The feasibility of tagging harbour porpoises in Dutch waters

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IMARES rapport
C009/16

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Report number C009/16

IMARES Wageningen UR
(IMARES - Institute for Marine Resources & Ecosystem Studies)

Client: Jeroen Vis
PO Box 20401
2500 EK Den Haag
The Netherlands

BO-11-018.02-000-IMARES-2 (K_NenR_166)

Publication date: 11th February 2016

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Recommended format for purposes of citation: Scheidat M, Bos O & Geelhoed SCV (2016) The feasibility of tagging harbour porpoises in Dutch waters. IMARES Report [C009/16]

P.O. Box 68
1970 AB IJmuiden
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 26
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 77
4400 AB Yerseke
Phone: +31 (0)317 48 09 00
Fax: +31 (0)317 48 73 59
E-Mail: imares@wur.nl
www.imares.wur.nl

P.O. Box 57
1780 AB Den Helder
Phone: +31 (0)317 48 09 00
Fax: +31 (0)223 63 06 87
E-Mail: imares@wur.nl
www.imares.wur.nl

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Contents

1. Summary

The tagging of harbour porpoise (*Phocoena phocosena*) with satellite-linked locators or time-depth recorders allows researchers to obtain data on the behaviour and ecology of this species. It is also a valuable tool to investigate the impact of human activities on individuals and a number of recent publications have highlighted that for porpoises in Dutch waters this knowledge is still scarce.

However, tagging also impacts the animals. In this report we are providing: 1) an overview of the technical status and the different types of tags, 2) how tags have been used in other areas on porpoises, 3) how tags can be attached to porpoises, 4) how porpoises can be obtained for tagging, and 5) what the legal framework for tagging in the Netherlands is. Finally we discuss relevant research questions and their relationship with current and future projects in The Netherlands and propose suitable pilot studies that take the results of this review into account.

A large number of different types of tags is available, such as satellite transmitters, time-depth recorders or tags that can record both the vocalisations of animals as well as the surrounding sounds, so-called acoustic tags. What tag is best suitable is linked to the research question that needs to be answered. Position tags, however, are always needed. Two systems are in use: the transmit signal to satellite Argos system, and the receive signal from satellite Fastloc GPS system. Some of the possible applications and possible effects of tagging on harbour porpoises are showcased in this report.

The attachment of tags on the porpoise can either be invasive, by using pins that are put through the dorsal fin, or non-invasive, by using detachable suction cups. Tags that are secured using pins generally stay on the animal much longer than those that are non-invasive. Alternative attachment ways have been investigated, but none are applicable yet. To attach the invasive tags, porpoises need to be handled directly. Most accessible are animals that are being rehabilitated, for example after they have stranded alive. Catching of porpoises is a challenge in North Sea waters. In other countries both stationary weir-like nets or actively pulled nets have successfully been used for live-capture of animals. For other cetacean species detachable tags are often deployed in the wild using cross-bows; this is potentially possible for porpoises also.

Tagging in the Netherlands involves a number of legal steps aimed at ensuring animal welfare. When considering tagging to answer a well-defined research question, a number of important points need to be taken into account: sample size and representativeness of the sample, impact on the natural behaviour of the tagged porpoise as well as the ethics of using a wild animal for research.

The potential impact on the animals varies between the different attachment methods. When considering tagging as a research method, the potential positive effect for the larger population has to be weighed against the potential negative effect on the individual.

To conclude this report, we propose that the best way forward, to better understand the ecology of the harbour porpoises in Dutch waters through tracking individuals, is to start by investigating some of the less invasive methods for tagging (small trailing edge tag, detachable tag) and apply them to captive-cared animals, or incidental captures (e.g. weir fishery) prior to trialling any wild capture programs. This would provide an insight into what methods could best work in The Netherlands, whilst also providing the first data on the behaviour of individual harbour porpoises in Dutch waters. Any kind of tagging project should involve the expertise of research groups that have used and/or are undertaking tracking studies of small cetaceans, particularly harbour porpoises.

2. Introduction

It is generally agreed that the use of tracking devices, such as satellite-linked locators or time-depth recorders (collectively referred to as 'tags'), can greatly improve our understanding of harbour porpoise (*Phocoena phocosena*) behaviour and ecology. But tagging also has an impact on animals, through the stress and potential injury during capture and the carrying of a device that will increase hydrodynamic drag. Animal welfare needs to be considered and carefully weighed against how increased knowledge could aid the conservation of this species.

The rationale for this report is based on the question "is it feasible to tag harbour porpoises in Dutch waters?" This research is commissioned by the Ministry of Economic Affairs.

A number of knowledge gaps concerning harbour porpoise biology in the Dutch North Sea have been identified in recent reviews, for example in the Dutch Harbour Porpoise Conservation Plan (Camphuysen & Siemensma 2011) and in a recent study by Heinis et al. (2015) on the cumulative effects of impulsive underwater noise on marine mammals. For The Netherlands specifically, we are still struggling to understand what drives harbour porpoise distribution and how is their behaviour influenced by anthropogenic activities, such as the building of offshore wind farms. On a larger scale, we do know that harbour porpoises are present in the Dutch North Sea year-round, however, we still do not understand their migration patterns within the North Sea.

In this report we will review current knowledge of:

- the technical status and the different types of tags;
- the world-wide use of tags, in particular on harbour porpoises;
- how to attach tags to the animals;
- how to obtain harbour porpoises for tagging;
- the legal framework for tagging in the Netherlands;
- relevant research questions and their relationship with current and future projects in The Netherlands.

Based on this last point, we will also:

- propose suitable pilot studies that could be conducted.

Recently, reviews of the technical aspects of tagging harbour porpoise were published (Lucke 2013, Teilmann & Siebert 2011). The results of these reviews have been incorporated in this document.

3. History of tagging harbour porpoises

The first dedicated research projects for using tags on harbour porpoises began in the seventies in the Bay of Fundy in Canada (Gaskin et al, 1975) and continued in 1981-1983 (Read & Gaskin 1985, Read et al. 1996). In the Bay of Fundy, harbour porpoises would regularly swim into the weirs of fishermen. The fishermen would then call the researchers and the animals were shifted into small boats where they were measured, examined, tagged and released (see section 3.3). VHF-transmitters were used, that had a maximum transmitting range across open water of 15-20 km. Tagged porpoises could be followed for up to 22 days (Read & Gaskin 1985). These telemetry studies were hampered by short periods of contact with tagged porpoises due to the animals' very short surface interval and the resulting difficulty of tracking at sea (Read & Westgate 1997).
The development and miniaturization of satellite-linked transmitters boosted telemetry studies. In the Bay of Fundy in 1994-1995, nine porpoises were equipped with satellite-linked transmitters and time-depth recorders. The tag design tried to reduce the drag of the device on the dorsal fin, and different designs were tried out. The actual attachment of the tags on the animals was by several bolts that passed through the dorsal fin. Satellite-linked tags were used, which could transmit the position of the porpoises to the ARGOS system. The data collected could also provide information on the quality of the position as well as the time the tag was above water. To save battery life a saltwater switch was used, which delayed transmissions until the tag was clear of the water, and data collection was not continuous. Individual porpoises could be followed for up to a maximum of 212 days. The results of these studies suggested that side-mounted tags had the best chances of delivering long-term data (Read et al. 1996, Read & Westgate 1997).

