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Does Grey Nurse Shark (*Carcharias taurus*) Diving Tourism Promote Biocentric Values Within Participants?

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Abstract: In Australia, humans can dive with critically endangered grey nurse sharks (*Carcharias taurus*) at Fish Rock, New South Wales. This industry has the potential to improve the environmental knowledge of participants and encourage pro-environmental attitudes within tourists. This study surveyed tourists pre and post participation in grey nurse shark dives to ascertain if the experience positively influenced the grey nurse shark knowledge and biocentric attitudes of tourists (short-term). Educational talks were provided to tourists of alternating boat trips to assess if education had a significant impact upon the knowledge and biocentrism of these tourists compared with those that were not provided with a talk. Survey data were collected across eight grey nurse shark dive boat trips from December 2008 to January 2009. Results indicated that those individuals likely to participate in a grey nurse shark dive were generally already knowledgeable and biocentric, hence the scope for further improvement was quite narrow. Significant improvements to the grey nurse shark knowledge and biocentric attitudes of tourists post dive were detected, however the majority of these improvements occurred within tourists already considered to be highly biocentric and knowledgeable pre dive experience. The provision of educational talks significantly improved the knowledge of participants but not their biocentrism. These findings are of importance as they highlight that the contribution the industry may provide to conservation by improving the biocentric attitudes and environmental knowledge of tourists may be minimal. Furthermore, it is important that accurate educational resources are developed and provided to tourists pre and post dive to avoid the development of misconceptions by tourists during grey nurse shark dives.

Keywords: Grey nurse shark, *Carcharias taurus*, biocentric, biocentrism, pro-environmental, shark dive, nature-based tourism.

INTRODUCTION

In Australia, humans can SCUBA dive with critically endangered grey nurse sharks (*Carcharias taurus* Rafinesque, 1810) at Fish Rock, New South Wales (Environment Australia 2002). Historically, the grey nurse shark in Australia was inaccurately portrayed as a 'man-eater', largely due to its formidable appearance (Environment Australia 2002, Boissonneault et al. 2005, Kessler 2005). Subsequently, grey nurse sharks were targeted by spear and line fishers in attempts to remove the species from the east coast of Australia, hence its current conservation status (Environment Australia 2002, Stow et al. 2006). The grey nurse shark dive industry has the potential to quash such perceptions, to exert positive influences on the pro-environmental attitudes of tourists and to improve their knowledge of the species and the marine environment (Zeppel & Muloin 2008). This in turn may encourage tourists to adopt more pro-environmental behaviours (Mayes et al. 2004), such as abiding by regulatory management practices.

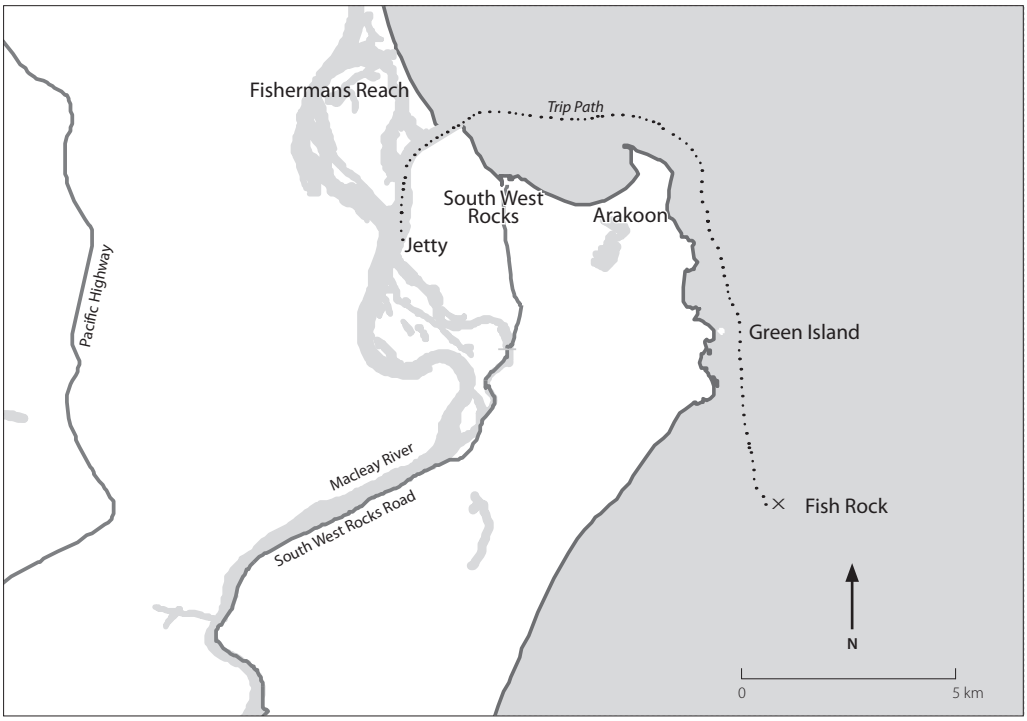
Scientific research is necessary to assess the validity of the claim that nature-based tourism has the potential to positively impact upon tourists' pro-environmental attitudes and environmental knowledge (Higham et al. 2009). Research methodologies of earlier studies incorporated the use of surveys to ascertain the environmental attitudes and knowledge of tourism participants (Wilson & Tisdell 2003, Finkler & Higham 2004, Mayes et al. 2004, Hughes & Saunders 2005, Christensen et al.

2007, Powell & Ham 2008, Mayes & Richins 2009). Some of these studies (Wilson & Tisdell 2003, Finkler & Higham 2004, Mayes et al. 2004, Christensen et al. 2007, Mayes & Richins 2009) surveyed participants immediately post tourism experience. The current study surveyed grey nurse shark dive tourists pre and post dive to ascertain the influence of this industry on improving pro-environmental views and values, i.e. biocentrism (Des Jardins 2001), and knowledge within participants. The potential of education to further increase biocentrism and knowledge within tourists was also investigated. It appears that this is the first study to document and compare biocentric attitudes and shark knowledge within shark dive tourists pre and post dive.

