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COUNTY COUNCIL

Dolphin Watch: Bottlenose dolphins and boat traffic on the Ceredigion coast, west Wales

2013 to 2015

By Sarah Perry,
Cardigan Bay Marine Wildlife Centre

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SUMMARY

- The Ceredigion Coast bottlenose dolphin and boat traffic survey (Dolphin Watch) provides a 22 year run of data on cetacean occurrence, levels of boat traffic and interactions between bottlenose dolphins (*Tursiops truncatus*) and boats along the Cardigan Bay coast.
- Since the first season's field work in 1994 a total of 11,270 watches have been completed as part of the Dolphin Watch project. During 2013, 2014 and 2015 a total of 1991 observation periods (watches) were carried out between June and September in each year (518 in 2013, 733 in 2014, and 740 in 2015).
- Observer effort was highest at New Quay harbour from 2013 to 2015, where 464, 572 and 582 watches took place. In 2013, 2014 and 2015 over 80% of two hour watches in each year were completed in good conditions for observing marine mammals (82% in 2013, 83% in 2014 and 84% in 2015).
- Sighting rates of bottlenose dolphins were highest at New Quay harbour in 2013 and 2015 and at Mwnt in 2014, when dolphins were present in 82 %, 62% and 80% of two hour watches respectively. Sightings rates were lowest at Aberporth in 2013 and Aberystwyth in 2014 and 2015.
- Over the duration of the project (1995-2015) average sightings rates at Mwnt and New Quay Birds Rock appear to have declined whilst at New Quay harbour the data suggests that on average based on data collected between 2004 and 2015 sightings rates have increased slightly. However, on closer examination of the data collected between 2013 and 2015 sightings rates have declined by more than 20% at both Mwnt (2014 - 2015) and New Quay harbour (2013 - 2015).
- The average number of dolphins observed per 15 minute interval was highest at New Quay harbour and at Mwnt.
- Dolphin group sizes observed at New Quay harbour were most consistent over the three years but the highest average group size (based on the average number of dolphins present in each observation period when sightings occurred) was observed at Mwnt in 2014. The largest group sizes were observed at New Quay harbour and New Quay Birds Rock, with these sites consistently recording larger group sizes of between 7 and 8 dolphins in all years (2013-2015).
- Bottlenose dolphins occupied New Quay harbour for the longest period, this is consistent with data collected in previous years, with dolphins recorded for more than half of each watch (one hour) on average.

- Young bottlenose dolphins were recorded more often at New Quay harbour where they were observed in more than 50% of watches in all years examined (2013 – 2015).
- As documented in previous years New Quay harbour had higher levels of boat traffic than other sites. Motor boats and Visitor Passenger Boats (VPBs) were the most frequently recorded boat types at New Quay harbour and New Quay Birds Rock, whilst canoes /kayaks were most frequently recorded at Aberystwyth and Aberporth; at Mwnt commercial fishing boats were recorded most frequently.
- Encounter rates between boats and dolphins were highest at New Quay harbour for all years followed by New Quay Birds Rock except in 2014. Visitor Passengers Boats accounted for the highest encounter rates at New Quay Harbour and Birds Rock followed by private motor boats.
- 2757 boat encounters were examined for rates of compliance and non-compliance with the code of conduct for boat users. Rates of compliance were highest at New Quay Birds Rock in 2013 and 2015 and in New Quay harbour in 2014. Low rates of compliance (average 44%) were observed at Mwnt for all years.
- Over half (55%) of non-compliance with the code of conduct were due to boats following an erratic course to either approach, follow or avoid dolphins. Motor boats, canoes and VPBs accounted for the largest proportion of non-compliance with the codes of conduct and in recent years the percentage of compliance with the code of conduct has declined for all boat types except canoes.
- Few dolphins were recorded reacting to encounters with boats although negative responses to non-compliance were recorded more often than positive or neutral responses. Whilst no change in dolphin behaviour was recorded more often to encounters where boats complied with the code of conduct.

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INTRODUCTION

Dolphin Watch has been running since 1994 and has now completed 22 years of data collection covering four sites in Ceredigion. This is the eighth Dolphin Watch survey report (Pierpoint & Allan 2000, 2001; 2002; 2004; 2006; Allan et al. 2010; Sampson et al. 2015). A peer reviewed paper was published in the Journal of the Marine Biological Association in 2009.

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, UK. Journal of the Marine Biological Association of the United Kingdom. 89 (5): 1033-1043.

Dolphin Watch was a community-led initiative established because of concerns over perceived increases in powered craft activity and its potential adverse effect on the local bottlenose dolphin population. When the study started in 1994, the aim was to obtain further information on cetacean site use and boating traffic that would help guide future management of the then recently formed voluntary Marine Heritage Coast (MHC). The study was designed in such a way as to encourage local people to take part and it was hoped that in doing so it would build support for the MHC and raise public awareness of the issue of boat disturbance.

In 1996 an area of Cardigan Bay was put forward to Europe as a candidate Special Area of Conservation (cSAC) as part of the EU Habitats Directive (adopted in 1992, Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). The area stretches from Ceibwr Bay in Pembrokeshire to Aberarth in Ceredigion and extends almost 20km from the coast covering almost 1000km². In 2003 the Cardigan Bay Special Area of Conservation (SAC) was designated as an SAC primarily because of its importance to the bottlenose dolphins, this SAC forms part of a network of protected sites known as the Natura 2000 (N2K) network.

The Dolphin Watch project takes place along the MHC within the Cardigan Bay SAC, it is supported by individual members of the public as well as staff and volunteers from organisations including the Wildlife Trust of South and West Wales' Living Seas team from the Cardigan Bay Marine Wildlife Centre (CBMWC), the National Trust and volunteers representing the Sea Watch Foundation. The project helps to inform the management of the site.

The principle aims of the project are:

- a) To monitor the presence of bottlenose dolphins at a number of coastal sites; and
- b) To gather data on boat traffic to aid coastal zone management.

Other aims and outcomes of the project include:

- To improve understanding of bottlenose dolphin site usage
- To monitor trends in dolphin occurrence
- To monitor levels of boat traffic
- To Investigate interactions between bottlenose dolphins and boats
- To assess the effectiveness of local codes of conduct
- To increase public awareness and appreciation of the marine wildlife in Cardigan Bay

METHODS

Bottlenose dolphin observations were examined at six study sites in Cardigan Bay, Wales from June to September in 2013, 2014 and 2015. These data were collected by a team of volunteers, a number of whom had taken part in the project in previous years alongside a number of volunteers new to the project. Records from New Quay harbour were collected and contributed to the database by the Cardigan Bay Marine Wildlife Centre (CBMWC).

Habitat use by bottlenose dolphins

Three watches of two hours each were scheduled daily at each site beginning at 11:00, 13:00 and 15:00. At Aberystwyth and New Quay Harbour, volunteers from the Cardigan Bay Marine Wildlife Centre carried out additional watches during the day throughout the field season (7am, 9am and 5pm). The two hour watches were divided into eight 15 minute intervals. At the beginning of each interval the start time and information on environmental conditions (general weather, visibility, wind direction and sea state) were recorded on the data sheet.

This information was later used to extract a subset of observations made in good conditions (visibility at least 2km, sea state 3 or less) for which sighting rates of bottlenose dolphins were calculated and comparisons made between study sites.

When marine mammals were present at the site their locations were marked on a map form. Locations were estimated by eye within a grid of guidelines to landmarks. A group (school) was considered to be animals of the same species in close proximity (within approximately 10 body lengths of another animal) and behaving in a similar manner. Abbreviated codes were written against each group location giving species name, group size, number of small calves and activity state at the beginning of the 15 minute interval or when first seen.

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

- a) the proportion of two hour watches in which dolphins were recorded; and
- b) the average count of dolphins in a 15 minute interval per two hour watch. In a previous report, a preliminary look at these data showed that numbers of sightings increased at New Quay from June onwards. In site comparisons therefore, sightings rates were calculated from observations recorded between the beginning of June and the end of September.

For watches in which dolphins were recorded at least once a further three 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. By using these maximum counts the total number of dolphins seen in each two hours was not estimated, as we could not determine this from the data collected.
- d) **Occurrence of young bottlenose dolphins** (juveniles or calves). The proportion of watches in which small calves were seen was examined. Bottlenose dolphins were recorded as

young animals if they were distinctly paler than the accompanying adult and approximately two-thirds of the adult length or less. Calves are identifiable by their smaller size and foetal folds may still be visible.

- e) **Site occupancy** – to examine the amount of time that dolphins occupy sites, the average number of 15 minute intervals with bottlenose dolphins present per watch was calculated, for watches in which dolphins were recorded at least once.

Observers are asked to assign an activity code to each dolphin group at the beginning of every 15 minute interval or when first sighted. This allowed us to describe the relative frequency with which different dolphin behaviours occurred. Although some observers also recorded changes in activity during the 15 minute intervals, only the first activity is used as this was considered to be a systematic sample of dolphin activity state at each site.

Encounters between bottlenose dolphins and boats.

Additional information was recorded on the data sheet when boats came within 300m of a group of dolphins; this is classed as a “boat encounter”. Only one boat encounters in each 15 minute interval was recorded. This reduced the likelihood of bias towards particular types of boat that observers may have considered to have a greater impact on dolphin behaviour. For each encounter the observer recorded the type of boat that was closest to a dolphin, the total number of boats within 300metres of the group of dolphins, whether the boat complied with the code of conduct for boat users and recorded all the dolphin behaviours that were observed. Boat operators were considered to have complied with the code of conduct if they either passed the animals at ‘no-wake’ speed and with no erratic alterations of course (code Y1), or slowed down gradually and stopped (Y2). Four codes were used when operators did not comply, these were either because they were travelling too fast within 300 metres of dolphins (N1), they followed an erratic course to approach, avoid 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). Finally, a special 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 which they must fly when they are invoking their licence.

Whether following the code of conduct affected how dolphins responded to encounters with boats was also examined. Observers recorded different dolphin responses during encounters. In the analyses some behaviours were grouped together, for example 'heading away fast swimming and 'heading away steadily (HS or HF), were grouped as a negative response (i.e. a change in dolphin behaviour to move away from a boat). Similarly, 'approaching' (AP), 'bow-riding' (B or BR) and 'following boat' were grouped as a positive response. Leaping or begin leaping (L or BL), tail-slap (TS) and grouping (GS or GF) were examined as separate categories.

RESULTS

Observer Effort

During 2013, 2014 and 2015 a total of 518, 733, and 740 observation periods (watches) were carried out between June and September in each year respectively. Since the first season's field work in 1994 a total of 11,270 watches have been completed as part of the Dolphin Watch project.

Originally observations were carried out at three sites; Aberporth, New Quay Head and Ynys Lochtyn. Mwnt was added to the site list from 1998 and from 2004 onwards data was collected at New Quay harbour and Aberystwyth using the same protocols.

Between 2013 and 2015 a total of 1,991 watches took place between June and September, 1,618 of these took place at New Quay harbour with the greatest number of watches (582) taking place at New Quay harbour in 2015.

Table 1: Observation period (watches) totals for June to end September 2013-2015

	All sites (June to Sept)	Mwnt (M)	Aberport h (AB)	New Quay Birds Rock (NQ)	Aberystw yth (TH)	Ynys Lochtyn (YL)	New Quay Harbour (HAR)
No. of watches in 2013	518	0	12	36	5	1	464
No. of watches in 2014	733	34	12	91	24	0	572
No. of watches in 2015	740	50	0	86	22	0	582
No. of watches June-Sept all years	1991	84	24	213	51	1	1618
Hours of effort 2013	1036	0	24	72	10	2	928
Hours of effort 2014	1466.5	68.75	24	182	48	0	1143.75
Hours of effort 2015	1478	100.5	0	172	43.75	0	1161.75
Hours of effort June – Sept all years	3980.5	169.25	48	426	101.75	2	3233.50

A further 1229 observations (watches) were undertaken outside June to September, these were largely conducted at New Quay harbour (1169) by volunteers from the Cardigan Bay Marine Wildlife Centre who conducted watches from April through to November in 2013 (377), 2014 (365) and 2015 (427). To make this report comparable to previous years only observations from June to the end of September are included in this analysis.

