Feasibility study for a pilot program: catching and tagging harbour porpoises in the Netherlands

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Contents

Summary

In this study the feasibility of tagging harbour porpoises in Dutch waters is evaluated, with the long-term objective to study their large-scale habitat use in the North Sea. Based on a detailed review of available information of tag types and catch methods, and discussions with experts experienced with tagging and handling porpoises it is concluded that tagging of porpoises in Dutch waters is feasible. The study provides recommendations on the catch methods, tag types and methods, potential sites for carrying out tagging, type of additional biological data to collect, as well as a preliminary protocol on how to tag harbour porpoises in Dutch waters.

Harbour porpoises are too small to attach tags from a distance (for example by use of a pole or cross-bow), so the animals need to be caught in order to attach the tag. Therefore, different catching approaches were considered: passive and active methods. The active catching strategy 'surface gillnet herding' is considered the most feasible in Dutch waters. This method has been applied with success in Denmark and Greenland, and experience is available. It provides the most flexibility in both tag location and timing, maximizing chances for animal presence under suitable environmental conditions. Passive methods were also considered, but they have several drawbacks. As passive methods rely on animals being caught in a net by chance, they require constant monitoring and a tagging team that is on permanent stand-by. Due to the required involvement of experienced Danish researchers and a veterinarian, the project team is not flexible enough to use this method as a starting approach in this pilot project. In the Netherlands, there is currently only one pound net used in the inner Eastern Scheldt, and the probability of catching a harbour porpoises is very small. Catching effort could be increased by constructing more nets, but construction is costly, and once constructed, nets cannot easily be re-located.

Because there is no single tag type that will address all research priorities, it is recommended to apply different tag types during the pilot project. It is recommended to start with three specific models: SPLASH10-336, SPOT-196J, and SPOT-F-398. This allows for comparison of configurations (one is mounted at the back, and two at the side of the dorsal fin), location accuracy (one has Fastloc® GPS in addition to Argos) and depth data (one of them does, the others do not collect this). The different tag types allow us to evaluate their relative value in contributing to the main research question on how porpoises use the North Sea.

To gain experience in the catching method, it is recommended to follow a phased approach: first, 'dry-runs' with a 'dummy' porpoise; second, tagging attempts in the sheltered Eastern Scheldt where there is a continuous presence of porpoises. Thirdly, as soon as sufficient experience with the method has been gained, catching can be carried out in other more exposed sites with direct connection to the North Sea. This third phase will concentrate on locations in the Wadden Sea, e.g. near Den Oever, or south-east of Texel.

A tagging protocol has been developed for the active catch tagging approach, which considers practical and safety considerations for the animals and personnel. The protocol can be further adapted based on experience from the initial dry-runs, feedback from ethical permitting agencies, and continuous evaluation of tagging attempts as the pilot project progresses.

1 Introduction & approach

The updated Harbour Porpoise Conservation Plan of the Netherlands (Ministry of Agriculture, Nature and Food Quality, 2020) recommended initiating a tagging study with harbour porpoises in the Netherlands. The Ministry of Agriculture, Nature and Food Quality, hereafter LNV, and the Dutch Governmental Offshore Wind Ecological Programme by Rijkswaterstaat on behalf of the Ministry of Economic Affairs and Climate (EZK): Wozep, hereafter RWS-Wozep, commissioned WMR and TNO to form a research consortium and carry out a four-year tagging pilot project. The main research question that the government would like to see answered (in the long term) is "How do harbour porpoises use the southern North Sea, and to what extent is this influenced by (anthropogenic) pressures?". Current research priorities concern the large-scale movements of harbour porpoises, their habitat preferences, and habitat use related to human activities in the southern North Sea over time.

Within the pilot project the feasibility of tagging harbour porpoises in the Dutch North Sea will be further explored, with the aim of developing a method for and gaining experience in catching, tagging and releasing harbour porpoises in their natural environment. If successful, the pilot-study provides initial insights into the large-scale movements and preferred habitats of the tagged harbour porpoises. The project intends to lay the foundation for a large-scale tagging program aiming to answer the main research question as stated above. The research questions for the current project are:

1. What is the best way of catching and tagging wild harbour porpoises in the Dutch North Sea or adjacent waters, with the least impact on the wellbeing of the animals?
2. Can harbour porpoises be successfully tagged in the Netherlands?
3. If so, harbour porpoises will be caught and tagged to collect data to answer the first priority policy questions on distribution and habitat use (research questions 1 & 2 of Vrooman *et al*. (2022):
    a. What are the large-scale movements of porpoises in the (southern) North Sea?
    b. What is the home range of harbour porpoises in the (southern) North Sea?

    If sufficient data are collected, first indications of behavioural responses to human activities and insights into foraging ecology could also be explored.

The first part of the pilot study consists of a feasibility study, which is the subject of this report. This report covers the process of arriving at decisions concerning the type of tags and catch method to be used, preferred fieldwork location(s), tagging procedure, and information and/or samples to be collected during restraint. Per subject, different options will be explored and discussed, including pros, cons and overall feasibility. Information will be gathered from literature, earlier reports (Ministry of Agriculture, Nature and Food Quality & Rijkswaterstaat (Wozep), 2022; Scheidat et al., 2016; Vrooman et al., 2022), expert opinion and expert experience. This will converge into a final recommendation to guide a decision on whether, and how, to proceed with the project.

2 Tags

There are various types of tags on the market that can be used for telemetry research, with different types of attachment, sensors and specifications (also see (Debets, 2023; Vrooman et al., 2022)). Since the first research priority from a policy perspective concerns the large scale movements and habitat preference in the southern North Sea, this chapter will only focus on tags that can provide information about that: tags that stay attached relatively long-term (at least weeks)[1], and transmit information through the use of satellites[2]. Since larger tags result in more hydrodynamic drag and thus discomfort to the animal, smaller tags are preferred. Moreover, due to the size and design of the tags and the fact that harbour porpoises are too small to attach tags from a distance (for example by use of a pole or cross-bow) the animals need to be caught and restrained to attach the tag. Catch methods and tagging procedure will be discussed in chapters 3 and 5.

2.1 Tag characteristics

All tags discussed here collect Argos geolocation and temperature data. Other characteristics are optional, and sometimes exclude each other. Table 2-1 gives an overview of the relevant tag models that are currently commercially available. The most relevant options are:

- **Manufacturer**: there are two main manufacturers of suitable satellite tags: Wildlife Computers (https://wildlifecomputers.com/) and Lotek (https://www.lotek.com/). In Denmark and Greenland there is a lot of experience with Wildlife Computers, and researchers involved state that their customer service and products are of high quality. Experiences with Lotek were fewer, and also less positive. The Lotek tags have not been successfully used on harbour porpoise yet.
- **Fastloc® GPS**: Fastloc® GPS is a snapshot GPS, calculating the geolocation of the tag based on a 'snapshot' of different satellites the moment the animal surfaces. It has very high accuracy (up to 50m) compared to 'regular' GPS systems (such as Argos), and therefore allows for fine-scale horizontal 2D movement tracking. Additionally, it works very fast, making it suitable for animals that surface very shortly, such as harbour porpoises (Wildlife Computers Inc, 2023). Depending on the settings, battery life can be reduced, see also (Vrooman et al., 2022). Fastloc® GPS is currently only available for one SPOT tag (see Table 2-1), meaning that it's not available for side-mounted tags and/or for tags that also collect depth data. According to J. Teilmann (*pers. Comm*., 2023) Fastloc® GPS has not been tested successfully on a fin-mount tag on harbour porpoises yet.
- **Light level sensor:** measuring light level is an option for some tags. This allows for light-level geolocation: a method where location is calculated based on the light level at that time of day, i.e. timing of sun-set and sun-rise. This is only an option for the Wildlife Computers SPLASH tags.
- **Depth sensor**: measuring depth (pressure) provides useful information about swimming and dive behaviour. This allows for time-at-depth histograms, depth profiles and maximum dive depths. The extra sensor does increase the size and weight of the tag, and reduces battery life, see also (Vrooman et al., 2022). Measuring depth is currently only an option for the Wildlife Computers SPLASH tags and the K2F 173A LOTEK tag.
- **VHF/UHF**: equipping a tag with an UHF (ultra-high frequency) or VHF (very high frequency) pinger allows for the tag to be located and actively tracked when in range by using a directional antenna and receiver. This can be useful if the behaviour and fitness of the animal is to be

[1] Duration of transmission depends on various factors, such as battery life, which is in turn affected by transmission rate and the collection of additional data such as depth, temperature or GPS. However, transmission duration also depends on the time the tag stays on the animal, which can be affected by attachment configuration but also by individual behaviour and individual physiological/physical characteristics. Lastly, a tag can simply stop functioning due to errors or breaking.

[2] To answer research questions on more detailed small-scale movements and behavioural information, suction cup tags can be used later in the pilot. These are attached to the animal's back by suction cups, and remain in place for a few days at most. These tags collect data on movements and possibly sound, in high resolution but over short periods of time. These tags can tell us something about the exact behaviour of animals in a certain place, and for instance about their direct reaction to human disturbance.

observed after placing of a tag, or if the tag needs to be retrieved after detachment, see also (Vrooman et al., 2022). This is currently only an option for the Wildlife Computer SPOT tags and the K2F 172D LOTEK tags. Another option for locating a tag is the Argos Goniometer, a device that is able to 'live' detect transmitting devices up to 100km. This works for all tags that use the Argos system.

- **Anti-fouling**: tags can be a substrate for biological growth (e.g. algae, barnacles), potentially increasing drag. This can be prevented by using anti-fouling coating. This should, however, be applied with caution as to not cover the saltwater switch, for example. Tags that have been retrieved in Denmark came back relatively clean (J. Teilmann, *pers. Comm.*, 2023), but tags recovered in Greenland were covered with some algal growth, also on the antennae (Heide-Jørgensen et al., 2017). Wildlife Computers offers two types: one containing a biocide that kills biofouling on contact (Micron), and another that is non-toxic but sloughs off marine growth (Propspeed).
- **Number of pins & position of deployment** (trailing edge or side of dorsal fin): there are various configurations to attach the tags to the dorsal fin. Depending on the size and shape of the tag it can be attached at the back (trailing edge) of the fin with 1 or more pins, or to the side of the fin with more than 1 pin. Balmer et al. (2014) state that single-pin attachment at the trailing edge of the fin has various advantages, including minimal blood vessel and dorsal fin damage in case of movement through or out of the fin[3], less hydrodynamic drag, easy attachment and thermal considerations (tag does not cover large area of fin). However, experience with harbour porpoises has shown that single-pin attachments had shorter duration, potentially due to migration out of the fin. Even with two pins at the trailing edge of the fin, durations were shorter than with the attachment to the side of the dorsal fin. The trailing edge of the harbour porpoise's dorsal fin is very thin, and with only 1 pin migration is likely. Moreover, the fin is rather small, and the tag might hit the saddle/back of the animal as its end moves up and down (J. Teilmann, *pers. Comm.*, 2023). A disadvantage of multiple pins, on the other hand, is that they won't erode at exactly the same speed (see "detachment"), potentially resulting in a tag where some but not all of the pins have come loose, and the consequences of that for positioning, drag and tissue damage.
- **Detachment**: detachment can occur unaided through the use of corrosive bolts (iron, magnesium), with the bolts corroding after, for example, one year. Non-corrosive material can also be used (as was done in (Nielsen et al., 2018)), meaning that the tag theoretically stays on the animal forever, unless it migrates out of the fin. This does, however, mean that the tag could stay on the animal until long after the battery has drained, inducing unnecessary potential discomfort for the animal.

2.2 Overview

Table 2-1 provides an overview of the currently available relevant tag models. It is recommended to start with the following tag models: SPLASH10-336, SPOT-196J, SPOT-F-398. This allows for comparison of:

- Configuration: the SPLASH10-336 & SPOT-196J are attached with 3 pins on the side of the fin, the SPOT-F-398 with 1 or 2 on the back
- Location accuracy: the SPOT-F-398 has Fastloc® GPS, providing more accurate location data than Argos.
- Depth: The SPLASH10-336 also collects depth data, the others do not.

Practical suitability of these different models can be tested, as well as duration of transmission[1]. The added value of temperature, depth and GPS data can also be considered. Based on this it can then be decided which tags are most suitable for the later stages of the project.

[3] Occasionally the attachment pins move through the fin, usually because of hydrodynamic drag. In certain cases the tag can migrate out of the fin entirely.

Table 2-1. Possible tag models and their characteristics. NB Tags can to some extent be adjusted to specific consumer wishes.

Manufac-turer	Model	Argos	(max) battery life (days)[4]	Weight (g)	Max depth (m)	Attachment	Fastloc® GPS	Depth sensor	Temperature sensor	Light sensor	L x W x H (mm)	VHF/UHF	Image	Price indication
Wildlife Computers	SPLASH10-397	Yes	130	86	2000	single pin, back of fin	No	Yes	Yes	Optional	190 x 22 x 30	No		$3,500
Wildlife Computers	SPLASH10-336	Yes	105	75	2000	3 (or 4) pins, side of fin	No	Yes	Yes	Optional	108 x 41 x 21	No		$3,300 (+extra build time
Wildlife Computers	SPOT-196J	Yes	300	55	2000	3 (or 4) pins, side of fin	No	No	Yes	No	82 x 19 x 52	Yes		$1,700
Wildlife Computers	SPOT-399	Yes	300	65	2000	single pin, back of fin	No	No	Yes	No	180 x 19 x 26	Yes		$1,700
Wildlife Computers	SPOT-F-398	Yes	70	68	2000	single pin, back of fin	Yes	No	Yes	No	180 x 19 x 26	Yes		$3,150

[4] Battery life depends on tag settings.

Lotek	K2F 163C	Yes	153	37	500	single pin, back of fin	No	No	Yes	No	75 x 20 x 25	No		€825
Lotek	K2F 172D	Yes	263	47	500	single pin, back of fin	No	No	Yes	No	100 x 20 x 25	Yes		€825
Lotek	K2F 173A	Yes	305/270 (incl. dive sensors)	45	500	single pin, back of fin	No	Optional	Yes	No	100 x 20 x 25	No		€825 – 1250
Lotek	K2F 176F	Yes	433	80	2000	Three pins, side of fin	No	No	Yes	No	83 x 22 x 80	No		€825

3 Catching methods

3.1 Passive methods

Passive catching methods essentially involve waiting until a harbour porpoise swims into a set catching device and gets (by)caught. Bycatch of porpoises and dolphins in passive devices is known from set gill nets, pound nets and weirs (Laidre, 2010; Neimanis et al., 2004; Read & Westgate, 1997; Teilmann et al., 2007, 2013). In Greenland narwhals were deliberately caught in set nets that were continuously monitored visually from shore

3.1.1 Set (gill) nets

Set (gill) nets are widely used to capture fish at various depths. The nets are set vertically in the water column, usually anchored to the sea floor and can be placed at various heights in the water (Figure 3-1). Fish are caught by getting stuck in the meshes or entangled in the net. The nets are typically left unattended for hours, e.g. during night-time, and in some occasions up to a few days, before being hauled in to extract the catch. Harbour porpoises can accidentally get bycaught in such nets. The mesh sizes of set nets vary depending on the target species, and especially nets with larger mesh sizes increase the risk of porpoises getting entangled and drowning. In Dutch waters on average 23 porpoises were estimated to get bycaught in these nets annually, based on a monitoring study in cooperation with the Dutch commercial gill net fleet during the period 2013-2017 (Scheidat et al., 2018). The method has not been used to successfully catch and tag harbour porpoises.