METHODS

A total of 27 SCUBA diver-grey nurse shark interactions across 15 boat trips were observed and documented at Fish Rock in New South Wales, Australia, from December 2008 to January 2009. Grey nurse shark dive tour boats depart from South West Rocks and travel to Fish Rock as shown in Map 1. The researcher travelled to and from Fish Rock onboard a 7.5 metre catamaran belonging to a local tourism operation.

To assess if this form of nature-based tourism improved the environmental knowledge of participants and encouraged them to adopt more biocentric values and attitudes in the short-term, participants were asked to complete a written survey (of approximately five minutes) prior to a grey nurse shark dive and then again post dive: a method found to be effective in earlier nature-based tourism research (Hughes & Saunders 2005, Powell & Ham 2008). Pre and post dive surveys were completed by tourists onboard the dive vessel. Survey participation was voluntary and a total of 47 paired surveys (consisting of both pre and post dive surveys) were completed by grey nurse shark dive tourists across eight of fourteen boat trips. The first two dives (spanning one boat trip) were carried out as practice dives and hence no data were recorded. Due to the participation in multiple dives by some divers and the potential for data collection to disrupt the schedules of tourism operations, survey data were collected during eight of the fourteen boat trips.



Map 1: Return trip from South West Rocks jetty to Fish Rock.

The survey design was adapted from Christensen et al.'s (2007) study on the effectiveness of a whale watching education program in Oregon, Canada, as it documented short-term biocentric values and knowledge of tourists and was considered an appropriate model. Participants' answers to pre dive surveys were compared with post dive surveys to determine if grey nurse shark dives had a significant impact upon participants' knowledge and perceptions of the marine environment and sharks (both generally and in relation to grey nurse sharks in particular). In addition to this, educational talks (of approximately five to ten minutes in length) were provided by the researcher to tourists of alternating trips. Educational talks were conducted on alternate boat trips in order to assess the effect these talks had on improving biocentrism and knowledge within participants. Educational talks provided information regarding grey nurse shark biology, distribution, population status, conservation status and management strategies, and were delivered utilising visual aids (laminated A4 sheets). Comparisons were then made between the post dive survey responses of those whom were provided with an educational talk and those whom were not.

To assess the biocentrism of tourists the following statements were included in the survey as adapted from Christensen et al. (2007):

- The marine environment requires our protection.
- It is important to protect the marine environment.
- It is important to protect sharks.
- It is important to spend money to protect sharks.
- Sharks are important for Australia.
- Sharks need a healthy marine environment to survive.
- My daily actions affect sharks.
- My daily actions affect the marine environment.

Participants were required to assign a score for each of the eight statements based on a scale of 1 to 5 where 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree (Musa 2002, Lück 2003, Finkler & Higham 2004, Christensen et al. 2007, Morris et al. 2007, Powell & Ham 2008). Therefore, the maximum overall score a tourist could achieve for the biocentric section of the survey was 40. For analyses purposes, mean response scores of 1–2.9 were considered non-biocentric, 3–3.9 represented neutral values and attitudes, and mean scores of 4–5 were deemed biocentric.

Specific questions relating to grey nurse sharks were also included and participants were asked to answer either 'yes' or 'no'. Participants were presented with the following seven knowledge questions and statements:

- Grey nurse sharks are a protected species.
- Grey nurse sharks are an endangered species.
- Is the population size of grey nurse sharks at an acceptable level in eastern Australia for their long-term survival?
- Are grey nurse sharks a threat to humans?
- Can a tourist pursue grey nurse sharks?
- Can a tourist diver touch a grey nurse shark?
- Are sharks an important part of the marine environment?

Correct answers were assigned a score of 1 and incorrect answers a score of 0, therefore, an overall result of 7 equated to a maximum score of 100% for the knowledge section of the survey. Tourists whose mean responses ranged from 0–0.4 were deemed to possess poor knowledge of grey nurse sharks and responses of 0.5–1.0 represented good grey nurse shark knowledge.

Statistical Analysis

For both aspects of this study the mean biocentric and knowledge responses of each diver were used as indicators of biocentrism and knowledge levels of tourists.

Both biocentric and knowledge pre and post grey nurse shark dive survey responses were compared using Wilcoxon paired-sample tests (Zar 1974).

The post grey nurse shark dive biocentric and knowledge survey responses of tourists provided with an educational talk and those whom were not were compared using Mann-Whitney tests (Zar 1974).

RESULTS

A total of 27 dives (N = 118 divers) spanned across 15 boat trips and total time spent in the field was 66.8 hours. The mean number of divers that participated in a grey nurse shark dive expedition (including the researcher and dive

operation employees) was 8.4 (standard deviation = 2.8 divers, range 3–12 divers, n = 14 boat trips). Of those divers presented with the option to participate in the survey study (N = 55) a total of 47 took part. (76.4%). Of these 47 surveys, the pre and post dive knowledge responses of three survey pairs could not be compared as some questions were not completed. When comparing the responses of tourists whom were provided with an educational talk with those whom were not the post dive knowledge survey responses of two participants could not be utilised for the same reason. The proportion of surveyed tourists exposed to an educational talk (tourists of four boat trips) was 57.4% (N = 27 divers). The proportion of those not provided with an educational talk (tourists of four boat trips) equaled 42.6% (N = 20 divers).

Comparison of Survey Responses Before & After Grey Nurse Shark Dive

Biocentric Statements

A Wilcoxon paired-sample test revealed that there was a significant difference (α=0.05, $0.01<P(\leq 338)<0.02$) between the pre and post dive responses for the biocentric survey statements, as shown in Figure 1.

