Dolphin and Porpoise Watch:

Effects of Water User Encounters on Bottlenose dolphin behaviour and site use

on the Ceredigion Coast, West Wales

2022

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Contents

Introduction 2
Method 2
Site use by bottlenose dolphins 3
Encounters between bottlenose dolphins and water users 4
Results 4
Observer effort 4
Survey conditions 5
Sightings rates 6
Group size 7
Sightings of young bottlenose dolphins 9
Site occupancy 10
Levels of water user traffic by site 10
Encounters between dolphins and water users 12
Compliance with the Ceredigion Marine Codes by water users during encounters with dolphins 16
Proportions of different types of non-compliance with the Marine Codes 16
The incidence of non-compliance for different water users 18
Effects of water user encounters on bottlenose dolphin behaviour 20
Acknowledgements 21
Appendix: Site use by harbour porpoise and grey seal 21

Introduction

Dolphin Watch was established in response to a community led initiative which raised concerns that perceived increases in powered craft activity may have potential adverse effects on the local bottlenose dolphin population. In 1994, when the Dolphin Watch study first began, the aim was to obtain further information on the relationship between cetacean site use and boat traffic; this data would then help to guide future management of the then recently designated voluntary Marine Heritage Coast (MHC). The project was designed with the aim of encouraging local people to participate in monitoring the dolphins, to both build support for the MHC and to raise public awareness of the issue of boat disturbance. In 2018 the project was expanded to also include and promote the recording of harbour porpoise sightings in Cardigan Bay.

In 1996 an area in the south of Cardigan Bay was put forward as a candidate Special Area of Conservation (cSAC) under the EU Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora,1992) because of its importance for the bottlenose dolphin population in Cardigan Bay.

In 2004 the Cardigan Bay Special Area of Conservation (SAC) was officially designated as an SAC. Stretching from Ceibwr Bay in Pembrokeshire to Aberarth in Ceredigion and extending almost 20km from the coast, Cardigan Bay Special Area of Conservation (SAC) protects the wildlife found in around 1000km^2 of sea. Cardigan Bay SAC forms part of a network of protected sites known as the Natura 2000 (N2K) network.

Dolphin Watch has now completed twenty eight years of data collection. This is the fourteenth Dolphin Watch survey report (Pierpoint and Allan 2000, 2001; 2002; 2004; 2006; Allan et al 2010; Sampson et al 2015, Perry 2016, Heath and Vaughan 2018, Heath and Vaughan 2019, Heath and Vaughan 2020, Heath and Vaughan 2022, Heath and Hughes 2025). A peer reviewed paper has also been published Pierpoint, C., Allan, L., Arnold, H., Evans, P., Perry S., Wilberforce, L and Baxter, J. (2009*)* Monitoring important coastal sites for bottlenose dolphin in Cardigan Bay, *Journal of the Marine Biological Association of the United Kingdom*. 89 (5): 1033-1043). Pease note: *The year 2020 is the only year in the project's twenty-seven year history to have an incomplete data set; this is due to the Covid 2019 pandemic and the measures put in place through lockdowns and activity restrictions until August 2020, so data was only collected in 2020 in a limited form. This data was used to inform site management; but did not provide a comparable data set to produce a report for the year 2020.*

The key aims of the DPW project are:

•To monitor the presence of bottlenose dolphins and harbour porpoise to improve our understanding of bottlenose dolphin and porpoise site usage and to monitor trends in dolphin and porpoise occurrence

•To monitor levels of water user traffic to aid coastal zone management and to assess the effectiveness of the Cardigan Bay Marine Codes

•To Investigate interactions between bottlenose dolphins/ harbour porpoise and water users, and how these interactions affect dolphin and porpoise behaviour

•To increase public awareness and appreciation of the marine wildlife in Cardigan Bay

Method

In 2022 bottlenose dolphin and harbour porpoise monitoring was completed at seven study sites in Cardigan Bay, West Wales. The data was collected by a team of volunteers, some of whom had already taken part in the project in previous years, but also working alongside volunteers new to the project. The study sites were located at Mwnt, Aberporth, Ynys Lochtyn, New Quay Bird's Rock, New Quay Harbour, Aberystwyth and Borth.
Records from New Quay Harbour were collected and contributed to the database by the Wildlife Trust of South and West Wales Living Seas' staff and volunteers from the Cardigan Bay Marine Wildlife Centre (CBMWC). Ceredigion County Council are very grateful for the staff and volunteer time dedicated to this research by the CBMWC without which this report would not be possible.

This year's report covers field data collected from 1st March to 31st October 2022, the same parameters used in the 2016, 2017, 2018, 2019 and 2021 Dolphin Watch reports. The data from March to October was analysed in to include the full length of the field season covered by volunteers at many of the sites, and to ensure that sufficient data collected in suitable conditions (visibility at least 2 km, sea state 3 or less) was available for analysis.

Site use by bottlenose dolphins

Watches of two hours each were scheduled with set start times of 09:00, 11:00, 13:00, 15:00, 17:00 and 19:00. At New Quay Harbour, The Wildlife Trust of South and West Wales Living Seas' staff and volunteers from the Cardigan Bay Marine Wildlife Centre carried out additional watches throughout the field season at 07:00. The two hour watches were divided into eight 15 minute intervals. At the beginning of each interval the start time and information on sighting conditions (general weather and visibility, wind direction and sea state) were recorded on a data sheet. This information was later used to extract a subset of observations made in good conditions (visibility at least 2 km, sea state 3 or less) for which sighting rates of bottlenose dolphins were calculated and comparisons made between study sites.

Dolphin and Porpoise Watch volunteers receive training at the start of each season to address any misconceptions and to update survey skills and data collection methodology. Volunteers are provided with a range of keys, guidance notes and a comprehensive photographic guide detailing cetacean behaviours that may be observed.

When marine mammals were present at the site their locations were marked on a map. Locations were estimated by eye within a grid of guidelines to landmarks. A group of bottlenose dolphins is considered to be animals in close proximity (within about ten body lengths of another animal) and behaving in a similar manner. Abbreviated codes were written against each individual animal or group location giving species name, group size, number of calves and behaviour at the beginning of the fifteen minute interval or when first seen.

From these systematic counts sighting rates for bottlenose dolphins were derived. Two indices were used to make comparisons between sites and with previous field seasons. These indices were:

a) The proportion of two hour watches in which dolphins were recorded

b) The average count of dolphins in a fifteen minute interval per two hour observation period.

For those watches in which dolphins were recorded at least once, three further indices were calculated:

c) Group size: as a measure of the average group size or number of dolphins aggregated at each site, the mean of the highest count recorded in each watch was used. The total number of dolphins seen in each two hours was not estimated, as we cannot determine this from the data collected. The aim of the study is not to identify individual animals; therefore we are unable to establish whether the same animal/s moved through the site more than once in a watch.

d) Occurrence of young bottlenose dolphins (juveniles or calves): bottlenose dolphins were recorded as calves if they were distinctly paler than the accompanying adult and approximately two-thirds of the adult length or less. Foetal folds may also still be visible.

e) Site occupancy: to examine the amount of time that dolphins tended to occupy sites, the average number of fifteen minute intervals with bottlenose dolphins present per watch was calculated for watches in which dolphins were recorded at least once.

Encounters between bottlenose dolphins and water users

Additional information was recorded on the data sheet when a water user/s came within 300 metres of a group of bottlenose dolphins. This is classed as an 'encounter'.

Only the first encounter in each fifteen minute interval was recorded. This reduced the likelihood of bias towards particular types of water users that observers may have considered to have a greater impact on dolphin behaviour.

For each 'encounter' the observer recorded the type of water user that was closest to a dolphin/group; the total number of water users within a 300 metre radius of an individual dolphin/group, and compliance/non-compliance with the Ceredigion Commercial Marine Code for wildlife trip boat operators, and the Ceredigion Marine Code for recreational water users; and all the dolphin behaviours that were observed.

Water users were considered to have complied with the Ceredigion Marine Codes if they either passed the animals at 'no-wake' speed, with no changes of course to approach (code Y1) or slowed down gradually and stopped (Y2). Four codes were used when water users did not comply and these were either because they were travelling too fast within 300 metres of dolphins (N1); they followed a changes of course to approach or follow dolphins (N2); they attempted to touch, feed or swim with dolphins (N3), or they were clearly exceeding 8 knots within a buoyed, low speed zone at New Quay (N4). A code (R) was used when the boat involved was a vessel permitted under licence from Natural Resources Wales to approach bottlenose dolphins for research purposes. These vessels carry a flag that they must fly when they are invoking their licence.

