

**BOTTLENOSE DOLPHINS**

**&**

**BOAT TRAFFIC**

**ON THE**

**CEREDIGION COAST,**

**WEST WALES**

**2010 to 2012**

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## SUMMARY

- The Ceredigion Coast Bottlenose Dolphin and Boat Traffic Survey provides a nineteen year run of data on cetacean occurrence, levels of boat traffic and interactions between bottlenose dolphins (*Tursiops truncatus*) and boats in Cardigan Bay.
- Sighting rates of bottlenose dolphins were highest at New Quay Harbour from 2010 to 2012, when dolphins were present in 63%, 74% and 81% of two-hour observation periods. Sighting rates were lowest at Aberporth in 2011 and 2012.
- Dolphin aggregations were largest on average at Mwnt in 2010 and 2012 and joint largest with New Quay Birds Rock in 2011. Double-figure numbers of dolphins were seen at Mwnt (15 to 20), New Quay Birds Rock and New Quay Harbour.
- Dolphins occupied New Quay Harbour on average for the longest period in all years.
- In 2012, as in previous reports, dolphins with calves were recorded more frequently at Mwnt than elsewhere. However, in 2010 and 2011 they were recorded more frequently at New Quay Harbour than at Mwnt.
- New Quay Harbour had much higher levels of boat traffic than other sites, as in previous years. Mwnt again had the least boat traffic.
- Encounter rates between boats and dolphins were highest at New Quay Harbour, followed by Birds Rock. Visitor passenger boat trips accounted for the highest encounter rates at New Quay Harbour and New Quay Birds Rock, but recreational motor boats were most often involved in dolphin encounters at Aberporth and Mwnt.
- 2665 boat encounters were examined for rates of compliance / non-compliance with codes of conduct for boat users. Compliance with the code of conduct was high, particularly at New Quay Birds Rock (93% of boat encounters) and New Quay Harbour (87%).
- Just over half of the boats not following the code of conduct were travelling too fast when close to dolphins, closely followed by boats taking an erratic course to follow dolphins. Operators of speedboats and motor boats were least likely to follow the code of conduct, followed by canoes and kayaks.
- As in previous years, relatively few dolphins were recorded reacting to boat encounters. Compliance with the code of conduct gave more positive responses by dolphins (for example heading towards the boat) and fewer negative reactions (such as heading away). Also, when boats followed the code of conduct fewer dolphins changed their behaviour in any way, which could be considered to be the most positive outcome.

## INTRODUCTION

This study has now completed 19 years of data gathering from four sites in southern Ceredigion. This is our seventh survey report (Pierpoint & Allan 2000; 2001; 2002; 2004; 2006; Allan et al. 2010). A paper 'Monitoring important coastal sites for bottlenose dolphin in Cardigan Bay, UK' (Pierpoint *et al*) was published in the Journal of the Marine Biological Association in 2009.

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). This community-led initiative was established because of concerns over perceived increases in powered craft activity and its potential adverse effect on the local bottlenose dolphin population. 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. The principle aims of the project have been: (a) to monitor the presence of bottlenose dolphins at a number of coastal sites; and (b) gather data on boat traffic to aid coastal zone management.

Several hundred people have taken part over the years, some of whom have participated in the survey since 1994.

## METHODS

Bottlenose dolphin observations were examined at four study sites, in Cardigan Bay, Wales, from June to September in 2010, 2011 and 2012. These data were collected by a team of volunteers, most of whom had already taken part in the project in previous years. The study sites were located at Mwnt, Aberporth, New Quay Birds Rock, and New Quay Harbour. Records at New Quay Harbour were collected and contributed to the database by the Cardigan Bay Marine Wildlife Centre.

### 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 New Quay Harbour, volunteers from the Cardigan Bay Marine Wildlife Centre carried out additional watches during the day. 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.

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 school was considered to be animals of the same species in close proximity (within about 10 body lengths of another animal) and behaving in a similar manner. Abbreviated codes were written against each school 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 sighting 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 2 hour watches in which dolphins were recorded; and b) the average count of dolphins in a 15 minute interval per 2 hour observation period. 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, sighting 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 identify individual animals or account for those which may have moved through the site more than once in a watch.

d) Occurrence of bottlenose dolphin calves. The proportion of watches in which small calves were seen was examined. Young 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 were often visible on a calf's flanks.

e) Site occupancy. To examine the amount of time that dolphins tended to occupy habitats at each site, 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 were asked to assign an activity code to each dolphin group at the beginning of every 15 minute interval. 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 has been used here and this was considered to be a systematic sample of dolphin activity state at each site.

### Encounters between bottlenose dolphins and boats

Further information was recorded on the data sheet when boats came within 300 metres of a bottlenose dolphin school. This was called a 'boat encounter'. Only the first boat encounter in each 15 minute interval was recorded, as encounters with different types of boat were being examined. 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 a 300 metre radius of the dolphin group; whether the boat complied with the code of conduct for boat users; and listed 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 the 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 the Countryside Council for Wales to approach bottlenose dolphins for research purposes. These vessels carried a flag or banner when they were engaged in research.

We examined whether following the code of conduct affected how dolphins responded to encounters with boats. Observers recorded different dolphin responses during encounters. In the analyses reported here some behaviours were grouped together - for example 'heading away, fast swimming' and 'heading away steadily or in a series of long dives' were grouped as a negative response (i.e. a change in dolphin behaviour to move away from a boat). Similarly, 'approaching', 'bow-riding' and 'following boat' were grouped as a positive response.

To investigate whether the overall density of boats affected dolphin responses during boat encounters, six categories of boat density were also recorded. Categories A and B, and D and E were combined, in some cases, to improve sample sizes. General levels of boat traffic in 2008 and 2009 were compared to previous years using standard 2 hour boat counts. These were tally counts of different types of boat in each watch.

Table 1: Boat density categories used within this report.

Boat density category	Boats within 50 m	Total boats within 300 m
A	At least 1	At least 5
B	At least 1	2 to 4
C	At least 1	1
D	none	At least 5
E	none	2 to 4
F	none	1

## RESULTS

### Observer effort

In 2010, 2011 and 2012, 696, 707 and 655 observation periods (watches) were carried out in each year respectively. Since the first season's field work in 1994, a total of 9,685 watches have been completed.

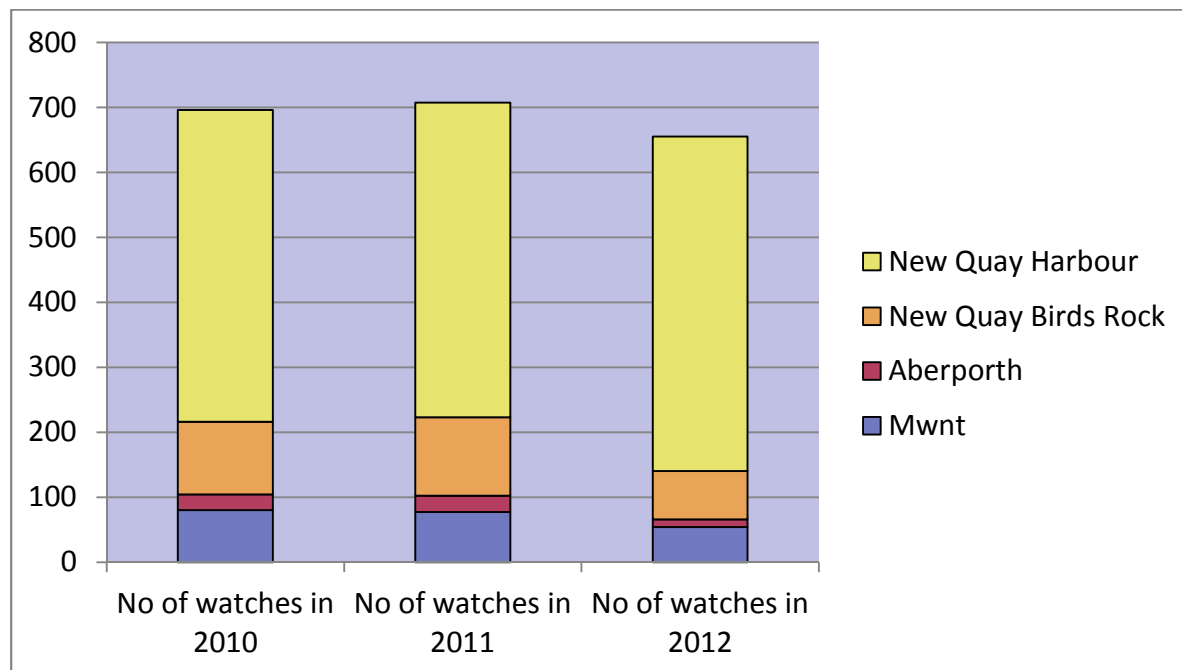
Originally observations were carried out at three sites: Aberporth, New Quay Head and Ynys Lochtyn. Mwnt was included from 1998, and Ynys Lochtyn was included until 2009. The Sea Watch Foundation and the Cardigan Bay Marine Wildlife Centre also began collecting data at New Quay Harbour using the same protocol from 2004. Between 2004 and 2007 watches were also carried out in Aberystwyth by Friends of Cardigan Bay.

Table 2: Observation period (watch) totals

	<b>All sites (June to Sept)</b>	<b>Mwnt (M)</b>	<b>Aberporth (AB)</b>	<b>New Quay Birds Rock (NQ BR)</b>	<b>New Quay Harbour (HAR)</b>
<b>No of watches June - Sept all years</b>	<b>2058</b>	<b>211</b>	<b>61</b>	<b>307</b>	<b>1479</b>
No of watches in 2010	696	80	24	112	480
No of watches in 2011	707	77	25	121	484
No of watches in 2012	655	54	12	74	515
<b>Hours of effort June - Sept all years</b>	<b>4076.5</b>	<b>413.25</b>	<b>120.25</b>	<b>607.25</b>	<b>2935.75</b>
Hours of effort 2010	1375.75	159.75	48	224	944
Hours of effort 2011	1408.5	151	48.5	241	968
Hours of effort 2012	1292.25	102.5	23.75	142.25	1023.75

A further 891 extra watches were undertaken outside June to September at New Quay Harbour between 2010 and 2012.