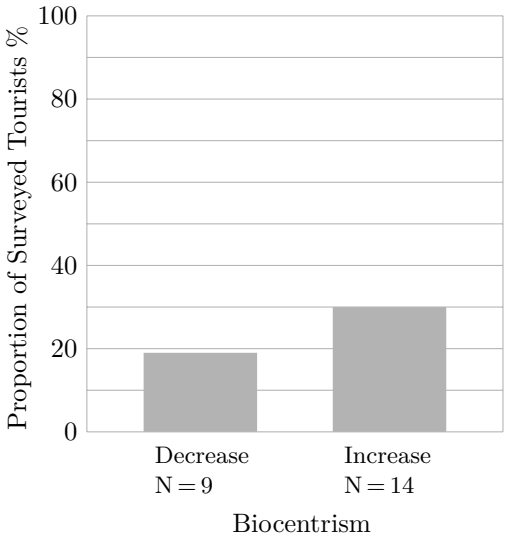


Figure 1. Change in biocentrism in tourists (%) post grey nurse shark dives (n = 47).

Results showed that 29.8% of tourists became more biocentric in their responses after the dive, 19.2% of tourists decreased their level of biocentrism, and 51.1% of tourists' answers did not change post dive. Expanding upon this, results in Figure 2 indicated that 83.3% of the tourists whose responses did not alter were already considered either completely biocentric (29.2%) or highly biocentric (54.2%); therefore the margin for improvement was either non-existent or very low.

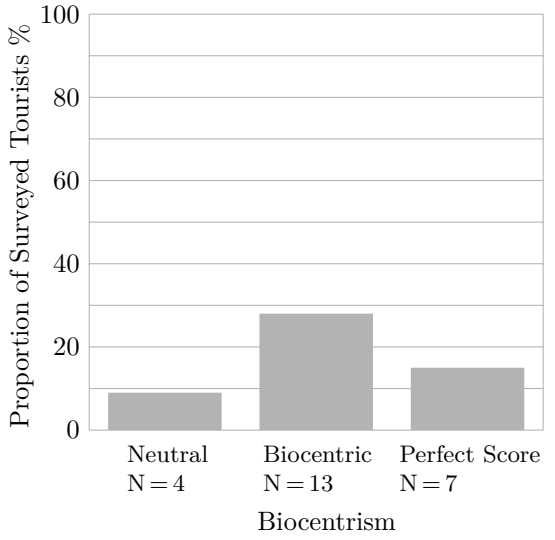


Figure 2. Proportion of tourists (%) whose post dive responses to the biocentric statements did not alter from their pre dive responses to the biocentric statements (n = 47).

Although results revealed a significant (α=0.05) change in survey respondents' answers post participation in a grey nurse shark dive (both increases and decreases in biocentrism were detected), the total proportions of tourists whom were considered to be non-biocentric, neutral and biocentric remained unchanged overall. Figure 3 indicates that whilst an increase in the level of biocentrism was documented, 57.1% of this increase was accounted for in pre dive biocentric tourists who further improved their biocentrism post dive. A further 28.6% of the detected increase in biocentrism was due to a slight improvement in biocentrism by tourists whose responses were considered neutral pre and post dive.

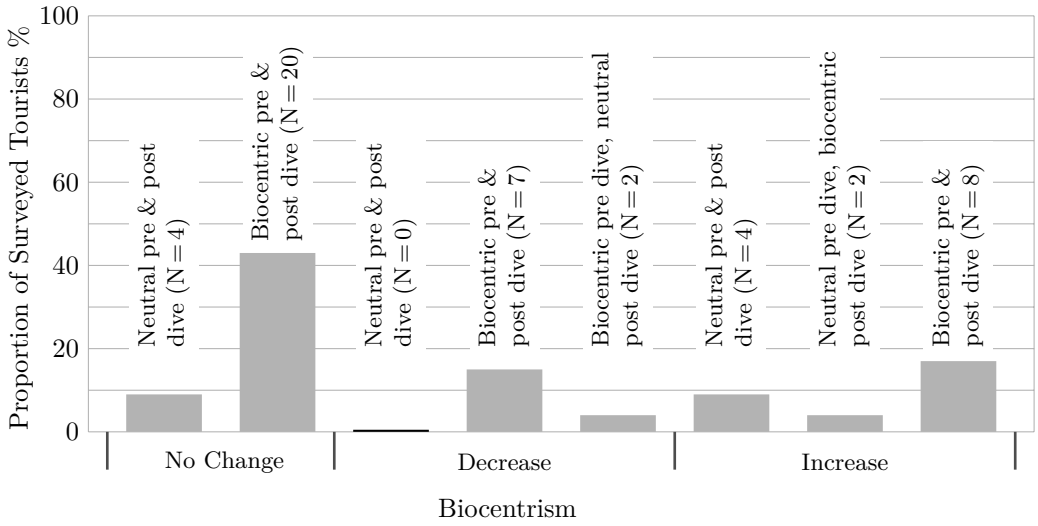


Figure 3. Proportion of surveyed tourists (%) per category (i.e. neutral pre dive or biocentric pre dive) who either experienced no change, a decrease or an increase in biocentrism post participation in a grey nurse shark dive (n = 47).

The remaining 14.3% increase in biocentrism was attributed to a shift from neutral to biocentric values within tourists (accounting for 4% of surveyed tourists). The proportion of tourists (4%) who experienced a shift from neutral to biocentric values (i.e. an increase in biocentrism) is mirrored by the proportion of tourists (4%) who exhibited a shift from biocentric to neutral values (i.e. a decrease in biocentrism); hence these incidences of change nullify each other in regard to the overall proportions of neutral and biocentric tourists.

