# 5. CHANGES IN CORAL REEFS

This chapter contains the first of my three environmental history narratives of changes in the Great Barrier Reef since European settlement, focusing on impacts on corals and corals reefs. Those changes are placed, first, in a geomorphological context: the coral reefs of the Great Barrier Reef have experienced decline during the last 6,000 years as a result of the Holocene evolution of the north-eastern Australian continental shelf, and many reefs now exist in a condition of considerable vulnerability to natural disturbances and anthropogenic impacts. Next, evidence of several human impacts is presented: the historical impacts of early European reef fisheries, coral mining, coral collecting, shell collecting and other impacts, including the blasting of access channels and tracks. Analysis of that evidence suggests that prolonged and intensive exploitation of many coral reefs in the Great Barrier Reef has occurred, with the result that some were probably far from pristine at the time of the formation of the GBRMP in 1975.

# 5. CHANGES IN CORAL REEFS

## 5.1 Introduction

Since European settlement, many changes have occurred in the coral reefs of the Great Barrier Reef, particularly the more accessible reefs in the Cairns and Capricorn-Bunker areas; those changes have occurred at many geographical scales, ranging from widespread coral bleaching events to the localised impacts of coral mining. In addition, changes in coral reefs have taken place at various temporal scales including long-term changes, such as the impacts of coral collecting, and short-term changes, such as cyclone damage. Indeed, classifying particular changes in the corals of the Great Barrier Reef is difficult since reefs are highly dynamic systems that are characterised by constant change at these various scales. Therefore, the account presented below documents changes in coral reefs that have resulted from both natural and human causes – or from a combination of both – but where one impact ends and another begins can be difficult to delineate precisely. For convenience, my account categorises changes in coral reefs according to causal factor and time period; this is not to deny that changes in coral reefs occur as a result of combined impacts whose effects vary geographically.

In an attempt to deal with such complexity, this chapter begins with an outline of geomorphological, macro-scale changes that have occurred in the Great Barrier Reef as a result of the Holocene evolution of the continental shelf, due to changing sea level and sedimentation patterns. This outline, provided in Section 5.2, represents a morphogenic approach to the evolution of the Great Barrier Reef and provides a context for the narratives of anthropogenic, historical changes that follow; such an approach indicates that the latter changes have been controlled by geomorphological factors that have made some reefs highly vulnerable to degradation and mortality. Within that larger context, the accounts of early European fisheries (Section 5.3), coral mining (Section 5.4), coral collecting (Section 5.5) and shell collecting (Section 5.6) that follow suggest that many of the most vulnerable reefs were intensively exploited, over a long period of time, and some were probably far from pristine at the time of the formation of the GBRMP, in 1975. Other activities such as bombing and channel blasting, which exacerbated the vulnerability and degradation of some reefs, are described briefly in Section 5.7.

In this chapter, particular emphasis is placed on two significant activities. The first is the coral mining industry, which took place in the Great Barrier Reef between 1900 and 1940 and for which no overview has previously been written. Twelve locations at which coral mining took place have been identified; some, such as Snapper Island reef and Kings Reef, sustained severe damage as a result of the use of gelignite or crowbars to remove coral. The coral mining industry was encouraged by the Queensland Government and was organised using a system of coral licences; however, documentary and oral evidence of unlicensed coral mining exists and the damage caused to coral reefs was more extensive than the surviving secondary sources indicate. The second emphasis in this chapter is placed on the sustained and widespread damage caused by coral collecting. While individual instances of coral collecting were apparently trivial, the cumulative impact of the removal of coral throughout much of the period of European exploration and settlement – particularly at major tourist centres, such as Green and Heron Islands – depleted some reefs. In addition to coral souveniring by tourists, both licensed and informal coral collecting took place for commercial purposes. Since the rate of coral removal was almost imperceptible, the full extent of coral collecting cannot be reconstructed, but the weight of evidence suggests that a very large amount of coral was removed from the Great Barrier Reef before 1970.

The evidence presented in this chapter is constrained in several ways. Records of changes in the coral reefs of the Great Barrier Reef are scarce for the period before the formation of the GBRMP; those that exist are difficult to interpret since they are based on the varying skills and perceptions of different observers, using different methods, for a vast, dynamic ecosystem. Therefore, the narrative of environmental change told in this chapter is based more on an evaluation of the likely impacts of reconstructed historical industries and other activities than on direct, scientific observations of the coral reefs. The issues raised by this approach – particularly those that concern individual perceptions of the condition of coral reefs – are considered in the conclusion of this chapter (Section 5.8). Nonetheless, some conclusions can be drawn about the extent of historical changes in the reefs. Some coral reef areas have been transformed and now exist in a highly degraded condition; others experienced less intensive, yet significant, modifications. A summary of these changes is presented in Section 5.8. The implications of these changes in coral reefs for contemporary management are not discussed in this chapter but are considered later, in Section 8.3.

## 5.2 The geomorphological context of changes in coral reefs

The Great Barrier Reef is a dynamic ecosystem characterised by continuous changes at various geographical and temporal scales; those changes are largely controlled by geomorphological and climatic factors.[1] Coral growth has varied in rate and extent during the Holocene, accelerating as hydro-isostatic processes adjusted sea level and as SST increased, but also inhibited by mechanical erosion and ecological processes, such as bioerosion, which denude coral. Therefore, coral reefs are typically patchwork assemblages of living, dying and dead coral; such spatial and temporal patchiness does not necessarily indicate the decline of coral reefs. However, in addition to that ecological variability, coral reefs have also been subjected to periodic changes as a result of variations in geomorphological, climatic, meteorological and biological factors. The most significant of these variations is discussed in this section: the Holocene evolution of the continental shelf, including variations in sea level and sedimentation patterns, which constitute a macro-scale context in which other, historical, anthropogenic changes have occurred. This section is based on the geomorphological approach to the evolution of the Great Barrier Reef developed by Hopley and on additional oral history evidence.[2]

### *5.2.1 The Holocene evolution of the continental shelf*

The modern coral reefs of the Great Barrier Reef evolved during the Holocene: an interglacial epoch of dramatic changes in sea level and in the position of the eastern Australian coastline. The north-eastern Australian continental shelf experienced a rise in sea level of over 100 metres, followed by a subsequent fall of several metres to present sea level, as a result of glacial ice sheet melting and the hydro-isostatic adjustment of the Australasian tectonic plate. As sea level rose during the early Holocene, the north-eastern Australian coastline migrated laterally to its present position as the continental shelf was inundated; that development is illustrated in Figure 5.1. The modern Great Barrier Reef evolved on the newly-formed continental shelf, but in varying geomorphological conditions that controlled the rate and location of coral reef development. In particular, variations in the dominant geomorphological controls on the

[1] Hopley, 'Continental shelf reef systems', pp. 303-304.
[2] For more details, see Hopley, *Geomorphology*; Hopley, 'Continental shelf reef systems'; Oral History Cassette (hereafter OHC) 35, 20 October 2003, *Changes in the Great Barrier Reef since European Settlement*, Oral History Collection, School of TESAG, JCU, October 2002-December 2003.


*Figure 5.1.* The position of the north-eastern Australian coastline during the Holocene: (a) at 20 metres; (b) at 40 metres, and (c) at 135 metres below present sea level. These maps illustrate the lateral migration of the north-eastern Australian coastline – and, consequently, the migration of the zone of terrigenous sedimentation – in response to variations in sea level.
*Source:* Hopley, *Geomorphology*, p. 167.

growth of coral reefs – sea level and sedimentation – have created, in different places and at different times, both favourable and hostile conditions for reef development. As a result of these variations, over around 6,000 years, some reefs have been brought close to thresholds of decline and may have experienced deterioration for geomorphological reasons. Conversely, other reefs – especially some offshore reefs – have flourished throughout the Holocene since they lie outside of the region of particular vulnerability to geomorphologically-controlled decline.

Hopley argued that, as sea levels along the eastern Australian coast rose during the early Holocene, the corals of the Great Barrier Reef were able to grow upwards at a similar rate, forming a barrier within which further reef development was possible. Modern sea level was reached and exceeded by around 6.5 ka, followed by a small fall in sea level to present-day conditions, which were achieved at around 6 ka.[3] Subsequently, Hopley argued, patterns of sediment discharge from the mainland to the Great Barrier Reef lagoon – which were dynamic during the period when the coastline was migrating westwards – also stabilised, with the result that the zone of terrestrial influence became static in its present position and sedimentation became concentrated in the newly-formed nearshore zone (Figure 5.1). Oral history evidence provides more detail about this model of Holocene shelf evolution; one expert informant, a geomorphologist, described the formation of an inshore mud-silt wedge in the Great Barrier Reef lagoon:

> What we see is [...] the sea level getting to more or less its present position by round about 6,000 years ago. At that time, the sea level had been rising fairly steadily over the continental shelf and the shoreline had never been stable for any length of time. So, although there was sediment coming down, it was never accumulating in one particular spot. For that reason, the amount of Holocene sediment over the shelf is relatively thin. Since 6,000 years ago, the shoreline has been more or less stable; this means that over the 6,000-year period all the sediment that's come down has more or less accumulated in the nearshore zone. So you've got this sediment wedge – a mud-silt wedge – which can be anything up to 15 metres in depth. And seismic surveys have shown this quite nicely.[4]

Hopley has presented evidence of the existence of this mud-silt wedge in the Great Barrier Reef lagoon and has also described its formation.[5]

[3] Hopley, 'Continental shelf reef systems', pp. 314-315.
[4] OHC 35, 20 October 2003, p. 7.
[5] Hopley, 'Continental shelf reef systems', pp. 318-319.

The stability of sea level and sedimentation after around 6 ka initiated considerable changes in the reefs of the Great Barrier Reef. Geomorphological descriptions of the Great Barrier Reef are based on a classification of different reef types according to their morphology and development; one scheme, devised by Hopley *et al*., is shown in Table 5.1. Although some reef types, such as ribbon reefs and fringing reefs, do not fit strictly within a developmental framework, most of the reefs in the Great Barrier Reef can be classified as juvenile, mature or senile (Table 5.1). Hopley argued that the progression of coral reefs from the juvenile stage to the mature and senile stages occurs under conditions of eustatic and isostatic stability: periods when tectonic movements of the continental crust are limited and sea level is relatively constant. During these periods of stability, coral reefs grow upwards to reach sea level and, subsequently, develop horizontally. During the mature phase of reef development, lagoons are formed; in the senile stage, the growth of live coral is restricted to the edge of the reef, while sediment infill occurs on the reef flat. Therefore, this model suggests that, in periods of tectonic and sea level stability, the deterioration of coral reefs occurs naturally as reefs progress through the juvenile and mature stages to reach a condition of senility.[6]

Hopley acknowledged that the Great Barrier Reef has experienced tectonic and eustatic stability since around 6 ka, when the coral reefs began the transition to maturity and senility.[7] Therefore, he suggested that many reefs within the Great Barrier Reef have declined from a juvenile state, in which rapid vertical coral growth took place, and instead have become characterised by sediment-covered reef flats, extensive patches of dead coral, and comparatively small margins of live coral growth. Using this model, the coral reefs of the Great Barrier Reef can be divided into four groups: (a) fringing and nearshore reefs that have been severely impacted by sedimentation, displaying high mortality and limited recovery; (b) fringing and nearshore reefs that have been significantly impacted by sedimentation, but that display ecological change, spatial patchiness in mortality, and some capacity to recover; (c) mid-shelf reefs that have experienced terrestrial impacts, resulting in increased vulnerability to bioerosion and displaying increased rates of coral rubble formation; and (d) offshore reefs which may have been affected by terrestrial influences, but for which degradation is only detectable

[6] Further details are given in Hopley, 'Continental shelf reef systems', pp. 325-326; see also Wood, *Reef evolution*, p. 153.
[7] Hopley, 'Continental shelf reef systems', p. 319.

**1. JUVENILE REEFS** (enhancement of Pleistocene relief):

(i) *Unmodified antecedent platform*: Pleistocene foundations without modern growth.

(ii) *Submerged reefs*: reefs not at modern sea level but with some growth over the older foundations, usually most prolific on the highest parts of these Pleistocene foundations.

(iii) *Irregular patch reefs*: patchy reef development as the growth from the Pleistocene highs reaches modern sea level.

**2. MATURE REEFS** (horizontal extension of modern reef flats):

(iv) *Crescentic reefs*: coalescence of patch reefs on the most productive windward margins, to produce a crescent shaped reef with open back reef area.

(v) *Lagoonal reef*: extension of the reef flat around the margins of the foundations to enclose or partially enclose one or more lagoons.

**3. SENILE REEFS** (masking of original relief):

(vi) *Planar reef*: infilling of lagoons by internal patch reef growth and sediment transport from windward markings to produce extensive reef flat, eventually with widespread sediment blanket.

**4. OTHER REEF TYPES**:

(vii) *Ribbon reef*: linear reefs growing from structurally or morphologically determined linear foundations.

(viii) *Incipient fringing reef*: with no extensive reef flat, but with corals growing over rocky foundations largely below low tide level, attached to mainland or continental islands.

(ix) *Fringing reef*: identifiable reef flat development, attached to mainland or continental island.

*Table 5.1.* A geomorphological classification of reefs in the Great Barrier Reef.

*Source:* Hopley *et al.*, 'Great Barrier Reef Marine Park', p. 50.

using geochemical analysis techniques.[8] This framework is illustrated in Table 5.2, together with some examples of coral reefs that have experienced these changes.

The significance of this morphogenic approach lies in the possibility that many reefs – particularly some fringing and nearshore reefs – may be characterised by extreme vulnerability; they may exist close to ecological thresholds beyond which recovery from further degradation is difficult. The expert oral history informant stated that 'thresholds that determine whether or not reefs can recover are always going to be fairly close – naturally – off the Queensland close: certainly the nearshore zone.'[9] As a consequence, anthropogenic impacts might exceed critical ecological thresholds on some vulnerable, inshore reefs; for these reefs, the impact of comparatively slight human impacts may have been critical. Furthermore, once coral growth has been inhibited by sedimentation, the same informant argued, it is much harder for recovery of reefs to take place; it is much easier to 'turn-off' than to 'turn-on' coral growth. The informant stated that:

> the indications are that, once you have a reef there, the reef will withstand fairly poor conditions. But if you kill it off, to turn it on again, you need in fact to increase those conditions – the quality of those conditions – quite significantly. So if you go past a threshold in terms of water quality, the reef may be able to just hang on by its toenails. But once it gets killed by, say, a single event – a big flood, cyclone, or whatever – it will find it very difficult, now, to come back because of those very poor water conditions.[10]

The decline of the coral reefs within 20 or 25 kilometres of the Queensland coast, therefore, probably occurred as the impacts of sediment and nutrient run-off from the mainland accelerated the natural tendency of these reefs to reach a stage of geomorphological senility.[11]

Examples of coral reefs that have experienced this type of decline include the reefs found in Halifax Bay and the fringing reefs of some continental islands. Here, the impacts of terrigenous sediments have been exacerbated by high water velocities in the nearshore zone, as the same informant stated:

[8] Additional details of this classification are given in OHC 35, 20 October 2003, pp. 7-10.
[9] OHC 35, 20 October 2003, p. 12.
[10] OHC 35, 20 October 2003, pp. 7-8.
[11] OHC 35, 20 October 2003, p. 13.

| *Type of reef* | *Characteristics of reef* | *Examples* |
|---|---|---|
| SEVERELY IMPACTED REEFS | Reefs influenced by an nearshore mud-silt wedge<br>Conditions of continuous turbidity<br>Mortality of corals with little or no recovery<br>Complete collapse of reef ecosystems | Stone Island reef<br>Goold Island reef<br>Alexandra Reef |
| SIGNIFICANTLY IMPACTED REEFS | Patchy reefs<br>High variability in coral mortality and recovery<br>Ecological change in coral reef ecosystems<br>Selection of sediment-resistant species<br>Survival of impact-resistant forms of coral<br>Increased prevalence of soft corals | Palm Island reefs<br>Halifax Bay reefs<br>Middle Island reefs<br>Cape Tribulation reefs |
| MODERATELY IMPACTED REEFS | Mid-shelf reefs with limited terrestrial influence<br>High cover of living corals<br>Recovery of corals from severe impacts<br>Increased coral skeleton porosity<br>Increased bioerosion of corals | Holbourne Island reef |
| SLIGHTLY IMPACTED REEFS | Offshore reefs with slight terrestrial influence<br>Healthy, resilient corals<br>Terrestrial influence not visible<br>Geochemical analysis required to reveal impacts | Wallaby Reef<br>Kangaroo Reef |

*Table 5.2.* Some different types of changes and impacts evident in selected coral reefs.

*Source:* Compiled from data provided in OHC 35, 20 October 2003, pp. 7-10.

> That [mud-silt] wedge, which can be up to three or four kilometres offshore, can actually encroach upon some of the nearshore reefs. The ones in Halifax Bay are an example of this. Even some of the nearshore fringing reefs of the high islands can get within this. The other thing is, with this high accumulation of sediment within what is basically the effective wave zone, every time you get rough weather, you get re-suspension of the sediments; so there is a natural process of [...] deteriorating water quality during the last 6,000 years. This is the reason why you have lots of fringing reefs in this nearshore zone, but they're all struggling. It is unwise to put *all* of this down to anthropogenic influence; there is a very good geomorphological reason for this decline in water quality.[12]

Therefore, this informant attributed the decline of the Halifax Bay reefs and many other inshore reefs to their location within the zone of high sedimentation levels that has formed since the stabilisation of sea level, at around 6 ka. In this model, the deterioration of the inshore coral reefs of the Great Barrier Reef is almost inevitable, since the control exerted by sea level no longer allows juvenile reefs to form.

This morphogenic perspective provides a macro-scale context for the accounts of historical changes in the Great Barrier Reef that follow. Those recent changes should be interpreted against a background of the high vulnerability of fringing and nearshore regions reefs as a result of their Holocene evolution. The anthropogenic activities that are described in the following accounts – including coral mining and coral collecting (Sections 5.4 and 5.5) – operated upon coral reefs that already had limited capacity to recover from environmental stresses; in some cases, the impacts of those activities have caused the complete mortality of parts of some reefs; the degradation of the reefs at Goold Island, Kings Reef and Alexandra Reef may have occurred in this way.[13] Some anomalies exist in this framework: Middle Reef, near Townsville, appears to display an unusual degree of resistance to mortality, despite experiencing highly turbid water conditions; on that reef, the informant stated, an 'absolutely amazing amount of coral' was found.[14] The reefs of Halifax Bay, similarly, contain resilient reefs: possibly as a result of their stable foundations on Pleistocene gravels. Nevertheless, this model of geomorphological controls on the Holocene evolution of the Great Barrier Reef provides a valuable means of interpreting changes in vulnerable coral reefs and the impacts of human activities.

[12] OHC 35, 20 October 2003, p. 7.
[13] OHC 35, 20 October 2003, *passim*.
[14] OHC 35, 20 October 2003, p. 10-11.

*5.2.2 Cyclone damage*

During the Holocene evolution of the Great Barrier Reef, reefs have also experienced geomorphological changes due to cyclone-related wave action, including abrasion as coral fragments and other debris are thrown against coral colonies. Occurrences of cyclones in the Great Barrier Reef have been reconstructed by Puotinen *et al*, Nott and Hayne, and Nott; Puotinen *et al*. documented the frequency and paths of cyclones in the Great Barrier Reef, and Nott and Hayne, and Nott, reconstructed their severity.[15] Cyclones, therefore, represent another environmental factor that caused changes in corals: in particular, in fragile species such as *Acropora* species, although other species have also been affected. Documentary sources refer to cyclones at Green Island (1858), Cooktown (27 January 1899 and 4-5 March 1899) and Low Isles (March 1911). While travelling in the Great Barrier Reef, Agassiz referred to Saville-Kent's observation of 'the wreckage of the fringing reef by a hurricane at Saddleback Island'.[16] For some locations, a time series of cyclones has been reconstructed; for example, Loch showed that severe cyclones affected Michaelmas Cay in March 1878, January 1906, March 1911, February 1920, February 1927, March 1934 and 1948, in addition to many smaller storms.[17] One record of cyclone damage stated that the jetty at Green Island was destroyed by a cyclone in 1946 and was reconstructed by the Cairns Harbour Board.[18]

The GBRC expedition to the Great Barrier Reef in 1936 described instances of damage to corals that were attributed to cyclones. For example, Mackay Cay was 'severely damaged' by a cyclone in 1934 and, at the reef between Ingram and Beanley Islands, the same report indicated that 'the sandy surface of this reef was caused by the destruction, through a cyclone, of a former cay.'[19] The observers found that Night Island had been devastated by a cyclone within the preceding 20 years; since that event, Steers stated:

[15] Puotinen *et al.*, *Atlas of tropical cyclones*, pp. 92-120; Nott and Hayne, 'High frequency'; Nott;' Intensity of prehistoric tropical cyclones'.
[16] GBRMPA, 'Green Island economic study: summary report, October 1979', Economic Associates Australia, Economic and Management Consultants, 1979, Appendix A: history of Green Island and its reef, SRS5416/1 Item 434, QSA; T. M. Almond, AR, Qld. Marine Dept., 1898-1899, *QVP*, Vol. 3, 1899, pp. 1025-1032, p. 1025; J. Mackay, AR, Qld. Marine Dept., 1910-1911, *QPP*, Vol. 3, 1911, pp. 1183-1198, p. 1187; A. Agassiz, *A visit to the Great Barrier Reef of Australia in the steamer 'Croydon,' during April and May, 1896*, Museum of Comparative Zoology, Cambridge, Massachusetts, 1898, p. 115.
[17] I. Loch, 'Michaelmas Cay', *Cairns Shell News*, Vol. 11, No. 49, June 1991, p. 5.
[18] GBRMPA, Green Island Economic Study, Appendix A.
[19] J. A. Steers, 'Detailed notes on the islands surveyed and examined by the geographical expedition to the Great Barrier Reef in 1936', *Reports of the GBRC*, Vol. 4, Part 3, 1938, pp. 51-104, pp. 70 and 84.

> To the north-west of the reef the mangrove mud has spread, and seems to have killed much of the reef. Incidentally, much of the whole area covered by the mangroves was sandy; there was also abundant *Thalassia*. […] Whilst the upper surface of the reef seems to be largely moribund, the general appearance of much of the cay and mangrove area is one of recovery and rejuvenation after a severe blow.[20]

The impacts of cyclone damage were not restricted to the northern Great Barrier Reef. At Lady Elliot Island reef, Steers stated that the cyclone of March 1936 'appears to have been responsible for building the outer ridge'.[21]

Oral history sources provide additional details of the impacts of cyclones on coral reefs. One informant, a geomorphologist, recalled the visible effects of the cyclone that struck the Bowen area in 1918, affecting the coral reefs at Stone and Holbourne Islands; at Stone Island, he reported that almost no coral had survived, even where coral communities would now be expected to be found.[22] Considerable damage also occurred at Holbourne Island when the reef moat was breached, leading to a dramatic change in water level.[23] The same informant stated:

> A cyclone hit [Holbourne Island] in 1918; the island prior to this – or the fringing reef – had a shingle ridge around the outer edge of the reef, which moated the water at low tide. Within this moat, there was quite good […] living coral. What happened during the cyclone was that the shingle rampart was breached; water levels became much lower on the reef flat and a lot of the living corals just died off. They are still there; they are high micro-atolls and you can see – about 30 or 35 centimetres below that level – where coral has grown since.[24]

The recovery of Holbourne Island reef – in contrast to the reef at Stone Island – was attributed, by this informant, to reduced sedimentation at Holbourne Island, which is further offshore and more distant from terrestrial impacts than is Stone Island.

Oral history evidence indicates that cyclone damage to corals has been witnessed by many observers, including catastrophic reductions in coral cover: one informant, a coral reef scientist, reported seeing changes in coral reefs: 'from incredibly rich coral communities with 50 to 75 per cent coral cover down to less than 5 per cent coral

[20] Steers, 'Detailed notes', pp. 94-95; see also p. 92.
[21] Steers, 'Detailed notes', pp. 54.
[22] OHC 35, 20 October 2003, p. 5.
[23] OHC 35, 20 October 2003, p. 3.
[24] OHC 35, 20 October 2003, p. 6.

cover'; however, the same informant described the rapid recovery of offshore coral reefs from cyclones, stating:

> You just get huge recruitment and rapid growth of *Acroporas*. Going back in 5 years' time after total devastation will show you what is apparently quite a healthy reef; although, if you look closely, you'll see most of the corals are less than half a metre in diameter. So you can get rapid recovery in exposed, high-energy situations.[25]

In contrast to offshore reefs, fringing reefs are particularly vulnerable to the effects of cyclones. The informant stated that 'a good cyclone reduces them to rubble with virtually no coral cover.'[26] As a result, historical changes in fringing reefs can be over-written by the influence of successive cyclones, resulting in changes to the structure of those reefs as coral rubble and larger coral pieces are transported by wave action.

Many informants recalled the effects of particular cyclones on specific reefs. One informant, a sugar cane cutter and recreational fisher, referred to the cyclone that struck Port Douglas in 1911; he also described the cyclone that occurred at Cape Tribulation on 12 March 1934.[27] Another informant, a shell collector, described the extent of the damage at Orpheus Island reef, stating that:

> I was in my early teens when we visited Orpheus Island, in the Palm group, and saw first-hand what destruction the power of a tropical cyclone can create: huge banks of broken coral metres deep cast high into the vegetation in drifts. By sifting through this coral, we found lots of spectacular shells we had only seen illustrated in Joyce Allen's *Australian Shells*.[28]

Another informant, a coral reef scientist, witnessed cyclone damage at Heron Island, when the disturbance came from an unusual direction and affected corals that had not adapted to cyclone conditions.[29] Many other oral history accounts describe the impacts of cyclones; that evidence is not presented here as it refers to the period after 1970, which falls outside the scope of my research.[30] Nonetheless, the evidence presented

[25] OHC 20, 9 September 2003, p. 2.
[26] OHC 20, 9 September 2003, p. 8.
[27] OHC 17, 2 September 2003, pp. 7 and 11.
[28] B. Collins, 'Recollections of the reef', Unpublished report, September 2003, pp. 1-2, p. 1.
[29] OHC 4, 14 January 2003, p. 10; see also Bennett, *Great Barrier Reef*, p. 25.
[30] Additional details are found in OHC 1, 30 October 2002, pp. 5-7; OHC 5, 11 February 2003, pp. 1 and 12; OHC 6, 17 February 2003, p. 6; OHC 16, 2 September 2003, p. 2; OHC 18, 5 September 2003, p. 2; OHC19, 9 September 2003, pp. 17-18; OHC 20, 9 September 2003, pp. 2, 3 and 8; OHC 26, 17 September 2003, p. 4.

above suggests that many coral reefs have been damaged by cyclones, although offshore reefs have generally recovered more rapidly from cyclone damage; in contrast, fringing and nearshore reefs have experienced slower recovery rates or – as at Stone Island – no recovery has occurred.

## 5.3 Early European fisheries: bêche-de-mer, pearl-shell and trochus

Although corals have been removed from the Great Barrier Reef since the period of earliest European exploration, the first sustained European commercial fisheries in the Great Barrier Reef were the bêche-de-mer, pearl-shell and trochus fisheries. While corals were not the focus of these industries, the harvested species formed part of the landscape of the coral reefs, and diving for these organisms was concentrated on – and near to – those reefs. Furthermore, although large fishing grounds for each of these industries were located in Torres Strait, the coral reefs of the Great Barrier Reef were also used extensively and, in some cases, the fisheries extended southwards as far as Moreton Bay. Therefore, these fisheries are considered within this chapter about changes in coral reefs. The earliest operation of the European reef fisheries was uncontrolled and few documentary records describe the beginning of the industries; the period of the historical bêche-de-mer and pearl-shell fisheries also lies beyond the range of oral history sources.[31] However, the later development of these industries – as a result of increasing concern about the depletion of resources and the abuse of Aboriginal and Torres Strait Islander workers – is described in Queensland Government records and reports, and the more recent trochus industry has been described in oral history sources.[32]

### *5.3.1 The bêche-de-mer fishery*

The early history of the bêche-de-mer (or trepang) fishery was first described in detail by Saville-Kent in the Annual Reports of the Queensland Chief Inspector of Fisheries

[31] Some details are provided in Loos *Invasion and resistance*, p. 126; Bauer, *Historical geography*, p. 125 acknowledged that production statistics for the bêche-de-mer fishery were not available before 1884.
[32] The Torres Strait pearl-shell industry has been documented by Ganter, *Pearl-shellers of Torres Strait*; pearl-shelling and bêche-de-mer fishing were discussed by Loos, *Invasion and resistance*; and the early European fisheries have also been considered by Reynolds, *North of Capricorn*, *passim*.

(CIF) that were published in the *QVP* and in the *QPP*.[33] The bêche-de-mer fishery began early in the European history of Queensland; one account attributes the earliest European commercial bêche-de-mer fishing to James Aicken, at Wreck Reef, in 1804.[34] By 1827, bêche-de-mer were being exported from Cooktown and, by 1848, the remains of a bêche-de-mer smoke-house had been found by the crew of *H.M.S. Rattlesnake*. In 1857, J. S. V. Mein built a bêche-de-mer curing station at Green Island, which operated until the 1890s, and descriptions of that station were published in *The Sydney Morning Herald* (26 February 1866) and in the *Cleveland Bay Express* (19 April 1873).[35] Many other curing stations were established in the Great Barrier Reef and, by 1880, bêche-de-mer stations were operating at Lizard Island, Green Island, Fitzroy Island, the Frankland Islands, the Barnard Islands and Dunk Island; in addition, the fishery at Cooktown employed thirteen vessels and two hundred workers.[36] Saville-Kent reported that the period 1881-1883 was the most flourishing for the industry; by 1889, 27 boats were operating from Cooktown, several boats each worked from Cairns, Ingham and Townsville, and a total of over 100 vessels were engaged in the trade.[37]

The fishery was based on the collection of sea cucumbers (*Holothuria spp.*) from the substrate of the coral reefs. Saville-Kent identified six commercial varieties of bêche-de-mer: teat-fish (*H. mammifera*), black-fish (*H. polymorpha*), red-fish (*H. rugosa*), prickly-fish or prickly-red (*H. hystrix*), lolly-fish (*H. vagabunda*) and sand-fish (*H. calcarea*); the names and values of those species in 1890 are shown in Table 5.3. Yet he also acknowledged that scientific information about these species – including their breeding habits and growth rates – was scarce and he implied that a considerable lack of knowledge about the sustainability of the fishery existed.[38] Nevertheless, a perception

[33] The account of the bêche-de-mer fishery presented in this section is based on evidence found in W. Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries of northern Queensland', *QVP*, Vol. 3, Part 2, 1890, pp. 727-734; see also Saville-Kent, *Great Barrier Reef*, p. 231.
[34] C. C. MacKnight, *The voyage to Marege: Macassan trepangers in northern Australia*, Melbourne University Press, Carlton, Victoria, 1976, p. 140.
[35] GBRMPA, 'Green Island Economic Study', Appendix A; Hopley, *Great Barrier Reef: ecology and management*, p. 19; J. S. V. Mein, 'A cruise inside the Great Barrier Reef, in 1857, and discovery of a reef and harbour', *The Sydney Morning Herald*, 26 February 1866, obtained from the CHS.
[36] V. Serventy, *Australia's Great Barrier Reef: a handbook on the corals, shells, crabs, larger animals and birds, with some remarks on the Reef's place in history*, Georgian House, Melbourne, 1955, p. 73; D. Jones, *Trinity phoenix: a history of Cairns and district*, The Cairns Post Pty. Ltd., Cairns, 1976, p. 16.
[37] Saville-Kent, *Great Barrier Reef*, p. 231; Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 730.
[38] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 729 and 731.

of plenty was articulated by some observers, such as Thorne, who stated that ‘considerable

| ***Species*** | ***Local name*** | ***Chinese name*** | ***Value per ton*** |
|---|---|---|---|
| *Holothuria mammifera* | Teat-fish, black and ordinary<br>Teat-fish, white | Se-Ok-Sum<br>Ma-See-Up | £140 to £150<br>£40 |
| *Holothuria rugosa* | Red-fish, ordinary and deep water<br>Red-fish, surf | Hung-Hur<br>Ba-Doy-Hur | £100 to £110<br>£80 to £90 |
| *Holothuria polymorpha* | Black-fish, deep water<br>Black-fish, ordinary and Caledonian | Chao-Sah-Oo<br>Woo-Sum | £110<br>£80 to £90 |
| *Holothuria vagabunda* | Lolly-fish | Chong-Sum | £35 |
| *Holothuria hystrix* | Prickly-fish (or prickly-red) | Chee-Sum | £30 to £40 |
| *Holothuria calcarea* | Sand-fish | (not named) | £20 to £30 |

*Table 5.3.* Species and values of bêche-de-mer harvested in Queensland, 1890. The difficulties involved in the using the various scientific nomenclature for bêche-de-mer species have been discussed by T. Skewes *et al*., *Stock survey and sustainable harvest strategies for Torres Strait beche-de-mer*, Final Report, CSIRO Marine Research and Australian Fisheries Management Authority, Cleveland, Queensland, 2004, pp. 14-15.

