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Bottlenose Dolphin Responses to Boat Traffic Affected by Boat Characteristics and Degree of Compliance to Code of Conduct

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Abstract: Levels of boat traffic in coastal seas have been steadily increasing in many parts of the world, introducing pressures on marine wildlife through disturbance. The appropriate management of human activities is important not only to preserve wildlife, but also for the local communities that depend on ecotourism for employment and their economy. This study presents further insight into bottlenose dolphin (*Tursiops truncatus*) responses to boats in New Quay Bay (West Wales) within the Cardigan Bay Special Area of Conservation. This region is heavily dependent on wildlife tourism, and marine traffic is regulated through a long-standing Code of Conduct. Based on a long-term dataset spanning the months of April to October and the years 2010–2018, the study found that compliance to a code of human behaviour increased dolphin positive responses towards boats. Dolphin responses to individual named boats and to different boat types were examined in greater detail. Speed boats, small motorboats, and kayaks were found to break the code most often, resulting in higher rates of negative response by dolphins. Visitor passenger boats formed the majority of boat traffic in the area, and showed greater compliance than other general recreational crafts. Suggestions are made for the better protection of the coastal dolphin population, as well as the role that citizen science can play to help achieve this goal through working directly with wildlife trip boats and the recruitment of local observers.

Keywords: sustainable ocean; UN Decade of Ocean Science for Sustainable Development; marine traffic management; Marine Protected Area; bottlenose dolphins; Cardigan Bay

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1. Introduction

Over 3 billion people depend on the ocean for food and employment, whilst it also provides well-being, cultural heritage, and support for sustainable livelihoods [1–3]. The decade 2021–2030 was announced as the Decade of the Ocean. It was established to create a system for sustainable development in which there would be globally shared information and knowledge on the restoration and maintenance of ocean health, but also the sustainable use of ocean space and available resources [1,4].

The Anthropocene brought rapid changes in biodiversity [5], a loss of sound-producing animals, and an increase in anthropogenic noise, as well as natural sounds, e.g., sea ice, and storms linked to climate change [6]. Anthropogenic underwater noise can be diverse and may vary greatly in range of impact: small recreational craft vs. supertankers, acoustic deterrent devices vs. seismic surveys [7]. Shipping is recognized as the main global contributor to underwater anthropogenic noise. The levels of contribution from sources of noise depend on ships' dimensions, tonnage, draught, load, and speed [7–9]. Larger boats have bigger engines that produce louder and lower frequency sounds. In contrast, the sound from recreational craft is much lower than from commercial boats and tends to be concentrated in coastal areas. The dominant source of sound from recreational boats is cavitation and turbulence generated by their propellers, although engine noise in areas of high boat density may add to ambient noise levels.

Boats can be a threat to marine animals in several ways: collisions leading to physical trauma or death [10], or causing short-term changes in behaviour, e.g., shifting patterns in daily activities, such as decreased periods of feeding, prolonged dive times, and changes in vocalisations [11–13], whilst long-term impacts include habitat avoidance, changes in social structure, increased predation, and population declines [12,14,15].

One of the best-studied marine animal groups in terms of noise pollution effects is marine mammals, and particularly odontocetes [7]. In the second "world ocean assessment II, Volume I" [16], cetaceans are identified as the group of marine mammals that is most vulnerable through their exposure to people. Ten out of 35 species show decreasing trends because of increased interactions with human activities. This is not only because of increased shipping but also because of increasing tourism, particularly in the coastal zone through the greater availability of personal craft, and tourist activities such as dolphin-watching tours [17–20].

One of the best-studied species is the bottlenose dolphin (*Tursiops truncatus*) due to its wide distribution in temperate and tropical waters around the world, and the coastal habitat of many populations [21]. The noise coming from shipping has been shown to affect the efficiency of communication in dolphins, forcing them to increase the levels of vocalisations and alter their frequency, as well as interfering with echolocation. Furthermore, long-term exposure to noise may also lead to physiological effects. Reduced hunting efficiency may result in poor body condition [22–24] and an increased risk of boat strikes [10]. Another example is the disruption of the complex social life of those animals. Bottlenose dolphins live in fission–fusion societies, meaning that although individuals may have long-term companionships with one another, they may leave groups for periods of time [25–27]. Social structure can be affected by noise if the group is disrupted, resulting in smaller groups where fusion increases with fear [28,29]. This has already been demonstrated to occur in this study population [30]. The consequences of noise on behaviour and health of cetaceans can be assessed through the monitoring of short-term changes in particular activities such as feeding, fast swimming, resting, socialising, etc. [31,32], and may also occur long-term [33]. Observing dolphin behaviour is challenging because of their largely underwater lifestyle, but is very much needed from a conservation management perspective. During boat encounters (boat–dolphin direct interactions, or boats passing dolphins), it is possible to observe their responses through the observation of any changes in behaviour: responses may be neutral with no change in behaviour, positive with dolphins approaching the boat and interacting with it (e.g., bow–riding), or negative with dolphins moving away and avoiding the boat [34].