Thus, results stated that the proportions of non-biocentric, neutral and biocentric tourists pre and post dives did not change, as shown in Figure 4. Prior to the dives 78.7% of tourists were considered biocentric and this proportion did not alter post dives, there were no (0%) non-biocentric tourists both pre and post dives and 21.3% of tourists remained neutral in their responses to the biocentric survey statements.

As depicted in Figure 5, the mean responses of tourists to 75% of the biocentric statements were considered biocentric (i.e. equal to or greater than a score of 4). The remaining 25% of biocentric statements received mean responses indicative of neutral (i.e. mean scores between 3.0–3.9) values and attitudes within tourists in relation to the impact of their daily actions upon sharks and the marine environment. The degree of biocentricity in the pre and post dive responses of tourists to 37.5% of statements increased (i.e. 'the marine environment requires our protection', 'it is important to protect sharks', 'my daily actions affect the marine environment'); the mean response of tourists to 25% of statements decreased post dive (i.e. 'it is important to protect the marine environment', 'sharks are important for Australia'); and, the mean response of tourists to the remaining 37.5% of biocentric statements did not alter (i.e. 'it is important to spend money to protect sharks', 'sharks need a healthy marine environment to survive', 'my daily actions affect sharks'). Although an increase in biocentrism was documented in the mean responses of tourists to 37.5% of the statements, a shift from neutral values and attitudes to biocentric views did not occur. Similarly, whilst a decrease in the level of biocentric responses to 25% of the statements occurred this was not reflected in a shift from biocentric to neutral views.

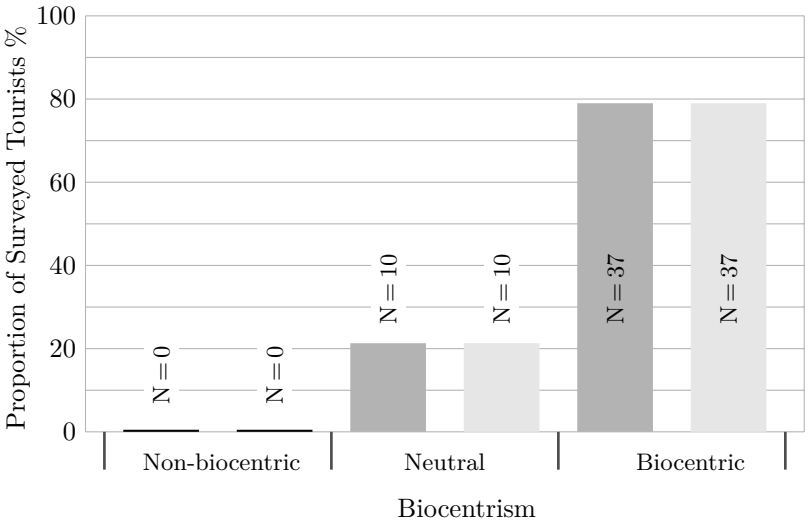


Figure 4. Proportion of non-biocentric, neutral and biocentric tourists (%) for pre and post grey nurse shark dives (n = 47). Pre dives Post dives

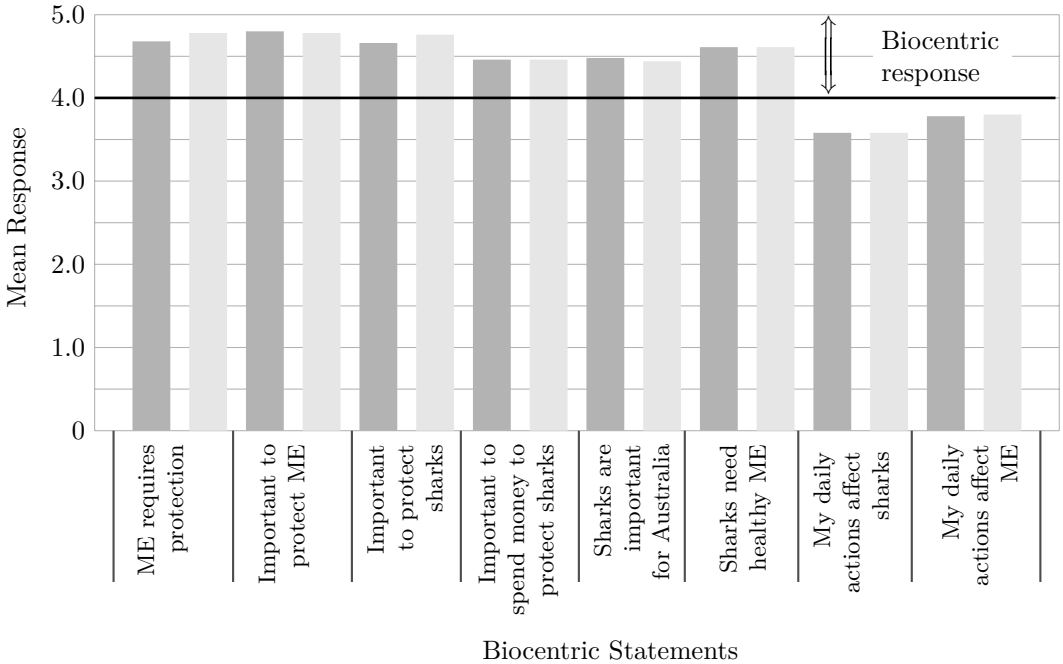


Figure 5. Biocentrism of tourists' responses pre and post dive to each biocentric statement. Biocentrism: 0–2.9 = non-biocentric, 3.0–3.9 = neutral, 4.0–5.0 = biocentric, ME = marine environment, n = 47. The point at which responses are deemed biocentric is indicated by the thickened black line. Pre dives Post dives

Grey Nurse Shark Knowledge Questions and Statements

A Wilcoxon paired-sample test indicated that there was a significant difference (α=0.05; 0.01<P(T≤326)<0.02) between the pre and post dive responses for the grey nurse shark knowledge survey questions and statements, as shown in Figure 6.

