

Increased Incidence of Entanglements and Ingested Marine Debris in Dutch Seals from 2010 to 2020

Anna Salazar-Casals ^{1,*}, Koen de Reus ^{2,3}, Nils Greskewitz ¹, Jarco Havermans ⁴, Machteld Geut ⁵, Stella Villanueva ¹ and Ana Rubio-Garcia ¹

¹ Sealcentre Pieterburen, 9968AG Pieterburen, The Netherlands; nils.greskewitz@zeehondencentrum.nl (N.G.); stella.villanueva@zeehondencentrum.nl (S.V.); ana.rubiogarcia@zeehondencentrum.nl (A.R.-G.)

² Comparative Bioacoustics Group, Max Planck Institute for Psycholinguistics, 6525XD Nijmegen, The Netherlands; koen.dereus@mpi.nl

³ Artificial Intelligence Lab, Vrije Universiteit Brussel, 1050 Ixelles, Belgium

⁴ Ecomare, 1796AZ De Koog, The Netherlands; jarcohavermans@ecomare.nl

⁵ Stichting A Seal Centrum voor Zeezoogdierenzorg, 3251LD Stellendam, The Netherlands; diere-narts@aseal.nl

* Correspondence: anna.salazarcasals@zeehondencentrum.nl

Juvenile Gray Seal Case Report

In 2019, Sealcentre Pieterburen (SCP) received a report concerning a juvenile gray seal entangled in a fishing net. The animal was first spotted on the island of Ameland but, at that time, it was not possible to catch the animal because it entered the water when caretakers approached. One week later, the same animal was reported on the island of Schiermonnikoog and, this time, caretakers managed to catch it. An initial assessment of the wounds caused by the fishing net indicated that the animal had suffered serious injuries and was in need of immediate help. The condition of the animal had clearly decreased from one week to the next, suggesting that its foraging capacity was impaired by the effect of the entanglement. Transport to SCP was then arranged, and the seal was brought to rehabilitation. At admission, veterinarians removed the fishing net and examined the wounds in further detail. The animal presented a deep, concerning wound on the right front flipper due to severe constriction of the net, and also presented superficial wounds on the neck and back. It became apparent that the movement of the affected flipper was very limited and would have made swimming and diving more difficult. Radiographs of the front flipper were immediately taken and sent to expert radiologists to assess the integrity of the bones and joints. The radiologists reported a full luxation of the elbow joint and possible subluxation of the carpal joint with severe tissue injury, possibly reaching the bone. High-quality radiographies should be performed when luxation of a joint is suspected. However, this requires the manipulation and proper positioning of the damaged limb which may be painful for the animal; hence, further investigation should be performed under sedation or general anesthesia [55]. The gray seal was thus put under general anesthesia with the intention of conducting bilateral front flipper radiographies and properly assessing the extent of the damage. Exploration of the affected carpal joint revealed exposition of carpal bones on the dorsal side, with multiple ligaments severed, and some muscles damaged; and on the ventral side of the joint, the intracapsular space was almost reachable, with several damaged tendons. Further treatment was deemed not possible by the veterinarians; thus, it was decided to euthanize the animal without performing the radiographies.

Yearly Numbers of Entanglements

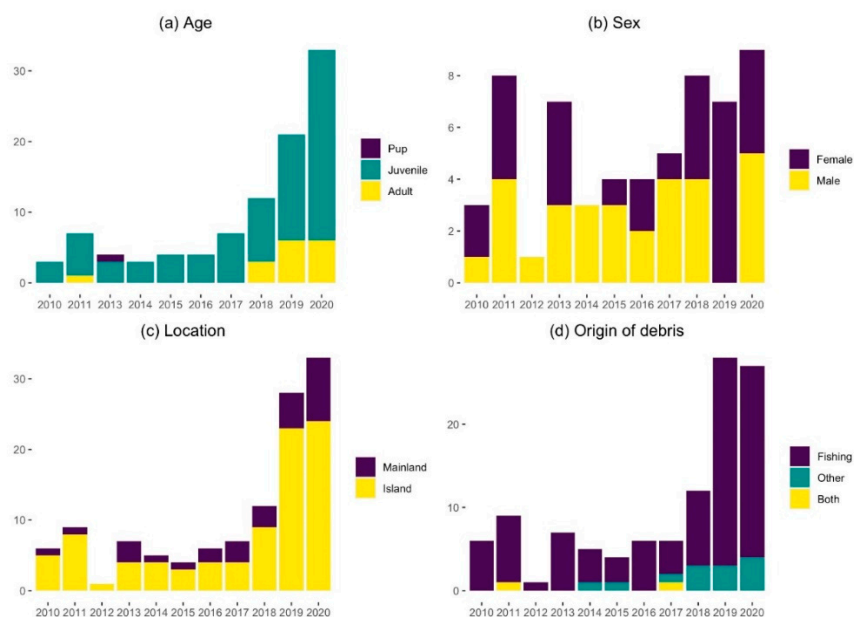


Figure S1. Yearly numbers of reported entanglements and/or debris ingestion in gray seals grouped by (a) age, (b) sex, (c) stranding location, and (d) origin of the entangling debris.