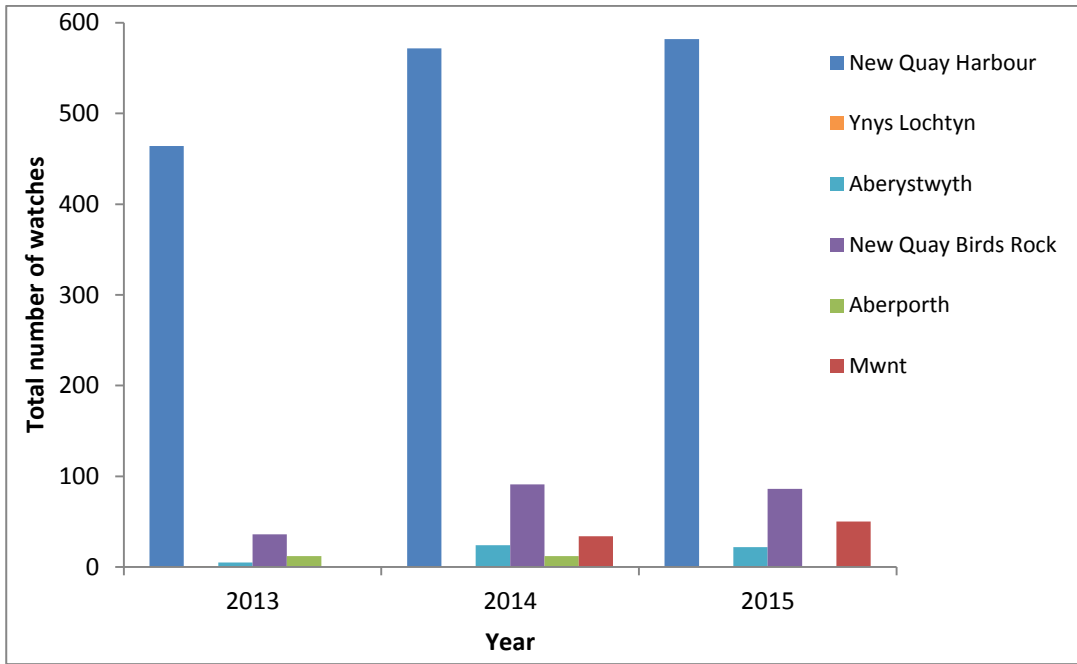


Figure 1: Total number of watches at different Dolphin Watch sites

Survey conditions

In 2013, 2014 and 2015 over 80% of two hour watches in each year were completed in good conditions for observing marine mammals (82% in 2013, 83% in 2014 and 84% in 2015).

Survey 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 15 minute intervals), conducted in Beaufort sea state 3 or less and where visibility was greater than 2 km were used for further analysis (Table 2). A total of 1654 Dolphin watch surveys were conducted in good conditions between 2013 and 2015.

Table 2: Number of watches conducted in good conditions, used for further analysis.

Number of watches in good conditions	Mwnt (M)	Aberporth (AB)	New Quay Birds Rock (NQ)	Aberystwyth (TH)	Ynys Lochtyn (YL)	New Quay Harbour (HAR)
2013	0	12	26	5	1	379
2014	30	12	71	22	0	472
2015	42	0	68	20	0	494

The median sea state recorded for all sites, for all years was sea state 2 (wavelets; glassy crests do not break). This was also true for individual years and for each site in each year when watches took place with the exception of Aberystwyth in 2014 and 2015 when the median sea state was 1 (calm, rippled surface).

The wind directions that were most frequently recorded were north-west (19.4%) and south-west (19.1%) over all sites for all years (Figure 2). In 2013 and 2015 the most frequently recorded wind direction during watches across all sites was south-westerly (11.4% and 12.6% of records respectively), whilst in 2014 the prevailing wind across all sites was north-westerly (11.4% of records).

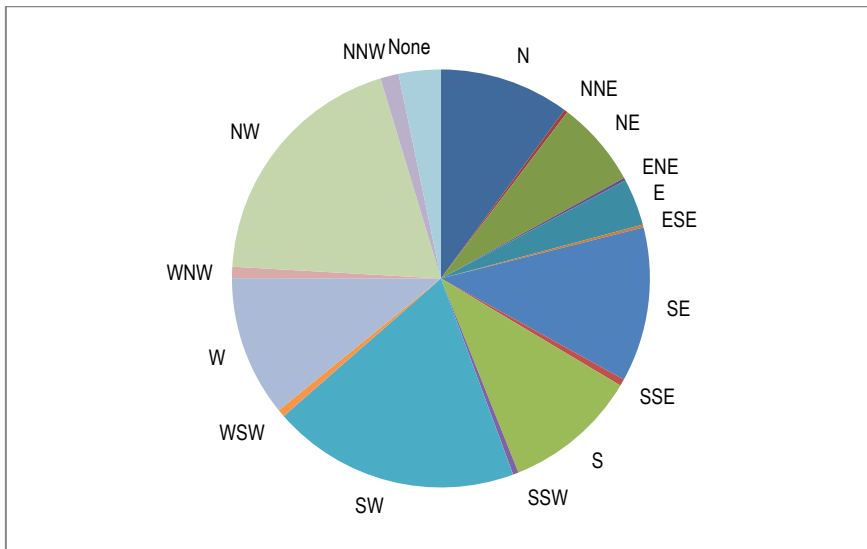


Figure 2: Prevailing wind - Frequency of wind direction recorded during all surveys 2013-2015

The exceptions (Table 2) were Ynys Lochtyn (2013 only) and Aberystwyth where the most frequently recorded wind direction across all years was south-easterly, this was also the case in 2015 and in 2013 the wind direction was variable whilst in 2014 the most frequently recorded wind direction during surveys was westerly. New Quay Birds Rock site also recorded a westerly wind direction as the most frequent direction in 2014 as did Aberporth in 2015.

Table 3: Prevailing wind during watches.

Site	All Years	2013	2014	2015
AB	NW	NW	NW	W
M	SW	No surveys	NW	SW
NQ	SW	SW	W	SW
TH	SE	VAR	W	SE
YL	SE	SE	No surveys	No surveys
HAR	NW	NW	NW	SW

Sightings

Sightings rates for bottlenose dolphins were calculated from 1654 watches: 423 in 2013, 607 in 2014 and 624 in 2015. These were watches with eight intervals recorded in good conditions (sea state <4 and visibility >2km) from June to the end of September (Table 2).

Table 4: Sighting rates of bottlenose dolphins

	Mwnt (M)	Aberporth (AB)	New Quay Birds Rock (NQ)	Aberystwyth (TH)	Ynys Lochtyn (YL)	New Quay Harbour (HAR)
2013	-	25%	42%	0%*	100%*	82%
2014	80%	42%	46%	32%	-	70%
2015	52%	-	50%	35%	-	62%

*Sites where five or less watches took place

Table 4 shows the percentage of two hour watches at each site with dolphin sightings. Excluding those years where five or less watches took place the highest sightings rates were at New Quay Harbour in 2013 (82%) and 2015 (62%) and in Mwnt in 2014. The lowest sightings rates were at Aberporth 2013 and Aberystwyth in 2014 and 2015, although low numbers of surveys took place at these sites.

The sightings rates have increased slightly at Aberystwyth and New Quay Birds Rock whilst sightings rates have declined by over 20% at both Mwnt and New Quay Harbour (Figure 3) between 2013 and 2015.

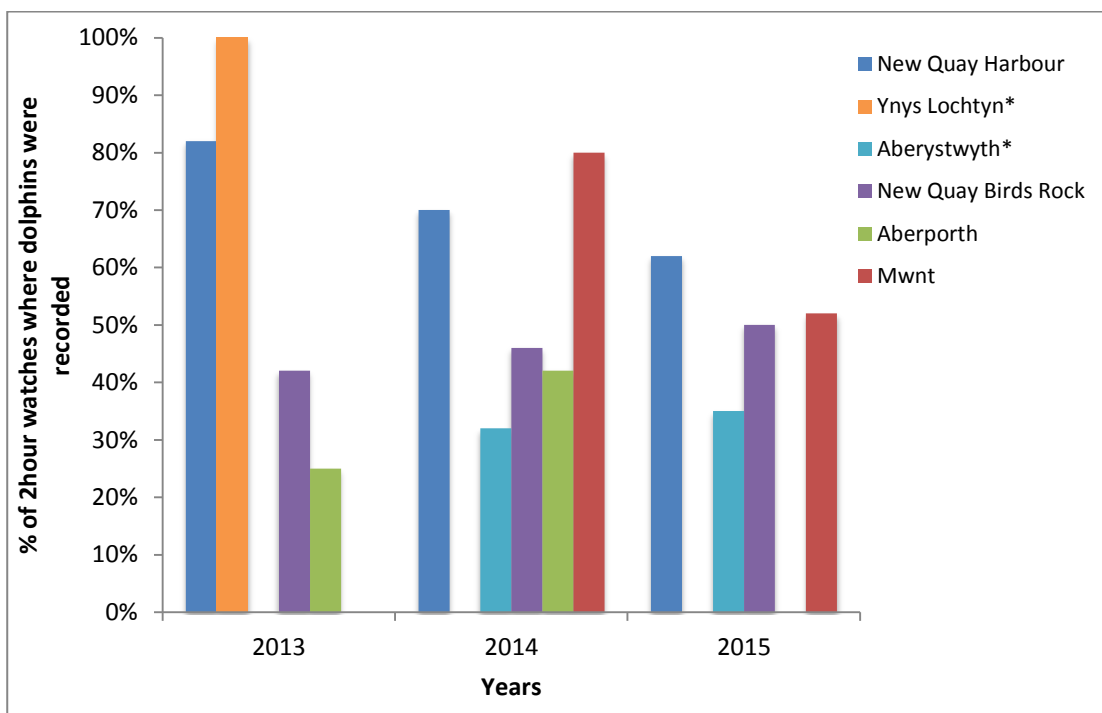


Figure 3: Sightings rates - Percentage of two hour watches in which dolphins were recorded

Figure 4 shows the percentage of two hour watches in which dolphins were recorded between 1995 and 2015. Sightings rates fluctuate between years and between sites; in the early years of the project sightings rates were highest at Ynys Lochtyn, more recently the highest sightings rates recorded have been in New Quay harbour and Mwnt however, a low number of surveys have taken place at Ynys Lochtyn, Aberystwyth and Aberporth over the last few years in comparison to previous years and are therefore not directly comparable.

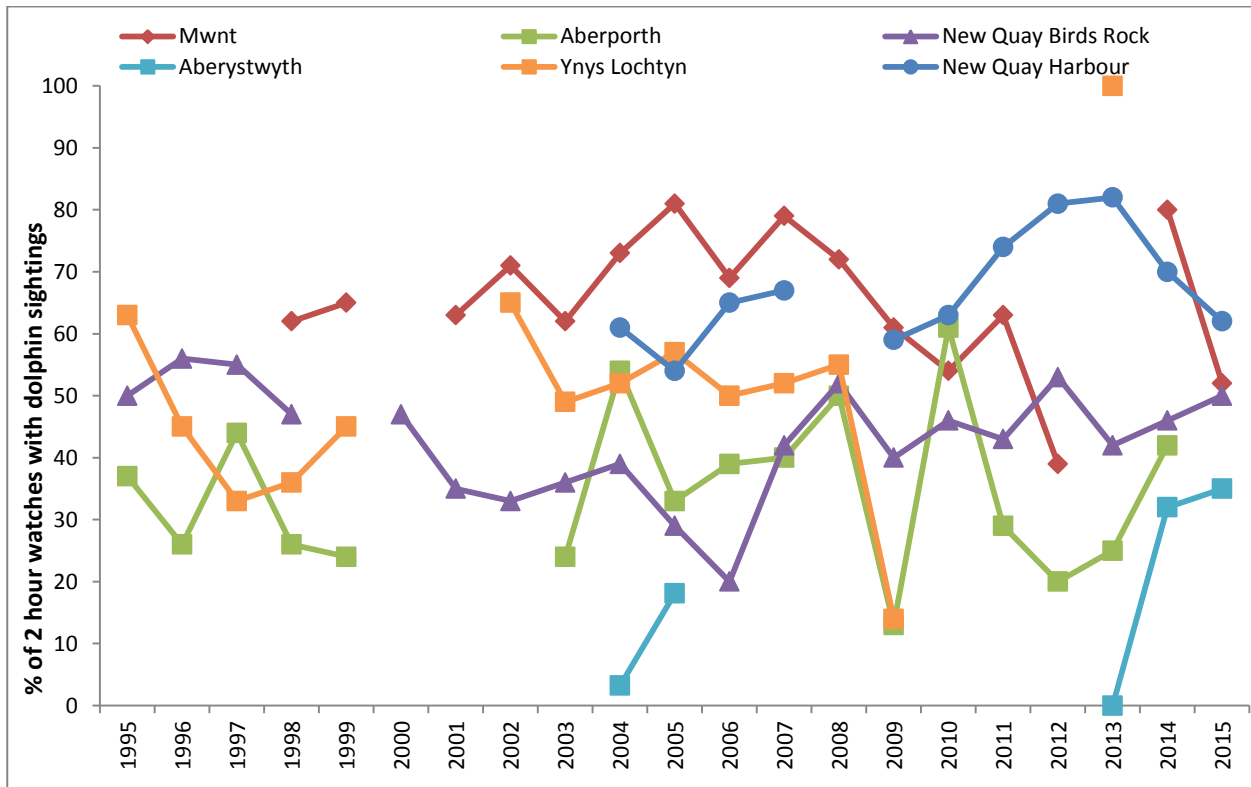


Figure 4: Sightings rates - Percentage of two hour watches in which dolphins were recorded 1995-2015