One of the largest semi-resident coastal populations of bottlenose dolphin in Europe (and the largest in the UK) frequents Cardigan Bay in west Wales [35,36]. For the protection of this vulnerable species, two Special Areas of Conservation were established in the bay during the 1990s under the EU Habitats Directive [37]. The coastal town of New Quay has become established as a major centre for dolphin watching, attracting tens of thousands of visitors each summer, estimated in 2013 to generate £7.2 million annually for the region [38]. Indeed, coastal tourism in Wales has been experiencing steady growth (10% annual rate), worth £602 million in 2013 [39]. New Quay Bay is an especially important site for dolphins that choose it for plentiful food and a safe location to nurse calves during the summer. For this reason, constant disturbance from boats represents a significant pressure for the dolphin population. Since 2012, the population that numbered around 300 animals has been in decline, with evidence of photo-identified individuals permanently leaving the area [36].

There are various ways in which to achieve sustainable development goals (SDGs): one of these is to generate knowledge, creating the necessary infrastructure and partnerships, and a second is to provide ocean science data and develop information policies [40–43]. A good example of sustainable dolphin-watching comes from Brazil, where Guiana dolphins (*Sotalia guianensis*) are facing immense tourist interest and have become endangered. The management of dolphin watching in Brazil now includes codes of conduct that must be applied by boats with checks made using GPS to track their routes, also recording the speed of the dolphin-watching boats. Research has shown that tourists are more likely to return to tourism companies that show a sustainable approach and that promote conserving dolphins, even if that means visiting but not seeing them on the route [17,44]. Other solutions include creating special protection zones where boat traffic is prohibited or is regulated by the code of conduct (for example, limiting distance from the boat to the animal, limiting boat speed, etc.) [45,46]. To choose the best management method, there is a need for the research, planning, and application of rules suitable for the regional maritime space.

This study aimed to identify responses of the bottlenose dolphin to boat types, and to particular boats, within a marine traffic zone, as determined by a long-term monitoring programme (2010–2018) to assess compliance with the local code of conduct in New Quay Bay, within Cardigan Bay, west Wales.

2. Methods

2.1. Study Area

New Quay Bay lies within the Cardigan Bay Special Area of Conservation (SAC) extending from Aberarth, Ceredigion to Ceibwr Bay, Pembrokeshire (Figure 1).

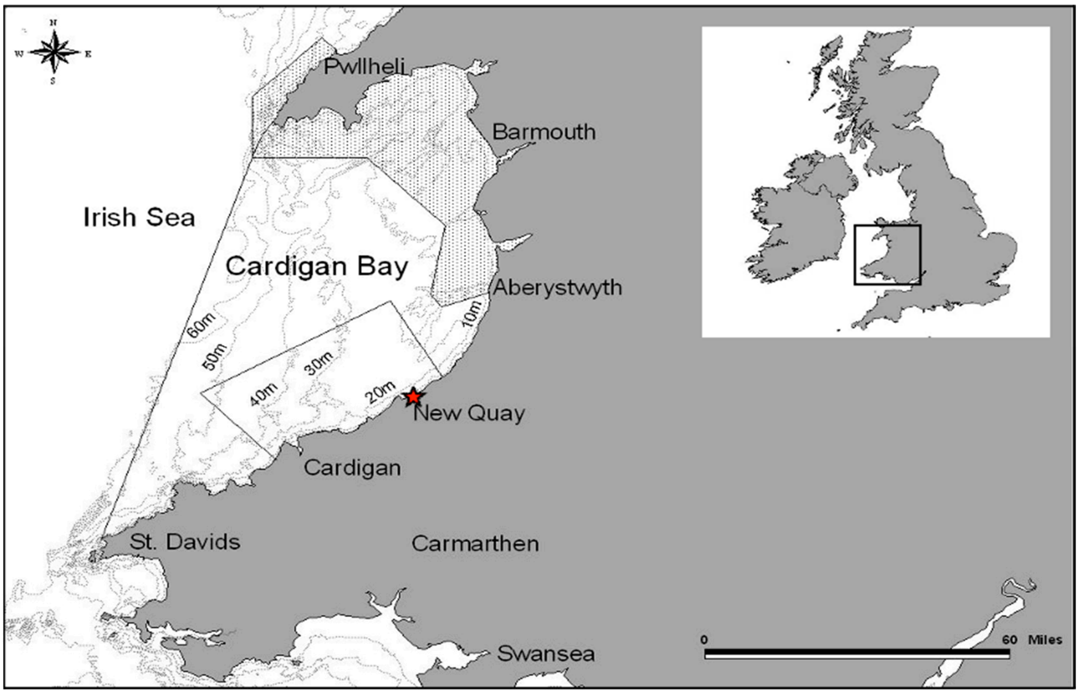

Figure 1. Study area—Cardigan Bay SAC (Special Area of Conservation) is the rectangular area in the south of the bay; the area demarcated in the north is Pen Llyn a'r Sarnau SAC. Observation point was New Quay Pier overlooking New Quay Bay (red star) (Source: Sea Watch Foundation).

New Quay itself is a small coastal town, but highly touristic, especially during summer. It is famous for being probably the easiest town in the United Kingdom for spotting bottlenose dolphins. People observe them directly from the pier, from the neighbouring cliffs, or by taking one of the available wildlife watching coastal tours. The area is steadily getting busier with every year that personal craft and travel become more affordable. In Cardigan Bay, a marine traffic code of conduct was first established for the Ceredigion Heritage Coast in the 1990s to reduce disturbance to bottlenose dolphins and nesting seabirds in the region. This code was later developed for use within the Cardigan Bay SAC [37], and formed the basis for testing compliance in this study (see Table 1).