We then examined whether compliance or non-compliance with the Ceredigion Marine Codes affected the dolphins' behaviour and how the dolphins responded to encounters with water users. Observers recorded dolphin behaviour for each fifteen minute interval throughout the two hour observation period and the dolphins' behavioural responses during encounters.

Results

Observer effort

During 2022 a total of 1650 observation periods (watches) were carried out between March and October (Table 1). Since the first season's field work in 1994 a total of 18,980 watches have been completed.
When the project began observations were carried out at three sites; Aberporth, New Quay Bird's Rock and Ynys Lochtyn. In recent years however, watches at Ynys Lochtyn have not taken place every year. During 2017 some watches were completed at Ynys Lochtyn by the Cardigan Bay Special Area of Conservation officer; due to lack of capacity this was not possible in 2018. Watches have been re-instated at Ynys Lochtyn in 2019.
Borth has also been added as a new site. Mwnt has been included since 1998; New Quay Harbour and Aberystwyth were added to the site list in 2004.
The New Quay Harbour data is contributed to the database by The Wildlife Trust of South and West Wales. This data is collected by Living Seas' staff and volunteers based at the Cardigan Bay Marine Wildlife Centre, following the same survey protocols but surveys are conducted over the full calendar year.

Table 1: Observation period (watch) totals in the period 1st March – 31st October 2022

	All sites	Mwnt	Aberporth	Ynys Lochtyn	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
No of watches	1650	133	79	1	117	1187	90	43
Hours of effort	3300	266	158	2	234	2374	180	86

Survey conditions

Between 1st March and the 31st October 2022, 1650 watches,3,300 hours of effort were completed in good conditions for observing marine mammals (Table 2). Watches conducted when conditions were not suitable were removed from the dataset. Only watches where data was available for the full two hour survey (eight successive fifteen minute intervals) conducted in Beaufort sea state 3 or less and where visibility was greater than 2 km were used for further analysis (Figures 1 & 2).

Table 2: Number of watches conducted in good conditions (used for further analysis)

	All sites	Mwnt	Aberporth	Ynys Lochtyn	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
Number of watches in good conditions	1650	133	79	1	117	1187	90	43
Hours of effort in good conditions	3300	266	158	2	234	2374	180	86

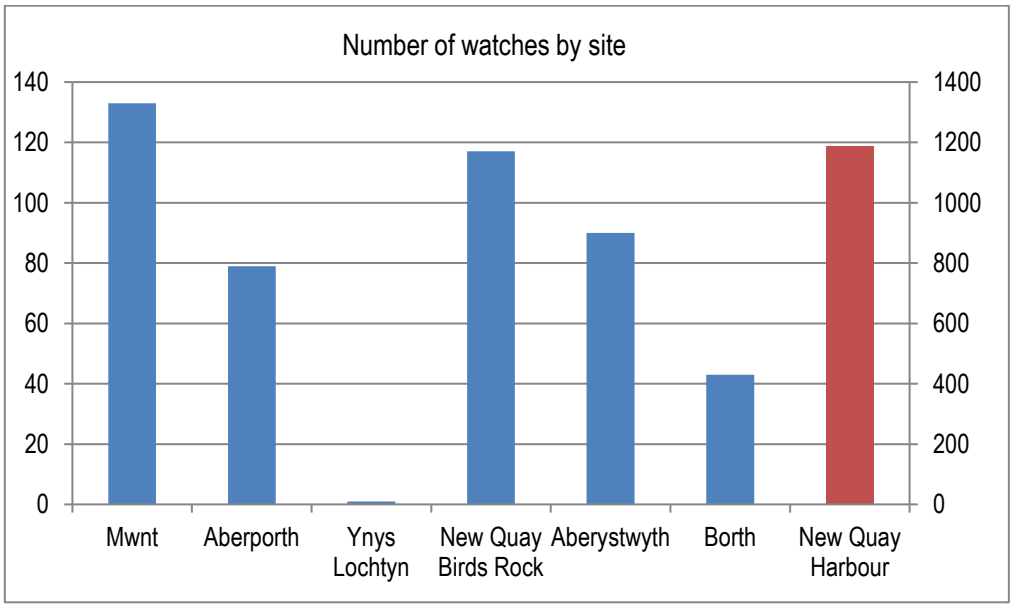

Figure 1: Number of watches conducted in good weather at Dolphin Watch monitoring sites
N.B. New Quay Harbour watches are conducted every day throughout the season from 7am to 7pm by Living Seas' staff and volunteers based at the CBMWC. The number of watches at this site is therefore much higher.

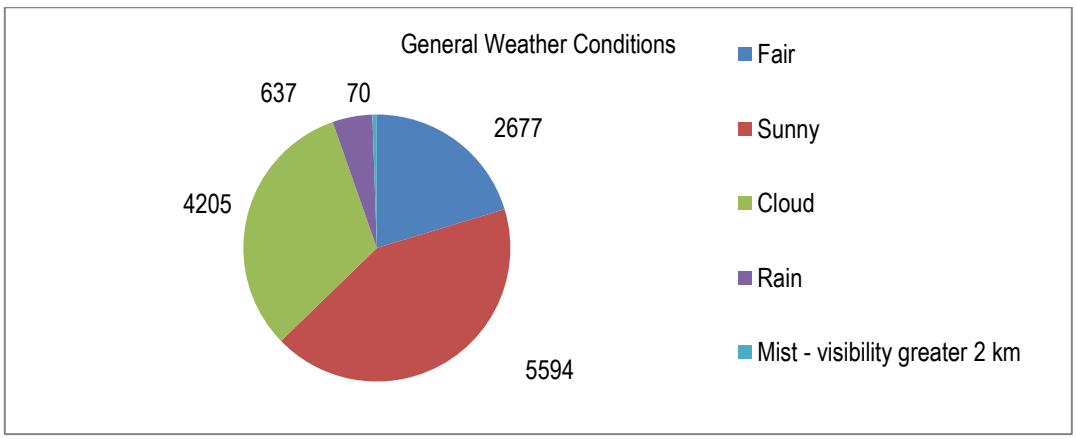

Figure 2: Weather conditions (number of intervals)

The median sea state across all sites was sea state 1 (calm, rippled surface). The median sea state for individual sites was also sea state 1 (calm, rippled surface).

Sightings rates

Sightings rates for bottlenose dolphins were calculated from 1650 watches. These were watches with eight intervals recorded in good conditions (sea state 3 or less and visibility >2km) between the beginning of March and the end of October 2022.

Table 3: Percentage of two hour watches at each site with dolphin sightings

Year	Mwnt	Aberporth	Ynys Lochtyn	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
2022	62%	43%	100% *	49%	67%	29%	40%

*Only one watch took place at Ynys Lochtyn in 2022

New Quay harbour had the highest sightings rating of all the sites at 67%, down slightly from the 2021 sightings rate of 72%. Sightings rates for New Quay Harbour had previously been dropping year on year since 2013, however the 2017 sightings rate of 73% was significantly higher than the 2016 figure of 58%, dropping slightly in 2018 to 68% and remaining at 68% in 2019.
The sightings rate at Mwnt for 2022 of 62% has increased significantly from the 2019 figure of 39%, and only a 2% drop from the 2021 figure of 64%.

Aberporth had remained constant at 23% in 2016 and 2017, with an increase to 33% in 2018, dropping to 17% in 2019; and dropping further in 2021 to 14%. In 2022 there was a significant increase in the sightings rate to 43%.

New Quay Bird's Rock showed only a small fluctuation in the previous few years until 2019, from the 2016 figure of 49% to 54% in 2017, dropping slightly to 52% in 2018, with a significant drop in 2019 to 39%. Rising again to 51% in 2021, with a slight fluctuation to 49% in 2022.

Ynys Lochtyn had a sightings rate of 50% in 2019, with the exact same sightings rate in 2021 of 50%. In 2022 only one watch took place, where dolphins were seen.

The sightings rate in Aberystwyth decreased significantly from 50% sightings rate in 2016 to just 16% in 2017, 17% in 2018, increasing to 23% in 2019 and increasing significantly in 2021 to 37.5%. In 2022 it has dropped gain to 29%.

Borth was a new site for 2019, with a sightings rate of 13%, increasing in 2021 to 24%, and increasing again to 40% in 2022.[1]

[1] (Figures for 2016 were taken from Heath, M and Vaughan, A (2018) 'Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, West Wales 2016'. Figures for 2017 were taken from Heath, M and Vaughan, A (2019) 'Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, West Wales 2017'. Figures for 2018 were taken from Heath, M and Vaughan, A (2022) 'Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, West Wales 2018'. Figures for 2019 were taken from Heath, M and Vaughan, A (2023) 'Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, West Wales 2019'. Figures for 2021 were taken from Heath, M and Hughes, I (2025) 'Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, West Wales 2021'.