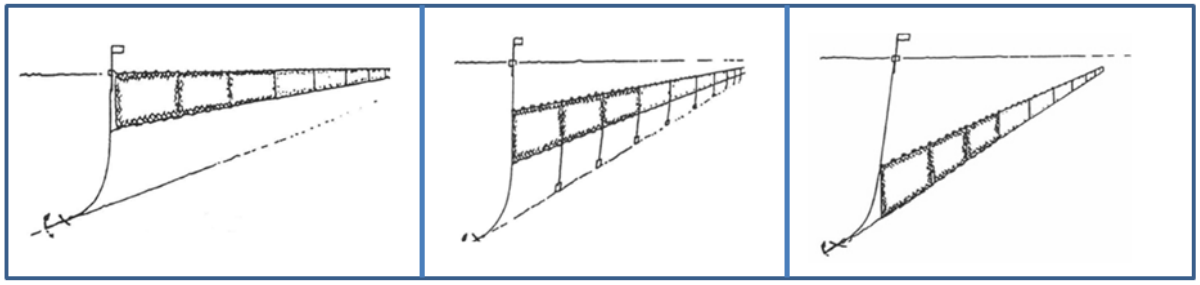


Figure 3-1. Schematic drawing of the use of a set nets for fisheries at different depths (https://vistikhetmaar.nl/onderwijs/lesmodules/passieve-visserijmethode/)

Narwhals (Monodon monoceros) have been captured deliberately in set nets that were under continuous 24-hour monitoring (Dietz et al., 2001, 2008; Laidre, 2010). The nets, of varying lengths and depths and with large mesh sizes (20 to 40 cm stretched mesh), were generally set perpendicular to shore, and deployed from shore or from the bow of a boat. The nets were kept afloat by a float line, and were generally anchored to the bottom. Once narwhals were recorded in the area the capture teams became stand-by, and when a narwhal became entangled the teams immediately set off in small boats to bring the animals and the net to the surface. The animals were then deployed with tags (sometimes after being brought to shore) before release.

Theoretically, gill nets can be used to catch porpoises alive, providing the nets are monitored continuously to instantly prompt action of the tagging team when a porpoise is caught. In practice, however, continuously monitoring is challenging and the tagging team would need to be on standby in the close vicinity of the gill nets to release caught individuals from the net before they drown and do so with a minimum of stress for the animal.

3.1.2 Pound nets

Pound nets have been successfully used to catch and tag harbour porpoises in nearshore Danish waters (Edrén et al., 2010; Sveegaard et al., 2011; Teilmann et al., 2007, 2013). Pound nets generally consist of a (semi-)enclosed trapping area, the so-called pound, connected to a fence (net) that funnels fish to the pound after which they become trapped but can still surface to breathe. In Denmark, this fence consists of a lead net that extends from the beach up to 1 km, and ends in a trap, the so-called pound

(Figure 3-2). Occasionally harbour porpoises become trapped in the pound nets (10 per year, on average, distributed over all nets of cooperating fishers in Danish waters). Mesh sizes are generally small (2 cm), so porpoises do not become entangled, but can swim around freely within the net, which in Denmark measures 10-30 m in diameter and 3-7 m in depth (Edrén et al., 2010; Sveegaard et al., 2011; Teilmann et al., 2007, 2013). Cooperation with fishers is key to use this method to tag porpoises. If fishers detect a porpoise within the pound they notify researchers to tag and release the animal. There is also a net lying at the bottom of the pound, and when a harbour porpoise is inside, the bottom net can gradually be pulled up until the animal is at the surface and can be handled. The current configuration of the nets can only be deployed in waters with little current. The method was once attempted in the Danish Wadden Sea, but the strong tidal currents broke down the set-up (J. Teilmann, *pers. comm*., 2022).

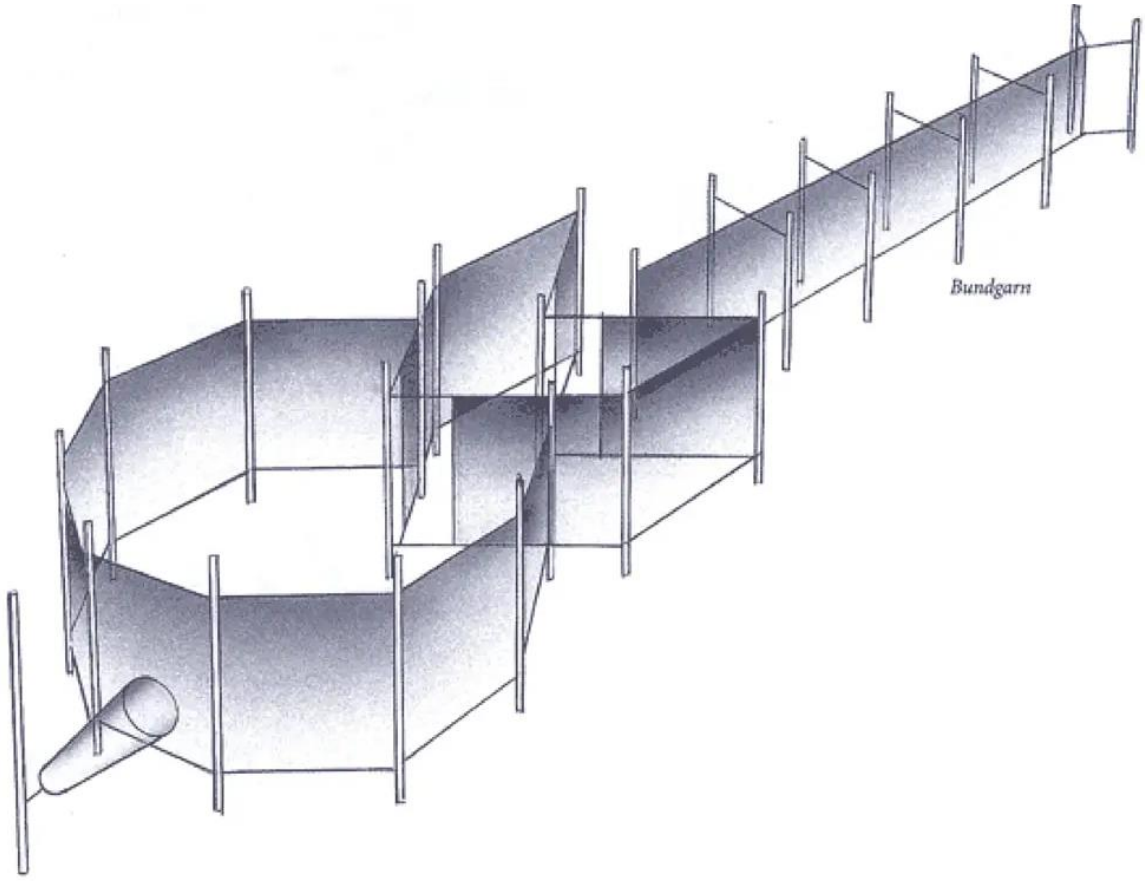


Figure 3-2. Danish pound net ("Bundgarn"). https://fiskerforum.dk/fakta-om-fisk/fangstmetoder/bundgarnsfiskeri/

In the Netherlands, pound nets are used to catch anchovy in the inner Eastern Scheldt intertidal area. The setup differs from the Danish pound nets; instead of a lead-net two lead lines of wooden stakes are set up in a V-position and used to guide fish to the semi-enclosed pound net area, which measures approximately 35 m in length and 15 m in width. The depth varies between 1m (low tide) and 5m (high tide) (Figure 3-3). The leading lines can extend as far as 1.5 km, and are located on sand banks that are exposed during low tide. Closer to the pound net area, the distance between the stakes becomes smaller. Fish (anchovy is the main target species) and other organisms are guided by the tidal channel towards and into the pound net area. As the tide recedes, the fish become trapped due to the configuration of the net (easy to swim in, but difficult to swim out). During low tide fishers attach a fish pot to the narrow end of the pound net, open a 'hatch' and guide the catch (on foot) with drift nets into the trap, from which the catch is scooped up into the vessel. The fishery is generally performed between mid-April and mid-August. Harbour porpoises are occasionally trapped and released alive, but the

numbers are unknown, ranging from "occasionally" to "maybe five in the last years" (*pers. comm*. with Rian van Dort & Henk van Schilt, August 2023). It is suggested by the fishers that the current positioning of the net means that a harbour porpoise would have to enter the shallows above the sandbank in order to get trapped, which it rarely does (harbour porpoises generally stick to the deeper gulley's of the Eastern Scheldt). There is currently only one family fishing company still performing this traditional method, and in only one location (close to Bergen op Zoom). The current Dutch set-up takes about three months to build, and is entirely tailored to making use of the tides. In its current configuration it can therefore only be operated in very shallow areas.
The Danish tagging programme showed that co-operation with fishers using these passive methods can result in access to bycaught animals. In the Netherlands, the fishers using pound nets in the Eastern Scheldt are willing to cooperate. However, both the Danish and Dutch method rely on incidental catches that are difficult to predict. Researchers have to be on 'stand-by' a large amount of the time, the fieldwork cannot be planned in advance and it is very well possible that hardly any harbour porpoise swims into the pound nets. Moreover, animals potentially are in the trap for a long time (up to 48 hours), possibly inducing a certain level of stress.

Figure 3-3 Pound net set up in the Netherlands, Eastern Scheldt. Photo by Don van Rooy (https://www.zeeuwseankers.nl/verhaal/weervisserij-in-de-oosterschelde)

3.1.3 Herring weir

Herring weirs are used in Canada to catch herring near the shore. They consist of kidney-shaped structures made from wooden stakes that are driven into the seafloor, with a nylon twine (1 cm mesh size) attached to them (Figure 3-4). On average, weirs enclose an area of 1500 m^2 and are 3-20 m in depth during low tide. The opening or mouth of the weir faces the shoreline, and a twine fence is installed between the mouth and the shore. Herring that follow the shoreline encounter the fence and are directed into the weir. Once inside, they are guided by the weir to swim along the perimeter, away from the weir mouth. Harbour porpoises regularly get bycaught in such herring weirs in Canada, allegedly following the herring (Neimanis et al., 2004). Some animals leave the weir independently, but most remain trapped. The animals are either removed with the herring through a fine mesh (0.75-1.25 cm) purse seine, or with a tailor-made, lighter, marine mammal seine with a 7.5 cm mesh size (Neimanis et al., 2004). This removal is, however, associated with some mortality, where mortality during attempted release with the marine mammal seine (2.5%) was significantly lower than with a herring seine (18.4%). Since the 1970s some of these bycaught animals have been equipped with radio or identification tags (Gaskin et al., 1975; Neimanis et al., 2004; Read & Westgate, 1997).

Like the pound nets, this method is not designed to catch porpoises, and the chance of catching an individual is unpredictable. Again cooperation with fishers is key to use this method to tag porpoises, since researchers need to be alerted by fishers when a porpoise is present in the weir. The current configuration of the nets has never been used in Europe to catch marine mammals. Although it should be possible to build a weir-like construction in the Netherlands, this is not considered feasible in the first phase of this project.

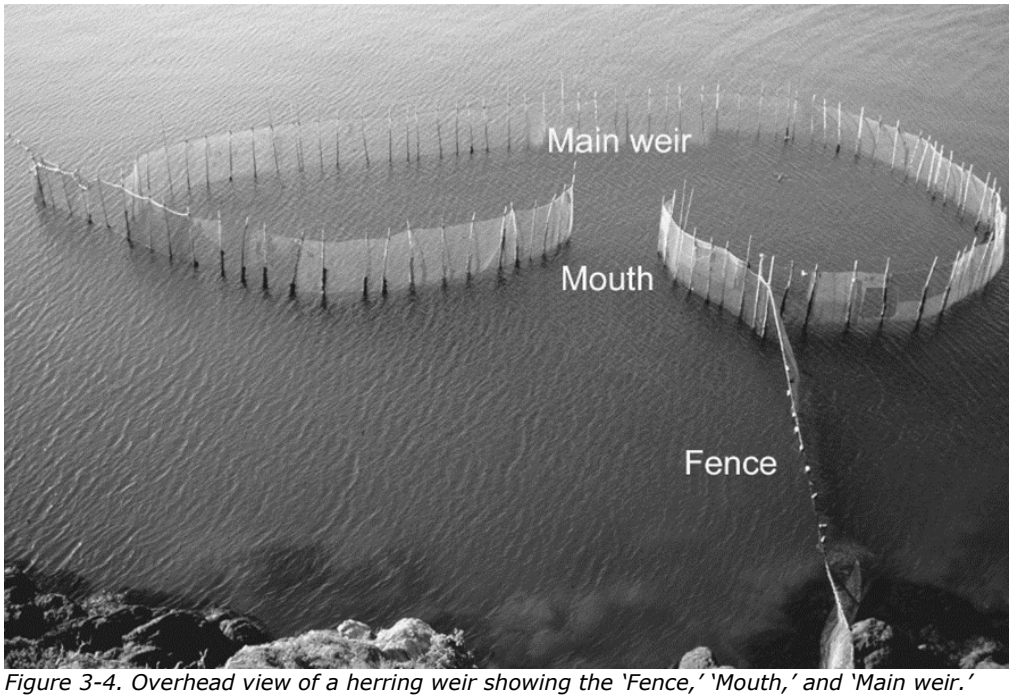


Figure 3-4. Overhead view of a herring weir showing the 'Fence,' 'Mouth,' and 'Main weir.' (Neimanis et al., 2004).

3.2 Active methods

Active methods can involve herding cetaceans into a catching device, e.g. a surface gill net, or actively surrounding animals by a seine net. Such methods have been successfully used to catch and tag dolphins, narwhals and porpoises (Ballance et al., 2021; Fair et al., 2006; Nielsen et al., 2018; Tervo et al., 2021; Wells et al., 2021).

