

Harbour seals (*Phoca vitulina*) in Dutch inland waters: an overview of reported sightings and some first data on diet

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Abstract: In the Netherlands, harbour seals (*Phoca vitulina*) inhabit all marine waters, including estuaries and the lower tidal parts of rivers. However, by damming most of the inland waters, these inland habitats became less accessible. Yet seals still venture inland, negotiating a range of man-made barriers. The seals move through devices that discharge water into the sea, or use shipping locks to reach inland waters. Today, considerable numbers of seals are found in two relatively open barred estuaries in the southwest of the country, i.e. Lake Grevelingen and the Eastern Scheldt. Smaller numbers are found in the more closed freshwater bodies Lake IJssel and Lauwersmeer in the north of the country and only few seals have been sighted at any one time in these lakes. Other individuals have swam up-river through the brackish ports of Rotterdam and beyond. Little is known on the feeding habits of these inland seals, despite the large numbers of animals involved. An overview of reported sightings of inland harbour seals has been compiled. Furthermore, for the first time the diet of a harbour seal, found dead in Lake IJssel, was studied. Prey species and sizes found in its stomach are described. A river lamprey (*Lampetra fluviatilis*) and 28 European flounders (*Platichthys flesus*) had constituted its last meal, while 12 European smelts (*Osmerus eperlanus*) had been taken shortly before that. All three prey species can be found in fresh, brackish and marine waters, but had in all likelihood been consumed in the freshwater Lake IJssel.

Keywords: harbour seal, *Phoca vitulina*, estuary, river, freshwater, stomach contents, diet.

Introduction

In the Netherlands, harbour seals (*Phoca vitulina*) live in the Wadden Sea, the North Sea and the Dutch Delta area (Brasseur & Reijnders 1995, Leopold et al. 1997, TSEG 2011, Brasseur et al. 2012, Strucker et al. 2012). As their name suggests, they were also commonly seen in sea ports and estuaries (Havinga 1933). In

fact, they can swim up-river for tens or even several hundreds of kilometres (Slooten 1941, De Smet 1978, Natuurlijk Alblasserwaard en Vijfheerenland 2012). With the damming of the major estuaries (Lauwerszee, Zuiderzee and Delta from north to south) this became less evident. Even so, any opening in waterway barriers might still be negotiated by “adventurous” seals.

Only two Dutch estuaries are still completely open (Eems and Western Scheldt), all others are barred in one way or another.

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Harbour seals resting on an intertidal sand flat in the central parts of Eastern Scheldt, east of the Zeelandbrug (background), 9 September 2012. Photo: Sabine Bos, WWF-Netherlands.

Barriers vary from nearly open (submerged storm barrier: Nieuwe Waterweg), to semi-open (storm surge barrier, only fully closed during extreme weather: Eastern Scheldt), semi-closed (water discharging sluices: Lauwersmeer, Lake IJssel, Haringvliet, Lake Grevelingen) and nearly closed (smaller dischargers and shipping locks: Delfzijl, Harlingen, IJmuiden, Katwijk, Vlissingen, Lake Veere, Terneuzen and many smaller sluices in the Wadden Sea, the Delta waters and further inland). All barriers, even solid dams (Zeehondencrèche Lenie 't Hart 2011), are at times crossed by seals as evidenced by sightings landward of these man-made obstacles. Such sightings are often reported to internet fora, but an overview of inland records is lacking.

Seals venturing into inland waters may encounter familiar prey species, such as European eel (*Anguilla anguilla*; Gazet van Antwerpen 2012) or European flounder (*Platichthys flesus*; Wsvdekreupel 2010). Further inland they must cope with a different prey base. There are several internet reports and photographs of freshwater fishes taken by seals, such as cyprinids (Biondina 2006), and some spectacularly large pike (*Esox lucius*; Klinkien & Klinkien 2011) and pikeperch (*Sander lucioperca*; Anonymous 2012). How-

ever, such records based on direct observations are likely to give a biased view of the seals' diet as spectacular cases, involving large or powerful fish, are probably over-represented, while smaller fish that are consumed under water go unnoticed.

There is little quantitative information on the prey choice of seals in Dutch fresh waters. A first attempt to find freshwater prey in the stomach of a seal found dead at Lake IJssel failed. The stomach was full of marine prey, showing that this seal had died at sea and was dumped inland (Leopold 2011).

In this paper an overview is presented of inland records of harbour seals in the Netherlands, and furthermore the stomach contents of a harbour seal that had died in Lake IJssel are described.