*Source:* Based on data provided in W. Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries of northern Queensland', *QVP*, Vol. 3, Part 2, 1890, pp. 727-734, pp. 730-731.

quantities' of bêche-de-mer were found in the northern Great Barrier Reef, and Palmer, who wrote that Queensland's bêche-de-mer resource was 'extensive' and that 'thousands of tons of this valuable fish are to be obtained' by Sydney firms that were willing to invest in the industry; in 1879, Palmer wrote that the revenue of the combined bêche-de-mer and pearl-shell fisheries was between £100,000 and £150,000 per year.[39]

The geographical distribution of the bêche-de-mer fisheries reached as far south as the reefs to the east of Mackay and as far north as Torres Strait; hence, the fisheries were concentrated in the northern Great Barrier Reef. The major centre of the fishery was located at Cooktown, with smaller centres at Cairns, Ingham and Townsville. In terms of their bathymetrical distribution, most of the commercial varieties were found on coral reefs in between 4 and 18 fathoms of water; the larger specimens of black-fish and red-fish were found at the deeper end of this range. The fishery took place using a system of small curing-stations, at many locations in the Great Barrier Reef, from which small luggers – of 5 or 6 tons draught – made daily journeys to the reefs; alternatively, a fleet of luggers remained in the vicinity of the reefs and used a tender to carry the catch to the curing station. In addition, a small number of schooners, weighing between 20 and 50 tons, were built at Cooktown and Thursday Island; those vessels carried portable curing facilities, as well as smaller boats and the processing equipment, and sometimes operated at sea for six months at a time.[40]

The average harvest for a bêche-de-mer station was around a ton of smoked product per month, as Saville-Kent, describing the harvests and the collection method, stated:

> A good average take for a fishing station working with only four boats, carrying twenty to twenty-four men, is one ton of cured bêche-de-mer per month. Two tons per month […] represents an occasional but exceptionally abundant take. […] The greater portion of the bêche-de-mer is simply picked off the reefs when the water has receded, but the finest red and black fish, and the prickly-fish almost exclusively, are obtained by diving during the same low tides from a depth of two or three fathoms.[41]

[39] E. Thorne, *The queen of colonies; or, Queensland as I knew it*, Samson Law, Marston, Searle and Rivington, London, 1876, p. 245; B. H. Palmer, *The exhibition essay on the geographical features, natural resources and productions of the Cook District of Queensland*, Cleghorn and Co., Brisbane, 1879, p. 31.
[40] See the details provided in Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 728 and 730-732.
[41] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729.

The collecting process, therefore, involved bêche-de-mer fishers walking on the coral reefs at low tide as well as diving for the animals; some damage to corals must have occurred during the harvest. Saville-Kent stated that the animals were 'collected in sacks by wading or diving from off the reefs during the low spring tides'.[42] In addition to the harvest, bêche-de-mer were taken as food for the crews on the boats.

Once the animals had been transported to the curing station, or to the schooner, they were smoked and dried. The process began when the fresh bêche-de-mer were immediately placed in large iron cauldrons and boiled for twenty minutes. The procedure, after boiling, was described by Saville-Kent in the following terms:

> The fish are then taken out, split up longitudinally with a sharp-pointed knife, gutted, and exposed on the ground in the sun until the greater portion of the moisture has evaporated. The largest specimens, such as prickly and teat fish, are frequently spread open, so as to dry more readily, with small transversely-inserted wooden splints. The greater amount of moisture having been got rid of, the fish are transferred to the smoke-house. […] The wood most in favour for the smoking process is that of the red mangrove, *Rhizophora mucronata*. Twenty-four hours in the usual period for which bêche-de-mer are left in the smoke-house […].[43]

After being smoked, the bêche-de-mer were bagged and transported to the nearest port, from which they were shipped to south-east Asia, particularly to markets in China.[44]

The quantities and values of bêche-de-mer taken from the Great Barrier Reef during the period from 1880-1889 are shown in Figure 5.2. These graphs show the variable yields and returns obtained from the fishery; from 1881-1883, the fishery expanded, while a decline in yields took place in 1887. From 1887-1890, the fishery recovered and, by the latter date, over 100 boats were engaged in the trade.[45] Overall, the scale of the bêche-de-mer trade was substantial and of considerable importance to the colony; the returns from the trade made the bêche-de-mer fishery the second most profitable marine export from Queensland, after pearl-shell.[46] However, the flourishing period of the fishery was

[42] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729.
[43] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729.
[44] L. S. Suggate, *Australia and New Zealand with Pacific islands and Antarctica*, rev. edn, George G. Harrap and Co., London, 1940, p. 157.
[45] Bauer, *Historical geography*, p. 125 acknowledged the fluctuations that characterised the bêche-de-mer fishery from 1884-1889; see also Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 730.
[46] Loos, *Invasion and resistance*, p. 118.

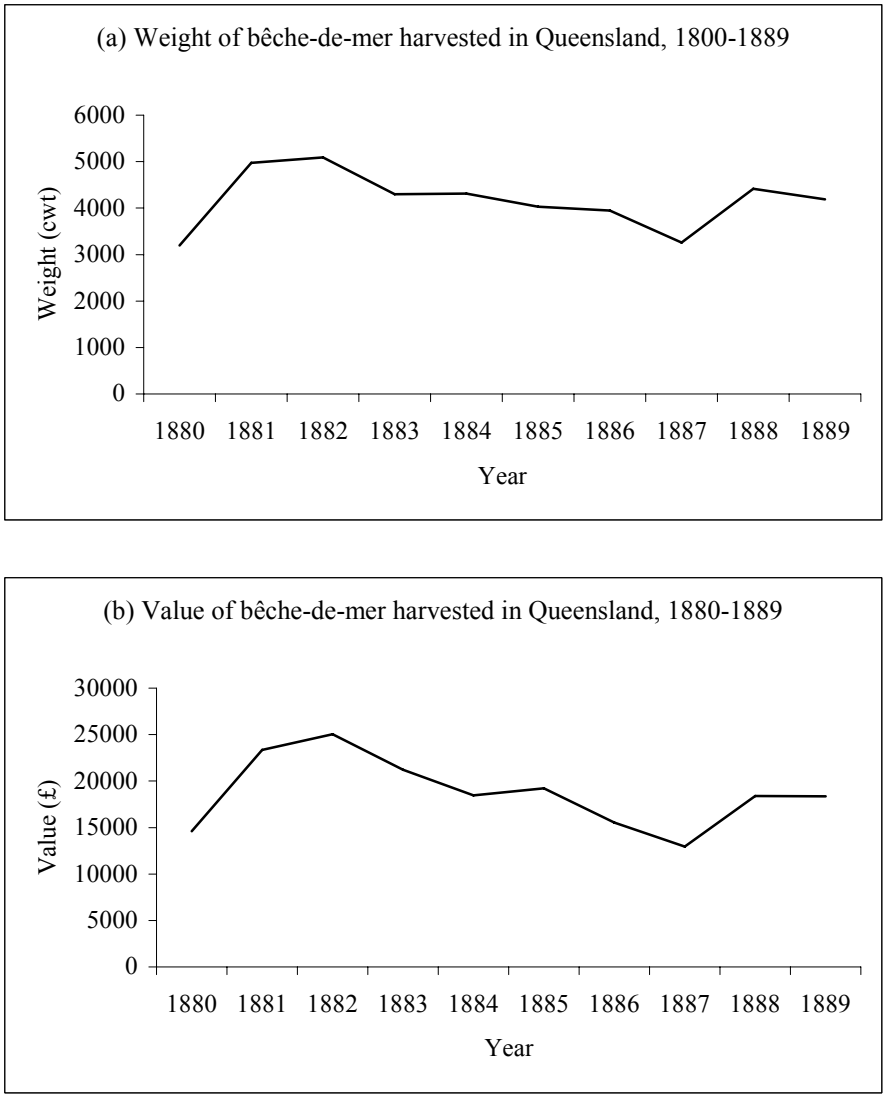



*Figure 5.2.* (a) Weights and (b) values of bêche-de-mer harvested in Queensland, 1880-1889.
*Source:* Compiled from data provided in Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 730.

short-lived. In 1890, Saville-Kent acknowledged the need for restrictions, surveillance of the fishery, and the appointment of an Inspector of Fisheries for the Cooktown district; in part, his concern derived from frequent reports of abuse of Aboriginal and Torres Strait Islander workers, and the fact that Indigenous workers were required to be registered at ports.[47] The industry required little capital investment and paid low wages, generally to Aboriginal and Torres Strait Islander workers. Due to these difficulties, the profitability of the bêche-de-mer fishery declined during the 1890s and, in 1897, discussing the violence and inefficiency of the industry, Bennett reported that the fishery was unsuccessful and that 'its total extinction would not be a matter for regret.'[48]

Despite the worsening economic prospects for the industry for the period from 1890-1900, some authors were optimistic about the wealth remaining in bêche-de-mer fishing. In 1899, Semon wrote that the Great Barrier Reef 'is one of the richest tripang [*sic*] grounds existing, and it is continually ransacked by a lot of white fishermen from Thursday Island, Cooktown, and other north Australian settlements.'[49] However, by 1908, documentary evidence indicates that periodic, severe depletion of bêche-de-mer stocks had occurred. The 1908 Royal Commission investigation into the Queensland pearl-shell and bêche-de-mer industries collected oral history evidence from many fishers, who complained that little or no bêche-de-mer were available and a closure of the fishery was recommended.[50] One bêche-de-mer fisher, Severin Berner Andreassen, reported that the animals had become scarce and few could be harvested at Kennedy Reef, near Hinchinbrook Island.[51] At all the places to the south of Cape Melville that he had visited, he claimed, 'the reefs were skinned'; another area of particular exploitation was reported to be Endeavour Reef, where bêche-de-mer were scarcely available as a result of intensive harvesting in the Bloomfield River area. José Denis Antonio, a

[47] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 732.
[48] G. H. Bennett, AR, Inspector of Pearl-shell Fisheries, *QVP*, Vol. 2, Part 2, 1897, pp. 680-683, p. 681.
[49] R. Semon, *In the Australian bush and on the coast of the Coral Sea: being the experiences and observations of a naturalist in Australia, New Guinea and the Moluccas*, Macmillan and Co., London, 1899, p. 246.
[50] J. Mackay *et al.*, *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 bêche-de-mer industries, Government Printer, Brisbane, 1908, p. lxxiii.
[51] This and the subsequent quotation are taken from Mackay *et al. Report*, p. 246.

bêche-de-mer fisher at Bloomfield River, also reported severe depletion of the resources in that area, stating that as a result of continuous fishing, 'the reef has no chance.'[52]
The report of the Royal Commission, written by Mackay *et al.*, found that the animals – which were 'formerly plentiful' in the Great Barrier Reef – had 'either been exterminated there or driven to seek refuge in the deeper waters adjacent'; hence, divers were increasingly required to search for the animals in depths of 6 or 7 fathoms. As a result, these authors stated that the bêche-de-mer fishery seemed to have reached its zenith in 1907 and that, since then, the reefs 'were fished bare'; consequently, they recommended a closure of the Queensland fishery for two years, enforced by a prohibition of bêche-de-mer exports from all Queensland ports. The Royal Commission concluded that the Queensland fishery was 'suffering from severe depression, which has resulted mainly from depletion of natural supplies.'[53] While the complete closure of the fishery did not take place, a reduction in fishing effort was achieved by discontinuing the issue of licences for Asian vessels. The subsequent decline in revenue for the bêche-de-mer fishery is shown in Figure 5.3, which illustrates the fluctuating values of bêche-de-mer harvests in Queensland for the period 1901-1940 and the overall improvement in the profitability of the industry between 1910 and 1920.

In 1912, Mackellar referred to the continuing operation of bêche-de-mer fishers in the Great Barrier Reef.[54] By the end of the first decade of the twentieth century, an increase in the export value of bêche-de-mer had taken place, followed by a much greater expansion of the industry during and after the First World War, as Figure 5.3 suggests. In 1920 and 1922, the value of the harvests exceeded £60,000 in each year. Those years, however, represented the peak of the fishery and, after 1922, the fishery again declined. Some bêche-de-mer fishing continued during the 1930s; one lugger working near Green Island at that time is shown in Figure 5.4, and substantial quantities of bêche-de-mer continued to be removed from the reefs. For example, in 1933, the Townsville Harbour Board published its annual returns, stating that 86 tons 16 cwt of bêche-de-mer had been exported, and the trans-shipment of a further 11 tons 16 cwt 2 qtr had occurred. In

[52] Mackay *et al. Report*, p. 240.
[53] Mackay *et al. Report*, p. lxxiii.
[54] C. D. Mackellar, *Scented isles and coral gardens: Torres Straits, German New Guinea, and the Dutch East Indies*, John Murray, London, 1912, p. 8.

September 1936, a cargo of 6 tons of bêche-de-mer was handled at Bowen Harbour by the A.U.S.N. Company. Another shipment, of 3 tons 19 cwt, was made in April 1937.[55]

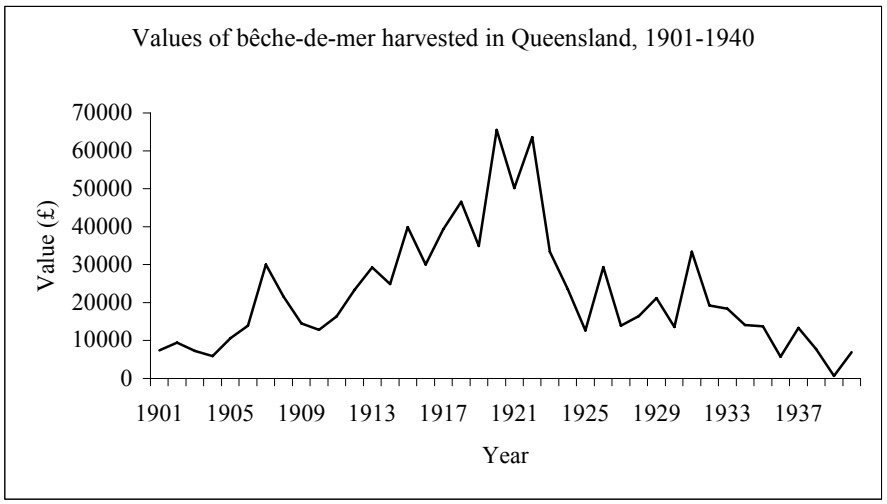
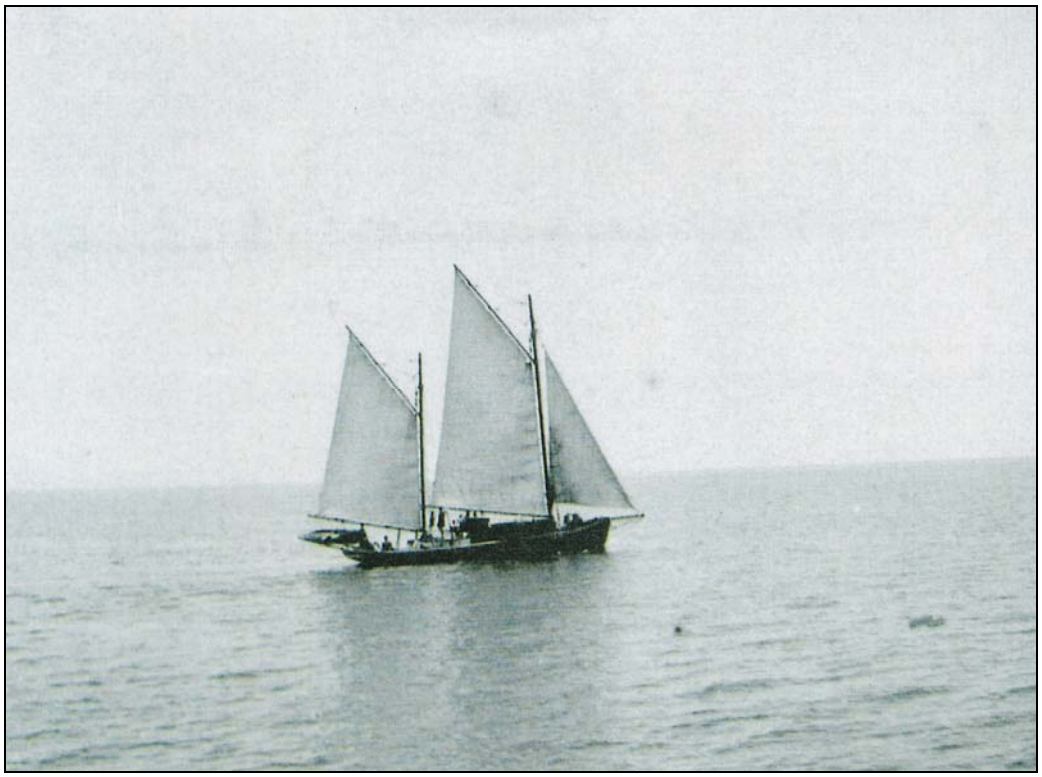



*Figure 5.3.* Values of bêche-de-mer harvested in Queensland, 1901-1940.
*Source:* Compiled from data in NADC (Northern Australia Development Committee), *Pearl-shell, bêche-de-mer and trochus industry of northern Australia*, NADC, Maribyrnong, Victoria, 1946, p. 44.



[55] 'Annual Returns of the Townsville Harbour Board', *Cummins and Campbell's Monthly Magazine*, Vol. 5, No. 71, March 1933, p. 37; Harbour Board, Bowen, Statistical Book No. 3, January 1931-December 1945, RSI5551/1 Item 3, QSA.

*Figure 5.4.* A bêche-de-mer lugger near Green Island, *c.*1931.

*Source:* Negative No. P05438, Cairns Historical Society Image Library, CHS.

During the 1930s, some optimism about the fishery remained, as Glenne suggested in 1938:

> There are no trepang fisheries like those of the Barrier Reef, where are found the bêches-de-mer [*sic*], which is neither a fish nor a slug, but an echinoderm. […] Indifferently called sea-slugs, trepangs, bêches-de-mer, teat fish, or sea cucumbers, they are prized by the Chinese, who will pay as much £160 a ton for this beloved delicacy.[56]

However, other authors acknowledged that the industry was declining. Suggate stated that the 'quantities of *bêche-de-mer*, obtained, like tortoiseshell, from the coasts of Queensland and Northern Territory, seem to be declining', and he stated that bêche-de-mer collection took place in conjunction with pearl-shelling.[57] By 1940, only small bêche-de-mer operations continued, as Figure 5.3 shows, including one fishery at Green Island. After that date, the fishery remained small although, in 1955, Serventy stated that 'as much as £300 per ton was paid for this delicacy', and bêche-de-mer fishing in the Great Barrier Reef has continued to the present day.[58] Overall, the evidence presented above suggests that, by the time of the formation of the GBRMP, thousands of tons of bêche-de-mer had already been removed from the Great Barrier Reef. Recent scientific monitoring of the species, as discussed in Section 8.3, indicates that bêche-de-mer are now significantly depleted in the Great Barrier Reef as a result of the commercial fisheries.

### *5.3.2 The pearl-shell fishery*

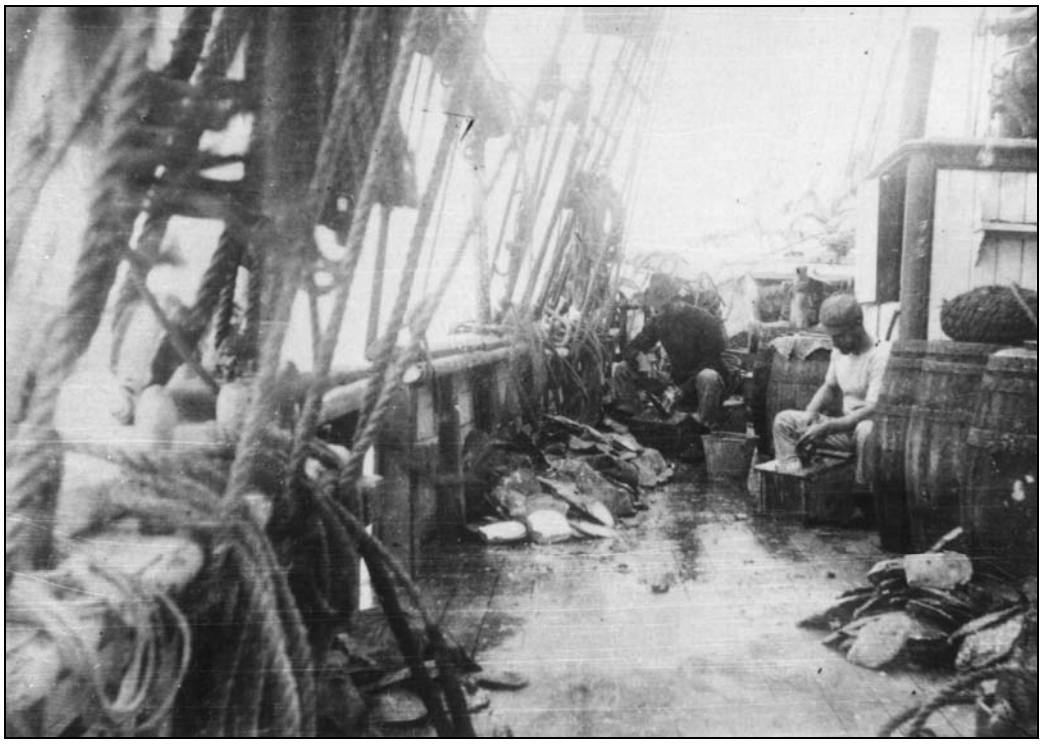
A detailed account of the operation of the Torres Strait pearl-shell industry has been provided by Ganter; yet, although Torres Strait was the centre of that industry, reefs in the Great Barrier Reef were also exploited for pearl-shell, so the fishery is also considered in this chapter.[59] The Queensland pearl-shell fishery was the first to operate in Australia; the earliest pearl-shell raised in Queensland was taken from Warrior Reef, in Torres Strait, in 1868. The fishery sought *Meleagrina margaritifera*, the common mother-of-pearl, which occurred in two varieties of approximately equal abundance: the gold-lipped oyster and the common oyster; of these two varieties, the common oyster,

[56] M. Glenne, *Great Australasian mysteries*, Stanley Paul, London, 1938, pp. 155-156.
[57] Suggate, *Australia and New Zealand*, p. 157.
[58] Serventy, *Handbook*, p. 76.
[59] Ganter, *Pearl-shellers of Torres Strait*; see also the account by C. Hedley, 'Australian pearl fisheries', *The Australian Museum Magazine*, Vol. 2, No. 1, January 1924, pp. 5-11.

with a purer and more uniform nacrous lining, was the more valuable.[60] A smaller pearl-shell, the black-lipped variety, was also found in Queensland waters as far south as Moreton Bay, but had not been harvested commercially by 1890; this variety was also known as 'Black Scotch', although uncertainty existed about its scientific name: *M. radiatus*, *M. fucatus* and *M. cummingii* were used variously to describe this variety.[61] Pearl-shell became one of the most economically significant exports from Queensland and was used in the manufacture of buttons and ornaments; the shell was exported to Europe and to south-east Asia. While pearls were sometimes taken with the shells, those were not the commercial object of the trade and were usually kept by the divers.[62]

The Queensland pearl-shell industry had its centre at Port Kennedy, on Thursday Island, where boats and crew members were registered and licensed, although pearling luggers worked shelling grounds in the Great Barrier Reef.[63] Like the bêche-de-mer and trochus fisheries, pearl-shelling depended on Aboriginal and Torres Strait Islander divers before the introduction of diving equipment in the 1880s. However, the industry operated with little regulation and it was not until 1877 that production statistics became available for the Queensland pearl-shell fisheries.[64] In that year, Senior wrote that pearl-shelling was 'a most thriving business' that had exported 200 tons of the material, at a value of around £200 per ton, from the port of Somerset in 1876. Senior stated that most of the luggers used – such as the vessel shown in Figure 5.5 – were owned by companies in Sydney; and he wrote that no taxes or licence fees were required of these companies by the Queensland Government, and that a merchant in Birmingham had already purchased £30,000 of pearl-shell.[65] Considerable optimism about the pearl-shell industry was expressed in Queensland. In 1879, Palmer wrote that the coasts of Queensland 'abound in pearl-shell', and stated that near Cooktown he saw 'shells as large as dinner plates and about ¾ of an inch thick', worth from £150 to £190 per ton.[66]

[60] Mackay *et al*., *Report*, p. xlvi.
[61] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729.
[62] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729; see also Glenne *Great Australasian mysteries*, p. 156.
[63] W. Saville-Kent, 'Pearl and pearl-shell fisheries of northern Queensland', *QVP*, Vol. 3, Part 2, 1890, pp. 703-712, p. 704.
[64] NADC (Northern Australia Development Committee), *Pearl shell, bêche-de-mer and trochus industry of northern Australia*, NADC, Maribyrnong, Victoria, 1946, p. 8.
[65] W. Senior, *By stream and sea: a book for wanderers and anglers*, Chatto and Windus, London, 1877, p. 311.
[66] Palmer, *Exhibition essay*, p. 30.



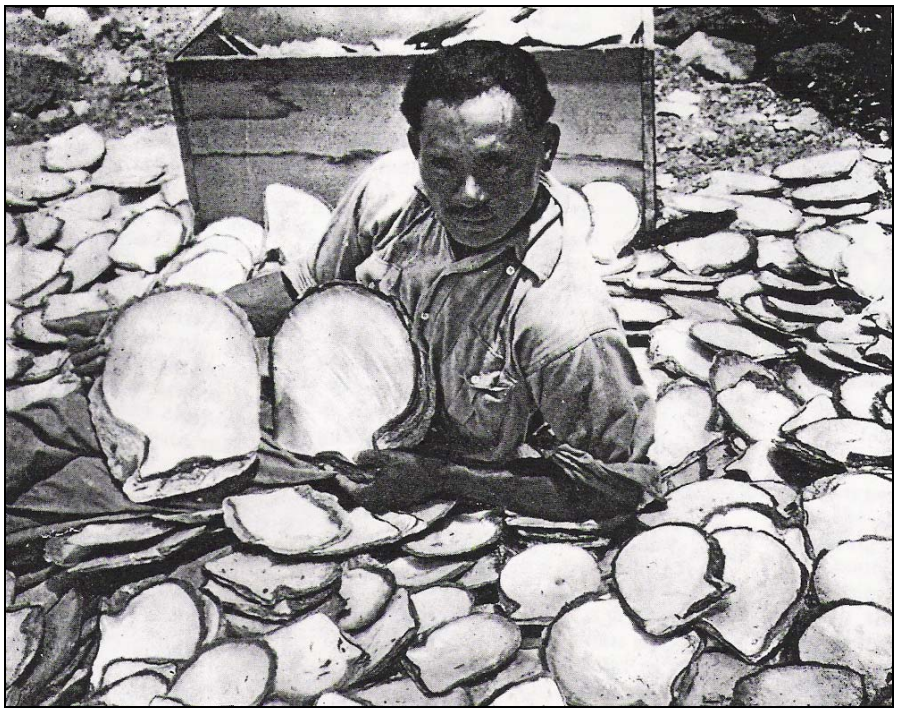


*Figure 5.5.* The collection of pearl-shell aboard a Queensland lugger (top); and the packaging of 'giant' (or 'silver-lip') pearl-shell for export, including one shell measuring 12 inches in diameter (bottom). *Source:* Negative No. 49810, Historical Photographs Collection, JOL; C. Hedley, 'Australian pearl fisheries', *The Australian Museum Magazine*, Vol. 2, No. 1, January 1924, pp. 4-11, p. 5.

However, the depletion of pearl oysters had been recognised by 1897, when the Queensland Departmental Commission on Pearl-Shell and Bêche-de-mer Fisheries was established to investigate the regulation of the fishery and to report the extent of exhaustion of pearl-shell resources.[67] The following year, the Queensland Inspector of Pearl-shell Fisheries, G. H. Bennett, suggested that the whole of Endeavour Strait should be closed; that area, he stated, 'comprises grounds which have been constantly worked for many years, and from which large quantities of shell have been taken in the past, but it is now very much impoverished'. Bennett acknowledged the need 'to close large areas of the pearling grounds for the purposes of conservation' so that the pearl oyster populations might recover, and he reiterated his concerns during the following two years, adding only that the need for the closure of the pearling grounds had become more urgent since there was practically no pearl-shell remaining in Endeavour Strait.[68]

Yet in 1890, Saville-Kent reported the continued profitability of the industry; he acknowledged that the pearl-shell fisheries of northern Queensland occupied 'a prominent position among the most important commercial industries of this Colony' and stated that, from 1884-1888, the average annual export value of pearl-shell was £69,000: more than double the combined value of the bêche-de-mer and oyster fisheries in Queensland. In 1890, Saville-Kent reported, 1,000 workers were employed in the pearl-shell industry at Thursday Island and 93 licences for pearling luggers were granted there, which was a reduction compared with the numbers operating before 1886; he attributed this decline to a large-scale migration of fishing operators to the Western Australian pearling grounds, although many of those operators subsequently returned to the Queensland fishery.[69]

However, in spite of these comments about the profitability of the fishery, Saville-Kent recognised that some depletion of the pearl-shell beds had already occurred since it had become necessary to obtain pearl-shell from increasingly deep water as the shallow-water stocks became scarce. He stated:

[67] J. Hamilton *et al.* (eds), 'Report, together with minutes of evidence and proceedings of the Commission appointed to inquire into the general working of the laws regulating the pearl-shell and bêche-de-mer fisheries in the Colony, Queensland Departmental Commission on Pearl-Shell and Bêche-de-mer Fisheries', *QVP*, Vol. 2, Part 2, 1897, pp. 1273-1352, p. 1305.
[68] G. H. Bennett, AR, Inspector of Pearl-shell Fisheries, *QVP*, Vol. 3, 1898, pp. 1041-1048, p. 1042; G. H. Bennett, AR, Inspector of Pearl-shell Fisheries, *QVP*, Vol. 5, Part 2, 1899, pp. 994-997, p. 995; G. H. Bennett, AR, Inspector of Pearl-shell Fisheries, *QVP*, Vol. 3, Part 2, 1900, pp. 1317-1321, p. 1319.
[69] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 727-728.

> The average depth of water from which the greater quantity of the mother-of-pearl shell is at present collected is seven or eight fathoms. In former years it was abundant, and is even now occasionally obtained in water of such little depth that it can be gathered with the hand at low spring tides. Twenty fathoms of water represent about the greatest depth from which the shell is profitably fished [...]. Some of the largest shell now placed on the market is collected at the above depth from off the New Guinea coast.[70]

In his account, Saville-Kent reported that by 1890, as a result of the depletion of the earliest-harvested pearl-shell beds, the largest shells – weighing 8 lb per pair – that were once found commonly throughout Torres Strait had become scarce.

Saville-Kent acknowledged that the harvest of pearl-shell included very small pearl oysters. Describing the yields obtained by the fishery, he stated that a typical harvest was from 600 to 700 pairs of pearl shells per boat in one month; this represented approximately one ton in weight, although he acknowledged that, under very favourable conditions, 1,200-1,800 pairs of shells could be harvested and that the owners of stations and boats awarded bonuses to divers and crews a bonus if they harvested over 1,000 pairs. One standard pair of shells was defined as 3 lb of pearl-shell and, although divers were encouraged to collect the largest shells, they were also able to obtain their bonuses by collecting very small pairs of shells if these added up to the same weight; as a result, no incentive existed to preserve stocks of immature pearl-shell oysters; consequently, he reported, 'a very considerable quantity of shell is brought in weighing from 1 lb to so little as 5 or 6 oz only per pair', which represented as many as 6,000 pairs of shells per ton. Furthermore, Saville-Kent acknowledged that the supply of pearl-shell was geographically variable and that the most accessible beds had been depleted to a far greater extent than others.[71]

Although Saville-Kent's report described the depletion occurring in Torres Strait, it is likely that similar depletion affected the northern Great Barrier Reef, since those pearling grounds were also used by the Queensland fishery. He argued that the depletion of the pearl-shell required immediate restriction and regulation of the industry. The decline in the average size of the pearl-shell harvested had reduced the value of the product; as Saville-Kent stated that previously 'the price for shell of good

[70] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 728-729.
[71] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 728-729.

quality ranged as high as £200 per ton, the shell itself was more readily accessible and […] the profits in the trade were consequently much more considerable.'[72] By 1890, however, the price of good quality shell had fallen to around £135 per ton, and Saville-Kent reported that industry support for restrictions in the pearl-shell fishery had strengthened and a trade body representing 73 boats voted to accept a size limit of either 7 inches from the front lip to the hinge overall, or of 6 inches across the diameter of the nacre; the latter measurement was preferable since the width of the surrounding border was highly variable, and this was the restriction that came into force.[73]

These officials of the Queensland Government were not the only authorities to report on the decline of pearl-shell resources. In 1908, the Royal Commission investigation into the Queensland pearl-shell and bêche-de-mer fisheries acknowledged that, as old and full-grown pearl shell had become scarce, the industry had adapted in an attempt to sustain yields: size limits had been imposed, pump-diving had been introduced, the average vessel size had increased and shore-station systems and pearling fleets had appeared.[74] From 1890-1893, the statistics of the industry changed in the following ways: the number of boats increased from 92 to 210, the gross take of pearl shell take increased from 632 to 1,214 tons, but the available catch per boat decreased from 6 tons 17cwt 1 qtr to 5 tons 15 cwt 2 qtr. Also, by 1893, a larger area was being fished for pearl-shell. Despite these changes, by 1894, the yield was stationary at 1,190 tons; by the following year the total harvest had fallen to 873 tons. By 1895, another source of pearl-shell had been found in Princess Charlotte Bay, but that resource was of inferior quality and may have contributed to a reduction in the market price for pearl-shell.[75]

The Royal Commission collected anecdotal evidence of the decline in pearl oysters, using qualitative interviewing. The evidence suggested that the 'shallow beds inshore and those in the intermediate neighbourhood of the Prince of Wales group were the first to show signs of having been over-fished.'[76] The causes of this depletion were thought to include the following eight reasons: (i) ignorance about the length of time required for pearl shell to mature, (ii) a belief that the supply was inexhaustible, (iii) the desire of

[72] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 729.
[73] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', pp. 729 and 734.
[74] Mackay *et al.*, *Report*, pp. xlvi-xlvii.
[75] Mackay *et al.*, *Report*, pp. lxix.
[76] Mackay *et al.*, *Report*, p. l.

pearl-shellers to raise as much shell as possible in the shortest space of time, (iv) the introduction of floating stations, which concentrated the work of the vessels, (v) excessive use of vessels, (vi) the introduction of many Asian divers, (vii) the lack of periodic closures of the fisheries, and (viii) the reduction in size limits, from 6 to 5 inches (nacre measurement). The Royal Commission concluded that the pearl-shell fishery was 'suffering from severe depression, which has resulted mainly from depletion of natural supplies'; consequently, urgent initiatives to cultivate the pearl oyster and to restrict the overseas labour force were required.[77]

Another investigation into the industry – the 1913 Commonwealth of Australia Royal Commission on the pearl-shelling industry – found that the pearl-shell fishery was still 'capable, if systematically and scientifically conducted, of considerable development.'[78] Individual pearl-shell divers were rewarded for large harvests using a system of incentives; the average annual harvest per diver was between 6 and 7 tons, but divers were encouraged to take up to 10 tons each year, and successful divers received a higher salary per ton. This system resulted in a large increase in the total pearl-shell yields during the periods 1911-1913 and 1918-1929; the yields obtained during the latter period were never exceeded in Queensland.[79] From 1912-1918 the value of pearl-shell had risen from £92,576 to £168,000, while the value of pearls during the same period increased from £25,000 to £63,000.[80] Nevertheless, after 1927, the industry declined as a result of the scarcity of pearl oysters. Between 1930 and 1934, the pearl-shell harvest decreased sharply and, subsequently, only a moderate improvement in yields occurred; in an attempt by the Commonwealth Government to support the struggling industry, a grant of £1,500 was made in 1935 to the Queensland fishery. In 1936, Christesen wrote that the only remaining pearl-shell was found in deep-water beds, and Roughley wrote that, although the resource was still available in Torres Strait, pearl-shell was smaller and less abundant to the south of Cairns.[81]

[77] Mackay *et al.*, *Report*, pp. li-lii and lxxv.
[78] Commonwealth of Australia, Royal Commission on the Pearl-Shelling Industry, *Progress report*, Government Printer, Melbourne, 1913, p. 591.
[79] NADC, *Pearl shell*, p. 11.
[80] G. Taylor, *Australia in its physiographic and economic aspects*, 4th edn, Clarendon Press, Oxford, 1925, p. 218.
[81] C. B. Christesen, 'Roving the coral seas', *Walkabout*, 1 June 1936, pp. 28-31, p. 31; T. C. Roughley, *The wonders of the Great Barrier Reef*, Angus and Robertson, Sydney, 1936, p. 219.