Two years after the Canadian studies, tagging of harbour porpoises started in Danish waters (e.g. Linnenschmidt et al. 2007, Teilmann et al. 2007, Teilmann et al. 2013). Between 1997 and 2008 more than sixty harbour porpoises were tagged. These animals were all unintentionally trapped in pound nets in Danish waters (see section 3.3). Pound nets are used all around Denmark, except in the North Sea. They consist of a lead net extending from the beach out to a distance of 1 km and ending in a trap. The trap is constructed in the shape of a pot (a bag net) allowing the trapped porpoise to breathe at the surface. The circumference of the bag is 40-80 m with a mesh size of about 2 cm. The meshes are too small for entanglement and the harbour porpoises are rarely injured and can swim around freely and dive to depths of 5-10 m. Harbour porpoises were usually captured and tagged within 24 h of being discovered by the fishermen. The animals were released after about 30 min. of handling.

In 2012, a study by Mads Peter Heide Jørgensen was initiated to catch and tag harbour porpoises in Greenlandic waters (see http://www.natur.gl/en/birds-and-mammals/marine-mammals/harbour-porpoise/satellite-tracking-harbour-porpoises/). The researchers from the Greenland Institute of Natural Resources worked together with hunters from Maniitsoq, and managed to tag two harbour porpoises with satellite transmitters. They used a salmon net in open water to catch the animals (see section 3.3). This study is ongoing and more results are expected to be available in Spring 2016.

4. Tagging of porpoises

3.1 Technical status of “tags”

This section is largely based on the review by Lucke (2013). Two categories of tags can be distinguished: those that need to be recovered to retrieve the collected data and those that transmit information to a receiver. The basic data collected is position. This can be augmented with finer-scale movement data, sound data and abiotic data, such as light and temperature levels. An overview of the different tag types can be found in table 1.

Table 1. Overview of different tag types and the data they can collect.

Tag type	**Brief description**
Positioning tags	
Argos	less accurate, transmit unique code and location determined based on code received by satellites, months-year duration
Fastloc GPS	more accurate, receive signals from satellites and determine location on board, location data then needs to be transmitted or tag retrieval is required, months duration
Recording dive behaviour	
Time-Depth-Recorder (TDR)	high resolution, weeks-months duration
Accelerometers & compass (in 2-D or 3-D)	detailed body movements, feeding behaviour, avoidance behaviour, days-weeks duration
Satellite linked dive recorder	low resolution, histograms or sample of dives, transmitting, months-year duration
Acoustic tags - need to be retrieved to download the recorded data	
A-tag	echolocation event recorder, recording data, days duration
D-Tag	full bandwidth recorder, recording data, hours duration, includes dive recorder, accelerometers and VHF
Bioacoustic probe	full bandwidth recorder up to 20 kHz, depth, temperature and 2D acceleration, recording data, hours duration
For recovery after detachment from the animal, additional equipment is necessary:	
Releaser mechanism	pins or suction cup
Timed	small, predictable
Corrosive metals	small, less predictable
Acoustic releaser	bigger, predictable
Retrieval equipment	
VHF transmitter attached to tag	range – line of sight
VHF receiver radio	necessary for finding a tag in open sea

Positioning tags

The use of the different tags depends on the research question. Position tags, however, are always needed. Currently for harbour porpoise location determinations, two systems are in use: the transmit signal to satellite Argos system, and the receive signal from satellite Fastloc GPS system.

<u>Argos system</u>

Argos satellite transmitters have been widely used for porpoise and seal tracking studies. A transmitter on the tag transmits a unique code which is detected by Argos equipment on board several satellites that orbit around the globe. Locations are calculated by measuring the Doppler shift on the transmitted signals that are received at two or more satellites.

The advantage of this system is that it only requires the transmitter to be in the air for 0.25 seconds to transmit to the satellite and that the researcher will have locations of the animal within 30 min. The short but powerful transmission and no need for data processing in the transmitter also permit battery life up to 1.5 years for porpoises (Teilmann unpublished data) and 1 year for seals (e.g. Born et al. 2004). The downside of this system is that the accuracy of locations can range from a few meters up to several kilometres.

Fastloc GPS system

The GPS system differs fundamentally from the Argos system as it is a receiving system rather than a transmitting system. The signals from the satellites are received and a location is calculated and stored inside the GPS tag. Therefore the tag needs to be retrieved from the animal or another system needs to transmit the GPS locations to a receiver on land. The traditional GPS system requires 30-60 sec to record a location, which does not work well for marine mammals at sea. The Fastloc GPS system developed in 2002 can provide accurate locations from marine mammals that expose a tag to the air for 10s of milliseconds (e.g. Patterson et al. 2010). The advantage of the Fastloc GPS is accurate locations almost every time an animal surfaces (if it coincides with the designated sampling rate) but the challenge is to make it small enough to be carried by porpoises as well as release the tag and get it back. The longevity of the Fastloc GPS on animals are in principle the same as for the Argos, but the size of equivalent tags are larger. A downside of Fastloc is that transmission of the location data may require more battery life, and it could be days to receive data on the location of the animal.

Recording swimming and diving behaviour

Time-Depth-Recorder

Since the 1960s, time-depth-recorders (TDR's) have been used to record time and dive depths for marine mammals (Kooyman 1965). A recent review of available types was written by Johnston et al, 2009. Different types have different data resolutions, sampling rates and accuracies. Current instruments record data at user defined intervals, usually every one or few seconds. Additional sensors, like temperature, light level and salinity, can be added to these instruments depending on the objective of the study.

Accelerometers and compass

In the more advanced loggers swimming speed, 3D compass and 2D or 3D accelerometers have been added to be able to get detailed tracks of animals under water. These tracks can be used to analyse e.g. dead reckoning, feeding behaviour or response to noise (e.g. Madsen et al. 2006, Wilson et al. 2008, Akamatsu et al. 2010).

Satellite linked dive recorders (SLDR)

Depth and other sensor data can also be recorded and relayed through Argos satellite transmitters. However, these devices have a limited maximum number of transmissions and a limited capacity per transmission. For example, Danish studies could only obtain data for parts of a day (e.g. Sveegaard et al. 2011). They set the transmitter to transmit every 45 s when at the surface. When the preset maximum number of transmissions was reached (250 [= 4–7 h/d] or 1,000 [= 22–24 h/d]) no further positions were available for that day.

Acoustic tags

A-tag

The A-tag is designed to record high frequency echolocation signals from small cetaceans (Akamatsu et al. 2005). It is capable of distinguishing between signals emitted by the animal carrying the transmitter and those of other animals. The tag functions like an ultrasonic event recorder. The sampling frequency of 2 kHz provides a time resolution and shortest click interval of 0.5 ms. The total recording time is battery limited to 60-70 h continuous recording. Duty cycle can be set to extent the period over which recordings are made. The instrument fits into a cylindrical waterproof housing measuring 21 x 122 mm and weighing 77 g. The A-tag has to be imbedded in a float for positive buoyancy after detachment from the animal. A VHF transmitter also needs to fit into the float for locating the float after detachment.

