Abstract

Given recent concerns about the degradation of coral reef ecosystems world-wide, we investigated the environmental history of the Great Barrier Reef of Australia using qualitative methods. In particular, we used archival and oral history sources to reconstruct changes in coral reefs, islands and marine wildlife species for the period 1860–1970 and we evaluated the potential of qualitative methods to inform marine environmental research. Here, we argue that qualitative research offers a valuable means of reconstructing environmental changes, their drivers and their historical contexts. However, we found that qualitative methods also had important limitations. Hence we identify strategies for addressing those challenges and we suggest criteria for ensuring the accuracy and rigor of qualitative sources in marine environmental research. Overall, we argue that qualitative methods offer distinctive insights into the environmental history of the Great Barrier Reef, and that qualitative reconstructions can act as important triggers for conservation of marine ecosystems.

Keywords: archival research, environmental history, Great Barrier Reef, marine environment, oral history, Queensland

Introduction

In the context of recent concern about the degradation of marine ecosystems, the condition of the Great Barrier Reef of Australia has received considerable scrutiny. Many authors have claimed that coral reefs world-wide are experiencing a critical deterioration as a result of impacts such as climate change, over-fishing and terrestrial run-off (Bellwood et al., 2004: 827–33; Hughes et al., 2003, 2005; Jackson et al., 2001: 629–38; Lawrence et al., 2002; Pandolfi et al., 2003, 2005). The Great Barrier Reef, shown in Figure 1, is the largest complex of coral reefs and associated species – and one of the most biologically diverse ecosystems – known to exist. The ecosystem extends...
for over 2000 kilometres along the north-eastern coast of Queensland and contains more than 2900 coral reefs. The Great Barrier Reef is regarded as one of the most pristine coral reefs in the world, yet the ecosystem nevertheless shows evidence of system-wide decline, including a significant reduction in coral cover over the last 40 years (Bellwood et al., 2004; Lucas et al., 1997: 65–6; QEPA, 1999: 5.4, 5.13 and 5.27; Wilkinson, 2000). Anecdotal reports
of the decline of the Great Barrier Reef also exist, attributing the degradation of coral reefs and their associated species to a wide range of human impacts. Attempts have been made to place changes in the ecosystem into historical perspective, but few environmental histories of the Great Barrier Reef have been written and limited historical information has been previously gathered about changes in the ecosystem (Bowen, 1994; Bowen and Bowen, 2002; Daley, 2005). In particular, few studies of the Great Barrier Reef have been based on the detailed, systematic interrogation of qualitative sources.

In this article, we demonstrate that qualitative methods can be used successfully to inform marine environmental research. We argue that qualitative sources can provide rich descriptions of environments and can offer a valuable means of reconstructing environmental changes, their drivers and their historical contexts. The use of qualitative sources allowed our environmental history narrative to extend back before the 1970s, when systematic scientific monitoring of the Great Barrier Reef commenced, to cover the period 1860–1970 for which scarce scientific information exists. Previously, archival and oral history sources had been little used to investigate changes in coral reefs, although they have considerable potential to inform environmental research (Daley, 2005). On the basis of our qualitative reconstruction, we suggest that many impacts on the Great Barrier Reef have been previously underestimated in scholarly works; those impacts include coral mining, coral and shell collecting, guano and rock phosphate mining, the creation of island coconut plantations, the introduction of exotic species, the development of infrastructure, and commercial dugong and turtle fishing. Many of these activities occurred in the Great Barrier Reef in more places, and for longer periods, than has been previously documented and parts of the Great Barrier Reef were probably far from pristine at the time of the formation of the Great Barrier Reef Marine Park (GBRMP) in 1975. However, the use of qualitative methods in marine environmental research has important limitations. Here we propose strategies to overcome those limitations and we suggest criteria to evaluate the accuracy and rigour of qualitative marine environmental research. Above all, we argue that qualitative methods offer distinctive insights into the environmental history of the Great Barrier Reef, and that qualitative reconstructions of marine ecosystems can act as important triggers for conservation.

We begin by outlining briefly what is known about the environmental history of the Great Barrier Reef based on scientific studies of large-scale impacts on the ecosystem. However, due to the complexity, size and geographical variability of the ecosystem, scholarly understanding of important periods and drivers of change is impoverished – especially for the period 1860–1970. The article goes on to relay what we have learned about the environmental history of the Great Barrier Reef, drawing on data culled from several thousand qualitative sources. We examine critically the sources used in our reconstruction and we suggest ways of using a variety of data to cross-reference information, where possible, so as to derive useful information about marine environmental changes. Hence in the sections that follow we consider in turn issues of data
collection and coverage, of data quality, and of the applicability of qualitative methods to marine environmental research. Specifically, we suggest ways to ensure that qualitative research into marine ecosystems is accurate and rigorous, and some criteria for evaluating qualitative sources. A case study is provided to illustrate our findings in relation to one specific location within the Great Barrier Reef: Low Isles (Figure 1).

The environmental history of the Great Barrier Reef

Many scientific studies have investigated environmental changes in the Great Barrier Reef (Hopley, 1982, 1988, 1989, 1994; Wachenfeld et al., 1997, 1998). These studies demonstrate that the Great Barrier Reef is a dynamic ecosystem characterized by constant changes at various geographical and temporal scales, largely due to geomorphological and climatic factors (Lawrence et al., 2002: 14). The Great Barrier Reef supported coastal Indigenous Australian societies for millennia but, following very rapid European settlement in Queensland, the natural resources of the ecosystem experienced more intensive exploitation, especially after 1900 (Bowen and Bowen, 2002: 2–3; Fitzgerald, 1982, 1984; Griggs, 1997, 2000; Hopley, 1989: 19). The direct exploitation of the Great Barrier Reef by European settlers commenced in the latter half of the 19th century in the form of bêche-de-mer (or trepang) and pearl-shell harvesting, as well as dugong and green turtle fishing. Another use of the Great Barrier Reef commenced when the first island tourist resorts were built on several islands (such as Green and Heron Islands) and a nascent reef fishing industry was also established. Although the present-day use of the Great Barrier Reef World Heritage Area (GBRWHa) is largely restricted to commercial and recreational fishing and tourism, scientific studies indicate that the ecosystem nevertheless displays systemic decline – including a substantial reduction in coral cover – since around 1960 (Bellwood et al., 2004: 828; Furnas, 2003; Jackson et al., 2001: 631; Pandolfi et al., 2003: 957; Williams, 2001). Terrestrial sediment and nutrient run-off, coral bleaching episodes, commercial and recreational fishing, tourism and coastal development are acknowledged to have impacted upon the Great Barrier Reef, with the most severe degradation affecting inshore habitats in the most accessible parts of the GBRWHa: in the Cairns, Townsville and Whitsunday regions, which have experienced intensive human use and substantial terrestrial run-off (Lawrence et al., 2002; McCulloch et al., 2003).