Methods

Inland records

An overview of reported inland harbour seal sightings in the Netherlands (1960-2012) was compiled, extracting data from <http://waarne-ming.nl>, <http://www.zeezoogdieren.org>, <http://www.lauwersmeer.com>, the personal database

of J. van der Hiele (EHBZ ZuidWest,- Eerste Hulp Bij Zeezoogdieren in the southwest of the Netherlands, i.e. the field team of the Netherlands Seal Rehabilitation and Research Centre Pieterburen that covers the Dutch Delta region) and additional records found online. Reports of harbour seals found dead in inland waters were included. Observation date, geographical coordinates, number of animals, observer and possible details were collected. Storm barriers, sluices and dams of the different sea arms and rivers were used as boundary for inland observations. All records from large waters that have open access to the North Sea (Wadden Sea, Eems-Dollard and Western Scheldt) were excluded, as were records from seaports, unless animals had passed through shipping locks. Finally, seals that had reportedly escaped from human care were also omitted as these evidently had not reached inland waters unaided. While collecting the data for this paper, similar inland harbour seal sightings in neighbouring countries were noted (see e.g. <http://www.mumm.ac.be/EN/Management/Nature/strandings.php>) but as this contribution describes the situation in the Netherlands, such records were not further pursued.

Stomach contents

On 16 November 2011, a dead harbour seal was found floating in the southern harbour of Den Oever, in the northwestern part of Lake IJssel. The animal was pulled out of the water by a small crane, taking care not to damage the carcass, and preserved frozen. The animal's sex, age class, weight and length were determined and a full necropsy was carried out at the Veterinary Department of Utrecht University to establish the cause of death (Roozen 2012). The complete stomach was taken out, refrozen and sent to IMARES for analysis. After thawing, all more or less intact fish were taken out, identified and measured directly if possible. If fish length could not be determined immediately,

the skulls with the sagittal otoliths were collected. The otoliths were taken out and their length and width were measured to the nearest 0.01 mm. Fish length and mass were then estimated from these measurements (Leopold et al. 2001). The remaining semi-digested food mass was rinsed out of the stomach into a glass jar, which was put underneath a gently running hot water tap to wash away all the flesh, fat and fluids. The hard parts that were left were dried and all otoliths and diagnostic bones (i.e. dentaries, maxillae, premaxillae, cleithra, urohials, urostyles and posttemporals; Mehner 1990, Watt et al. 1997) were collected, identified to species and counted. The otoliths were ranked by species and size. Pairs of left and right otoliths were sorted together. All otoliths were measured and corrected for wear according to Leopold & Winter (1997) and the size, mass, and energy content of every fish were subsequently estimated. Small bivalves and gastropods, presumably secondary prey, were also collected and identified.

Results

Inland records

In figure 1 all retrieved locations of live sightings of harbour seals that crossed a man-made barrier to get into inland waters, are depicted (1,637 sightings, of both single animals and groups of various sizes, involving in total 10,172 animals, including possible resightings of individuals in space and time). No weight was given to the number of seals per sighting and no correction for possible differences in reporting rates between locations was applied. A particular seal might have been reported more than once, however multiple observations at the same location overlap on the map and therefore will not show. The sightings data could not be corrected for effort and apparent distribution patterns might thus be influenced by the accessibilities of the various water bodies and local differences in willingness to