D-Tag

The digital acoustic recording tag or D-tag is a motion and acoustic tag. When combined with TDR, accelerometer and compass sensors it is able to relate the acoustic recordings to the behaviour of the animal. The D-tag is built into a hydrodynamic floating house with four suction cups that can be released with a timer. For retrieval a VHF tag emits from the rear end. The D-tag has provided unique results for frequencies up to 45 kHz with stereo hydrophones (Madsen et al. 2006). The D-tag is a full bandwidth recorder from about 50 Hz to 160 kHz that can be set by the user. The memory and battery capacity is designed to last for up to 48 hours depending on sampling frequency and whether one or two sound channels are used.

Bioacoustic probe (Acousonde™)

This acoustic tag is developed for large whales or seals that use lower frequency vocalisation or for recordings of background noise (Burgess 2008). In its latest version it optionally records up to 114 kHz and has depth, temperature, 3D compass, 3D tilt and ambient light sensors. The tag can be applied with two suction cups and retrieved by a VHF transmitter and a strobe light.

3.2 Attachment of the tags

Tags need to be securely attached to a harbour porpoise and ensure that the tag doesn't vibrate due to the current when the animal is swimming. Tags can be attached on a porpoise with different methods that vary in how invasive they are and how long the device could remain on the animal. The attachment technique selected depends on the goals of the study, including duration of tag deployment required, and opportunity to capture and restrain the animal. Detachable tags are widely used for short-term studies, for the longer-term studies, tags are attached with invasive methods, such as bolts through the dorsal fin.

Suction cup tags

Detachable suction cup tags have been successfully applied to Yangtze finless porpoises (*Neophocaena asiaeorientalis asiaeorientalis*), and remained attached for an average of approximately 9 hours (e.g. Akamatsu et al. 2005), and to Dall's porpoise (*Phocoenoides dalli*) for a maximum of 41 minutes (Hanson & Baird 1998). In the Dall's porpoise study, 15 attempts were made to attach tags with suction cups and three succeeded. In a recent Danish study archival multi-sensor DTAG3 tags were placed on ten wild harbour porpoises to study noise exposure and behaviour in the Danish Straits. The suction-cup attached tags provided continuous recordings for up to 24 hours, while logging stereo sound (500kHz sampling rate), triaxial magnetometry, acceleration and depth (250-625Hz) (pers. comment Jonas Teilmann). These type of tags have been temporarily attached on small cetaceans without requiring capturing and handling of the animal (table 2). Such remote deployment is achieved using a pole (for bow-riding or bigger species) or a cross-bow (for smaller species). For porpoises this has not been done so far.

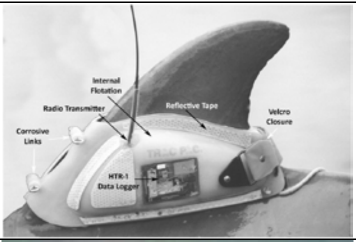
Invasive attachment

The attachment method which is currently predominantly used for tagging harbour porpoises involves capture and insertion of one or more bolts through the dorsal fin, to keep the tag in place (table 3). These bolts are either corrosive (magnesium) or can be released by a dedicated release mechanism.

Release mechanisms require additional space and weight (battery power), and therefore increase the device size. To attach bolts, the fin after is locally anaesthetized and small-diameter holes are made through the fin. After inserting the bolts through the hole the devices can be attached and locked on both sides.

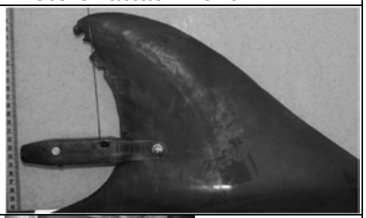
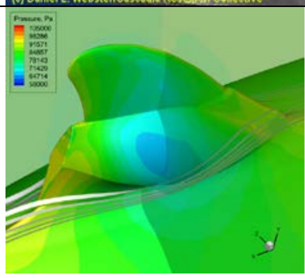
A recent study has shown that a one pin attachment at the trailing edge of the dorsal fin of bottlenose dolphins is a promising method that minimises drag and thus burden to the individual then previous designs (Balmer et al. 2014) (table 3).

Table 2. Examples of the attachment of tags on small cetacean species using suction cups.

<table>
<tr><th>Description</th><th>Photo of attachment</th></tr>
<tr><td>A suction cup liner which is kept in place by a Velcro closure at the back of the dorsal fin. Links at the front of the cover corrode over time to release the tag. The tag floats, which allows recovery.
Photograph: Wells et al. 2013, on a bottlenose dolphin (Turciops truncatus)</td><td>
</td></tr>
<tr><td>A detachable D-tag on a captive harbour porpoise at Fjord & Bælt in Kerteminde, Denmark. The tag is attached using suction cups.
Source: http://blogs.hsc.edu/biology/files/2011/01/tagged-harbor-porpoise.jpg

Wisniewska et al. 2015.</td><td>
</td></tr>
<tr><td>Digital Acoustic Tag using suction cups attached to a short-finned pilot whale (Globicephalus macrorhynchus) dorsal fin.
Source: http://superpod.ml.duke.edu/read/category/news/page/2/</td><td></td></tr>
</table>

Table 3. Examples of attachments of tags to small cetacean species using bolts or alternative designs.

Description	Photo of attachment
Satellite-linked time-depth-recording transmitter (Wildlife Computers SPLASH tag) attached by means of a single pin to the trailing edge of the dorsal fin (on bottlenose dolphin). From: Wells et al. 2013	
Attachment of a Wildlife computer tag on a Greenlandic porpoise with pins. Source: http://www.natur.gl/en/birds-and-mammals/marine-mammals/harbour-porpoise/satellite-tracking-harbour-porpoises/	
Satellite-linked and VHF radio tag on a bottlenose dolphin. Source: http://www.sefsc.noaa.gov/labs/beaufort/protected/marinemammals/telemetry.htm	
A bottlenose dolphin with a depth-transmitting LIMPET satellite tag. Source: http://www.cascadiaresearch.org/Hawaii/October2014.htm	
Theoretical design of a dorsal fin tag that would minimise drag, proposed by Pavlov & Rashad (2012).	

Alternative attachments

One of the main criticisms of invasive attachment methods is that tags are attached with bolts through the fin. A number of studies are trying to achieve secure attachment in a less invasive way. For example Pavlov & Rashad (2012) designed a tag shape that can generate a lift force using the same principle as in an airfoil design. The resultant hydrodynamic force is directed downwards, keeping the tag on the fin. The tag was designed using computer-generated simulations of a swimming dolphin. Attachment requires that the animal be continually in motion. It is unclear, whether the tag would remain attached to an animal resting at the surface, as no lift force is produced in the absence of movement. The shape and size of a harbour porpoise dorsal fin differs from the dorsal of the modelled dolphin, which means a new tag design for porpoises would be needed. As this method has never been tested on live animals it is difficult to predict its potential success for tag attachment on a porpoise.

3.3 How to obtain a porpoise

One of the challenges of tagging a harbour porpoise is getting close to one. Several methods have been applied previously.

Canadian weir fishery

The weir fishery is an ancient method for catching juvenile herring or other fish. The weir is a large stationary trap that is typically built near the shore in shallow water (figure 1). Herring weirs are placed in a way to catch herring when they are moving to deeper water. Harbour porpoises can become trapped in weirs while following schools of herring. Once in the weir, they are able to swim, feed, and breathe. In the Bay of Fundy the Harbour Porpoise Release Programme (HPRP) was developed in 1991. Local fishermen are assisted by the HPRP Team to ensure the safe release of harbour porpoises from their herring weirs. When a porpoise is found by the team, the weir fisherman is contacted immediately and arrangements are made to release the animal, using a special “mammal seine”. This net has a mesh size (20 cm) which allows the herring to swim back through the net, leaving only the porpoise. Two divers are in the water to monitor and aid the porpoise if needed. Once the net is closed so that the porpoise stops swimming, a diver can gather the porpoise and bring it to a release skiff. The animals are measured and in some cases tagged, using a satellite tag (figure 1).