The average number of dolphins observed was similar between years at the different sites (Table 5 and Figure 5). The highest numbers were observed at New Quay Harbour in 2013 and at Mwnt in 2014 and 2015. This is similar to results from previous year's observations where New Quay Harbour and Mwnt showed the highest average number of dolphins (Figure 6). However, at both of these sites the average number decreased slightly each year observations took place in 2013-2015. Lower numbers were observed at Aberporth although the average was the same for both years that watches took place.

Table 5: Average number of dolphins observed in a 15 minute interval, when dolphins were sighted

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	NA	1.75	2.77	NA*	3*	1.75
2014	3.54	1.75	2.7	1.68	NA	1.83
2015	3.44	NA	2.95	2.09	NA	1.97
All Years	3.49	1.75	2.82	1.9	3	1.84

*Sites where five or less watches took place

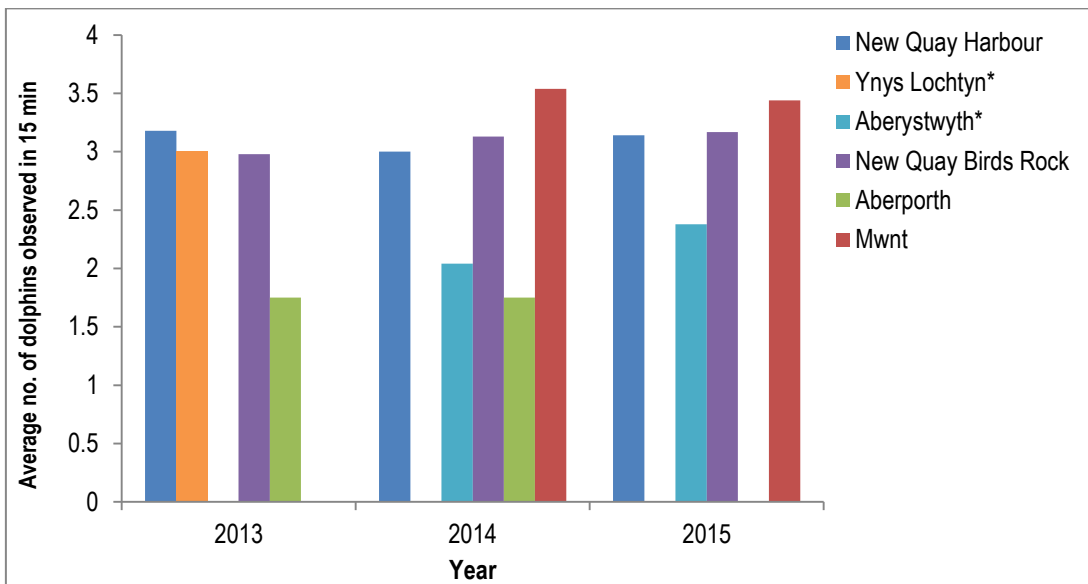


Figure 5: Mean number of bottlenose dolphins observed in 15 minutes

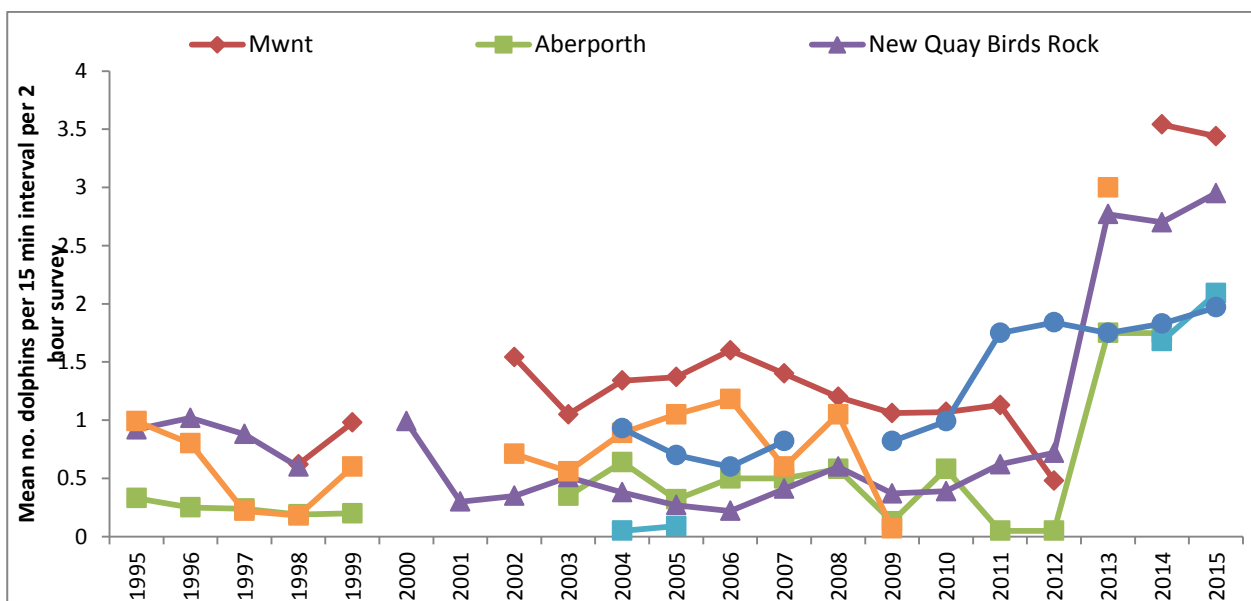


Figure 6: Mean number of bottlenose dolphins per 15 minutes per 2 hour watch

Group Size

The average number of dolphins present in each observation period (watch), when sightings occurred, were used as a measure of group size (Table 6).

Group sizes observed at New Quay harbour were most consistent over the three years (~2.9) and the highest average group sizes observed were at Mwnt in 2014, not including Ynys Lochtyn where only one watch took place (Figure 7).

Table 6: Mean bottlenose dolphin group size during watches

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	-	1.7	3.3	-*	5*	2.93
2014	4.3	2	2.9	1.8	-	2.86
2015	3.8	-	3.3	3.1	-	2.89

*Sites where five or less watches took place

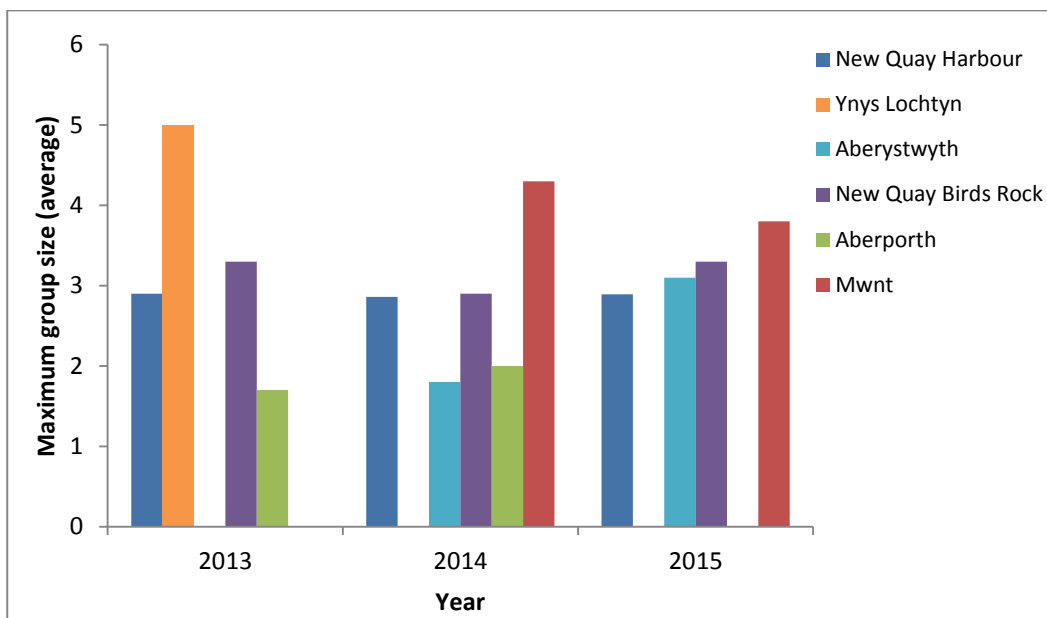


Figure 7: Average group size of bottlenose dolphins observed during watches

The maximum dolphin group size observed at each site was investigated, the highest recorded group size were observed at New Quay Harbour (8) and New Quay Birds Rock (8) with these sites showing consistently larger groups of 7 or 8 animals in all years (2013-2015).

Table 7: Maximum recorded group size at each site

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	-	2	7	-*	5*	8
2014	4.3	3	8	2	-	7
2015	3.8	-	8	5	-	8

*Sites where five or less watches took place

Site Occupancy

Site occupancy is defined as the amount of time that bottlenose dolphins were present at each site. It is measured as the average number of 15 minute intervals that dolphins were recorded, per 2 hour watch.

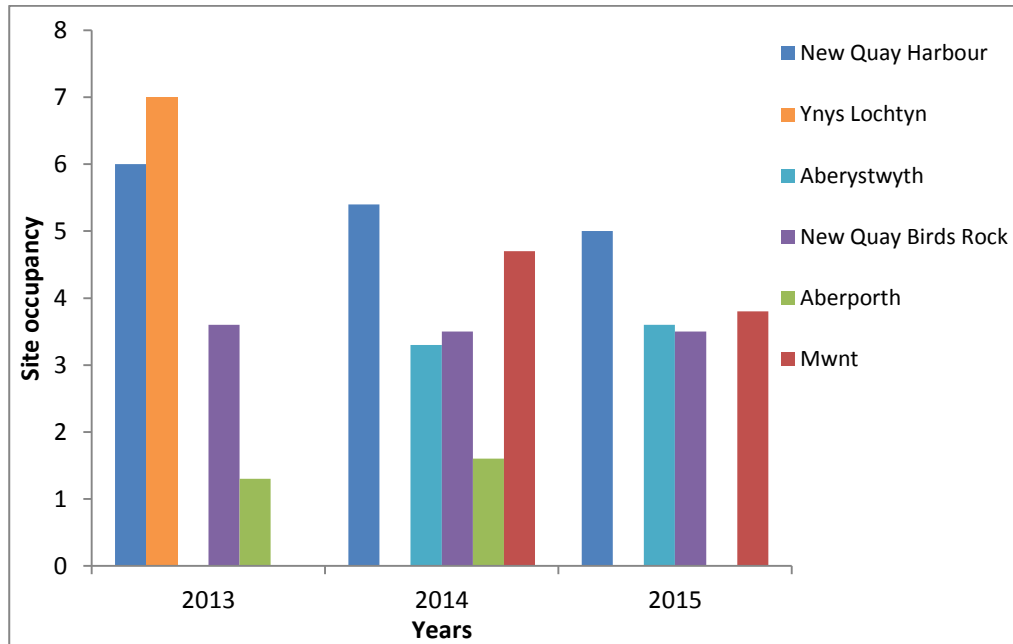


Figure 8: Site Occupancy (number of intervals per watch that dolphins were present)

Not including Ynys Lochtyn due to the low number of watches that took place, New Quay harbour had the highest occupancy rates in each year, with dolphins present for more than four intervals (one hour) out of eight, on average (Figure 8 and Table 8). Aberporth had the lowest site occupancy rates.