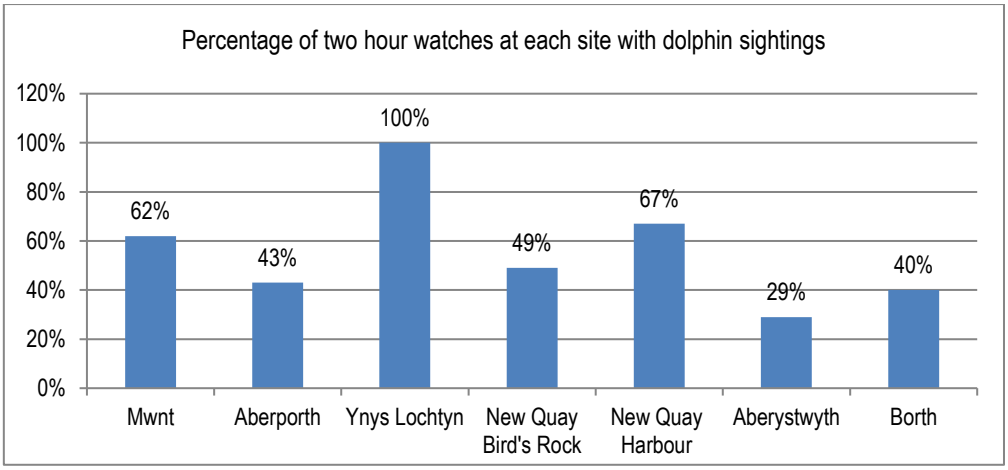

Figure 3: Sightings rates - percentage of two hour watches in which dolphins were recorded

Table 4: Mean average number of dolphins observed in a fifteen minute interval where dolphins were sighted

Year	Mwnt	Aberporth	Ynys Lochtyn	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
2022	4.6	3	5*	4.6	2.3	2.5	2.4
2021	4.3	3	2.8	3.8	3.75	2.2	2.4
2019	3.7	2.7	2.9	3.7	3.3	2.1	2
2018	3.7	2.5	No watches	4.1	4	2.4	No watches

*Only one watch took place at Ynys Lochtyn in 2022

At sites where 5 watches or more took place watches at Mwnt and New Quay Bird's Rock recorded the highest average number of dolphins in 2022 (Table 4 & Figure 4). New Quay Bird's Rock had shown a decrease between 2013 and 2017, however sightings increased in 2018, dropping slightly in 2019, with a significant increase in 2021 to 4.6. Average numbers at Mwnt had remained constant in 2019 and 2018, increasing in 2021, and increasing again in 2022 to 4.6.

Aberporth has stayed constant at 3, the highest mean average for the site in recent years

At the Aberystwyth site the average number of dolphins has increased slightly in 2022 from the previous two years. At Ynys Lochtyn only one watch took place in 2022.

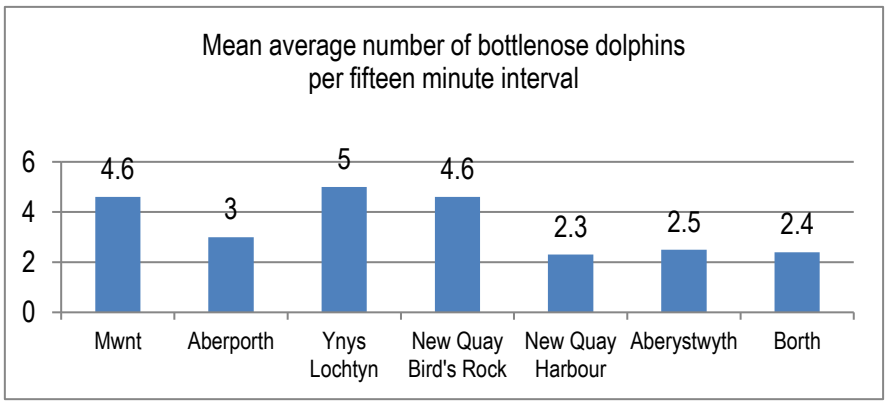

Figure 4: Mean average number of dolphins observed in a fifteen minute interval where dolphins were sighted

Group size

The mean average of the highest group size of dolphins recorded per interval in each two hour watch when sightings occurred was used as a measure of group size (Table 5 & Figure 5).

The greatest mean group size occurred at New Quay Harbour and New Quay Bird's Rock.

Table 5: Mean average of the highest group size of bottlenose dolphins recorded in each two hour watch

Year	Mwnt	Aberporth	Ynys Lochtyn	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
2022	4.4	2.9	5*	3.9	3.4	2.6	2.3
2021	4.1	3	2.6	3.9	3.6	2.3	2.3
2019	3.2	3	2.6	4	4.2	1.9	2
2018	3.5	2.6	No watches	3.8	4	2	No watches

** Fewer than 5 watches recorded with sightings*

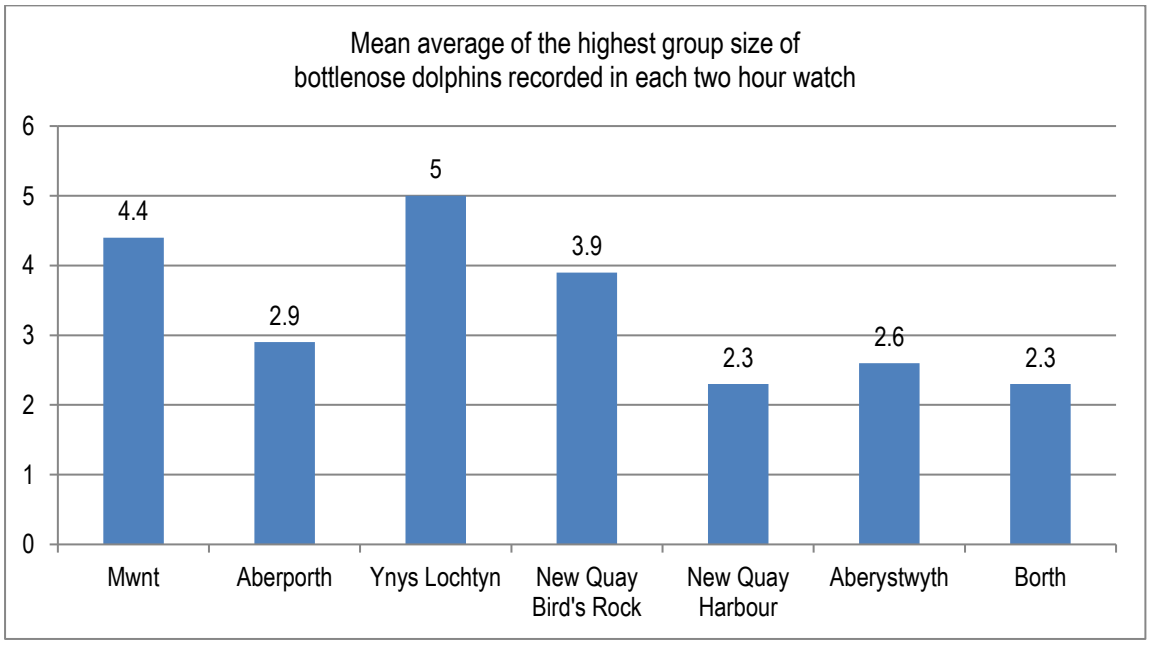

Figure 5: Mean average of the highest group size of bottlenose dolphins recorded in each two hour watch

Maximum recorded group size at each site

The maximum dolphin group size observed at each site was also recorded (Table 6 & Figure 6). The largest group sizes were observed at New Quay Harbour (11 animals) Mwnt (10 animals) and New Quay Bird's Rock (8 animals). The Mwnt, New Quay Bird's Rock and New Quay Harbour sites show consistently larger groups of animals in all years since group size was first included in the 2008 report.