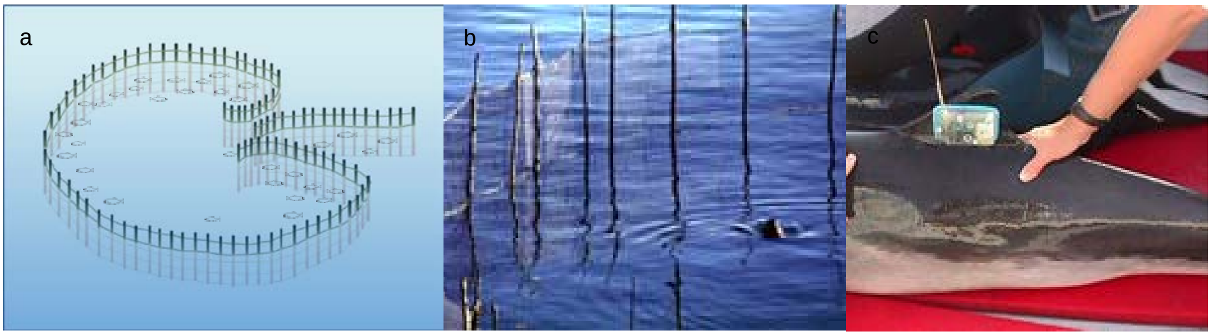


Figure 1: Sketch of a weir net b. Harbour porpoise in a weir net in the Bay of Fundy (source: http://www.gmwsrs.org/release.htm) c. Attachment of a tag on a harbour porpoise that was taken from a weir net (source: http://whale.wheelock.edu/whalenet-stuff/stophpNo/Hpprogram.html)

Danish pound net fishery

In Denmark a fishery similar to the weir fishery in Canada occurs, using pound nets (Bundgarn). The nets are placed in the coastal waters in the Danish Inner waters. When fishermen find porpoises in their nets they cooperate with researchers to remove the animals from their nets (figure 2). The animals are examined, (often) tagged and released.

Figure 2: Harbour porpoise in a Danish pound net b. The porpoise is taken out of the net c. The porpoise is examined and tagged (source: http://bios.au.dk/videnudveksling/til-myndigheder-og-saerligt-interesserede/dyr_satellitsporing/marsvin/).

Live catch of porpoises in Greenland

In recent years a study in Greenland waters has been started that uses salmon nets to catch harbour porpoises from a boat. According to our knowledge this is the first time porpoises have been successfully caught alive in open waters. For this method to work, very good weather conditions are needed as well as an experienced crew (Heide-Jørgensen personal communication). The first experiences indicate that the animals will be caught "without receiving any appreciable cuts" (source: http://www.natur.gl/en/birds-and-mammals/marine-mammals/harbour-porpoise/satellite-tracking-harbour-porpoises/).

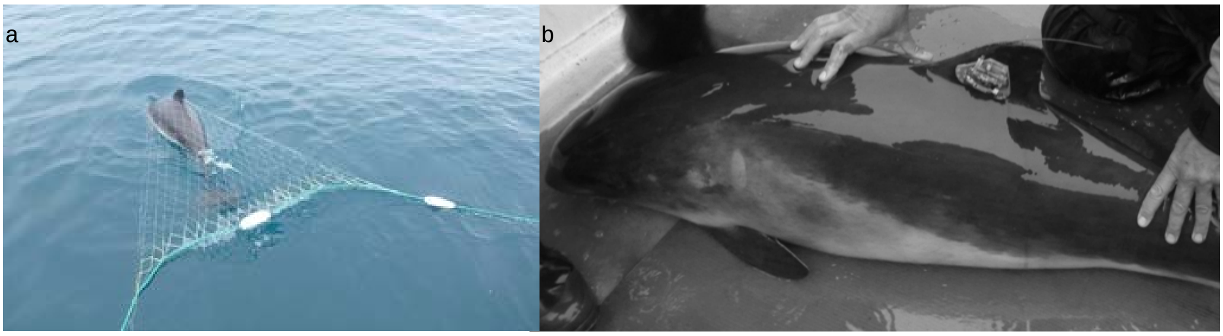


Figure 3: Harbour porpoise caught with a salmon net, b. Animal being tagged (source: http://www.natur.gl/en/birds-and-mammals/marine-mammals/harbour-porpoise/satellite-tracking-harbour-porpoises/)

Bycatch of live porpoises in Dutch fisheries

On rare occasions, live harbour porpoises have been taken from in fishing gear in The Netherlands. In general, porpoises that are caught in gillnets will drown because they will not reach the surface to breath. However, on 5th April 2014 two porpoises were caught alive in a recreational gillnet that was positioned very close to the coast in Noordwijk. The trapped poroises could reach the surface and breath so remained alive. They were released by the Koninklijke Nederlandse Redding Maatschappij (KNRM, coast guard) (https://www.knrm.nl/waar-wij-zijn/reddingstations/noordwijk-aan-zee/reddingrapporten/twee-bruinvissen-gered-uit-staande-netten-6cacb4ac).

There is also a small-scale traditional "weervisserij" (weir fishery) in the Oosterschelde that targets anchovy (Figure 4). In June 2013, a harbour porpoise swam into a weir and was released alive (http://www.behoudweervisserij.nl/nieuws/page/4/). It is not clear how often such occurrences take place, but it is likely that it is rare.

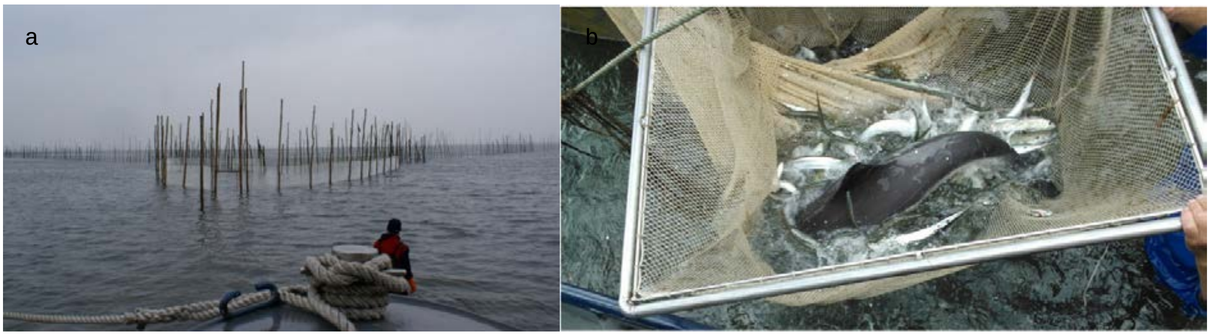


Figure 4: Weerfishery in Bergen op Zoom; b. Harbour porpoise taken from the net on 3rd June 2013. Source: http://www.behoudweervisserij.nl/nieuws/page/4/

Rehabilitated live strandings / bycatches

Another source of live animals are those that are not caught from the wild, but have stranded alive. Harbour porpoises that are found stranded alive along the Dutch coast are generally brought to SOS Dolfijn in Harderwijk, The Netherlands. The ultimate aim of SOS Dolfijn is to rehabilitate the animals so they can be returned to the sea. To do this, the porpoises have to be considered healthy, in no need of medication, have a normal growth, height and weight for their age, show no abnormal behaviour, be sufficiently old and experienced to survive on their own and, finally, pose no danger to the wild population of porpoises (source: http://www.sosdolfijn.nl/opvangcentrum/terug-naar-zee). If all these criteria are fulfilled animals are released.