Table 8: Site Occupancy (mean number of 15 minute intervals per watch when dolphins were present)

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	-	1.3	3.6	-*	7*	6
2014	4.7	1.6	3.5	3.3	-	5.4
2015	3.8	-	3.5	3.6	-	5

*Sites where five or less watches took place

Sightings of young bottlenose dolphins

Young bottlenose dolphins were recorded more often in New Quay Harbour, where they were observed in more than 50% of the watches in all years (2013-2015). No young dolphins were recorded at Aberporth and Ynys Lochtyn in 2013 and none in Aberystwyth in 2015. The percentage of watches when young dolphins were recorded was relatively consistent at New Quay Harbour over the three years between 2013 and 2015 (Table 9 and Figure 9).

Table 9: Young dolphin sightings (percentage of watches when dolphins present with young animals)

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	-	0%	18.2%	-*	0%*	52.6%
2014	41.7%	20%	21.2%	42.9%	-	61%
2015	39.1%	-	37.1%	0%	-	59.6%

*Sites where five or less watches took place

Young dolphins were sighted at both Mwnt and Aberystwyth in more than 40% of the watches during 2014 and at Mwnt for just under 40% of the watches in 2015. The percentage of watches where young dolphins were sighted at New Quay Birds Rock increased from 18.2% in 2013 to 30.7% in 2015, an increase of 18.9% over 3 years.

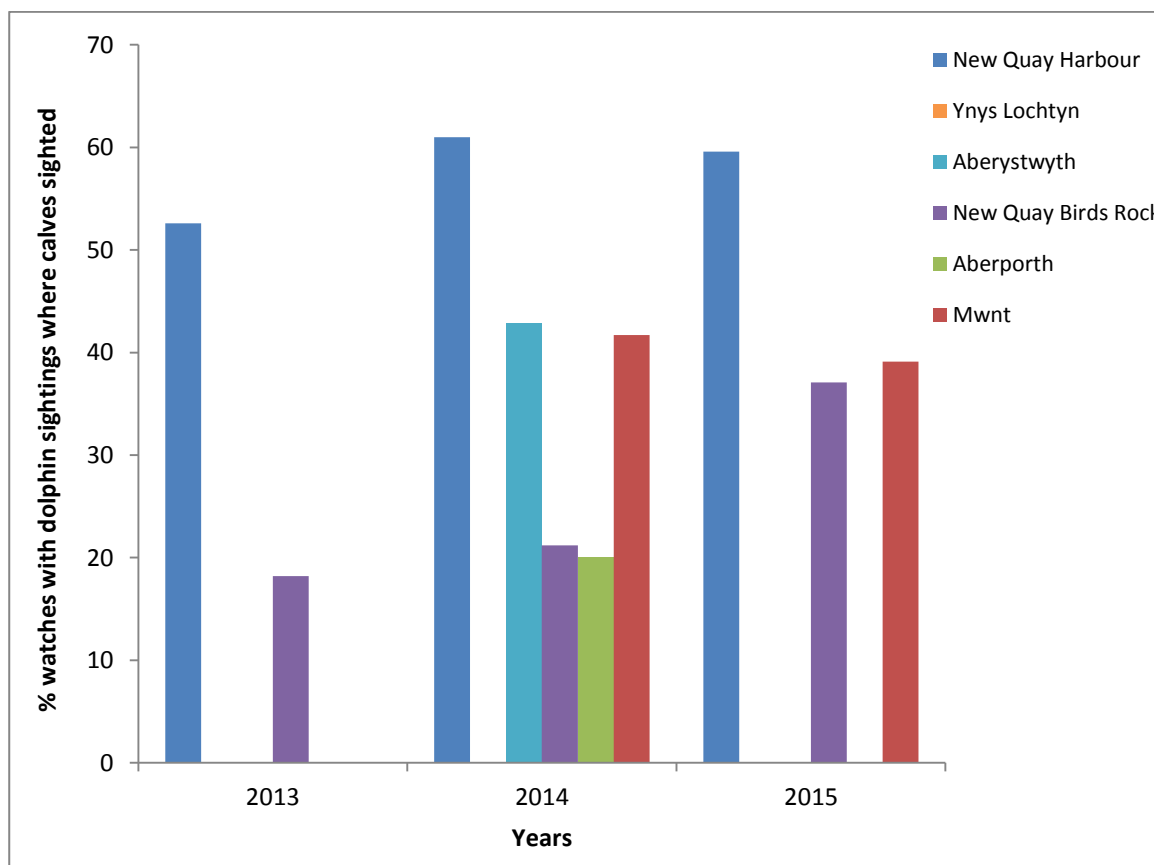


Figure 9: Percentage of watches with dolphins when young animals were also sighted

Levels of Boat traffic

Levels of boat traffic are recorded during every watch using tally counts of different boat types. Average boat counts are compared between sites and between years (Table 10 and Figure 10). New Quay Harbour with between 23.6 boats per watch in 2014 and 29.5 in 2015 was the busiest site for boat traffic followed by Birds Rock and Aberystwyth. The lowest average boat counts were recorded at Mwnt in 2014 and 2015. paddleboards are included in the canoe/kayak category.

Table 10: Average boat counts per watch for each site

	Mwnt	Aberporth	New Quay Birds Rock	Aberystwyth	Ynys Lochtyn	New Quay Harbour
2013	-	7.7	11.7	21.8*	4*	29.3
2014	4.3	5.2	14	9.8	-	23.6
2015	4	-	10.5	8.4	-	29.5

*Sites where five or less watches took place

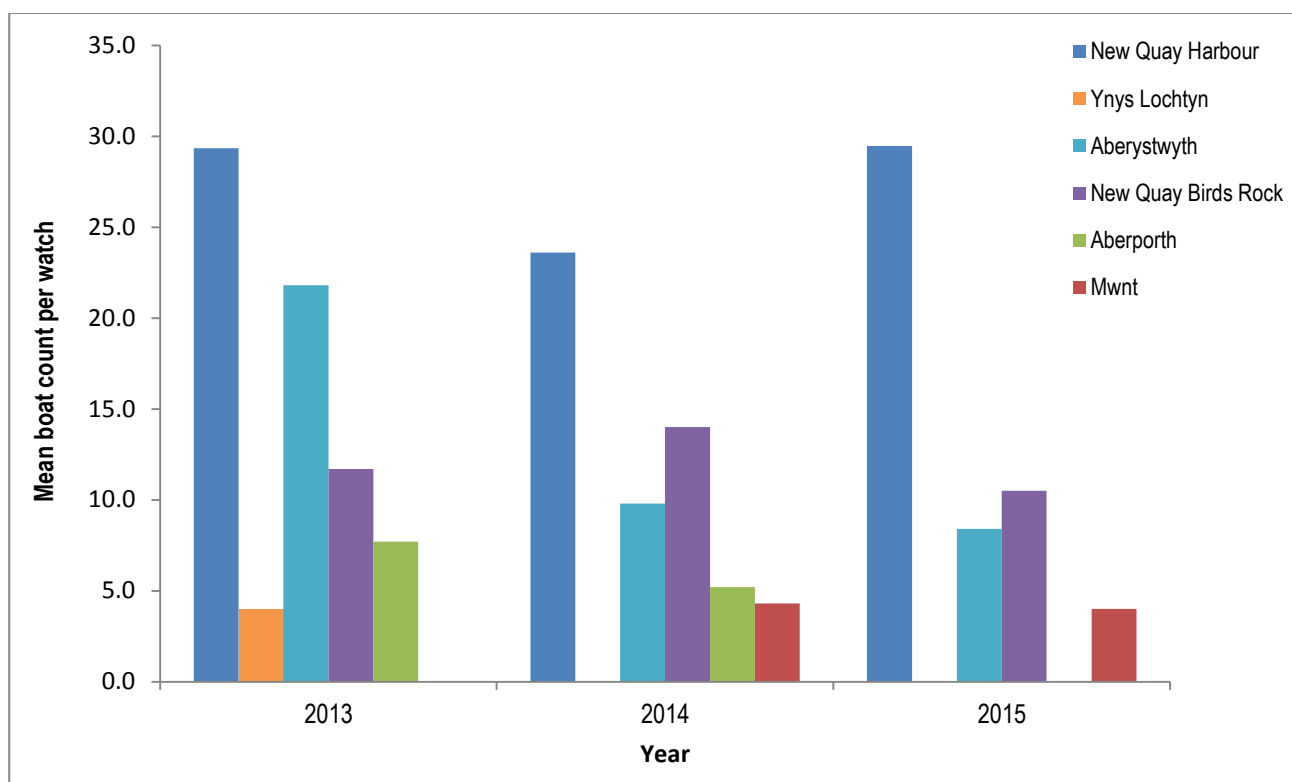


Figure 10: Mean boat counts per watch for each site

The most frequently recorded boat type across all sites was canoes/kayaks in 2013 and visitor passenger boats in 2014 and 2015 (Figure 11 and Table 11).

Visitor passenger boats, motor boats and canoes/kayaks were most frequently recorded boat types between 2013-2015 across all sites with average boat counts per watch (2 hours) of 2.2-2.4 for motor boats, 2.3-2.5 for visitor passenger boats and 1.5-3.2 for canoes/kayaks.

The number of canoes/kayaks recorded across all sites decreased over the three years whilst counts of motor boats, commercial fishing boats and visitor passenger boats has remained relatively constant across all years.

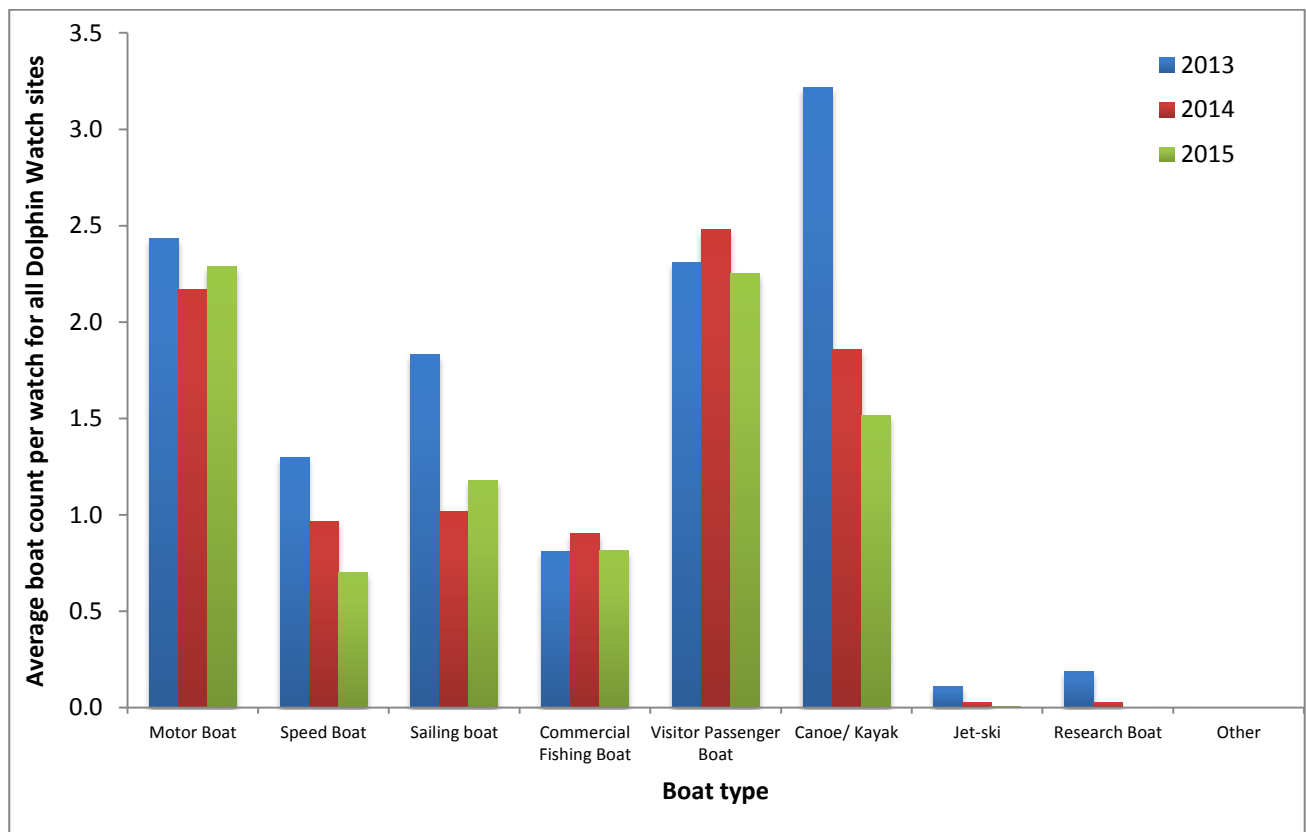


Figure 11: Annual mean count of different boat types across all Dolphin Watch sites