Besides bottlenose dolphins (*T. truncatus*), Cardigan Bay SAC is also important for harbour porpoise (*Phocoena phocoena*), grey seal (*Halichoreus grypus*), river lamprey (*Lampetra fluviatilis*), and sea lamprey (*Petromyzon marinus*), as well as for the presence of several sensitive habitats, such as sandbanks, reefs, and sea caves [37]. Bottlenose dolphins, harbour porpoises, and grey seals are all top predators, dependent on basal and intermediate levels of the food web, and therefore, protecting these species goes a long way in protecting the entire marine ecosystem of the area.

Table 1. Compliance with marine traffic regulations (Code of Conduct) in Cardigan Bay SAC.

Code	Definition	Compliance with Code
Y1	Passing cetaceans with no-wake speed or no rapid changes in course.	Compliant
Y2	The boat slows down and stops in the presence of dolphins.	Compliant
N1	The boat does not slow down within 300 m of dolphins.	Non-compliant
N2	Following dolphins by rapid changes in course and speed.	Non-compliant
N3	Following, touching, or feeding dolphins.	Non-compliant
R	A boat is a boat with permission under license from CCC (boats under flag when under research)	Compliant

2.2. Data Collection Protocols

Land-watch data used in this study were collected in 2006–2018 during 2 h watches (between 07:00–21:00) from the pier in New Quay (Figure 1), recording environmental conditions (sea state, Beaufort scale), visibility (1: 1–5 km, 2: 6–10 km, 3: >10 km) at 15-min intervals. No land watch was undertaken if visibility was less than 1 km (due to the risk of missing or misidentifying animals) [47]. Sightings included observations of both groups and individuals. If there were several groups in sight, the first group observed was recorded and, if possible, other groups present were described separately. When dolphins were present: behaviour (e.g., suspected feeding, aerial behaviours) and the numbers of dolphins within age groups, as explained in [48,49], were recorded every 5 min to allow changes to be observed and recorded [50]. Dolphin encounters with boats were also monitored, and boat compliance with the code of conduct was recorded (Table 1). Compliance with the code of conduct has been judged based on observations of boat movement and behaviour (speed, direction of movement, distance from the dolphins (A. <50 m, B. 50–100 m, C. 100–200 m, D. 200–300 m) by the boat operator). Recorded boat types included small motorboats (sMB, <15 m), medium motorboats (mMB, 15–30 m), visitor passenger boats (VPB), row boats including kayaks (RB), yachts/sailboats (YA), speed boats (SB), fishing boats (FI), jet skis (JS), research boats (R), and ferries (FE). Dolphin responses were recorded as neutral (no change in behaviour), positive (swim towards boat), and negative (swim away). The closest distance observed between the dolphin(s) and the boat were recorded to establish whether there were any differences in dolphin response.

Named boats (e.g., "VIK-Viking", E5-Ermol 5 and boat types (e.g., visitor passenger boats—VPB)) were identified to determine how dolphins respond to that boat and its activity (Table 1). Recording those may help with estimating the characteristics of boat movements that could have a greater impact on dolphin responses and their habitat use and therefore provide an opportunity for the improvement of the management of the site. Recording types of boats is important for recognising which boats are more likely to move at greater speed or in an unpredictable way that may be perceived as a threat by dolphins [47,51]. Data on named boats were collected because dolphins in previous studies have been observed to react differently to individual boats that they know, since they occur in their habitat on a regular basis, allowing animals to become acquainted with the specifics of movement of each boat, and perhaps the owner's style of driving [49–51].

Observers rotated every two hours to avoid fatigue. Binoculars were used to confirm the identity of boats and to examine dolphin behaviour, unless dolphin–boat interactions occurred within 100 metres and could be described directly from naked-eye observations.

2.3. Data Sources and Data Preparation for Analyses

Systematic observations were undertaken by the Sea Watch Foundation (SWF) from April to October across the years 2006–2018, using the protocols described above. Here, we use only the data from 2010–2018 because, in the earlier years, although compliance with the code of conduct was recorded, responses to individual boats were not differentiated.

For further information on the earlier period, see [47]. Following each dedicated watch, volunteers entered the data into an Excel spreadsheet, with validation checks by Sea Watch staff. Variables used in this analysis included boat type and name, assessment of compliance with code of conduct, and dolphin response (Table 1).

Neutral responses from dolphins were excluded from analysis due to the difficulty to interpret marginal changes. Any incomplete or blank record was fully removed. Boat types and named boats were filtered into two groups: most frequently, recorded boat types (recorded 460–2123 times); and less frequently, recorded boat types (recorded below 460 times, but often, there were boats recorded at the site only once or twice). Therefore, for the needs of this paper, only those most frequent boat types and named boats were retained.

2.4. Analyses

The binomial GLM model was applied to establish whether (1) dolphin responses differed between months and years; (2) boat compliance changed between months or years; (3) boats were complying with the codes of conduct; (4) dolphins responded differently to different boat types; and (5) dolphins responded to different individual boats (named boats). GLM allows for fitting categorical data of most often non-normal distributions. The equation of the GLM is similar to multiple regression:

$$EY = \beta_0 + \Sigma_j \beta_j X_j$$

where EY—expected value of response variable, $\beta_0 + \Sigma_j \beta_j X_j$ (β_j, β_0—coefficients and/or weights assigned to predictor variables X_j) in GLM = extension of the possible relationship between η and represents linear predictor.

