

From hunters to nature observers: a record of 53 years of diver attitudes towards sharks and rays and marine protected areas

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Abstract. Human values, perceptions, attitudes and interactions with the natural environment have been found to change over time, with social and economic information used to inform management decisions and actions. Content analysis is applied here to a 53-year long collection of the popular dive magazine, *SportDiving*, to identify recreational divers' experiences with regard to sharks and rays, the Great Barrier Reef (GBR) and marine protected areas (MPAs). This analysis suggests there has been a diversification of diver activities with the emergence of passive-observational activities such as SCUBA diving. Attitudes towards sharks and rays have changed significantly, with recreational divers changing from a group that could be described as *adventure-seeking hunters* to a group that can be described as *nature-appreciating observers*, suggesting an increase in conservation awareness. The GBR continues to be a highly regarded dive destination, with divers perceiving positive effects of protection within MPAs. However, declines in the abundance of large fish and sharks and rays were occasionally reported throughout the 53 year period. Collectively, these types of data can show changes in resource-use patterns, perceptions and attitudes and provide information that supplements scientific monitoring data. These data may be valuable where scientific data is scarce, historical records difficult to obtain, and where attitudinal change can significantly affect future resource use.

Additional keywords: content analysis, Great Barrier Reef, perceptions, SCUBA diver, spearfishing.

Introduction

The use of natural resources and ecosystems can be affected by the values, beliefs, perceptions and attitudes of the people interacting with the environment (Gregory and Wellman 2001; Broderick 2007) and these values and beliefs can also affect conservation and management outcomes. The link between attitudes and behaviour has been the focus of research in all fields of social science for many years (e.g. Ben-Akiva *et al.* 1999). Generally, an individual's attitude in combination with other psychological (Pendleton *et al.* 2001; Ridout *et al.* 2008; Sampei and Aoyagi-Usui 2009), social (Wolch *et al.* 1997; Lemyre *et al.* 2006; Kleypas and Eakin 2007) and economic characteristics will lead to behavioural intention, which is a precursor for behaviour (Ajzen 2001). In the past few decades, there has been increasing focus on better understanding this link between attitude and behaviour in the context of natural resource use and management, with human attitudes characterised and typologies developed (Gregory and Wellman 2001; Broderick 2007). For instance, Callicott (1991) described four schools of 'ocean ethics', ranging from 'puritan-frontier development

ethics' focussed on conquering the natural environment and exploiting resources, to more contemporary 'romantic-transcendental preservation ethics' that appreciate nature for intrinsic values independent of human use. All of these factors affect how people view and interact with the marine environment. Therefore, understanding trends in the values, beliefs and attitudes of resource users is useful when making management decisions and planning for conservation.

Spearfishers and SCUBA divers are key user groups in marine parks such as the Great Barrier Reef (GBR) (GBRMMPA 2009a) and the number of these recreational divers has grown steadily worldwide over the past decades (PADI 2010). Recreational divers pursue a wide variety of diving activities including hunting and spearfishing, photography, exploration and being immersed in 'nature' (Byron 1998). An increased understanding of diver activities, the overall utility of marine parks, and diver attitudes towards various species that occur in these locations may provide valuable information about management effectiveness, and for setting management and conservation priorities. Additionally, resource users such as recreational divers can

provide information on long-term environmental changes. For instance, oral histories from GBR communities helped interpret contemporary scientific monitoring data, and revealed significant perceived changes in coastal environments, fisheries, coral reefs and trends in activities and resource use (Fernbach and Nairn 2007). Historical accounts from the 1800s have also been used to identify the extent of decline of species such as the dugong (GBRMPA 2009a). Such observations of natural landscapes by non-scientists over time are increasingly recognised for their potential to provide important ecological information not otherwise available through scientific monitoring programs (Robertson *et al.* 2000; Saenz-Arroyo *et al.* 2005; Silvertown 2009).