The annual harvests and values of the Queensland pearl-shell fishery from 1890-1940 are shown in Figure 5.6, which illustrates the considerable variability that characterised the industry. In particular, the reductions in pearl-shell harvests during the First World War, and again during the early 1930s, are evident in Figure 5.6. This graph shows that, in a similar manner to the bêche-de-mer fishery, pearl-shelling reached its highest levels during the 1920s, although the peak of the latter industry occurred slightly later, in 1929, when 1,429 tons of pearl-shell were harvested. During the Second World War, pearling luggers were requisitioned by the Australian Navy and no commercial pearl-shelling took place from 1941-1945. During those years, one report stated that:

> exports of pearl shell was prohibited and later the Department of Munitions took over all the stocks in Australia, which were used for making prismatic compass dials for the Australian and Canadian armies, and to supply gold-lipped pearl shell for use as currency by the forces in New Guinea. Stocks fell so low that it became necessary to arrange for some pearl shell fishing [...].[82]

Nevertheless, this small revival of the pearl-shell industry during the Second World War was short-lived as, subsequently, synthetic plastics replaced pearl-shell in the manufacture of buttons and the pearl-shell market collapsed.

A later report by the industry by the Northern Australia Development Committee (NADC), published in 1946, reached similar conclusions as the 1908 Queensland Royal Commission about the over-exploitation of resources; the report by the NADC described the early phase of the industry, when pearl-shell was plentiful and could be collected from shallow water, and the necessity for divers to exploit increasingly deep stocks. The NADC acknowledged that until 1900 the Queensland fishery was far more successful than that of Western Australia; but that the Queensland fishery then declined, comparatively, until 1925. After that date, the Queensland industry recovered and dominated Australian production until its final collapse.[83] Yet the report acknowledged the severe over-exploitation of pearl oyster stocks, stating that:

> the beds had become very depleted, and of course the huge output of shell by the up-to-date Japanese ships had an adverse effect on the world market, and with the losses suffered by the Broome pearlers in the hurricane of 1935, left the Australian industry at a low ebb.[84]

[82] NADC, *Pearl shell*, p. 10.
[83] NADC, *Pearl shell*, p. 8.
[84] NADC, *Pearl shell*, p. 9.

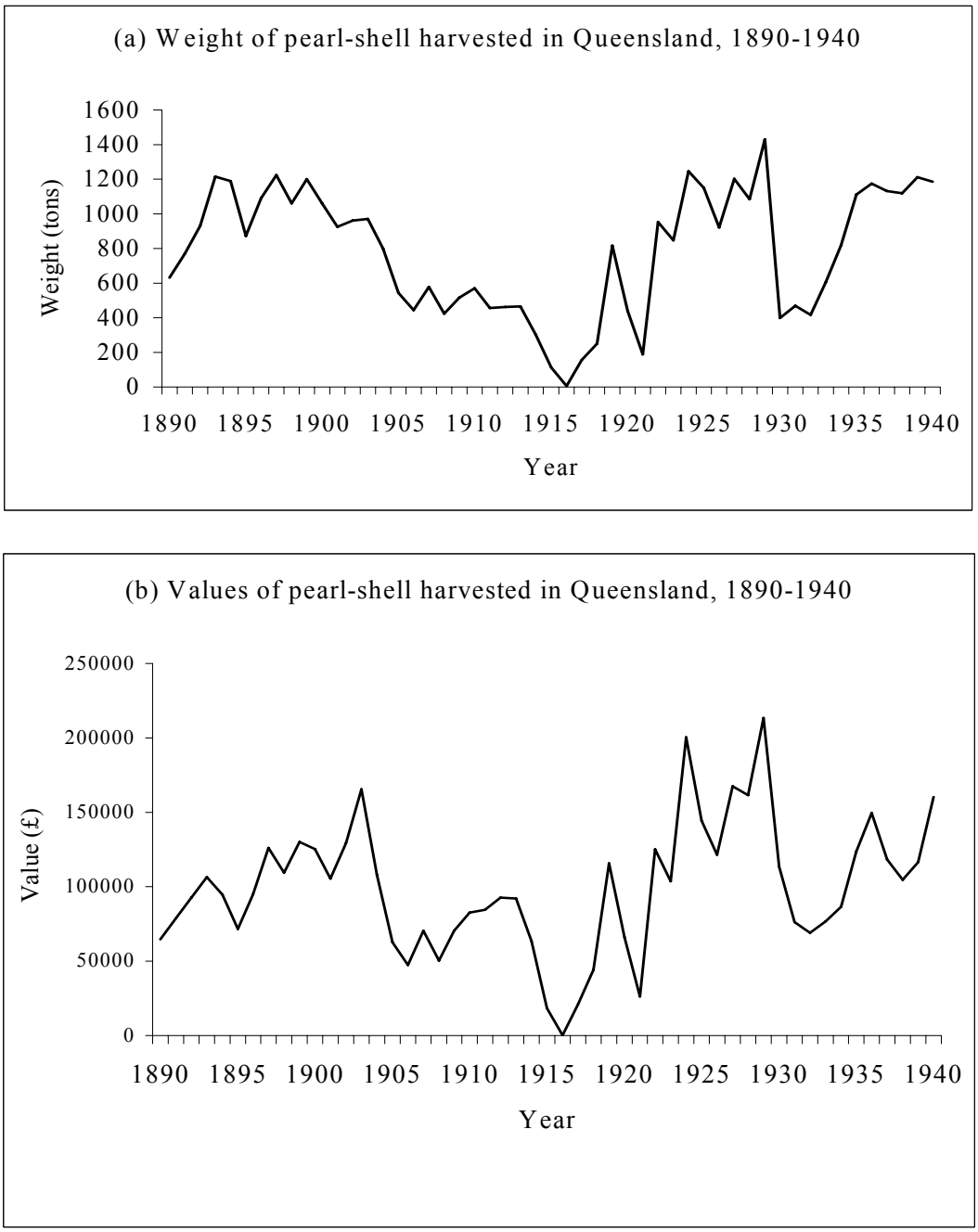



*Figure 5.6.* (a) Weights of pearl-shell harvested in Queensland, 1890-1940; (b) Values of pearl-shell harvested in Queensland, 1890-1940.

*Source:* Compiled from data provided in Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 730; NADC, *Pearl shell*, p. 44.

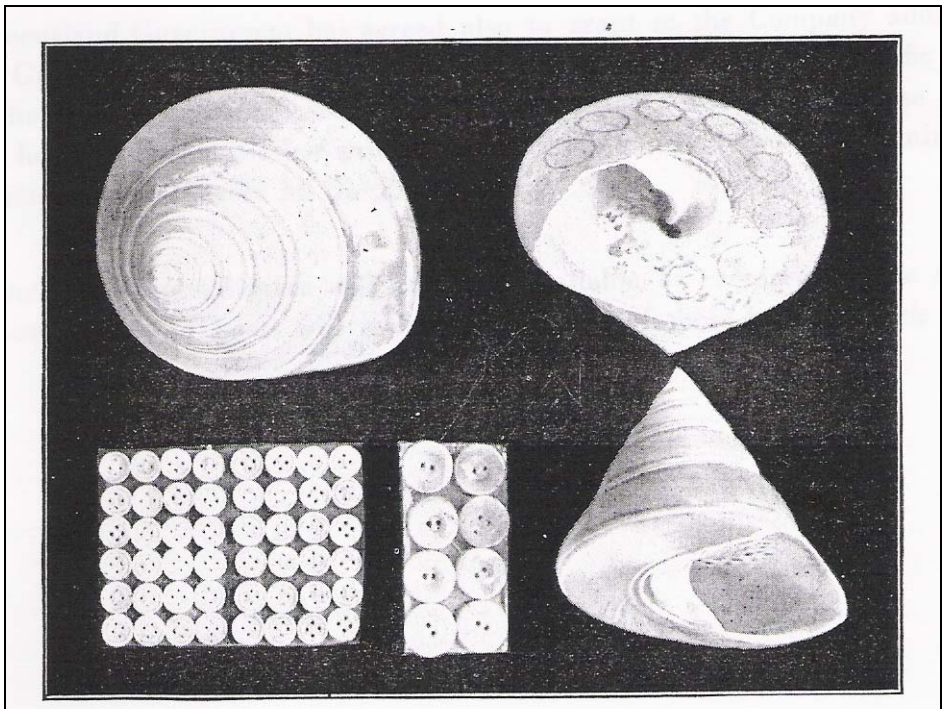
The NADC concluded that the Queensland pearl-shell fishery had operated on a basis that was far from sustainable and, hence, was comparatively short-lived.

Serventy, writing in 1955, reported that both the value of pearl-shell and the cost of labour and transport in the industry fluctuated considerably; as a result, the high profitability of pearl-shelling before the First World War had decreased and manufacturers had turned increasingly to synthetic materials as substitutes for pearl-shell.[85] Like the bêche-de-mer industry, an accurate evaluation of the overall impact of the fishery on the resource is hindered by a lack of records for the early period of harvesting; few documentary records illuminate the period before the earliest depletion of pearl-shell was reported. Nevertheless, the evidence presented above suggests that the activities of pearl-shellers were widespread in the Great Barrier Reef and that intense depletion of pearl-shell beds took place during the period in which this industry operated. Like the bêche-de-mer fishery, and in spite of regulatory measures, the pearl-shell industry exhausted the marine resources on which it was based.

### *5.3.3 The trochus fishery*

The harvesting of trochus (*Trochus niloticus*) in the Great Barrier Reef occurred later than the main period of the bêche-de-mer and pearl-shell fisheries, since trochus was regarded as inferior to pearl oysters as a source of shell and was less sought after, although it was intended for the same purposes: button manufacture and the ornamental trade. The collection and use of trochus is illustrated in Figure 5.7. Between at least 1912 and the 1950s, a large amount of trochus was harvested from the Great Barrier Reef. In 1912, Taylor reported that the value of trochus in the Queensland fishery was £12,000, with most of the revenue derived from exports to Austria and Japan, and by 1916 the annual trochus harvest was around 500 tons.[86] In July 1917, one shipment of trochus shell – weighing 5 tons 11 cwt – was handled in Bowen harbour by the A.U.S.N. Company; another shipment, of 6 tons 9 cwt, was transported in May 1936. Two further shipments of shell – weighing 3 tons 16 cwt, and 6 tons respectively – were

[85] Serventy, *Handbook*, p. 75; the replacement of the marine products with synthetic materials is also described in OHC 13, 4 August 2003, p. 3.
[86] Taylor, *Australia in its physiographic and economic aspects*, p. 218; see also GBRMPA, *Reef notes: trochus shells*, GBRMPA, Townsville, 1987.



TROCHUS SHELL (Trochus Niloticus). Cleaned shells showing pearly lustre. Shell marked for punching out of buttons. Pearl buttons made from Trochus Shell.

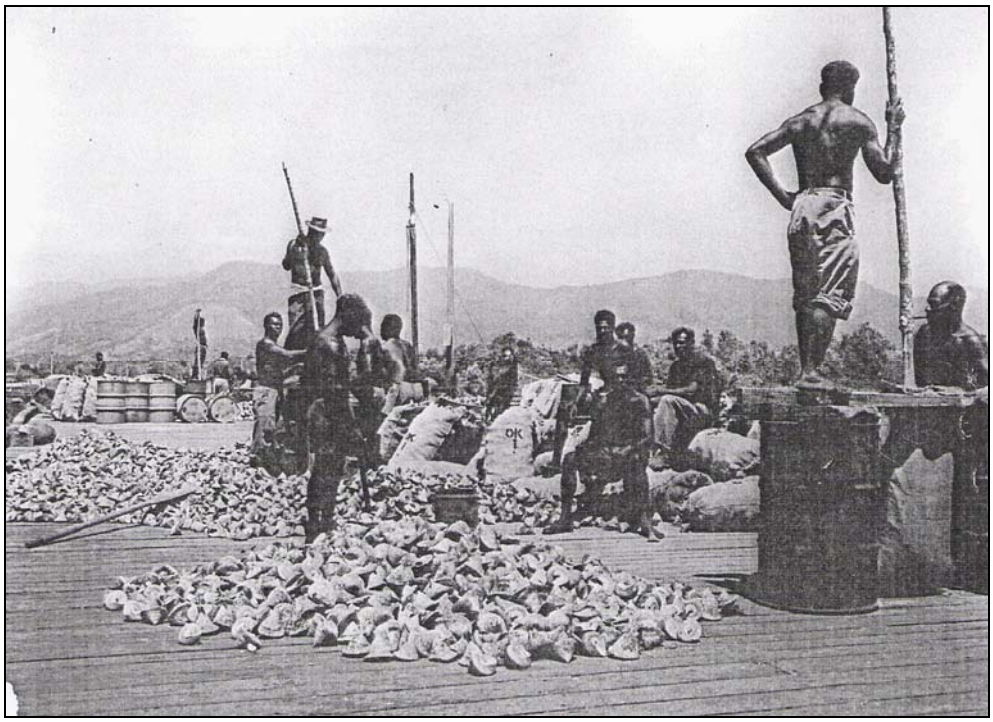


*Figure 5.7.* The use of trochus shells for button manufacture, 1929 (top); and a Torres Strait Islander crew bagging trochus shells on the wharf at Smiths Creek, Cairns, 1950s (bottom).

*Source:* Great Barrier Reef Fisheries Ltd., *Tapping the wealth of the Great Barrier Reef*, Great Barrier Reef Fisheries Ltd., Sydney, 1929, p. 15; Image No. P09334, Image Library, CHS.

handled at Bowen in July and August 1939.[87] The material continued to be collected primarily for export, as Suggate reported in 1931, with the majority used to supply the Japanese market.[88] The reefs of the northern Great Barrier Reef were extensively fished for trochus, and a large fishery also existed in Torres Strait, but the industry subsequently expanded to include the whole Great Barrier Reef, including the little-charted Swain Reefs in which trochus luggers operated as early as 1936.[89]

As the trochus fishery operated more recently than the bêche-de-mer and pearl-shell fisheries, some oral history evidence illuminates its operation. One oral history informant, a former trochus diver, described diving for trochus in the area between Cooktown and Sudbury Reef, near Cairns, stating that the crews worked the reefs 'till we had nineteen to twenty ton, […] enough for the boat to carry. Used to call in Cooktown and put off some shells'. The same informant reported that the trochus crews worked for between six and eight months of the year, based at islands and harvesting many reefs between Cooktown and Cairns, and he stated: 'I was still on the boat at wartime. [...] The Americans used to buy the shell during the war, for making buttons.'[90] Another informant – also a trochus diver – recalled working many reefs between Cape York and Cooktown, and he stated:

> we seemed to work from a little below Somerset right down to almost Portland Roads. There were a lot of reefs and they'd work right along the reefs. And they'd usually anchor the boat on the leeward side and you'd row a dinghy and work your way back to the boat. So, depending on the tides, you were diving in shallow water up to quite deep: we went down about 14 or 15 feet.[91]

The same informant reported that trochus divers searched reef edges to find trochus; some carried the shells by hand, holding about a dozen at a time, but most used a small bag until the trochus could be emptied onto the boat. The processing of the animal took place on deck, as the same informant explained: 'they'd be boiled up and the meat dried

[87] Harbour Board, Bowen, Statistical Book No. 1, July 1915 – February 1926, RSI5551/1 Item 1, QSA; Harbour Board, Bowen, Statistical Book No. 3, January 1931 – December 1945, RSI5551/1 Item 3, QSA.
[88] Suggate, *Australia and New Zealand*, p. 157.
[89] C. B. Christesen, 'Roving the coral seas', *Walkabout*, 1 June 1936, p. 28.
[90] Fred Mundraby, cited in J. Thomson (ed), *Reaching back: Queensland Aboriginal people recall early days at Yarrabah*, Aboriginal Studies Press, Canberra, 1989, p. 85.
[91] OHC 13, 4 August 2003, p. 3.

away and it was dried out or something, because people used to eat it, and the shell would be bagged-up.'[92]

Another informant reported the abundance of trochus on reefs in the Cairns area after the end of the Second World War (Figure 5.7). In 1948, when he arrived in Cairns, this informant recalled seeing 'all the luggers' and the 'trochus shell just lying around' on the reefs.[93] This informant also recalled working on reefs near Mackay and as far south as the Swain Reefs; throughout the period of the fishery, he reported, trochus was plentiful on the reefs: 'it was everywhere.' He worked on board a ketch-rigged vessel and stated that hundreds of luggers were working the reefs.[94] The same informant described the processing of trochus – and also the collection of an inferior type of shell, known as 'chicken-shell' – in the following terms:

> It fits inside a round tobacco tin; it's called chicken-shell and you're not really supposed to harvest it. They made a half-hearted effort to check luggers when they came in to see if there was any chicken-shell on board. The divers used to hide it. […] Most of the boats fished one ton [of trochus] a day, with 16 crew members on board, and they carried the old, square 44-gallon kerosene drums with a handle. [...] That's what they'd do the shelling in when the shell came on board.
>
> In the afternoon there would be a fire started in a 44-gallon drum that was split open a bit so that you could put another 44-gallon drum inside [...]. There was a hole cut out and you had mangrove water. That would make the water boil. Then you threw the shells in. After a few minutes you fished the shells out, put them on the deck, and all the crew would sit around with their piece of wire and their hook on the end: put that in the shell […] and they'd pull the meat out.[95]

Another informant – also a former trochus diver – stated that, at Cairns in 1952, trochus-shell was valued at £500 per ton, and that divers were restricted to collecting shells no smaller than two inches in diameter in order to conserve trochus stocks.[96]

In comparison with pearl-shelling, Serventy stated that trochus diving had the advantage of not requiring diving suits and mechanical breathing apparatus, because trochus could

[92] OHC 13, 4 August 2003, p. 3.
[93] OHC 7, 19 February 2003, p. 4.
[94] OHC 7, 19 February 2003, pp. 5-6.
[95] OHC 7, 19 February 2003, pp. 4-5.
[96] OHC 22, 12 September 2003, pp. 1-2.

be found on the tops and the sides of reefs in shallow water, as one informant verified.[97] In addition, Serventy stated:

> Instead of the boards used for the tenders which are a feature of pearling luggers, trochus boats have a large boiler attached to the stern. In here the trochus is boiled, the meat extracted and either eaten by the crew or smoked for sale ashore. The shell is packed ready for sale. It does not fetch the same high price as pearl shell and is also a much more fluctuating market.[98]

As a result of the fluctuating market – and because of the size limits imposed – the trochus fishery did not result in such prolonged, widespread exploitation of coral reefs, in contrast to the bêche-de-mer and pearl-shell fisheries. The decline of the trochus industry was precipitated by the introduction of synthetic plastics in the 1950s, which caused the market for trochus to collapse, rather than by shortages of the natural material.[99]

Evidence of the survival of trochus stocks is found in several sources. In 1962, for example, Rees stated that trochus shells up to eight inches in diameter could still be obtained from the Great Barrier Reef and were still used to manufacture buttons; in addition, monthly records of trochus taken from the Lizard Island group by the crew of the *Placid* indicate that, in February 1964, a total weight of 5 tons 5 cwt 1 qtr 11 lbs of trochus was taken, and in April 1964 the amount was 10 tons 11 cwt 2 qtr 10 lbs.[100] Since 1970, a limited market for trochus was re-established and trochus fishing has continued in the Mackay area; the recent fishery, however, is small in comparison with the historical fishery that operated between 1912 and the 1950s. Overall, the evidence presented above suggests that the earlier fishery removed thousands of tons of trochus from reefs throughout the Great Barrier Reef; but in contrast with the bêche-de-mer and pearl-shell industries, the operation of that fishery reduced but did not exhaust the supply of trochus.

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[97] OHC 22, 12 September 2003, p. 1.
[98] Serventy, *Handbook.* pp. 75-76.
[99] OHC 7, 19 February 2003, pp. 4-5; see also S. Domm, 'Corals of the Great Barrier Reef', *Royal Commission on Great Barrier Reef Petroleum Drilling, Transcript of Proceedings*, 22 May 1970 – 14 July 1970, Vol. 1, AGPS, Brisbane, 1970, p. 45.
[100] H. Rees, *Australasia: Australia, New Zealand, and the Pacific Islands*, Macdonald and Evans, London, 1962, p. 102; NADC, *Pearl shell*, p. 44; 'Miscellaneous correspondence re. annual returns', RSI3284/1 Item 2, QSA.

## 5.4 Coral mining in the Great Barrier Reef, 1900-1940

The extent of coral mining in the Great Barrier Reef has been little recognised. Endean claimed that no limestone mining had yet occurred in the Great Barrier Reef; Carruthers' earlier review of limestone mining in the Great Barrier Reef stated that little information about the subject existed.[101] Bowen and Bowen mentioned two instances of coral mining in the Great Barrier Reef, but no overview of the industry has been published, despite the fact that public opposition to a proposal to mine coral from Ellison Reef, near Innisfail, initiated the most significant environmental protest in Australian history and led to the formation of the GBRMP.[102] Analysis of archival records held at the QSA and oral history evidence indicates that coral mining took place in at least twelve locations in the Great Barrier Reef, between 1900 and 1940, with the encouragement of the Queensland Government. During this period, thousands of tons of coral were removed and pulverised to produce agricultural lime for sugar cane fields on the adjacent coastal land, and several coral reefs and cays experienced severe exploitation; parts of those reefs may have been far from pristine at the time of the formation of the GBRMP. Coral mining, therefore, is one European impact in the Great Barrier Reef that has previously been overlooked.

Information about coral mining is contained in many documents of the QDHM and the QEPA. Particularly useful material was found in the files relating to the preservation of coral from exploitation, the issue of coral licences and the *Fish and Oyster Acts, 1914-1935*; these files were located with the assistance of the archivists at the QSA. However, the records of the QDHM held at the QSA begin and then end abruptly, with large discontinuities between series; archivists at the QSA suggested that other files may have been lost when the Departmental offices in Brisbane were inundated in the Australia Day floods of 1974. The logical sequence of coral licences suggests that more areas were mined for coral than are revealed by the surviving records. Documentary evidence also suggests that unlicensed coral mining took place at some locations, such as King's

[101] R. Endean, *Australia's Great Barrier Reef*, UQ Press, St. Lucia, Queensland, 1982, p. 300; D. S. Carruthers, 'Limestone mining', in Australian Conservation Foundation, *The future of the Great Barrier Reef: papers of an Australian Conservation Foundation symposium, Sydney, 3 May 1969*, Australian Conservation Foundation, Parkville, Victoria, 1969, pp. 47-50, pp. 47 and 49.
[102] Bowen and Bowen, *Great Barrier Reef*, p. 291; see also the account found in OHC 14, 26 August 2003, p. 6.

Reef, near Innisfail, before the system of coral licences was introduced. Therefore, coral mining probably took place more extensively than the following account indicates.

Oral history sources provided additional information for the reconstruction of the historical extent of coral mining; these sources also provided some details of the process of coral mining, the infrastructure used in the industry and the impacts that remain in the landscape. Furthermore, oral history informants revealed that coral mining took place at Snapper Island: a location for which no coral licence appears to have been issued. Oral history sources, therefore, provide further evidence that coral mining was more widespread – and more intensive – than surviving documentary records indicate. In addition, three oral histories contained many points of agreement about the nature, methods and duration of coral mining at Snapper Island, and a fourth oral history source was consistent with documentary accounts of coral mining at Upolu Cay.[103] Therefore, although some uncertainties exist in the oral sources – particularly concerning the precise dates of the mining operations – triangulation of sources was possible.

Before coral mining for the manufacture of agricultural lime commenced in the Great Barrier Reef, in 1900, lime burning was already an established practice; the earliest recorded instances of Europeans using shells or coral gathered from the Great Barrier Reef to produce lime date from the 1840s. In 1844, lime for the construction of the navigation beacon at Raine Island was obtained by burning *Tridacna* and *Hippopus* shells; and in 1847, at the time of settlement of Port Curtis (now Gladstone), an abundance of shells for lime-burning was reported in the locality.[104] Lime was used to make mortar, but burnt coral was also used as a building material in its own right. In 1864, G. Bowen informed the Royal Geographical Society of London that the creation of a new settlement at Port Albany, Cape York was facilitated by the presence of 'large beds of coral, of the best description for making lime'.[105] In an early description of Queensland, A. J. Boyd stated: 'The corals bordering our coasts also supply

[103] The relevant interviews are OHC 16, 2 September 2003; OHC 17, 2 September 2003; OHC 28, 19 September 2003; and OHC 36, 28 October 2003.
[104] D. Lawrence and J. Cornelius, 'History, relics and tower graffiti', in A. K. Smyth *et al.* (eds), *Raine Island and environs Great Barrier Reef: quest to preserve a fragile outpost of nature*, Raine Island Corporation/GBRMPA, Brisbane, 1993, pp. 1-11, p. 4; Fitzgerald, *From the Dreaming to 1915*, p. 94.
[105] G. Bowen, 'Containing reports upon the formation of a new settlement at Cape York, at the northernmost point of the Australian continent; and upon the completion of the survey of the inside of the Great Barrier Reef, off the north-east coast, by Commander Robinson, R.N.', *Proceedings of the Royal Geographical Society of London*, Session 1863-1864, Vol. 8, No. 4, 1864, pp. 114-118, p. 116.

inexhaustible deposits of lime.'[106] By 1900, the church at Fitzroy Island had been built by the Yarrabah Aboriginal Mission using coral taken from the fringing reef at the island; this church is shown in Figure 5.8. The use of coral as a building material, therefore, appears to have been an established practice and much larger structures were also constructed using burnt coral, such as the church at Darnley Island.[107] Apart from wood, coral was the most readily available building material for the construction of buildings on islands with fringing reefs, and it could easily be worked.

In the Great Barrier Reef, coral mining took place in order to manufacture agricultural lime for the sugar cane farms on the adjacent coastal land; coral was mined from accessible coral reefs and cays and burnt as a cheap and chemically pure source of lime.[108] Lime was used to fertilise the acidic soils of the northern coastal districts in an attempt to increase sugar yields; burnt lime was also used as a settling agent in the process of manufacturing raw sugar. In 1915, the QBSES reported that, in north Queensland, terrestrial sources of lime were expensive; Ernest Scriven, the Director of the QBSES, stated:

> The price of lime in Northern sugar districts is still unduly high, and efforts are being made by many of the Farmers' Associations to open up various lime deposits and also to procure coral lime, coral sand, and shell deposits.[109]

In 1916, Scriven reported that interest in coral lime was high and pulverising machines were already on the market. Farmers were advised to use coral fertilisers in combination with green manures and, by 1920, coral lime was being applied in the Mossman, Goondi, Mourilyan and South Johnstone areas at a cost of £3 per ton for coral sand and £4 per ton for burnt coral lime.[110]

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[106] A. J. Boyd, *Queensland*, Qld. Government Emigration Office, London, 1882, p. 28.
[107] N. R. Strelitz, 'Trojan car trip, 1925, from Thursday Island to Pascoe River, Cape York, showing coral church (All Saints), Darnley Island', Image No. P02139, Image Library, CHS.
[108] J. Kerr, *Northern outpost*, 2nd edn, Mossman Central Mill Co., Mossman 1995, pp. 92-94. See also G. L. Spencer and G. P. Meade, *Cane sugar handbook: a manual for cane sugar manufacturers and their chemists*, 8th edn., John Wiley and Sons, Inc., New York, 1945, p. 132, which describes the use of lime from coral beach sand in Hawaiian factories; N. J. King, 'Soil acidity and liming', in N. J. King *et al.* (eds), *Manual of cane-growing*, Angus and Robertson, Sydney, 1965, pp. 99-109, pp. 104 and 108, provided details of the use of lime in sugar cane production and acknowledged the chemical purity of lime manufactured from coral.
[109] E. Scriven, AR, QBSES, 1914-15, *QPP*, Vol. 2, 1915-1916, p. 1175.
[110] E. Scriven, AR, QBSES, 1915-16, *QPP*, Vol. 2, 1916-1917, p. 1237; E. Scriven, AR, QBSES, 1920-21, *QPP*, Vol. 2, 1922, p. 1034.

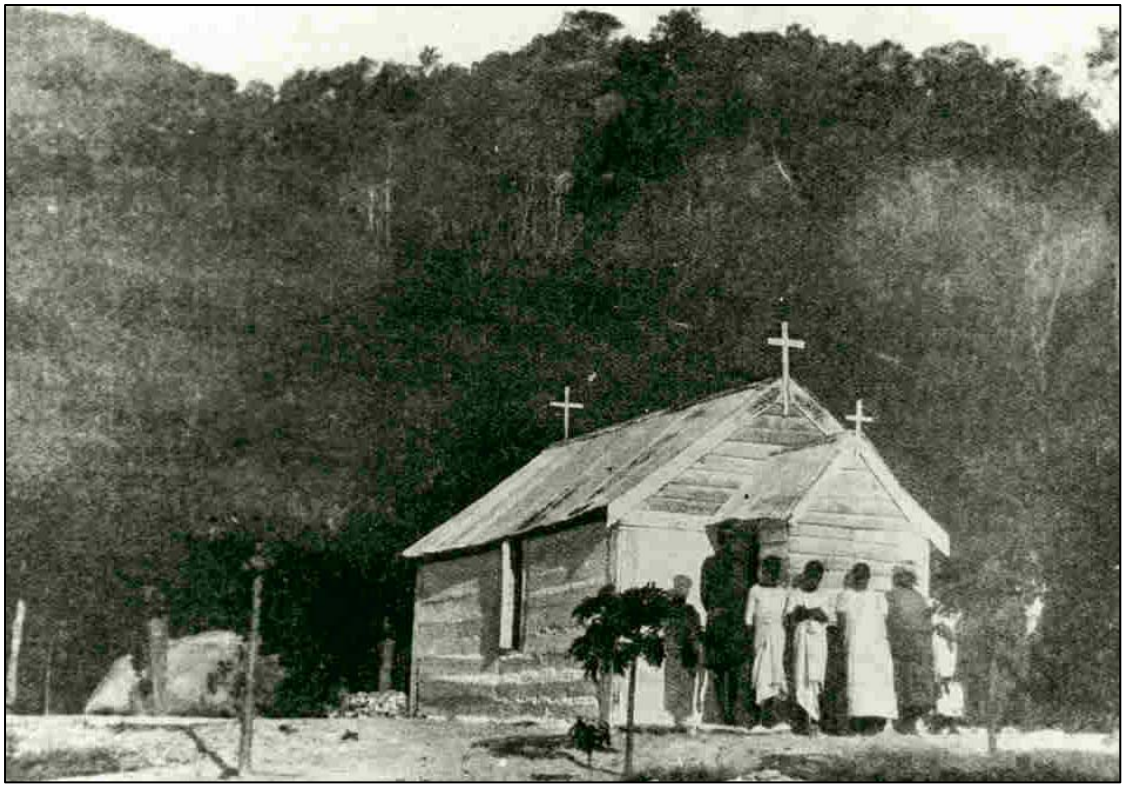

*Figure 5.8*. Church built from burnt coral at Kobbura outstation, Fitzroy Island, *c.*1900.
*Source*: Negative No. 43835, Historical Photographs Collection, JOL.