Figure 1: Number of watches at different sites



### Sighting conditions

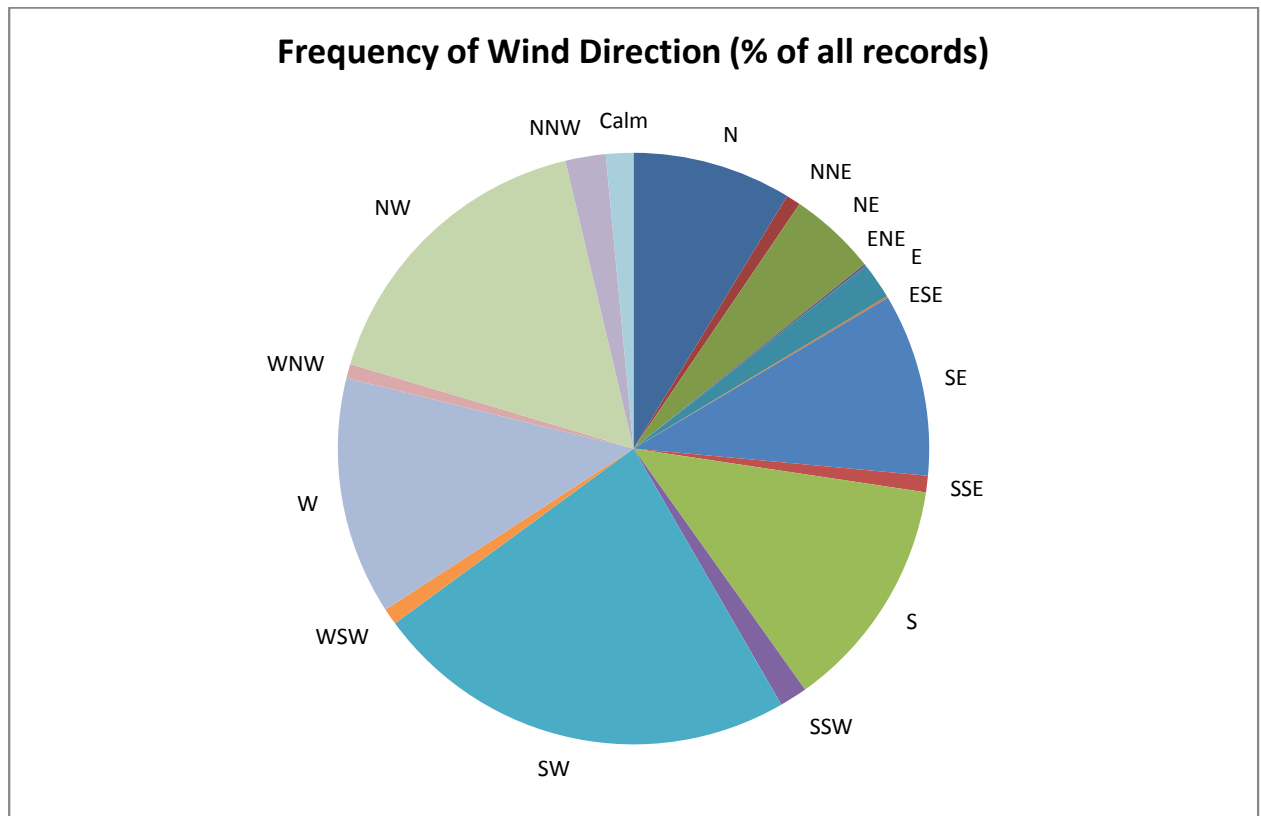
In 2010, 2011 and 2012, 80%, 85% and 82% of 2 hour watches were completed in relatively good conditions for observing marine mammals. During these watches there was always at least 2 km visibility and the sea state did not exceed Beaufort 3 sea surface criteria (HMSO 1983) in each of eight successive 15 minute intervals. Sighting rates for bottlenose dolphin on the Cardigan Bay coast, from June to September, were calculated from 2851 observation periods: 560 in 2010, 598 in 2011 and 535 in 2012.

In all years and at all sites, the median sea state recorded was 2 (wavelets - crests do not break). This was also true of individual years, and for each site in each year that watches were made, except for Aberporth in 2010, when the median sea state was 1 (calm, rippled water surface).

The wind direction was most frequently recorded as south-westerly overall, and also at each site. The exceptions were in 2010, when Mwnt recorded northerly and New Quay Harbour recorded north-westerly winds more frequently. Also, in 2011 New Quay Birds Rock most frequently recorded westerly winds. Overall, south-westerly winds made up 23% of records over the three years.



Figure 2: Prevailing Wind



### Sightings

A subset of 1693 watches was used in the sightings calculations. These were watches with eight intervals recorded in good conditions from June to the end of September (sea state less than four and visibility at least 2km).

Number of watches used in sightings calculations	Mwnt	Aberporth	New Quay Birds Rock	New Quay Harbour
2010	59	18	79	402
2011	59	24	96	420
2012	38	10	55	433

Table 3: Sighting rates of bottlenose dolphins

Percentage of two hour watches at each site with dolphin sightings

	Mwnt	Aberporth	New Quay Birds Rock	New Quay Harbour
<b>2010</b>	54%	61%	46%	63%
<b>2011</b>	63%	29%	43%	74%
<b>2012</b>	39%	20%	53%	81%

In all years New Quay Harbour had higher sighting rates than the other sites, and in 2011 and 2012 Aberporth had the lowest rates, as can be seen in Table 3 and Figure 3. Overall sighting rates have dropped slightly over the three years.

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

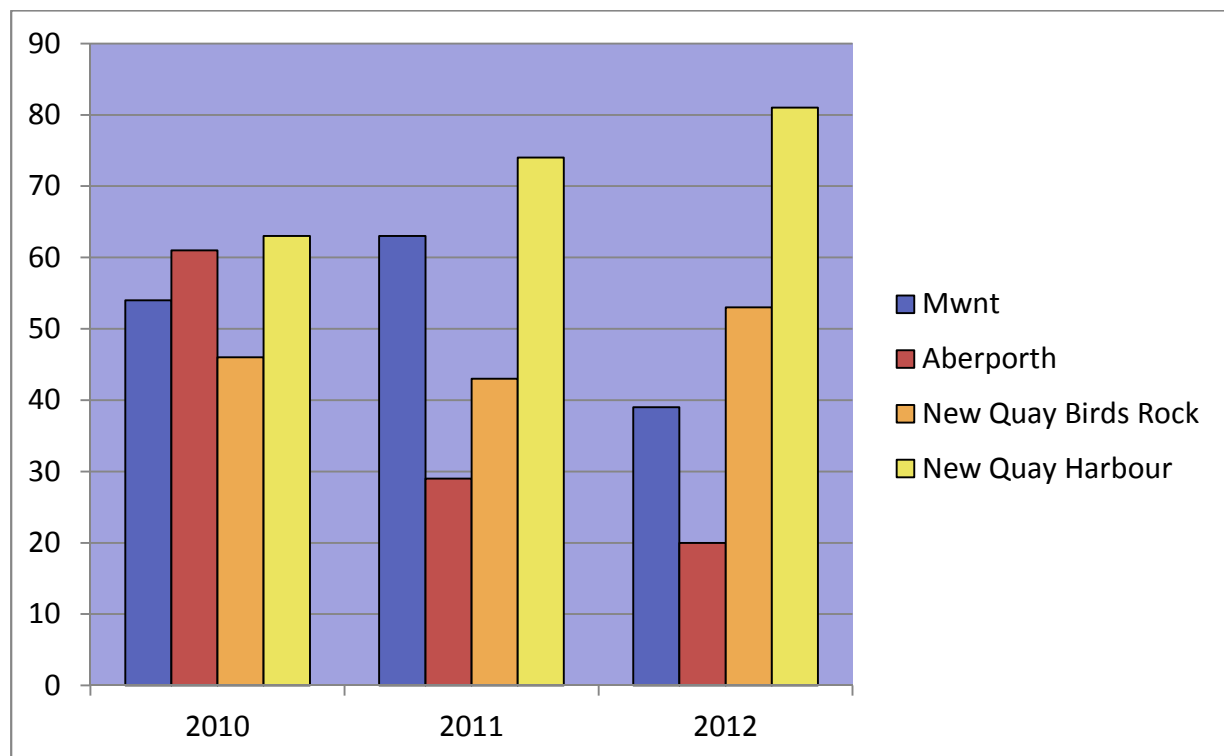
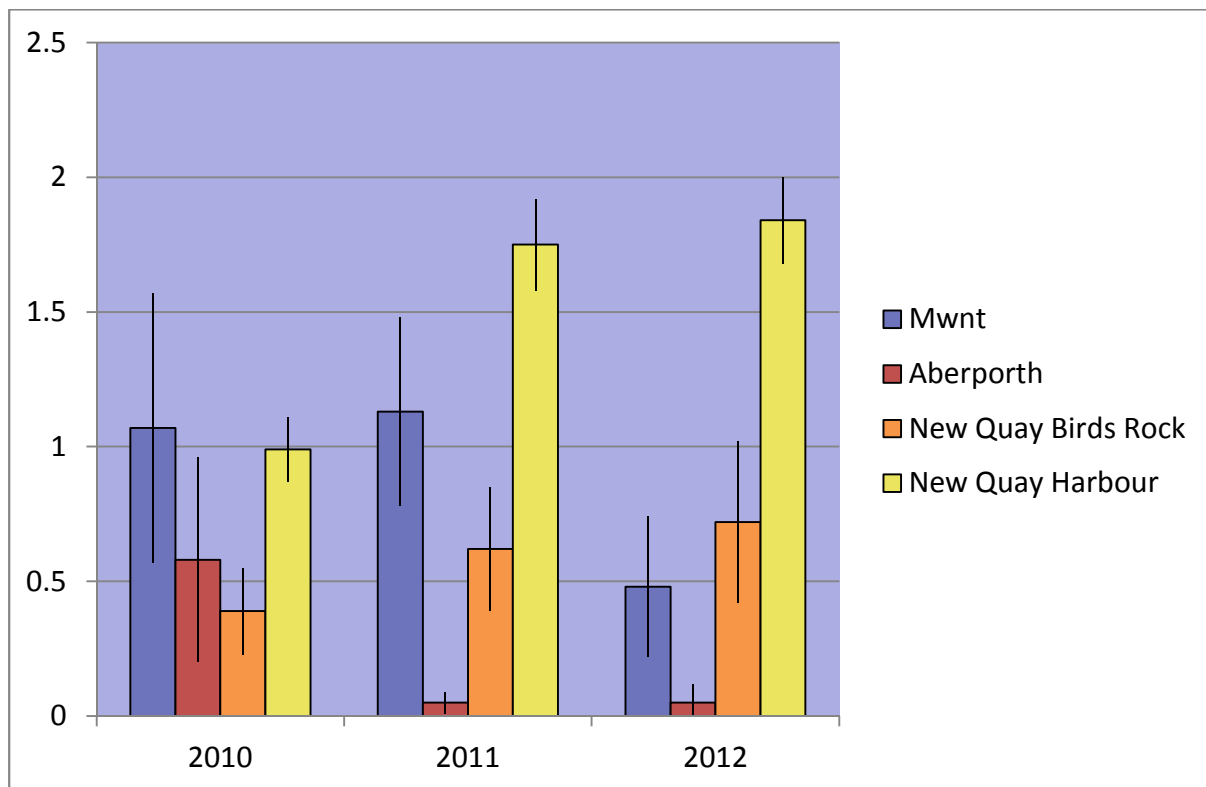


Figure 4: Average number of dolphins seen in 15 minutes



The average number of dolphins counted was similar to the chart of sighting rates, in that relatively high numbers were counted at Mwnt and particularly at New Quay Harbour. However, relatively low numbers were counted at Aberporth, which fits with previous years.