In the absence of sufficient scientific data about changes in the ecosystem for the period before 1970, the environmental history of the Great Barrier Reef can be extended and enriched using qualitative sources. Our reconstruction shows that the degradation of coral reefs and their associated species can be attributed to many human impacts: mining, habitat destruction, over-collection of marine specimens, commercial and recreational fishing, sediment and nutrient run-off, infrastructure development, pollution and the introduction of exotic species (Daley, 2005). While some of these activities were already
known to marine environmental scientists, our research shows that many of these activities occurred in the Great Barrier Reef in more places, and for longer periods, than has been previously documented. Thus dugong populations were acknowledged to be severely over-exploited as early as 1890, and pearl oysters and green turtles were harvested until those resources were locally depleted by 1927 and 1930, respectively (Christesen, 1936: 31; Moorhouse, 1935a: 20; Roughley, 1936: 219; Saville-Kent, 1890b: 713). Other activities in the Great Barrier Reef during the period 1860–1970 included coral mining, coral and shell collecting, guano and rock phosphate mining, the creation of island coconut plantations, the introduction of goats to many islands, and the construction of airstrips and tourism resorts (Daley 2005). Some of these activities – such as the coral mining industry that removed thousands of tonnes of coral from at least twelve locations in the Great Barrier Reef between 1900 and 1940 – would probably have remained unknown to marine environmental scientists in the absence of the surviving archival qualitative sources (Daley and Griggs, 2006).

Issues of data collection and coverage

The research was conducted by a multi-disciplinary team comprising an experienced historical geographer, two experienced marine scientists (including an academic researcher and an environmental manager) and a postgraduate student, with additional guidance from a range of academic researchers in the disciplines of biology, coral reef ecology and geography. We used an array of qualitative methods in our study; our sources are listed in Table 1. In particular, we made extensive use of archival and oral history materials, consulting many official records of the Cairns City Council, Queensland Department of Agriculture and Stock (QDAS), Queensland Department of Harbours and Marine (QDHM), Queensland Department of Native Affairs (QDNA), Queensland Environmental Protection Agency (QEPA), Queensland Government Tourist Bureau (QGTB) and Queensland Premier’s Department held in the Queensland State Archives (QSA) in Brisbane. Those archival sources were supplemented with documentary evidence gained from the official reports published in the Queensland Parliamentary Papers (QPP) and Queensland Votes and Proceedings (QVP), from export statistics published in the Statistics of the Colony of Queensland (SCQ) and in the Statistics of the State of Queensland (SSQ), from a sample of several hundred historical books, and from additional historical leaflets, maps, films and photographs.

Oral history sources provided further information, and 47 original semi-structured interviews were recorded between October 2002 and December 2003 with expert informants who were recruited using a snowballing technique. The informants included commercial and recreational fishers, tour operators, divers, naturalists, authors, nature photographers, lighthouse keepers, marine scientists, conservationists, museum staff, academic geographers,
Table 1  Sources of data used in our study

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<th>Source</th>
<th>Period</th>
<th>Type of material</th>
<th>Locations</th>
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<tr>
<td>Government reports</td>
<td>Pre-1970</td>
<td>QPP, QVP, SCQ, SSQ</td>
<td>Cairns Historical Society, Cairns</td>
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<td>University of Queensland Library, Brisbane</td>
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<td>Government records</td>
<td>Pre-1970</td>
<td>QDHM, QDNA and QEPA records</td>
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<td>QSA, Brisbane</td>
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<td>Historical books</td>
<td>Pre-1960</td>
<td>Description and travel literature</td>
<td>Australian Museum Library, Sydney</td>
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<td>Fiction</td>
<td>Cairns City Library, Cairns</td>
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<td>Scientific texts</td>
<td>Fryer Library, Brisbane</td>
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<td>GBRMPA Library, Townsville</td>
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<td>James Cook University Library, Cairns</td>
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<td>Queensland Museum Library, Brisbane</td>
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<td>Historical films</td>
<td>Pre-1960</td>
<td>Scenic films</td>
<td>Mitchell Library, Sydney</td>
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<td>Scientific films</td>
<td>ScreenSound Australia (National Screen and Sound Archive), Canberra</td>
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<td>Historical leaflets</td>
<td>Pre-1960</td>
<td>Information pamphlets</td>
<td>GBRMPA Library, Townsville</td>
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<td>Tourism brochures</td>
<td>John Oxley Library, Brisbane</td>
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<td>Tourism leaflets</td>
<td>National Library of Australia, Canberra</td>
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<tr>
<td>Historical maps</td>
<td>Pre-1970</td>
<td>Hydrographic survey charts</td>
<td>Historical Maps Collection, National Library of Australia, Canberra</td>
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<td>Scientific maps</td>
<td>Maps Unit, State Library of Queensland, Brisbane</td>
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<td>Tourism maps</td>
<td>QSA, Brisbane</td>
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<th>Source</th>
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<td>Historical photographs</td>
<td>Pre-1970</td>
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<td>Scientific photographs</td>
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<td>Historical Photographs Project, GBRMPA, Townsville</td>
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<td>IMAGES photographic collection, National Library of Australia, Canberra</td>
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<td>John Oxley Library, Brisbane</td>
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<td>Manuscripts</td>
<td>Pre-1980</td>
<td>Field diaries and notes</td>
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<td>Miscellaneous correspondence</td>
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<td>Newspapers</td>
<td>Pre-1960</td>
<td>The Cairns Post</td>
<td>The Cairns Post Archives, Cairns</td>
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<td>Original oral histories</td>
<td>2002–2004</td>
<td>Audio cassettes</td>
<td>Collected at various locations in Australia, and by telephone</td>
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<td>Interview transcripts</td>
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<td>Pre-existing oral histories</td>
<td>Pre-2000</td>
<td>Audio cassettes</td>
<td>Oral History Collection, National Library of Australia, Canberra</td>
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<td>Interview transcripts</td>
<td>Oral History Collection, School of History, James Cook University, Townsville</td>
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sugar-cane farmers and cane-cutters, tourists and local residents. The oral history materials were subsequently deposited at the Great Barrier Reef Marine Park Authority (GBRMPA) Library in Townsville. Reference is made to these original interviews using the abbreviation OHC (Oral History Cassette), followed by the cassette number, the date of the interview and the transcript page number(s). Our evidence was cross-referenced wherever possible, and information was collected and analysed in accordance with well-established methodological principles in qualitative research (Allen and Montell, 1981; Bouma and Atkinson, 1995; Denzin and Lincoln, 2000: 1–28; Gillham, 2000; Miles and Huberman, 1984; Robertson, 2000). Nonetheless, further consideration of the accuracy, quality, reliability and validity of our sources and methods forms part of the discussion below.