Table 6: Maximum recorded group size at each site

Year	**Mwnt**	**Aberporth**	**Ynys Lochtyn**	**New Quay Bird's Rock**	**New Quay Harbour**	**Aberystwyth**	**Borth**
2022	12	10	5	12	15	5	6

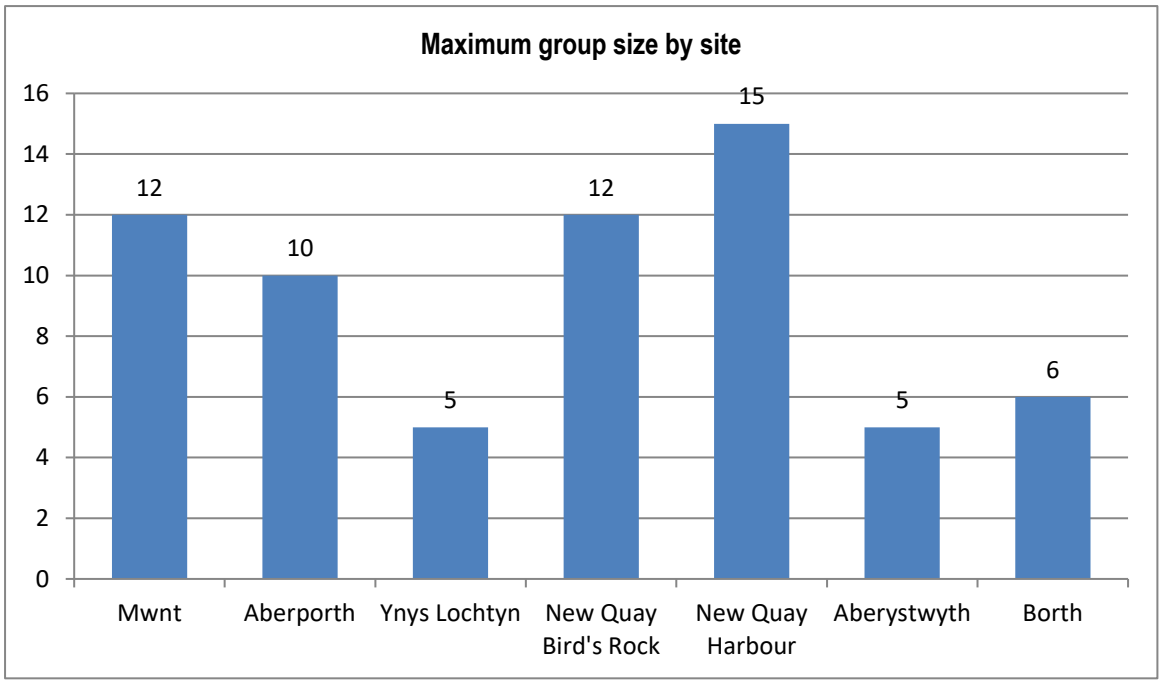

Figure 6: Maximum group size of bottlenose dolphins by site

Sightings of young bottlenose dolphins

Young dolphins were sighted across all sites (where more than 5 watches took place) during 33% of intervals. New Quay Harbour had the highest sightings rate of animals with calves, seen in 66% of the watches during 2022, the same figure as in 2021. New Quay Bird's Rock has had a significant percentage increase in 2022 to 37% from the 2021 figure of just 19%. The number of young bottlenose dolphins recorded at New Quay Bird's Rock has fluctuated widely in recent years from 44% of watches with young dolphins present in 2018 to 23% in 2019. Young dolphins were sighted at Mwnt in 29% of watches, a slight drop from the 2021 figure of 31%. In 2019 the percentage was 15%, a significant drop from 43% of the watches during 2018; and 53% in 2017. At Aberporth young dolphins were seen in 24% of watches, where previously young dolphins had not been recorded. In Aberystwyth young dolphins were seen in 23% of watches, a significant decrease from the 2021 figure of 39%. Borth had a percentage sightings rate of dolphins with calves at 18% in 2022.

Table 7: Young dolphin sightings (percentage of watches when dolphins present with young animals) at sites where more than five watches took place

Year	Mwnt	Aberporth	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
2022	29%	24%	37%	66%	23%	18%
2021	31%	0%	19%	66%	39&	30%
2019	15%	20%	23%	61%	14%	67%
2018	43%	0%	44%	68%	33%	No watches
2017	53%	0%	23%	50%	0%	No watches
2016	41%	33%	24%	50%	0%	No watches

Site occupancy

Site occupancy is defined as the amount of time that bottlenose dolphins were present at each site. It is measured as the mean average number of fifteen minute intervals that dolphins were recorded per two hour watch; i.e. when dolphins were present, how long did they stay.

Table 8: Site occupancy (mean number of fifteen minute intervals per watch when dolphins were present) at sites where more than five watches took place

Year	Mwnt	Aberporth	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
2022	4.6	3.4	3.6	5	3.6	3
2021	4.1	1	4.4	5.2	2.4	3
2019	3.2	3.2	3.7	5	3.7	7
2018	4.8	1.2	3.4	5	5	No watches
2017	3.4	1	3.8	5.3	2.8	No watches

Water user encounters

Levels of water user traffic by site

Water user traffic was monitored by tally counts of water-craft over each two hour observation period. A total tally of 27,577.
New Quay Harbour was the busiest site for water user traffic followed by New Quay Bird's Rock, then Aberporth and Aberystwyth were equal third. Borth was fifth, with the lowest water user count at Mwnt (Table 9 & Figure 7).

Table 9: Mean water user counts per two hour watch 2022 (where more than 5 watches took place)

	Mwnt	Aberporth	New Quay Birds Rock	New Quay Harbour	Aberystwyth	Borth
2022	2.4	6.6	9.6	20.9	8	4

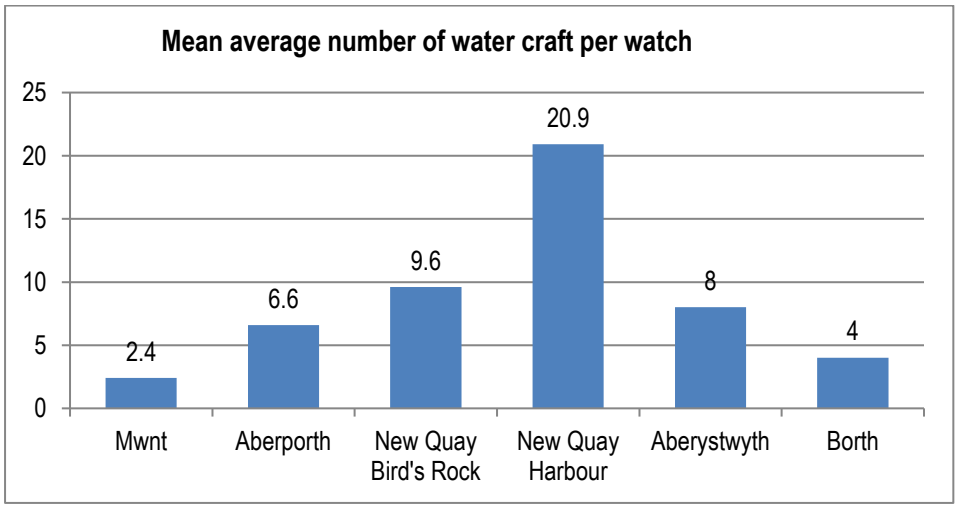

Figure 7: Mean average water user counts per two hour watch for each site

The most frequently recorded water user types in New Quay Harbour in 2022 were canoes, kayaks and paddleboards, with 8645 recorded. Visitor passenger boats were the second highest recorded at 7591. The next highest category was motor boats at 3236, sail boats at 2264 and speed boats/RIBs at 2092.

New Quay Bird's Rock, had the second highest water user count; where visitor passenger boats were the most frequent, with 692 recorded. The next most frequently recorded water user at this site were motor boats with a count of 145 recorded. The third most frequently recorded type of water user were canoes and stand up paddleboards at a count of 128. Commercial fishing boats, speed boats and sail boats all had similar coats at this site, with counts of 59, 46 and 43 respectively. Therefore the number of visitor passenger boats at Bird's Rock is significantly higher than any other type of water user.

