7. CHANGES IN MARINE WILDLIFE

Some species of marine wildlife in the Great Barrier Reef – especially dugongs and several species of marine turtle – have been exploited by commercial fisheries since European settlement; those animals have also been subjected to a variety of other impacts, such as the use of green turtles for turtle-riding by tourists, and Indigenous hunting. This chapter presents a narrative of changes in dugong and marine turtles, focusing particularly on the impacts of the European commercial fisheries – based on dugongs and turtles – that operated since the mid-1800s until 1969, although certain other impacts are also considered: the supply of dugong oil to Aboriginal settlements from 1940-1970, Indigenous hunting of dugongs and turtles, turtle-riding, and the farming of turtles in Torres Strait from 1970-1979. Although the latter activity lies beyond the main period considered in my research (1860-1970), turtle farming is included in this account because of the extent of the manipulation of turtles that resulted from that activity, and also because a rare opportunity to consult restricted archival files about turtle farming was presented during my research at the QSA. Overall, I argue in this chapter that these activities have resulted in a significant reduction in the numbers of dugongs and turtles in the Great Barrier Reef. In addition to the accounts of changes in those animals, this chapter also includes brief accounts of some impacts on humpback whales, sharks and some fish.

7. CHANGES IN MARINE WILDLIFE

7.1 Introduction

Since European settlement in Queensland, various human activities have exploited the marine wildlife of the Great Barrier Reef, especially the dugong (*Dugong dugon*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and humpback whale (*Megaptera novaeanglia*) populations of the east Australian coastal waters. Those animal populations are not confined in their geographical range to the Great Barrier Reef; instead, at least some individuals of several species migrate beyond its boundaries in some cases at least as far as Torres Strait, to the north of the GBRWHA, and Moreton Bay, to the south, although individuals of some species such as sea turtles and humpback whales travel still greater distances.[1] Therefore, the marine wildlife species considered in this chapter are not confined to the GBRWHA yet they comprise an important part of the Great Barrier Reef ecosystem.[2] Furthermore, the Great Barrier Reef represents a critical habitat for some species, providing feeding grounds, breeding areas and refuges; therefore, the east Australian dugong, turtle and whale populations and the habitats of the Great Barrier Reef are interdependent. Significant changes have occurred in these populations since European settlement commenced in Queensland; hence those species were considered in my study of changes in the Great Barrier Reef since European settlement.

This chapter focuses on some substantial changes that have occurred in dugong and marine turtle populations, since those animals have particular associations with specific habitats within the Great Barrier Reef and the industries that exploited dugongs and turtles were also located in the Great Barrier Reef. Evidence of the operation of those industries was found in the QSA, in archival records of the QDHM – including restricted files that were consulted with the permission of the Queensland State Archivist – and in the Annual Reports of the QDHM, and various reports of Queensland

[1] The ranges of dugongs and marine turtles in Australia, for example, have been documented by H. Marsh *et al.*, 'Conserving marine mammals in Australia and Oceania', in C. Moritz and J. Kikkawa (eds), *Conservation biology in Australia and Oceania*, Surrey Beatty and Sons, Chipping Norton, 1993, pp. 225-244.

[2] Populations of dugongs, and of green and loggerhead (*Caretta caretta*) turtles, were listed as part of the nomination of the World Heritage values of the Great Barrier Reef; see Lucas *et al.*, *Outstanding universal value*, p. 34.

Inspectors of Fisheries. These documentary sources have been supplemented with oral history material provided by key informants who have observed changes in dugong and turtle populations; their accounts suggest that impacts have been sustained by these animals due to over-fishing, other destructive practices by fishers and by tourist operators, turtle farming in Torres Strait, and Indigenous hunting. In this chapter, the narratives of changes in dugong and turtle populations are followed by brief accounts of some impacts on whales, sharks and some fish.

7.2 Impacts on dugongs

The dugong (*Dugong dugon*), a herbivorous marine mammal that occurs in, but is not restricted to, the GBRWHA, is listed as vulnerable to extinction by the World Conservation Union (IUCN), as Marsh *et al.* have acknowledged. Since the animal is long-lived and slow-reproducing, with considerable investment in each dugong calf, the species is vulnerable to over-exploitation by humans, and Marsh *et al*. have described many factors that threaten the size of dugong populations, including habitat loss, disease, and drowning in nets.[3] As a result of the life-history of the dugong, such impacts – in combination with the dependence of the animal on seagrass as a source of food – mean that the maintenance of dugong numbers, and the recovery of depleted dugong populations, is now difficult to achieve. Furthermore, dugongs are highly mobile animals that sometimes migrate across large distances, and in remote waters, with the result that impacts on dugongs are difficult to assess.[4]

In this section, some changes in dugong populations that have resulted from various activities are discussed, including the European commercial dugong fishery that operated from 1847-1969, the manufacture of dugong oil for medicinal use in Aboriginal settlements between 1940 and 1971, and Indigenous hunting of dugongs. Those three impacts are considered in turn below, using evidence from both documentary and oral history sources. Most emphasis is placed on the operation of the European commercial dugong fishery and the production of oil for use in Aboriginal settlements as those two impacts can be reconstructed in most detail using archival records found at the QSA; in contrast, scarce documentary evidence exists to describe

[3] Marsh *et al.*, *Dugong*, p. 1.
[4] Marsh *et al.*, *Dugong*, pp. 2-3.

the impacts of Indigenous hunting of dugongs. Information about both the operation of the European fishery and the impacts of Indigenous hunting, however, was obtained from oral history informants. Together, the accounts of the three impacts on dugongs contained in this section constitute a narrative of historical exploitation of dugongs which was unsustainable – at least at particular times and in localised areas – that reduced dugong numbers considerably; declining dugong numbers were reported as early as the 1880s and the species required legal protection in 1888, indicating that dugong populations have been threatened by human activity for more than a century.

7.2.1 The European commercial dugong fishery, 1847-1969

The European commercial dugong fishery, which operated from 1847-1969 in the vicinity of Moreton Bay, has been reconstructed below using documentary sources, including the Annual Reports of the Queensland CIF and of the QDHM, and oral history evidence provided by one surviving dugong fisher. The fishery produced dugong oil, hides, bones and meat, and was carried out in Moreton, Tin Can, Wide, Hervey and Rodds Bays, and also at a small dugong factory in Cardwell; the locations of these individual fisheries and their periods of operation are shown in Figures 7.1 and 7.2 respectively. An account of the dugong fishery in the Moreton Bay area was written by Johnson, who argued that, although the fishery declined by 1920, commercial dugong fishing was pursued in Queensland from 1847 until the mid-1970s.[5] In common with the humpback whale fishery that was based at Tangalooma whaling station, also in Moreton Bay, commercial dugong fishing occurred with little regard for the sustainability of the harvest; Johnson argued that this disregard resulted from a perception that the 'bounteous seas' provided a limitless supply of animals. Johnson acknowledged that the first recorded European encounter with a dugong on the east coast of Australia – by Matthew Flinders in 1799 – ended with the animal being shot with three musket balls.[6] The European commercial dugong fishery was pioneered by several dugong hunters in Moreton Bay, who operated from a station at Amity Point, on North Stradbroke Island; this fishery was operating by January 1847, although Welsby suggested that some dugong fishing occurred earlier at Amity Point, in the 1830s, and at

[5] M. Johnson, ''A modified form of whaling': the Moreton Bay dugong fishery, 1846-1920', in M. Johnson (ed), *Brisbane: Moreton Bay matters*, Brisbane History Group Papers No. 19, Brisbane History Group, Brisbane, 2002, pp. 27-38, p. 27.
[6] Johnson, 'Modified form of whaling', pp. 27 and 29.