A variety of issues relate to the availability and scope of the qualitative materials describing the Great Barrier Reef. Scarcity of data was a significant problem for several reasons: records were not originally collected; subjects were not of contemporary interest; records were not preserved or archived; and some records were lost or destroyed. As a result, the time series is fragmentary – particularly for archival records – and for some environmental changes, as in our account of guano and rock phosphate mining, we were required to consult multiple sources to fill gaps (Daley and Griggs, 2006). However, many other issues were raised both by the pragmatic function and political nature of the sources and of the likely circumstances of their production. Our analysis of qualitative sources indicates that their coverage is uneven: it focuses on popular areas of the Great Barrier Reef in the vicinity of the Cairns, Townsville and Whitsunday areas, on key tourist island resorts, and on certain charismatic marine wildlife species and other species of commercial significance. In addition, the materials display a Eurocentric bias and they reflect the capacities and interests of the early European observers of the Great Barrier Reef. Therefore, the sources emphasize visible, discreet environmental impacts rather than imperceptible, gradual changes. Below, we discuss the most salient of these issues.

The scope of our study was largely determined by the availability or scarcity of data, which provided opportunities and constraints, respectively. Most significantly, very few qualitative sources describe the condition of the Great Barrier Reef prior to 1860. Earlier records are generally broad descriptions of entire coral reef formations and they largely represent geomorphological and hydrographic aspects of those structures without reference to individual coral reefs; even some accounts published after 1860, such as a notable work by Agassiz, focus on the macro-scale description of the Great Barrier Reef’s structure (Agassiz, 1898; Dana, 1872; Darwin, 1842). These works provided almost no information about the ecological condition of the ecosystem – nor could they valuably inform our environmental history account. For the period after 1860, however, a significant resource is available in historical books and in the official records and reports of the Queensland Government; those texts
indicatethatincreasingattention w as paid tothe condition of smaller parts of
the Great Barrier Reef, to specific islands and coastal areas, and to some
marine wildlife species. Such documentary records were created by natural-
ists, natural historians, scientists, public officials and journalists, and they are
exemplified by the detailed accounts of the Queensland Inspector of Fisheries,
William Saville-Kent (Saville-Kent, 1890a, 1890b, 1890c, 1893). Other, rich,
historical descriptions of the Great Barrier Reef (categorized as 'Queensland
description and travel') include the works of the naturalist, Edmund Banfield,
and various other popular writers such as Sydney Elliott Napier, Charles
Barrett and Arnold Charles Cooper Lock (Banfield, 1908; Barrett, 1930; Lock,
1955; Napier, 1928). We searched these works thoroughly to secure rich
descriptions of Great Barrier Reef habitats including, for instance, detailed
information about vegetation change on Dunk Island, near Innisfail.

Nevertheless, given the vast geographical extent of the Great Barrier Reef,
the coverage of these sources represents only a tiny fraction of the ecosystem.
For many parts of the Great Barrier Reef, no documentary evidence was avail-
able, and our sources revealed very uneven geographical coverage of the
ecosystem. In particular, the Capricorn-Bunker Group of the southern Great
Barrier Reef is comparatively well-documented in historical books, leaflets,
films and Queensland Government reports and records, reflecting its proxim-
ity to the State capital, Brisbane, and the earlier popularity of that area for
tourism, scientific research and naturalism in comparison with the more
remote Far Northern Section). The relative scarcity of documents describing
the Far Northern Section hindered the cross-referencing of our sources, as
there were locations for which oral histories could not be supported by docu-
mentary sources and vice versa. Where our sources could not be cross-
referenced, they were not used to derive conclusions unless a high degree of
internal consistency suggested that those observations were reliable. However,
the variability in geographical coverage of documentary materials underlines
the fact that European access to, and use of, the Great Barrier Reef varied
along the coast of Queensland; as a result, different parts of the ecosystem
have different environmental histories.

Issues relating to the availability of sources were especially apparent in the use
of archival files. McLoughlin (1999, 2000) described the difficulties involved in
obtaining and using archival materials in New South Wales, and we encoun-
tered comparable problems for Queensland in our research. For example, the
sequence of archival files of the QDHM that relates to coral mining begins and
ends abruptly; the Deputy State Archivist of the QSA stated in 2003 that other
files may have been lost when the Departmental offices in Brisbane were inun-
dated during the Australia Day floods of 1974. The administration of the Great
Barrier Reef involved six different Queensland and Commonwealth Government
Departments, as Bowen and Bowen (2002) acknowledged, and the archival
records of those Departments contained gaps and varied in their coverage. As a
result of these limitations, our environmental history is incomplete and we
deduce that some environmental changes occurred for which other evidence may have been lost. For instance, the sequence of surviving records of coral mining licenses indicates that other licenses were probably issued in addition to those now held in the QSA. To some extent, we were able to use oral histories to illuminate environmental changes that could not be reconstructed using surviving archival sources alone; the coral mining operation at Snapper Island, north of Cairns, for example – for which no archival evidence was found – was reconstructed instead using oral history evidence (Daley and Griggs, 2006).

Our study was also constrained by difficulties in obtaining suitable oral history evidence. Oral history informants who could remember the period before the Second World War were difficult to find or were unable to take part in the research because of poor health. Informants were also scarce for the period from 1945 to 1955, and the environmental history narratives for that period are comparatively sparsely supported by oral history evidence; for that period, therefore, we relied more heavily on documentary sources. In contrast, many informants were found for the period since 1970, although this period was not the focus of our research and those informants could not provide the extended historical perspective that we sought. Informants were most easily recruited in the Cairns area, where our study was based; the closer proximity of the Great Barrier Reef to the mainland in northern Queensland – as well as the abundance of tourist activities in the Cairns and Whitsunday areas – meant that more informants may have encountered the Great Barrier Reef in those areas than elsewhere. We made research trips to central and southern Queensland, and we also used telephone interviewing, in order to recruit informants from other locations.

