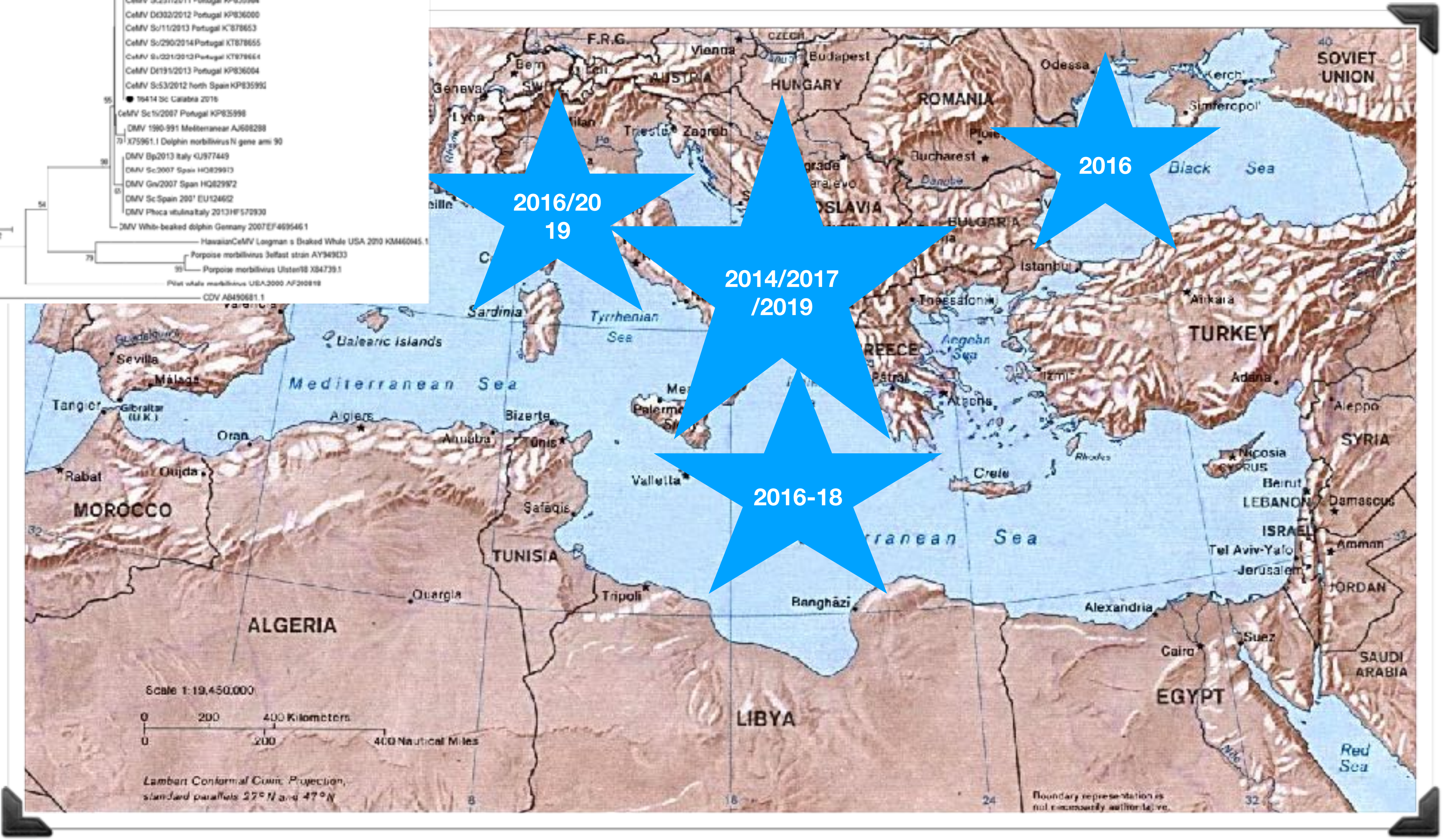
[1]IZS Piemonte Liguria Valle d'Aosta, Via Bologna, 148, 10154 Torino, Italy
[2]Department of Comparative Biomedicine and Food Science, University of Padua, Viale dell'Università 16, Agripolis, 35020 Legnaro (PD), Italy
[3]Faculty of Veterinary Medicine, University of Teramo, Piazza Aldo Moro, 45, 64100 Teramo, Italy
[4]IZS Mezzogiorno, Via della Calabria 27, 84132 Salerno, Italy
[5]IZS Sardegna, Duca degli Abruzzi 8, 07100 Sassari, Italy
[6]IZS Lazio Toscana, Via Appia Nuova, 1411, 00178 Roma, Italy
[7]IZS Sicilia, Via G. Marinuzzi, 3, 90129 Palermo, Italy
[8]Vertebrate Zoology Department, Museum of Natural History of Milan, Corso Venezia 55, 20121 Milano, Italy
[9]Department of Earth, Physical and Environmental Sciences, University of Siena, Via P.A. Mattioli 4, 53100 Siena, Italy
[10]CIBRA, Centro Interdisciplinare di Bioacustica e Ricerche Ambientali, Dept. of Earth and Environment Sciences, Università di Pavia, Via Taramelli 24, 27100 Pavia, Italy



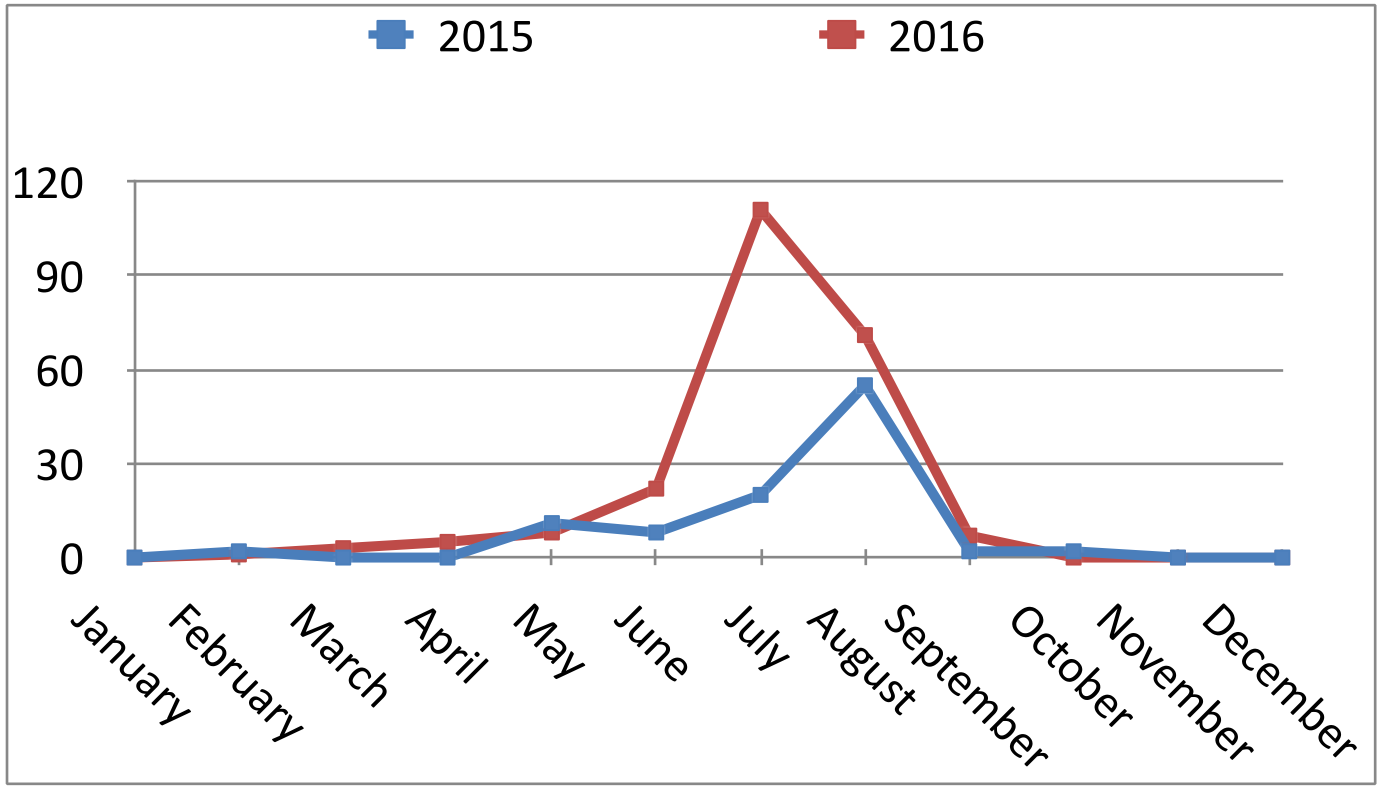


DMV Mediterranean outbreaks

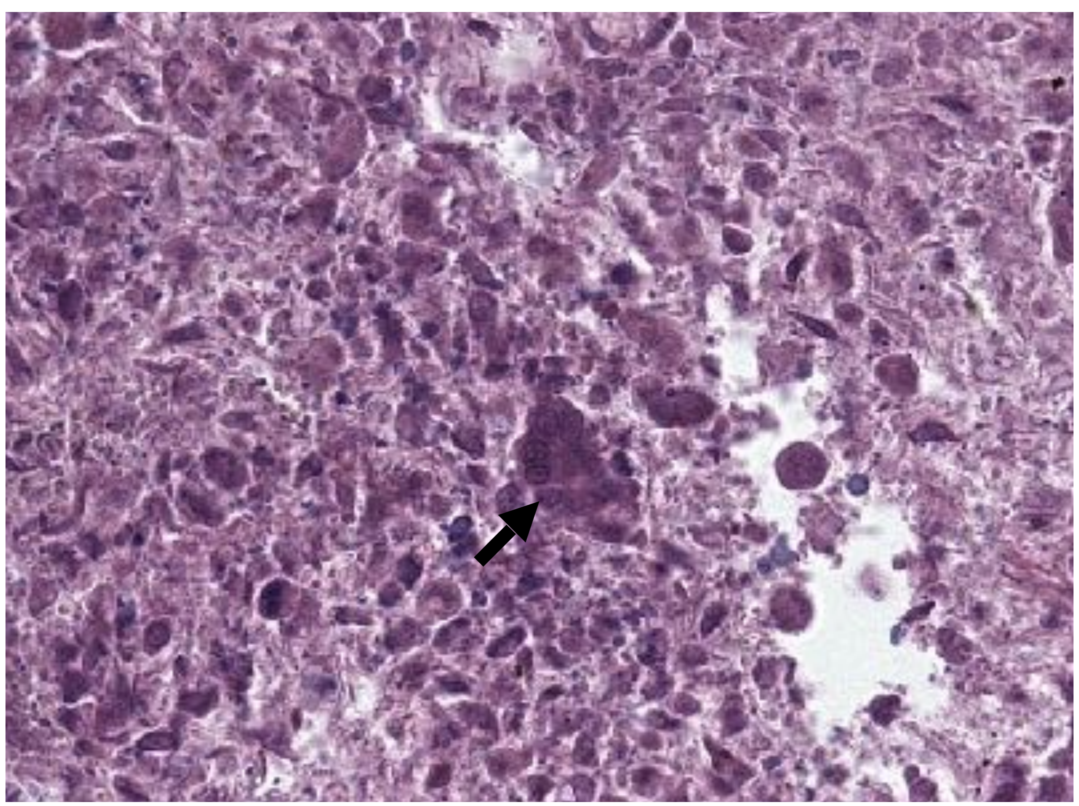


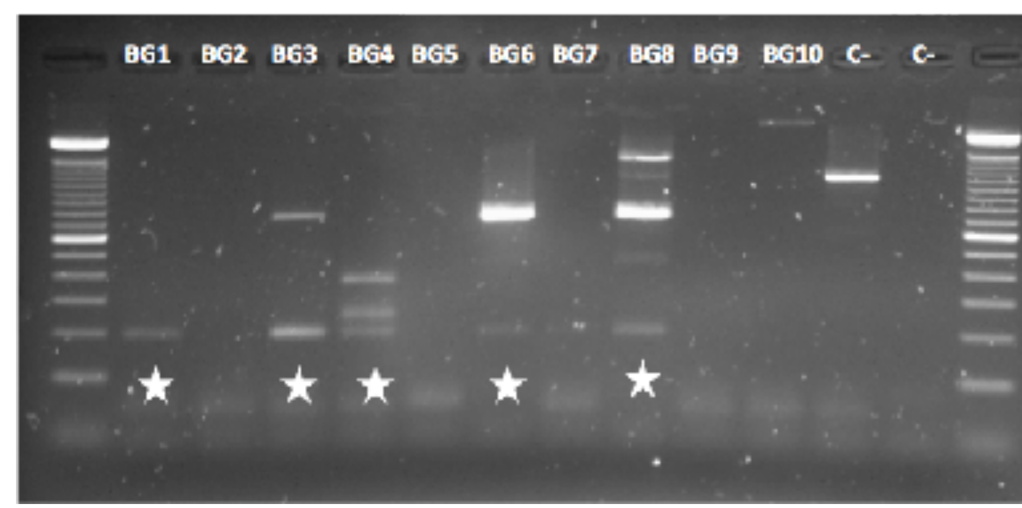


DMV Bulgaria



ID	Animal	Tissue	NESTED-PCR for DMV detection	Sequencing
BG1	*Phocoena phocoena*	Thymus	Positive	Yes
BG2	*Phocoena phocoena*	Lung	Negative	No
BG3	*Phocoena phocoena*	Pulmonary lymph nodes	Positive	Not Sequenced
BG5	*Phocoena phocoena*	Spleen	Negative	No
BG4	*Delphinus delphis*	Mesenteric lymph nodes	Positive	Not Sequenced
BG6	*Delphinus delphis*	Tonsil	Positive	Yes
BG7	*Delphinus delphis*	Lung	Negative	No
BG8	*Delphinus delphis*	Spleen	Positive	Yes
BG9	*Delphinus delphis*	Brain	Negative	No
BG10	*Delphinus delphis*	Brain	Negative	No





1996 - 2021

25 ANS YEARS ACCOBAMS

Vol. 132: 215–220, 2019
https://doi.org/10.3354/dao03323

DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org

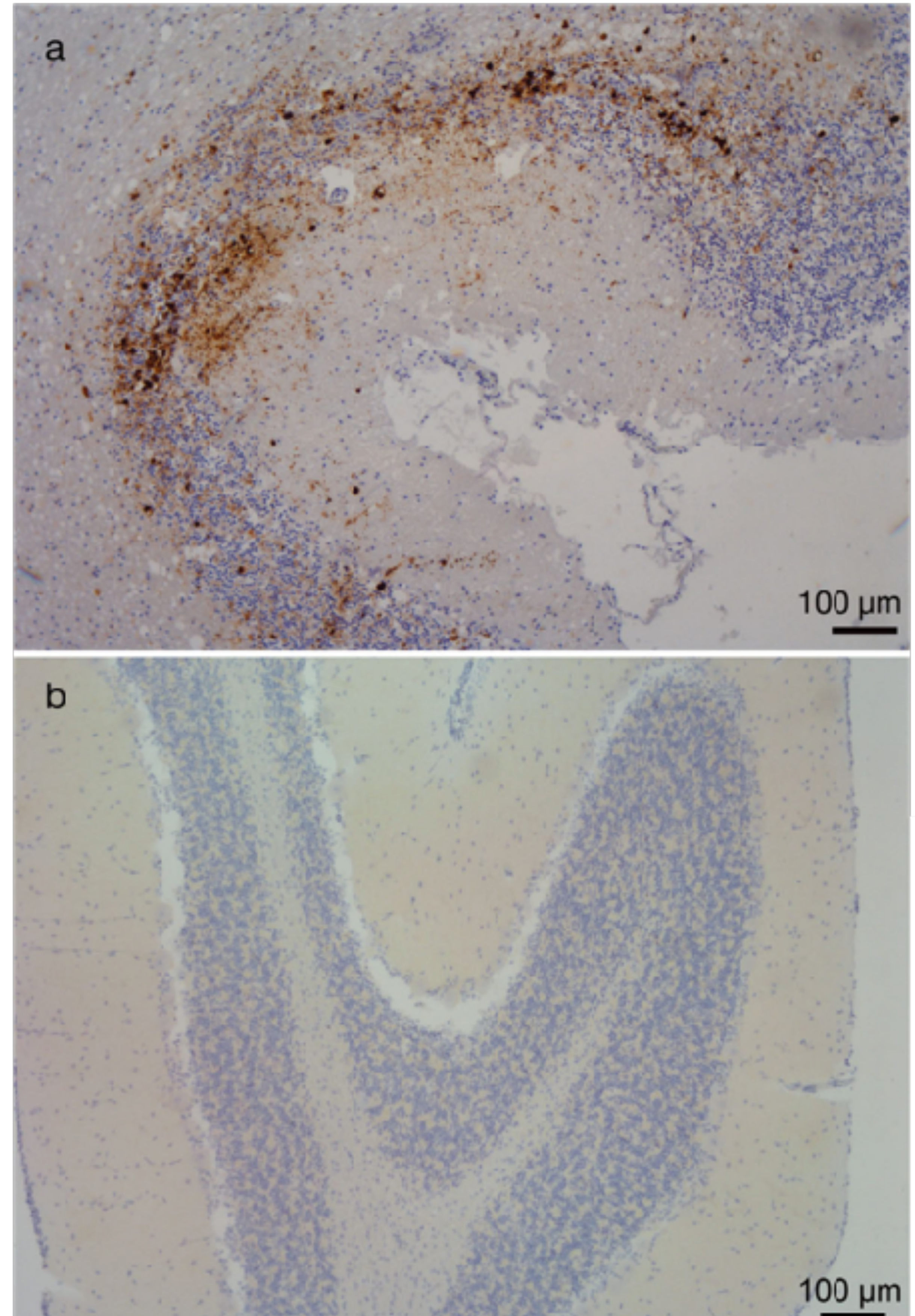
Published online January 24

NOTE

Novel dolphin morbillivirus (DMV) outbreak among Mediterranean striped dolphins *Stenella coeruleoalba* in Italian waters

Alessandra Pautasso[1], Barbara Iulini[1], Carla Grattarola[1], Federica Giorda[1,2], Maria Goria[1], Simone Peletto[1], Loretta Masoero[1], Walter Mignone[1], Katia Varello[1], Antonio Petrella[3], Antonio Carbone[3], Antonio Pintore[4], Daniele Denurra[4], Francesco Scholl[5], Antonella Cersini[5], Roberto Puleio[6], Giuseppa Purpari[6], Giuseppe Lucifora[7], Giovanna Fusco[7], Giovanni Di Guardo[8], Sandro Mazzariol[9], Cristina Casalone[1,*]

[1]Istituto Zooprofilattico Sperimentale del Piemonte Liguria e Valle d'Aosta, 10154 Torino, Italy
[2]Institute for Animal Health and Food Safety (IUSA), Faculty of Veterinary Medicine, University of Las Palmas de Gran Canaria, 35413 Arucas, Las Palmas, Canary Islands, Spain
[3]Istituto Zooprofilattico Sperimentale della Puglia e Basilicata, 71121 Foggia, Italy
[4]Istituto Zooprofilattico Sperimentale della Sardegna, 07100 Sassari, Italy
[5]Istituto Zooprofilattico Sperimentale del Lazio e della Toscana, 00178 Roma, Italy
[6]Istituto Zooprofilattico Sperimentale della Sicilia, 90129 Palermo, Italy
[7]Istituto Zooprofilattico Sperimentale del Mezzogiorno, 80055 Portici, Italy
[8]Faculty of Veterinary Medicine, University of Teramo, 64100 Teramo, Italy
[9]University of Padova, Department of Comparative Biomedicine and Food Science (BCA), 35020 Legnaro-Padova, Italy



1996 - 2021

25 ANS YEARS

ACCOBAMS

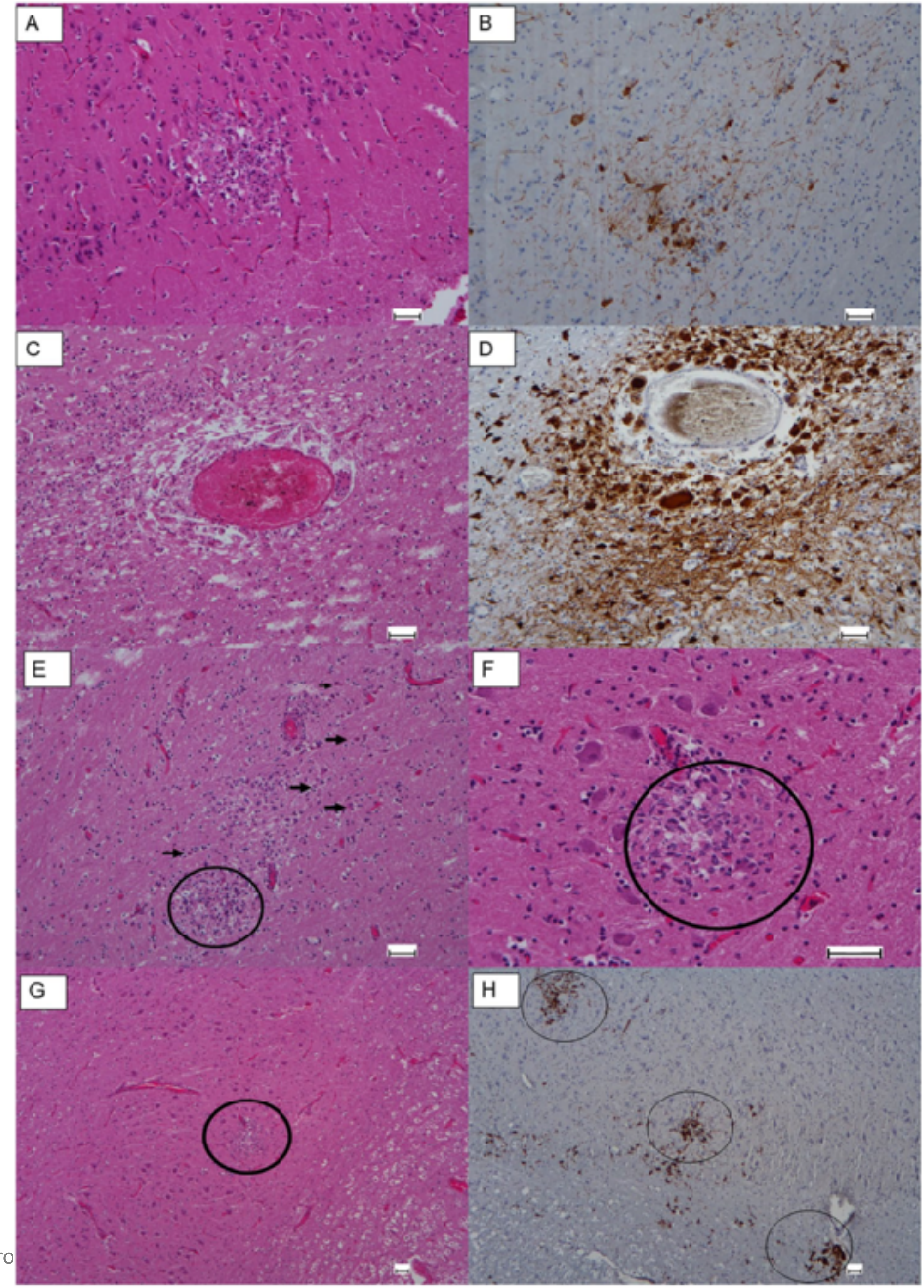
SCIENTIFIC REPORTS

OPEN

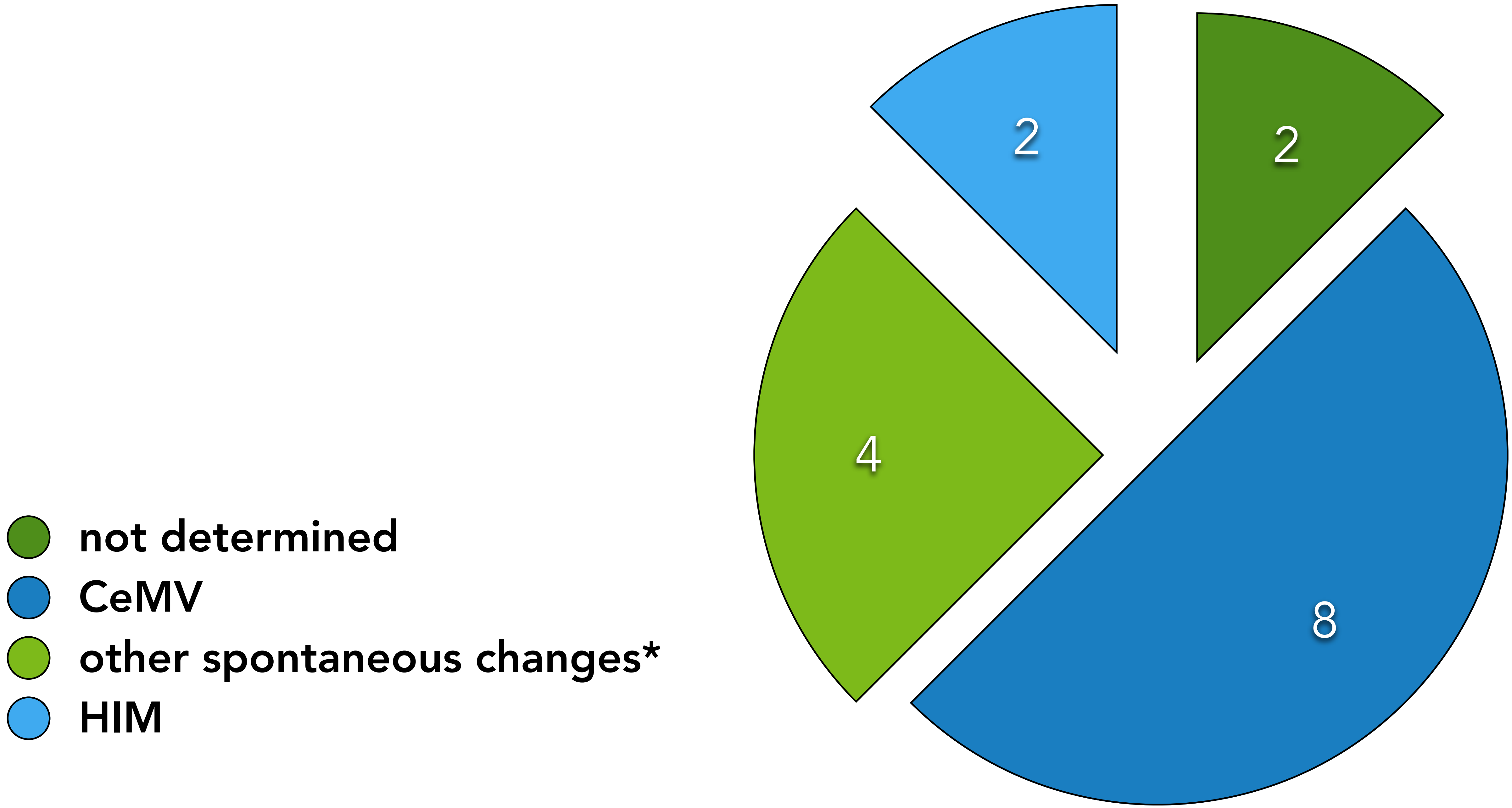
Circulation of a novel strain of dolphin morbillivirus (DMV) in stranded cetaceans in the Mediterranean Sea

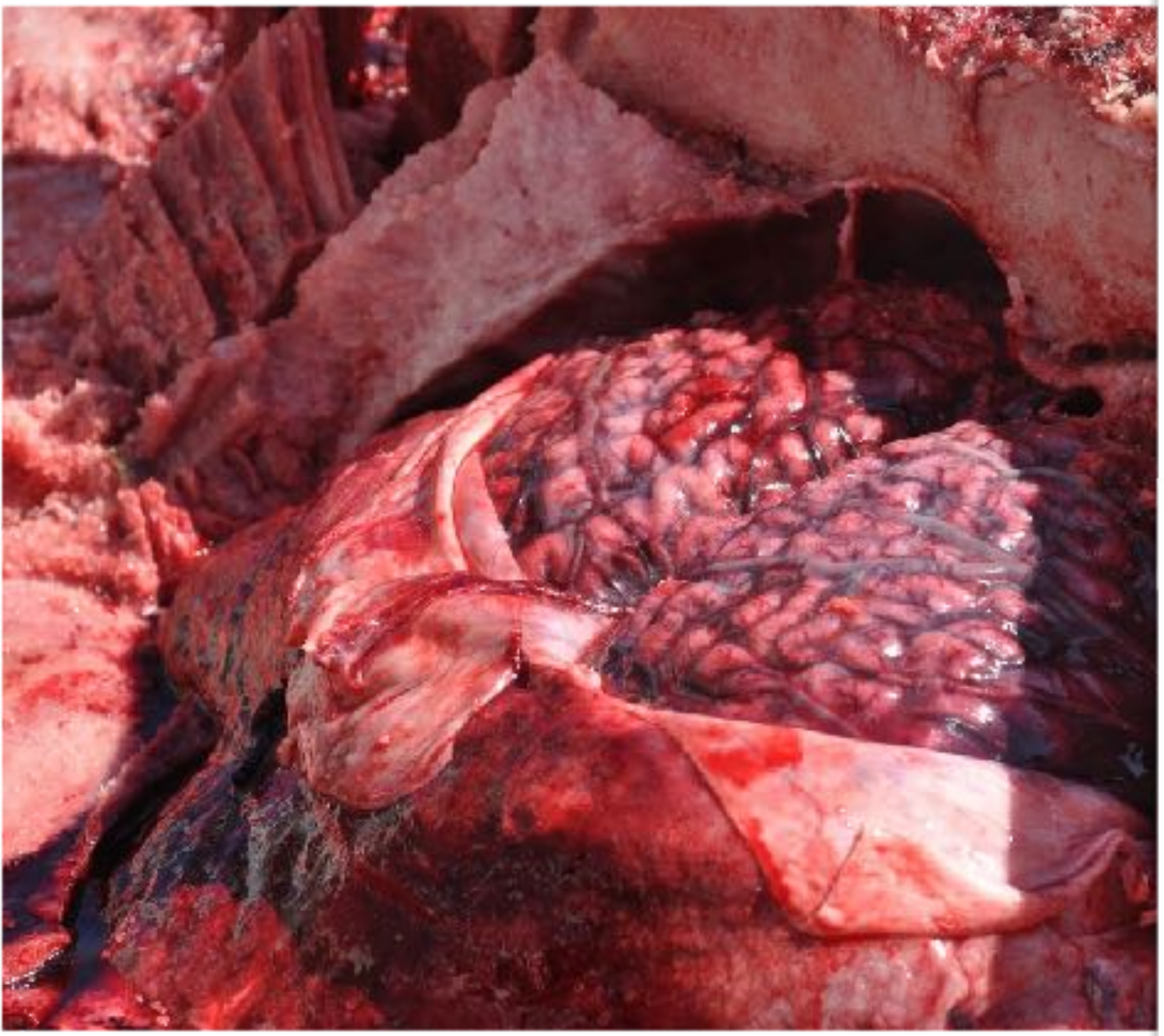
Received: 12 October 2017
Accepted: 20 June 2018
Published online: 05 July 2018

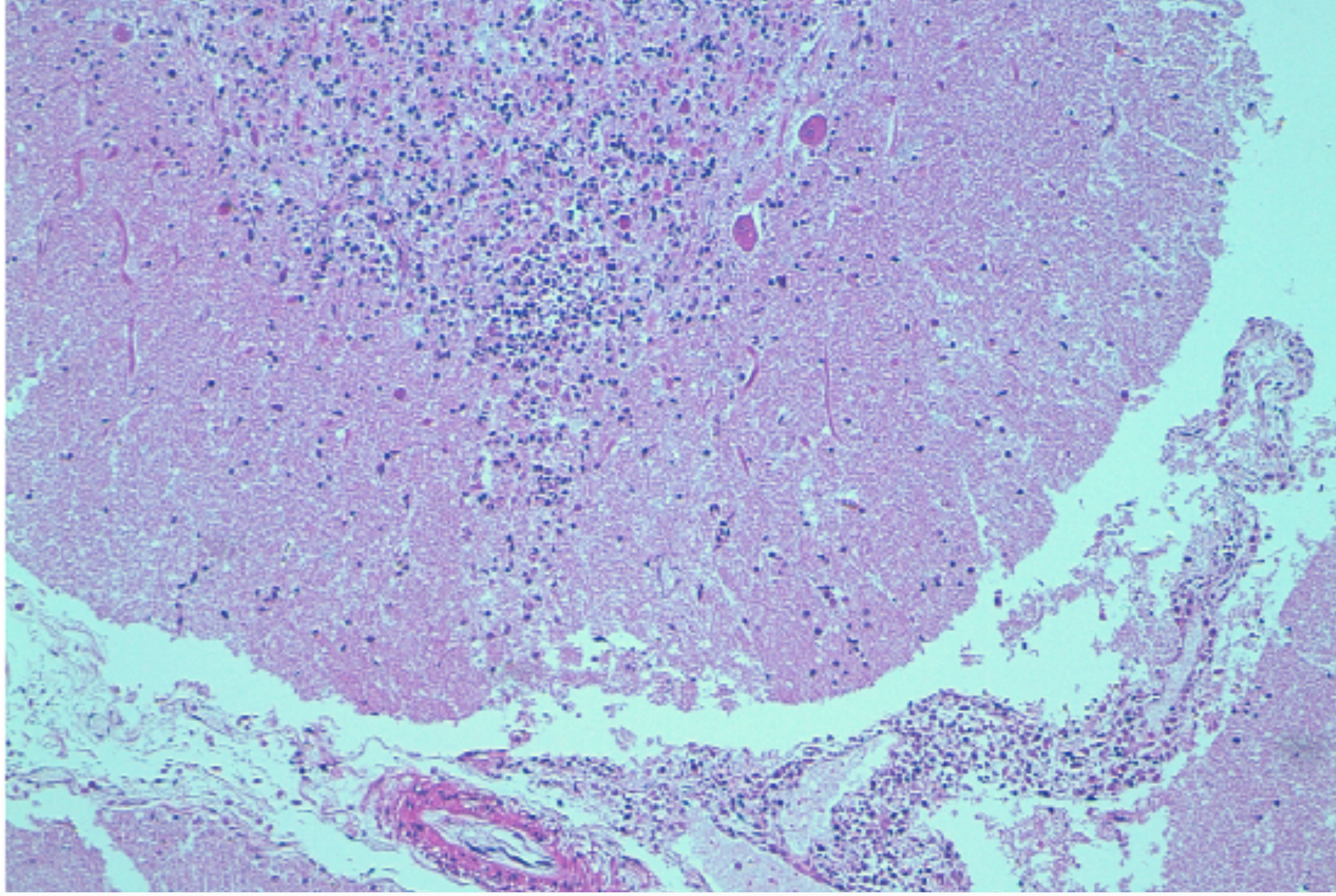
Francesco Mira[1], Consuelo Rubio-Guerri[2,3], Giuseppa Purpari[1], Roberto Puleio[1], Giulia Caracappa[1], Francesca Gucciardi[1], Laura Russotto[1], Guido Ruggero Loria[1] & Annalisa Guercio[1]

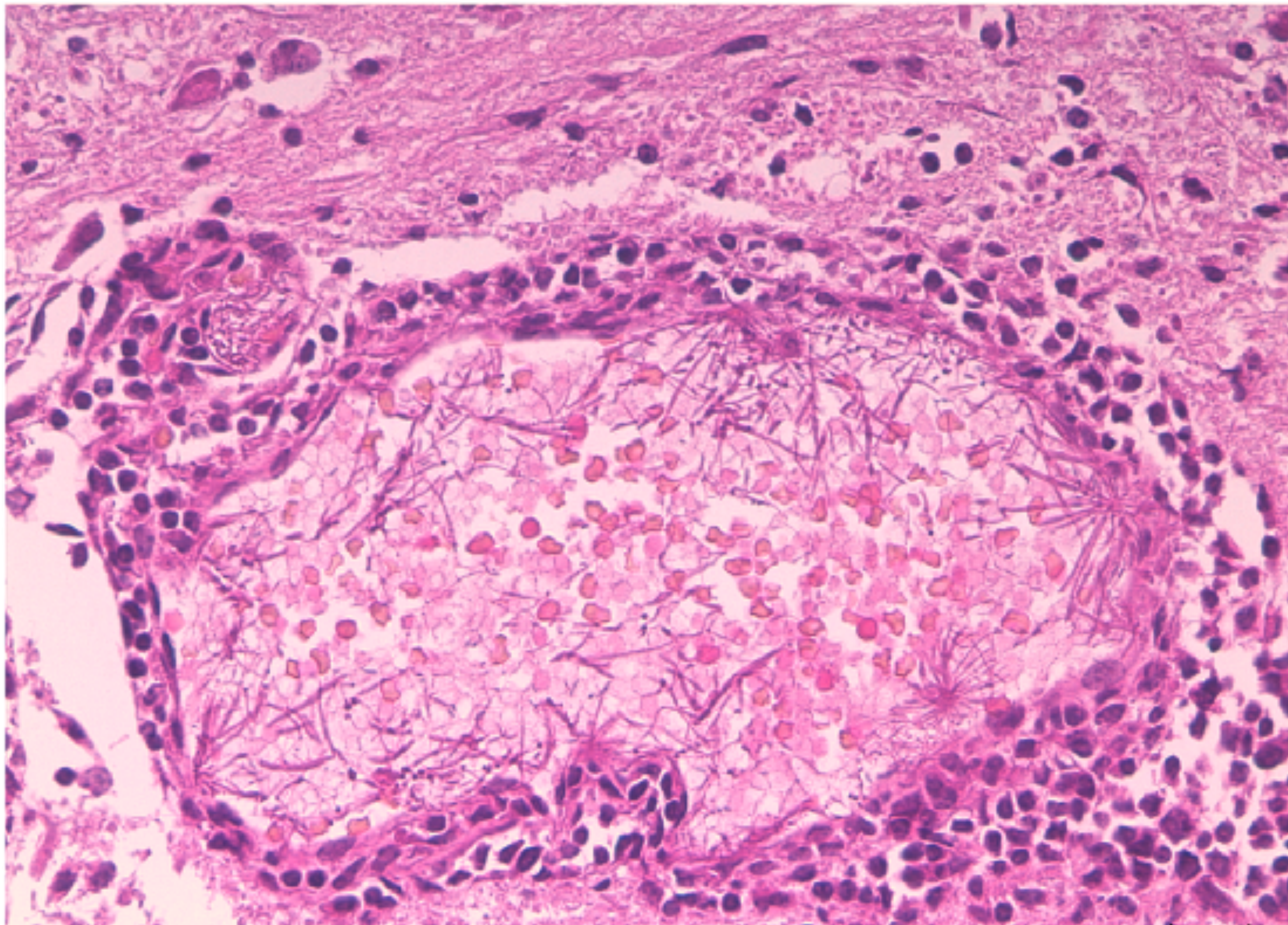


MAIN FINDINGS 2006-2021
29 fin whales stranded 1 minke whale

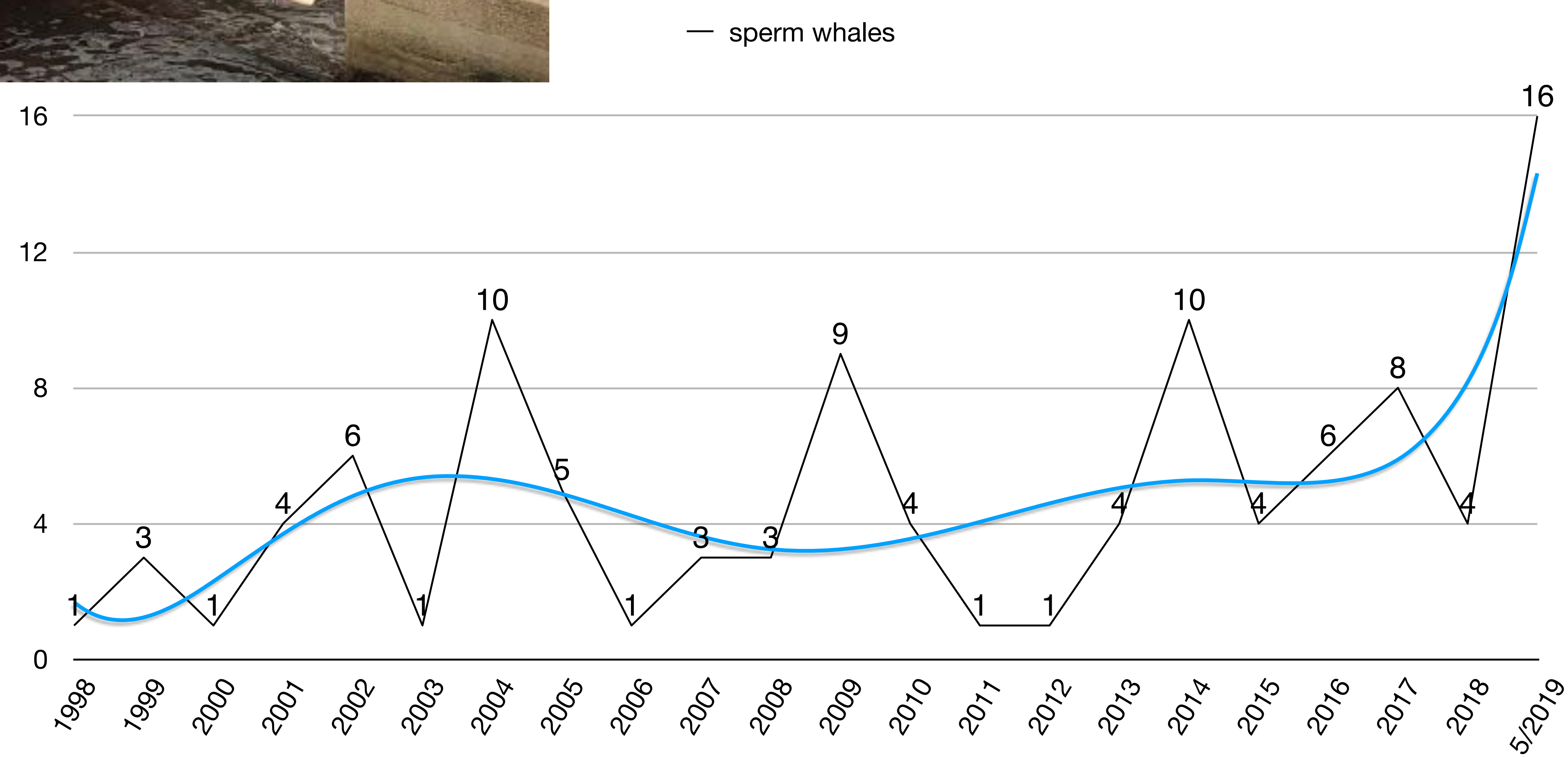






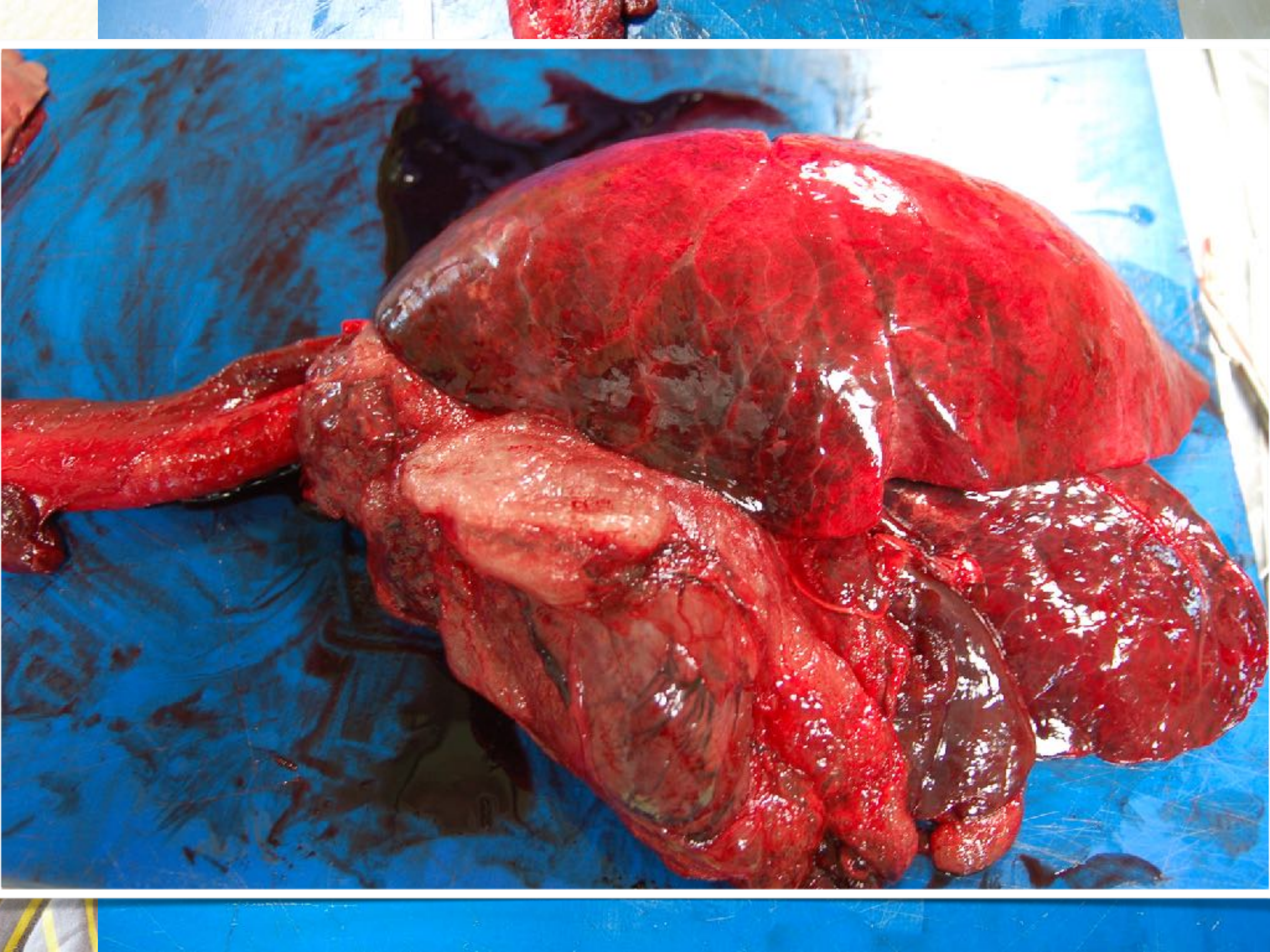


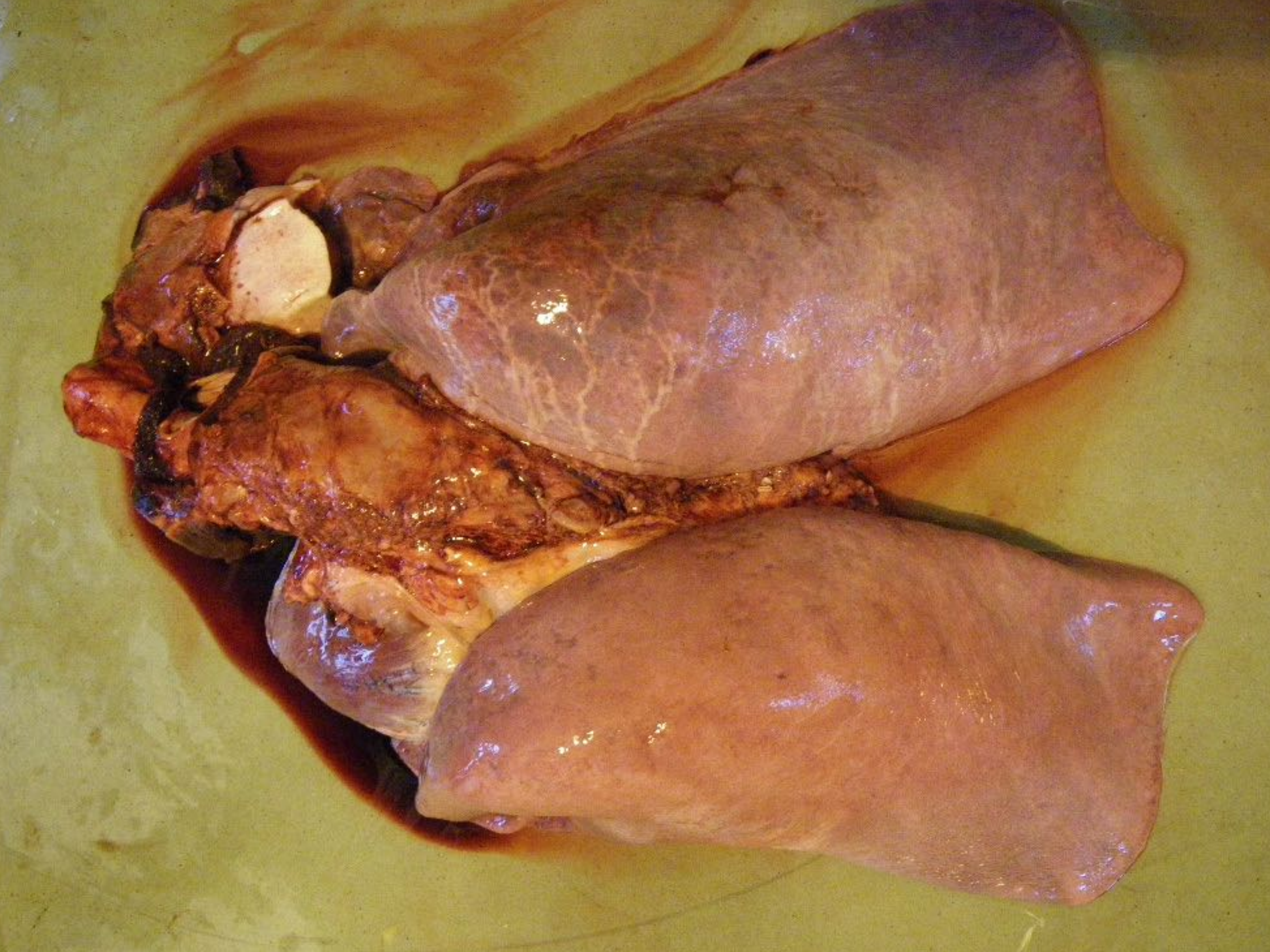
SPERM WHALES 2019

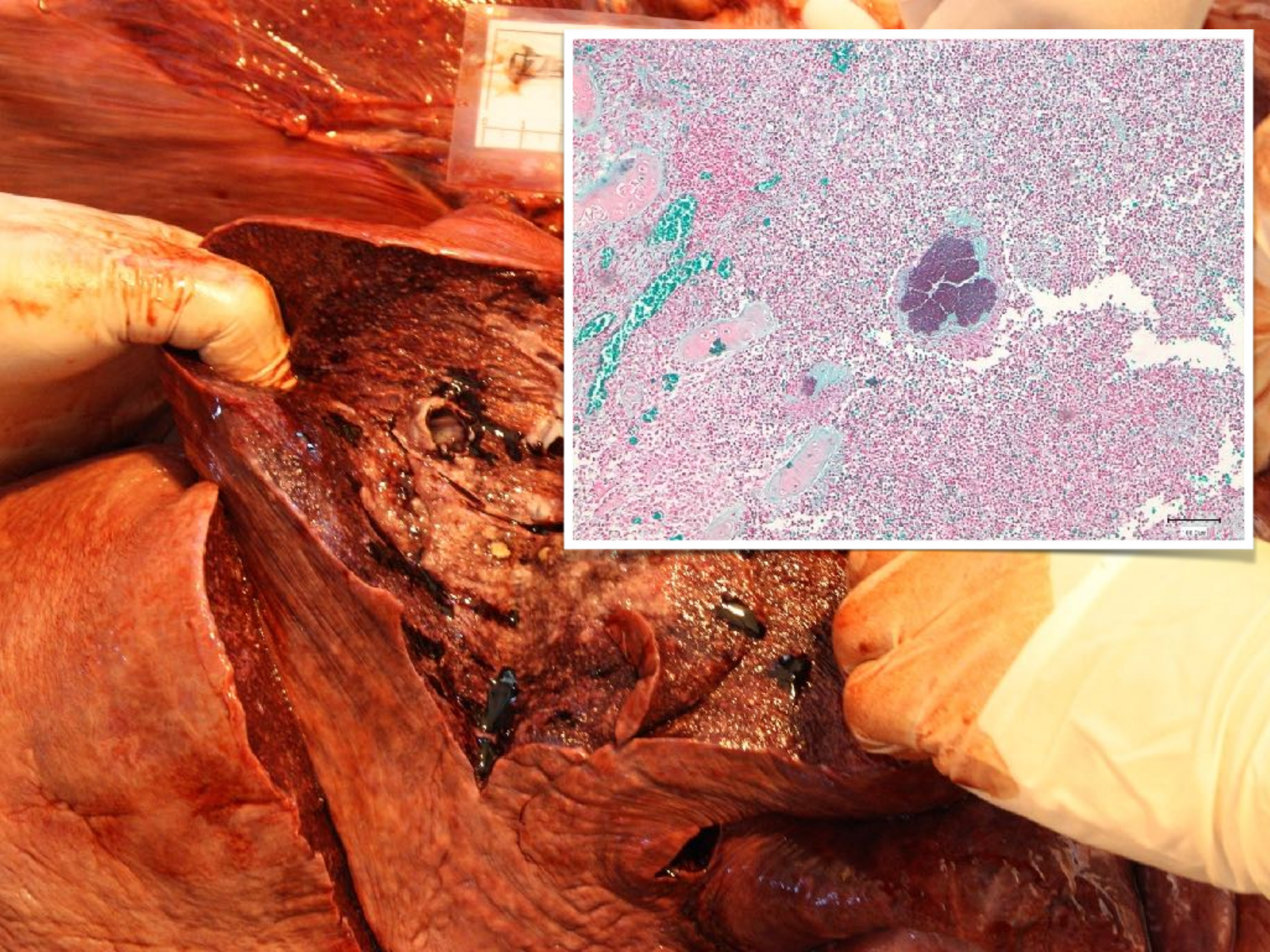


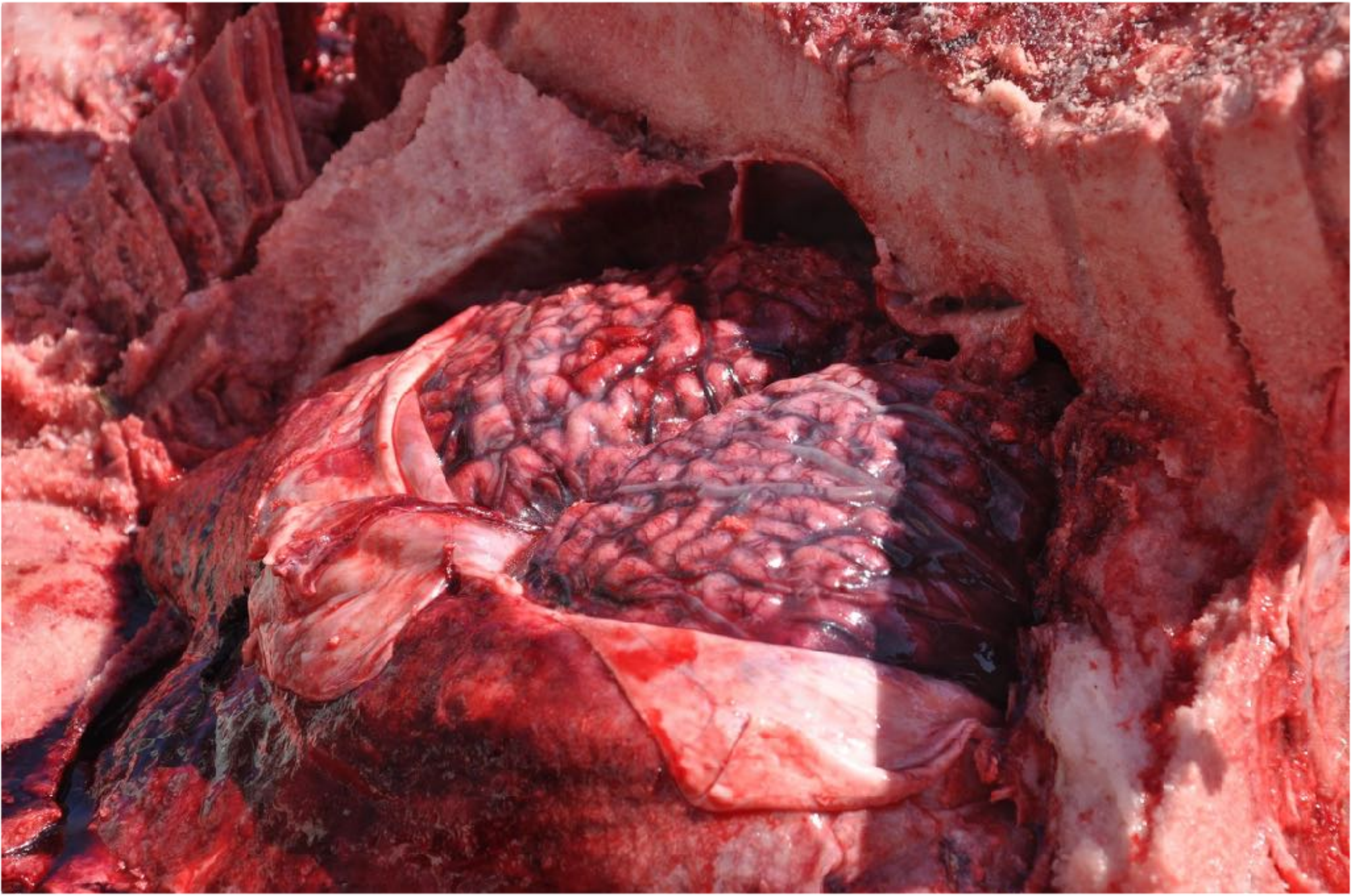
CeMV-Associated Gross Pathology

- Bronchopneumonia
- Meningeal hyperemia, meningitis, and brain edema
- Lymphadenopathy
- Mucosal erosions/inflammation (enanthema)
- Ocular lesions



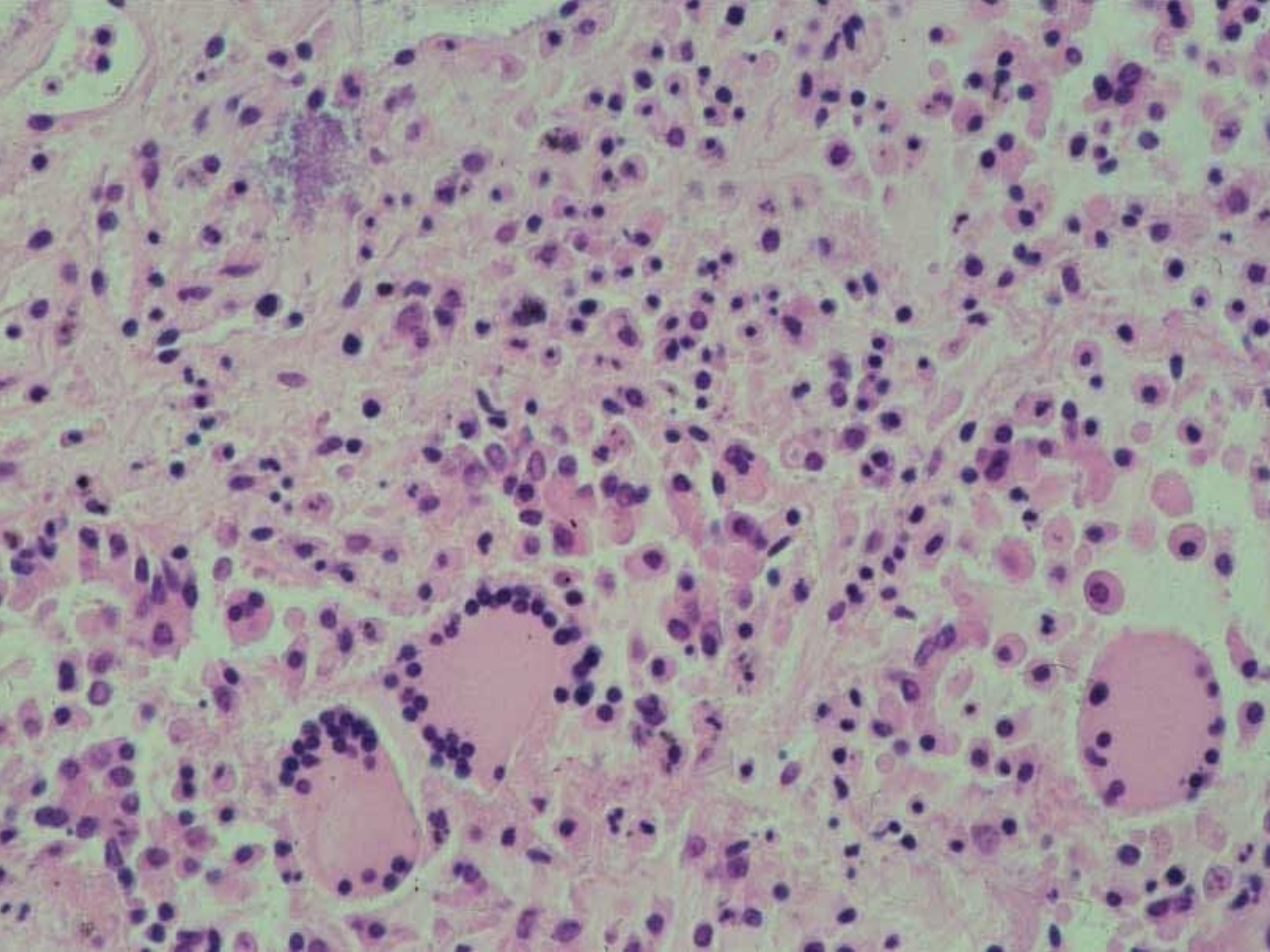


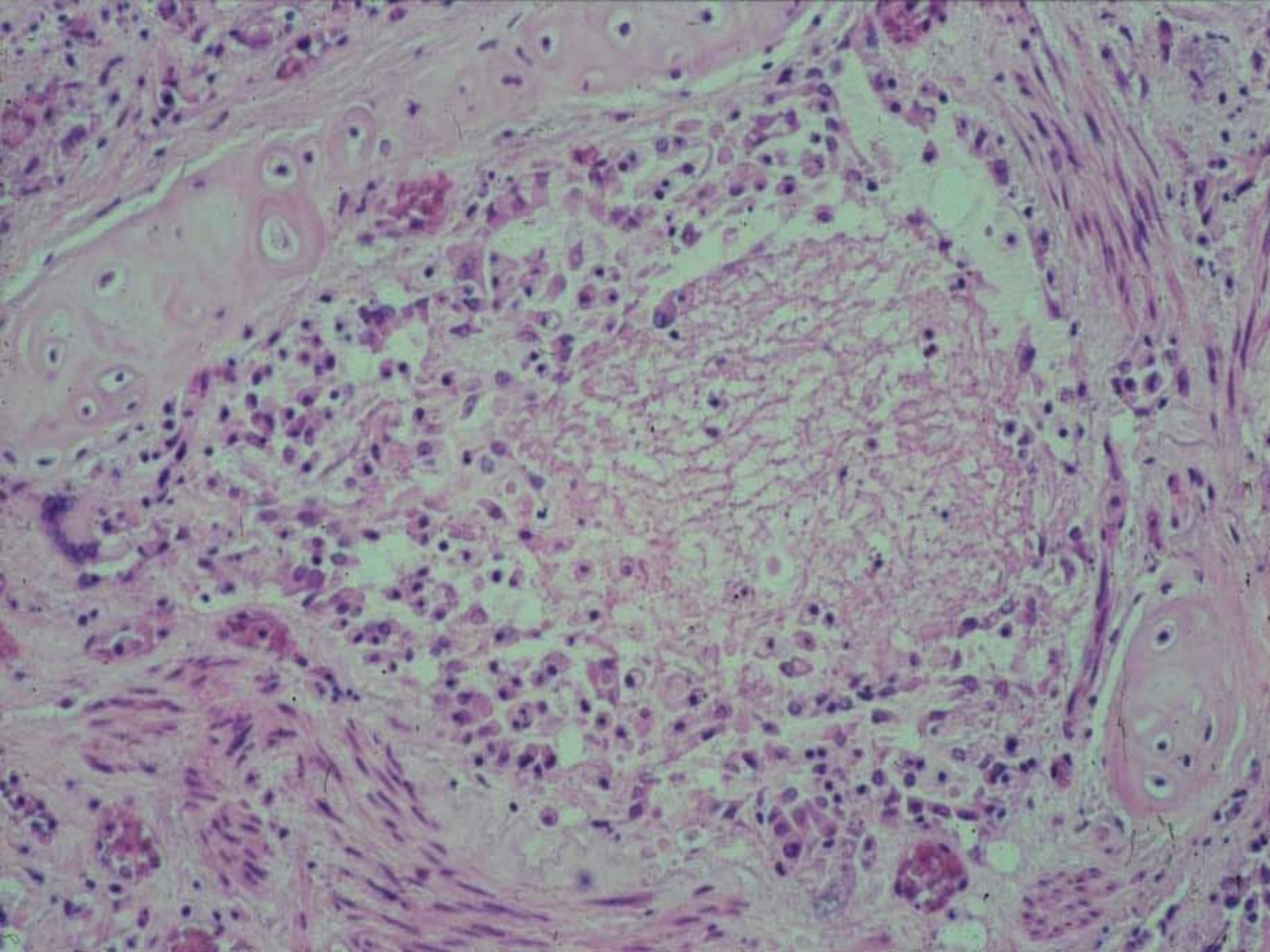




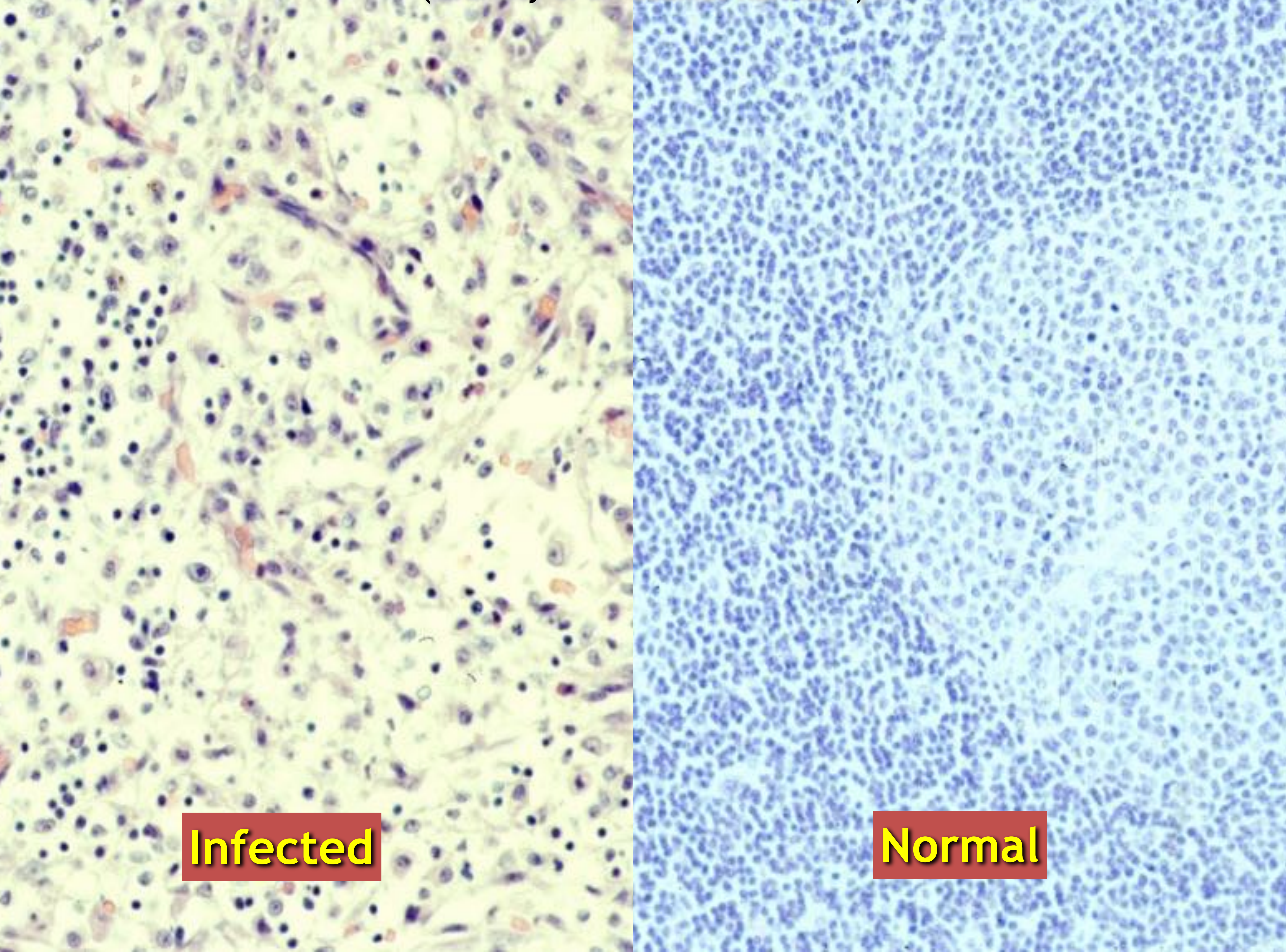
CeMV-Associated Microscopic Pathology

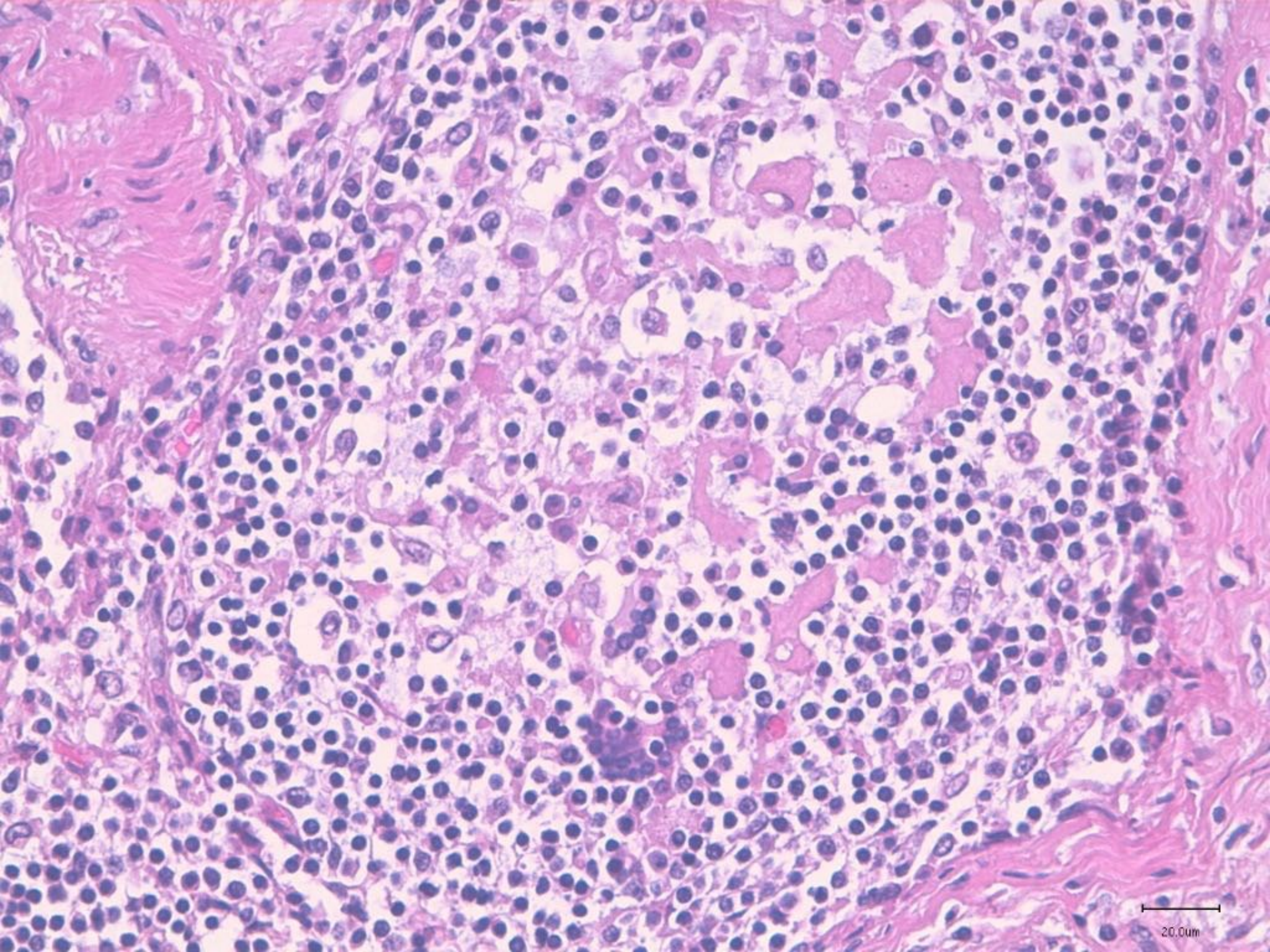
- Bronchiolo-interstitial pneumonia (72%)
- Pulmonary syncytia (65%)
- (Meningo)-encephalitis (69%)
- Syncytia in brain (22%)
- Lymphoid depletion (spleen, lymph nodes)
- Syncytia in lymph nodes (19-31%)
- Viral inclusions in infected cells