Results found that 20.5% of tourists experienced a decrease in knowledge post dive and 9.1% of tourists became more knowledgeable after the dive. As shown in Figure 7, 70.5% of tourists' levels of knowledge did not alter; 25% of tourists already possessed good levels of grey nurse shark knowledge and a further 45.5% obtained the correct answer to all knowledge questions and statements, therefore the margin for improving knowledge was either minimal or non-existent.

Of the tourists whose knowledge decreased after participating in a grey nurse shark dive, 22.2% were considered to have poor grey nurse shark knowledge both pre and post dive and 77.8% were deemed knowledgeable both prior to and after the dives. Figure 8 indicates that a shift in tourists from good knowledge of grey nurse sharks pre dive to poor knowledge post dive was not documented. Therefore, although a decrease in knowledge did occur, it did not influence the overall proportions of tourists who possessed poor knowledge or good knowledge pre and post dive. However, in regards to the tourists whose knowledge increased after participating in a grey nurse shark dive, 25% went from having poor knowledge prior to the dives to possessing good knowledge after the dives, thereby accounting for the 2% increase in the proportion of knowledgeable tourists overall post dive as depicted in Figure 9. The remaining 75% of tourists that experienced an increase in grey nurse shark knowledge were already deemed knowledgeable pre dive and so this result did not impact upon the overall proportions of tourists with poor or good knowledge.

Therefore, although the proportion of tourists whose knowledge decreased (20.5%) post participation in a grey nurse shark dive was greater than that of those whose knowledge increased (9.1%), the overall proportion of tourists possessing good knowledge increased by 2% post participation in a grey nurse shark dive, as indicated in Figure 9.

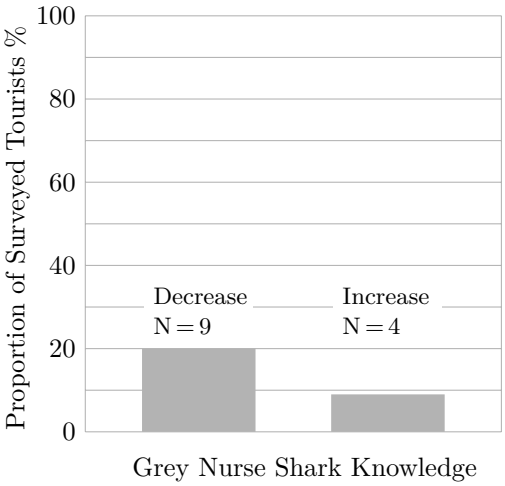


Figure 6. Change in grey nurse shark knowledge of tourists (%) post grey nurse shark dive (n = 44).

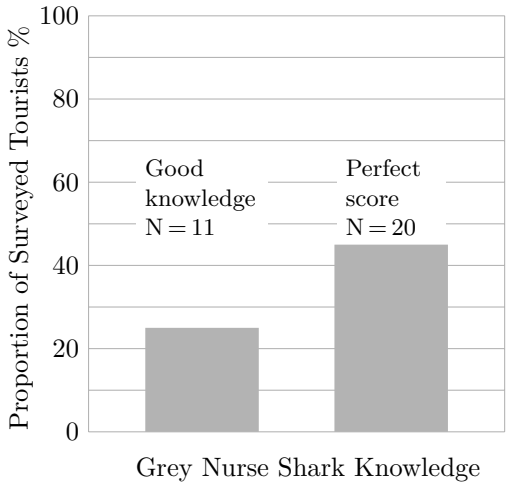


Figure 7. Proportion of tourists (%) whose post dive responses to the knowledge questions and statements did not alter from their pre dive responses to the knowledge questions and statements (n = 44).

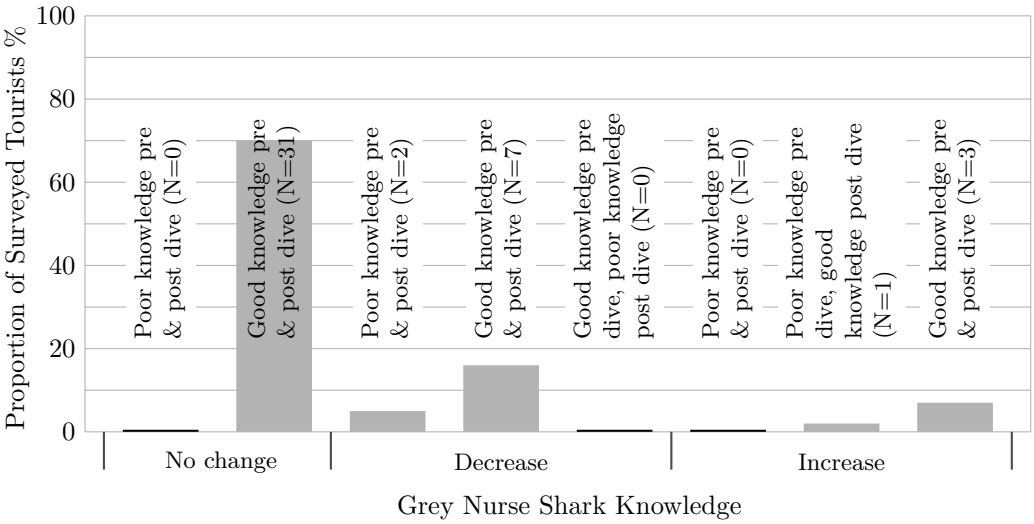


Figure 8. Proportion of surveyed tourists (%) per category (i.e. poor knowledge pre dive or good knowledge pre dive) who either experienced no change, a decrease or an increase in knowledge post participation in a grey nurse shark dive (n = 44).