Table 4: Average number of dolphins seen in a 15 minute interval

	<b>Mwnt</b>	<b>Aberporth</b>	<b>New Quay Birds Rock</b>	<b>New Quay Harbour</b>
<b>2010</b>	1.07	0.58	0.39	0.99
<b>2011</b>	1.13	0.05	0.62	1.75
<b>2012</b>	0.48	0.05	0.72	1.84

Figure 5: Sighting rates over the years:

Percentage of two hour watches in which dolphins were recorded: 1995 - 2012

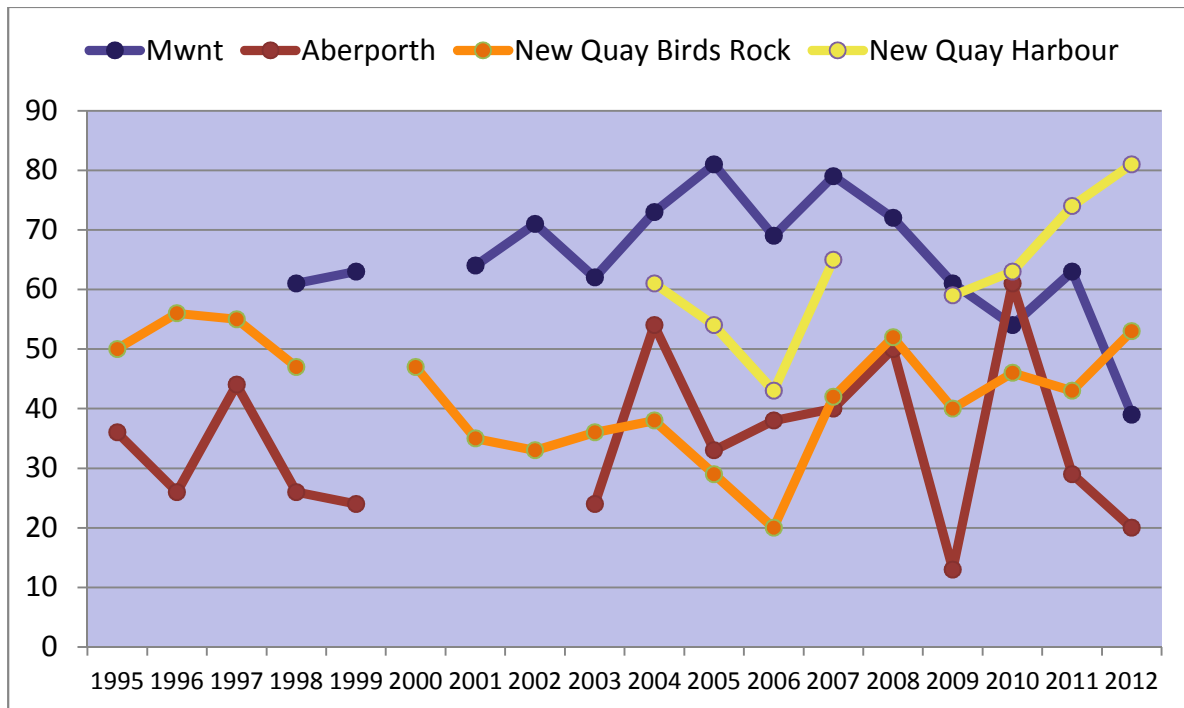
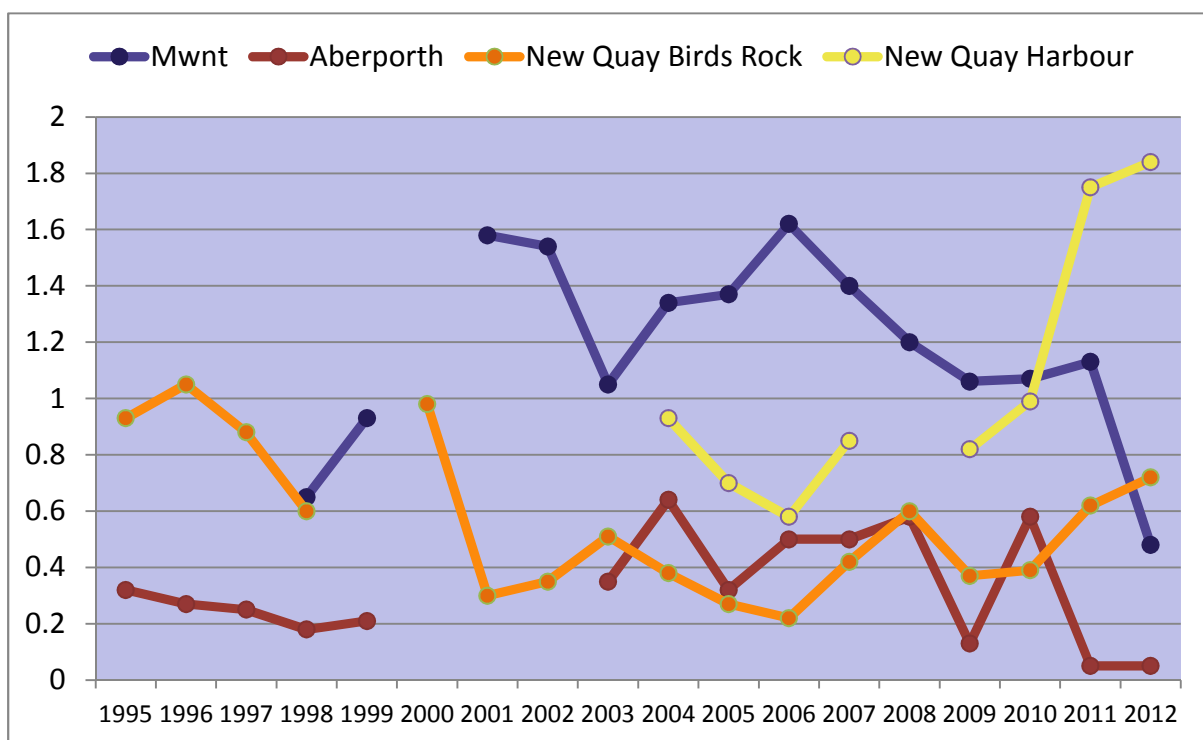


Figure 6: Average dolphin counts over the years:

Average number of dolphins seen in 15 minutes: 1995 – 2012



## Group Size

The highest counts of dolphins present in observation periods, when sightings occurred, were used as a measure of group size. The counts may have included groups of dolphins that habitually travelled together, but also may have been temporary aggregations of animals.

Figure 7: Dolphin group size – maximum group size in a watch (on average)

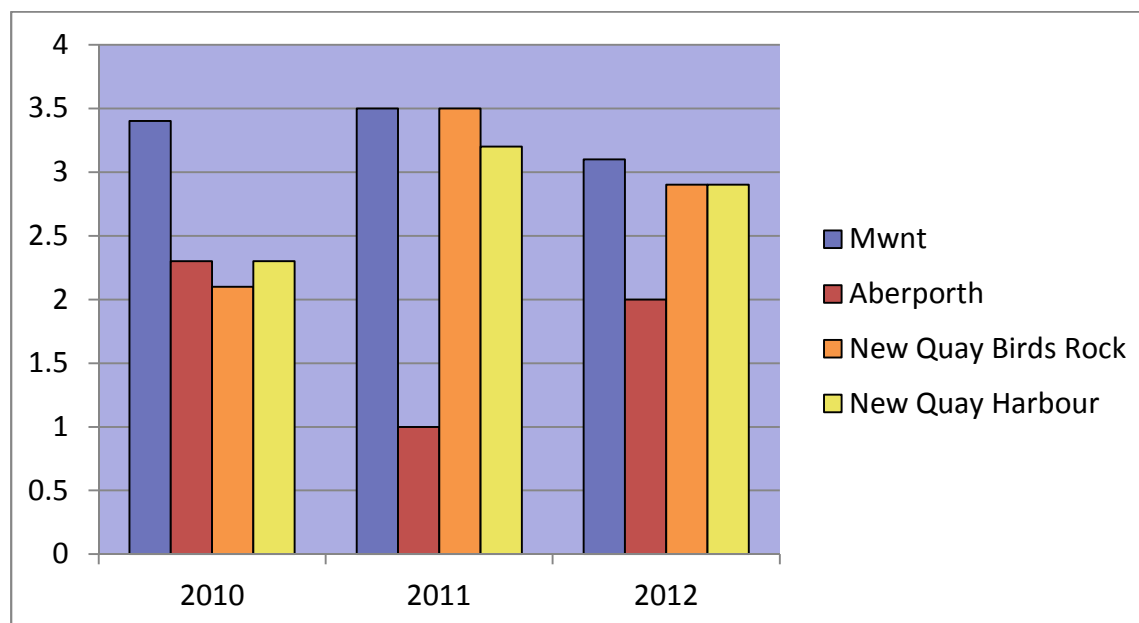


Table 6: Maximum dolphin group size (mean)