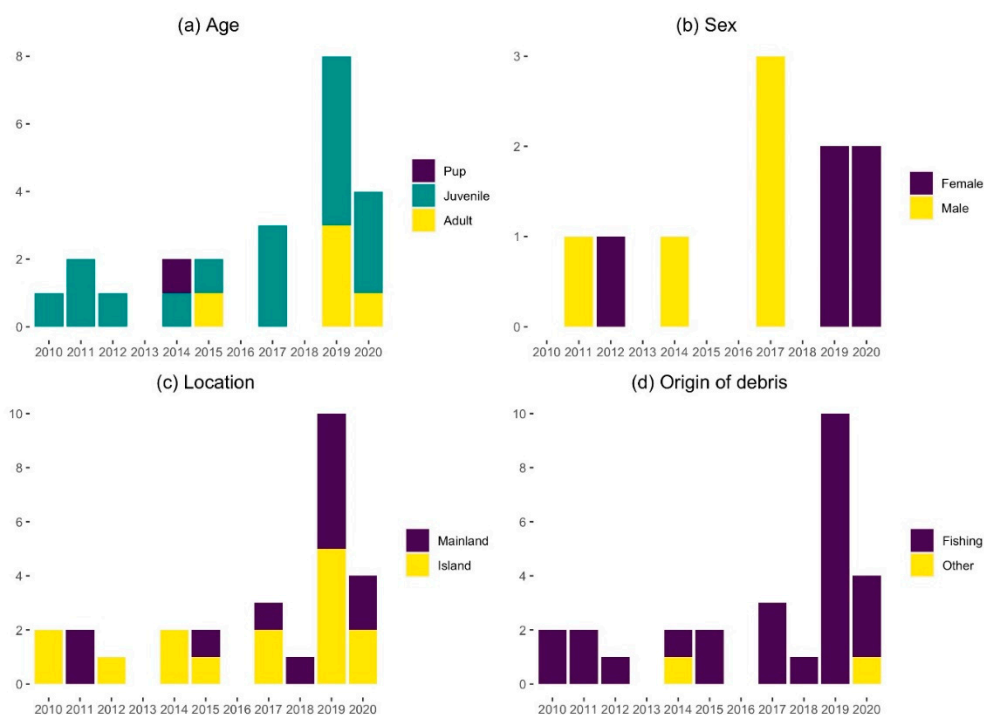


Figure S2. Yearly numbers of reported entanglements and/or debris ingestion in harbor seals grouped by (a) age, (b) sex, (c) stranding location, and (d) origin of the entangling debris.

Form for Collecting Entanglement Data

We have developed a form to help Dutch stranding networks collect standardized data when faced with an animal affected by marine debris. Collecting standardized data will facilitate future data analysis.

Table S1. Form for Collecting Entanglement Data.

Category	Specifics	Comments
General	Date (dd/mm/yyyy)	___/___/___
	Location (use WGS84 coordinates)	Latitude: _____ Longitude: _____
	Found by	<ul style="list-style-type: none"> Stranding network
		Name: _____
		<ul style="list-style-type: none"> Member of the public
Animal	Reported to	Name: _____
		Phone number: _____
		<ul style="list-style-type: none"> A Seal Ecomare Sealcentre Pieterburen
	Species	<ul style="list-style-type: none"> Gray seal Harbor seal Other: _____
	Age	<ul style="list-style-type: none"> Pup (< 1 month old) Weaner (1–12 months old) Yearling (1–2 years old) Sub-adult (2–3 years old) Adult (> 3 years old) Unknown
Entanglement	Sex	<ul style="list-style-type: none"> Male Female Unknown
	Status of the animal	<ul style="list-style-type: none"> Dead Alive
	Action taken	<ul style="list-style-type: none"> No action Released on site Brought to rehabilitation center
	Type	<ul style="list-style-type: none"> External Ingested
	Body location	<ul style="list-style-type: none"> Neck Head Flippers (front or hind) Whole body Ingested Unknown
	Type of material	Fishing/boating origin

	<ul style="list-style-type: none"> • Fishing net
	Type (if known): _____
	<ul style="list-style-type: none"> • Rope • Fishing line • Fishing hooks • Other: _____
	Materials of other origins
	<ul style="list-style-type: none"> • Clothing • Industrial materials • Household materials • Other: _____
Severity	<ul style="list-style-type: none"> • Serious • Non-serious • Unknown

Table S2. Classification of entanglement lesions based on observed injuries.

Severity of entanglement	Description
Serious	Infected, deep, extensive wounds Trailing gear (could anchor, drag, or wrap the animal) Hook in mouth (could be ingested) Ingestion of gear Confirmed death due to entanglement
Non-serious	Superficial, fresh, non-infected wounds Hook in lip, flipper, or other external body part
Unknown	Presence of wounds unknown (e.g., animal too far away) Animal too decomposed to assess severity of wounds

Note. This table is inspired from the classification made by Forney and colleagues [53].