Coral mining for agricultural lime commenced in 1900 and continued until at least 1940. During this period, at least twelve coral areas, shown in Figure 5.8, were mined in the Great Barrier Reef. One report, written by a shell collector, indicated that the mining of coral reefs occurred at the Barnard Islands around 1900; she stated:

> At the turn of the century last, coral mining was carried out in the Barnard Islands […] and also at the mouth of the Mowbray River: Yule Point. Because of shifting sands and coastal erosion, at times extinct reef is exposed here along the shore. I think the sugar industry used this resource.[111]

Another of the earliest operations took place at Snapper Island, near Cape Tribulation, where Jerry Doyle operated a lime kiln. The kiln was constructed in 1901 by the Mossman Central Mill Company (MCMC), which signed a contract with Jerry Doyle to provide burnt lime, and he produced 'ample supplies' of lime and fertiliser.[112] The lime kiln was fired using wood from the Daintree rainforest, which was transported to the island on board the *Nellie*, and coral was probably obtained from the accessible and extensive fringing reef on the south-western side of the island; two archival sources describe the track that was cut to allow the firewood to be transported to the lime kiln.[113] The company opened a grinding plant to improve the quality of the coral lime, and Doyle's operation was still in progress in 1911 when the MCMC also entered into a contract for lime with the Chillagoe Railway and Mines Company; subsequently, in 1914, coral mining was carried out by Ishimoto, who was paid £2 per ton by the MCMC to deliver coral lime to the old wharf on the Mossman River.[114]

Another early coral mining operation took place near Innisfail, where E. Garner of Clump Point reported taking coral for agricultural lime from the foreshores of the Barnard Islands in 1900 and from Kings Reef in 1918; these activities pre-dated the introduction of the coral licensing system by the Queensland Government. Garner claimed that he had been granted permission to remove coral by Captain Mackay, and reported difficulty in taking much coral because 'we can only get on Kings Reef for

[111] Collins, 'Recollections of the reef', p. 1.
[112] QEPA, *Visitor information: Snapper Island NP and Marine Park*, QEPA, Brisbane, 2003; Kerr, *Northern outpost*, p. 93.
[113] In-letter Ref. AWG:LDM, William L. Rutherford, Port Douglas to District Forester, Atherton, 11 May 1967, SRS5146/1 Box 2 Item 10, NP64, Snapper Island, QSA; In-letter Ref. AWG:LDM, District Forester, Atherton to Sec., Qld. Dept. of Forestry, Brisbane, 19 May 1967, SRS5146/1, NP64, Snapper Island, QSA; QEPA, *Visitor information: Snapper Island*.
[114] Kerr, *Northern outpost*, pp. 93-94.

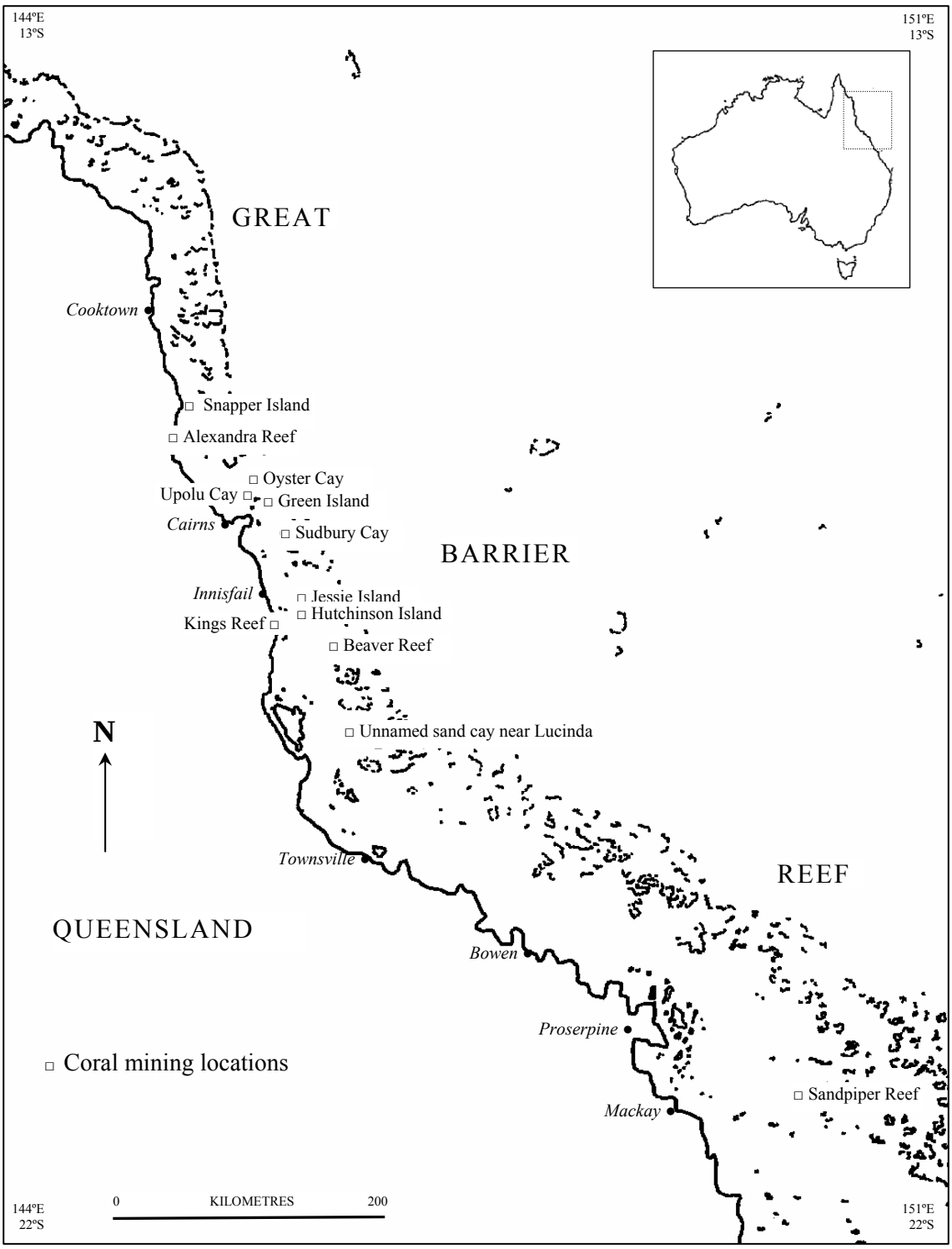


*Figure 5.9*. Coral mining locations in the Great Barrier Reef, 1900-1940.

*Sources*: Compiled from archival files contained in PRV8340/1 Item 1, QSA, and also from details provided in OHC 16, 2 September 2003; OHC 17, 2 September 2003; and OHC 28, 19 September 2003, *passim*.

about two hours at dead low water springs each day'.[115] However, this operation appears to have continued for many years; later, stating that he was too old to continue coral mining, Garner asked for the mining permit to be transferred to his son, Edward Henry Garner, who also operated at a coral area on Kings Reef during the 1930s.

Before 1920, other than Garner's permit, coral mining in the Great Barrier Reef appears to have been unregulated. Oral history evidence indicates that, by 1920, extensive coral mining had taken place at Snapper Island: the location of that operation is shown in Figure 5.10.[116] Coral mining at Snapper Island reef may have been continuous since the operation by Jerry Doyle; before the First World War, a German settler – possibly Albert Diehm – operated the lime kiln at Snapper Island and took coral from the fringing reef on the south-western side of the island. One informant, a farmer and recreational fisher, who recollected the mining operation stated, 'I can remember the railway lines across the reef at Snapper Island, on the south-west corner, where the spring is.'[117] This informant also recalled:

> there was a German man there […] until during the First World War, or just before it, and he was mining the coral off the big flats of coral there: it's mostly dead coral. He had a railway line across the reef. He would push out his little trolley, smash the coral off with a crowbar, put it in, wheel it up the reef – or had horses to pull it up – and take it up and burn it in a kiln that he had gouged out of the rocks there – and I think that's still there – chop the trees down on the island to burn them, and cook the coral down into a lime that he supplied to the Mossman Mill for settling their sugar.[118]

This informant stated that, in the Mossman Mill, the settled mixture was removed as filter mud – or filter press – and spread on the cane fields. He reported that this practice continued until a terrestrial source of lime replaced the use of coral lime as a flocculant. He believed that the coral mining operation continued until the outbreak of the First World War, when the German settler was interned.[119]

[115] In-letter Ref. 0663, E. Garner, Clump Point to Mr. W. V. B. Forrester, Port Master, 23 January 1935, PRV8340/1 Item 1, QSA.
[116] Evidence of the Snapper Island operation is found in OHC 16, 2 September 2003; OHC 17, 2 September 2003; and OHC 28, 19 September 2003, *passim*.
[117] OHC 16, 2 September 2003, p. 4.
[118] OHC 16, 2 September 2003, pp. 4-5.
[119] OHC 16, 2 September 2003, pp. 5-6.

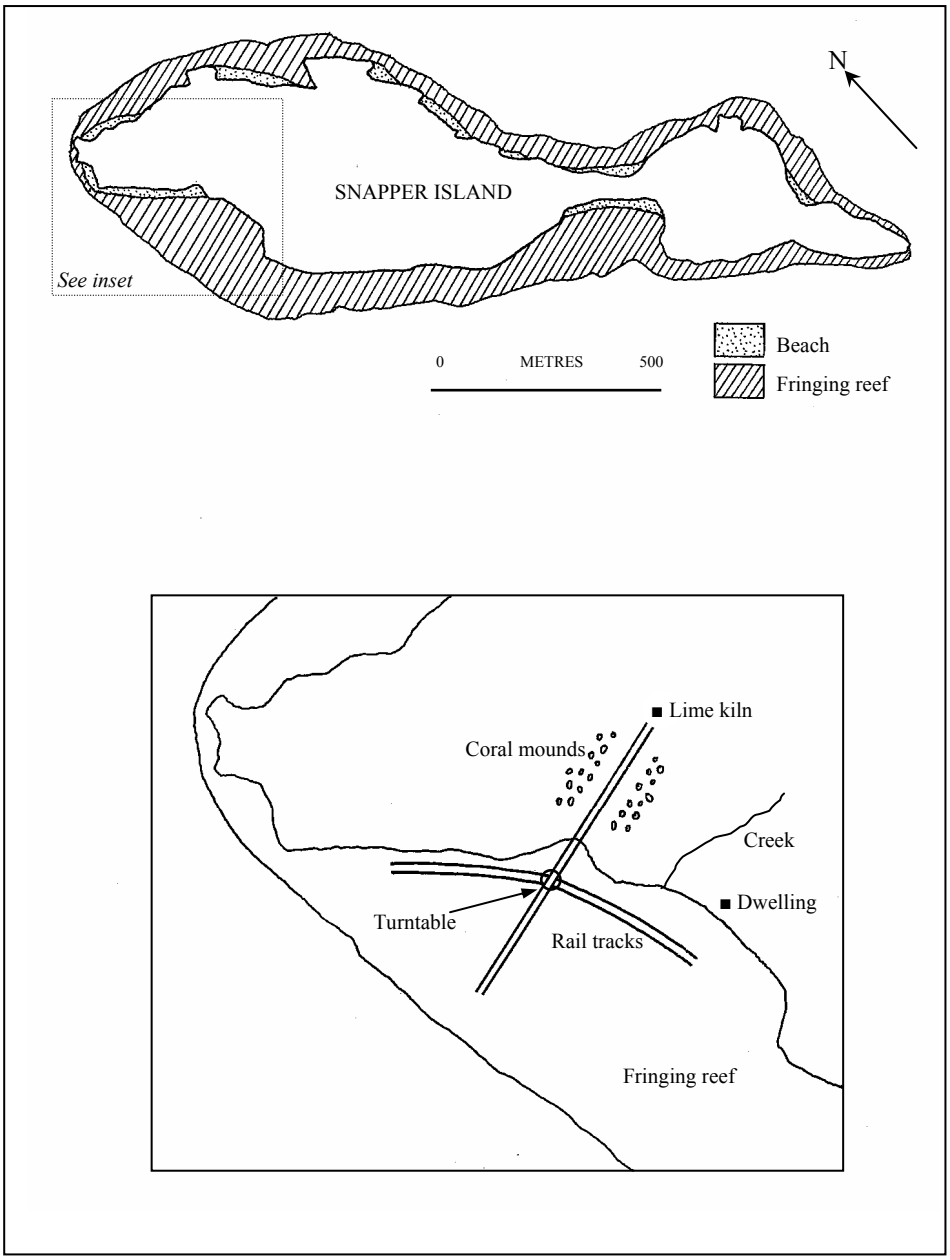


*Figure 5.10*. The location of the coral mining operation at Snapper Island.

*Source*: Compiled from information in OHC 17, 2 September 2003, p. 3 and QEPA, *Visitor information: Snapper Island*.

Another oral history account, by a retired cane-cutter, indicates that coral mining was carried out at Snapper Island by Jim Tyrie.[120] This informant reported that large pieces of coral – that could be lifted by a man – were removed from the fringing reef using crowbars and were loaded into horse-drawn wagons. These wagons were transported to the island along rail tracks that were laid across the fringing reef, parallel to the high water mark, and across the island to the lime kiln. A turntable was installed to transfer the wagons from one rail line to the other. The coral pieces were stored in piles beside the rail track before being burnt in the kiln and crushed; two heaps of coral and the remains of the lime kiln still survive on the island, as Figure 5.10 shows. The details of the coral mining operation at Snapper Island were described by this informant in the following terms:

> On the south-western face [of Snapper Island…] they had their lime kiln, burning the lime [...]. There was a bloke who used to live over there – this was First World War, somewhere around there, turn of the century […] – and he used to do the burning of the lime. They cleared a big slope of hill for firewood and it's since grown up again. […] Well, they had a portable tramline, like this tramline here [*indicates a nearby cane track*] […]. The portable rail is only twenty pounds and it will take the same size wheels, so they had small trucks to cart these blocks away. There are still two big heaps of them over there that they never got around to burning. And the coral was about two foot […]: some would be a metre long. And there are two big rows of them where they brought them round by boat, put them up there, and the business folded up before they could use them all.[121]

The positions of the lime kiln, the tramline and the two mounds of coral pieces are shown in Figure 5.10.

Additional details about the process of removing and burning the coral from the fringing reefs were provided by this informant, who stated:

> They had railway lines to bring the wood down […] and they had the rail there and a turntable would come there [*indicates map*]. They dropped [the coral] into a hole, and they had rail line going there and down the beach. And there are big heaps of coral: a strong man would be able to pick them up and carry them. Of course it was dead coral they got from around the fringing reef […]; and they could go out and bust it open with crowbars, carry it back and put it in [the lime kiln]. […] The heaps of stone are still there and, if you know where to look, you can see the big hole in the side of

[120] OHC 17, 2 September 2003, p. 3.
[121] OHC 17, 2 September 2003, p. 2.

> the hill that they used to tip this wood into, and then put these stones on top so [the coral] would burn, and then they could crush it.[122]

The operation at Snapper Island pre-dated the system of coral licences introduced by the QDHM and represents a second example, in addition to Garner's operation at Kings Reef, of unregulated coral mining in the Great Barrier Reef.

The amount of coral taken from the reef is unknown because, as one informant stated, 'he could have taken it from here for years […]. These rails down the beach were there for a long time after the war, and they disappeared all of a sudden.'[123] However, some evidence of the scale of the operation remains in the landscape, as the informant stated:

> If you went over to look at the heaps of coral, […] you could see the heaps of stone, you could see the incinerator – the place where they burnt it – and you could see the rails, the cutting in the hill and where they had their turntable; because the load came down one angle on a truck, and they'd spin it round and take it this way [*indicates map*] and tip it into the hole. You could see all that.[124]

After Tyrie concluded mining at Snapper Island, one informant believed, he moved to the Daintree settlement and sought lime from another source. Another informant suggested that a terrestrial source of lime replaced the material taken from Snapper Island reef after the lime burner ceased operating there; he stated, 'they bought lime from other sources after the bloke on Snapper Island. They started using lime from Chillagoe, which is on the land'.[125] The evidence presented above suggests that, by that time, a considerable amount of coral had been removed from Snapper Island reef.

In contrast to the scarcity of documentary evidence for the earlier period, more extensive evidence of coral mining exists for the 1920s, by which time soil analysis had revealed the need for agricultural lime in sugar cane farming. In addition, coral mining operations had become more organised, being based on a system of coral licences. Several individuals were granted licences to remove coral for the production of agricultural lime; the survival of some of these licences makes a more substantial reconstruction of the coral mining industry possible. The existence of the licences also

[122] OHC 17, 2 September 2003, p. 2; this description of the operation is similar to the account provided in OHC 16, 2 September 2003, pp. 4-5.
[123] OHC 17, 2 September 2003, p. 3.
[124] OHC 17, 2 September 2003, p. 14.
[125] OHC 16, 2 September 2003, p. 6; see also OHC 17, 2 September 2003, p. 3.

indicates that, by the 1920s, coral mining was taking place with the encouragement of the Queensland government. In 1922, mineral leases were issued for the removal of coral and coral sand from Green Island and from Oyster and Upolu Cays. The operations were reported to have been significant: one account claims that thousands of tons of material were removed from Upolu Cay; the licence for coral mining at Upolu Cay was re-issued in 1926 and the removal of material from these locations appears to have continued throughout the 1920s until the mid-1930s.[126] One oral history informant suggested that Upolu Cay had been mined for coral sand by the company, Koppins, although the quantity of coral sand taken was not known.[127]

One of the pioneers of coral mining in the Great Barrier Reef was Albert Diehm of Innisfail. In 1927, Diehm was granted a Quarry Licence by the Atherton office of the Queensland Sub-Department of Forestry to remove coral from Hutchinson and Jessie Islands in the Barnard Group. During the following year, he produced lime at Maria Creek, near Innisfail, using coral from those islands. A QDHM memorandum about Diehm's operation stated that:

> the crushing works operated by [Albert] Diehm are situated on the Northern end of Hutchinson Island, North Barnard Group, above high-water mark. The plant consists of a Fordson tractor and a disintegrator. The estimated capacity is sixteen tons per day but the estimated daily output is six tons per day.[128]

At the end of 1928, Diehm applied for a Mineral Lease over half an acre of coral on the western side of Hutchinson Island and one-fifth of an acre of coral on the western side of Jessie Island in order to continue his operation.[129]

The initial success of coral mining in northern Queensland attracted the interest of capital investors in southern Australia. In 1928, an article in the *Melbourne Herald* described the industry in the following terms:

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[126] I. Loch, 'Michaelmas Cay', *Cairns Shell News*, Vol. 11, 1991, p. 5; see also 'Great Barrier Reef: Supplies of coral sand', *The Cairns Post*, 16 January 1933, p. 11; Bowen and Bowen, *Great Barrier Reef*, p. 291.
[127] OHC 15, 27 August 2003, p. 10.
[128] Memo Ref. 1159, A. E. Aitken, Harbour Master, Innisfail to Port Master, Qld. Marine Dept., Brisbane, 12 March 1928, PRV8340/1 Item 1, QSA.
[129] 'Application to remove coral, etc. from islands and Barrier Reef', *c.*1929, PRV8340/1 Item 1, QSA.

> There are splendid prospects of a profitable industry in crushing the coral of the Great Barrier Reef for fertiliser. The pioneer of the industry is Mr. Diehm, who recently installed a £500 plant on North Barnard Island, and has already supplied 200 tons of pulverised coral to Innisfail farmers.
>
> Mr. Diehm stated today that one farmer had put twenty tons in his fields and the cane treated has shown an advance of two feet six inches over other cane. […] He intends to bring regular supplies of the fertiliser to Innisfail.
>
> Recently Mr. Diehm obtained additional gear from England and hopes to operate on a larger scale now that pioneering difficulties had been overcome. There were almost unlimited supplies of coral to be drawn on.[130]

By mid-1929, Diehm had extracted and crushed coral at Hutchinson Island for at least three years.

Coral was mined not only from islands and cays: it was also removed from inshore coral reefs in the northern Great Barrier Reef, which were more accessible from the mainland and more convenient to work. In 1929, a lease to mine coral at Alexandra Reef, near Port Douglas, was granted to G. Averkoff of Port Douglas who, like Diehm, intended to produce lime for sugar cane fields (Figure 5.9).[131] The location of the coral reefs was between Yule Point and the Mowbray River, and the coral lay 'approximately 5 chains' below high water mark'; Averkoff's sketch map of this area is reproduced in Figure 5.11. As the adjacent land was mangrove swamp and the removal of coral would not interfere with any other industry, the Secretary of the Queensland Marine Board, J. D. W. Dick, suggested that this application should be granted subject to a royalty of 1d. per cubic yard on all coral removed; Averkoff then constructed a lime plant and supplied coral lime to the MCMC for fifteen years, until his operation was taken over by the McDowell Brothers, who continued to deliver the lime to sugar cane farmers.[132]

Several other applications were made to mine coral during the same period. In 1929, High Island, adjacent to the Frankland Group, was the subject of a coral mining application by R. McGuigan, whose application was considered at the same time as

[130] *Melbourne Herald*, 24 January 1928, cited in In-letter, N. G. Roskruge, Deputy Director, Navigation and Lighthouses, Qld. Marine Branch (Navigations and Lights Services), Brisbane to Dr. Marks, Hon. Sec., GBRC, Brisbane, 20 July 1929, PRV8340/1 Item 1, QSA.
[131] In-letter Ref. 47990, G. Averkoff, Port Douglas to Harbour Master, Port Douglas, 27 September 1929, PRV8340/1 Item 1, QSA; In-letter Ref. 47990, E. J. Whelan, Harbour Master, Port Douglas to CIF, QDHM, Brisbane, 1 October 1929, PRV8340/1 Item 1, QSA.
[132] Out-letter Ref. 29/9270T, J. D. W. Dick, Sec., Qld. Marine Board Office, Brisbane to US, Treasury, Brisbane, 29 October 1929, PRV8340/1 Item 1, QSA; see also Kerr, *Northern outpost*, p. 94.

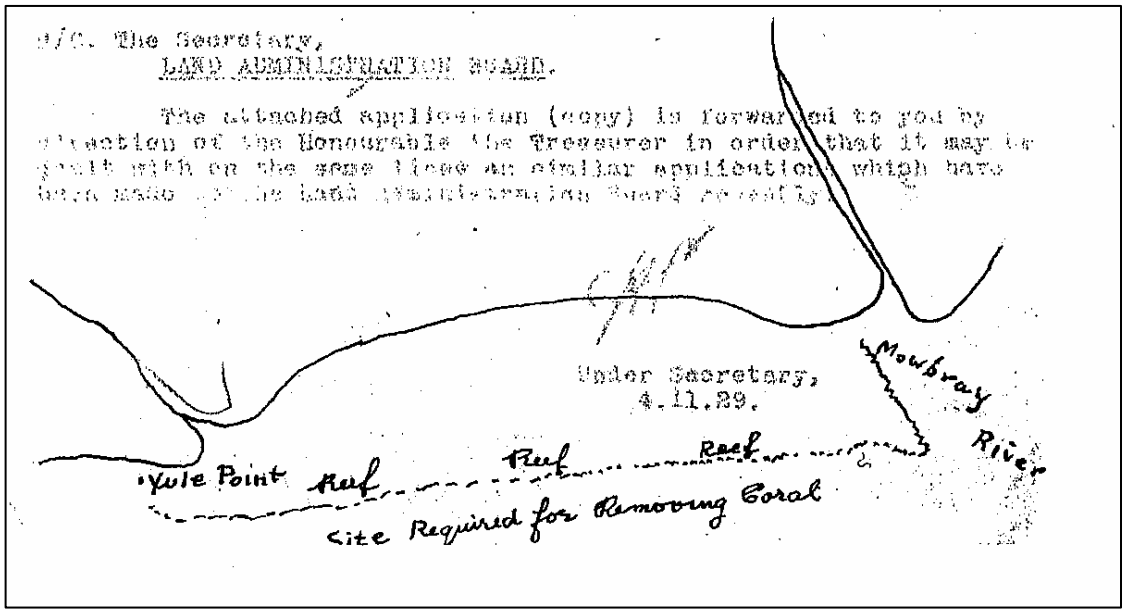


*Figure 5.11*. Sketch map showing the coral mining site at Alexandra Reef requested by Averkoff, 1929. *Source*: In-letter Ref. 47990, G. Averkoff, Port Douglas to Harbour Master, Port Douglas, 27 September 1929, PRV8340/1 Item 1, QSA.

those of Diehm; at Pialba, Henry M. Taylor stated that he had access to thousands of tons of coral and claimed the sole right to remove this material using an oil engine.[133] Companies as well as individuals made applications to mine coral. In 1929, Great Barrier Reef Fisheries Ltd. of Sydney proposed to manufacture 'natural fertilisers obtained from burnt coral'.[134] In the same year, a syndicate of investors in Sydney and Melbourne applied to mine coral and limestone from seven islands in Queensland waters – including Masthead Island – in order to supply a lime works in Brisbane.[135] No evidence was found in the QSA to indicate whether or not these leases were granted.

By the late 1920s, therefore, coral mining was regarded as an industry that had the potential to generate significant profits for venture capitalists. In 1928, Edward Sanders of Cooktown applied for leases to dredge coral sand from twelve locations, comprising more than fifty acres, between Mossman and Masthead Island.[136] A syndicate formed by Sanders argued that 100,000 tons of agricultural lime could be used each year in the sugar districts – which they claimed covered 300,000 acres – and that around 10,000 tons of burnt lime were already being used annually by sugar mills, refiners, farmers and builders.[137] The syndicate estimated the demand for agricultural lime to be 8,000 tons per year in Mackay, 8,000 tons per year in Cairns, 10,000 tons per year in Innisfail and 10,000 tons per year for burnt lime; they claimed that, at around £3 per ton, other sources of lime were too expensive for farmers. The syndicate proposed a company to work lime deposits in the Great Barrier Reef 'to supply the cane farmers with a cheap high-grade agricultural lime'; the Queensland Government Agricultural Chemist, J. C. Brunich, supported their proposal, as did Sir Matthew Nathan and the Cane Growers' Associations and Executives of Cairns, Innisfail and Mackay.[138]

Further expansion of the coral mining industry occurred during the 1930s; more extensive coral mining took place, and the industry was organised using a system of

[133] 'Application to remove coral'; Out-letter Ref. 28/7419, Qld. Marine Dept., Brisbane to Chief Engineer, Qld. Harbours and Rivers Dept., Brisbane, 24 April 1928, PRV8340/1 Item 1, QSA.
[134] Great Barrier Reef Fisheries Ltd., *Tapping the wealth of the Great Barrier Reef*, Great Barrier Reef Fisheries Ltd., Sydney, 1929, p. 5.
[135] J. E. Lane, Brisbane to Sec., Qld. Prov. Forestry Board, 18 October 1929, PRV8340/1 Item 1, QSA.
[136] In-letter, E. Sanders to Hon. Min. for Mines, Brisbane, 22 March 1928, PRV8340/1 Item 1, QSA; In-letter, E. Sanders to Hon. Min. for Mines, Brisbane, 4 April 1929, PRV8340/1 Item 1, QSA.
[137] In-letter, E. Sanders to Hon. Min. for Mines, 15 August 1928, PRV8340/1 Item 1, QSA.
[138] In-letter, Messrs. E. Sanders and others' syndicate (E. Sanders, G. H. Pritchard, Jas. G. Campbell and T. L. Jones) to Hon. A. J. Jones, Min. for Mines, Brisbane, 7 December 1928, PRV8340/1 Item 1, QSA.

Coral Areas: reefs and cays that were individually leased and that were considered to be suitable for working. By 1930, applications by at least eight individuals and syndicates for the issue of coral licences were being considered by the Queensland government.[139] Between 1930 and 1934, leases for five locations were granted to Edward Sanders: for Coral Areas No. 1 Cairns (Oyster Cay), No. 3 Cairns (Sudbury Cay), No. 1 Innisfail (Beaver Reef), No. 1 Mackay (Sandpiper Reef) and No. 1 Townsville (an unnamed sand cay to the north-east of Lucinda).[140] The applications for coral leases at these areas were accompanied by sketch maps, two of which are reproduced in Figures 5.12 and 5.13. Another coral area at 'Apollo Banks' (Upolu Cay) was leased to Walter Edward Tanner Edward Tanner and Maurice Joseph Kenny of Yungaburra in 1930, whose company – Tanner and Kenny Contractors – applied to dredge for coral lime to produce fertiliser.[141] Later, in 1934, the lease for the coral area at Hutchinson Reef was extended and the coral leases held by Sanders, with the exception of the site at Oyster Cay, were taken up by Andrew Albert Holland of Sydney.[142]

Some concerns were expressed about the advisability of permitting coral mining in the Great Barrier Reef. In addition to public complaints about the destruction of Upolu Cay, the archival sources indicate considerable differences in the opinions of Queensland government officials towards coral mining.[143] One supporter of the industry, Cullen, the Chief Engineer of the QDHM, discussed the coral mining operation at Upolu Cay, stating that 250 tons of material had been removed from the cay by Tanner and Kenny during the nine-month period from 1 January-30 September 1931. Cullen argued that the public concerns about the destruction of the cay were 'sentimental' ones and that the resulting disturbance to seabirds – even if this occurred at several cays – could not be regarded seriously. Furthermore, Cullen stated:

[139] 'Regulations governing the taking of coral or shell-grit – Section 18 of *The Fish and Oyster Act of 1914*', PRV8340/1 Item 1, QSA.
[140] These details were compiled from many files contained in PRV8340/1 Item 1, QSA.
[141] In-letter Ref. 29/2120, Tanner and Kenny Contractors to Sec., Qld. Dept. of Mines, Brisbane, 5 August 1929, PRV8340/1 Item 1, QSA; In-letter Ref. 30/6493, Forbes, for US, Brisbane to CIF, QDHM, Brisbane, 13 November 1930, PRV8340/1 Item 1, QSA.
[142] In-letter Ref. 6699, A. A. Holland, Sydney to CIF, QDHM, Brisbane, 30 October 1934, PRV8340/1 Item 1, QSA; Out-letter, CIF, QDHM, Brisbane to Harbour Master, Mackay, 5 October 1934, PRV8340/1 Item 1, QSA; In-letter Ref. 33/5239, A. A. Holland to CIF, QDHM, Brisbane, 1933, PRV8340/1 Item 1, QSA.
[143] F. H. Dean, 'Correspondence: destroying Upola Bank on Barrier Reef', *The Cairns Post*, 27 October 1931, p. 11; In-letter, F. H. Dean, Kuranda to Mr. Atherton, Min., Qld. Dept. of Mines, Brisbane, 20 November 1931, PRV8340/1 Item 1, QSA.

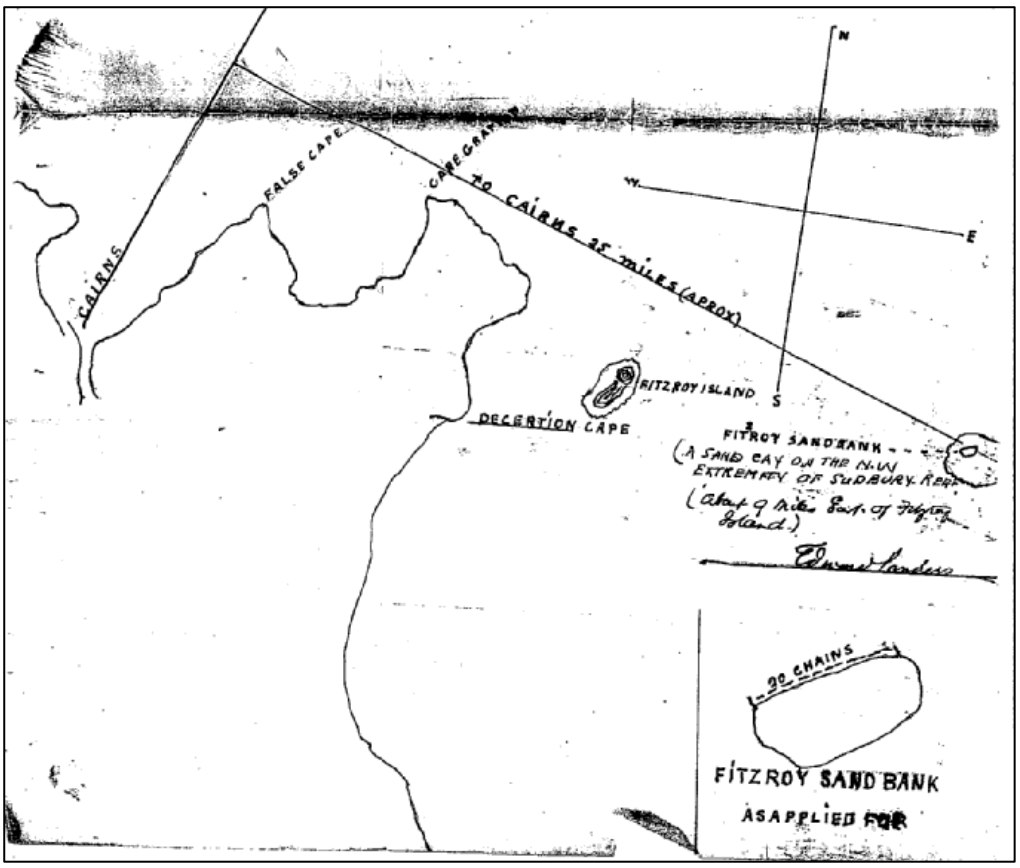


*Figure 5.12*. Sketch map accompanying Sanders' application to mine coral from Sudbury Cay, 1930.
*Source:* PRV8340/1 Item 1, QSA.