The link between attitudes and behaviour and conservation and management outcomes is particularly relevant for sharks and rays, as there is an urgent conservation imperative (Graham *et al.* 2001; Fowler *et al.* 2005; Dulvy *et al.* 2008). Many species of sharks and rays are under increasing pressure around the world including the GBR (Robbins *et al.* 2006; Heupel *et al.* 2009). Sharks and rays perform important ecological roles in marine ecosystems (Stevens *et al.* 2000; Kitchell *et al.* 2002; Heithaus *et al.* 2008) and growing concerns have prompted GBR managers to list shark conservation and management as a priority issue (GBRMPA 2009a). Many drivers for human-induced shark and ray population declines exist, but one not frequently discussed is the effect of attitudes held towards this species group. Evidence suggests that in the past, sharks were often perceived as dangerous and had a reputation for being 'monsters' due to their fierce appearance (Pollard *et al.* 1996; Dobson 2006; Ferguson 2006), evoking strongly negative, utilitarian and moralistic public attitudes (Thompson and Mintzes 2002). Negative attitudes towards perceived 'dangerous' wildlife have been shown to affect the status of species populations and effectiveness of conservation efforts (e.g. Newhouse 1990). For instance, research in the USA (Kellert 1994; Kellert *et al.* 1996; Casey *et al.* 2005) and Europe (Kaczensky *et al.* 2004) found that negative attitudes towards 'dangerous' wildlife or predators often generate behaviours that lead to negative environmental outcomes. This complex mix of negative emotions towards sharks, often enhanced by negative media coverage (Ferguson 2006), could affect shark conservation and management efforts.

Similarly, the link between attitudes and behaviour and conservation and management outcomes applies to Marine Protected Areas (MPAs). The GBR is one of the largest MPAs in the world, covering 344 440 km², with marine park zoning the primary means of management (GBRMPA 2005). The GBR is a well known dive destination, known locally and around the world for its spectacular flora and fauna, including sharks and rays (Coleman 1994). Other MPAs around Australia, including Ningaloo in Western Australia and the south-east coast temperate marine environments, are also increasingly explored by Australian and international recreational divers (Coleman 1994). However, the GBR ecosystem is under increasing pressure from numerous factors including habitat degradation, extractive activities and climate change (GBRMPA 2009a). A wide variety of social information on the GBR has been collected, including attitudes towards the reef and perceptions of risks and threats to the associated ecosystem (e.g. Young and

Temperton 2007). Crown-of-thorns seastars (COTS) and oil spills were once considered to pose the most serious risks to the marine environment (Moscardo 2001; Kleypas and Eakin 2007); however, more recent data show that climate change and water quality decline are now perceived to be the major issues (Young and Temperton 2007). This type of information is used to help prioritise management actions on the GBR (GBRMPA 2009a). In addition, the direct economic contribution of tourism on the GBR is estimated at AU\$5.1 billion per annum (AccessEconomics 2005) with around two million tourists visiting the GBR each year (GBRMPA 2009b). Given the value of tourism in protected areas, many studies are increasingly focussing on what drives customer satisfaction, expectations and levels of appreciation of environmental condition (Musa 2002; Moore and Polley 2007; Uyarra *et al.* 2009). The investigation of recreational diver perceptions of the marine environment may also identify attitudes towards MPAs as management tools.

In this study, we apply a social analysis tool, content analysis, to investigate changes in the values, perceptions, beliefs and attitudes of recreational divers towards sharks and rays, the GBR and MPAs, as reported by divers in a popular dive magazine, *SportDiving*. Content analysis has been widely used to identify patterns and trends in values, perceptions and attitudes and also to reveal information about historical environmental conditions. Content analysis itself has existed for many years and can be defined as a technique for making inferences by objectively and systematically identifying specified characteristics of messages (Holsti 1969). The tool can be applied to a variety of information sources including interviews, films, TV, advertising, newspapers, and magazines (Macnamara 2006). In a marine science context, this technique was successfully applied to gauge opinions about MPAs in the USA by Fish *et al.* (2002).

We hypothesised that: the activities of recreational divers have diversified over time; dominant themes of diver interactions with the marine environment and its management can be identified; diver interactions with and attitudes towards sharks and rays have changed significantly over time; and that divers have noticed changes in the marine environment. Collectively, this information can assist marine resource managers in understanding how recreational divers interact with, and respond to, the marine environment, which in turn can influence management outcomes.