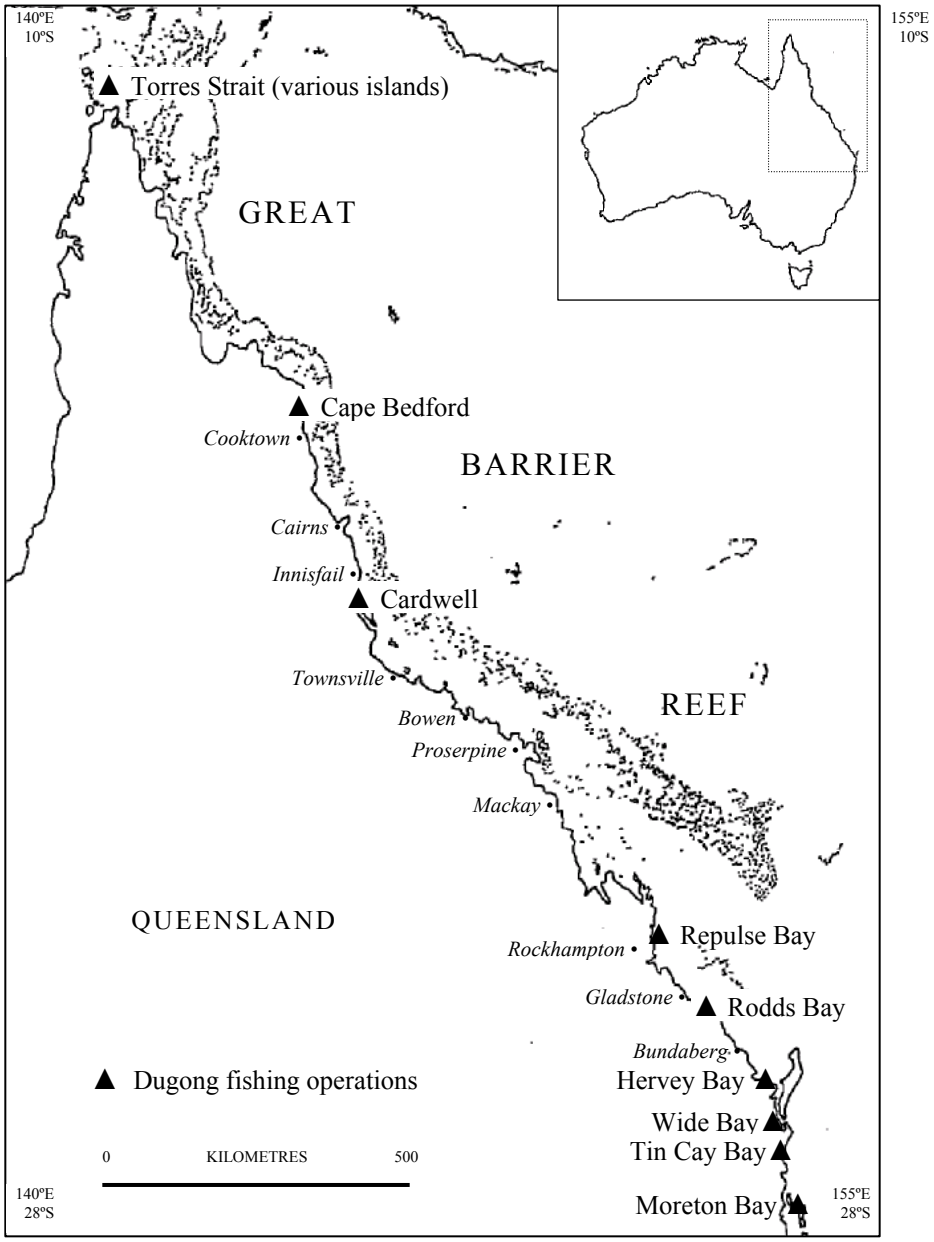


Figure 7.1. Locations of individual dugong fishing operations in Queensland, 1840-1970.

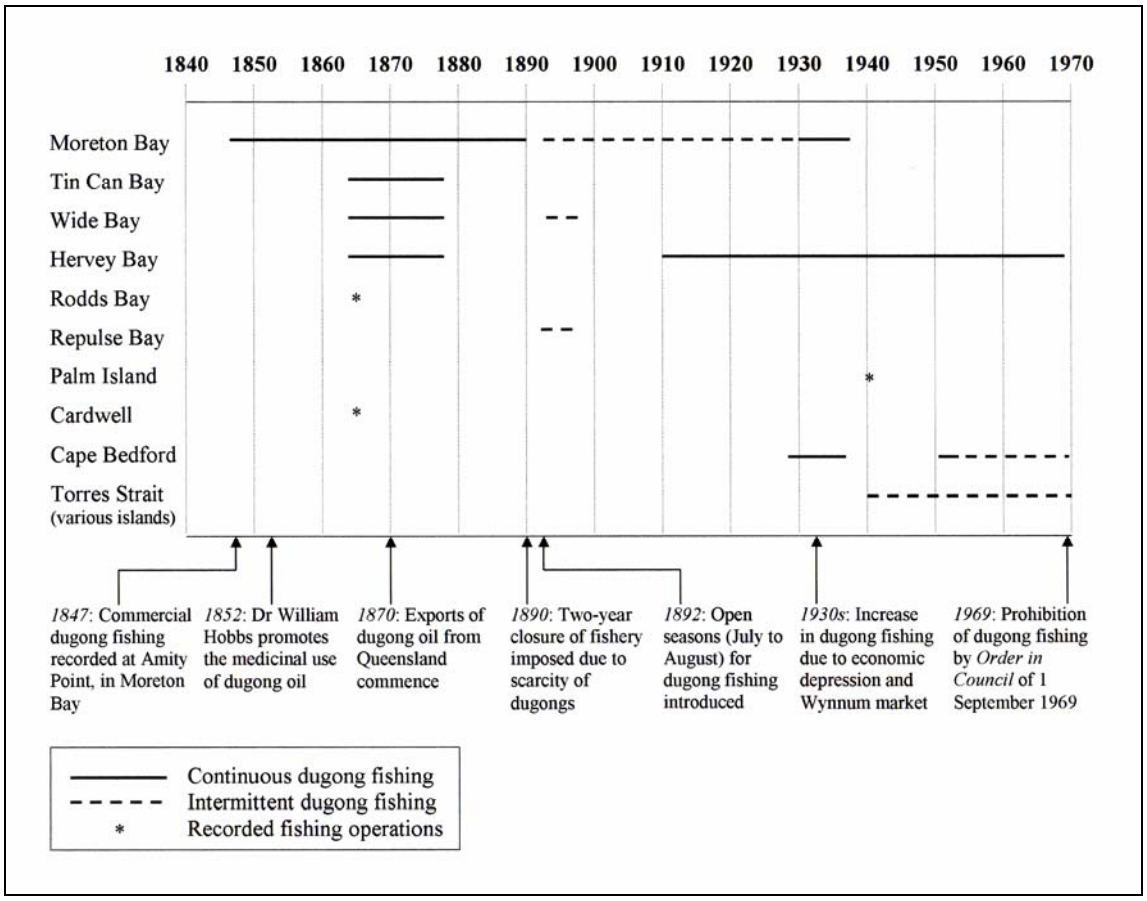


Figure 7.2. Periods of operation of individual dugong fishing operations in Queensland, 1840-1970.