The expected values of response and the linear predictor can be presented as g(EY) = η, where g-link function transforms the scale of expected values of response to the scale of linear predictor η, which is a linear combination of explanatory variables, and so it can have any value on real scale (from [52]).

The binomial GLM model used in the R package was stats 3.6.2 and a function "glm()" with family binomial [53,54]. The data were checked for normality plots of residuals [55,56]. However, for this study, data transformation was considered unsuitable, as GLM binomial models deal better with non-normally distributed count/categorical data than with transformed data [57–60], since it might change the result or affect the degree of fit of the model [60–62]. Binomial GLM analyses were conducted after estblishing that the autocorrelation test (ACF) [63,64] showed small values, confirming that this type of test is suitable for these data [54].

Dolphin response: positive (1) or negative (0) was modelled as the response variable. Dolphin response was considered depending on compliance with the code of conduct (Table 1), named boat and boat type. Chi-squared tests were used to test for the significance ($p < 0.05$) of these relationships. Each GLM model was summarised, presenting coefficients that describe the size and direction of the relationship between predictor (year, boat type, named boat, dolphin response (negative, positive)) and response variable (dolphin response, boat behaviour (compliance, non-compliance)). Coefficients for categorical variables are visible for all of the tested levels, except the one described "As reference" with "0" and "1" coding. Each coefficient estimates the variability between the estimates obtained by continuously taking samples from the same population. For this reason, for a further understanding of the results, this article presents the above-described coefficients and SE (standard errors).

3. Results

A total of 8768 effort hours of land-watches were analysed from April to October in the years 2010–2018. There were no significant differences in dolphin responses to boats depending on month: $\chi^2(6, 1211) = 11.76$, $p = 0.13$ or year: $\chi^2(8, 1209) = 28.88$, $p = 0.10$ of observation. Boat compliance with the Code of Conduct did not differ significantly between months. However, there was a significant difference between years ($\chi^2(8, 1183) = 28.87$, $p = 3.3 \times 10^{-4}$), with a general increase in compliance (Table 2, Figure 2). Boats complied with the code most of the time (68–90% of the encounters) from 2010–2018.

Table 2. Standardised coefficients (Coeff) ± Standard error (SE) of the general linear model (GLM) for the relationship between the probability of compliance y = 1 and non-compliance with the code of conduct from 2010 to 2018 in April–October, in New Quay are shown to enable a comparison between boat behaviour (compliance, non-compliance). The intercept indicates the character of the relationship between boat behaviour and year.

Variable	Coeff ± SE
2010	As reference
2011	0.07 ± 0.33
2012	0.71 ± 2.04
2013	0.73 ± 0.31
2014	0.33 ± 0.29
2015	0.82 ± 0.32
2016	0.13 ± 0.33
2017	0.82 ± 0.34
2018	1.30 ± 0.35

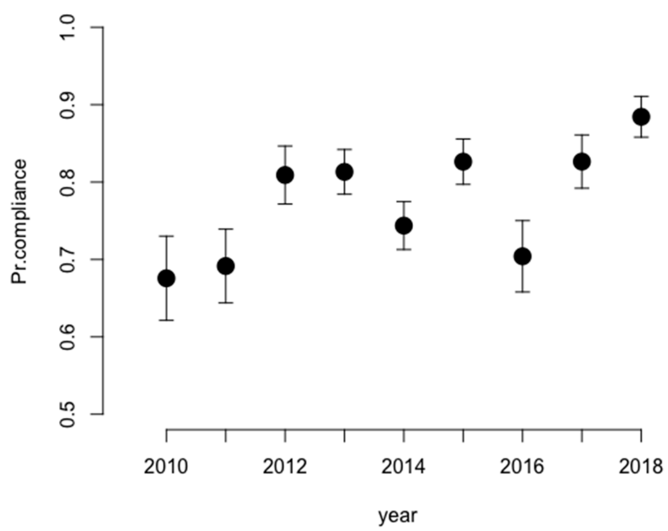

Figure 2. Compliance (y = 1) and non-compliance (y = 0) with codes compared in the years 2010–2018.

3.1. Dolphin Responses to Different Boat Types

Boat types were compared to assess whether dolphin responses differed between them. The types of boats that were recorded most frequently from April to October in the years 2010–2018 were VPB (N = 3461), sMB (N = 838), and SB (N = 802). Other boat types recorded frequently included YA (N = 598), RB (N = 532), and FI (N = 499). As noted earlier, only negative and positive dolphin responses are analysed here; 5061 neutral responses, 770 negative and 448 positive responses were recorded.

During encounters with dolphins, negative responses were recorded in 19% of all encounters with SB (N = 752), 17% with sMB (N = 754), 15% with RB (N = 495), 12% with FI (N = 464), 10% of all VPB encounters (N = 3155), and 8% of all encounters with YA (N = 558).

The number of positive responses was greatest for YA with 13% of all encounters (N = 558), 7% for VPB (N = 3155), 10% for FI (N = 464), 7% for sMB (N = 754), 6% for RB (N = 495), and 3% for SB (N = 752).