	<b>Mwnt</b>	<b>Aberporth</b>	<b>New Quay Birds Rock</b>	<b>New Quay Harbour</b>
<b>2010</b>	3.4	2.3	2.1	2.3
<b>2011</b>	3.5	1	3.5	3.2
<b>2012</b>	3.1	2	2.9	2.9

Overall, the maximum recorded dolphin group size, at each site in each of the three years was as follows:

Table 7: Highest recorded group size overall

<b>Maximum recorded group size</b>	<b>Mwnt</b>	<b>Aberporth</b>	<b>New Quay Birds Rock</b>	<b>New Quay Harbour</b>
<b>2010</b>	15	4	6	6
<b>2011</b>	7	1	10	10
<b>2012</b>	6	2	6	9

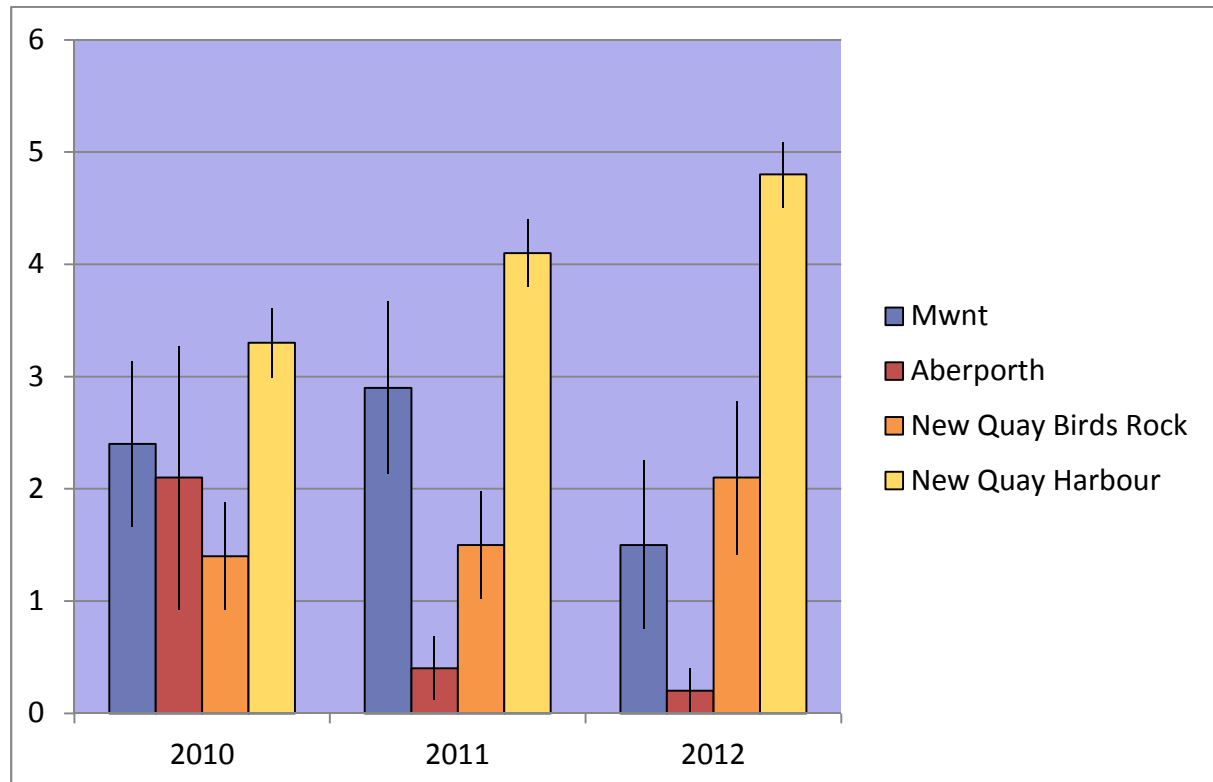
(Mwnt was counted as 15 in calculations, but was actually estimated as 15 to 20)

## Site Occupancy

Site occupancy is defined here as the amount of time that bottlenose dolphins were present at each site.

It has been measured as the average number of 15 minute intervals that dolphins were recorded, per two hour watch.

Figure 8: Site occupancy (number of intervals per watch when dolphins were present)



New Quay Harbour had the highest occupancy rates in every year, with dolphins present for more than four intervals out of eight (1 hour) on average.

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

	<b>Mwnt</b>	<b>Aberporth</b>	<b>New Quay Birds Rock</b>	<b>New Quay Harbour</b>
<b>2010</b>	2.4	2.1	1.4	3.3
<b>2011</b>	2.9	0.4	1.5	4.1
<b>2012</b>	1.5	0.2	2.1	4.8

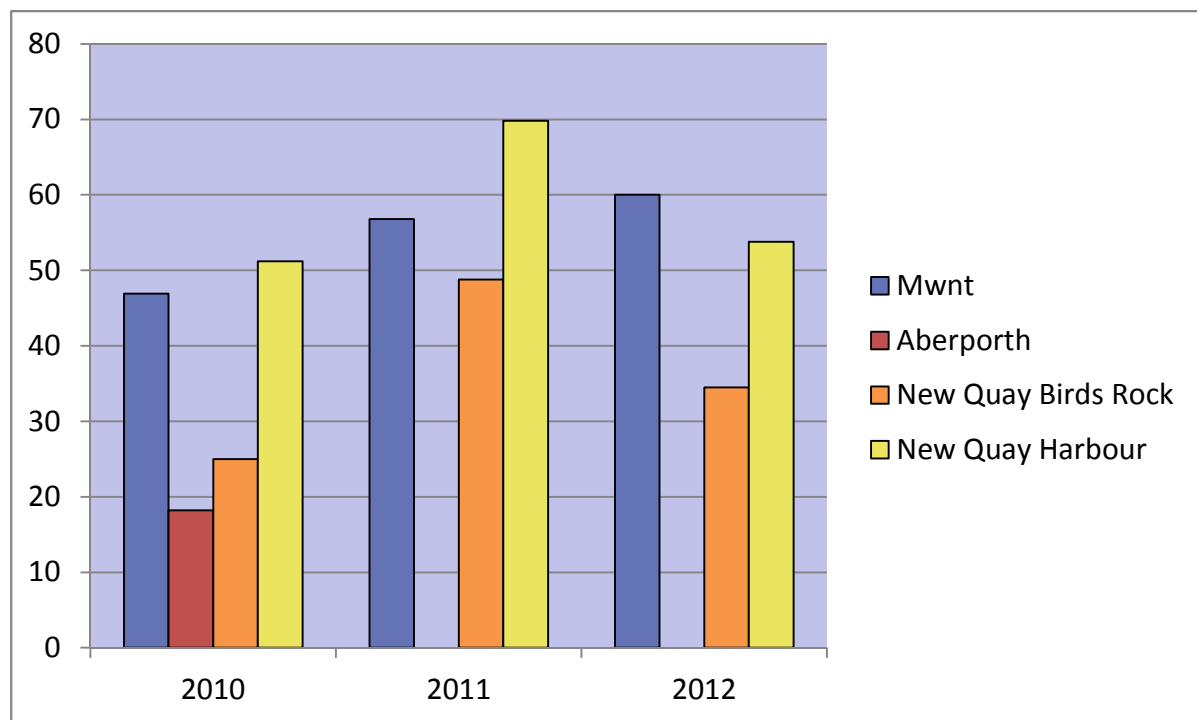
### Sightings of Bottlenose Dolphin Calves

Bottlenose dolphin calves were more often seen at New Quay Harbour and Mwnt than at other sites, where they were seen in a higher percentage of watches than in 2008 and 2009. No calves were recorded at Aberporth in 2011 and 2012, but this was from relatively few watches, and they were in a reasonable proportion of watches in 2010.

Table 7: Calf sightings (as a percentage of watches with dolphin sightings)

	Mwnt	Aberporth	New Quay Birds Rock	New Quay Harbour
<b>2010</b>	46.9%	18.2%	25%	51.2%
<b>2011</b>	56.8%	0%	48.8%	69.8%
<b>2012</b>	60%	0%	34.5%	53.8%

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



## Levels of Boat Traffic

Boat traffic was monitored by tally counts of vessels over each 2 hour observation period. Average boat counts are compared between sites and between years. New Quay Harbour was the busiest site for boat traffic followed by Birds Rock and then Aberporth, with the lowest boat counts on average at Mwnt.