Pelican Banks. The purpose of the fishery was to obtain dugong oil, which was used for cooking and in the production of cosmetics, and which represented a new export from the colony of Queensland.[7]

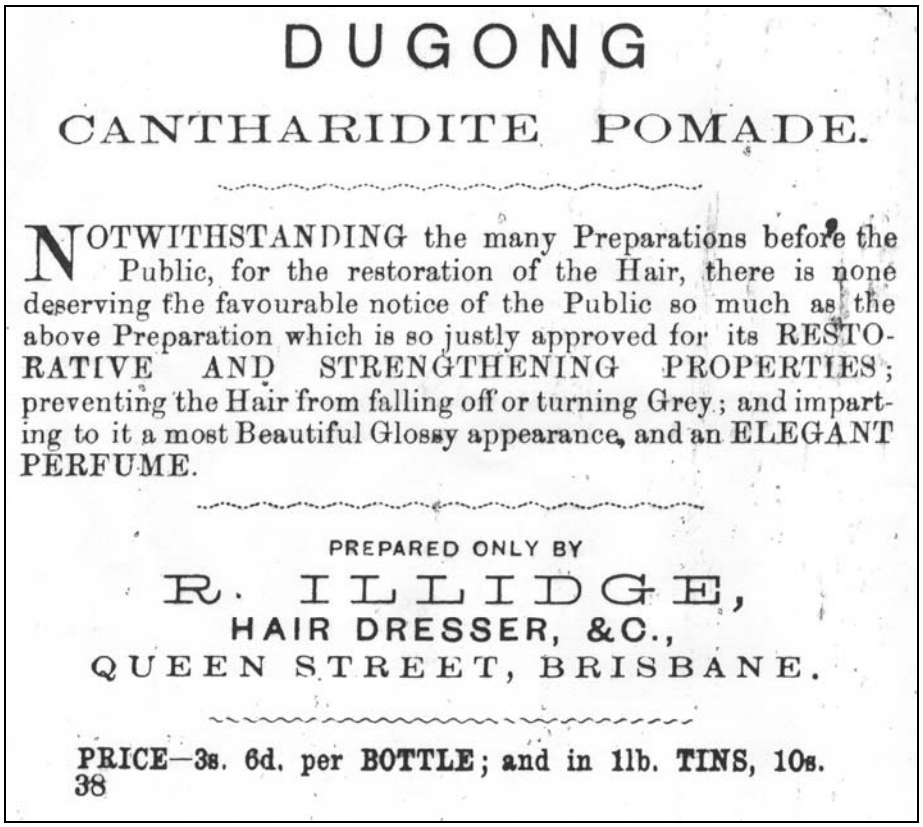
The establishment of a market for dugong oil is attributed to Dr. William Hobbs, the Queensland Government Medical Officer, who encouraged the manufacture of medicinal oil from dugongs after 1852 as a substitute for cod liver oil. In 1854, Hobbs exhibited a sample of dugong oil at the Sydney Museum and orders were subsequently received for the product; the product was also marketed at the Paris Exposition of 1855. Hobbs' efforts to promote the dugong oil industry led to the establishment of a dugong fishing station at St. Helena Island, in Moreton Bay, in 1856, and subsequent expansion of the dugong fisheries took place to the north of Moreton Bay. An account of the early growth of the dugong fishery by Loyau stated:

> [the dugong fishery] was started at Maryborough in 1860 by a man named Ching. Messrs. F. Bryant and A. G. Crocker […] were associated in the business. The late Dr. Hobbs, of Brisbane, is regarded as a pioneer in the industry, and was the first to make known publicly the medicinal qualities and dietetic uses of the dugong. Mr. A. K. Bruce, Chemist, of Maryborough, made large sales of the dugong products in 1860-61 to southern buyers […].[8]

In 1861, the availability and use of dugong oil was publicised in the medical journal, *The Lancet*, and from that year the availability of dugong oil was recorded by Theophilus Parsons Pugh in *Pugh's Almanac*. In addition to the supply of dugong oil to local markets, an order for 1,000 gallons of dugong oil had been placed by 1862 by a British supplier of pharmacists.[9] Between 1862 and 1870, advertisements for dugong oil were published in *Pugh's Almanac*, one of which is reproduced in Figure 7.3.

Additional details of the methods used in the early commercial dugong fishery are found in an account of 1860 by Bennett, who described the use of a floating station at which the catch was processed, in addition to harpoons and nets. He reported that:

[7] *Sydney Morning Herald*, 25 January 1847, p. 2; T. Welsby, *Early Moreton Bay recollections*, The Outridge Printing Co., Ltd., Brisbane, 1907, pp. 52 and 57.
[8] G. E. Loyau, *The history of Maryborough and Wide Bay and Burnett Districts from the year 1850 to 1895; compiled from authentic sources*, Pole, Outridge and Co., Brisbane, 1897, p. 365.
[9] E. Thorne, *The queen of colonies; or, Queensland as I knew it*, Samson Low, Marston, Searle, and Rivington, London, 1876, pp. 257 and 264; T. P. Pugh, *Pugh's Almanac*, T. P. Pugh's Printing Office, Brisbane, 1861, p. 48; *Brisbane Courier*, 4 September 1862, p. 2; *Brisbane Courier*, 31 July 1863; T. Welsby, *Sport and pastime in Moreton Bay*, Simpson Halligan and Co. Ltd., Brisbane, 1931, p. 86.



DUGONG

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NOTWITHSTANDING the many Preparations before the Public, for the restoration of the Hair, there is none deserving the favourable notice of the Public so much as the above Preparation which is so justly approved for its RESTORATIVE AND STRENGTHENING PROPERTIES; preventing the Hair from falling off or turning Grey; and imparting to it a most Beautiful Glossy appearance, and an ELEGANT PERFUME.

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PRICE—3s. 6d. per BOTTLE; and in 1lb. TINS, 10s.

38

Figure 7.3. An advertisement for dugong oil, 1870.

Source: Pugh's Almanac, 1870, no pagination.

> a small cutter was fitted out early in the season, with a boiler for 'trying down' the oil. Several aborigines [*sic*] were on board, and the animal was to be harpooned in a manner similar to that by which whales are captured. The success, however, was so indifferent, that it did not pay the expenses, and was abandoned, the Dugong having been found to be too wary even for the blacks [*sic*]. Since that time nets have been employed, and the result has been more productive. The nets are usually cast at night, in the places frequented by the animals, who become entangled in the meshes, and on average about two are captured every night. The natives [*sic*] (who name the animal *Yungun*) are very fond of its flesh, and Europeans who have tasted it pronounce it a great delicacy.[10]

The use of the floating station and harpoons indicates the extent to which the dugong fishery operated, initially, as a derivative of commercial whaling, though Bennett's account suggests that nets were soon adopted in place of harpoons by some fishers. Bennett provided details of the yield of oil obtained from large dugongs, although he also acknowledged the apparent variability in the dugong fishery, stating: 'A full-grown animal yields from 10 to 12 gallons of oil. [...] Some are very large, and weigh from 8 cwt to half a ton.'[11]

By 1864 additional dugong fisheries had commenced at Tin Can, Wide, Hervey and Rodds Bays and a small dugong fishing station operated at Cardwell; by 1865, the possibility of a substantial dugong oil industry had been recognised, as dugong numbers were reported to be very large in Queensland waters.[12] Describing what he regarded as 'a new and important branch of industry', Rowe stated:

> The dugong (*Halicore australis*) is abundant on all the eastern coasts of the colony, but Stradbroke Island is the chief seat of the fishery. […] Now that the oil is discovered to be valuable, it is exported to England in such quantities, that the fate of the dugong is sealed; and the fishery will eventually drive it in diminished numbers to the farthest and least approachable spots on the extreme north of the coast.[13]

A report published in the *Brisbane Courier* in 1869, however, reported that the distribution of dugongs in Queensland coastal waters was uneven: the animals were

[10] G. Bennett, *Gatherings of a naturalist in Australia*, John van Voost, London, 1860, pp. 165-166.
[11] Bennett, *Gatherings of a naturalist*, p. 166.
[12] Anon., 'Dugong oil: correspondence', *The Lancet*, Vol. 78, Issue 1995, 23 November 1861, p. 508; Johnson, 'Modified form of whaling', pp. 31-32; D. Jones, *Cardwell Shire story*, Jacaranda Press, Brisbane, 1961, p. 121.
[13] G. Rowe, *The colonial Empire of Great Britain, considered chiefly with reference to its physical geography and industrial productions: the Australian Group*, SPCK (Society for the Promotion of Christian Knowledge), London, 1865, pp. 123-124.

more numerous in Wide, Hervey and Rodds Bays than in Moreton Bay and were found 'at all seasons of the year in almost incredible numbers' in the tropical latitudes of Queensland.[14]