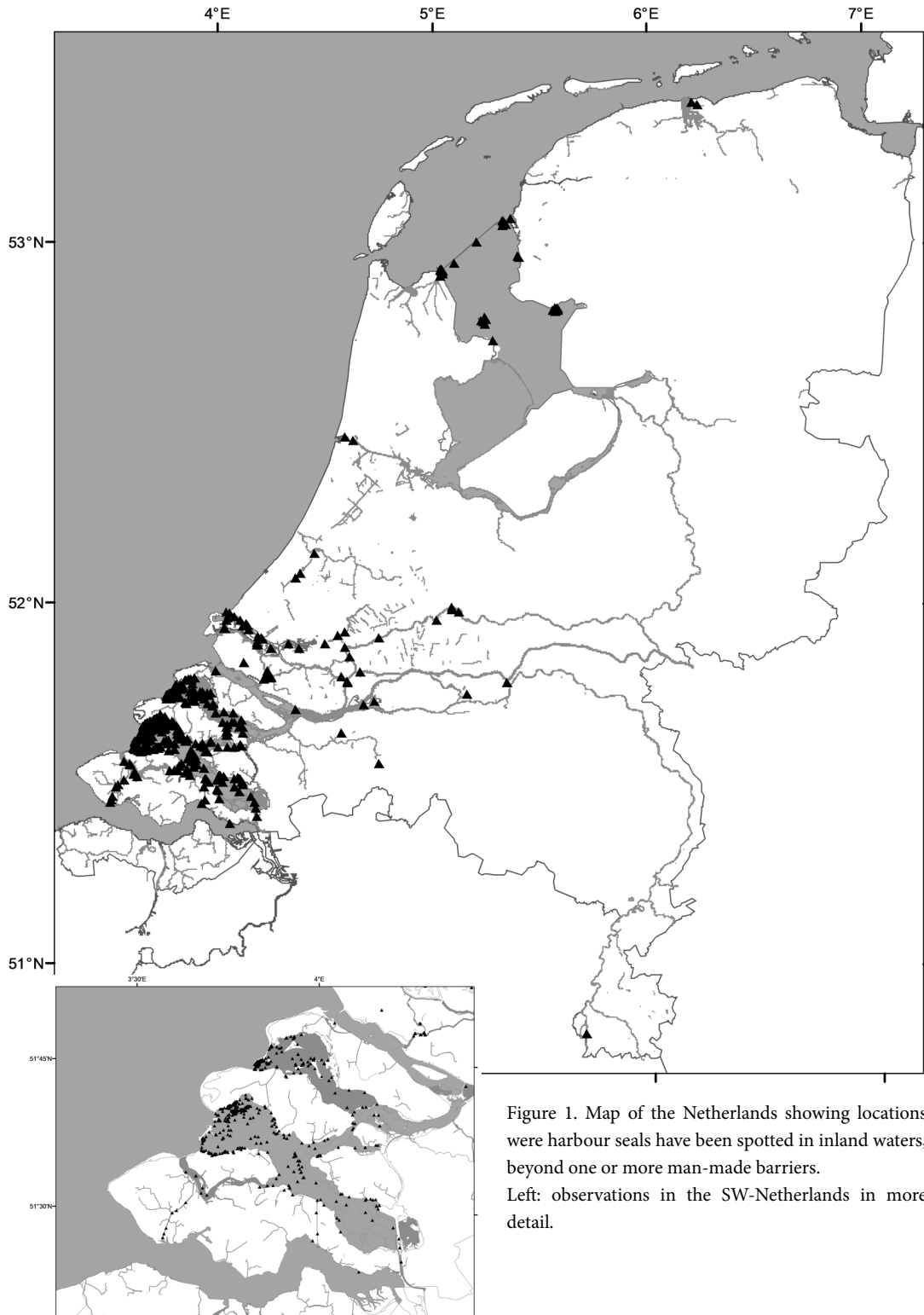


Figure 1. Map of the Netherlands showing locations where harbour seals have been spotted in inland waters, beyond one or more man-made barriers. Left: observations in the SW-Netherlands in more detail.

report sightings. Moreover, seals swimming in very large water bodies such as Lake IJssel may have been less likely to get reported.

It is immediately clear that seals were reported from all over the semi-open Eastern Scheldt and the semi-closed Lake Grevelingen. A few seals had negotiated sluices at Vlissingen (Western Scheldt) and were spotted in the channel through Walcheren and Lake Veere. Likewise, seals had swum through sluices in Hellevoetsluis (Kanaal door Voorne), Katwijk (Leidschendam), IJmuiden (Noordzeekanaal) and Lauwersoog (Lauwersmeer). Several harbour seals had been found in Lake IJssel. Probably most intriguing are the sightings of seals that had swum up the large rivers and tributaries in the southwest of the country, in exceptional cases all the way to Vianen (filmed eating (Klinkien & Klinkien 2011)), Breda (Stadsarchief Breda), Heerwaarden (Brabants Dagblad, 2 November 2012) and even Maastricht (www.waarneming.nl, Limburgs Vogelnet). One seal had managed to get through a sluice which only opens a couple of hours a month, into a freshwater fishing pond near Bath (Biondina 2006). No sightings have been reported from fully enclosed water bodies such as Lake Oostvoorne. A total of 122 dead harbour seals have been reported from inland waters: 5 from Lake IJssel and 117 from the southwest Netherlands, of which 23 were collected to establish e.g. the cause of death.