Table 11: Average counts of different boat types across all Dolphin Watch sites

	Motor Boat	Speed Boat	Sailing boat	Commercial Fishing Boat	Visitor Passenger Boat	Canoe/ Kayak	Jet-ski	Research Boat	Other
2013	2.4	1.3	1.8	0.8	2.3	3.2	0.1	0.2	0.0
2014	2.2	1.0	1.0	0.9	2.5	1.9	0.0	0.0	0.0
2015	2.3	0.7	1.2	0.8	2.3	1.5	0.0	0.0	0.0

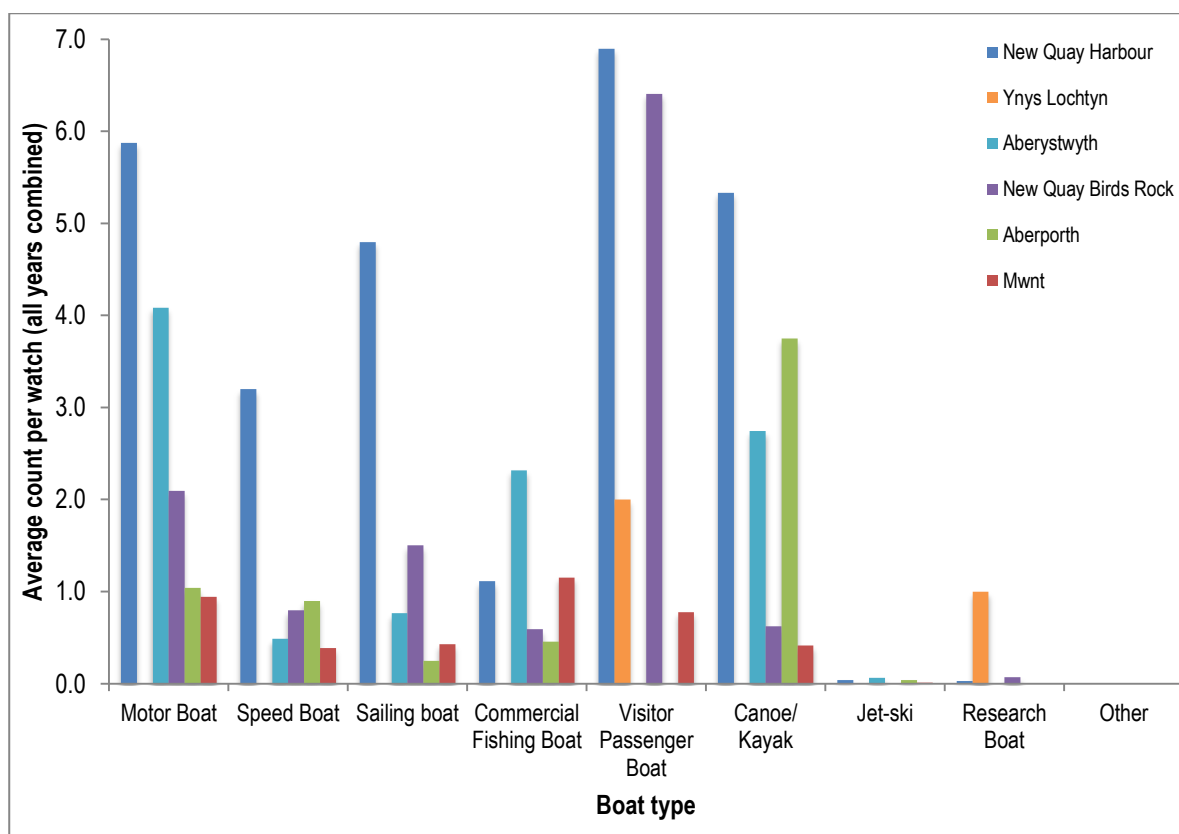


Figure 12: Mean count of different boat types recorded at each Dolphin Watch site for all years

Mean counts of visitor passenger boats (VPBs) combined for all years were highest at New Quay Harbour (6.9) and New Quay Birds Rock (6.4) (Figure 12 and Table 12). Mean counts of canoes were highest at New Quay Harbour (5.3), Aberporth (3.8) and Aberystwyth (2.7).

Table 12: Average counts of different boat types for each site (2013-2015 combined)

	Motor Boat	Speed Boat	Sailing boat	Commercial Fishing Boat	Visitor Passenger Boat	Canoe/Kayak	Jet-ski	Research Boat	Other
Mwnt	0.9	0.4	0.4	1.2	0.8	0.4	0.0	0.0	0.0
Aberporth	1.0	0.9	0.3	0.5	0.0	3.8	0.0	0.0	0.0
New Quay Birds Rock	2.1	0.8	1.5	0.6	6.4	0.6	0.0	0.07	0.0
Aberystwyth	4.1	0.5	0.8	2.3	0.0	2.7	0.1	0.0	0.0
Ynys Lochtyn	0.0	0.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0
New Quay Harbour	5.9	3.2	4.8	1.1	6.9	5.3	0.0	0.0	0.0

Levels of boat traffic at individual Dolphin Watch sites

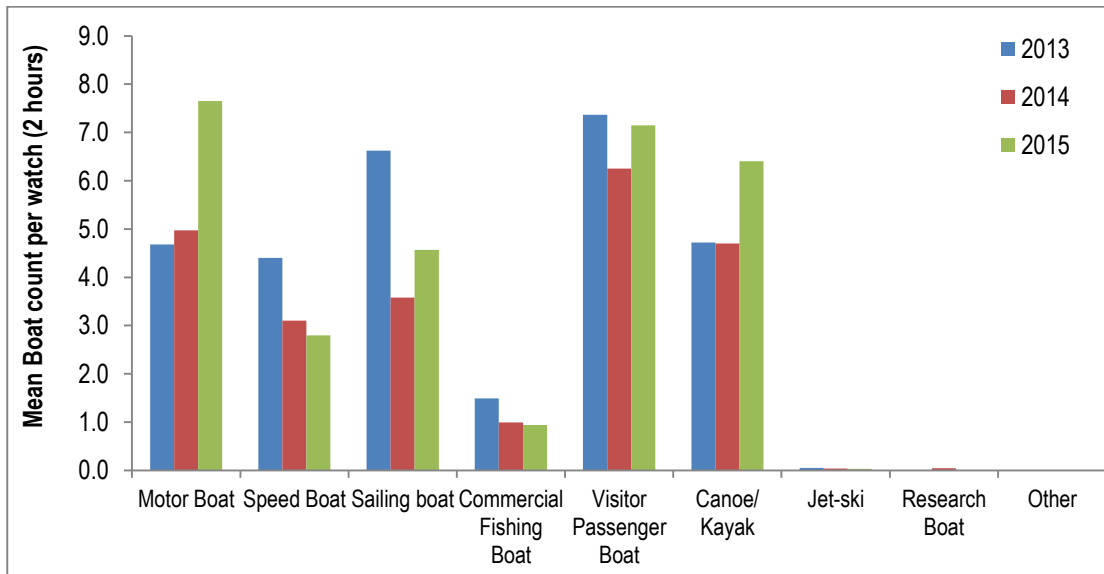


Figure 13: Mean count of different boat types recorded at New Quay Harbour (2013-2015)

There was an increase in the mean count per watch of motor boats and canoes/kayaks recorded at New Quay Harbour in 2015 whilst mean counts of visitor passenger boats and commercial fishing boats remained relatively constant across all three years (Figure 13). Motor boats and canoes/kayaks were the most frequently counted boat type at the New Quay Harbour site in 2015 whilst mean counts of visitor passenger boats per watch were greatest in 2014 and 2013 along with sailing boats.

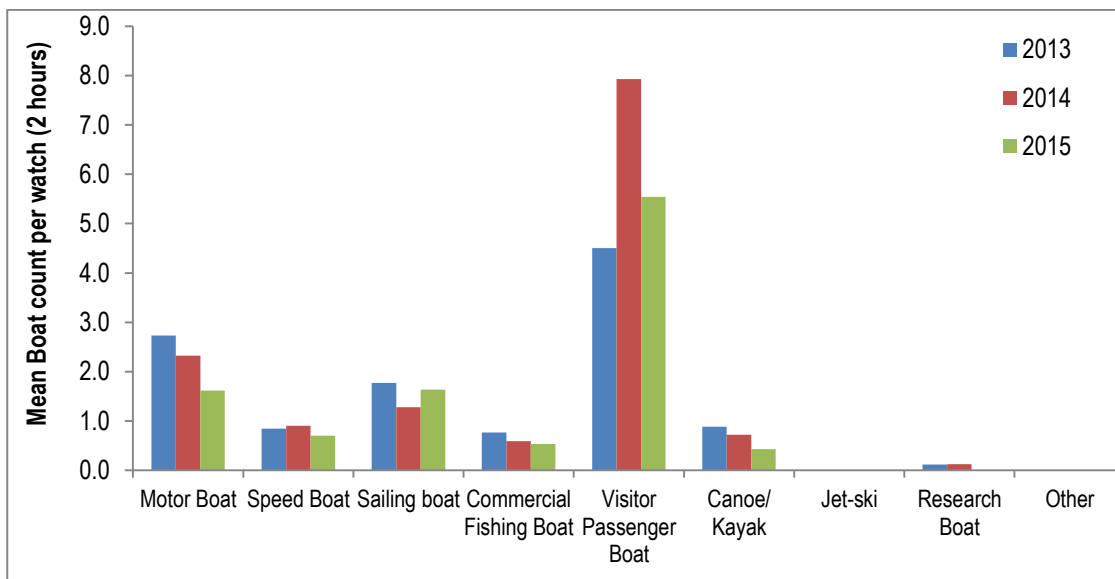


Figure 14: Mean count of different boat types recorded at New Quay Birds Rock (2013-2015)

Mean counts of different boat types remained relatively constant across all years for New Quay Birds Rock site with an increase in the number of visitor passenger boats counted in 2014 (Figure 14). The most frequently recorded boat type at New Quay Birds Rock was visitor passenger boats followed by motor boats and sailing boats.

Mean counts of different boat types for Aberystwyth, Aberporth and Mwnt are shown in Figures 15-17. Numbers of canoes/kayaks and motor boats are highest at Aberystwyth and Aberporth in 2013 whilst the highest numbers were recorded for commercial fishing boats and motor boats at Mwnt in 2014 and 2015.

No visitor passenger boats were recorded at Aberystwyth or Aberporth (2013 and 2014) but they were recorded at Mwnt, for the two years when surveys took place (2014 and 2015).