After 1870, exports of dugong oil, hides, tusks and bones took place from Queensland to New South Wales, Victoria, Western Australia, Great Britain and Canada. Quantities of dugong oil exported from Queensland from 1870-1902 are shown in Figure 7.4, which indicates that exports of dugong oil fluctuated during that period, although some large quantities of oil were shipped. A total of 291 dugong hides and 4 cwt. of dugong bones were also exported to Great Britain from 1876-1878.[15] The hides were used to manufacture leather products and the bones were used to produce ornamental cutlery handles. In addition to these products, soap was manufactured using dugong stearin, the material that remained in the filters after the oil had been drained away, and this product was exported to London. However, in spite of the lucrative prospects of the export trade, and Hobbs' efforts to secure an overseas market for dugong products, the majority of the dugong oil, hides and bones was sold at the Brisbane markets, while the meat was cured and sold or given away in the locality of the fishing stations.[16]

An extensive description of the dugong resources of Queensland, by Ebenezer Thorne, was published in 1876. Thorne acknowledged the abundance of this resource, which was plentiful in the northern Great Barrier Reef, and was also found as far south as Moreton Bay, although in lower numbers in the latter area. Thorne also described the small-scale attempts to establish dugong fisheries in the Moreton Bay area, attributing their lack of success to the 'intemperance of the men employed'.[17] During the 1870s, as Thorne also described, dugong processing stations continued to operate at Tin Can, Wide, and Hervey Bays. The dugong carcasses were boiled down and butchered Thorne also alluded to the problems of contamination of dugong oil which had already destabilised the market for this product. Thorne stated that an average dugong produced five or six gallons of oil and 100-200 pounds of lean meat; however, he claimed, a large

[14] This report is cited in Thorne, *Queen of Colonies*, p. 254.
[15] These statistics have been compiled using *SCQ*, 1870-1900, *passim*; and *SSQ*, 1901-1902, *passim.*
[16] Johnson, 'Modified form of whaling', p. 32.
[17] Thorne, *Queen of colonies*, pp. 248-249.

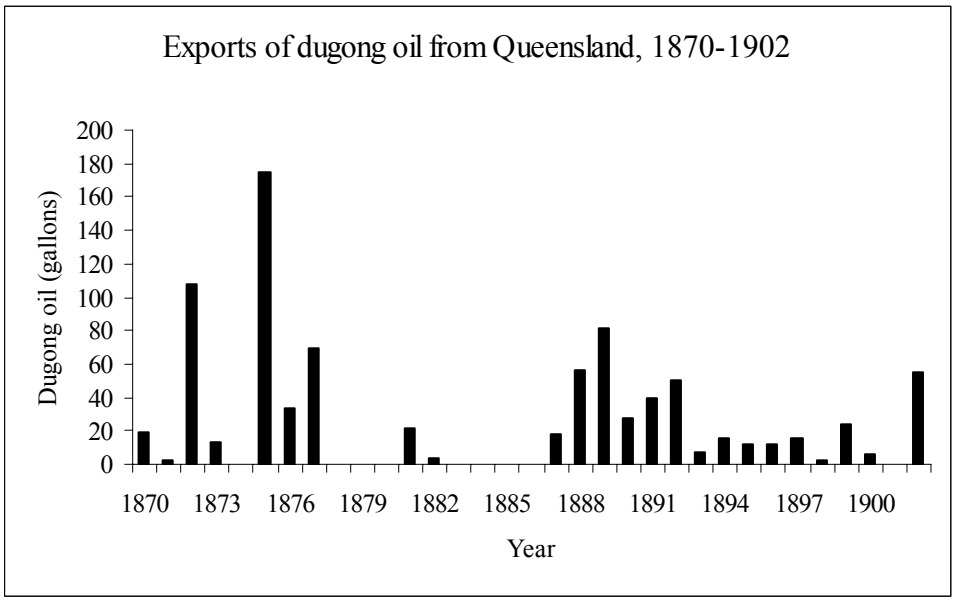

Figure 7.4. Quantities of dugong oil exported from Queensland, 1870-1902.

Source: Compiled from data provided in *SCQ*, 1870-1900; and in *SSQ*, 1901-1902, *passim.*

dugong could weight as much as a ton, and such a specimen could produce up to twenty gallons of purified oil: a much larger figure than that reported by Bennett in 1860.[18]

Thorne's account also contains descriptions of exceptionally large herds of dugongs; the same reports have since been repeated by other authors. Thorne cited an account by one fisherman who claimed to have seen a herd of dugongs 'which appeared to fill the water with their bodies. He computed this 'school' or mob to be half a mile wide and from three to four miles long'; another report of a very large herd of dugongs was cited by Thorne as follows:

> The writer's boat was once anchored in Hervey's Bay, in one of those channels through which the tide passes when running off the flats. For between three and four hours there was a continuous stream of dugongs passing while the tide went out, which those in the boat could only liken to the rush of cattle out of a stock-yard after a general muster. Some of the men in the boat said that millions of dugong passed; but some thousands must have gone out with that tide.[19]

Considering the apparent size of those herds, and the perceived scale of the dugong feeding grounds, Thorne could see no limit to the potential of the commercial dugong fishery, which he suggested might even rival the cod-fisheries of Newfoundland.

Notwithstanding these reports of enormous herds of dugongs, during the 1880s more systematic analysis of dugong numbers and behaviour commenced. In 1886, C. S. Fison, the Queensland Inspector of Fisheries, reported that observations of dugongs had been made along the coast, and he stated: '[dugongs] feed upon the grass growing upon the bottom in parts of [Moreton] Bay. They are very timid, and on the nearest approach of a boat drop down rapidly.'[20] From this year, the Annual Reports of the Queensland Inspector of Fisheries included catches of dugongs; the Annual Report of 1887 stated: 'There are a considerable number of them still in Moreton Bay, and already one man here with only one net has been able to take 18 head during this season.' The dugongs had reached a price of about £5 each and were caught with long nets made from manila rope. Furthermore, a seasonal pattern to their abundance was observed, as Fison stated:

[18] *Cf.* Bennett, *Gatherings of a naturalist*, p. 166; Thorne, *Queen of colonies*, pp. 254 and 262.
[19] Thorne, *Queen of colonies*, pp. 260 and 265-266.
[20] C. S. Fison, 'Report on the oyster fisheries of Moreton Bay', *QVP*, Vol. 3, Part 2, 1886, pp. 827-837, pp. 833 and 835.

> After flooded seasons they are always abundant in this part of the country, and I suppose the same holds good for other bays up North, for it does not go any further South than the boat channel at Southport, at one time a favourite haunt but now destroyed by traffic.[21]

Fison also reported an apparent scarcity of dugongs, citing one report which stated: 'We left Great Sandy Island Strait in 1880, and since our return, eighteen months since, have found the dugong much scarcer'; the report also described seasonal variations in the amount of weed in Moreton Bay.[22]

Additional details of the methods used in catching dugongs are found in an account of 1882, by Boyd, who described the daily examination of the nets by dugong fishers. Boyd stated: 'When [the dugong fishers] discover a dugong entangled in the meshes, they attack it with spears, and after a faint struggle it is drawn to the store, flensed, and boiled down.'[23] Boyd reported that, by that year, dugong meat fetched a ready sale in Brisbane. However, considerable dispute arose over the organisation of the dugong fishery. One concern related to the desirability of expanding the existing system of licences for dugong fishing. By 1888, J. Lionel Ching, of Maryborough, called for the wider use of licences, claiming that he was the only licensed dugong fisherman in Queensland, despite the fact that 'many parties' fished for the animal further north of Wide Bay.[24] A second debate concerned methods of fishing for dugongs. Not all dugong fishers used the large-meshed nets that Ching had adopted; smaller-meshed nets were in use that prevented the dugong calves from escaping, and the use of harpoons by other fishers led to the wasteful destruction of animals. Ching complained that the damage caused by harpooning was 'utterly ruining' his business and suggested that the more destructive methods of fishing should be replaced by the use of 36-inch mesh nets. He also reported that he had imported a steam plant from England for boiling-down dugong oil more efficiently.[25]

[21] C. S. Fison, 'Report on the oyster fisheries of Moreton Bay', *QVP*, Vol. 4, Part 1, 1887, pp. 121-123, p. 123.
[22] J. Lionel Ching, Maryborough, to Harbour Master, Maryborough, 7 May 1888, cited in C. S. Fison, 'Report on the oyster and other industries within the ports of Moreton Bay and Maryborough', *QVP*, Vol. 3, Part 2, 1888, pp. 761-775, p. 764.
[23] A. J. Boyd, *Queensland*, Queensland Emigration Office, London, 1882, p. 30.
[24] Cited in Fison, 'Report on the oyster and other industries', p. 764.
[25] Cited in Fison, 'Report on the oyster and other industries', p. 764.