The GLM model revealed that there was a significant difference between boat types and dolphin response: $\chi^2(5, 1186) = 101.86$, $p = 2.2 \times 10^{-6}$. The greatest difference was between YA and SB. Almost all of the responses recorded for YA were positive, whilst for SB, the majority of responses were negative (Figure 3, Table 3).

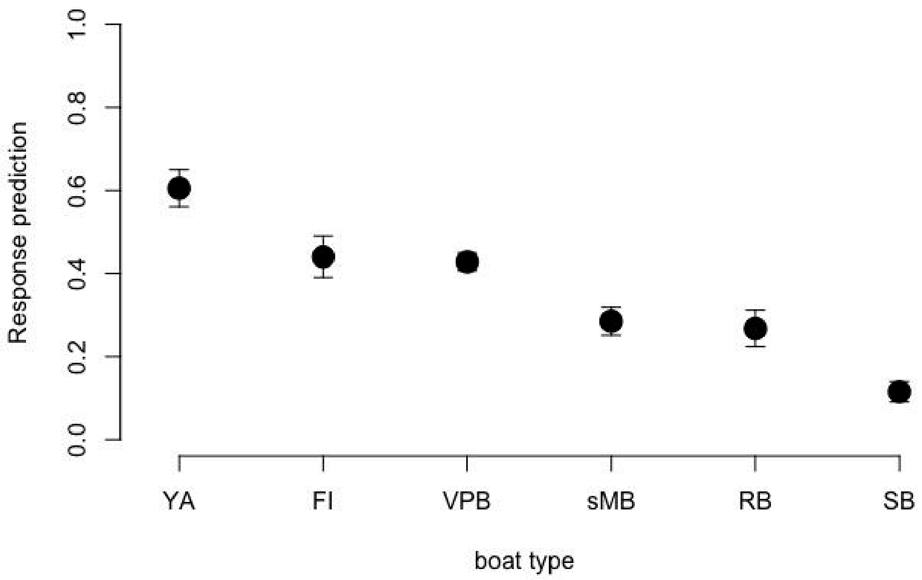

Figure 3. The probability of a dolphin showing a positive (y = 1) and negative response (y = 0) to the most frequent boat types (YA: yacht/sailing boat, FI: fishing boat, VPB: visitor passenger boat, sMB: small motor boat, RB: row boat, SB: speed boat) in encounters recorded in New Quay between April-October 2010–2018, together with standard errors.

Table 3. Standardised coefficients (±SE) for the general linear model (GLM) of the relationship between the probability of a dolphin positive response to the most frequently (460–2123 times) recorded in encounters by boat type (YA—yacht, FI—fishing boat, VPB—visitor passenger boat, sMB—small motor boat, RB—row boat, SB—speed boat) are shown to enable a comparison between dolphin responses (negative, positive) to different boat types.

Variable	Coeff ± SE
YA	As reference
FI	0.01 ± 0.67
VPB	0.0005 ± 0.72
sMB	$7.32 \times 10^{-8} \pm 1.35$
RB	$9.56 \times 10^{-7} \pm 1.43$
SB	$1.10 \times 10^{-15} \pm 2.47$

3.2. Dolphin Responses to Operations by Named Boats

The most frequently recorded named boats (see: Section 2.2) were all of type VPB: Viking (VIK), Ermol 5 (E5), Ermol 6 (E6), Islander (ISL), Sulaire (SUL), Dunbar (DUN), Anna Lloyd (ANN), and ORCA. The total number of encounters for the above-listed named boats was calculated to be 3070, of which 475 encounters were recorded as either negative or positive dolphin response (VIK, N = 17; E5, N = 91, E6, N = 169; ISL, N = 97; SUL, N = 46; ORCA, N = 12). Of those 475 encounters, about 58% resulted in a negative, and 42% a positive response. The GLM tests showed a non-significant difference between different named boats and dolphin responses ($\chi^2(7, 467) = 12.57$, $p = 0.08$), with dolphins responding similarly to most of the boats. ISL, SUL, DUN, and ANN were recorded with positive dolphin responses in about 40% of encounters (Figure 4, Table 4).

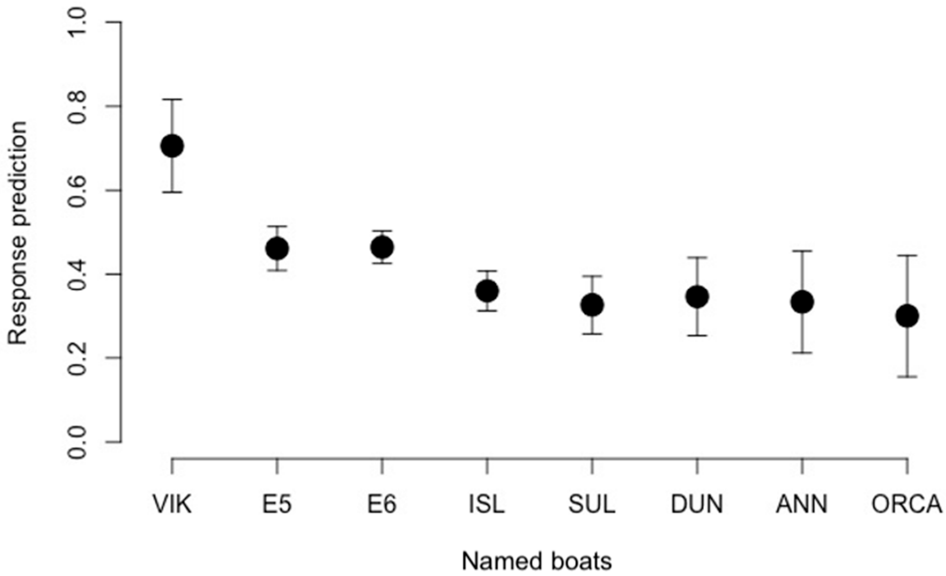

Figure 4. Prediction of dolphin positive y = 1 and negative y = 0 responses to the most frequent named boats in New Quay from 2010 to 2018 in April–October, together with standard errors.