Table 10: Total count of different water user types on each site in 2022 in good weather watches

Site	motor boat	speed boat/RIB	sail boat	commercial fishing boat	Visitor passenger boat	Canoe/ kayak/ sup	jet-ski	totals	No. of watches
Mwnt	68	29	18	8	76	120	1	320	133
Aberporth	47	52	28	17	7	365	4	520	79
New Quay Bird's Rock	145	46	43	59	692	128	2	1115	117
New Quay Harbour	3236	2092	2264	854	7591	8645	43	24,725	1187
Aberystwyth	170	59	49	66	0	378	3	725	90
Borth	31	8	11	11	0	98	11	170	43
Totals	3697	2286	2415	1015	8366	9734	64	27577	1649

Table 11: Mean average counts of different water user types for each site by two hour watch in 2022

Site	motor boat	speed boat/RIB	sail boat	commercial fishing boat	visitor passenger boat	Canoe kayak/SUP	jet-ski	No. of watches
Mwnt	0.5	0.3	0.14	0.06	0.6	0.9	0.007	133
Aberporth	0.6	0.6	0.54	0.2	0.09	4.6	0.05	79
New Quay Bird's Rock	1.24	0.4	0.4	0.5	5.9	1.09	0.02	117
New Quay Harbour	2.73	1.8	1.9	0.72	6.4	13.24	0.04	1187
Aberystwyth	1.9	0.7	0.54	0.73	0	4.2	0.03	90
Borth	0.72	0.2	0.3	0.3	0	2.3	0.3	43

New Quay Harbour

Due to the high volume of water users in the New Quay Harbour area, a factor unique to this site; water user counts per watch time and dolphin occupancy per watch time were also investigated to examine whether there is a correlation between the number of water users and site use by bottlenose dolphins.
The watch between the hours of 1100 – 1300 has the greatest average number of water users recorded per watch at 25.6.
The watches from 07:00 – 09:00 hours recorded the highest percentage of dolphins at 69%, this period also had the lowest boat count with a mean average of 7.

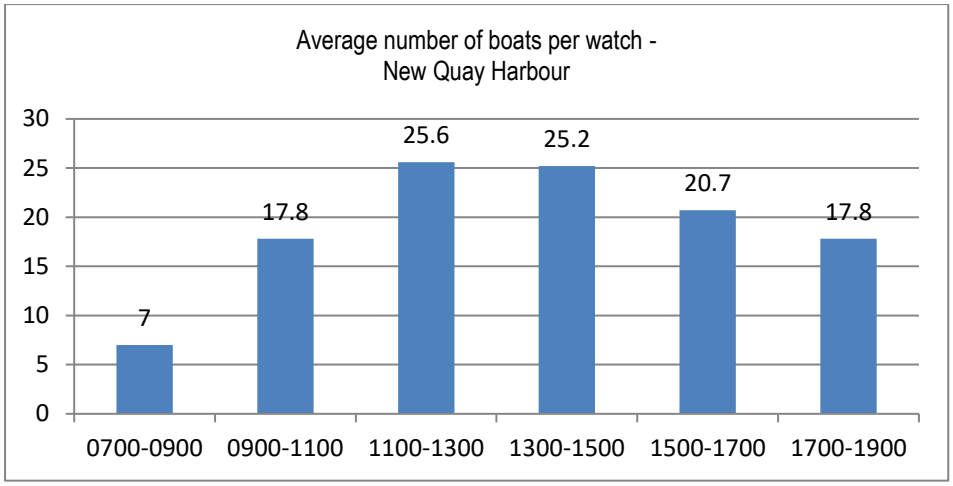

Figure 7: Average number of water users recorded by time of watch at New Quay Harbour 2022

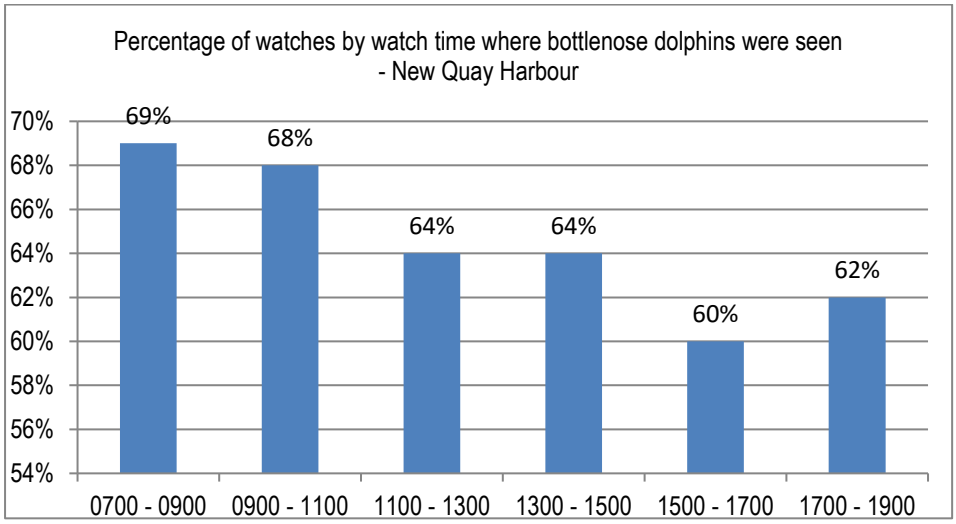

Figure 8: Percentage of watches by time of day where dolphins were seen at New Quay Harbour 2022

The graphs below show the average number of water-craft by watch for the three most frequent types of water-craft recorded from the New Quay Harbour monitoring site.

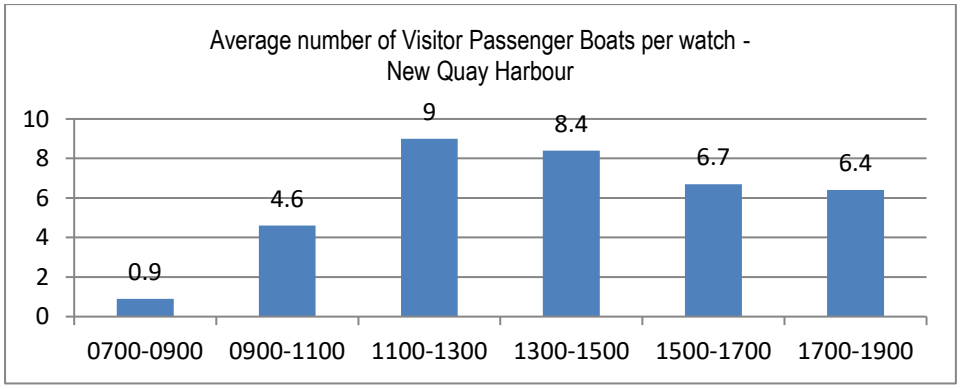

Figure 9: Average number of Visitor Passenger Boats recorded per watch at New Quay Harbour 2022

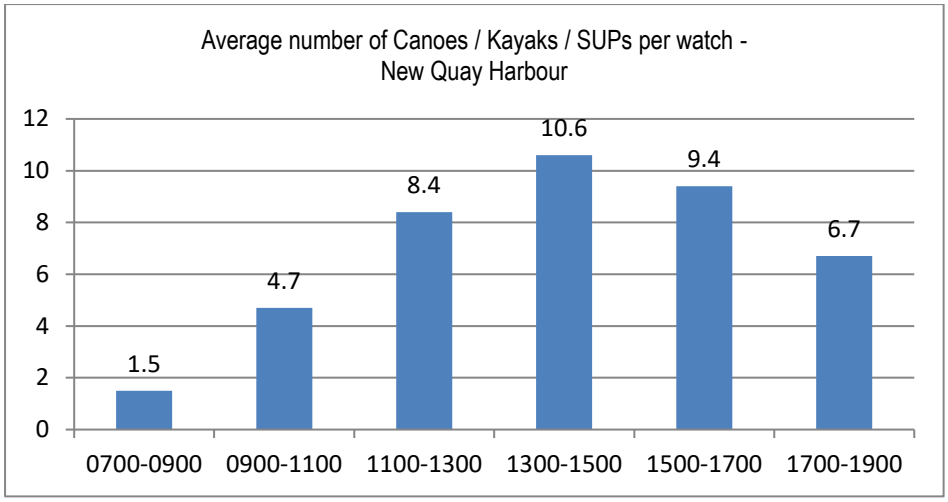

Figure 10: Average number of Canoes / Kayaks / SUPs per watch at New Quay Harbour 2022

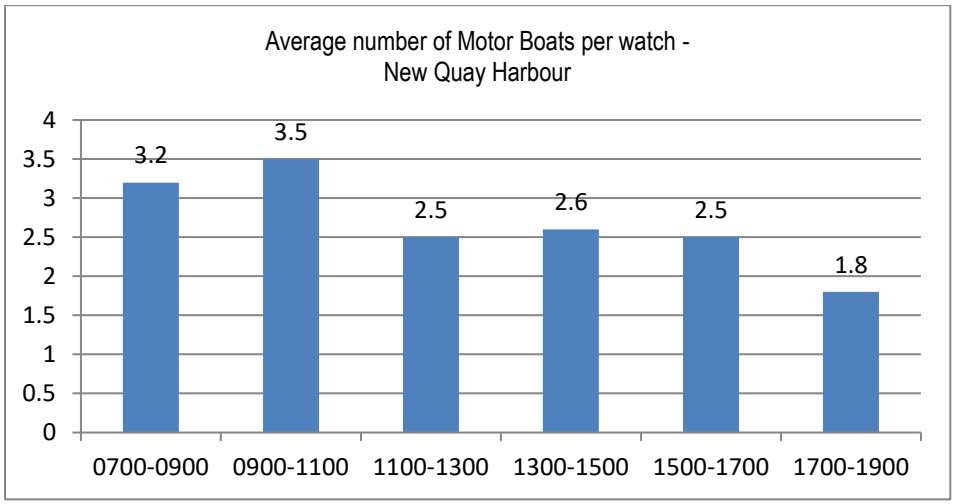

Figure 11: Average number of Motor Boats recorded per watch at New Quay Harbour 2022