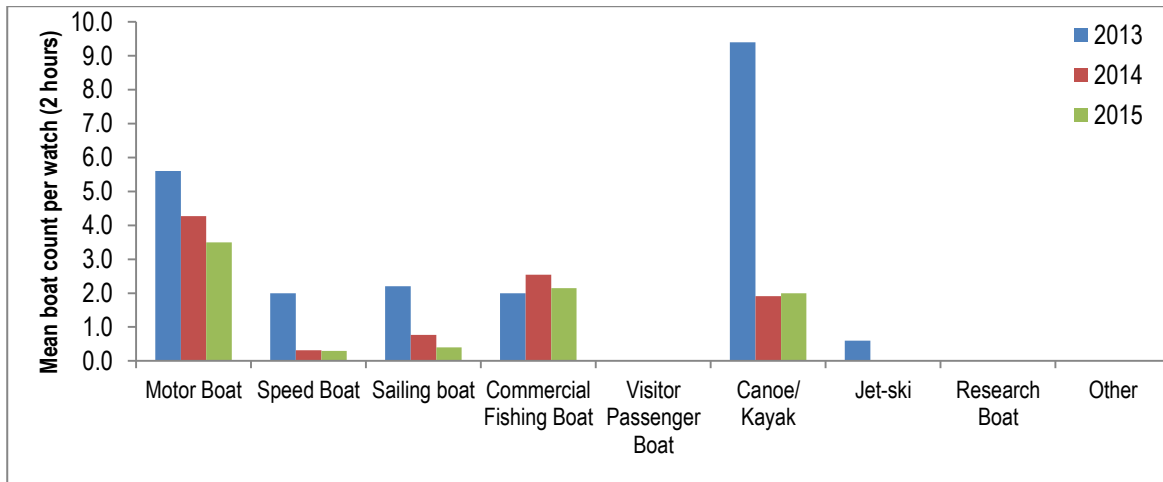


Figure 15: Mean count of different boat types recorded at Aberystwyth (2013-2015)

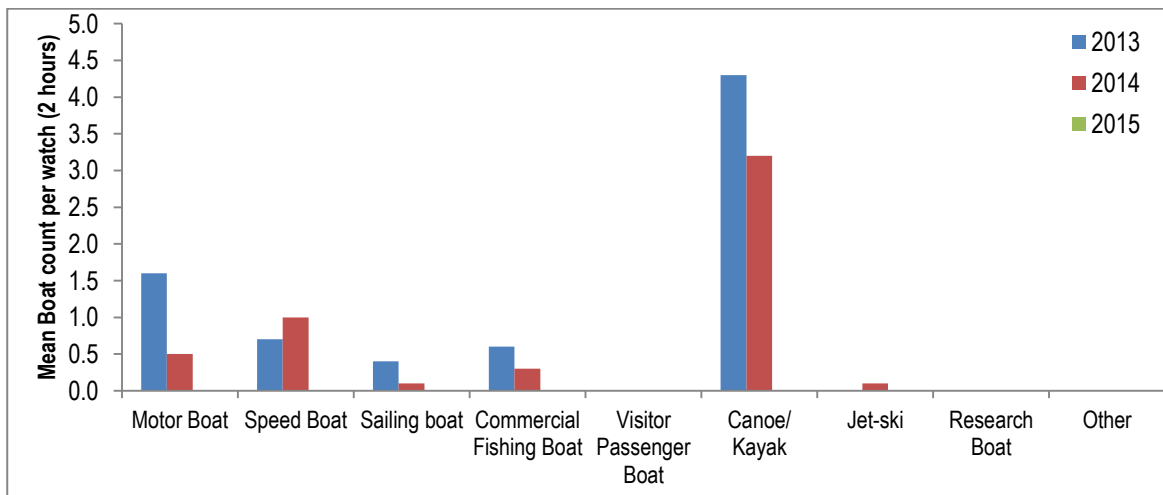


Figure 16: Mean count of different boat types recorded at Aberporth (2013-2014)

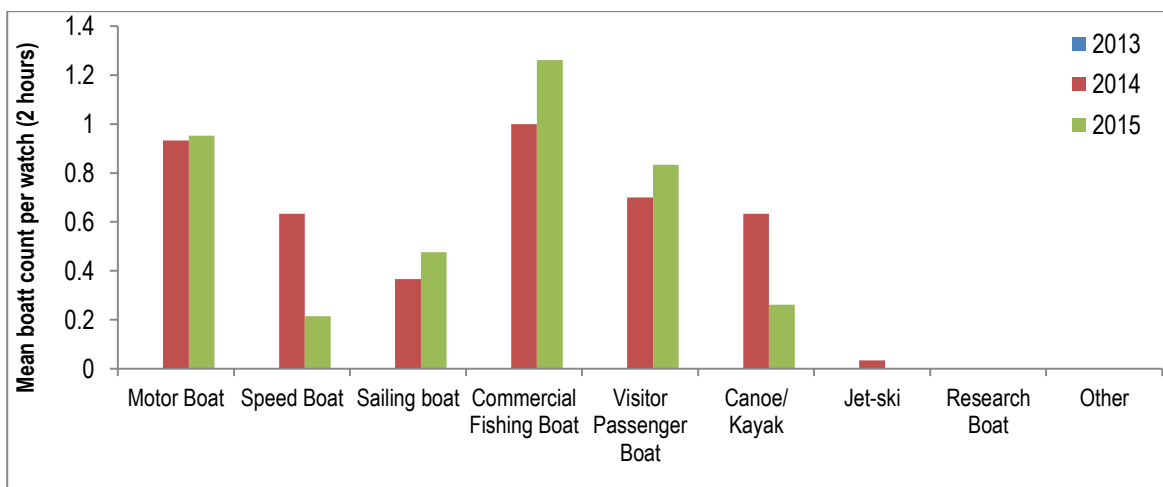


Figure 17: Mean count of different boat types recorded at Mwnt (2013-2015)

Encounters between dolphins and boats

During dolphin watch surveys a boat encounter occurs when a vessel approaches within 300m of a dolphin or a group of dolphins.

A total of 2751 encounters between bottlenose dolphins and sea going vessels were recorded between 2013 and 2015 with the highest number of encounters recorded at New Quay harbour in all years (1087 in 2013, 741 in 2014 and 693 in 2015).

There were no boat encounters recorded at Ynys Lochtyn. The highest observed encounter rates were at New Quay Harbour for all years with the highest encounter rate observed in 2013 (1.4/hour) (Figure 18).

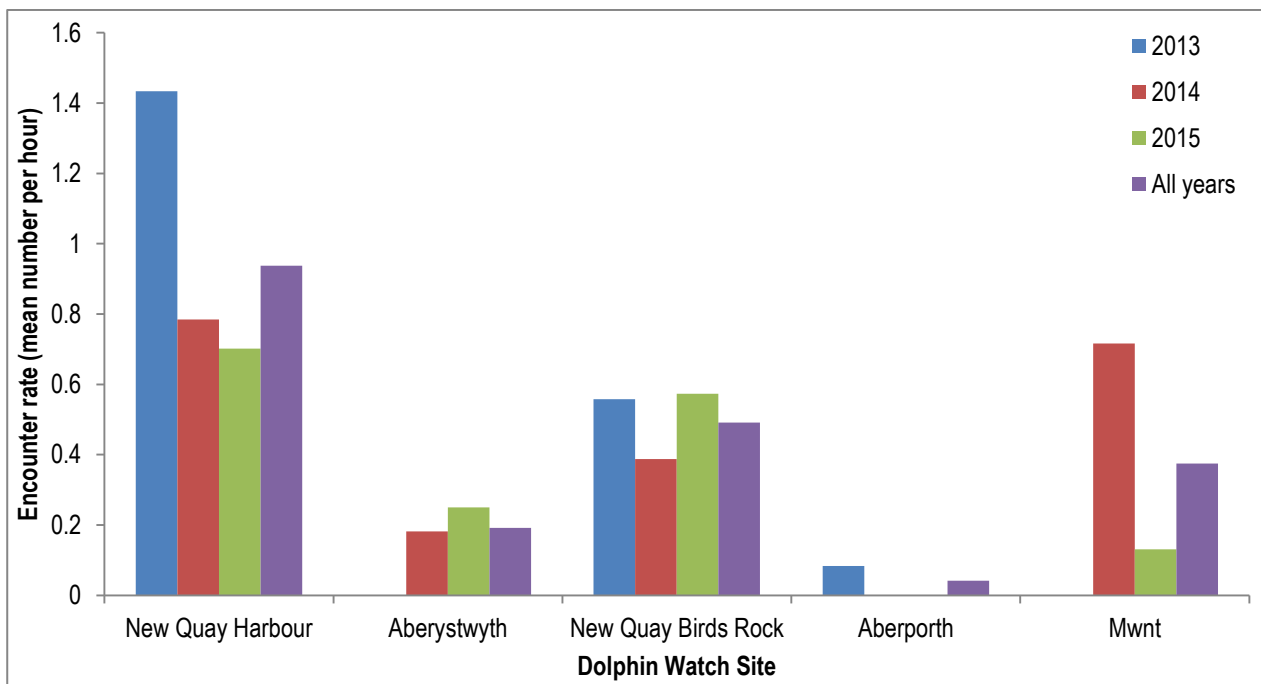


Figure 18: Rates of encounters between bottlenose dolphins and boats (mean number per hour) for each year

The different types of boats involved in these encounters with bottlenose dolphins were examined for each year (Figures 19 - 21).

Encounters with Visitor Passenger Boats (VPBs) were the most frequently recorded in all years followed by motor boats, with the highest encounter rates at New Quay harbour in 2013 and 2014 and at New Quay Birds Rock in 2015.

The highest encounter rate with commercial fishing boats were recorded at New Quay Birds Rock in 2015, in 2014 the highest encounter rate with commercial fishing boats was at Mwnt. Most encounters with canoe/kayaks or paddleboards were recorded at New Quay Harbour in all years.

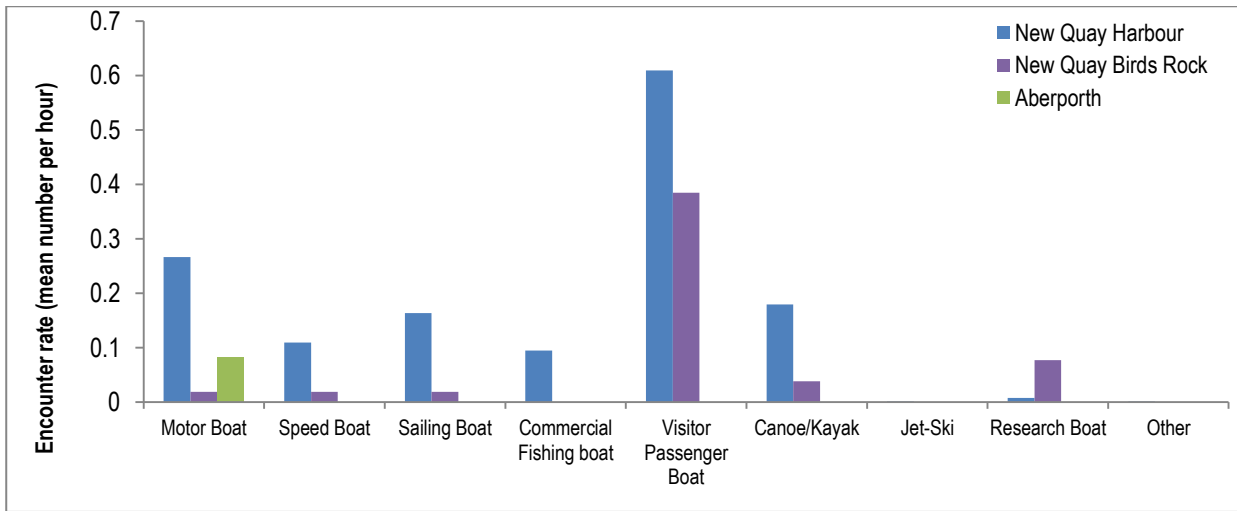


Figure 19: Rate of encounters between bottlenose dolphins and boats (mean number per hour) for each site in 2013