3.2.1 Surface gillnet herding

In Greenland, boats were used to herd harbour porpoises into surface gillnets (Figure 3-5) to tag them (Nielsen et al., 2013; Nielsen et al., 2018). Two 19-feet boats with 150 hp engines and a crew of four people were used to catch porpoises. The so-called net-boat contained the capture nets, while the other so-called chasing-boat was used for herding the harbour porpoises. Once a harbour porpoise was spotted, one or more surface gillnets were quickly launched from the net-boat. The chasing-boat then tried to herd the harbour porpoise(s) towards the net. Similarly to set nets, the nets are equipped with a buoyancy line at the top and a weighted bottom rope at the bottom, so that the net hangs vertically in the water but is light enough to be lifted to the surface by a porpoise (to breathe). The nets are not anchored. For this method, a large mesh size is necessary in order for the animals to become entangled. An additional advantage of this large mesh is a reduction of the weight of the net, making it more manageable and enables a captured animal to remain at the surface. The mesh size used in Greenland was 20 cm. Entanglement of the harbour porpoise was easily observed when the float line of the net was pulled down, and as soon as a harbour porpoise was entangled the boats went to the net and pulled the harbour porpoise to the surface. The porpoise was guided into a stretcher, and brought on board for handling and tagging. Herding typically lasted 15 to 20 minutes. After applying a tag and/or collecting some biological information, the harbour porpoise was released, and generally swam away with regular surfacing (Nielsen et al., 2018). The capturing was performed together with experienced hunters, who

were skilled in predicting harbour porpoise movements. Tag retention times ranged between 137 and 376 days (Heide Jorgensen et al., 2017).

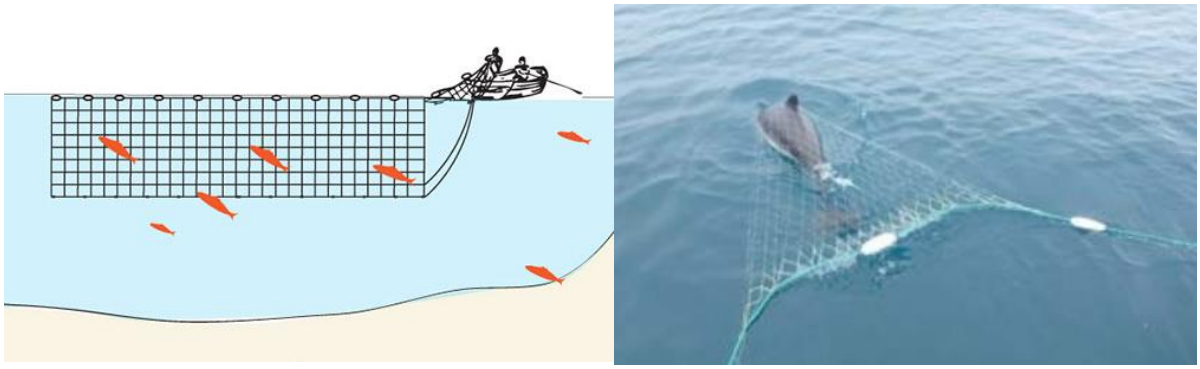


Figure 3-5. Left: schematic drawing of a (salmon) surface gillnet used in fisheries (Monterey Fish Market, 2023), and right: photo of harbour porpoise caught in a surface gillnet (Photo by Mads Peter Heide-Jørgensen, https://natur.gl/afdeling/afdeling-for-pattedyr-og-fugle/groenlands-mindste-hval-spores-nu-fra-satellit/).

The method was also used to tag six animals in the Danish Wadden Sea (Scheidat et al., 2024; van Beest et al., 2018). The nets used in Denmark were longer (260 m), 9 m deep and were made of 0.7 mm twine with a mesh-size of 18 cm between the knots (van Beest et al., 2018). Animals were successfully captured and released without problems (handling time on board <30 minutes), with the duration of data transmission ranging between 102 and 264 days. Both in Denmark and Greenland the researchers did not experience any mortality during capture, handling or tagging of the porpoises (Lemming, 2018; Nielsen et al., 2018; van Beest et al., 2018; J. Teilmann, *pers. comm., 2023*).

An adapted version of the surface gillnet method was also used in the attempt to capture individuals of the critically endangered vaquita (*Phocoena sinus*), with the aim of temporarily housing them for protection and captive breeding (for reintroduction) of this species (Rojas-Bracho et al., 2019). Two animals were targeted and captured successfully. However one (a juvenile) was released 4 h later because it appeared stressed in the housing enclosure, and the other (an adult female) died of capture myopathy[5] 3 hours after its attempted release, 4 hours after capture (initiated after the animal deteriorated quickly in the housing enclosure). The program was then suspended because of the risk of additional mortalities to the population. Experts agree that the vaquita appears to be specifically sensitive to stress and capture myopathy, potentially more so than other cetacean species (Teilmann, van Elk, *pers. Comm.* 2023).

This method allows researchers to selectively capture specific individuals. It does, however, likely induce a certain amount of stress to the animals. The method can only be applied during flat calm seas (sea state 0-3), and ideally the weather is overcast (to minimize glare). The net height should nearly equate to water depth, to minimize the (escape) gap between net and seafloor. However, specifically in areas with hard substrate on the seafloor (e.g. rocks, shellfish beds) the net should not touch the seafloor to prevent it from getting stuck. Preferably light-weight nets are used, to facilitate handling and towing of nets and enable captured animals to remain at the surface to breath. Depending on catch location, nets of different heights could be used.

3.2.2 Set net herding

In Greenland, narwhals have been actively herded into set nets similar to the ones described under section 3.1.1 (Tervo et al., 2021). Nets with a length of either 40 or 80 meters and a depth of 5 to 8 meters were set up and anchored from the shore. The nets were constantly monitored by lookouts stationed on land. If narwhals were seen in the area, a number of speedboats were deployed to guide

[5] Capture myopathy an occur when an animal exerts itself too much (for example in a trap). It is a metabolic syndrome that has been well documented for live stranded cetaceans (Câmara et al., 2020) as well as other animals (Breed et al., 2019). It leads to a number of responses and a rapid degeneration of heart and skeletal muscle (Herráez et al., 2013).

the narwhals towards the nets. When a narwhal was entangled, the net was released from the anchor and the narwhal was carefully brought to the surface and guided towards the shore, where it was examined and tagged. The length of the anchor line was adjusted as needed to ensure that the narwhals remained afloat at all times. On average, the time spent in the net from capture to release was 66 minutes (with a standard deviation of 14), while the handling time ranged from 9 to 41 minutes (Tervo et al., 2021).

This catching method can only be used in areas where continuous visual monitoring of nets is possible. It has not been used to catch and tag harbour porpoises.

3.2.3 (Purse) seine net encirclement

Various species have been (by)caught with (purse) seine net encirclement. Seine fishing is a method in which a net is deployed in such a way that it surrounds the target species (generally schools of fish) (Figure 3-7). The net hangs vertically in the water, held down by weights and buoyed by floats. A seine net can be deployed from shore (beach seine), from a small boat or from larger boats in the open ocean (purse or Danish seining). When deployed from boats, the net can be closed at the bottom once the school of fish is surrounded, after which it is hauled in/brought alongside the vessel.

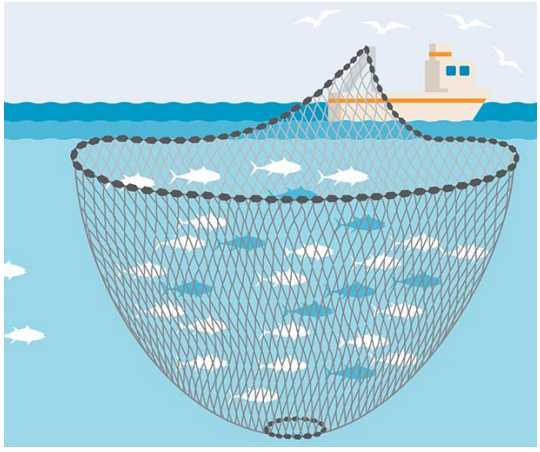


Figure 3-7. Schematic drawing of a purse seine net (https://www.msc.org/what-we-are-doing/our-approach/fishing-methods-and-gear-types/purse-seine)

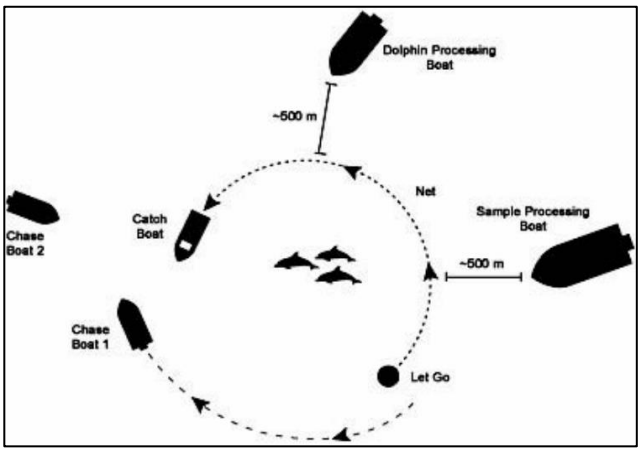


Figure 3-6. Boat positioning during net deployment (Fair et al., 2006).

In the US common bottlenose dolphins (*Tursiops truncatus*) have been caught using seine net encirclement (Fair et al., 2006; Schwacke et al., 2014; Wells et al., 2017). The capture generally took place in calm and shallow water, where the substrate was firm enough for researchers to handle the dolphins effectively. Different boats were involved, such as a chase boat, a catch boat and a dolphin handling boat (Figure 3-6). Typically, a catch and chase boat would approach the dolphins closely while the remaining boats stay nearby. When conditions were safe and a sufficient number of chase boats with an adequate number of dolphin handlers were present, a large seine net (366 x 7 m, 22 cm mesh size) (Figure 3-6) was deployed around the target dolphin(s) as the catch boat accelerated around them. Other boats were then positioned to create an acoustic and mechanical barrier to the dolphins until the net was completely closed. The dolphins then either got entangled in the net, or the net enclosure was decreased in size and/or handlers entered the water to maneuver the dolphins towards the netting or attempting to manually restrain them. In all cases they were then handled and tagged, either in the water of after being transferred to foam pads on a boat before release (Fair et al., 2006; Wells et al., 2017).

A similar method was used for Franciscanas (*Pontoporia blainvillei*) in shallow waters in Argentina and Brazil (Wells et al., 2021). The dolphins were captured using encirclement in shallow water by a large seine net of 500 x 4.5 m, with a 15 cm stretched mesh. The capture process involved around 40 people on small boats searching for dolphins in calm sea conditions. The water depth was measured to ensure safe capture conditions, and if it was less than 3 meters, the net was deployed from a fast-moving boat.

Trained handlers in boats around the net assisted the dolphins, and observers monitored the net to report entanglement. The circle of the net was contracted, and the dolphins were guided into the net and received immediate assistance from handlers (Wells et al., 2021).

The use of purse seine net encirclement has been proven successful in deeper waters during tuna captures (Ballance et al., 2021). Fishers in the Eastern Tropical Pacific locate tuna schools by searching for dolphins (pantropical spotted (*Stenella attenuata*), spinner (*Stenella longirostris*) and, to a lesser extent, short-beaked common dolphins (*Delphinus delphis*) and/or seabird flocks, as indicators for so called multispecies feeding aggregations. Once located, the main boat starts deploying the net around the school and speedboats are used to chase the tuna and the dolphins into the net and/or to prevent them from swimming the other way. After encirclement, the bottom of the net is pursed to trap the tuna. As dolphins are not the target species, they are nowadays generally released, but the method could potentially be used to catch and tag them.

Seine nets can capture multiple individuals at once, enabling the selection and tagging of individuals and releasing them as a group, rather than releasing them individually. However, porpoises are generally solitary or live in (very) small groups. Moreover, they are fast and generally avoid boats. If an attempt is made to encircle them, it is expected that they will swim away in the opposite direction (J. Teilmann, *pers. comm*., 2023, as reported in (Veldhuis, 2023)). Additionally, the purse seine nets are generally very big and heavy. It takes time to close them, allowing them to escape (as happened with common minke whales (*Balaenoptera acutorostrata*) (J. Teilmann, *pers. comm*., 2023, as reported in (Veldhuis, 2023)). Moreover, if the net is too heavy and a harbour porpoise gets entangled it might not be able to lift the net to the surface to breathe, and thus drown (J. Teilmann, *pers. comm*., 2023, as reported in (Veldhuis, 2023)).

3.3 Summary

Table 3-1 provides an overview of all methods and their (dis)advantages. In general, passive catch methods have as main disadvantage that they are unpredictable. Consequently, a team has to be on constant stand-by to tag an animal once it is reported caught. Another disadvantage is the static nature of the catch devices; moving them to other places is not easily done. Pound nets and herring weirs are presumably less stressful to animals than active methods, since the animals swim into the catch device 'voluntarily' and can move around. They are, however, enclosed for up to a day or more, potentially causing some level of stress. Active catch methods have as main advantage that they can be flexibly used, targeting specific areas (and animals) in dedicated periods. The main disadvantage is the dependence on calm weather and weak currents. Furthermore, herding animals into the net can cause stress to the animals, and there remains a small risk of drowning.

Based on Table *3-1* it is recommended to start with an active catching strategy, of which the surface gillnet herding is considered the most feasible in Dutch waters. The main arguments for this are (i) the method has been applied with success, with experience being available and (ii) it provides the highest flexibility in both tag location and timing; it can be planned, deployed in various locations and can be optimized for animal presence and environmental conditions. The method should, however, be tested in and adjusted to Dutch waters. Passive methods could be revisited later on, once more experience has been built up in the Netherlands, and depending on the outcome of the active catching experiments of the pilot project.

Table 3-1. Overview of methods, pros and cons and overall feasibility

Method	Advantages	Disadvantages	Overall feasibility
Passive catch methods			
Set (gill) nets	• Relatively easy to set up	• Unpredictable → Team has to be on constant stand-by • Net has to be under 24/7 constant supervision to prevent drowning. • Inflexible: once net is in certain place not easy to move	24/7 supervision unfeasible, thus risk of drowning very high.
Pound net - Danish	• Animal can swim freely inside net • Proven method, experience available	• Unpredictable → Team has to be on constant stand-by • Requires low to no currents • Requires shallow waters • Inflexible: once net is in certain place not easy to move	Not likely to be successful in Dutch areas due to strong currents, unless nets are strengthened. Fact that it cannot be planned is a big downside, especially since (initially) many people (also from abroad) have to be involved for training etc. If a net is set and the location turns out to be inadequate, it's quite a hassle to move the entire net.
Pound net - Dutch	• Animal can swim freely inside net • Method is already deployed in one location in NL	• Unpredictable → Team has to be on constant stand-by • Takes a long time (3 months) to build • Method of catching porpoise once it is inside needs to be developed • No experience in areas other than Oosterschelde • Difficult to translate to other environments, such as the Wadden Sea or North Sea • Requires shallow waters • Inflexible: once net is in certain place not easy to move	Has potential in current location (Eastern Scheldt). However, method to catch porpoise once it's inside the net needs to be developed. Additionally, the current location does not 'attract' many porpoises. Potentially later in the project, when researchers are trained and can act swiftly once an animal is (by)caught.
Herring weir	• Animal can swim freely inside net	• Unpredictable → Team has to be on constant stand-by • No experience with method in NL • Requires shallow waters • Inflexible: once net is in certain place not easy to move	Similar issues as with the methods above: difficult to plan, difficult to move in case of inadequate location.
Active catch methods			
Surface gillnet herding	• Can be planned in advance • Specific animals can be targeted • Flexible: possible in different locations and relatively easy to move • Proven method, experience available	• Herding may be stressful for the animal • (Small) risk of drowning if entanglement goes unnoticed • Requires (very) calm weather	Seems most feasible method in this region, but some cons need to be taken into account.
Set net herding	• Can be planned in advance • Specific animals can be targeted	• Herding will be stressful for the animal • (Small) risk of drowning if entanglement goes unnoticed • Requires (very) calm weather • Inflexible: once net is in certain place not easy to move • No experience for harbour porpoise • Risk of damage due to storms	Similar to surface gillnet herding, but less flexible, thus less feasible.
(Purse) seine net encirclement	• Can be planned in advance • Specific animals can be targeted	• Requires (very) calm weather • No experience for harbour porpoise	Could be successful, but no experience with this for harbour porpoise or in these regions.

