Initial Report on Use of Porpoise Detector (POD) on Arklow Bank – summer 2002

Harbour Porpoises

For: Airtricity
Date: December 2002

By: Coveney Wildlife Consulting Ltd.

Unit 4, Kilcoole Ind. Est., Co. Wicklow. E-mail: jcoveney@iol.ie.
Phone: 01 201 1721. Mobile: 087 276 5158. Fax: 01 201 1767.

Company No. 336952. VAT No: IE 6356952W.
Directors: John Coveney, BSc PhD, Dip EIA Mgmt; Marian O'Sullivan BSc, PhD.

1 Preface

1.1 Summary

This report presents results of initial field trials of the POD, carried out on the Arklow Bank between June and September 2002. The POD is an acoustic data logger, designed to operate unattended and detect the sonar clicks of the harbour porpoise (*Phocoena phocoena*). The POD stores detected clicks and upon retrieval from the sea, data are downloaded to a PC.

The two most recent deployments successfully detected porpoises, as well as recording other sources of clicks which were differently categorized. Porpoises were present for 16 out of a total of 25 logging days, and encounters ranged in duration from 1 second to over 25 minutes.

By allowing data collection over complete 24h periods and for several successive days, the POD revealed porpoise activity during both daylight and night time hours. Further collection of this type of data, otherwise unavailable to visual observers, will enable the investigation of tidal or diurnal patterns of activity.

It is concluded that, in principle, the POD is a suitable tool for the surveillance and monitoring of harbour porpoises on the Arklow Bank, and for the investigation of spatial and temporal distribution of porpoises around the bank, and of fine-scale habitat use of this area by porpoises. It is limited, however, by being unusable with modern laptops and until suitable software can be located for temporal analysis of the porpoise detections.

1.2 Table of Contents

1.2.1 List of Figures

1.2.2 List of Tables

1.3 Report Team

Ruth Leeney, Zoology Dept. UCD.

John Coveney, Coveney Wildlife Consulting Ltd.

1.4 Acknowledgements

Nick Tregenza for supply of POD and advice on its use.

Dr. Tasman Crowe, UCD (RL's Ph.D supervisor)

Jens Hansen and Pat Keogh of the Firehawk for assistance with POD deployment

Billy Clarke for the cover shot

2 Introduction

Visual surveys (Coveney and Phalan 2001) for the environmental impact statement (EIS) and the monitoring programme (Coveney Wildlife Consulting Ltd. 2002) of the Arklow Bank wind farm have shown that harbour porpoises (*Phocoena phocoena)* occur there regularly but probably in small numbers.

One of the aims of the project's monitoring programme (Coveney and Phalan 2001) included testing of an acoustic porpoise detector (POD) at fixed point and in towing studies. If the testing is successful, the aim of the POD work would be to complement the visual surveys in improving our understanding of the usage of the area by porpoises. This report present results of the successful feasibility testing of the POD at a fixed point.

Harbour porpoises are listed on Annex II of the EU Habitats Directive (92/43/EEC) as a species for which special areas of conservation (SACs) should be designated in the most suitable areas of their range. As yet, however, no SACs for harbour porpoises have been designated in Irish waters. Whether the Arklow Bank qualifies for designation as an SAC for porpoises, showing that the wind farm does not have a significant adverse impact on the area's porpoises is desirable.

2.1 Background on the POD

The POD (Figure 1) is a self-contained submersible computer and hydrophone that recognises and logs echo-location clicks from porpoises and dolphins (Tregenza 2002) at distances of up to 300m. The version used here is also known as a TPOD because it can also detect and distinguish dolphin species from porpoises – especially bottle-nosed dolphins (*Tursiops truncatus*).