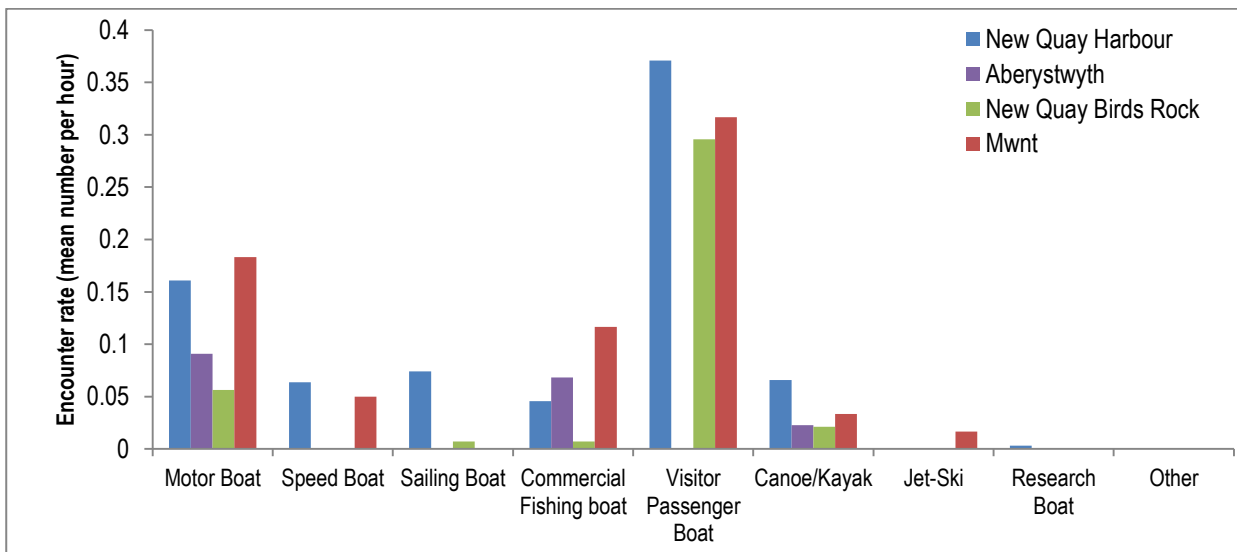


Figure 20: Rate of encounters between bottlenose dolphins and boats (mean number per hour) for each site in 2014

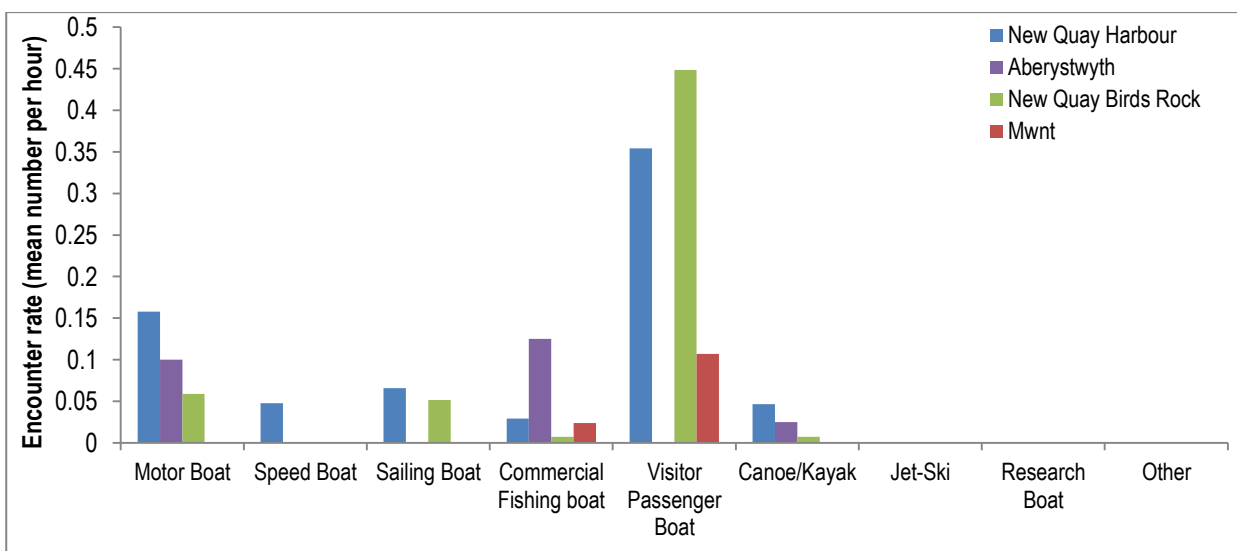


Figure 21: Rate of encounters between bottlenose dolphins and boats (mean number per hour) for each site in 2015

Compliance with the Ceredigion Marine Code by boat users during encounters with dolphins

There were 2755 boat encounters in which the observer recorded the boating activity in relation to the Ceredigion Marine Code (Table 13). The Ceredigion Marine Code are guidelines provided to all boat users, commercial and private boat owners. Over 3 years boat users followed the code of conduct in 87% of the encounters with bottlenose dolphins that were observed (89% in 2013, 88% in 2014 and 84% in 2015). There were 349 encounters recorded during surveys between 2013 and 2015 during which the boat users did not appear to follow the Ceredigion Boat Users Code of Conduct, compared to 2402 where compliance with the code of conduct was observed. There were no surveys conducted at Mwnt in 2013 or Aberporth 2015 and no boat encounters recorded at Aberporth in 2014. No boat encounters were recorded at Ynys Lochtyn and therefore this site is not included in this section.

The number of boat encounters with bottlenose dolphins when compliance with the marine code was recorded varied between survey sites. Excluding Aberporth (only two encounters observed), the highest average compliance was observed at New Quay Birds Rock (91%), followed by New Quay Harbour (88%) for all years (Table 13). During 2014 compliance at New Quay Birds Rock declined to 82% and compliance was highest at New Quay Harbour (91%). In 2015 compliance at New Quay Harbour declined to just 83% and increased to 97% at New Quay Birds Rock, the highest compliance observed over the three years examined. A much lower percentage complied with the marine code at Mwnt over all three years examined, although there were only 54 encounters in total at this site.

Table 13: Percentage compliance with the Ceredigion Marine Code during bottlenose dolphin encounters

	% compliance with code of conduct				Number of boat encounters				Number of encounters where boat not follow code of conduct			
	2013	2014	2015	All Years	2013	2014	2015	Total	2013	2014	2015	All years
Mwnt		49	27	44		43	11	54		22	8	30
Aberporth	100			100	2	0		2	0			0
New Quay Birds Rock	90	82	97	91	29	55	78	162	1	8	2	11
Aberystwyth	0	88	80	83	0	8	10	18	0	1	2	3
New Quay Harbour	89	91	83	88	1087	741	693	2521	119	70	116	305
All sites	89	88	84	87	1118	847	792	2757	120	101	128	349

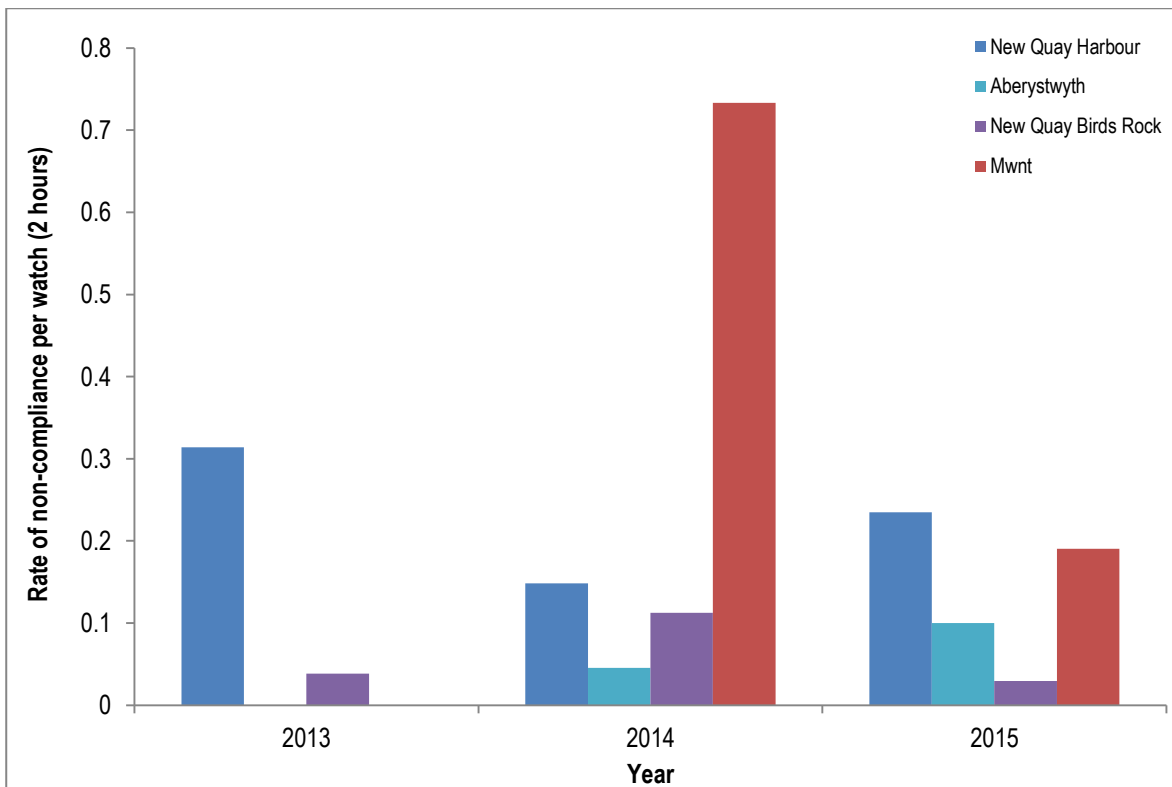


Figure 22: Rate of non-compliance with Ceredigion Marine Code per watch (2 hours)

The rate of non-compliance with the marine code (Figure 22) per Dolphin watch survey shows that non-compliance appears to be most prevalent at Mwnt. Despite a greater percent of encounters where the boat did not follow the code of conduct in 2015 compared to 2014 (Table 14), the rate of non-compliance with the code was highest during 2014 when an average of 0.7 incidences occurred during each watch conducted (Figure 22).

The percentage of encounters where boats did not follow the marine code (Table 14) increased at all sites examined between 2013-2015 with the exception of New Quay Birds Rock where there was an observed increase in 2014 (15%) followed by a decline in 2015 to the percent observed in 2013 (3%).

Table 14: Percentage of non-compliance with Ceredigion Marine Code during bottlenose dolphin encounters

	Percentage of encounters where boat did not follow Ceredigion Marine Code			
	2013	2014	2015	All years
Mwnt		51	73	56
Aberporth	0			0
New Quay Birds Rock	3	15	3	7
Aberystwyth	0	13	20	17
New Quay Harbour	11	9	17	12
All sites	11	12	16	13

Proportions of different types of non-compliance to Ceredigion Marine Code

The majority of cases (55%) of non-compliance with the marine code involved boats manoeuvring erratically to either approach, avoid or follow the dolphins or boats travelling too fast within 300 metres of a group of dolphins (42.4%) (Table 15).

Table 15: Percentage of type of non-compliance with code of conduct during bottlenose dolphin encounters

Boat activity (during non-compliance)	Number of encounters	Percentage of non-compliance
N1: Too fast, wake speed within 300m of dolphins	148	42.4%
N2: Erratic course to approach, avoid or follow dolphins	193	55.3%
N3: Attempted to touch, feed or swim with dolphins	5	1.4%
N4: Exceed 8 knots within zoned area (New Quay)	3	0.9%

The incidence of non-compliance for users of different boat types

Motor boats, speed boats, and canoes (includes kayaks and paddleboards) had the highest levels of non-compliance with the marine code for all years examined (Table 16). Motor boats and canoes also accounted for the largest proportion of all non-compliance measured. High levels of compliance with the marine code were observed during encounters between Visitor Passenger Boats (VPBs) and dolphins for each year examined although the number of VPBs not complying increased in 2015 (Table 16). Alongside motor boats, canoes and speed boats, VPBs also accounted for a high proportion of all non-compliance measured 22%.