In particular, our study lacked an Indigenous Australian perspective towards changes in the Great Barrier Reef. Although we contacted Aboriginal and Torres Strait Islander communities and Indigenous Land Councils, and we sought to involve Indigenous informants in our study, no such involvement took place: many communities – with the exceptions of the Yarrabah, Palm Island and Umagico communities – did not grant permission for local residents to be interviewed. Where permission was granted, contact with informants failed to generate any recorded oral histories. Unfortunately, therefore, our environmental history study does not represent Indigenous perspectives towards the impacts of European settlers in the Great Barrier Reef and that subject remains a valuable direction for further research, if the required trust and research capacity can be established. The only engagement with Indigenous concerns in our study was the use of restricted archival files of the former QDNA. Those files provided valuable information about the capture of dugongs in order to produce medicinal oil for use in Aboriginal settlements, about commercial dugong and turtle fishing by Aboriginal communities, and about commercial attempts to farm marine turtles in Torres Strait as a source of employment for Torres Strait Islander people. However, the sensitive and restricted nature of many of these archival files creates further problems of
access to data and compounds the Eurocentric character of environmental history accounts of the Great Barrier Reef. Paradoxically, while rich descriptions of environmental changes in the Great Barrier Reef for the period before 1960 are comparatively scarce – particularly for habitats and species that were not crucial to the developing economic base of Queensland – certain types of qualitative material were available in vast quantities. Many historical books categorized as ‘Queensland description and travel’ contain references to the Great Barrier Reef, although a limited ability to search for sub-categories restricted our ability to sift this material efficiently. The large majority of these works did not provide useful ecological information about changes in the coral reefs, islands and marine wildlife species of the Great Barrier Reef, although they frequently provided interesting examples of the ways in which the ecosystem was used and perceived. A related problem was the tendency for many authors to provide extremely rich descriptions of coral reefs, but with insufficient geographical information to permit any precise locations to be identified; hence, their evidence could not be used. As a consequence, the most valuable ecological information for our study was obtained through a very extensive process of searching large numbers of texts. We dealt with this problem by adopting a sampling procedure, using electronic catalogue searches based on 92 keywords, and then by searching for other works by the most informative authors or using those keywords that yielded the most valuable data.

The issues described above present considerable challenges to qualitative research for a marine environment. Several strategies can be used to secure reasonable data, nonetheless. The use of an array of qualitative sources and methods allowed gaps in the data to be filled; this approach also enabled comparisons of different methods and revealed consistent biases in some sources. For instance, the Annual Reports of the QDHM were concerned with the marine resources of the Great Barrier Reef; in contrast, our oral history evidence focused on changes in the most popular recreational locations and in charismatic megafauna. Cross-referencing of sources formed another valuable strategy and in some cases this allowed unexpected data to be collected, as in one instance when a historical photograph of a green turtle fishing enterprise on the Fitzroy River – reproduced in Figure 2 – prompted one oral history informant to disclose his involvement in the trade and to provide valuable information about the supply of green turtles to the Lakes Creek Meat Works, in Rockhampton.

As a consequence of our use of qualitative materials to reconstruct ecological changes for which scant scientific information existed, we were obliged to rely on the use of proxies. The use of proxy evidence in our study is guided by the use of that term by scientists reconstructing Holocene or Quaternary environmental changes. Bell and Walker (2005: 17), for example, stated: ‘The term “proxy” is used to refer to any line of evidence that provides an indirect measure of former climates or environments’. Those authors acknowledged
that qualitative sources such as parish records can function as proxies for ecological changes (emphasis in original; see also Roberts, 1998: 211). Where changes in the Great Barrier Reef could not be reconstructed directly from surviving qualitative sources, we reconstructed the extent of the historical activities that were based on the ecosystem’s resources and then estimated the likely ecological impacts of those activities. For instance, our account of the impacts of commercial dugong fishing to supply oil to Aboriginal settlements used official records of the oil quantities ordered by the Superintendents at the settlements; those figures were combined with other records indicating the quantity of oil available from a dugong of average size to provide an indication of the numbers of animals caught. The validity of this approach requires consideration since it involves assumptions about the direction and magnitude of ecological changes and about the causal relationships involved. In a study of reconstructions of historical dugong populations in the Great Barrier Reef, Marsh et al. (2005) emphasized the importance of making such assumptions explicit and subjecting them to appropriate scrutiny. Furthermore, the use of
proxies may lead to heavy reliance on some key sources. For instance, our reconstruction of coral mining relied on a comparatively small number of documents held at the QSA, although those documents contained extremely valuable evidence.

**Issues of data quality**

Many authors have discussed the problems of subjectivity that characterize qualitative research (Bailey et al., 1999; Crang, 2002; Denzin and Lincoln, 2000; Gillham, 2000; Silverman, 1993; Strauss and Corbin, 1998). Partiality, bias and subjectivity characterized the materials we consulted, even where those materials were produced by scientists using positivist, empirical techniques. The comparative scarcity of systematic, qualitative records for the Great Barrier Reef prior to 1960 in part reflects contemporary perceptions about which subjects were, and which were not, worthy of scholarly attention. Furthermore, many of the documentary sources consulted in our study actually contained numerous quantitative data, such as the extensive records of bêche-de-mer, pearl-shell and trochus harvests from the northern Great Barrier Reef and Torres Strait published by the QDHM, although those data were usually published alongside qualitative descriptions of the development of those industries. In any case, the selection of subjects for recording and publication reflects judgments about the value of Great Barrier Reef resources and industries. Hence our qualitative sources generally privileged those marine resources that were beneficial to the development of Queensland. Yet those sources were rarely intended to produce data for scientific analysis; instead, they were published for administrative and political reasons and their interpretation in contemporary ecological research requires caution. For instance, records of the annual numbers of dugongs caught in Moreton Bay are not continuous; for some years, the extent of this fishery was not reported by the Queensland Chief Inspector of Fisheries. This absence does not imply that the capture of dugongs commenced or ceased – but rather that reporting the harvest was, between particular years, either impossible, or not of administrative significance.

Issues of language and nomenclature presented other considerations. The relative lack of scientific knowledge that existed about the Great Barrier Reef, before the establishment of systematic scientific monitoring, limited the quality and extent of qualitative descriptions of the ecosystem. Prior to 1950, for example, a small number of generic terms – such as *Madrepore*, *Acropora*, 'brain coral', 'branching coral' and 'plate coral' – were used to describe an abundance of coral species in a coarse fashion; more detailed scientific information about coral taxonomy was not available until advances in coral classification were made by Veron (1986, 1995, 2000) and other coral reef scientists since the 1970s. This problem is compounded by the fact that difficulties in accessing the Great Barrier Reef in the period before the widespread use of motorized boats and underwater viewing equipment limited the number of coral reefs and
species that could be observed and described in qualitative sources. Our analysis of the types of records preserved in historical books and official documents suggests that accurate observations of coral reefs may have been prevented by the unwillingness of observers to get into the water, perhaps due to an inability to swim, fear of sharks and other marine organisms, or unwillingness to steer vessels too close to hazardous coral reef structures. Furthermore, prior to the introduction of GPS technology, precise geo-referencing of coral reef locations was difficult. As a result, there exists a scarcity of qualitative data about the Great Barrier Reef that is useful to modern marine ecologists.