The POD listens to sound in the sea through a ceramic transducer embedded in its wall. It detects clicks by the comparison of the outputs of 2 filters which select energy from different frequency bands of the sound spectrum. The centre?? frequencies can be changed 6 times during each minute so that clicks can be sought at different frequencies. Click detection is initiated by the occurrence of peaks of relatively higher levels of sound energy at one filter frequency. After recovery from the POD, these data are subsequently processed on an external PC

The PC software takes the click data and finds "trains" - more or less regular sequences of clicks that are characteristic of sonars - either boat or cetacean sonars. This eliminates all sources of random clicks (for example, propellers, sand movement, snapping shrimps). The remaining click trains are then classified by the programme TPOD, to distinguish boat sonars from cetaceans. Five classes of train classification are used:

- ***Cet hi*** – trains with a high probability of coming from a cetacean. TPOD shows these in red.
- ***Cet lo*** – less distinctive trains, shown in yellow. If these trains appear in association with red trains, they are probably of cetacean origin.

Figure 1. POD set up for fixed deployment – and with user.

- **..?..** – doubtful trains (green). These are often cetacean trains but can be unreliable, as they contain multiple clicks in clusters, which may also indicate a non-cetacean origin.

- **..??..** – very doubtful trains (blue). Most of these trains contain multiple clicks in clusters, and are usually from boat sonars.

- **Fixed rate** – Inevitably, some boat sonars will be logged by the POD since they can be at the same pitch as cetacean sonar. These trains are shown in pink.

Train detection allows the POD to identify clicks from porpoises or dolphins, which do not have a very distinctive spectrum, but do fall into very distinctive trains. So train detection may remove over 90% of the logged clicks, leaving a clear record of cetacean encounters.

3 Methods

3.1 POD Deployment Dates, Position and Method of Deployment

Following an initial short towing on 1 June 2002 to test basic use , the POD was deployed 13.6 km east of Arklow at N 52° 48.436' W 5° 56.690' for four periods between June and early September 2002 (Table 1). This position is just west of the Bank where the water is roughly 10m deep.

A line was attached from the middle of the POD to a weight on the seabed. A second line ran between the POD and a marker buoy at the surface; this line was 5m in length and thus ensured that the POD remained at roughly 5m below the water surface. The large buoy also balanced the negative buoyancy of the POD and its two sets of alkaline battery cells. The lid of the POD, which is oriented downwards during deployment, had a small weight attached to maintain the apparatus in an overall vertical position.

Table 1. POD deployment dates on the Arklow Bank – summer 2002[1].

No.	Deployment Date	Deployment Period	Data status
1	13 – 20 June	6 days, 23 hours & 5 min	Unusable[2]
2	20 – 28 June	7d, 16h & 9m	Unusable[2]
3	01 – 11 August	9d, 13h & 52m	Usable
4	16 August – 01 September	15d, 12 h & 51m	Usable

[1] The POD was deployed at N 52° 48.436', W 5° 56.690'. This is 13.6 km east of Arklow and is just west of the Bank. The water here is 10-12m deep and the POD was deployed at 5m below the surface.

[2] The POD was returned to the supplier for modification after these deployments

3.2 Data Analysis

Data was analysed from deployments no. 3 and 4 to identify porpoise click trains and to calculate how many periods of porpoise activity were recorded over these time periods. A period of activity, or "encounter", was considered to have ended when a period of at least ten minutes had elapsed without any porpoise clicks detected.

Boat sonars and other clusters of clicks are also often recognised by the programme as click trains, so initially only trains in the "*Cet all*" classification, containing trains with high ("*Cet hi*") and lower ("*Cet lo*") probabilities of coming from a cetacean, were included in the analysis. Doubtful "*..?..*" trains were then incorporated for comparison.

The programme *Tpod* also allows for various click train-related values to be viewed. The most useful of these is pulse repetition frequency (PRF), which is a measure of the gap between successive clicks logged. This can provide some basic behavioural information on the cetaceans occurring in an area, since different rates of click production can be linked to different activities such as hunting and feeding.

Additional analyses have examined the settings on the TPOD and the data they produced, in order to modify these settings for maximum efficiency in future deployments.