Stomach contents

The seal found dead in Lake IJssel was considered, although not very fresh, still useful for necropsy. It concerned a healthy adult female in a good nutritional condition, 1.54 m long and weighing 56 kg. It showed no external signs of damage, but the internal examination revealed that the animal had a broken spine and extensive hypodermic bleeding in the blubber and muscle tissue around the chest. Considering the massive haemorrhage this was assumed to have been inflicted ante-mor-

tem. Therefore, the broken spine was the likely cause of death, although drowning could not be excluded, given the limited possibilities to firmly conclude on the cause of death due to the condition of the carcass (Roozen 2012, S. Roozen, personal communication).

The stomach was full of prey remains, containing both recognisable individual fish, a paste of more digested fish and free-laying fish otoliths. A complete river lamprey (*Lampetra fluviatilis*) of 27.5 cm was present (table 1). Furthermore we found six recognisable European flounders, that had clearly been ingested shortly before death. While these fishes were too far digested to be measured directly, their skulls were all intact and the otoliths inside were still in pristine condition. We collected another eighteen pairs and four single European flounder otoliths, showing very little or no wear, from the remaining stomach contents. Only one otolith showed severe wear and may have stemmed from an earlier meal. The reconstructed sizes of the flounders ranged from 9.2 to 23.9 cm ($n=28$ fishes; table 1). Finally, ten pairs and two single otoliths of European smelt (*Osmerus eperlanus*) were found. None of these were still present in the skulls and all showed wear (figure 2), some more than others, indicating that the smelt were eaten some time before most of the flounders, even if smelts are less robust fish than flounders. The smelts must have been taken by the seal itself, rather than by the flounders (secondary prey) as flounders prey mainly on benthic invertebrates (Binnendijk 2006), that are generally much smaller than the reconstructed sizes of the smelts (5.2 to 14.3 cm; table 1). None of the other distinctive fish bones found in the stomach revealed the presence of additional prey species or individuals as these matched the European flounders and European smelts, already identified from the otoliths. Although only 28 of the 41 prey found (68%) were flounders, these flatfishes constituted 94% of the prey intake, both in terms of ingested biomass and energy (table 1). All three fish prey species are found both in Lake IJssel and in the adjacent Wadden Sea and

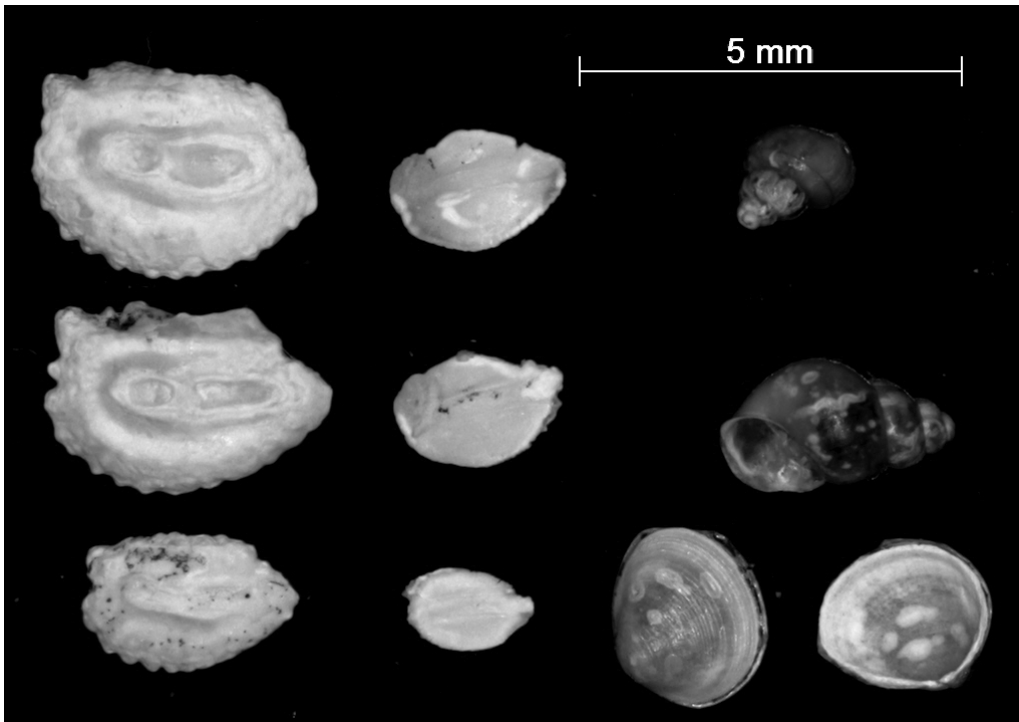


Figure 2. Examples of pristine otoliths of European flounders (left), worn otoliths of European smelt (middle), New Zealand mud snails and pill clams found in the stomach of the seal found dead in Den Oever.

based on this prey spectrum the seal might thus have been feeding in either water body before it met its violent death. However, ten New Zealand mud snails (*Potamopyrgus antipodarum*) and five pill clams (*Pisidium subtruncatum*) were also found in the stomach. These minute freshwater gastropods and bivalves must have been prey of the flounders and indicate that these fish had been ingested by the seal in Lake IJssel, as neither mollusc species occurs in the Wadden Sea.