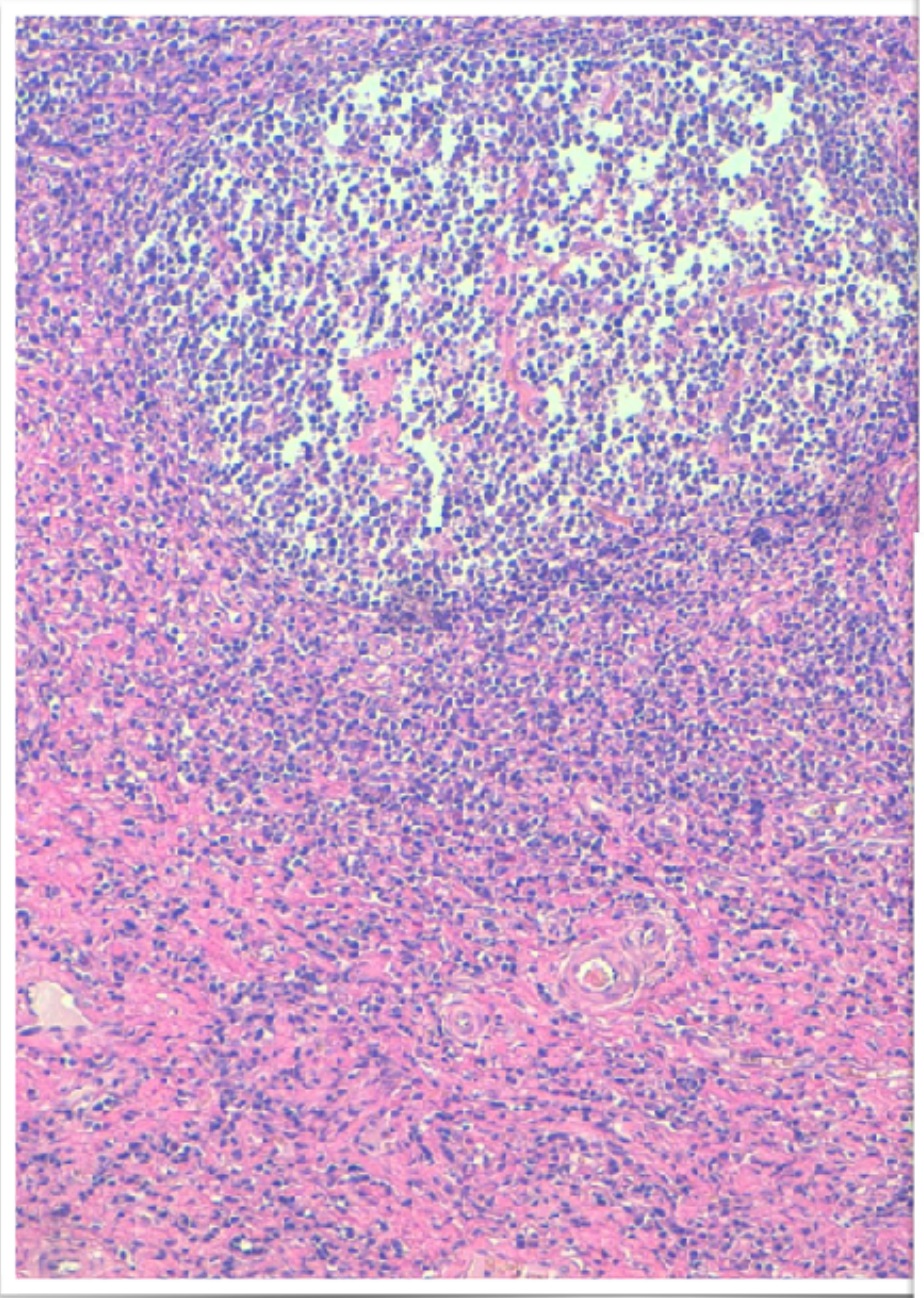


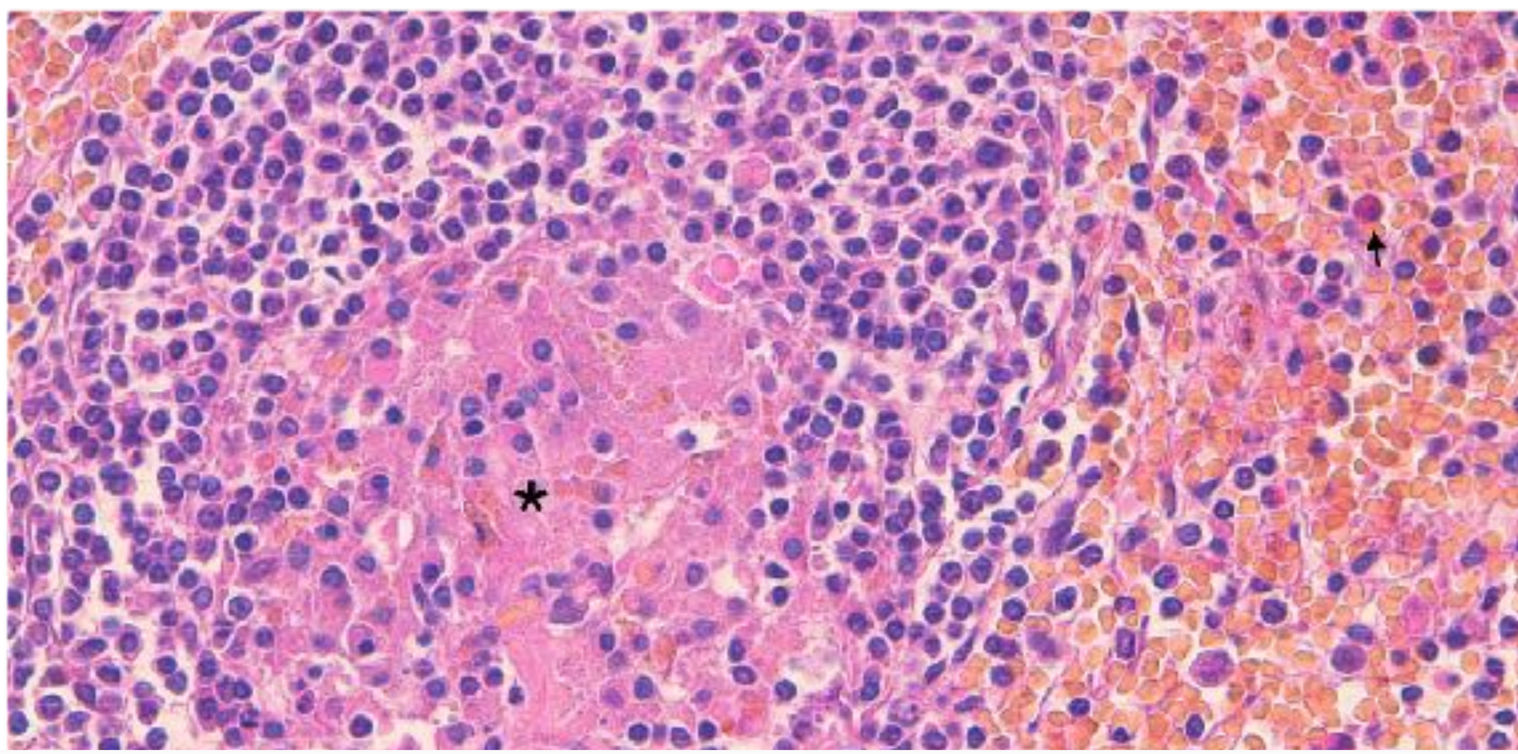
(courtesy of Dr. Seamus KENNEDY)

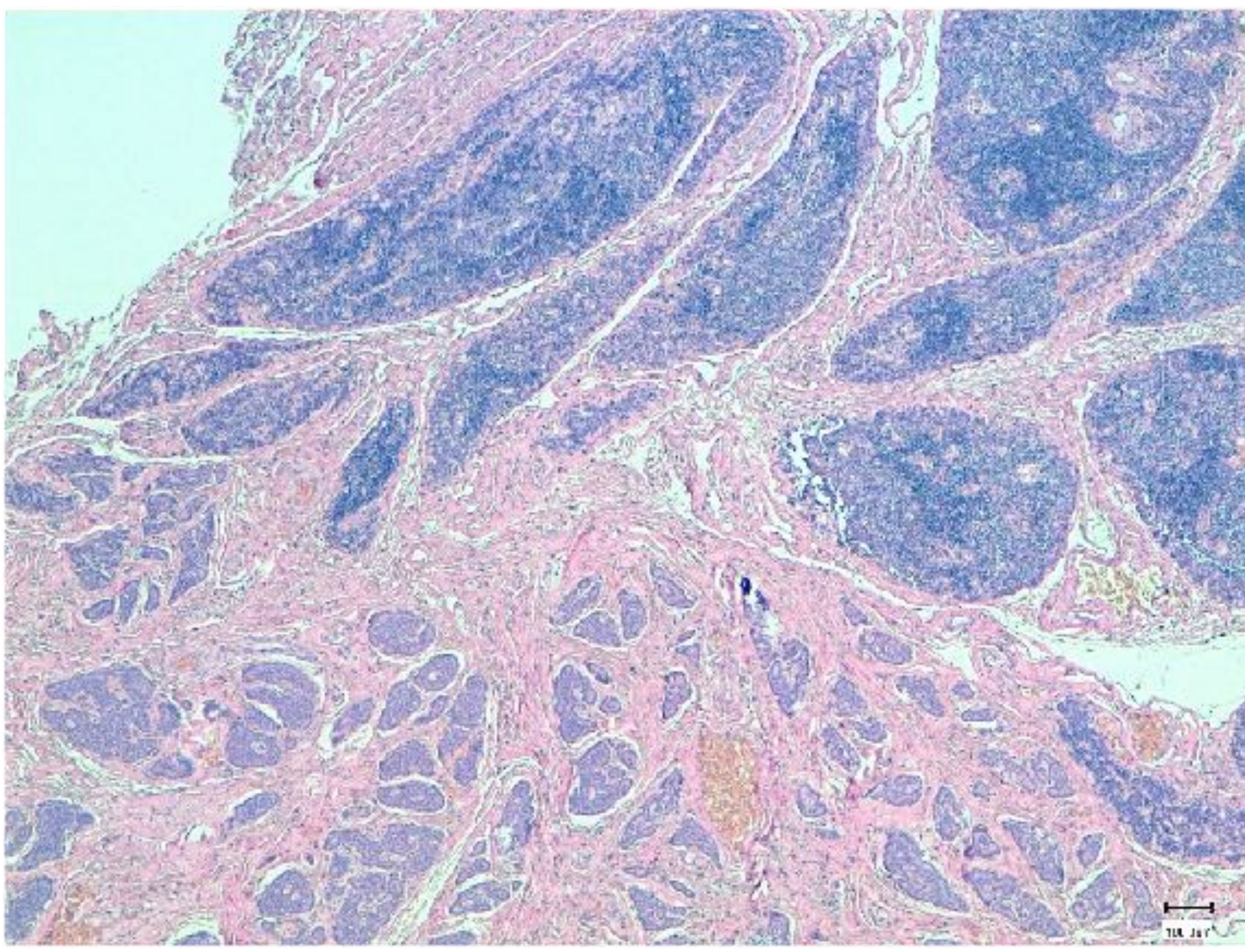


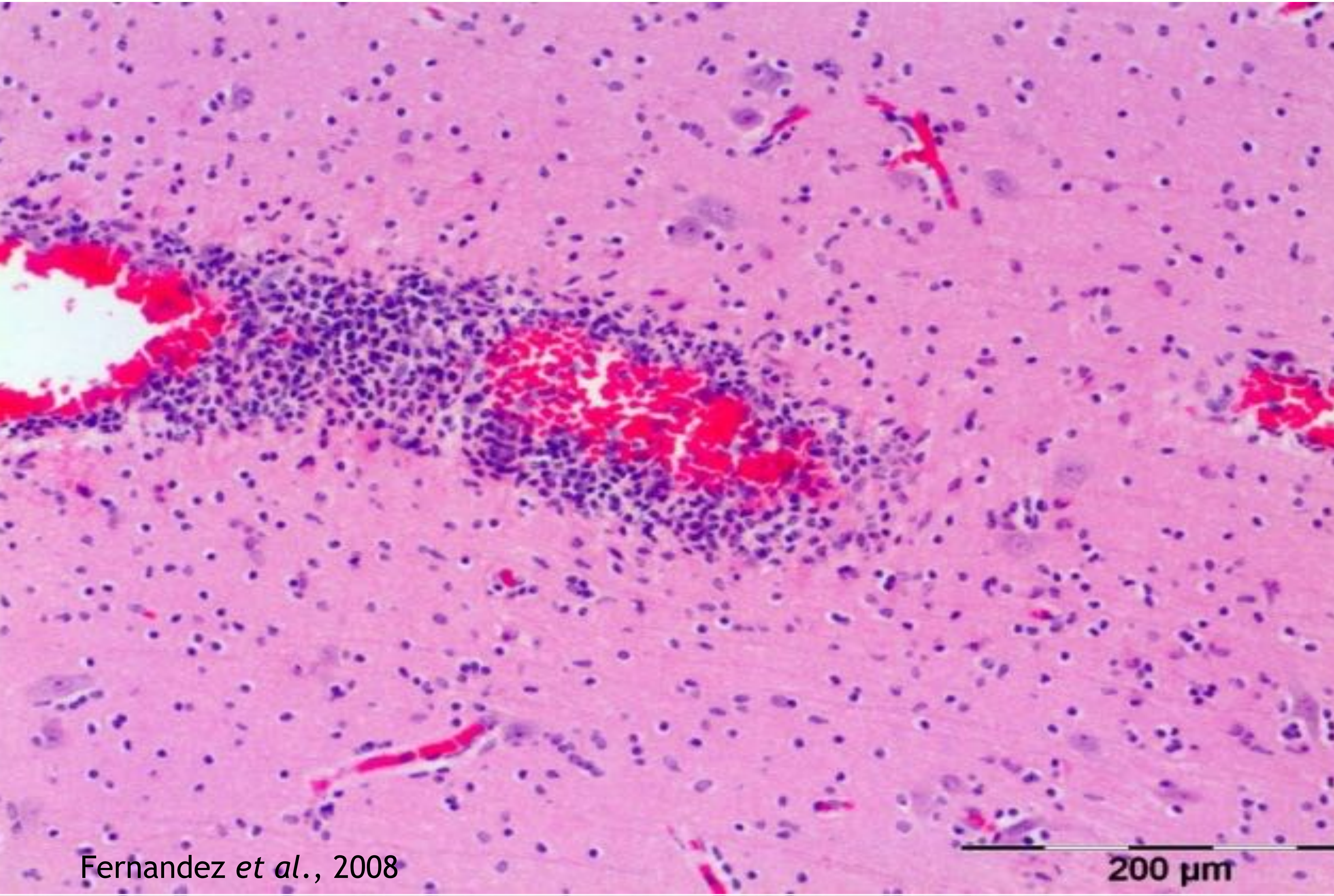

20.0um

DMV Mediterranean outbreak 2013

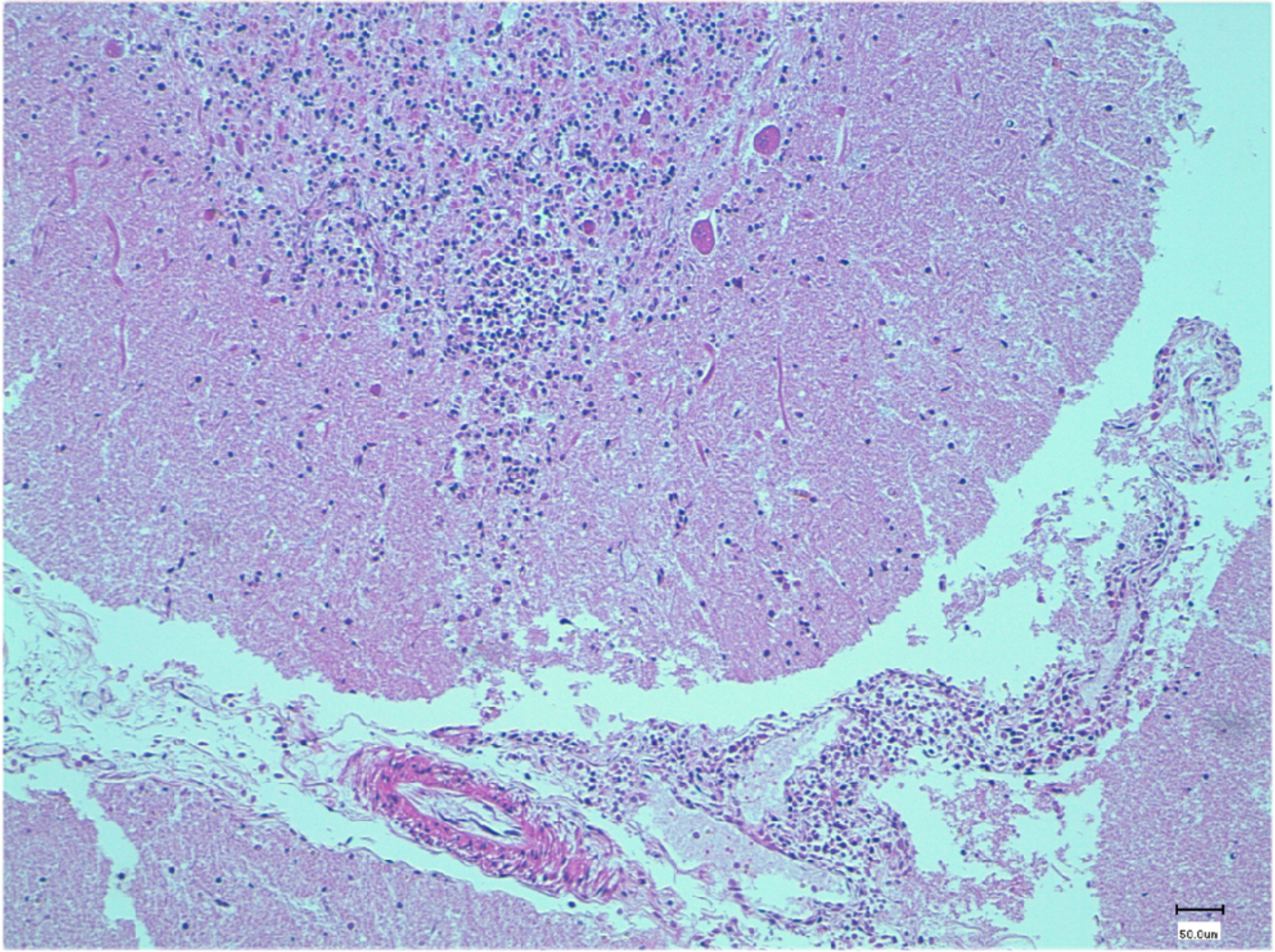


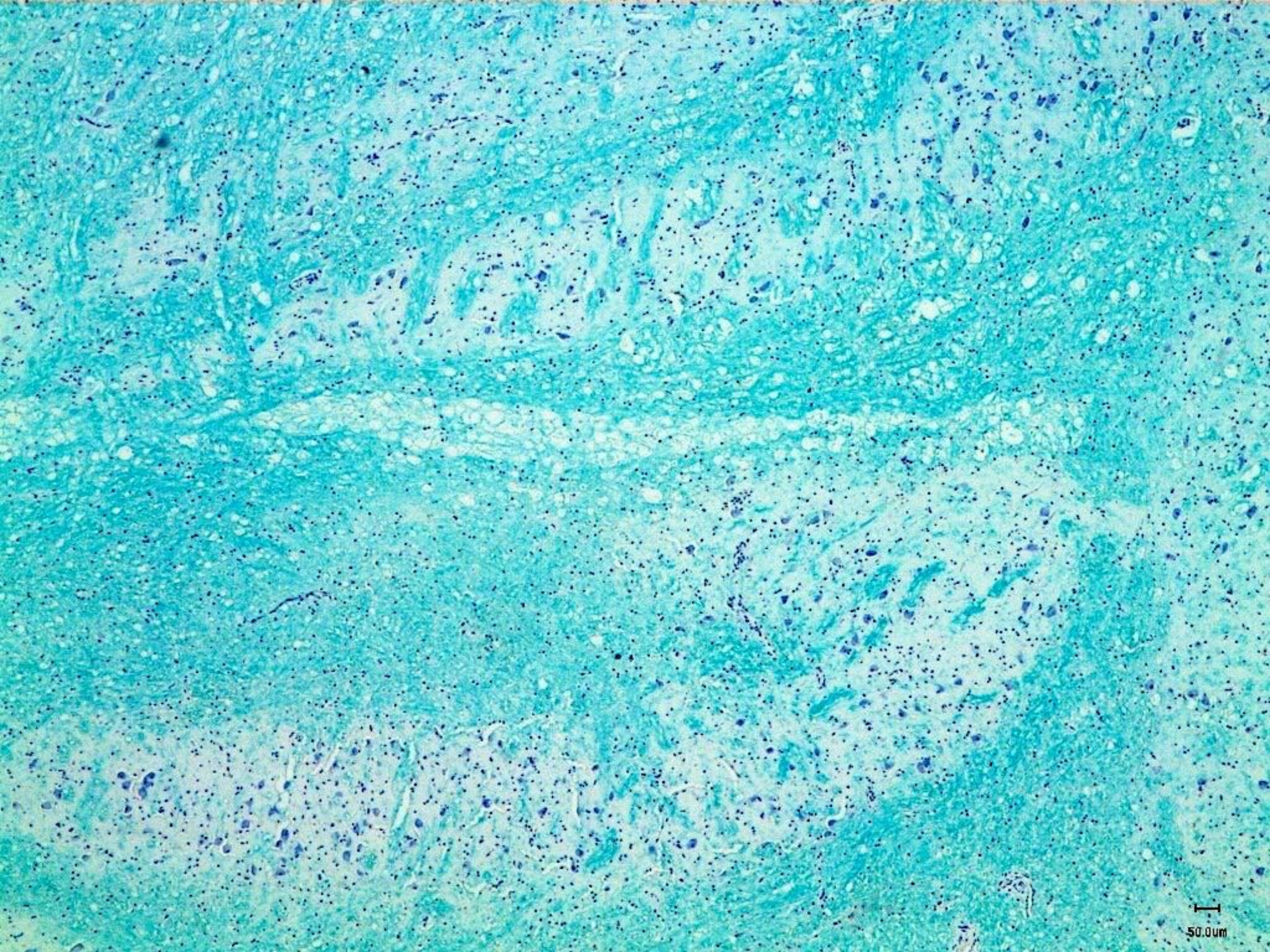


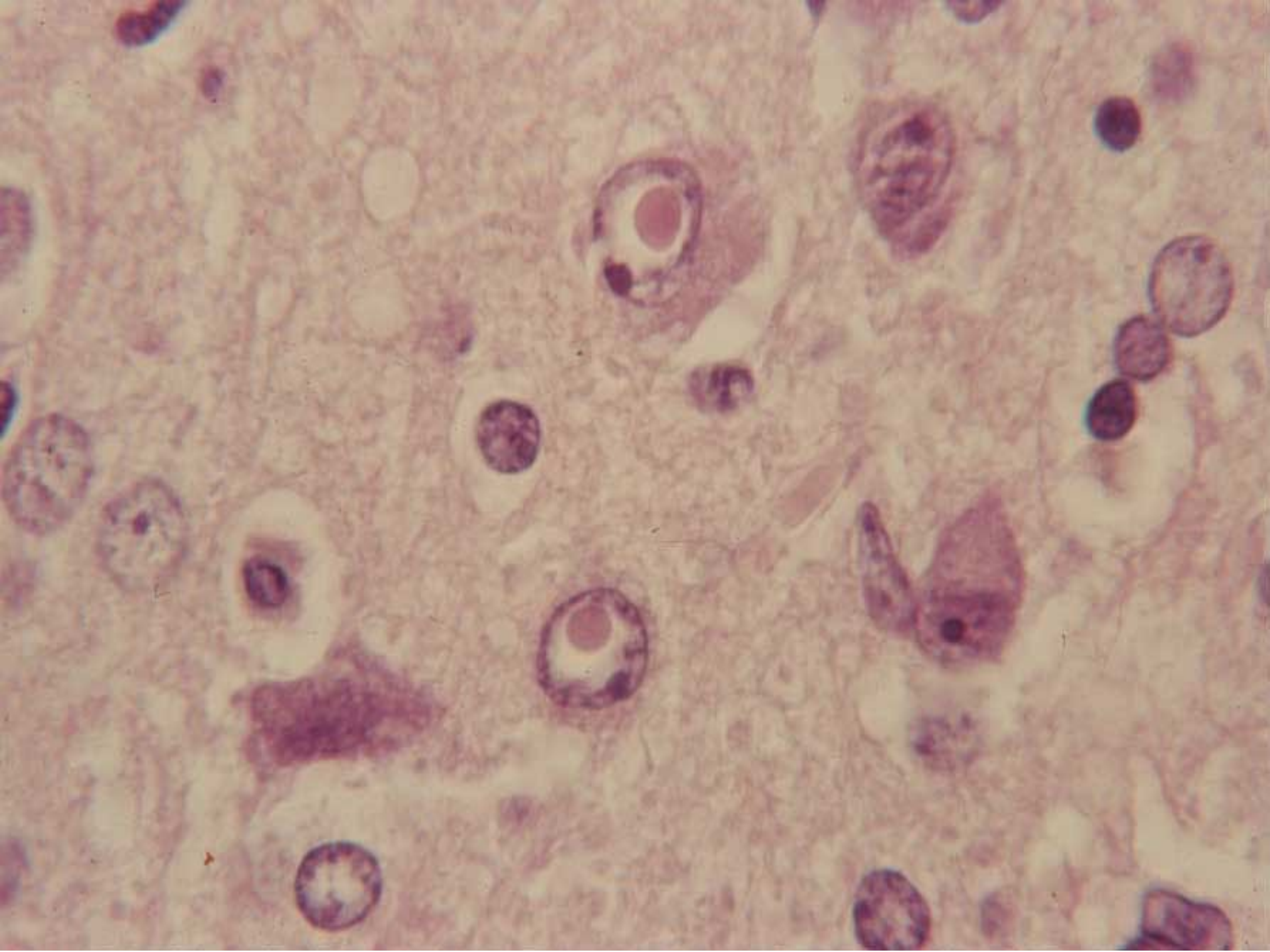


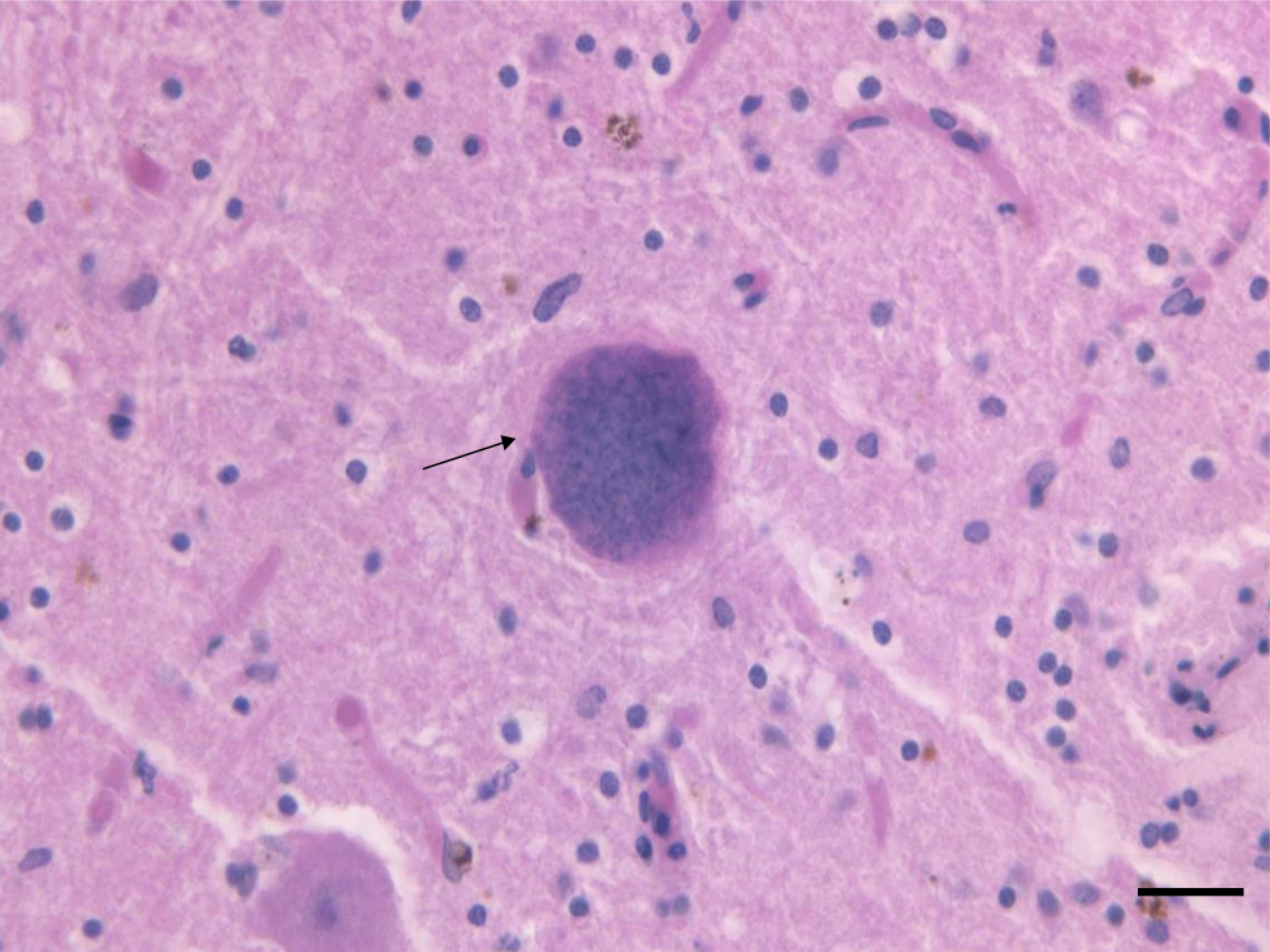


Fernandez *et al.*, 2008


50.0um


50.0um





DMV diagnosis:

- Direct isolation

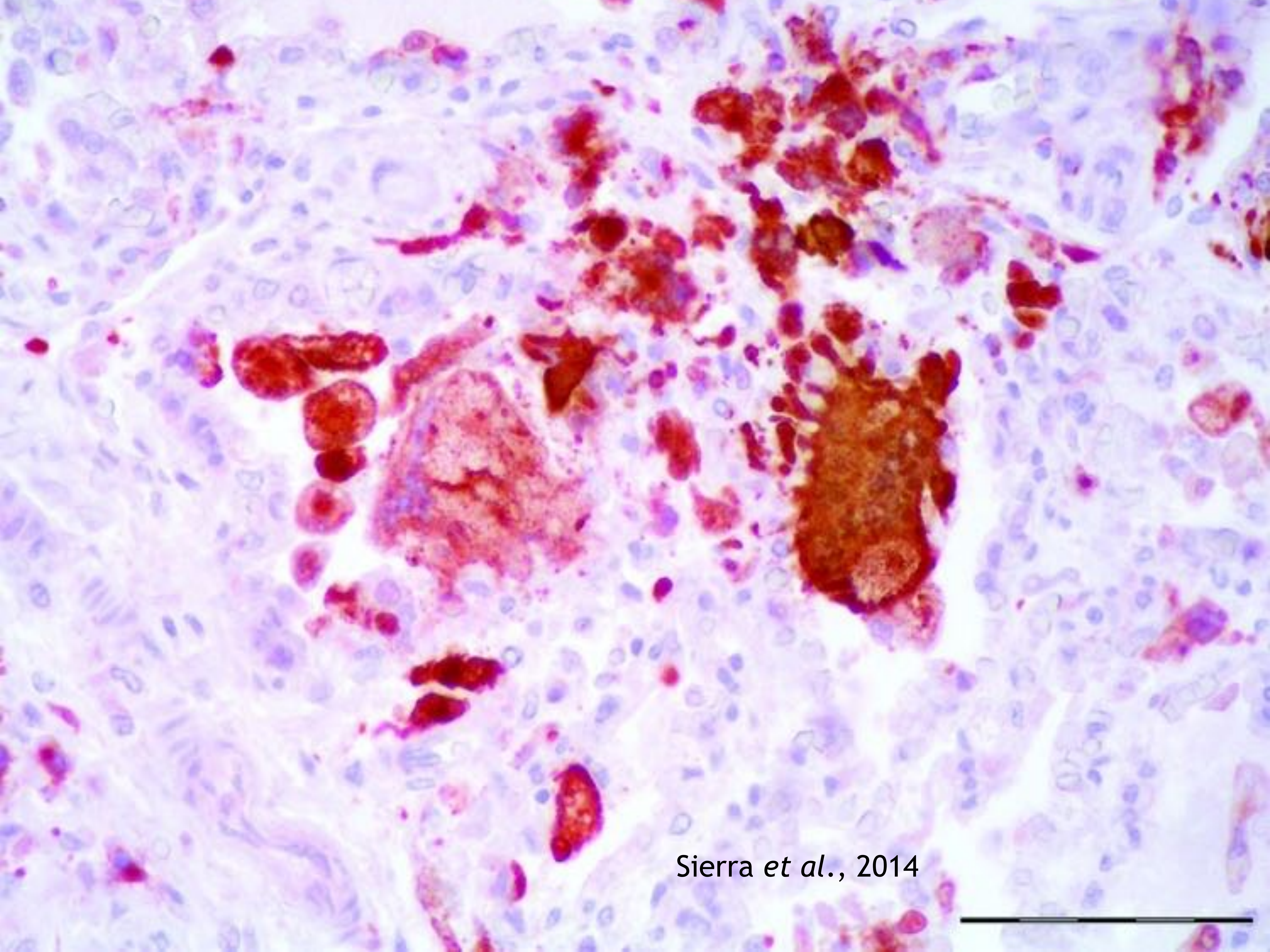
- IHC mouse monoclonal anti-bodies for CDV nucleoprotein (VMRD)

- rt-PCR 429 bp (Barrett et al., 1993) gene P or

- rt-PCR 78 bp (Krafft et al., 1995; Saliki et al., 2002) gene P or

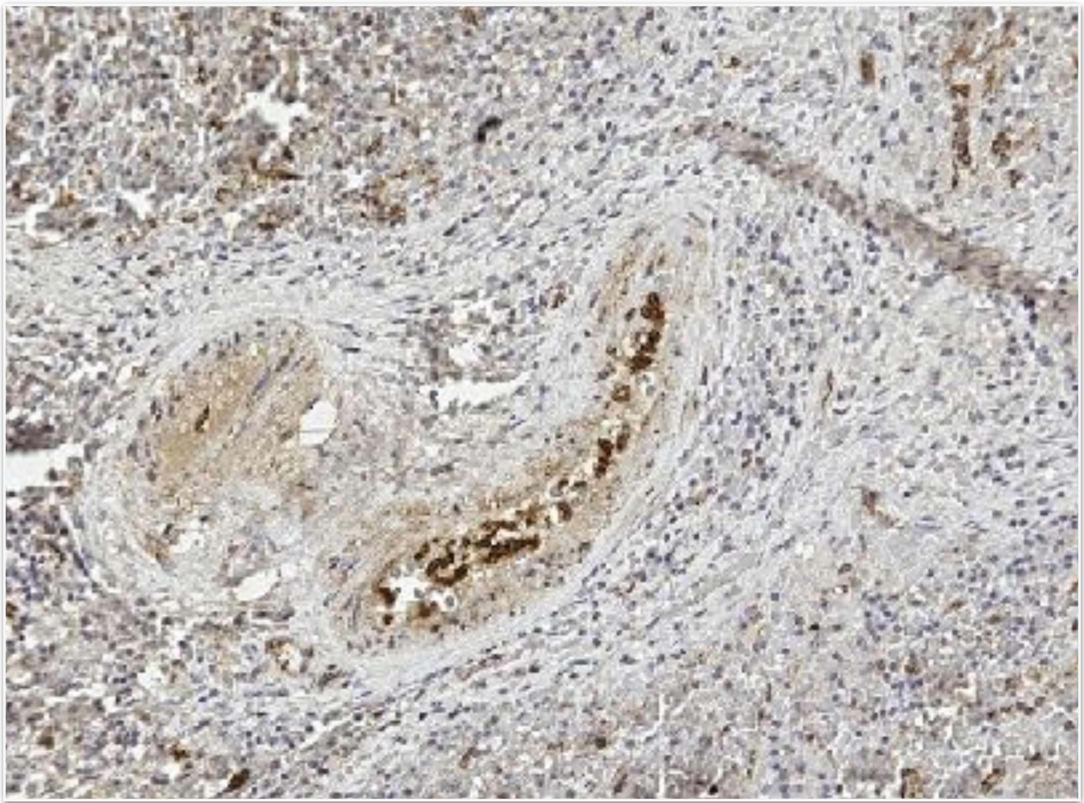
- UPL rt-PCR (Rubio-Guerri et al., 2013) gene F

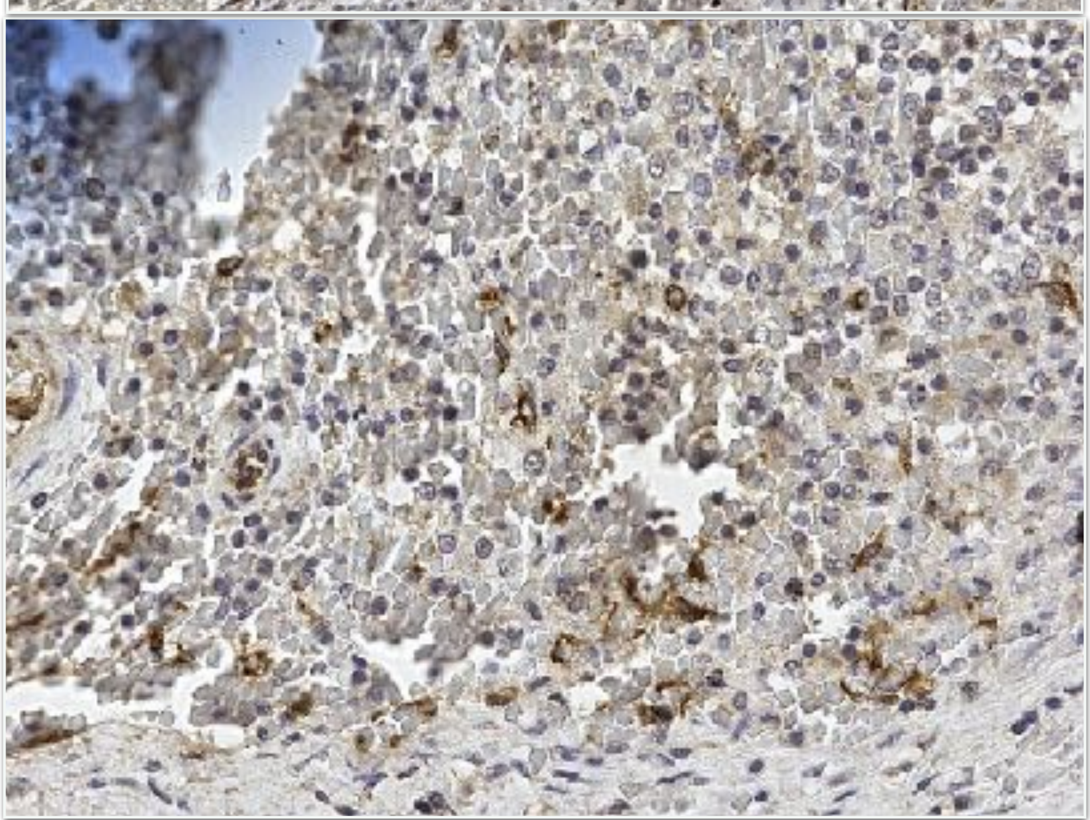
- Partial nucleoprotein (N1), fusion protein (F), and hemagglutinin (H) could be amplified using cetacean morbillivirus (CeMV)-specific primers (Belliere et al., 2011)
- nested-PCR su H protein (Centelleghe et al., 2016)
- RT-PCR con primers degenerati (Verna et al., 2017)

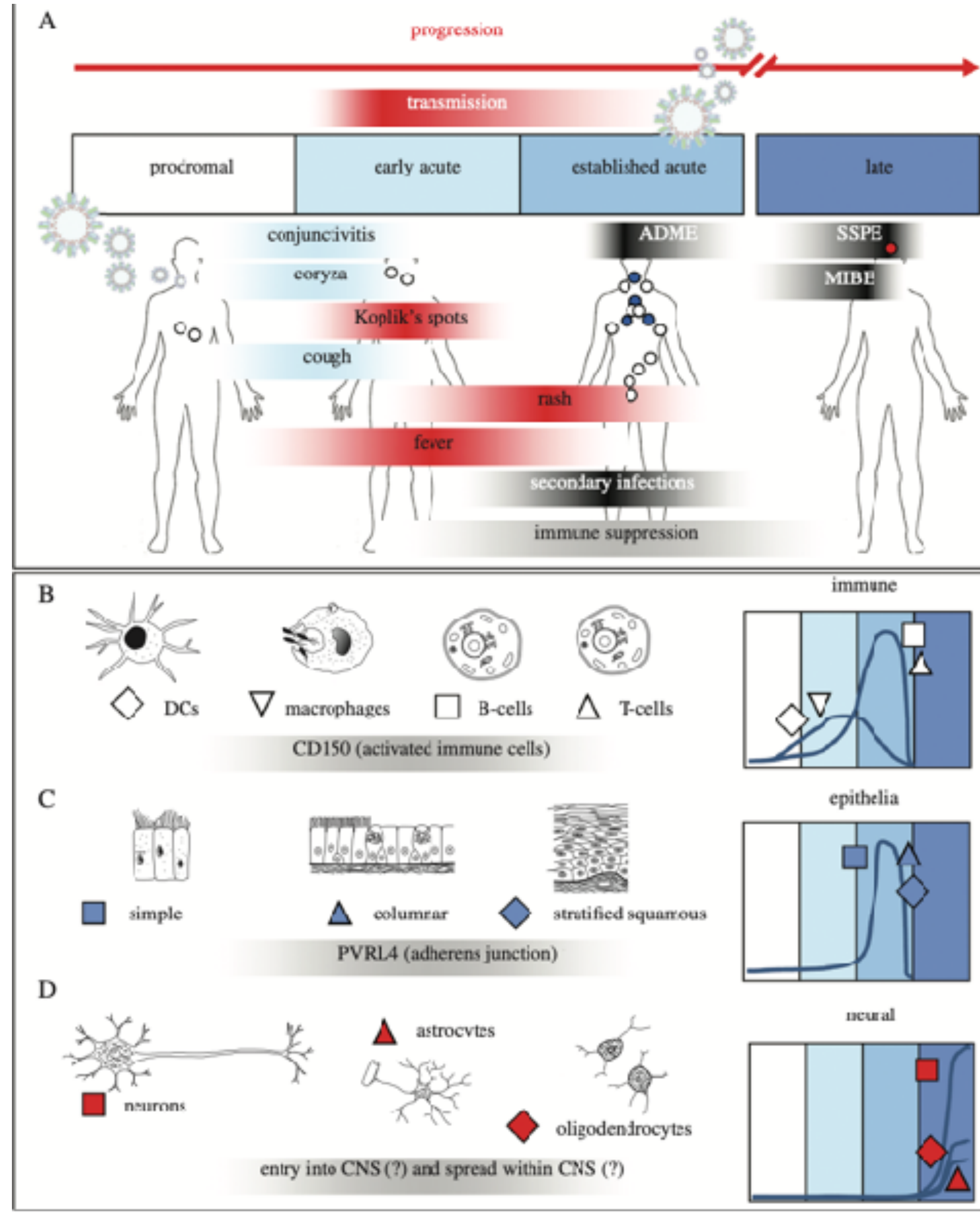

Sierra *et al.*, 2014

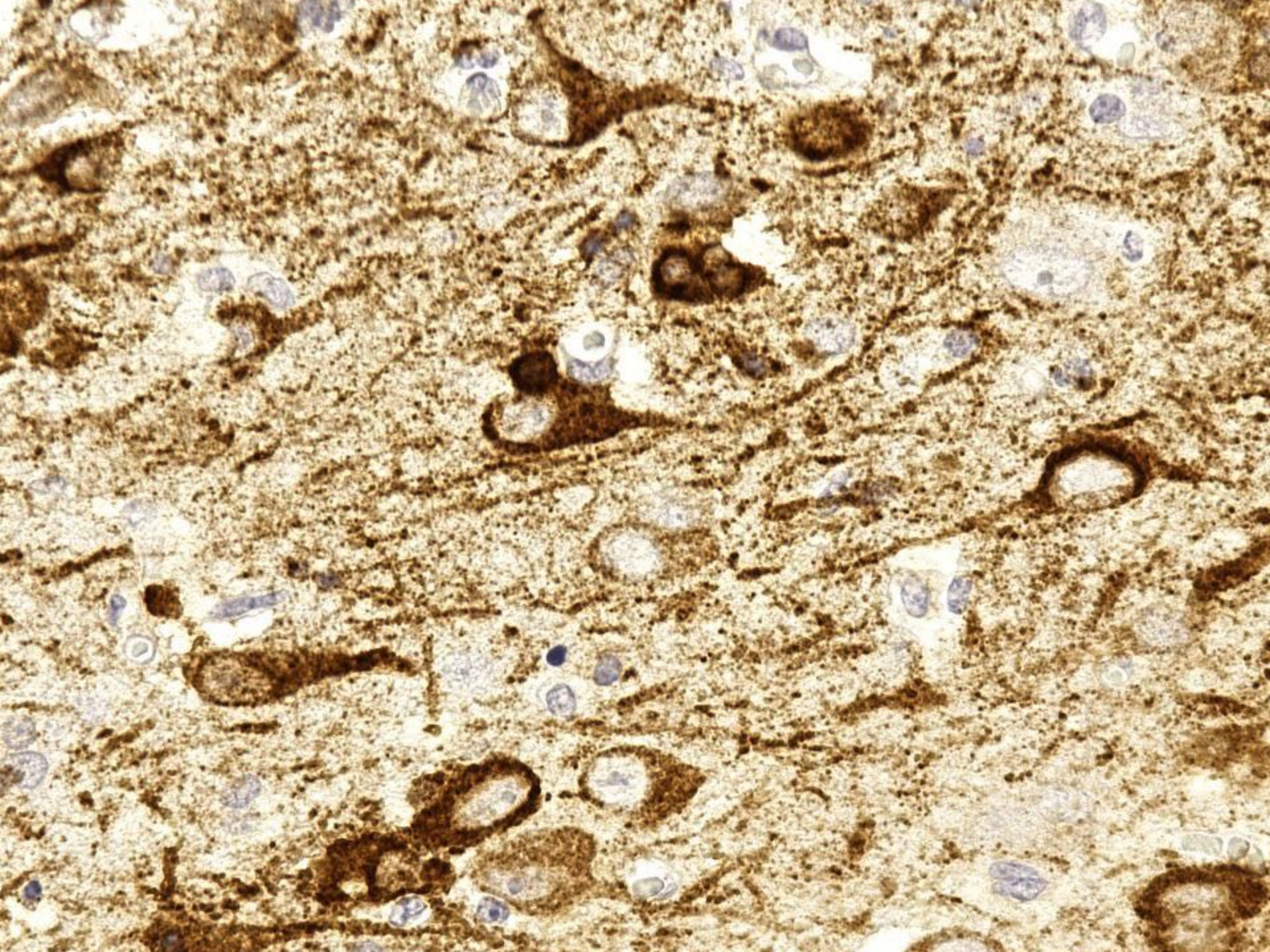
ANTI CDV-NP MONOCLONAL ANTIBODY

SW UME 2014









Herpesvirus

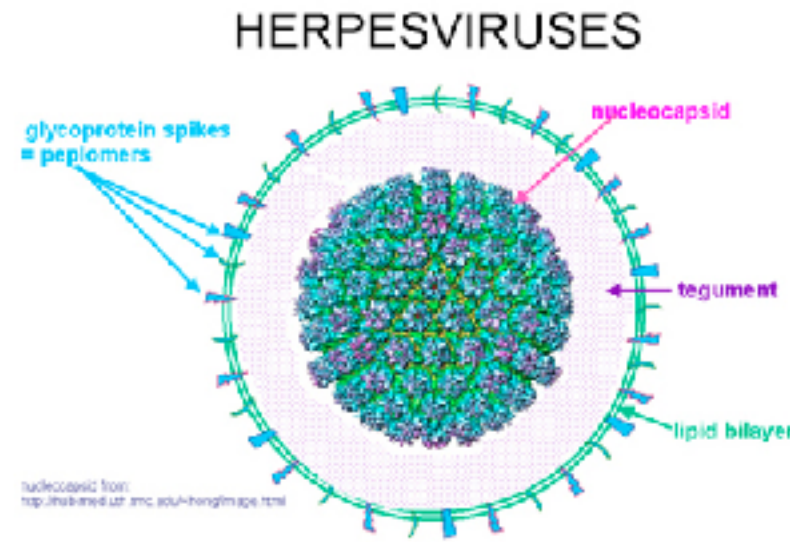
- Herpesvirus - DNA virus with envelope

- alpha (related to human) and gamma-herpesviruses (typical of cetaceans)

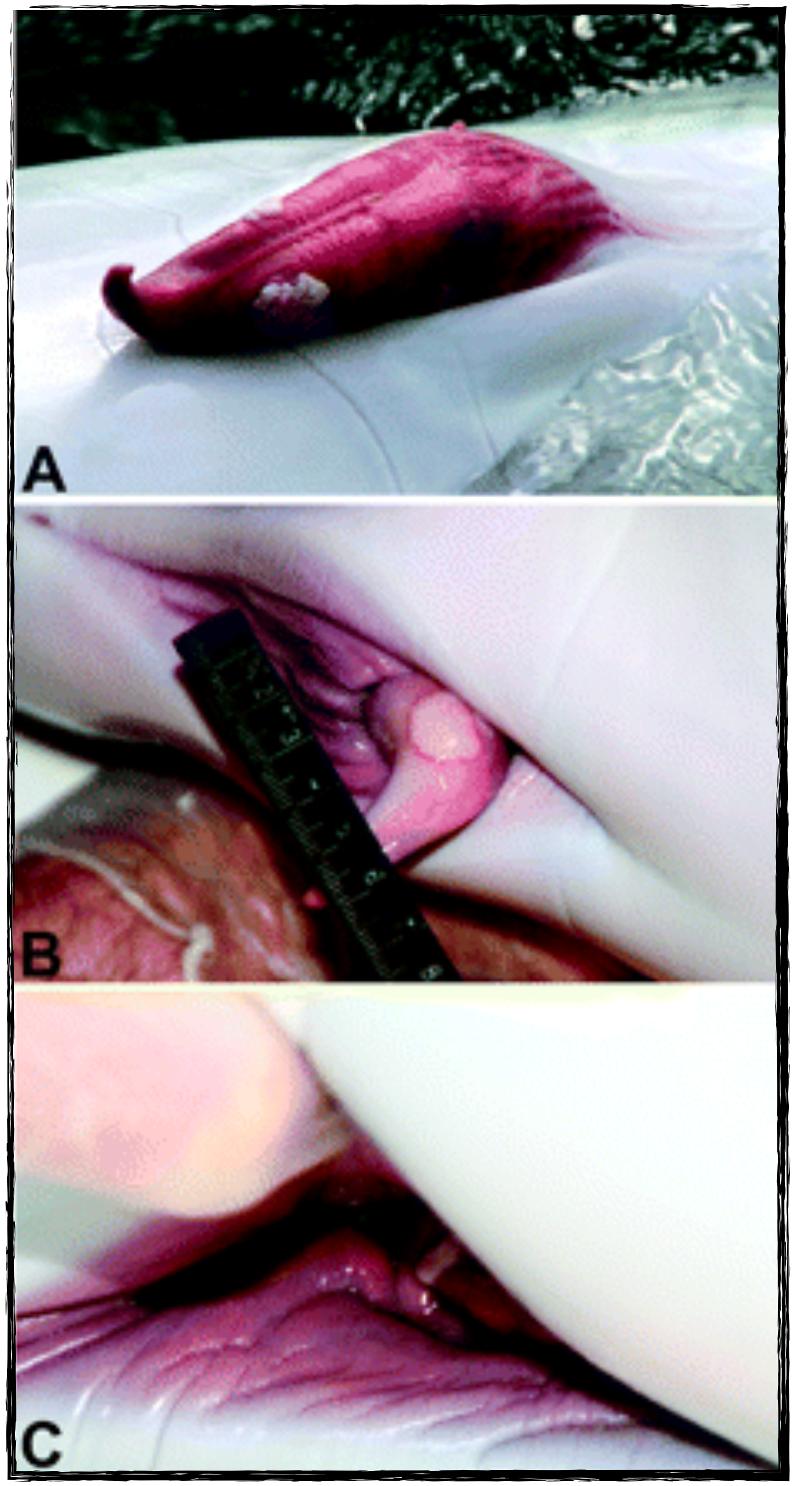
- Frequently PCR isolation: not clear its role but it is responsable for secondary infection

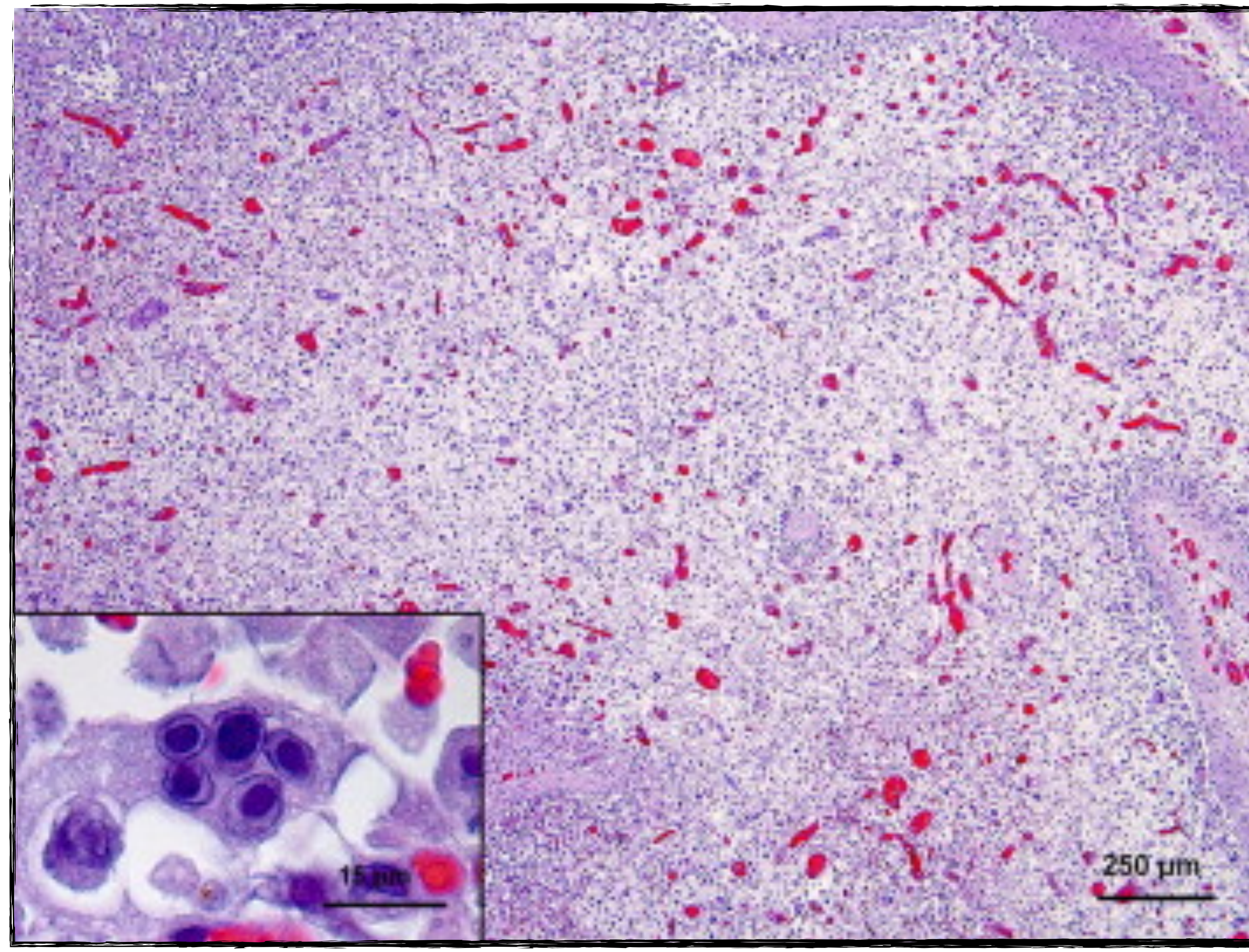
- Trophism for epithelium (skin and mucosa) and nervous tissue (neurons, glial cells)

- Main findings: systemic acute necrotizing infections, proliferative transient dermatitis, interstitial nephritis, non-purulent encephalitis.

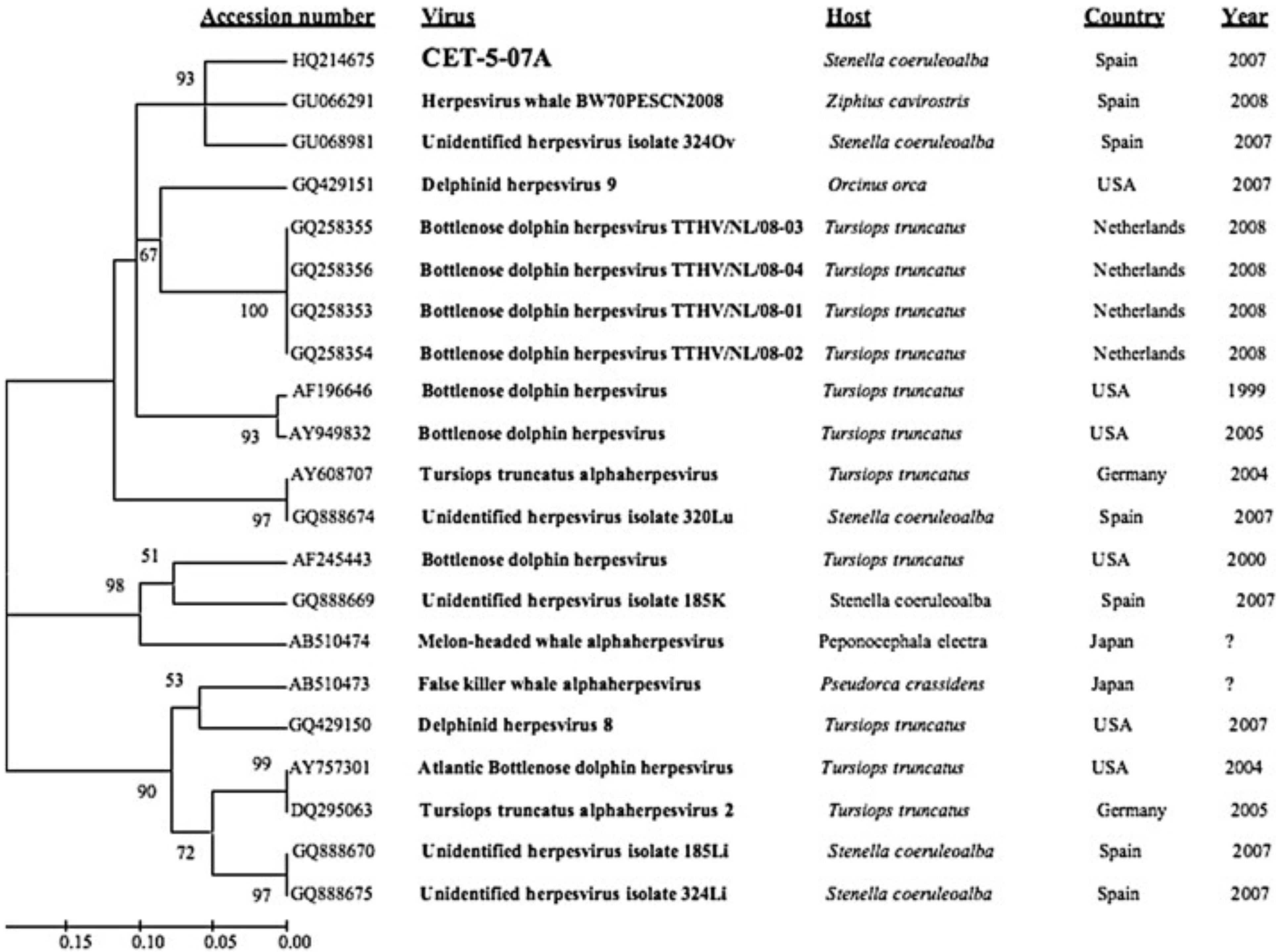


Herpesvirus





Herpesvirus



Poxvirus

- Poxvirus (EM similar to cowpox)

- Evident in tattoos-like lesions: flat or slightly arised, black, gray or yellow, irregularly elliptical, localized or systemic.

- Enzootic in some populations, mainly in juvenile. Not life-threatening population.

Other virus

***Papillomavirus*: cutaneous and genital wards. Epithelial hyperplasia with koylocytes; genital tumors. USA Tt seropositivity 52% (captive) and 90% (wild).**

***Ortomyxovirus*:** Isolation of Influenza virus A (H1N3, H13N2, H13N9,

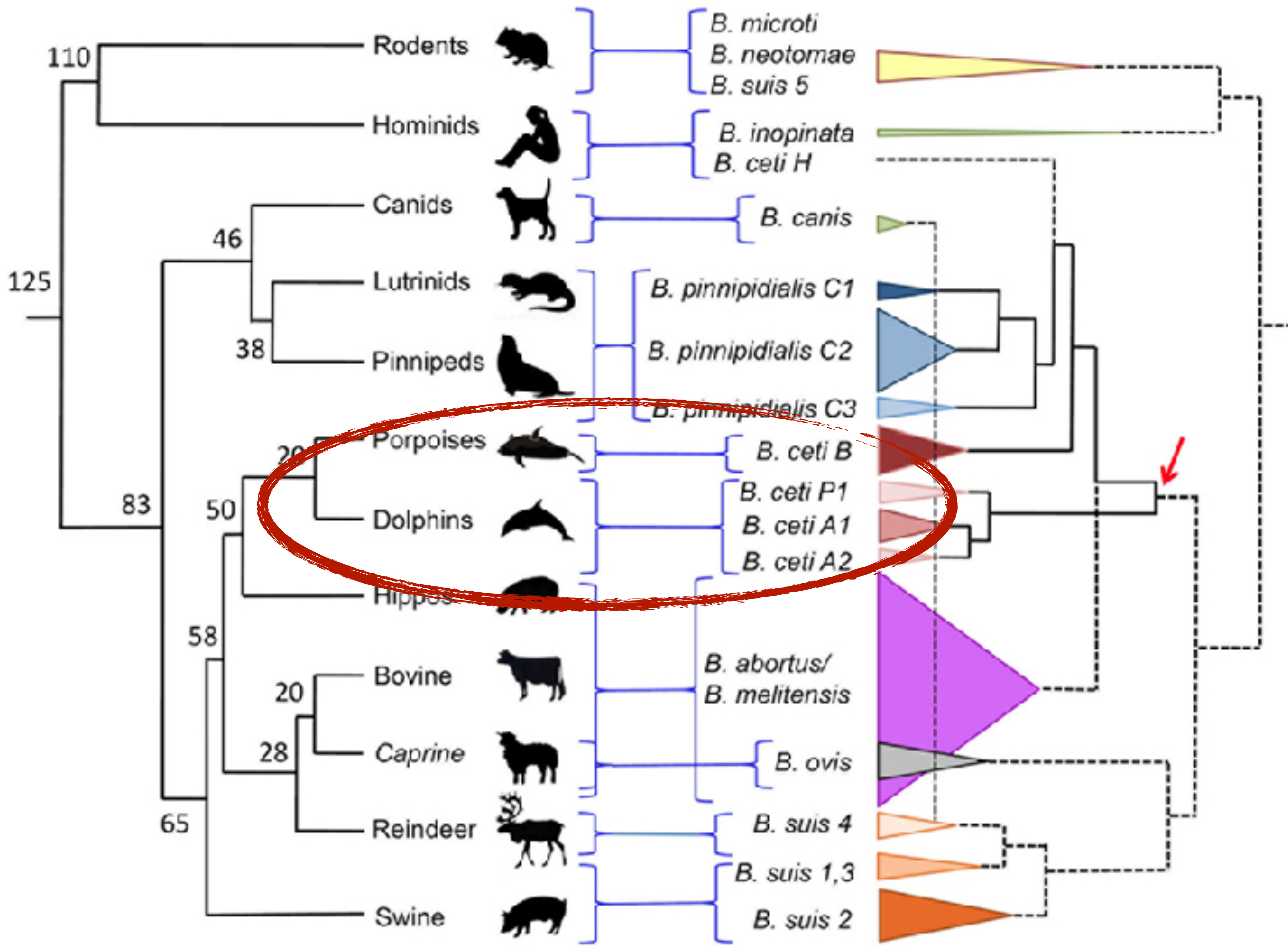
***Calicivirus*:** isolation from vesicles of Tt. Antibodies in whales.

Hepatitis B virus: hycterus and hepatitis in captive animals

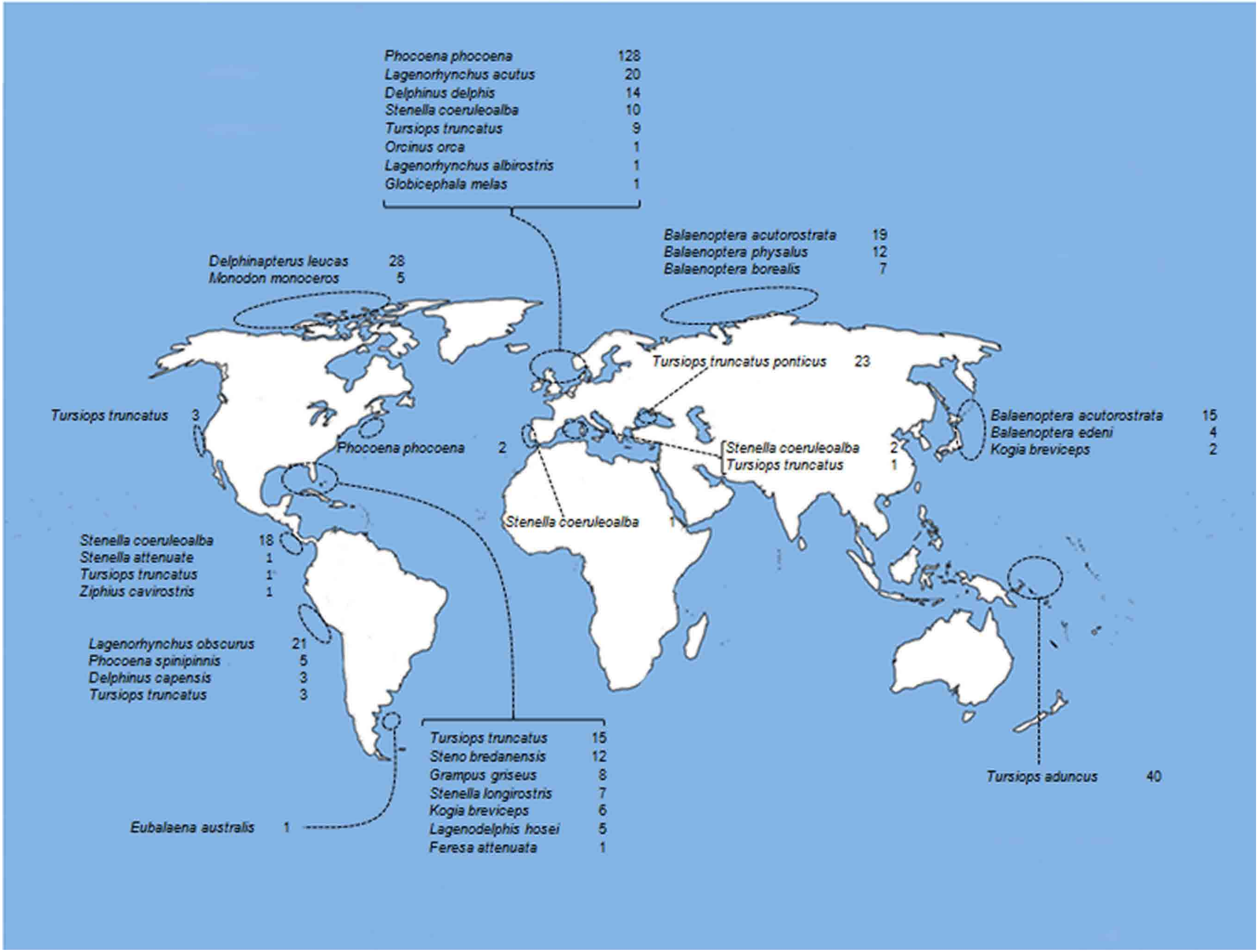
***Adenovirus*:** from intestines of cetaceans. No lesions.


A
B
C
D

Brucella spp.



Brucella spp.



Brucella ceti

Brucella ceti: main pathological findings

- CNS: non-suppurative meningo-encephalitis and chorioditis, Purkinkje cells, gliosis, ependymal necrosis

- Reproductive system: granulomatous endometritis, severe necrotizing placentitis, abortus, absecess and epididimitis and orchitis.

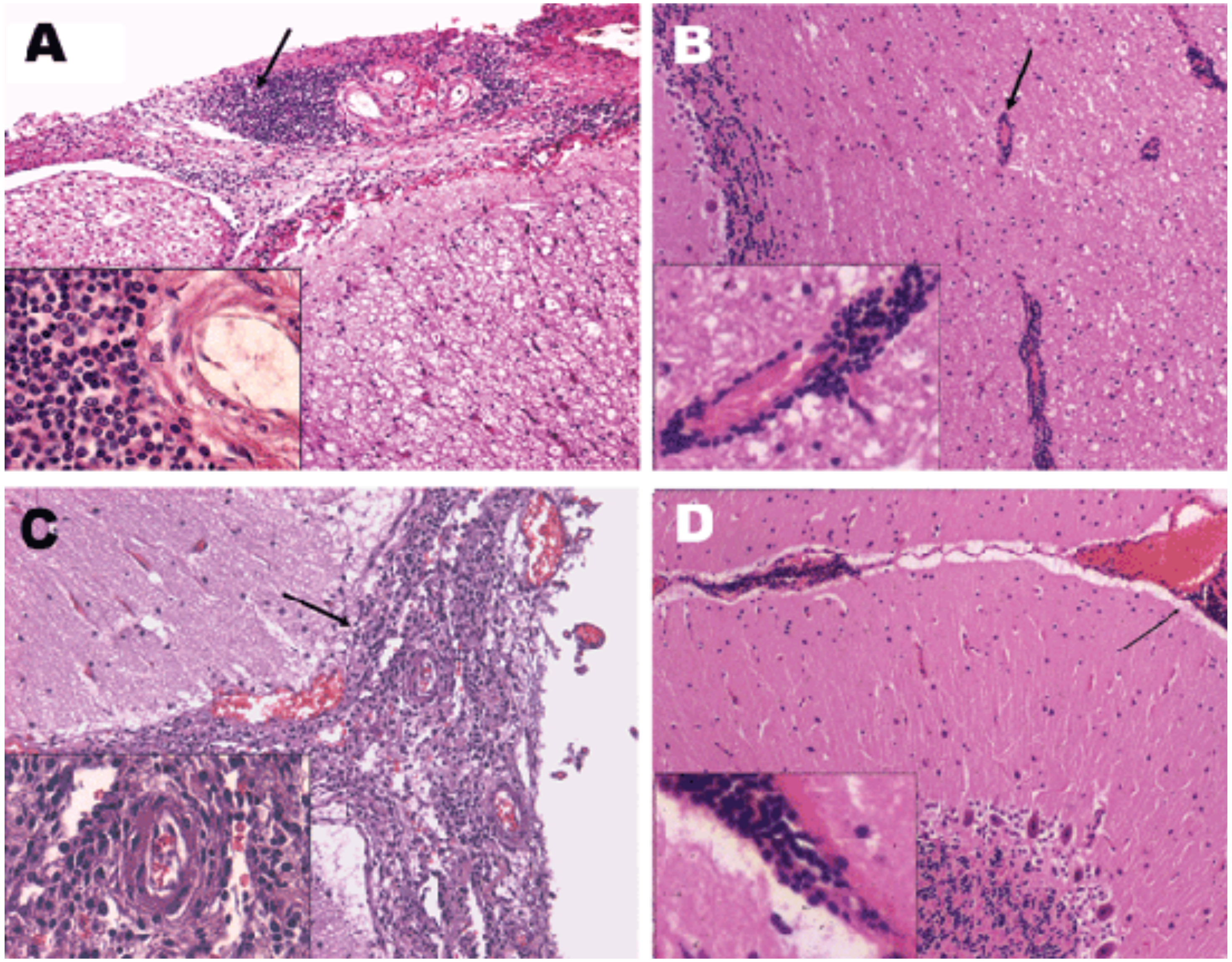
- Circulatory system: vegetative endocarditis (mitral valve) with myocardial deg. and fibrosis

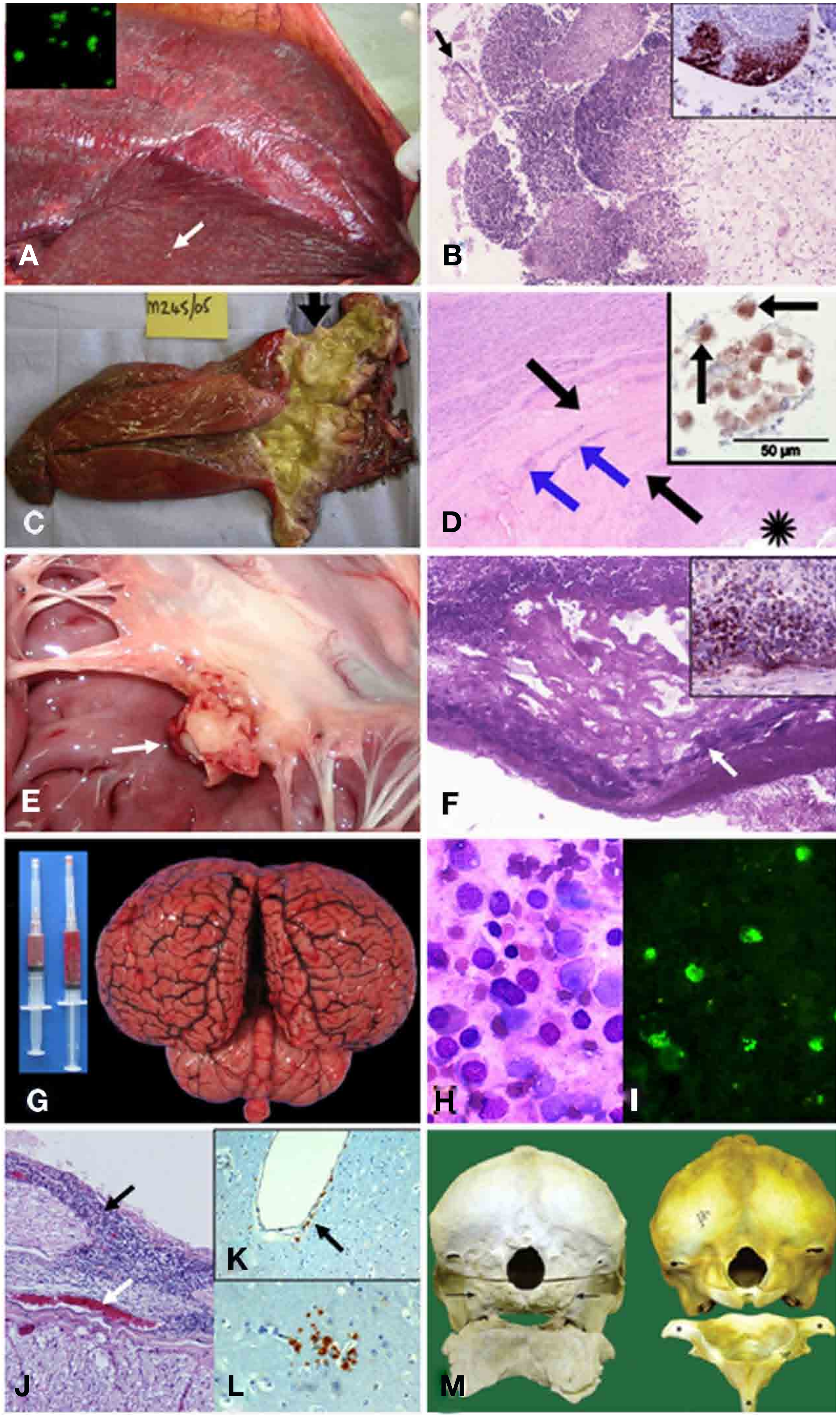
- Bone: discospondylitis, atlanto-occipital fusions

- Respiratory: secondary infections and isolation within other pathogens-related lesions (i.e. nematodes)

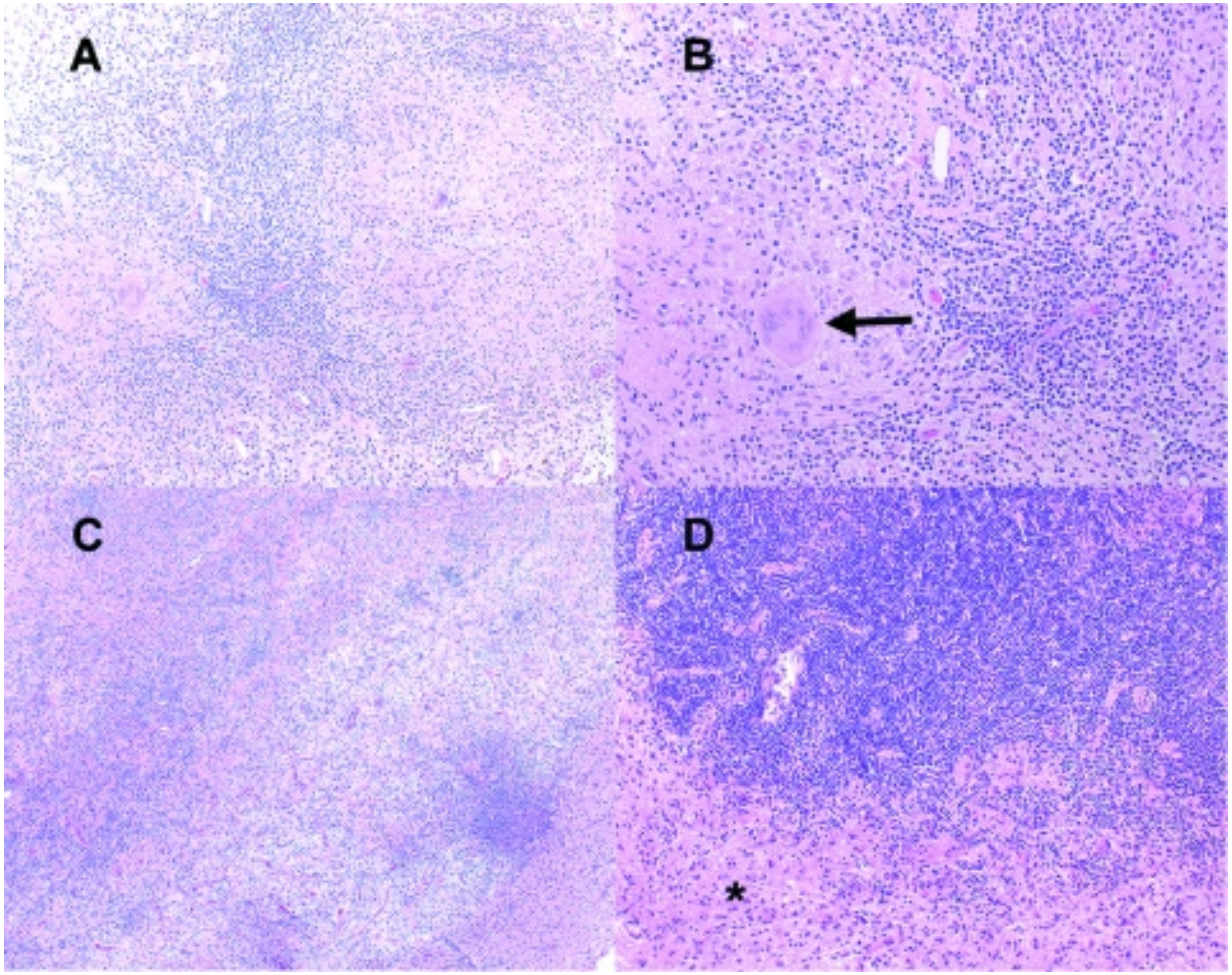
- Spleen and lymph nodes: necrotic foci and chronic inflammation in liver, spleen, lymph nodes with increased volume.