4 Results

4.1 Technical Results

4.1.1 Deployment and Retrieval of Equipment

The arrangement described in the methods (above) proved to be a secure means of POD deployment in depths of 10-12m, on a sandy substrate. In all instances of POD retrieval, the apparatus was found to be almost exactly at the original GPS position. During some of the deployment periods, the equipment weathered occasions of rough seas and high winds. The entire equipment took up little deck space and was easily deployed and retrieved by two people.

4.1.2 Power Supply

The POD's operating time is limited by battery life, which in turn is limited by amount of data being logged. The longest of the logging periods (16.08 to 01.09) encompassed 15 days of recording, and less than half the battery power was used for this deployment. It is predicted that at similar levels of porpoise activity, a full set of 12 LR20 I.5V alkaline batteries will allow the POD to operate for up to 4 weeks.

4.1.3 Data Retrieval and Download

Problems have repeatedly been experienced when downloading data from the POD. According to the manufacturer, there is a communications problem between PODs and modern computers. The only current means of retrieving the data is the use of one specfic old laptop, which must be connected to an external zip drive in order save the large POD data files. The main problem with this set-up is that the slow operation of the laptop makes data downloading a lengthy procedure. As this laptop belongs to UCD and is used there for other work, getting it to and from the POD when required complicates the logistics. This has also interfered with the training of Coveney Wildlife staff in setting up and downloading data from the POD. It is hoped that this problem will be resolved by the manufacturer in the near future so that the POD can used with Coveney Wildlife's modern laptop.

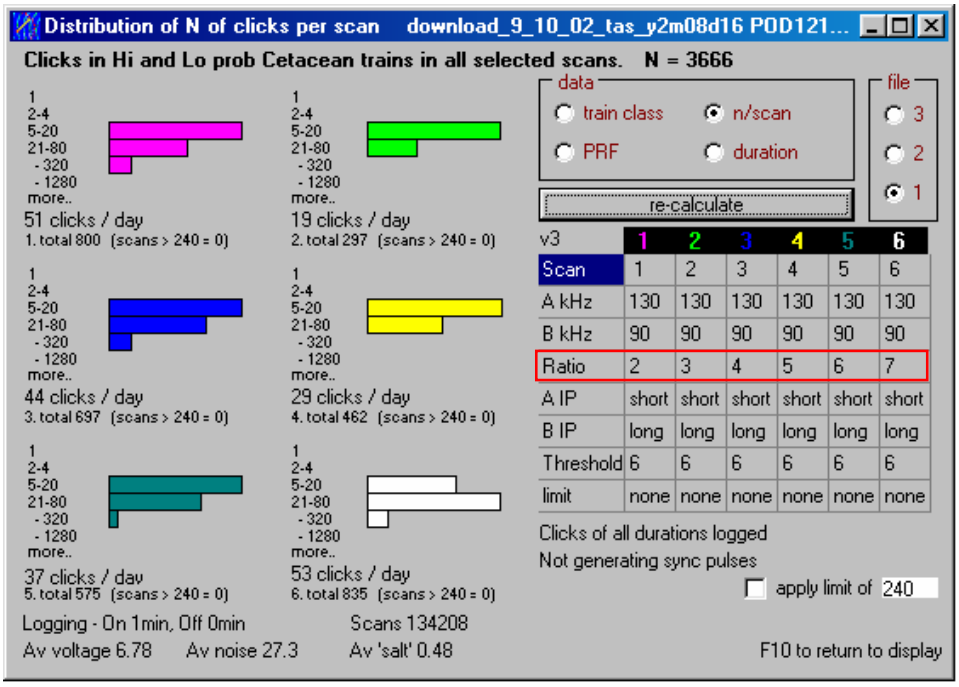
4.1.4 POD Settings

There are many sounds in the ocean which may be detected and logged as clicks by the POD, and logged. Comparison of the raw data, that had all of the clicks logged in the deployment period, with the subsequent click train file, demonstrated the efficiency of the system in eradicating all non-train clicks from the data and hence substantially reducing the "noise" present in the data.