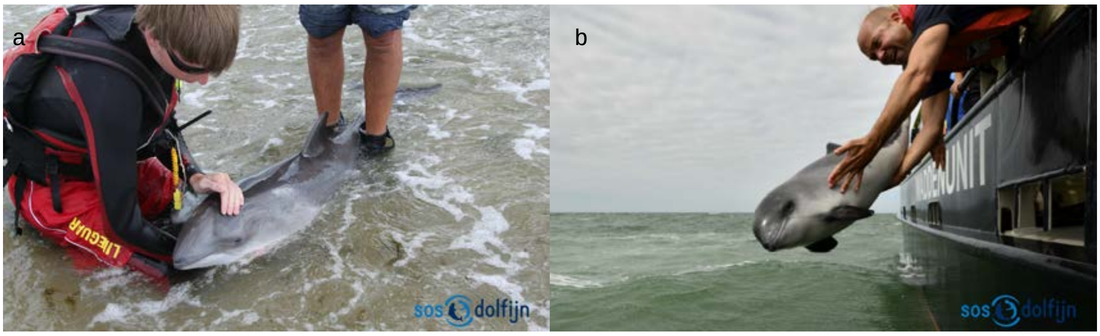


Figure 5: Live-stranded Harbour porpoise; b. Release of a rehabilitated porpoise (source: www.sosdolfijn.nl)

There is some experience on tagging rehabilitated harbour porpoises in The Netherlands. In October 1997 two harbour porpoises that had been rehabilitated were tagged. The animals were kept in a floating pen at “Neeltje Jans” (close to the entrance of the Oosterschelde) and their behaviour was monitored while they carried the tags. The animals were released, but both tags stopped transmitting 16 hours after release. It is assumed that there was a technical failure of the tags, as both tags did not start up after a programmed pause of several hours, and both tags stopped at the same time (pers. comment Ron Kastelein). Also, in 2000, a harbour porpoise that had been rehabilitated for 4.5 months in an indoor pool in Harderwijk was placed in a floating pen at “Neeltje Jans” (Geertsen et al. 2004). It was monitored for 80 consecutive days, 10 days before tag attachment (a satellite dive recorder and a VHF-radio tag), 30 days during attachment and 40 days after removal of the transmitters. During the attachment period the animals food consumption increased dramatically, probably due to the extra drag caused by the transmitters. After one month of attachment, an infection occurred around the frontal pinhole, which was extremely painful for the animal. Therefore the transmitters were removed. This reaction was probably due to drag from two tags and occasional seaweed attached to the tags during the last part of the attachment period, which caused the skin around the hole in the fin to open up, and allowing pathogens to enter. After the tags were removed epithelia closed the pinholes after two days.

3.4 Potential effects of tagging

Tagging of animals can have effects during different stages of the process:

1. Catching
2. Tagging procedure
3. Carrying of the tags

Catching

Catching a harbour porpoise poses a risk to the animal. Apart from the stress, an animal can drown once caught in a net. To prevent this, the net should be checked continuously. An entangled animal should be removed from the net and moved while fully supported in water to the processing site/vessel. If water enters the blowhole, pneumonia can develop after release. Extreme care should be taken to prevent this from happening.

Handling any wild cetacean poses a risk to the animal. Being removed from the water itself is a highly stressful situation for an animal that spends all of its life in the sea. Monitoring the animal's behaviour is necessary to recognise acute stress. Increased respiration rate and/or heartbeat rate, and anxiety may be signs of stress, although passivity may also be a sign (Norman et al. 2004). If signs of stress are recognised, Eskesen et al. (2009) advise this may be reduced by pouring water over the handled animal and/or lowering it into water. Despite all possible precautions, Norman et al. (2004) advise that handling a marine mammal outside the water still poses a risk, that can potentially lead to injury or death of the animal.

Tagging procedure

The tagging process can also increase stress experienced by porpoises (Geertsen et al. 2004). The reaction of individuals to handling and tagging, measured as heart rate, respiration rate and cortisol levels, is highly variable (Eskesen et al. 2009). It should be recognised that tranquilizers (Valium) used to sedate the animal may also impact on its well-being (Eskesen et al. 2009). A particular case is the tagging of females with calves as this not only potentially impacts the mother, but also poses a risk to the well-being of the calf.

The physical effect from the tag implementation includes bleeding and cell damage, as well as physiological responses such as blood clotting and inflammation. Also, sensing the device placement could cause pain and stress.

Tagging by remote methods, such as using a cross-bow or a pole to attach devices with suction cups, potentially has less impact on animals than capture, restraint and handling. For larger whales, tags can be fitted using attachments that penetrate (e.g. anchored arrow heads) and lodge into the blubber and muscle layer of the animal. For smaller cetaceans such as the harbour porpoise, the blubber and muscle layers are too thin to allow this method with the current tag design.

Remote tagging has (up to now) never been done for harbour porpoises. The most likely reaction of porpoises to remote tagging is similar to what is known about the reaction of biopsy darting on small cetaceans. During biopsy darting, a small sample of the skin and blubber is taken via a dart that is shot in the skin, and bounces off. In most cases, biopsy sampling induces a short-term (<5 min) behavioural impact on hit (and missed) individuals. No long-term effect of biopsy sampling has been observed.

Therefore biopsy sampling is generally considered to have low impact on cetaceans (e.g. Gorgone et al. 2008, Kiszka et al. 2010, Parsons et al. 2003).

Hanson & Baird (1998) have tagged Dall's porpoises (*Phocoenoides dalli*) and documented their reactions to suction cups attached remotely by cross-bow. They made 15 attempts, and had 13 hits. In two hits, the porpoise did not react. In 11 hits, startle reactions were seen immediately, but shortly after these the porpoises resumed bow-riding or returned to the boat from which the cups were launched.

Carrying of the tags

The size and form of the tag, the form of attachment and the site of the attachment on the animal can have a significant impact on the drag on the device, which may influence how well it remains on the animal (Tudorache et al. 2014). The weak point of bolt- or pin-attached devices is the tag-induced drag which causes additional load on the pin penetrating the fin's tissue (Irvine et al. 1982). If the drag is too high, the pin can cut the fin, thus causing significant injury (Irvine et al. 1982, Chilvers et al. 2001). A number of studies have also described the degeneration of the dorsal fin tissue leading to subsequent out-migration of the pins over days or months (e.g. Irvine et al. 1982, Orr et al. 1998). Sonne et al. (2011) examined the condition of two tagged-recaptured harbour porpoises from the Danish straits: a female porpoise that was bycaught 84 days after attachment with a prototype transmitter, and a male that was bycaught 343 d after attachment with a more hydrodynamic transmitter. The female had scar tissue on the dorsal fin and the transmitter had migrated backwards towards the tail. The male showed neither. One reason for the caudal transmitter migration in the female porpoise could be the hydrodynamic drag of the unit that was higher than the model used for the male. Albeit a small sample size, the study indicates that earlier tag designs may have had greater impacts on the dorsal fin and a higher chance of tag migration, probably relating to the larger drag, than more recent hydrodynamic designs. More modern designs decrease the drag of a transmitter, thus facilitating healing of the pin holes and reducing the risk of tag migration.