Materials and methods

The most widely circulated independent Australian-owned dive magazine in the Asia-Pacific region, *SportDiving* magazine, was the information source for the content analysis applied here. Around 15 000 copies of *SportDiving* are distributed every 2 months. Market penetration is via Australian and Asian newsagents, dive retailers and worldwide subscribers. *SportDiving* is one of the oldest publications in underwater sports, first appearing as *Australian Skindiving & Spearfishing Digest* in the 1950s, with the name changing to *Australian Skindivers Magazine* in the 1960s and *Skindiving in Australia* in the 1970s and 1980s. Throughout the magazine's history, articles and features have been submitted by voluntary contributors, encompassing a range of subjects including first-hand dive

experiences and perceptions, equipment advances, scientific research and species updates. Importantly, divers' experiences, feelings and perspectives when observing sharks and rays play a prominent role in the published articles.

The content analysis used here is loosely based on Neuendorf (2002). In total, 94 magazines, covering 7494 pages, dated between 1953 and 2006 were analysed. Magazine issues were sourced from personal collections, the Great Barrier Reef Marine Park Authority Library, the editor's archive collections and inter-library loans from New South Wales Fisheries. Fewer magazines were available for the early period owing to lower readership at that time. Although the publication dates were recorded for each magazine, they were categorised into 'survey blocks' of between 2 and 4 years comprising 1953–1956, 1964–1965, 1973–1975, 1984–1985, 1994–1995, 1999–2002 and 2003–2006. The chosen survey blocks spanned particular periods of interest such as the declaration of the Great Barrier Reef Marine Park (1975) and the rezoning of the Marine Park (2004). Within each time period, adequacy of numbers was ensured where, for instance, some magazines could not be obtained for analysis.

Restricting our content analysis to one data source could limit the generality of the findings. We argue, however, that three characteristics of *SportDiving* magazine support its use as the primary data source. First, *SportDiving* is the longest continuous dive publication and is still actively published today. Second, *SportDiving* has retained the same editorial team over the entire life of the publication, which reduces variation from editorial biases. Lastly, articles are written by recreational divers from the general public and are thus more likely to represent diver attitudes than articles written by professional correspondents.

Steps were also taken to ensure that patterns found in our study were not an artefact of the width of categorisation as determined by the chosen survey blocks. A pilot study was conducted on 19 magazines for the period 1999–2002 to ensure correct sampling of material and applicability of themes. While a sensitivity analysis of data from all magazines was not possible, the change observed in our findings was gradual and constant, with no fluctuation in the signal. Additionally, the National Library of Australia catalogue was investigated to identify the numbers and types of recreational dive magazines published over time. These trends in publication types and dates of first publication reflect the trends in recreational diving interests and activities reported in our study. Finally, the authoritative text 'The History of Spearfishing and Scuba Diving in Australia' (Byron 1998) was analysed to identify changes in diver activity, attitude and behaviour between 1917 and 1997. The data from these sources support the findings and patterns from our study and are available in Accessory Publications 1 and 2 (available on the *Marine and Freshwater Research* website).

Information for the articles, features and letters in *SportDiving* magazine was systematically recorded including the issue number, month, year, page number, country, area, dive site, activity undertaken (e.g. SCUBA, spearfishing, snorkelling) and article category (sharks and rays, the GBR and/or MPAs). Other information recorded in a summary of the narrative included environmental and marine observations (e.g. too many sharks, not enough sharks, beautiful coral, coral decimated by

COTS) and value and attitudinal remarks (e.g. magnificent creature, pride in killing shark menace).

A combination of both qualitative and quantitative content analysis was used to analyse the dataset. Quantitative analysis used size and frequency of messages to analyse trends while qualitative content analysis was used to identify significant thematic groupings by focussing on the dominant repetition of words or phrases within articles. The approach used here followed a similar procedure to that outlined in Morse (1994), Neuendorf (2002) and Rogan *et al.* (2005).

Analysis

The frequency of numbers and types of articles was quantified to describe trends in publication focus, diver interactions, reported perceptions and the appearance of themes. A *K*-means cluster analysis was used to determine natural groupings within the qualitative dataset (run on SYSTAT 8.0, Systat Software Inc., Chicago, IL). Any significant groupings of diver activity for different categories and attitudes were identified. The data were coded numerically to undertake the cluster analysis. Diver activities were allocated individual numeric codes according to the specific identified activity (e.g. Spearfishing = 1, SCUBA = 5). Thematic groupings were assigned a 'zero' or 'one' depending on whether that theme occurred within any article within a particular survey block. The data were initially assigned randomly to the *K* clusters. Cases were then moved around between clusters iteratively to minimise measures of cluster variability. For each thematic grouping, the between-cluster mean square (derived from the between cluster sum of squares – Between SS) and the within-cluster mean square (derived from the within cluster sum of squares – Within SS) was compared. The variables were ordered by *F*-ratio. The reported *F*-ratios do not test significance because the clusters are formed to characterise differences. Instead, these statistics are used to characterise relative discrimination.