Figure 10: Mean boat counts per watch from 2010 to 2012

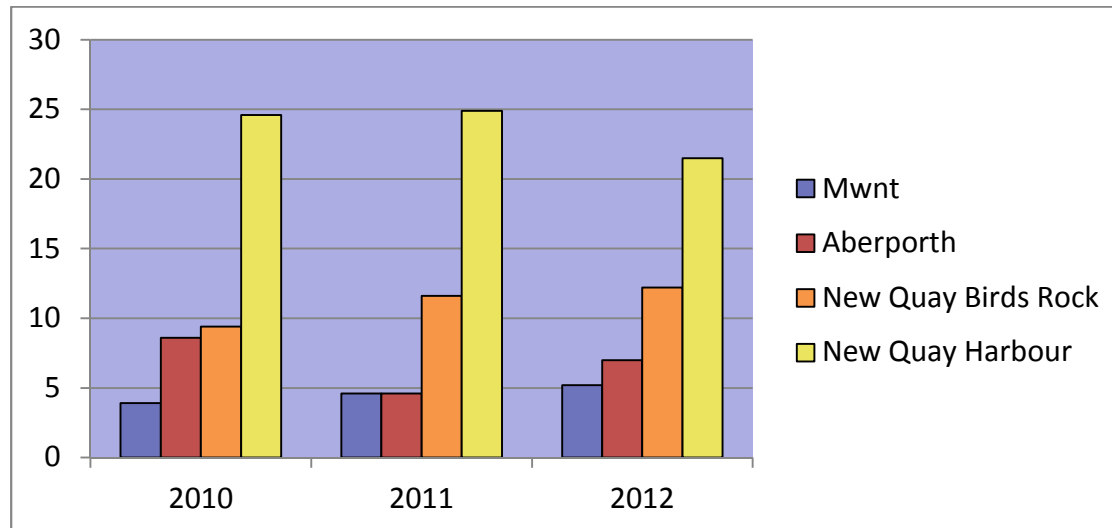
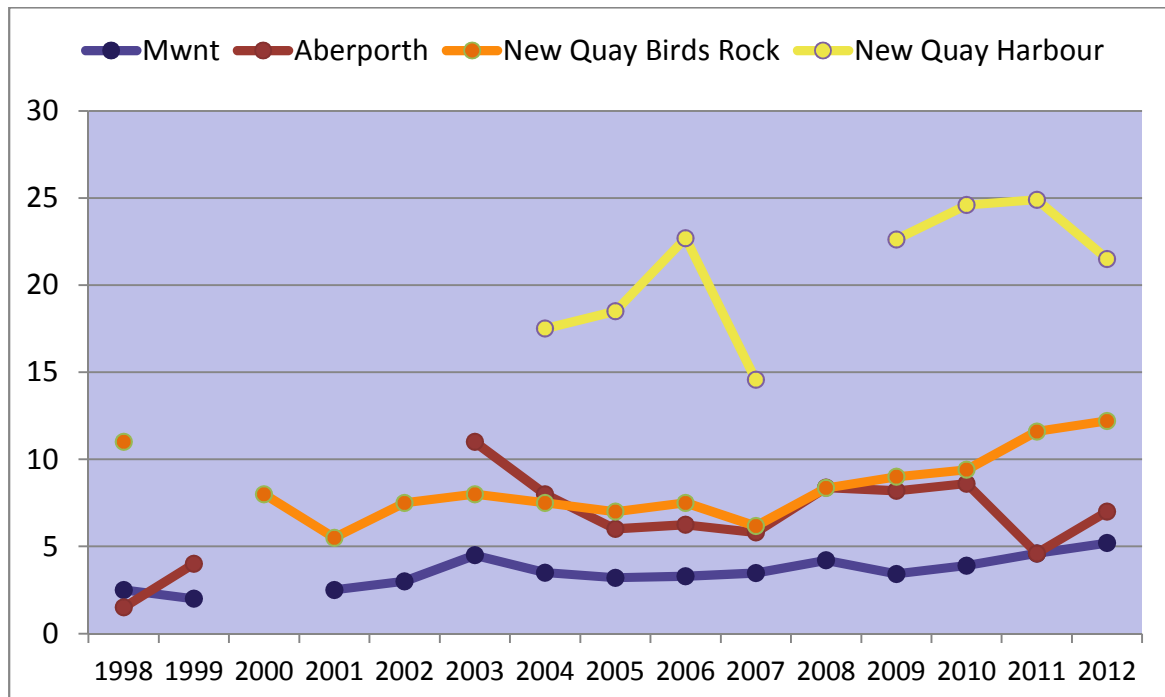


Table 8: Average boat counts from 2010 to 2012 for each site

	<b>Mwnt</b>	<b>Aberporth</b>	<b>New Quay Birds Rock</b>	<b>New Quay Harbour</b>
<b>2010</b>	3.9	8.6	9.4	24.6
<b>2011</b>	4.6	4.6	11.6	24.9
<b>2012</b>	5.2	7	12.2	21.5
<b>Overall mean</b>	<b>4.6</b>	<b>6.7</b>	<b>11.1</b>	<b>23.6</b>



Figure 11: Average boat counts over the years: 1998 - 2012



The average recording rates for different types of boat are shown in Figure 12. As can be seen, the higher levels of boat traffic at New Quay Harbour were mainly motor boats, speed boats, sailing boats and visitor passenger boats (VPBs). Numbers of canoes/kayaks were also highest at this site, although these were also more frequent at Aberporth. Visitor passenger boats were also more evident at New Quay Birds Rock. Speed boat and water-skier counts were combined in this graph. Water-skiers weren't all separated during data entry and even when distinguished have always been recorded in low numbers. Tables 8 and 9 show the counts used for the above figures.

Figure 12: Average counts of different boat types on each site (2010 to 2012 combined)

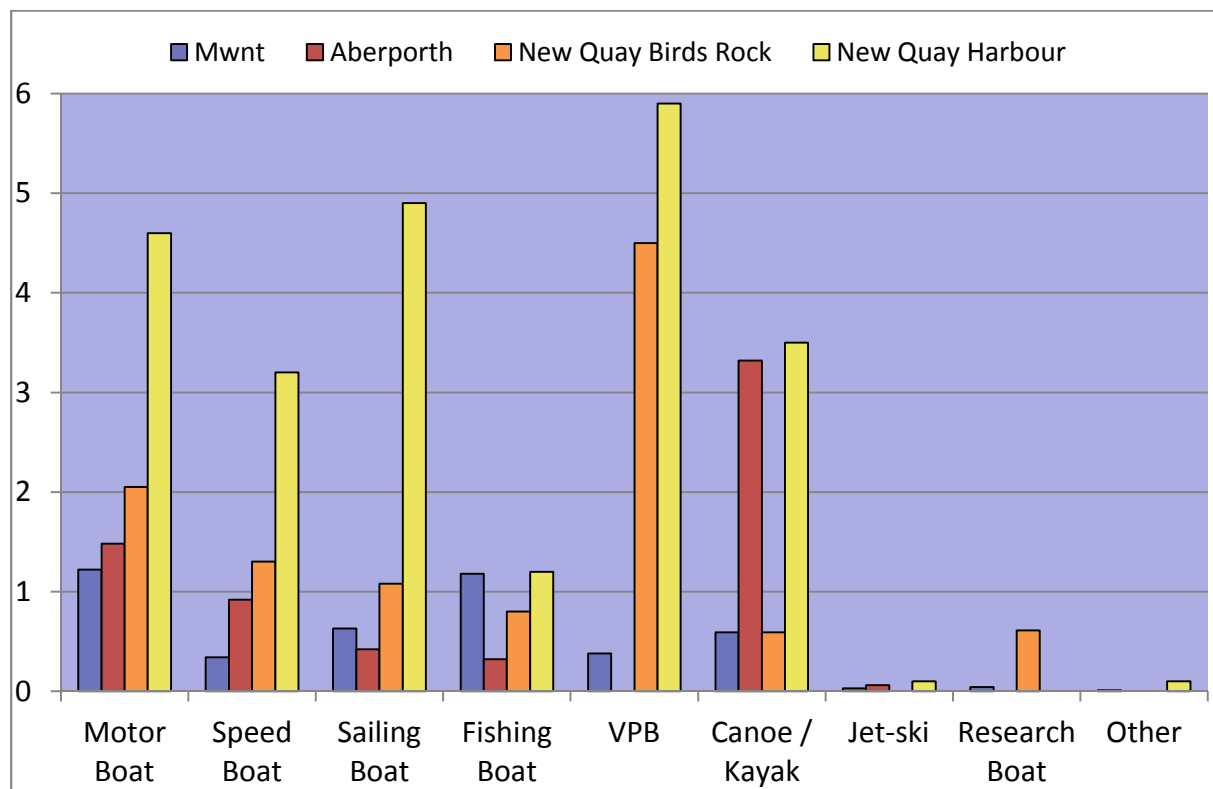


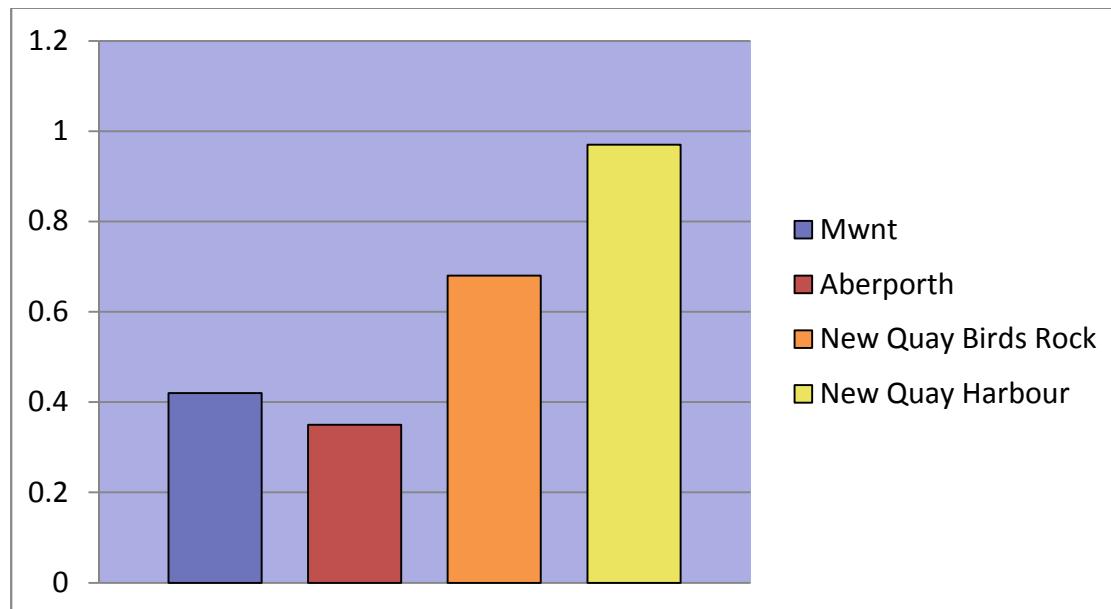
Table 9: Average counts of different types of boat on each site (three years combined)

	Motor Boat	Speed Boat	Sailing Boat	Fishing Boat	VPB	Canoe / Kayak	Jet-ski	Research Boat	Other
<b>Mwnt</b>	1.2	0.3	0.6	1.2	0.4	0.6	0	0	0
<b>Aberporth</b>	1.5	0.9	0.4	0.3	0	3.3	0.1	0	0
<b>New Quay Birds Rock</b>	2.1	1.3	1.1	0.8	4.5	0.6	0	0.6	0
<b>New Quay Harbour</b>	4.6	3.2	4.9	1.2	5.9	3.5	0.1	0	0.1