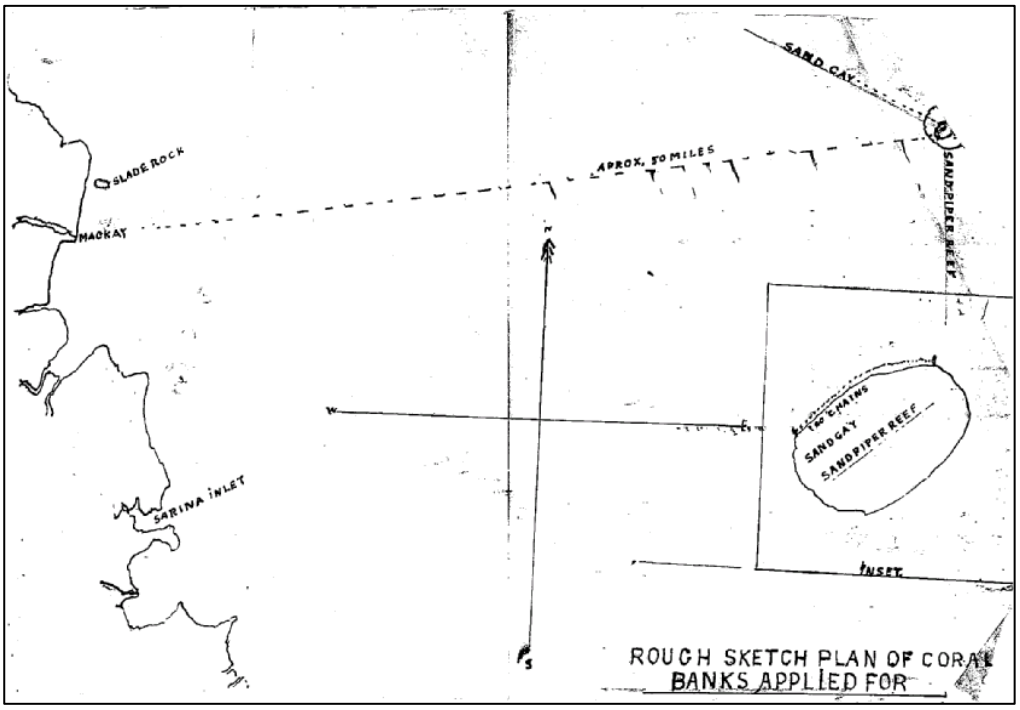


*Figure 5.13*. Sketch map accompanying Sanders' application to mine coral from Sandpiper Cay, 1930.
*Source:* PRV8340/1 Item 1, QSA.

> Assuming (by way of argument) that the cay at which material is being obtained by Messrs Tanner and Kenny was in the course of years entirely removed, it would be because a product of some value was being obtained.[144]

Cullen's view represented a utilitarian perspective towards the resources of the Great Barrier Reef; such a view – in which coral was regarded either as a source of limestone or as a means of promoting tourism – formed the basis of the coral licence system.

In contrast to the view of Cullen, in 1931, the Cairns Town Council (CTC) expressed its concern that the removal of coral from Green Island was threatening the popularity of the island with tourists.[145] In correspondence with the Queensland Government, the CTC requested legislation to protect Green Island reef from being stripped of its coral, but this request was met with reluctance by the Queensland Treasury because coral mining was 'an industry which the Government considers it advisable to encourage.'[146] Eventually, the Queensland Government, acknowledging that there was no legal authority by which the reef at Green Island could be placed under the protection of the local Council, issued a licence for the removal of coral from Green Island reef to the CTC; that licence conferred sole rights to removal of coral from Green Island reef on the CTC.[147] Subsequently, in 1937, the Queensland Government did legislate to prohibit the removal of coral from the foreshores and reefs surrounding Green Island, Low Isles, Michaelmas Cay, Arlington Reef and Oyster Cay; yet the earlier decision to protect Green Island reef was highly significant: it created what was effectively the earliest marine protected area in existence, and the formation of this area is discussed in more detail in Section 8.7.2.[148]

Nevertheless, the removal of coral continued in other locations in the Great Barrier Reef. From 1936-1938, extensive coral mining took place in the Innisfail area. Edward Henry Garner was granted a lease over Coral Area No. 2 Innisfail (Kings Reef); Thomas Roper held a lease for the adjacent Area No. 5 and also for Areas No. 3

[144] Out-letter Ref. 31/9363, A. Cullen, Chief Engineer, QDHM, Brisbane to US, Treasury, Brisbane, 19 November 1931, PRV8340/1 Item 1, QSA.
[145] In-letter, Town Clerk, Cairns to Qld. Marine Board Office, Brisbane, 21 August 1931, SRS146/1 Item 2, QSA.
[146] In-letter Ref. L.A.C.T. Gen., US, Treasury, Brisbane to Town Clerk, Cairns, 22 January 1931, SRS146/1 Item 2, QSA.
[147] In-letter, US, Treasury, Brisbane to Town Clerk, Cairns, 20 April 1932, SRS146/1 Item 2, QSA.
[148] SRS146/1 Item 2, QSA; the formation of the earliest marine protected are has been discussed by Lawrence *et al*., *Great Barrier Reef*, p. 25.

(Hutchinson Island) and No. 4 (Jessie Island).[149] The locations of the coral areas at Kings Reef are shown in Figures 5.14 and 5.15. Garner reported mining about 70 tons of coral from his site during the quarter ending on 30 June 1935 and 60 tons the following quarter; he also helped to mine Roper's lease. The licences were granted on the condition that explosives would not be used in removing coral; however, the QDHM received complaints that Garner used gelignite to blast coral from the reef before bringing the rubble ashore for burning.[150]

In 1939, a syndicate comprising the Villalba Brothers and Martinez and Company applied for leases over Beaver and Taylor Cays, near Dunk Island, and over Coral Area No. 1 Townsville ('Sand Cay Island', to the north-east of Lucinda), in order to collect coral lime.[151] On 7 May 1940, a lease was granted to Martinez, Chapman and Company of Innisfail to remove 1,000 cubic yards of coral from Sand Cay Island; the rights were sold for 3 d per cubic yard.[152] This application indicates the willingness of syndicates to invest considerable amounts of capital in coral leases and suggests that, by the end of 1930s, coral mining in northern Queensland had become an established, profitable industry. However, the series of coral licences preserved at the QSA indicates that this lease was the last granted before the outbreak of the Second World War disrupted marine industries in the Great Barrier Reef; during that war, boats were impounded and access to the coral reefs and cays was restricted.[153]

No archival evidence was found to indicate whether or not coral mining resumed after the end of the Second World War; the extent of coral mining during the period between 1945 and 1967, when the proposal to mine coral from Ellison Reef was refused, is unknown. The reports of the CIF published in the *QPP* indicate that coral and shell-grit licences were issued continuously by the Queensland Government throughout the period from 1930-1968, representing an increasing number of coral licences, as Figure

[149] In-letter Ref. 37/4439, Thos. G. Hope, Acting US, Treasury to Official Sec. to His Excellency the Lieutenant Governor, Brisbane, 8 July 1937, SRS31/1 Box 13, QSA.
[150] In-letter Ref. 0991, E. H. Garner, Clump Point to Inspector of Fisheries, Innisfail, 29 January 1936, SRS31/1 Box 13/1, QSA; D. Jones, *Hurricane lamps and blue umbrellas: a history of the Shire of Johnstone to 1973*, The Cairns Post Pty. Ltd., Cairns, 1973, p. 317.
[151] Out-letter, Sec., Prov. Admin. Board, QDHM to Sec., Land Admin. Board, Qld. Dept. of Public Lands, Brisbane, 31 July 1939, SRS31/1 Box 13/1, QSA.
[152] In-letter Ref. 225/47, Sec., Qld. Forest Service, Qld. Forestry Sub-Dept., Brisbane to Sec., QDHM, Brisbane, 26 July 1940, SRS31/1 Box 13/1, QSA.
[153] The impounding of boats in the Second World War is described in OHC 42, 13 November 2003, p. 2.

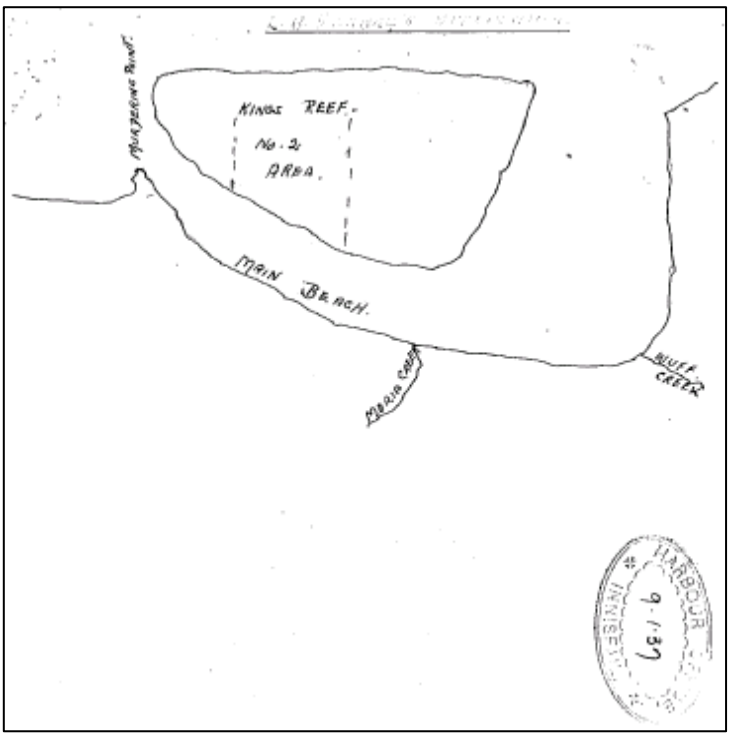


*Figure 5.14*. Sketch map showing Garner's application to mine coral from Kings Reef No. 2 Area, 1937. *Source:* PRV8340/1 Item 1, QSA.

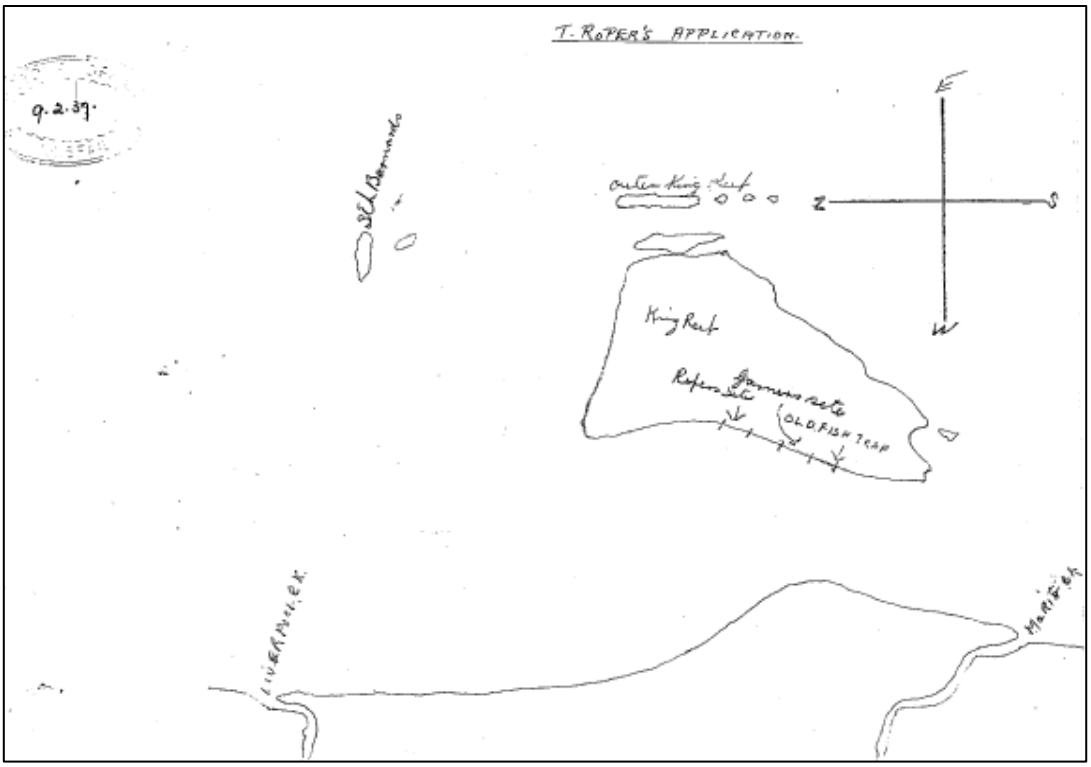


*Figure 5.15*. Sketch map showing Roper's application to mine coral from areas at Kings Reef, 1937. *Source:* PRV8340/1 Item 1, QSA.

5.16 illustrates; the details of the twelve coral areas for which licences have been found are summarised in Table 5.4. One oral history informant suggested that, after the Second World War, cheaper, terrestrial sources of agricultural lime were used by sugar cane farmers, including lime obtained from Chillagoe. In addition, in 1940, increasing attention was given to the protection of coral reefs in response to the development of tourism in the Cairns, Townsville and Whitsunday regions; the extraction of coral from twenty-eight coral reefs in the Great Barrier Reef was prohibited (Section 8.7.2).[154] Attempts were made to access additional materials relating to the use of agricultural and industrial lime from sugar industry organisations and informants in Mossman, Cairns, Mulgrave, Innisfail and Brisbane; those attempts were unsuccessful, either because records managers were uncooperative or because records were reported to be unavailable. Hence, this account of coral mining in the Great Barrier Reef is incomplete and further research is required to elucidate the period after 1940.

Nevertheless, a considerable amount of documentary material describes the impacts of coral mining in the Great Barrier Reef. The earliest indication of the degradation associated with the industry concerned the works by Tanner and Kenny Contractors at Upolu Cay. In 1931, a complaint about their operation was published in *The Cairns Post*, which stated that Upolu Cay 'was being destroyed by a firm taking away the bank for fertiliser purposes and depriving the sea birds of a home that has been theirs for many years.'[155] Material was removed from Upolu Cay by running a tramline into the centre of the cay and quarrying coral to a depth of about four feet; the tramline and the location of the coral mining area are shown in Figures 5.17 and 5.18 respectively.[156] During the nine months from January-September 1930, Tanner and Kenny Contractors removed 250 tons of material from the cay.[157] Although their coral licence permitted the removal of coral from the foreshore – below high water mark – Tanner and Kenny had mined the centre of the cay and, by October 1930, the height of the cay had been reduced and almost no bird life or vegetation remained.[158]

[154] OHC 10, 10 March 2003, p. 7; Letter Ref. 4868, Sec., QDHM, Brisbane to Sec., Qld. Sub-Dept of Forestry, Brisbane, 29 October 1940, PRV8340/1 Item 1, QSA.
[155] Dean, 'Correspondence'.
[156] In-letter Ref. 33/3117, C. J. Hamilton, Land Agent and Deputy Land Commissioner, Cairns to Sec., Land Admin. Board, Brisbane, 19 January 1933, PRV8340/1 Item 1, QSA.
[157] Out-letter Ref. 31/9363, Chief Engineer, QDHM, Brisbane to US, Treasury, Brisbane, 19 November 1931, PRV8340/1 Item 1, QSA.
[158] In-letter Ref. 0316, J. Brewster, Harbour Master, Cairns to Port Master, Brisbane, 16 January 1932, PRV8340/1 Item 1, QSA.

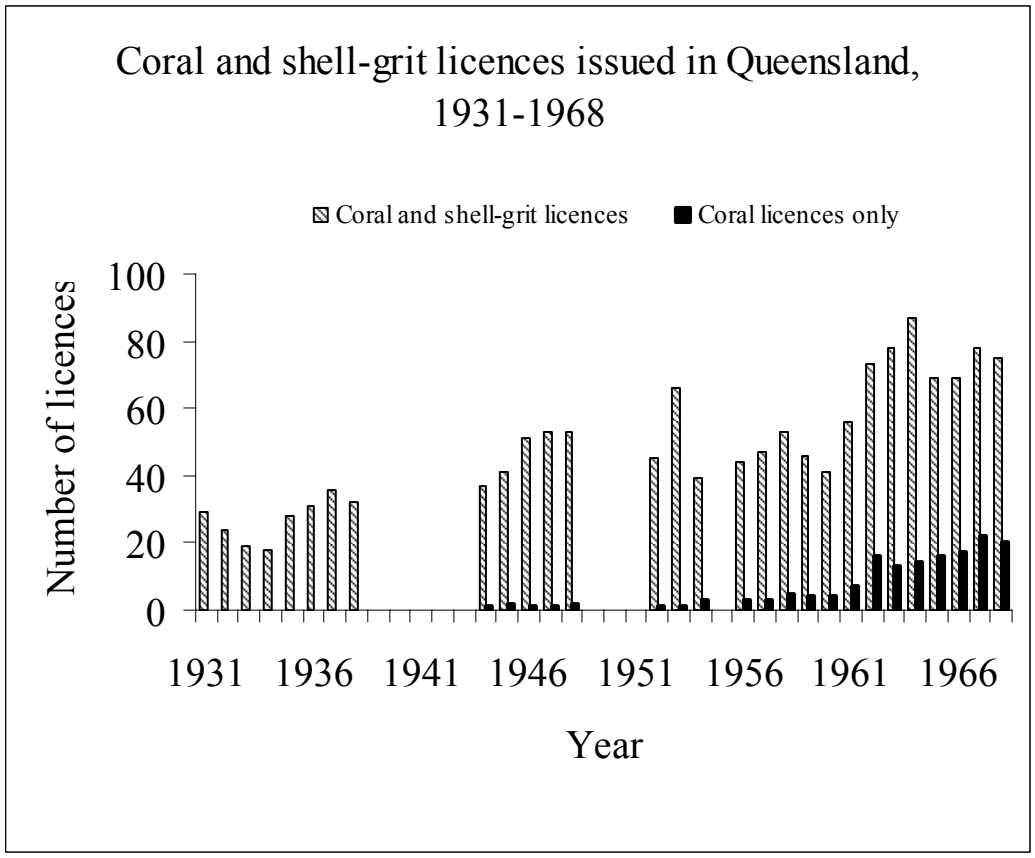


*Figure 5.16.* Numbers of coral and shell-grit licences issued in Queensland between 1931 and 1968. After the Second World War, a distinction was made between coral and shell-grit licences; Figure 5.16 indicates the total number of coral and shell-grit licences issued and the number of licences issued specifically for the removal of coral.

*Source:* Compiled from data provided in the AR of the QDHM, *QPP*, 1932-1969, *passim.*

| ***Location*** | ***Period*** | ***Operator(s)*** | ***Extent of modification*** |
|---|---|---|---|
| *Snapper Island* | *c.*1900-1930s | Jerry Doyle; Unknown German migrant; Jim Tyrie | Severe modification; coral mining using crowbars, horse-drawn wagons and rail tracks across the fringing reef; landscape impacts remain detectable. |
| *Kings Reef* (Coral Area No. 2 Innisfail) | 1918-1938 | E. Garner; Edward Henry Garner | Severe modification; coral mining using explosives; coral reef now appears significantly degraded. |
| *Oyster Cay* (Coral Area No. 1 Cairns) | 1922-1934 | Edward Sanders | Extent of damage unknown |
| *Upolu Cay* | 1922-1933 | Walter Edward Tanner and Maurice Joseph Kenny | Severe modification; removal of large amounts of material from the centre of the cay; one report stated that almost half the cay had been removed as a result of mining. |
| *Green Island* | 1922 | Not known | Damage to the reef prompted the Cairns Town Council to seek legal restriction of the removal of coral. |
| *Hutchinson Island* (Coral Area No. 3 Innisfail) | 1928-1938 | Albert Diehm; Thomas Roper | Significant removal of coral; coral was pulverised on the northern end of Hutchinson Island using an engine. |
| *Jessie Island* (Coral Area No. 4 Innisfail) | 1928-1938 | Albert Diehm; Thomas Roper | Significant removal of coral; coral was pulverised on the northern end of Hutchinson Island using an engine. |
| *Alexandra Reef* | 1929 | G. Averkoff | Significant impacts likely; the coral area included the entire coral reefs between Yule Point and the Mowbray River; coral reefs now appear significantly degraded. |
| *Unnamed sand cay* (Sand Cay Island) (Coral Area No. 1 Townsville) | 1930-1935 | Edward Sanders; Andrew Albert Holland | Extent of damage unknown |
| *Beaver Reef* (Coral Area No. 1 Innisfail) | 1930-1935 | Edward Sanders; Andrew Albert Holland | Extent of damage unknown |
| *Sandpiper Reef* (Coral Area No. 1 Mackay) | 1930-1935 | Edward Sanders; Andrew Albert Holland | Extent of damage unknown |
| *Sudbury Reef* (Coral Area No. 3 Cairns) | 1930-1935 | Edward Sanders; Andrew Albert Holland | Extent of damage unknown |
| *Kings Reef* (Coral Area No. 5 Innisfail) | 1938 | Thomas Roper and Edward Sanders | Extent of damage unknown |

*Table 5.4*. Summary of coral mining areas in the Great Barrier Reef, 1900-1940.

*Source*: Compiled from data provided in archival files contained in PRV8340/1 Item 1, QSA; and in OHC 16, 2 September 2003; OHC 17, 2 September 2003; and OHC 28, 19 September 2003.

*Figure 5.17*. The jetty at Upolu Cay used for loading material mined from the cay, *c.*1933.
*Source:* PRV8340/1 Item 1, QSA.

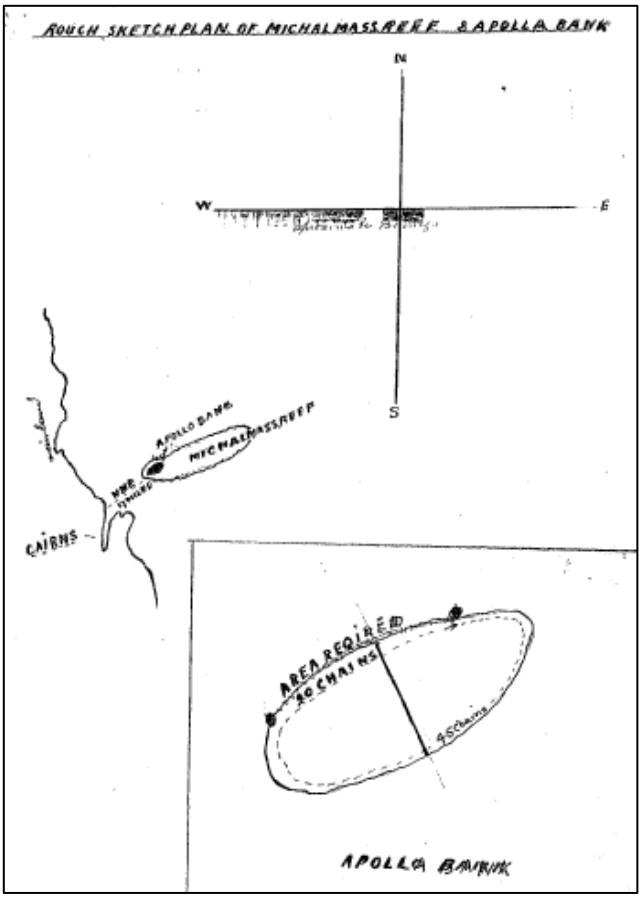


*Figure 5.18*. Sketch map accompanying Tanner and Kenny's application to mine coral from Apollo Bank (Upolu Cay), 1930.

*Source:* PRV8340/1 Item 1, QSA.

As both Upolu and Oyster Cays had been declared sanctuaries for animal and bird life in 1926, the destruction caused at Upolu Cay provoked objections from naturalists, who were also concerned about the possibility of similar destruction at Oyster Cay. By 1933, Sanders had not yet commenced removing coral from his lease at that site. In spite of public protests, both coral leases were renewed in 1933.[159] By 12 January 1933, Tanner and Kenny had caused further 'serious damage' to Upolu Cay – one report claimed that almost half the cay had disappeared – and continued to disregard the requirement to mine only from the foreshores of the cay.[160] In addition to the disruption caused to seabirds, the removal of material threatened the stability of the cay and increased its susceptibility to erosion during storms. Finally, in 1934, in response to complaints about the extent of destruction caused by coral mining, the coral licences for both Upolu and Oyster Cays were revoked by the QDHM.[161]

Other evidence of the destruction caused by coral mining exists for Kings Reef, near Innisfail, where the operation carried out by Garner also elicited complaints. Several reports claimed that the nearby bathing beach at Murdering Point had become unusable as a result of sharp pieces of coral being washed ashore after Garner's blasting operations. One of these reports stated that:

> Garner is in the habit of using explosives to loosen the coral from the reef, which when broken off he leaves in heaps. The prevailing weather and currents set in from where he is blasting towards Murdering Point beach, and the result is that sharp and light pieces of coral are washed in and are a danger to persons using the beach [...]. The pieces of coral also cut fishing nets used by the fishermen at the beach. After any boisterous weather there is always a fair amount of coral washed in to the beach, and even in fine weather a good deal of it comes in.[162]

[159] In-letter Ref. 0316, J. Brewster, Harbour Master, Cairns to Land Agent, District Land Office, Cairns, 30 August 1933, PRV8340/1 Item 1, QSA.
[160] In-letter, C. J. Hamilton, Land Agent, District Land Office, Cairns to Sec., North Qld. Naturalists' Club, Cairns, 7 September 1933, PRV8340/1 Item 1, QSA; In-letter, C. J. Hamilton, Land Agent, District Land Office, Cairns to Mr H. F. Todd, Assistant Sec., GBRC, 28 September 1933, PRV8340/1 Item 1, QSA; In-letter, H. J. Freeman, Instructor in Fruit Culture to US, Qld. Dept. Agriculture and Stock, Brisbane, 12 September 1933, PRV8340/1 Item 1, QSA.
[161] Bowen and Bowen, *Great Barrier Reef*, p. 291.
[162] In-letter, Constable F. R. Donovan, Silkwood to Police Magistrate, Innisfail, 13 July 1935, SRS31/1 Box 13/1, QSA; In-letter Ref. 6174, Inspector of Fisheries, Innisfail to CIF, QDHM, Brisbane, 10 August 1936, SRS31/1 Box 13, QSA.

The use of explosives by Garner was also blamed for driving fish away from the area: another concern for the fishers besides damage to their nets. On the miners themselves, the blasted coral inflicted skin burns and large 'coral sores' that resembled ulcers.[163]

No other documentary evidence of the destruction of coral reefs and cays as a result of coral mining was found in the archival sources. Attempts were made to obtain additional documents about the impacts of coral mining from the Mossman, Innisfail and Brisbane offices of the CANEGROWERS organisation, and from the Mulgrave Mill, near Cairns; some of those records managers were uncooperative and others reported that no relevant records were held.[164] Hence, the remaining environmental impacts of coral mining can only be estimated. The inshore coral reefs, which were the most accessible mining locations, probably suffered the most sustained and destructive impacts of coral mining; Kings Reef and Alexandra Reef are the reefs most likely to have been extensively degraded, since they were worked from a comparatively early date – before 1930 – and were easily reached from the coast. Today, both reefs appear to be almost completely degraded: the reef flat at Kings Reef is characterised by coral rubble, soft corals, mud and algae and lacks extensive hard coral communities; the surface of Alexandra Reef, shown in Figure 5.19, comprises dead coral, with living colonies found only at the submerged edges of the reef.[165] While the dead coral found at these reefs cannot be attributed solely to coral mining, the blasting and removal of coral has probably contributed to their degradation.

Oral history evidence suggests that the impacts of coral mining were extensive at Snapper Island reef and large mounds of mined, unburnt coral still exist on the island near the remains of the lime kiln. In addition to the removal of coral from the reef flat using crowbars, the coral cover was probably diminished by trampling of horses and the construction of rail lines across the surface of the reef.[166] While Snapper Island was less accessible than the inshore reefs at Kings and Alexandra Reefs, a dwelling was built on the island, which enabled more sustained mining to take place than on the uninhabited cays. In common with other inshore and fringing reefs, Snapper Island reef was particularly vulnerable to human impacts. However, unlike Kings and Alexandra Reefs,

[163] Jones, *Hurricane lamps*, p. 317.
[164] The official name of the CANEGROWERS organisation is capitalised.
[165] See the discussion in OHC 35, 20 October 2003, p. 6.
[166] OHC 16, 2 September 2003, pp. 4-6; OHC 17, 2 September 2003, pp. 2-3 and 17.

*Figure 5.19.* Alexandra Reef, near Port Douglas, 2003.

*Source:* Photographs taken by Ben Daley.

in the 1990s, Snapper Island reef contained a very large cover and diversity of living corals, as one oral history informant – a marine biologist – reported. Consequently, the discernable impacts of coral mining are now probably more apparent in the landscape of the island than in the fringing reef.[167]

In summary, coral mining in the Great Barrier Reef was more extensive than has previously been acknowledged. Between 1900 and 1940, coral mining developed from an isolated activity carried out by individuals into a well-organised industry, encouraged by the Queensland Government and organised using a system of licences and Coral Areas, and at least twelve areas in the Great Barrier Reef were mined for coral. Although some locations – the Barnard Islands and Kings Reef – were worked since 1900, and mining had begun at Snapper Island by 1914, more extensive operations took place during the 1920s and 1930s, which attracted syndicates of investors as well as individual coral miners. By the onset of the Second World War, coral mining had become an established and profitable industry in northern Queensland, supplying cheap agricultural lime to sugar cane farmers on the adjacent coast and industrial lime to sugar mills, and coral extraction was concentrated in the Cairns and Innisfail areas where a cheap terrestrial source of lime was not yet readily available.

However, this account of coral mining is incomplete as a result of gaps in the archival records, the difficulty in obtaining original oral histories for the period before 1940, and the lack of extensive scientific monitoring of the Great Barrier Reef before 1970. The sequence of surviving records of coral areas – which includes Coral Areas No. 1 (Cairns) and No. 3 (Cairns), but not No. 2 (Cairns) – suggests that more locations were mined than are mentioned here. Furthermore, other instances of unlicensed coral mining may have taken place that are not mentioned in the documentary record, just as extensive operations took place at Snapper Island without, apparently, any documentary evidence surviving in the records of the QDHM that I consulted at the QSA. Therefore, this account gives an overview of what may have been a more extensive industry in the Great Barrier Reef. Nonetheless, evidence of the impacts of coral mining indicates that the significant environmental degradation may have occurred at Upolu Cay, Kings Reef and Alexandra Reef. The evidence presented above also indicates that considerable

[167] OHC 20, 9 September 2003, p. 8.

damage occurred to the fringing reef at Snapper Island, and that the extent of the degradation caused at Green Island led eventually to the prohibition of coral removal from that reef (Section 8.7.2). At these locations, coral mining may have caused significant changes in parts of several reefs of the Great Barrier Reef; implications of those changes for the management of the GBRWHA are discussed in Section 8.3.

## 5.5 'Loved to death': coral collecting in the Great Barrier Reef

A recent investigation into the coral harvest fishery in Queensland stated that coral harvesting in Queensland has been regulated since 1932, when the industry existed to supply the souvenir market.[168] Analysis of numerous documentary records, including Queensland government reports, archival records held at the QSA and a selection of historical books, reveals that informal coral collecting predated the regulation of this fishery in Queensland; furthermore, this activity has been intensive and sustained at many locations in the Great Barrier Reef. Although individual occurrences of coral collecting have been comparatively small and localised when considered in the context of the scale and diversity of coral reefs, the cumulative impacts of many coral collectors, in many places, over a prolonged period of time is likely to have been considerable; one oral history informant argued that parts of the Great Barrier Reef have been 'loved to death' by visitors to the reefs.[169] In addition to the informal removal of coral by visitors to the Great Barrier Reef, commercial coral collecting has been a consistent impact on numerous reefs; although many licences to collect coral have been issued, over several decades, many sources of evidence indicate that the industry has removed more coral than was formally permitted.

An account of the historical extent of coral collecting is valuable, therefore, since the impacts of this activity are likely to have been more severe and widespread than has previously been acknowledged. However, the reconstruction of both informal and commercial coral collecting is difficult for many reasons: the lack of systematic records, the impossibility of estimating coral harvests as a result of illegal collecting, the problems in identifying coral species, the scarcity of monitoring and policing of the activities of collectors, the vast geographical range of coral reefs in which collectors

[168] Harriott, *Sustainability of Queensland's coral harvest fishery*, p. 11.
[169] OHC 13, 4 August 2003, p. 6.

worked, and the reluctance of some coral collectors to contribute oral history evidence of their activities. In addition to these problems, individual instances of coral souveniring have been regarded as trivial and the changes that have resulted from souveniring were often imperceptible because they occurred so gradually. Nonetheless, the account presented below contains a discussion of the general scope of coral collecting, including several examples of coral collecting in specific locations, in order to provide an overview of the extent of this activity.

The strongest evidence of the scale of the commercial coral collecting industry is found in the records of the coral licences that were issued to professional collectors; the surviving licences are held at the QSA. Some oral history sources, historical books and photographs supplement these records with additional details of the extent of coral collecting and its impacts. However, in the surviving records of coral and shell-grit licences issued by the QDHM, uncertainty exists about the precise use for which the permits were intended. The sequence of licences is continuous with the licences that were issued for coral mining, which initially took place for the manufacture of agricultural lime (Section 5.4); however, terrestrial sources of agricultural lime probably replaced lime manufactured from coral, and coral collected since the 1950s increasingly supplied the curios and ornamental trades.[170] Yet early instances of the ornamental use of coral date at least to 1879, and the collection of coral from the Great Barrier Reef for curios has taken place continuously throughout the period of European settlement.

In addition to the collection of coral for curios and souvenirs, coral was also collected for scientific investigations by early European explorers and naturalists, including Jukes, who discussed his own coral collection in a letter of 27 July 1844, which stated:

> I shall be entitled to a few weeks' holiday when I return, before setting to work in London, as I suppose I shall have to do if I bring home a good collection. I am, however, still in absolute uncertainty as to what is to be done with the results of my labours – whether I am to do what I like with them, or whether they are to go to the British Museum, or where. We sadly want a scientific department in the Government to take the management of these things [...]. How you would envy the corals which we get here! The most magnificent masses of branched corals are now dying on the

[170] One oral history informant described the increasing collection of coral for aquaria since the 1950s; see OHC 31, 4 October 2003, pp. 1, 3 and 5-6.