A further difficulty – especially with long time series – is the inconsistencies that were introduced as a result of different reporting procedures, the use of different units of measurement, the reporting preferences of different officials, and the consolidation of analytical categories in Queensland Government reports. These difficulties are revealed in the use of publications such as the SCQ and SSQ, in which coral exports are measured in ‘packages’ of indefinite size, export values change from pounds sterling to dollars, tortoise-shell exports are listed variously in imperial pounds and in monetary values, export quantities of dugong oil are merged with export quantities of other oils, and exports of turtle meat are not differentiated from exports of other meats. A further difficulty is the deflation of currency values that accompanied inflation during the historical period of our study. The integrity of historical time series, in general, is highest for discrete industries that operated for short periods, such as the humpback whale fishery, based at Tangalooma, in Moreton Bay, near Brisbane, between 1952 and 1962, which exploited the humpback whale populations of the Great Barrier Reef, and the rock phosphate industry that operated at Holbourne Island, near Bowen, from 1918 to 1921. The output of both of those industries is described in continuous time series, and the humpback whale fishery was also monitored by scientists of the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Nevertheless, the integrity of short data sets is not guaranteed: the removal of wild turtle eggs in Torres Strait between 1970 and 1979 by turtle farmers is illuminated by limited documentary evidence because that programme failed to incorporate adequate scientific monitoring (Coulter, 1958: 1015; 1959: 1096–7; 1960: 1153; Peel, 1961: 750).

Consequently, the interpretation of such sources requires caution and, where possible, cross-referencing of sources is required in order to improve the precision and reliability of these data. In our reconstruction of many impacts on the Great Barrier Reef, including coral mining, coral and shell collecting, guano mining, island vegetation clearance, the introduction of exotic species, island infrastructure development, and dugong and turtle harvesting, we found many opportunities to cross-reference our documentary and oral sources. Therefore, none of those accounts relied on a single source, and some impacts, such as the changes resulting from the construction of the Heron Island boat channel, were described by many qualitative sources, including photographs. Where an abundance of
sources allowed comparisons to be made, we found that the official reports and records published in OPP, QVP, SCQ and SSQ, in general, provided greater precision and reliability than other historical documents. At least, those materials were subjected to public scrutiny and, during the many decades of their publication, considerable expertise in collecting and reporting these data was acquired by public officials.

Similar variations in data quality characterized our oral history evidence. That evidence was frequently disappointing in its quality and coverage. Many informants could not provide details about the underwater environment, even if they regularly visited the Great Barrier Reef in boats. If informants had not actually looked underwater with snorkelling or SCUBA equipment, or had not walked on coral reefs at low tide, their recollections of changes in coral reefs lacked precision. For example, one informant, an experienced coral collector, provided the following description:

We used to dive quite a bit around what is now called Vlasoff Cay [near Cairns] – it used to be called Little Upolu – and there were some pretty spots there. I’ve dived that for quite a few years and I can’t say that I noticed any particular change there. But I haven’t been out there for several years now, so what it’s like now I just wouldn’t be sure. We used to go along the coast and have a look at the coastal reefs, too. There used to be some pretty coral along the coast. Even Double Island [near Cairns] had some nice coral around it. I haven’t been there for many years. I don’t know what it’s like now, but it used to be pretty good. Further up, just before you get to Port Douglas, the reef there has some interesting types of coral. And there used to be a lot of weed – a small kelp weed – growing there. [...] In latter years, that reef deteriorated, too.

In addition, comparatively few informants had re-visited coral reefs and had looked for environmental changes; if informants had done so, few had kept systematic, detailed records of those changes, their locations and their dates. Furthermore, observations of environmental changes may have contained inaccuracies or ambiguities. Often, for example, oral history informants could not remember at which one of several coral reefs they had actually observed an environmental change.

The triangulation of one oral history source with another was not always sufficient to ensure the authenticity of data, because two independent informants may have simply recounted the same well-known story about environmental change, or both informants may have read the same documentary account. This difficulty – the transmission of environmental stories – is compounded by the observation, described by Cronon (1992), that narrators of environmental history can adopt either optimistic or tragic plots in their narratives, and so reach different conclusions, despite using the same historical evidence. Therefore, oral history interviews should not simply record narratives of environmental changes, but should also probe the ways in which such narratives have been acquired. For example, several oral history informants who described coral mining in the Great Barrier Reef recalled details that had been
published in a documentary account written by a local historian, Dorothy Jones (Jones, 1961: 317); one informant acknowledged that his evidence was informed by Jones’ account. His oral history evidence was discounted since it appeared to add no original material to that written account.

However, some oral history informants provided unique evidence – that was not supported by any other source – yet which was apparently authentic. This observation applied particularly to very early recollections for which no other source was found; it also applied to specialized observations made by expert witnesses, and for which no other informant could be expected to have comparable knowledge. In these instances, lack of triangulation should not have precluded the use of this oral evidence, since these informants could in fact provide more valuable material than other, less well-informed individuals. Furthermore, to dismiss these unique insights would have been to fail to exploit the distinctive possibilities offered by oral history research. Unique evidence was handled in the following way: it was identified as the evidence of a single informant; that informant was acknowledged to be an expert; the material was cited at length, so as to preserve as much of the original context of the observations as practicable; and cross-references were made, where possible, to related scholarly sources that indicate that the oral evidence may be credible. These procedures were developed in an attempt to ensure the quality of unique evidence.

Since many environmental changes occur over time scales longer than human life-spans, oral history evidence is not suitable for investigation of longer-term changes. Oral history evidence is limited by the scarcity of informants who can recall other changes of shorter duration, yet which require decades of observation, such as the recovery of massive corals from disturbances or the impacts of the coral mining industry. For changes of this period, however, oral history evidence can be cross-referenced with documentary sources. For shorter period – decadal – variations, oral history is highly effective, since that period coincides with the period for which many informants worked professionally in a single area, or visited the same locations on several occasions on a recreational basis. Therefore, for example, oral history evidence was particularly suitable for collecting detailed descriptions of decadal changes in coral cover, island vegetation and fauna, the development of infrastructure on islands, marine wildlife species abundance, and harvests of fisheries. Of particular suitability for oral history research are discrete, memorable environmental impacts of short duration, such as the dugong fishery at Burrum Heads, near Bundaberg, and the operation of commercial turtle fishers at Masthead Island and on the Fitzroy River. In contrast, oral history informants (other than certain expert informants) could not detect invisible impacts, chronic conditions or very gradual environmental changes.