4 Location and time of year

The selection of the optimal location for attempting to catch harbour porpoises depends on several factors. Suitable locations should adhere to the following criteria:

- It should be a relevant location in relation to the primary research questions
- There should be a reasonable chance of finding porpoises
- Depending on the preferred catch methods and the experience of the crew, there may be requirements regarding depth, currents and weather. In general, calm weather and low currents will optimize sightings of porpoises, and make capturing and handling of an animal easier.
- It should be easily accessible (by a small boat)
- Safety in relation to (recreational) shipping, fishing, and diving activities should be considered

As this is a pilot project, a stepwise approach is recommended, where initial catch attempts are carried out in the most favourable conditions to minimize risks to animals and crew. Once experience is gained, the project can be moved to locations that are best suited for obtaining data to determine range and habitat use of porpoises on the North Sea. Potential locations for tagging considered for the pilot project are:

- The Wadden Sea
    - The Marsdiep/Texel
    - The Ems estuary
    - Near Den Oever
    - other Wadden Islands and surroundings (Terschelling West/ Rottummerplaat)
- Frontal systems near ports (North Sea coast)
    - IJmuiden port (or Scheveningen port)
- The Eastern Scheldt

The locations are discussed in more detail and per criteria in the following sections.

4.1 Dutch Wadden Sea

4.1.1 Wadden Sea general

This section describes the (Dutch) Wadden Sea in general. Several potentially suitable locations within the Dutch Wadden Sea are discussed in more detail in the following sections.

4.1.1.1 Relevance to research question

The Dutch Wadden Sea is part of the largest intertidal flat system in the world, extending along the coasts of Denmark, Germany and the Netherlands. It mainly consists of gullies and sandflats, the latter of which are exposed during low tide. On the seaward side it is protected by barrier islands, with tidal inlets in between connecting it to the North Sea (Figure 4-1). Harbour porpoises use the area and can freely move into the North Sea (Scheidat et al., 2024).

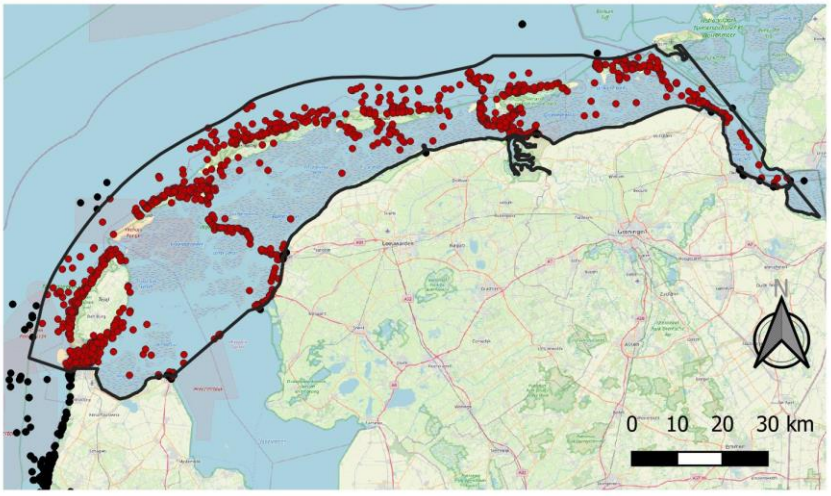


Figure 4-1. Recorded observations (dots) on www.waarneming.nl, from 2012-2022, in the Dutch Wadden Sea area. Strandings & remains excluded. Red records included in analyses. NB. One dot can represent multiple harbour porpoises. Observer bias towards ferry routes and islands; the intertidal areas are hard to access.

4.1.1.2 Accessibility

There are several harbours around the Wadden Sea. However, due to the sand flats boats with greater drafts are restricted to certain routes and cannot access all areas, especially during low tide.

4.1.1.3 Harbour porpoise occurrence

Harbour porpoises are regularly recorded in the area, and occur in both offshore and intertidal waters (Scheidat et al., 2024; Figure 4-1). They show seasonal movements and changes in local occurrence over time (Scheidat et al., 2024; Unger et al., 2022). It is largely unknown whether porpoises reside in the area permanently or whether they only use it for, for example, foraging. However, six porpoises that were tagged in the Danish Wadden Sea showed high site fidelity throughout the year and therefore possible residency (Scheidat et al., 2024; Unger et al., 2022). For the Dutch part of the Wadden Sea, records on www.waarneming.nl show peaks in spring and autumn (Figure 4-2). The pattern of a higher incidence of porpoises towards the North Sea, as found in the Ems estuary (Brasseur et al., 2011) seems a general pattern for the Wadden Sea area.

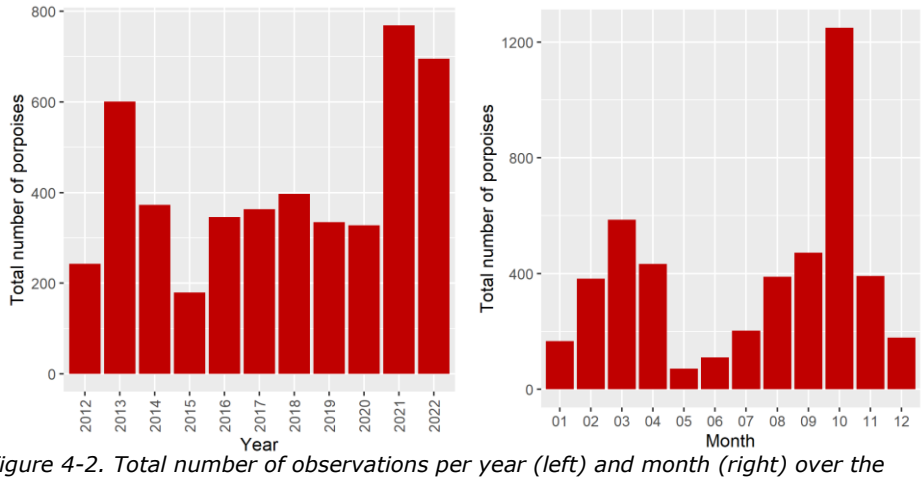


Figure 4-2. Total number of observations per year (left) and month (right) over the period 2012-2022 in the Dutch part of the Wadden Sea, within the area (black outlined) as depicted in Figure 4-1. Data from www.waarneming.nl.

4.1.1.4 Environmental conditions

The area is somewhat sheltered from the wind when compared to the North Sea. However, due to the intertidal nature of the area, currents are strong during rising and receding tide, especially in some of the gullies and the inlets. Depths vary between 0 and 40 m, depending on tides and location. When working in the area, good knowledge of the tides and depths is required, as there is a risk of running dry or getting stuck.

4.1.2 Marsdiep/Texel

4.1.2.1 Relevance to research question

The Marsdiep is a tidal inlet between Den Helder and the island of Texel. It is one of the connections between the Wadden Sea and the North Sea (Figure 4-3), and harbour porpoises use it to move in and out of the Wadden Sea with the tides (IJsseldijk et al., 2015).

4.1.2.2 Accessibility

The Marsdiep lies in the vicinity of several harbours: the harbour of Den Helder, including the Navy port, and the harbour of the NIOZ (Netherlands Institute for Sea Research). A bit more towards the North East, on the eastern side of Texel there is also the small harbour of Oudeschild. Depending on the exact catching location, the Marsdiep area is therefore highly accessible by (small) boat. The inlet is, however, also used by shipping, and traffic intensity can be high, but most vessels are restricted to deeper waters. Deploying a driftnet is only allowed with permission of the Den Helder Vessel Traffic Control Centre, or might be prohibited altogether. Texel provides lookout points to find and follow porpoises. On the Den

Helder side it would be necessary to obtain permission from the navy to use lookout points on their basis.

4.1.2.3 Harbour porpoise occurrence

Harbour porpoise occurrence in this area is well studied (e.g. Boonstra et al., 2013; Geelhoed et al., 2017; IJsseldijk et al., 2015) and it has been shown that harbour porpoises are regularly present. Boonstra et al. (2013) analysed harbour porpoise sightings between January and May in 2010 and 2011, and recorded highest abundances around mid-March, with a disappearance in April. Abundances were higher at high tide. IJsseldijk et al. (2015) also recorded more animals in the area during high tide, and in the morning (N.B. these factors could be collinear). Both studies recorded more harbour porpoises in the northern part of the area (on the side of Texel). Observations on www.waarneming.nl in the region also peak in late winter/early spring, and again in autumn (but to a lower extent) (Figure 4-5).

4.1.2.4 Environmental conditions

The area is characterized by strong tidal currents. Depth varies between 14 and 30 m. A location on the south-eastern leeside of Texel is potentially more sheltered and thus more suitable to actively catch and tag harbour porpoises (Figure 4-4).

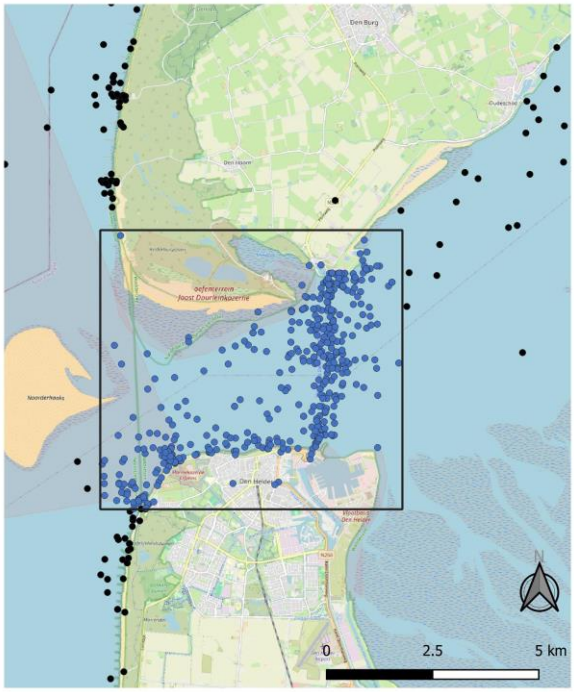


Figure 4-3. Recorded observations (dots) on www.waarneming.nl, from 2012-2022, in the Marsdiep area. Strandings & remains excluded. Light blue records included in analyses. NB. One dot can represent multiple harbour porpoises. High density 'bridge' between Den Helder & Texel mainly represents observations from the ferry.

Figure 4-4. Depth profiles in south of Texel close to the Marsdiep (source: webapp.navionics.com). The bar indicates a width of 200 m, the approximate length of the net.

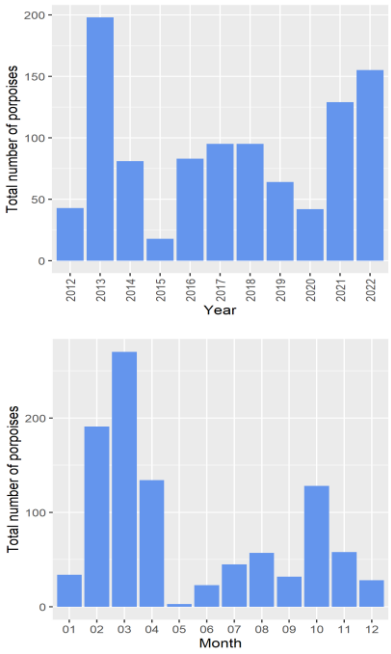


Figure 4-5. Total number of observations per year (top) and month (bottom) over the period 2012-2022 in the Marsdiep, within the area (black outlined) as depicted in Figure 4-3. Data from www.waarneming.nl.

4.1.3 Ems estuary

4.1.3.1 Relevance to research question

The Ems estuary is an estuary on the Dutch-German border, connecting the Ems river to the Wadden Sea (Figure 4-6). It is in open connection with the North Sea. It is a highly industrialized area, with seaports and chemical industries (e.g. Delfzijl, Eemshaven).

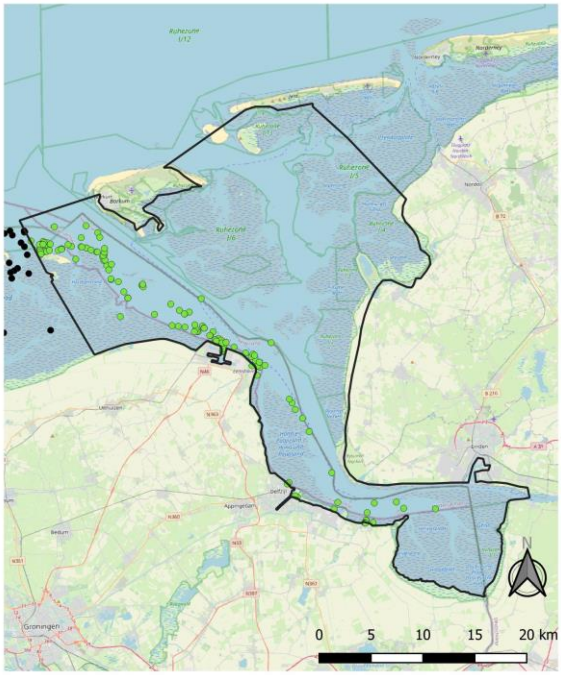


Figure 4-6. Recorded observations (dots) on www.waarneming.nl, from 2012-2022, in the Ems area. Strandings & remains excluded. Green records included in analyses. NB. One dot can represent multiple harbour porpoises. Only Dutch (no German) records are included.

4.1.3.2 Accessibility

The estuary can most easily be accessed from Eemshaven as northernmost harbour. Delfzijl harbour lies ca 15 km to the south.