Encounters between dolphins and water users

The protocol followed during a Dolphin Watch survey defines an encounter as occurring when any watercraft travels within 300m of an individual dolphin or a group of dolphins. A total of 4660 water-craft users were within 300 meters of dolphins during an encounter in 2022. Because the current protocol only records the behaviour of the first watercraft in an encounter during each Observation Period the total number of encounters recorded between bottlenose dolphins and watercraft in 2022 was 2245. The highest observed encounter rates were at New Quay Harbour; Bird's Rock had the second highest encounter rate, followed by Mwnt. Encounters with visitor passenger boats were most frequently recorded.

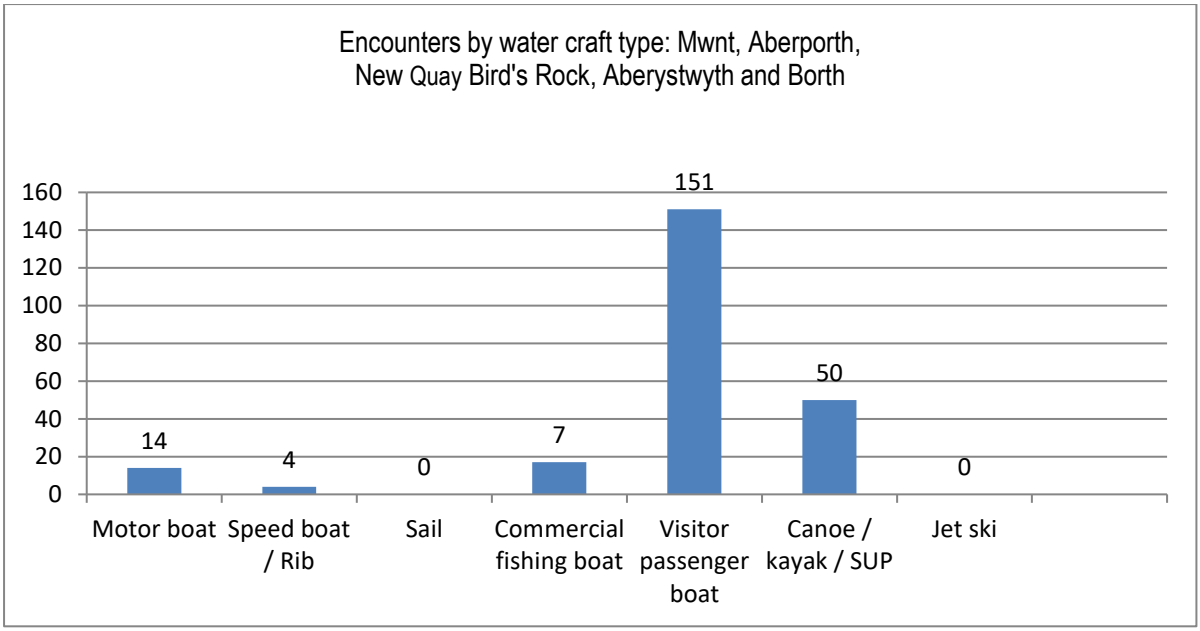

Figure 12: Encounters by water user type: Mwnt, Aberporth, Ynys Lochtyn, New Quay Bird's Rock, Aberystwyth and Borth 2022

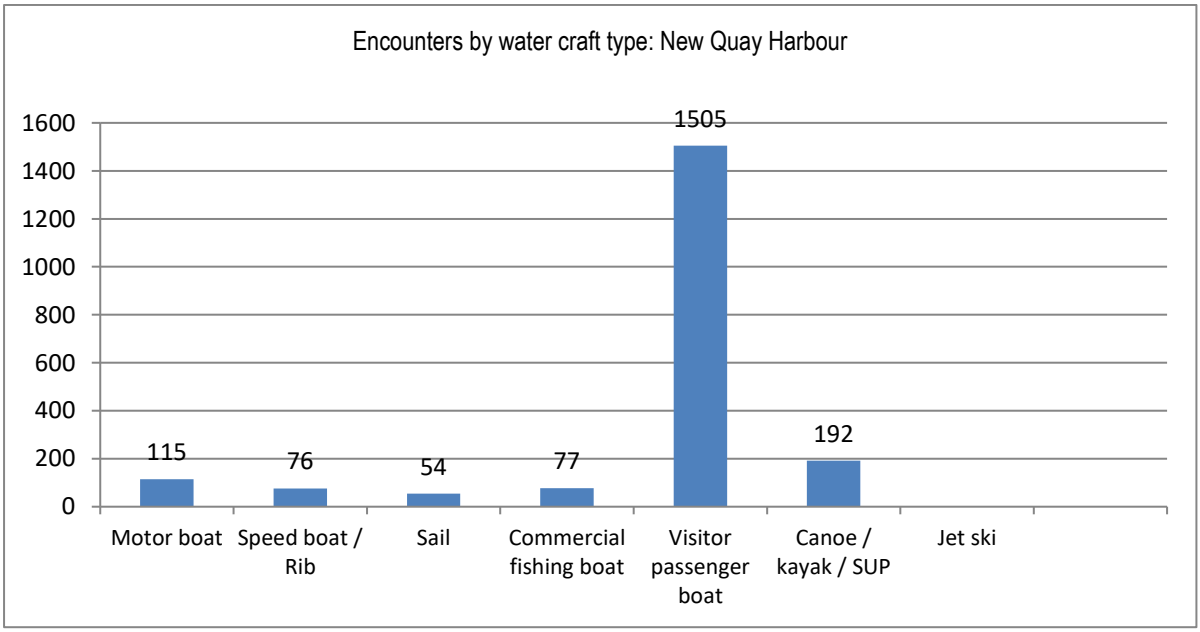

Figure 13: Encounters by water user type: New Quay Harbour 2022

Compliance with the Cardigan Bay Marine Codes by water users during encounters with dolphins

There were 2289 encounters recorded between water users and dolphins during the 2022 survey period. In 1982 (86%) of the encounters the observer recorded that the water user followed the relevant Marine Code; these Marine Codes are the guidelines for recreational water users and for commercial passenger boats. There were 307 (14%) of encounters in which water users did not follow the appropriate Marine Code (Table 12).

The rate of compliance with the Ceredigion Marine Codes varied by location; Borth recorded only one encounter in 2022, therefore this data cannot provide an accurate or fair indication of compliance at this site. At the remaining sites water users at New Quay Bird's Rock had the highest rate of compliance at 92%, followed by

New Quay Harbour at 87%. Aberporth and Mwnt had similar compliance rates of 76% and 75% respectively, while Aberystwyth had the lowest compliance rate at just 59% (Table 12 and Figure 14).