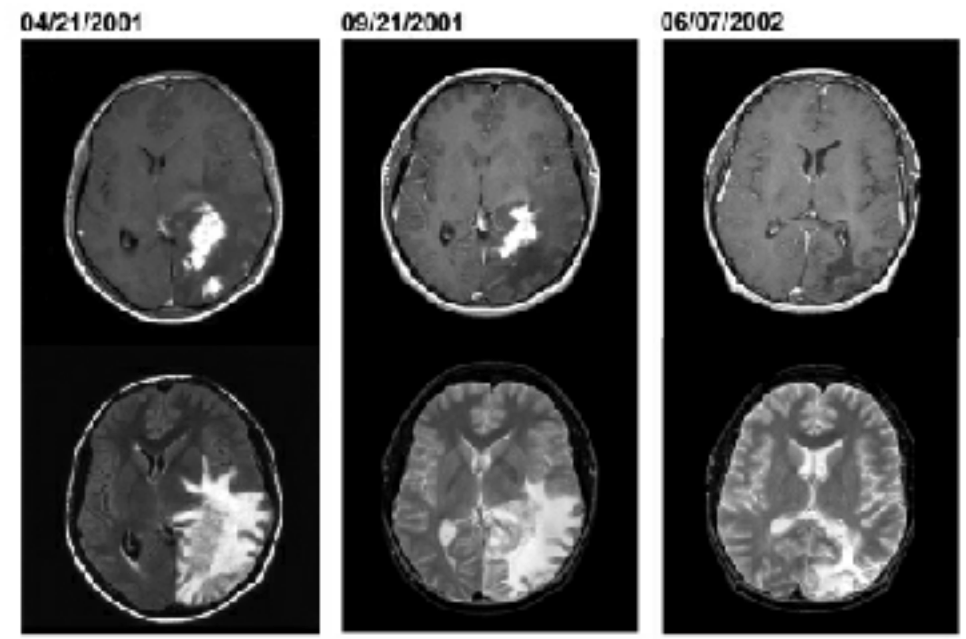
Brucella ceti



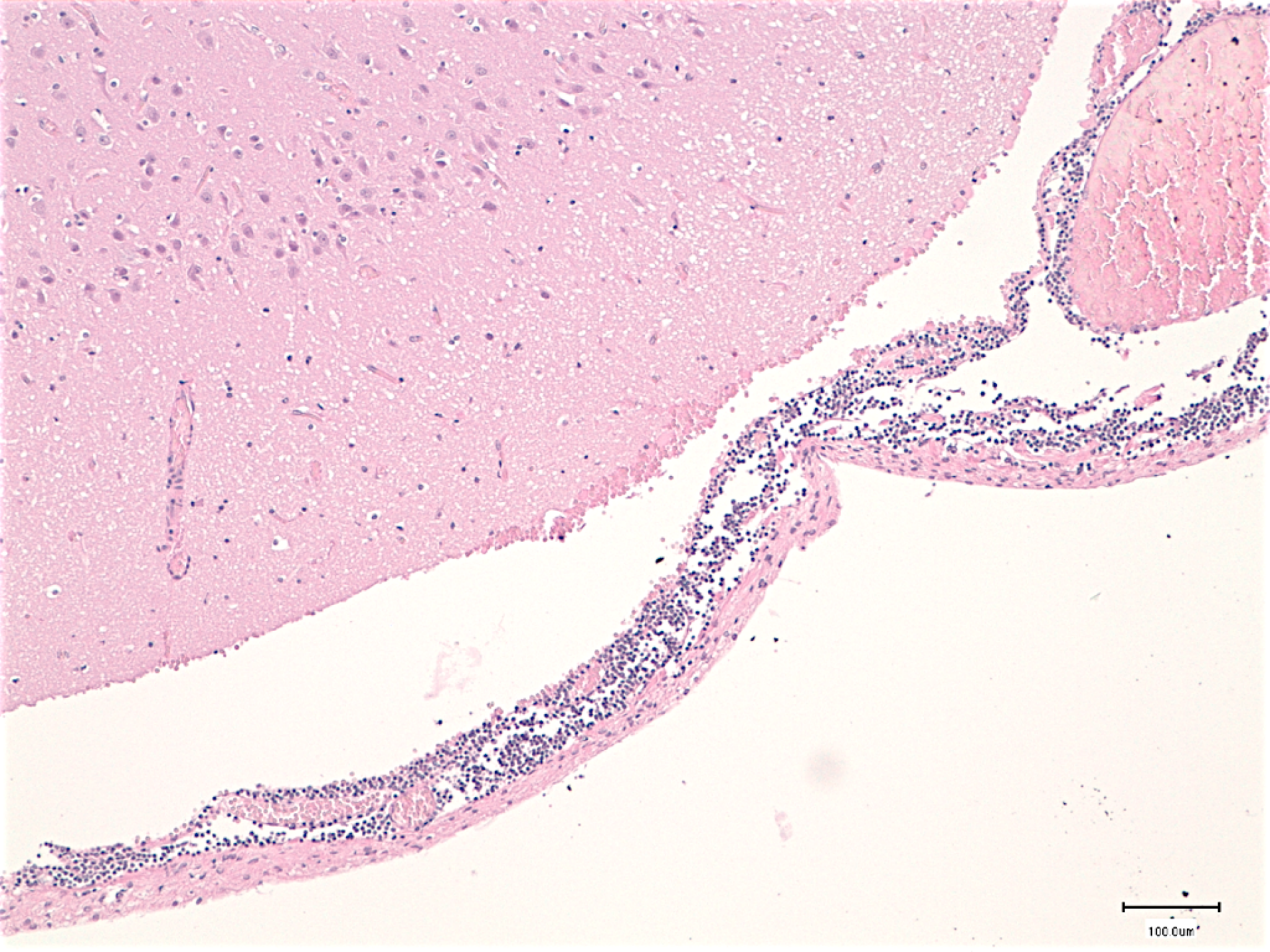


Human neurobrucellosis





Brucella ceti ST 26 in the Mediterranean in striped dolphins
1 case of ST 27 in bottlenose dolphin in Croatia


100.0um

Brucella diagnosis:

- Direct isolation (14 days in selective/non selective media): blood agar, serum dextrose agar, Colombia agar supplmented with 5% sheep blod and OXOID or *Brucella*-agar added with 5% horse serum

Species	RTD phage lysis[a]								Sera against[b]		Growth on dyes[c]								
	Tb	Wb	Iz	R/C	CO_2[d]	H_2S[e] 72 h	Urease minutes	Nitrate reduction	A	M	Thionin				Basic fuchsine	O-safranin	Omp2b restriction pattern	MLVA-16 type	ST typ[illegible]
											10	20	40	100	20	100			
B. abortus biovar 1 Fe[illegible]	–	+	–	–	–	+	>120	–	+	–	–(–)	–(–)	–(–)	–(–)	+(+)	+(+)	Biovar 1 type	Biovar 1 type	ST1
B. [illegible] dolphin[f]	–	+	–	–	–	–	60–90	+	+	+	+(+)	+(±)	+(–)	+(+)	+(–)	+(–)	N/K/P	A1, A2, P	ST26[g]
B. [illegible] porpoise[f]	–	+	–	–	–	–	60–90	+	+	–	+(+)	+(+)	+(+)	+(–)	+(–)	+(–)	M/J	B	ST23
B. [illegible] human[h]	–	–	–	–	–	–	60–90	ND	–	+	+	+	+	–	+	+	O/[illegible]	H	ST2[illegible]
B. pinnipedialis seal[f]	–	–	–	–	+	–	60–90	+	+	–	+(–)	+(–)	+(–)	+(–)	+(–)	+(–)	P/[illegible], L/[illegible], O/[illegible]	C1, C2, C3	ST25, [illegible]24

[a] RTD, routine test dilution of phages. Tb, Tbilisi; Wb, Weybridge; Iz, Izatnagar and rough type Wb derivative R/C.
[b] [illegible] against lipopolysaccharide epitopes, measured as agglutination with monospecific serum.
[c] [illegible] concentrations expressed in μg/ml of culture medium with 10% CO_2 or, within parenthesis, with incubation without CO_2.
[d] [illegible]quirement.
[e] [illegible]duction.
[f] [illegible]ference strains (Muñoz et al., 2006; Foster et al., 2007; Hernández-Mora et al., 2008; Zygmunt et al., 2010; Guzmán-Verri et al., unpublished results).
[g] [illegible]aracterized only in B. ceti isolated in dolphins from the Atlantic Ocean.
[h] [illegible]
ND, not done.

- PCR-RFLP of genes coding for outer membrane proteins Omp2a, Omp2b and Omp25

- IF

Other bacterial and mycotic diseases

- *Erysypeloyhtix rhusiopatiae*: septicemia with romboid cutaneous findings.

- *Vibrio* spp., *Aeromonas hydrophila, Photobacterium damselae* spp. (parts of intestinal flora) > possible septicemia

- *E. coli*, *Salmonella* spp., *Clostridium* spp., *Lactococcus* spp. > intestinal endotoxemia and septicemia.

- *Staphylococcus aureus*, MRSA, *Pseudomonas* spp., *Streptococcus* spp., *Proteus* spp. > mainly broncho-pneumonia.

- *Nocardia* spp., *Mycobacterium* spp. > granulomatous lesions

- *Helicobacter* spp. > gastric ulcers

- *Criptococcus neoformans and laurentii*, *Histoplasma capsulatum* > pneumonia and dermatitis

- *Aspergillus, Zygomices, Candida, Fusarium* spp.: several localized infection (skin, GI, lungs, bones, ear) and systemic dissemination

- *Lacazia loboi* (lobomycosis): systemic mycotic diseases from skin traumas.

VIRAL IMMUNOLOGY

Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens

Michael J. Mina[1,2,3]*†, Tomasz Kula[1,2], Yumei Leng[1], Mamie Li[2], Rory D. de Vries[4], Mikael Knip[5,6], Heli Siljander[5,6], Marian Rewers[7], David F. Choy[8], Mark S. Wilson[8], H. Benjamin Larman[9], Ashley N. Nelson[10]‡, Diane E. Griffin[10], Rik L. de Swart[4], Stephen J. Elledge[1,2,11]†

Measles virus is directly responsible for more than 100,000 deaths yearly. Epidemiological studies have associated measles with increased morbidity and mortality for years after infection, but the reasons why are poorly understood. Measles virus infects immune cells, causing acute immune suppression. To identify and quantify long-term effects of measles on the immune system, we used VirScan, an assay that tracks antibodies to thousands of pathogen epitopes in blood. We studied 77 unvaccinated children before and 2 months after natural measles virus infection. Measles caused elimination of 11 to 73% of the antibody repertoire across individuals. Recovery of antibodies was detected after natural reexposure to pathogens. Notably, these immune system effects were not observed in infants vaccinated against MMR (measles, mumps, and rubella), but were confirmed in measles-infected macaques. The reduction in humoral immune memory after measles infection generates potential vulnerability to future infections, underscoring the need for widespread vaccination.

(Padova), Italy

(2 November 2019)

Letter to the Editor

Measles, immune amnesia, and cetaceans

Giovanni DI GUARDO, DVM, Dipl. ECVP,
Professor of General Pathology and Veterinary Pathophysiology,
University of Teramo, Faculty of Veterinary Medicine,
64100 - Teramo, Italy (Email address: gdiguardo@unite.it)

and

Sandro MAZZARIOL, DVM, PhD,
Professor of Veterinary Pathologic Anatomy,
Department of Comparative Biomedicine and Food Hygiene,
University of Padua, 35020 - Legnaro (Padova), Italy

The loss of immune memory against previously encountered pathogens, which has been reported in measles virus (MV)-infected humans and macaques (1), provides further support to the crucial need for measles vaccination on a global scale. Indeed, this newly characterized immunomodulatory process sums itself to the well-known viral immunosuppressive effects (2), thereby representing an additional explanatory key for the >100,000 deaths annually caused by MV (3).

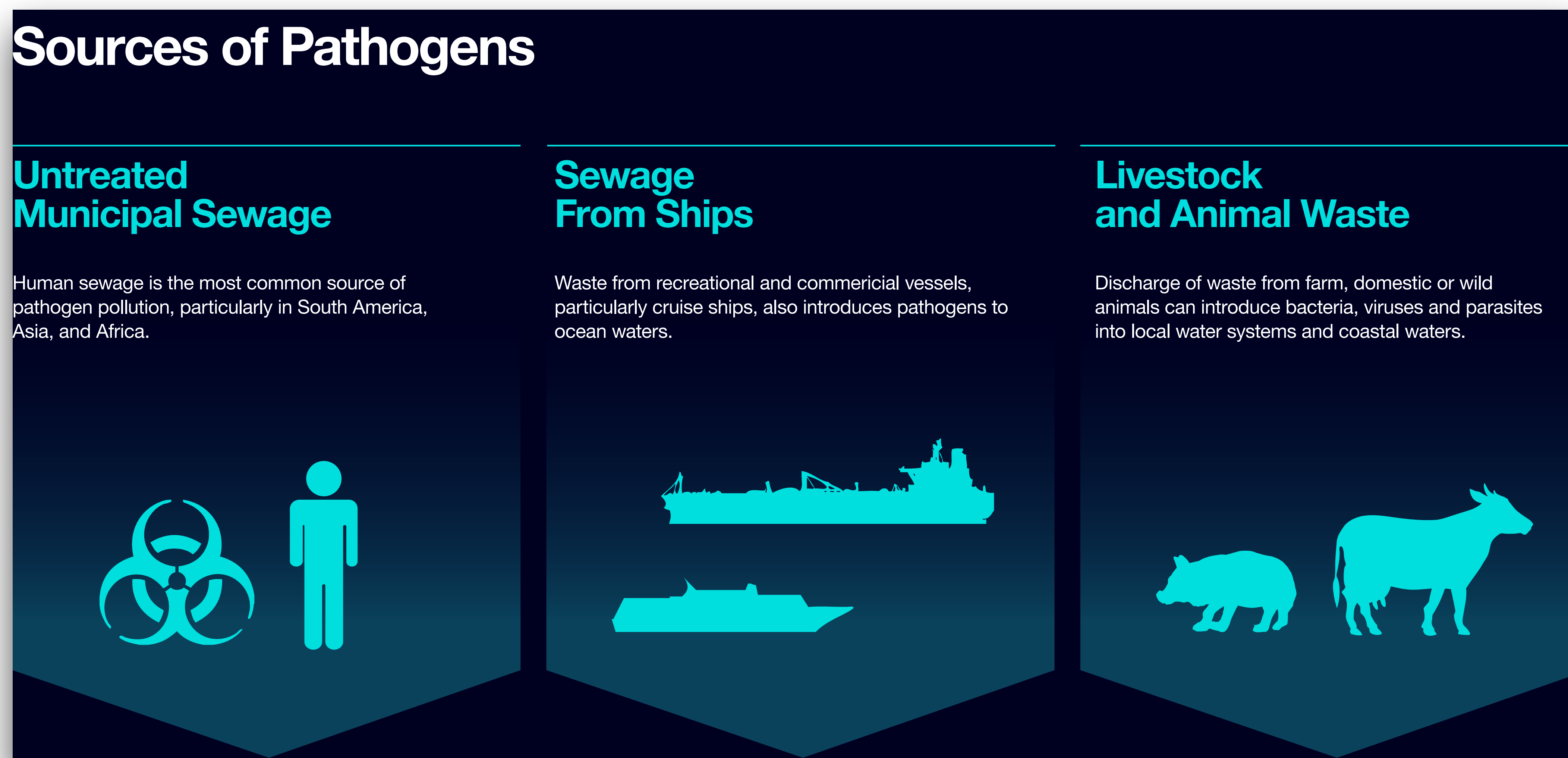
Within such framework, it would be of interest to know the role, if any, played by viral-specific and host-specific factors in the development of MV-induced "immunological amnesia" (IA) (1). More in detail, to what extent does IA depend upon the viral strain responsible for the infection? And, are there any differences, in terms of IA magnitude, between Th1-dominant versus Th2-dominant individuals infected by MV?

We are investigating since many years wild dolphins naturally infected with cetacean morbillivirus (CMV), a devastating pathogen closely related to MV. These animals frequently develop an immunosuppression similar to that experienced by MV-infected humans (4), although Guiana dolphins (Sotalia guianensis) harboring a given CMV strain may undergo an even more prominent, multicentric lymphoid cell depletion (5). These viral strain-driven differences in the severity of host's immunodeficiency could be accompanied, among others, by different expression levels of the SLAM/CD150 immune cell viral receptor - specifying the well-documented lymphotropism of both animal and human morbilliviruses - in Th1-dominant as compared to Th2-dominant individuals (4). Similar viral-host interaction dynamics could also modulate MV-induced IA, although we don't know if CMV-infected dolphins may develop any IA-like condition.

Comparative immunopathological and immunopathogenetic studies in CMV-infected cetaceans may thus provide valuable insight into a more in-depth understanding of MV-induced IA, thereby setting a parallel infection model for an ad hoc dissection of virus-related and host-related factors involved in the determinism of this alarming condition.

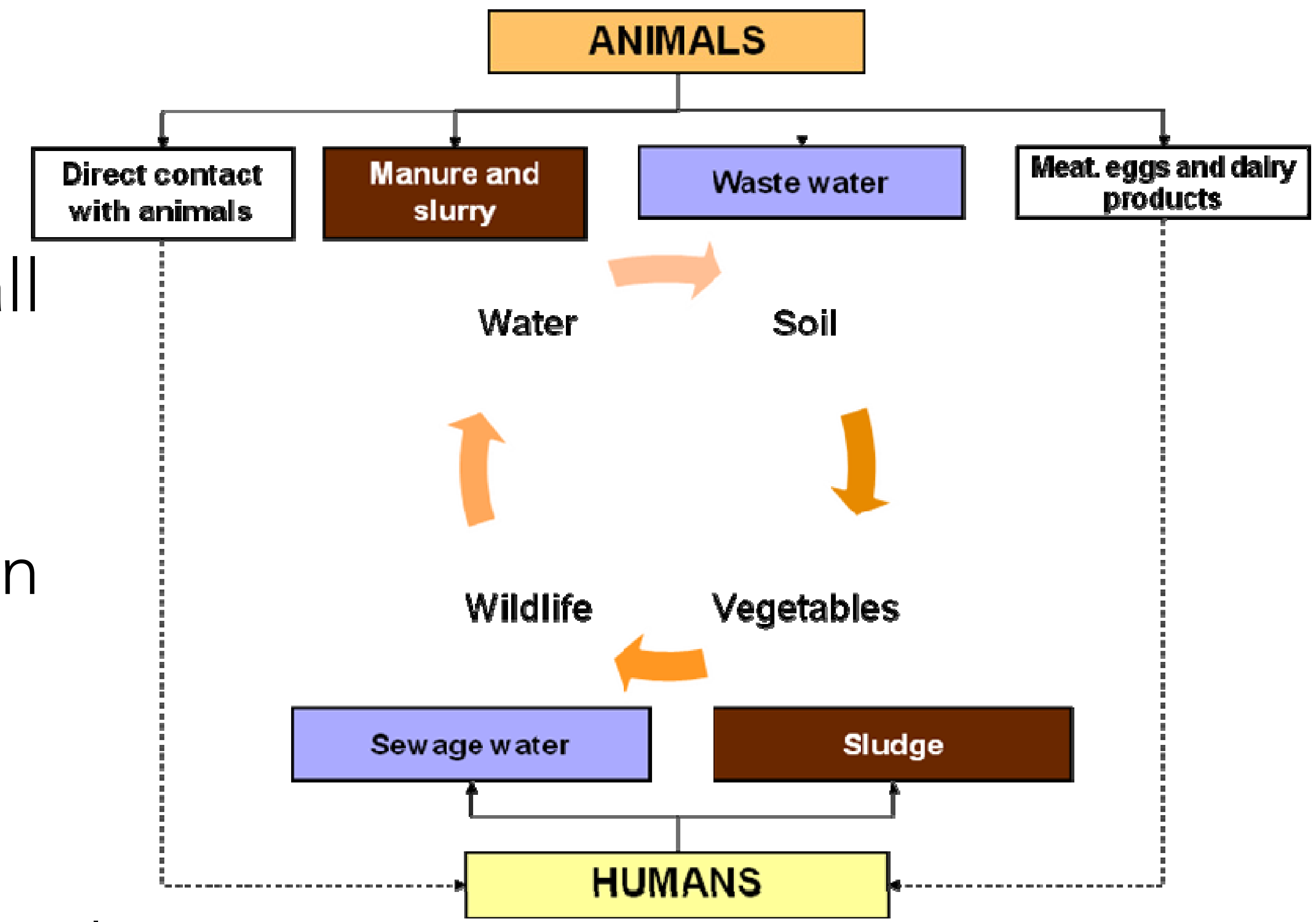
Terrestrially derived bacteria: anthropozoonoses?

- Fecal bacteria: *E. coli*, *Edwardsiella tarda*, *Enterococcus* spp.
- Bacteria coming from farming activities: *Salmonella* spp. *Listeria* spp, *Ureaplasma* spp, *Erysipelothrix rhusiopatiae, etc.*
- Multi-drug resistant bacteria: MRSA (*Staphylococcus aureus*)
- All these bacteria are opportunistic and they cause diseases in immunocompromised individuals: newborns, old, pregnant, after DMV



MRSA

- 1972 - Ist report in cattle
- now reported in almost all livestocks
- old thoughts: from human to animals through hand and nostrils
- new thoughts: bi-directional
- healthy animals - reservoir



frontiers
in Immunology

CASE REPORT
published: 22 November 2018
doi: 10.3389/fimmu.2018.02726

Check for updates

Death Associated to Methicillin Resistant *Staphylococcus aureus* ST8 Infection in Two Dolphins Maintained Under Human Care, Italy

Sandro Mazzariol[1], Michela Corrò[2], Elena Tonon[2], Barbara Biancani[3], Cinzia Centelleghe[1] and Claudia Gili[3]*

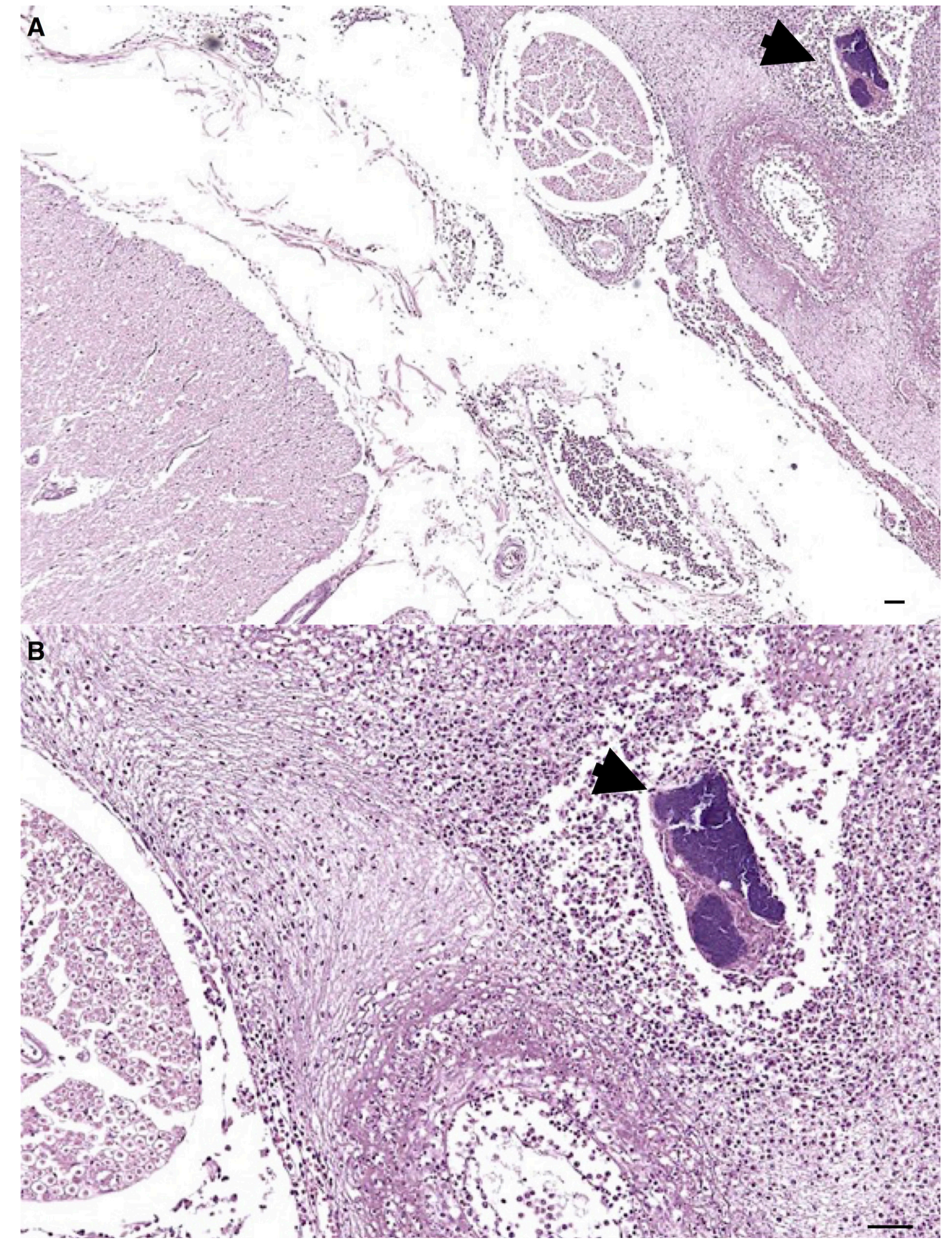
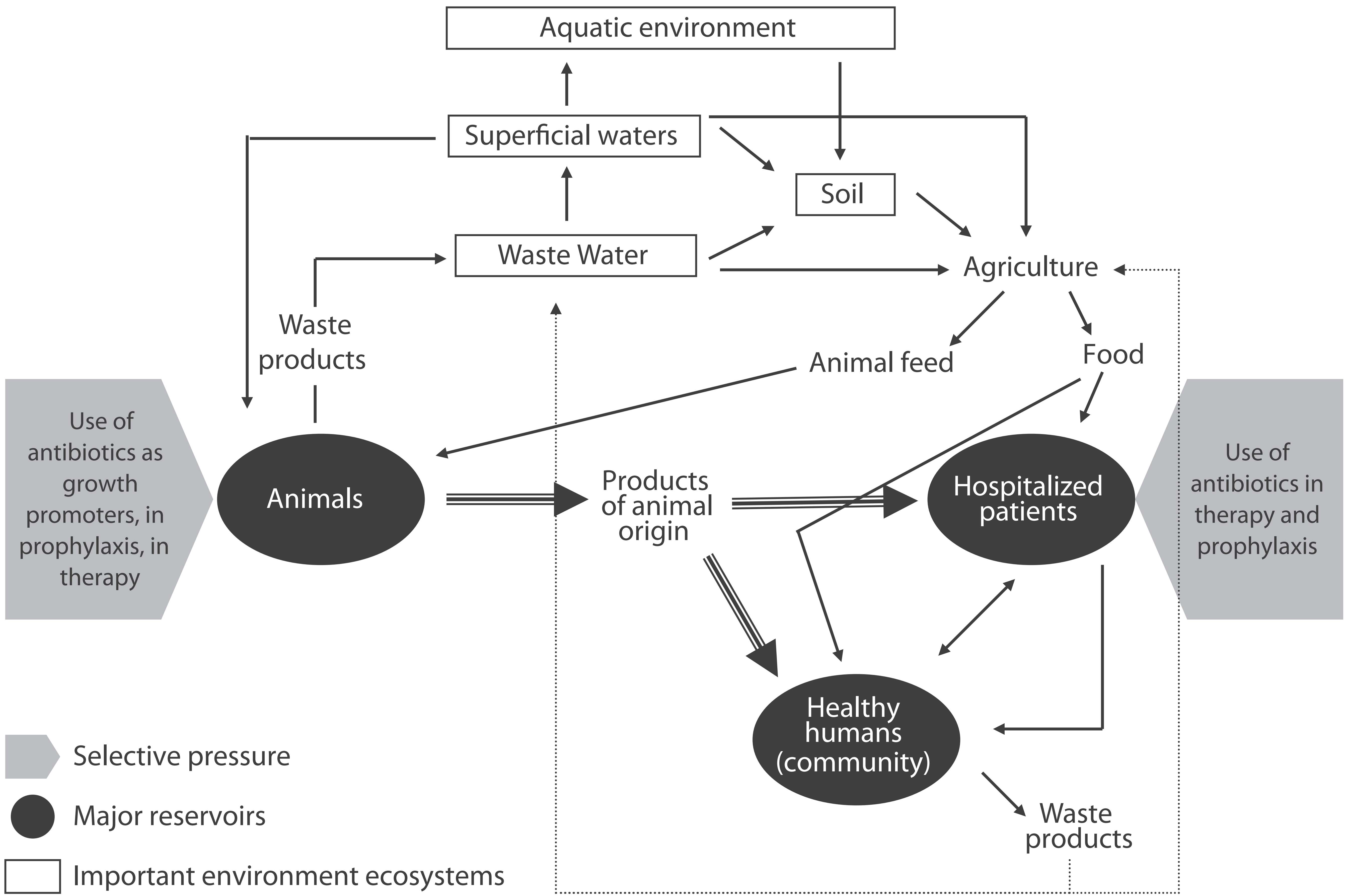
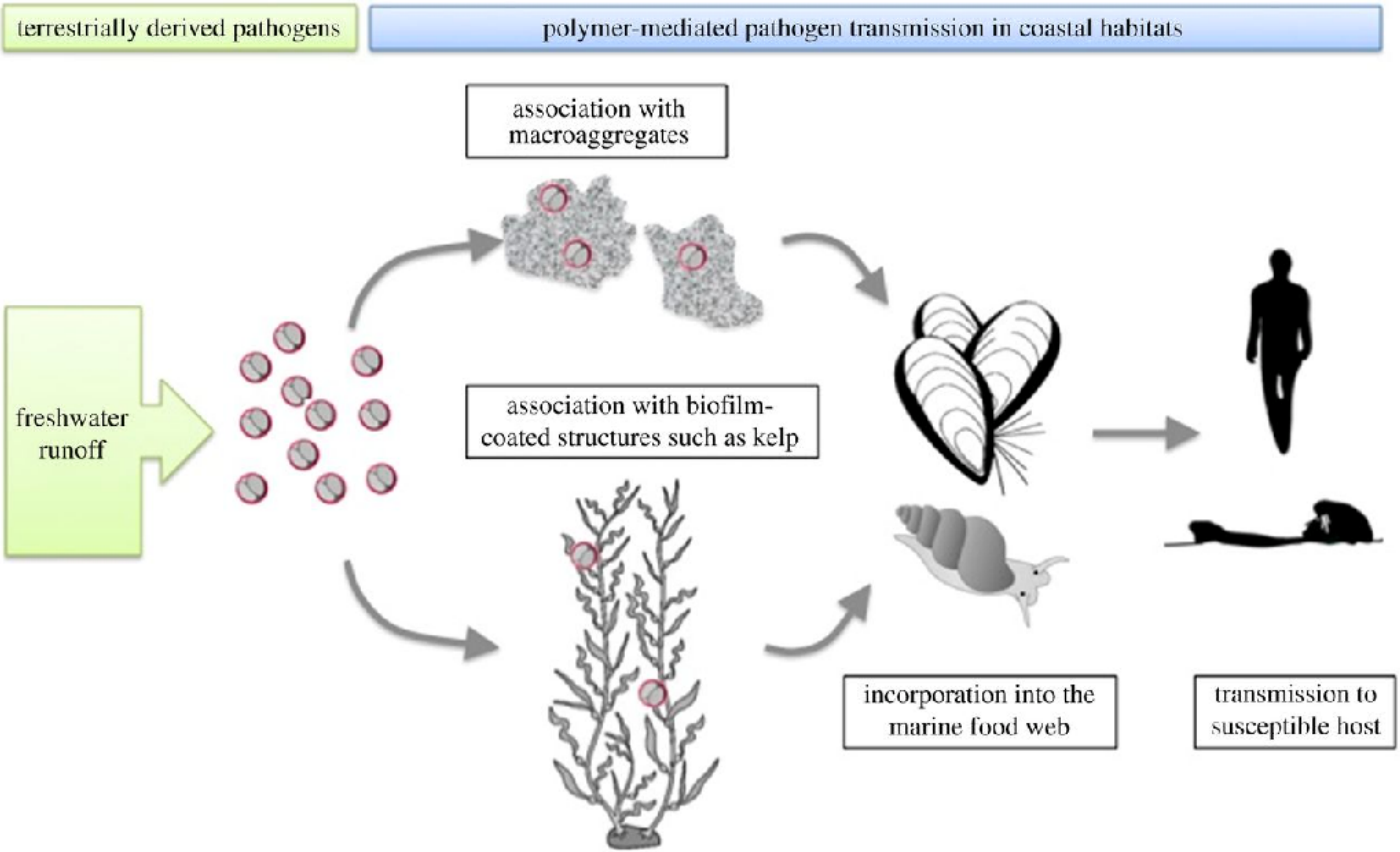


FIGURE 1 | Severe multifocal purulent meningitis in a Risso's dolphin's (*Grampus griseus*) brainstem. On the right, a severe purulent inflammation can be noticed along with a necrotic vessels' wall and a bacterial aggregate (arrowhead). Hematoxylin and Eosin, magnification 4x **(A)** and 10x **(B)**.



Aquatic environment
Superficial waters
Soil
Waste Water
Agriculture
Waste products
Animal feed
Food
Use of antibiotics as growth promoters, in prophylaxis, in therapy
Animals
Products of animal origin
Hospitalized patients
Use of antibiotics in therapy and prophylaxis
Healthy humans (community)
Waste products
Selective pressure
Major reservoirs
Important environment ecosystems


terrestrially derived pathogens
polymer-mediated pathogen transmission in coastal habitats
association with macroaggregates
freshwater runoff
association with biofilm-coated structures such as kelp
incorporation into the marine food web
transmission to susceptible host

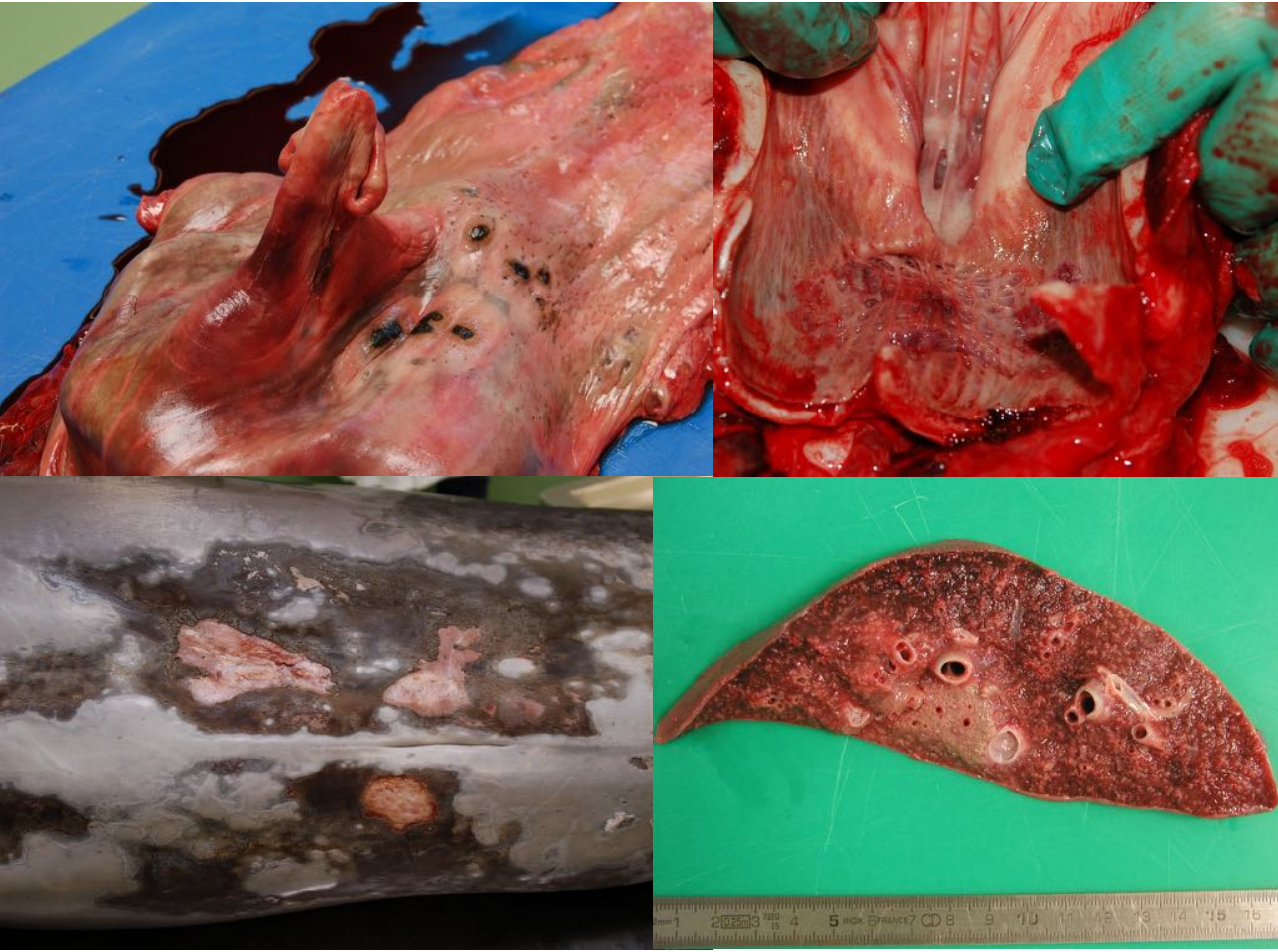


Streptococcal fascitis

Staphylococcus septicemia

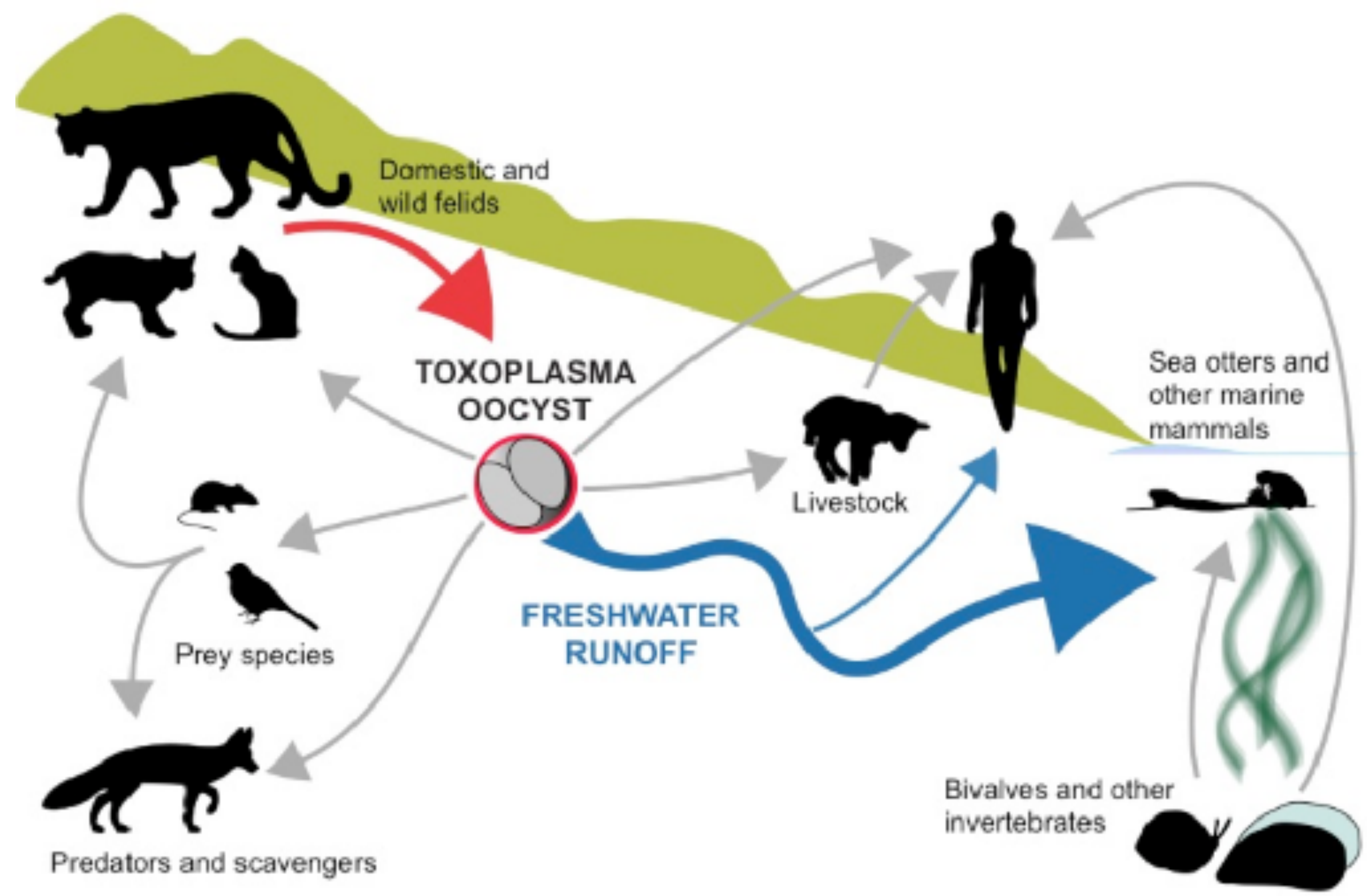
E. coli peritonitis

Other bacterial findings

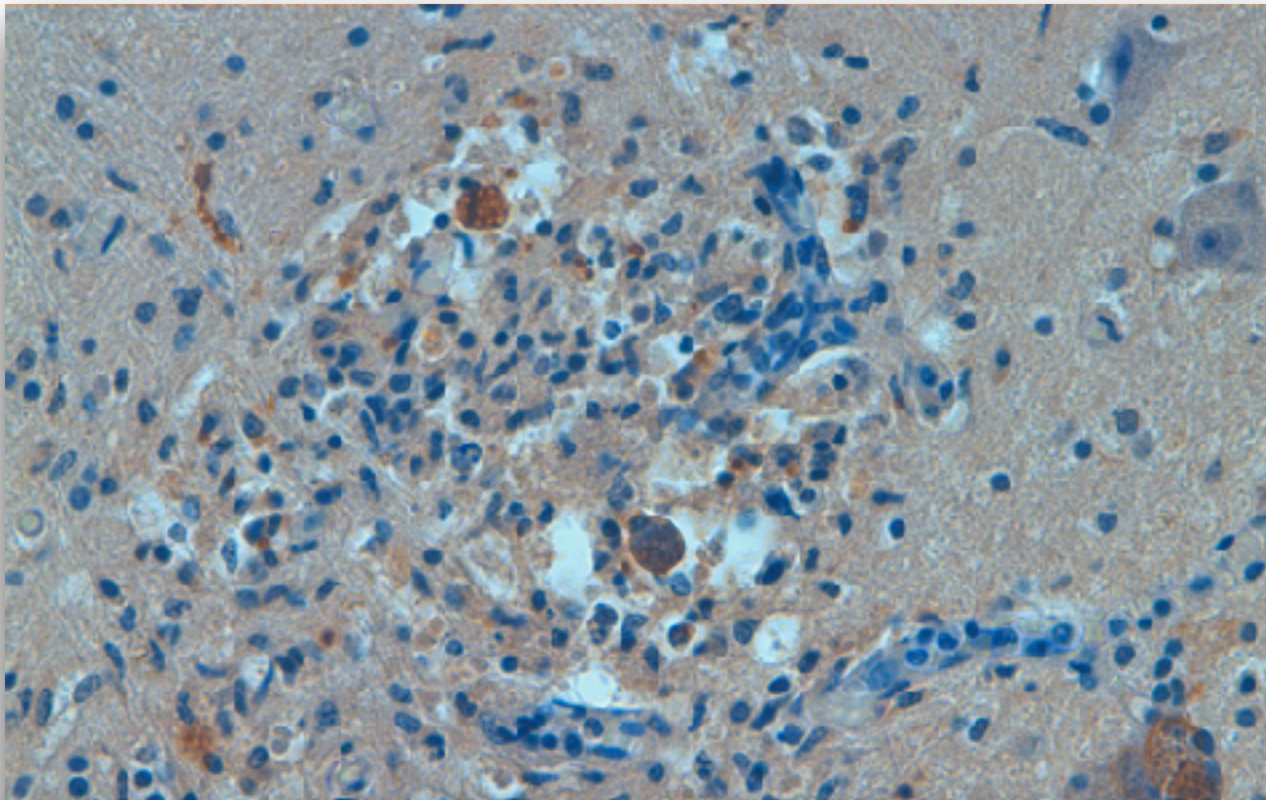


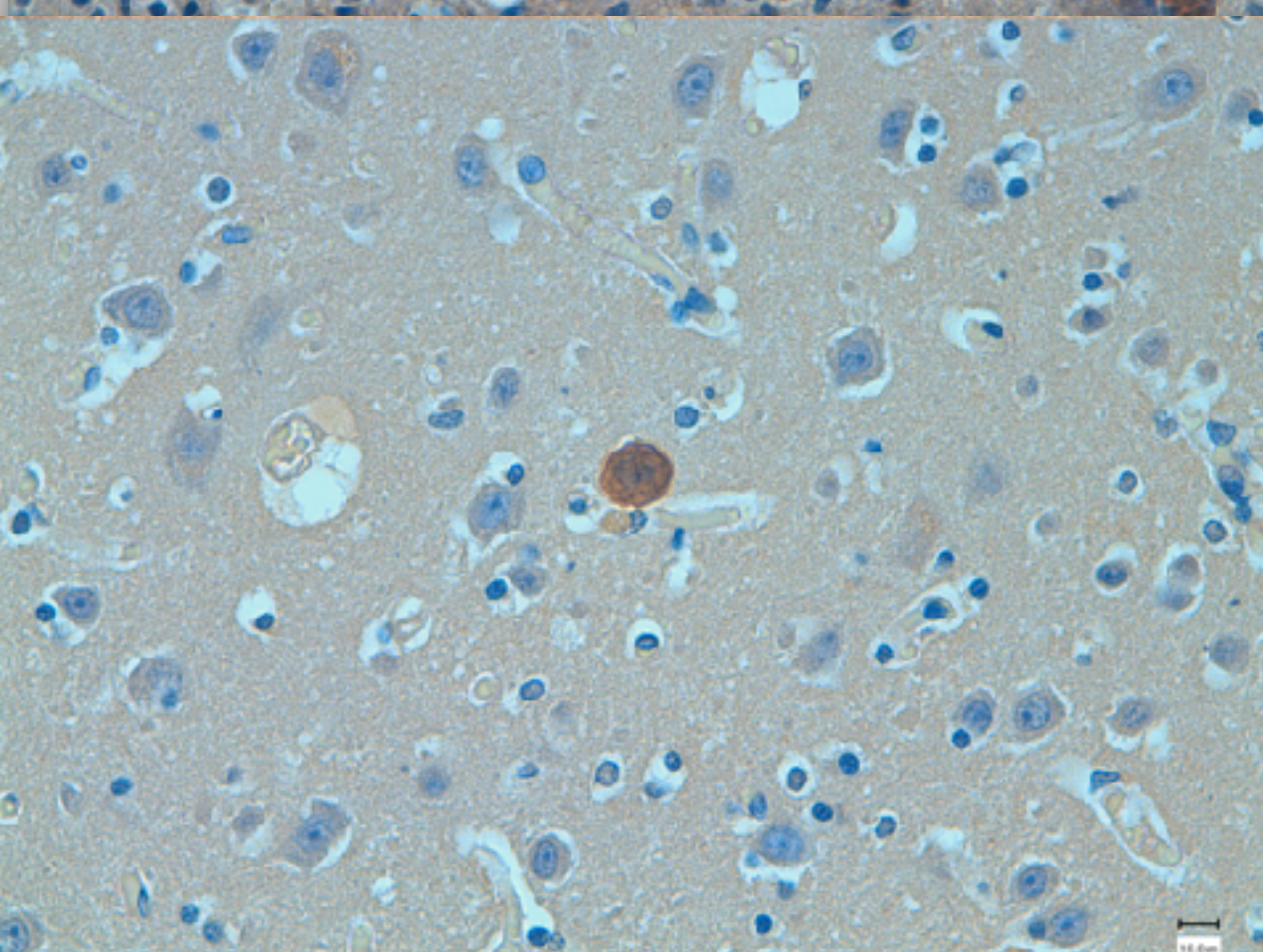
T. *gondii* in marine mammals

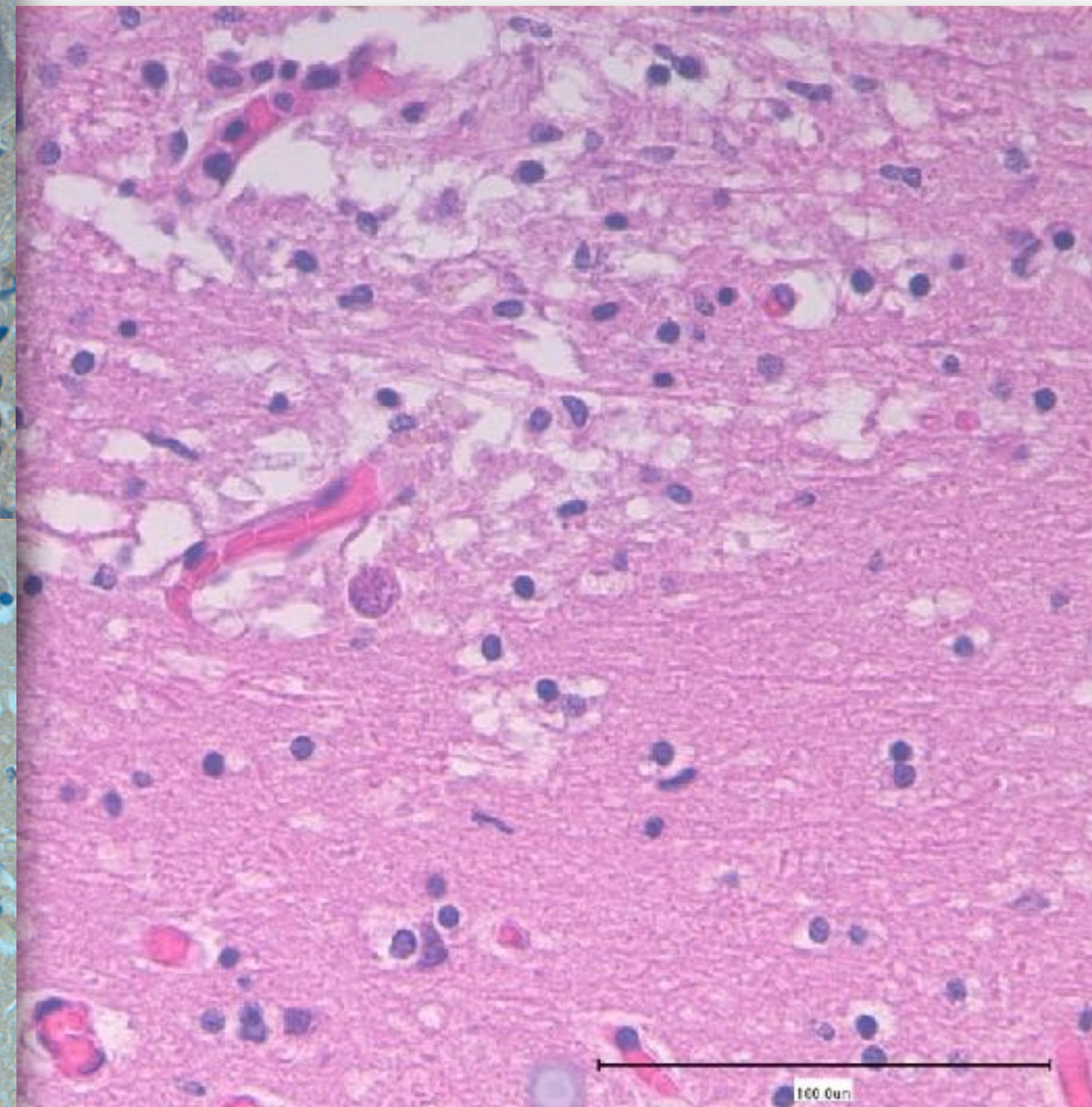
- 1998-2014: 16% + serology in striped and bottlenose dolphins
- 2004: 19% + serology in striped, bottlenose, common dolphins and porpoise
- 2006-2012: 10% in the Adriatic (molecular and IHC)
- 2015: 12% in Italy (molecular and IHC)

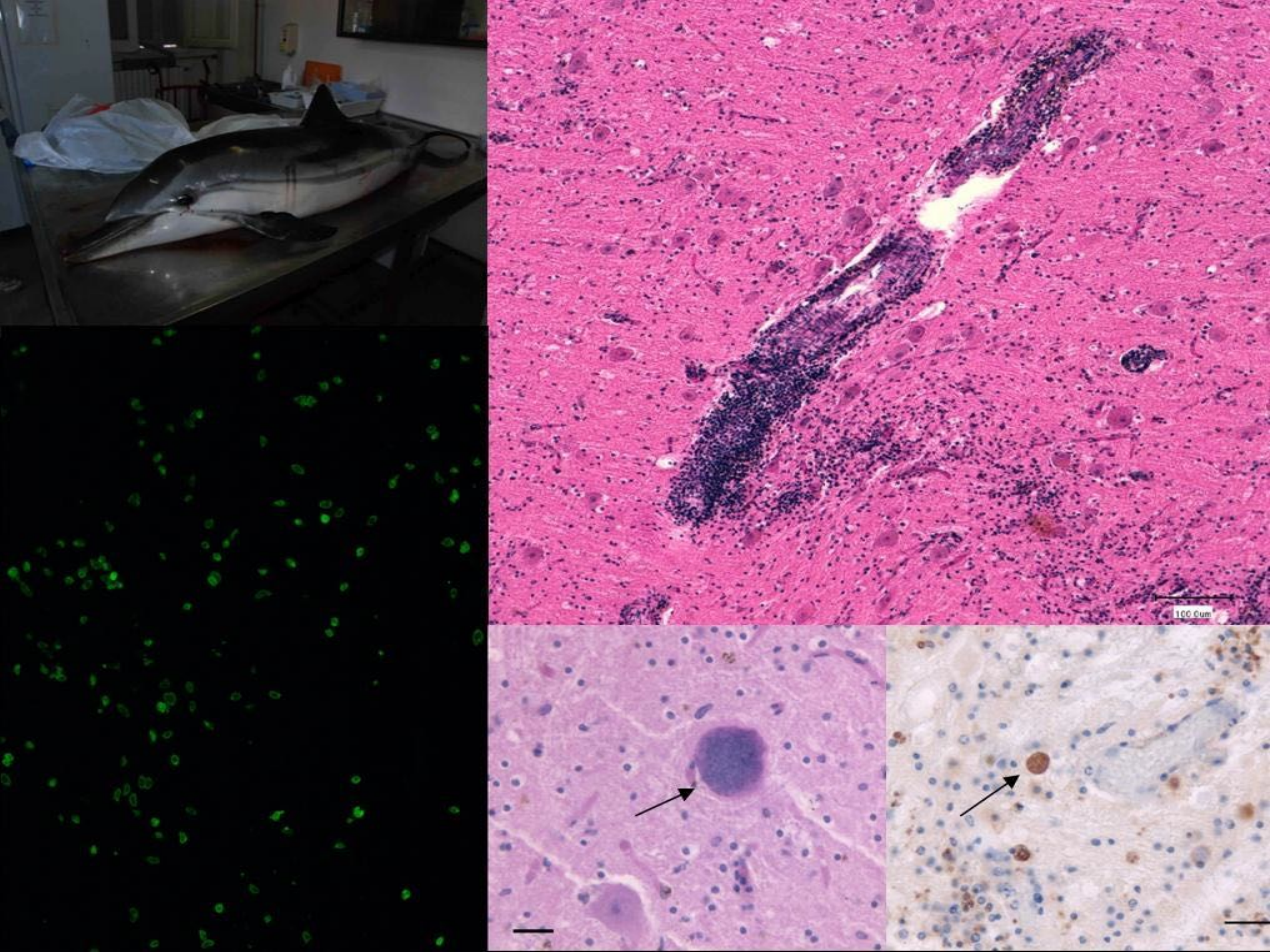


Toxoplasma gondii in bottlenose dolphins

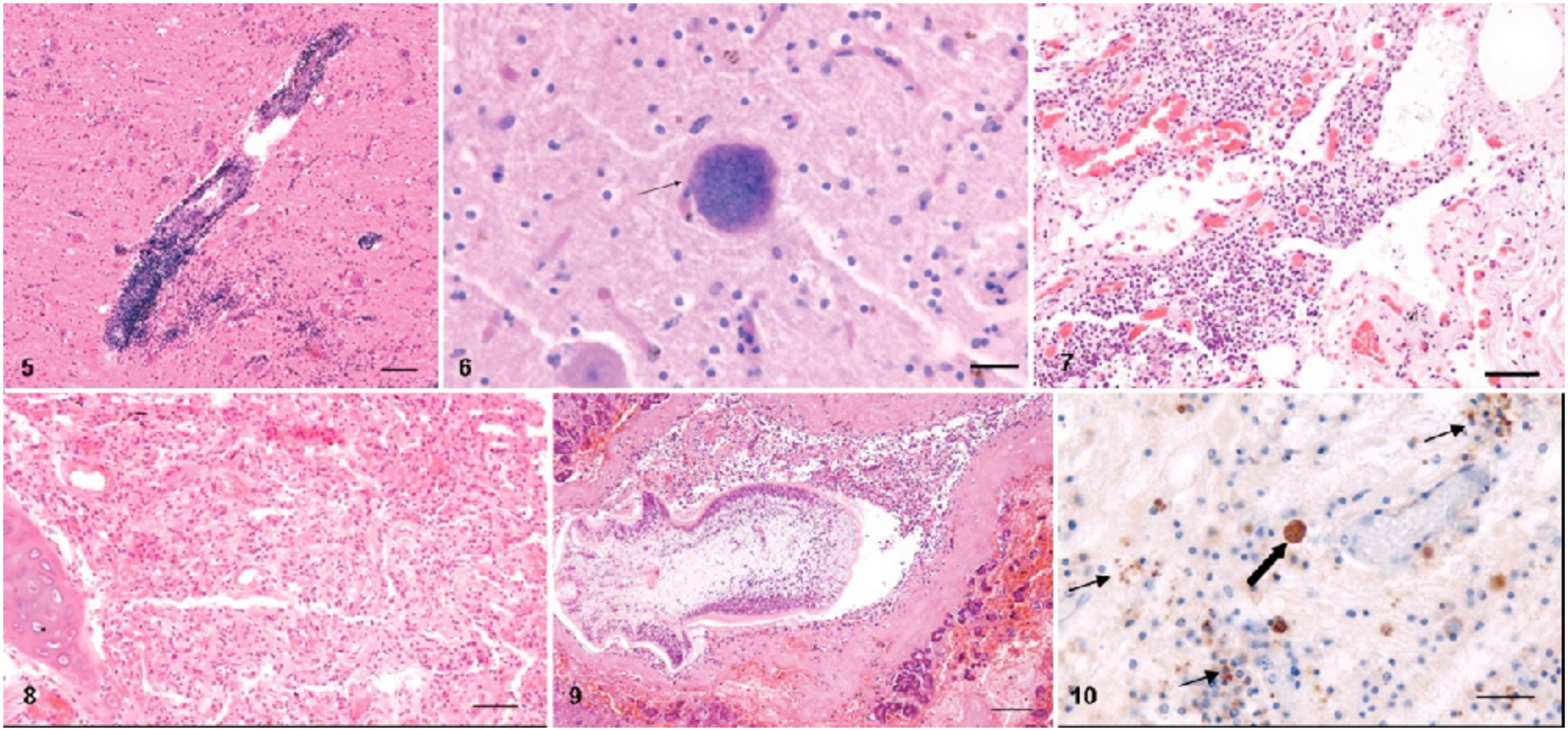


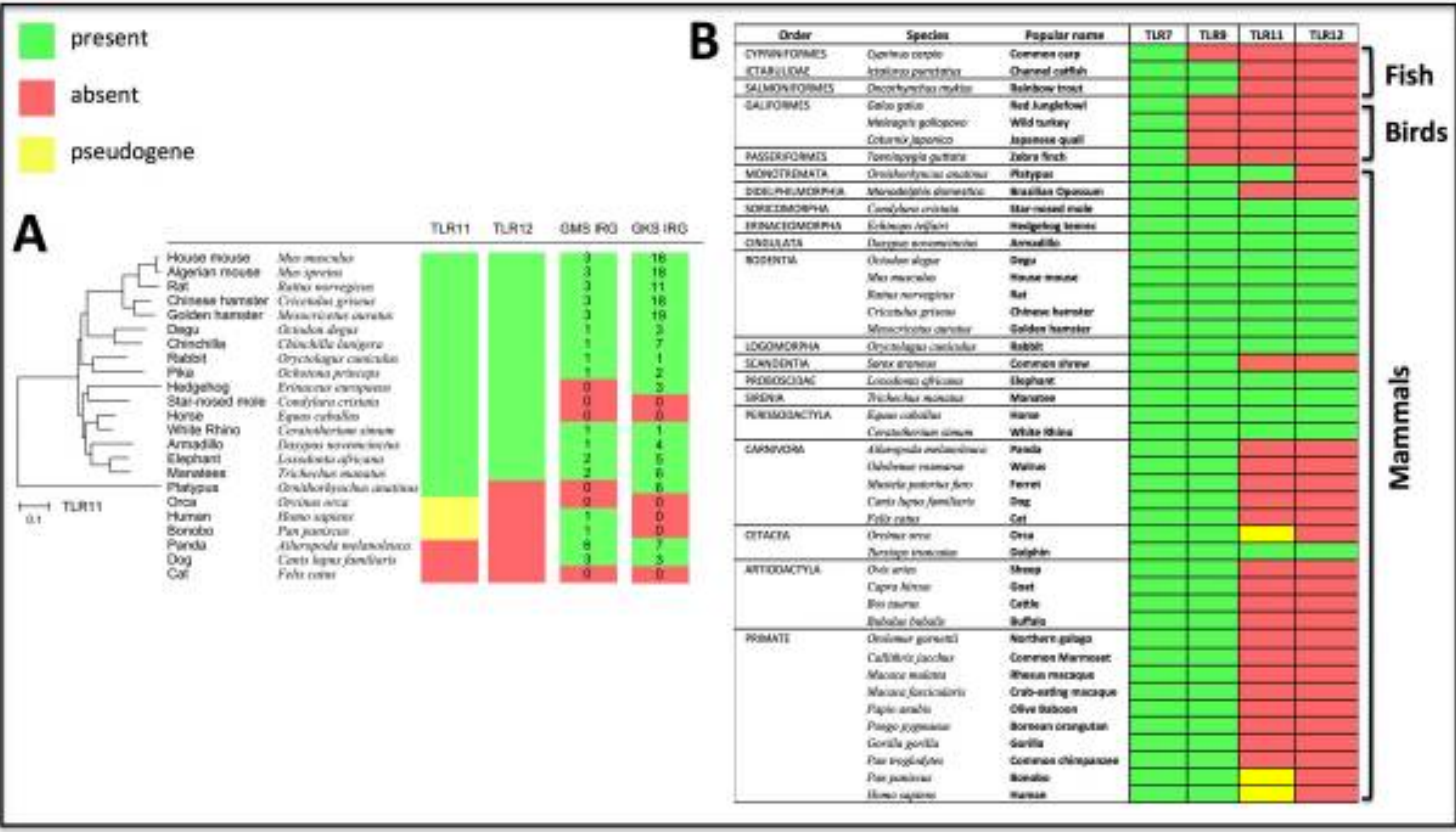


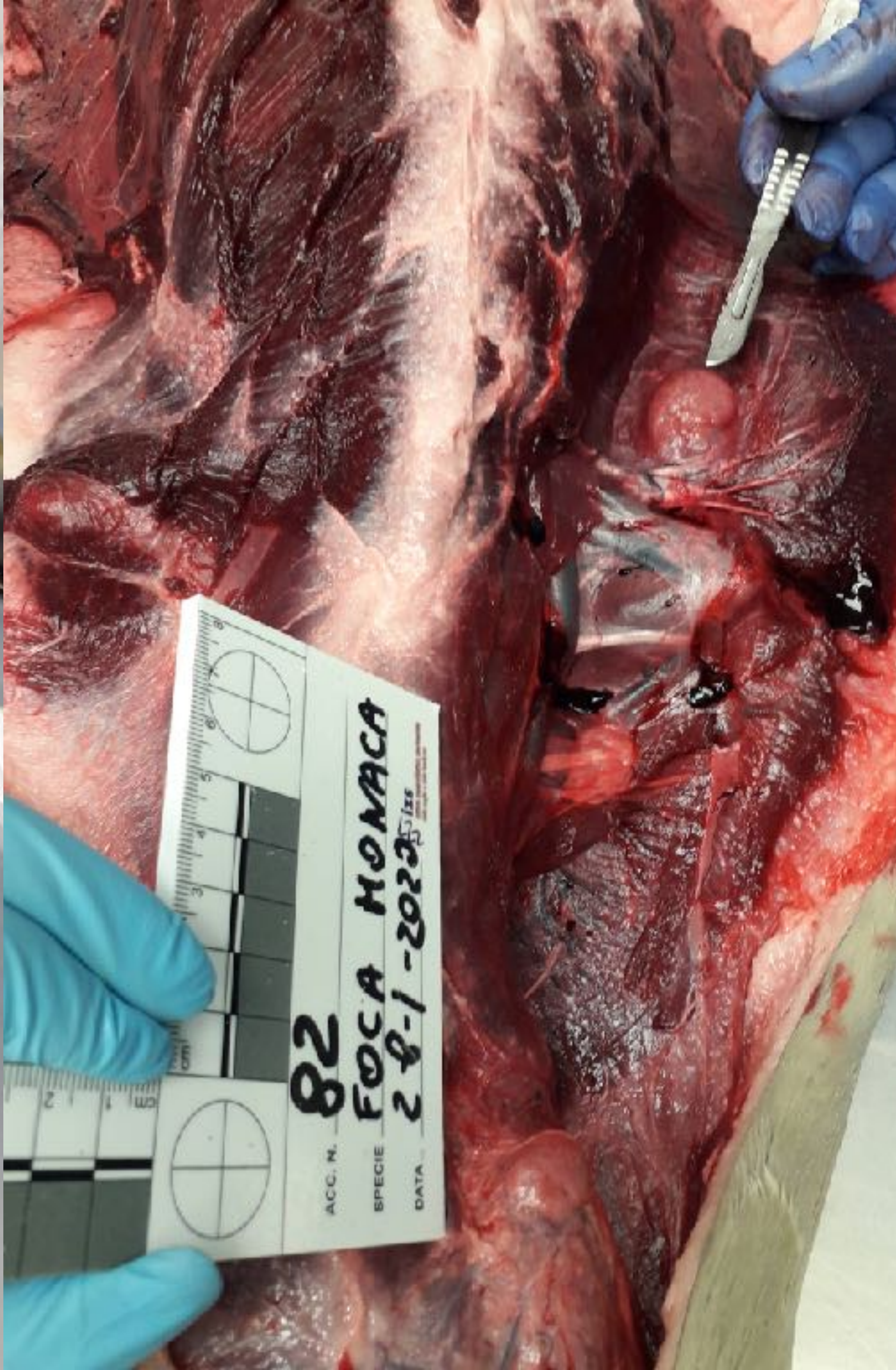


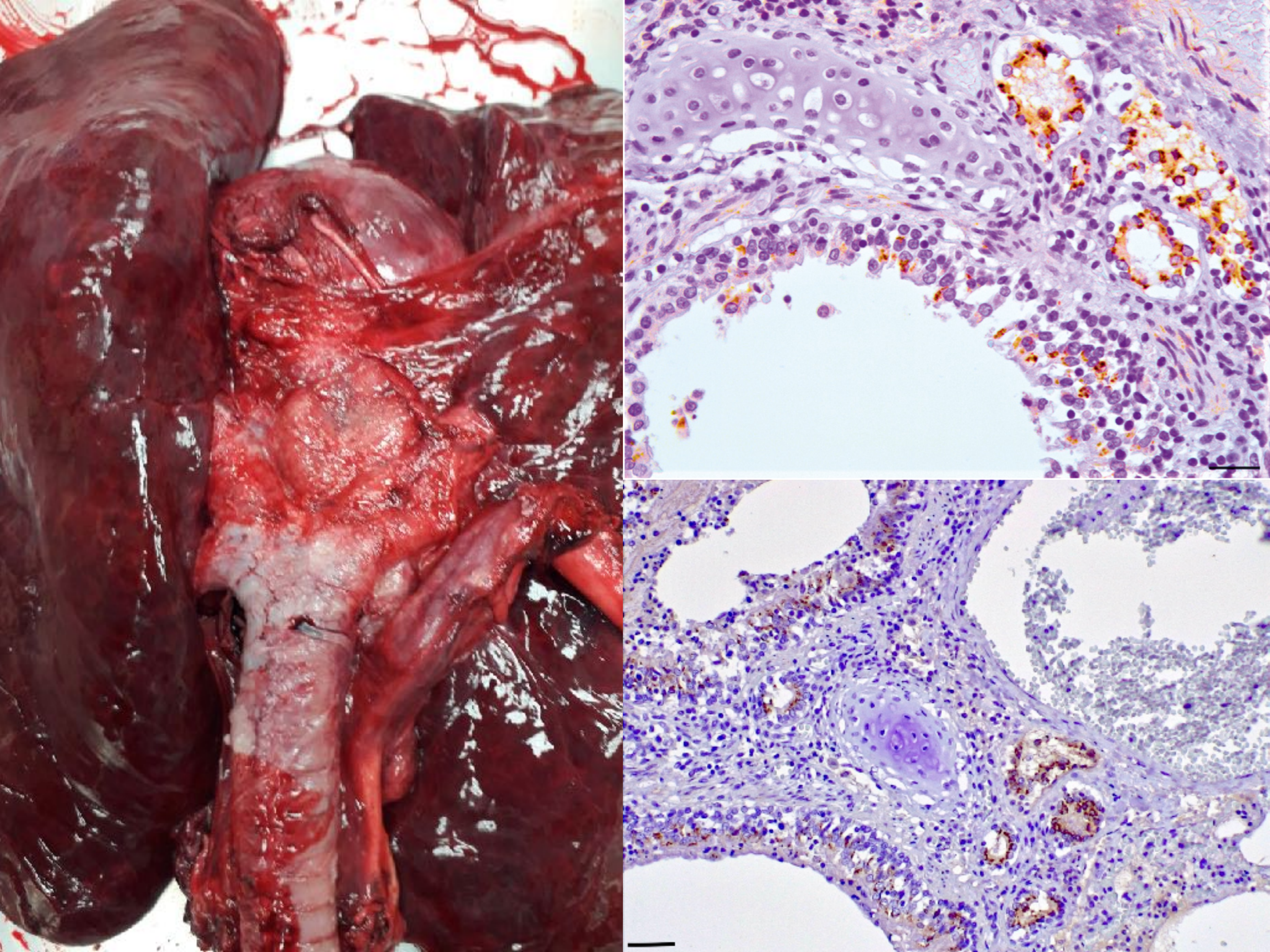


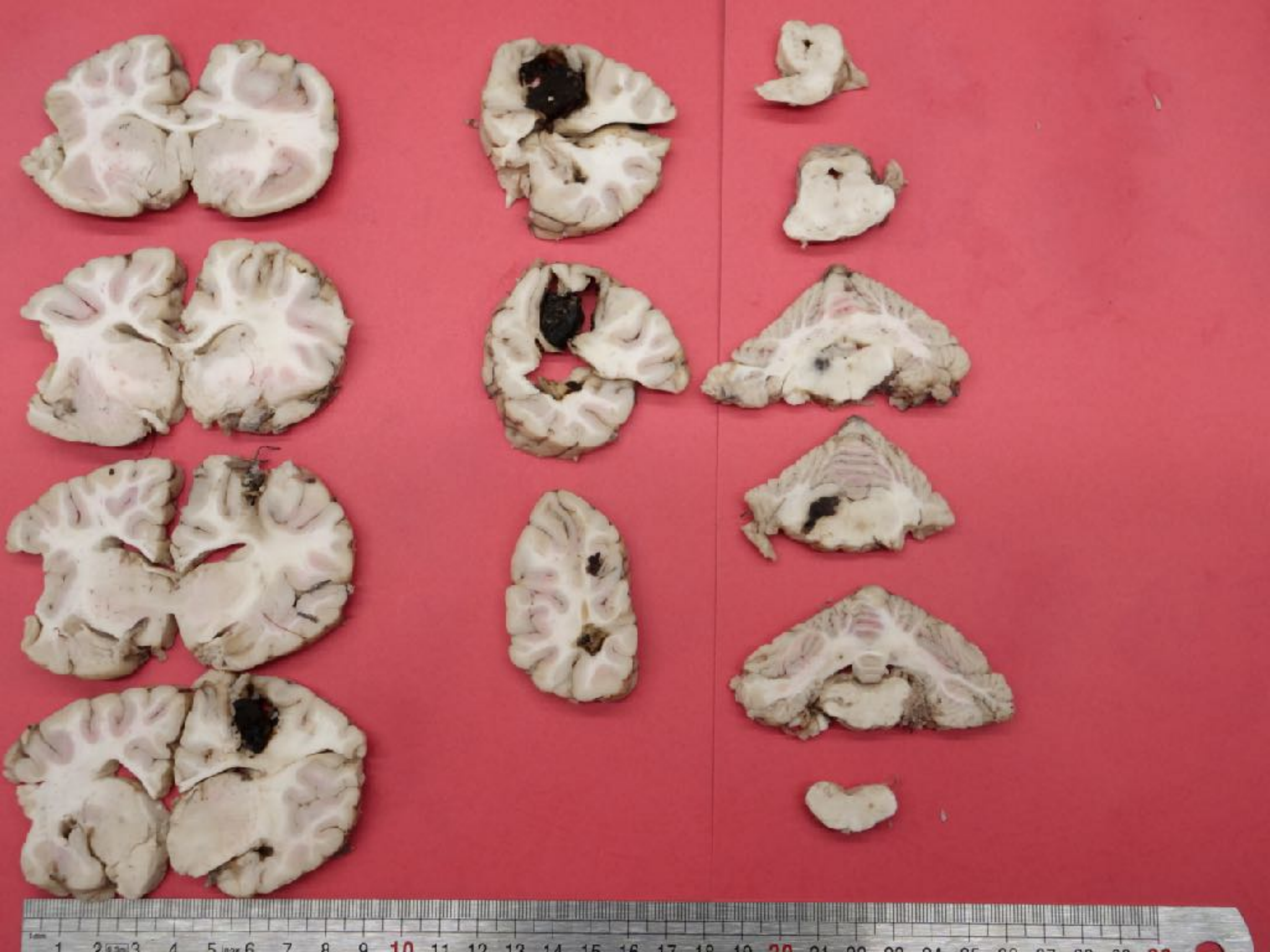
Toxoplasma gondii




present
absent
pseudogene
A
TLR11
TLR12
GMS IRG
GKS IRG
House mouse
Algerian mouse
Rat
Chinese hamster
Golden hamster
Degu
Chinchilla
Rabbit
Pika
Hedgehog
Star-nosed mole
Horse
White Rhino
Armadillo
Elephant
Manatee
Platypus
Orca
Human
Bonobo
Panda
Dog
Cat
0.1
B
Order
Species
Popular name
TLR7
TLR9
TLR11
TLR12
Fish
Birds
Mammals


ACC. N. 82
SPECIE FOCA MONACA
DATA

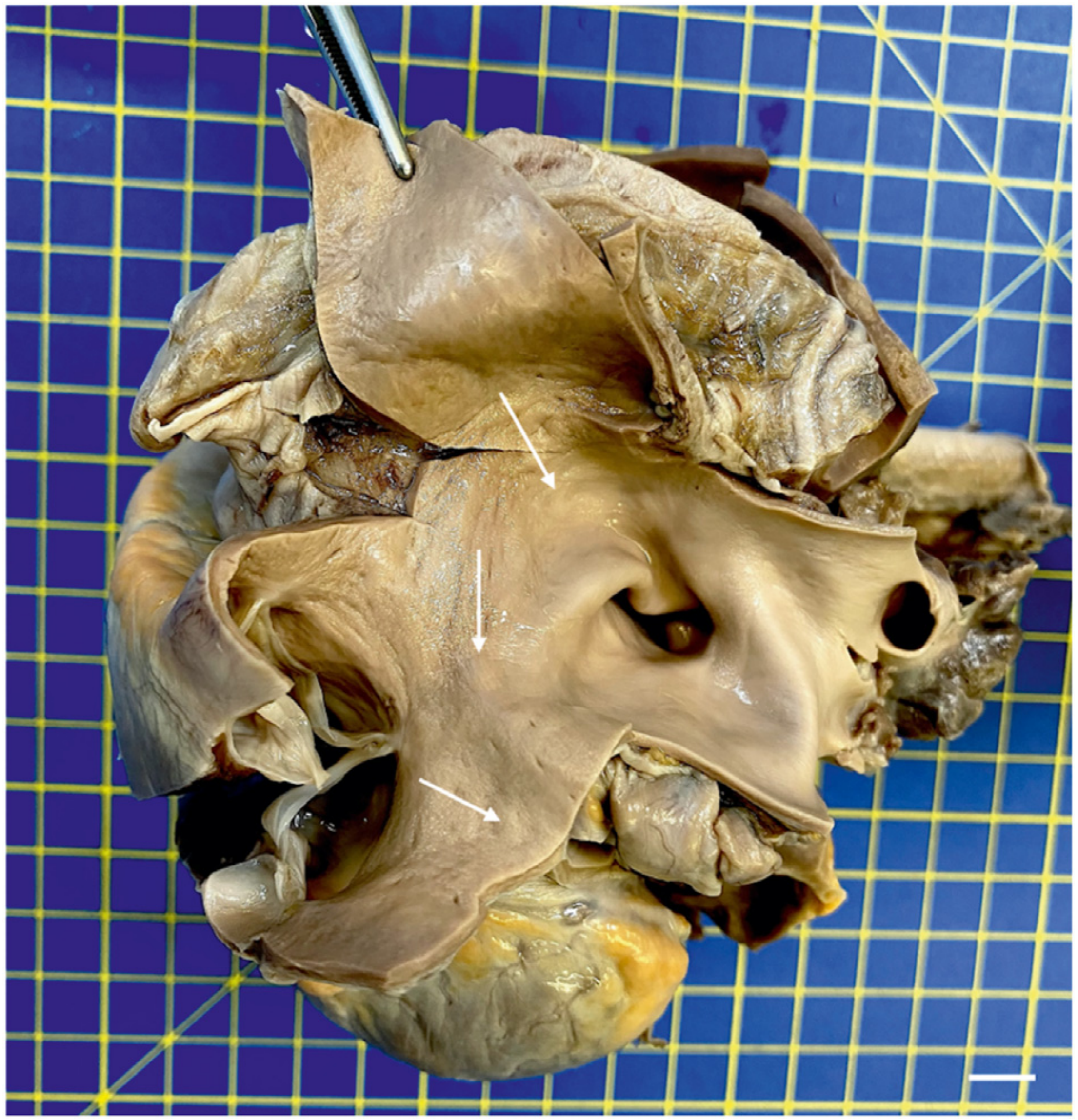


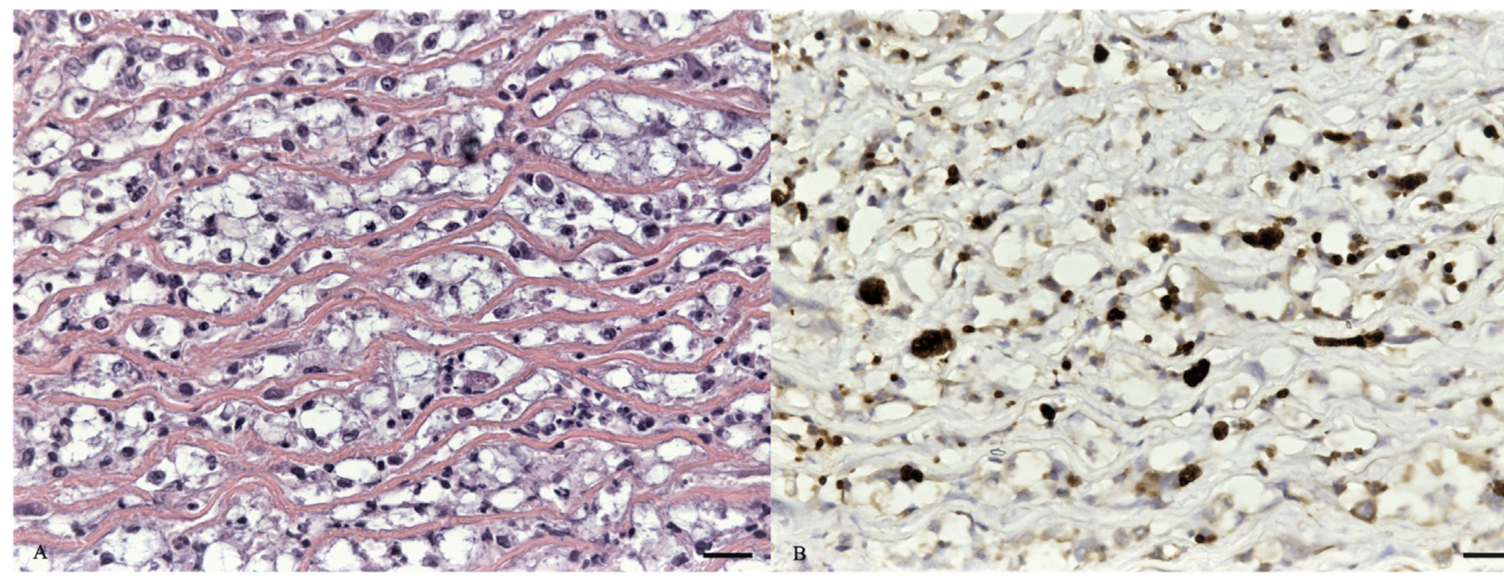


Atypical Toxoplasmosis in a Mediterranean Monk Seal (*Monachus monachus*) Pup

Sandro Mazzariol[*], Cinzia Centelleghe[*], Antonio Petrella[†], Federica Marcer[‡], Matteo Beverelli[†], Cristina E Di Francesco[§], Gabriella Di Francesco[¶], Ludovica Di Renzo[¶], Giovanni Di Guardo[§], Tania Audino[+], Letizia Tripodi[+] and Cristina Casalone[+]

[*] *Department of Comparative Biomedicine and Food Science, University of Padua, Legnaro, Padova,* [†] *Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata, Foggia,* [‡] *Department of Animal Medicine, Production and Health, University of Padua, Legnaro, Padova,* [§] *Faculty of Veterinary Medicine, University of Teramo,* [¶] *Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise, Teramo and* [+] *Istituto Zooprofilattico Sperimentale del Piemonte, Torino, Italy*





Toxoplasma gondii

T. gondii related pathology

- CNS: gliosis and scattered foci of granulomatous encephalitis (> TT) and/or non-purulent meningo-encephalitis (>SC).