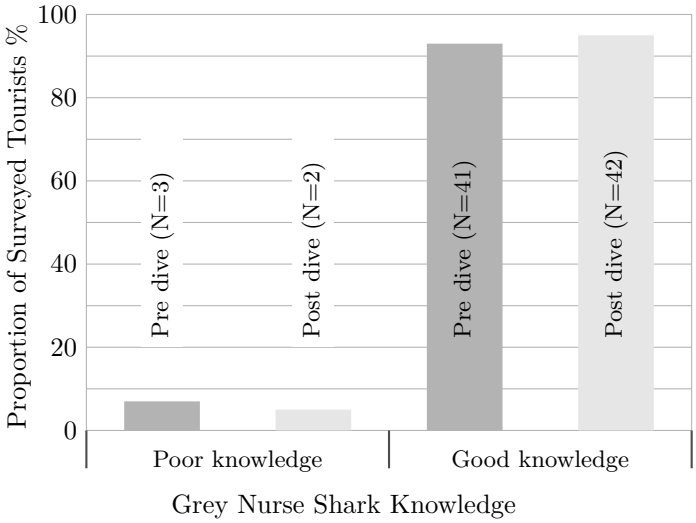


Figure 9. Proportion of tourists (%) possessing poor knowledge and good knowledge pre and post grey nurse shark dive (n = 44).

The proportions of tourists who answered the knowledge questions and statements correctly pre dive and post dive is presented in Figure 10 (the phrase 'grey nurse shark' is abbreviated to 'GNS' in Figure 10). For 28.6% of the knowledge questions and statements the provision of the correct response increased post dive (i.e. 'grey nurse sharks are an endangered species', 'can a tourist diver touch a grey nurse shark?'); for a further 28.6% of knowledge questions a decrease in the provision of correct answers was documented (i.e. 'is the population size of grey nurse sharks at an acceptable level in eastern Australia for their long term survival?', 'are grey nurse sharks a threat to humans?'); therefore, for the remaining 42.9% of the knowledge questions and statements the proportion of tourists who responded correctly did not alter post grey nurse shark dive (i.e. 'grey nurse sharks are a protected species', 'can a tourist pursue grey nurse sharks?', 'are sharks an important part of the marine environment?').

Figure 10 indicates that 80% or more tourists provided correct responses both pre dive and post dive to all but 1 of the knowledge questions and statements (i.e. 85.7% of questions and statements). The proportion of tourists who answered the remaining question (i.e. 'is the population size of grey nurse sharks at an acceptable level in eastern Australia for their long term survival?') correctly pre dive was 66% and this amount decreased to 59% post dive.

Comparison of Post Grey Nurse Shark Dive Survey Responses of those given an Educational Talk & those whom were not

Biocentric Statements

A Mann-Whitney test found that there was not a significant difference (α=0.05; $0.01<P(U\leq 317.5)<0.02$) between the biocentric survey responses of tourists whom were provided with an educational talk and those whom were not. Therefore, the null hypothesis that the provision of educational talks does not improve biocentrism within tourists post participation in a grey nurse shark dive should be accepted.

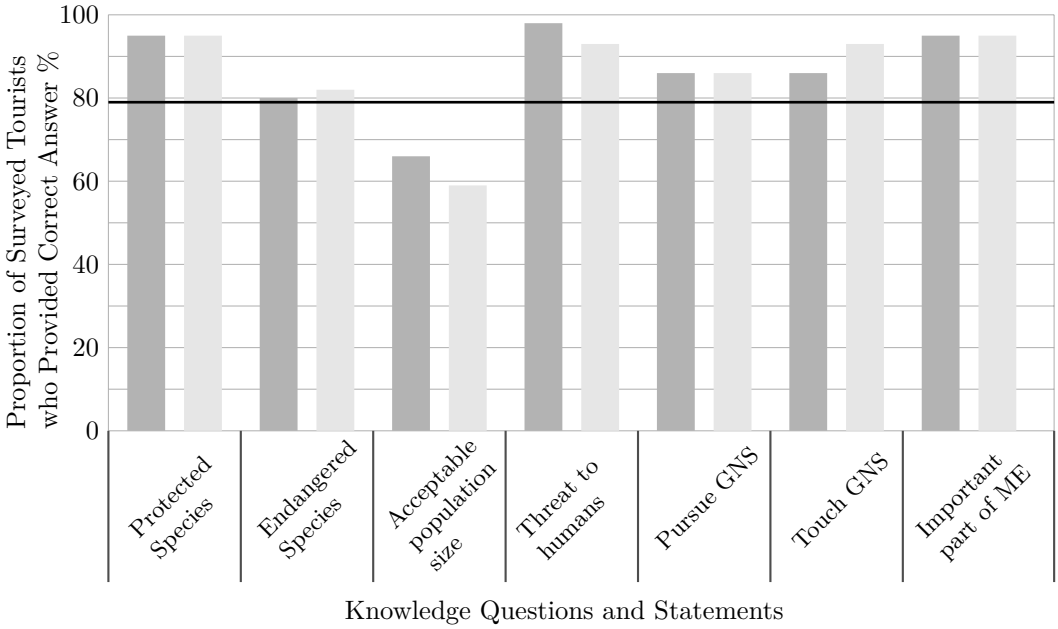


Figure 10. Proportions of tourists (%) who answered knowledge questions and statements correctly pre dive and post dive. GNS = grey nurse sharks, ME = marine environment, n = 44. The point at which responses are deemed biocentric is indicated by the thickened black line. Pre dives Post dives