Table 12: Percentage of compliance/non-compliance with the Ceredigion Marine Codes during dolphin encounters

Site	Total number of water user encounters	Number of water user encounters following the Marine Codes	Percentage compliance with the Marine Codes	Number of water user encounters not following the Marine Codes	Percentage non-compliance with Marine Codes
Mwnt	67	50	75%	17	25%
Aberporth	21	16	76%	5	24%
New Quay Bird's Rock	118	108	92%	10	8%
New Quay Harbour	2053	1791	87%	262	13%
Aberystwyth	29	17	59%	12	41%
Borth*	1	0	0%	1	100%
All sites	2289	1982	87%	307	13%

*Only one encounter was recorded at Borth in the 2022 monitoring season

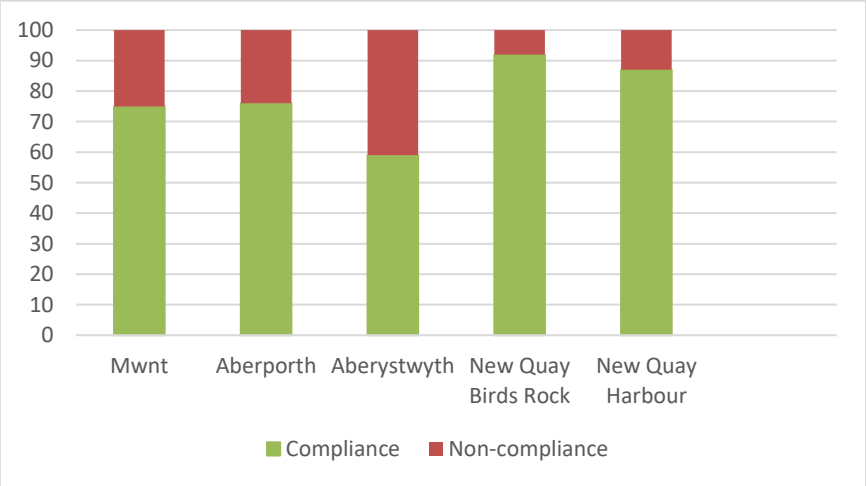

Figure 14: Percentage of compliance/non-compliance with the Ceredigion Marine Codes during dolphin encounters where five or more encounters took place (as a percentage of all recorded encounters per site)

Proportions of different types of non-compliance with the Ceredigion Marine Codes

The majority of cases of non-compliance with the Cardigan Bay Marine Codes involved water users manoeuvring to either approach or follow the dolphins (65%) or vessels travelling too fast within 300 metres of a group of dolphins (35%) (Table 13).

Table 13: Relative proportions of types of non-compliance with the Ceredigion Marine Codes

Water user activity (when not complying with the Cardigan Bay Marine Codes)	Number of encounters	Percentage of non-compliance
N1: Too fast, wake speed within 300m of dolphins	105	34%
N2: Erratic course to follow dolphins	199	65%

N3: Attempted to touch, feed or swim with dolphins	3	1%

The incidence of non-compliance for different water users

Motor boats had the highest rate of non-compliance: in 33% of all encounters with a motorboat the water user did not follow the Cardigan Bay Marine Code. (Table 14).

Table 14: Non-compliance of different types of water user

Water user type	Number of non-compliant water users by type	Total number of encounters by type	Percentage of non-compliance by type
Speedboat (rib)	23	79	24%
Motor boat	40	137	33%
Canoe/kayak/SUP	85	237	12%
Commercial fishing boat	22	116	27%
Sailing boat	5	60	10%
Visitor passenger boat	125	1646	5%
Jet-ski	2	2	50%
Other (RNLI & research)	5	12	100%
Total	307	2289	20%

Percentage of non-compliance during encounters by water user type by site (where more than five encounters took place)

The sites where more than five water user encounters were recorded are Mwnt, Aberporth, New Quay Bird's Rock, New Quay Harbour and Aberystwyth.
At Mwnt and Aberporth, motorboats, speedboats and canoes, kayaks and SUPS were observed not complying with the Ceredigion Marine Codes.
At New Quay Bird's Rock Visitor Passenger Boats and commercial fishing boats were the water user types recorded for non-compliance.
At New Quay Harbour, all water user types, with the exception of jet skis, were recorded not following the Marine Codes.
At Aberystwyth, motor boats, a commercial fishing boat and canoes, kayaks and SUPs were observed not complying with the Ceredigion Marine Codes.

Table 15: Percentage of non-compliance during encounters by water user type by site
N.B. Ynys Lochtyn and Borth recorded less than five encounters in 2022 so are not included in the table below.

		Motor boat	Speed boat (rib)	Commercial fishing boat	Sail boat	Visitor passenger boat	Canoe/ kayak/SUP	Jet ski	Other (RNLI/ research)	Total
Mwnt	Number of non-compliant water users by type	5	2	0	0	0	10	0	0	17
	Total number of encounters by type	5	5	6	1	30	19	0	1	67
	Percentage non-compliance by type	100%	40%	0%	0%	0%	53%	0%	0%	25%

Aberporth	Number of non-compliant water users by type	1	2	0	0	0	2	0	0	5
	Total number of encounters by type	1	3	5	0	0	11	1	0	21
	Percentage of non-compliance by type	100%	66%	0%	0%	0%	18%	0%	0%	24%
New Quay Bird's Rock	Number of non-compliant water users by type	0	0	2	0	8	0	0	0	10
	Total number of encounters by type	1	0	5	0	106	4	2	0	118
	Percentage of non-compliance by type	0%	0%	40%	0%	8%	0%	0%	0%	8%
New Quay Harbour	Number of non-compliant water users by type	29	18	21	5	117	67	0	5	262
	Total number of encounters by type	116	70	81	58	1521	194	0	13	2053
	Percentage of non-compliance by type	25	26	26%	9%	8%	35%	0%	38%	13%
Aberystwyth	Number of non-compliant water users by type	5	0	1	0	0	6	0	0	12
	Total number of encounters by type	13	0	2	1	0	13	0	0	29
	Percentage of non-compliance by type	38%	0%	50%	0%	0%	46%	0%	0%	41%

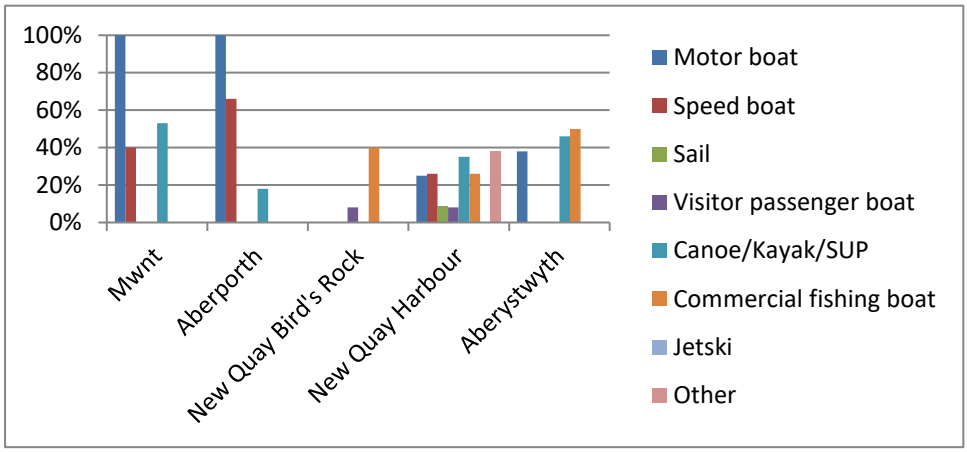

Figure 15: Percentage of non-compliance during encounters by water user type by site

Effects of water user encounters on bottlenose dolphin behaviour

How dolphins responded to positive and negative encounters with water users (whether they followed the relevant Marine Code) was also examined. Observers recorded the different dolphin responses during encounters. In the analyses certain behaviours are grouped together; for example 'heading away fast swimming' and 'heading away steadily' (HS or HF) are grouped together as a negative response (i.e. a change in dolphin behaviour to move away from a water user). Likewise 'approaching' (AP) and 'bow-riding' (B) are grouped together as positive responses. 'Leaping' or 'begin leaping' (L or BL), 'tail-slap' (TS) and 'grouping' (GS or GF) are listed as separate categories but classed as negative responses.