From 1888, some documentary evidence indicates that dugongs appeared to be scarcer in Moreton Bay, although Johnson attributed this scarcity, not to over-fishing, but to an increase in boat traffic in the Bay.[26] While the animal was seen less commonly in the Moreton Bay area, dugongs were still reported to be plentiful in more northerly waters: especially in Rockingham Bay, near Cardwell, where in 1872 Eden stated:

> About two hundred yards from the shore, and extending for half a mile with an interval of a few yards between each, could be seen every morning a troop of dugongs or sea-cows (*Halicore australis*) basking in the early sun, previously to their taking themselves off to graze on their submarine pastures. [...] Its favourite haunts are bays into which streams empty themselves, and here the water is about two to five fathoms in depth, feeding on the submarine vegetation growing on the banks [...].[27]

Scientific investigation of the animal continued and, by 1888, the low fertility rate of the dugong had also been realised. Fison acknowledged that dugongs 'breed once a year, and have only one calf at a time'; he also reported that, of the sixteen dugong caught in Moreton Bay in 1888, almost all 'were cows in calf, or the young calves were found attending the mother'.[28] In an attempt to rectify the lack of sustainability of such a harvest, restrictions on dugong fishing in Moreton Bay were recommended, which could be introduced under the *Queensland Fisheries Act (1887)*; Fison argued that such measures would prevent 'the utter extermination of the herd'.[29] Those restrictions were introduced on 1 September 1888 and remained in force for two years. By 1889, the sporadic presence of a small herd of dugongs had been reported on the western side of Moreton Island, but Fison stated that these animals were protected under the same clause of the *Fisheries Act*.[30]

Fison's observations are significant: they indicate that, in the early period of the commercial dugong fishery, concerns about the lack of sustainability of the harvest provoked a legal intervention to conserve the animals. The excessive destruction of dugongs was also reported by Saville-Kent, who stated in his report of 1890 that:

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[26] Johnson, 'A modified form of whaling', p. 34.
[27] 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, pp. 295-296.
[28] Fison, 'Report on the oyster and other industries', p. 764.
[29] Fison, 'Report on the oyster and other industries', p. 764.
[30] C. S. Fison, 'Report on the oyster fisheries of Moreton Bay and Great Sandy Island Strait', *QVP*, Vol. 3, Part 2, 1889, pp. 937-941, p. 939.

> a great amount of harm is done to the legitimate Dugong fishery through the wasteful destruction of the animal in Wide Bay by means of harpooning, and also through the extensive slaughter of the young calves.[31]

Saville-Kent reported that harpooning of the dugongs had the effects of causing many of the wounded animals to escape, and of frightening the remaining animals in the herd away. In consequence, Saville-Kent recommended that dugong fishing should be restricted exclusively to the use of stake-nets, with a mesh-size of at least one yard square, which would allow the protection of the calves; he also advocated the prohibition of dugong fishing using harpoons. However, because a suckling dugong calf without a mother would be unlikely to survive, Saville-Kent's recommendation that dugong fishing should be restricted exclusively to the use of large mesh-size nets may not have been an adequate conservation measure.

In 1892, the period of restrictions on the dugong fishery ended and commercial dugong fishing recommenced at North Stradbroke Island; 46 dugongs were caught during that season.[32] Yet concerns about the sustainability of the fishery had not been allayed and, in response to the scale of the resumption in dugong fishing, a second two-year closure was introduced on 1 January 1893. This closure was rescinded in June of the same year, however, after large herds of dugongs entered Moreton Bay; Johnson associated that event with extensive flooding in south-eastern Queensland during February 1892. Instead of the complete closure of the fishery, an open season – comprising June, July and August of each year – was introduced and enforced strictly using large fines; harpooning for dugongs was prohibited and a more extensive licensing system was introduced.[33] By the end of 1893, the Queensland commercial dugong fisheries had been regulated in similar ways to other commercial fisheries: using restrictions of permitted equipment and spatial and temporal closures of fishing grounds.

By 1893, Saville-Kent described the existence of individual dugong fisheries in Moreton and Wide Bays (Figure 7.1); he also referred to the operation of another dugong fishing station in Repulse Bay, near Mackay, for which the following details were recorded:

[31] W. Saville-Kent, 'Fisheries, Wide Bay district', *QVP*, Vol. 3, Part 2, 1890, pp. 713-714, p. 713.
[32] Johnson, 'A modified form of whaling', p. 36.
[33] Welsby, *Sport and pastime*, p. 69.

> The price, or value in goods, paid by the station proprietor to the natives [*sic*] for each dugong captured, is five shillings; but of these the purchaser only requires the oil-producing livers, and the hides, bones, and teeth, leaving the natives the carcases to feast upon. The hides, if well-cured, realise a price of 4½d per lb, the large tusks of the male about half-a-crown per pair, while the bones make the best charcoal for sugar refining. […] After many years' experience, it has been found at the Repulse Bay station that the old cows yield the most oil, the quantity being sometimes as much as eight or ten gallons, but on the average only four or five. The winter months, with respect to the amount of oil obtained, are the most profitable ones for the industry.[34]

In contrast to the southern Great Barrier Reef, Saville-Kent stated that the northern Great Barrier Reef and Torres Strait had no systematic dugong fishery, although Indigenous hunting of dugongs took place in those regions.

Saville-Kent's perception of large numbers of dugongs was supported by an anecdotal report, cited by Welsby, of an extremely large herd that was seen in Moreton Bay in July 1893. One dugong fisherman, Fred Campbell, stated that:

> when out in a boat near the Black Beacon, at the western entrance to the Rous Channel, [I] saw a herd of dugong that extended from near that beacon almost to the lower sandhills on Moreton Island, a distance, at the least, of three miles, the width being 300 yards. The day was glassy calm, the water so clear that every object could be seen in it with perfect distinctiveness.[35]

Campbell reported that he watched the herd of dugongs for over an hour, during which time 'there were never less than twenty or thirty breathing simultaneously'; he estimated that several hundred dugongs were present in the herd and recalled that they were 'feeding quietly in about two fathoms of water.' By the time of this report, a correlation was believed to exist between dugong abundance and seasonal rainfall patterns: heavy rainfall during the preceding summer would be followed by flooding, and then by an abundant dugong season.[36]

Fison reported that in 1894 the dugong fishery in Moreton Bay had been successful during the three-month open season; yet by 1896, dugongs were again scarcely caught

[34] Saville-Kent, *Great Barrier Reef*, p. 328.
[35] Welsby, *Sport and pastime*, p. 56.
[36] Welsby, *Sport and pastime*, pp. 57 and 72; the rediscovery of a herd of dugongs in Moreton Bay in 1976 and 1977 was reported by G. E. Heinsohn *et al.*, 'Discovery of a large population of dugongs off Brisbane, Australia', *Environmental Conservation*, Vol. 5, 1978, pp. 91-92, and that population may have been present continuously since 1893 but with variations in the abundance of dugongs. Several hundred dugongs can often now be observed in Moreton Bay; H. Marsh, 16 May 2005, pers. comm.

in Moreton Bay, although Fison reported that the animals remained numerous in the northern Great Barrier Reef.[37] After that year, the dugong industry failed to supply a significant market for oil and only a small, variable fishery took place between 1900 and the 1920s. In 1902, James Stevens, Inspector of Fisheries, stated:

> The demand for dugong during the last winter has not been a sufficient inducement for fishermen, although the fish has been plentiful. The only person who did start caught 30, and so did very well, selling the hides at 7d per lb for carriage brakes. The flesh, too, served a good purpose […].[38]