- Reproductive: necrotizing placentitis and/or scattered necrotizing foci in the foetus; abortion.

- Other: granulomatous/chronic inflammation in muscles (heart, muscular layers); necrotizing lymphadenitis.

T. gondii diagnosis

- PCR: aimed to detect *Apycomplexa* spp.

- Microscopic: IHC with anti-*T. gondii* antibodies.

DIAGNOSTIC FRAMEWORKS

-Infectious diseases

- **Fishery interaction**

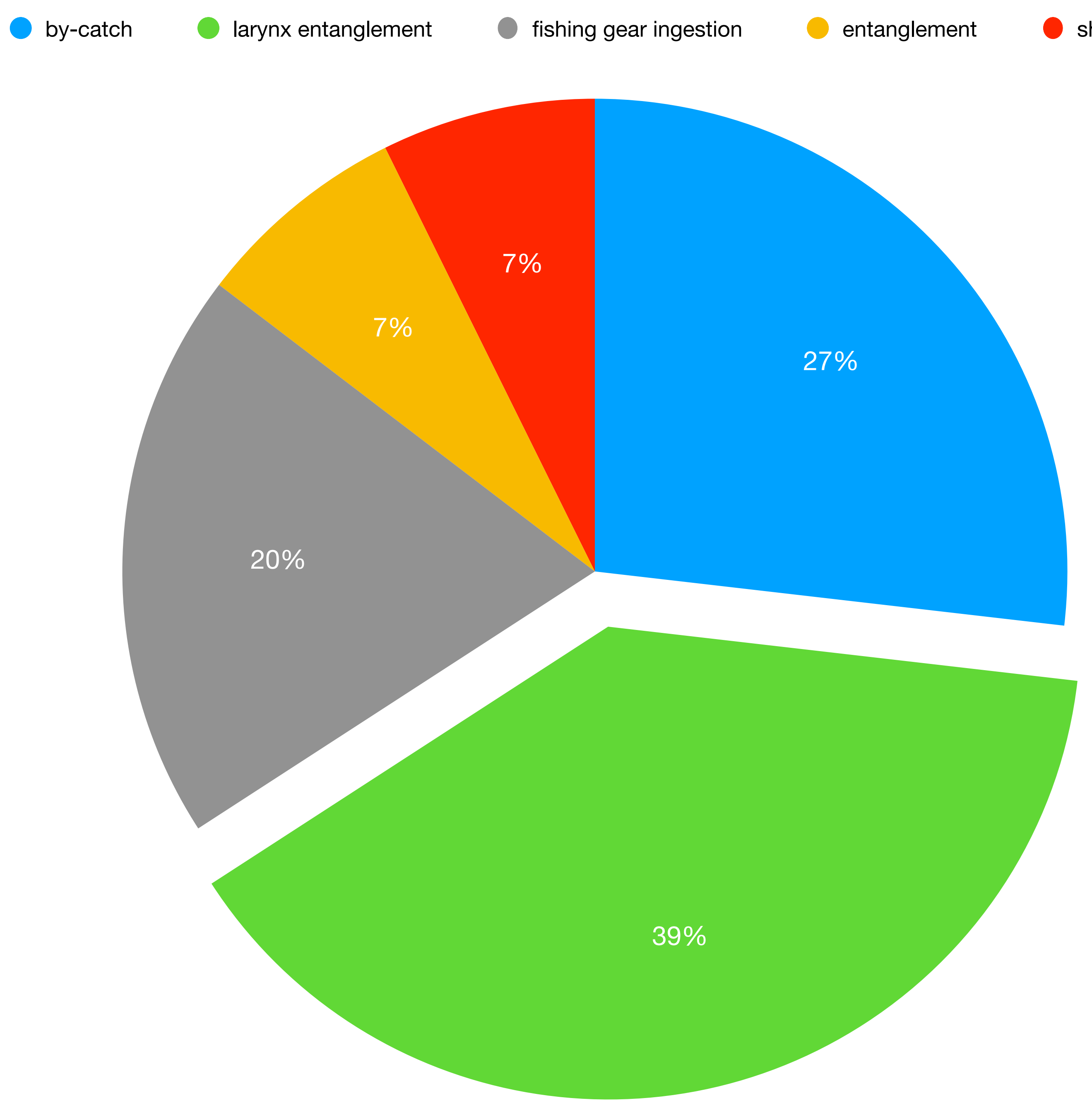
- Marine litter ingestion and evaluation

- Ship strikes

- Noise impacts

- Others causes of death

Human induced mortality in Italy 2015-2019



5. Fishery interaction common evidences: literature review

Possible interactions:

1. by-catch;
2. entanglement
3. gear ingestion/larynx entanglement
4. direct killing;
5. prey depletion.

- In case of by-catch ***small cetacean*** die for asphyxia and/or drowning.
- ***Large whales*** usually die for starvation.

5. Fishery interaction common evidences: literature review

DIAGNOSIS OF BY-CATCH

- Usually based on external evidences (**lacerations and marks of nets**).

- Finding an entangled animal is not enough to diagnose by-catch: it could be a **secondary cause**. True also the opposite.

- **A detailed necropsy is necessary**

- **Pathological evidences** suggestive of interactions with fisheries are:
1) Injures related to the gears/lines;
2) Evidences of drowning/asphyxia;
3) Evident recent feeding;
4) Absence of concomitant or predisposing diseases.

www.lifedelfi.eu

5. Fishery interaction common evidence literature review

Vol. 103: 229–264, 2013
doi: 10.3354/dao02566
DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org
Published April 11

FREE ACCESS

THEME SECTION

Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma

Editors: Michael J. Moore[1,*], Julie van der Hoop[1], Susan G. Barco[2], Alex M. Costidis[3,9], Frances M. Gulland[4], Paul D. Jepson[5], Kathleen T. Moore[6], Stephen Raverty[7], William A. McLellan[8]

[1]Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, USA
[2]Virginia Marine Aquarium and Marine Science Program, Virginia Beach, Virginia 23451, USA
[3]Physiological Sciences, College of Veterinary Medicine, University of Florida, Gainesville, Florida 32610, USA
[4]Marine Mammal Center, Fort Cronkhite, Sausalito, California 94965, USA
[5]Institute of Zoology, Zoological Society of London, London NW1 4RY, UK
[6]International Fund for Animal Welfare, Yarmouth Port, Massachusetts 02675, USA
[7]British Columbia Ministry of Agriculture, Abbotsford, British Columbia V3G 2M3, Canada
[8]Biology and Marine Biology, University of North Carolina Wilmington, Wilmington, North Carolina 28403, USA

[*]Present address: Biology and Marine Biology, University of North Carolina Wilmington, Wilmington, North Carolina 28403, USA

Table 2. Criteria sets for diagnosis of underwater entrapment in pinnipeds and cetaceans. For explanation of Codes and scorings 'Confirmed', 'Probable' and 'Suspect' see 'Introduction and overview' and Appendix 1

Criterion	Confirmed				Probable[a]			Suspect
Cetaceans								
Reported by fisheries observer	✓							Most parsimonious conclusion based on observer experience
Entangled in gear			✓	✓				
Code 2 or 3			✓					
Froth in lungs					✓	✓	✓	
Whole or partially digested prey in stomach				✓	✓	✓	✓	
Bruising around appendages/neck					✓	✓	✓	
No other significant gross pathology					✓	✓	✓	
Good nutritional status				✓	✓	✓	✓	
Net marks		✓						
Rope/line marks					✓			
Amputation/body slit						✓		
Rostral/mandibular fractures							✓	

BY-CATCH

5. Fishery interaction common evidences: literature review

BY-CATCH GROSS EVIDENCES:

- Injures due to direct interaction
- lacking of extremities
- fins, head and rostral injures
- lacerations and nets marks (features could suggest the type of gear)
- incisions and deep wounds due to sharp objects
- penetration wounds
- tail abrasions

5. Fishery interaction common evidences: literature review

BY-CATCH GROSS EVIDENCES:

5. Fishery interaction common evidences: literature review

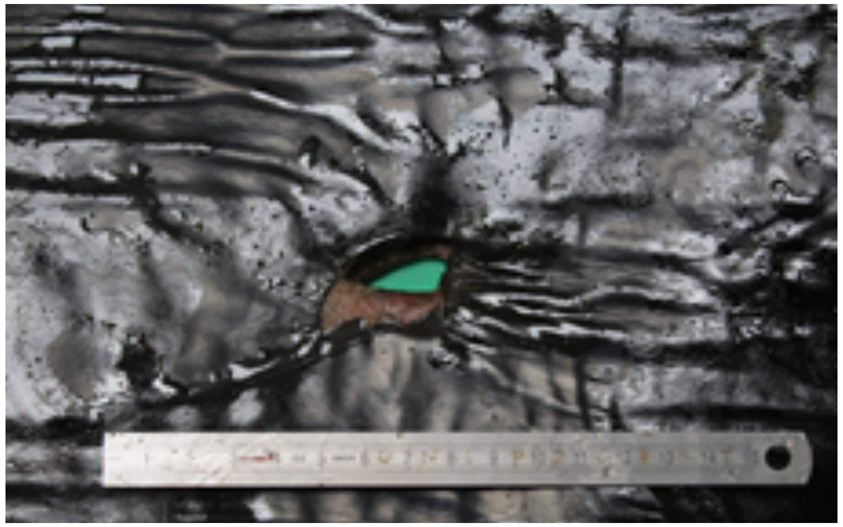
BY-CATCH GROSS EVIDENCES:

5. Fishery interaction common evidences: literature review

BY-CATCH GROSS EVIDENCES:

Other evidences

- abrasions
- blunt traumas
- subcutaneous haemorrhages and petechiae
- lines and nets
- skull fractures
- visceral haemorrhages



5. Fishery interaction common evidences: literature review

www.lifedelfi.eu

BY-CATCH GROSS EVIDENCES

90 Dis Aquat Org 127: 83–95, 2018

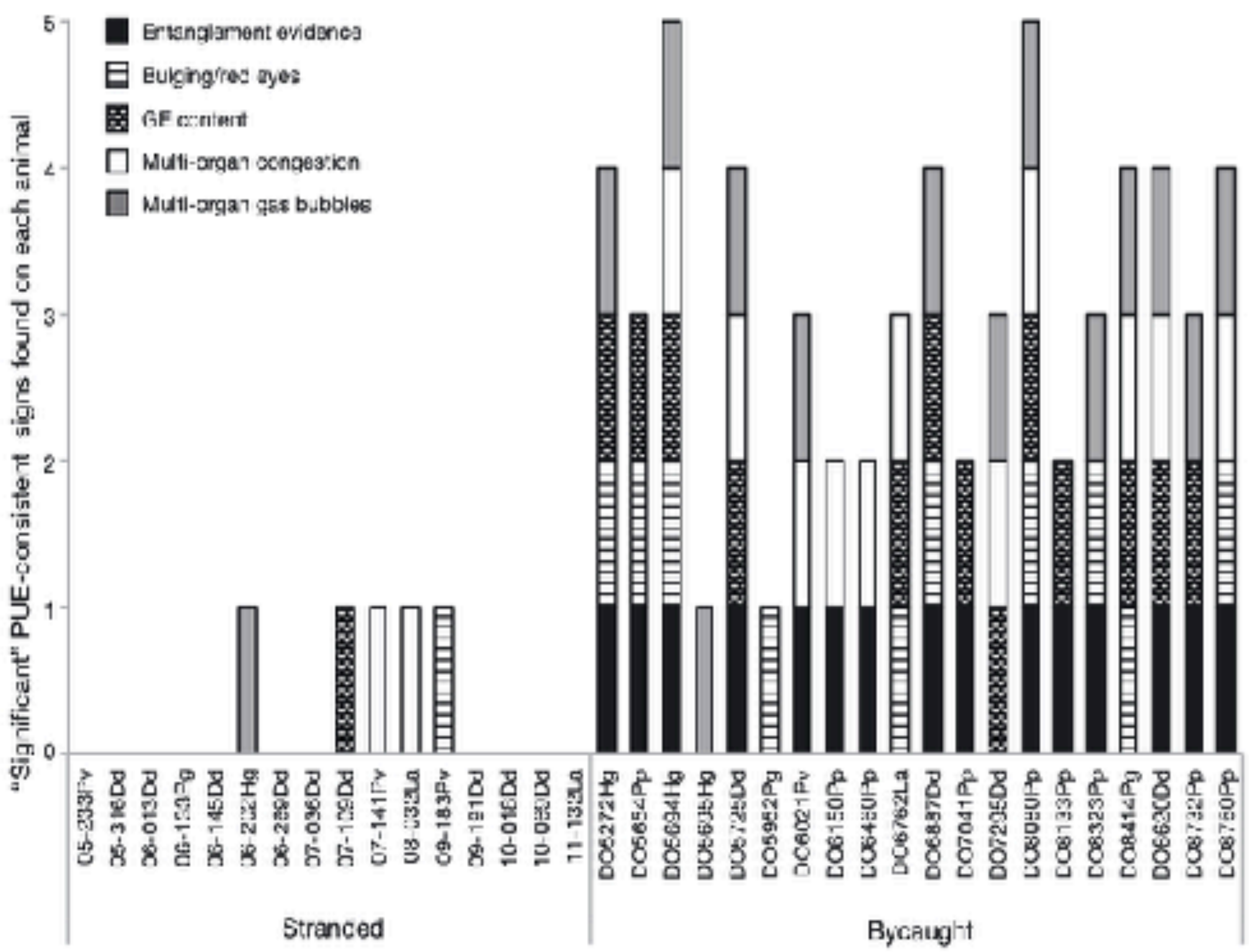


Fig. 3. Comparison of prevalence of multiple peracute underwater entrapment (PUE) signs in bycaught and stranded marine mammals. Animal ID numbers correspond to those given in Tables 1 & 2. GE: gastroesophageal

Vol. 127: 83–95, 2018
https://doi.org/10.3354/dao03186
DISEASES OF AQUATIC ORGANISMS
Dis Aquat Org
Published January 31

Discrimination between bycatch and other causes of cetacean and pinniped stranding

Yara Bernaldo de Quirós[1,2], Meghan Hartwick[1,3], David S. Rotstein[4], Michael M. Garner[5], Andrea Bogomolni[1], William Greer[6,7], Misty E. Niemeyer[8], Greg Early[7], Frederick Wenzel[5], Michael Moore[1,*]

5. Fishery interaction common evidences: literature review

BY-CATCH GROSS EVIDENCES

OPEN ACCESS Freely available online PLOS ONE

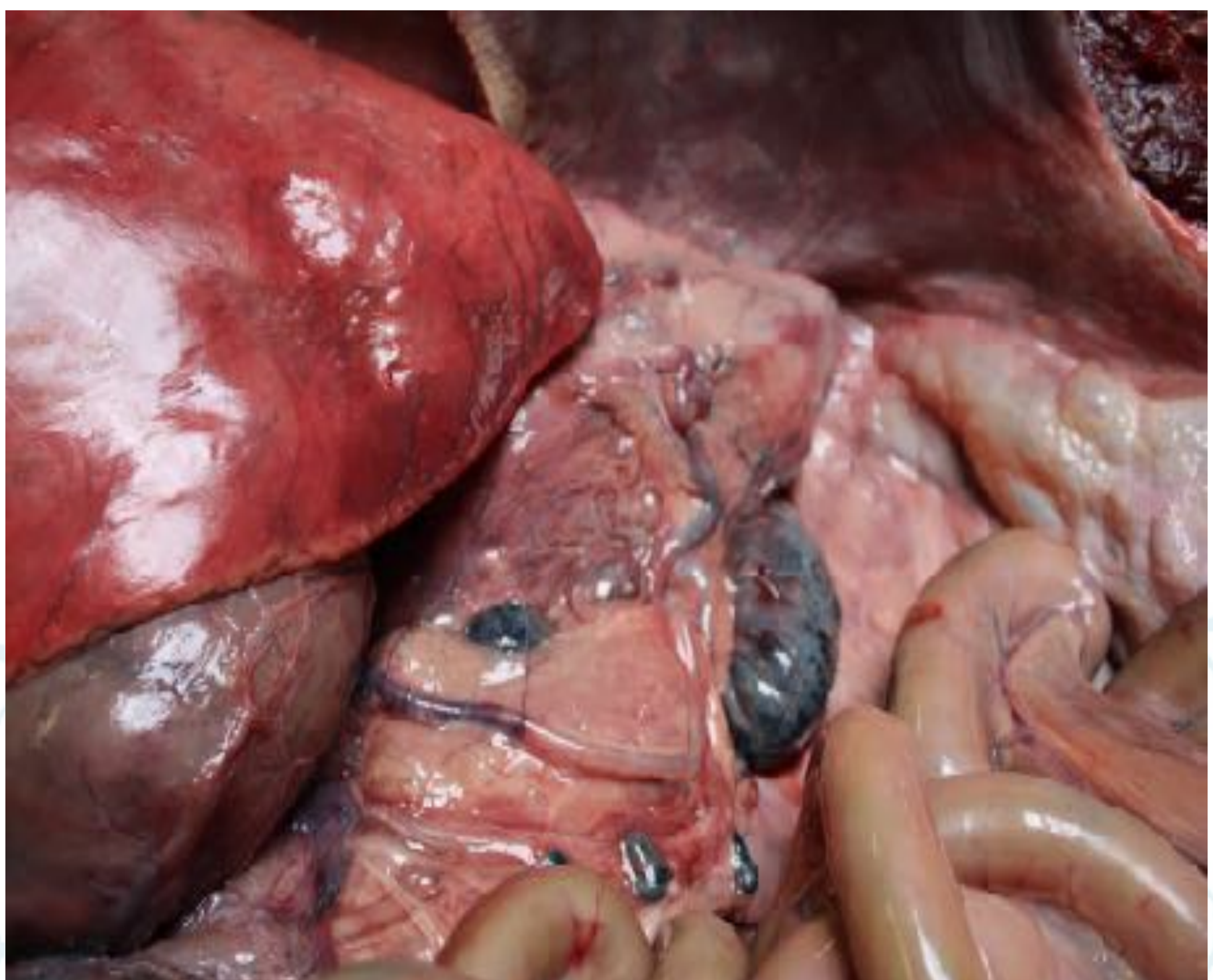
Compositional Discrimination of Decompression and Decomposition Gas Bubbles in Bycaught Seals and Dolphins

Yara Bernaldo de Quirós[1*], Jeffrey S. Seewald[2], Sean P. Sylva[2], Bill Greer[3,4], Misty Niemeyer[5], Andrea L. Bogomolni[1,6], Michael J. Moore[1]

Contents lists available at ScienceDirect
Research in Veterinary Science
journal homepage: www.elsevier.com/locate/rvsc

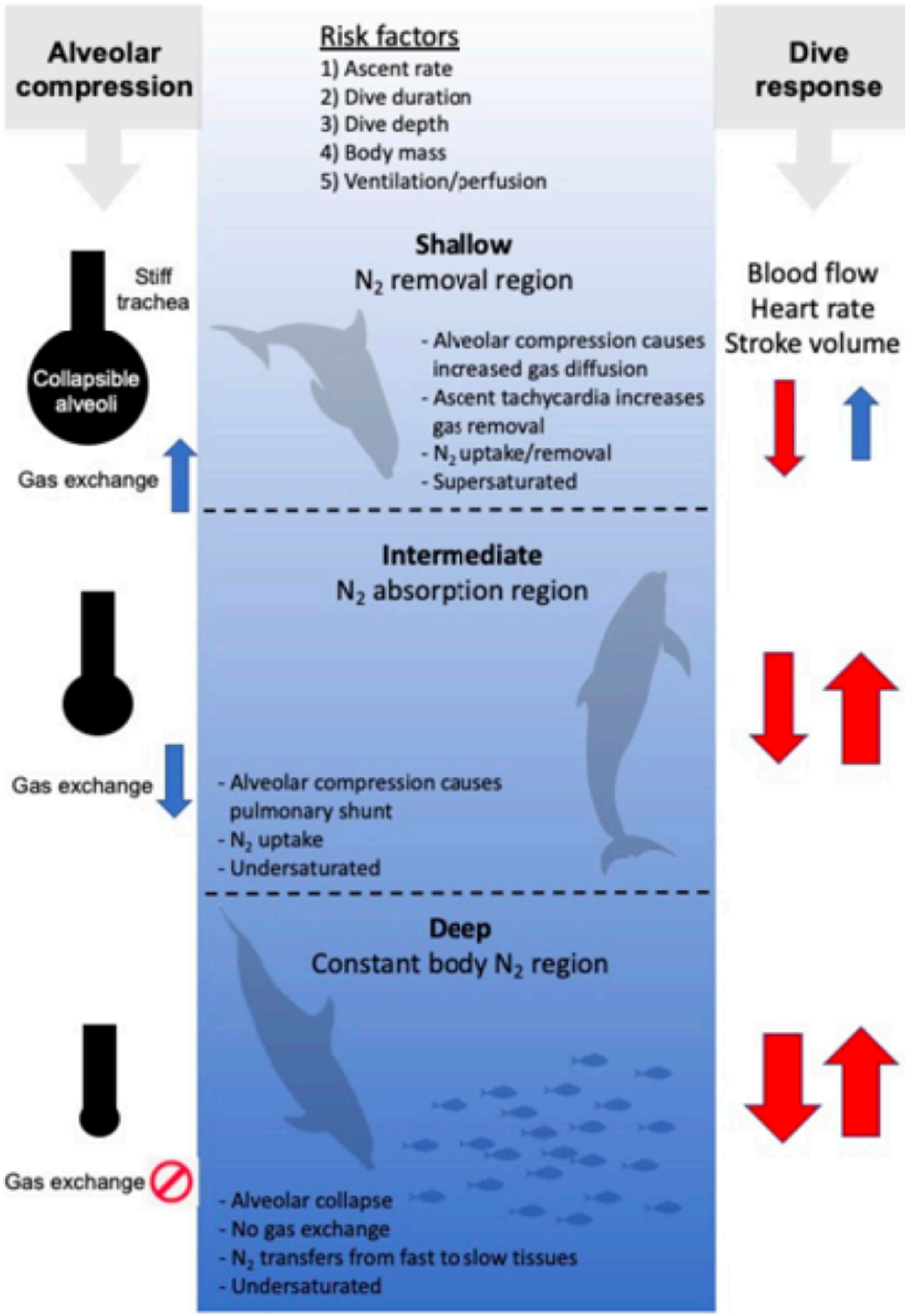
Differentiation at necropsy between in vivo gas embolism and putrefaction using a gas score

Yara Bernaldo de Quirós, Pedro Saavedra, Andreas Møllerløkken, Alf O. Brubakk, Arve Jørgensen, Óscar González-Díaz, José L. Martín-Barrasa, Antonio Fernández



5. Fishery interaction common evidences: literature review

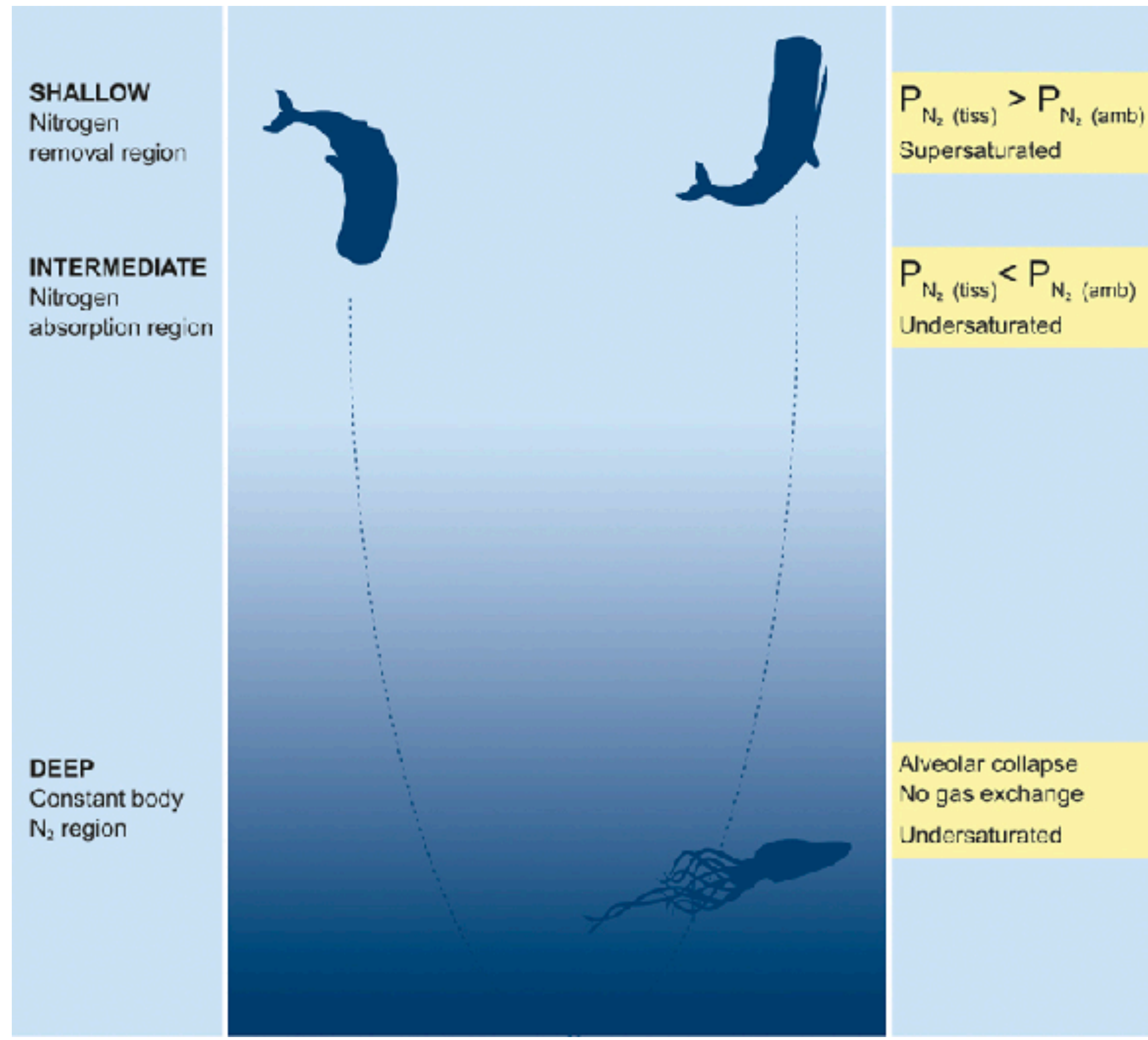
BY-CATCH GROSS EVIDENCES

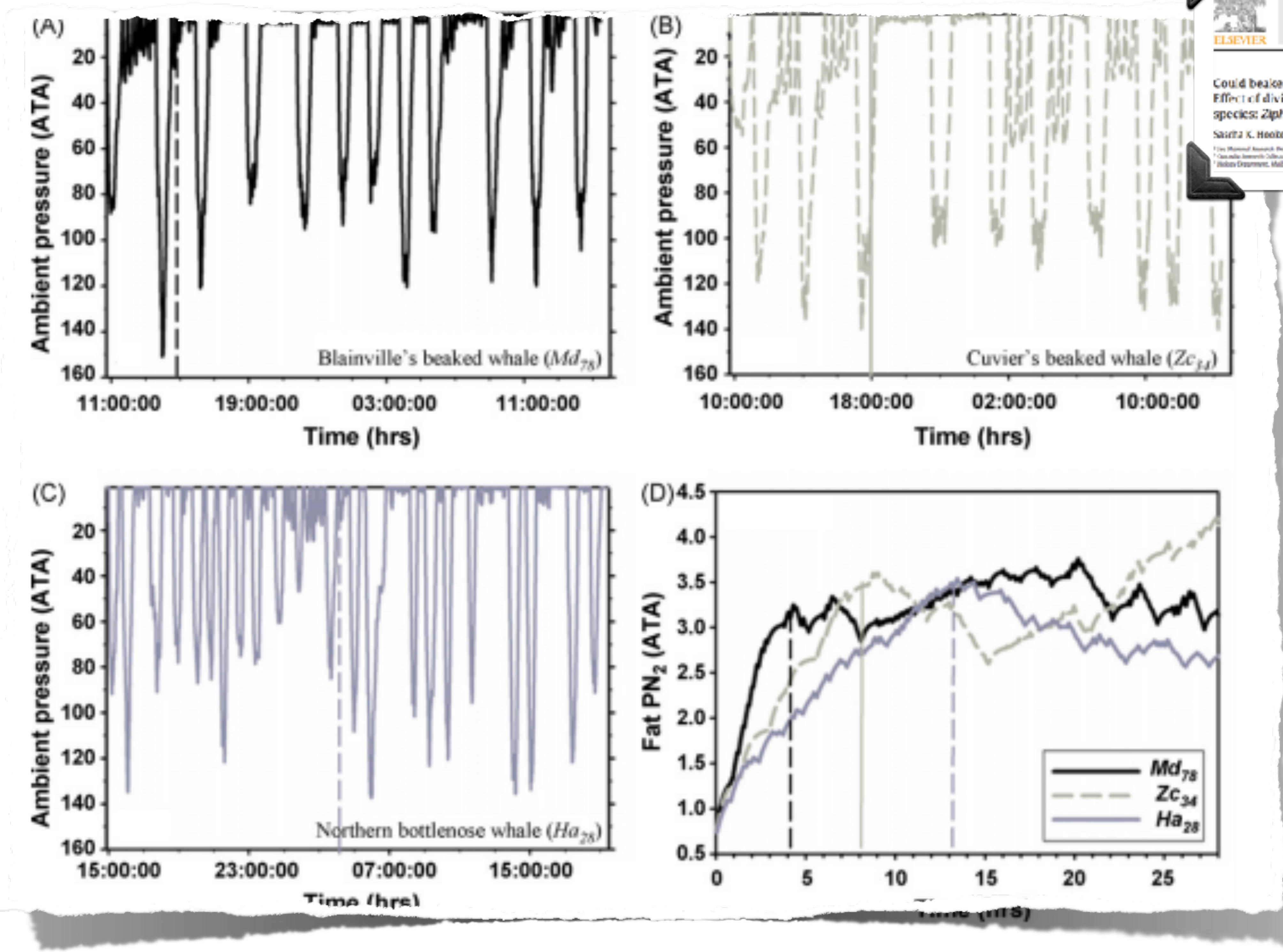


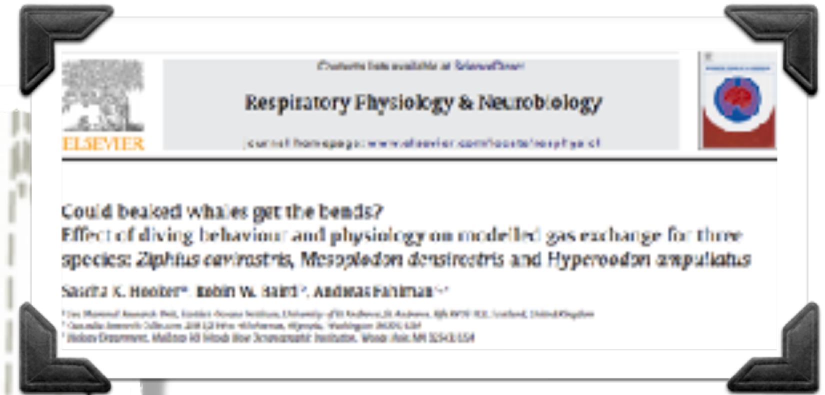
frontiers in PHYSIOLOGY
FOCUSED REVIEW
published: 28 January 2014
doi: 10.3389/fphys.2014.00013

How man-made interference might cause gas bubble emboli in deep diving whales

Andreas Fahlman[1], Peter L. Tyack[2], Patrick J. O. Miller[2] and Petter H. Kvadsheim[3]*
[1] Department of Life Sciences, Texas A&M University Corpus Christi, Corpus Christi, TX, USA
[2] Sea Mammal Research Unit, University of St. Andrews, St. Andrews, UK
[3] Maritime Systems Division, Norwegian Defence Research Establishment (FFI), Horten, Norway





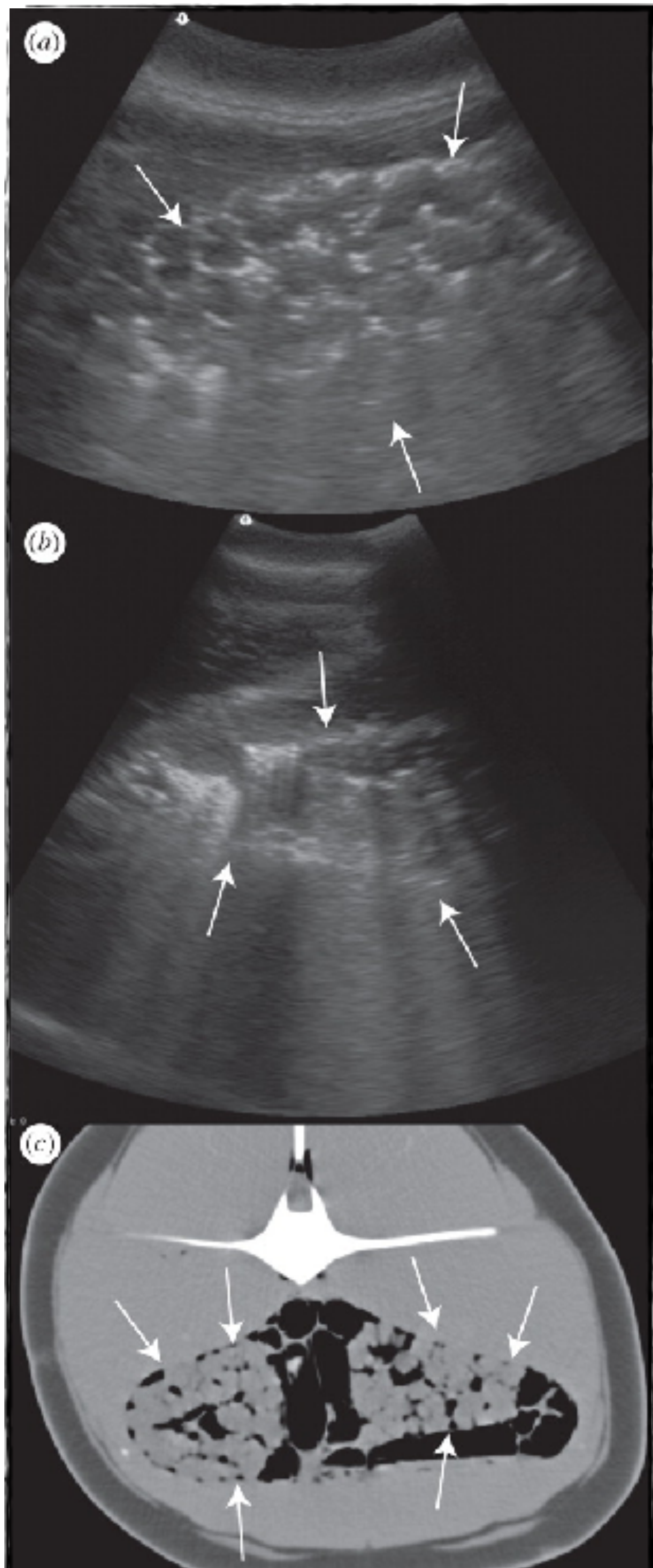


Respiratory Physiology & Neurobiology

ELSEVIER

Could beaked whales get the bends?
Effect of diving behaviour and physiology on modelled gas exchange for three species: *Ziphius cavirostris*, *Mesoplodon densirostris* and *Hyperoodon ampullatus*

Sascha K. Hooker, Robin W. Baird, Andreas Fahlman



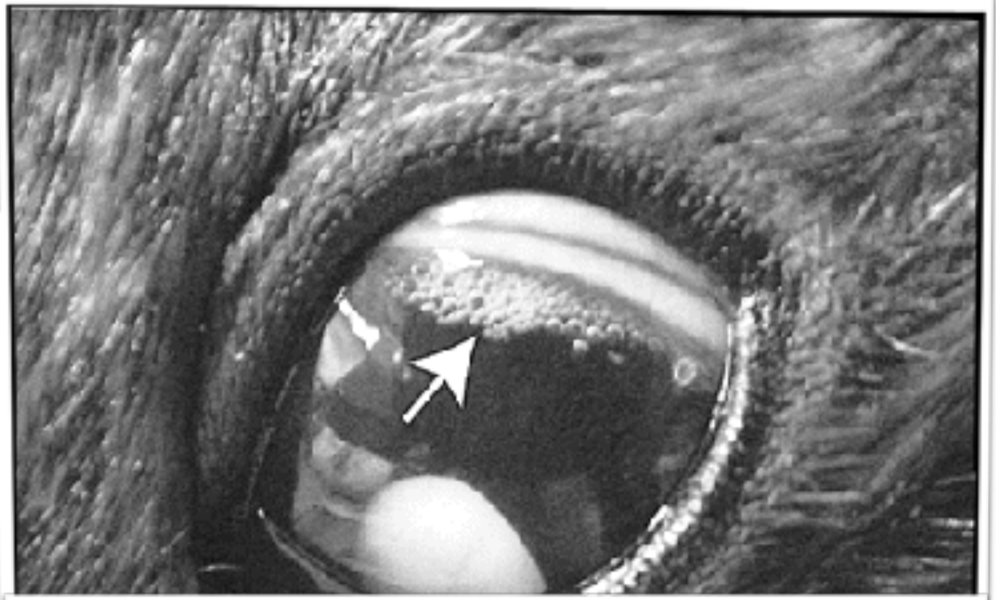
PROCEEDINGS OF THE ROYAL SOCIETY B

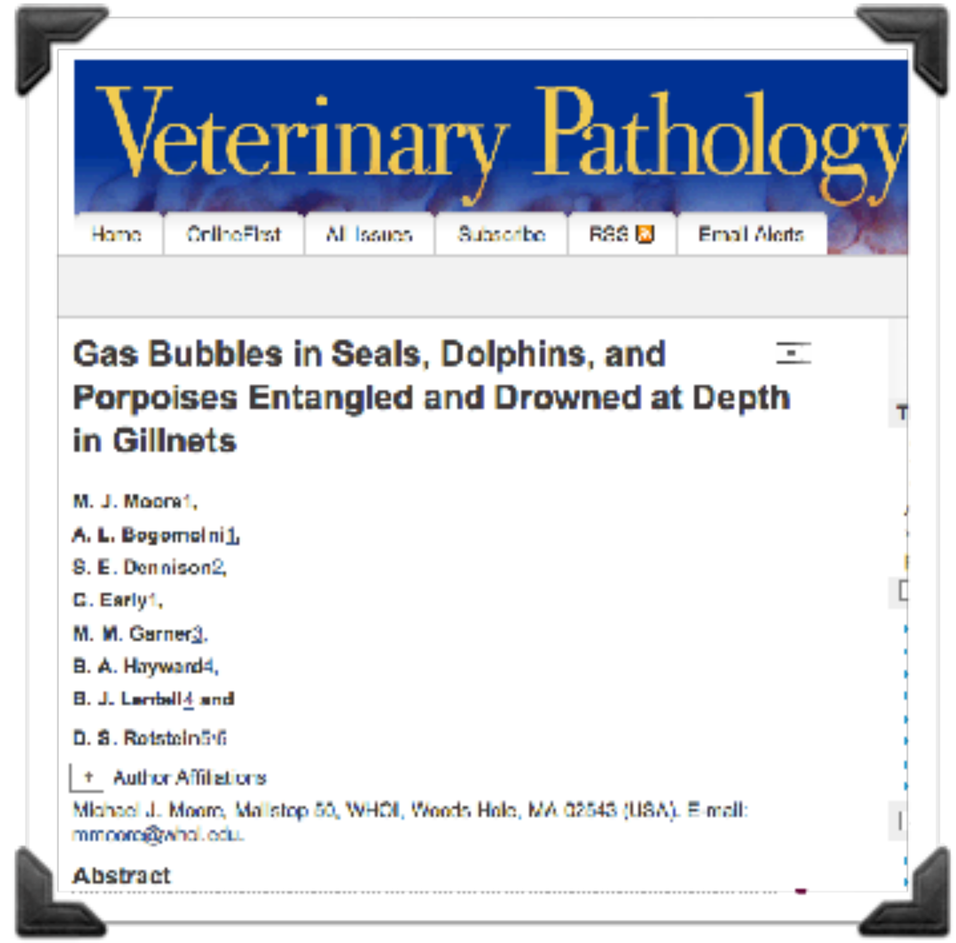
Bubbles in live-stranded dolphins

S. Dennison[1], M. J. Moore[2,*], A. Fahlman[3], K. Moore[4], S. Sharp[4], C. T. Harry[4], J. Hoppe[4], M. Niemeyer[4], B. Lentell[2] and R. S. Wells[5]

+ Author Affiliations

↵*Author for correspondence (mmoore@whoi.edu).





Veterinary Pathology

Home | OnlineFirst | All Issues | Subscribe | RSS | Email Alerts

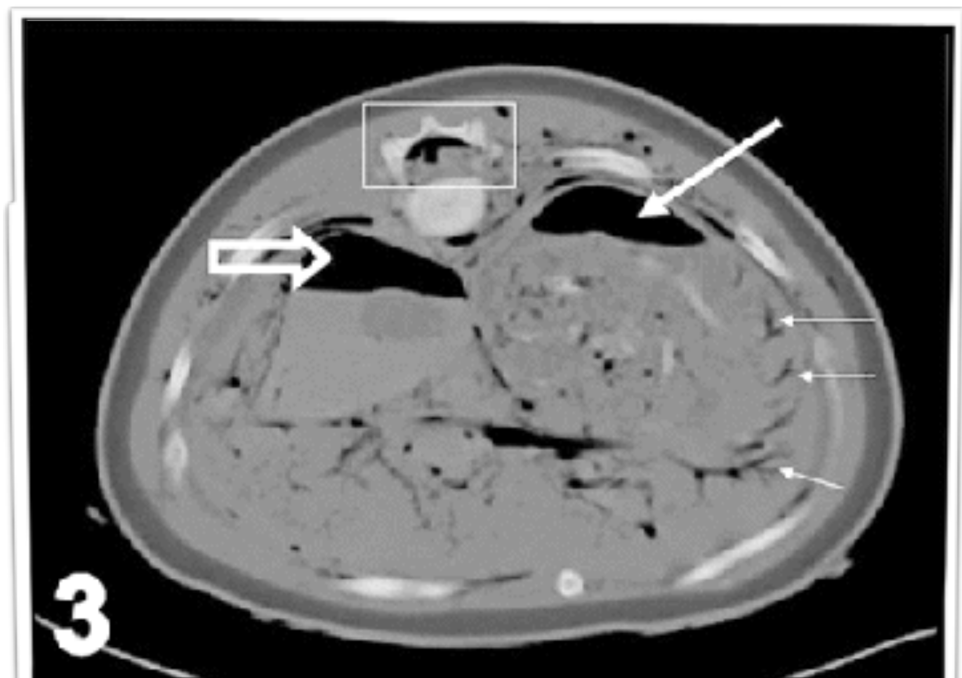
Gas Bubbles in Seals, Dolphins, and Porpoises Entangled and Drowned at Depth in Gillnets

M. J. Moore[1],
A. L. Bogomolni[1],
S. E. Dennison[2],
C. Early[1],
M. M. Garner[3],
B. A. Hayward[4],
B. J. Lentell[4] and
D. S. Rotstein[5,6]

+ Author Affiliations

Michael J. Moore, Mailstop 50, WHOI, Woods Hole, MA 02543 (USA). E-mail: mmoore@whoi.edu.

Abstract



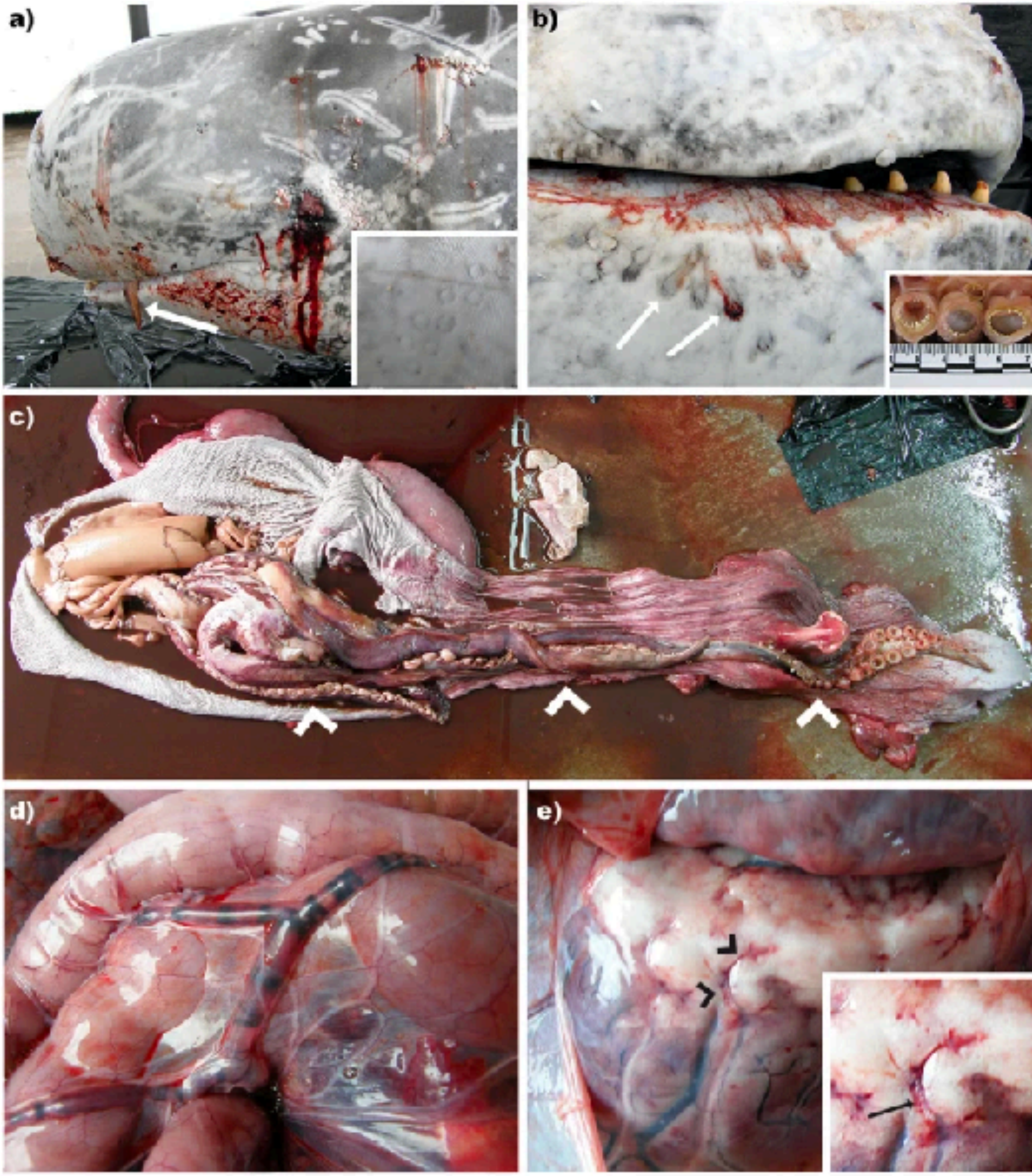
1996 - 2021 25 ANS YEARS ACCOBAMS

SCIENTIFIC REPORTS

OPEN

Deadly acute Decompression Sickness in Risso's dolphins

A. Fernández, E. Sierra, J. Díaz-Delgado, S. Sacchini, Y. Sánchez-Paz, C. Suárez-Santana, M. Arregui, M. Arbelo & Y. Bernaldo de Quirós



5. Fishery interaction common evidences: literature review

in Marine Science
ORIGINAL RESEARCH

Novel Necropsy Findings Linked to Peracute Underwater Entrapment in Bottlenose Dolphins (*Tursiops truncatus*)

Alexandra L. Epple, Jeanne T. Daniel, Susan G. Barco, David S. Rotstein and Alexander M. Costidis

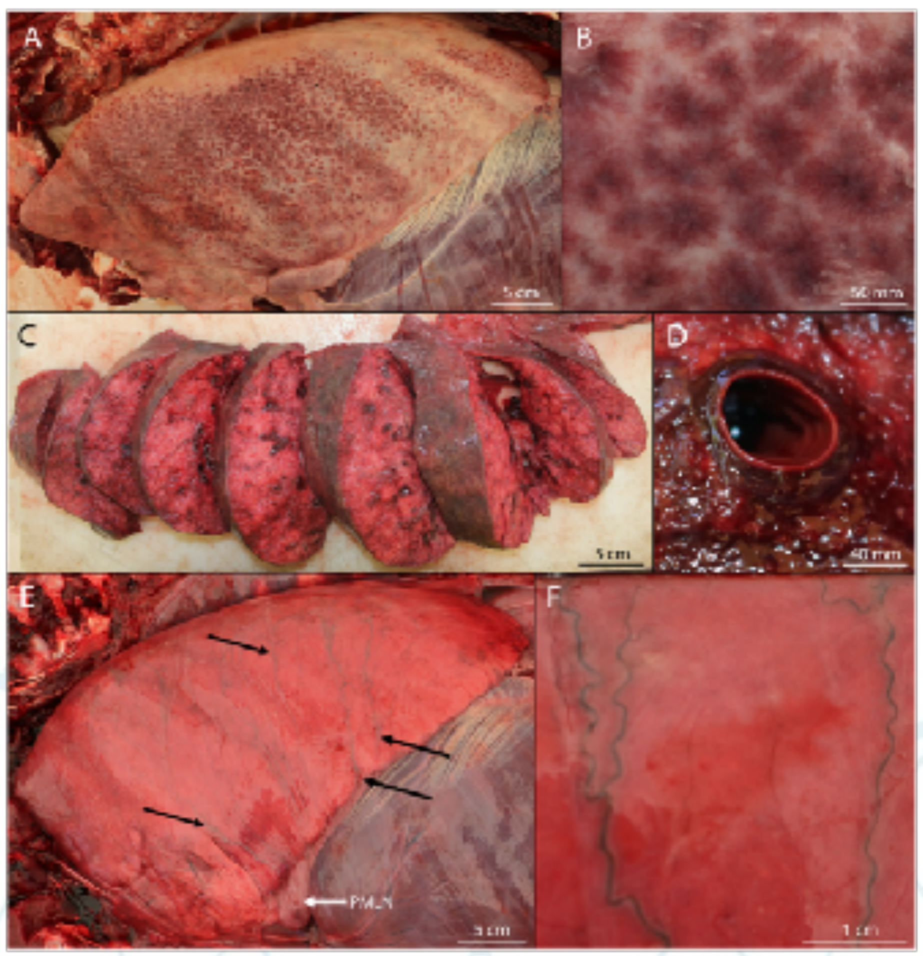


FIGURE 1 | Pulmonary lesions in bycaught bottlenose dolphins. (A) Pulmonary petechiae. (B) Detail of pulmonary petechiae. (C) Pulmonary perivascular edema and/or hemorrhage. (D) Detail of pulmonary perivascular edema and/or hemorrhage. (E) Hemorrhagic lymph draining (black arrows) to the pulmonary marginal lymph node (PMLN, white arrow). (F) Detail of hemorrhagic pulmonary lymph.

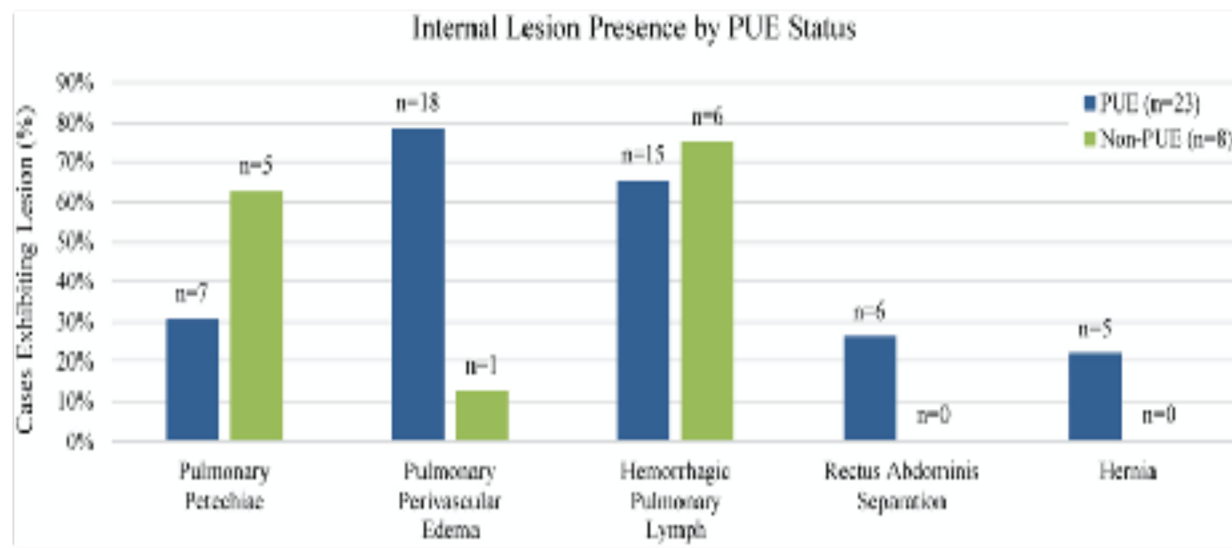


FIGURE 5 | Lesions present in bottlenose dolphins. Pulmonary petechiae and hemorrhagic pulmonary lymph were more common in non-PUE cases, while rectus abdominis separations and hernias were only found in PUE cases. Pulmonary perivascular edema was the most common lesion observed in PUE cases.

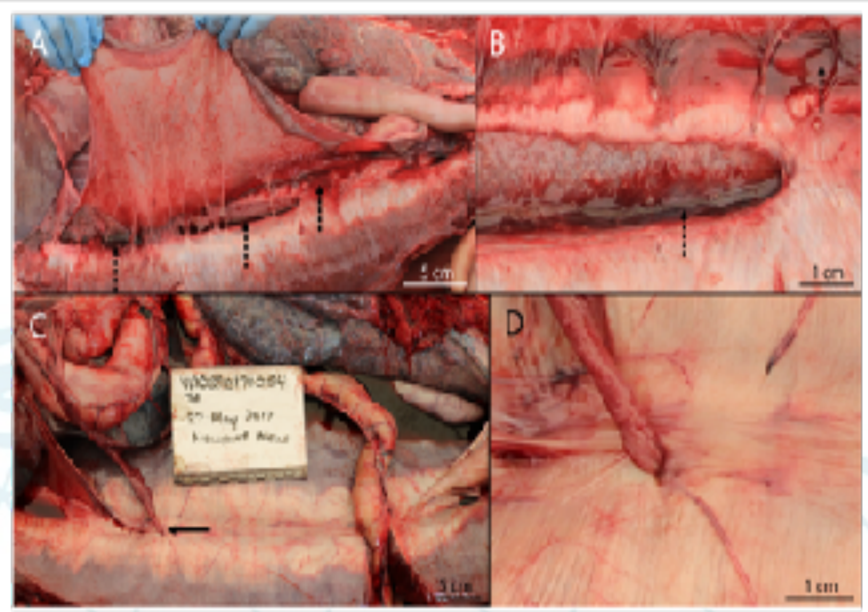
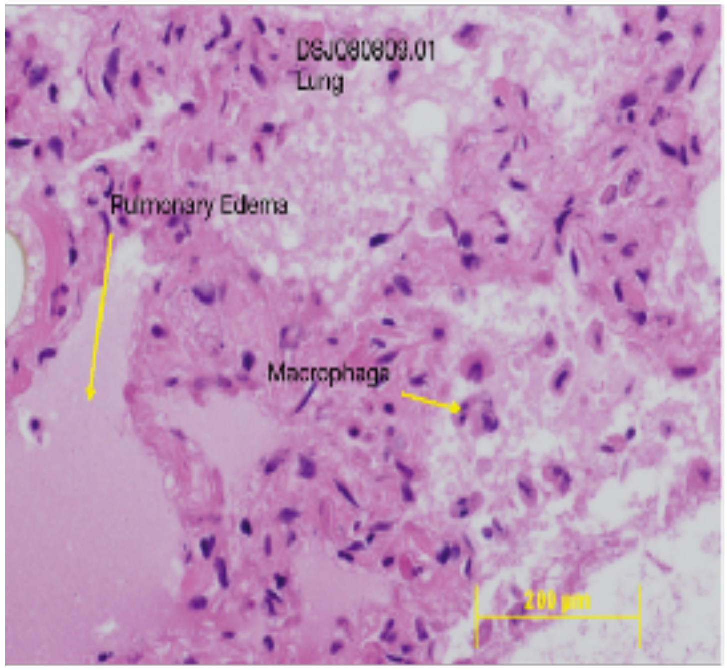
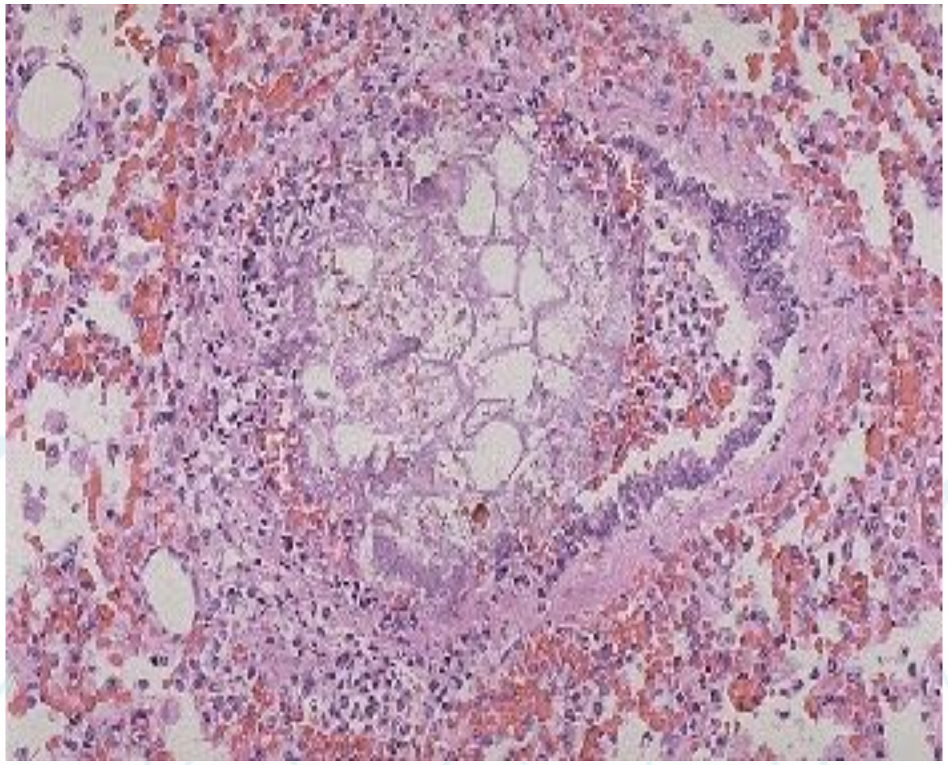


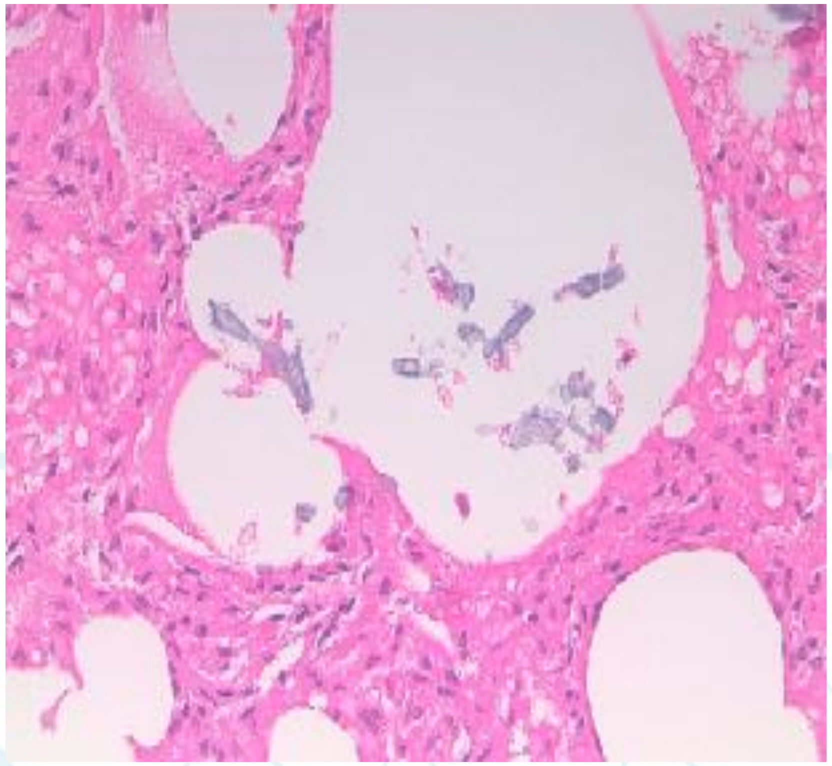
FIGURE 2 | Abdominal lesions in bycaught bottlenose dolphins. (A) Separation of the rectus abdominis muscles with intact peritoneum reflected back. Emissary blood vessels from cranial epigastric artery and vein visible as long strands. Note the hemorrhagic edema present along the length of the separation (dotted arrows). (B) Detail of caudal margin of rectus abdominis separation showing hemorrhagic edema (dotted arrows) and irregular margins consistent with tearing. (C) Omental hernia through rectus sheath (solid arrow). This hernia is chronic, however, gross presentation of acute hernias did not differ. Note that the caudal incision (to the right of the image) with the intestinal loop is an artifact of dissection. (D) Detail of omental hernia. Note the emissary vessel emanating from the hernia location and an additional emissary vessel to the right of the hernia.