Figure 2 shows a screenshot from the "settings" page of the software programme *Tpod*. Each minute of logging by the POD consists of six 10 second scans, represented by the six bar charts on the left. Each chart represents the daily average number of clicks over the entire logging period that were recorded by a particular scan and its setting values. In this case, each scan was set with a different sensitivity ratio of filter A to filter B (see "Ratio" table on the right of the screenshot - in red). A higher ratio of A to B requires the energy of any click logged by filter A (high frequency value) to be much greater than the energy of the same click logged by filter B

(lower frequency value). Since porpoise clicks are high frequency and narrow band, they should be logged at higher energy filter settings (ratio values 5 to 7). Data logged at ratio values of 2 to 7 were compared in order to determine the most suitable settings for this location. As can be seen from the bar charts for scans 1 to 6, all of the filter settings produced similar results in terms of number of cetacean clicks logged. The similar shapes of these charts also indicates that no scan is detecting and logging significantly different data. This shows that the higher energy filter settings, which filter out more non-porpoise clicks, can be used without significant loss of genuine clicks which were picked up only at the lower energy settings.

Figure 2. Screenshot from *Tpod* showing the POD settings used (ratio values highlighted in red box), and the resulting mean number of clicks detected in each 10s scan (barcharts).



4.2 Biological Results

4.2.1 Porpoise Detection

Acoustic detections data obtained from the POD to date have been used to describe, in a limited fashion, porpoise activity on the Arklow Bank. This will become more detailed as the acoustic database grows.

Table 2. August 01 – 10. All encounters (enc) recorded and the classification of trains contained in each.

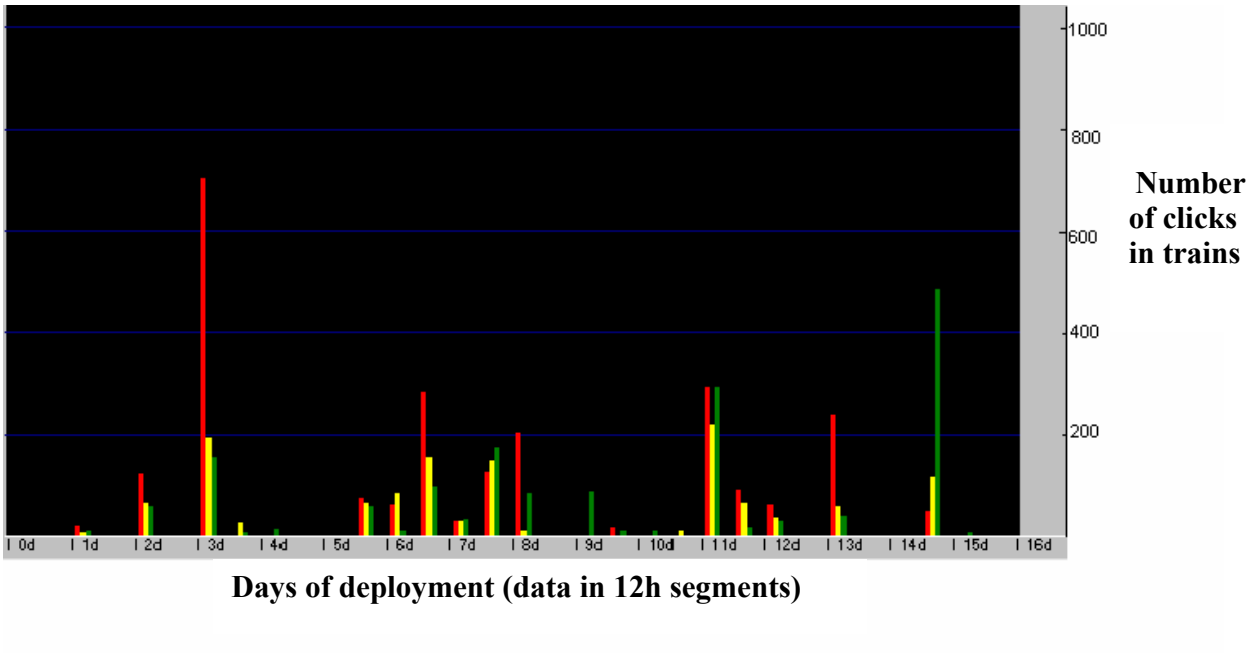
Enc no.	*Date*	*Time start*	*Time end*	*Enc duration*	***Cet hi***	*Cet lo*	*..?..*
1	06/08	20:46:37	20:50:03	00:03:26	*	*	*
2	06/08	22:57:46	22:59:21	00:01:35	*	*	*
3	08/08	08:40:04	08:40:14	00:00:10	*	-	*
4	08/08	14:37:16	14:37:16	< 1s	-	-	*
5	08/08	19:19:04	19:19:06	00:00:02	-	-	*
6	08/08	19:47:33	19:47:36	00:00:03	-	-	*
7	09/08	01:25:34	01:25:36	00:00:02	-	-	*
8	09/08	02:52:14	02:52:14	< 1s	-	*	-
9	09/08	08:08:37	08:08:37	< 1s	-	-	*
10	09/08	16:49:24	16:49:25	00:00:10	-	-	*
11	09/08	03:32:13	03:32:23	00:00:10	-	*	-
12	10/08	00:52:13	00:52:25	00:00:12	*	*	-