Discussion

Presence

After the construction of barriers across many of the Dutch estuaries, harbour seals have continued to swim into these waters, negotiating a variety of man-made barriers.

This is most apparent in the southwest of the country, where circa 35 seals are now more or less constantly present in Lake Grevelingen and some 100 animals in the Eastern Scheldt (aerial survey data Rijkswaterstaat Waterdienst summer 2010 (Strucker et al. 2012), and synoptic land and ship-based counts (J. van der Hiele, personal communication)). Seals can enter and leave these waters through the sluice in the Brouwersdam that opens during low tide or the shipping locks in Bruinisse (Lake Grevelingen) and through the semi-open Eastern Scheldt dam respectively. Animals also manage to cross more solid barriers and enter freshwater lakes, such as Lake IJssel and Lauwersmeer, or swim upriver and, passing sluices, into channels.

Although some individuals may be true residents of the Eastern Scheldt and Lake Grevelingen, seals are frequently spotted moving through the barriers (J. van der Hiele, personal

Table 1. Prey fishes taken by a harbour seal found dead in Lake IJssel, November 2011: total numbers of fish with the length ranges, summed mass and energy content. Energy densities (kJ/g) were taken from Spitz et al. (2010) for flounder; Temming & Herrmann (2003) for smelt; Börjesson et al. (2003) for river lamprey.

Prey species	N	Length range (cm)	Σ prey mass		Σ energy	
			(g)	(%)	(kJ)	(%)
European flounder (<i>Platichthys flesus</i>)	28	9.2 – 23.9	1265.7	94	7341	94
European smelt (<i>Osmerus eperlanus</i>)	12	5.2 – 14.3	55.7	4	269	3
River lamprey (<i>Lampetra fluviatilis</i>)	1	27.5	32.7	2	206	3
Total	41		1354.1	100	7816	100

communication). Also tagging experiments in the Eastern Scheldt have shown that seals move frequently into and out of the estuary (Brasseur & Reijnders 2001, Brasseur et al. 2012). Similarly, tagged seals also passed through the drainage sluices in the Afsluitdijk (Brasseur et al. 2012), to enter Lake IJssel from the Wadden Sea and vice versa. Within Lake IJssel, the tracking data yielded a much larger range, i.e. the entire lake, than is indicated by sightings. Therefore the opportunistic and non-effort related sightings data, originating from the public, are not suitable for quantitative analyses of seal numbers or densities. However, they do give a first impression on the distribution of inland seals and show that it is not unusual to find animals at considerable distances from the sea, in all kinds of inland waters: from marine to brackish and freshwater.

Diet

Not much is known about how seals survive in inland water bodies and which prey they consume here. Despite the relatively large numbers present in several waters in the Delta area, no studies on their diet have yet been undertaken. Just a few incidental reports of seals catching large freshwater fish exist (see: Introduction), concerning animals that had entered inland waters through Rotterdam, Katwijk, IJmuiden and the Afsluitdijk.

The diet of seals in Dutch waters is rather

poorly known, even in marine waters. Older studies (Metzelaar 1921, Brouwer 1928, Havinga 1933) using stomach contents of by-caught and shot seals show that flatfish, particularly European flounders, were highly important, but that a large variety of other fish was also taken, including demersal roundfishes such as gadoids (Gadidae), gobies (Gobiidae) and bull-rout (*Myoxocephalus scorpius*) and pelagic roundfishes such as Atlantic herring (*Clupea harengus*) and European anchovy (*Engraulis encrasicolus*). Modern diet studies (Brasseur et al. 2004, Brasseur et al. unpublished results), using fish remains in seal faeces, yield a similar diet, dominated by flatfish, sandeels (Ammoditidae), gadoids and dragonets (Callionymidae). Interestingly, both the old and the modern studies found river lamprey to be part of the harbour seal diet in the Netherlands.