4.1.3.3 Harbour porpoise occurrence

In 2009 and 2010 CPODs[6] detected harbour porpoise occurrence in the Dutch part of the Eems area between Borkum and the Dollard (Brasseur et al., 2011). Average acoustic activity was highest in early spring (March), showed a dip in summer and increased slightly again in autumn. There were differences between CPOD locations, and activity seemed to decrease deeper into the Dollard. Acoustic activity was highest towards the North Sea. These patterns were generally confirmed by a study in German waters south of Eemshaven in 2019-2022 (Taupp & Gauger, 2023) that found the highest acoustic activity in spring and late summer, and lowest activity in the inner Ems waters. This seasonal pattern was less pronounced at the northern locations. Data from www.waarneming.nl indicate a strong peak in early autumn (Figure 4-7). Overall it can be seen that the number of records in the Ems is lower than in the other areas. Observations seem more frequent in the area near Rottumerplaat (see section 4.1.5).

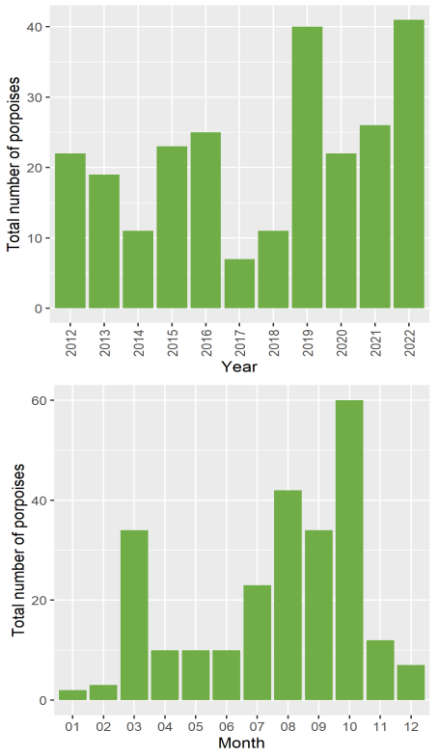


Figure 4-7. Total number of observations per year (top) and month (bottom) over the period 2012-2022 in the Ems Estuary, within the area (black outlined) as depicted in Figure 4-6. Data from www.waarneming.nl.

4.1.3.4 Environmental conditions

Depth in the region varies between 0 and 20 m (Figure 4-8), with currents of up to 1-1.5 m/s (Schoemans, 2012). Locations outside the main shipping lane and closer to the shore are somewhat shallower, and more accessible during high tide.

Figure 4-8. Depth profiles in part of Ems estuary (source: webapp.navionics.com). The (small) bar indicates a width of 200 m, the approximate size of the gillnet.

[6] Continuous POrpoise Detectors: passive acoustic monitoring devices designed to detect and record sounds of cetaceans.

4.1.4 Den Oever

4.1.4.1 Relevance to research question

There is occasional presence of porpoises on the Wadden Sea side of Den Oever (Figure 4-10). Like other animals in the Wadden Sea, these animals have direct access to the North Sea.

4.1.4.2 Accessibility

The location has good accessibility from the port of Den Oever itself.

4.1.4.3 Harbour porpoise occurrence

Porpoises are occasionally seen when the discharge sluices between Lake IJssel and the Wadden Sea open, allowing for fish to enter the Wadden Sea and attracting fish migrating upriver[7]. During the 2012-2022 period only in 4 years harbour porpoise observations were registered at www.waarneming.nl, and mainly in autumn (Figure 4-9). It is unclear whether this is effort-related and due to less effort in other years, or whether there were hardly any animals in other years. They mostly occurred in spring, which could again be an effect of effort, but could also be connected to the upriver migration of smelt occurring in spring (Tulp et al., 2013).

4.1.4.4 Environmental conditions

The Den Oever location is a relatively confined and sheltered area. Depth varies between 12 and 15 m in the deeper trench and gets shallower (2-3 m depth) at the edges (Figure 4-11). Due to its confinement (width ~500 m), it needs to be checked whether presence of other ships would limit the catching of animals.

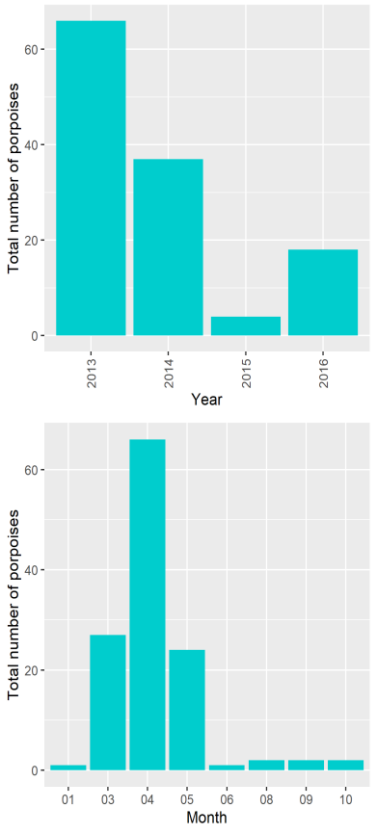


Figure 4-9. Total number of observations per year (left) and month (right) over the period 2012-2022 in the Den Oever area, within the area (black outlined) as depicted in Figure 4-10. Data from www.waarneming.nl.

Figure 4-10. Recorded observations (dots) on www.waarneming.nl , from 2012-2022, in the Den Oever area. Strandings & remains excluded. Turquoise records included in analyses. NB. One dot can represent multiple harbour porpoises.

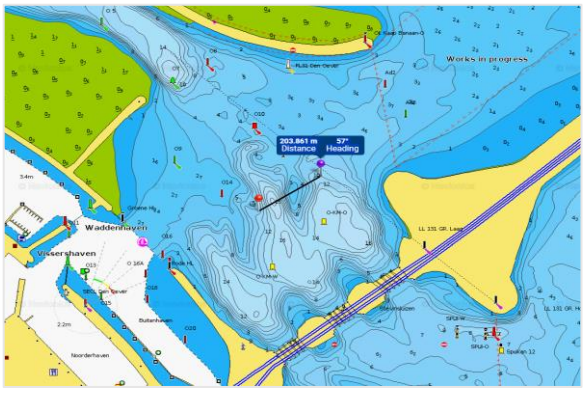


Figure 4-11. Depth profiles around Den Oever (source: webapp.navionics.com). The bar indicates a width of 200 m, the approximate size of the gillnet.

[7] Freshwater fish are being 'flushed out' and may serve as potential easy meals. Additionally, the discharged freshwater from the sluices attracts fish that want to move from the Wadden Sea into Lake IJssel. However, migration into Lake IJssel is still severely hampered, causing large aggregations of fish near the sluices (Griffioen et al., 2014, 2022; Tulp et al., 2013). This might make the area attractive for fish predators.

4.1.5 Terschelling West / Rottummerplaat

4.1.5.1 Relevance to research question

Animals near the Wadden Islands have good access to the North Sea.

4.1.5.2 Accessibility

Due to the remoteness, these locations are relatively inaccessible. Potential catch locations in the vicinity of Rottumerplaat are reachable in 1-1.5 hr by boat from Eemshaven. An alternative harbour is located on the southwestern side of the German island Borkum. Terschelling can be reached from Harlingen haven. In both cases a camp could be set up on the islands (as is done for seal tagging campaigns). However, it leads to less flexibility than when using one of the main land locations, which can be selected more ad hoc based on weather conditions and presence of animals.

4.1.5.3 Harbour porpoise occurrence

Animals are occasionally observed around these areas, but no systematic monitoring has been done, making it relatively hard to predict when animals are present. Data from www.waarneming.nl show a peak in autumn for both locations, which is slightly different from the overall pattern in the region (Figure 4-14, Figure 4-12 & Figure 4-13). This can partly be explained by effort: in autumn many birdwatchers visit these areas, hoping for rarities. Note that due to the presence of grey seal haul-out sites near Terschelling West, there is an increased risk of invertedly catching or disturbing seals.

4.1.5.4 Environmental conditions

The areas are occasionally characterized by periods with strong tidal currents. Although the areas are relatively unsheltered, shallow banks typically have a dampening effect allowing for relatively flat water. West of Terschelling there are relatively narrow areas between banks, which could allow for effective encirclement of porpoises (Figure 4-15).

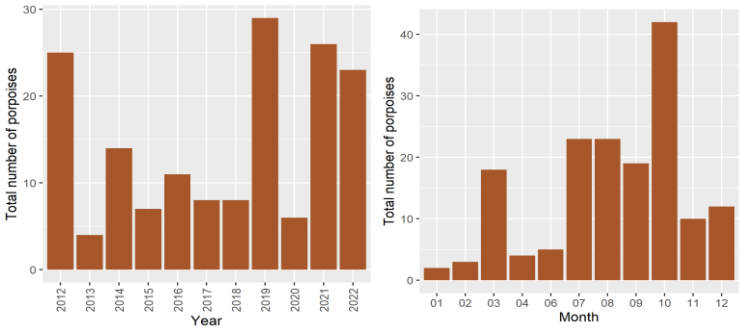


Figure 4-12. Total number of observations per year (left) and month (right) over the period 2012-2022 round the Rottumerplaat, within the area (black outlined) as depicted in Figure 4-14, right. Data from www.waarneming.nl.

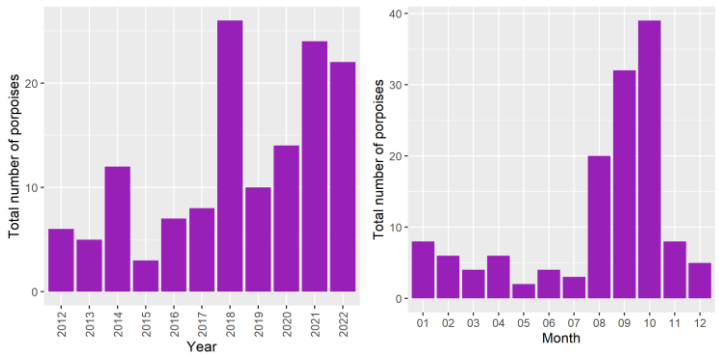


Figure 4-13. Total number of observations per year (left) and month (right) over the period 2012-2022 around the west of Terschelling, within the area (black outlined) as depicted in Figure 4-14, left. Data from www.waarneming.nl.

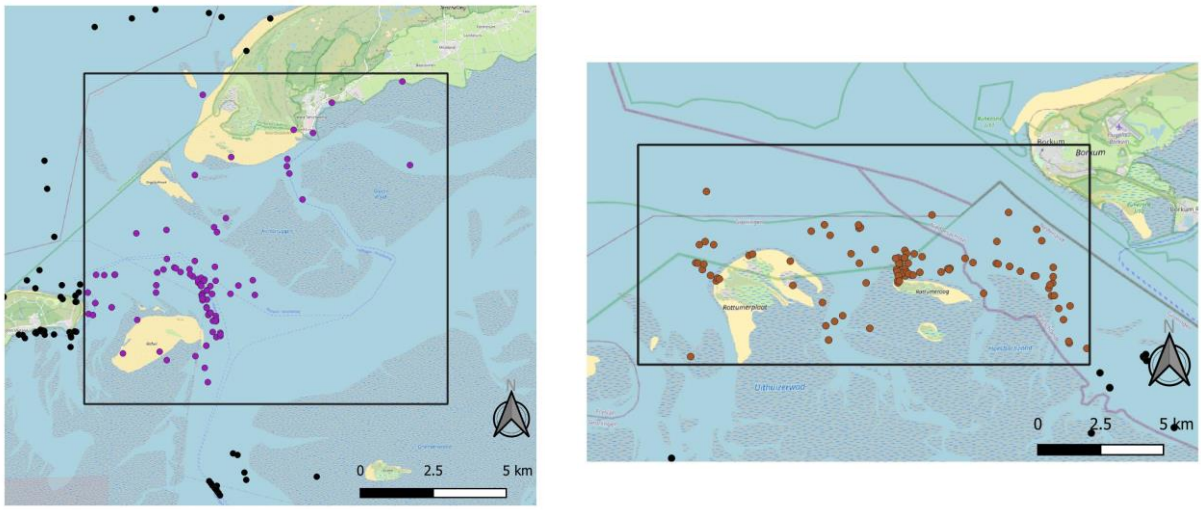


Figure 4-14. Recorded observations (dots) on www.waarneming.nl, from 2012-2022 around the west of Terschelling (left) and the Rottumerplaat (right). Strandings & remains excluded. Purple (left) and brown (right) records included in analyses. NB. One dot can represent multiple harbour porpoises.

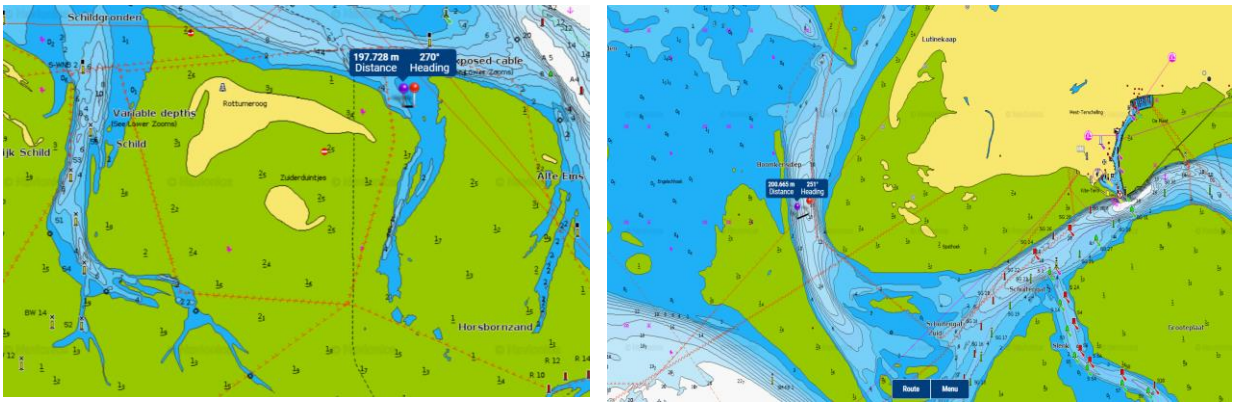


Figure 4-15. Depth profiles west of Terschelling (right) and Rottummerplaat (left) (source: webapp.navionics.com. The bar indicates a width of 200 m, the approximate size of the gillnet.

4.2 Frontal systems near ports (North Sea coast)

4.2.1 Relevance to research question

There are various locations along the North Sea coast where harbour porpoises are sighted frequently. Examples are the piers of IJmuiden, Scheveningen or the mouth of the river Meuse (Figure 4-16).

4.2.2 Accessibility

Such locations are in the vicinity of harbours, and the piers provide lookout points to find and follow porpoises. The areas might, however, be busy with shipping and other activities. Near piers concrete blocks or other hard substrate litters the sea floor.

Figure 4-16. Hot spots of harbour porpoises sightings in the Netherlands, based on data over the period 2012-2022. Data from www.waarneming.nl. NB effort is not homogeneously distributed.

4.2.3 Harbour porpoise occurrence

The occurrence follows the seasonal pattern occurring throughout the southern North Sea coast; so with peaks in spring and autumn and a through in summer (see also Figure 4-23).