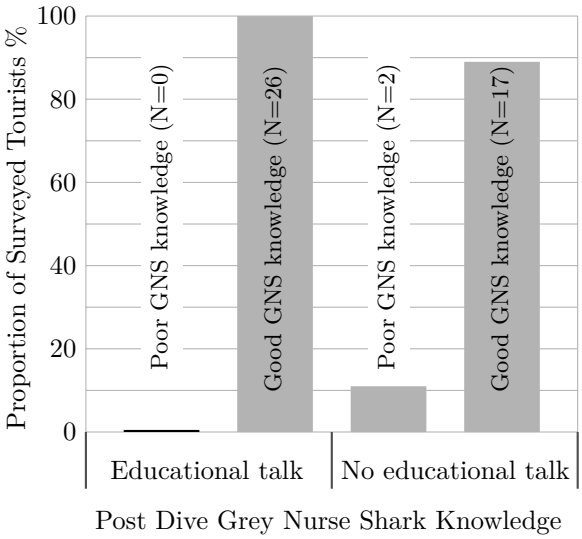


Figure 11. Knowledge of surveyed tourists provided with an educational talk and of those not provided with an educational talk (n = 45, GNS = grey nurse shark).

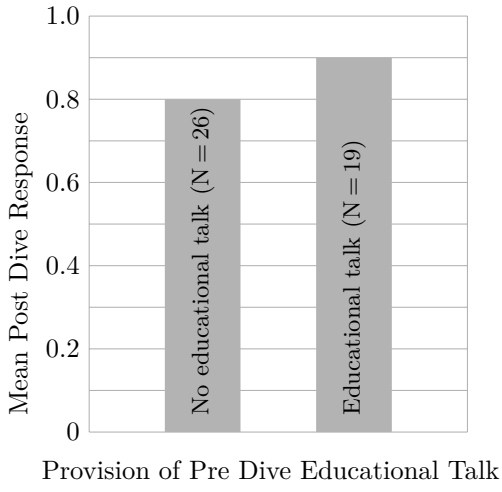


Figure 12. Mean post dive survey response to knowledge questions and statements of tourists provided with an educational talk and of those whom were not provided with an educational talk (0–0.4 = poor knowledge, 0.5–1 = good knowledge, n = 45).

Knowledge Questions & Statements

Mann-Whitney test results indicated that there was a significant difference (α=0.05; $0.01<P(U\geq 494)<0.02$) between the post dive knowledge survey answers of those present for an educational talk and of those who were not. Figure 11 (the phrase 'grey nurse shark' is abbreviated to 'GNS' in Figure 11) shows that 100% of tourists that were provided with an educational talk possessed good grey nurse shark knowledge post dive. Of the tourists whom were not provided with an educational talk 89.5% were considered knowledgeable post dive and 10.5% were deemed to have poor grey nurse shark knowledge. Therefore, the provision of an educational talk appeared to increase the proportion of tourists who had a good level of grey nurse shark knowledge by 10.5%.

The mean response to the knowledge questions and statements post dive of tourists provided with an educational talk and of those whom were not are presented in Figure 12.

It can be seen from Figure 12 that the mean response to the knowledge questions and statements of tourists whom were provided with an educational talk was 0.9, which indicates a greater level of grey nurse shark knowledge compared with tourists whom were not provided with an educational talk, whose mean response was 0.8. Hence, a 12.5% increase in the mean post dive response of those tourists whom were provided with an educational talk was documented.

DISCUSSION

Nature-based tourism has the potential to benefit conservation by improving pro-environmental attitudes and environmental knowledge within tourists (Ballantyne et al. 2008, Zeppel & Muloin 2008). In addition, it has been found that provision of education during nature-based tourism experiences can further enhance these benefits (Hughes & Saunders 2005, Christensen et al. 2007, Powell & Ham 2008, Zeppel & Muloin 2008). Results of this study indicated that both positive and negative influences were exerted on the

biocentrism and knowledge of tourists (short-term) who participated in a grey nurse shark dive at Fish Rock, New South Wales. Although an increase in biocentrism was documented post dive, the majority of this improvement occurred in tourists that were deemed biocentric pre dive. Furthermore, the decreases in biocentrism reported only occurred within pre dive biocentric tourists. In addition, the improvements to and decline of knowledge that were documented occurred largely within tourists that already possessed a substantial degree of grey nurse shark knowledge prior to their dive experience. Therefore, it is necessary to discuss current results holistically (rather than focusing on individual results in isolation from each other) and the probable reasons behind them to prevent their misinterpretation.

Previous research (Hughes & Saunders 2005, Christensen et al. 2007) investigating the influence of nature-based tourism on pro-environmental attitudes and knowledge within tourists has suggested that prepossession of such views and values may be partially (if not wholly) responsible for the apparent lack of sway that tourism has in increasing pro-environmental attitudes within participants. The same could account for the minimal (although significant) increases in knowledge documented in this and Morris et al.'s (2007) study. In addition, it has been surmised that whilst the ability of tourists to recall and relay facts presented to them during a nature-based tourism experience may indicate improvements in their short-term knowledge, it does not necessarily signify that they personally agreed with the information or that the knowledge gained in turn positively influenced their attitudes towards the target species and conservation (Hughes & Saunders 2005). Tourists' perceptions of the target species, environment and the tourism experience itself may also influence the level of knowledge attained from participation in nature-based tourism activities. Hence, in situations where educational resources supplement the nature-based tourism experience, the content and quality of the resources (whether they be presentations, informal talks, interpretation materials or otherwise) appear to be of utmost importance to ensure that the desired information and messages (relating to management guidelines, conservation and so forth) are effectively communicated to tourists (Mayes et al. 2004, Ballantyne et al. 2008, Zeppel & Muloin 2008, Mayes & Richins 2009). In order to facilitate maximum conservation benefits through the provision of education and to prevent the potential for further misconceptions to arise if tourists seek additional information from other sources (for example, the media, documentaries, books and so forth), it is proposed that the information provided during tours is consistently reviewed and updated to ensure its accuracy.