Results

Across the 53-year period, 317 articles were analysed. Of these, 129 articles were about sharks and rays, 84 were about the GBR and 104 were about MPAs. Within that period, changes in the numbers and types of articles written were observed. In particular, the number of articles that focussed on sharks and rays varied, with the highest number of articles published between 1964 and 1965 (35 of 46). After this period, the focus on sharks and rays decreased only to rise again in the mid-1990s. The number of articles focussing on MPAs peaked from the early 1970s, while articles written specifically about the GBR peak around the mid-1970s, coinciding with the establishment of the marine park in 1975 (Fig. 1).

Diver activity

The articles published show a change in reported diver activity over time (Table 1). Articles from the 1950s and 1960s reported mainly spearfishing activities, but since the 1980s, articles have focussed more on SCUBA diving. This change is most evident in articles that focus on sharks and rays, with SCUBA-focussed articles rising from ~28% of articles before 1985 to 77% of published articles by 2006. A similar shift is observed for

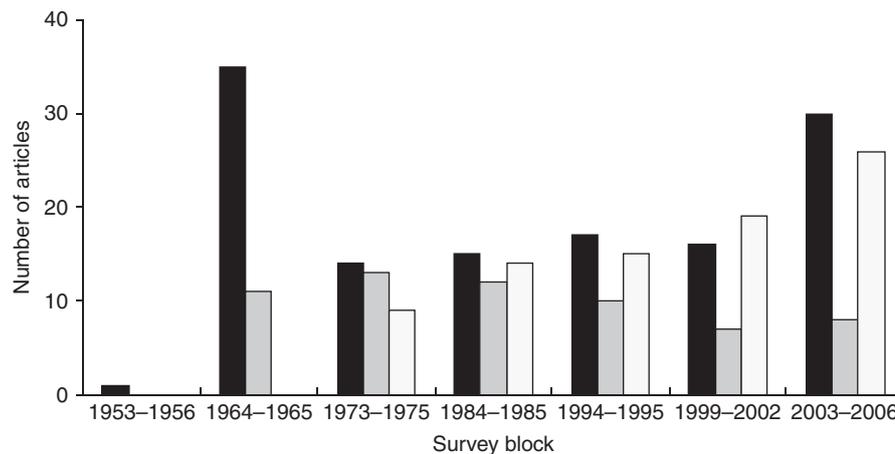


Fig. 1. Number of articles published in *SportDiving* (between 1953 and 2006) about sharks and rays (black), the Great Barrier Reef (GBR; dark grey) and Marine Protected Areas (MPAs; light grey) over time.

Table 1. The percentage of articles written about spearfishing and SCUBA diving in *SportDiving* between 1953 and 2006 within each category for all survey blocks

GBR, Great Barrier Reef; MPA, Marine Protected Area

Survey block	Sharks and rays		GBR		MPAs	
	Spearfishing	SCUBA	Spearfishing	SCUBA	Spearfishing	SCUBA
1953-1956	100	0	0	0	0	0
1964-1965	74	0	82	9	0	0
1973-1975	43	29	13	80	0	89
1984-1985	66	27	0	92	0	93
1994-1995	0	59	0	100	0	100
1999-2002	0	94	0	100	0	100
2003-2006	3	77	0	100	0	100

articles written about the GBR, where spearfishing accounts for 82% of activities recorded between 1964 and 1965 but where SCUBA diving accounts for 100% of activities recorded for the GBR after 1994. All articles in the MPAs category after 1994 are about SCUBA diving.

Diver perceptions and attitudes

Qualitative analysis revealed that divers reported several common themes related to perceptions, values and attitudes. The analysis identified eight thematic groupings for articles on sharks and rays, six for articles about the GBR, and five for articles concerning MPAs (Table 2). The thematic groupings were used as a basis for a *K*-means cluster analysis to determine whether there was evidence of a diver 'typology' on the basis of the diver's reported attitudes to sharks and rays.