5. Fishery interaction common evidences: literature review

BY-CATCH MICRO EVIDENCES







5. Fishery interaction common evidences: literature review

Nondomestic, Exotic, Wildlife and Zoo Animals–Original Article

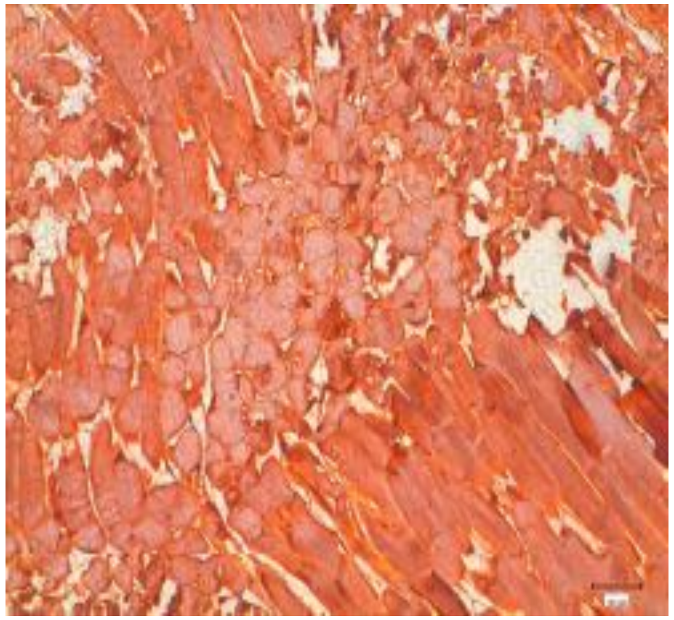
Veterinary Pathology
2017, Vol. 54(2) 298-311

Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0300985816660747
journals.sagepub.com/home/vet

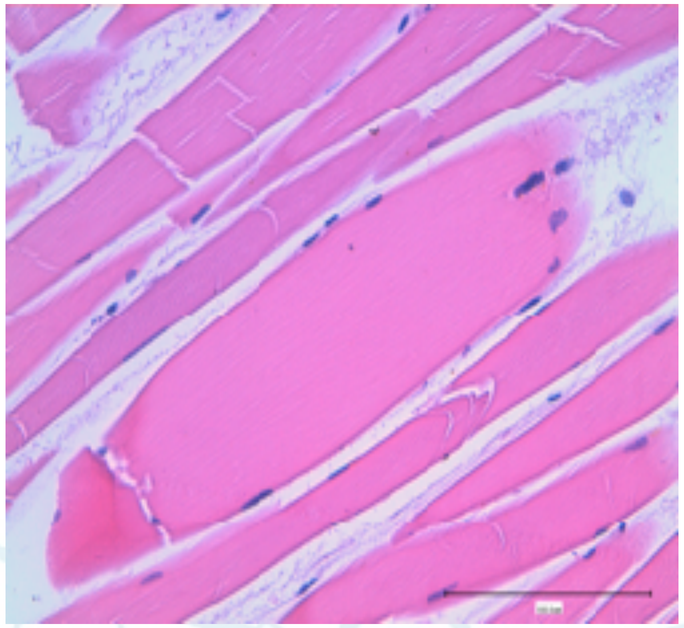
Muscle Pathology in Free-Ranging Stranded Cetaceans

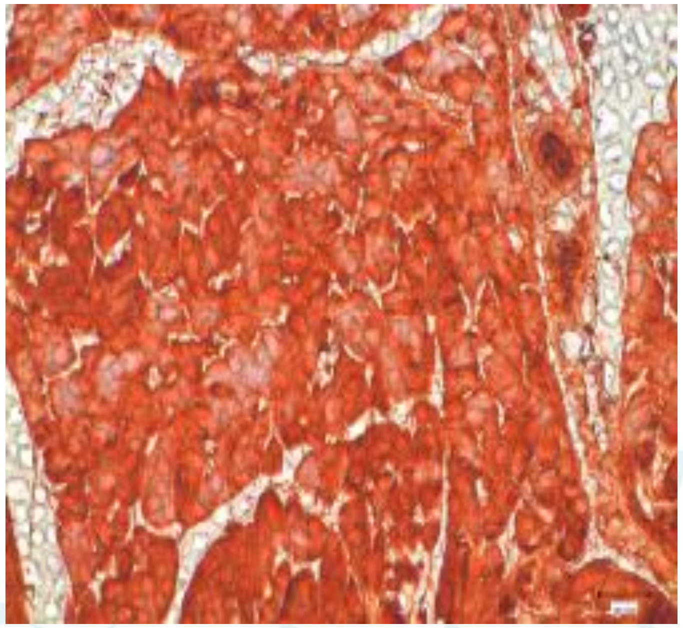
E. Sierra[1], A. Espinosa de los Monteros[1], A. Fernández[1], J. Díaz-Delgado[1], C. Suárez-Santana[1], M. Arbelo[1], M. A. Sierra[2], and P. Herráez[1]

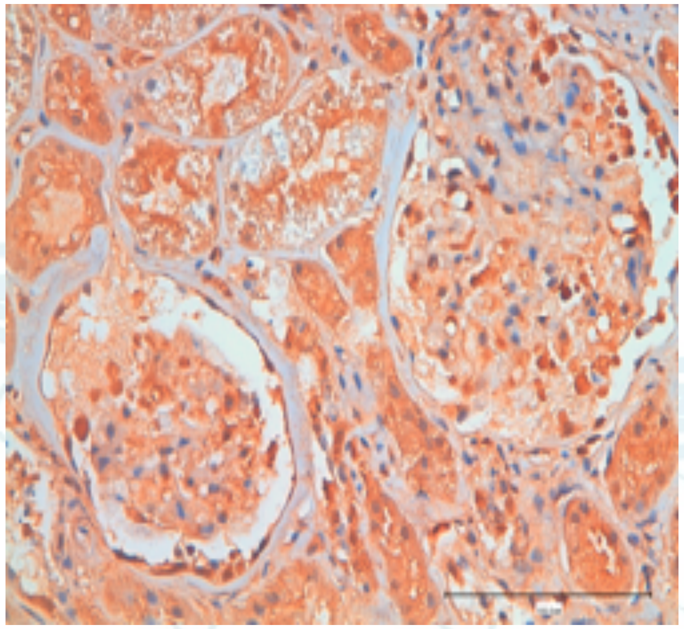
Capture myopathy due to entanglement



IHC anti-fibrinogen





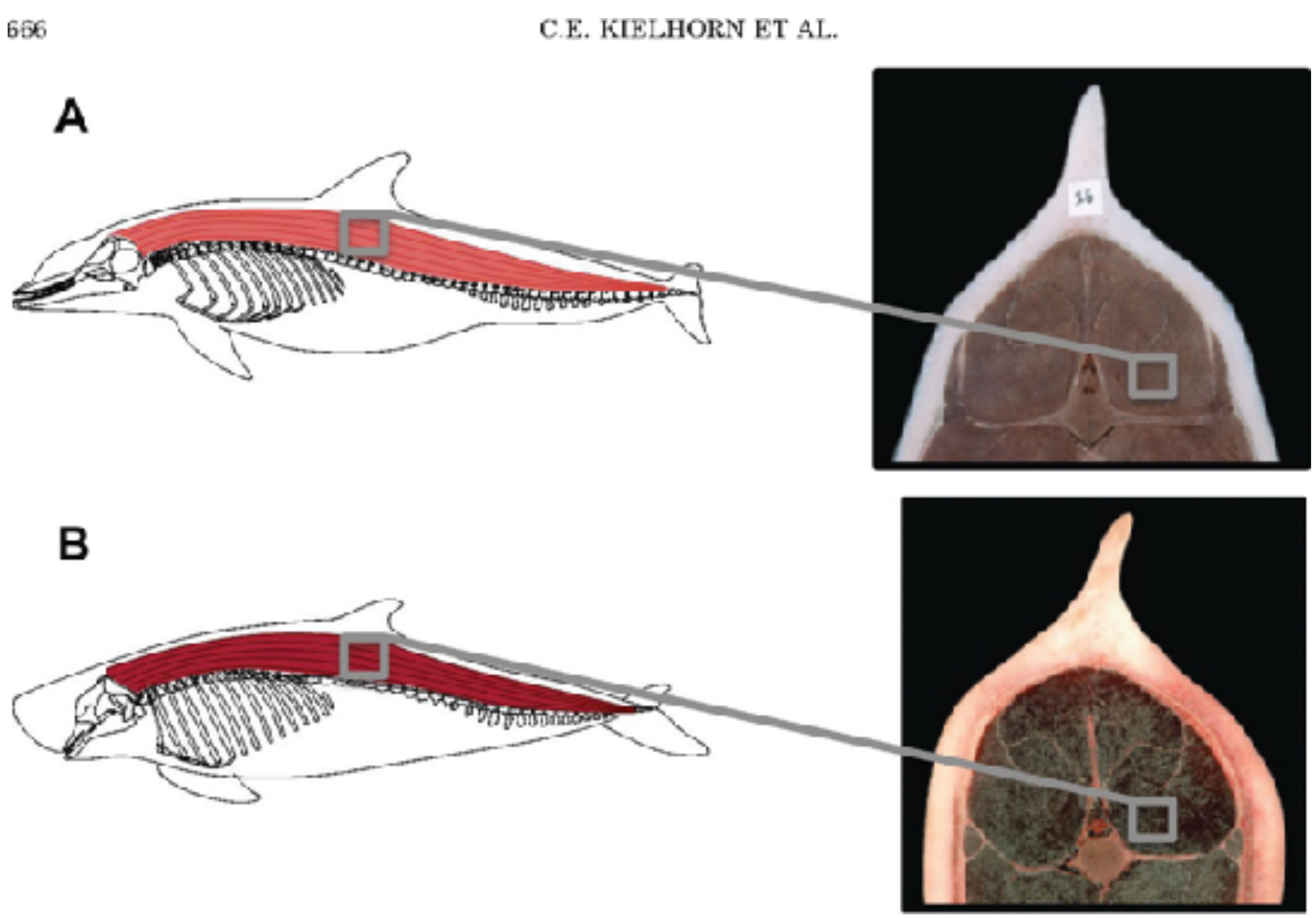


IHC anti-myoglobin

INTERNAL EXAMINATION

SKELETAL MUSCLE

- ✓ Examine the quality of the fascia and muscle on the body before removing it
- ✓ Note the color, texture, thickness and abnormalities
- ✓ Look for hemorrhage, post mortem pooling of blood in vessels (hypostasis or post mortem lividity) and bruising (hematoma)



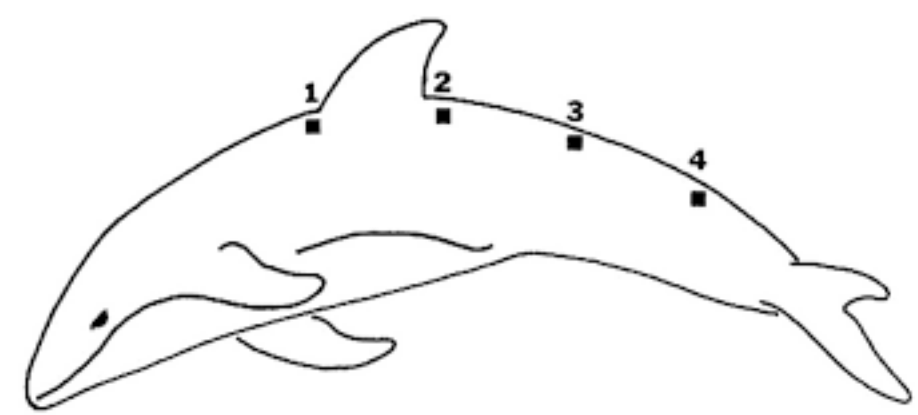

ELSEVIER

Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology

Volume 126, Issue 2, June 2000, Pages 181-191

Body size and skeletal muscle myoglobin of cetaceans: adaptations for maximizing dive duration

S.R. Noren, T.M. Williams



Capture myopathy

Fear and distress, independent of chase and/or restraint are important factors in the aetiology of all forms of CM. Sudden /surprise attacks by predators can cause CM without extensive chase.

Occur more frequently in mammals and birds, and particularly in terrestrial ungulates—artiodactyls (even toed ungulates such as camels, deer, oxen and pigs) and perissodactyls (odd toed ungulates such a horses, tapirs and rhinoceroses)—and in long-legged birds such as flamingos and shorebirds

The three time-based syndromes are:

a. peracute (characterized by hyperkalemia, cardiac fibrillation and death,

b. sub-acute (characterized by tubular nephrosis, renal failure and death;

c. chronic (characterized by congestive heart failure, and death.

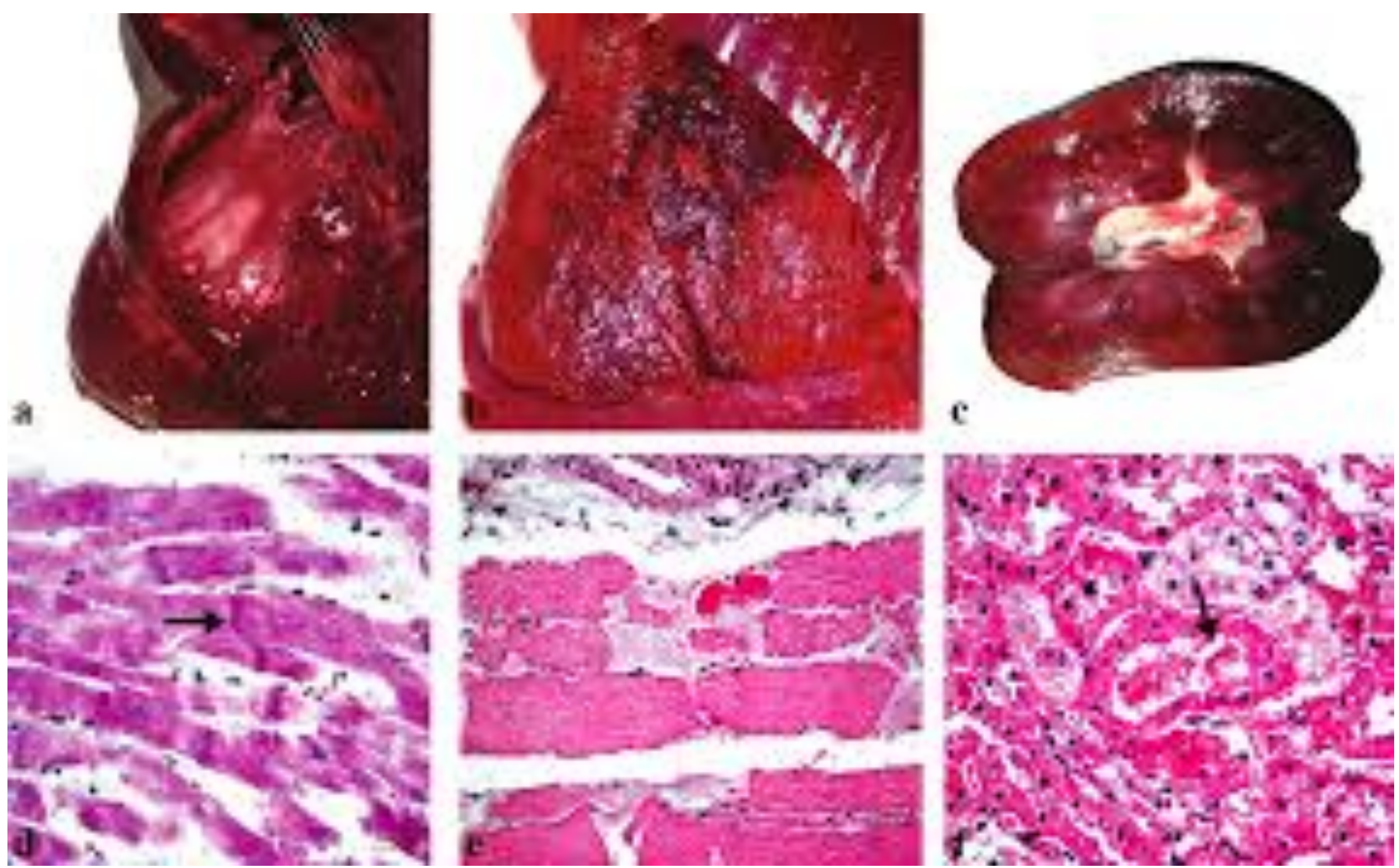
d, non-lethal cases: physical impairment such as lameness or loss of the ability to walk or fly (also before death in lethal cases).

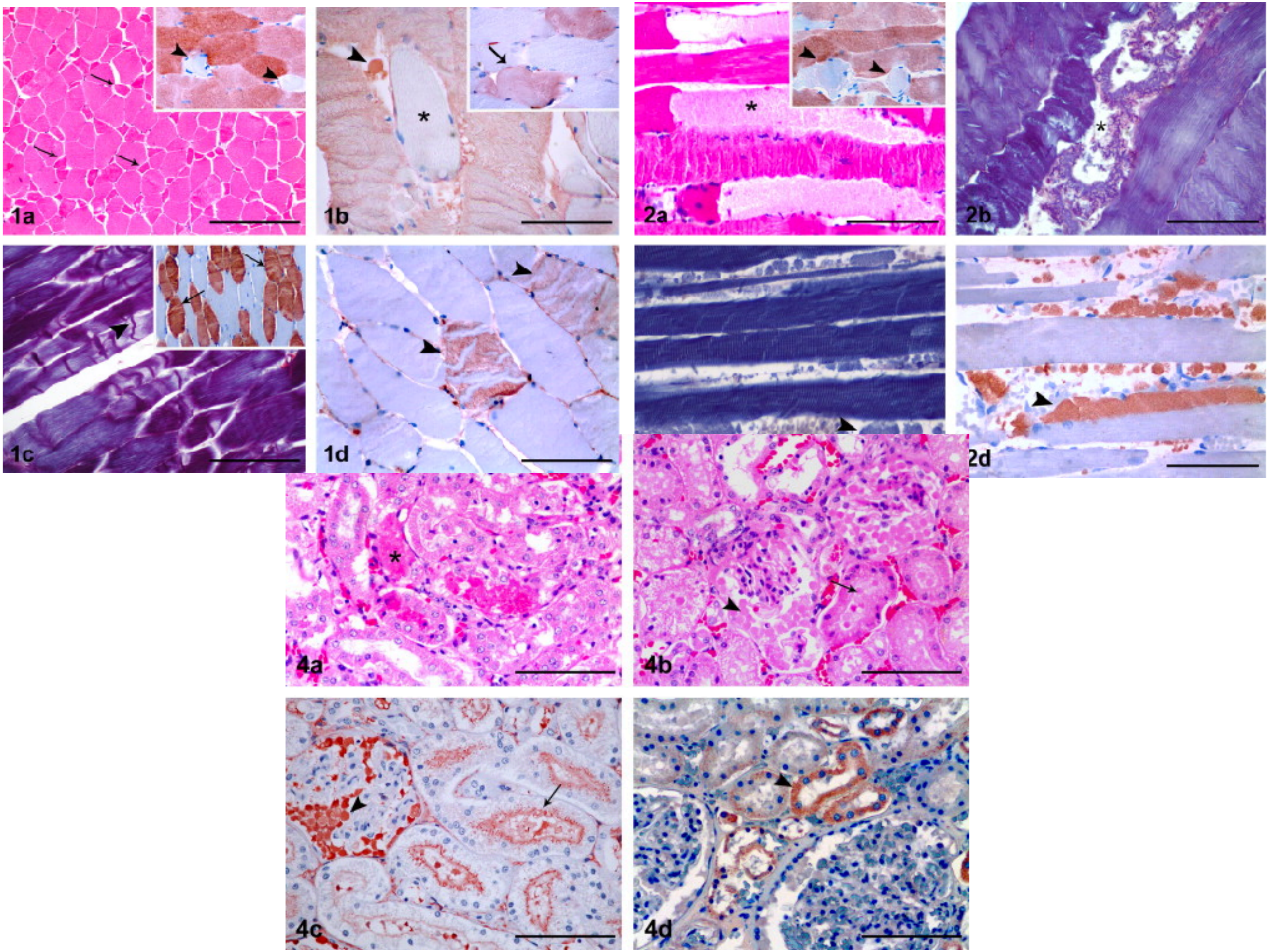
Capture myopathy

The internal experience of fear triggers robust autonomic responses in terrified animals. The physiological effects of these responses contribute to all types of CM.

The diagnosis of CM is often made when these histologic findings are noted in association with a characteristic set of events.

Typical histologic lesions including small areas of necrosis and occasional capillary microthrombii within skeletal muscle and other organs are commonly reported.




1a
1b
2a
2b
1c
1d
2d
4a
4b
4c
4d

5. Fishery interaction common evidences: literature review


Contents lists available at ScienceDirect

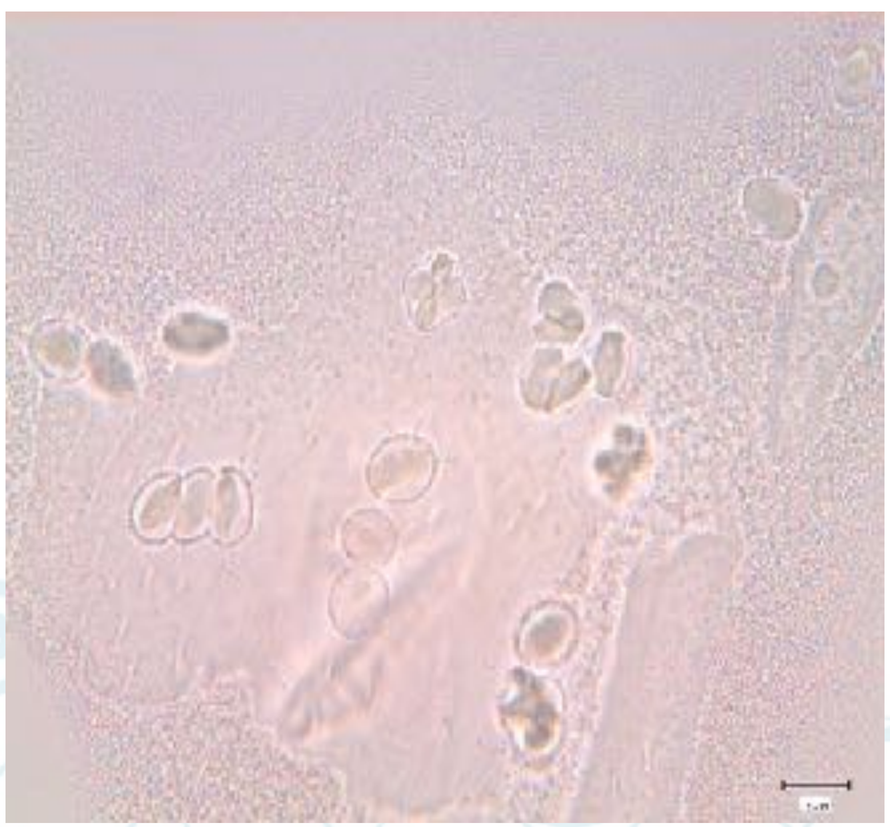
Forensic Science International

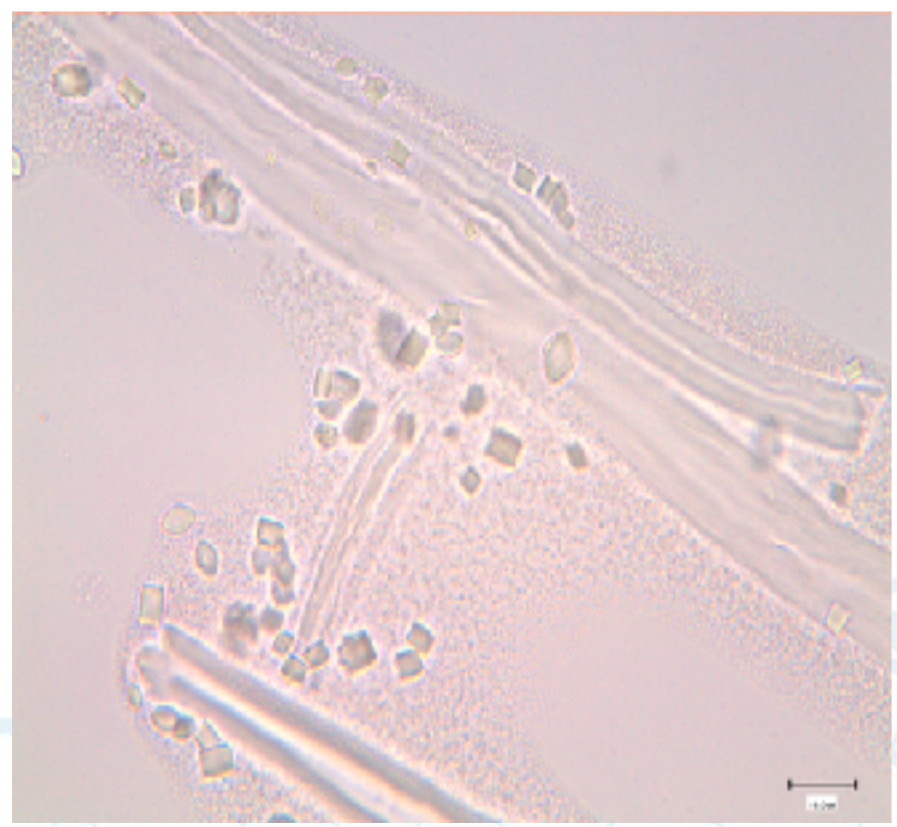
journal homepage: www.elsevier.com/locate/forsciint

Rapid Communication

The diatoms test in veterinary medicine: A pilot study on cetaceans and sea turtles

Silva Rubini[a], Paolo Frisoni[b], Chiara Russotto[a], Natascia Pedriali[a], Walter Mignone[c], Carla Grattarola[d], Federica Giorda[d], Alessandra Pautasso[d], Stefania Barbieri[e], Bruno Cozzi[f], Sandro Mazzariol[f,*], Rosa Maria Gaudio[b]





5. Fishery interaction common evidences: literature review

BY-CATCH OTHER EVIDENCES

Recent feedings

Findings fresh food remains in the stomaches could confirm diagnosis:

- confirm interaction with fisheries
- suggest health condition of the dolphin
- acute death

Other causes of death

- External examination is not enough
- It is necessary to confirm absent predisposing factors

5. Fishery interaction common evidences: literature review

DIRECT KILLING

5. Fishery interaction common evidences: literature review

DIRECT KILLING

5. Fishery interaction common evidences: literature review

DIRECT KILLING

5. Fishery interaction common evidences: literature review

www.lifedelfi.eu

ENTANGLEMENT

www.lifedelfi.eu

5. Fishery interaction common evidences: literature review

ENTANGLEMENT

5. Fishery interaction common evidences: literature review

www.lifedelfi.eu

FISHING GEAR INGESTION

www.lifedelfi.eu

5. Fishery interaction common evidences: literature review

MARINE MAMMAL SCIENCE, **(*): ***–*** (*** 2008)

DOI: 10.1111/j.1748-7692.2008.00259.x

Bottlenose dolphin (*Tursiops truncatus*) depredation resulting in larynx strangulation with gill-net parts

Martina Đuras Gomerčić
Department of Anatomy, Histology and Embryology,
Faculty of Veterinary Medicine, University of Zagreb,
Heinzelova 55, 10000 Zagreb, Croatia
E-mail: martina.gomercic@vef.hr

Ana Galov
Department of Animal Physiology,
Faculty of Science, University of Zagreb,
Rooseveltov trg 6, 10000 Zagreb, Croatia

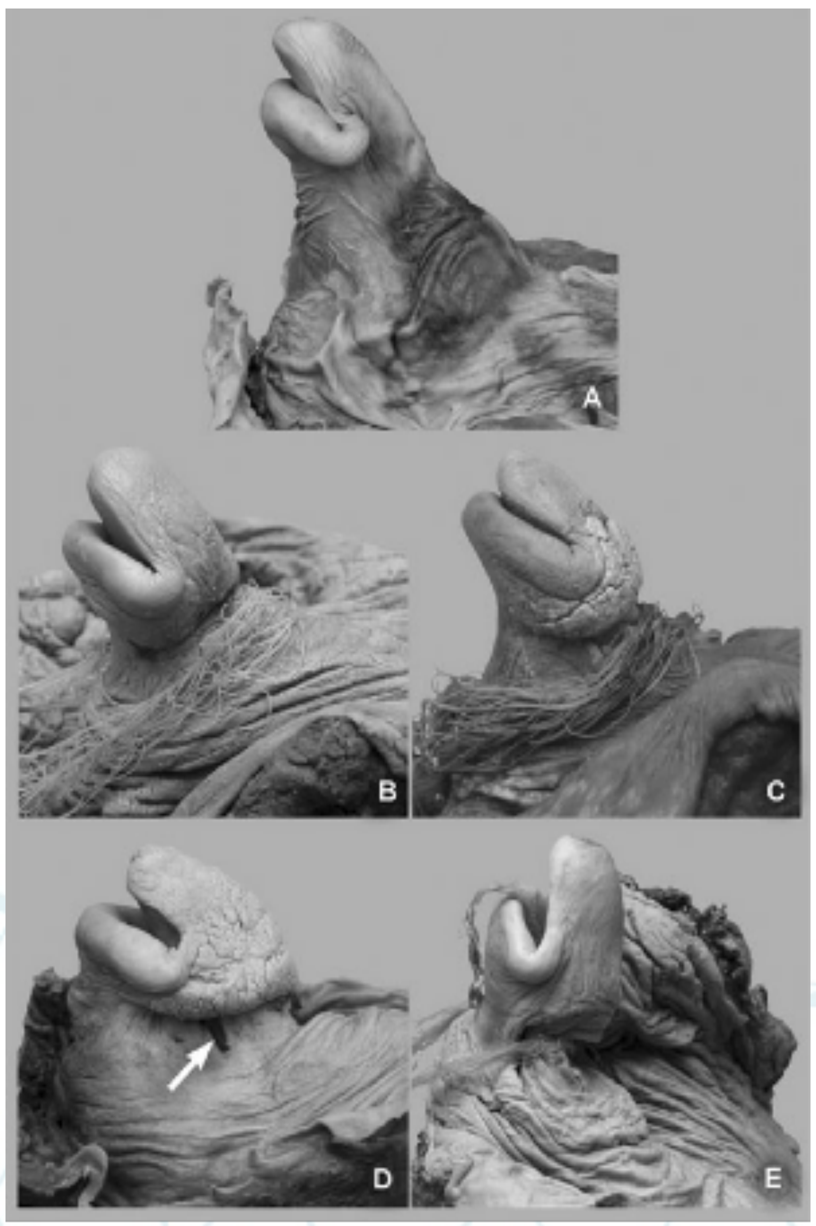
Tomislav Gomerčić
Department of Biology,
Faculty of Veterinary Medicine, University of Zagreb,
Heinzelova 55, 10000 Zagreb, Croatia

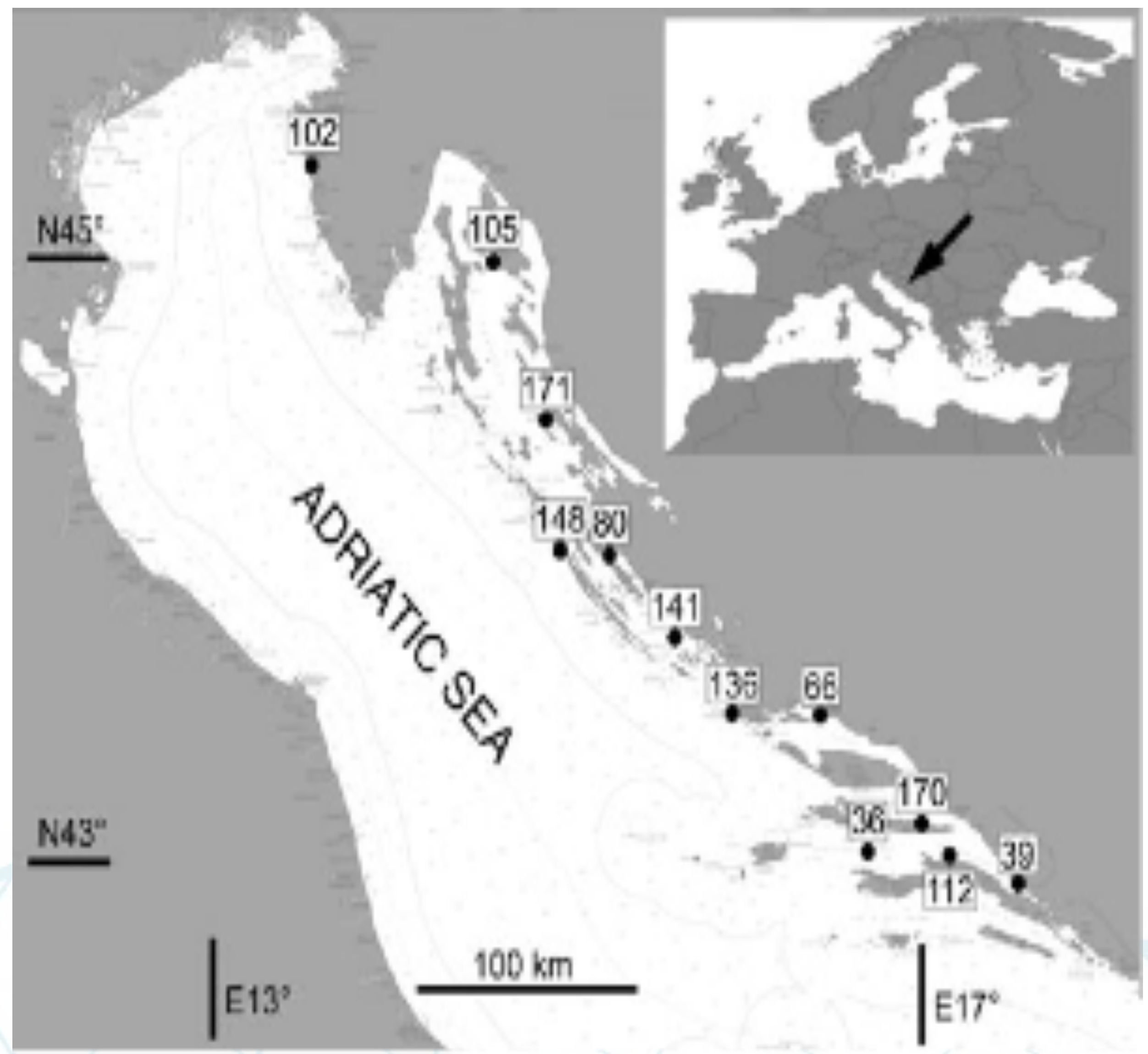
Darinka Škrtić
Snježana Ćurković
Hrvoje Lucić
Snježana Vuković
Department of Anatomy, Histology and Embryology,
Faculty of Veterinary Medicine, University of Zagreb,
Heinzelova 55, 10000 Zagreb, Croatia

Haidi Arbanasić
Department of Animal Physiology,
Faculty of Science, University of Zagreb,
Rooseveltov trg 6, 10000 Zagreb, Croatia

Hrvoje Gomerčić
Department of Anatomy, Histology and Embryology,
Faculty of Veterinary Medicine, University of Zagreb,
Heinzelova 55, 10000 Zagreb, Croatia

FISHING GEAR INGESTION





5. Fishery interaction common evidences: literature review

www.lifedelfi.eu

FISHING GEAR INGESTION

- Same diagnostic framework of marine litter ingestion approved by IWC & ACCOBAMS
- Working on NCC parameters

1996 - 2021 ACCOBAMS

TIER 3

C/P - certain/patognomonic
C - consistent
S - suspected

B(A) - active by-catch
B(P) - passive by-catch
LE - larynx entanglement
CE - chronic entanglement
I - ingestion
II - intentionally injured

CATEGORIES	FINDINGS	B(A)	B(P)	LE	CE	I	II	DCC
Direct evidences of fishing interaction	fishing interaction in the animal history (specific for each category) (13, 19, 20)	C/P	C/P	C/P	C/P	C/P	C/P	1-5
	presence of fishing gears (active v/s passive) (13, 19, 20)	C/P	C/P		C/P			1-4
	net marks/linear signs (acute) (13, 19, 20)	C/P	C/P					1-3
	net marks/linear signs (chronic, i.e. constriction lesions) (13, 19, 20)				C/P			1-3
	presence of fishing gear around larynx (11)			C/P				1-4
	penetrating wounds (13, 19)	C	C				C/P	1-3
	mutilation with acute inflammatory reaction	C	C				C/P	1-3
	mutilation with chronic inflammatory reaction	S	S		S			1-3
	gunshot/bullet wounds (13, 19)						C/P	1-3
	contusions (13, 19)	C						1-3
	fractures (13, 19)	C						1-4
Other fishery interaction - associated lesions	capture myopathy (to be confirmed with histology and IHC) (20)	C/P	C/P					1-3
	separation of the rectus abdominis muscles (9)	C	C					1-2
	gas bubbles in main vessels (3)	C	C					1-2
	linea alba erniation (9)	C	C					1
Nutritional findings	presence of fresh oesophagic/gastric content (13, 19)	C	C					1-4
	absence of fresh gastric content (13, 19)			S	C			1-4
	good NCC (13, 19)	C	C					1-3
	poor NCC (13, 19)			S	C			1-3
Aspecific findings	bulging eyes/red eyes (4)	C						1-2
	microscopic muscular haemorragies (histology) (20)	S	S					1-3
	pulmonary and vascular changes (epicardial petechiae, edema, froth/ blood-tinged watery fluid in the airways, congestion, bullae in the lung parenchyma, incomplete collapse of the lungs, chyle in the ductus thoracicus and) (4)	S	S					1-3
	multiorgan congestion (4)	S	S					1-3
Other pathologies	absence of other ongoing diseases (4, 13, 20)	C	C					1-3

1996 - 2021

25 ANS YEARS

ACCOBAMS

LOWERING FISHING INTERACTIONS life DELFI

www.lifedelfi.eu

LIFE DELFI

Dolphin Experience: Lowering Fishing Interactions

LIFE18 NAT/IT/000942

Action A3

Harmonized necropsy protocol including diagnostic framework for by-catch

Framework for fishery interaction

TIER 1

At this level, only entanglement can be hypothesized. The table here below reports the list of external findings related to the interaction with the fishery. If at least one findings is recorded, the fishery interaction with fishing is confirmed.

CATEGORIES	FINDINGS
Findings that confirm the interaction with the fishery	fishing interaction in the animal history
	presence of fishing gear (differentiate passive and active fishing gear)

TIER 2

The table below summarizes the list of fishery interaction findings , including entanglement and ingestion, that can be assessed by a Tier 2 executer. If one or more of the relevant (confirming) findings are reported, the fishery interaction is confirmed. If only the presence of recent feeding remains in the oesophagic/gastric content is observed, the interaction cannot be confirmed.

CATEGORIES	FINDINGS	ENTANGLEMENT	INGESTION
Findings confirming the interaction with the fishery	fishing interaction in the animal history	x	
	net marks/linear signs (acute or chronic)	x	
	presence of fishing gears (differentiate passive and active fishing gear)	x	
	presence of fishing gear around larynx (differentiate passive and active fishing gear)	x	
	presence of fishing gear or fragments in the gastro- intestinal tracts		x
Findings suggesting the interaction with the fishery	presence of recent feeding	x	

DIAGNOSTIC FRAMEWORKS

-Infectious diseases

- Fishery interaction

- **Marine litter ingestion and evaluation**

- Ship strikes

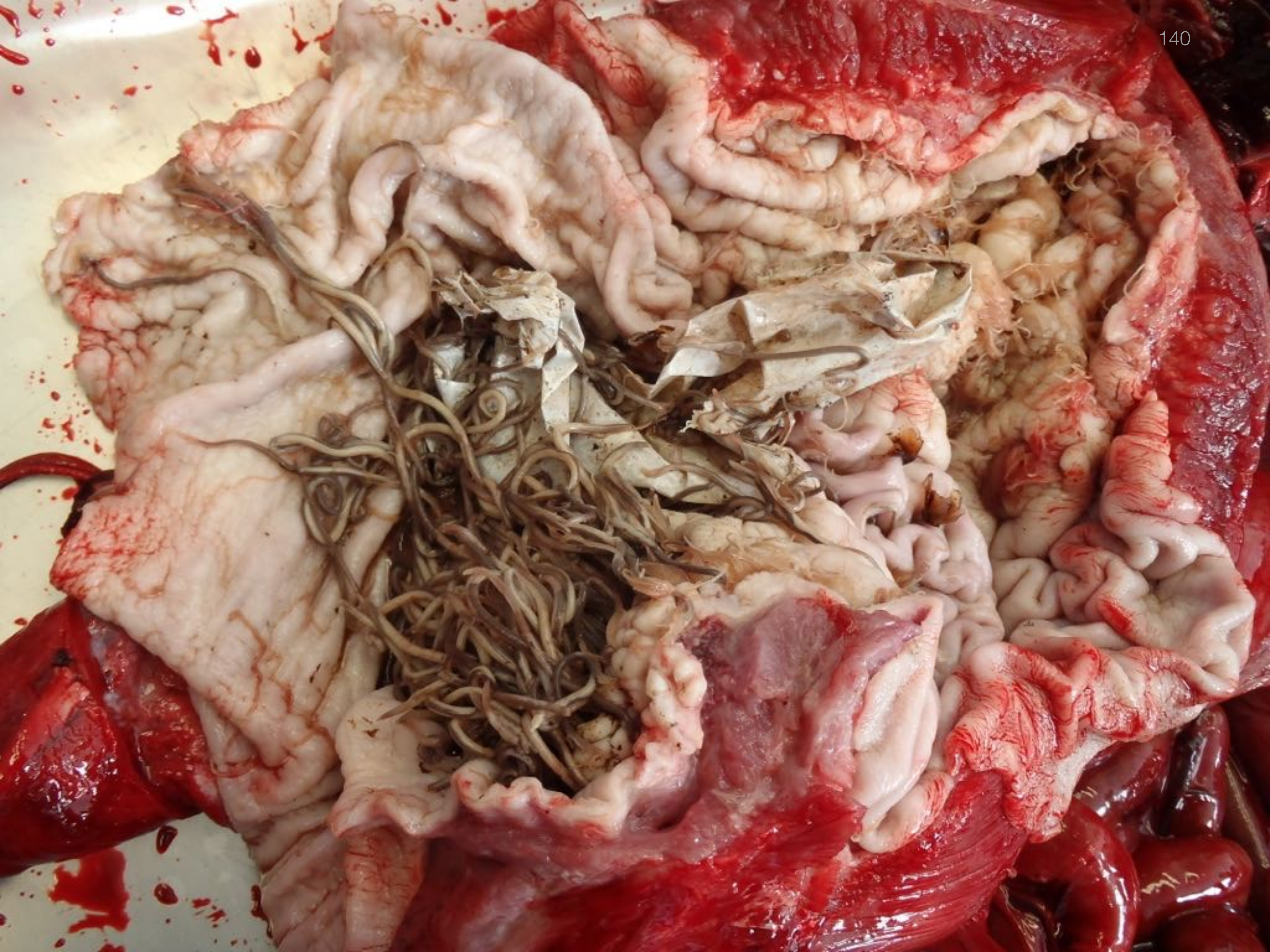
- Noise impacts

- Others causes of death

FOREIGN BODY: ingestion of debris/litter items causing digestive obstruction, perforation or other symptoms.

Moderate-severe presence of marine debris in the GIT could be consistent with		
Postmortem interpretation	**Postmortem findings**	**Notes**
Incidental finding	Limited / moderate amount of marine debris without lesion associated with the foreign body	The volume and location of the debris should be evaluated
Possible contribution to the cause of death and/or deterioration of health condition*	Partial repletion or obstruction with moderate-severe presence of lesion associated with the foreign body (e.g.: ulcerations, hyperkeratosis of the forestomach, gastritis and/or enteritis, haemorrages, etc.)	It is necessary to interpret in the general context of the postmortem study (necropsy and histopathology, as well as complementary analyzes if needed), and exclude other possible causes of death
Probable cause of death	Traumatic perforation, severe impaction or complete obstruction of GIT with severe presence of lesion associated (e.g.: ischemia, necrosis, perforation, peritonitis, etc.)	
* Long-term pathological processes can cause or increase the possibility of presenting of other secondary processes like infectious diseases, parasitic infestation and / or signs of malnutrition or starvation (poor - very poor body condition, serous atrophy of fatty deposits, muscular atrophy, pancreatic acinar atrophy, etc.)		

Plastic and other



Contents lists available at ScienceDirect

Environmental Pollution

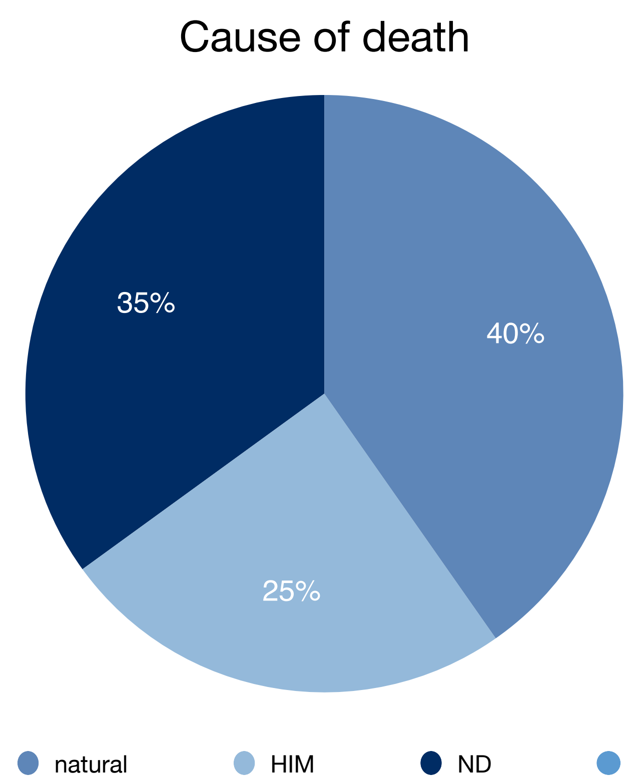
journal homepage: www.elsevier.com/locate/envpol

Retrospective study of foreign body-associated pathology in stranded cetaceans, Canary Islands (2000–2015)☆

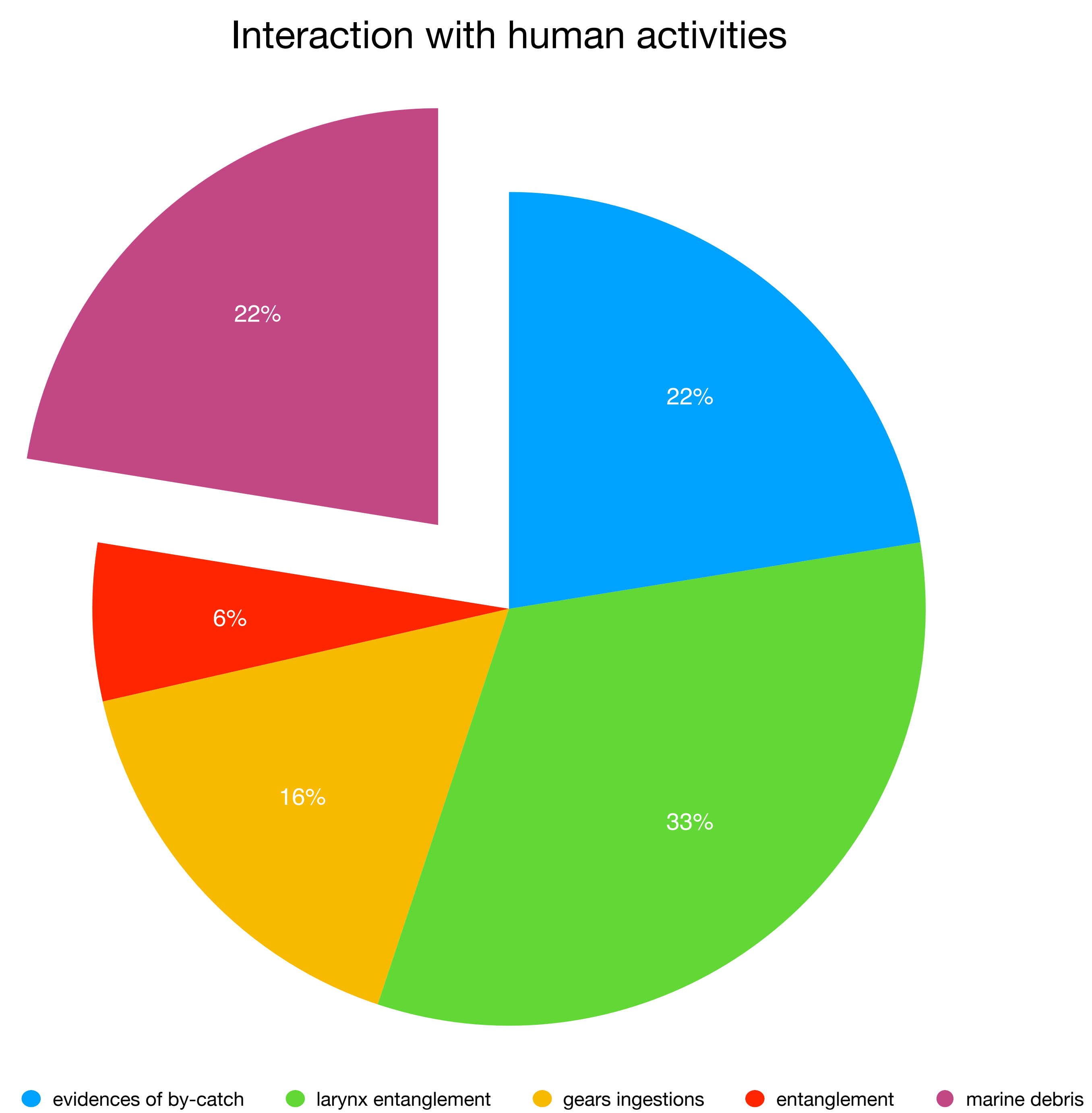
R. Puig-Lozano [a], Y. Bernaldo de Quirós [a, *], J. Díaz-Delgado [a], N. García-Álvarez [a], E. Sierra [a], J. De la Fuente [a], S. Sacchini [a], CM. Suárez-Santana [a], D. Zucca [a], N. Câmara [a], P. Saavedra [b], J. Almunia [c], M.A. Rivero [a], A. Fernández [a], M. Arbelo [a]

Highlights

- Foreign bodies were found in 7.7% (36/465) studied cetaceans in the Canary Islands in a 16 year period.
- Severe digestive disease (impactions and gastrointestinal perforations) caused the death of 13 animals (2.8%,13/465).
- Plastic was the most common item found (80.6%).
- Poor body condition and deep diving behavior were risk factors for foreign body ingestion.
- Adult age was a protective factor for foreign body ingestion.



2015-2019



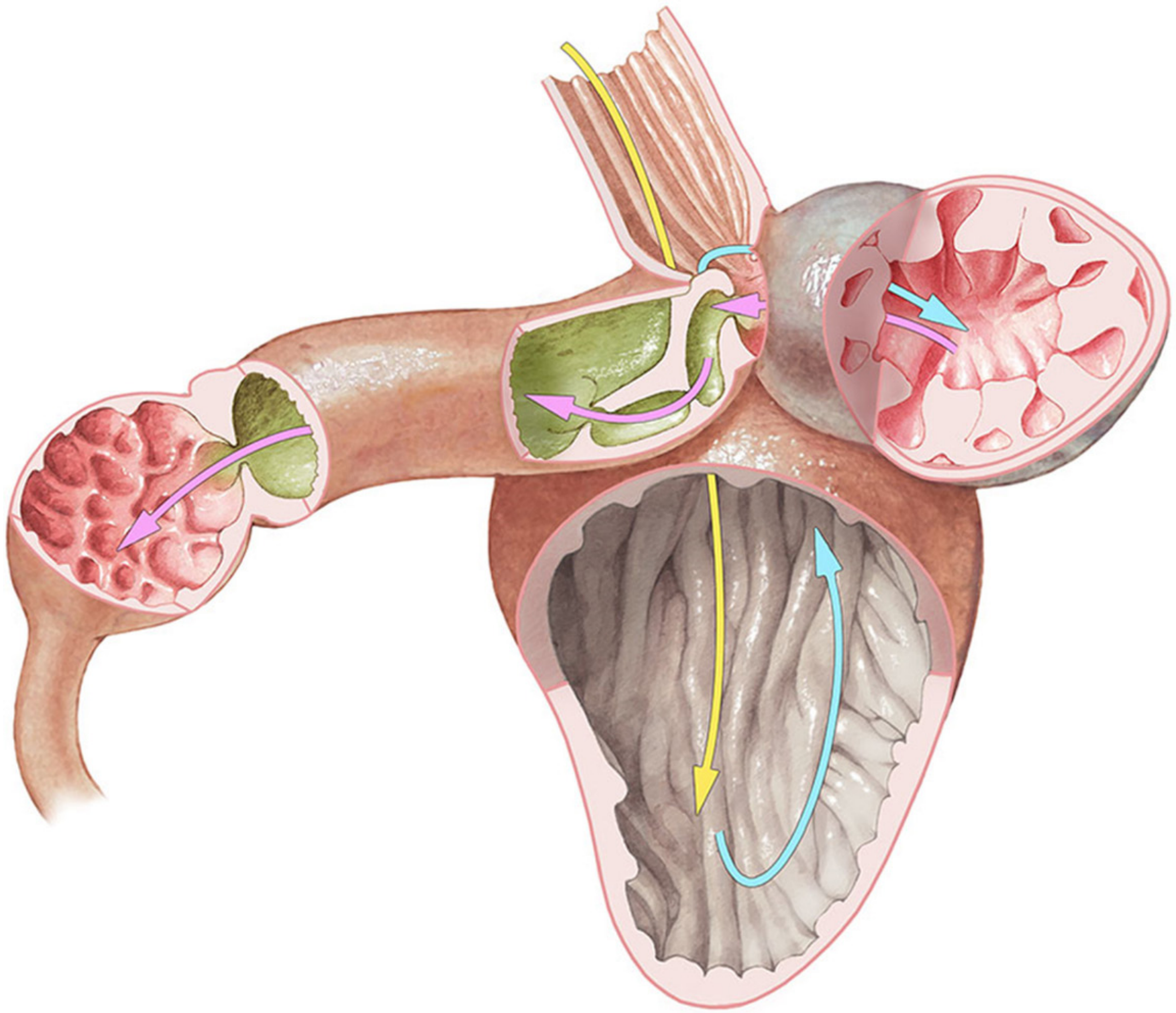
- Marine debris found 3% of the examined cetaceans

- > sperm whales,

- then beaked whales, striped dolphins & bottlenose dolphin

Plastic ingestion - effects

- Obstruction
- Costipation
- Pain
- Reduced feeding
- Reduced energy
- Increased energy consumption
- Chemical transfer
- Microbiome changes



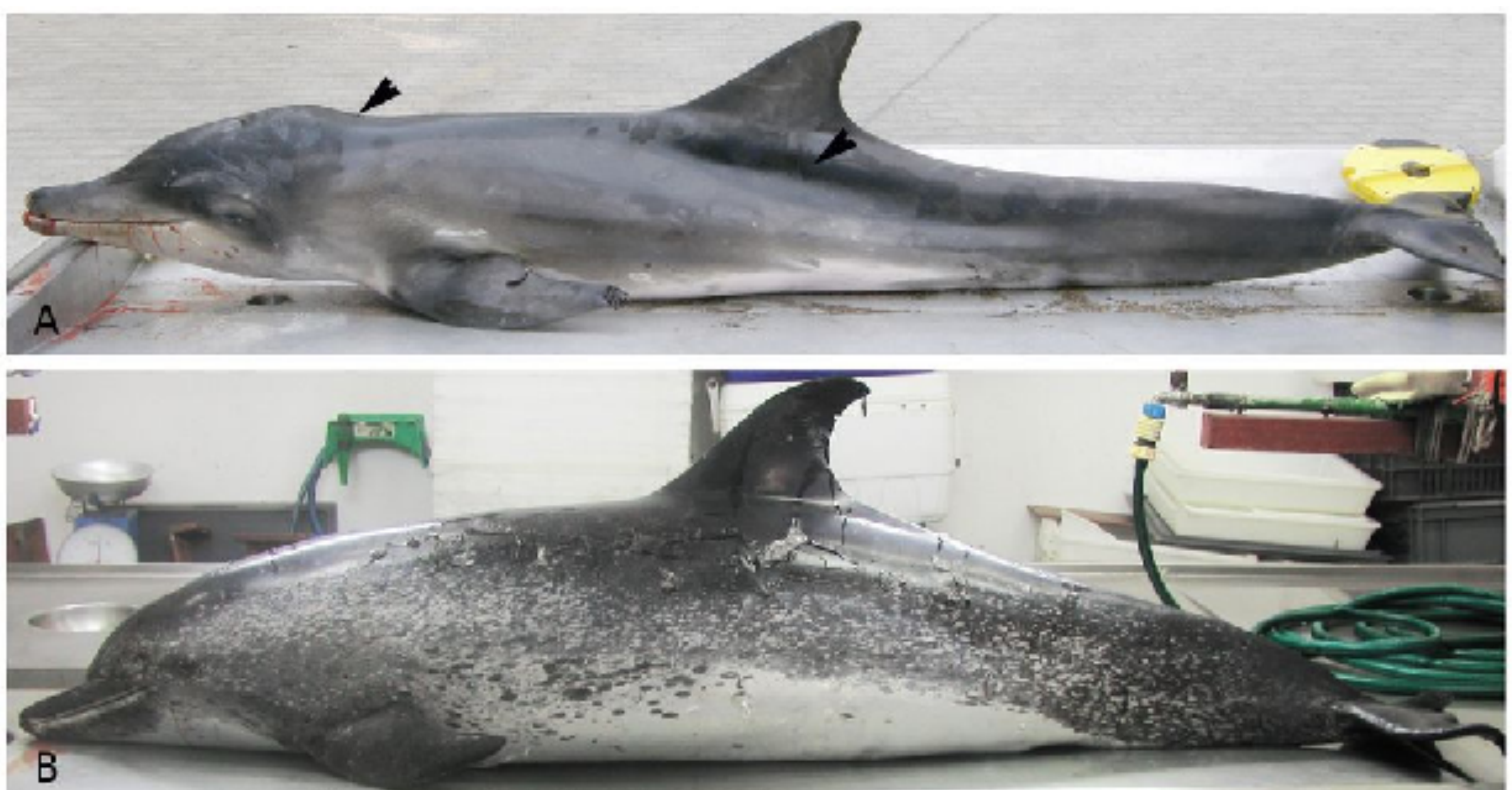
NUTRITIONAL CONDITION

- ***Emaciation*** is a serious, usually chronic and progressive condition characterized by significant (>20%) body weight loss.

- ***Cachexia*** is the termed used to describe the end stage of emaciation.

- Significant weight loss, associated with emaciation or cachexia, typically results from catabolism of body fat and protein in excess of caloric intake.

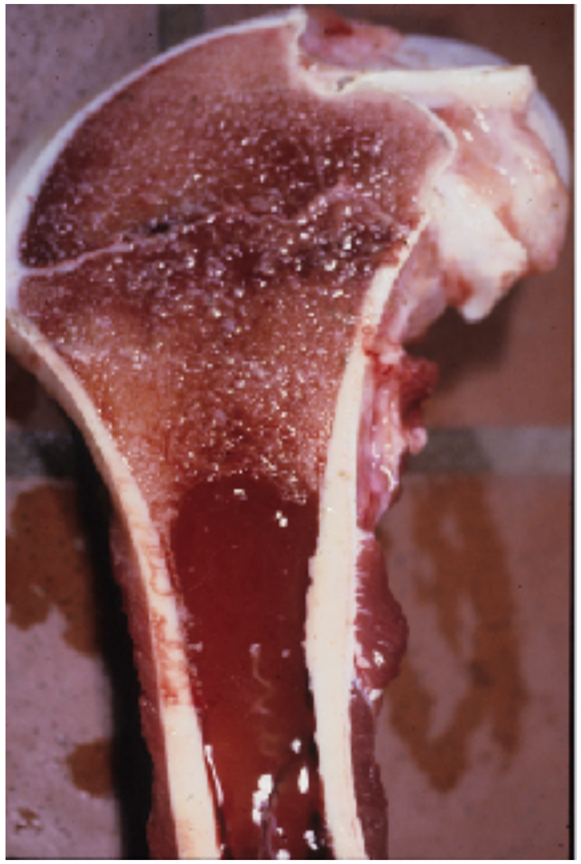
- Increased metabolism (hypermetabolic), inadequate consumption or assimilation of nutrient, or excessive nutrient loss contributes to significant weight loss.



NUTRITIONAL CONDITION

<u>Gross findings suggesting cachexia:</u>

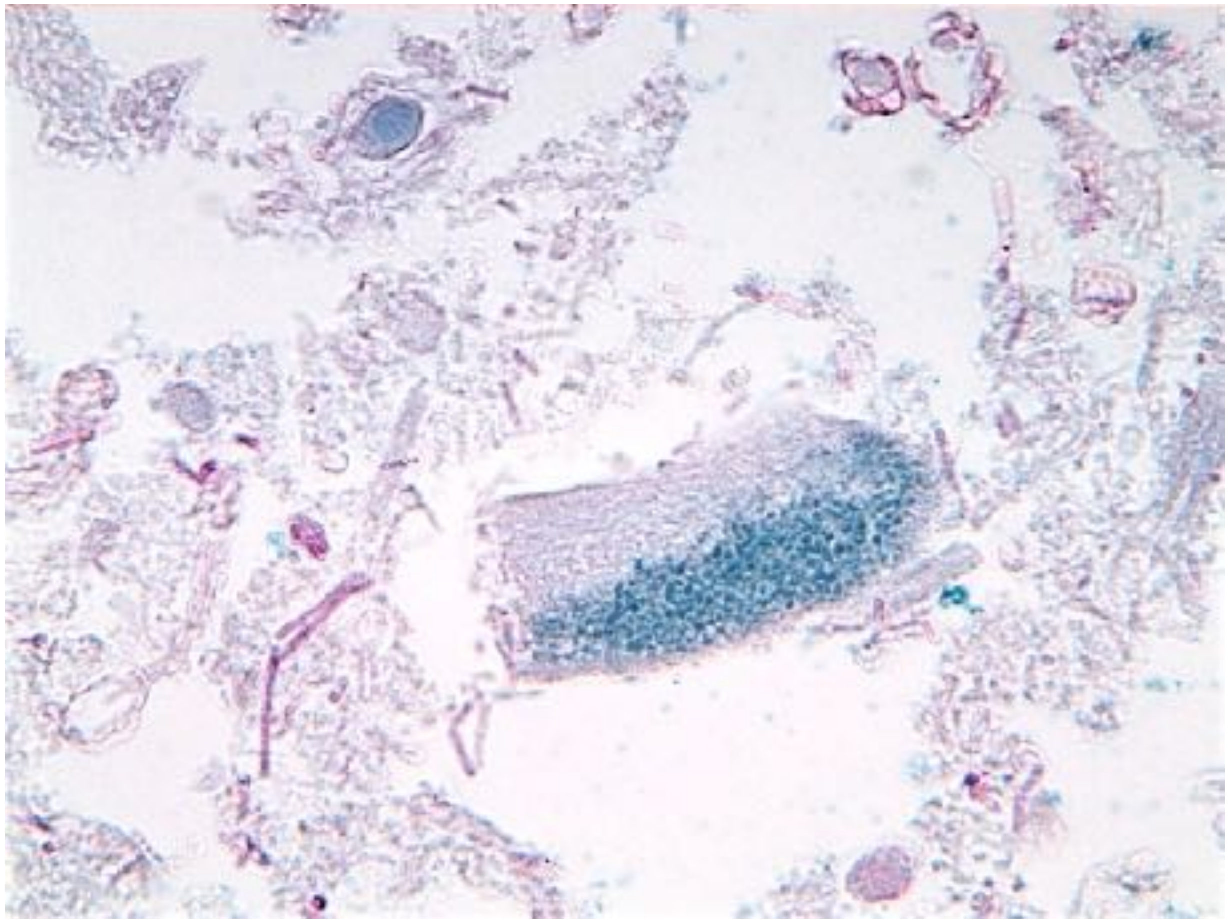
- ✓ Muscle atrophy with evidences of bones angles
- ✓ Reduced fat depots (subcutaneous, pericardial, peri-renal, mesenteric, intra-muscular) with fat gelatinous atrophy (pericardial, subcutis and medullary)
- ✓ Body cavities (peritoneum/pericardium/pleural) effusion and subcutaneous edema
- ✓ Kidney Fat Index (peri-renal fat weight/kidney weight x 100)
- ✓ Visceral atrophy (liver, heart, etc) with weight reduction (25%- 40%)
- ✓ Absence of food remains in the stomach.
- ✓ Dark and dry feces.
- ✓ Dark liver with filled bladder. Possible hepatic steatosis.
- ✓ Hemorrhagic erosive/ulcerative gastro-enteritis.

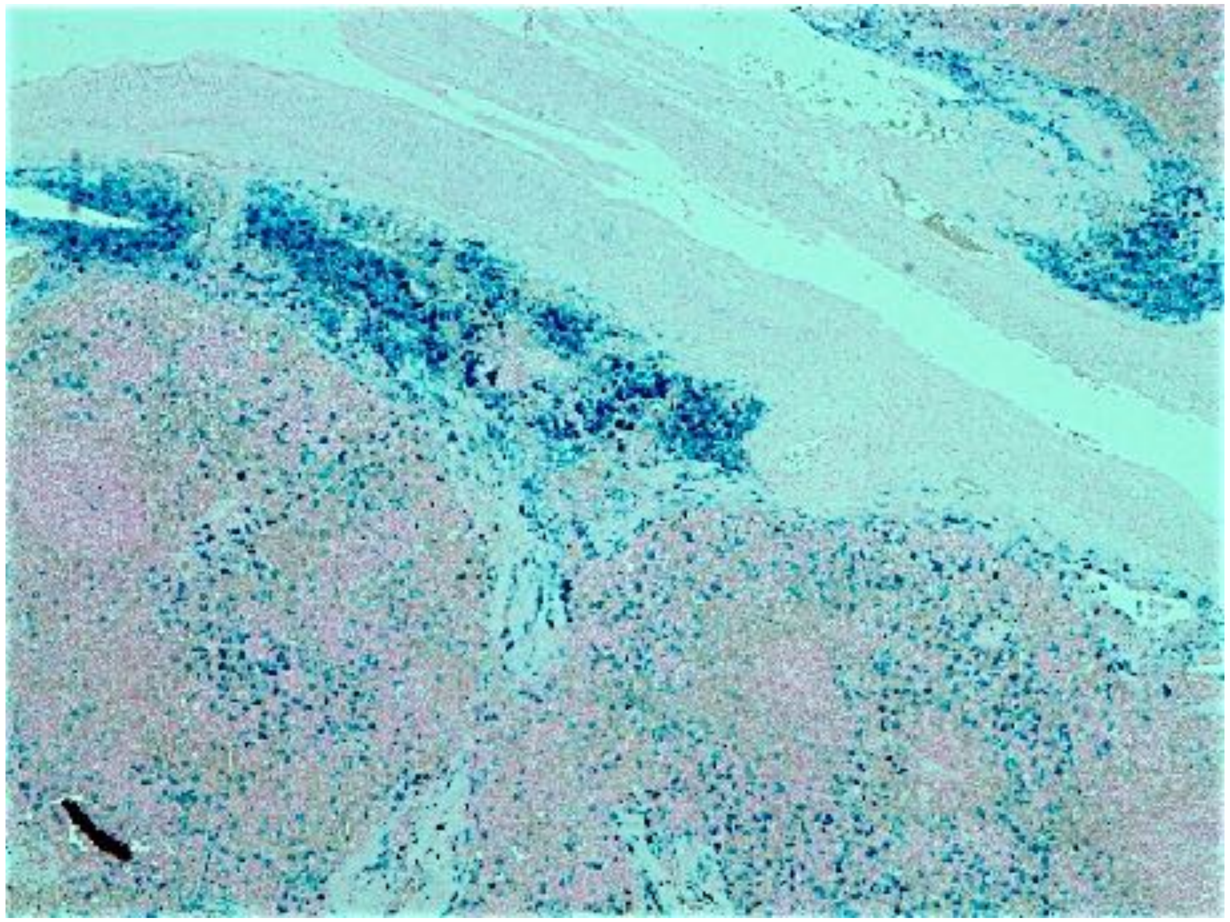


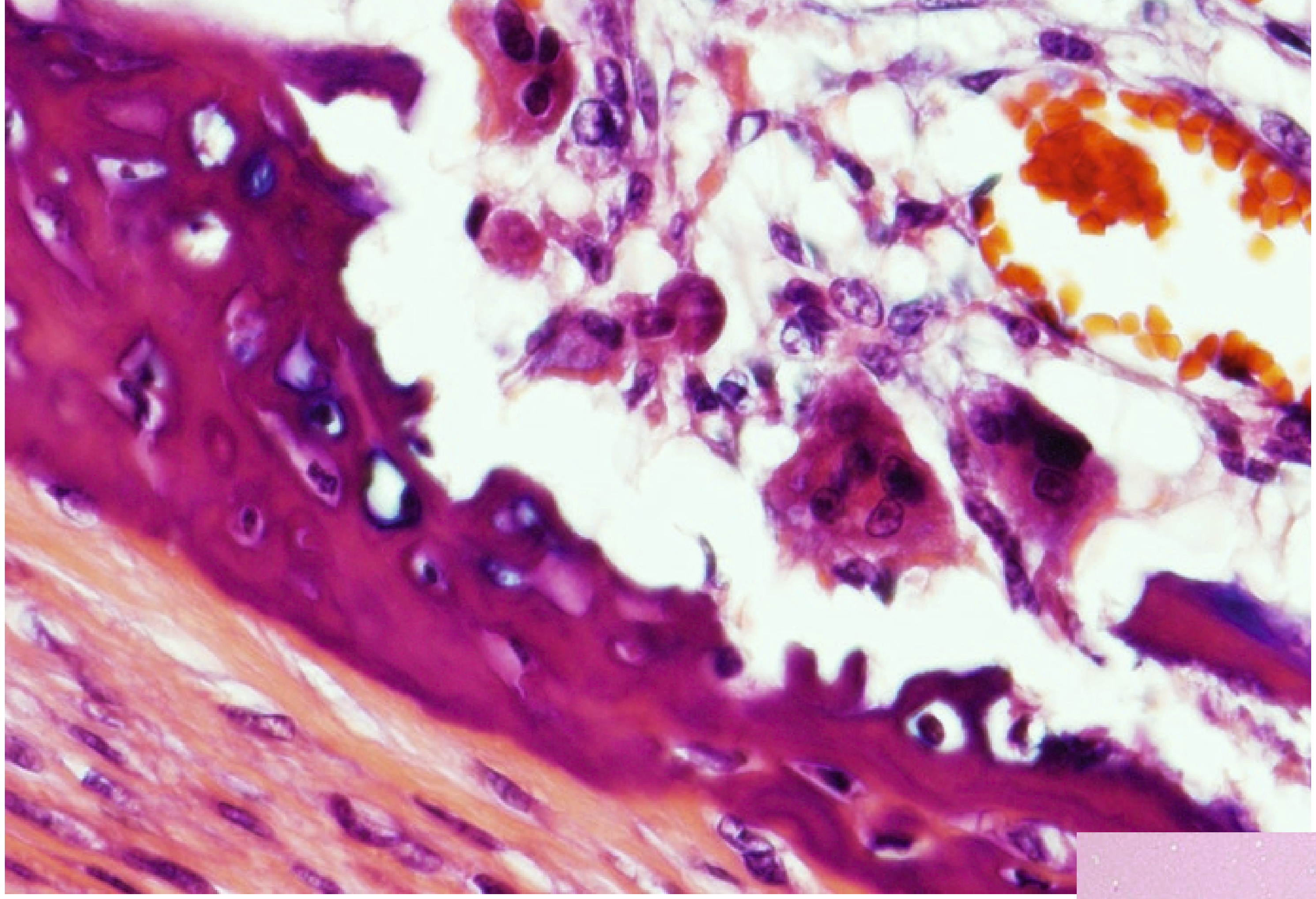
NUTRITIONAL CONDITION

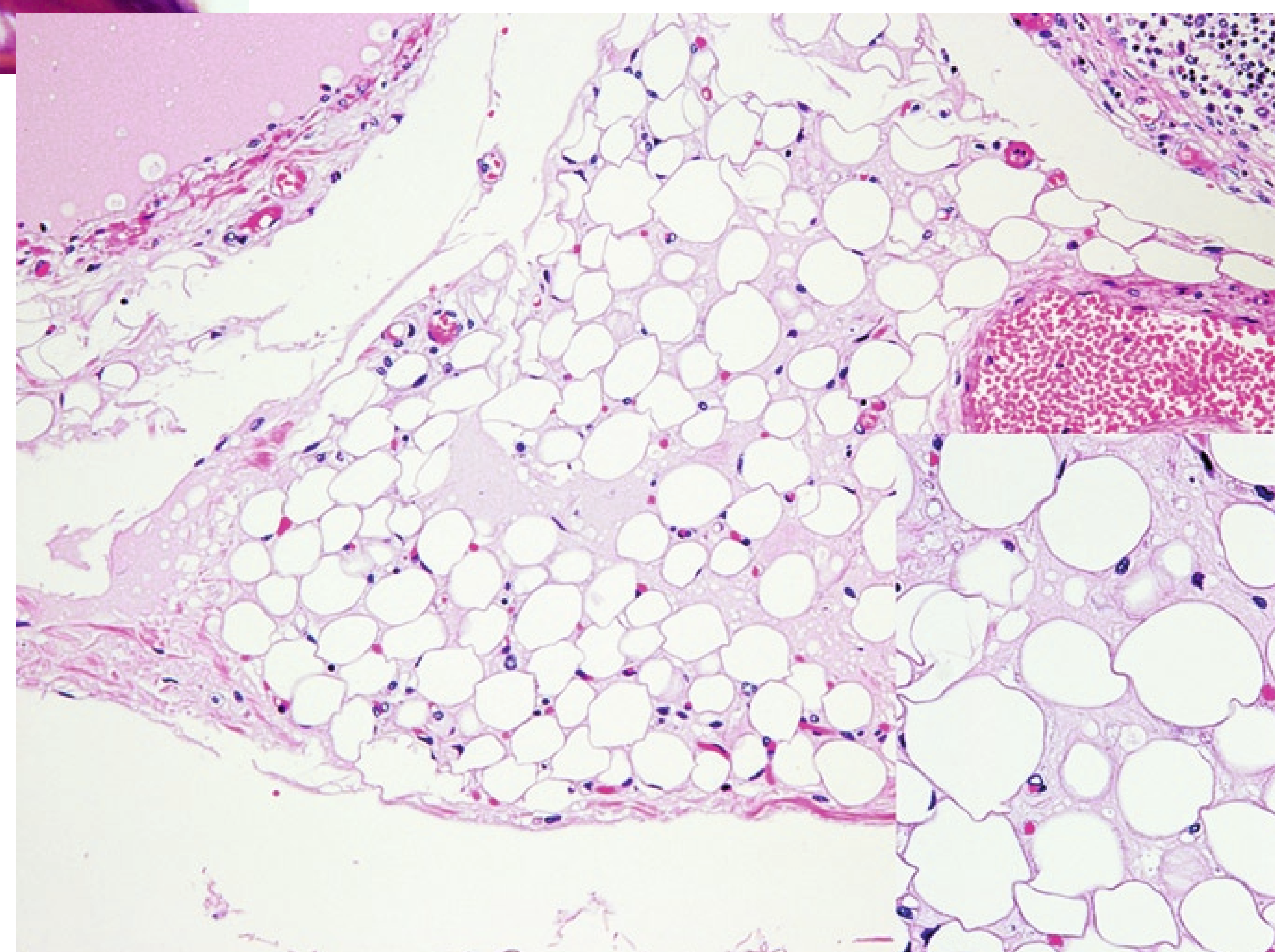
Rilievi patologici <u>microscopici</u> indicativi di cachessia:

- ✓ Hemosiderin storages in liver (> Kuppfer) and spleen (Prussian Blue staining)
- ✓ Hepatic and muscular lipofuscinosis (Schmorl's e PAS staining)
- ✓ Absent/reduced glycogen in hepatocytes (PAS/Diastasis)
- ✓ Microscopic atrophy of intestinal villi with hemorrhagic enteropathy.
- ✓ Hepatocytes atrophy and/or steatosis
- ✓ Edema of tissues with possible hemorrhages
- ✓ Bone rearrangement









DIAGNOSTIC FRAMEWORKS

-**Infectious diseases**

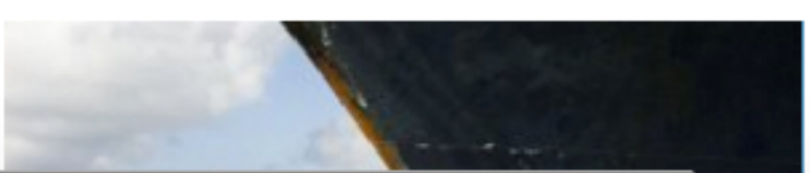
- **Fishery interaction**

- **Marine litter ingestion and evaluation**

- **Ship strikes**

- Noise impacts

- Others causes of death



A near-miss between a whale and a container vessel. Picture: CINMS/NOAA

Ship Strikes: collisions between whales and vessels

Most reports of collisions between whales and vessels involve large whales, but all species can be affected. Collisions with large vessels often go unnoticed and unreported. Animals can be injured or killed and vessels can sustain damage. Serious and even fatal injuries to passengers have occurred involving hydrofoil ferries, whalewatching vessels and recreational craft.