> poop; but, alas, they are too bulky and too brittle to get home, so I shall content myself with small pieces.[171]

Other examples of coral collecting carried out by early European explorers, naturalists, natural historians and scientists were described by Bowen and Bowen, who showed that large collections of coral were transported from the Great Barrier Reef to institutions in Sydney and London.[172] Oral history evidence also suggests that large scientific coral collections were created before 1960, including a large collection made during a voyage aboard the *Cape Moreton* by Professor Stephenson of the University of Queensland and Dr. Wills of Cornell University, and another collection made during the scientific expedition to Low Isles in 1954, although those collections were not maintained.[173]

However, those collections were few in number and highly selective; they formed a small part of the cumulative impact of coral collecting. In contrast, the collection of coral for commercial ventures represented a much more significant impact on coral reefs. The coral trade had commenced by 1879, when six packages of coral were exported from Queensland to New South Wales.[174] In 1890, Saville-Kent stated that:

> A remarkable species of coral that is not infrequently obtained by the pearl-shell divers in Torres Straits and throughout the Barrier region is the black coral, *Antipathes arborea*. This coral possesses a high commercial value in the Indian market, the supplies hitherto having been chiefly derived from the vicinity of Jeddah, in the Red Sea. I am informed that the produce of the Jeddah Fishery has greatly diminished within the last few years, and that the discovery of new sources of supply would be gladly welcomed. There is, I consider, every element in favour of the development of a profitable black-coral fishery in North Queensland waters.[175]

By around 1900, coral collection was taking place at Masthead Island, as Figure 5.20 illustrates, and by 1929 the commercial sale of coral as curios and ornaments – including other species besides *Antipathes arborea* – had increased. An account of Green Island produced by the Cairns Harbour Board stated: 'There is a caretaker on the island who has a very fine exhibition of reef products and marine life, and pretty coral

[171] J. B. Jukes, *Letters and extracts from the addresses and occasional writings of J. Beete Jukes*, ed. C. A. Browne, Chapman and Hall, London, 1871, p. 230.
[172] Bowen and Bowen, *Great Barrier Reef*, *passim.*
[173] These coral collections were discussed in OHC 4, 14 January 2003, p. 2.
[174] These exports are recorded in *SCQ*, 1879, p. 174.
[175] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 8.

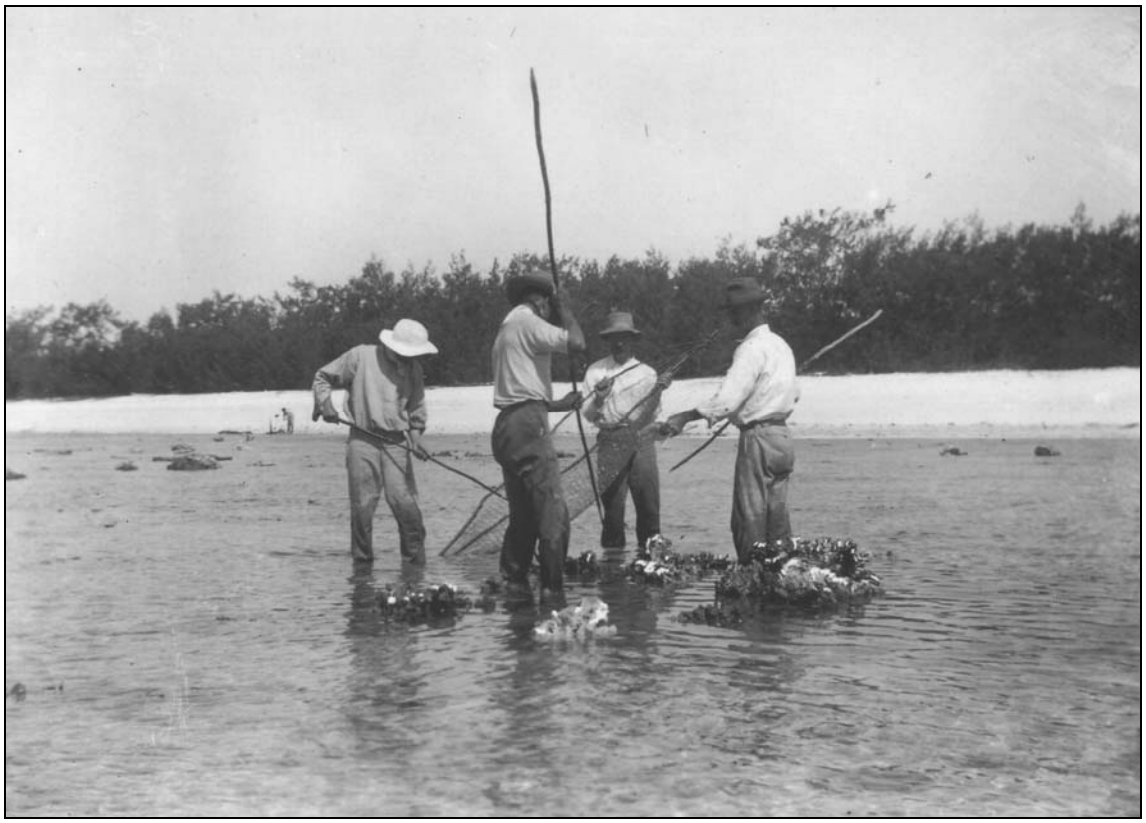

*Figure 5.20.* Coral collecting at Masthead Island, *c.*1900.

*Source:* Negative No. AP3:433, Robert Etheridge Photograph Collection, AM Archives.

specimens are obtainable at a very low cost.'[176] In addition, visitors to the island were encouraged to explore the reef at low tide for themselves, and the opportunity to souvenir coral was regarded as one of the attractions of the island resorts.

However, the activities of tourists – in particular, taking coral from the reefs – caused concern about environmental degradation at the major resorts, including Hayman, Heron and Green Islands where, from 1930 onwards, coral specimens were readily available as ornaments and curios.[177] Some of this concern was intended to prevent anticipated damage as the tourist industry developed, as the following account by the Secretary of the Provisional Administration Board of the QDHM illustrates:

> a suggestion was made to this Department by the Director of the Queensland Government Tourist Bureau that it is desirable to prohibit or restrict the removal of live coral from Queensland waters, in view of anticipated developments of the tourist traffic to islands in the Barrier Reef area and the possibility of considerable destruction of growths of coral forming scenic attractions in the neighbourhood of the tourist resorts.[178]

Nevertheless, some degradation of coral reefs had already occurred, the Secretary reported: for example, in 'the Stone Island area where tourists and others have done some damage to the coral formations from a scenic point of view.'

Another area about which early concerns about the coral collecting were publicised was the Whitsunday Islands; one account, written by H. G. Lamond in 1933, requested the Queensland government to prohibit coral collectors 'from removing oysters or coral, shells and other beauties from the Molle reefs' since degradation was occurring in those places.[179] In another letter, Lamond argued that damage to the reefs was occurring, not only as a result of the removal of specimens, but also because other corals were damaged in the process.[180] In the same year, the Queensland Government passed

[176] Cairns Harbour Board, AR, Fourth Revised Pamphlet on The Port of Cairns, North Qld., Australia, Cairns Post Pty. Ltd., Cairns, 1929, PRV8340/1 Item 1, QSA, p. 46.
[177] C. Barrett, 'The Great Barrier Reef and its isles: the wonder and mystery of Australia's world-famous geographical feature', *National Geographic Magazine*, Vol. 58, No. 3, September 1930, pp. 355-382, p. 375.
[178] Out-letter Ref. 32/3263, Sec., Provisional Admin. Board, QDHM, Brisbane to US, Treasury, Brisbane, 10 May 1933, PRV8340/1 Item 1, QSA.
[179] In-letter Ref. 06598, H. G. Lamond, Molle Islands to US, Qld. Dept. of Agriculture and Stock, Brisbane, 15 March 1933, PRV8340/1 Item 1, QSA.
[180] In-letter Ref. 4488, H. G. Lamond, Molle Islands to Qld. Dept. of Harbours and Fisheries, Brisbane, 10 August 1933, PRV8340/1 Item 1, QSA.

legislation to protect the most vulnerable locations by prohibiting the taking of coral from the foreshores and reefs of eighteen islands: Masthead, Heron, Lady Musgrave and North-West Islands (Bunker Group); Middle and South Islands (Percy Isles); Tern and Red Bill Islands (Northumberland Islands); Scawfell, Molle, Shaw, Lindeman, Hayman, St. Bees and Brampton Islands (Cumberland Islands); Stone Island (Edgecombe Bay); Bait Reef; and the foreshores and reefs of Cid Harbour (Whitsunday Island).[181] The following year, the foreshore and reef surrounding Hamilton Island (Whitsunday Passage) were added to the list of protected areas.[182]

Nevertheless, coral collecting remained a popular activity amongst both amateur collectors and naturalists. Ellis described the joy of coral collecting as follows:

> So far as naturalists are concerned, I can hardly imagine one being happier than when taking a stroll at low spring tide on the Barrier Reef, with its wealth of shells, corals, crabs, sea-urchins, beche-de-mer, and other strange things that only a naturalist could classify.
>
> Every stone one turns over reveals material for a collection; every piece of live coral broken off seems to add its share; not only the polyp which made the structure, but the weird and wonderful tiny crabs, shrimps, and little fish that make their homes among the branching coral. Everything seems to be teeming with life. And it is not necessary to be a naturalist to enjoy these wonders; any one with a love of nature would be thrilled. The scale on which things are done, too, is befitting the noble proportions of this great reef.[183]

In contrast, in 1939, Ratcliffe described the disappointment he experienced when walking across a dead coral reef between Dunk Island and a smaller island of the Family Group, at low tide, and finding few biological specimens.[184] Yet the practice of coral collecting and the treatment of specimens had by then become well-established; an efficient method of cleaning coral by covering it in coral sand for about a week was commonly practiced, and coral specimens were then tinted in an attempt to reproduce the colours of the living reef.[185]

[181] Order in Council, 1 June 1933, PRV8340/1 Item 1, QSA.
[182] Order in Council, 27 September 1934, PRV8340/1 Item 1, QSA.
[183] A. F. Ellis, *Adventuring in coral seas*, Angus and Robertson, Sydney, 1936, p. 83.
[184] F. Ratcliffe, *Flying fox and drifting sand: the adventures of a biologist in Australia*, Chatto and Windus, London, 1939, p. 139.
[185] H. C. Richards, 'Some problems of the Great Barrier Reef', *Journal and Proceedings of the Royal Society of New South Wales*, Vol. 71, 1937, pp. 67-85, p. 73.

In spite of the legal protection of some coral reefs that existed since 1933, complaints were still made about the degradation of other reefs by coral collectors. At the beginning of 1938, the Honorary Secretary of the GBRC, E. O. Marks, wrote to the Queensland Treasurer, stating:

> This Committee has for many years felt much anxiety in regard to the harm which must result from promiscuous gathering of marine and other trophies, and thoughtless destruction of fauna and flora along the Queensland coast. The effects of such vandalism are necessarily greatest in the most accessible places – especially in the vicinity of tourist resorts.[186]

The degradation was of particular concern in the Whitsunday region; another report, by the lessee of South Molle Island, Mr A. W. Bauer, claimed that 'the coral reefs surrounding Mid Molle and Denman Islands are suffering through the action of persons removing coral.'[187] The Director of the QGTB suggested that those two islands should be given the same legal protection from coral collectors as other protected reefs. In June 1938, the number of foreshores and reefs protected under *The Fish and Oyster Acts, 1914 to 1935* was increased to include the remainder of Whitsunday Island as well as Mid Molle, Denman, Hook, Border, Deloraine, West Molle and Long Islands in the Whitsunday Group, and Seaforth Island in the Cumberland Group.[188]

Yet the legal protection of coral reefs did not prevent their degradation by coral collectors, who continued to souvenir specimens illegally. The attractions of 'reefing' were described by the Secretary of the Queensland Office of the Commissioner for Railways who, after visiting Lady Musgrave Island, wrote that:

> Lady Musgrave has extensive coral reefs which provide ample opportunities for reefing at low tides when tourists can see every variety of marine growth and life. […] On the edge of the reefs and in coral pools, coral gardens flourish in all their beauty.[189]

However, the Secretary reported that the reef specimens were so numerous that 'it becomes difficult to prevent tourists from collecting them.' He also reported that, in an

[186] In-letter Ref. 38/14394, E. O. Marks, Hon. Sec., GBRC, Brisbane to Hon. F. A. Cooper, Treasurer, Brisbane, 12 December 1938, PRV8340/1 Item 1, QSA.
[187] Cited in In-letter Ref. 39/6316, Dir., QGTB, Brisbane to Sec., QDHM, 1 June 1939, PRV8340/1 Item 1, QSA.
[188] Order in Council, 20 July 1939, PRV8340/1 Item 1, QSA.
[189] In-letter Ref. L40.2373.11, Sec., Office of the Commissioner for Railways, Brisbane to Sec., QDHM, Brisbane, 22 May 1940, PRV8340/1 Item 1, QSA.

attempt to dissuade visitors from taking coral collecting, the caretakers of Lady Musgrave Island, Mr and Mrs Bell, 'discourage the removal of marine growths in every way and to assist in this object specimens of reef life are not even collected for display purposes at the settlement.'[190]

The impacts of coral collectors were not limited to the resort islands, such as Lady Musgrave Island; other islands in the vicinity of resorts were also affected as tourists undertook day-trips. One report, written in 1940 by NP Ranger G. Gentry, argued that Hoskin and Fairfax Islands were being damaged since they were visited regularly by tourists from Lady Musgrave and Heron Islands; his report stated: 'There is no doubt that a fair quantity of coral is taken as specimens. Some most outstanding coral beds are to be found around these two islands.'[191] Similarly, NP Ranger E. McKeown reported that camping parties from the districts between Cairns and Innisfail that regularly camped on High Island, in the Frankland group, were removing coral specimens from the Frankland Islands.[192] By 29 October 1940, the foreshore and reef of Green Island had been included on the list of islands from which the removal of coral was prohibited; by the end of the same year, the reefs at Hoskin and Fairfax Islands, and those at the Frankland Islands, had also been protected.[193]

However the removal of coral continued. At Green Island, Noel Monkman, the Honorary National Parks (NP) Ranger and Honorary Inspector of Fisheries, complained in 1944 about the removal of specimens by American servicemen, stating that:

> I am having an extremely difficult time in protecting the Reef at Green Island from destruction by servicemen spending their week-end leave here. As you are no doubt aware, we have from 200 to 300 men arrive on the island each week-end. I have done my best to prevent the despoiling of the Reef but it is beyond my control. On many occasions when I have requested men to cease breaking

[190] In-letter Ref. L40.2373.11, Sec. to Sec., PRV8340/1 Item 1, QSA.
[191] In-letter Ref. 225/45, Geo Gentry to Sec., Sub-Dept. of Forestry, Brisbane, 11 October 1940, PRV8340/1 Item 1, QSA.
[192] In-letter Ref. 225/45, E. McKeown, NP Ranger, Tully to Sec., Sub-Dept. of Forestry, Brisbane, 20 September 1940, PRV8340/1 Item 1, QSA.
[193] Out-letter Ref. 4868, Sec., QDHM, Brisbane to Sec., Sub-Dept. of Forestry, Brisbane, 29 October 1940, PRV8340/1 Item 1, QSA; Extract 40/13764, G.D.Q. 225/45, J. D. W. Dick, CIF, QDHM, Brisbane to Sec., Forestry Sub-Dept., Brisbane, 4 December 1940, SRS5416/1 Box 10 Item 59, NP219 Bunker, QSA; Extract 40/13764, G.D.Q., 225/45, J. D. W. Dick, CIF, QDHM, Brisbane to Sec., Forestry Sub-Dept., Brisbane, 4 December 1940, SRS5416/1 Box 10 Item 58, NP220 Bunker, QSA.

> off coral and filling their knapsacks with it or collecting kit boxes full of shells and starfish, the men have in many instances become very abusive and aggressive.[194]

Investigation of this issue revealed that Monkman himself, with his brother-in-law, sold corals at the Green Island kiosk; a display of those corals is shown in Figure 5.21.[195] In response, Monkman argued that the corals at the kiosk were not taken from Green Island reef; instead, he stated, coral collectors 'have collected these specimens by boat on distant reefs adjacent to the Island, and also purchase from the Island boys [*sic*] on the luggers visiting Green Island.'[196] After the introduction of legislation, hence, some impacts of collecting were transferred to reefs that were not protected by restrictions.

The damage wrought by coral collectors – including by reef-walking – was apparent to many observers. At Heron Island in 1944, Gentry saw 'evidence that shells and coral have been removed in the past', and at Green Island, A. C. C. Lock stated, 'it was evident that some of the coral had been broken apart, and killed, by visitors walking upon it.'[197] In addition to those reports, Serventy stated that:

> coral and shell have developed into a minor industry. So much so that most tourist islands in self defence have had to prohibit the 'picking' of coral and the gathering of shells, at least in large quantities. Boats working from Cairns bring in coral for the tourist trade […].[198]

Furthermore, the extent of manipulation of coral reefs had increased to the point where the 'transplantation' of coral from unprotected reefs to resorts, in which coral depletion had taken place, was feasible. By 1952, at Green Island, coral specimens were imported from adjacent reefs in order to supplement the coral gardens that surrounded the underwater observatory', with the result that a total length of seventy feet of coral gardens could be viewed by tourists.[199]

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[194] In-letter Ref. JRD/LL, N. Monkman, Green Island Kiosk to E. McKeown, Forestry Officer, Tully, 1 June 1944, SRS5416/1 Box 66 Item 447, NP836 Trinity 'R' – Green Island – Protection of marine life, QSA.
[195] In-letter, Hon. Sec., NQNC, Cairns to Mr. Jones, Hon. Min. for Lands, Brisbane, 17 July 1944, SRS5416/1 Box 66 Item 447, NP836 Trinity 'R' – Green Island – Protection of marine life, QSA.
[196] 'Copy of letter attached', 25 January 1945, SRS5416/1 Box 65 Item 443, NP836 Trinity 'J' – Green Island, QSA; J. D. W. Dick, CIF, Brisbane to Secretary, Qld. Forestry Sub-Dept., Brisbane, 23 February 1945 SRS5416/1 Box 65 Item 443, NP836 Trinity 'J' – Green Island, QSA.
[197] Letter written by G. Gentry, NP Ranger, addressee not stated, 10 May 1944, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA; Lock, *Destination Barrier Reef*, p. 207.
[198] Serventy, *Australia's Great Barrier Reef*, p. 77.
[199] In-letter, C. J. Trist to NP Ranger McKeown, Tully, 17 January 1952, R836 Trinity 'P', QSA.

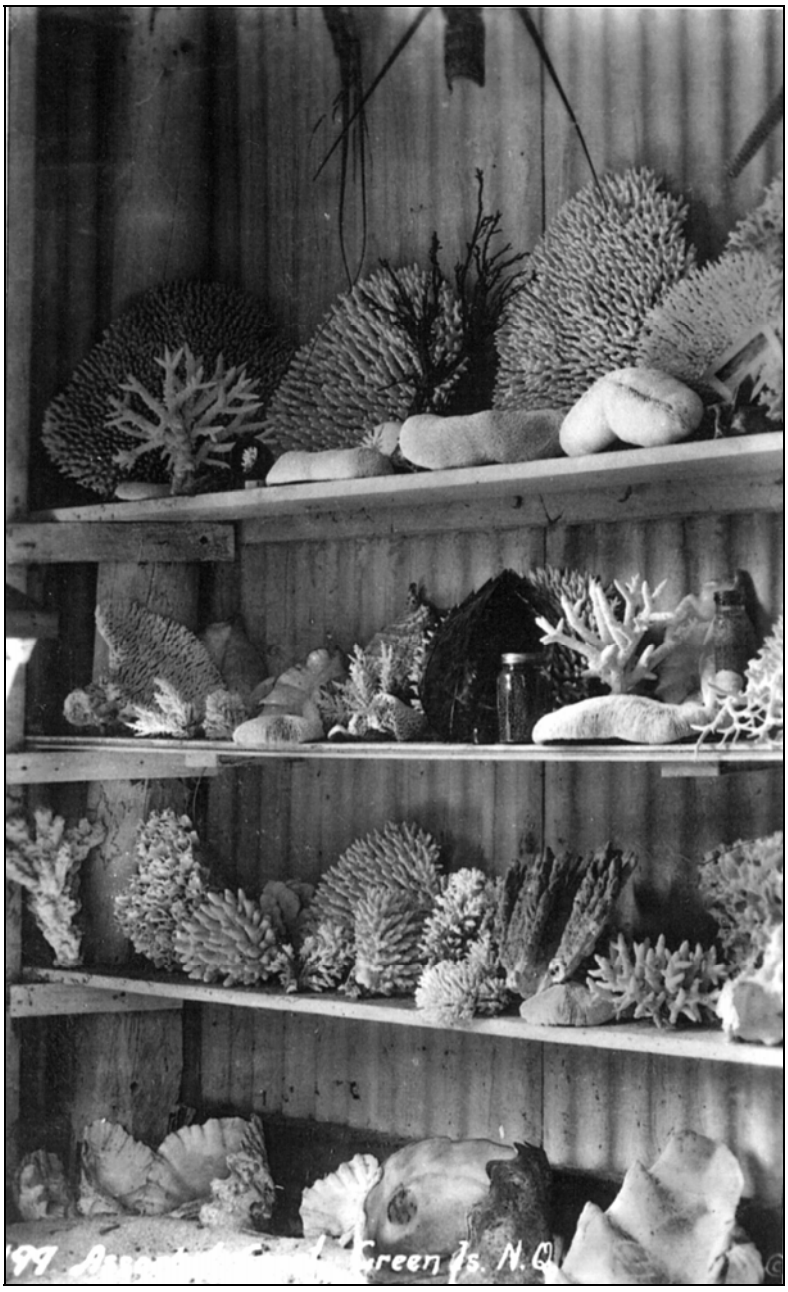


*Figure 5.21.* Assorted coral displayed at the Green Island kiosk, *c.*1940.
*Source:* Uncatalogued photograph obtained from CHS, courtesy of G. Jennex.

Green Island was not the only location to experience degradation due to coral collecting; Heron Island reef was also depleted by tourist souveniring, as shown in Figure 5.22. Commercial coral collecting also took place at Heron Island reef and Wistari Reef, and the depletion of species there was reported by Monkman in 1955, when he was the Honorary Ranger and Honorary Fisheries Inspector at Heron Island, who stated:

> the *Don Juan* […] anchored inside the Heron Island reef for several days, whilst the crew of that boat, *i.e.* two young men and a woman, had been systematically combing the reef during the period of each low tide, both day and night, and had already collected a considerable number of living shellfish and colonies of coral. [...] These people were conducting a business of the sale of such specimens by making the shells into jewellery and bleaching and colouring the coral. [...] I went out to this boat, and found coral bleaching on the deck and also a considerable number of specimens of all sizes of a particularly beautiful shell known as the Heron Island volute (*Pullchra*). Heron Island is noted for this particular shell which is only found there and on the surrounding reefs.[200]

Monkman also reported that the woman claimed that 'she had now collected sixty of these shells in the last few days'; in addition, although this incident took place at Heron Island, the owner of the boat 'did most of his collecting of coral and shells on Wistari Reef, adjacent to Heron Island.'

As a result of the cumulative impacts of tourist souveniring and the increasing impacts of commercial coral collecting, Wistari Reef and One Tree Island reef had deteriorated by 1955. Describing the decline of these reefs, Monkman stated:

> I have been working on the Reef for 25 years as a marine biologist and film producer, and during that period have seen the sad sight of some of our most beautiful reefs being destroyed as thing of beauty and wonder, and have seen the selling of coral and shells become an outrageous racket.
>
> Wistari Reef has already commenced to deteriorate through these depredations, and I would implore your Department to protect this reef before it suffers the same fate as so many other reefs. This also applies to One Tree Reef, but I see no reason at all why all the reefs on the Great Barrier should not be rigidly protected.[201]

[200] In-letter Ref. 2A/D0, 152/4335, Noel Monkman, Hon. Ranger, Hon. Fisheries Inspector, Heron Island to W. Wilken, Sec., Brisbane, 3 January 1955, SRS5416/1 Box 66 Item 446, NP836 Trinity 'P' – Green Island – Underwater observation chamber, QSA, pp. 1-2, p. 1.
[201] In-letter Ref. 2A/D0, Monkman to Wilken, SRS5416/1 Box 66 Item 446, NP836 Trinity 'P' – Green Island – Underwater observation chamber, QSA, p. 1.

*Figure 5.22.* Tourists gathering coral specimens from Heron Island reef, *c.*1930.
*Source:* QS189/1 Box 17 Item 73, Queensland Industry, Services, Views, People and Events; Photographic Proofs and Negatives; Islands – Barrier Reef, QSA.

Regardless of the prohibition of coral collecting, visitors continued to remove specimens from the Great Barrier Reef throughout the 1960s. Coral was also used for commercial and official purposes; one collection was used to decorate the QANTAS office in Tokyo, and a much larger collection, comprising over 1,350 coral specimens and six giant clams was displayed at the 1967 Exposition in Montreal.[202]

Other than the informal collecting of souvenirs, coral collecting took place in a more organised manner, encouraged by the Queensland Government, using a system of coral collecting licences. Evidence of these licences survives in the QSA for the period 1962-1969 and nineteen coral areas have been identified using these records, but it is likely that the industry was more extensive than the extant records indicate. The nineteen coral collecting areas that have been reconstructed using archival evidence were located at twelve reefs and islands; their distribution, shown in Figure 5.23, indicates that during this period the coral collecting industry exploited reefs in the vicinity of the major ports of Cairns, Townsville, Mackay and Gladstone, although a concentration of coral areas occurred in the Cairns area. A summary of the nineteen coral collecting areas is given in Table 5.5, which also identifies their lessees; analysis of Table 5.5 indicates the operation of a small number of professional coral collectors in relatively precisely-defined coral areas, although it is not certain how the boundaries of coral areas were defined, nor whether any monitoring and policing of commercial collecting took place.

Some additional evidence provides more detail about the coral collecting industry. Applications for coral collecting licences had to be made to the Queensland Government and were accompanied by sketch maps of the proposed area, such as the examples illustrated in Figure 5.24, which accompanied the application by B. E. Keong. Further details of the coral collecting areas leased are given in Table 5.5. In addition to the nineteen areas listed in Table 5.5, other applications for coral collecting were made, such as A. F. Paterson's application for a licence to remove coral from Otter Reef, near Cardwell.[203] However, regarding this application, the Harbour Master at Townsville stated that:

[202] QS189/1 Box 17 Item 73, Queensland Industry, Services, Views, People and Events; Photographic Proofs and Negatives; Islands – Barrier Reef, QSA; A. J. Peel, AR, QDHM, *QPP*, Vol. 2, 1966, pp. 841-857, p. 852.
[203] In-letter, A. F. Paterson, Southport to QDHM, 1 June 1964, Folder 1964, PRV14712/1 Box 190 Item 788, Subject batches – Oyster, coral and shell grit, QSA.

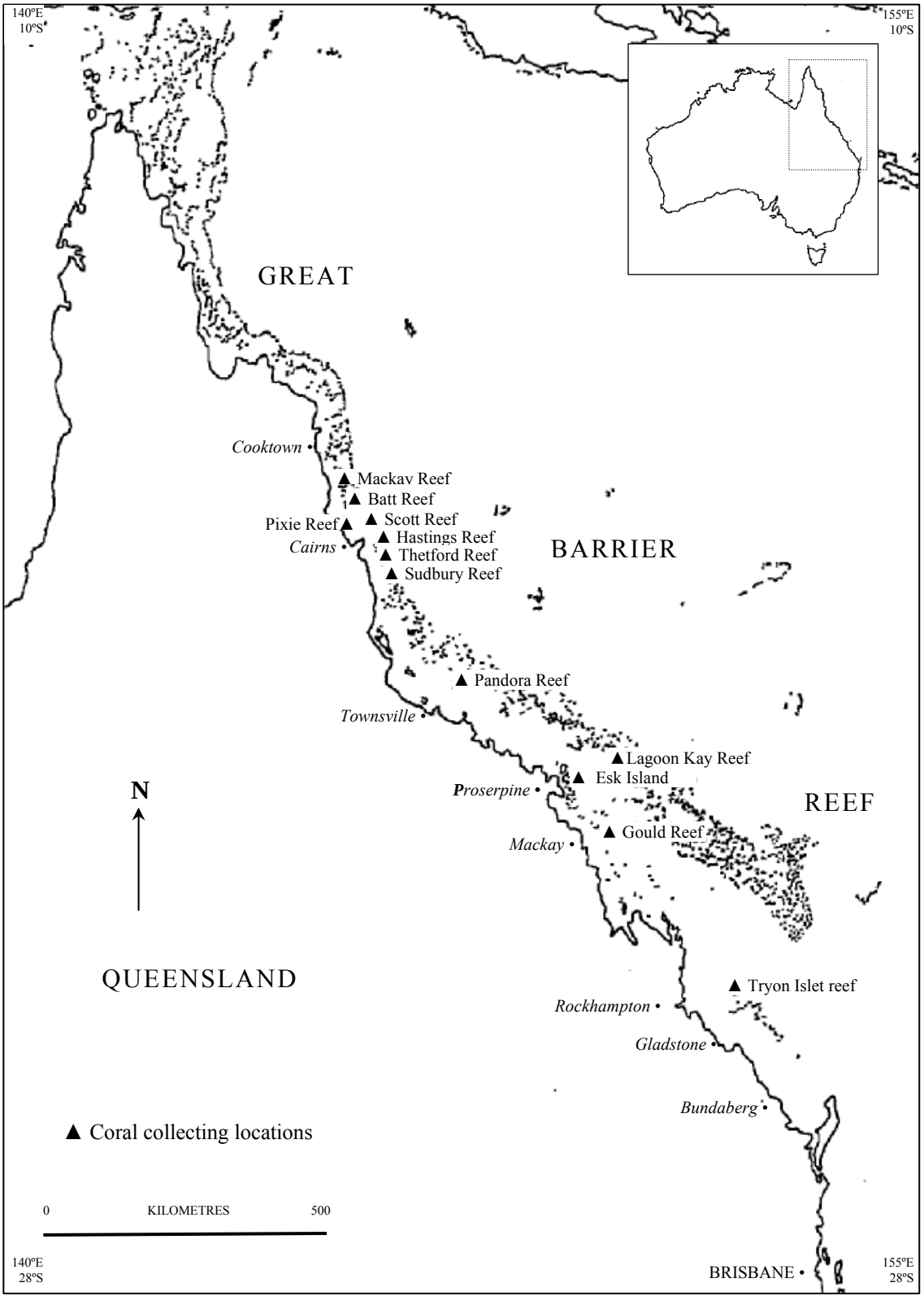


*Figure 5.23.* Coral collecting areas in the Great Barrier Reef, 1962-1969.

*Source:* Compiled from archival files found in Folder 1964, PRV14712/1 Item 788 Box 190, QSA.

| ***Location*** | ***Period*** | ***Operator(s)*** |
|---|---|---|
| *Coral Area No. 2 Cairns* (Scott Reef) | 1962-1969 | Peggy Corbett;<br>R. W. H. and M. E. Philpot |
| *Coral Area No. 3 Cairns* (Sudbury Reef) | 1962-1969 | J. and M. Hoeg-Staun<br>(Cairns Coral Curios) |
| *Coral Area No. 4 Cairns* (Hastings Reef) | 1962-1966 | George Leonard Alexander Snow |
| *Coral Area No. 5 Cairns* (below low water mark on the western side of Scott Reef) | 1967 | Vincent Vlasoff |
| *Coral Area No. 6 Cairns* (below low water mark, south-western side of Hastings Reef) | 1963-1969 | Arthur Hugh Read |
| *Coral Area No. 7 Cairns* (below low water mark, western side of Hastings Reef) | 1964-1969 | Denis Charles Wrightson |
| *Coral Area No. 9 Cairns* (below low water mark, north-western face of Pixie Reef) | 1964-1969 | Gordon Oke |
| *Coral Area No. 10 Cairns* (below low water mark, Mackay Reef, 11 miles east of Cape Tribulation) | 1964-1969 | Ronald McKauge |
| *Coral Area No. 11 Cairns* (below low water mark, northern face of Thetford Reef) | 1964-1969 | Roland John Edwards |
| *Coral Area No. 14 Cairns* (below low water mark, south-western side, Batt Reef) | 1969 | E. I Cleland and J. R. Henson |
| *Coral Area No. 1 Townsville* (below low water mark, southern side of Pandora Reef) | 1966-1969 | Douglas Tarca |
| *Coral Area No. 15 Mackay* (below low water mark, western side of Esk Islet) | 1963-1969 | B. E. Keong and P. R. Jansen<br>(Mandalay Coral Gardens) |
| *Coral Area No. 17 Mackay* (below low water mark, 20 chains on that part of Gould Reef at approximately 148°48'E 19°27'S) | 1966-1968 | Cyril James Looke |
| *Coral Area No. 18 Mackay* (below low water mark, near Esk Islet) | 1966-1969 | Herbert Charles Liddell |
| *Coral Area No. 19 Mackay* (Lagoon Kay Reef, approximately 40 miles from Hayman Island, normally submerged) | 1967-1969 | William Wallace |
| *Coral Area No. 20 Mackay* (northern extremity of Gould Reef) | 1969 | Lillian Cowern |
| *Coral Area No. 1 Gladstone* (below low water mark, north-western corner of Tryon Islet reef) | 1968 | Harold Frederick Manning |
| *Coral Area No. 8 Gladstone* (eastern portion of a reef surrounding Tryon Islet) | 1963-1969 | Joyce Burnett and Sirian Hamilton Harlow |

*Table 5.5*. Summary of coral collecting leases in the Great Barrier Reef, 1962-1969.

*Source:* Compiled from archival files found in Folder 1964, PRV14712/1 Item 788 Box 190, QSA.


*Figure 5.24.* Sketch map accompanying Keong's application for two lease areas (see dashed boxes): at Mandalay Point and Hook Island (Whitsunday Group), 1966.
*Source:* SRS31/1 Box 13 Item 99, Licence for removal of coral – Miscellaneous, QSA.