## Encounters between Dolphins and Boat Users

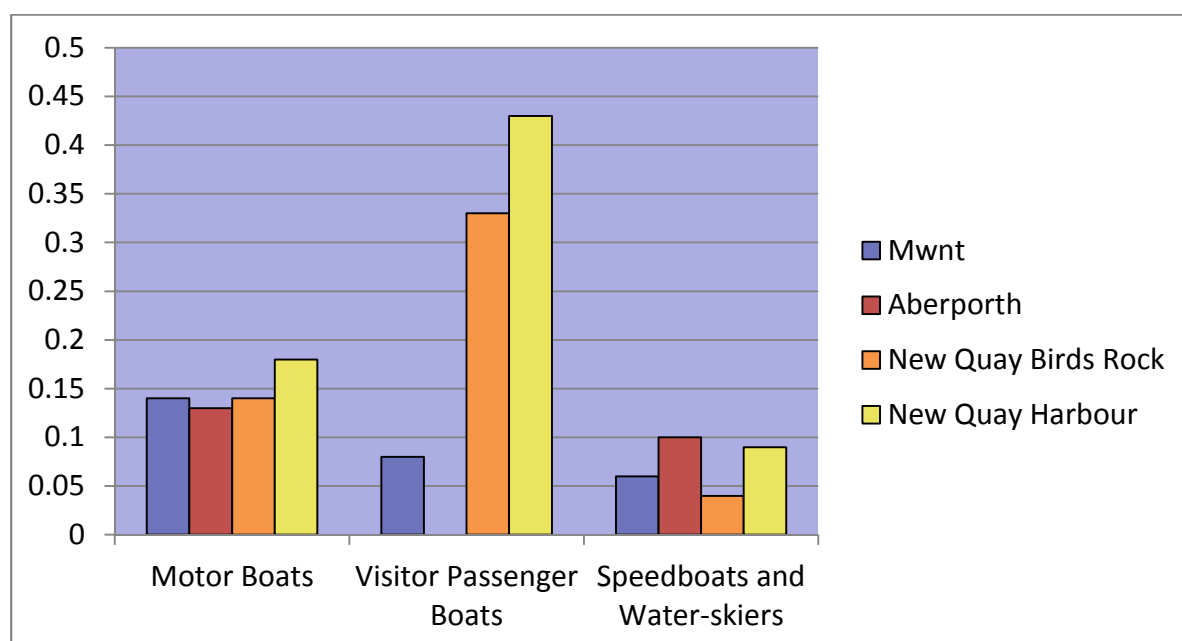
A total of 3706 bottlenose dolphin encounters with boats were recorded between 2010 and 2012, with the highest observed encounter rate per hour at New Quay Harbour, followed by New Quay Birds Rock.

Figure 12: Overall rates of encounter between dolphins and boats (mean number per hour)



The different types of boat involved in these encounters were also examined (see Figure 13). Amongst propeller-driven boats, visitor passenger boats were the most frequently recorded encounter per hour followed by recreational motor boats, with the highest rates at New Quay Harbour followed by New Quay Birds Rock. Most speedboat and water-skier encounters were recorded at Aberporth and New Quay Harbour.

Figure 13: Rate of dolphin encounter with different types of boat (mean number per hour)



### Compliance with codes of conduct by boat users in encounters with dolphins

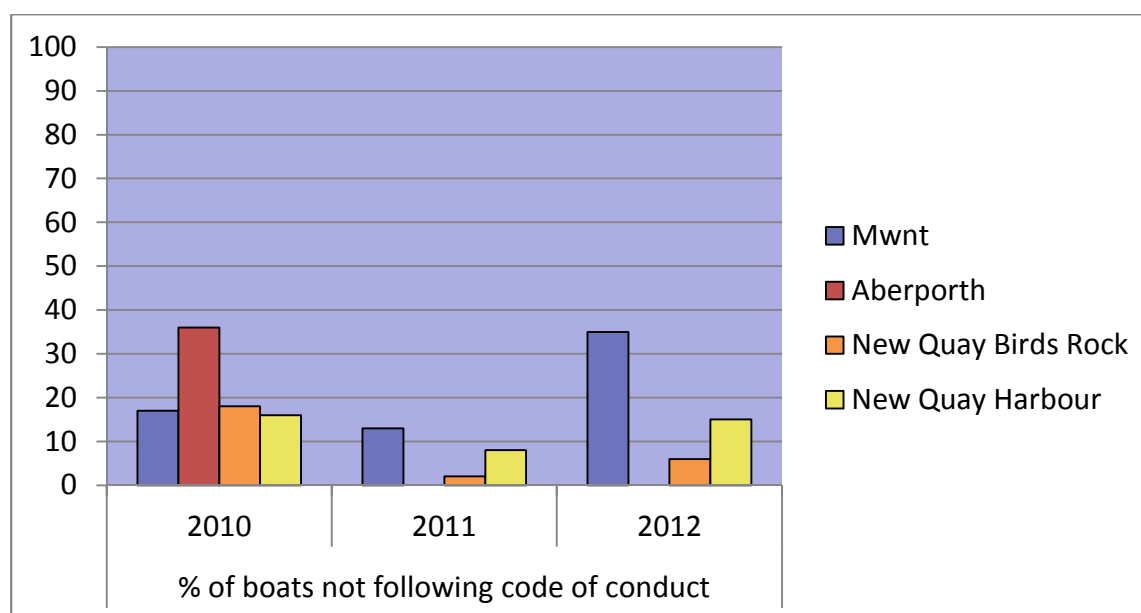
There were 2665 boat encounters in which the observer recorded whether the boat user followed the relevant code of conduct. These codes of conduct were the guidelines for either recreational boat users or for vehicle passenger boats. Boat users followed the code of conduct in 87 percent of encounters with bottlenose dolphins. There were 341 cases in which boat users did not follow the code of conduct.

The number of boat encounters with dolphins when guidelines were followed varied with location. The highest compliance was by boat users in the New Quay Birds Rock area at 93%, followed by New Quay Harbour (87%) and Mwnt (85%). A lower percentage followed the code of conduct at Aberporth (64%), although this was from only 14 encounters in total.

Table 10: Percentage of compliance with code of conduct during dolphin encounters

	Percentage compliance with codes of conduct	Total number of encounters	Number of boats not following code of conduct			
			2010	2011	2012	All years
<b>Mwnt</b>	81%	86	4	6	6	16
<b>Aberporth</b>	64%	14	5			5
<b>New Quay Birds Rock</b>	93%	163	7	1	4	12
<b>New Quay Harbour</b>	87%	2402	100	77	131	308
<b>All sites</b>	87%	2665	113	84	141	341

Figure 14: Rates of non-compliance (as a percentage of all recorded encounters per site)

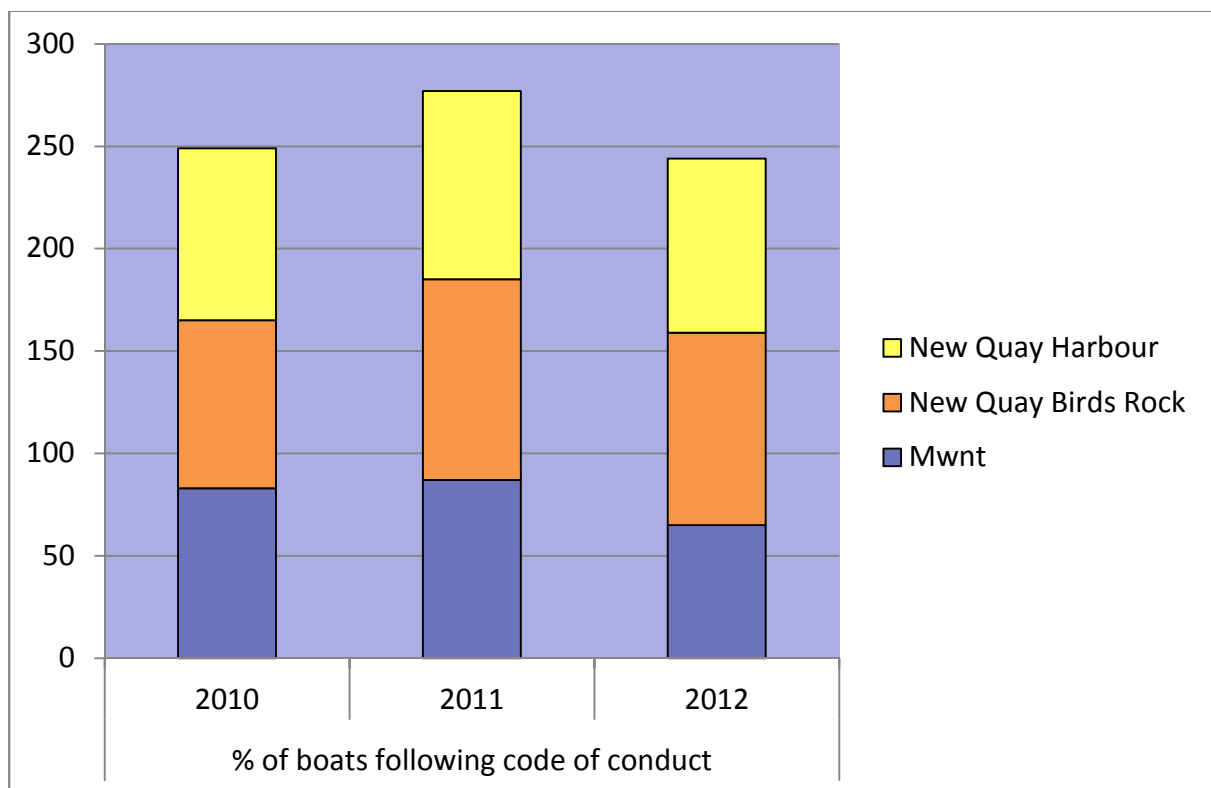


N.B. Aberporth did not record any type of encounter in 2011 or 2012.

Table 11: Rates of non-compliance with codes of conduct within each site individually

	Percentage of boats not following code of conduct		
	2010	2011	2012
Mwnt	17%	13%	35%
Aberporth	36%		
New Quay Birds Rock	18%	2%	6%
New Quay Harbour	16%	8%	15%

Figure 15: Cumulative rate of compliance for each of three sites



(Measured as percentage of encounters on each site - i.e. out of a maximum of 300 percent.)

The above figure doesn't include Aberporth, as no boat encounters of any type were recorded during 2011 and 2012, so it would give a misleading trend of decreasing compliance with the codes of conduct over the three years.