4.2.4 Environmental conditions

The fronts between North Sea water and outflow from rivers are known foraging areas for porpoises. A likely candidate location is the IJmuiden pier, where water from the North Sea Canal flows into the North Sea (Figure 4-19 and Figure 4-17). As this location is on the North Sea coast, it is more exposed and thus more challenging in terms of wind, currents, and waves. The presence of a shipping lane to the harbour entrance and steep increase in depth to shore likely makes it more challenging to capture animals. Possibly animals need to be herded away from the shipping lane and towards shore to minimize escaping below the net. A check for underwater obstacles associated with pier needs to be carried out.

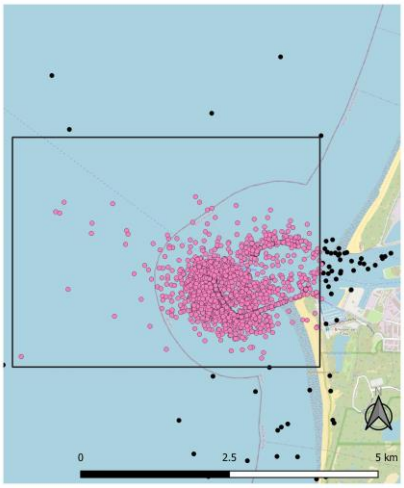


Figure 4-17. Recorded observations (dots) on www.waarneming.nl, from 2012-2022, around the IJmuiden pier. Strandings & remains excluded. Pink records included in analyses. NB. One dot can represent multiple harbour porpoises.

Figure 4-18. Total number of observations per year (left) and month (right) over the period 2012-2022 around the pier of IJmuiden, within the area (black outlined) as depicted in Figure 4-17. Data from www.waarneming.nl.

Figure 4-19. Depth profiles in front of the Port of Ijmuiden (source: webapp.navionics.com), as an illustration of one of the potential tagging sites along the North Sea coast. The bar indicates a width of 200 m, the approximate size of the gillnet.

4.3 Eastern Scheldt

4.3.1 Relevance to research question

The Eastern Scheldt is a semi-enclosed sea-inlet in the south of the Netherlands (Figure 4-20). At the entrance to the North Sea there is a storm surge barrier, which is only fully closed at storm tides. It is unknown to what extent harbour porpoises cross the storm surge barrier (Jansen et al., 2013). The location can therefore not be considered in direct open connection with the North Sea. An advantage of this area is that the tagged animals can potentially be resighted relatively easy after tagging, allowing for monitoring behaviour, health and tag performance and positioning[8]. Such follow-up studies are strongly recommended by the scientific community (Andrews et al., 2019; Norman et al., 2004). Additionally, it would be interesting to find out if harbour porpoises pass the storm surge barrier into the North Sea.

4.3.2 Accessibility

There are many marinas surrounding the Eastern Scheldt. In summer the area can be busy with sailing and other (recreational) vessels, as well as diving activities. The area provides convenient lookout points to find and follow porpoises.

4.3.3 Harbour porpoise occurrence

The area is inhabited by an estimated 60-70 harbour porpoises (Stichting Rugvin, 2022a). There are a few locations where they are sighted very often (almost 100% sighting chance, weather permitting, Figure 4-20). It is assumed that the harbour porpoises occur in the area year-round, although not much research effort has been done during winter. Records from www.waarneming.nl support this pattern; sightings fluctuate throughout the year, although the highest number of records occurred in January for this period (Figure 4-22). The areas along the Zierikzee to Burghsluis coastline (green box in Figure 4-20) have various hotspots with regular presence of animals.

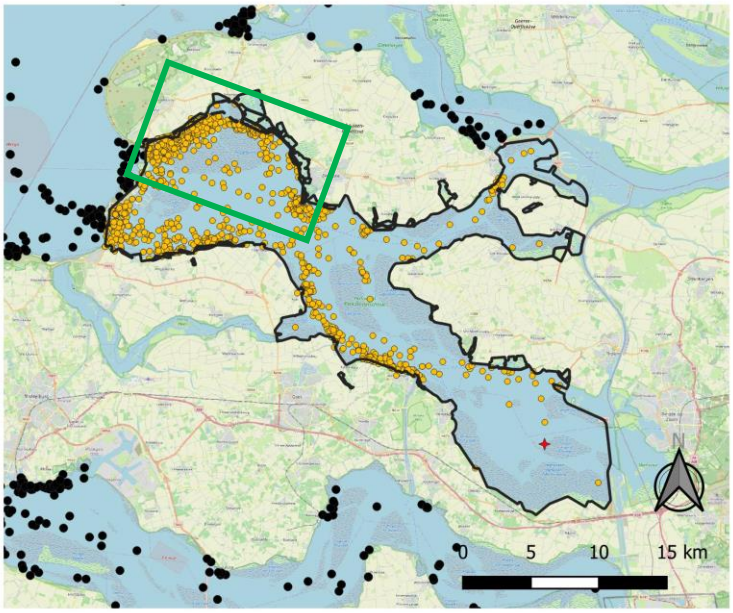


Figure 4-20. Recorded observations (dots) on www.waarneming.nl, from 2012-2022, in the Oosterschelde area. Strandings & remains excluded. Yellow records included in analyses. NB. One dot can represent multiple harbour porpoises. Red star represents location of Dutch pound net (see section 3.1.2). Green box indicated coastline between Zierikzee and Burghsluis.

[8] This is currently not included in the planning/budget.

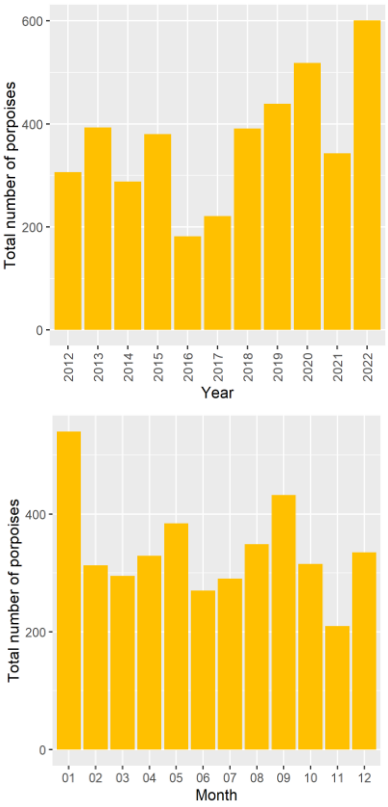


Figure 4-22. Total number of observations per year (top) and month (bottom) over the period 2012-2022 in the Oosterschelde, within the area (black outlined) as depicted in Figure 4-20. Data from www.waarneming.nl.

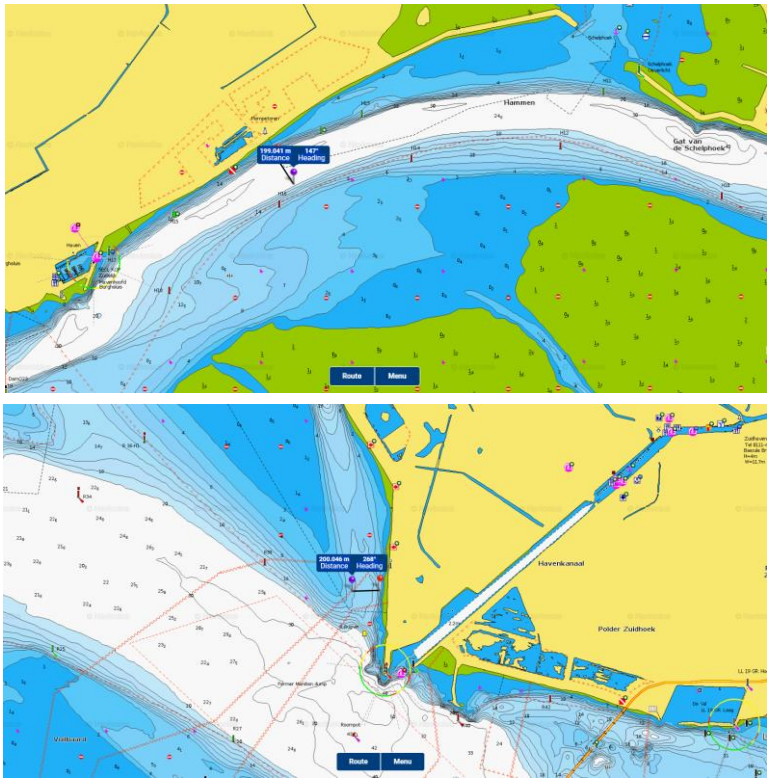


Figure 4-22. Depth profiles in northern part of the Eastern Scheldt near Burghsluis (top) and Zieriekzee (bottom) (source: webapp.navionics.com).The bar indicates a width of 200 m, the approximate size of the gillnet.

4.3.4 Environmental conditions

The conditions are generally calmer than on the North Sea, although (strong) tidal currents can be present. The narrow gullies allow for effective entrapment of porpoises in the area (Figure 4-22). Due to bivalves such as mussels and oysters littering the bottom, care has to be taken to avoid the net getting entangled/damaged.

4.4 Time of Year

The two most important factors (that are beyond the control of the researchers) affecting the success of the fieldwork are weather and porpoise availability. Both strongly vary during the time of year and per location.

Systematic shore-based counts, so-called sea-watching[9], showed the highest sighting rates in the coastal zone (up to 5-10 km from shore) in late winter and early spring, and a strong decrease in April to very low sighting rates in May and June (Camphuysen, 2011; IJsseldijk et al., 2021). Observations on www.waarneming.nl, generally from shore, confirm the near-shore sea-watching pattern, with highest number of observations in winter and autumn and a through in summer (Figure 4-23). However, aerial surveys suggest similar densities and abundances in spring and summer further offshore in the Dutch North Sea (Geelhoed & Scheidat, 2018). Strandings along the Dutch coast, which are affected by abundance, but also by mortality and sea conditions show peaks in spring and summer (IJsseldijk et al., 2020).

Something else to keep in mind concerning the time of year is the chance of encountering (young) calves. Mother-calf pairs should be omitted from this study due to their vulnerability and interdependence (Andrews et al., 2019; Norman et al., 2004), so ideally the tagging does not take place in a period with a high chance of mother-calf pairs. Most calves are born between May and August (Bjørge & Tolley, 2009).

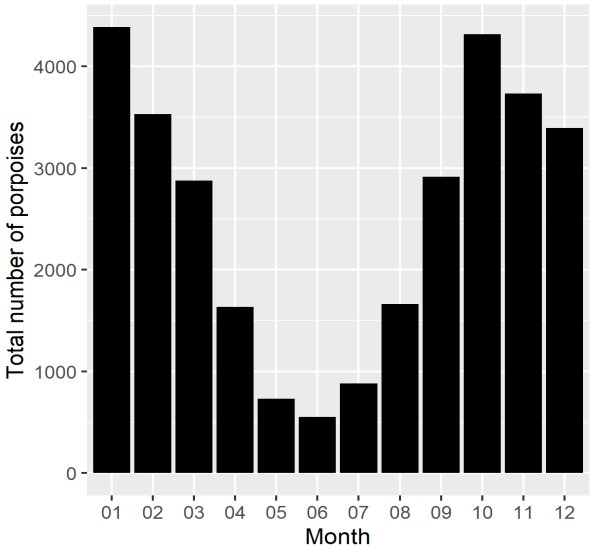
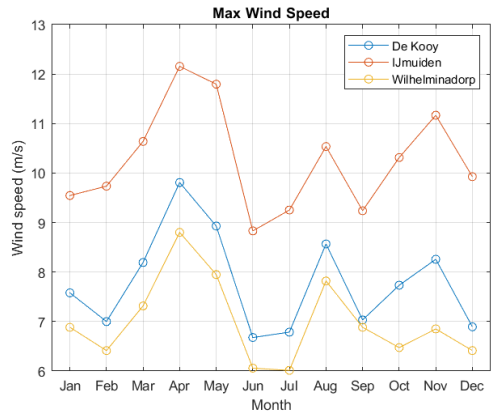


Figure 4-23. Total number of observations per month, over the period 2012-2022 along the Dutch coast. Data from www.waarneming.nl.



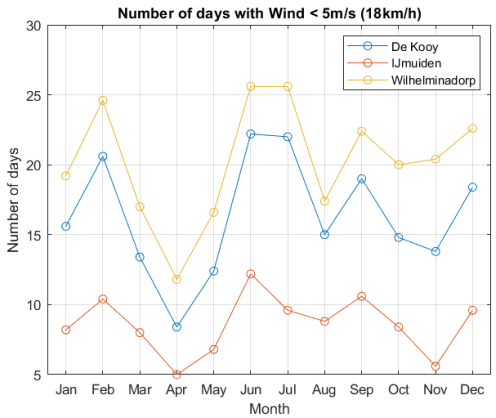


Figure 4-24. Weather conditions (left: mean wind speed; right: number of days with mean wind speed < 5 m/s) for three different locations, based on measurements in 2022 as measured on different weather stations located near potential tagging sites. Wind conditions in the Eastern Scheldt (Wilhelminadorp) tend to be better due to sheltering, providing more workable days with low wind conditions. Conditions at IJmuiden appear worse, likely due to direct exposure to the North Sea.

[9] Aimed at migrating birds, but marine mammals are systematically recorded too.

The active catching relies on being able to detect and track animals for a sufficiently long duration to direct the tagging teams towards the animals. Weather conditions can seriously affect the ability to detect porpoises (Teilmann, 2003), but also the handling of the animal on board of the ship requires calm weather conditions. Good working conditions are expected in periods of low wind speeds (< 5 m/s), within periods of slack tide to avoid strong currents. A comparison of wind data near different tagging locations (Figure 4-24) indicates that, for these locations, weather conditions are best in the Eastern Scheldt (measured at Wilhelminadorp) and worst at the North Sea coastline (measured at IJmuiden), and intermediate near Texel (measured at De Kooy).

4.5 Summary

The suitability of the different potential tagging locations and timing considered can be summarized qualitatively based on different criteria (Table 4-1 and Table 4-2). Optimal conditions appear to be present during February/March, and September. The beginning of May could also be an option for the Eastern Scheldt, but care has to be taken to avoid catching mother/calf pairs or pregnant females (to be released immediately), as this is the start of the calving season.

A practical consideration is that accessibility/flexibility between several sites would be beneficial to optimize use of trial time. Exact timing of the trials will be site-specific. Most potential tagging locations here have reasonable tidal currents (~1 m/s, or 2 kts, but much higher in some areas, e.g. Marsdiep) that have to be considered. Periods of slack tide are preferable to limit the amount of drift during experiments, which could lead to navigational issues and more difficulty in handling nets with a caught porpoise. The first experience with net deployment and recovery during initial dry-runs will provide a better indication for the range of current conditions in which active catching and tagging can be carried out.