Ship Strikes

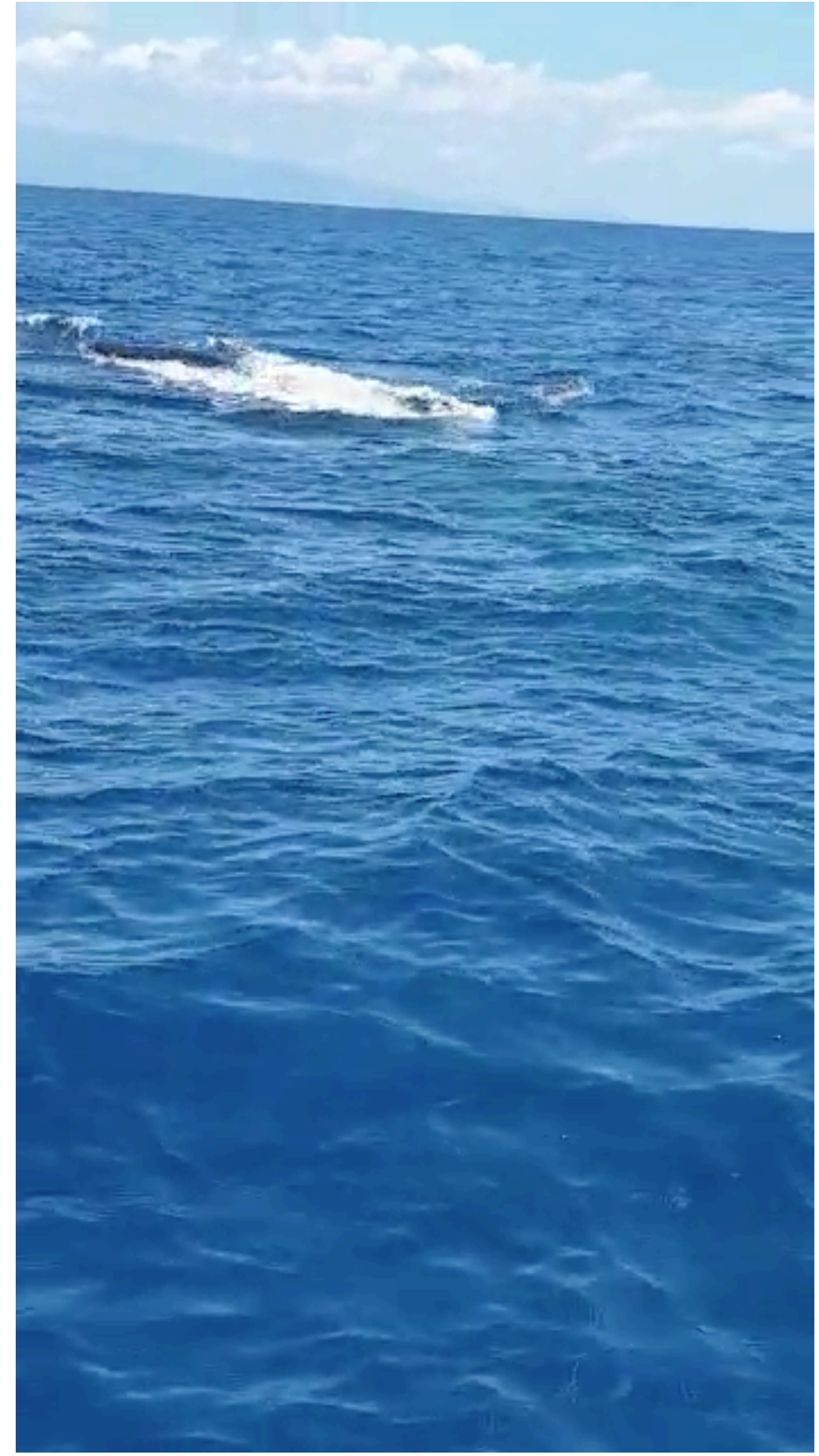
1986 – 2020 : 42 reported whales

Species	**Total stranded**	**Total Collided**	**% on stranded**	**% on collided**
Balaenoptera physalus	**96**	**16**	**16,67%**	**38,10%**
Physeter macrocephalus	**206**	**10**	**4,85%**	**23,81%**
Balaenoptera acutorostrata	**4**	**1**	**25%**	**1,8%**

Ship Strikes: propellers



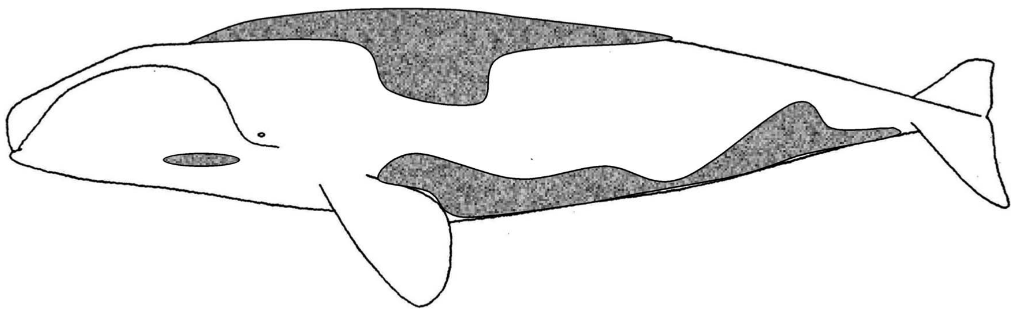
a)



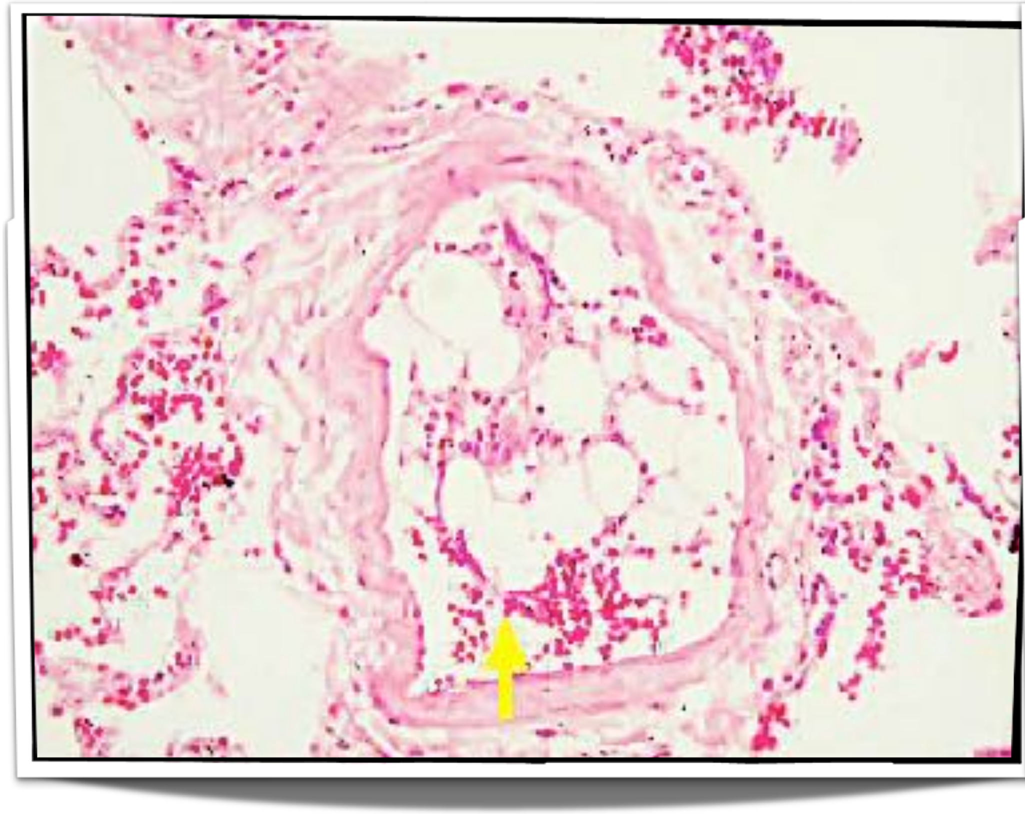
SHIP STRIKES: blunt trauma

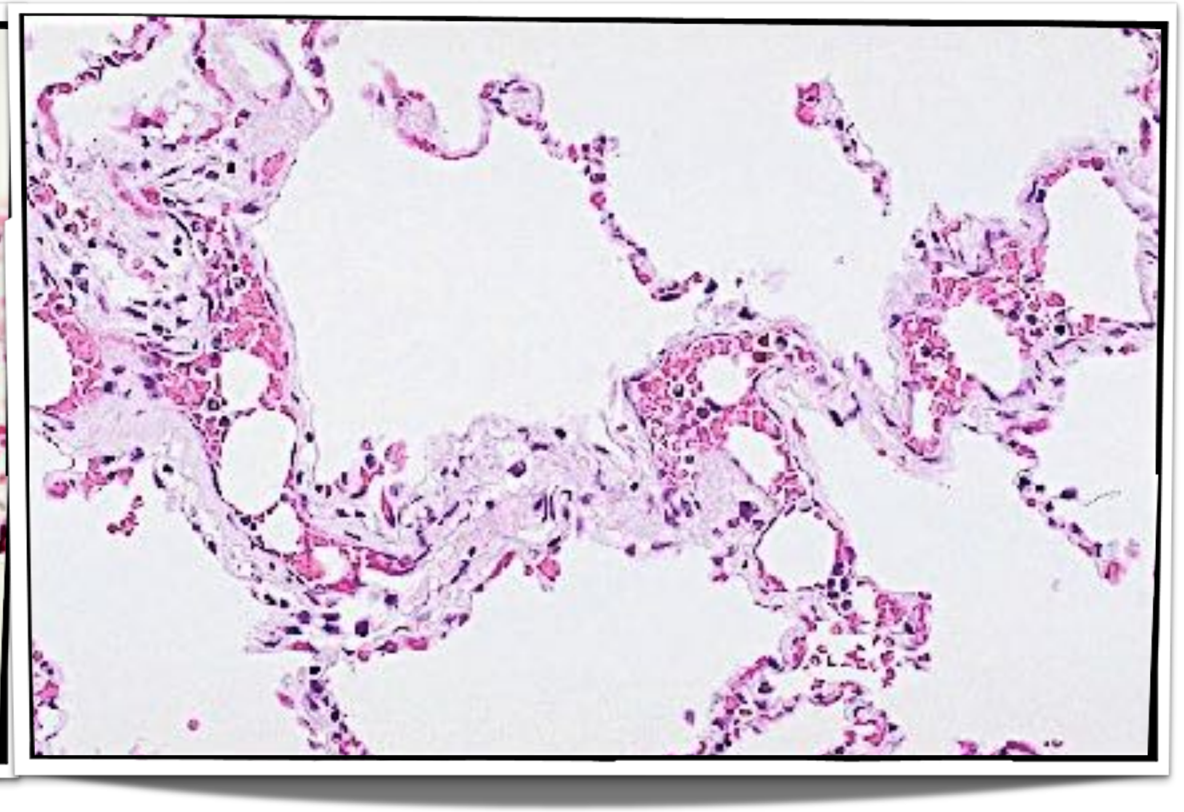
Ship Strikes

Post-mortem diagnosis



- Most carcasses are badly preserved
- Injures could be post-mortem.
- How to differenziate ante- and post-mortem injures?
- Fat emboli in lungs!!





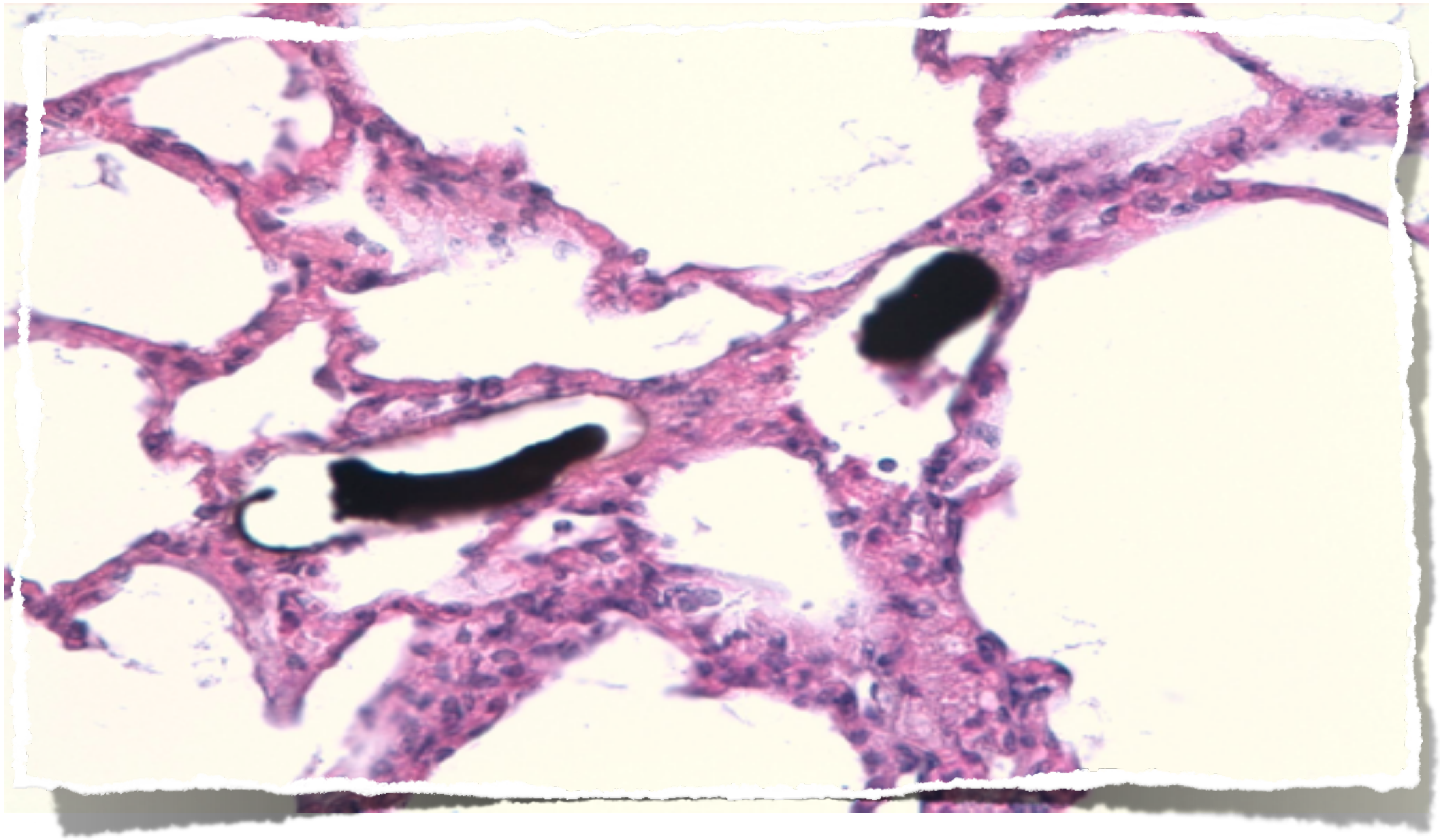
Ship Strikes

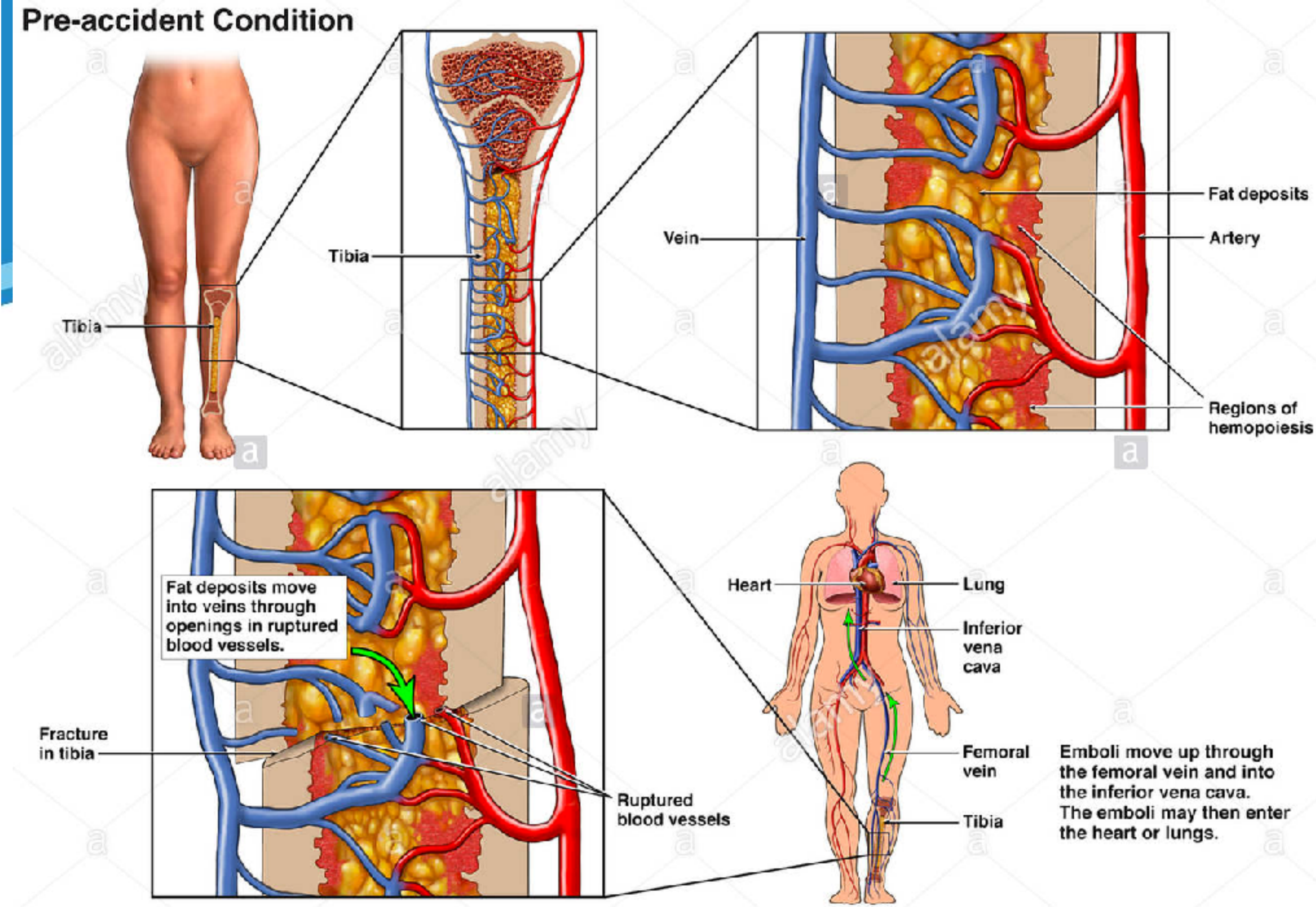
Specific stainings

. Sudan black

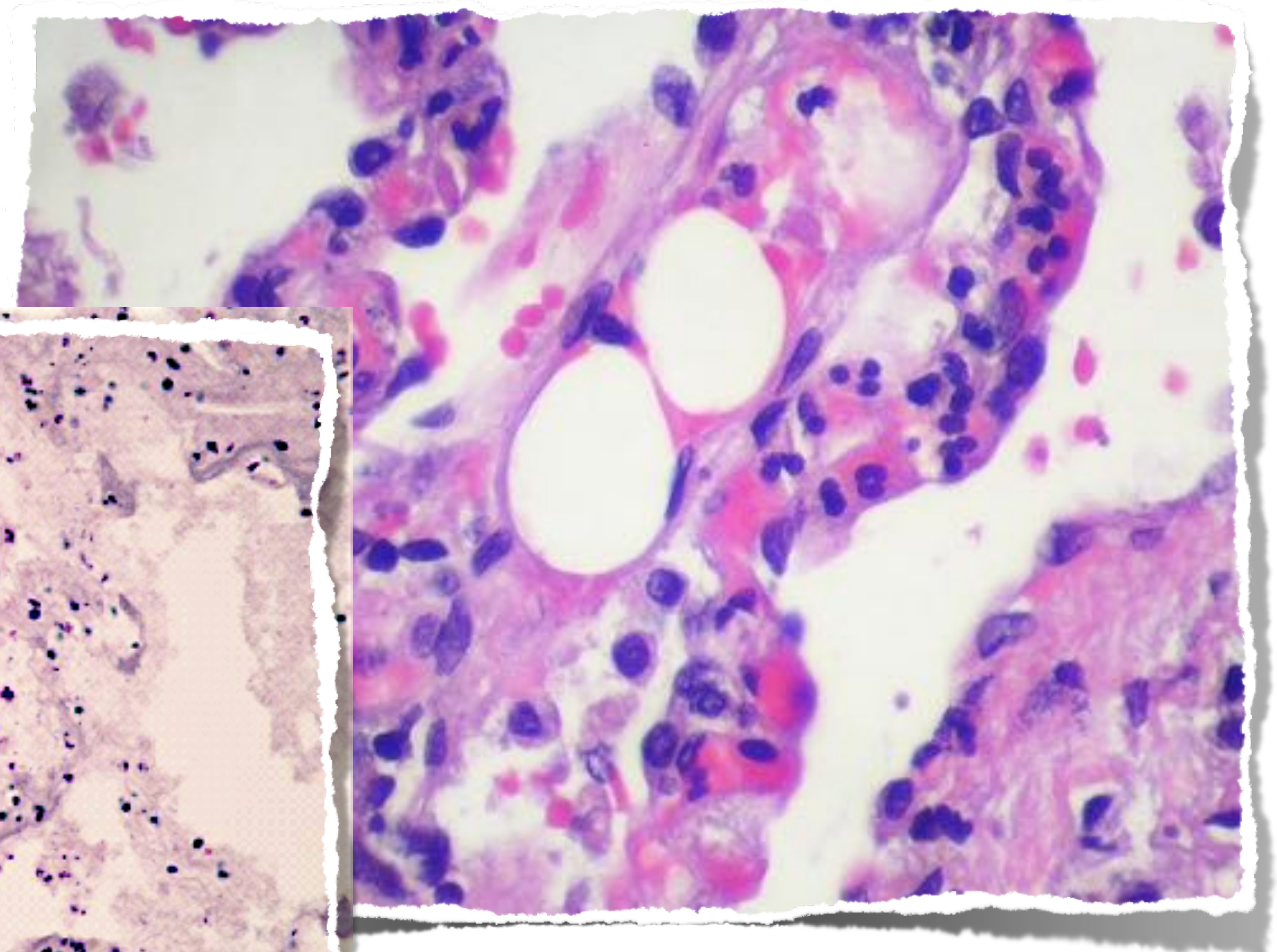
. O-Red-Oil

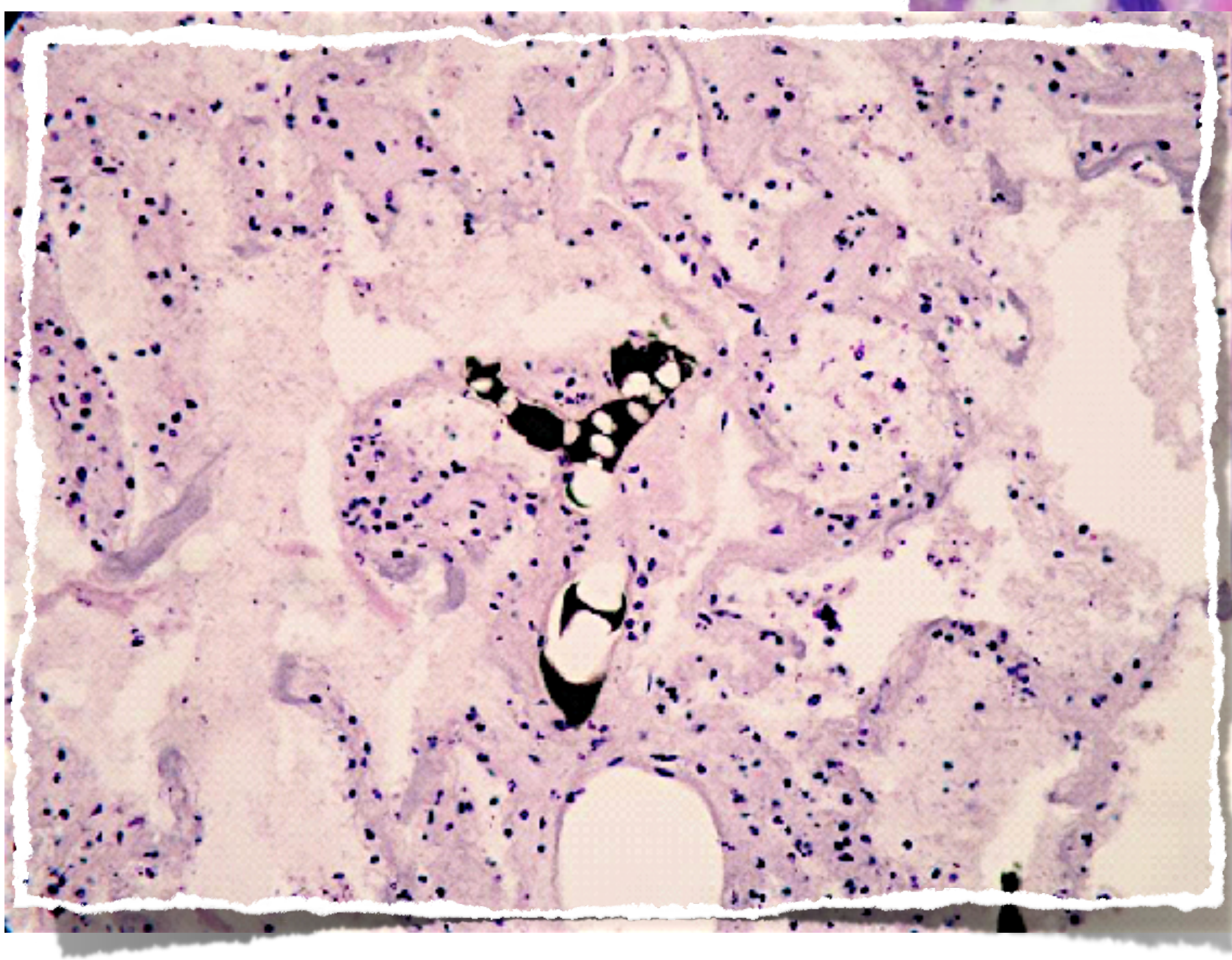
. **OsO_4 "*en bloc*" post-fixation technique**



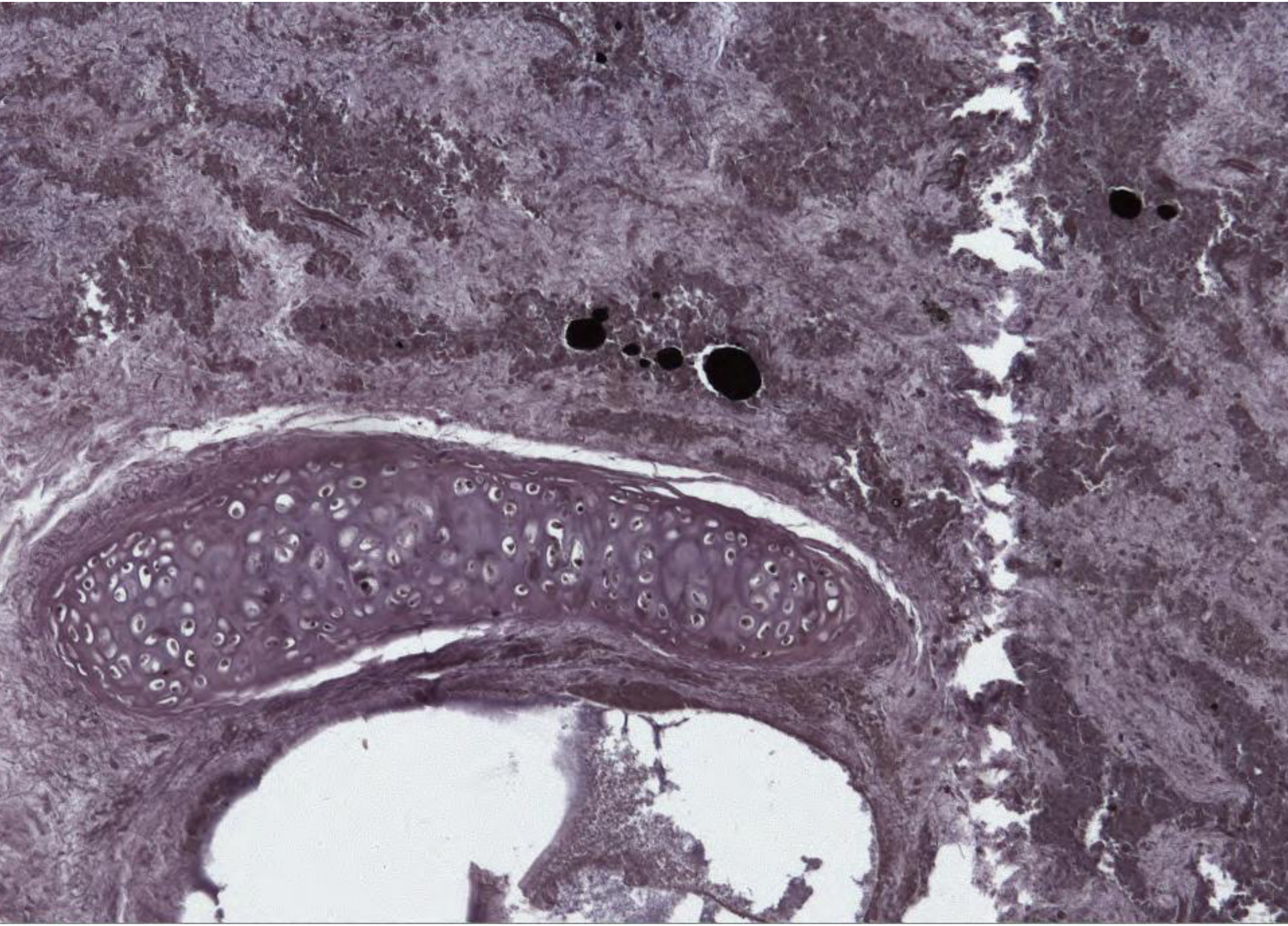

Pre-accident Condition
Tibia
Tibia
Vein
Fat deposits
Artery
Regions of hemopoiesis
Fat deposits move into veins through openings in ruptured blood vessels.
Fracture in tibia
Ruptured blood vessels
Heart
Lung
Inferior vena cava
Femoral vein
Tibia
Emboli move up through the femoral vein and into the inferior vena cava. The emboli may then enter the heart or lungs.

Ship strikes





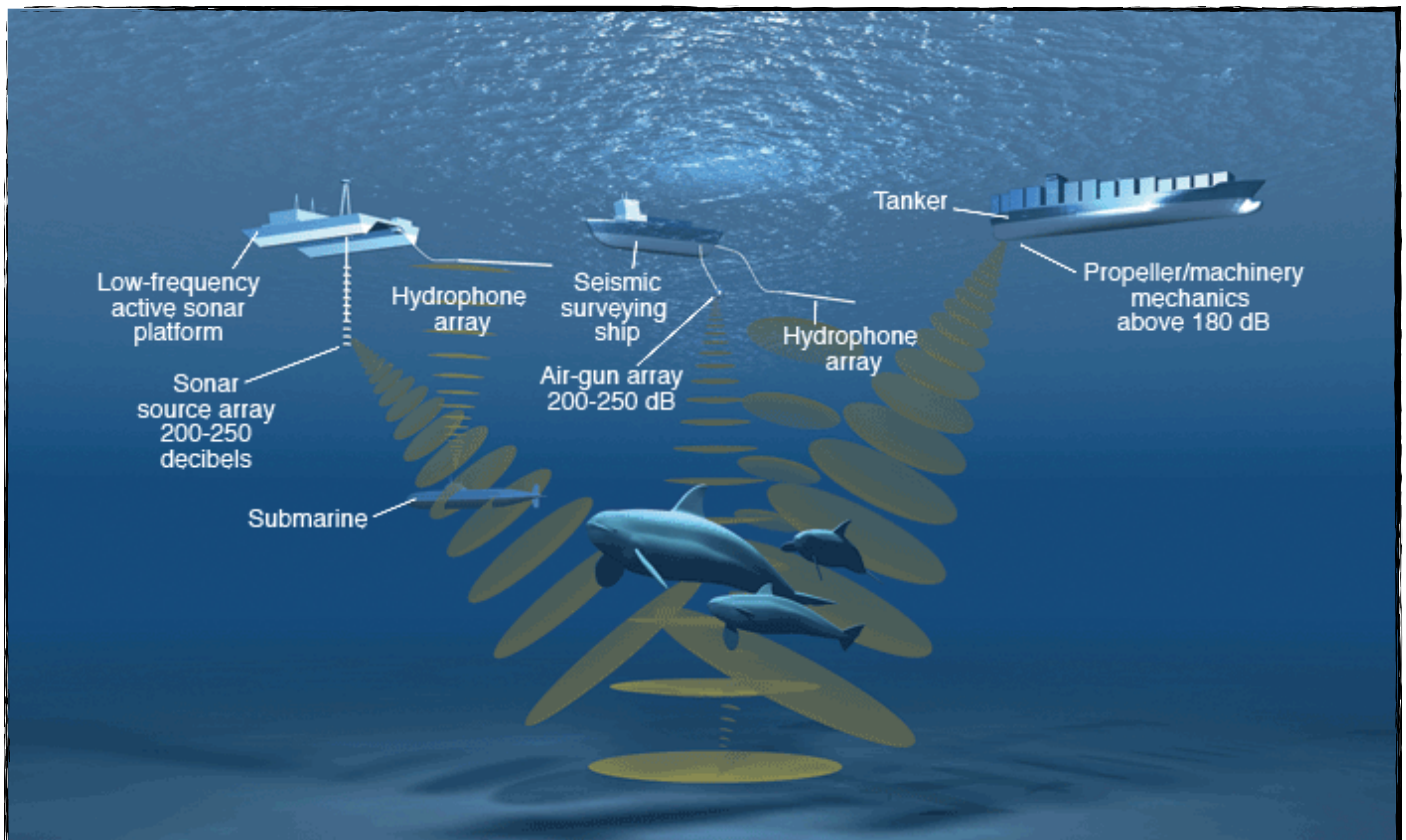
Ship Strikes



DIAGNOSTIC FRAMEWORKS

- **Infectious diseases**
- **Fishery interaction**
- **Marine litter ingestion and evaluation**
- **Ship strikes**
- **Noise impacts**
- Others causes of death

Sound Effects



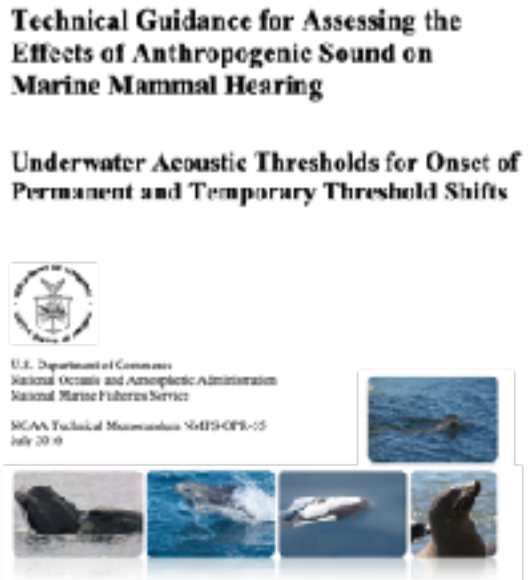


Table ES1: Marine mammal hearing groups.

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

The effects of seismic airguns on cetaceans in UK waters

CAROLYN J. STONE AND MARK L. TASKER

Joint Nature Conservation Committee, Dunnet House, 7 Thistle Place, Aberdeen, AB10 1UZ, UK

Contact e-mail: cjsbarton@barnacle1.fsnet.co.uk

ABSTRACT

Observations undertaken during 201 seismic surveys in UK and adjacent waters were analysed to examine effects on cetaceans. Sighting rates, distance from the airguns and orientation were compared for periods when airguns were active and when they were silent, both for surveys with airgun arrays of large volume and surveys with smaller volume arrays. The results demonstrate that cetaceans can be disturbed by seismic exploration. Small odontocetes showed the strongest lateral spatial avoidance (extending at least as far as the limit of visual observation) in response to active airguns, while mysticetes and killer whales showed more localised spatial avoidance. Long-finned pilot whales showed only a change in orientation and sperm whales showed no statistically significant effects. Responses to active airguns were greater during those seismic surveys with large volume airgun arrays than those with smaller volumes of airguns. It is suggested that the different taxonomic groups of cetaceans may adopt different strategies for responding to acoustic disturbance from seismic surveys; some small odontocetes move out of the immediate area, while the slower moving mysticetes orient away from the vessel and increase their distance from the source but do not move away from the area completely.

KEYWORDS: NOISE; EUROPE; CONSERVATION; SURVEY-VESSEL; SHORT-TERM CHANGE; MONITORING

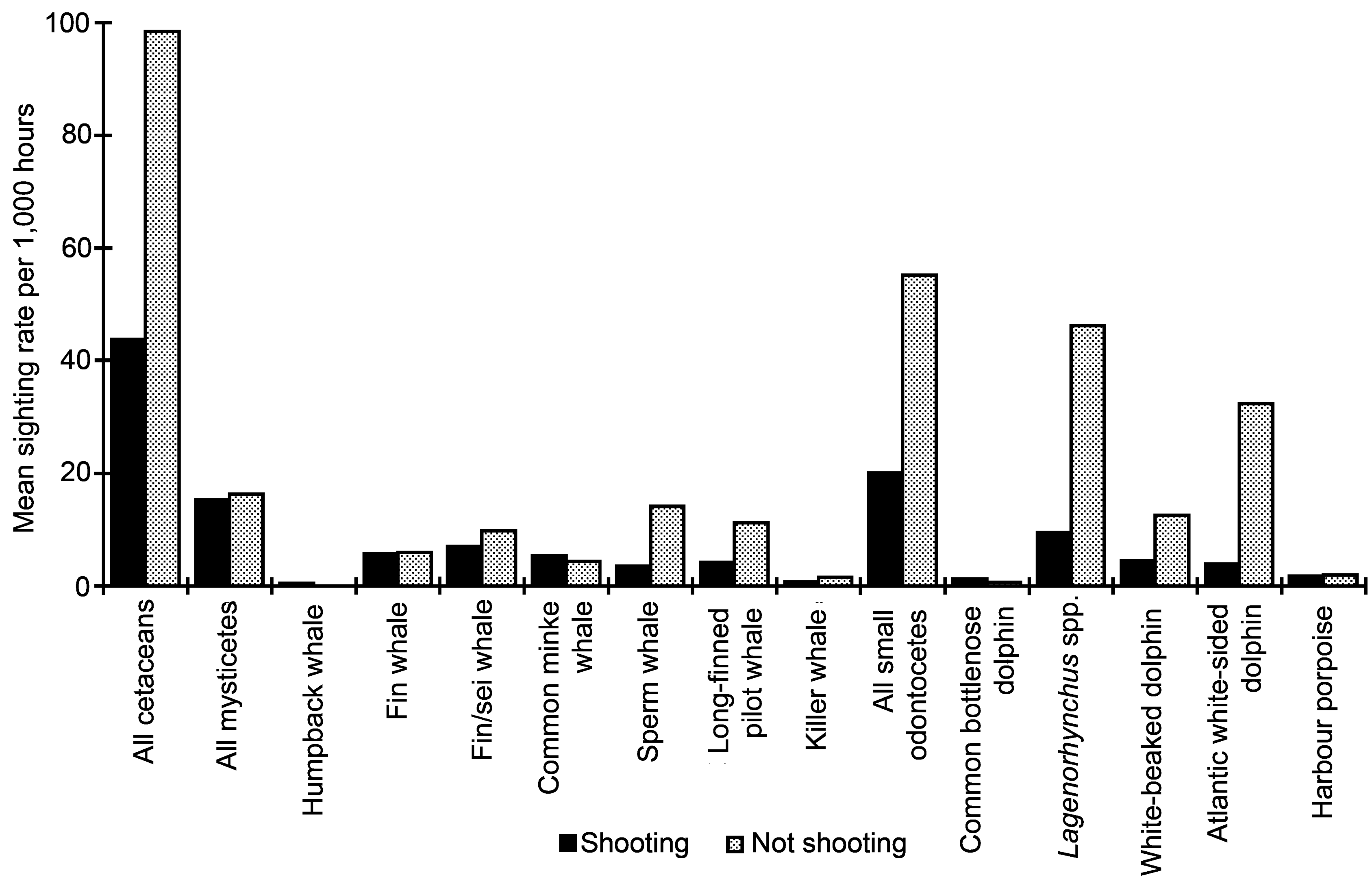


Fig. 2. Sighting rates of cetaceans in relation to the use of large volume airgun arrays.

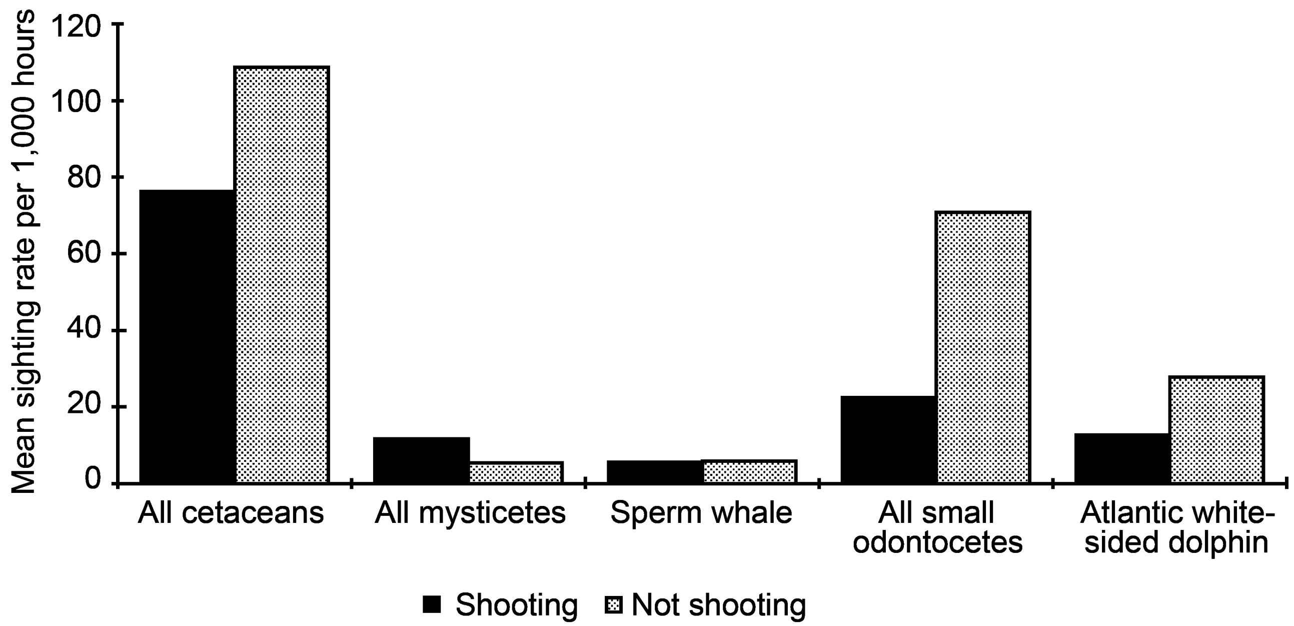


Fig. 3. Sighting rates of cetaceans in relation to the use of airguns during site surveys.

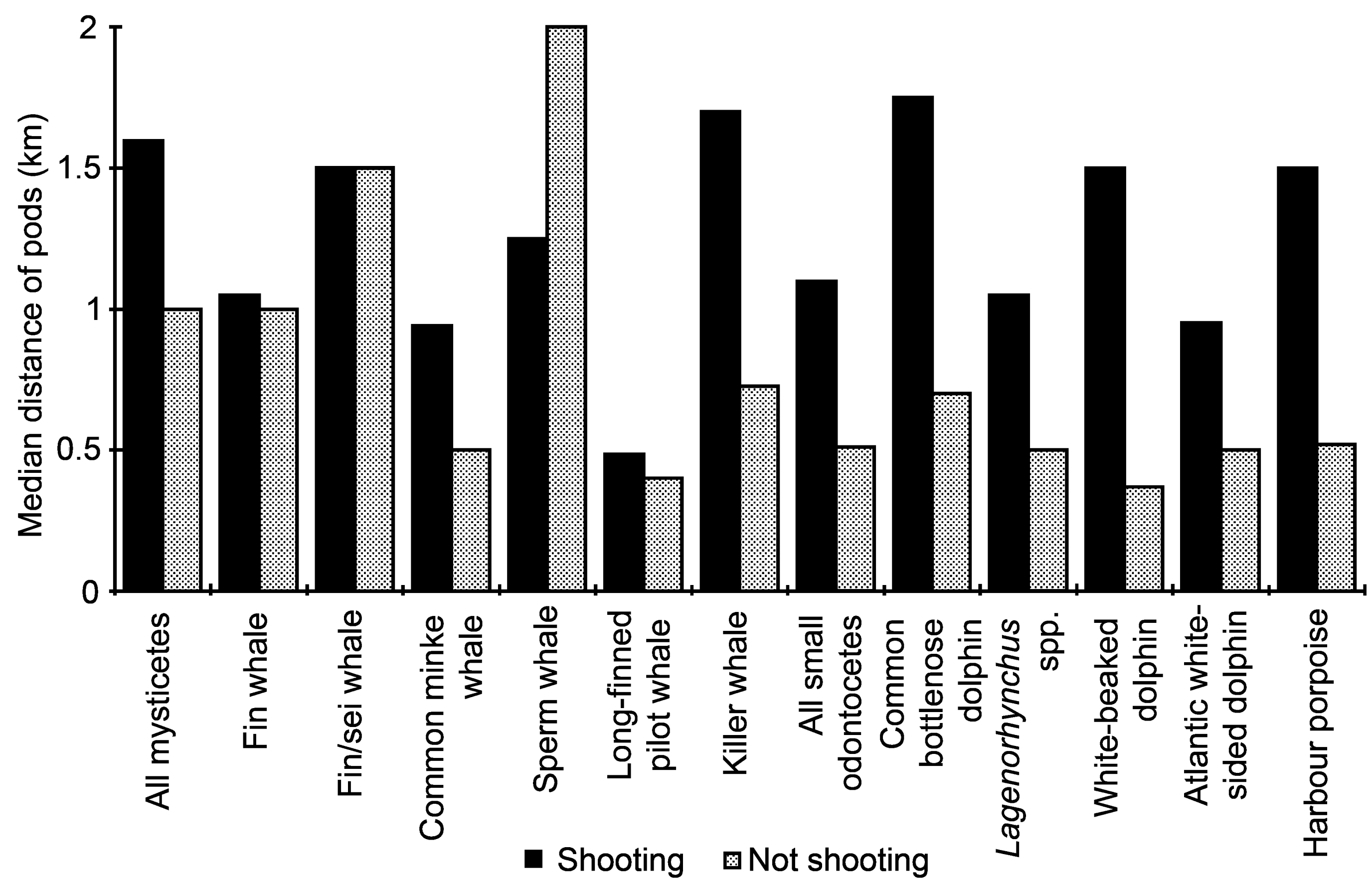
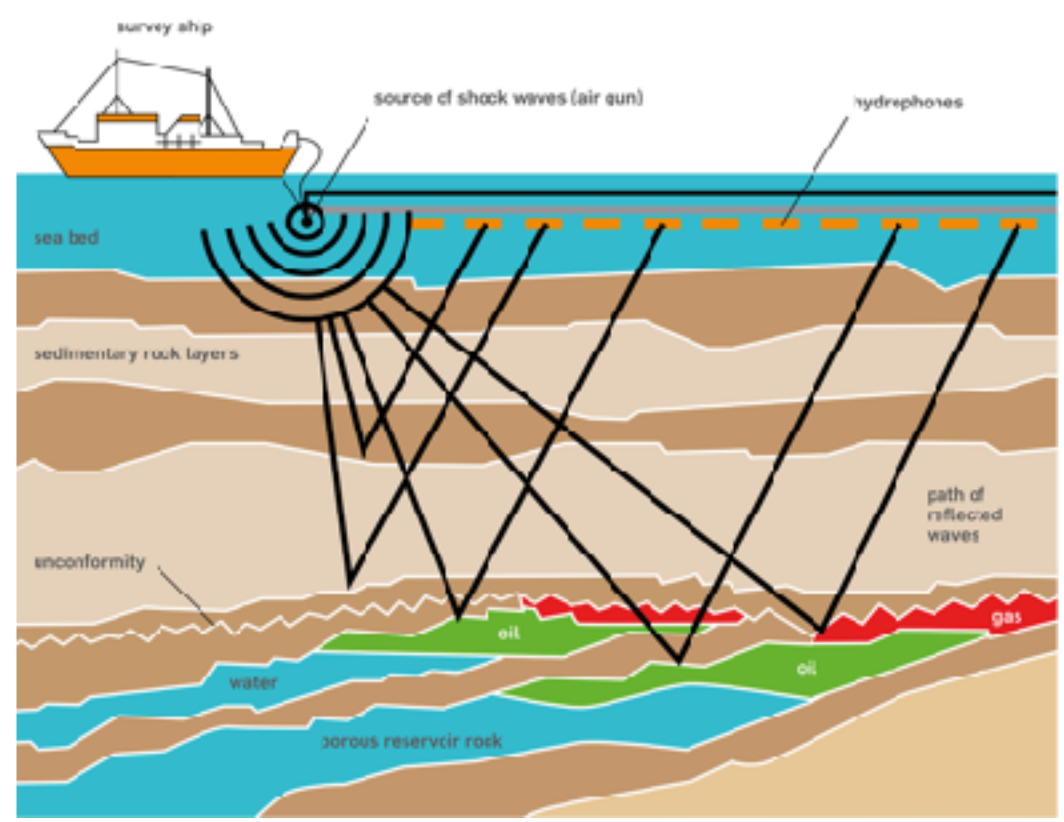


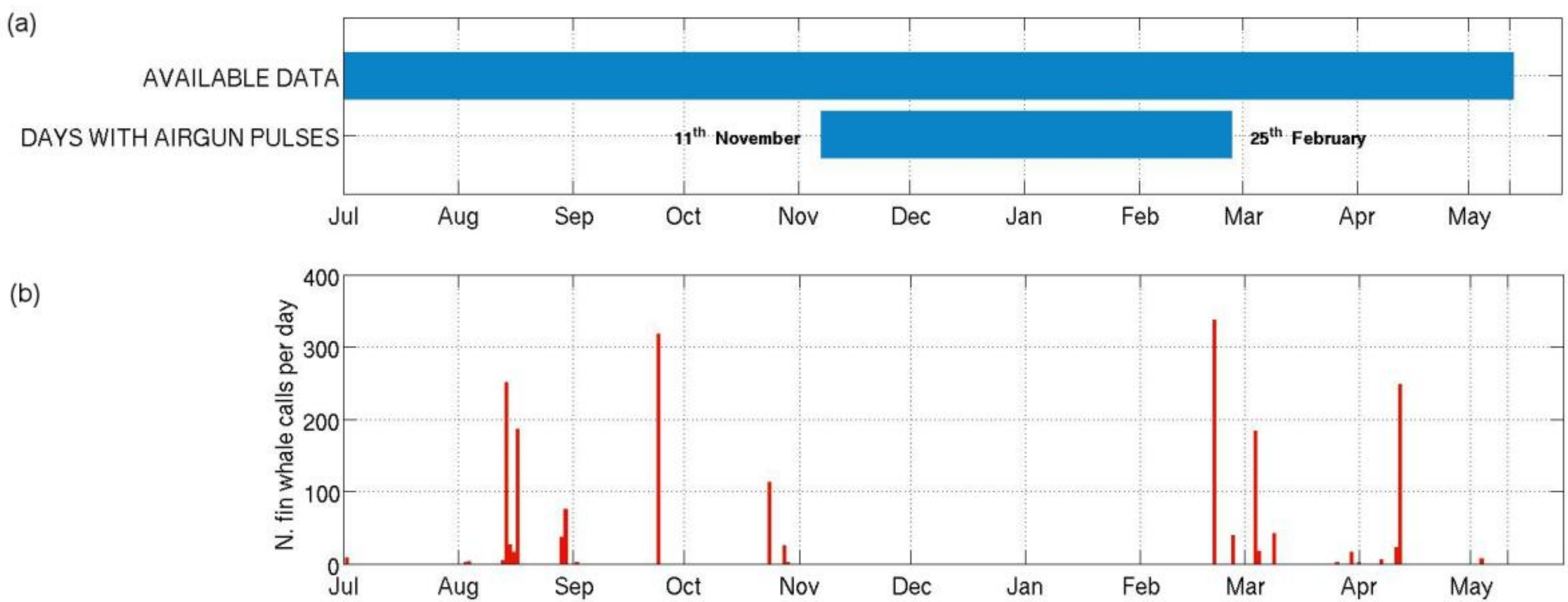
Fig. 4. Median closest distance of approach of cetaceans to large volume airgun arrays in relation to airgun activity.

Proceedings of Meetings on Acoustics
Volume 27 http://acousticalsociety.org/

Fourth International Conference on the Effects of Noise on Aquatic Life
Dublin, Ireland
10-16 July 2016

Shipping noise and seismic airgun surveys in the Ionian Sea: Potential impact on Mediterranean fin whale.





Int. J. Environ. Res. Public Health **2015**, *12*, 12304-12323; doi:10.3390/ijerph121012304

OPEN ACCESS

International Journal of
Environmental Research and Public Health
ISSN 1660-4601
www.mdpi.com/journal/ijerph

Review

Noise in the Sea and Its Impacts on Marine Organisms

Chao Peng, Xinguo Zhao and Guangxu Liu *

College of Animal Sciences, Zhejiang University, Hangzhou 310058, Zhejiang, China;
E-Mails: SUPERJUNIOR_PC@163.COM (C.P.); xinguozhao@zju.edu.cn (X.Z.)

* Author to whom correspondence should be addressed; E-Mail: guangxu_liu@zju.edu.cn;
Tel.: +86-571-8898-2636.

Academic Editor: William E. Hawkins

Received: 12 July 2015 / Accepted: 25 September 2015 / Published: 30 September 2015

Table 2. Example studies showing effects of anthropogenic noise on acoustic communication and physiological hearing system of marine organisms.

Species	Types of Anthropogenic Noise	Effects	References
M. angustirostris	increased ambient noise	constrains acoustic communication	Southall *et al.*, 2003 [45]
C. chromis *S. umbra* *G. cruentatus*	boating and shipping noise	reduces auditory sensitivity and shifts the hearing threshold	Codarin *et al.*, 2009 [7]
H. didactylus	boating and shipping noise	constrains acoustic communication and shifts the hearing threshold	Vasconcelos *et al.*, 2007 [46]
P. phocoena	seismic air-gun shooting	shifts the hearing threshold	Lucke *et al.*, 2009 [48]
T. truncatus	experimental noise emanating device	shifts the hearing threshold	Nachtigall *et al.*, 2004 [49]
P. auratus	seismic air-gun shooting	damages the hearing sensory epithelia	McCauley *et al.*, 2003 [37]
L. vulgaris *S. officinalis* *O. vulgaris* *I. coindetii*	experimental noise emanating device	damages the hearing sensory epithelia	André *et al.*, 2011 [52]
A. dux	seismic air-gun shooting	damage to internal fibers, statocysts, stomachs, and digestive tracts	Guerra *et al.*, 2011 [53]

Table 3. Example studies showing effects of anthropogenic noise on the individual behavior of marine organisms.

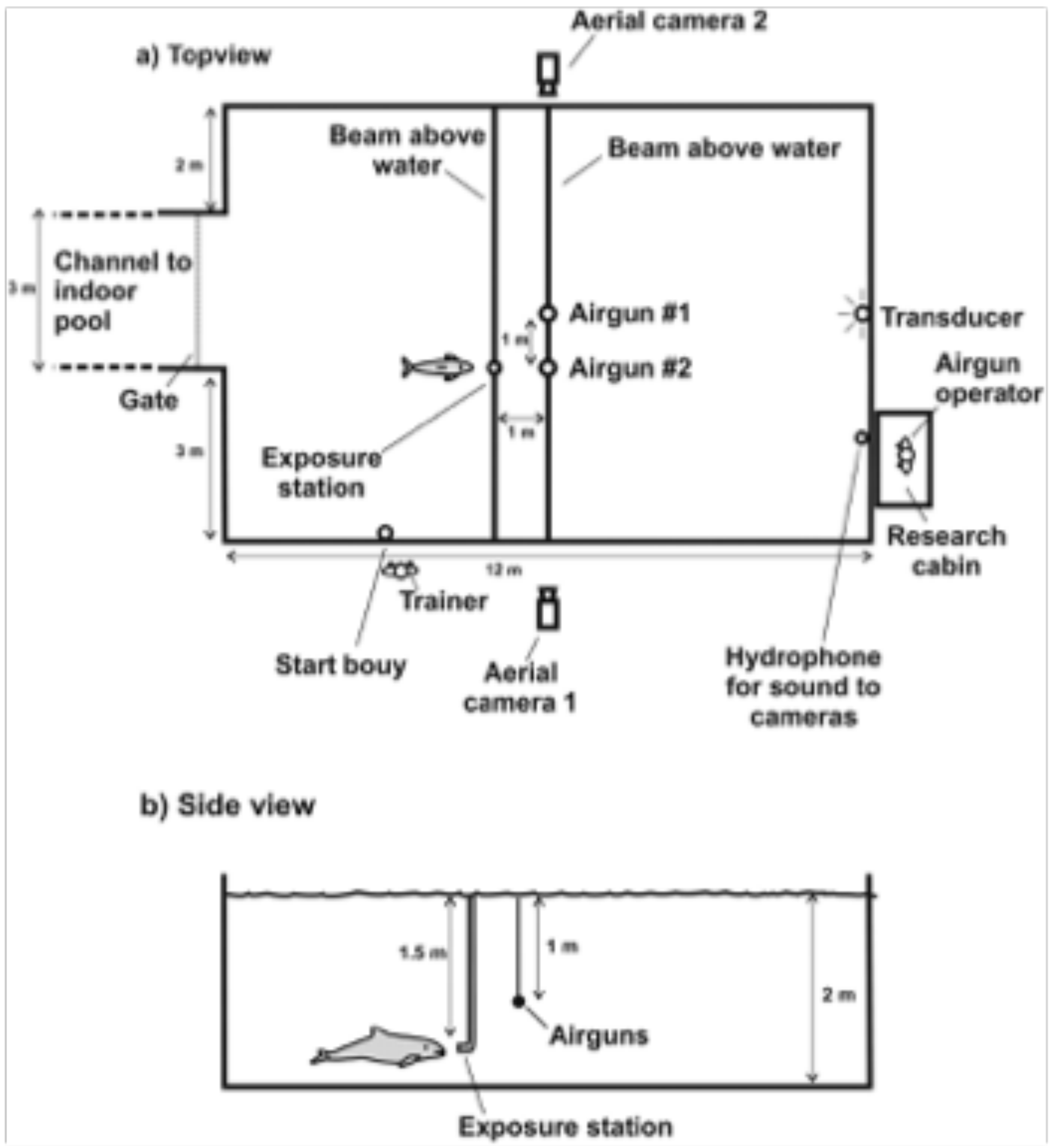
Species	Types of Anthropogenic Noise	Effects	References
D. labrax *C. labrosus* *T. luscus* *G. morhua* *P. pollachius* *T. trachurus* *A. Anguilla* *C. harengus*	experimental noise emanating device	induces startle response	Kastelein *et al.*, 2008 [6]
P. dentex *P. auratus* *S. australis*	seismic air-gun shooting	induces startle response	Fewtrell and McCauley, 2012 [54]
C. pallasii	boating and shipping noise	induces avoidance responses	Schwarz and Greer, 1984 [38]
N. pulcher	boating and shipping noise	reduces digging and defense capabilities, increases aggression	Bruintjes and Radford, 2013 [58]
G. aculeatus	experimental noise emanating device	increases in food-handling error	Purser and Radford, 2011 [59]
C. clypeatus	boating and shipping noise	reduces defense capabilities	Chan *et al.*, 2010 [60]
C. maenas	boating and shipping noise	reduces defense capabilities	Wale *et al.*, 2013 [61]
M. novaeangliae	ATOC (Acoustic Thermometry of Ocean Climate) sound	increases distance and time intervals between successive surfacing	Frankel and Clark, 2000 [65]
M. novaeangliae	Sonar	modifies courtship calls	Miller, 2000 [63]
T. truncatus	pile driving noise	modifies sound producing	David, 2006 [62]
E. glacialis *E. australis*	vessels noise	modifies calling behavior	Parks *et al.*, 2007 [64]
G. cruentatus *C. chromis*	boating and shipping noise	decreases time in nest caring and increases time in the shelters	Picciulin *et al.*, 2010 [57]
C. caretta	seismic air-gun shooting	induces startle response	DeRuiter *et al.*, 2012 [56]
M. densirostris	mid-frequency sonar	disrupts foraging and induces avoidance behavior	Tyack *et al.*, 2011 [55]

Table 4. Example studies showing effects of anthropogenic noise on the population distribution and abundance of marine organisms.

Species	Types of Anthropogenic Noise	Effects	References
Z. cavirostris	Sonar	causes mass strandings	Frantzis, 1998 [68]
A. dux	seismic air-gun shooting	causes mass strandings	Guerra *et al.*, 2011 [53]
O. orca	high-amplitude acoustic harassment devices	induces emigration	Morton, 2002 [73]
P. phocoena *T. truncatus*	pile driving noise	induces emigration	Thompson *et al.*, 2010 [75]
C. harengus, *M. poutassou*	seismic air-gun shooting	induces emigration	Slotte *et al.*, 2004 [4]
P. phocoena	wind farm noise	induces emigration and alters vertical distribution	Carstensen *et al.*,2006 [74]
G. flavescens *P. minutus* *P. microps* *T. bubalis* *M. scorpius*	wind farm noise	no detectable effects on community structure and biodiversity	Wilhelmsson *et al.*, 2006 [78]
S. goodie *S. paucispinis* *S. chlorostictus* *G. morhua* *M. aeglefinus*	seismic air-gun shooting	decreases catch rate	Skalski *et al.*, 1992 [43]; Løkkeborg *et al.*, 1993 [36]; Engås *et al.*, 1996 [41]
P. virens	boating and shipping noise	decreases catch rate	Engås, 1994 [40]
M. aeglefinus	experimental noise emanating device	decreases catch rate	Nicholson *et al.*, 1992 [42]
P. cygnus	seismic air-gun shooting	no detectable effect on catch rate	Parry and Gason, 2006 [77]
P. novaezelandiae	experimental noise emanating device	decreases population recruitment	Aguilar de Soto *et al.*, 2013 [39]
A. crassa *H. crenulatus*	tidal turbine and wind turbine noise	decreases population recruitment	Pine *et al.*, 2012 [80]
C. crangon	experimental noise emanating device	decreases reproduction rates	Lagardère, 1982 [35]
M. magister	seismic air-gun shooting	no detectable effect on larval survival	Pearson *et al.*, 1994 [79]
Z. cavirostris *M. densirostris* *M. europaeus*	naval sonar	mass strandings	Cox, *et al.*, 2006 [70]
Z. cavirostris *M. densirostris* *M. europaeus*	naval sonar	mass strandings	Fernández, *et al.*, 2005 [71]
Z. cavirostris *M. densirostris* *M. europaeus*	naval sonar	mass strandings	Jepson, *et al.*, 2003 [72]
L. kempii *T. truncates* *C. caretta*	Underwater explosives	mass strandings	Klima *et al.*, 1988 [69]

Temporary hearing threshold shift in a harbor porpoise (*Phocoena phocoena*) after exposure to multiple airgun sounds

Ronald A. Kastelein,[1,a)] Lean Helder-Hoek,[1] Shirley Van de Voorde,[1]
Alexander M. von Benda-Beckmann,[2] Frans-Peter A. Lam,[2] Erwin Jansen,[2]
Christ A. F. de Jong,[2] and Michael A. Ainslie[2]
[1]*Sea Mammal Research Company (SEAMARCO), Julianalaan 46, 3843 CC Harderwijk, The Netherlands*
[2]*TNO Acoustics and Sonar, Oude Waalsdorperweg 63, 2597 AK, The Hague, The Netherlands*



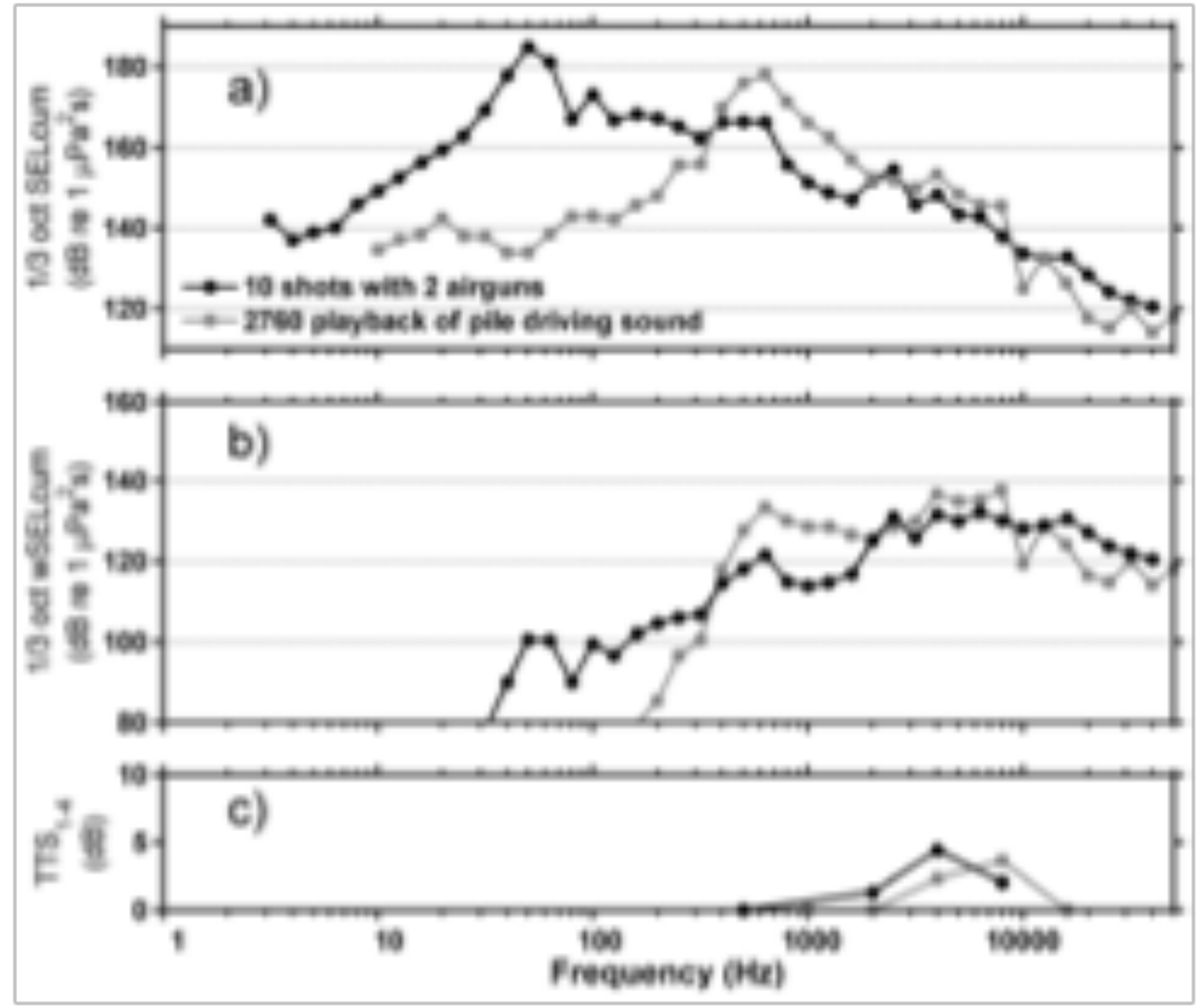


FIG. 5. (a) Unweighted one-third octave (base 10) band SELcum spectra of 10 double airgun shots (present study; shot interval: ~17 s), and of 2760 pile driving playbacks strikes/h (inter-pulse interval 1.3 s) during a 120 min exposure (Kastelein *et al.*, 2015a). (b) Measured frequency-weighted one-third octave (base 10) band SELcum from both studies, using the NOAA's (NMFS, 2016) weighting function for harbor porpoises (see Fig. 4). (c) Observed mean TTS_{1-4} for different test frequencies (0.5, 1, 2, 4, and 8 kHz). The frequency bands with maximum weighted SELcum overlap with the frequencies at which TTS occurred.

Sound Effects

OPEN ACCESS Freely available online PLoS one

Hearing Loss in Stranded Odontocete Dolphins and Whales

David Mann[1,2]*, Mandy Hill-Cook[3], Charles Manire[2¤a], Danielle Greenhow[1], Eric Montie[1], Jessica Powell[1,2¤b], Randall Wells[1,4], Gordon Bauer[2,5], Petra Cunningham-Smith[2], Robert Lingenfelser[6], Robert DiGiovanni Jr.[7], Abigale Stone[8], Micah Brodsky[9], Robert Stevens[9], George Kieffer[10], Paul Hoetjes[11]

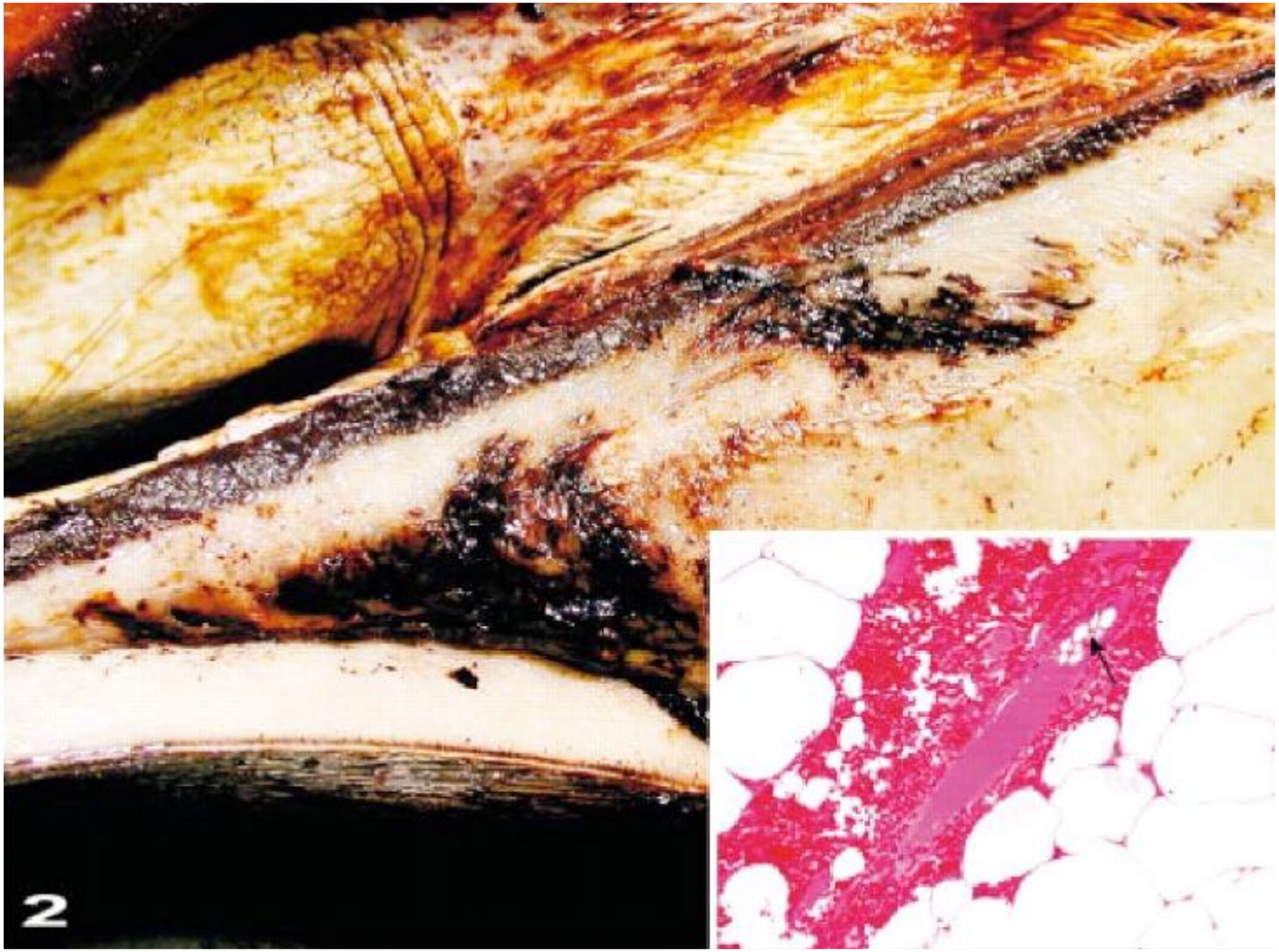
1 College of Marine Science, University of South Florida, St. Petersburg, Florida, United States of America, **2** Mote Marine Laboratory, Sarasota, Florida, United States of America, **3** Department of Biology, Portland State University, Portland, Oregon, United States of America, **4** Chicago Zoological Society, c/o Mote Marine Laboratory, Sarasota, Florida, United States of America, **5** Division of Social Sciences, New College of Florida, Sarasota, Florida, United States of America, **6** Marine Mammal Conservancy, Key Largo, Florida, United States of America, **7** Riverhead Foundation for Marine Research and Preservation, Riverhead, New York, United States of America, **8** Clearwater Marine Aquarium, Clearwater, Florida, United States of America, **9** Dolphins Plus, Key Largo, Florida, United States of America, **10** Southern Caribbean Cetacean Network (SCCN), Bapor Kibra, Curaçao, Netherlands Antilles, **11** Department of Environment and Nature, Willemstad, Curaçao, Netherlands Antilles

Abstract

The causes of dolphin and whale stranding can often be difficult to determine. Because toothed whales rely on echolocation for orientation and feeding, hearing deficits could lead to stranding. We report on the results of auditory evoked potential measurements from eight species of odontocete cetaceans that were found stranded or severely entangled in fishing gear during the period 2004 through 2009. Approximately 57% of the bottlenose dolphins and 36% of the rough-toothed dolphins had significant hearing deficits with a reduction in sensitivity equivalent to severe (70–90 dB) or profound (>90 dB) hearing loss in humans. The only stranded short-finned pilot whale examined had profound hearing loss. No impairments were detected in seven Risso's dolphins from three different stranding events, two pygmy killer whales, one Atlantic spotted dolphin, one spinner dolphin, or a juvenile Gervais' beaked whale. Hearing impairment could play a significant role in some cetacean stranding events, and the hearing of all cetaceans in rehabilitation should be tested.