An important consideration for the attachment of any devices to marine mammals is its impact on hydrodynamics. The increased drag of a device will induce higher energetic costs on swimming and diving, potentially causing long-term effects on the physiology and health status of the animal (Scott & Chivers 2009, Balmer et al. 2010). Small cetacean bodies are very streamlined and optimized for swimming with as little energetic expenditure as necessary. Any attachment to their dorsal fins or other parts of their bodies will affect their balance, swimming gait and subsequently energy balance. Few studies have been conducted on the effects of attachment. A recent study by van der Hoop et al. (2014) investigated the effect of drag from a tag on metabolic rate, cost of transport and swimming behaviour of four captive male bottlenose dolphins. The results indicated that the dolphins reacted to the tags by changing their behaviour, in particular by swimming slower (van der Hoop et al. 2014). Berga et al. (2015) are the first to study the effects of a tag on harbour porpoises. They compared the diving behaviour of 12 tagged harbour porpoises, with and without a second tag. The secondary tag reduced the mean diving depth from 7.6 m to 4.6 m, increased mean dive duration by 5.6 sec., and increase mean time spent at the surface from 18.9 min./hr to 20.7 min./hr. The last two differences were not statistically significant.

Suction cup tags can have an impact also. In the rehabilitation centre Harderwijk in the Netherlands, the effect of suction cups on a porpoise was studied by attaching a transmitter with several 0.5 cm suction cups on the dorsal fin (Kastelein et al. 1997). After 8 hours attachment, blood blisters were found on the locations where the cups had been attached. The blisters were considered to be painful, since the animal did not allow the keepers to touch the dorsal fin for several days. If and how this affected the animal's behaviour was not described.

5. Legal framework in The Netherlands

4.1 International laws

The harbour porpoise is protected under the EU Habitat Directive (Annex II and IV), the CITES Convention Appendix I, the Bern Convention, the Bonn Convention and ASCOBANS. Furthermore, the porpoise is on the IUCN Red List of Threatened Species, and the OSPAR list of threatened and/or declining species and habitats (http://minez.nederlandsesoorten.nl/content/bruinvis-phocoena-phocoena-ssp-phocoena). Animal experiments follow the EU Directive on protection of animals used for scientific purposes (2010/63/EU).

4.2 National laws and permits

The international laws to protect the harbour porpoise and its habitat are implemented in the Dutch Flora and Fauna Act (Flora- en Faunawet, 'FF-act') and the Nature Protection Act (Natuurbeschermingswet, 'NB-act'). The harbour porpoise is protected against anthropogenic activities under the FF-act Articles 3 and 4. These two laws will be integrated with a third law in a new over-arching Nature Protection Act, which will be implemented on 1 July 2016. Furthermore, the protection of animals used for scientific purposes is implemented in the Experiments on Animals Act (EAA, Wet op Dierproeven).

Tagging of harbour porpoises may be considered to be an animal experiment and also the purposes behind these procedure fall within the scope of the EAA. Therefore tagging of harbour porpoises requires a license from the competent authority, the CCD.

To tag harbour porpoises, the following permits and exemptions are needed (see Table 4)

- Exemption from the FF-act to be able to catch animals
- Permit to perform catching/releasing activities within Natura 2000 areas
- An institutional license to perform animal experiments under the Experiments on Animals Act (Wet op Dierproeven). The WUR has such a license.
- A project license from the Competent Authority (CCD). Before applying a project to the competent authority it requires the consent of the local animal welfare body. For evaluation by the competent authority the project needs to have a positive advice from an ethical committee (Dierenexperimentencommissie, DEC) acknowledged by the CCD. All people involved in the experiments need to be competent and licensed under the EAA.

The core of the project authorisation is to ensure the implementation of replacement, reduction and refinement. Furthermore, for reasons of animal welfare and conservation, in case of the use of animals taken from the wild in procedures it should be scientifically justified that the purpose of the procedures cannot be achieved using animals bred specifically for use in procedures. The evaluation by the DEC and the CCD consist of a harm-benefit analysis of the project, to assess whether the harm to the animals in terms of suffering, pain and distress is justified by the expected outcome taking into account ethical considerations, and the ultimate benefit for human beings, animals or the environment;. Previous experiences and insights from the Danish tagging experiments should be used while writing this project. For the other permits and exemptions similar information has to be prepared.
More information on animal experiments:
http://www.zbo-ccd.nl/ (Centrale Commissie Dierproeven)
http://www.ncadierproevenbeleid.nl/ (Nationaal Comité Advies Dierproevenbeleid)
http://www.wageningenur.nl/nl/Dossiers/dossier/Dierproeven.htm

Table 4. Overview of permits needed for harbour porpoise tagging and releasing.

	Permit / exemption	Remarks
Tagging	Flora and fauna act	A generic permit can be obtained
Tagging	EAA (Wet op de Dierproeven)	Project license from CCD Personal license for all people involved in animal experiments
Tagging	Nb-wet 1998	For tagging of seals in Natura 2000 areas, permits are required from the relevant province. This will be the same for tagging of harbour porpoises in Natura 2000 areas. The procedure is in accordance with the Algemene Wet Bestuursrecht (General Administrative Law Act). The so-called extended procedure is minimum 26 weeks. After receiving the permit request, stakeholders can view the application documents for 13 weeks, provide their view in the next 8 weeks, after which a decision is made. After that, there is another period of 6 weeks, in which people can object to the decision. If the time-schedule cannot be made, another 13 weeks may be added. In the case of seals, tagging in the Netherlands is a sensitive issue. Therefore, some objections to tagging of harbour porpoise must be expected. Tagging of harbour porpoises outside Natura 2000 areas will not need a Nb-wet permit.

6. Research questions and constraints

While tagging studies can be applied to answer a large range of different research questions, a number of points need to be considered. In Table 5 we provide an overview of the primary research questions that have been highlighted as a priority for Dutch waters and give our assessment on the feasibility of each study, the current research priority, as well as the potential impact on the tagged animals.

The most important constraints we face when trying to design a research program, are the following:

Sample size and representativeness

- A population of harbour porpoises is made up of a large number of individuals. To allow us to derive any general conclusions on what a population does, or how difference in age, sex or life stage impact behaviour, we need to representatively sample the population. This could mean that a sample should cover all age/ sex classes of porpoises. Or one could choose to begin with a sub-sample of the population, such as only juvenile male porpoises. In the wild, it is difficult to distinguish age or sex (unless there is a mother-calf pair – indicating an adult female). To address this difficulty, one would have to assume that over time enough animals are caught from all parts of the population and that the sampling method is not biased to a certain type.