Table 16: Percentage of type of non-compliance with Ceredigion Marine Code for different boat types

	Number of non-compliant boats			Percentage of non-compliance to code of conduct (%)			Proportion of non-compliance
	2013	2014	2015	2013	2014	2015	All years
Motor Boat (MB)	37	37	47	18	21	28	0.35
Speed Boat (SB)	25	16	16	30	25	34	0.16
Water-skier (SS)	0	0	0	0	0	0	0
Sailing boat (SAIL)	6	1	6	5	1	8	0.04
Commercial Fishing Boat (CF)	2	5	4	3	9	11	0.03
Visitor Passenger Boat (VPB)	9	24	44	2	6	10	0.22
Canoe/ Kayak/Paddleboard (C)	38	17	11	28	25	23	0.19
Jet-ski (J)	0	1	0	0	100	0	0
Research Vessel (R)	3	0	0	30	0	0	0.01
Other (O)	0	0	0	0	0	0	0
All Boat Types	120	101	128	11	12	16	1

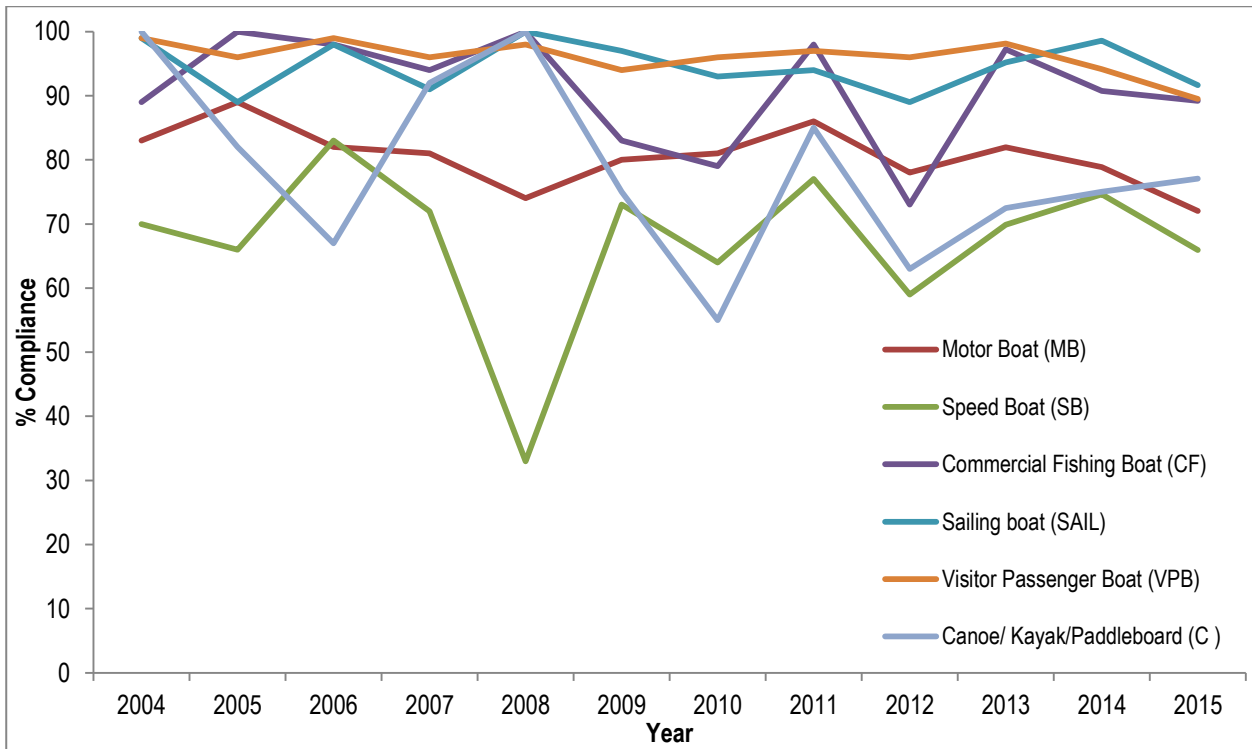


Figure 23: Percentage of compliance with the Ceredigion Marine Code for different boat type

Figure 23 shows the percent compliance with the marine code for different boat types since 2004, this highlights changes in compliance for each boat type over the years 2004-2015. Amongst all boat types there has been a decline in the percentage of boats complying with the marine code over the three years examined. In particular, the percent of motor boats (MB), speed boats, sailing boats (SAIL) and visitor passenger boats (VPB) not complying to the code of conduct increased in 2015 (Figure 23); in comparison the percentage of canoes complying with the marine code increased in 2015.

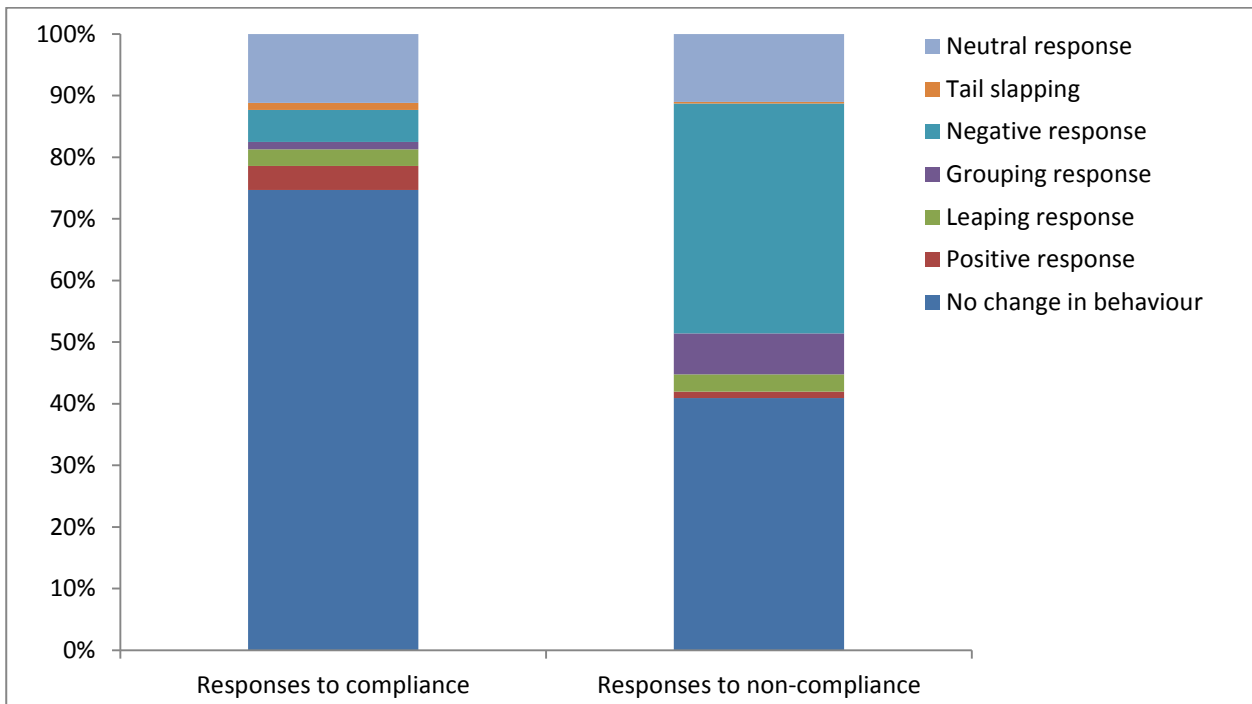


Figure 24: Dolphin responses to boat encounters, depending on whether the boat complied with the Ceredigion Marine Code

Effects of boat encounters on bottlenose dolphin behaviour

The effect of boat encounters on bottlenose dolphin behaviour was not examined in detail however whether dolphins responded differently to boats when boat users followed the marine code was investigated.

The effect of non-compliance on dolphin behaviour is of concern, in particular any negative responses from boat encounters, for example dolphins changing their behaviours or moving away. Changes in group structure, neutral responses, tail slapping and leaping were examined separately as well as positive responses such as dolphins including bow riding or heading towards the boat. No change in dolphin behaviour observed during an encounter was also examined separately as this could be considered a neutral response and could indicate that the dolphins were unaffected by the encounter.

The data suggests that dolphins exhibited no change in behaviour more frequently during encounters where the encounter boat followed the marine code (Figure 24).

Positive responses were exhibited more frequently during encounters where the boat complied with the marine code and there were more negative responses than neutral or positive responses exhibited by dolphins during encounters when boats did not comply with the marine code.

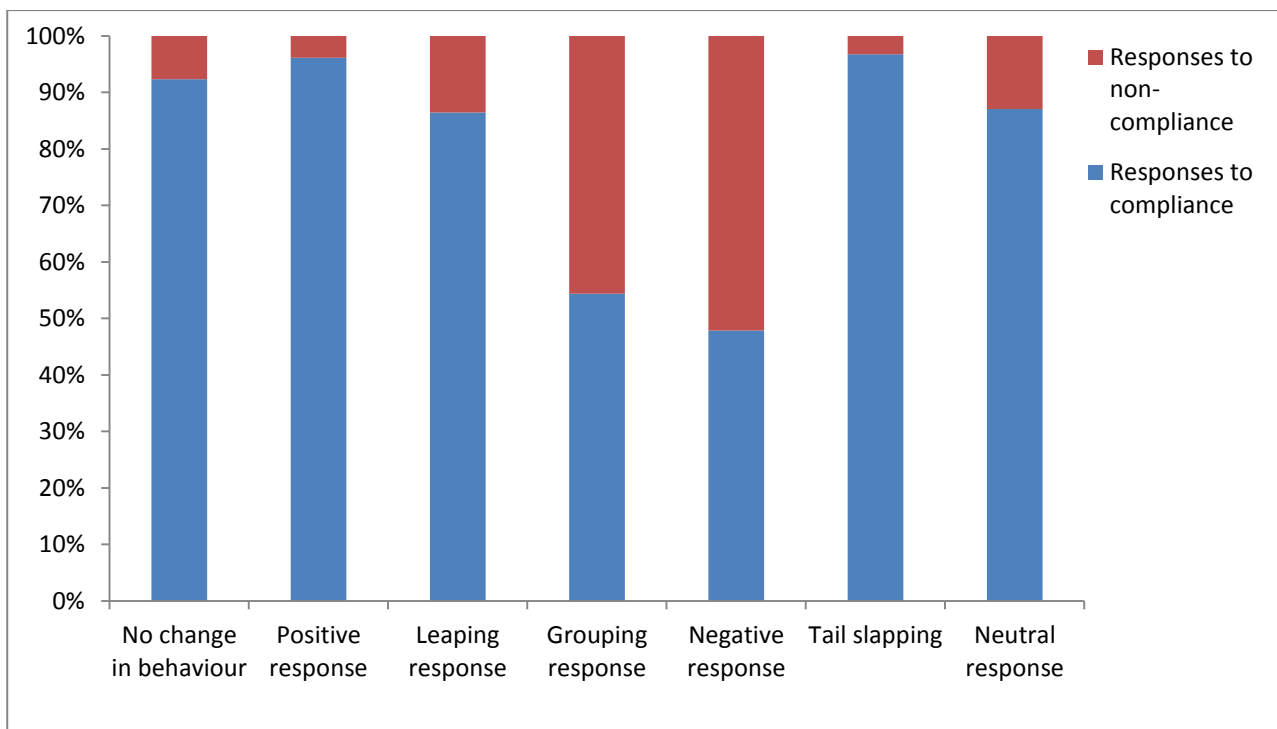


Figure 25: Dolphin behavioural responses to boat encounters, comparison of percentage occurrence between compliance and non-compliance

Grouping responses and negative responses were observed more frequently during encounters where boats did not comply with the code of conduct whilst no changes in behaviour and behaviours considered as a positive response to an encounter were recorded more frequently during encounters where the code of conduct was followed (Figure 25). Interestingly tail slapping was observed more frequently as a response to compliance to the marine code than non-compliance.

Acknowledgements

Thank you to all the hundreds of people that have contributed to the Dolphin Watch data collection over the last 22 years. Over 150 people contributed observations between 2013-2015. Observers over these three seasons are listed below, with apologies for any errors or omissions.

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Recommendations for the Dolphin Watch Project

Listed below are a summary of the authors' recommendations for the Dolphin Watch project data collection:

- This long running project (22 years of data collection) would benefit from an increase in additional volunteer participation and survey effort at sites experiencing with low amounts of survey effort in recent years, in particular Aberporth, Ynys Lochtyn and Aberystwyth in order to ensure data collected is robust and comparable across years
- Encourage volunteer involvement and participation in the project outside the core survey times and days of the week, as demonstrated by the data collection at New Quay Harbour by volunteers from the Cardigan Bay Marine Wildlife Centre
- Consider updating methodology and database to enable recording of all boat encounters, not just one per 15 minute interval to facilitate additional analysis
- Update of the behaviour categories and provide volunteers with a detailed key to ensure consistent behavioural information is recorded, option of unknown behaviour
- Update of the Code of Conduct categories and provide volunteers with detailed key to ensure consistent encounter information is recorded. Include separate categories applicable to commercial boat operators marine code
- Survey sheets to be checked on a regular basis by site coordinators to ensure consistency in data being collected across sites