Table 4. Standardised coefficients (±SE) for the general linear model (GLM) of dolphin positive y = 1 and negative y = 0 responses to the most frequent named boats recorded from New Quay harbour (2010–2018).

Variable	Coeff ± SE
VIK	As reference
E5	1.02 ± 0.57
E6	1.016 ± 0.55
ISL	1.451 ± 0.57
SUL	1.60 ± 0.61
DUN	1.51 ± 0.67
ANN	1.57 ± 0.76
ORCA	1.72 ± 0.87

3.3. Compliance with Code of Conduct by Boat Type, 2010–2018

Compliance with the Code of Conduct varied significantly between different boat types ($\chi^2(6, 6787) = 3937.2$, $p = 2.2 \times 10^{-16}$). Boats did comply with codes of conduct most of the time during encounters with dolphins. However, there were some differences in compliance between different boat types. The greatest differences were the lower compliance for the following boat type codes: SB, RB, sMB, and mMB, ranging between 71–82%. Boats

FI, YA, and VPB were more compliant with the codes, ranging from 87 to 97% of encounters (see Table 5, Figure 5).

Table 5. Standardised coefficients (±SE) for general linear models (GLM) of the relationship between the probability of compliance y = 1 and non-compliance with the code of conduct from April to October in the years 2010–2018, in New Quay by boat type (speed boat (SB), row boat (RB), small motor boat (sMB), medium motor boat (mMB), FI (Fishing boat), YA (yacht, sailing boat), visitor passenger boat (VPB).

Variable	Coeff ± SE
SB	As reference
RB	0.32 ± 0.13
sMB	0.59 ± 0.12
mMB	0.71 ± 0.35
FI	0.94 ± 0.16
YA	1.09 ± 0.15
VPB	2.68 ± 0.13

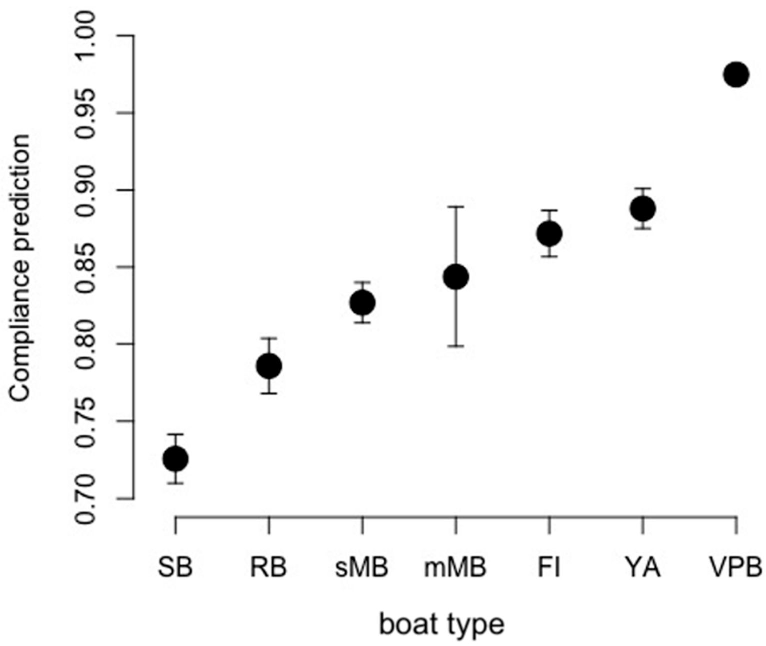

Figure 5. Compliance (y = 1) and non-compliance with codes (y = 0) by boat type (SB: speed boat, RB: row boat, sMB: small motor boat (6–15 m), mMB: medium motor boat (15–30 m), FI: fishing boat, YA: yacht, VPB: visitor passenger boat) from April to October in the years 2010–2018. Some years do not contain all months of data.

3.4. Dolphin Response to Boat Compliance with the Code of Conduct

There were 770 negative responses and 448 positive responses recorded during encounters in April–October, 2010–2018. The boats that were complying with the Code of Conduct resulted in significantly more dolphin positive responses ($\chi^2(1, 1216) = 1159.2$, $p = 2.6 \times 10^{-16}$) (Figure 6, Table 6).

Table 6. Standardised coefficients (±SE) for general linear models (GLM) of the relationship between dolphin response (negative, positive) and the probability of compliance y = 1 and non-compliance with the Code of Conduct across the years 2010–2018 and months April–October in New Quay.