In addition to those products, 55 gallons of dugong oil were exported from Queensland to Victoria in 1902. Stevens attributed the lack of fishing effort to the collapse of the market that resulted from contamination of the dugong oil. Initially the impurity of the oil was blamed on negligence during the refining process; subsequently, samples of the oil were found to have been diluted with large quantities of shark oil. In 1905, Welsby stated that in Moreton Bay dugongs were 'not nearly so numerous as in years past', and Stevens reported that the dugong fishery in the Moreton Bay area was 'at a standstill' as only eight animals were caught during the season; yet Stevens stated that high prices could still be obtained for dugong oil and hides if production were increased, and he acknowledged that much larger stocks of dugongs were found in coastal waters to the north of Wide Bay. The following year, using one net, the dugong catch in Moreton Bay increased to 45 dugongs, which were taken during an eight-week period.[39]

By 1907, dugong fishing stations were still operating in Moreton Bay at Amity Point and Pelican Banks. However, the following year, James H. Stevens, Inspector of Fisheries, reported that in Moreton Bay the dugong fishery had again been unsuccessful due to poor weather. By 1908, the oil was 'almost unobtainable'; seventy bottles were sent to the Franco-British Exhibition in that year, which represented almost all of the available supplies. In 1909, the scarcity of animals was attributed to a lack of seagrass at

[37] C. S. Fison, 'Report on the oyster and other fisheries of Moreton Bay', *QVP*, Vol. 3, Part 2, 1894, pp. 1112-1113, p. 1113; C. S. Fison, AR, Inspector of Fisheries, *QVP*, Vol. 4, Part 1, 1897, pp. 617-637, p. 637.
[38] J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1902, pp. 965-968, p. 967.
[39] *SSQ*, 1902, p. 199; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 2, 1905, pp. 1037-1042, pp. 1041-1042; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 2, 1906, pp. 1403-1424, p. 1419; T. Welsby, *Schnappering and fishing in the Brisbane River and Moreton Bay waters*, The Outridge Printing Co., Brisbane, 1905, p. 95.

the Moreton and Boolong Banks.[40] By 1910, no further dugong fishing had taken place in Moreton Bay. The following reasons were given for the lack of fishing effort:

> The dugong, it is said, is more scarce now than previously, and the men who used to engage in this fishing have become too old; several are dead, and the younger men do not seem to like the preparing of the oil, or do not understand the process. There is, at present, a great demand for dugong oil in Brisbane, and its value is becoming better known.[41]

A small increase in dugong fishing took place in Moreton Bay in 1911, at Boolong Banks, where 16 or 17 large animals were caught. However, Stevens continued to express his concern about the depletion of the dugong population; he suggested that the increasing prevalence of motor boats in Moreton Bay was the main cause of their scarcity.[42]

A small revival of the commercial dugong fishery took place during the First World War as an alternative to supplies of cod-liver oil, which had became scarce, was sought. However, Stevens stated that the revival of the fishery was short-lived because of the scarcity of dugongs. Limited dugong fishing continued during the 1920s; for example, the Amity Point station was still operating in 1923 and supplied dugong meat, hides, tusks and bones as well as oil; by that year the dugong hides were being used to manufacture high-quality leather, engine belts and carriage brakes.[43] In 1923, however, a publication by the Queensland Government Intelligence and Tourist Bureau (QGITB), compiled by the GBRC, stated that dugongs were 'too rare to provide meat for the butchering trade' and uncertainty about the survival of the species was expressed.[44] In general, Stevens stated, only intermittent fishing for dugongs took place in Moreton Bay

[40] Welsby, *Early Moreton Bay recollections*, pp. 52 and 57; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1908, pp. 904-907, p. 907; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 2, 1909, pp. 927-932, p. 931.
[41] J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1910, pp. 924-928, p. 928.
[42] J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1911, pp. 1191-1193, p. 1192; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1913, pp. 1031-1033, p. 1033; J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1914, pp. 974-975, p. 975.
[43] J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 1, 1918, pp. 1663-1665, p. 1665 J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 3, 1919, pp. 340-344, p. 342; Johnson, 'A modified form of whaling', p. 37; Welsby, *Sport and pastime*, pp. 84-85.
[44] QGITB (Queensland Government Intelligence and Tourist Bureau), *The Great Barrier Reef of Australia: a popular account of its general nature, compiled by the GBRC*, QGITB, Brisbane, 1923, p. 25; see also *Brisbane Courier*, 23 February 1929, p. 23.

during the 1920s, not only because of the reported scarcity of the animals but also because general fishing and oyster harvesting were more lucrative activities.[45]

The perceived decline of the dugong was a complex issue. On the one hand, concerns were expressed about declining dugong numbers; in 1922, for example, Banfield complained of the increasing rarity of dugongs as a result of their being slaughtered by Japanese trochus, bêche-de-mer and pearl-shell crews. On the other hand, anecdotal reports of large herds of dugongs continued to be made, including one sighting of at least 80 dugongs, 'on the outer side of the Rainbow Channel, near the openings and passages of Big Pelican [Banks]' in 1928.[46] While some authors acknowledged that the vast herds that once were reported in Moreton Bay were not seen, uncertainty existed about the extent of the decline in dugong numbers: the animals may have become more timid or their herding behaviour may have altered. In 1931, Welsby stated:

> [the dugong] can be found […] from as far north as Torres Strait right down throughout the Great Barrier Reef to as far south as Moreton Bay. In the latter place it still exists in great numbers, although the idea is prevalent that the single dugong, or the herds, are not now seen in like number and manner as in years ago. My own experience, and it is that of others, is that they are again as plentiful as ever, although not seen so much as they were in earlier days.[47]

Welsby also acknowledged that the distribution of dugongs matched the distribution of seagrass, since dugong were seen feeding even at the extreme edges of seagrass beds that uncovered at low tide. Dugong tracks could be seen through these seagrass beds – even if the animals themselves could not be observed – and the ability of Indigenous fishermen to 'read' the age of dugong tracks was exploited in setting the dugong nets.

Yet the difficulty in estimating the size of the dugong populations remained. Welsby stated: 'It is strange how many boating parties pass over the waters of Moreton Bay and never see a dugong', although he also stated that 'dozens and dozens' of dugongs were reported to be present in the waters between Wynnum and Amity Point and that the

[45] For example, see J. H. Stevens, AR, Inspector of Fisheries, *QPP*, Vol. 2, 1920, pp. 569-572, p. 570; J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 2, 1930, pp. 39-41, p. 40.
[46] Cited in G. M. Allen, *Extinct and vanishing mammals of the western hemisphere, with the marine species of all the oceans*, American Committee for International Wildlife Protection, New York, 1942, p. 533; Welsby, *Sport and pastime*, p. 56; earlier, in 1913, Banfield, *Confessions of a beachcomber*, p. 162 mentioned that dugongs appeared to be less abundant in Hinchinbrook Channel than in previous years.
[47] Welsby, *Sport and pastime*, pp. 62-63.

animals 'abound upon and around the Moreton, Amity and Pelican banks in hundreds the whole year through'.[48] Those reports indicate the uncertainty that characterised early estimates of the dugong population in Moreton Bay. Nonetheless, that dugong population continued to supported sporadic commercial fisheries, which probably resumed in response to the need for employment in the deteriorating economic conditions of the 1930s; dugong fishing was probably also encouraged after 1930 in Hervey Bay by the establishment at Wynnum of a company that intended to manufacture a variety of fish and shark products.[49] One party carried out dugong fishing in Moreton Bay and in the Burrum River in 1930 and 1931, catching thirty-five animals of varying sizes in one month at the latter location; in the following year, about 100 dugongs were caught in Hervey Bay during one season. By 1935, dugong fishing was concentrated in Hervey Bay, where 19 dugongs were caught, followed by a larger harvest in 1936 in which one fisher caught 30 animals. In 1937 and 1938, 50 and 35 dugongs were taken during those respective years.[50]