Whilst biocentrism increased in 29.8% of survey participants a large proportion (57.1%) of this improvement occurred in tourists previously deemed biocentric prior to the dive experience. In a study on a whale watching education program in Oregon, Canada, Christensen et al. (2007) noted that the increase in biocentrism of tourists who participated in the program compared with those who did not may have been attributed to the likelihood that people with strong existing biocentric attitudes were more likely to participate in and be more receptive to the program compared with those of weaker biocentric orientations. Similarly, Morris et al. (2007) concluded that although the manatee knowledge of boaters who participated in a Manatee Watch outreach program was quite high, boaters who did not participate in the program also exhibited a high degree of knowledge. This notion is of great relevance to the results of the current study. Whilst the overall proportion of biocentric tourists did not increase as a result of participating in a grey nurse shark dive nor was an increase documented as a result of the provision of an educational talk (i.e. educational talks did not significantly influence biocentric views), an increase in biocentrism was detected. This was due to the large proportion (78.7%) of tourists who were already deemed to be biocentric prior to the dives; hence whilst their level of existing biocentrism could improve, only 21.3% of tourists had the potential to shift from neutral views and values to biocentric attitudes. Furthermore, 14.9% of tourists obtained a 'perfect

score' of biocentrism (i.e. answered 'strongly agree' to all eight biocentric statements) pre dive and so no improvement could take place.

Similarly, although a small proportion (9.1%) of tourists experienced an improvement to knowledge post dive, 75% of these tourists were already deemed to possess good levels of grey nurse shark knowledge prior to the dives. A total of 93% of participants were considered to hold good grey nurse shark knowledge pre dive experience, so the group of tourists most in need of knowledge improvements (i.e. those with poor grey nurse shark knowledge) represented only 7% of the grey nurse shark divers. In light of these results, it is suggested that the premise that nature-based tourism presents real benefits to conservation by encouraging people to become more environmentally aware, concerned and knowledgeable may not be entirely valid as it appears that those likely to participate in such activities generally already possess these qualities: a finding supported by the results of other studies (Christensen et al. 2007, Morris et al. 2007). Hence, the conservation benefits to be gained from improving the biocentrism and knowledge of participants via nature-based tourism may be minimal. It is therefore suggested that in order for conservation to derive maximum benefit from positive shifts in biocentrism, non-biocentric and neutral individuals need to be the target demographic. However, the feasibility of this is dubious as such individuals would require not only a preparedness to finance such an experience but also a willingness to participate in an activity that may not particularly appeal to them (due to the possible absence of a certain degree of interest in the environment and the focal species).

Furthermore, a significant increase in the proportion of tourists with good grey nurse shark knowledge was detected in tourists provided with an educational talk compared with those whom were not. The inclusion of the correct responses to the knowledge survey questions and statements in the educational talks and the use of visual aids containing important facts may have prompted the retention and recollection of this information post dive (Hughes & Saunders 2005), regardless of whether tourists personally believed in the validity of them. This is reflected in results, which indicated that improved knowledge does not parlay into an improvement in overall biocentrism.

Lastly, when viewing each knowledge question individually it becomes apparent that the perceptions developed by tourists during their dive experience may be an important factor determining the accuracy of their responses. For example, a 7% decrease in the proportion of tourists who correctly answered the question 'is the population size of grey nurse sharks at an acceptable level in eastern Australia for their long term survival?' was documented. Prior to the dives, many tourists may have been informed (via media, scientific literature, educational talks as a part of the current study, or elsewhere) that the east Australian population of grey nurse sharks consists of approximately 300–500 individuals and is a critically endangered stock (Environment Australia 2002). However, during their dive experience some tourists may have encountered a large amount (counts of 30 or more individuals were not uncommon) of grey nurse sharks in the one area (i.e. Fish Rock) which could have led to the false assumption that the population status of grey nurse sharks is not as low as they previously believed it to be. Further support for this notion exists in the post dive responses of tourists to the question 'are grey nurse sharks a threat to humans?'. After participating in a grey nurse shark dive the proportion of tourists who incorrectly believed that grey nurse sharks are a threat to humans increased by 5%. Again, this may be attributed to tourists' visual perceptions of grey nurse sharks (i.e. large, strong animals with sharp, protruding teeth) when viewed in close proximity and the associated connotations. Therefore, the potential for tourists to adopt inaccurate perceptions as a result of their experience must be identified so that such inconsistencies are demystified via education programs or interpretation resources both pre and post nature-based tourism experience. In addition, it is of utmost importance to evaluate such programs to ensure that the content conveys important information and assists in the development of appropriate perceptions of the target species.

Future Management

In light of the potential for incorrect perceptions to cause a decline in the knowledge of tourists, it is clear that the content and quality of educational and interpretation resources are important factors when assessing the sustainability of nature-based tourism endeavours. Specifically in relation to the grey nurse shark dive industry at Fish Rock, it is important that tour operations clarify with tourists that whilst they may encounter a large number of sharks during their dive experience, Fish Rock is an identified critical habitat site (Environment Australia 2002) and thereby does not represent an accurate portrayal of grey nurse shark populations elsewhere along the east coast of Australia. In addition, such resources need to be developed in situations where they are currently absent.

Further research of the extent to which nature-based tourism activities positively influence the pro-environmental attitudes of tourists (and hence, benefit conservation) is required before industry allowances are made based upon this assumption. This is particularly pertinent when allowances are made for tourism settings of which the focal species is critically endangered. In addition, research investigating the causal links between improved knowledge and biocentrism within tourists is recommended.

CONCLUSION

This research demonstrated that nature-based tourism has the capacity to both promote and hinder pro-environmental attitudes and improve knowledge within tourists. It is probable that greater increases in both biocentrism and knowledge were not documented due to the high proportion of tourists whom were already considered biocentric and knowledgeable prior to their dive experience; hence, the scope for improvement was narrow.

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