The use of oral history sources also raised issues of participation and representation; many views are not gathered in oral history research. In our study, the views of Indigenous Australian people were not represented. Such omissions are
significant limitations of any environmental history narrative, yet it is not possible to include every point of view; instead, those limitations should be acknowledged. Further oral history research could be carried out with Indigenous Australian informants who may provide radically different narratives of environmental changes in the Great Barrier Reef. Our use of oral history methods also did not represent the evidence of those potential informants who were not willing to participate in our research – sometimes because they expressed fears that their evidence would be used to justify restrictions of their activities in the GBRWHA – and the evidence of those informants who would not allow key data to be recorded, including shell collectors who expressed concern about being blamed for the perceived depletion of shells. Other than assuring confidentiality to those informants, no other strategy to encourage disclosure of this information could be devised. The most potentially valuable information, then, often proved to be sensitive and was not recorded. Overall, the reservations held by reluctant informants underlines the fact that qualitative research into marine environments is based on perceptions – of the research process as much as of the marine environment.

**Issues of applicability to marine environmental research**

Baxter and Eyles (1997: 507) drew attention to the importance of establishing and demonstrating rigour in qualitative research and they listed eleven strategies for ensuring that researchers in social geography demonstrated the accuracy and reliability of their findings. Their strategies are as follows: providing a rationale for the methodology; using multiple methods; identifying the groups of respondents; including interview quotations; providing details of how interviews were conducted; describing procedures for data analysis; undertaking lengthy fieldwork; revisiting respondents; asking respondents to verify data; connecting the research findings with scholarly literature; and providing a means of demonstrating clear linkages between researcher interpretations and the meanings held by respondents. Their suggestions apply equally to our research; but, here, we extend their work and suggest additional criteria for ensuring that qualitative research into marine environments is accurate and reliable.

We suggest that the value of qualitative evidence could be assessed using the criteria listed in Table 2. Although these criteria are indicative only, as a result of the diverse nature of qualitative materials, the most valuable qualitative sources in our study were characterized by geo-referenced observations to specific parts of coral reefs, or to precise marine locations, at specific dates, and they contained observations made by competent scientists. At best, this type of evidence enabled species-level identification of organisms and revealed environmental changes observed during several successive visits to specific coral reef locations. The best observers displayed a sensitivity to the appearance of marine environments and an awareness of the possibility – but not
<table>
<thead>
<tr>
<th>Category</th>
<th>Criteria</th>
<th>Examples</th>
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<tbody>
<tr>
<td><strong>Most valuable</strong></td>
<td>Geo-referenced observations to specific parts of coral reefs or to precise marine locations</td>
<td>Hedley (1924)</td>
</tr>
<tr>
<td></td>
<td>Observations made by competent scientists</td>
<td>Mackay et al. (1908)</td>
</tr>
<tr>
<td></td>
<td>Dates of observations recorded and provided</td>
<td>Moorhouse (1935a, b)</td>
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<td></td>
<td>Species-level identification of organisms</td>
<td>Saville-Kent (1890a, b, c; 1893)</td>
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<td></td>
<td>Several successive visits to specific locations</td>
<td>Steers (1938)</td>
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<tr>
<td></td>
<td>Sensitivity to appearance of marine environments</td>
<td>OHC 4, 14 January 2003</td>
</tr>
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<td></td>
<td>Critical awareness of observer biases, errors in recollection, and subjectivity</td>
<td>OHC 15, 27 August 2003</td>
</tr>
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<td></td>
<td>Information about critically endangered species</td>
<td>OHC 30, 3 October 2003</td>
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<tr>
<td></td>
<td></td>
<td>OHC 35, 20 October 2003</td>
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<td></td>
<td></td>
<td>OHC 44, 4 December 2003</td>
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<tr>
<td><strong>Highly valuable</strong></td>
<td>Geo-referenced observations to individual coral reefs or to general marine locations</td>
<td>Banfield (1908)</td>
</tr>
<tr>
<td></td>
<td>Observations made by competent observers (non-scientist professionals with relevant expertise)</td>
<td>Barrett (1930, 1943)</td>
</tr>
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<td></td>
<td>Some dates of observations recorded and provided (at least to year-level)</td>
<td>Lack (1968)</td>
</tr>
<tr>
<td></td>
<td>Genus-level identification of organisms</td>
<td>Napier (1928)</td>
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<tr>
<td></td>
<td>Information about endangered species</td>
<td>OHC 12, 2 July 2003</td>
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<td></td>
<td></td>
<td>OHC 34, 12 October 2003</td>
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<td></td>
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<td>OHC 41, 12 November 2003</td>
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<tr>
<td><strong>Moderately valuable</strong></td>
<td>Geo-referenced observations to particular regions of the Great Barrier Reef</td>
<td>Caldwell (1936, 1938)</td>
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<tr>
<td></td>
<td>Observations made by proficient amateur observers with some relevant expertise</td>
<td>Christensen (1936)</td>
</tr>
<tr>
<td></td>
<td>Some dates of observations recorded and provided (at least to decade-level)</td>
<td>Hughes (1937)</td>
</tr>
<tr>
<td></td>
<td>Accurate identification of organisms to Order-level or using common names</td>
<td>OHC 19, 9 September 2003</td>
</tr>
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<td></td>
<td>Information about vulnerable species</td>
<td>OHC 27, 17 September 2003</td>
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<tr>
<th>Category</th>
<th>Criteria</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least valuable</td>
<td>Geographical locations not identifiable from observations</td>
<td>Lamond (1936)</td>
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<td></td>
<td>Amateur observations</td>
<td>QGITB (1923)</td>
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<td></td>
<td>Dates of observations not recorded or provided</td>
<td>QGTB (1930)</td>
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<td></td>
<td>No taxonomic information available</td>
<td>Reid (1933)</td>
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<td></td>
<td>Little sensitivity to appearance of marine environments</td>
<td>OHC 25, 16 September 2003</td>
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<td></td>
<td>No critical awareness of observer biases, errors in recollection, or subjectivity</td>
<td>OHC 28, 19 September 2003</td>
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<tr>
<td></td>
<td>Observers committed to positions of political, economic or environmental advocacy</td>
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Note: Examples relate to the Great Barrier Reef. These criteria are indicative only, as a result of the diverse nature of qualitative materials. Also, they do not include Indigenous Australian perspectives.
the inevitability – of environmental change. Those observers often also
demonstrated critical awareness of observer biases, errors in their recollection,
and the subjectivity of their observations. An alternative, but equally valuable,
type of qualitative evidence contained information about species of conserva-
tion concern, which could represent data of considerable conservation value.
In contrast, the least valuable qualitative evidence was characterized by few or
none of these attributes and could also reflect positions of political, economic
or environmental advocacy held by observers. In suggesting these criteria, we
are interested in the value of qualitative sources to inform marine ecological
reconstructions and hence we emphasize the value of scientifically accurate,
verifiable, environmental information. The value of any source of data
depends on the purpose of the research, however, and we acknowledge that
different research goals would identify different criteria and evaluate sources
differently.