> Present policy requires that coral leases are normally submerged at all times and remote from public areas. This proposed lease on 'Otter Reef' is a popular fishing ground and anchorage for amateur fishermen. I recommend that this application should be refused.[204]

Thus, one requirement of the coral areas was that they should not be visible from the surface; the coral areas were required to remain below low water mark. Nonetheless, some coral was removed from Otter Reef, as Paterson stated that live coral was 'easily obtained at low water and is abundant.'[205]

The impacts of commercial coral collectors were greater that those of individual tourists, although the numbers of the former were far smaller. Commercial operators sometimes took coral from protected reefs, such as Green Island reef, as one oral history informant has revealed.[206] Commercial collectors also removed enormous quantities of corals from individual reefs; examples of abundant coral harvests are shown in Figures 5.25 and 5.26, which illustrate the collecting business of the pioneer aviator, Tom McDonald, who also operated a jewellery trade using coral specimens. McDonald and his co-workers collected coral from reefs in the Cairns area, including Double Island reef. Yet no documentary evidence of their business was found in the archival materials that were searched at QSA; their coral collecting pre-dated the coral licence system and indicates that extensive commercial removal of material had already taken place by the time that coral leases were first issued.

Hence, during most of the period of European settlement in Queensland, widespread coral collecting occurred; by 1962, a significant industry was established – and probably operated along similar lines – until the formation of the first Marine Parks in 1974. As Lawrence *et al*. stated:

> coral collecting remained a popular pastime for tourists. The limited restrictions on collecting under Queensland Fisheries legislation that remained in force well into the 1970s were an indication that coral souveniring continued to be a popular activity. The Queensland Government declared marine

[204] In-letter, Harbour Master, QDHM, Townsville to Sec., QDHM, Brisbane, 3 July 1964, Folder 1964, PRV14712/1 Item 788 Box 190, QSA.
[205] In-letter, Inspector of Fisheries, QDHM, Townsville to CIF, QDHM, Brisbane, 17 June 1964, Folder 1964, PRV14712/1 Item 788 Box 190, QSA.
[206] Coral collecting at the protected reef at Green Island is mentioned in OHC 31, 4 October 2003, p. 1.

*Figure 5.25.* Frank Kelly, Inky Nicholls, Harry Bird and Tom McDonald gathering coral at Double Island reef, *c.*1930.

*Source:* Image No. P09768, Image Library, CHS.

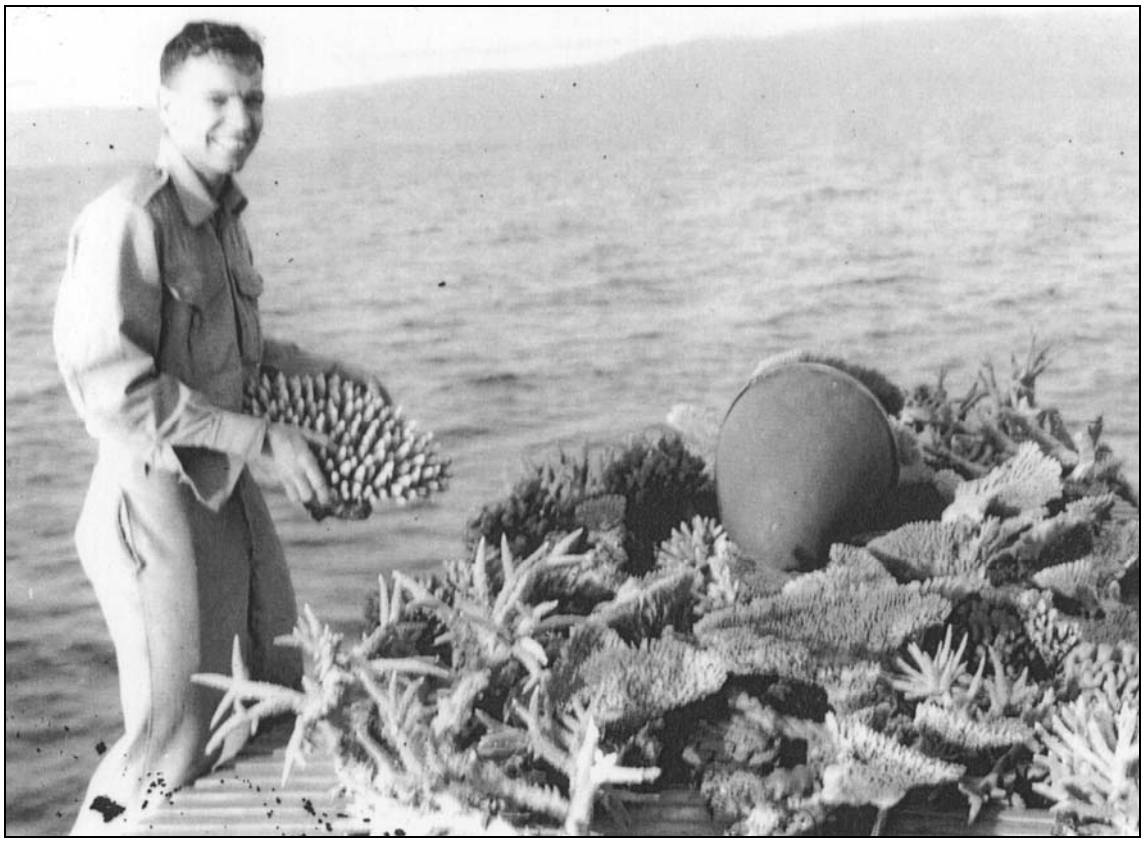

*Figure 5.26.* Jack Clarke aboard the *Suva* gathering coral for Tom McDonald, *c*.1930.
*Source:* Image No. P09769, Image Library, CHS.

park status over two heavily used reef sites, the Heron-Wistari Reef and Green Island Reef in 1974, under the Queensland *Forestry Act 1959*.[207]

Overall, from earliest regulation of coral collecting in 1932 until the 1980s, coral collection in the Great Barrier Reef increased, as Harriott has shown; the coral fishery now removes around 50 tonnes of material per year from 50 authorised coral areas.[208] The nature of commercial coral collecting has altered, as Oliver has acknowledged, from a focus on the souvenir trade – in which one species, *Pocillopora damicornis* (also called 'brown-stem'), dominated the harvest – to supplying the live aquarium industry with high-value species, including soft corals, anemones and other Cnidarians.[209]

The evidence presented in this section indicates that coral collecting has occurred in many parts of the Great Barrier Reef throughout the period since European settlement, and that particular degradation of coral reefs has taken place at Double, Green, Heron, Masthead and Lady Musgrave Islands, and at Wistari Reef. That degradation has been due to the combined impacts of prolonged, cumulative coral souveniring by tourists and to the removal of large amounts of material by commercial collectors. Despite restrictions of the removal of coral since 1932, both licensed and unlicensed collecting continued; extensive documentary reports describe the deterioration of coral reefs that accompanied coral collecting, and those accounts are supported by oral history evidence. Coral collecting, therefore, forms a significant – yet previously overlooked – cause of environmental change in many coral reefs of the Great Barrier Reef. The implications of coral collection for contemporary management of the GBRWHA are considered in Section 8.3.

## 5.6 Changes in shell populations of the Great Barrier Reef

The previous section has described changes in coral reefs as a result of coral collecting; similar degradation was inflicted on coral reefs by shell collectors, since they removed species from coral reefs and also damaged corals in the process by reef-walking. Shell collecting forms part of a group of harvesting activities that has depleted many reef

[207] Lawrence *et al*., *Great Barrier Reef*, p. 27.
[208] Harriott, *Sustainability*, p. 11.
[209] J. Oliver, *An evaluation of the biological and economic aspects of commercial coral collecting in the Great Barrier Reef Region*, Report to the GBRMPA, October 1985, Townsville, GBRMPA, 1985; Harriott, *Sustainability*, p. 11.

organisms, including corals, and to some extent the distinctions between these activities are artificial: some collectors collected various marine specimens during their visits to the Great Barrier Reef. Nevertheless, sufficient evidence – both documentary and oral – exists to suggest that the impacts of shell collecting have been considerable; this evidence is presented below. The discussion contained in this section is divided into two parts: first, some general impacts of shell collecting are considered, before the more specific damage that has been sustained by giant clams (*Tridacna spp.*) is described. The evidence presented here indicates that significant, prolonged and widespread removal of shells has occurred in the Great Barrier Reef since the earliest European exploration of the ecosystem took place.

### *5.6.1 Impacts of shell-collecting*

Shells have attracted the interest of collectors and observers in the Great Barrier Reef since the earliest period of British exploration and settlement in Queensland. Two reports state that James Cook observed 'giant cockles' – giant clams growing 'to a length of ten feet and a weight of a ton' – and ate some of the smaller ones.[210] Joseph Beete Jukes, in his journal on 29 October 1844, wrote: 'I then determined to live ashore to arrange my shells'; and in 1872, C. H. Eden stated:

> There was a beautiful little island called Garden Island, to which the inhabitants of Cardwell used to resort for oyster picnics, and where a great number of cowries of all sizes could be found by turning over the stones at low water.[211]

In 1892, Bartley referred to the practice of collecting Australian marine shells, especially different *Conus* species, and he stated that *Cypraea* are 'walked off' from the beaches of eastern Australia.[212] Agassiz, who visited the Great Barrier Reef in 1896, reported that at Stone Island reef, near Bowen, 'the bottom of the bay is covered with fine mud and broken shells', although that damage may have been due to the tropical cyclone that struck Port Denison (now Bowen) on 30 January 1884; further north,

[210] Christesen, 'Roving the coral seas', p. 31; R. Bedford, *The Great Barrier Reef: a series of photographs by E. F. Pollock and Frank Hurley*, Art in Australia, Sydney, 1928.
[211] Jukes, *Letters and extracts*, p. 234; C. H. Eden, *My wife and I in Queensland: an eight years' experience in the above colony, with some account of Polynesian labour*, Longmans, Green and Co., London, 1872, p. 294.
[212] N. Bartley, *Opals and agates; or, scenes under the Southern Cross and the Magelhans: being memories of fifty years of Australia and Polynesia, with nine illustrations*, Gordon and Gotch, London, 1892, pp. 218-219.

Agassiz wrote: 'we were struck with the great number of dead Nautilus and Spirula shells thrown up on the sand beaches of the Three and Two Isles groups' and by the abundance of dead cuttlefish bones that were associated with these shells.[213] By the end of the nineteenth century, therefore, these records suggest that European explorers and settlers had made observations of shell species and had collected many specimens.

The impacts of shell collecting intensified during the twentieth century as more collectors worked the reefs and as more locations became accessible to tourists, commercial collectors and shell clubs. The destruction of shell populations and other marine life at Green Island as a result of tourists taking souvenirs, for example, was reported as early as 1929; as tourist resorts developed, the difficulty in preventing increasing numbers of visitors from souveniring shells became apparent.[214] Describing a cruise in the Great Barrier Reef in the early 1930s, Ivan A. Hughes reported shell collecting at Langford Island reef flat, and at Redbill Island reef he stated: 'Great slabs of dead coral were overturned and their undersides scanned for the pretty cowrie shells nestling in the crevices'; Redbill Island reef also produced 'a rich harvest' of spider shells. In 1930, Barrett wrote: 'Combing the reef for shells is a delightful recreation'[215]

However, the activities of shell collectors generated opposition as well as enthusiasm; during the 1930s, some individuals expressed concern to regulate the activity and to prohibit collecting at some locations. One location about which concern was expressed was the Molle Islands, in the Whitsunday Group, where the lessee, H. G. Lamond, requested the Queensland Government to restrict the taking of shells, for he stated: 'The trouble as I see it – and I have taken particular note – is not what the people take and preserve. It is what they damage in getting specimens.'[216] In 1938 by E. O. Marks, the Honorary Secretary of the GBRC, expressed anxiety about 'the harm which must result from promiscuous gathering of marine and other trophies' in the Great Barrier Reef; he

[213] Agassiz, *Visit to the Great Barrier Reef*, p. 107 and 115; see also J. D. Switzer, *Directions for the use of ship-masters navigating in the South Pacific or on the Queensland coast*, James C. Beal, Brisbane, 1889.
[214] Out-letter, Town Clerk, Cairns to US, Treasury, Brisbane, 12 December 1929, SRS146/1 Item 2, QSA; see also Out-letter, Town Clerk, Cairns to Chairman, Qld. Marine Board Office, Brisbane, 26 September 1931, SRS146/1 Item 2, QSA.
[215] I. A. Hughes, *In the wake of the 'Cheerio': the narrative of a memorable cruise in Great Barrier Reef waters*, I. A. Hughes, Sydney, 1937, pp. 5 and 27; Barrett, 'Great Barrier Reef', pp. 378 and 380.
[216] In-letter Ref. 06598, H. G. Lamond to US; In-letter Ref. 4488, H. G. Lamond to Qld. Dept. of Harbours and Fisheries, 15 March 1933, PRV8340/1 Item 1, QSA.

acknowledged that the effects of over-collecting were greatest in the most accessible places: those in the vicinity of the tourist resorts.[217]

Yet while Lamond and Marks regarded the activities of collectors as vandalism, other observers were more sympathetic to the actions of tourists; for example, C. J. Trist stated: 'Thoughtlessness rather than vandalism can better describe the desire of this temporary population to souvenir and interfere with the natural beauty of these islands.'[218] However, the effectiveness of the regulation of shell collection often depended upon the willingness of caretakers at the island resorts to enforce protective legislation. At Lady Musgrave Island, in 1940, one officer of the QGTB reported the need to curtail shell collecting by tourists, acknowledging that the caretakers, Mr and Mrs Bell, 'discourage the removal of marine growths in every way and to assist in this object specimens of reef life are not even collected for display purposes at the settlement'; these measures were taken because the need to preserve shells at Lady Musgrave Island reef had become pressing. [219]

Exceptions to the restrictions on shell collecting were made for some particular purposes, such as scientific research. For example, two demonstrators and Research Fellows of the UQ, Miss M. Cross and Miss P. Hardy, were permitted to collect shells on behalf of Professor Goddard in the Whitsunday Group – especially at Hayman Island – for a period of a fortnight from 19 August 1941. A similar period of shell collecting at Heron Island by Miss G. Thornley, a member of the Royal Zoological Society, on behalf of the AM, was permitted on 15 December 1941; permission was also given to Miss Thornley to collect shells at Green Island from 1-8 August 1950.[220] The Secretary of the QDHM acknowledged that permits for shell collecting in the interests of scientific research represented a special case, and that in general shell collecting should

[217] In-letter, 38/14394, E. O. Marks, Hon. Sec., GBRC, Brisbane to the Hon. F. A. Cooper, Treasurer, Treasury, Brisbane, 12 January 1938, PRV8340/1 Item 1, QSA.
[218] Circular No. 727, C. J. Trist, Sec., Qld. Sub-Dept. of Forestry, Brisbane, 'Memo: Protection of Islands – Barrier Reef', 23 March 1939, PRV8340/1, Item 1, QSA.
[219] In-letter, Sec., Office of the Commissioner for Railways, Brisbane to Sec., QDHM, Brisbane, 22 May 1940, PRV8340/1 Item 1, QSA.
[220] Out-letter, F. A. Cooper, Treasurer, Qld. Treasury, Brisbane to Miss M. Cross and to Miss P. Hardy, UQ, Brisbane, 14 August 1941, PRV8340/1 Item 1, QSA; Out-letter Ref. 41/10354, Sec., QDHM, Brisbane to Miss G. Thornley, Lidcombe, New South Wales, 15 December 1941, PRV8340/1 Item 1, QSA; Out-letter, Chief Administrative Officer and Sec., QDHM, Brisbane to Sec., Qld. Sub-Dept. of Forestry, Brisbane, 5 January 1950, SRS5416/1 Box 66 Item 447, NP836, Trinity 'R' – Green Island – Protection of Marine Life, QSA.

be discouraged. Yet the Queensland Government remained ambivalent about shell collecting, for evidence of over-collecting and damage to reefs in tourist areas accumulated; on the other hand, some shell collections were used to promote both scientific research and the development of the tourist industry in Queensland. The latter concern was reflected in the decision of the QGTB to purchase a shell and coral collection from Mr G. Andrew, of Ipswich, at a cost of £25, which would be used 'for window displays and other display purposes and prove a very great feature in attracting business for the Barrier Reef'.[221]

By the 1950s, however, both the extent of shell depletion and the level of concern about damage to the reefs had intensified. The Honorary Secretary of the Caloola Club of Sydney, following a visit to Heron and North West Islands, wrote the following account of the extent of the damage inflicted by shell collectors, which is quoted at length because it provides a rich description of that damage:

> Being by nature of our objects, apprehensive of anti-preservational practices, we were impressed by the amount of poaching and destruction that has and is taking place on the reefs surrounding Heron Island. Numerous shells in which the animals were still alive were seen to be collected by guests, not with the intention of private collection, but for illicit trading: a hat full of live Cone shells, several live Cowries of varying species. On one occasion after a visit to Nor'West [North West] Island, a large live Bailer was collected by a member of the Management Staff and it later came to our notice that lampshades using Bailer Shells were available at a given store for Five Pounds. One member of our party was approached by a guest who had a large quantity of 'very good coral for sale'. That the illicit taking of live material is high is very evident by the depreciation of species since my last visit some ten years ago.
>
> Amongst trinkets on sale at the island were large stocks of 'turtles' made from Cowries of two or three species; I do not know the source of supply of these trinkets, but it is certain that it is very difficult to collect shells of the quality used, without the taking of live material.
>
> During a cruise to a neighbouring island, the suspicious behaviour of two craft near the edge of a reef, suggested poaching of coral and associated life, particularly when they quickly weighed anchor and steamed off, out of range.[222]

[221] In-letter, Dir., Qld. Tourist Services, Brisbane to US, Qld. Dept. of Mines and Immigration, Brisbane, 20 August 1954, RSI920/1 Item 8, General correspondence batches – Previous files, QSA.
[222] In-letter, Dir., QGTB, Brisbane to Sec., QDHM, Brisbane, 21 March 1955, RSI920/1 Item 9, General correspondence batches – General Tourist Bureau matters, QSA, p. 1.

As a result of this extensive over-collection and poaching of shells, the author concluded that 'we are certain that it has already had repercussions' on the health of the reef at Heron and North West reefs.[223]

In reply, the management of the Heron Island resort acknowledged the cumulative degradation occurring to shell populations. He stated:

> To a certain extent I agree with the submissions of the Secretary of the Club in regard to the gradual depreciations of coastal and marine life, which occurs to a small degree rather constantly, and which [are] a source of continual worry to us. [...] As you know, guests frequently endeavour to take with them a souvenir of their stay, and it is the cumulative effect of this over a period of time which is our major worry. It is possible that certain guests, who would be very few in number, endeavour to obtain material for trading, but I can stress most strongly that this is not countenanced by the Management, and in any cases occurring within our knowledge, we take all action possible to prevent it. The inclination of guests to obtain a souvenir is our principal reason for maintaining a supply of trinkets in the Canteen, but we would point out that the entire supply of items for this purpose is obtained from Cooktown and North Queensland.[224]

Further concerns were expressed to the Hon. E. M. Hanlon, Premier of Queensland, by the Honorary Secretary of the National Parks Association of Queensland, who acknowledged 'the gravity of the position regarding the Barrier Reef natural resources and wonders', including shell populations, since these resources were being 'stripped bare'; and despite the prohibition of shell collecting, the same author claimed that Mrs Cain, the wife of the Premier of Victoria, had stayed recently at a Great Barrier Reef resort and had brought back a 'marvellous collection of shells'.[225]

The most heavily impacted shell collecting locations were most likely the Heron Island, Wistari and Green Island reefs, despite their status as totally protected reefs, because these reefs were the ones most commonly visited by tourists. Subsequently, however, vulnerable areas also included other coral cays within easy reach of the main Queensland ports as regular shelling trips to locations such as Michaelmas and

[223] Dir., QGTB to Sec., QDHM, 21 March 1955, RSI920/1 Item 9, QSA, p. 1
[224] In-letter, Dir. to Sec., p. 2.
[225] In-letter, J. K. Jarrott, Hon. Sec., NP Association of Qld., Brisbane to the Hon. E. M. Hanlon, Premier of Qld., Brisbane, 3 October 1947, RSI920/1 Item 9, QSA, pp. 1-2.

Arlington reefs were organised by shell clubs and were widely advertised.[226] In addition, the depletion of shells was also concentrated in those areas that surrounded protected reefs, but which were easily accessible from the resorts. Julie Booth, who observed the impacts of shell-collectors at Fairfax Island in 1969, stated that visitors from the tourist resort at Lady Musgrave Island 'spend the day here, combing the reef for shells', because shell collecting was prohibited at the reef at Lady Musgrave Island; she reported that one party included more than twenty collectors, who arrived at Fairfax Island from Lady Musgrave Island in four aluminium dinghies.[227] These activities, even if sporadic, probably inflicted intensive damage during the shelling visits.

Despite its protected status, Green Island reef continued to suffer degradation from over-collecting. One report of 1958 stated that the reef 'is being stripped by unthinking day trippers and other visitors. At low tide they swarm on the reef with buckets and bags and cart away living coral and shells.'[228] No reduction in this activity was apparent by 1973, when another report stated: 'On a recent visit to Green Island I was appalled to see the number of people returning to the mainland with plastic bags full of coral and shells.'[229] The collection of shells for jewellery manufacture was described as follows:

> [Ron and Mary Rogan] were noted in many parts of the world for the distinctive hand-made jewellery they produced, all of it featuring shells of the Great Barrier Reef. At this time of year the yardman, Jolly McKay, spent some hours each day searching for shells, making a tour of the beaches as the tide went out for specimens washed up, then paddling the reefs in old sandshoes, turning over blocks of coral, thus exposing clusters of tiny living shell-fish […].'[230]

Further damage from shell collecting at Green Island, and at Michaelmas Cay, were reported in *The Cairns Post* in 1972. Damage also occurred to corals, as a result of shell collectors failing to replace overturned coral boulders; in particular, the 'intense

[226] H. S. Ladd, 'Preliminary report on conservation and controlled exploitation of the Great Barrier Reef', *Royal Commission on Great Barrier Reef Petroleum Drilling: transcript of proceedings*, Vol. 1, Government Printer, Brisbane, 1970, pp. 53-57, p. 56.
[227] In-letter, J. Booth, Fairfax Island to W. Wilkes, Sec., 30 September 1969, SRS5416/1 Box 10 Item 58, NP220, Bunker, QSA.
[228] Article, 'Hands off Green Island', *Courier-Mail*, 20 September 1958, found in SRS5416/1 Box 66 Item 447, NP836, Trinity 'R', QSA.
[229] Anne Taylor, Darlinghurst, New South Wales to Qld. Dir. of Forestry, Brisbane, 12 October 1973, SRS5416/1 Box 66 Item 447, NP836, Trinity 'R', QSA.
[230] M. Noonan, *Flying Doctor on the Great Barrier Reef*, Hodder and Stoughton, London, 1962, p. 105.

depredation by shell collectors' on fringing reefs to the north of Cairns was reported by Isobel Bennett to be so severe that very little living coral remained on the reefs.[231]

By 1974, degradation due to shell collecting had also been reported at Lizard Island. In that year, describing changes in the Lizard Island reefs, Roger Steene wrote:

> I have been a constant visitor to the Island and its adjacent reefs for the past 18 years and environmental changes seem to be ever increasing since the establishment of the aerodrome and the discovery of the island as a good anchorage and camping area.
>
> During my earlier visits, the *Mauritania* cowrie shell was abundant on the fringing reef on the east side of the island. As time went by and this knowledge became wide-spread, collectors and others took them until recently, I was not able to find a single specimen. I actually saw a group who had a box with 150 of these shells to sell. Two years ago, I counted 17 in a half day period.[232]

Also in 1974, Steve Domm, the Director of the Lizard Island Research Station, reported that a charter boat had been at Lizard Island for a week 'with much shell collecting going on, also a small clam had been killed and eaten, plus earlier someone removed a giant clam from the lagoon.'[233] In response to the increasing number of reefs depleted by commercial shell collectors, the Wildlife Preservation Society of Queensland requested increased protection of Lizard Island reefs and the other reefs in the vicinity of Cairns, especially Green Island reef and Michaelmas Reef; over-collection of shells was also reported at the fringing reef at Orpheus Island.[234]

Analysis of oral history evidence provided by shell collectors provides a more sympathetic view of their activities, although these informants nevertheless admitted that shell collecting has impacted upon coral reefs. One informant acknowledged that some shell species, due to their short larval stage or direct development, have declined in numbers as a result of degradation of their habitat; while this informant reported that she knew of no shell species that have become impossible to locate, she stated that the

[231] Article, 'Vandalism at Green Island?', *The Cairns Post*, 23 November 1972, found in NP836 Trinity 'A', Green Island, QSA; I. Bennett, 'Audio-visual: the Great Barrier Reef', Manuscripts, Box 6, Folder 18, Miscellaneous, 1967-1995, MS9348, Papers of Isobel Bennett, 1944-2000, NLA, pp. 12 and 23.
[232] R. Steene, Cairns to S. Domm, Dir., Museum Research Station, Lizard Island, 20 May 1974, SRS5416/1 Box 28 Item 179, NP153, Flattery 'A' – Lizard Island, QSA, pp. 1-2.
[233] In-letter, S. Domm, Resident Dir., Lizard Island Research Station to 'Alan', 3 August 1974, SRS5416/1 Box 28 Item 179, NP153, Flattery 'A' Lizard Island, QSA.
[234] In-letter, Joan M. Wright, President, Wildlife Preservation Society of Qld. Inc. to S. Domm, Resident Dir., Lizard Island Research Station, 22 July 1974, SRS5416/1 Box 28 Item 179, NP153, Flattery 'A' Lizard Island, QSA; Endean, *Australia's Great Barrier Reef*, p. 279.

occurrence of many shells is now highly variable.[235] However, the same informant argued that over-collection is not the only possible explanation for variability in shell populations; these variations may also be related to seasonal effects, breeding aggregations, high rainfall, water salinity, turbidity and growth of seaweed and seagrass. The same informant suggested that shell populations are characterised by geographical as well as temporal variability; for example, during extended periods of drought, she stated, shell collectors 'have located species along the coast that are more usually found on offshore reefs', which could be explained by higher salinity and water clarity due to reduced terrestrial run-off, although she argued that ecological analysis is required in order to test this hypothesis.[236]

Another informant described the impacts of shell collecting in the Capricorn-Bunker Group, based on the observations of long-term collectors – those with more than fifteen years' experience each – for the period 1998-2003; this period was compared by these observers with their earlier recollections of those reefs.[237] These shell collectors were described as 'serious collectors' who targeted particular specimens for personal collections; as a result, the informant claimed, 'the actual number of shells collected is minimal, compared to the number of shells observed in the habitats that were searched.'[238] The shell collectors in this region collected various species, including cowries, cones, volutes and bivalves, and collecting trips in the Capricorn-Bunker group lasted for periods of up to two weeks at a time. The informant stated that:

> Many years ago it was common to find remnants of fish-eating cones scattered over the reef, as a result of mollusc-eating fish feeding on the in-coming tide: also cowries and other shell species. Since these discussions started some five years ago, careful observation has shown a significant decrease in the amount of broken shell on the reef flat, with no noticeable decline in shell numbers; in fact, on some reefs, quite a significant increase in numbers has become apparent.[239]

Like the previous informant, this shell collector argued that not all impacts on shell populations can be attributed to shell collectors; he argued that the annual number of

[235] Collins, 'Recollections of the reef', p. 2.
[236] Collins, 'Recollections of the reef', p. 2.
[237] M. Ford, 'Shell populations in the Capricorn-Bunker group of the Great Barrier Reef', Unpublished report, November 2003, *Changes in the Great Barrier Reef since European Settlement*, Oral History Collection, School of TESAG, JCU, 3 pp.
[238] Ford, 'Shell populations', p. 1.
[239] Ford, 'Shell populations', p. 1.

shell-collectors visiting the Capricorn-Bunker group was less than fifty, and that the area of reef that could be searched during low tides by those collectors was very small: approximately 2-3% of the total area during a twelve-hour period.[240]

Although these shell collectors claimed that other factors may explain the variability of shell populations in the Great Barrier Reef, most of the evidence presented above indicates that extensive degradation has occurred both to shell populations and to some coral reefs as a result of shell collecting. The long time-period during which collecting has taken place in the Great Barrier Reef, the lack of protection of shells during the early period of European settlement in Queensland, the considerable difficulties in enforcing restrictions of shell collecting and the desire of the Queensland government to promote tourism in the Great Barrier Reef have resulted in impacts on shell populations that have been sustained for many decades. These impacts were concentrated around the major tourist resorts in the Cairns, Whitsunday and Capricorn-Bunker areas: especially at Green Island, Heron Island, Wistari Reef, Lady Musgrave Island and the Lizard Island reefs. To these recreational shell collecting impacts has been added the influence of the commercial shell trade, which also removed large quantities of shells. Therefore, the cumulative impact of shell collecting has depleted the locations mentioned above of their shells and may have resulted in ecological changes at these reefs.

### *5.6.2 Impacts on giant clams*

Giant clams, *Tridacna spp.* – in particular, *Tridacna gigas* – have attracted the attention of shell collectors since the early period of European settlement. In 1892, the existence of huge *Tridacna* shells in the Great Barrier Reef, 'four of them to a ton', was reported by Bartley.[241] The species attracted attention for its size and because of the danger it supposedly presented to swimmers; that perception was articulated in a report of 1935, describing the giant clam population at Low Isles, which also drew attention to the destruction of the species by visitors, stating that:

> At Clam Spit the latest count of the clams that had been rolled there, and that numbered 80 a year ago, now stands at 69. The majority of these animals are favourably situated so that few deaths should normally occur from now on. Unfortunately, visitors to the Island seeing these 'dangerous'

[240] Ford, Shell populations, p. 2.
[241] Bartley, *Opals and agates*, p. 218.

> animals have a tendency to slash them across, saying as they do, 'You'll never drown another person.' It is an extremely childish action, that results from the continued publishing of the childish story that once upon a time a person put his [*sic*] foot in a clam which closing on it held him prisoner until the tide came in and drowned him.[242]

Damage to giant clams was also reported in 1937 at the reef on the south-eastern side of Green Island, where visitors habitually took small clams away with them; furthermore, clams were killed by spearing, as the following account, by a NP Ranger, states: 'Fish spears have on occasions been thrust into clams, killing them.'[243] One example of this type of destruction was given by NP Ranger McKeown, who stated that 'some time ago a large clam was brought in from one of the outer reefs, and placed in shallow water for exhibition purposes; recently this clam was speared, and killed'; consequently, the NP Ranger argued that the collection of shells from Green Island should be prohibited.[244] Figure 5.27 illustrates this popular misconception about the danger of *Tridacna spp*.

Giant clams were removed from the reef – or were damaged *in situ* – for a variety of reasons besides popular fear of the danger they presented to swimmers. In 1930, Barrett acknowledged that the demand for unusual shell species – particularly the giant clams – was considerable, and he stated that the valves of *Tridacna gigas* were sought as garden ornaments and home aquaria.[245] An account by Ellis, in 1936, described the use of giant clams for food, at Raine Island, but also their exploitation as curios, stating that:

> A feature which impressed us considerably at Raine Island was the enormous number of giant clam-shells (*Tridacna gigas*) found in a shallow lagoon, perhaps four feet deep at low tide. […] An average pair of these enormous bivalves would weigh about three hundred-weight and measure about three feet in length; some indeed were considerably larger. [...] The fish of these *Tridacna* are enormous, but the only portion used by our Chinese labourers for food was the muscle connecting the two sides. It will convey some idea of the size of these gigantic mollusca if it is realized that this muscle usually weighs about five pounds [...]. The giant clams with their inner surface of pure white, like polished marble, are considerably sought after as curios. As garden ornaments they are quite a success, and when filled with water are beloved by the birds.[246]

[242] F. W. Moorhouse, 'Report of Field Investigator for quarter ended 30 June 1935', *Reports of the GBRC*, No. 6, Government Printer, Brisbane, 1935, p. 2.
[243] In-letter, E. McKeown, NP Ranger, Tully to Sec., Brisbane, 10 April 1937, SRS5416/1 Box 66 Item 448, NP836, Trinity 'R', QSA.
[244] In-letter, E. McKeown, NP Ranger, Tully to Sec., Brisbane, 19 January 1938, SRS5416/1 Box 66 Item 448, NP836, Trinity 'R', QSA.
[245] Barrett, 'Great Barrier Reef', pp. 378 and 380.
[246] Ellis, *Adventuring in coral seas*, pp. 83-84.


*Figure 5.27.* A popular misconception about the danger of giant clams (*Tridacna spp.*), 1966.
*Source:* J. Thomson, *The Great Barrier Reef*, Nelson Doubleday, Crow's Nest, New South Wales, 1966, p. 38.

An example of the ornamental use of giant clam shells, at Orpheus Island in 1967, is shown in Figure 5.28.

Extensive damage to giant clams in the Great Barrier Reef occurred as a result of the activities of poachers: particularly from Taiwan, China and Korea. One report stated:

> The clam fishery is exploited by Nationalist Chinese and Korean fishermen, and the semi-dried clam meat produced commands an excellent price in the Orient. The adductor muscle is cut from the clams and dried aboard the fishing vessels. The operators generally work in knee-deep water at low tide and, although they leave the clam shells where they are, they damage a large amount of coral wading to them.[247]

The main period during which the poaching of *Tridacna gigas* took place – after 1970 – falls outside the scope of my research and the details of that activity are not given here. Nevertheless, the evidence presented above suggests that giant clam numbers had already declined since European settlement; furthermore, due to the slow growth rates of these organisms, the overall increased mortality of giant clams caused by tourists, clam fishers and poachers is likely to have been unsustainable.

However, the effects of tourists, clam fishers and poachers did not represent the only impacts on giant clams. Despite official protection of many marine species, the Commonwealth Government arranged in 1966 for the removal of giant clams from the Great Barrier Reef; these specimens probably formed part of the coral reef display in the 1967 Exposition at Montreal. One report stated that:

> In April, 1966, a clam-collecting party working from and with the assistance of the 'Cape Moreton' (Commonwealth Department of Shipping and Transport) obtained six unusually large specimens of giant clams for incorporation in the [coral reef] display.[248]

The removal of six unusually large giant clams from the Great Barrier Reef at the request of the Commonwealth Government as recently as 1966 suggests that limited conservation of this organism was encouraged, even by Commonwealth Government officials, before the creation of the GBRMP in 1975.