### Relative proportions of different types of non-compliance

Most cases of non-compliance involved boats travelling too fast within 300 metres of dolphins, and three within the buoyed 8 knot zone at New Quay. A further 158 cases involved boat users following an erratic course to remain close to dolphins and five where an attempt was made to touch, feed or swim with the dolphins.

Table 12: Relative proportions of types of boat non-compliance with code of conduct

<b>Boat activity</b> (when not complying with codes of conduct)	<b>Number of encounters</b>	<b>Percentage of non-compliance</b>
N1: Too fast, wake speed within 300m of dolphins	175	51.3 %
N2: Erratic course to follow dolphins	158	46.3 %
N3: Attempted to touch, feed or swim with dolphins	5	1.5 %
N4: Speed over 8 knots within New Quay zoned area	3	0.9 %

### The Incidence of non-compliance for users of different types of boat

Speedboats and motor boats had the highest levels of non-compliance with the code of conduct, as a proportion of all speedboats and motor boats that complied. They also accounted for the largest proportion of all non-compliance measured. A consistently high percentage of visitor passenger boats complied with the code of conduct.

Table 13: Non-compliance of different types of boat

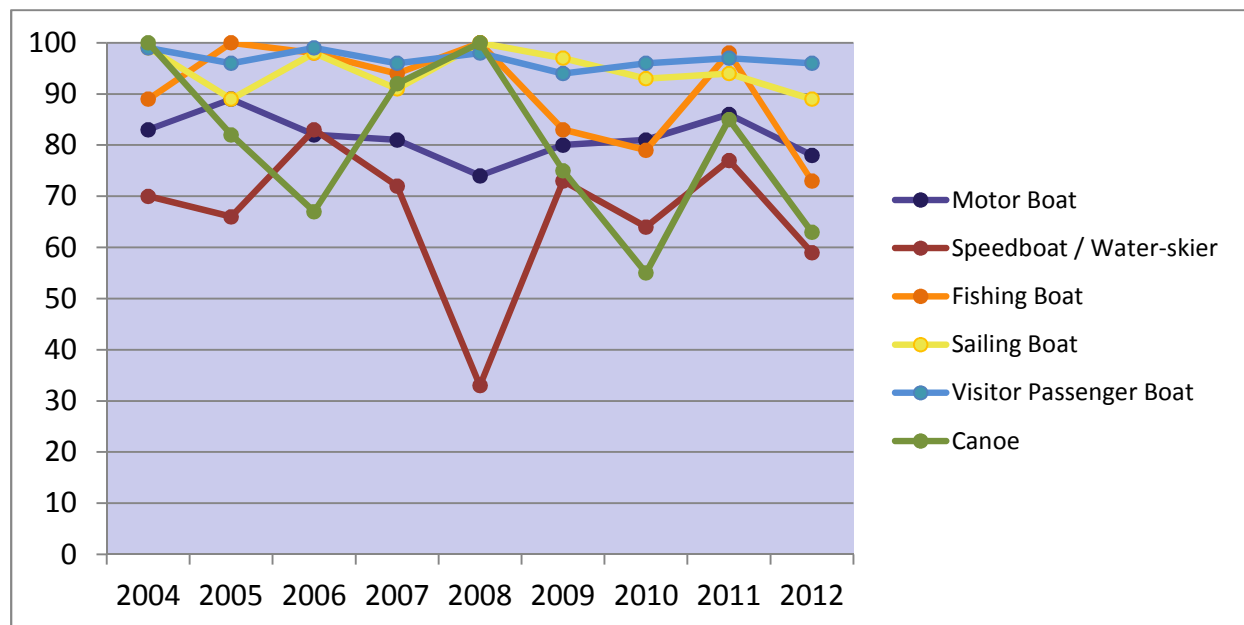
	Number of non-compliant boats			Percentage of non-compliance in boat types			Proportion
	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>All years</b>
<b>Motor Boat</b>	31	28	38	19%	14%	22%	0.29
<b>Speedboat</b>	20	20	37	31%	22%	40%	0.23
<b>Commercial Fishing Boat</b>	16	1	14	21%	2%	27%	0.09
<b>Sailing Boat</b>	6	7	8	7%	6%	11%	0.06
<b>Water-skier</b>	3	1	1	60%	50%	50%	0.01
<b>Visitor Passenger Boat</b>	10	13	17	4%	3%	4%	0.12
<b>Canoe</b>	27	12	20	45%	15%	37%	0.18
<b>Jet-ski</b>	0	0	1	0	0	100%	0
<b>Other</b>	0	1	3	0%	7%	11%	0.01
<b>All boat types</b>	<b>115</b>	<b>83</b>	<b>139</b>	<b>16%</b>	<b>8%</b>	<b>15%</b>	<b>1</b>

Compliance over the years

Table 14: Percentage of different boat types complying with code of conduct over the years

Compliance (%)	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>Motor Boat</b>	83	89	82	81	74	80	81	86	78
<b>Speedboat / Water-skier</b>	70	66	83	72	33	73	64	77	59
<b>Fishing Boat</b>	89	100	98	94	100	83	79	98	73
<b>Sailing Boat</b>	99	89	98	91	100	97	93	94	89
<b>Visitor Passenger Boat</b>	99	96	99	96	98	94	96	97	96
<b>Canoe</b>	100	82	67	92	100	75	55	85	63
<b>Jet-ski</b>	75	0	0	100	33	0	100	100	0
<b>All Boats</b>	<b>91</b>	<b>87</b>	<b>88</b>	<b>88</b>	<b>88</b>	<b>87</b>	<b>84</b>	<b>92</b>	<b>85</b>

Figure 15: Percentage of different boat types complying with code of conduct over the years

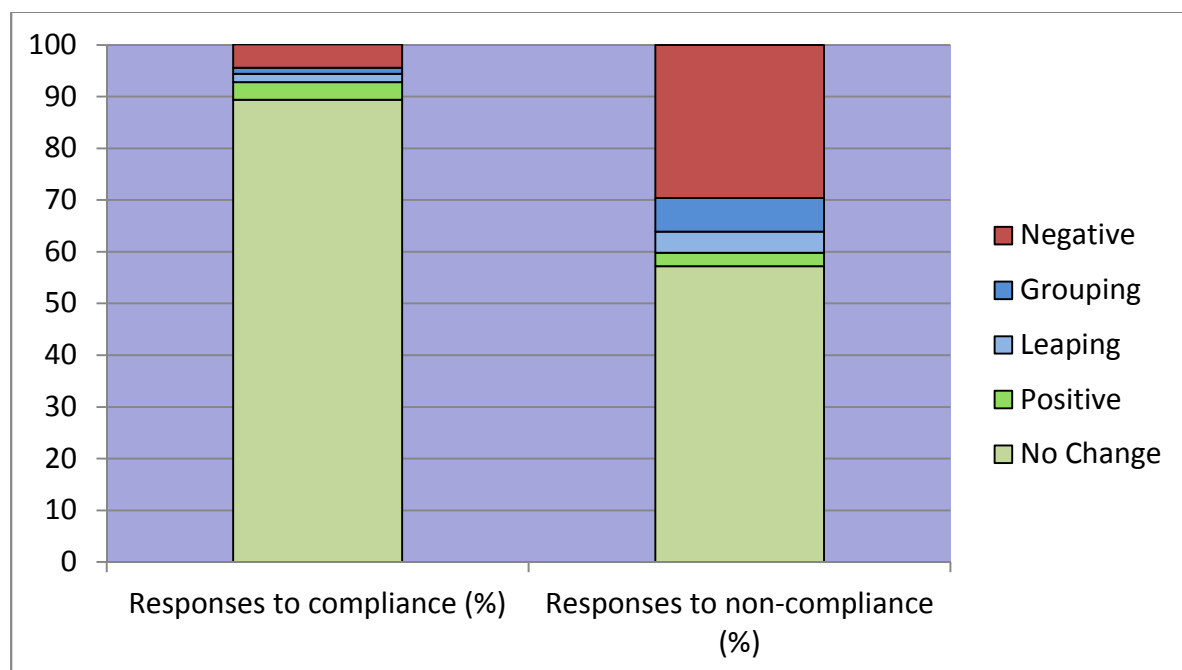


## Effects of boat encounters on bottlenose dolphin behaviour

Whether dolphins responded differently to boats when boat users followed the code of conduct was investigated. Of particular concern was the incidence of 'negative' responses, i.e. dolphins that changed their activity and headed away from the boat. Changes in group structure - dolphins that grouped closely together or split up, were examined separately, as were dolphins recorded leaping. 'Positive' responses were also looked at, where dolphins swam towards, bow-rode or followed a boat. If dolphins did not change their behaviour when a boat was encountered, this could be considered to be the best indication of dolphins being unaffected by them, so this is also shown below.

The following figures are also detailed in the tables.

Figure 15: Dolphin responses to boat encounters, depending on whether the boat complied with the code of conduct.



The next figure uses the same data as above, but with each response adjusted to 100%, to highlight the apparent trend, when boats did not follow the code of conduct. The difference in the proportion of positive responses, or no change in behaviour, was moderate, but in negative responses it was more marked.



Figure 16: Dolphin responses to boat encounters, expressed as a percentage.