We found no records of stomach content analyses of the 23 dead harbour seals collected for research, apart from two animals secured from Lake IJssel by IMARES. One of these is reported here, the other (found near Andijk, 22 April 2012) had an empty stomach. This study provides the first comprehensive information on prey species taken by a harbour seal in Lake IJssel. Interestingly, no true freshwater fish had been taken, but rather flatfishes and other anadromous fishes, a diet that would have also been expected in the Wadden Sea. Possibly this particular seal had only been present in Lake IJssel shortly, persisting in taking fish species it knew as prey from the



Harbour seal hauled out in Ridderkerk, River Meuse, 28 August 2010. *Photo: Michiel Dral, © NU.nl.*

Wadden Sea. Clearly, more stomach contents of seals found dead in freshwater bodies are needed. Therefore, any seal found dead inland should be submitted to a full necropsy that includes a stomach content analysis, to get a full account of the prey taken by such stray animals. Similarly, the stomach content of the seals found dead in land-locked marine waters such as Lake Grevelingen and the Eastern Scheldt should be investigated to get an understanding of seal feeding habits in these estuaries. While a seal's stomach content is indicative of its last meal, other techniques are now available that would shed some light on residence times of seals found dead in inland waters. Stable isotope analysis of bone or muscle tissue would provide additional information on their feeding location over a longer time period (Jansen et al. 2012). This would be particularly relevant for seals found in the Eastern Scheldt or Lake Grevelingen, as this would show whether seals fed largely in marine, brackish or fresh water habitats.

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Jaap van der Hiele (EHBZ ZuidWest) added his personal database of sightings and local knowledge to these records. The records submitted to waarneming.nl were made available for this study on request. Rommert Cazemier helped sorting out the seal sightings in the Lauwersmeer and eastern Lake IJssel. The map was made by Elze Dijkman. Jan Pronk secured the dead seal in Den Oever, which was then transported to Utrecht University by Simon de Vries. Dr Marc Lavaley (Royal Netherlands Institute for Sea Research) identified the freshwater molluscs. Suse Kühn, Eileen Heße and Lara Mielke took the photograph of the otoliths and molluscs. We thank two anonymous referees for their stimulating comments on the manuscript.

References

- Anonymous 2012. Zeehond in het Spui - Hoekse waard. URL: <http://www.zeezoogdieren.org/wordpress/?p=9185#more-9185>; viewed November 2012.
- Binnendijk, E. 2006. Dieet van 11 demersale vissoorten in de Nederlandse Voordelta. Report 06.007. Wageningen Imares, Yerseke, the Netherlands. URL: <http://edepot.wur.nl/146719>; viewed November 2012.