The importance of using qualitative sources with due critical awareness has
been emphasized by Marsh et al. (2005), in response to several contentious
assessments of the past conditions of several coral reefs, including reconstruc-
tions of the historical populations of some marine wildlife species (Jackson
et al., 2001; Pandolfi et al., 2003). Reconstructions of those populations based
on relatively uncritical analyses of documentary sources, as exemplified in
studies by Jackson et al. (2001) and by Pandolfi et al. (2003), are highly prob-
lematic. Marsh et al. (2005) investigated the assumptions on which those
reconstructions were based and argued that, while such estimates may act as
valuable triggers for conservation, they are unrealistic as targets for the recov-
ery of vulnerable populations. In particular, they stressed that greater scientific
understanding of the diving behaviour of dugongs can inform more accurate
aerial survey estimates of the abundance of these animals. While such investi-
gations indicate the lack of sustainability of current Indigenous hunting of
dugongs in Torres Strait, those studies also show that the response of marine
wildlife species to anthropogenic and natural pressures may be complex, and
that further scientific research and monitoring of dugongs is required to under-
stand local changes in dugong abundance (Chilvers et al., 2004: 222; Marsh
et al., 2004: 435). Qualitative researchers can make valuable contributions to
contemporary scientific and environmental management debates by offering
more skilled analyses of historical documents and oral history evidence than
some recent approaches have incorporated. In return, modern scientific
research offers the possibility that the use of qualitative sources can be made
more rigorous if qualitative researchers make their interpretive assumptions
explicit and then subject those assumptions to appropriate scrutiny.

The main strength of qualitative methods is that they offer distinctive
insights into environmental changes – and their historical contexts – that are
not available using other sources. For example, the extent of the coral mining
industry in the Great Barrier Reef cannot be reconstructed using quantitative
techniques because the effects of that industry can no longer be distinguished
from other mechanical impacts on the coral reefs that were mined. The transformation of some cays in the Great Barrier Reef as a result of the establishment of coconut plantations, similarly, may not have been revealed without the evidence found in the Annual Reports of the QDAS and the Agent-General for Queensland. Nor could the impacts of turtle farming in Torres Strait have been documented using quantitative techniques, since the necessary ecological information was not gathered. In the absence of quantitative data, qualitative sources provide the only means of reconstructing these significant environmental changes. Furthermore, where archival qualitative sources appear to be incomplete – as with the surviving records of coral mining licences – then other qualitative materials, such as oral history interviews, can provide additional information.

Qualitative materials can also reveal the contexts of environmental changes and allow the production of rich descriptions of historical processes. For example, our research indicates that the operations of both the commercial dugong and turtle industries in Queensland were motivated by influential individuals or companies, whose energetic promotion of the fisheries was critical in their development. Moreover, the development of both of these industries during the 19th century was connected to the emerging world economy: both industries shipped products to Europe – and particularly to London – where individual buyers could be found at various Expositions and exhibitions and where those products could be promoted by the Agent-General for Queensland (Daley, 2005). Therefore, a postcolonial reading of these qualitative sources reveals that the Great Barrier Reef dugong and turtle fisheries did not operate independently of the emerging world economy, but were dependent upon distant markets and traders. Similarly, the operations of the early European reef fisheries for bêche-de-mer, pearl-shell and trochus were controlled by international markets, yet the influence of those economic forces varied between these resources. Hence, pearl-shell resources collapsed before the demand for the product declined, while the demand for trochus decreased before that resource had been depleted. These historical contexts are revealed only by qualitative materials and are not discerned using scientific methods.

A further value of qualitative research for marine environments is in identifying possible sites, themes or baselines for use in scientific research and monitoring. Our results indicate strongly the need for scientific research and monitoring of the coral reefs, islands and marine species of the GBRWHA. We have suggested particular test sites and marine wildlife species which might valuably inform scientific research, monitoring and modelling programmes, including eleven locations that might be suitable for the analysis of coral mining impacts, thirteen island habitats that have been modified in various ways, and six marine wildlife species that may require additional conservation measures as a result of their historical exploitation. For those sites and species, our historical accounts could usefully be linked with geochemical and ecological reconstructions of environmental changes. Our research has also identified
numerous baselines, since the locations and dates of various historical impacts have been reconstructed in considerable detail. Those baselines suggest that the exploitation of the Great Barrier Reef took place earlier, for a longer period, in more locations and more intensively than has previously been documented. Consequently, in 1975, the newly-formed GBRMPA inherited management responsibilities for an ecosystem that was probably far from pristine.

Case study: coral death at Low Isles

Some of the issues discussed above are illustrated by a case study of the use of qualitative methods in assessing the changing condition of the coral reef at Low Isles, north of Cairns (Figure 1). Extensive scientific observations were made of the Low Isles reef during the 1928–1929 Great Barrier Reef Expedition (British Museum (Natural History), 1930–1940). Those observations were recorded in detail and a map of the Low Isles reef was produced (Figure 3). In August 1954, a group of scientists re-visited Low Isles for the purpose of investigating changes in the reef since the earlier expedition. One expert oral history informant interviewed during our research, a marine biologist, took part in the 1954 research trip; she then returned to the reef in 1969, aboard the Cape Moreton, and later aboard the Marco Polo, with Professors Yonge and Steers (who had also been to Low Isles previously) during the Second International Coral Reef Symposium and she made further comparisons of the condition of the corals. That informant reported observing ‘very significant differences’ in the Low Isles reef; especially, she acknowledged that considerable changes had occurred to the large corals known as *Porites* micro-atolls in the vicinity of Thomas Alan Stephenson’s former ‘Porites Pond’, located on the north-eastern part of the reef, which is illustrated in Figure 3. She stated:

That *Porites* colony was very much in existence at that time [August 1954]. [...] My remembrance of these *Porites* micro-atolls was that around the perimeter of each there were masses of the tubeworm, *Spirobranchus*. And in 1969, [...] I couldn’t find anything, anywhere. To me, it was all dead coral. I thought I must have made a mistake. I don’t think that any of the other people interested in coral reefs, like Stephenson and Endean and [Yonge and Steers], had been back to Low Isles from 1954 to 1969, and all of them expressed surprise at seeing what had happened in that time.8

This informant reported that the *Porites* corals had been covered in mud, which she attributed to sedimentation from the Barron and the Daintree Rivers. During a subsequent visit to Low Isles in July 2000, the same *Porites* corals were photographed; two of those photographs are reproduced in Figure 4.