Sharks and rays

The frequency at which thematic groupings appeared in articles about sharks and rays showed a clear change in perception and attitude. Before 1975, the dominant values and perceptions attributed to sharks and rays were related to 'fear, danger, or annoyance' and 'hunting and pride'. However, by 1984 the

dominant values and perceptions being reported by divers change to those of 'excitement' at seeing sharks, 'wonderment and respect' for the animals, and sharks being 'harmless creatures' (Fig. 2). These values and perceptions are typified by author's statements, for example, those relating to emotions such as 'hunting and pride':

'...the day proved to be the greatest slaughter of sharks underwater we have ever carried out.' (Issue 14.3, March 1964, page 10)

and

'I don't think there will ever be a letter to the editor decrying the slaughter of whalers...we were after them all and if a stray white pointer happened by, all the better.' (Issue 15.9, September 1965, page 18)

Comments relating to 'wonderment and respect' for sharks include, for example:

'A true and spectacular act of nature' (in reference to watching tiger and reef sharks amassed feeding on schools of baitfish. Issue 41, December/January 1993/1994, page 83)

Table 2. Definition of thematic groupings outlining the predominant attitudes and perceptions of the authors within each category (*SportDiving* 1953 to 2006)

GBR, Great Barrier Reef; MPA, Marine Protected Area

Thematic group	Narrative used in defining thematic group
Shark and rays	
Hunting/Pride	Thrill of hunting/killing sharks/rays and feeling proud of such kills
Excitement	Excitement of seeing sharks/rays, sharks/rays considered the main attraction of the dive
Disappointment	Disappointment of too few sharks/rays to observe or to kill
Fear/Danger/Annoyance	Feeling of fear, nervousness, annoyance at too many sharks/rays, unpredictability and reference to 'man-eaters' or 'monsters'
Conservation	Numbers in decline, sightings becoming rare, a need for greater conservation efforts and the sharks'/rays' right to exist in the oceans
Wonderment/Respect	Respect for the creatures, being beautiful, magnificent and/or spectacular
Regular/Guaranteed Sightings	Guaranteed sightings of sharks/rays and dive sites with regular sightings
Harmless Creatures	Animals being curious, inquisitive and non-aggressive. Also includes reference to negative media portrayal of sharks/rays
The GBR	
Beauty/Colour/Condition	Beauty, colour, condition of the dive site/reef and good visibility/clear water
Excitement/Safety/Diversity	Fantastic diving, safe diving, diversity of marine life and good operator behaviour
Sizeable Fish/Abundance	Large fish (to see or to catch), abundance of fish and large fish populations
Small size fish/Small populations	Small populations of fish and small size of fish
Threats	Crown-of-thorns seastar and poor operator behaviour
Poor Condition	Poor visibility and lack of colour on the reef
MPAs	
Beauty/Colour/Condition	Beauty, colour, condition of the dive site/reef and good visibility/clear water
Excitement/Safety/Diversity	Fantastic diving, safe diving, diversity of marine life and good operator behaviour
Sizeable Fish/Abundance	Large fish, abundance of fish and large fish populations
Threats/Poor Condition	Crown-of-thorns seastar, illegal fishing, lack of colour
Responsive to protection	Increasing fish abundance, improving condition of dive site

and

'Her power and grace a product of more than 300 million years of unparalleled evolutionary success' (in reference to an encounter with a silvertip shark, *Carcharhinus amblyrhynchos*. Issue 80, June/July 2000, page 70).

For further quotations, see Accessory Publication 3.

These trends were confirmed by the cluster analysis. Analysis of activities undertaken and grouped by year of article publication shows two significant clusters around 1975 and 1997 with different reported experiential emotions in relation to sharks and rays. The two clusters have been labelled according to the prevalent attitude of the divers at those times: the *adventure-seeking hunter* (1975) and the *nature-appreciating observer* (1997). *Nature-appreciating observer* had a zero score for hunting and pride while, in contrast, *adventure-seeking hunter* had higher average ratings for fear and danger. Surprisingly, however, the average score for excitement for the *adventure-seeking hunter* was lower than that for the *nature-appreciating observer* (Table 3).