A summary of the approximate catches of dugongs in Moreton Bay between 1884 and 1938 is shown in Figure 7.5. Uncertainty about the size of the dugong catches for the years 1912-1928, due to the lack of records of dugong harvests found in the Annual Reports of the Inspector of Fisheries, is apparent from the data missing from Figure 7.5; this omission indicates the comparatively low status of the dugong fishery in Queensland; for many years no reports at all illuminate the harvest. Nevertheless, Figure 7.5 illustrates the increased effort that took place in the fishery during the years from 1930-1938. As a result of that increase in dugong fishing, by around 1940, dugong populations were reported to be 'rapidly diminishing in numbers'.[51] Nevertheless, Lack wrote that the commercial dugong fishery continued in 1940, with centres at Hervey Bay and Torres Strait, and that 70 dugongs were caught in Hervey Bay during that year. Intermittent fisheries continued from that date until 1969, when dugongs were protected

[48] Welsby, *Sport and pastime*, pp. 103-104.
[49] J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 2, 1932, pp. 6-7, p. 6.
[50] J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 2, 1931, pp. 5-6, p. 6; J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 1, 1935, pp. 1091-1093, p. 1091; J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 1, 1936, pp. 1141-1144, p. 1142; J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 1, 1937, pp. 1403-1404, p. 1403; J. D. W. Dick, AR, Acting CIF, *QPP*, Vol. 1, 1938, pp. 1283-1284, p. 1283; see also C. Lack, 'Dugong fishing in early Queensland', *Newsletter of the Royal Australian Historical Society*, November 1968, pp. 4-6, p. 5.
[51] D. Tennant, *Marvels of the Great Barrier Reef, North Australia and New Guinea*, 2nd edn, Thomas Tennant, Chatswood, New South Wales, *c.*1940, p. 49.

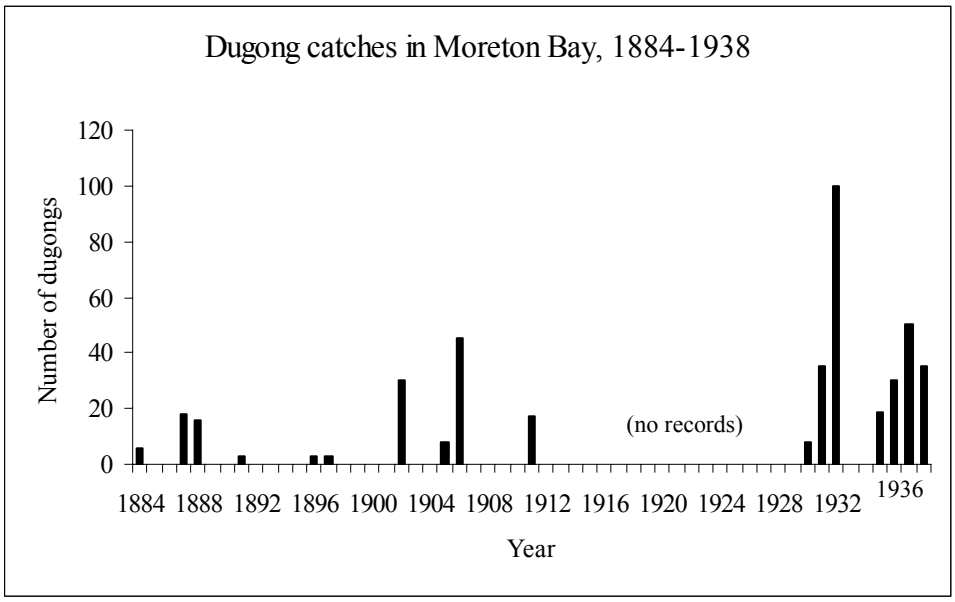

Figure 7.5. Numbers of dugongs caught in Moreton Bay, 1884-1938 (where records were available).
Source: Compiled from data provided in *QVP*, 1884-1900; and in *QPP*, 1901-1938, *passim*.

by a Queensland *Order in Council* issued on 20 March 1969; however, by that date, Lack stated that the dugong herds on the South Queensland coast had been almost wiped out.[52]

The period of commercial dugong fishing between 1910 and 1969 is illuminated by oral history evidence obtained from one surviving dugong fisher who operated in Hervey Bay, which overlaps with the period for which documentary evidence is available in the *QPP*; the oral history evidence presented below is also supported by two documentary sources that describe the same fishing operation.[53] In around 1910, the dugong fishery at Burrum Heads commenced, with nets being set close to North Shore by Percy Wheeler, an Aboriginal man, who was described as a 'professional fisherman plus dugong fisherman in his spare time'; Wheeler was later joined by John Schwarzrock. These fishers used two boats, *The Grany* and *Cutty Shark*, to tow dugongs to the beach for butchering; this was reported to have been an easy task because 'the dugong were plentiful and caught very close to the beach.'[54] Wheeler used a shore station, comprising several boilers and a processing plant, and around 80 per cent of the dugong oil supplied to the market was produced at the station at Burrum Heads. By 1922, Wheeler was still operating the dugong station; other fishers had also commenced operations, including the Bellerts, at Toogoom; the Smith brothers, in the Isis River area; and a German man named Hans Welop. Wheeler's operation at Burrum Heads was followed by another dugong fishing operation, owned by Bill Bilsborough, who continued to work his station until 1963, when it was taken over by Mel Simpson and Cliff Chew.[55] Bilsborough's dugong fishing operation at Traveston is illustrated in Figure 7.6.

Oral history evidence indicates that the dugong fishing operations were not permanent, but operated intermittently in response to orders for dugong oil. The same informant stated that:

[52] Lack, 'Dugong fishing', p. 5; QDPI, *Annual report, 1968-69*, QDPI, Brisbane, 1969, p. 36.
[53] A detailed account of the dugong fishing operation forms the subject of OHC 34, 12 October 2003; see also N. C. Johnson, *Memories: Burrum Heads*, The Publication Committee, Burrum Heads, 1988, pp. 76-81; J. Promus, 'Netting dugong', *Walkabout*, 1 March 1937, pp. 40-41.
[54] OHC 34, 12 October 2003, p. 1; Johnson, *Memories: Burrum Heads*, p. 77.
[55] OHC 34, 12 October 2003, pp. 1 and 6; Johnson, *Memories: Burrum Heads*, p. 77.

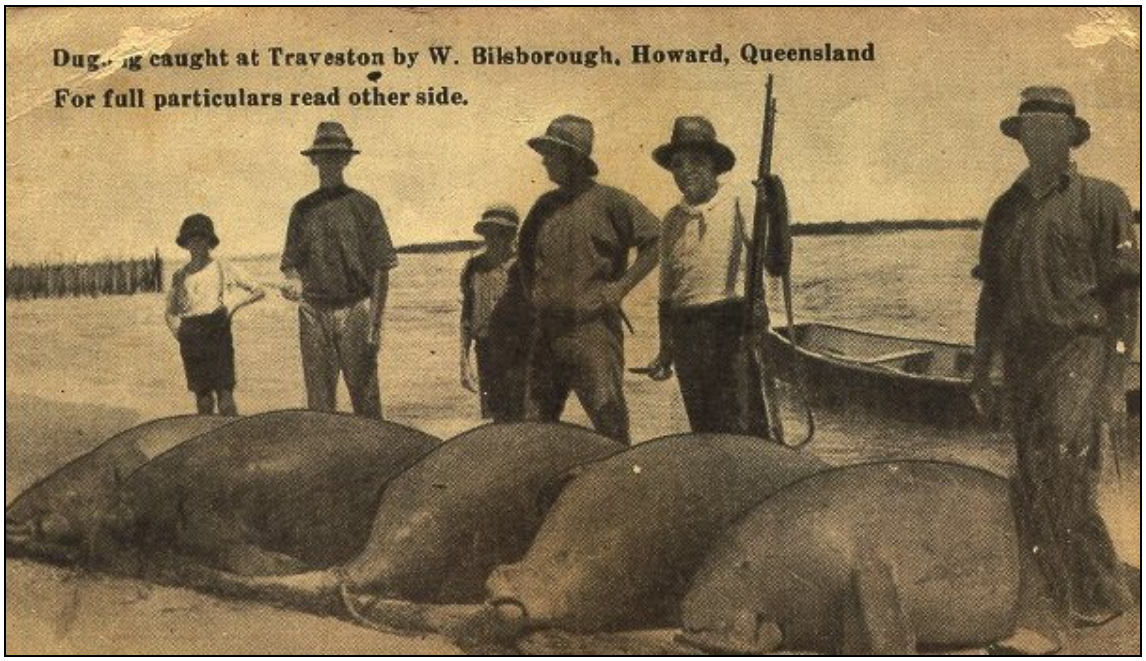

Figure 7.6. Dugongs caught in Hervey Bay by Bill Bilsborough, *c.*1937.