Table 2 shows all encounters in the August 01-10 file. Analysis of click trains in this file discerned 12 encounters, of which four contained *Cet hi* trains. Six encounters consisted only of doubtful trains, while the remaining two encounters contained only trains classified as *Cet lo*. Since the encounters containing *Cet hi* trains also encompass many *Cet lo* trains, and since these lower probability trains give more continuity to the encounters, it was considered reasonable to recognise the *Cet lo* trains as also of porpoise origin. The maximum encounter duration for this period was 3 minutes 26 seconds.

Encounters and their details were extracted manually from the output provided by the click analysis software (*Tpod*). This was a lengthy procedure and it was therefore not feasible to go into the same detail for the second file, containing data from August 16 to September 01.

Figure 3 depicts the occurrence of *Cet hi*, *Cet lo* and *..?..* click trains for this file, in 12-hour segments. At this coarse scale, it is apparent that click trains were recorded in every day, with 12 out of 15 days containing high-probability cetacean trains. Displaying the data in 12h segments means that several encounters in any one segment will be combined. Thus for example, August 22 (Figure 3, day 6) contains 4 separate encounters, the first beginning at 02:25 and the last at 17:32. The two morning encounters are combined into a set of bars for the first half of 22.08, and likewise the third and fourth encounters are displayed as one set of click counts. At a smaller timescale, separate encounters are graphically distinct.

Figure 3. **Graph of number of clicks in trains per 12h segment, logged between August 16 and September 01. Train classes are *Cet hi* – red, *Cet lo* – yellow, doubtful *..?..*- green. Graph exported from *Tpod* software.**



4.2.2 Notes on Behaviour

Neither file contained clicks with pulse repetition frequencies (PRFs) above about 150/s. When they are actively hunting, porpoises produce feeding click trains with PRFs of over 200/s; thus is may be inferred that the porpoises detected during these trials were not feeding in the area.

Encounters were logged throughout the day and night, with no obvious prevalence of higher numbers at any certain time of day. With additional data, it will be possible to analyse around-the-clock activity in more detail, to test for any clear diurnal patterns in occurrence or behaviour. However, software suitable for automating analyses click trains in relation to duration and time of occurrence this will be required. This may be available from Welsh based researchers and this is being followed up.

Table 3 gives the number of encounters consisting of *Cet hi* and *Cet all* trains, for each day. The data was first analysed for *Cet hi* encounters only and yielded 27 encounters. The duration of encounter varied greatly with some lasting over 25 minutes. The inclusion of *Cet lo* trains increased the number of encounters logged to 44, as well as extending maximum encounter duration.