[247] S. Domm, 'Corals of the Great Barrier Reef', *Royal Commission on Great Barrier Reef Petroleum Drilling: transcript of proceedings*, Vol. 1, Government Printer, Brisbane, 1970, pp. 44-46, p. 44.
[248] A. J. Peel, AR, QDHM, *QPP*, Vol. 2, 1966, pp. 841-857, p. 852.


*Figure 5.28*. Giant clam shells used as ornaments at Orpheus Island, 1967.
*Source:* SRS189/1 Box 17 Item 73, QSA.

## 5.7 Other changes in coral reefs

This section presents evidence of various other, physical impacts on coral reefs of the Great Barrier Reef that have occurred since European settlement: dynamiting of coral reefs for fish, clearing of channels and tracks in coral reefs, military impacts, and impacts of reef-walking, which are discussed in turn. All of these activities took place before the formation of the GBRMP and some – for example, dynamiting for fish – were prevalent as early as 1913. Some of the activities mentioned below – such as military impacts and the clearing of access channels and tracks – had intensive, local impacts on coral reefs; the evidence suggests that others, including dynamiting for fish, were widespread in the Great Barrier Reef before protective legislation was introduced. Therefore, the activities presented in this section represent a diverse group of impacts that varied in their geographical distribution and intensity. The evidence presented below indicates that the coral reefs at Green, Heron, Lady Musgrave and East Fairfax Islands, and North Reef, have been significantly modified by human activities, and that many other reefs – especially nearshore reefs near Cairns, Innisfail and Cape Tribulation – have also experienced some degradation.

### *5.7.1 Dynamiting of coral reefs for fish*

Although the dynamiting of coral reefs for fish is an issue that has been overlooked in some recent accounts of human use of the Great Barrier Reef, documentary and oral history evidence indicates that the practice was once prevalent in Queensland coastal waters and reefs.[249] In 1913, the Queensland Treasury Departmental Committee investigated the Queensland fisheries; the Committee commented that, at almost every port, 'complaints were made that dynamite is freely used for taking fish', and stated that:

> The use of explosives for the purpose of obtaining fish in the inland waters has, it is stated, been most freely adopted in the waters in the neighbourhood of any large construction works which have been carried out, and to this abuse the residents attribute the scarcity of fish owing to the destruction of so much of the 'small fry.'[250]

[249] For example, dynamiting for fish is not discussed in Lawrence *et al*., *Great Barrier Reef*.
[250] E. J. Boult *et al.*, 'Report of the Treasury Departmental Committee upon the fisheries industry of the State of Queensland (other than pearl-shell) and Appendices', *QPP*, Vol. 3, 1913, pp. 1037-1056, pp. 1041 and 1052.

In an attempt to control the problem of dynamiting, prosecutions for the illegal use of explosives for taking fish were made in 1925, in the Brisbane and Maryborough districts, and large fines were issued. Describing these measures, the Director of the Queensland Marine Department stated: 'It is hoped these will have a salutary effect on persons disposed to this method of destroying fish, which is most wasteful to fish life and dangerous to the user'; numerous prosecutions for the use of explosives for fishing were reported in Queensland during the period 1925-1970.[251]

However, preventing the use of dynamite by fishers was not easy. In 1931, J. D. W. Dick, the Acting CIF, reporting a prosecution for the use of explosives, stated that:

> This nefarious practice is particularly destructive of young fish, and is most difficult to detect, as the offender can carry the necessary equipment in his pocket, and usually selects some infrequented locality in which to carry out his purpose. In the case referred to the offence was detected by the Police in the Innisfail district.[252]

By 1933, despite regulations and publicity aimed at preventing the use of explosives, the practice had not ceased; J. Wyer, the Honorary Secretary of the NQNC, stated that 'dynamiting on the reef is as prevalent as ever': a fact he attributed to inertia on the part of those who were responsible for enforcing the legislation; and as a result of dynamiting for fish, Wyer stated: 'The amount of damage in the aggregate is enormous and every effort should be made to bring the offenders to book.'[253] In 1937, the Honorary Inspector of Fisheries at Green Island acknowledged similar problems at Green Island, where it proved difficult to control 'this popular fishing ground'; this observer stated: 'Dynamiting of fish in the past has been prevalent along the reef, and from Fitzroy Island and Oyster Cay a distance of 20 miles should be visited at least once weekly by an Inspector of Fisheries.'[254] In addition to these documentary sources, two oral history informants recalled instances of people fishing using dynamite in the Cairns area, although one indicated that the practice became less common after the

[251] V. Forrester, AR, Qld. Marine Dept., *QPP*, Vol. 3, 1925, pp. 291-300, p. 295; AR, QDHM, *QPP*, 1925-1970, *passim.*
[252] J. D. W. Dick, 'Report of the Acting CIF', *QPP*, Vol. 2, 1931, pp. 5-6, p. 6.
[253] In-letter, J. Wyer, Hon. Sec., NQNC to Hon. Sec., GBRC, 20 September 1933, PRV8340/1 Item 1, QSA.
[254] In-letter, M. T. Keating, Hon. Insp. of Fisheries, Green Island to CIF, Brisbane, 21 November 1937, PRV8340/1 Item 1, QSA.

Second World War.[255] By that date, however, dynamiting for fish had taken place in Queensland coastal waters and reefs for more than three decades.

### *5.7.2 Clearing of channels and tracks in coral reefs*

Some instances of damage to the corals of the Great Barrier Reef as a result of the creation of channels and tracks have been recorded, including descriptions of the access tracks cleared to allow the servicing of lighthouses, the channel created at Lady Musgrave Island, and the large boating channel and harbour formed at Heron Island. The latter of these tracks and channels comprises the largest of these channels; it is also the example for which most documentary and oral history evidence exists. An early attempt to improve access to Heron Island for boats took place in the early 1960s, when explosives were used to breach the outer rim of the reef on the south-western side of the western tip of the cay, close to the wreck of the *Sydney*.[256] Then, in 1965, Queensland Airlines proposed a Sandringham flying-boat service to Heron Island and applied for permission to build a sea-plane landing strip in the Heron Island lagoon. The creation of the landing strip required the removal of around thirty-five coral bommies from the proposed landing area.[257] The Director of the QDHM, A. J. Peel, wrote to the Queensland Treasury, stating that there would be no objection to the removal of the bommies in the lagoon 'provided that any necessary blasting is kept to a minimum and small charges are used.'[258]

Subsequently, between October 1966 and October 1967, the channel and harbour at Heron Island were dredged to allow easier access for boats across the reef to the cay. The dredge spoil was used to create a bank around the boat channel in an attempt to prevent sediments washing into the depression; spoil was also deposited as a spit on the south-western side of the island.[259] The channel altered the appearance of the Heron Island reef, which was photographed by Isobel Bennett before and after the creation of

[255] Dynamiting for fish is described in OHC 17, 2 September 2003, pp. 4-5.
[256] Report Ref. 70/4028 G.D.Q., D. A. Robinson, 'Heron Island erosion', 20 August 1970, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA, p. 2.
[257] In-letter, Hon. John Herbert, Min. for Labour and Industry, Brisbane to Hon. H. Richter, Min. for Local Government and Conservation, 13 September 1965, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA.
[258] In-letter Ref. 19.102. A. J. Peel, Dir., QDHM, Brisbane to Under-Treasurer, Qld. Treasury, Brisbane, 22 November 1965, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA.
[259] Report Ref. 70/4028 G.D.Q., Robinson, 'Heron Island erosion', p. 2.

the channel, and two of her photographs are shown in Figure 5.29 (a) and (b). Following the creation of the channel, concern was expressed about rapid erosion as a result of changing sediment flows over the Heron Island reef. Erosion was reported at the western end of the Island from 1960-1966: the period since the initial breach in the outer rim of the reef was made.

However, the full impacts of the channel were not immediately discernable, as a report about the impacts of the creation of the boat channel, written by Patricia Mather in 1971, stated:

> The effects of the most recent activity – the cutting of a channel through the reef crest at the south-west end of the cay and the excavation of a harbour with half-tide walls cannot yet be evaluated. But build up of sand along the southern side of the cay – where it was previously being lost – and loss of sand around the north-west and western parts appears to be taking place rapidly as a result of the change in flow characteristics past the island and over the reef, caused by the presence of this deep channel through the reef.[260]

Nevertheless, a significant area of the coral reef was affected by the construction of the channel. Another report, in 1970, claimed that 'virtually no recolonisation' of corals had occurred since the creation of the channel.[261] In addition to these reports, many oral history informants observed changes at Heron Island reef associated with the dredging of the boat channel, especially changes in sedimentation in the channel and in the surrounding portions of the reef flat.[262] One stated that near the channel, adjacent to the island, 'the entire top of that reef dropped probably in the order of four centimetres […] because of the speed of draining of the lagoon that used to occur at that end.'[263]

Other channels and tracks were created in reefs besides the channel at Heron Island. Another boat channel was cut through the reef at Lady Musgrave Island; at that reef, a report by Steers during a geographical expedition to the Great Barrier Reef stated:

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[260] P. Mather, Hon. Sec., GBRC, 'Statement on the possible effect following construction of a landing strip on Heron Island (Statement compiled by the GBRC)', 22 July 1971, SRS5416/1 Box 10 Item 60, NP 268, Bunker, QSA, p. 5.
[261] Royal Commission into Exploratory and Production Drilling for Petroleum in the Area of the Great Barrier Reef, *Report of the Royal Commission*, Vol. 2, AGPS, Canberra, 1974, p. 724.
[262] Examples include OHC 4, 14 January 2003, pp. 1-2; OHC 9, 28 February 2003, p. 4; OHC 11, 1 July 2003, p. 2; OHC 30, 3 October 2003, pp. 2-3; OHC 44, 4 December 2003, p. 3.
[263] OHC 9, 28 February 2003, p. 4.

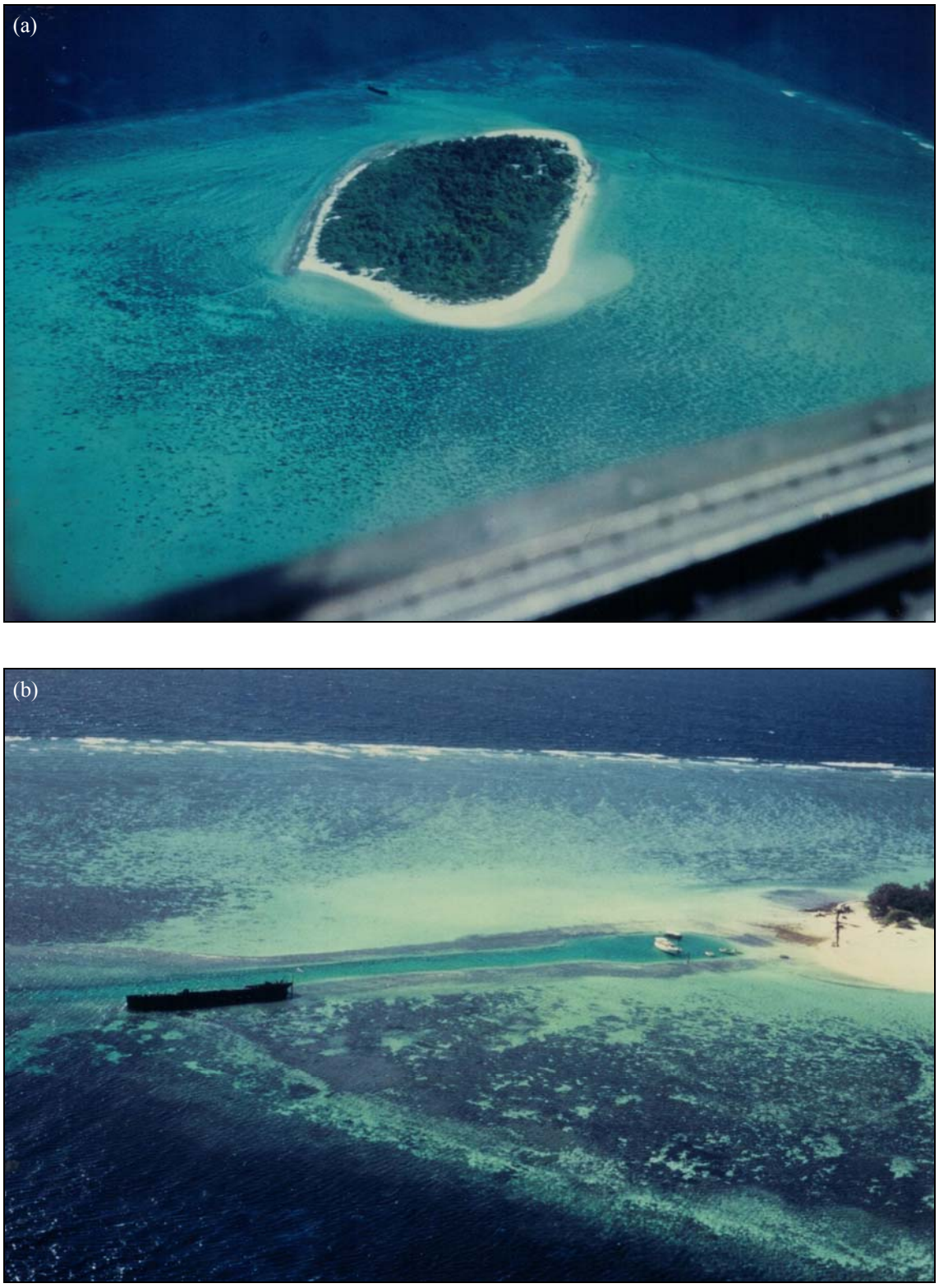


*Figure 5.29*. (a) The Heron Island reef before the construction of the boat channel, 1948; (b) The Heron Island reef after the construction of the boat channel, August 1971.

*Source*: Photographs taken by Isobel Bennett, used with permission.

> There is a narrow passage through the reef which is said to have been made by Japanese fishermen. I have no definite information on this matter, the passage is certainly narrow, and as far as appearances are concerned could have been formed in this way. As it is the only clear gap through the reef, and contains reasonably deep water, it is not easy to explain it on purely natural grounds.[264]

A survey undertaken in 1966 recorded the position and dimensions of the boat channel at Lady Musgrave Island reef: the channel was located to the north-west of the cay, and was 100 feet long, 66 feet wide and 20 feet deep, as Figure 5.30 demonstrates.

Another access track was created at North Reef, in around 1960, to allow the lighthouse supply vehicle – an amphibious 'DUKW' – to transport stores from the *Cape Moreton* supply vessel to the lighthouse. An entry in the *Sailing Directions* used by the Captain of the *Cape Moreton*, made on 13 May 1960, stated: 'Narrow gap in live coral to be blasted to width suitable for [low water] DUKW landing.'[265] The track was created at the edge of reef flat, on the north-western side of the island, as Figure 5.31 illustrates. Many other reefs were traversed by the amphibious vehicles used by the lighthouse supply service, and the *Sailing Directions* describe the difficulty in negotiating some reefs in the vehicles as a result of isolated coral outcrops and coverings of live soft corals, which presumably were damaged in the process.[266]

### *5.7.3 Military impacts in the Great Barrier Reef, 1940-1960s*

Some documentary and oral evidence suggests that some coral reefs have been damaged by military activities: especially the reef areas that were used for bombing practice. The impact of military activities was greatest around the time of the Second World War, when mine-laying took place in the Great Barrier Reef, and in the two decades afterwards, when several islands and reefs were used for military target practice. In 1940, the threat of Japanese invasion from the Coral Sea prompted the Australian Navy to lay mines in each major shipping passage through the Great Barrier Reef; the No. 11 Catalina squadron, based at Cairns, was responsible for long-range mine-laying operations in the Great Barrier Reef. The impact of the mines used in the Second World

[264] Steers, 'Detailed notes', p. 56.
[265] H. G. Chesterman, *Sailing directions, Lightship Cape Moreton from South Island (Burnett River) to Torres Strait: including Coral Sea lights and weather stations, and the Great North East Channel*, Queensland Museum, Brisbane, 1973, no pagination.
[266] Chesterman, *Sailing directions*, *passim.*


*Figure 5.30.* The boat channel created at Lady Musgrave Island reef, 1966. The North symbol, 'N', has been added to the North arrow for clarity.
*Source:* Ref. 66/16656A, 2 November 1966, SRS5416/1 Box 9 Item 57, NP224, Bunker – Lady Musgrave Island, QSA.

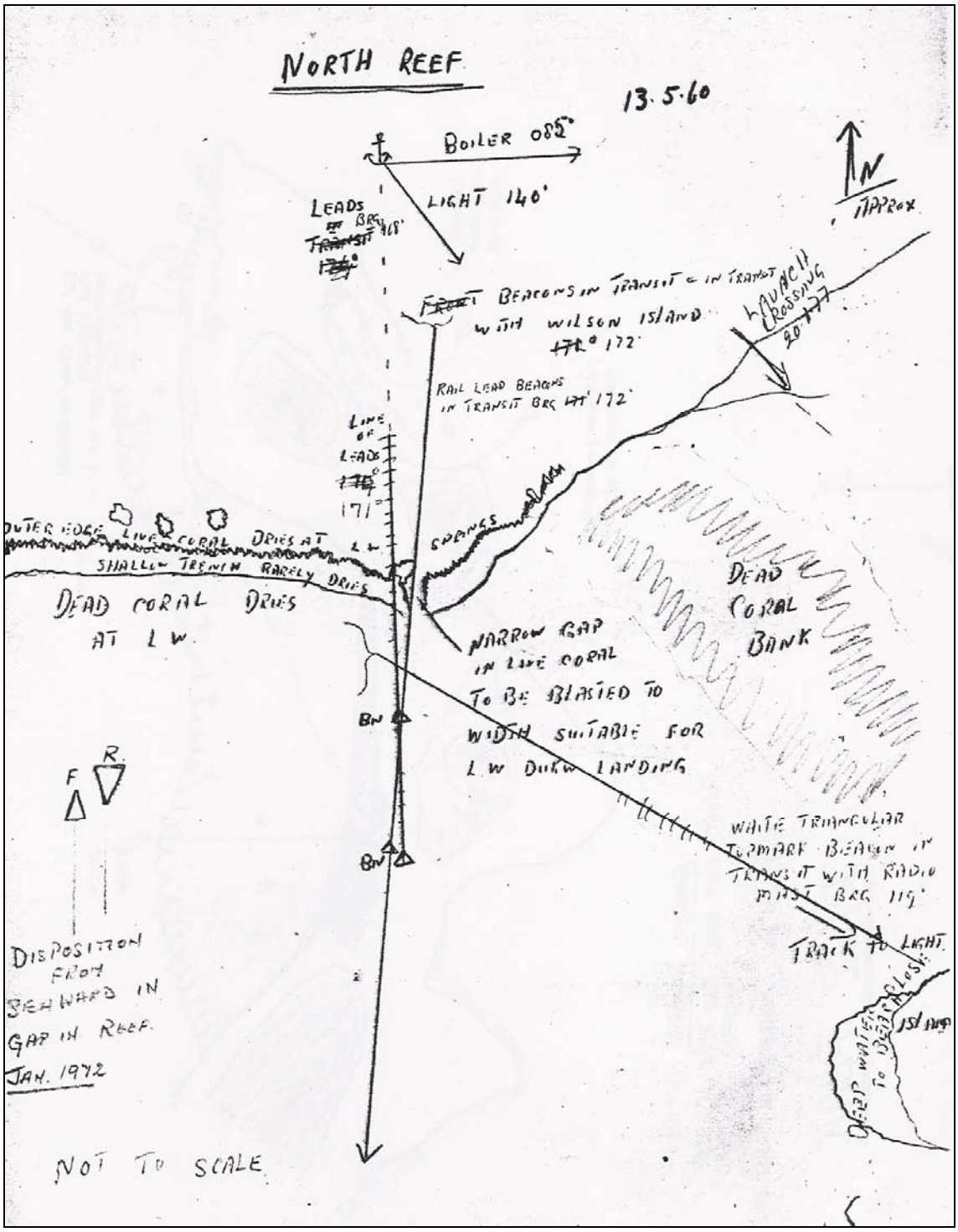


*Figure 5.31.* The access track to be created for the lighthouse supply vessel at North Reef, 1960.
*Source:* H. G. Chesterman, *Sailing directions, Lightship Cape Moreton from South Island (Burnett River) to Torres Strait: including Coral Sea lights and weather stations, and the Great North East Channel*, Queensland Museum, Brisbane, 1973, no pagination.

War lasted beyond the duration of that conflict; Lurie described the finding of an unexploded bomb in the 1960s at Michaelmas Cay, where a controlled detonation of the bomb was carried out by the Australian Navy.[267] Several oral history informants recalled the mine-laying taking place and the occasional explosions of mines that drifted onto coral reefs; one informant thought that an explosion of a Second World War mine, located by the Australian Navy, might have taken place at Mackay Reef, and another I recalled the sinking of the *Warrnambool* in Princess Charlotte Bay while attempting to retrieve mines after 1945.[268]

One oral history informant described the explosion of a mine at Green Island, in around 1946, in the following terms:

> the remnants of World War Two […] were visible everywhere. Mines: the big brown balls with all the spikes poking out of them? Some were sunk on the edge of the reefs, some were on top of the reefs, some were washed offshore on sand cays and even one, in about 1946, drifted up one night on the south-eastern side of Green Island on a high tide. It hit the rocks and exploded. […] There was a building there that they called the kiosk: it blew the front off this.[269]

The same informant reported that the mines sometimes escaped from the chains that held them in place in the shipping lanes; he argued that the mines 'would have damaged the reef […] pretty severely, because they were big bombs.' However, in addition to mine-laying, the Catalina aircraft also took part in target practice, during the Second World War, at the reef at Upolu Cay; one informant reported that, after the bombing of the reef, 'there was shrapnel all around the place.'

Few details of military activities were found in documentary sources; for example, although Cid Harbour, at Hayman Island, was used as a submarine base during the Second World War, no descriptions of the impacts of the base were located. However, some evidence of the effects of bombing practice in the Great Barrier Reef after the

[267] N. Bartlett, 'By air to the Reef', *South West Pacific*, New Series No. 18, 1940, pp. 6-9, p. 7; R. Lurie, *Under the Great Barrier Reef*, Jarrolds, London, 1966, pp. 79, 81; see also D. Baglin and B. Mullins, *Australia's Great Barrier Reef: wonderland of coral cays and rocky isles, fantastic marine life and tropical vegetation*, Horwitz Publications Inc, North Sydney, 1969, p. 32.
[268] OHC 22, 12 September 2003, pp. 2-3; OHC 28, 19 September 2003, p. 13; Collins, 'Recollections of the reef', p. 2.
[269] OHC 22, 12 September 2003, p. 2.

Second World War exists, because some observers visited the target sites afterwards and reported on the damage inflicted there. In 1952, the CIF stated that:

> A trip to Lady Musgrave Island to collect specimens of fish and coral revealed that this reef is now practically a marine desert, which, in all possibility, is attributable to the fact that the area was used as a practice bombing target during the war.[270]

In addition to the extensive damage at Lady Musgrave reef, further destruction took place at East Fairfax Island, which was also used as a bombing range. For East Fairfax Island, other details about the destruction of corals were not found, but the damage to corals – as at Lady Musgrave Island – was probably severe, as Hopley acknowledged.[271]

### *5.7.4 Impacts of reef-walking*

Some coral reefs have been used for reef-walking by tourists; this activity is not merely a recent phenomenon, as S. F. Denton, in an account written in 1889, stated:

> we spent hours wandering over [the coral reefs] at low tide. They extended partly round the island, and were a constant pleasure and delight to us. It seemed a shame to walk over the reefs, breaking at every step lovely corals, which would be the pride of our museums. Some of the branching corals, radiating from a centre, and as large over as a round table, were very graceful. […] In places, the reef was covered […] with soft corals – or 'sea flesh,' as it is called – resembling thick, wet leather, and very smooth and slippery to walk upon.'[272]

Another account, accompanying a photographic study of the Great Barrier Reef in 1928, referred to the 'deep indigo of *Heliopera* coral as the foot snaps it'.[273] Almost certainly, many visitors to the Great Barrier Reef went reef-walking, and in 1932 the QGTB issued the following advice to reef-walkers: 'Old boots should be carried for use when walking in the lagoon, also boots to protect the feet and ankles from coral scratches.'[274]

[270] E. J. Coulter, AR, CIF, *QPP*, Vol. 1, Part 2, 1952, pp. 1009-1012, p. 1011.
[271] Hopley, *Geomorphology*, p. 341.
[272] Denton, *Incidents of a collector's rambles*, p. 171.
[273] Bedford, *Great Barrier Reef*, no pagination.
[274] QGTB (Queensland Government Tourist Bureau), *Heron Island, Capricorn Group, Great Barrier Reef, Queensland*, QGTB, Brisbane, 1932.

However, while damage was inflicted on the corals by reef-walking, the individuals who visited the reefs provided some of the only reef descriptions for the period before underwater observations using snorkels and SCUBA equipment were possible. For example, an account of dead and living corals at Cape Tribulation reefs, written by Joske in 1930, was based on his experiences of reef-walking.[275] Hence, a quandary existed in relation to the value of reef-walking: the activity damaged corals, yet also allowed some individuals to gain knowledge about the nature and diversity of coral reefs, and reef-walking became a popular activity that appealed to naturalists, scientists, 'beachcombers', and coral and shell collectors. Geographically, however, the impacts of reef-walking were concentrated at the major tourist resorts, especially Green and Heron Islands; from those cays, visitors could easily access large expanses of coral reef. As early as 1938, one report stated: 'Parties of sightseers are frequently guided over the Green Island reef at low water', and a similar intensity of use of the reef flat, by reef-walkers, was observed at Heron Island.[276]

After the formation of the GBRMP in 1975, the threat presented by reef-walkers to the most popular coral reefs was acknowledged; a report about the degradation of corals at Green Island, published in 1978, stated: 'Under certain conditions reef walking can be very destructive. The greatest damage occurs in very fragile habitats but can also be significant where the concentration of reef walkers is very high.'[277] A submission by the Queensland Conservation Council, also in 1978, argued the need to 'disperse areas of reef walking' in order to minimise the damage occurring at the major tourist centres, especially Green and Heron Islands.[278] As the impacts of reef-walkers were concentrated spatially and temporally, one report about Green Island stated that:

> restrictions should be placed on people walking on the reef at low tide. Numbers are large when low tides coincide with the times of day visits during peak periods, and damage caused simply by walking on the reef must be significant.[279]

[275] H. D. A. Joske, *A life to live*, Popular Publications, South Melbourne, 1930, p. 180.
[276] Ratcliffe, *Flying fox and drifting sand*, p. 139; In-letter, E. McKeown, NP Ranger, Tully to Sec., 4 October 1938, SRS5416/1 Box 66 Item 447, NP836, Trinity 'R' – Green Island, QSA; J. Gunn, *Barrier Reef by trimaran*, Collins, London, 1966, p. 109.
[277] G. Goeden, *Green Island Management Plan: submission on marine resources*, Qld. Fisheries Service, Brisbane, 1978, SRS5416/1 Box 63 Item 431, NP836, Trinity 'B' Transfer Batch 1, QSA, p. 12.
[278] Queensland Conservation Council, 'Submission to the QNPWS on the Green Island Management Plan', 1978, SRS5416/1 Box 63 Item 431, NP836, Trinity 'B' Transfer Batch 1, QSA, p. 4.
[279] In-letter, N. H. Traves, Indooroopilly to Dir., QNPWS, 31 July 1978, SRS5416/1 Box 63 Item 431, NP836, Trinity 'B' Transfer Batch 1, QSA, p. 1.

Although more recent impacts of reef-walking lie outside the scope of my research, the evidence presented briefly above suggests that reef-walking, like many other activities in the Great Barrier Reef, pre-dates the creation of the GBRMP by many decades and has caused significant concern to be expressed about degradation of coral reefs.

## 5.8 Conclusion

This chapter contains descriptions of many anthropogenic impacts on the coral reefs of the Great Barrier Reef, based on documentary and oral history evidence, and demonstrates that many coral reefs have been modified by a variety of human activities: early European reef fisheries, coral mining, coral collecting, shell collecting, and various other physical impacts. These impacts have been sustained – in some cases – for more than a century before the formation of the GBRMP, with the result that many reefs were far from pristine at the time of their earliest protection. Furthermore, as the context provided in Section 5.2 has shown, many of these impacts occurred in coral reefs that were already vulnerable to degradation for geomorphological reasons; as a result of the cumulative impacts of human activities, some reefs probably now exist in a significantly modified condition, compared with the period before European settlement, and the implications of changes in coral reefs for management are discussed in Section 8.3.

A summary of the main changes is provided in Table 5.6, although this does not represent a comprehensive description of changes in the coral reefs of the Great Barrier Reef, for several reasons. First, Table 5.6 lists pre-1960 changes only, since that forms the period with which my research is primarily concerned; later impacts on coral reefs – such as the commercial coral collecting industry and the creation of the access channel and track at Heron Island and North Reef – are not included, though they form part of the material discussed above. Second, Table 5.6 includes only those changes for which documentary and oral history evidence exists; other changes, such as of dynamiting for fish, and military impacts, are illuminated by scarce information and cannot be reconstructed in detail. For these activities, only a selection of locations is shown in the illustrations, although their historical extent must have been far greater. Third, Table 5.6 does not include macro-scale, gradual changes that have occurred during the period

since European settlement, such as variations in water quality, yet which may have impacted significantly on coral reefs. Such changes cannot easily be reconstructed using

| ***Location*** | ***Period*** | ***Impacts*** |
|---|---|---|
| Raine Island reef | By 1936 | Destruction of giant clams |
| Cape Tribulation reefs | 1860-1960 | Significant degradation due to sedimentation |
| Snapper Island reef | *c.*1900-1930 | Extensive coral mining |
| Low Isles reef | 1935 | Destruction of giant clams |
| Alexandra Reef | 1860-1960<br>1929 | Severe degradation due to sedimentation;<br>Extensive coral mining |
| Oyster Cay reef | 1922-1934 | Coral mining |
| Upolu Cay reef | 1922-1933<br>*c.*1945 | Extensive coral mining;<br>Military bombing target practice |
| Double Island reef | *c.*1930 | Extensive coral collecting |
| Green Island reef | 1922<br>1929-1960<br>1937<br>1937 | Coral mining;<br>Extensive coral and shell collecting;<br>Destruction of giant clams;<br>Dynamiting for fish |
| Sudbury Cay reef | 1930-1935 | Coral mining |
| Frankland Islands reefs | 1940 | Coral collecting |
| Jessie Island reef | 1928-1938 | Extensive coral mining |
| Hutchinson Island reef | 1928-1938 | Extensive coral mining |
| Innisfail area reefs | 1931 | Dynamiting for fish |
| Kings Reef | 1918-1938 | Extensive coral mining using explosives |
| Beaver Cay reef | 1930-1935 | Coral mining |
| Goold Island reef | 1860-1960 | Severe degradation due to sedimentation |
| Sand Cay Island reef | 1930-1935 | Coral mining |
| Palm Island reefs | 1860-1960 | Significant degradation due to sedimentation |
| Halifax Bay reefs | 1860-1960 | Significant degradation due to sedimentation |
| Middle Island reef | 1860-1960 | Significant degradation due to sedimentation |
| Holbourne Island reef | 1860-1960<br>1918 | Moderate degradation due to sedimentation;<br>Severe tropical cyclone damage |
| Stone Island reef | 1860-1960<br>1918<br>1934 | Severe degradation due to sedimentation;<br>Severe tropical cyclone damage;<br>Coral collecting |
| Hayman Island reef | 1930-1960 | Extensive coral collecting |
| Molle Island reefs | 1937 | Coral and shell collecting |
| Whitsunday Island reefs | 1934 | Coral collecting |
| Hamilton Island reefs | 1935 | Coral collecting |
| Sandpiper Island reef | 1930-1935 | Coral mining |
| Cumberland Islands reefs | 1934 | Coral collecting |
| Northumberland Isles reefs | 1934 | Coral collecting |
| Percy Isles reefs | 1934 | Coral collecting |
| North-West Island reef | 1934-1960 | Extensive coral and shell collecting |
| Heron Island reef | 1930-1960 | Extensive coral and shell collecting |
| Wistari Reef | 1955 | Coral collecting |
| One Tree Island reef | 1955 | Coral collecting |
| Masthead Island reef | 1900-1960 | Coral collecting |
| Hoskyn Islands reefs | 1940 | Coral collecting |
| Fairfax Islands reefs | 1940<br>*c.*1945 | Coral collecting;<br>Military bombing target practice |
| Lady Musgrave Island reef | 1934<br>By 1938<br>*c.*1945 | Extensive coral collecting;<br>Creation of access channel;<br>Military bombing target practice |

*Table 5.6.* Summary of major changes in coral reefs described in this chapter.

archival and oral history data; the implications of this fact for environmental management are discussed in Chapter 8.

Nonetheless, Table 5.6 shows that many changes have occurred in the Great Barrier Reef during the period 1860-1960. Figure 5.32 illustrates the distribution of major changes in coral reefs, which have occurred at nearshore reefs in three main areas: the Cairns, Whitsunday and Capricorn-Bunker areas. This distribution is explained by the accessibility of coral reefs in these three areas, in contrast to the greater difficulty in reaching the Swains Reefs, which lie further offshore, or the reefs to the north of Cooktown, which are further from coastal centres of European settlement. Table 5.6 also provides details of coral reefs that have experienced changes, indicating that other areas also experienced impacts – including coral reefs in the Palm Island, Townsville and Mackay areas – though the evidence that has been presented in this chapter suggests that those impacts were less pronounced than in the Cairns, Whitsunday and Capricorn-Bunker areas. The narrative presented in this chapter, therefore, has been one of prolonged, cumulative impacts on coral reefs that have occurred in the vicinity of the main European settlements in coastal Queensland; those impacts have varied in their intensity and duration, but nonetheless probably caused significant transformations of parts of some coral reefs.