Impact on behaviour

- Ideally we would like to investigate animals that show completely undisturbed natural behaviour. Often however our methods have some impact on our study animal. Even when conducting a shipboard survey the noise of the vessel will lead to avoidance behaviour of porpoises. For tagging, investigation impact is obviously going to occur. First of all there is the stress that will occur due to the handling during the tagging. We cannot assume that all animals that are caught are healthy, some might have problems that compound with handling stress to cause serious injury or even death during the handling. Secondly, the attachment of the tag will inevitably causes some distress, in particular if it involves the drilling of holes through the dorsal fin. And finally the tag itself will cause an additional drag on the animal when it is swimming. The successful studies in Denmark, Canada and Greenland indicate that porpoises are able to compensate for the additional energy needed to accommodate carrying the tag. In the absence of data on normal behaviour, it may have to be assumed that information recorded from tagged harbour porpoises is close to normal, but this should be investigated where possible.

Ethics

- The ethics of using live animals in any research project needs to be taken into account. There is the legal framework that needs to be followed (section 4.2), as well as consideration of other stakeholders (e.g. NGOs, general public). This calls for an in-depth evaluation of the aim of the research question and if there are alternative ways available to achieve the required knowledge. A number of studies (Heinis et al. 2015, Camphuysen & Siemensma 2011) have highlighted that data on Dutch harbour porpoises is lacking and that this is making it difficult to effectively protect this species. For a tagging research project, it is especially important to make a clear case on why the potential infliction of harm on individual porpoises can benefit the larger population. Basically, the potential positive effect for the larger population has to be weighed against the potential negative effect of the individual.

Table 5. Overview of research topics and type of research needed. T.b.d – To be determined. Priority 1 – highest priority, 3 – lowest.

Research topic	Aim	Research activity	Feasibility (1=high, 3=low)	Priority (1=high, 3=low) (HP-Protection Plan)	Predicted impact on animal(s) (1=low, 3= high)	**N animals needed**	1-5	5-10	10-50	**Tagging duration**	hours to days	weeks	months	**Parameters to be recorded**	GPS position	Depth profile, swimming behaviour, etc.	acoustic data (clicks & ambient sound)	**Data transmission**	data transmitted remotely	tag retrieval needed	**Attachment/Detachment**	Pin(s)	Suction cup	**Relative tag size**	small	large	**Animal handling**	dircet handling - rehabilitated	direct handling - catch	cross-bow / pole
Development of method	investigate the feasibility of catching harbour porpoises using weir fishery	Literature study on the potential to use weir fishery to catch porpoises in the NL; define most important parameters; interviews with weir fishermen in the NL on frequency of catches & their interest to cooperate	1	1	1	-				-				-				-			-			-			-			
Development of method	Develop and apply an adequate method to catch harbour porpoises for tagging	based on above project - look into the use of the salmon net in Greenland; use and cooperate with weir fishery in selected areas with high potential for successful catches. Prepare stand-by tagging team in case of porpoise catch.	2	2	2		x			t.b.d.				t.b.d.				t.b.d.			t.b.d.			t.b.d.					x	
Development of method	Pilot study to investigate the possibility to attach non-invasive tags on harbour porpoises using cross-bows	Using a detachable tag to conduct a pilot study in a sheltered coastal area for short-term deployment on a few animals	1	1	2		x				x				x	x	x			x			x	t.b.d.						x
Individual migration	First insight in large-scale seasonal migration patterns for an individual, generate hypotheses, pilot-project	Tag a few (rehabilitated) animals; aim for a tag that will have low impact and will stay on animal for as long a time period as possible; obtained data on movement can be related to (a)biotic factors	1	1	2		x						x		x				x		t.b.d.				x			x		
Population migration	Large-scale seasonal migration patterns of harbour porpoises in the (southern) North Sea	Tag a fair number of animals that are representative of the population with a positioning tag; aim for a tag that will stay on animal for as long a time period as possible; obtained data on movement can be related to (a)biotic factors	3	1	2				x				x		x				x			x			x				x	
Individual habitat requirements and use	Understand habitat use of a few harbour porpoises in relation to (a)biotics. Pilot study	Tag a few animals (rehabilitated); get in-depth long-term data on swimming behaviour and habitat use using time-depth recorders; relate their behaviour to habitat characteristics (depth, habitat, etc); Generate hypotheses	2	1	3		x				x				x	x			x			x				x		x		
Population habitat requirements and use	Understand habitat use of harbour porpoises in the southern North Sea relation to (a)biotics	Tag a representative sample of animals of male and female, older and younger; get in-depth long-term data on swimming behaviour and habitat use using time-depth recorders; relate their behaviour to habitat characteristics (depth, habitat, etc)	3	1	3				x		x	x			x	x			x			x				x			x	
Communication	Understand communication patterns between HPs	Tag a few animals. In-depth study of (a) few individuals for a short-term study. Using (detachable) acoustical tags. Attachment to animals via catch or crossbow.	2	3	2		x	x			x				x	x	x		x	x			x			x		x	x	
Impact of sound	Understand impact of (anthropogenic) sound on harbour porpoise behaviour. Pilot study.	pilot study with a few animals using acoustic tags; investigate (acoustic) behaviour of porpoises and sound at sea	2	1	2		x	x		t.b.d.					x	x	x		x	x	t.b.d.					x		x		
Impact of sound	Understand impact of (anthropogenic) sound on harbour porpoise behaviour	in-depth study with a representative sample of animals using acoustic tags; investigate (acoustic) behaviour of porpoises and sound at sea	3	1	2			x	x	t.b.d.					x	x	x		x	x	t.b.d.					x			x	
Noise	Visualise sound landscape as experienced by HP	Tag a few animals (rehabilitated). In-depth study of (a) few individuals using detachable tags.	2	2	1		x				x				x	x	x		x	x			x			x		x		

7. Potential research projects in The Netherlands – step by step approach

While it is clear from our overview in Table 5 that there are a large number of research questions that are both of imminent importance for the conservation of harbour porpoises, it also highlights that it is not possible to start tagging harbour porpoises right away. Certain basic questions need to be addressed first, such as:

- how to obtain animals, while considering the welfare of the caught animal?
- how to ensure that the attachment and use of any tag poses as little impact as possible for the individual animal?

In the following we sketch three projects we believe are needed before larger scale tagging efforts should be undertaken in Dutch waters.

6.1 Pilot study with captive-cared animals that may be released

One of the main challenges is to catch a harbour porpoise safely in the wild with as little risk as possible for injury or death. One way to test the efficacy of methods is to first use an animal that has been kept in captivity for a period. As described in section 3.3, in The Netherlands injured harbour porpoises are brought to SOS Dolfijn in Harderwijk. Here, they receive feeding and medical attention, and if there are no substantial reasons against it, they are returned to the North Sea.

There are a number of advantages and disadvantages in using a captive-cared animal for a tagging study:

+ The data provided by the tag will not only answer the research question, but will also provide data on the success of the captive care.
+ The animal can be tagged under controlled conditions with less stress on the individual, than would occur by catching, handling and tagging a wild animal.
+ Either a small, detachable, satellite tag could be used (to provide detailed data over a shorter time period) or a small tag that is attached through the dorsal fin (to will provide data on movements of the animal over a longer time period).
- It is not clear if an animal that has stranded will show “normal” behaviour. SOS dolfijn makes sure that only animals that fulfil specific criteria are released again (e.g. sufficiently old and experienced). When selecting a porpoise for tagging it should be taken into consideration that it is as “normal” as possible.
- As with any study involving the handling of live animals, the ethics of the proposed research project needs to be considered. A captive-cared animal already has gone through abnormal stress and additional stress needs to be balanced against potential knowledge gain.