Table 4-1. Overview of the environmental conditions and animal presence for selecting good tag locations and periods. Colours indicate qualitative assessment of conditions (Blue: good, Yellow: medium; Red: poor).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Weather												
Abundance Wadden Sea/ North Sea coast												
Abundance Eastern Scheldt												
Calving												
Tourist boat traffic												
Diving activity												

Since the first tagging attempts will be carried out in a pilot study in which experience with the catch method still needs to be gained, it is recommended to follow a stepwise approach. This would entail starting with 'dry-runs', in which no porpoises are caught, but setting and hauling the nets (ideally with a porpoise 'dummy') and cooperation between the ships is practised. This will also allow the team to better assess the time window in which can we worked when strong currents are present. Subsequently, it is recommended to do the first actual tagging attempt in a sheltered location, with little waves and wind and a (relatively) predictable high harbour porpoise occurrence. The Eastern Scheldt seems a logical first location because:

a) Porpoise presence is predictable and relatively high. This also applies -to some extent- to North Sea coastal zone (e.g. IJmuiden) and Marsdiep, but not to other Wadden Sea locations. Furthermore porpoises occur year-round in the Eastern Scheldt, including during the 'good-weather' periods of spring and summer (whereas porpoise occurrence decreases in spring in most other locations).

b) The Eastern Scheldt seems to offer a good trapping opportunity. At low tide, porpoises are 'concentrated' in the wide channel surrounded by shallows. A number of sites in the Wadden Sea have a similar bathymetry, but at many sites there are side channels, making the setting of 260m of net a challenge. In the Marsdiep and the North Sea, the water depth is more or less equal and shallower areas to aid concentrating animals are lacking.
c) Frequency of good weather conditions decreases in the order Eastern Scheldt, Wadden Sea, North Sea. At all sites, good weather conditions are most likely during the May-August period.
d) Shelter and thus relatively calm conditions seem to be most present in Eastern Scheldt and at some Wadden Sea locations, but lack in the North Sea.
e) Related to c and d: average and probability of low or no waves increases in order of Eastern Scheldt, Wadden Sea to, North Sea.

Table 4-2. Overview of the qualitative suitability of potential locations for tagging of porpoises.

Location	Relevance to research question	Porpoise occurren-ce	(Seasonal) predicta-bility	Accessibility	Environ-mental conditions	Shipping Commercial	Shipping recreational off-sseason	Shipping recreational in-season
Wadden Sea general	High	Medium	Medium	Medium	Medium	Low	Medium	High
Marsdiep/Texel	High	High	High	High	Medium/ Poor	High	Medium	High
Wadden Sea Islands	High	Medium	Medium	Low/ Medium	Medium	Low	Medium	Medium
Eems estuary	High	Low	Medium	Low/ Medium	Medium	Mediu m	Medium	Medium
Den Oever	Low/ Medium	Low		High	Medium	Low	Medium	Medium
North Sea (coastline)	High	Low	Medium	High	Poor	High	Medium	Medium
Eastern Scheldt	Low	High	High	High	Good	Low	Low	Medium
North Sea (offshore)	*Out of scope for pilot project*							

Since the data collected in the Eastern Scheldt may not be the most relevant in answering the current research questions (depending on whether the tagged animals cross the storm surge barrier), it is recommended to only tag a very limited number of animals (up to 3) there. As soon as enough experience with the method has been gained, it is recommended to catch and tag at other locations. This leads to the third stage of the pilot project: tagging animals in more challenging conditions at sites with direct connection to the North Sea. Catching at different locations in the Wadden Sea (Den Oever, or south-east of Texel) seems a logical next step given the forementioned conditions. To pinpoint other suitable locations in the Wadden Sea it is necessary to get a more detailed picture of the occurrence of porpoises at potential tagging locations. Danish researchers with experience in tagging porpoises advised to remain flexible in the selected site, and to choose the location depending on actual conditions and presence of animals. For this reason sites that are easily accessible (Texel, Den Oever) are preferred over more distant sites (other Wadden Islands, such as (west) Terschelling or Rottummerplaat). Depending on the learning curve and increase in catching success-rate the next step would be to attempt tagging along the North Sea coastline (e.g. IJmuiden pier).

5 Proposed catching and tagging procedure

After thorough consultation with experts (researchers with field and or porpoise- or seal tagging experience, a veterinarian with experience in porpoises and animal welfare bodies[10]) the following *preliminary* procedure for catching and tagging harbour porpoises in the Dutch North Sea is proposed. It is proposed to use the active catch method of surface gillnet herding. This method involves two or more small boats and potentially lookouts based on shore. The high-level procedure (illustrated in Figure 5-1) consists of the following phases.

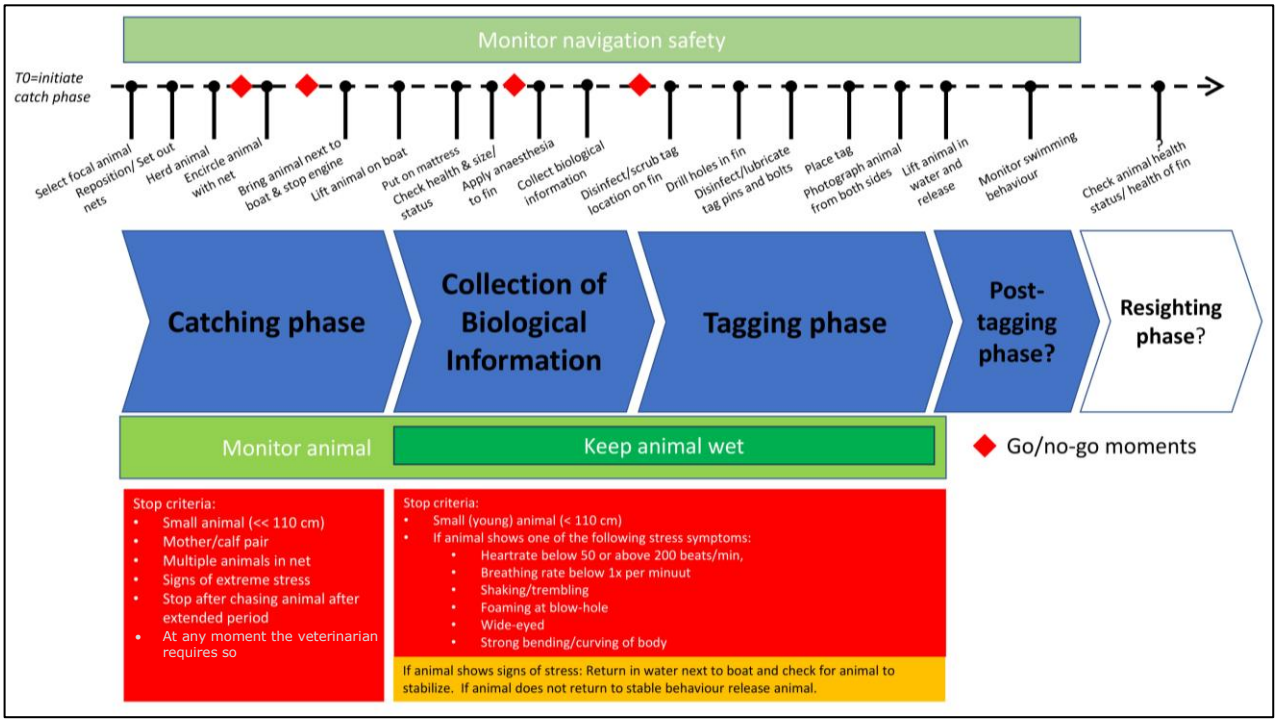


Figure 5-1. High-level protocol for tagging porpoises using active catch method.

1. Catching phase
    a. When a suitable harbour porpoise is sighted from one of the boats or from land, one or more drifting gill nets (130-260 m long, depth depending on catch location, mesh size 180 mm), is set from a dedicated net-boat. One or more boats then herd the porpoise towards the net.
    b. As soon as the porpoise becomes entangled, the boats swiftly drive to the net, where the engines are stopped to prevent further stress to the animal.
    c. The animal is taken out of the net, if necessary by cutting the net.
    d. If multiple animals are caught in the net, one animal will be selected for capturing, and the remainder will be released.
    e. While still in the water, females are checked for (heavy) pregnancy by using an echograph. If pregnancy is determined, the animal will be released immediately.
2. Harbour porpoise on board and selection of animals
    a. The porpoise is carefully lifted onboard, and placed on a stretcher (tailored for porpoises) on foam mattresses.
    b. When the animal is stable on board, a triage to determine if the animal is suited to be tagged, is performed by visually examining the animal for injuries or abnormalities.
    c. A second part of the triage is the length of the animal. Only animals longer than 110cm will be tagged. Animals <110 cm are considered too young and therefore unsuitable for tagging. However, other biological information about the animal will then be collected, to get the most

[10] Instantie voor Dierwelzijn (IvD) of Wageningen Research, Dierexperimentcommissie (DEC) of Wageningen University and Research.

information out of this opportunity without causing much additional discomfort to the discomfort caused by catching it.

d. During the period the animal is on board, its condition is continuously monitored by a designated team member. The animal's breathing is continuously monitored (visually and using a lap time stopwatch). Water is regularly poured over the animal to keep it cool and stimulate breathing. The animal is immediately returned to the water (while placed in the stretcher), if it shows any of the following signs of stress (Norman et al. 2004b; Eskesen et al. 2009): breathing less than once per minute, trembling, foaming at the blowhole, wide-open eyes, strong curvature of the body, and excessive struggling. This usually causes the porpoise to start breathing regularly and to stabilise (Eskesen et al. 2009; J. Teilmann *pers. comm.*, 2023). When the porpoise has stabilised (this can take 5-10 min), the animal can be hoisted back on board and the procedure can be continued. Otherwise, it is released.

3. Collection of biological information phase
    a. Animals considered suitable for tagging (see 2): The dorsal fin is locally anaesthetised by applying anaesthetic ointment to both sides of the dorsal fin. Biological information is collected during the application time of the ointment.
    b. All animals: The animal is weighed in the stretcher using a crane scale
    c. All animals: The girth of the animal is measured at three sites (just in front of the dorsal fin, just behind the dorsal fin and just behind the pectoral fins). The sex is also visually determined.
    d. All animals: Blubber thickness is measured using an ultrasound dorsally and laterally at the same locations as the girth measurements (3c).
    e. All animals: Swabs are collected from the blowhole, genitalia and anus.
    f. All animals: A blood sample is taken from the tail blade of the porpoise.
    g. All animals: The animal is photographed on both sides for potential individual recognition when resighted.
    h. Animals that are not tagged are released after this.
4. Tagging
    a. After about 15 minutes' application time of the anaesthetic ointment (and collection of biological information), the identified tag attachment site on the dorsal fin is cleaned with an antiseptic such as isopropyl alcohol or 10% povidone iodine solution. The area is then medically cleaned.
    b. Then (depending on the type of tag) 1 to 3 holes are drilled in the dorsal fin with a disinfected 8 mm cork drill bit mounted on a slow-speed cordless drill. The satellite transmitter is mounted with silicon-coated nylon threaded bolts and nuts. The threaded bolts are sterilised and smeared with antiseptic ointment before insertion. The biopsies taken from drilling the holes are frozen to allow subsequent analyses (DNA, contaminants).
    c. In addition to photographs for individual recognition the dorsal fin with the tag is also photographed at close range.
5. Release
    a. The tagged porpoise is released by stretcher after max 60 minutes since being caught.
6. Post-tag phase
    a. The behaviour of the porpoise after release is monitored. Given the cryptic nature of porpoises, it is expected that the tagged porpoises can be followed for only a brief period.
7. Resighting phase
    a. Depending on the location and tag type, an attempt at resighting can be done to assess the health of the tagged individual.

Throughout all phases personnel will continuously monitor for navigational safety purposes, as well as potential entanglement of other animals in the net.

This high-level description of the procedure will be worked out in more detail leading up to the field trials, describing, for example, clear go/no-go conditions when to break off the tagging attempt for

safety of the animal, roles and responsibilities of team-members, and equipment (vessels, tagging and medical supplies, safe net deployment procedures). The procedure will be adaptive, meaning that during each catch and tag attempt, the different steps should be carefully recorded, including the timing. After each attempt the process will be evaluated: what went well, what could be improved? Where could time be gained, which operations should be done differently? This should then be taken into account in the next catching attempts, and the protocol should be adjusted accordingly. Experience from initial dry-runs (running the protocol without animals present, potentially with a dummy), and feedback from permitting agencies will also be used to further specify the initial procedures.

6 Collection of information and/or samples during restraint

The capturing of wild porpoises provides a unique opportunity to obtain biological samples from healthy individuals. Such information can help understand the population health status, and can be compared to data collected from stranded individuals. Here we summarize the type of samples that could be collected during the period in which the animal is restrained on deck during the tagging process.

- Measuring length & girth: this can be considered obligatory since it tells you something about the health and age of the animal. As such, it could serve as one of the criteria to decide on whether to tag an animal or not (for example by not tagging animals under a certain length). Additionally, the combination of length and girth can inform about the nutritional state and thus health of the animal (Stepien et al., 2023), and help decide whether an animal is fit for tagging.
- Gender: this is relatively easy to determine (see Annex 1), and is useful for later interpretation of the results and variation between sexes.
- Eye, blowhole, genital and anal swabs: these can (later) be tested for bacteria, viruses and parasites
- Blood sample: a blood sample can be taken from the fluke; this can later be tested for diseases, but also for stress hormones, pregnancy and DNA.
- Blubber thickness: blubber thickness can inform about nutritional state of the animal, although it is affected by other factors too (water temperature, season, measuring position on the body, body size, age, sex, etc. (Kastelein et al., 1997, 2018, 2019)). This can be measured with an ultrasound.
- DNA: DNA analyses can inform about population structure and help determine whether a population consist of (genetically differentiated) subpopulations and next-of-kin analyses which are relevant for conservation of the species. The samples can, for example, be compared to samples from other countries in Europe (Norway, Denmark, UK) or even from North-America (e.g. Olsen et al. 2022). In the tagging procedure, a biopsy is automatically taken during the drilling of holes through the dorsal fin. This biopsy can later be analysed for DNA. Alternatively, a skin scraping or blood sample could be taken instead.
- (Fat) biopsy: the biopsy taken from the dorsal fin can also potentially be analysed for pollutants. Cetaceans accumulate persistent organic pollutants (POPs) and heavy metals due to their relative longevity and function as a top predator. Concentrations of those in cetacean tissues can infer about contamination levels within the species and the ecosystem (IJsseldijk et al., 2018; van den Heuvel-Greve et al., 2021).
- Photo(-ID): harbour porpoises can be individually identified based on pigmenting, the shape of their dorsal fin and scars and marks (Elliser et al., 2022; Stichting Rugvin, 2022b). Taking a photo of the animal on both sides allows for comparing with earlier or later photos and thus for potential identification. Moreover, a close-up of the attached tag could help investigate the development of the tag site (healing, potential migration) if compared to follow-up pictures.