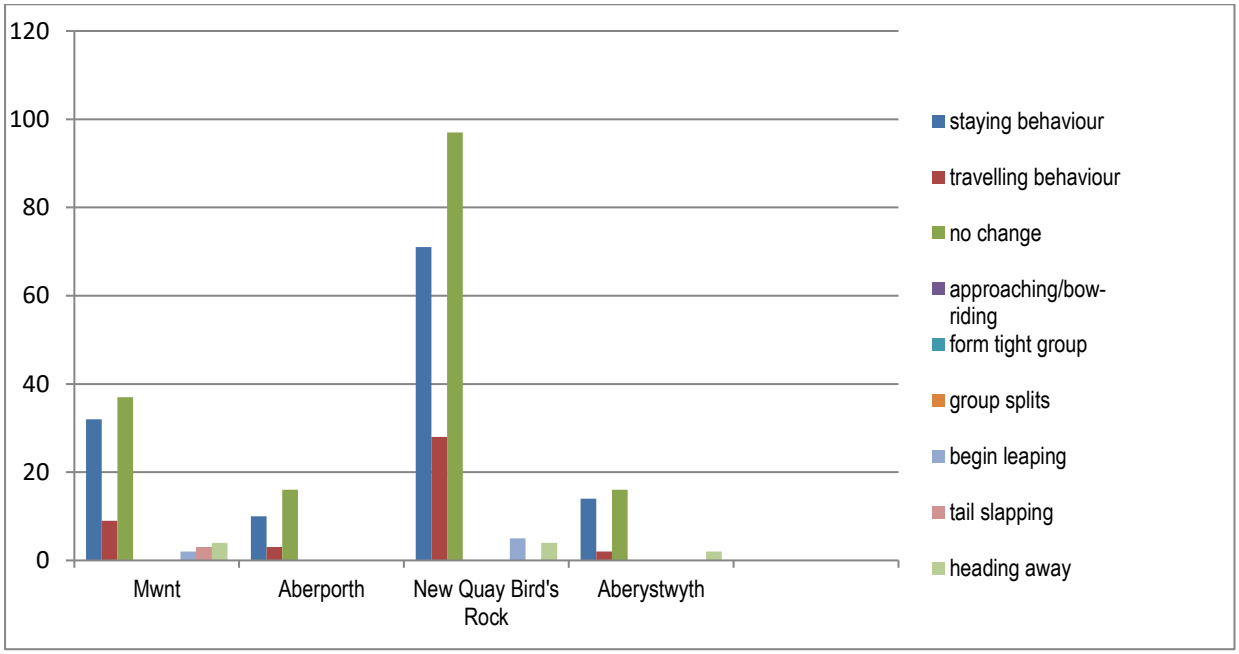

Figure 16: Dolphin behavioural responses to positive water user encounters (water users following the Ceredigion Marine Codes) at the Mwnt, Aberporth, New Quay Bird's Rock and Aberystwyth monitoring sites.

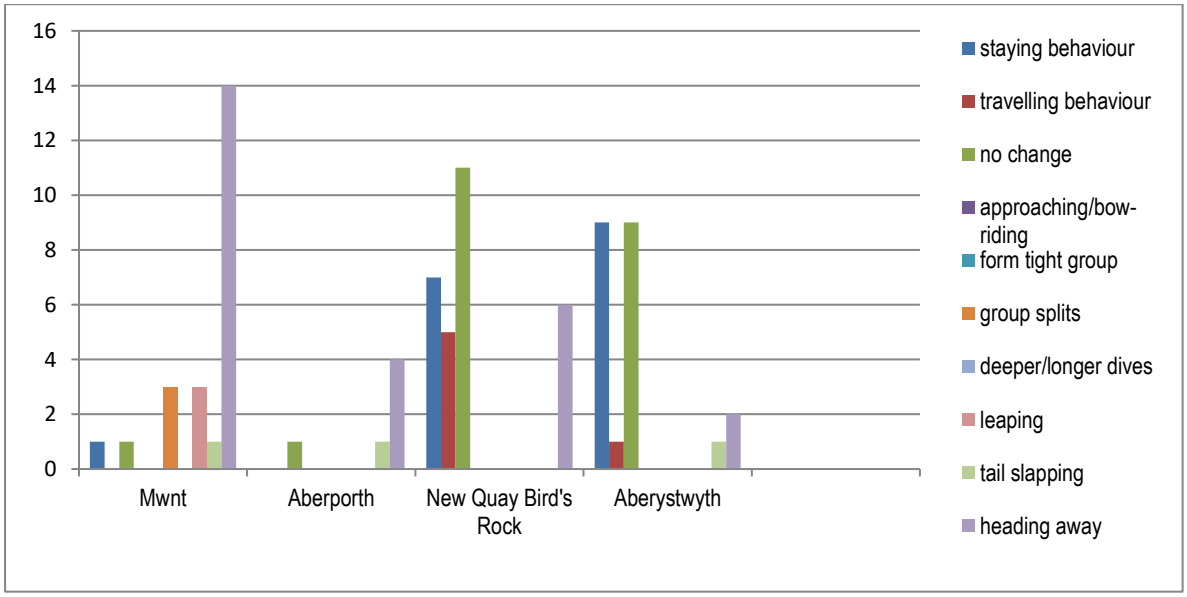

Figure 17: Dolphin behavioural responses to negative water user encounters (water users not following the Ceredigion Marine Codes) at the Mwnt, Aberporth, New Quay Bird's Rock and Aberystwyth monitoring sites.

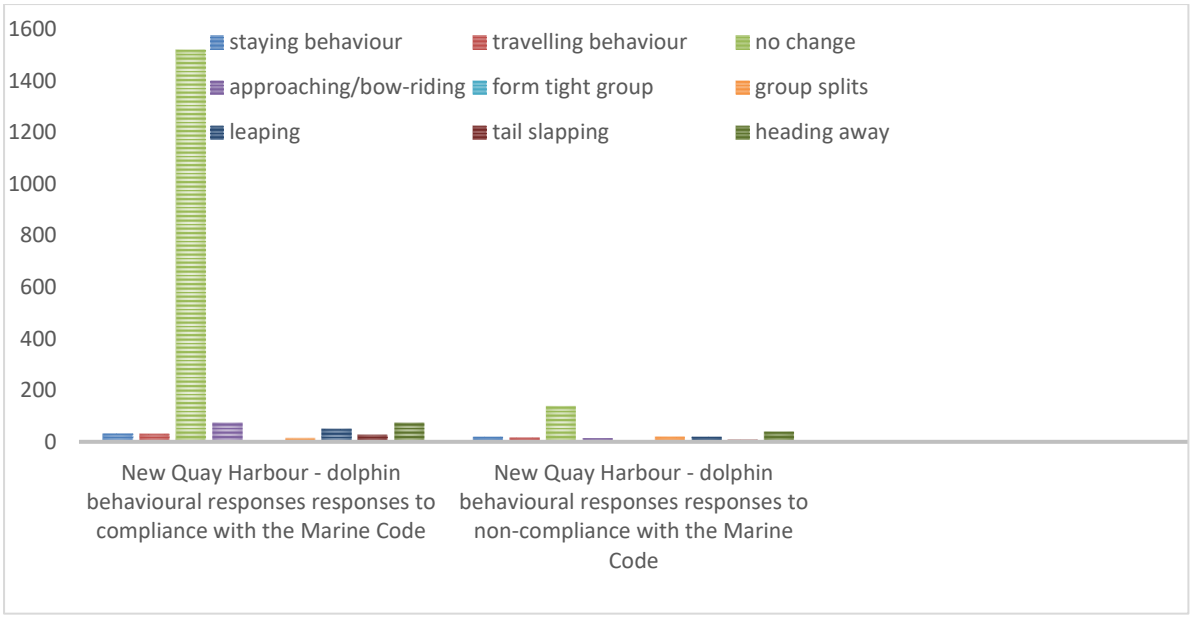

Figure 18: Dolphin behavioural responses to negative and positive water user encounters (water users following the Ceredigion Marine Codes) at the New Quay harbour monitoring site.

All sites showed that when the Ceredigion Marine Codes were followed, 'no change' was the most frequently recorded response (Figure 16).
During encounters where the water user did not comply with the Ceredigion Marine Codes, 'heading away' 'was the most frequently recorded responses at Mwnt and Aberporth.

At New Quay Bird's Rock, New Quay Harbour and Abeystwyth 'no change' was the most frequently recorded behaviour whether the Marine Codes were complied with by water users or not.
This suggests that although the data demonstrates that dolphins occupy the New Quay harbour areas less when the number of water users is greatest; bottlenose dolphin responses to water users encounters are similar at both this site and New Quay Bird's Rock a mile to the west of New Quay Harbour, whether or not the water user follows the Ceredigion Marine Codes, suggesting that animals may be becoming habituated to water user encounters in this area.
Although New Quay Harbour has shown 'no change' as the most frequently recorded behaviour whether the Marine Codes were complied with by water users or not, this is the first year that New Quay Harbour and Aberystwyth have shown these results.
Dolphins within close proximity to water users are potentially at risk both physically and behaviourally from the impact of the interaction, and may lead to potential collisions or vessel strikes between water users and bottlenose dolphins in these areas.

Acknowledgements

Thank you to all the hundreds of people that have contributed to the Dolphin Watch data collection over the last twenty-eight years. More than 80 people contributed observations in 2022. Observers' names are listed below, with apologies for any errors or omissions.

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Appendix

Site use by harbour porpoise and Atlantic grey seal

Atlantic grey seal

	Mwnt	Aberporth	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
Number of seals recorded	149	14	137	188	17	8

Harbour porpoise

	Mwnt	Aberporth	New Quay Bird's Rock	New Quay Harbour	Aberystwyth	Borth
Number of harbour porpoise recorded	9	0	1	38	3	2