Other observations and sentiments reported since the 1980s include positive references to 'regular or guaranteed sightings', the 'disappointment' of not seeing any or enough sharks, and references to the declining numbers of sharks and rays and/or a need for greater conservation efforts. Although small in number, 10 of 124 article entries within the sharks

and rays category make reference to a change (reduction) in shark and ray abundance. Such observations include, for example:

'Carpet sharks and wobbegongs that used to be seen in fair numbers are now becoming rare in NSW' (Issue 15.3, March 1965, page 23);

'Once we needed to go no further than the Barrier Reef or Coral Sea for good shark action, but indiscriminate long lines have depleted the large marine life that was so prolific in the 60s and 70s.' (Issue 106, Oct/Nov 2004, page 23)

and

'Most of the good spots we frequented 30 or 40 years ago have been denuded of life to the point where we simply no longer go to those places anymore.' (Issue 106, Oct/Nov 2004, page 23)

The GBR and MPAs

Thematic groupings in the majority of articles about the GBR related to the 'beauty, colour and condition' ($n = 38$) of the reef and the 'sizeable fish/abundance' ($n = 27$). There was no significant change in the number of articles identifying the aesthetic beauty and environmental significance of locations in the GBR between 1953 and 2006. The excitement associated with the experience of being on the GBR was also consistent over time

($n = 16$). Only a small number of articles focus on 'small fish size or small populations', 'threats or COTS', or the 'poor condition' of the reef ($n = 14$).

Similarly, with respect to MPAs, the majority of articles focus on the 'beauty, colour and condition' ($n = 33$) of, and 'sizeable fish/abundance' in, marine parks ($n = 23$). The frequency of occurrence of these themes is consistent over time.

As with the sharks and rays category, articles in both the GBR and MPA categories make reference to changes over time, with reports of positive responses of fish abundance and reef health to protection ($n = 11$). Three references in relation to the GBR and eight references within the MPA category were made. Articles reported these positive responses with respect to another time in

the past or some significant change that had taken place. For example, articles in the MPA category reported that:

'During the 5 years since becoming a marine reserve the animals of Popes Eye have responded tremendously... increases in numbers and sizes of reef fish within a matter of months.' (Issue 14.1, January 1984, page 26)

and

'[the] benefits of 20 years of protection are clear, ... marine areas outside of the reserves have also begun to benefit as fish and crays migrate.' (Issue 76, Oct/Nov 1999, page 103).

One article within the GBR category made reference to the re-zoning of the GBR undertaken in 2004:

'Surely the recent increase in totally protected areas in the GBR Marine Park will ensure that more reefs become or stay as good as this one!' (Issue 113, Dec/Jan 2005/2006, page 61)

For further quotations, see Accessory Publication 3.

Discussion

Changes in diver activity

Trends in the number and percentage of articles in *SportDiving* show a change in reported diver activity and focus. The number of articles about sharks and rays peaked in the 1970s, perhaps due to diver interest in hunting sharks. A subsequent peak in the 1990s could be explained by increasing awareness and concern by authors over the status of shark and ray populations. The number of articles about the GBR has decreased proportionally over time; however, the GBR remains a popular diving destination with at least 10% of articles in a given survey block referring to the GBR. The decreasing proportion of GBR articles may reflect the expansion of the SCUBA dive industry into a wider range of locations. The number of articles written about MPAs has steadily increased; however, this may simply reflect the greater coverage of dive sites within protected areas as the number of MPAs increased since the 1970s (Wood *et al.* 2008).

The diversification of diving activities and reduced focus on spearfishing is supported by data from the diving industry. Diving certification agencies report that the number of new SCUBA divers licensed in Australia every year increased significantly during the 1970s and 1980s, peaking at 54 000