- Biondina, B. 2006. Zeehond "Brammetje" op weg naar huis! URL: <http://www.zeevisland.com/vangstbericht/maanden/VB--2006/KANT--MAART--2006.htm>; viewed November 2012.
- Börjesson, P., P. Berggren & B. Ganning 2003. Diet of harbor porpoises in the Kattegat and Skagerrak seas: accounting for individual variation and sample size. *Marine Mammal Science* 19: 38-58.
- Brabants Dagblad 2012. Zeehond in de Maas bij Heerwaarden. URL: <http://www.brabantsdagblad.nl/regios/11971389/Zeehond-in-de-Maas-bij-Heerwaarden.ece>; viewed November 2012.
- Brasseur, S. & P. Reijnders 1995. The harbour seal in the Netherlands: ecological profile harbour seal. Report, ISBN 90-369-3431-1. Rijksinstituut voor Kust en Zee, Den Haag, the Netherlands.
- Brasseur, S.M.J.M. & P. Reijnders 2001. Zeehonden in de Oosterschelde, fase 2. Effecten van extra doorvaart door de Oliegeul. Report 353. Alterra, Wageningen, the Netherlands.
- Brasseur, S.M.J.M., I. Tulp., P.J.H. Reijnders, C.J. Smit, E.M. Dijkman, J.S.M. Cremer, M.J.J. Kotterman & H.W.G. Meesters 2004. Voedseleecologie van de gewone en grijze zeehond in de Nederlandse kustwateren. Report 905. ISSN 1566-7197. Alterra, Wageningen, the Netherlands.
- Brasseur, S., G. Aarts, E. Meesters, T. van Polanen Petel, E. Dijkman, J. Cremer & P. Reijnders 2012. Habitat preferences of harbour seals in the Dutch coastal area: analysis and estimate of effects of offshore wind farms. Report C043-10; OWEZ R 252 T1 20120130. Wageningen IMARES, Texel, the Netherlands. URL: http://www.noordzeewind.nl/wp-content/uploads/2012/04/OWEZ_R_252_T1_20120130_harbour_seals-2.pdf; viewed November 2012.
- Brouwer, G.A. 1928. De levensomstandigheden van den zeehond (*Phoca vitulina* L.) in Nederland. *De Levende Natuur* 33: 115-119.
- De Smet, W.M.A. 1978. Zeehonden langs de Belgische kust en in de binnenwateren. *De Wielewaal* 44: 138-154.
- Gazet van Antwerpen 2012. Zeehond in Schelde bij Hobokense polder. URL: <http://album.gva.be/foto/uw-goed-nieuws-hoboken-metropool-stad/id333127-zeehond-in-schelde-bij-hobokense-polder.aspx>; viewed November 2012.
- Havinga, B. 1933. Der Seehund in den Holländischen Gewässern. *Tijdschrift van de Nederlands Dierkundige Vereeniging* 3: 79-111.
- Jansen, O.E., L. Michel, G. Lepoint, K. Das, A.S. Couperus & P.J.H. Reijnders 2012. Diet of harbor porpoises along the Dutch coast: A combined stable isotope and stomach contents approach. *Marine Mammal Science*, Article first published online: 1 November 2012. DOI: 10.1111/j.1748-7692.2012.00621.x.
- Klinkien, J. & B. Klinkien 2011. Lunchende zeehond in de Lek bij Vianen. URL: <http://www.rtvUtrecht.nl/nieuws/333763>; viewed November 2012.
- Leopold, M.F. 2011. Onderzoek aan maaginhoud toont aan: dode zeehond *Phoca vitulina* Emmeloord was niet afkomstig uit IJsselmeer of Waddenzee. *Sula* 24: 91-94.
- Leopold, M.F., C.J.G. van Damme, C.J.M. Philippart & C.J.N. Winter 2001. Otoliths of North Sea fish: interactive guide of identification of fish from the SE North Sea, Wadden Sea and adjacent fresh waters by means of otoliths and other hard parts. CD-ROM. ETI, Amsterdam, the Netherlands.
- Leopold, M.F., B. van der Werf, E.H. Ries & P.J.H. Reijnders 1997. The importance of the North Sea for winter dispersal of harbour seals *Phoca vitulina* from the Wadden Sea. *Biological Conservation* 81: 97-102.
- Leopold, M.F. & C.J.N. Winter 1997. Slijtage van otolieten in de maag van een aalscholver. *Sula* 11: 236-239.
- Mehner, T. 1990. Zur Bestimmung der Beutefisharten aus Fragmenten der Wirbelsäule bei der Nahrungsanalyse (Osteichthes, Teleostei). *Zoologischer Anzeiger* 225: 210-222.
- Metzelaar, J. 1921. Voedsel van den Zeehond. *De Levende Natuur* 26: 158.
- Natuurlijk Alblasserwaard en Vijfheerenland 2012. Zeezoogdieren in de Alblasserwaard en Vijfheerenlanden. URL: <http://www.natuurlijkalblasserwaardenvijfheerenlanden.nl/content/view/178/25/>; viewed November 2012.
- Roozen, S.B. 2012. Pathological findings in stranded seals (*Phoca vitulina* and *Halichoerus grypus*) in Noord-Holland and Texel (2011/2012). BVSc thesis. Faculty of Veterinary Medicine, University Utrecht, Utrecht, the Netherlands.
- Slooten, A. 1941. Een vreemde zeehondenwaarneming. *Amoeba* 20(8): 113.
- Spitz, J., E. Mourock, V. Schoen & V. Ridoux 2010. Proximate composition and energy content of fo-