Variable	Coeff ± SE
Negative	As reference
Positive	1.78 ± 0.20

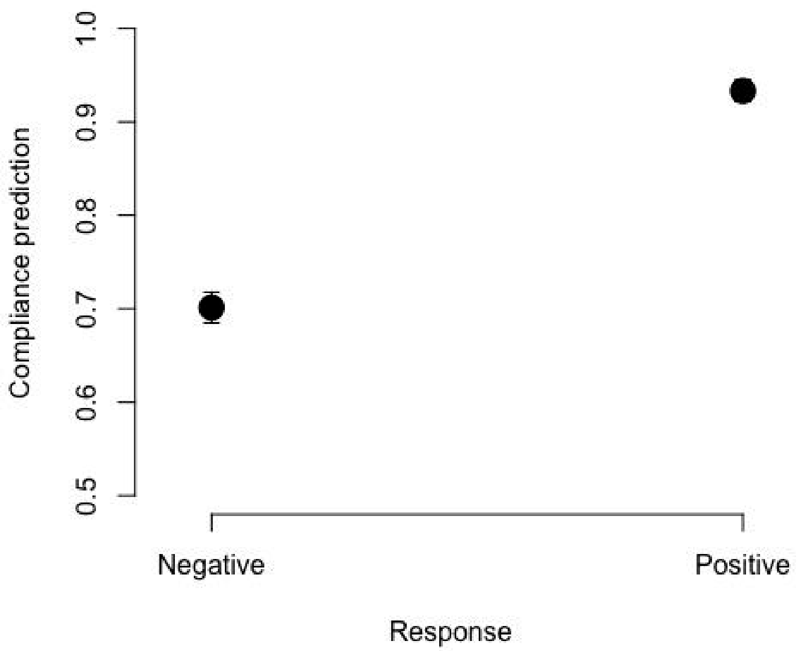

Figure 6. Compliance (y = 1) and non-compliance with codes (y = 0) and dolphin positive and negative response from 2010 to 2018 in April–October. Some years do not contain all months of data.

4. Discussion

A significant difference was observed in dolphin responses to various boat types. This study highlights the fact that VPBs (visitor passenger boats) are a major part of New Quay's boat traffic (accounting for 52% of all 6730 boat recordings considered in this study). These are therefore important to take into account for site management.

Even though VPB boats formed the majority of boat movements, it was other boat types that showed the most negative responses, particularly SB (speed boats: 19%), sMB (small motorboats: 17%), and RB (row boats: 15%) (Figure 2). There are several likely reasons for these results. Visitor passenger boats are probably most familiar to at least those dolphins that are resident to the area. Between April and October, VPB travel the area on an almost daily basis, weather permitting. They are also shown to be the most observant to the Codes of Conduct. By contrast, speed boats and some other motorboats are generally used on a more ephemeral basis; they usually travel at greater speeds and often along unpredictable boat tracks, and they were shown to be least compliant to Codes of Conduct. Interestingly, row boats (mainly kayaks) elicited one of the highest percentages of negative dolphin response. This might be caused by the fact that often, they approach too close to animals and are silent as they do not have an engine. Because of this, they may not be detected by dolphins until they are in close proximity. On a number of occasions, strong flight responses have been observed. Other studies in Cardigan Bay have shown general results indicating that dolphins respond differently in areas where Codes of Conduct are applied compared with those where they are largely absent [65] whilst individually recognizable dolphins that are resident to New Quay Bay are more likely to tolerate disturbance compared with more transient dolphins [51]. Differences in Cardigan Bay dolphin responses may result in an overall decline in the population through the emigration of some of the individuals. The more residential dolphins in New Quay Bay seem to have adapted to the VPB boats and tolerate them, showing relatively little negative response, and those boats have also adapted their behaviour to reduce any negative impacts. This is reflected in the lack of a long-term trend in overall dolphin response to boats in New Quay Bay over time.

Speedboats and small motorboats broke the Code of Conduct more often than other boat types (in 18–29% of encounters, the Code of Conduct was broken). Evidence of the longer-term consequences of the recreational disturbance of bottlenose dolphins in Cardigan Bay has been obtained from earlier observations [36,66,67], and has been reported from other locations around the world (see, for example [49–51]).

Another important aspect revealed in this study was that Cardigan Bay's Code of Conduct does not protect individual dolphins if there are many encounters over a short period caused by several boats in the vicinity. As a consequence, the same dolphin might experience close encounters with successive boats (Table 1). This could be solved by regulating the number of boats that can approach dolphins at any one time and imposing a time limit for how long any boat can be in close proximity of a dolphin individual or group. In other parts of the world, some codes include restrictions on the number of commercial boats operating in the area and/or the number of boats at any one time that can approach dolphins [32], but there seem to be no instances where the duration of exposure to the disturbance of individual dolphins is kept within specific limits [68–70]. This is likely to be because of the difficulty in routinely recognizing individual animals and applying a code of conduct that addresses this.

4.1. The Benefit of Research for the Community and the Good of Cardigan Bay, the Bottlenose Dolphins and Ocean Literacy: How It Works Now, and What Can Be Improved

It is encouraging that the majority of boat types for most dolphin encounters were found to comply with the code (Figure 4). This may not be a surprise since, generally, people around the world do respect laws and even voluntary codes if they see the rationale behind them and the benefits [71]. It has been shown that, with respect to VPB boats, it is more likely that tourists will come back and recommend others if one is applying sustainable and animal-friendly human behaviours [72,73]. Ecotourism, such as dolphin watching, is believed by many to promote conservation, and thus the preservation of nature. However, it is often up to local businesses and the government to ensure that the educational/sustainable character of these activities is maintained [74–78]. The high level of boat compliance with the code of conduct might not be the case for locations other than New Quay Bay (the study area). Compliance with a code of conduct is easier to ensure when in front of the town of New Quay, but further down the coast, further away from regular view, compliance may not be so high.