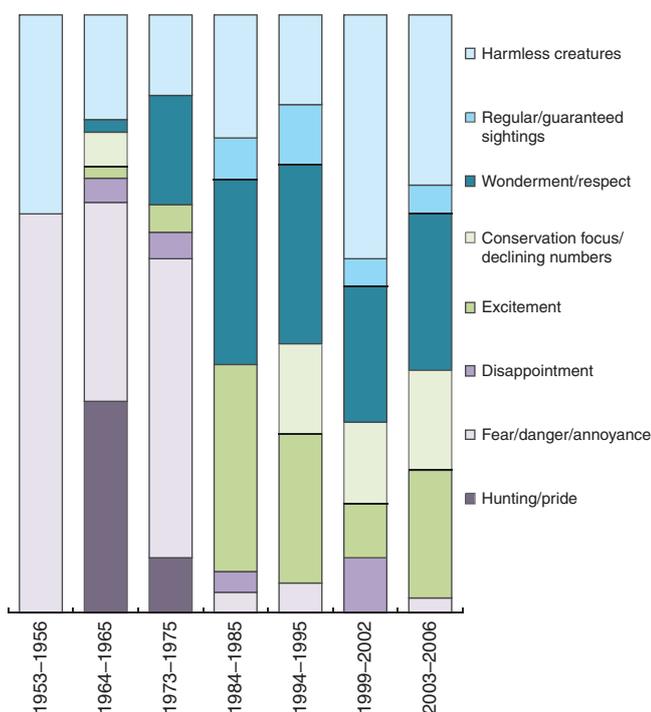


Fig. 2. The proportion of each theme appearing in articles on sharks and rays published in *SportDiving* between 1953 and 2006 (100% stacked column graph).

Table 3. Clusters representing author attitude based on the proportion of articles within thematic groupings for the category sharks and rays (*SportDiving* 1953 to 2006)

The between-cluster mean square is derived from the between cluster sum of squares (Between SS), and the within-cluster mean square is derived from the within cluster sum of squares (Within SS)

Thematic grouping	Cluster 1 – Adventure-seeking hunter ($n = 59$)	Cluster 2 – Nature-appreciating observer ($n = 65$)	Between SS	Within SS	F-ratio
Year	1975	1997	28 545.122	6031.555	577.381
Hunting or pride	0.24	0.00	1.741	10.678	19.896
Fear, danger, or annoyance	0.56	0.09	6.745	19.989	41.170
Excitement	0.05	0.26	1.373	15.401	10.875
Disappointment	0.05	0.03	0.012	4.786	0.318
Conservation	0.05	0.12	0.161	9.863	1.996
Wonderment and respect	0.14	0.32	1.473	21.777	8.253
Harmless creatures	0.15	0.40	1.894	23.227	9.947

new divers in 1991 (Lippmann 2008). The number of recreational diving publications has also increased and diversified, with SCUBA diving publications increasing between the 1960s and 1990s (see Accessory Publication 1). Analysis of Byron's 'The History of Spearfishing and Scuba Diving in Australia' (1998) shows a similar diversification of activities (see Accessory Publication 2). More passive, observational diving interactions could be driven by the influence of the media, peer groups and increased education (e.g. Pollard *et al.* 1996). However, the emergence of different recreational diving interests may also be due to changes in legislation. For instance, reductions in reported spearfishing activities after 1975 could be explained by an increase in the number of MPAs. In the GBR, spearfishing is not allowed with underwater breathing apparatus (other than snorkel), and is prohibited in several designated zones (GBRMPA 2008). These zones are popular for snorkelling and diving activities and are therefore often the source of articles in *SportDiving* magazine.

Changes in diver attitudes

This study illustrates a significant change in diver attitudes over time, particularly towards sharks and rays. The number of divers characterised as *adventure-seeking hunters* decreased while the number of *nature-appreciating observers* increased through time. These two clusters of diver attitude correspond to typologies of attitudes towards the natural environment and wildlife as reported in other studies. The *adventure-seeking hunter* type is analogous to the dominionistic and negativistic attitude type while the *nature-appreciating observer* is similar to the naturalistic, ecologicistic and scientific attitude as described by Kellert (1985), or the 'romantic-transcendental preservation ethics' described by Callicott (1991). Interestingly, the present analysis indicates that the contributing authors could be classified as one attitude type around 1975, after which contributing authors change attitude to become virtually the opposite type by 1997.

Analysis of Byron's 'The History of Spearfishing and Scuba Diving in Australia' (1998) reveals identical changes in recreational diver attitudes towards sharks and rays (see Accessory Publication 2). Pollard *et al.* (1996) described how attitudes towards the grey nurse shark (*Carcharias taurus*) in NSW changed over time. In the 1960s, spearfishers contributed to the shark's decline, but by 1984 they were actively contributing to the protection of the species. More recently, a survey by Australia's peak spearfishing body (the Australian Underwater Federation) found that the majority of survey respondents placed a high value on sharks, expressed concerns about the status of shark populations, and responded that sighting a shark increased the enjoyment of ocean-related activities (Sutton 2009). Positive attitudes towards sharks have also been identified for other user groups such as recreational fishers, who revealed that they placed a low value on catching sharks and rays, but a high value on their existence in the wild and on releasing them in good condition (Lynch *et al.* 2010).