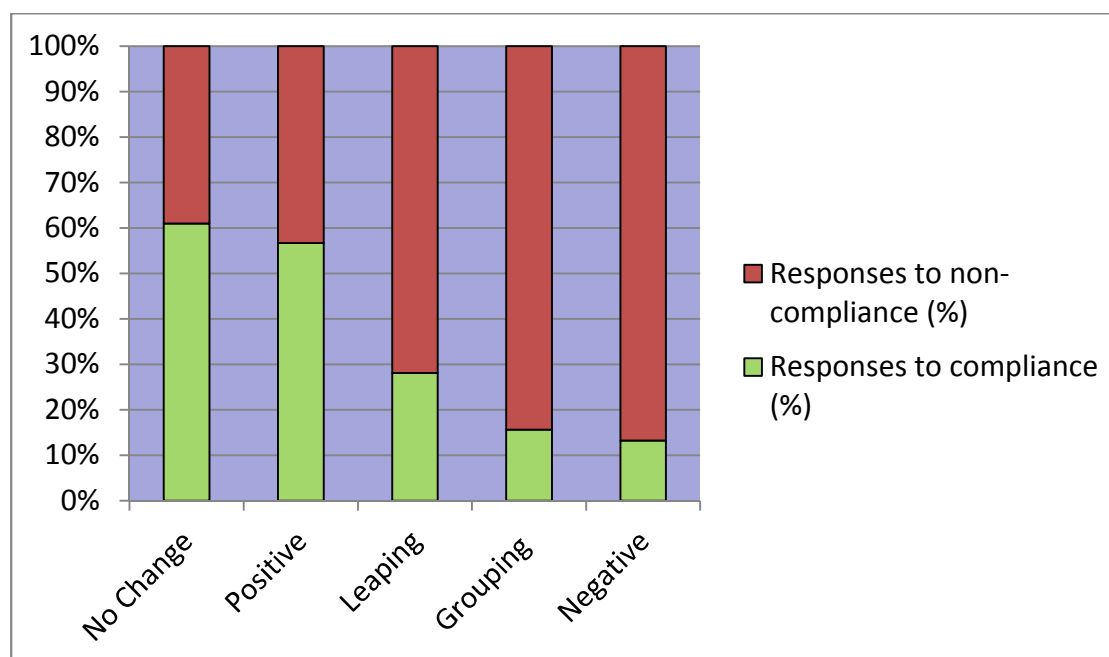


Table 14: Comparison of dolphin responses to boat encounters, with boat users' compliance with the code of conduct (numbers)

	No change in behaviour	Positive response	Leaping response	Grouping response	Negative response	Total no. of boat encounters
Responses to compliance	2074	78	36	28	104	<b>2320</b>
Responses to non-compliance	195	9	14	22	101	<b>341</b>

Table 15: Comparison of dolphin responses to boat encounters and boat users' compliance with the code of conduct (percentage)

	No Change	Positive	Leaping	Grouping	Negative	All boat encounters
Responses to compliance	89.4%	3.4%	1.6%	1.2%	4.5%	100%
Responses to non-compliance	57.2%	2.6%	4.1%	6.5%	29.6%	100%

### Dolphin responses during encounters with boats at different densities

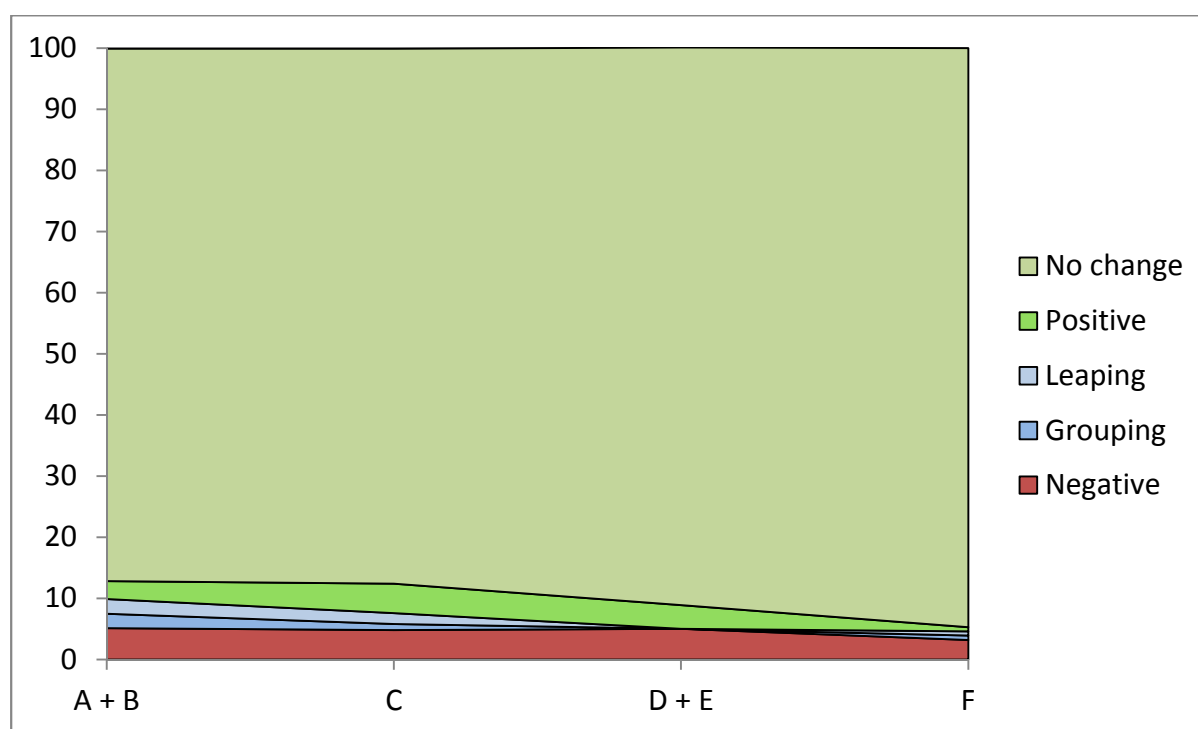
Comparisons were also made of dolphins' responses to boat encounters, with different boat densities (how many boats were nearby and how close they were), as well as whether they were following the code of conduct.

Table 16: Key to different boat densities

	<b>Within 50 metres</b>	<b>Within 300 metres</b>
A + B	At least one boat	More than one boat
C	At least one boat	Only one boat
D + E	None	More than one boat
F	None	Only one boat

Figure 17: Proportion of different dolphin responses, to boats following code of conduct

(Boats are fewer and / or further away on the right hand side of chart)



When they did not follow the code of conduct (see Figure 18 below), some of these boat densities gave less predictable results, with more dolphins grouping or splitting when there was only one boat nearby (category F). However, the results are based on a very small number of responses (see table 19 below), and there might also be some other difference, for example the speed of the boat involved in the encounter, rather than just the presence of a second, perhaps stationary, boat.

Table 17:

Compliance	Negative	Grouping	Leaping	Positive	No change	Total no of boat encounters
A + B	30	14	14	17	508	583
C	51	11	19	51	924	1056
D + E	9	0	0	7	165	181
F	14	3	3	3	412	435

Table 18:

Compliance (%)	Negative	Grouping	Leaping	Positive	No change	Total % of boat encounters
A + B	5.1	2.4	2.4	2.9	87.1	100
C	4.8	1	1.8	4.8	87.5	100
D + E	5	0	0	3.9	91.2	100
F	3.2	0.7	0.7	0.7	94.7	100

Figure 18: Proportion of different dolphin responses, to boats not following code of conduct (Boats are fewer and / or further away on right hand side of chart)

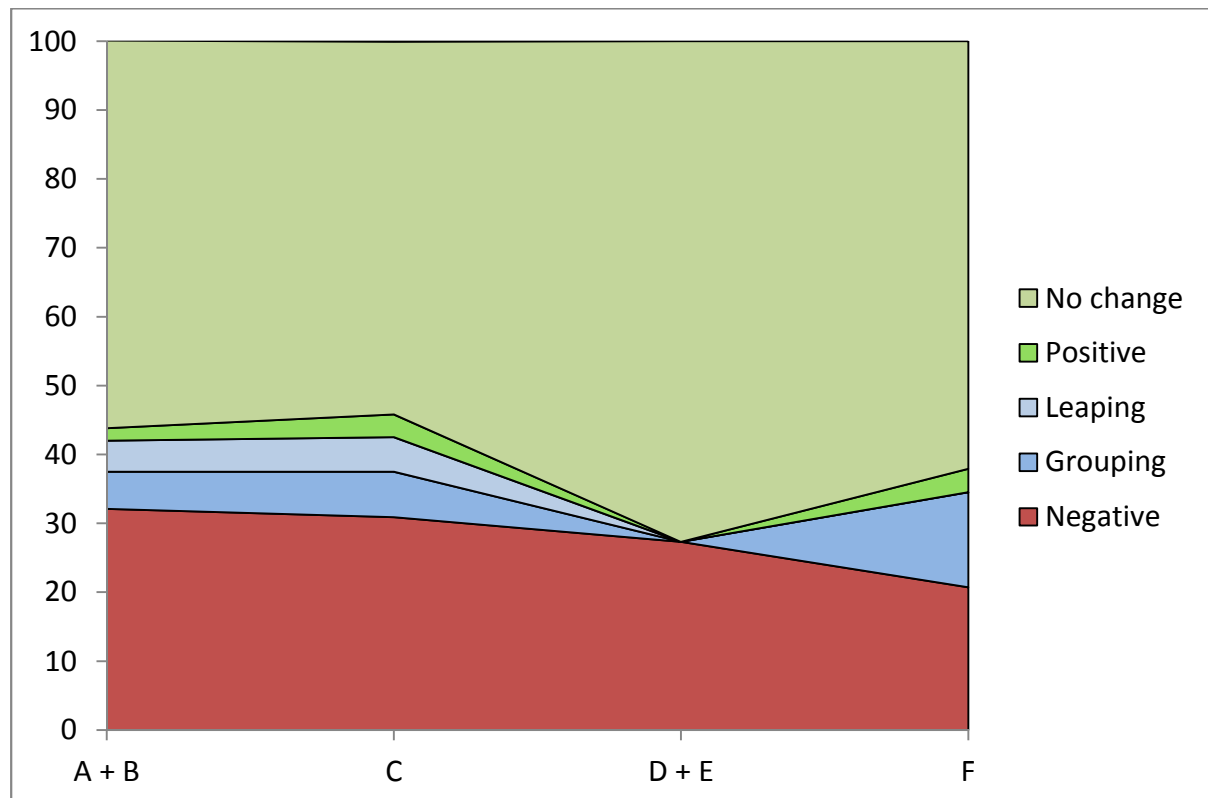


Table 19: Responses of dolphins to boats following the code of conduct

Non-compliance	Negative	Grouping	Leaping	Positive	No change	Total no of boat encounters
A + B	36	6	5	2	63	112
C	56	12	9	6	98	181
D + E	3	0	0	0	8	11
F	6	4	0	1	18	29

Table 19: Responses of dolphins to boats following the code of conduct

Percentage non-compliance	Negative	Grouping	Leaping	Positive	No change	Total % of boat encounters
A + B	32.1	5.4	4.5	1.8	56.3	100
C	30.9	6.6	5	3.3	54.1	100
D + E	27.3	0	0	0	72.7	100
F	20.7	13.8	0	3.4	62.1	100

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