Every sample that is collected may have an effect on the animal, and potentially increases handling time. The benefits of taking additional samples should therefore always be weighed against the additional impacts on wellbeing. Samples should be taken by personnel with the necessary training.

It is recommended to at least measure the animals' length, girth and blubber thickness, determine their gender and take photos (for potential photo-ID and to follow development of the tag attachment site). These can be obtained with relatively limited additional handling time. Additionally, a biopsy of the dorsal fin will be available as a result of the tagging procedure. Other samples, such as swabs and blood samples can be taken once the team is experienced with handling the animal.

7 Project risk assessment

There are certain risks associated with this project, specifically with the fieldwork. These include risks for the animals and personnel involved, and other project-related risks related to timing, budget and quality of the project outcome. In addition, project risks related to stakeholder management and (social) media attention can be identified. A risk analysis of each identified threat determined the probability of its occurrence, as well as the severity of its effect, may the threat actually occur. The combination of these two leads to a certain risk category (Table 7-1). Table 7-3 presents the identified risks as well as suggested measures (also see Table 7-2).

Table 7-1. Risk assessment table and risk categories.

Probability							
	>80%	5					
	40-80%	4					
	10-40%	3					
	1-10%	2					
	< 1%	1					
RISK MATRIX			1	2	3	4	5
			Negligible		Medium		Severe
			Severity effect				

Acceptable risk; no priority, no measure(s) necessary
Some risk; attention necessary, no measure(s) necessary
Important risk; decide per case whether measure(s) necessary
High risk; direct improvement necessary, develop measure(s)
Very high risk; stop activities, develop measure(s)

Table 7-2. Type of measures and their definition

Type of measures	**Definition**
Avoid	*The chance/possibility of occurrence of a particular risk is eliminated; the risk is avoided*
Limit	*The aim is to reduce the cause or effect of the risk. If an attempt is made to reduce the cause, this measure is carried out in advance.*
Share	*Sharing a risk does not directly eliminate the risk, but reduces it because it is expected or agreed that another party will be able to manage or bear the risk.*
Accept	*A choice can also be to accept a risk. This often involves including extra money for this in your estimate, or adjusting the schedule.*

Table 7-3. Identified project risks associated with the pilot porpoise tagging study with their associated probability, severity, risk category and suggested measures. The threats are ordered from high to low risk.

Threat	**Proba-bility**	**Severity effect**	**Risk category**	**Measure**
Catching in the North Sea or adjacent waters appears to be challenging, and more alternatives need to be sorted out	5	5	Very high risk	Avoid: explore feasibility, be creative, explore all options, involve right experts. Get experience in calmer conditions. Otherwise; Accept, terminate project.
Permits are not ready in time or not issued at all	3	5	High risk	Avoid: prepare the applications well and in time, discuss with experts Otherwise accept: delay (in case of not ready in time) or terminate project (in case of not issued at all)
Catching turns out to be impossible after different approaches	4	5	High risk	See previous risk. Accept, terminate project
Presence of animals is limiting the efficacy of field work	3	4-5 (depends on actual number of animals)	High risk	No animals: Accept/adjust → try different season/location. Use approach that is easily translatable to other locations. Few animals: Accept

NGOs/stakeholders question usefulness and necessity	4	2	Important risk	Avoid/Limit: Involve stakeholders early in the process, keep them informed, prepare a good communication protocol, including the rationale for the project.
Negative publicity arises in the media	4	2	Important risk	Avoid: Involve stakeholders early in the process, keep them informed, prepare a good communication protocol in order to respond to (public) messages and opinions, including the rationale for the project. Otherwise accept.
The fieldwork is disturbed by 'protesters'	1	5	Important risk	Avoid: Involve stakeholders early in the process, keep them informed, prepare a good communication protocol in order to respond to (public) messages and opinions, including the rationale for the project. Be discrete with information/specific fieldwork information and protect privacy of team members.
An animal dies during a tagging attempt	1-2	5	Important risk	Avoid: develop strict protocols (including decisions to leave animal alone), use experienced teams, cooperate with vet If it occurs: limit/share: be transparent about it, follow communication protocol, investigate cause of death. Decide whether to terminate project or conduct new attempt. Adapted protocol if deemed necessary to avoid future risks.
WMR does not have enough capacity	2	5	Important risk	Avoid: plan in advance, if limited capacity: involve more people
Aarhus does not have enough capacity (at the right moment)	2	5	Important risk	Plan well in advance, accept, adjust planning
Insufficient data is collected to do any analyses	4-5	1-2	Important risk	Accept, think about project continuation/elongating
Satellite tags are not readily available	2	5	Important risk	Adjust planning and budget, order tags well in advance
Acoustic tags are not readily available	5	2	Important risk	Adjust planning and budget, order tags well in advance. Accept, currently not priority tag type.
There is not enough money to finish the project	2	5	Important risk	Avoid/adjust, keep track of budgets during project, communicate in time about (un)expected/coming shortages
Contracts are causing a serious delay	4-5	2	Important risk	Accept: delay
Accident with person during fieldwork	1	5	Important risk	Avoid: develop, and closely adhere to safety protocols
Fishers refuse to cooperate on catching methods	2	2	Acceptable risk	Avoid: make sure we're not (too) dependent on fishers, get knowledge somewhere else (WMR/RWS/NIOZ/Aarhus…)
TNO does not have enough capacity	1	3	Acceptable risk	Avoid: plan in advance, if limited capacity: involve more people

8 Synthesis and recommendations

A detailed analysis was carried out to evaluate different methods to catch and tag porpoises in Dutch waters, for the purpose of carrying out a pilot study aimed at tagging porpoises to study their movement patterns in the North Sea. The analysis consisted of literature study, discussions with experts (researchers with field and or porpoise- or seal tagging experience, a veterinarian with experience in porpoises and animal welfare bodies), and a review of environmental conditions and presence of porpoises at different locations. From this evaluation we conclude that tagging of porpoises is feasible. Our recommendations for the different aspects can be summarized as follows.

8.1 Catching method

Different catching approaches were considered. Based on Table *3-1* it is recommended to start with an active catching strategy, of which the surface gillnet herding is considered the most feasible in Dutch waters. The main arguments for this are (i) the method has been applied with success, with experience being available and (ii) it provides the highest flexibility in both tag location and timing; it can be planned, deployed in various locations and can be optimized for animal presence and environmental conditions. The method should, however, be tested in and adjusted to Dutch waters.

Passive methods could be revisited later on, once more experience has been built up in the Netherlands, and depending on the outcome of the active catching experiments of the pilot project.

8.2 Tag location & time

Since the first tagging attempts will be carried out in a pilot study in which experience with the catch method still needs to be gained, it is recommended to follow a stepwise approach. This would entail starting with 'dry-runs', in which no porpoises are caught, but setting and hauling the nets (ideally with a 'porpoise dummy') and cooperation between the ships is practised. This will also allow the team to better assess the time window in which can be worked and when strong currents are present. Subsequently, it is recommended to do the first actual tagging attempt in a sheltered location, with little waves and wind and a (relatively) predictable high harbour porpoise occurrence. The Eastern Scheldt seems a logical first location. Since the data collected in the Eastern Scheldt may not be the most relevant in answering the current research questions (depending on whether the tagged animals cross the storm surge barrier), it is recommended to only tag a very limited number of animals (up to 3) there. As soon as enough experience with the method has been gained, it is recommended to catch and tag at other locations. This leads to the third stage of the pilot project: tagging animals in more challenging conditions at sites with direct connection to the North Sea. Catching at different locations in the Wadden Sea (Den Oever, or south-east of Texel) seems a logical next step given the forementioned conditions. To pinpoint other suitable locations in the Wadden Sea it is necessary to get a more detailed picture of the occurrence of porpoises at potential tagging locations. Danish researchers with experience in tagging porpoises advised to remain flexible in the selected site, and to choose the location depending on actual conditions and presence of animals. For this reason sites that are easily accessible (Texel, Den Oever) are preferred over more distant sites (other Wadden Islands, such as (west) Terschelling or Rottummerplaat). Depending on the learning curve and increase in catching success-rate, the next step would be to attempt tagging along the North Sea coastline (e.g. IJmuiden pier). Exact timing of the trials will be site-specific. Optimal conditions appear to be present during February/March, and September. The beginning of May could also be an option for the Eastern Scheldt, but care has to be taken to avoid catching mother/calf pairs or pregnant females (to be released immediately), as this is the start of the calving season. After the pilot phase, once more experience has been gained in the catch method, one can evaluate the potential of tagging porpoises in even more challenging conditions, such as near (potential) wind-farm locations, or further offshore.

8.3 Tag type

It is never 100% sure what effect the tags have on the animals. However, the experience and results from Denmark/Greenland and the judgement of the veterinarian lead to the conclusion that, despite some initial pain, hydrodynamic drag and a small risk of complications (Vrooman et al., 2022), the effects of tag attachment on the animal's wellbeing could be considered acceptable (if, of course, weighed against the advantages of the research for the whole population).

Different tag types that are currently available on the market were evaluated in chapter 2. It is recommended to apply different tag types during the pilot project, to obtain complementary data needed to address the main research question, and evaluate their relative contribution to addressing this question. Based on that, in combination with the research questions and the recommendation to start in the Eastern Scheldt, it is recommended to start with the following tag models: SPLASH10-336, SPOT-196J, SPOT-F-398. This allows for comparison of:

- Configuration: the SPLASH10-336 & SPOT-196J are attached with 3 pins on the side of the fin, the SPOT-F-398 with 1 or 2 on the back
- Location accuracy: the SPOT-F-398 has Fastloc® GPS, providing more accurate location data than Argos (potentially specifically relevant in a smaller location such as the Eastern Scheldt).
- Depth: The SPLASH10-336 also collects depth data, the others do not.

Practical suitability of these different models can be tested, as well as duration of transmission[1]. The added value of temperature, depth and GPS data can also be considered. Based on this it can then be decided which tags are most suitable for the later stages of the project.

8.4 Adaptive tagging protocol

For the active catching and tagging approach to work and be safe for the animals, an adaptive protocol needs to be adopted and fully specified at the start of the tagging field work. A high-level description of the protocol for the catching and tagging procedure, as laid out in Chapter 5, describes the key considerations on how the animals are approached and handled on deck. This high-level description of the procedure will be worked out in more detail leading up to the field trials. Experience from initial dry-runs (running the protocol without animals present, potentially with a dummy), and feedback from permitting agencies will be used to support the start-up of the procedures.

8.5 Collecting additional information

It is recommended to at least measure the animals' length, girth and blubber thickness, determine their gender and take photos (for potential photo-ID and to follow development of the tag attachment site). Additionally, a biopsy of the dorsal fin will be available as a result of the tagging procedure. Other samples, such as swabs and blood samples can be taken once the team is experienced with handling the animal.

9 Quality Assurance

Wageningen Marine Research utilises an ISO 9001:2015 certified quality management system. The organisation has been certified since 27 February 2001. The certification was issued by DNV.

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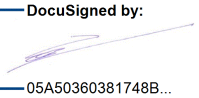
Justification

Report C019/24
Project Number: 4318100423

The scientific quality of this report has been peer reviewed by a colleague scientist and a member of the Management Team of Wageningen Marine Research

Approved:	dr. H.V. Winter Scientific researcher
Signature:	DocuSigned by:  05A50360381748B...
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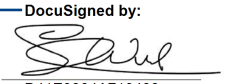
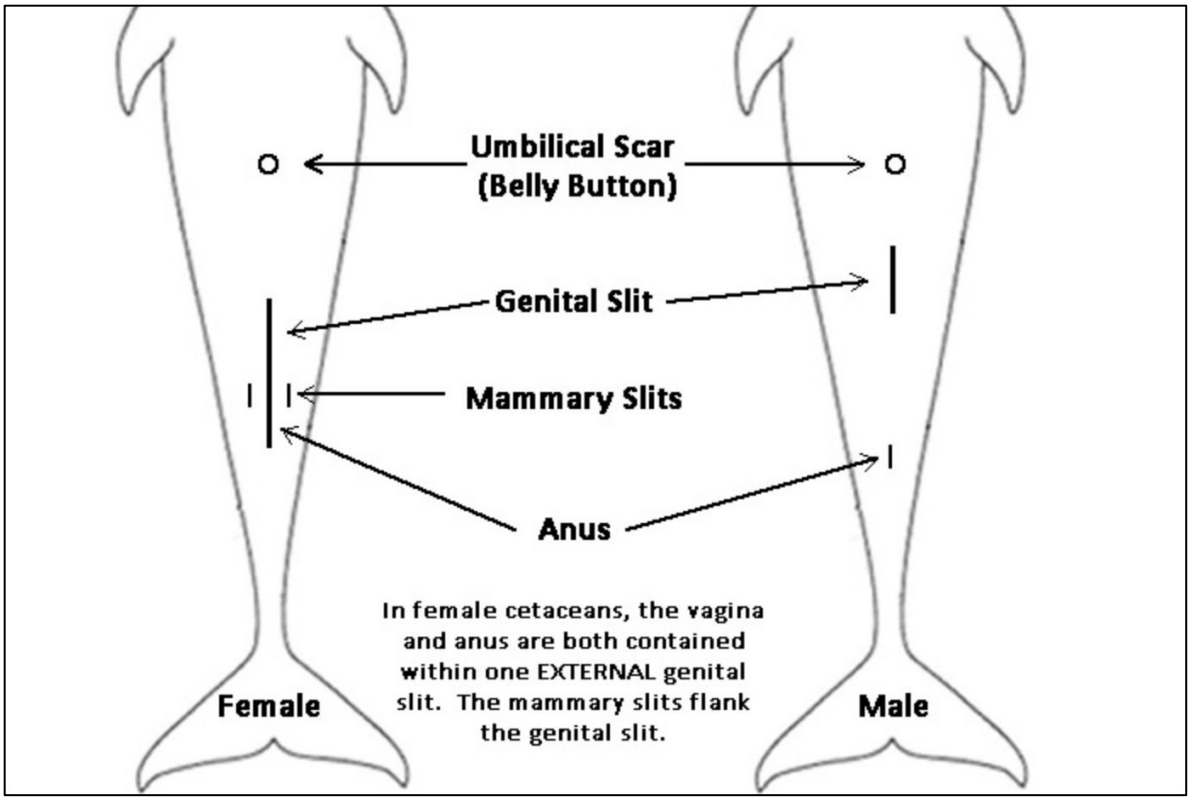
Approved:	C.J. Wiebinga Business Manager Projects
Signature:	DocuSigned by:  D41E9304A710493...
Date:	29 March 2024

Annex 1 Gender determination cetaceans

From: https://mmapl.ucsc.edu/basic-response/gender-id/cetaceans



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With knowledge, independent scientific research and advice, **Wageningen Marine Research** substantially contributes to more sustainable and more careful management, use and protection of natural riches in marine, coastal and freshwater areas.

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