This account has several implications. The potential for research into changes in a coral reef using qualitative sources is exceptionally rich in this example. At a single coral reef, one particular area – the ‘*Porites* Pond’ – was identified
precisely as the location of change; that location can be identified on the map of Low Isles produced during the 1928–1929 Great Barrier Reef Expedition (Figure 3) and could also be re-located, during subsequent visits, by other scientists. The timing of the observations of that area can also be identified precisely: the observations were made in 1928 and 1929, in August 1954, in 1969, and in July 2000. Scientific observations were made on each occasion by several expert observers who were highly competent in observing coral reefs – at least by contemporary standards at the times of their visits. The observations were recorded in the form of detailed, written notes and were also documented in photographs. Corals and other species were identified to the genus level (including *Porites* and *Spirobranchus*) in these observations. The more recent observations could be compared with the published record of the 1928–1929 study, which served – for these scientists – as an ecological and geomorphological baseline. Several scientists visited the reef on each occasion, which allowed for discussion and comparison of their observations. The informant who participated in the oral history interview had her written and photographic records available at the time of the interview for reference; a second oral history informant – also a competent marine scientist – also visited Low Isles separately in 1970 and reported

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**Figure 3.** Map of Low Isles showing the location of the ‘Porites Pond’ near the northern extremity of the reef, adjacent to the ‘Tripneustes Spit’, 1928–1929

*Source: Stephenson et al. (1930–1940: 23)*
the apparent degradation of that reef in comparison with the published records of the 1928–1929 Great Barrier Reef Expedition. All of these factors suggest that the reliability of these observations is probably extremely high; indeed, this example represents probably the best imaginable scenario for the reconstruction
of changes in a coral reef using qualitative sources. In spite of this, no information about the causes of the deterioration of the *Porites* corals – other than the suggestion that sedimentation from the nearby Barron and Daintree Rivers may have been responsible – could be obtained. In spite of extensive qualitative descriptions of the deterioration of corals, scientific research and monitoring of coral reefs is required in order to elucidate the causes of those changes (see McCulloch et al., 2003).

**Conclusion**

Qualitative data can be invaluable in reconstructing ecological histories. In this article, we have demonstrated that qualitative sources can provide vital historical and contextual clues into the history of one of the most important and endangered ecological treasures in the world. We have discussed many aspects of the use of qualitative research into the Great Barrier Reef and have explored some implications for the use of qualitative sources in marine environmental research. We have also suggested criteria for the evaluation of qualitative sources in marine environmental research (Table 2) and illustrated some of the issues in the use of those sources by means of a case study. Of course, the particular nature of qualitative sources means that criteria of the sort presented in Table 2 cannot be applied rigidly to materials. Hence the exceptional potential of the sources described in our case study yielded a clear description of one environmental change (the sedimentation of *Porites* corals on the northern part of Low Isles reef) but little causal information. In contrast, the apparently less promising archival qualitative sources used to reconstruct the coral mining industry provided not only robust indications of the nature of that industry’s impacts but also considerable details about the methods and motivations of coral miners, the involvement of the Queensland Government in promoting the industry, and the precise locations of some habitat modifications that remain in the landscape (Daley and Griggs, 2006). These and other surprises repeatedly characterized our experience of using qualitative methods to reconstruct the environmental history of the Great Barrier Reef. We suggest that the criteria presented in Table 2 might provide guidance to researchers in collecting and analysing qualitative material relating to marine environments; nevertheless, researchers should be alert to the potential of qualitative sources that do not fit neatly into our classification.

Overall, our findings are consistent with other reconstructions of ecological changes, which indicate that the coral reefs of both the inner and the outer Great Barrier Reef now exist in conditions that are far from pristine. For instance, Pandolfi et al. (2003: 957) stated:

The overall historical trajectory of reef degradation across all cultural periods is markedly linear [...]. Most importantly from the perspective of reef conservation and management, most of the reef ecosystems [considered in our survey] were
substantially degraded before 1900. Recent widespread and catastrophic episodes
of coral bleaching and disease have distracted attention from the chronic and
severe historical decline of reef ecosystems [...]. However, all of the reefs in our sur-
vey were substantially degraded long before the first observations of mass mortality
resulting from bleaching and outbreaks of disease.

Therefore, these authors argued that the contemporary management of the
Great Barrier Reef should be concerned with ‘restoring the reefs that are clearly far from pristine’; those reefs require to be ‘promptly and massively pro-
tected from human exploitation’ if they are to survive (GBRMPA, 2004; Pandolfi et al., 2003: 957).

In another recent account of the degradation of the Great Barrier Reef as a
result of human activities, Hughes et al. (2005: 2) argued that a wealth of qual-
itative information about the profound transformations of marine ecosystems
resulting from human activities has been largely ignored in contemporary envi-
ronmental management. Those authors also acknowledged that ecologists
increasingly focus on the ‘cumulative and interactive effects of sequences of
events, rather than concentrating solely on the most recent insult that leads to
ecosystem collapse’ (Hughes et al., 2005: 2). Qualitative research can make
valuable contributions to the ecological study of environmental changes, not
least because qualitative methods are well suited to exploring the ‘cumulative
and interactive effects of sequences of events’ (Hughes et al., 2005: 2). Our
reconstruction of the environmental history of the Great Barrier Reef for the
period 1860–1970 combined rich descriptions of environmental changes, inves-
tigations of the economic and political contexts of those changes, and
analysis of the linkages between the exploitation of the Great Barrier Reef dur-
ing the 19th century and the emerging world economy. Such an approach has
much to offer ecological research into marine environments. Qualitative
researchers, in turn, can benefit from closer engagement with the concerns and
methods of marine environmental scientists and managers.

ACKNOWLEDGEMENTS

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Australian Research Council (ARC), with additional funding from GBRMPA.
The authors also wish to thank the oral history informants who contributed to
the study, and the three anonymous reviewers of this article.

NOTES

1. A more detailed account of coral, guano and rock phosphate mining in the Great
Barrier Reef, together with a discussion of the reconstruction of that industry
using archival records, is provided by Daley and Griggs (2006). A similar recon-
struction of historical coral collecting in the Great Barrier Reef is provided by Daley
and Griggs (2008).
2. These activities and issues have been discussed at greater length by Daley (2005).
3. See, for example, the description of popular reluctance to swim near reefs provided in OHC 22, 12 September 2003: 7.
4. Examples include OHC 1, 30 October 2002: 7; OHC 4, 14 January 2003: 2; OHC 12, 2 July 2003: 4; OHC 24, 15 September 2003: 3.
7. These and other implications for the contemporary management of the GBRWHa have been outlined by Daley (2005).

REFERENCES


Mackay, J., Douglas, H.A.C. and Bennett, G.H. (1908) *Report, Together with Minutes of Proceedings, Minutes of Evidence Taken before the Commission, and Appendices,*
Queensland Royal Commission Appointed to Inquire into the Working of the Pearl-Shell and Beche-de-Mer Industries. Brisbane: Government Printer.


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