Table 3. **August 16-September 01, number of encounters (enc) for *Cet hi* and *Cet all* (*Cet hi* + *Cet lo*) trains.**

date	*No. enc (Cet hi)*	*No. enc (Cet all)*
17.08	1	1
18.08	2	4
19.08	3	4
20.08	0	0
21.08	1	3
22.08	4	4
23.08	3	5
24.08	2	2
25.08	1	1
26.08	0	2
27.08	4	9
28.08	1	3
29.08	3	3

30.08	2	3
31.08	0	0
01.09	0	0

4.3 Summary of Results

4.3.2 Technical Results

4.3.2.1 Postive

- The POD successfully detects harbour porpoise clicks.
- The POD distinguishes porpoise clicks from other sources of underwater sound.
- The POD should operate for up to four weeks before requiring battery replacement.

4.3.2.2 Negative

- The POD can be set up and downloaded only with one old laptop.
- Software is required to perform further analysis of genuine porpoise detections to improve our understanding of how they use the area

4.3.3 Biological Results

- Porpoise activity was recorded at the site on 17 out of a total of 25 days.
- 50 separate encounters (*Cet all*) were recorded over the two deployment periods; of these, 6 occurred between August 01 and 10, and 44 between August 16 and September 01.
- Further data are required in order to investigate diurnal, tidal, seasonal or other patterns of porpoise abundance.

4.4 Discussion

Acoustic monitoring of cetaceans has several distinct advantages over visual methods. Sighting rates can be strongly affected by sea state, particularly for small, inconspicuous species such as harbour porpoises. Acoustic detection rates do not decline with increasing sea state (Pierpoint 2001) and can thus be used to maintain survey coverage for periods with unfavourable sighting conditions. The POD is unique in being designed for stationary deployment; this provides data

over extended time periods and around-the-clock, allowing for investigation of temporal patterns in cetacean abundance. Some inferences about behaviour may also be made from in-depth analysis of acoustic recordings. However, it is not possible to assess numbers of animals or structure of groups from this data nor is possible to detect porpoises that are not calling..

Deployed *in situ*, the POD will provide extensive of data on the use of the Arklow Bank by harbour porpoises over long time periods. The POD is currently being tested for use while being towed. If it proves feasible for use during visual surveys of birds and marine mammals by towing it behind the survey vessel, the combination of visual data and acoustic detections will allow the cross-calibration of these methods and an improved understanding of porpoise distribution around the bank at certain points in time. Again, however, the problems with computers and data analysis software will need to be overcome.

In addition, recent concerns have been raised regarding evidence that a number of marine mammal species respond to acoustic and physical disturbance, such as that associated with seismic surveying or construction work (Harwood & Wilson 2001). It is therefore important to monitor the distribution and behaviour of porpoises in the study area, in order to assess the effects of any acoustic disturbance introduced to this ecosystem.

5 References

Coveney J & Phalan B. 2001. Arklow Bank Seabird and Marine Mammal Survey July 2000 – June 2001. Unpublished

Coveney Wildlife Consulting Ltd. 2002. Interim Report No. 1 on Year 3 of Seabird & Marine Mammal Surveys of the Arklow Bank July - October 2002. Unpublished

Harwood J & Wilson B, 2001. The implications of developments on the Atlantic Frontier for marine mammals. Continental Shelf Research 21 (8-10).

Pierpoint C, 2001. Harbour porpoise distribution in the coastal waters of SW Wales. A report to the International Fund for Animal Welfare.

Pierpoint C, Baines M & Earl S, 1999. Field trials of the POD – an acoustic data logger – to monitor harbour porpoise activity in Newport Bay, Pembrokeshire. A report to the Countryside Council for Wales and the Wildlife Trusts. Unpublished.

Tregenza N, 2002. www.chelonia.demon.co.uk (POD website).