Implications for conservation and management

Information about activity, attitude and perception can be useful for conservation and management of species, the GBR and

MPAs. For many regions in both developed and developing nations, increasing economic potential of dive areas through the creation of tourism opportunities is a prime objective (Fernandes *et al.* 2005). From this study, it appears that most divers provide positive reports about their experiences in the GBR, making regular references to the safety of dive sites, the beauty of the marine life, species diversity and richness and good visibility. The tourism industry relies on the quality of the experience and health of the dive sites and this information may provide insight into the likelihood of repeat diver visitation.

Anecdotal and published evidence suggests that changes in resource-use patterns and attitudes have facilitated improved outcomes for marine resource management. Diver perceptions about the value of protection and the appropriateness of spearfishing in protected areas helped to assess potential zoning changes in the GBR. Of all submissions received during two rounds of public consultation undertaken by the Great Barrier Reef Marine Park Authority (GBRMPA) in relation to the re-zoning process (see Fernandes *et al.* 2005; for details), 24–37% were from those specifically seeking increased conservation outcomes for the GBR (GBRMPA 2005). Similarly, in southern Europe, Mangi and Austen (2008) found that among different groups of stakeholders, divers and dive operators now rank conservation as the most important objective of MPA implementation. Analyses of stakeholder behaviours and attitudes could help authorities gauge the potential receptiveness of these groups to conservation and other planning changes. In the present study, the perceived effectiveness of protection was evident in articles related to the GBR and other MPAs, with divers reporting positive responses of fish abundance and reef health to protection. These observations provide supplementary information to the large body of data collected through quantitative biological research to assess the effectiveness of MPAs.

Additionally, the data presented in this study provide valuable insights into how conditions may have changed before the onset of formal monitoring programs. While only 21 of 302 article entries made comparisons between current and historical conditions, the numbers of such articles increased in the last decade and indicate the decline of some large fish and sharks. For marine managers and fisheries authorities, qualitative historical observations may provide invaluable information about the state and health of habitats and fish populations both past and present, and in particular with regard to temporal comparisons of specific dive sites and/or reef areas.

Limitations and considerations

Several factors need to be considered when interpreting content analysis results. This study focussed on a single group of stakeholders within Australia, and these findings may not apply to other contexts or locations. As with all analyses of written material, the investigator can only analyse what has been published, and has to assume that this material represents the attitudes and perceptions of that time. While individual author biases can be somewhat moderated by analysing texts from multiple authors and sources, these biases may still exist. Editors can exert significant influence over which material is published and therefore editorial bias also exists in many publications, including scientific peer-reviewed literature (Grod *et al.* 2010). While *SportDiving* was chosen in part for the consistency of its

editorial staff (the editors have been the same over the last 50 years), editor bias may still influence articles that are published. Additionally there is a range of publications dedicated to spearfishing (see Accessory Publication 1). Authors who write about spearfishing activities and present their opinions and attitudes may instead choose to submit to those publications. A content analysis of this material may reveal some differences in perceptions and attitude.

While this study can illustrate changes in author activity, attitudes and perceptions, we cannot identify the factors driving these changes. Detailed structured surveys of readers, authors and editors could identify these factors, and could also help to account for author and editor biases. Nevertheless, while the factors driving these changes cannot be identified, the content of *SportDiving*, and the diversification of recreational diving publications and viewpoints expressed in other sources all point to a broadening of interests that attest to the emergence of a new diver typology focussed on observational based activities, a greater appreciation of sharks and rays, and increasing concern for the marine environment.

Acknowledgements

We thank the editors of *SportDiving* magazine for the loan of archive material and support for the project. We also thank New South Wales Fisheries and the Great Barrier Reef Marine Park Authority librarians (Ms Suzie Davies and Ms Jenny Zadkovich) for the loan of additional copies of the magazine, and for assistance in searching through the National Library of Australia catalogue. Thanks also go to the Great Barrier Reef Marine Park Authority for facilitating this research. We appreciate the helpful comments provided by the anonymous reviewers.

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Manuscript received 16 June 2010, accepted 24 March 2011