- rage species from the Bay of Biscay: high- or low-quality food? ICES Journal of Marine Science 67: 909-915.
- Stadsarchief Breda. URL: http://www.stadsarchief.breda.nl/index.php?option=com_webtentoonstelling&view=detail&id=188; viewed November 2012.
- Strucker, R.C.W., F.A. Arts & S. Lilipaly 2012. Watervogels en zeezoogdieren in de Zoute Delta 2010/2011. Report BM 12.07. Rijkswaterstaat Waterdienst, Vlissingen, the Netherlands.
- Temming, A. & J.P. Herrmann 2003. Gastric evacuation in cod. Prey-specific evacuation rates for use in North Sea, Baltic Sea and Barents Sea multi-species models. Fisheries Research 63: 21-41.
- TSEG (Trilateral Seal Expert Group) 2011. Common Seals in the Wadden Sea in 2011. Aerial Surveys of harbour seals in the Wadden Sea in 2011: Solid increases in total number as well as pups. URL: <http://www.waddensea-secretariat.org/news/news/Seals/Annual-reports/seals2011.html>; viewed November 2012.
- Watt, J., G.J. Pierce & P.R. Boyle 1997. Guide to the identification of North Sea fish using premaxillae and vertebrae. ICES Cooperative Research Report 220. International Council for the Exploration of the Sea, Copenhagen, Denmark.
- Wsvdкреupel 2010. Zeehond bij natuurhaven de Kreupel - IJsselmeer 2010. URL: <http://www.youtube.com/watch?v=48ZjR7v-ING>; viewed November 2012.
- Zeehondencreche Lenie 't Hart 2011. Overstekende zeehond doodgereden op Afsluitdijk. URL: <http://www.zeehondencreche.nl/wb/pages/topics/overstekende-zeehond-doodgereden-op-afsluitdijk.php?p=40>; viewed November 2012.

Samenvatting

Gewone zeehonden (*Phoca vitulina*) in Nederlandse binnenwateren: locaties van zichtwaarnemingen en enige, eerste gegevens over voedselkeuze

De gewone zeehond komt van oudsher voor in alle Nederlandse kustwateren, inclusief de zeearmen in de Delta, de benedenlopen van de grote rivieren, de Zuiderzee en de Lauwers-

zee. Bij de realisatie van de Deltawerken zijn, behalve de Eems en de Westerschelde, alle verbindingen tussen de zee en binnenlandse wateren in Nederland voorzien van barrières, variërend van een in de bodem liggende stormvloedkering tot massieve dammen en dijken. Deze laatste zijn echter steeds voorzien van doorlaatmiddelen, hetzij om water af te voeren, hetzij om schepen te schutten. Zeehonden kunnen hier ook gebruik van maken om het binnenland in te zwemmen. Vooral in de Oosterschelde en de Grevelingen worden grote aantallen zeehonden gezien. Wellicht zitten hier vaste bewoners bij, maar het staat vast dat zeehonden geregeld de doorlaatmiddelen die deze voormalige zeearmen scheiden van de Noordzee passeren. Zeehonden blijken zelfs vindingrijk in het nemen van de meer gesloten barrières en zwemmen zo meren, rivieren en kanalen in. Onbekend is echter wat zeehonden eten in de verschillende binnenwateren, hoewel hier sinds 1993 in totaal 122 dode dieren werden gemeld, waarvan er 23 werden verzameld voor onderzoek. De maaginhoud van een zeehond, dood aangespoeld bij Den Oever in november 2011, verschaft de eerste informatie over prooi-soorten in binnenwateren. Sectie wees uit dat deze zeehond een gebroken ruggengraat had en hoogstwaarschijnlijk een traumatische dood gestorven was. Het betrof een volwassen vrouwtje, weliswaar in staat van ontbinding maar op het moment van doodgaan in goede lichamelijke conditie. Kort voor haar dood had ze vooral bot (*Platichthys flesus*) gegeten. Behalve van bot werden in de maag resten van spieringen (*Osmerus eperlanus*) aangetroffen en een nog geheel gave rivierprik (*Lampetra fluviatilis*). Het totaal van 28 botten vertegenwoordigde 94% van de biomassa en energetische waarde van de recent verorberde prooien. Alle gegeten vissen komen zowel in het IJsselmeer als in de Waddenzee voor. Daarom kon niet direct bepaald worden waar de zeehond haar laatste maaltijd(en) genoten had. Er werden echter secundaire prooien gevonden die meer duidelijkheid brachten. Enkele minuscule slakjes en

tweekleppigen werden in de maag aangetroffen: Jenkins' waterhoren (*Potamopyrgus antipodarum*; een exoot) en scheve erwtenmosselen (*Pisidium subtruncatum*; inheems). Deze twee weekdiertjes komen alleen in zoetwater voor en maken aannemelijk dat de vissen uit de maag van de zeehond in het IJsselmeer zijn gevangen. Deze studie suggereert dat er

van dode zeehonden nog veel te leren valt en er wordt daarom voor gepleit om voortaan magen van geborgen, dode zeehonden uit binnenwateren vaker te onderwerpen aan een dieetonderzoek.

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