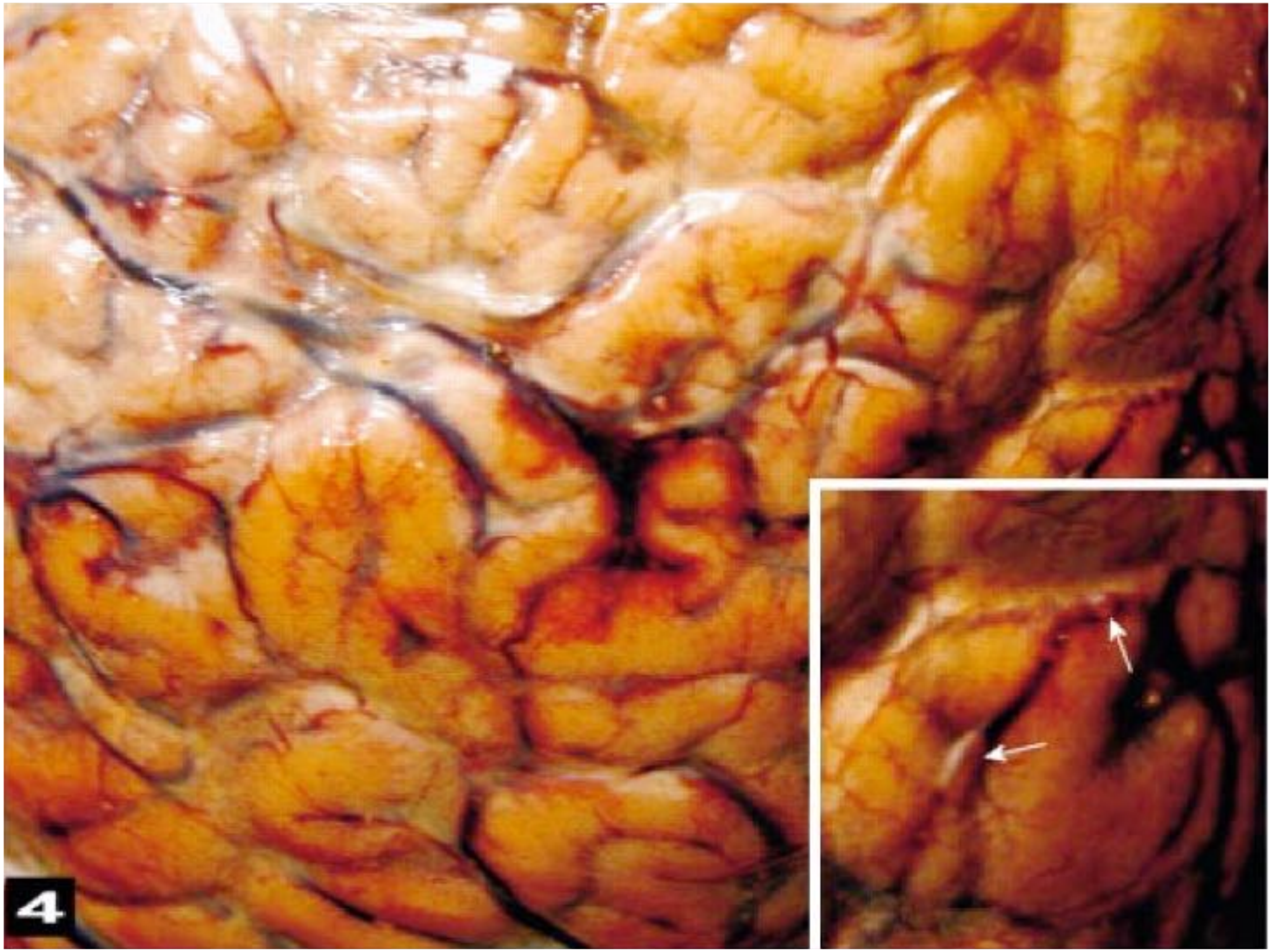
Military Sonar

Fernández A et al. Vet Pathol 2005;42:446-457



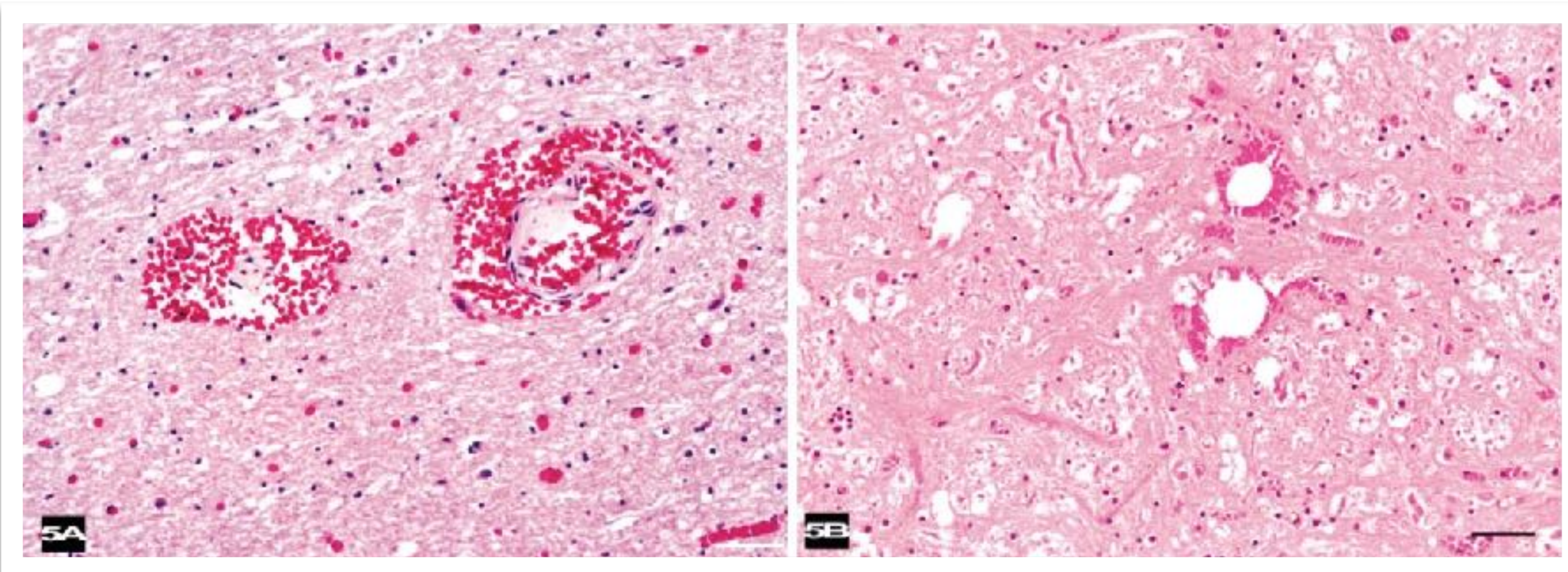
Fernández A et al. Vet Pathol 2005;42:446-457

Veterinary Pathology



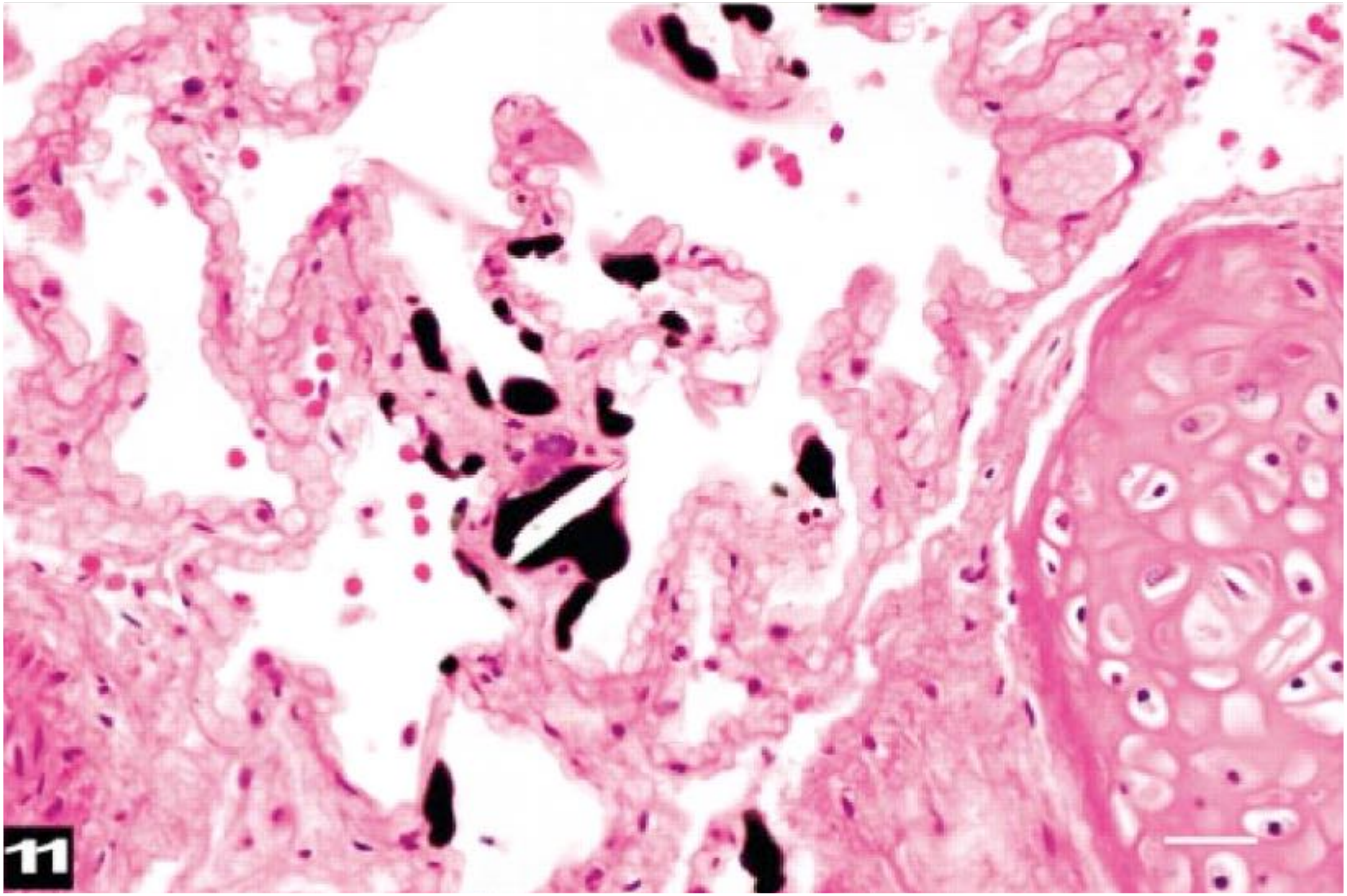
Fernández A et al. Vet Pathol 2005;42:446-457

CNS; beaked whale.



Fernández A et al. Vet Pathol 2005;42:446-457

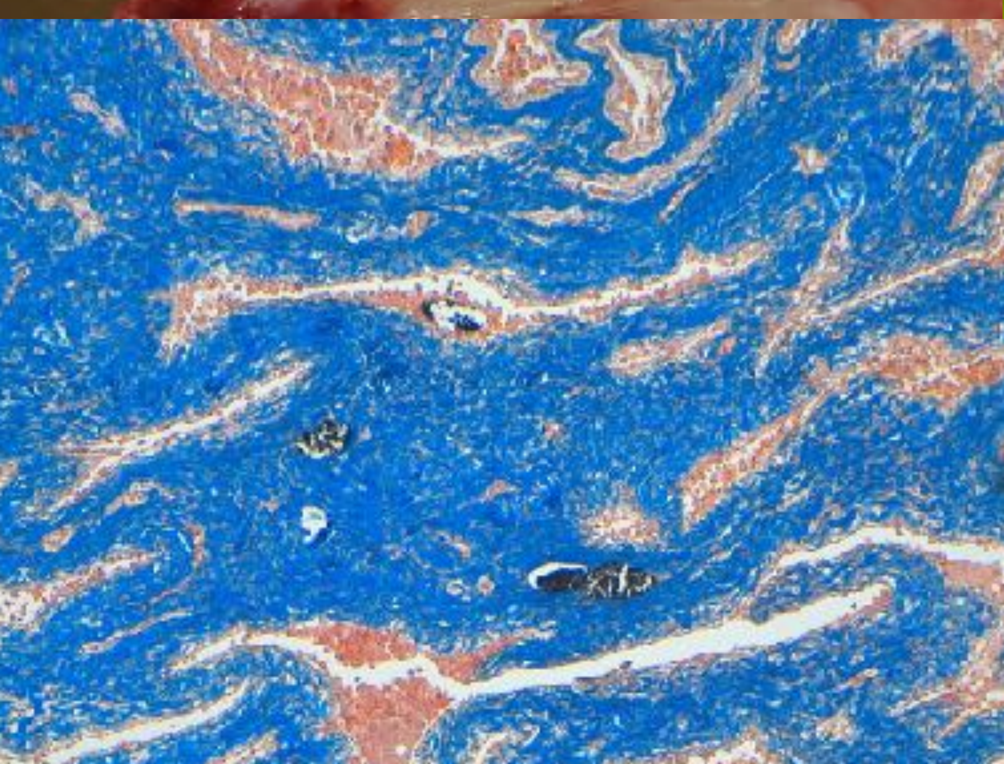
Lungs; beaked whale

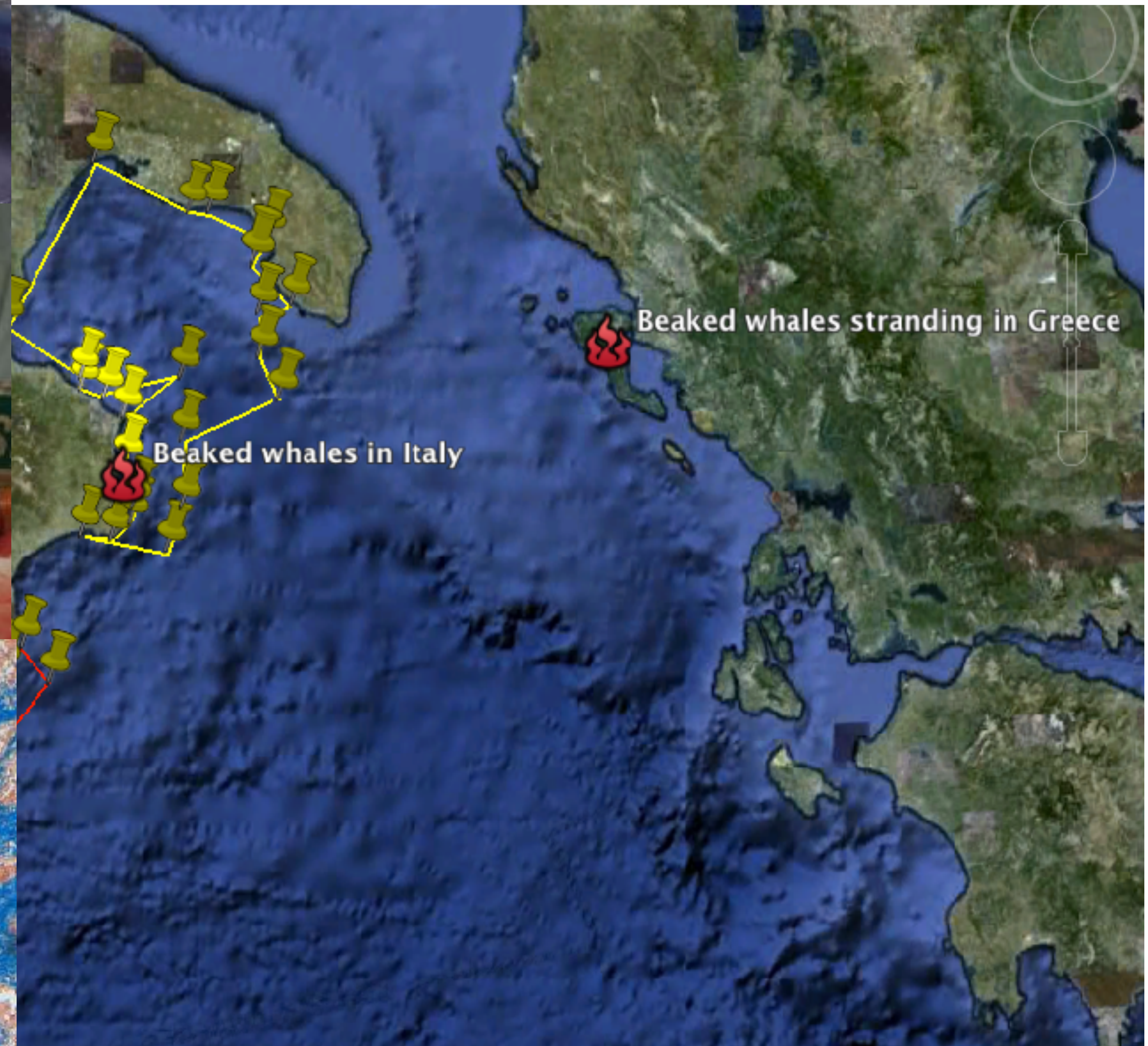


Fernández A et al. Vet Pathol 2005;42:446-457

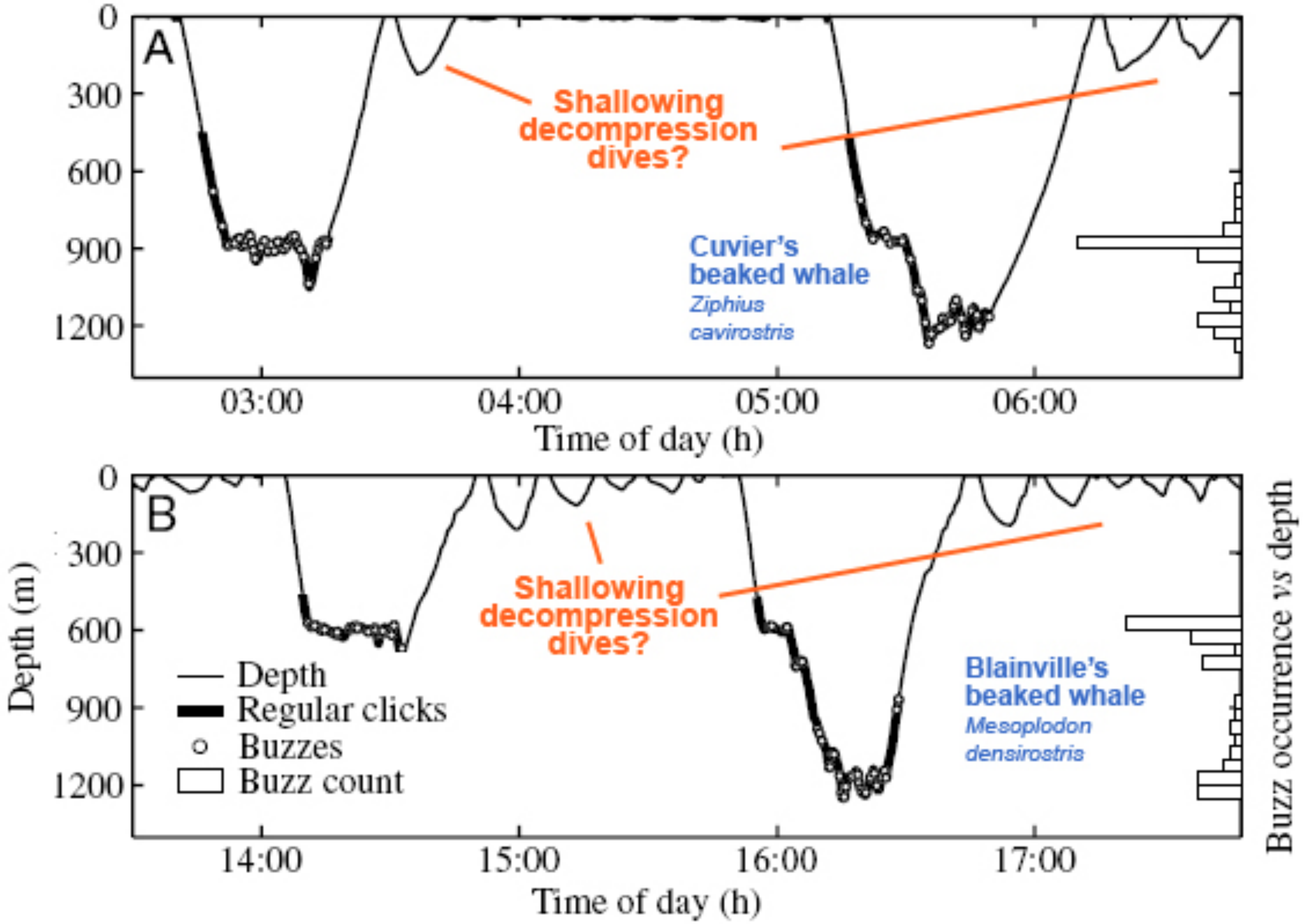
Veterinary Pathology

30 Nov 2011





"Gas and Fat embolic syndrome"



Gas and Fat embolic syndrome: protocol

1) External examination

SCIENTIFIC REPORTS

OPEN

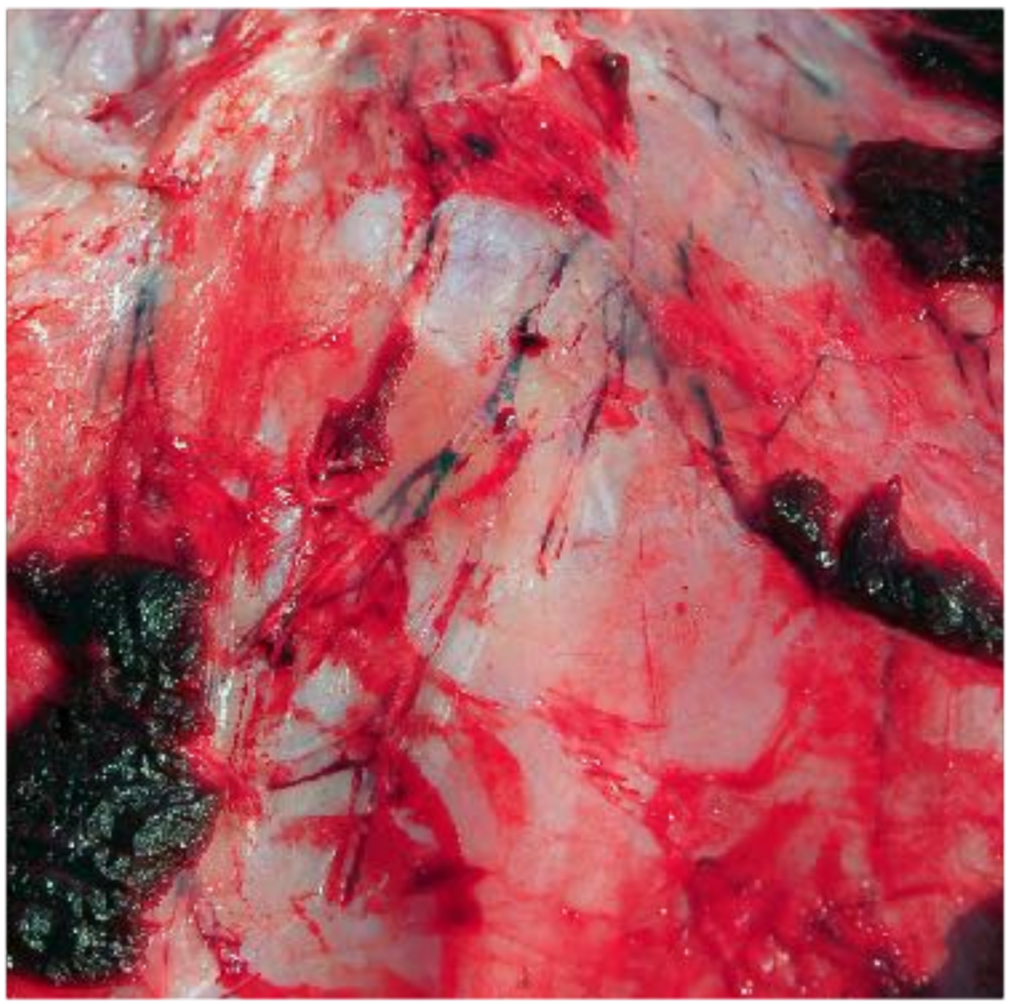
Methodology for *in situ* gas sampling, transport and laboratory analysis of gases from stranded cetaceans

Gas and Fat embolic syndrome: protocol

2) Careful subcutaneous examination

Gas and Fat embolic syndrome: protocol

3) Gas bubbles sampling

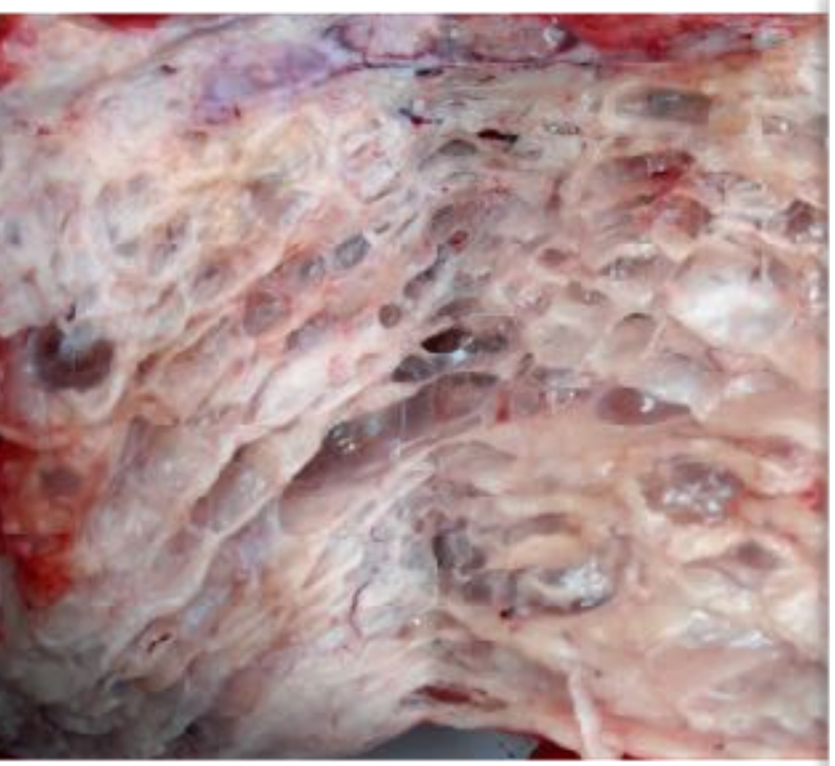


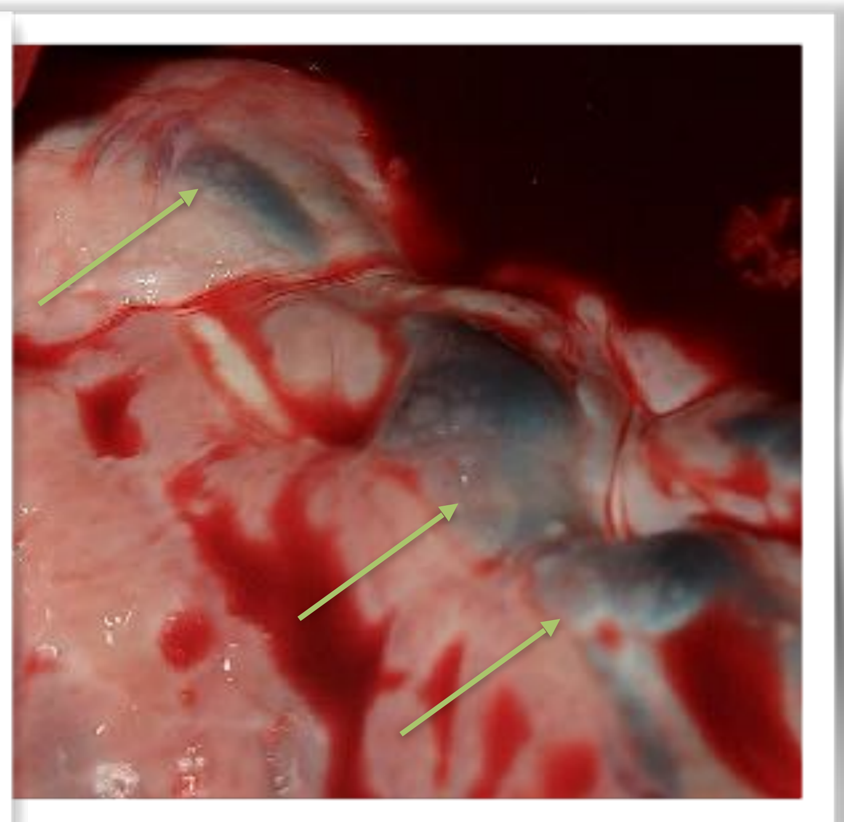
Gas and Fat embolic syndrome: protocol

4) Opening abdomen and evaluation of:
- mesenteric veins
- renal veins
- lombo-sacral veins

Gas and Fat embolic syndrome: protocol

5) Opening the thorax and evaluation of
- coronaric veins
- pleuric bubbles
- pneumothorax





Gas and Fat embolic syndrome: protocol

6) Presence of gas in all the sites:

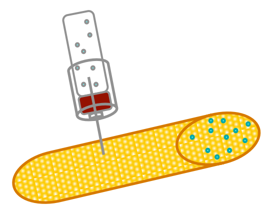
Who	Subcutaneous veins	Mesenteric veins	Lombo-sacral veins	Coronaric veins	Emphysematous findings	TOTAL
Animal n	0-VI	0-VI	0-VI	0-VI	0-III	0-27

GAS SCORE	DEFINITION
0	**Absence of gas bubbles** within venous vessels (Fig 1a, 1d, 1g)
I	**Occasional small bubble** found by carefully screening of venous vessels (Fig 1b).
II	**Few bubbles:** Gas bubbles are more easily found but a careful screening of different venous vessels and sectors of the veins is also required. The quantity of gas bubbles is easy to count. In addition, small "discontinuities of blood" can be present. These discontinuities of blood are small sections of veins showing absence of red cells and associated haemoglobin but with clear liquid instead, presumably plasma from which the red cells have retracted. There is no evidence of gas in these sections, and the veins show different grades of collapse.
III	**Few bubbles but larger discontinuities of blood.**
IV	**Moderate presence of gas bubbles** within a specific vein (Fig 1h). The presence of gas bubbles is obvious at this score, and a careful screening for localized gas bubbles is no longer necessary. Counting gas bubbles would be a tedious but possible task.
V	**Abundant presence of gas bubbles** (Fig 1i); many gas bubbles of different volumes would be present within the same vein making quantification of bubbles very difficult, if not impossible.
VI	**Complete sections of vessels filled with gas** (Fig 1c, 1e, 1f). This occurs by the coalescence of gas bubbles. Quantification of bubbles is no longer possible.

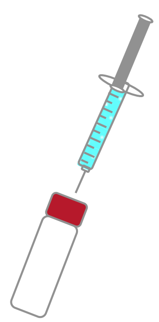
Gas and Fat embolic syndrome: protocol

1 Sampling

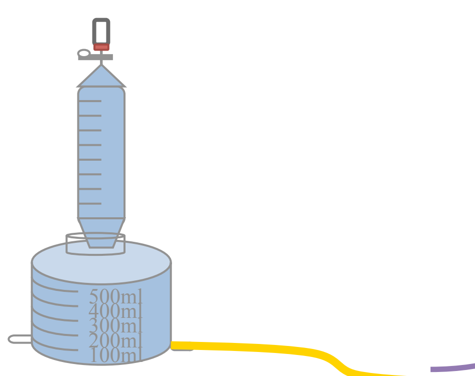
➢ Dalle cavità



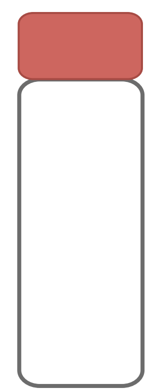
➢ Dalle bolle



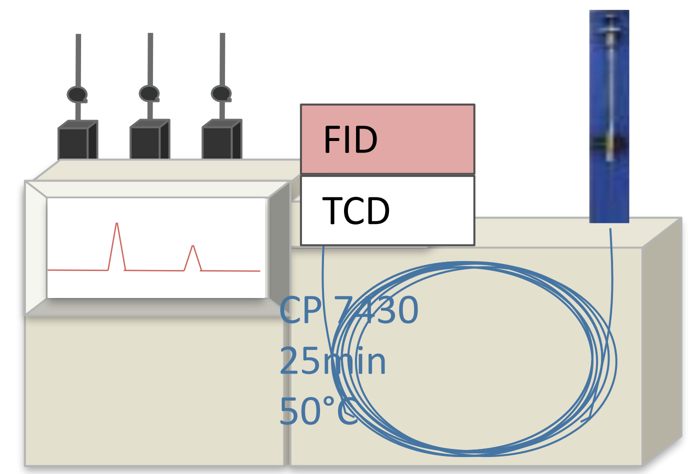
➢ Dalle cavità cardiache

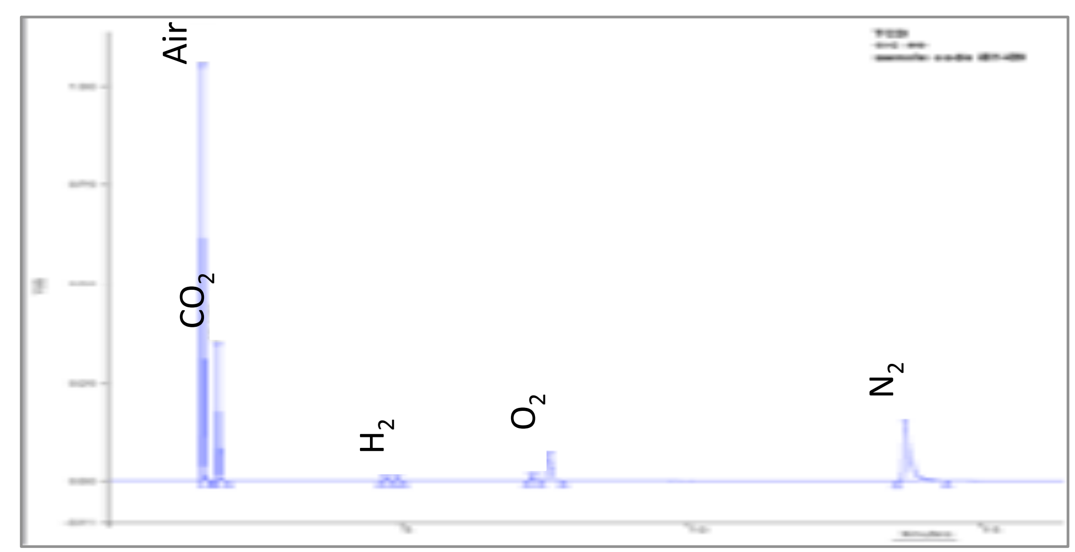


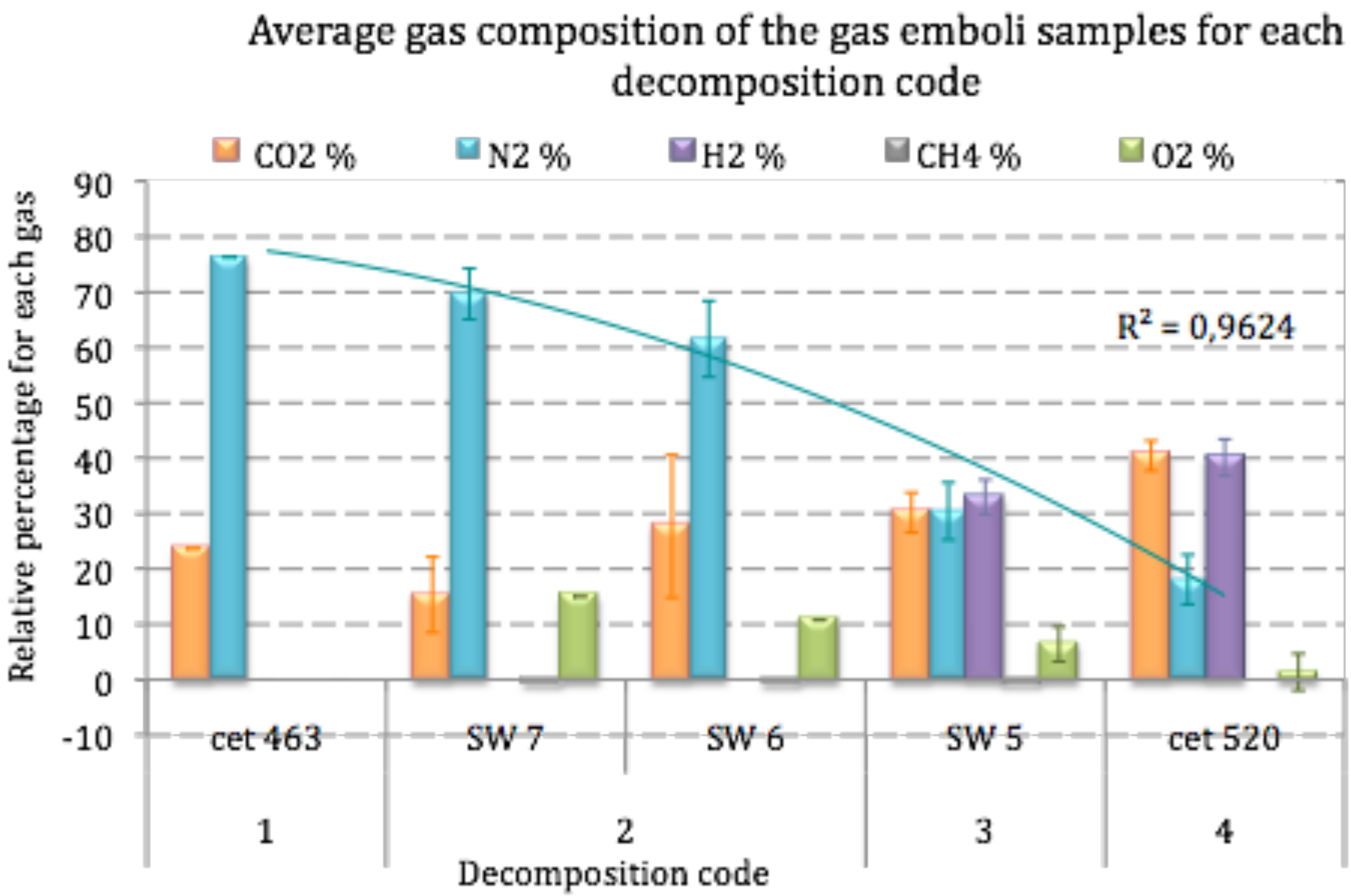
2 Preservation and sampling



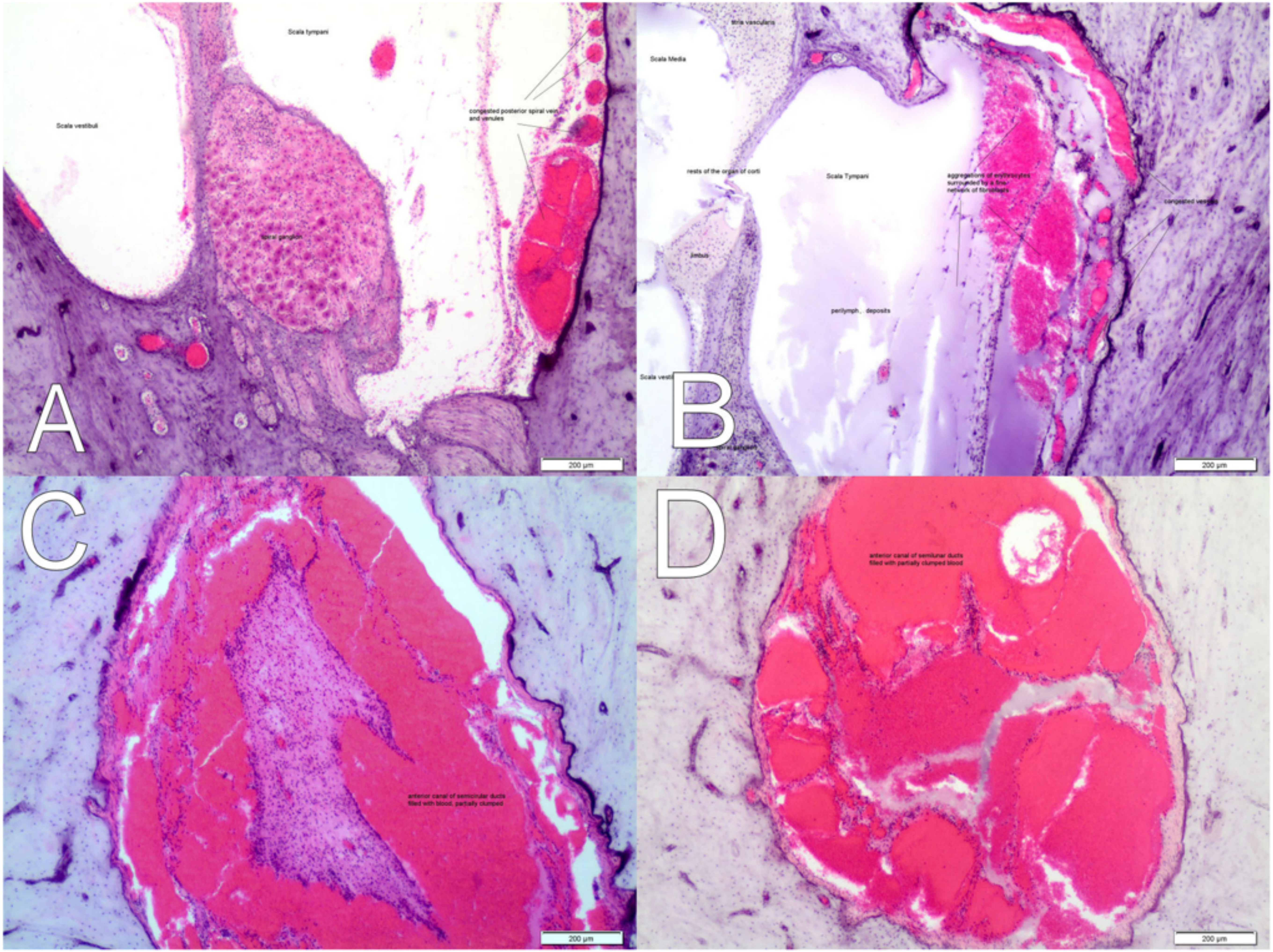
3 Analysis






Average gas composition of the gas emboli samples for each decomposition code
CO2 %
N2 %
H2 %
CH4 %
O2 %
Relative percentage for each gas
90
80
70
60
50
40
30
20
10
0
-10
R² = 0,9624
cet 463
SW 7
SW 6
SW 5
cet 520
1
2
3
4
Decomposition code


nert 4.5" ammunition
Live 7.62 ammunition
Unspecified echo sounder
Unspecified sonar
Underwater telephone 8KHz
cho sounder 35KHz
cho sounder 50KHz
cho sounder 200KHz
ynx Dipping Sonar
onar 2089 2-4 KHz
onar 2050 4-8 KHz
ommand activated sonobuoy 10KHz
ide scan sonar 2094D - 100KHz
elicopter exercise 9th June
Unconfirmed bottlenose dolphin sighting
irst report of MSE



Scala tympani
congested posterior spiral vein
and venules
Scala vestibuli
spiral ganglion
A
200 µm
stria vascularis
Scala Media
rests of the organ of corti
Scala Tympani
aggregations of erythrocytes
surrounded by a fine
network of fibroblasts
limbus
perilymph, . deposits
B
200 µm
C
anterior canal of semicirular ducts
filled with blood, partially clumped
200 µm
D
anterior canal of semilunar ducts
filled with partially clumped blood
200 µm

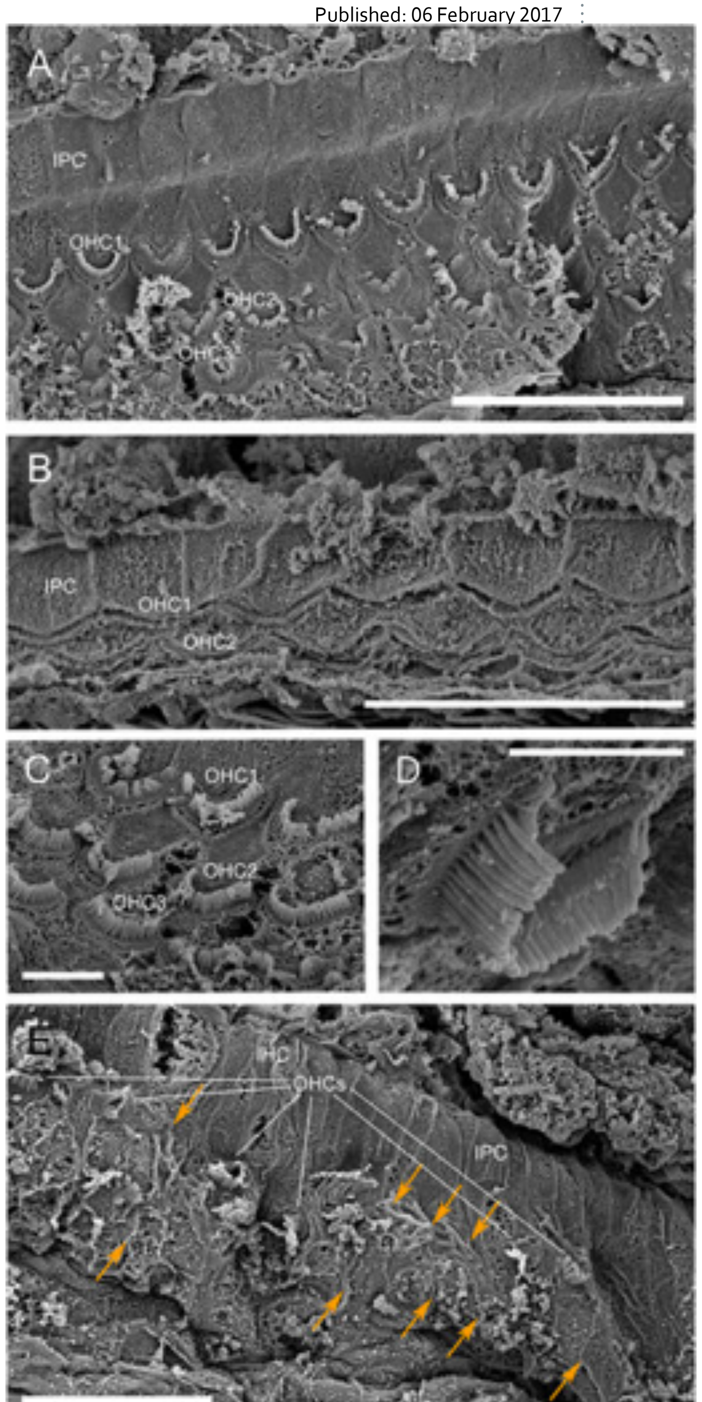
SCIENTIFIC REPORTS

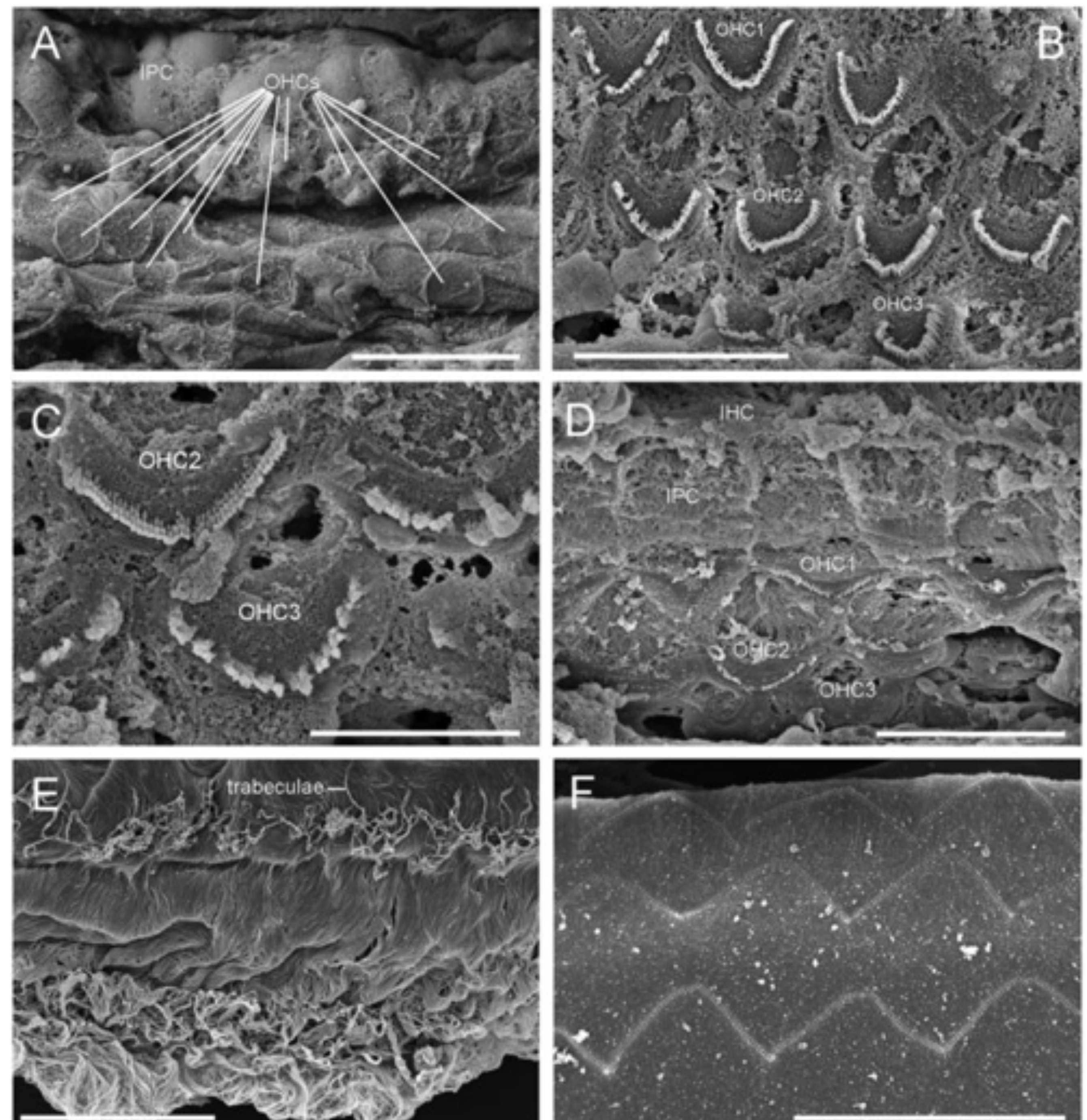
OPEN

Implementation of a method to visualize noise-induced hearing loss in mass stranded cetaceans

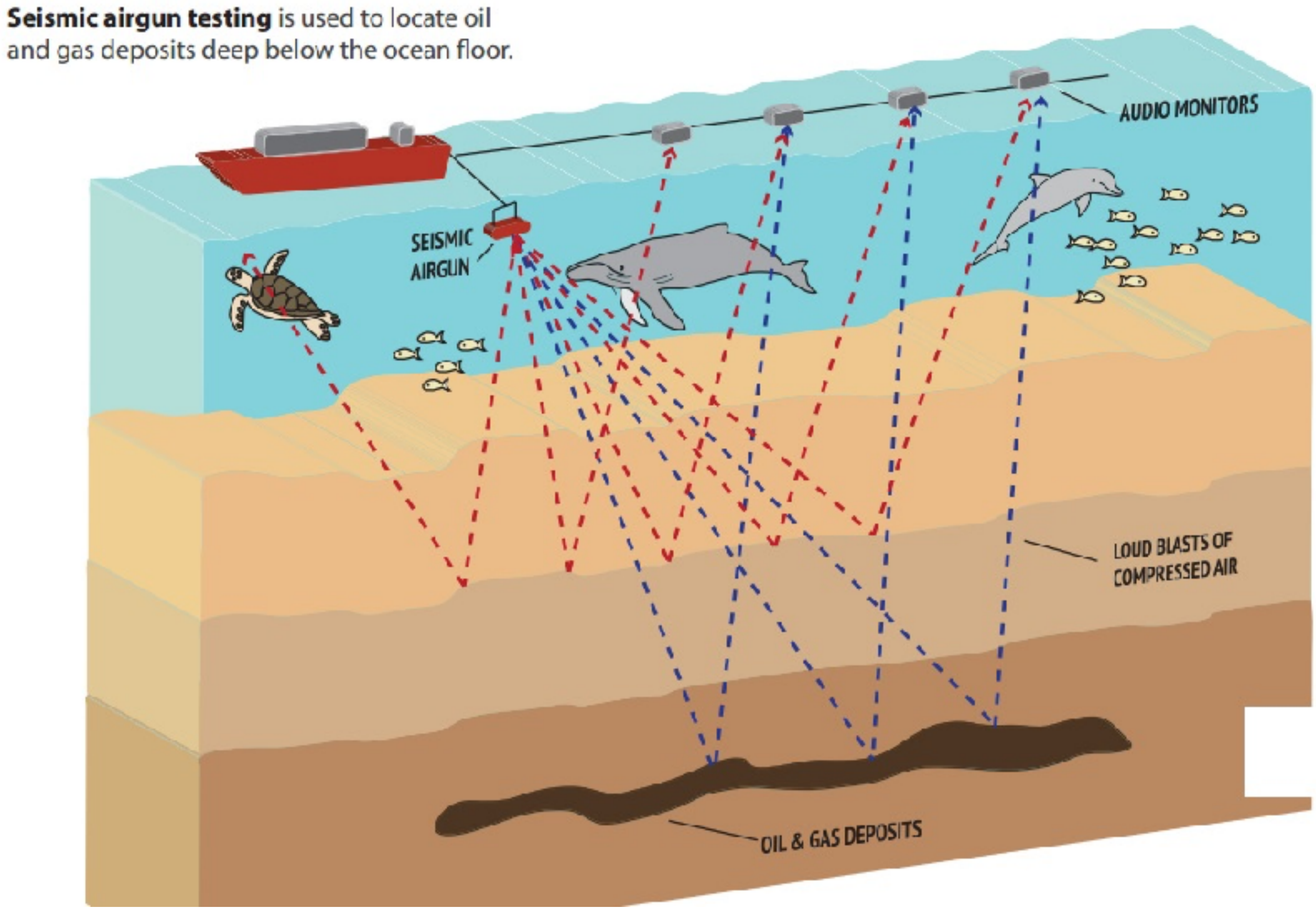
Received: 22 September 2016
Accepted: 04 January 2017
Published: 06 February 2017

Maria Morell[1,2], Andrew Brownlow[3], Barry McGovern[3,4], Stephen A. Raverty[5], Robert E. Shadwick[1] & Michel André[2]

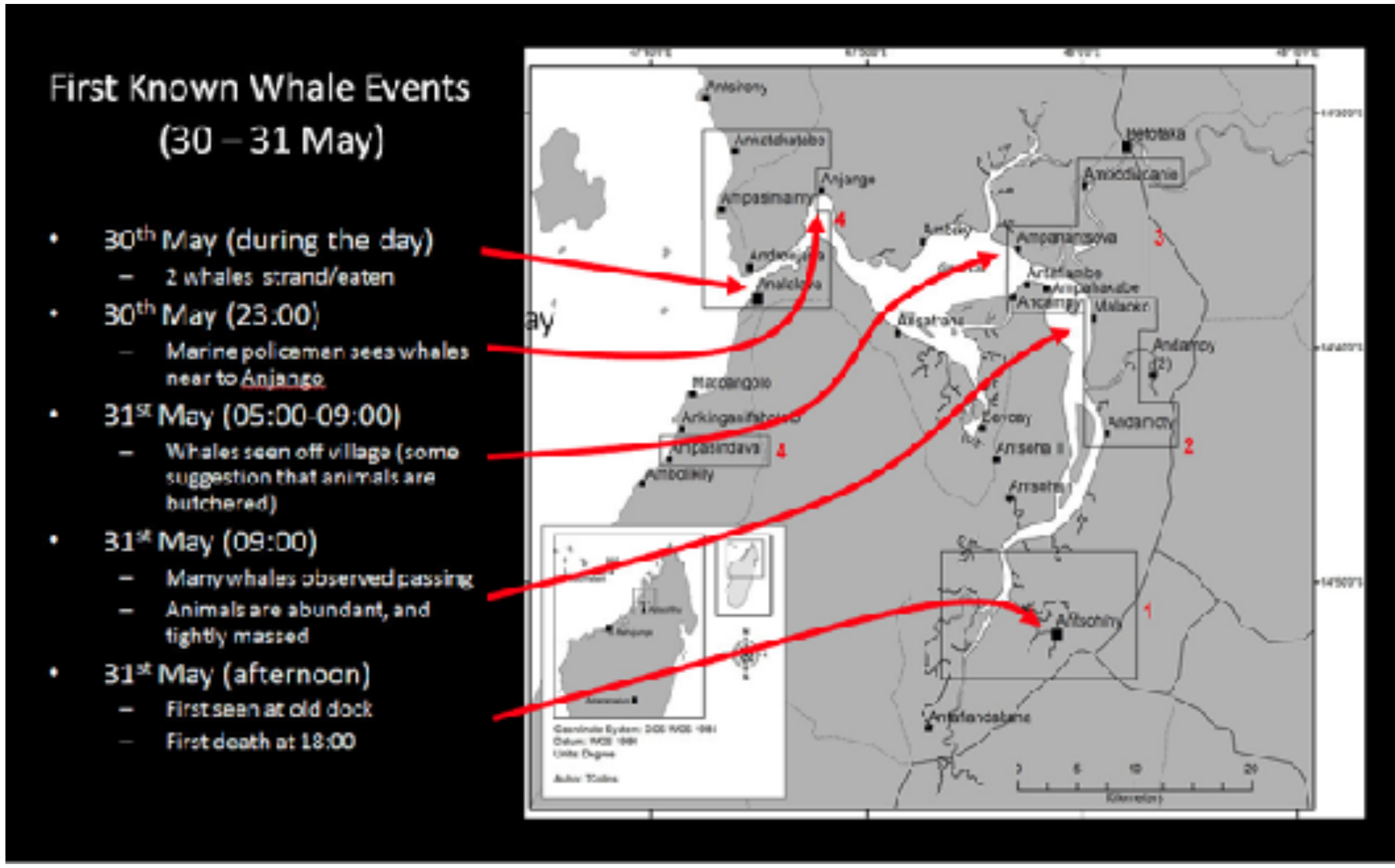




Seismic surveys



Sonar scanning 2008 Madagascar Mass stranding melon-headed whales



The Journal of Veterinary Medical Science

NOTE

Wildlife Science

Sound exposure-induced cytokine gene transcript profile changes in captive bottlenose dolphin (*Tursiops truncatus*) blood identified by a probe-based qRT-PCR

I-Hua CHEN[1)], Lien-Siang CHOU[2)], Shih-Jen CHOU[1)], Jiann-Hsiung WANG[1)], Jeffrey STOTT[3)], Myra BLANCHARD[3)], I-Fan JEN[4)] and Wei-Cheng YANG[1)]*

Noise exposure - 800-Hz pure-tone sound (40 strikes/min, duration 150 msec) lasting 30 min.

Received sound pressure level (SPL) - 153 dB re 1 μPa

Estimated mean received SPL - 140 dB re 1 μPa

Exposure interval - 2 days 3 times/day

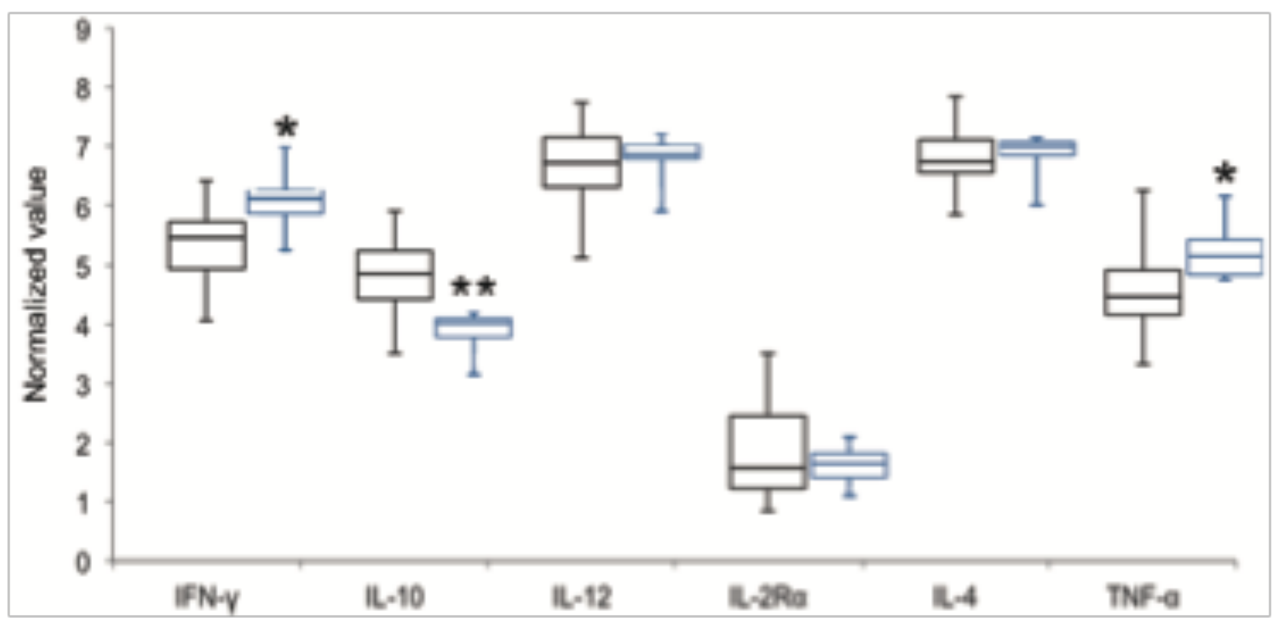
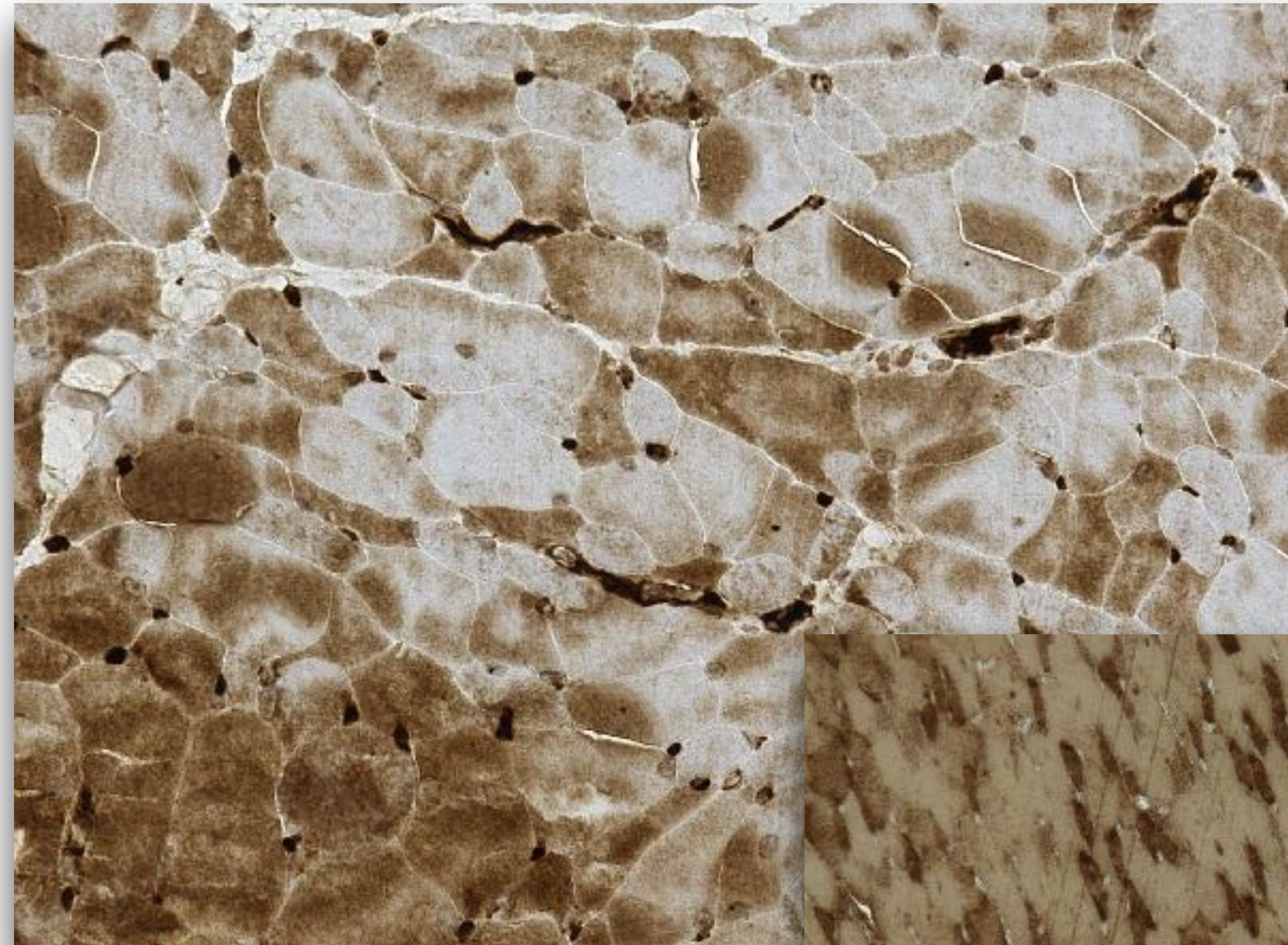


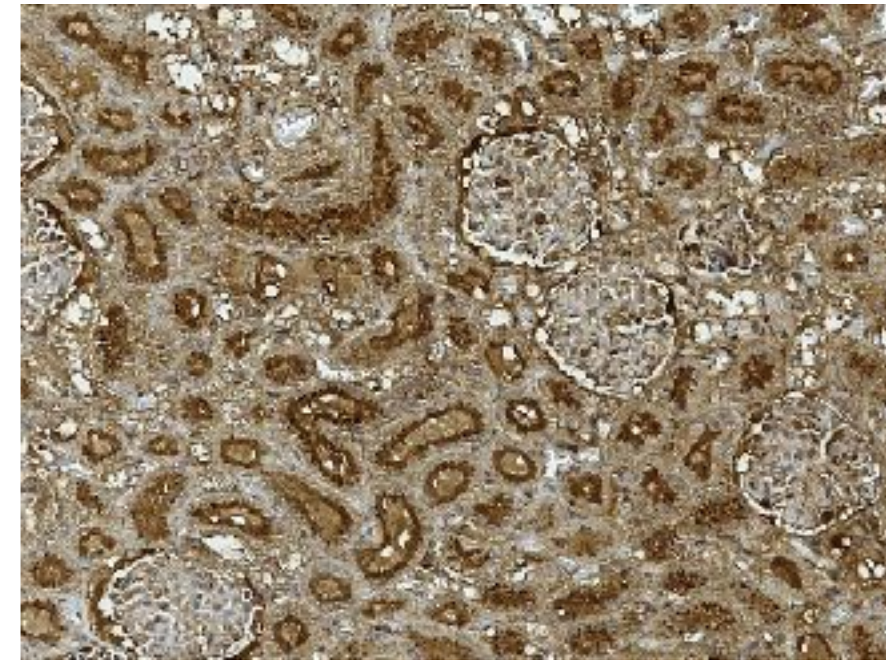
Fig. 1. Box plot of normalized value of 6 immunologically relevant genes for healthy samples (n=24, black) and noise-exposed samples (n=6, blue). Significant differences between the two sample groups are indicated by stars (*P<0.05; **P<0.01). Standard deviation/coefficient of variation of tested genes for healthy samples: IFNγ 0.68/0.13, IL-10 0.64/0.13, IL-12 0.76/0.12, IL-2Rα 0.76/0.41, IL-4 0.50/0.07 and TNFα 0.74/0.16.