The proposed research project would aim to use the smallest, most hydrodynamic tag available to minimise anticipated negative impacts on the animal.

6.2 Catching wild porpoises

For all the research questions that relate to porpoises and that could be addressed with the tagging data, it is vital to obtain a representative sample of the population. To do this it is necessary to catch porpoises out of the wild population. The methods for this (as described in section 3.3) are most commonly the use of a weir-like net into which porpoises swim when following fish. The big advantage of such a method is that the porpoises are generally unharmed and can be removed from the net under controlled circumstances to avoid injury. The use of a net in open water, as done in the Greenlandic example, potentially poses threats for an animal as there is direct contact with a broader-mesh net.

If tagging is to take place in Dutch waters it is important to investigate in more detail what kind of capture methods could be successful. Such a study should investigate:

- What is the occurrence of bycatch of porpoises in the Oosterschelde in the "weervisserij"?
- Is there potential to use a weir-like fishery in areas of sheltered waters along the Dutch coast?
  - If yes, how could the design of such a net look like?
  - What would be a good timing (porpoise occurrence), to try out this capture method?
  - Could there be a cooperation with the existing weir fishery?
- What would be the best protocol to proceed when a catch occurs to ensure that animals do not have health problems at a later stage (e.g. involve experienced national and international partners)?
- What is the applicability of the Greenlandic method in Dutch waters?
- Are there other options for catching porpoises (with minimal impact on the animals)?

This project would call for a close cooperation with fishermen to develop ideas for a pilot study to try out "porpoise friendly" ways of catching animals. A possible location is an area with sheltered waters and a known occurrence of porpoises. For such a project a strong involvement of stakeholders (e.g. NGOs) is necessary to ensure that the necessity of catching porpoises is well communicated. Proper handling of the porpoises is absolutely essential to avoid long-term health problems.

6.3 tag attachment

As described above, one of the main challenges is to attach transmitters to a porpoise safely in the wild, with as little risk as possible for injury. A first step to minimize the risk is reviewing all available tags and selecting the least disruptive design to answer specific research questions. It might be prudent to first gain experience in a pilot study with non-invasive attachment methods and short-term deployments, before scaling up to longer-term attachment methods and longer-term studies.

This pilot study could be conducted in the Oosterschelde. In this semi-closed area, tens of harbour porpoises are present and the waters are sheltered in comparison to the North Sea. In such a pilot study, experience could be gained in attaching suction tags with a cross-bow, for example. The animal's reactions can be described and quantified, followed by an assessment of potential negative effects. The tags would be retrieved after they detach and would deliver information on the animal's behaviour on short-term time scales (hrs to days). Depending on the assessment of the effects and the information gained a decision should be made on the next steps of tagging porpoises.

8. Final Conclusions

In this document, we identified the possibilities and limitations to tag harbour porpoises in the Dutch North Sea waters. As with any research, it is important to start with a well-defined research question which should include a clear definition of what kind of data and how much of it is needed to provide the required information. If the sample of animals has to be representative of the population, this will mean a considerable number of animals is required, covering different sex, age and life stages. Because we know so little of harbour porpoise behaviour in the wild, even tagging just one animal could provide a huge amount of new information. This type of individual data can also answer some specific research questions and can help to form new hypotheses.

The type of tag and its attachment as well as the handling of the animal during the tagging will have a different scale of impact on the animal. Suction cup tags have proven to be very useful in short-term deployments on cetaceans. They have a lower impact on the health of the animal than capture, handling and more invasive procedures, but, on the downside, they only collect data for a short time. The attachment with pins through the dorsal fin is more invasive. However, there is a large difference in the potential impact depending on the size of the tags and their placement. Smaller tags that are placed at the trailing edge of the dorsal fin appear to be the less harmful than larger ones attached to the side of the dorsal fin. So while the suction-cup attachment of recoverable data loggers offers high-quality data that are limited in geographic and temporal scope, satellite tags attached with pins enable coverage of large spatial and temporal scales. Most likely a combination of both approaches would be the most effective to answer the pressing research questions about harbour porpoise movement and habitat use.

There are a number of different ways to obtain animals to attach the tags to them. The least disturbing way is probably to use of animals that are about to be released from captivity. These animals are accustomed to human handling and can be tagged (invasive or non-invasive) in a controlled environment. Catching wild harbour porpoises may be achieved by actively following individuals with a net, or passively by waiting for animals to swim into a weir-type net. The latter method might be an option in sheltered Dutch estuaries. And finally, using a cross-bow to launch a tag fitted on an arrow with a suction cap, while challenging, has been successfully used for small cetaceans, and may be trialled on wild harbour porpoises in Dutch waters. This method may be the least invasive method currently available to get some data on short-term movements of individuals in particular habitats.

Any research on animals must take ethical aspects into consideration and evaluate if and in what way individual animals are potentially harmed. But it is also important to remember that harbour porpoises face a large range of threats caused by human activities. The research questions we have identified as priorities for The Netherlands are all driven by a conservation concern for the harbour porpoise population in the southern North Sea. So when considering tagging as a research method, the potential positive effect for the larger population has to be weighed against the potential negative effect on the individual.

In the Netherlands we have identified some of the large knowledge gaps that make it difficult to provide well-informed advice on the management and conservation of harbour porpoises. An example of this is the behaviour of harbour porpoises in reaction to anthropogenic sound (Heinis et al. 2015, van Beest 2015) Although we have a baseline from animals in captivity, for the extrapolation to the wild population we have to make assumptions (Heinis et al. 2015). Similarly, the lack of data on migration patterns of harbour porpoise in the North Sea makes achieving international conservation aims very challenging. For example, animals might move from an area of low bycatch impact to an area of high bycatch impact within a year, crossing country borders. More detailed knowledge on how these animals move throughout the North Sea over time could aid more effective protection of the population. Information on harbour porpoise individual behaviour can directly feed into models of how they use their habitat – and maybe more importantly – how they will change their habitat use when parameters (such as food availability or temperature) change in the future (e.g. van Beest 2015).

It is important to learn from others that have used and are undertaking tracking studies of small cetaceans, particularly harbour porpoises. International cooperation is important for any harbour porpoise tagging work in the Netherlands.

As a conclusion from this report, we propose that the best way forward is to start by investigating some of the less invasive methods for tagging (small trailing edge tag, detachable tag) and obtaining animals (captive-cared, weir fishery, suction-cap attachments) first. This will provide an improved insight into what methods could best work in The Netherlands, while also providing the first data on the behaviour of individual harbour porpoises in Dutch waters.

9. Acknowledgements

We would like to thank Klaus Lucke, Ron Kastelein (SEAMARCO), Roger Kirkwood, Chris Pool (DEC) and Nanneke vd Wal (DEC) for providing helpful comments on (sections of) this report.

10. Quality Assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 124296-2012-AQ-NLD-RvA). This certificate is valid until 15 December 2015. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Fish Division has NEN-EN-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 1th of April 2017 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

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Justification

Rapport C009/16
Project Number: 4316810020

The scientific quality of this report has been peer reviewed by the a colleague scientist and the head of the department of IMARES.

Approved: Roger Kirkwood
Researcher

Signature:

Date: 28th January 2016

Approved: Tammo Bult
Business Unit Manager

Signature:

Date: 11th February 2016