In New Quay, the local community respects nature and the dolphins, and they are keen to collaborate with environmental and scientific NGOs such as the Sea Watch Foundation, to educate tourists on board trip boats concerning wildlife and conservation. Although it seems that the Code of Conduct is being applied by the majority of boats at least within New Quay Bay, it is important to obtain a full picture of both awareness and observance of the Code of Conduct through social interviews, as well as to map the areas where the code is applied appropriately. A study by Vergara-Pena [65] in Cardigan Bay revealed differences in knowledge by recreational boat users about the Code of Conduct ("55%, N = 96, were unaware of it"). The knowledge also differed by region within Cardigan Bay (Pen Llŷn a'r Sarnau SAC and Cardigan Bay SAC; see Figure 1). There was greater awareness about the existence of the Code of Conduct within Cardigan Bay SAC. This study also interviewed boat operators (wildlife watching boats, VPB), the majority of whom expressed that the current Code of Conduct was sufficient enough to meet conservation goals and wildlife watching tour needs. Clients visited New Quay mainly to experience dolphin-watching tours, which highlight the importance of dolphin presence for the community.

A similar approach was undertaken in Malaysia by Thompson et al. [7] within Kilim Karst Geoforest Park (mangroves). They conducted 14 semi-structured interviews, analysing companies' websites and collecting observations of tourist–host relationships during jet-ski, kayak, and boat tour operations. One of the conclusions made by the authors was that "eco" in ecotourism is perceived by companies as an economically advantageous label to apply in a competitive manner rather than as a sustainable modifier to traditional forms of tourism, and that whereas it may achieve some of the sustainable goals such as education about nature, it also might divide society competing to earn more money. There has been relatively little research on this aspect in Cardigan Bay, as the earlier mentioned study on boat operators [65] did not take into account questions about the dependence of income of wildlife watching tours on the eco trend in ecotourism—e.g., tours with wildlife education and those without, operator judgement on competition between operators (present, absent), and the perspective of clients on the need for wildlife education, and satisfaction with the current information given (amount, quality). It would be interesting to examine those further and see if the eco term is perceived by New Quay operators as economically advantageous, and if this matches client responses. Protecting the environment and the dolphins for New Quay society is important because tourism, particularly dolphin watching and wildlife boat tours, is the main attraction for visitors to the area, and for the community's well-being (health, wealth, and aesthetic values). An important role in this process is made by ocean literacy (interactions between the ocean and people) and education that should improve society's knowledge and understanding of environmental issues, for example by involving them in citizen science projects [52,76]. Sea Watch Foundation's land-watch project aims to involve locals but also visiting students/volunteers of all races, genders, nationalities, and cultures (accomplishing SDGs 4 and 5) to collect data for the further aim of protecting the common good of dolphins. The presence of dolphins brings tourists to the community, and therefore improves their well-being (SDG 8). The project is also good for the sustainable environment (well-managed tourism e.g., code of conduct application) for the health and well-being of dolphins, and thus for the good of Cardigan Bay (SDG 14) and its community.

4.2. Conclusions

The monitoring of boat traffic alongside studies of dolphin interactions or encounters can be a successful tool in assessing how disturbance may be affecting those animals in the long term. Here, we show that compliance with a local code of conduct increased within New Quay Bay over the years 2010–2018, with the probability of compliance being greater than non-compliance. When boats complied with the code, dolphins were more likely to respond to them in a positive way. A short-term change in behaviour such as avoidance may lead to longer-term displacement from their preferred habitat, becoming a wider problem with increasing tourism and numbers of personal watercraft observed in coastal areas globally. Boats used for personal recreation (speed boats, kayaks, etc.) were less compliant and caused more negative responses, and tended to be owned by non-residents, providing a greater challenge for reaching out and making them aware of disturbance issues. In order to achieve greater sustainability through the regulation of boat traffic, it is necessary to find and apply solutions acceptable to all stakeholders. In the case of this popular Marine Protected Area, the local community through greater touristic activity and improved awareness of environmental issues, whilst the wildlife of the bay enjoys a healthier and better managed environment. This study demonstrates that sustainable development can be achieved in New Quay Bay (and potentially beyond) within a Marine Protected Area, with the help of education, regulation and cooperation with citizens, alongside scientific enquiry.

4.3. Recommendations

Future studies should focus more on studying and comparing various management solutions for regulating different forms of marine traffic, e.g., adapting codes of conduct to different target groups, applying new quieting technologies for boats (so long as they are not so quiet that they pose a threat of physical strike, through stealth), and perhaps more extensive interviews with different sectors of society to identify potential conflicts before they occur. In many cases, conflicts result from a lack of awareness of potential pressures but also a lack of recognition of the potential benefits of sustainable management. The emphasis therefore should often be on improved education and outreach. In our study, visitor passenger boats already understood the potential pressures of their actions and were invested in mitigating negative effects. In the case of personal crafts, an effort should be made to reach the owners with education programmes available on-site and/or by placing information boards as a reminder about the Code of Conduct.

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