DIAGNOSTIC FRAMEWORKS

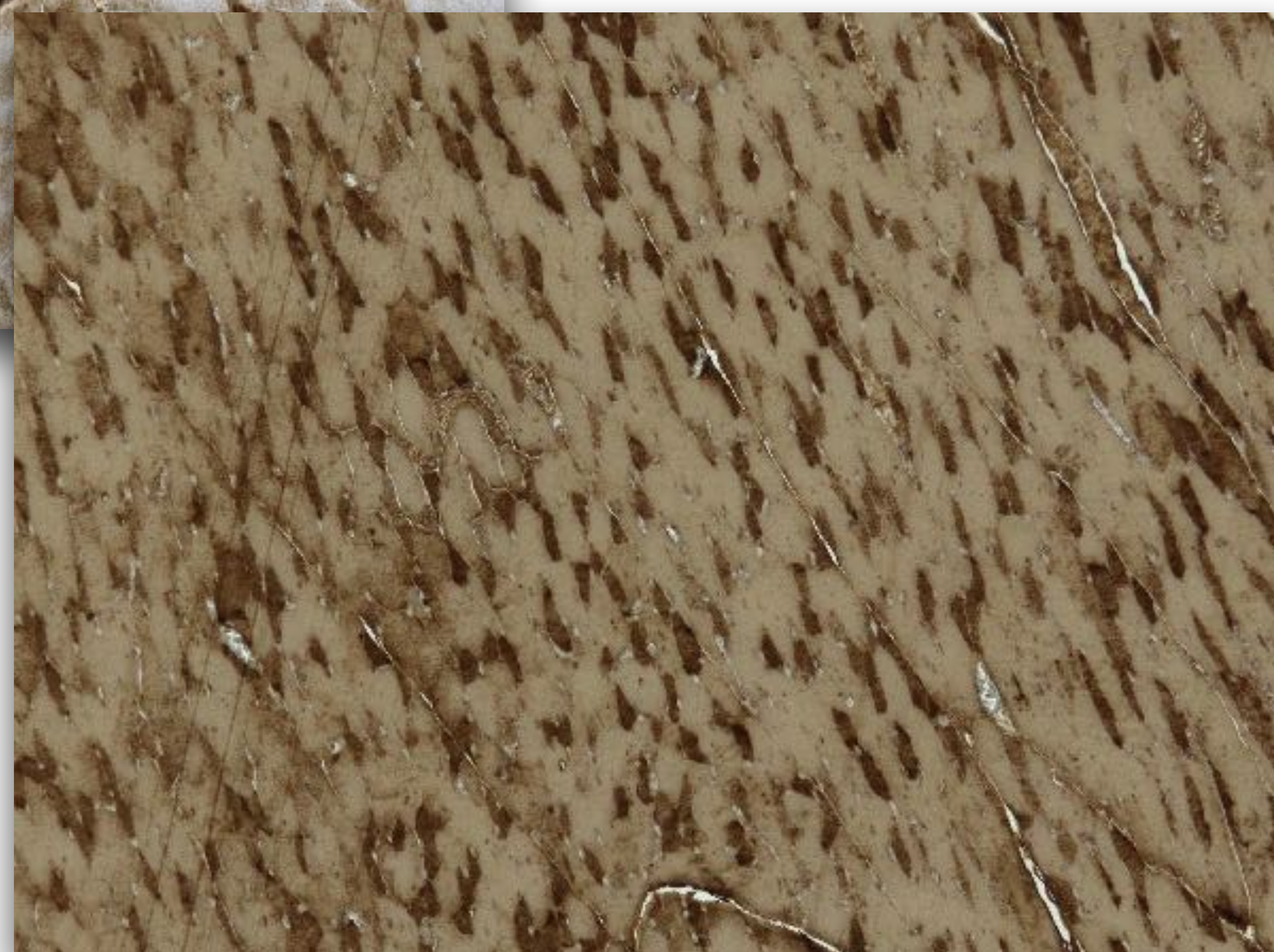
- **Infectious diseases**
- **Fishery interaction**
- **Marine litter ingestion and evaluation**
- **Ship strikes**
- **Noise impacts**
- **Others causes of death**



muscle, striped dolphin, anti fibrinogen, 20x



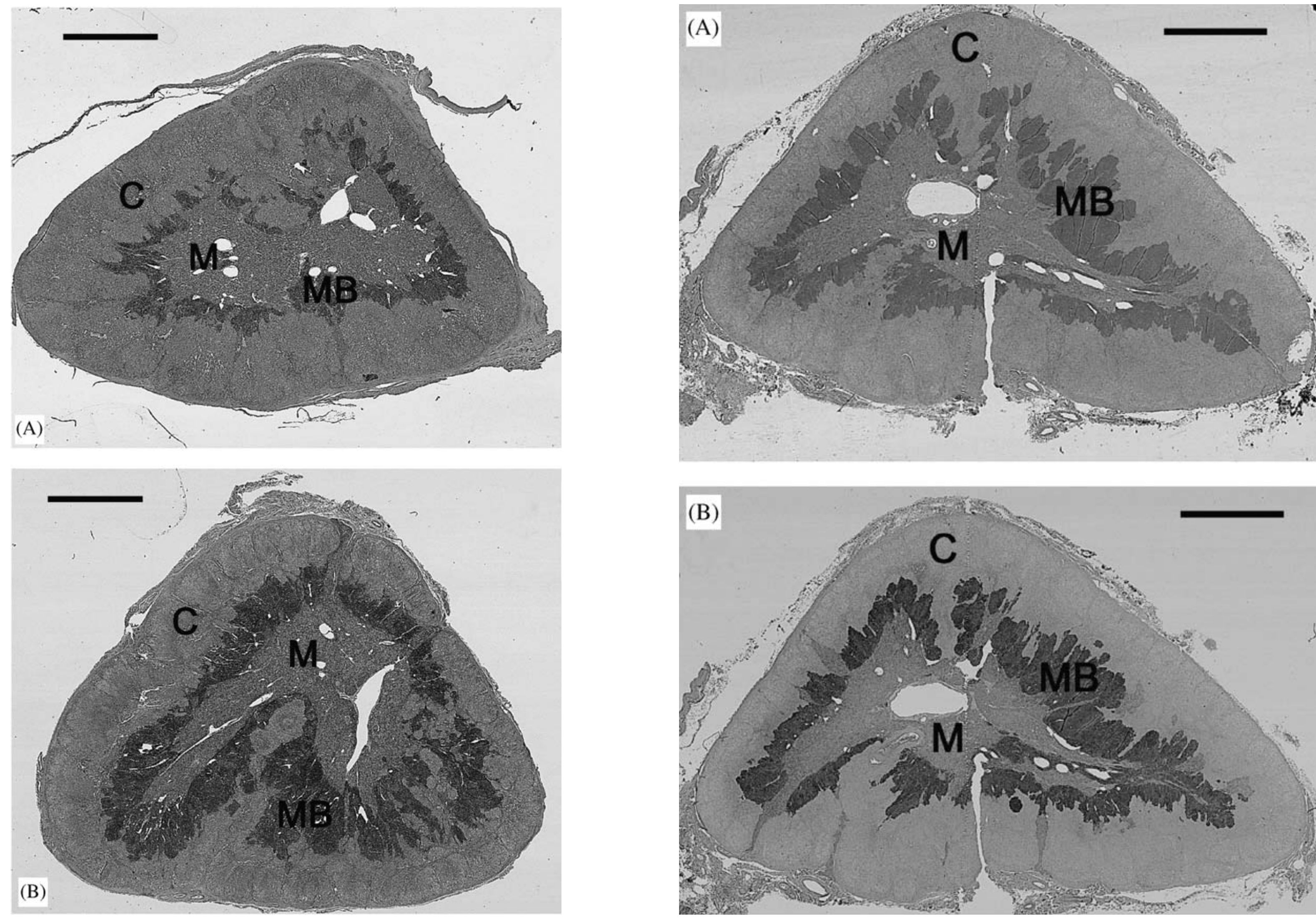
\

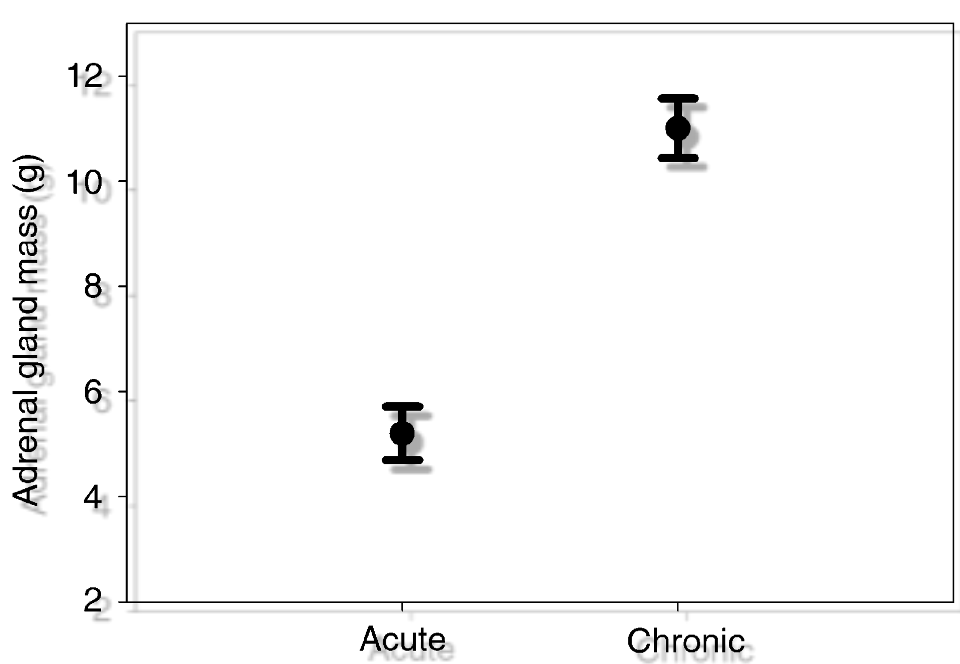


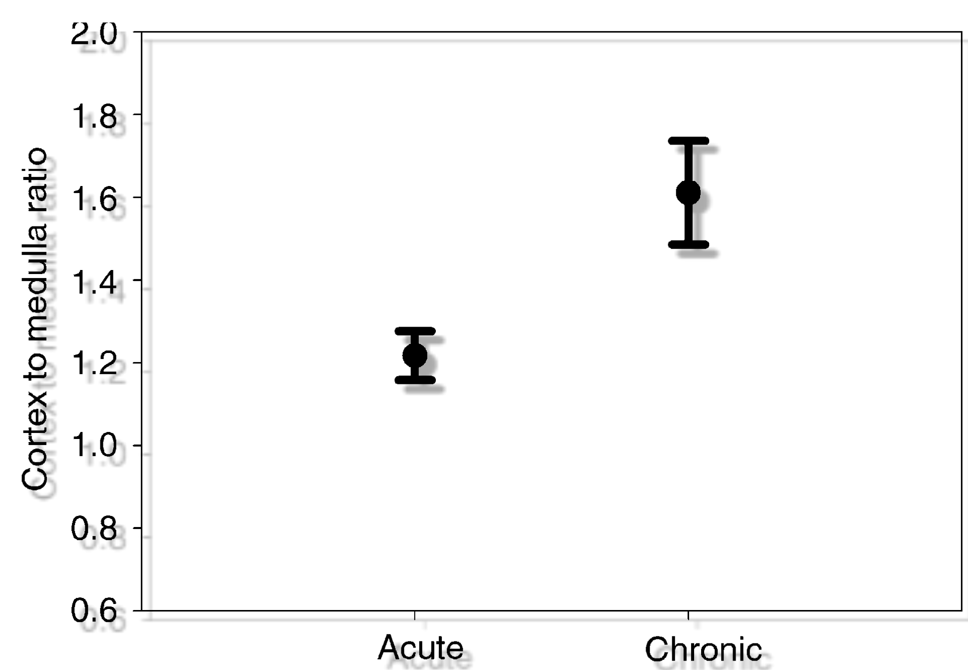
Time since strandings vs euthanasia

T (h)	ID	Species	t (h)	Lesioni (IHC)		MB renale
				muscolo	cuore	
0-6 h	190	TT	0	MB: - FIB: +	MB: - - FIB: +	-
	208	FW	4	MB: - FIB: +	MB: - FIB: -	+
	211	FW	0	MB: - FIB: +	c.a.	+
	281	GM	4	MB: - FIB: +	MB: - FIB: +	-
6-12 h	134	FW	8	MB: - FIB: +	c.a.	+
	218	SC	8	MB: - FIB: +	MB: - FIB: +	+
	215	**GG**	**6**	**MB: - - FIB: n.r.**	**MB: - FIB: + +**	**+**
	221	SC	8	MB: - FIB: + +	MB: - FIB: +	+
12-24 h	**201**	**TT**	**24**	**MB: n.r. FIB:+ +**	**c.a.**	**-**
	225	GG	24	MB: - - FIB: +	MB: - FIB: +	+
>24 h	173	PM	36	MB: - - FIB: + +	MB: - - FIB: + +	+

Acute vs chronic stress







Stress: post-mortem findings

<u>Skin:</u>

- **lesions due to mutilation/automutilation**
- **findings consistent with licking/biting: psicogen dermatitis (**characterized by well delimited erythematous/ulcerative area on flanks or abdomen and alopecic area close to the anus, elbow, thigh) or **licking dermatitis**(alopecia, exudation, hypercheratosis, hyperpigmentation)
- **intra-specific traumatic injuries**
- **traumatic injuries following anomalous behavior.**

<u>Stomach:</u> ulcers and hemorrhages (hypoperfusion and not due to endogenous corticosteroid)

<u>Liver:</u> lipidosis (metabolic stress syndrome

<u>Heart:</u> muscular hypercontraction (micro)

<u>Lungs:</u> meconium asipration syndrome(micro); exercise hemorrhages

<u>Muscle(micro):</u> rabdomyolisis and possible hemoglobinuria, necrosis and hemorrhages

<u>Genital:</u> abortion

<u>SNC:</u> hyppocampal degeneration

<u>Adrenal:</u> corticali hemorrhages (macro e micro) with degeneration minima (micro); cortical hyperplasia

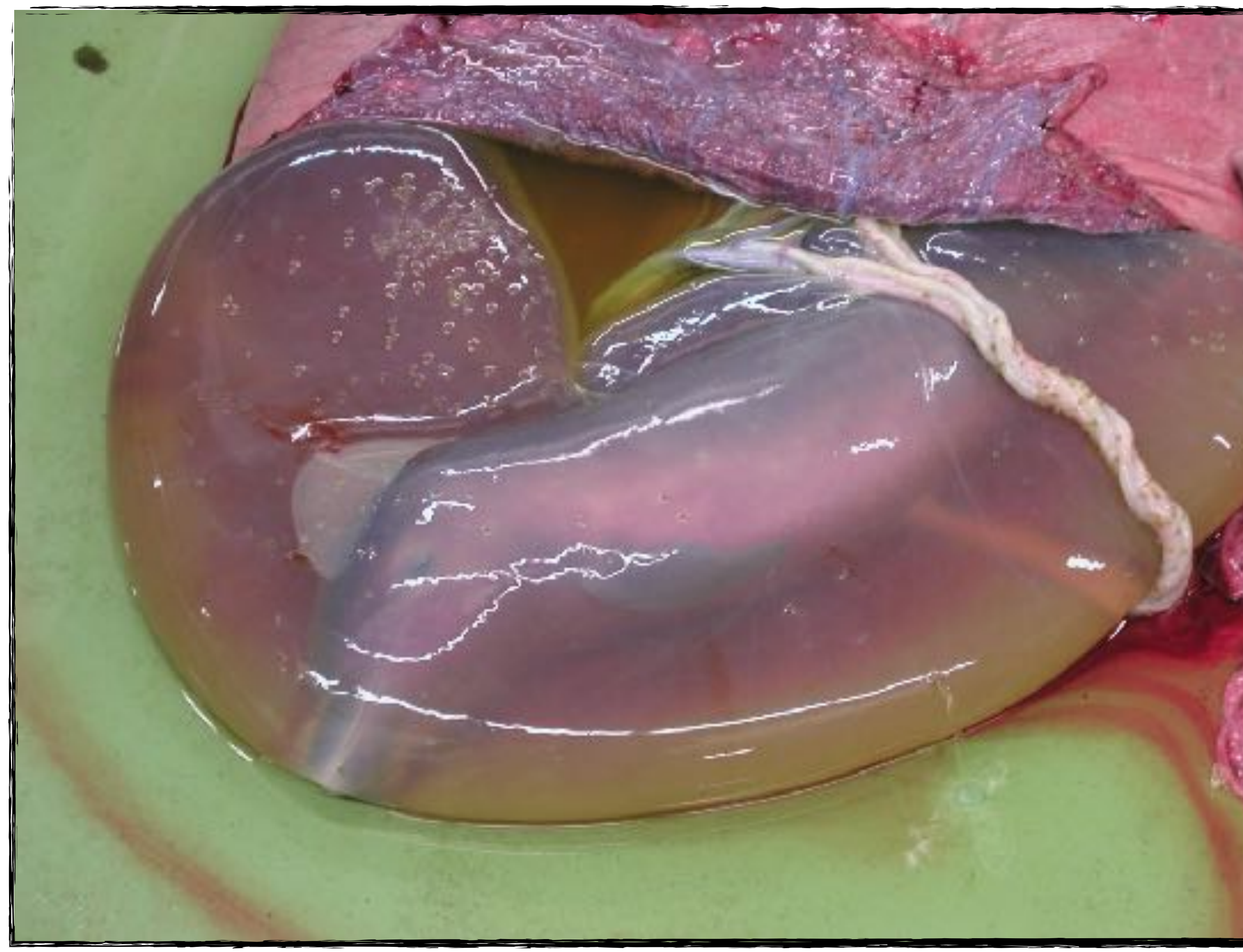
Other spontaneous diseases: newborns

- Abortion and intra-uterum infection (Morbillivirus, Brucella, T. gondii)

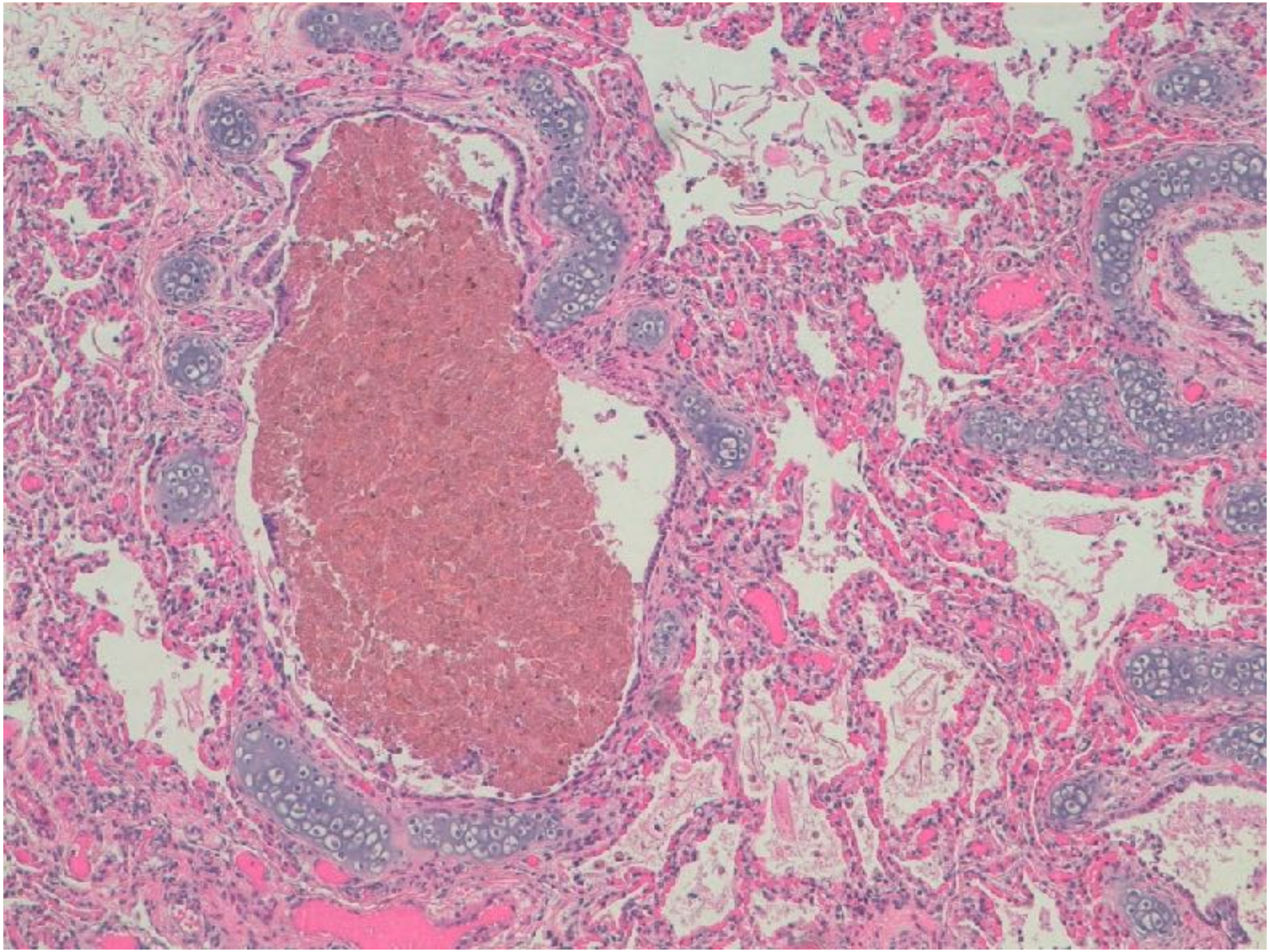
- Peri-partum stressful events: meconium aspiration syndrome (MAS)

- Lost/abandoned animals

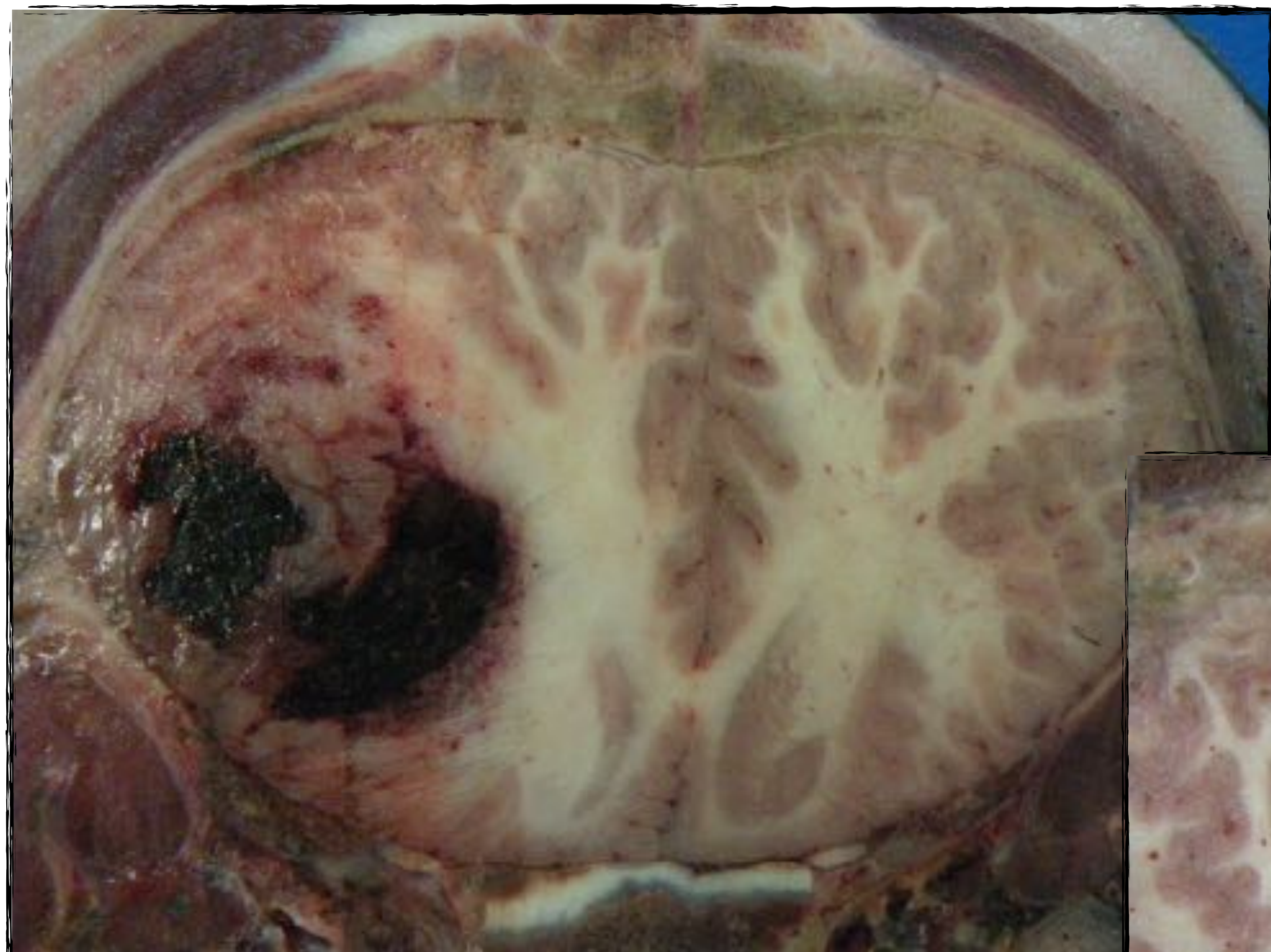
- Infanticide (mother, males, etc.)

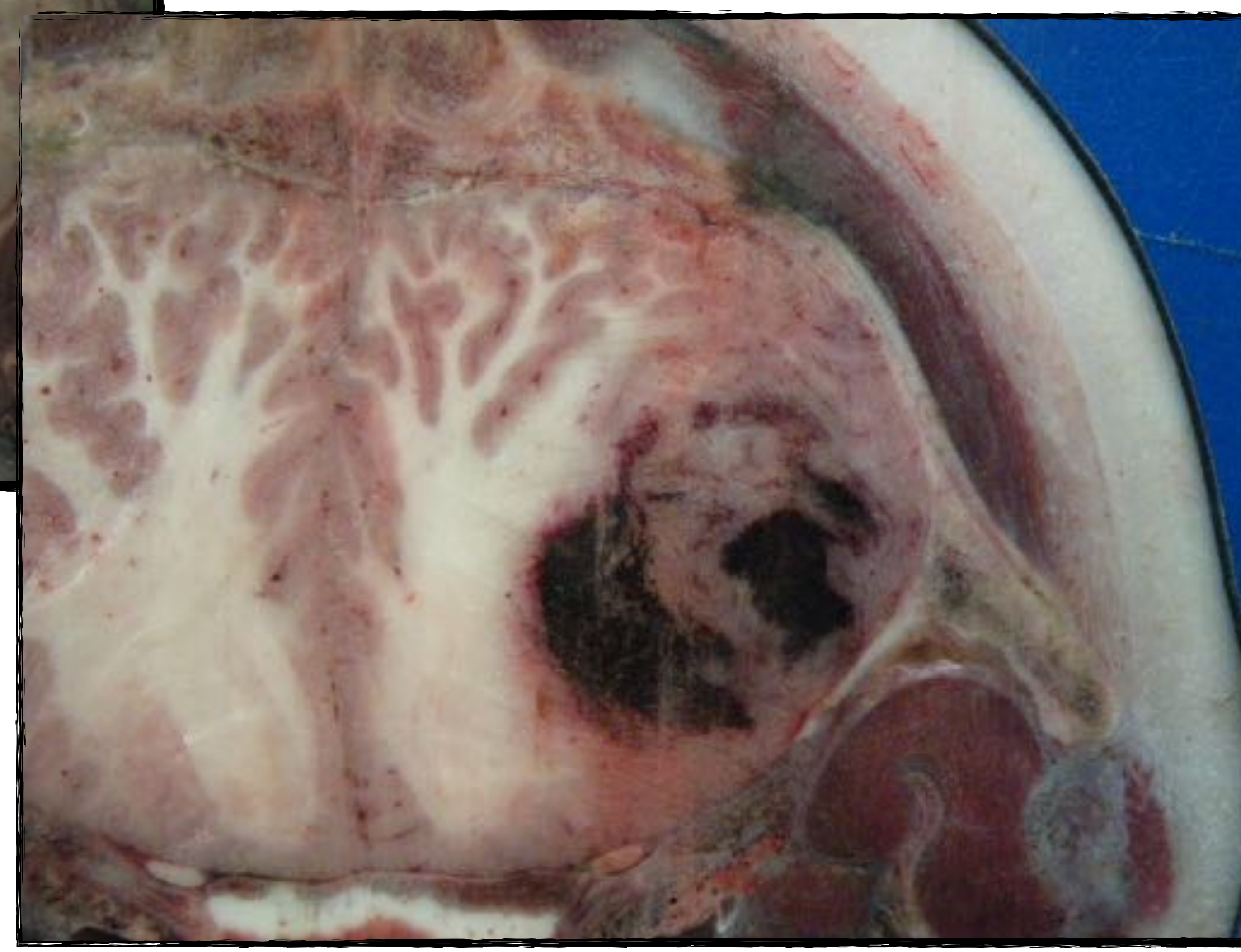


Other spontaneous diseases: newborns - MAS



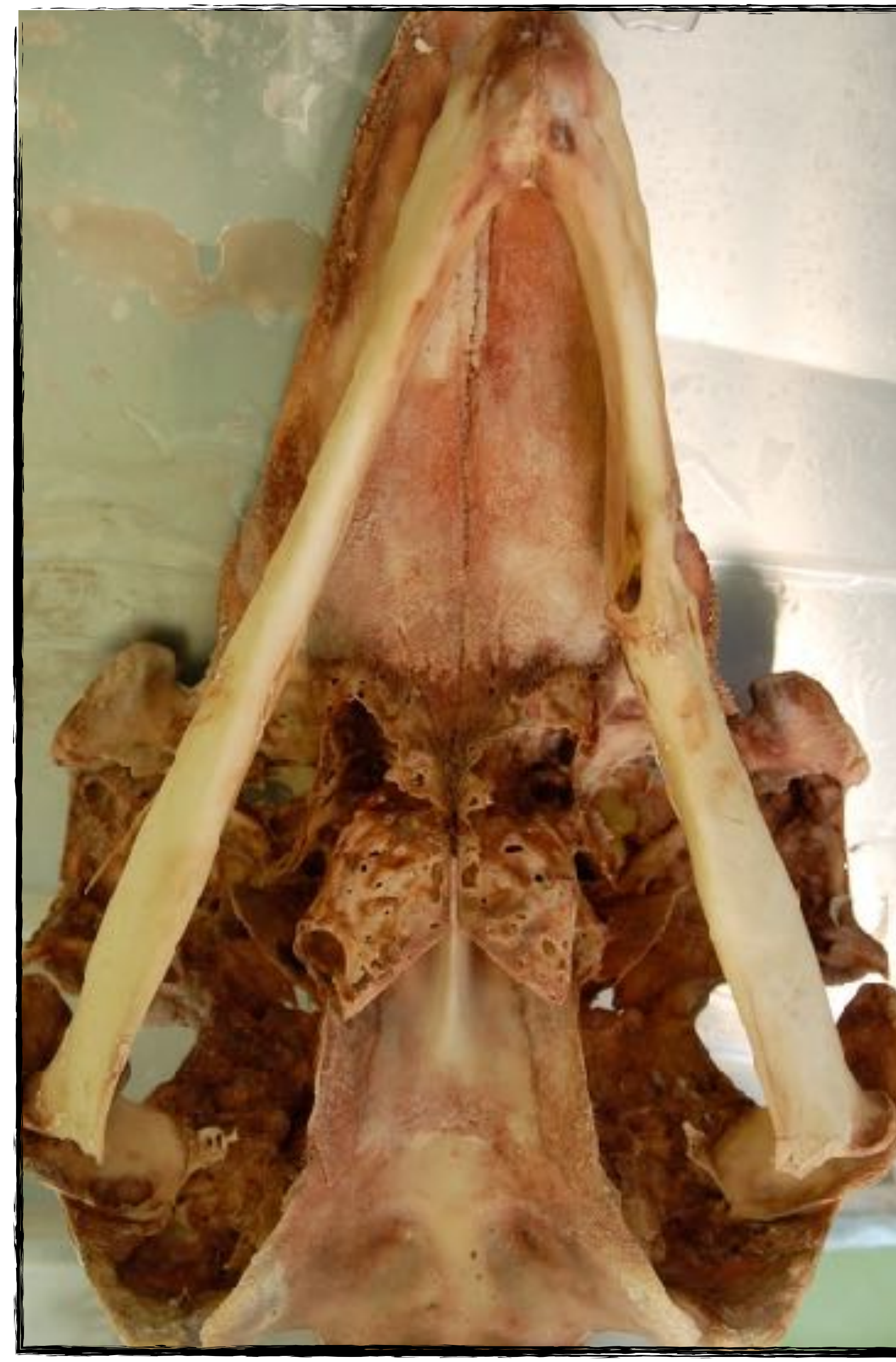
Other spontaneous diseases: newborns - infanticide?



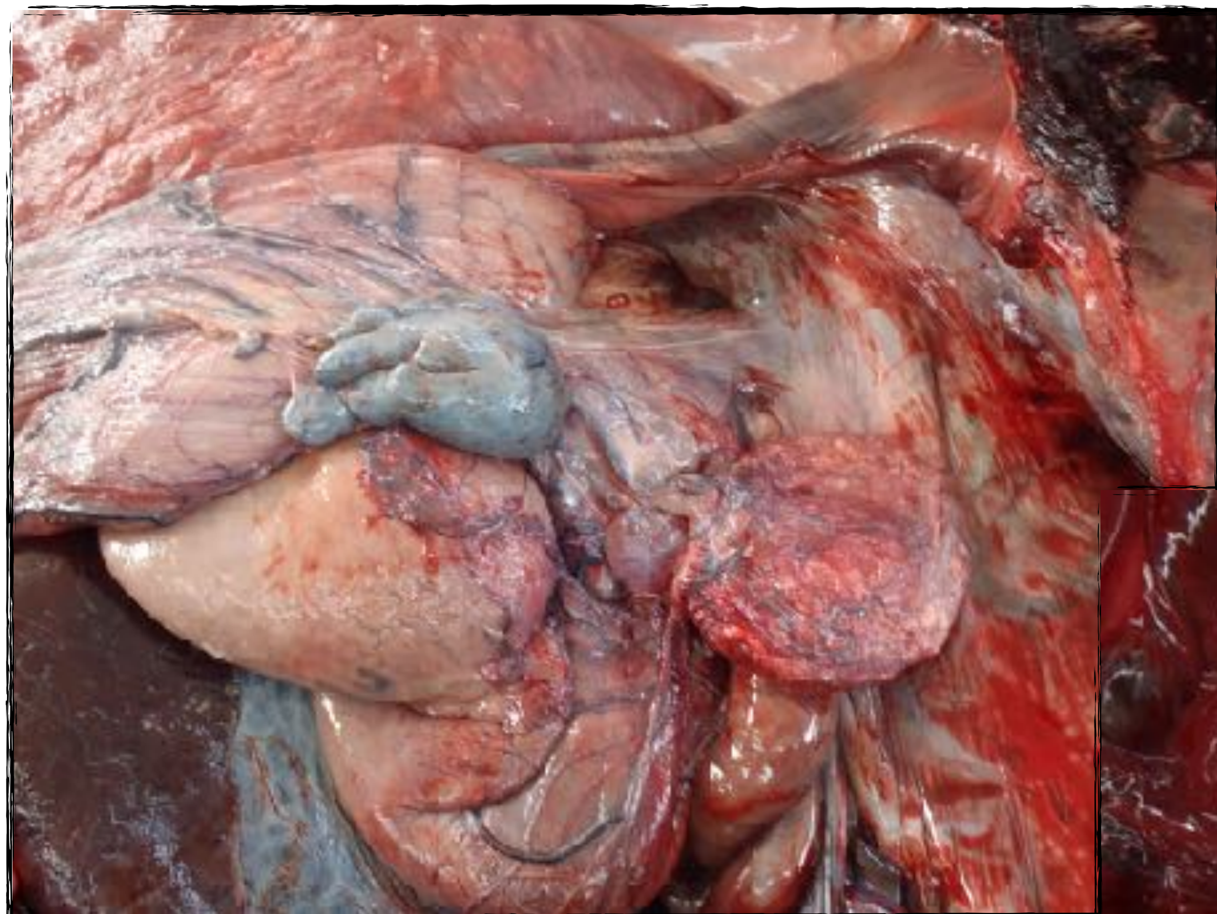
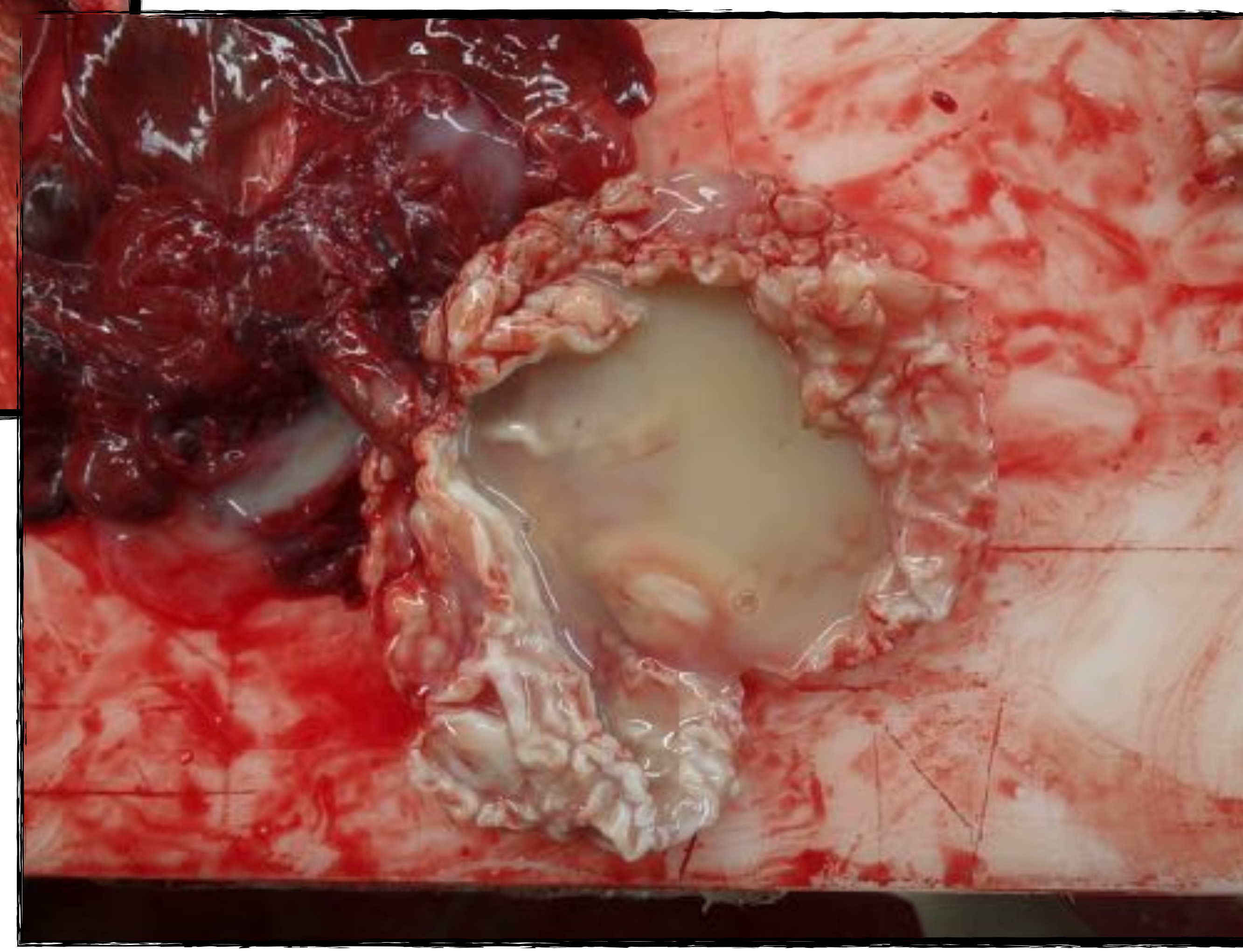


Other spontaneous diseases: newborns - infanticide!

Other spontaneous diseases: intra-specific interaction



Other spontaneous diseases: senescence

Other spontaneous diseases: senescence?

Other spontaneous diseases: senescence!

Pollutants

- Direct and acute intoxication (i.e. oils spills, environmental accidents)

- Bioaccumulation and chronic effects of persistant organic pollutants (POPs): immune system impairment, neoplastic changes, endocrine disruption.

- Organic pollutants and heavy metals

Pollution: oil spills

Toxicity or harmful effects are dependent upon:

- the mixture and types of chemicals that make up the oil or are used to clean up the oil
- the amount of exposure (dose for internal exposures or time for external exposures)
- the route of exposure (inhaled, ingested, absorbed, or external)
- the biomedical risk factors of the animal (age, sex, reproductive stage, and health status)

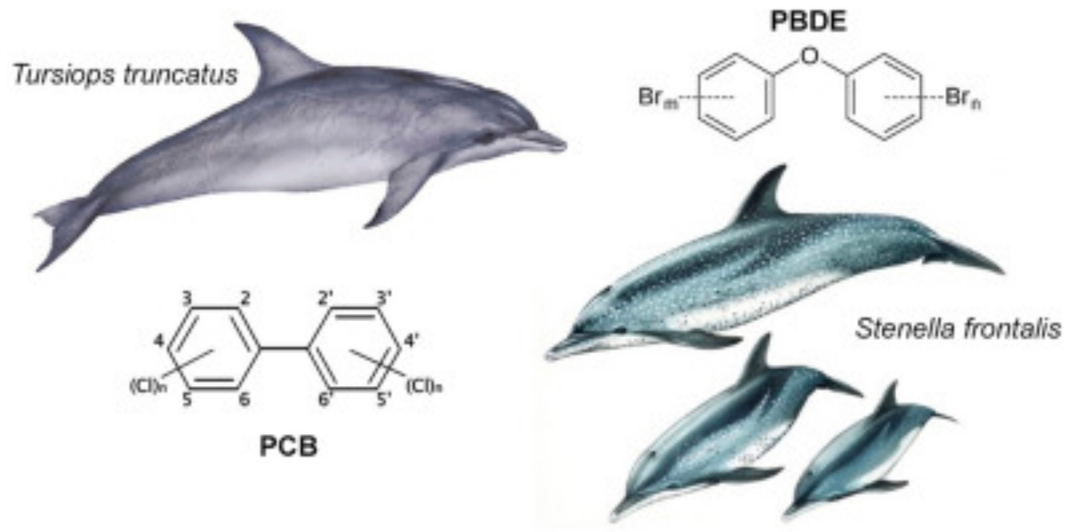
Direct effects:

- External skin and eye irritation, burns to mucous membranes of eyes and mouth, and increased susceptibility to infection. For large whales, oil can foul the baleen they use to filter-feed, thereby potentially decreasing their ability to eat.

- Inhalation of volatile organics from oil or dispersants may result in respiratory irritation, inflammation, emphysema, or pneumonia.

- Ingestion of oil or dispersants may result in gastrointestinal inflammation, ulcers, bleeding, diarrhea, and maldigestion.

- Absorption of inhaled and ingested chemicals may damage organs such as the liver or kidney, result in anemia and immune suppression, or lead to reproductive failure or death.



REPORT

Predicting global killer whale population collapse from PCB pollution

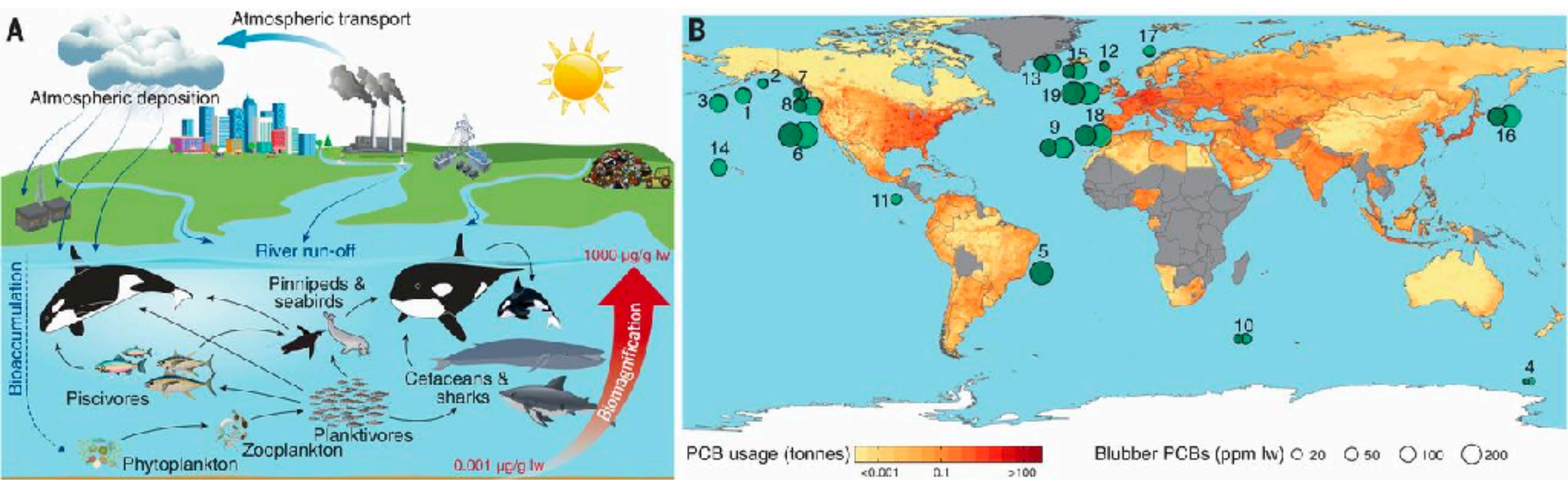
Jean-Pierre Desforges[1,*], Ailsa Hall[2,*], Bernie McConnell[2], Aqqalu Rosing-Asvid[3], Jonathan L. Barber[4], Andrew Brownlow[5], Sylvain De Guise[6,7], Igor Eulaers[1], Paul D. Jepson[8], Robert J. Letcher[9], Milton Levin[6], Peter S. Ross[10], Filipa Samarra[11], Gísli Víkingsson[11], Christian Sonne[1], Rune Dietz[1,*]

[1]Department of Bioscience, Arctic Research Centre, Aarhus University, Frederiksborgvej 399, P.O. Box 358, 4000 Roskilde, Denmark.
[2]Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews, St Andrews, KY16 8LB, UK.
[3]Greenland Institute of Natural Resources, P.O. Box 570, 3900 Nuuk, Greenland.
[4]Centre for Environment, Fisheries and Aquaculture Science, Pakefield Road, Lowestoft NR33 0HT, UK.
[5]Scottish Marine Animal Stranding Scheme, SRUC Veterinary Services Drummondhill, Stratherrick Road, Inverness IV2 4JZ, UK.
[6]Department of Pathobiology and Veterinary Science, University of Connecticut, 61 North Eagleville Road, Storrs, CT 06269-3089, USA.
[7]Connecticut Sea Grant, 1080 Shennecossett Road, Groton, CT 06340-6048, USA.
[8]Institute of Zoology, Zoological Society of London, Regent's Park, London NW1 4RY, UK.
[9]Ecotoxicology and Wildlife Health Division, Environment and Climate Change Canada, National Wildlife Research Centre, Carleton University, Ottawa, Ontario K1A 0H3, Canada.
[10]Ocean Wise Conservation Association, P.O. Box 3232, Vancouver, British Columbia V6B 3X8, Canada.
[11]Marine and Freshwater Research Institute, Skúlagata 4, 101 Reykjavík, Iceland.

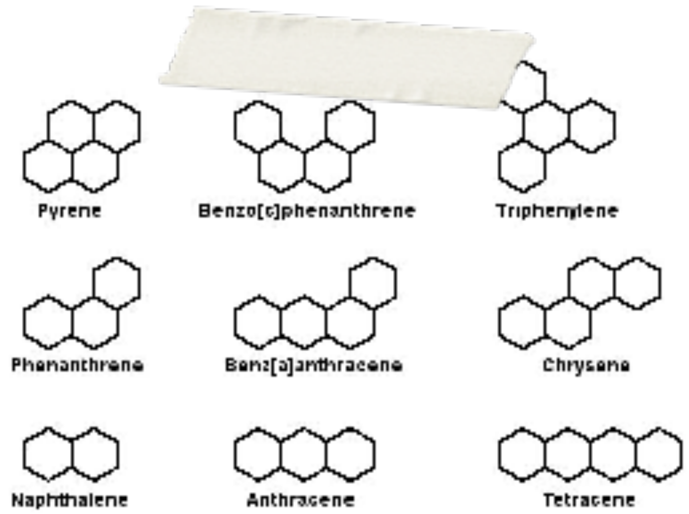
*Corresponding author. Email: jpd@bios.au.dk (J.-P.D.); rdi@bios.au.dk (R.D.); ajh7@st-andrews.ac.uk (A.H.)

- Hide authors and affiliations

Science 28 Sep 2018:
Vol. 361, Issue 6409, pp. 1373-1376
DOI: 10.1126/science.aat1953



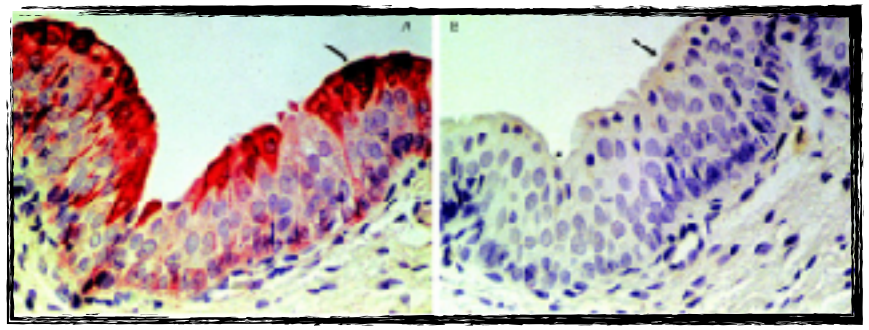
Polycyclic Aromatic Hydrocarbons (PAHs)



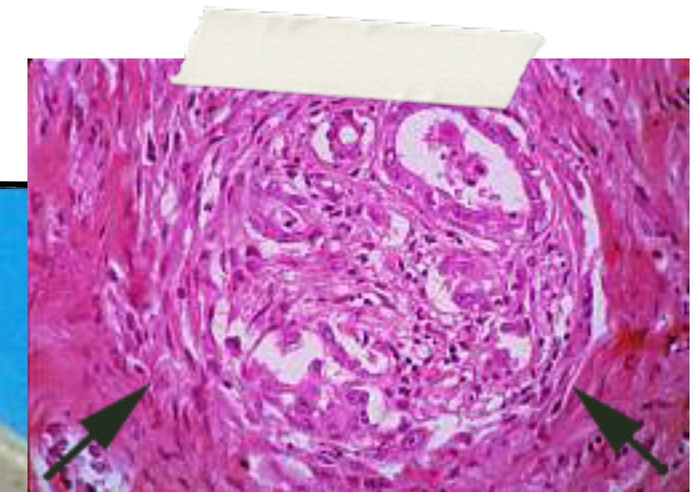
Formed by thermal decomposition and recombination of several molecules in natural and artificial processess

Interference with cellular membrane and enzyme functioning: mutagenic, carcinogenic and immunosuppressants.

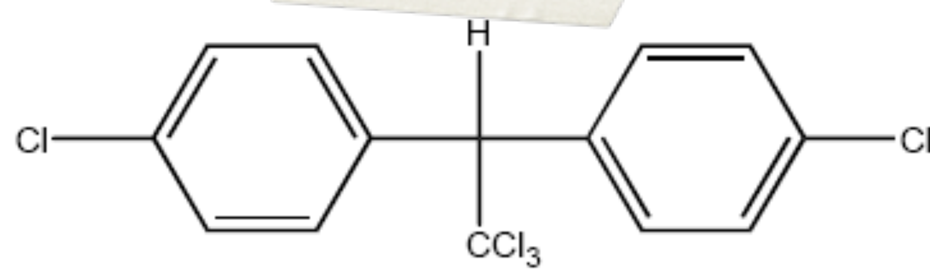
Alterate Cytochrome P450 1A1 expression (CYP1A1)



Polycyclic Aromatic Hydrocarbons (PAHs)



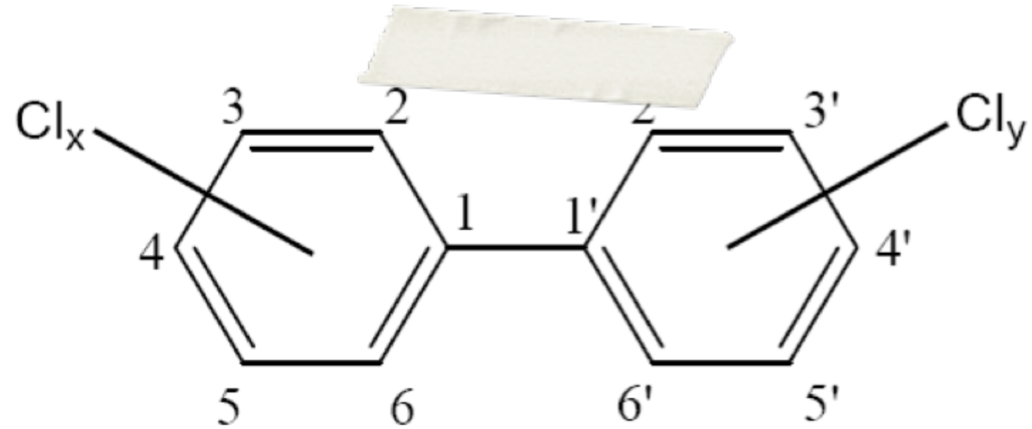
Dichloro Diphenyl Trichloro-ethane (DDT) and metabolites



Insecticide, cheap and easy to produce with low acute toxicity for humans. Used against malaria and typhoid fever. Banned from ‘70s in Europe and USA.

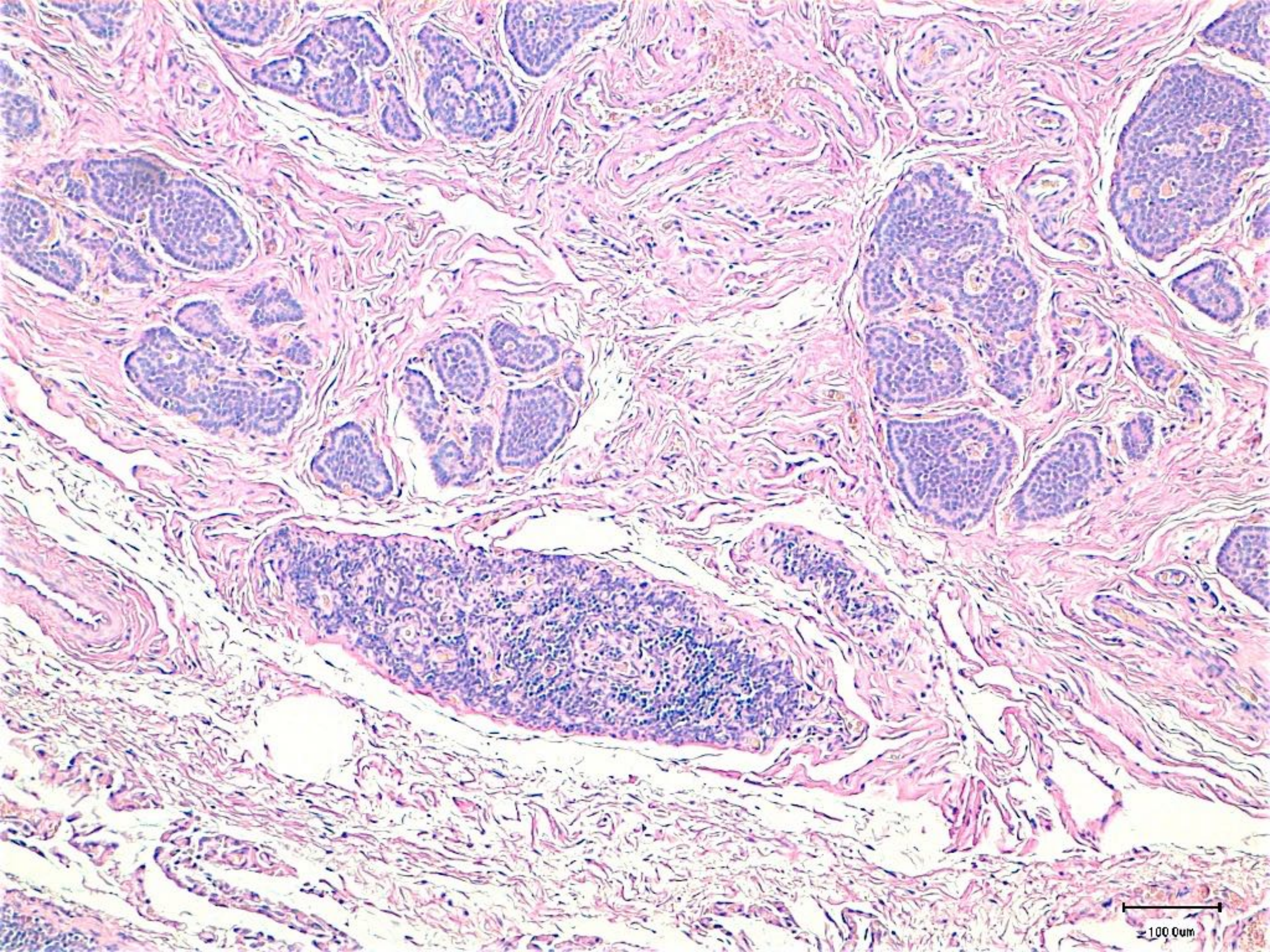
Dose-dependent neurotoxicity. Liver toxicity during chronic exposure. Endocrine disruptor with xeno-estrogenic activity. Immunosuppresant.

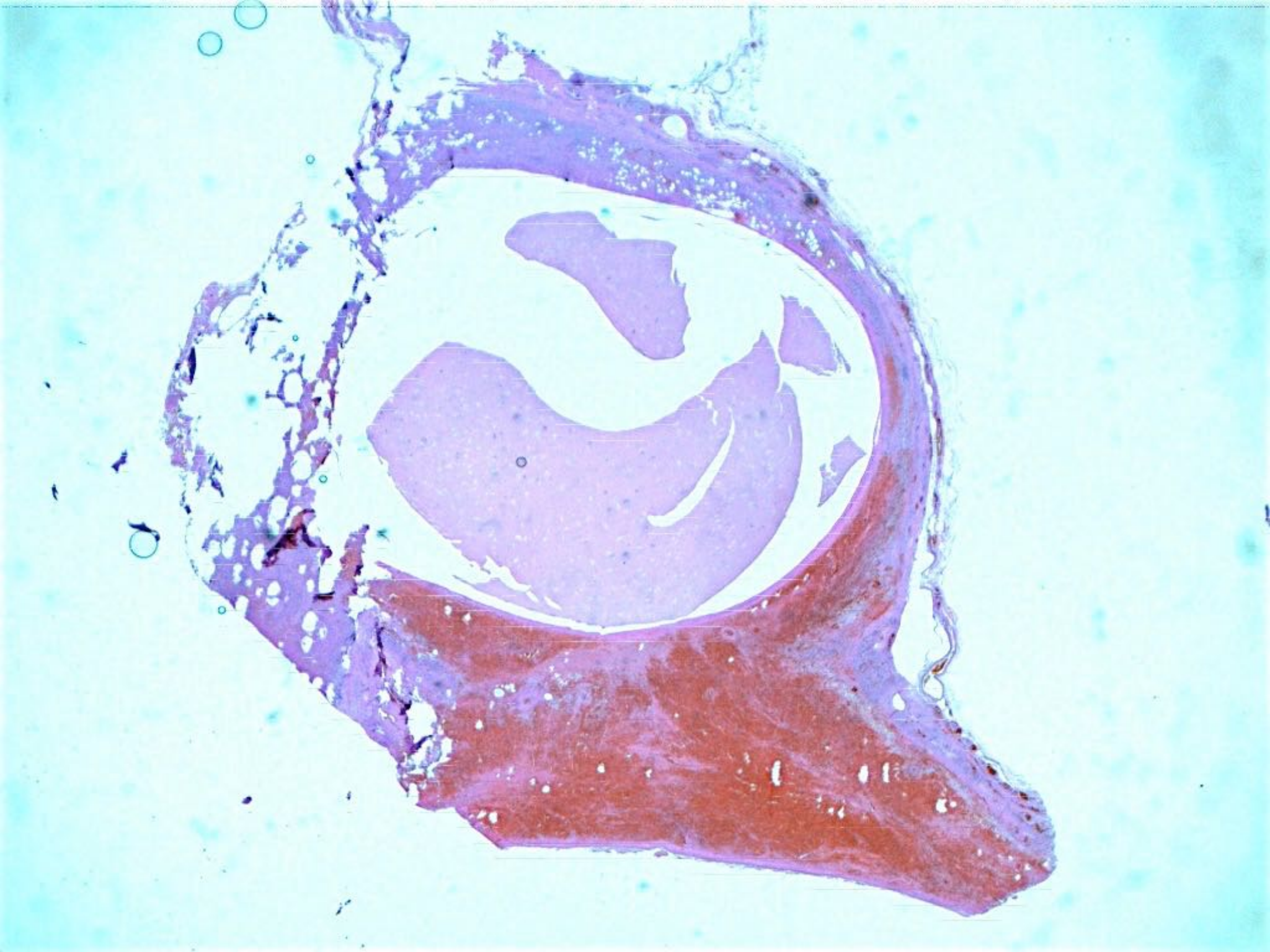
PolyChloroBiphenyles (PCBs)

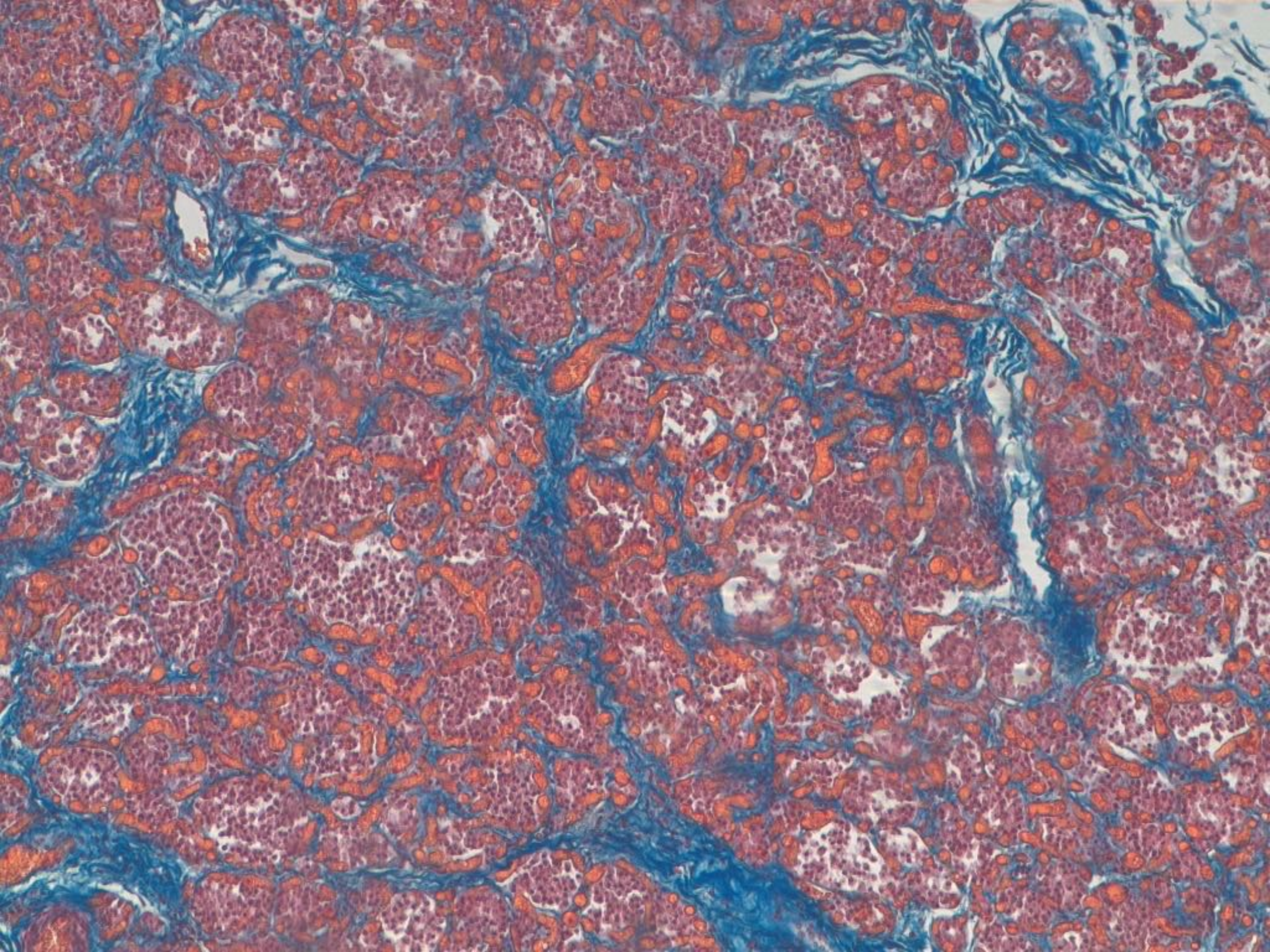


Used during I World War and by industries for toxicity. Produced during fires and burning organic wastes.

Hepatic, ocular, thyroid, immune and CNS effects. Behavioral and growing changes. Carcinogenic effects.


100.0um





POPs as Immunosuppressants

Aguilar and Borrel (1994)

- Studied Morbillivirus epizootic in striped dolphins (*Stenella coeruleoalba)* the Mediterranean Sea from 1990-1992

- Discovered that concentrations of PCBs were significantly higher during a Morbillivirus outbreak

POPs as Immunosuppressants
Aguilar and Borrel (1994)

- Methods:
  - Dolphins were classified as 'infected' or 'healthy'
  - Tissue samples taken
  - PCB concentrations measured
  - Compared infected dolphins to healthy dolphins

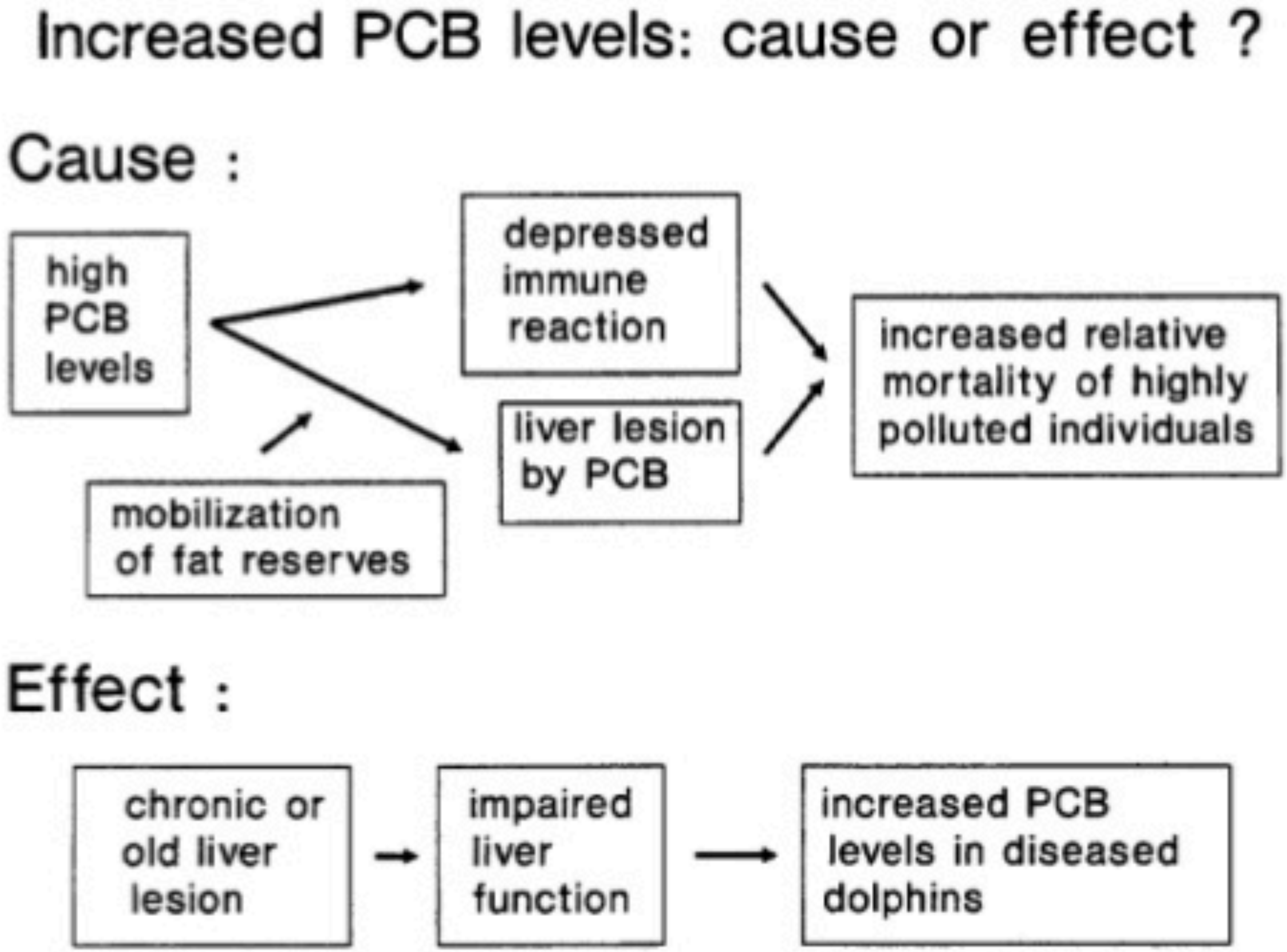


Fig. 5. Hypothetical mechanisms to explain the observed relationship between abnormally high PCB blubber concentrations in striped dolphins affected by the epizootic and their susceptibility to the disease (for explanation, see the text).

Aguilar and Borrel 1994

Heavy metals

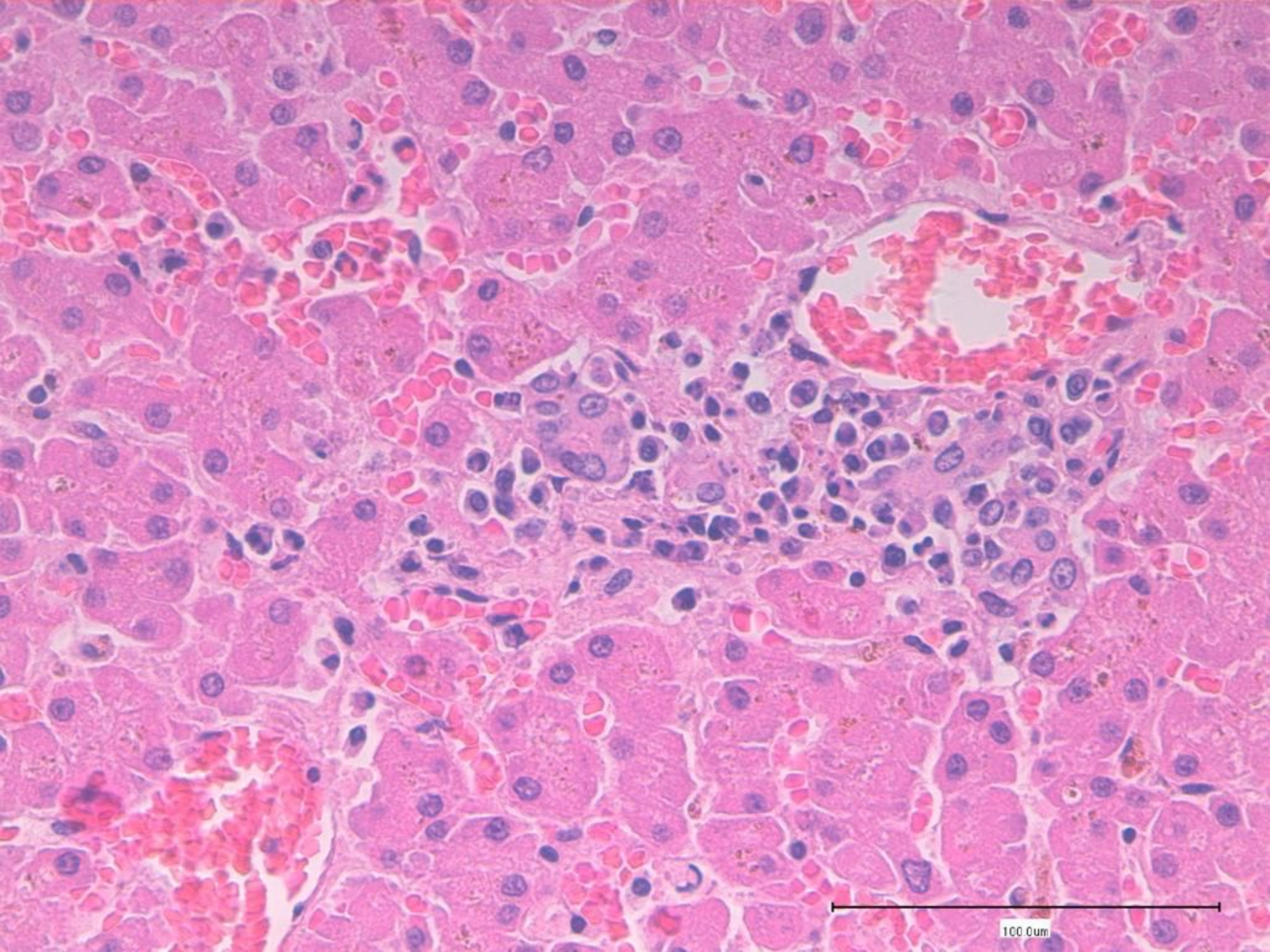
- Cetaceans detoxify MeHg by creating inorganic Hg (HgSe)

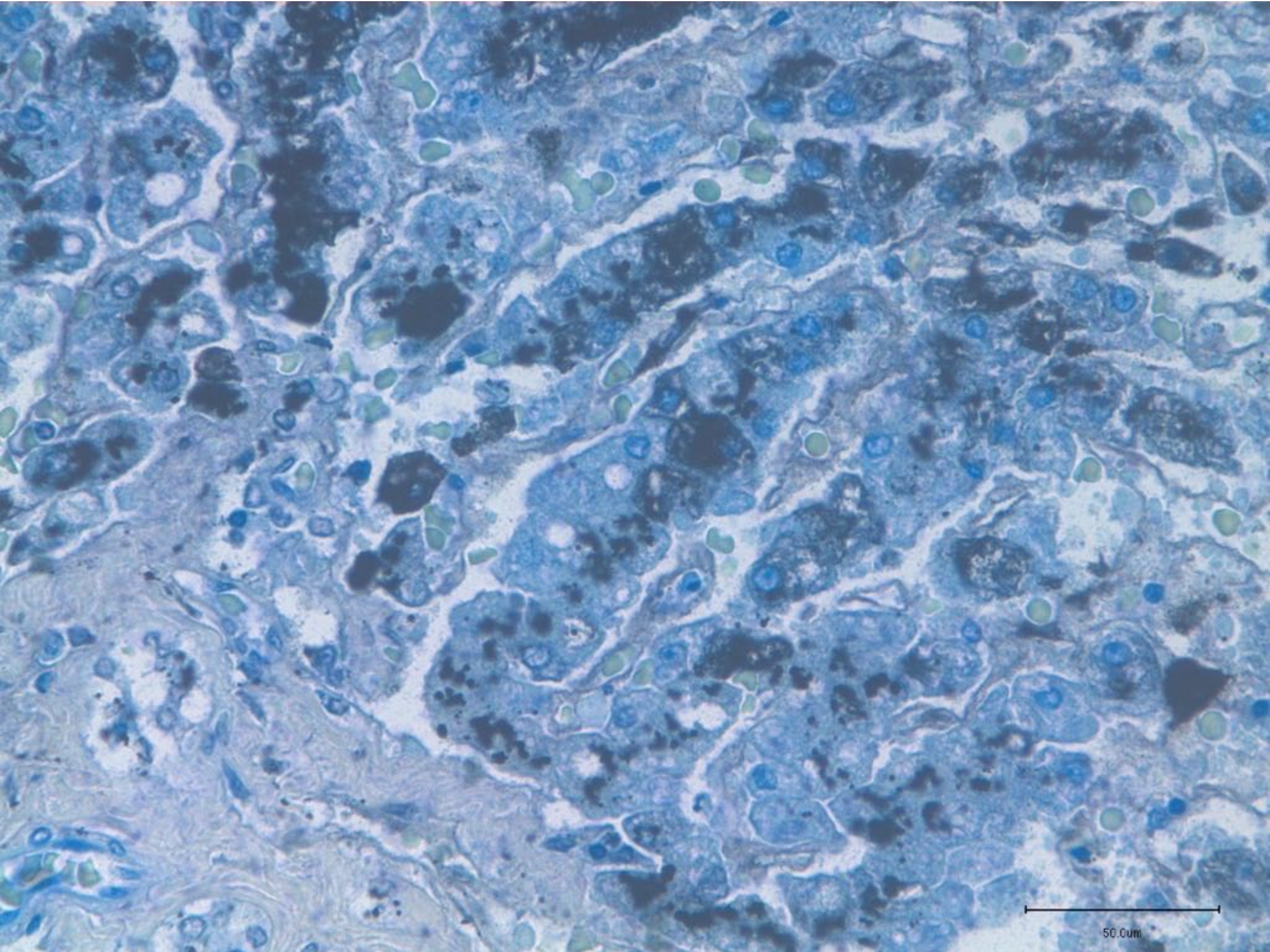
- TotHg in cetaceans is very high, in particular in the Mediterranea Sea

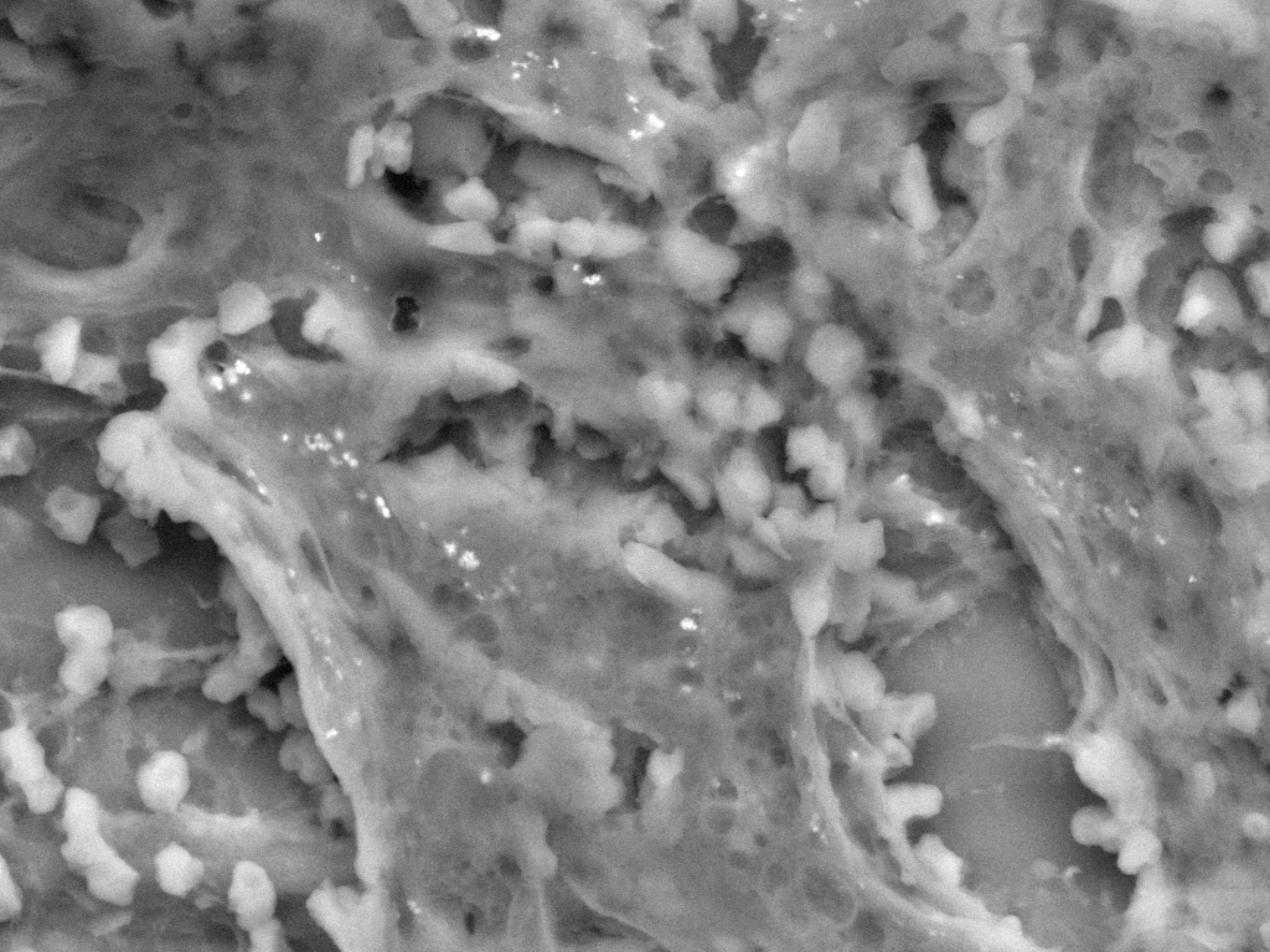
- In evaluation mercury levels, compare hepatic, muscular and renal Hg and Se concentrations (1:1) and consider MeHg in all organs.

- MeHg has neurotoxic and nephrotoxic effects. Inorganic Hg affects immune response.

- Starvation determines Hg circulation (macrophages) and reduces excretion.


100.0um


50.0um



Fresh waters skin disease

Received: 12 February 2020 | Accepted: 21 April 2020
DOI: 10.1111/gcb.15163

PRIMARY RESEARCH ARTICLE

Global Change Biology WILEY

Unchartered waters: Climate change likely to intensify infectious disease outbreaks causing mass mortality events in marine mammals

Claire E. Sanderson[1,2] | Kathleen A. Alexander[1,2]

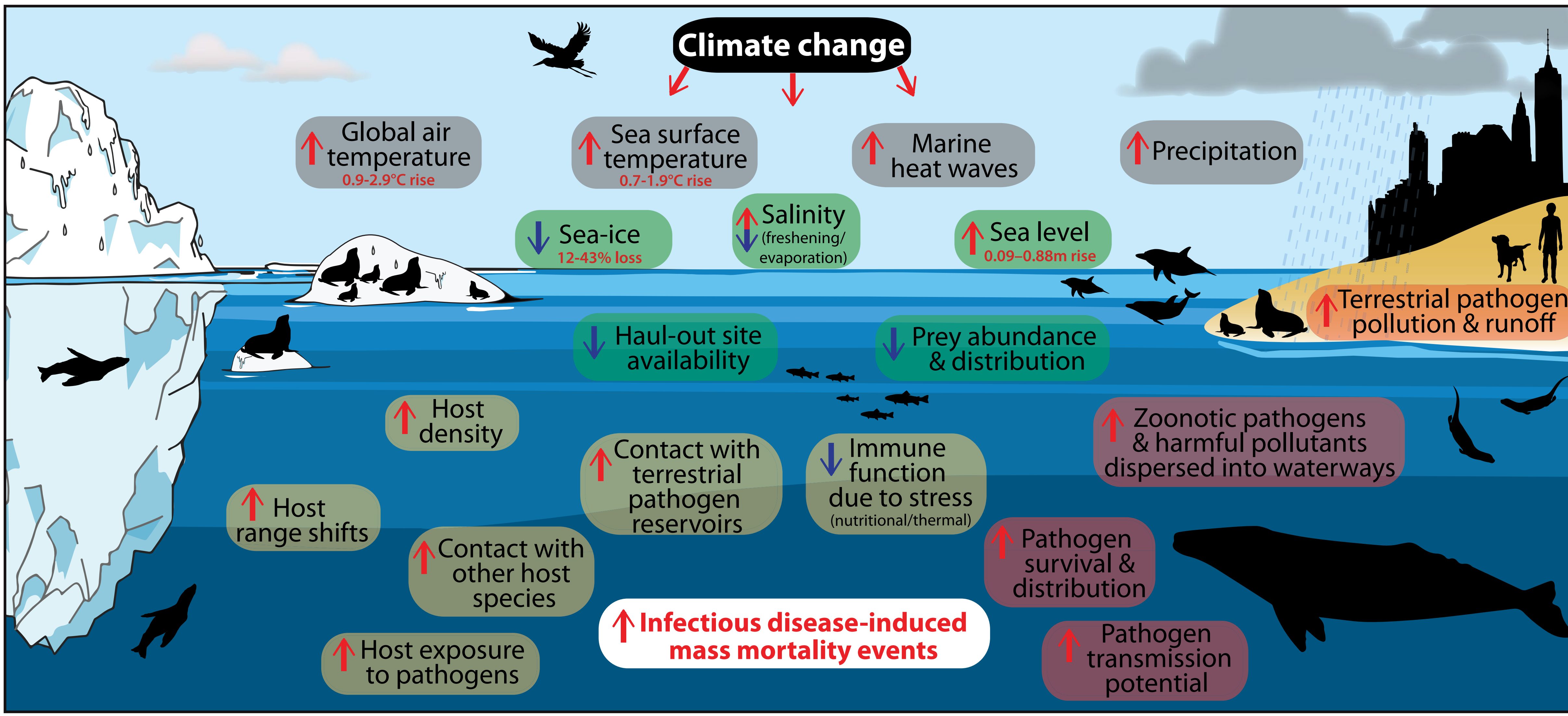


FIGURE 6 Proposed mechanisms for increased infectious disease epizootics causing mass mortality events (ID MMEs) in marine mammals due to climate change. Climate drivers (grey) have the potential to create cascading effects on the host (yellow), pathogen (red) and environment (green), resulting in increased ID MMEs in marine mammal species. Red text provides estimated range impacts on specified climate-impacted variables, as projected to occur by 2070 in relation to the mean levels observed from 1986–2005 (Rintoul et al., 2018).

THANK YOU FOR YOUR ATTENTION!

Prof. Sandro Mazzariol, DVM, PhD
Department of Comparative Biomedicine and Food Science (BCA) - University of Padova
Cetaceans strandings Emergency Response Team (CERT)
Centro Interuniversitario per la Ricerca sui CEtacei (CIRCE)
International Whaling Commission Strandings Expert Panel Chair

AGRIPOLIS - Ed. Museo
Viale dell'Università 16
35020 - Legnaro (PD)

e-mail: sandro.mazzariol@unipd.it
skype: smazzariol