Source: Photograph obtained from Mrs. Anita Jensen, courtesy of Professor Helene Marsh.

> the dugong fishery wasn't a permanent, ongoing thing; it was only done when they got their orders in for the oil. And the fishery would last a fortnight to three weeks, depending on their oil order, to fill the oil order in. The oil orders came from three Chemists that I eventually sold it to in later years when I took over the outfit. One of them was Chemist Roush in Brisbane; his Chemist's shop is still there – the Chemist Roush itself wouldn't be, but his business is still in Adelaide Street, in Brisbane. We had two local guys for the oil: Heard Kingston – a Chemist in Maryvale – and Jim Verrister was the other Chemist, in Maryvale. They were the three buyers of the dugong oil in this district.[56]

The informant stated that four dugong fishing trips were carried out each year, at intervals of roughly three months, and that around 200 dugongs were caught annually; however, some seasonal variations in numbers of dugongs occurred between fisheries.[57]

The dugongs were caught using nets composed of six-millimetre cotton and hemp rope; their mesh size was 28 inches square, and the nets were 10 meshes deep and 50 metres long. These nets were suspended from a coir rope and set on the bottom of the bay, using floats to keep the topmost rope on the surface of the water. A dugong fishing outfit consisted of six to eight nets, of which about four were used at one time; the nets were set among the dugong tracks in the feeding grounds, which were located approximately three kilometres offshore, on both the northern and the southern sides of the Burrum River. The informant recalled that the number of nets used was chosen according to the apparent level of dugong activity, stating:

> We'd select an area where they were working pretty heavy and, if we thought there were going to be too many dugongs there, we would only use the amount of gear that we thought would catch enough. It would be no more than three or four [dugongs], although we have had catches of sixes and eights; but we used to like no more than about four or five, at the most, because that was enough to handle in the one day.[58]

The nets were weighted with pick anchors and set in straight lines; if four nets were used, two were set in an east-west direction, and the other two ran north-south. The nets were left in place for the duration of that fishing operation, which could last for two or three weeks.[59]

[56] OHC 34, 12 October 2003, pp. 1-2.
[57] OHC 34, 12 October 2003, p. 6.
[58] OHC 34, 12 October 2003, p. 2.
[59] OHC 34, 12 October 2003, p. 2.

The dugong nets were cleared every morning, at sunrise, using a skiff. The informant estimated that roughly half of the dugongs were drowned; the rest were caught alive and were killed using a rifle. The animals were released from the nets by slicing the snouts, tow-ropes were attached to the bodies, and the dugongs were then towed by the launch to the processing station on the beach at Burrum Heads.[60] By that time, the carcasses had become bloated, which made them easier to handle since they could be rolled up on to the beach and positioned so that the tails lay down-slope. Then the butchering of the dugongs took place: a procedure that was described in the following terms:

> You took the belly-hide, split it long-ways down, took half one way and then half the other. There were special cuts, like a butcher would do a piece. [...] Then the belly fat strips were taken off in roughly about six- to eight-inch strips, down to where you'd finished skinning them. Took that all off. Then they were rolled over and the head taken off. The head of the dugong […] produced much more oil than any other part; there was a lot of fat in the head. Then on the back, with them rolled over, there'd be another cut put long-ways down and the hide dropped off. But the hide was always left hanging on down at the tail end, onto the tail. [...]
>
> Then the fat was taken off the back section; but the fat is only about a third of the thickness of the fat on the belly section. Then, of course, came the dugong steak; this was the next cut that came off. Down the back, each side, the back-bone is hollowed in. Then you've got a ridge running down, and the meat was cut in both sides of this ridge that runs down, which looks just like solid steak. [...] And you took a strip off each side, from the top end down to the tail. And possibly round about thirty kilos of good meat, roughly, you would get off an average-sized dugong.[61]

The dugong steaks that were cut from the carcasses were given away to local residents and visitors from the coal-mining works at Howard, who gathered on the beach during the processing of the dugongs.

The next stage in the process involved the rendering of the fatty parts of the animal for oil. At the plant, four steel boilers, each holding five-hundred gallons, were arranged on top of railway bars above a wood fire. The boilers were pumped half-full of sea water; then the dugong blubber and other parts were placed inside and the fires started. After the water had boiled, the rendering process took ten hours, after which time the fires were extinguished. Next, the oil was skimmed off the top of the water and the drums were emptied and prepared for the next catch. The oil was then filtered and bottled

[60] OHC 34, 12 October 2003, pp. 2-3.
[61] OHC 34, 12 October 2003, pp. 3-4.

before being delivered to the Chemist shops; the dugong fishery continued until the entire oil order had been completed. The oil obtained a price of £5 per gallon. The informant stated that some dugong oil was used for medical purposes, but the majority was used in the manufacture of cosmetic creams. The dugong carcasses were disposed of by towing them to the middle of the Burrum River, puncturing the stomach and releasing the remains, which were consumed by sharks.[62]

Considering anecdotal reports of declines in dugong numbers, the informant reported that mackerel fishing practices, before the legal protection of dugongs required their alteration, had caused excessive destruction of dugongs. As a result of concerns about the accidental by-catch of dugongs in mackerel nets, one mackerel fishing ground – that was also a dugong feeding ground – was closed, and the remaining mackerel grounds were fished using float nets, rather than sink nets, with the result that the by-catch of dugongs was reduced. The mackerel float nets were also reduced in their depth, from fifteen feet to eight feet, and were also limited in their breaking-strain.[63] The informant reported that another impact on dugong numbers related to the status of their feeding grounds. Degradation of the seagrass beds adjacent to the Burrum River occurred after a severe flood in 1992 when extensive siltation of the beds occurred; as a result, 35 or 40 dugongs died on the coast between Burrum Heads and Moreton Bay, and 15 or 20 animals died in Hervey Bay, at Burrum Heads. This event lies beyond the scope of my research and further details of that flood are not provided here; however, the informant compared the effects of the 1992 flood with previous floods in the 1950s and 1960s, and argued that the latter did not cause similar damage to seagrass beds. He attributed the difference in impacts on the seagrass beds to an increase in concentrations of agricultural chemicals in the runoff during the intervening period.[64]

The evidence provided by this oral history informant includes rich detail about the methods used in the dugong fishing station at Burrum Heads and the scale of that operation. The informant indicated that the annual harvest of the Burrum Heads dugong

[62] OHC 34, 12 October 2003, pp. 4-5.
[63] OHC 34, 12 October 2003, pp. 7-8.
[64] OHC 34, 12 October 2003, pp. 10-12; A. Preen and H. Marsh, 'Response of dugongs to large-scale loss of seagrass from Hervey Bay, Queensland, Australia', *Wildlife Research*, Vol. 22, 1995, pp. 507-519, provide additional details of the effects of the 1992 floods and cyclone on seagrass in Hervey Bay; H. Marsh, School of TESAG, JCU, Townsville, 28 May 2005, pers. comm., acknowledged that diuron is known to inhibit the growth of seagrass, but that the effect of high turbidity following these floods is likely to have been a more significant factor in causing dugong mortality.

fishers prior to 1969 was around 200 animals; that annual catch is approximately the size of the total dugong herd now reported, by the informant, to be present in the Toogoom-Burrum Heads Bay and almost half of the size of the dugong herd thought by the informant to exist now in Woodgate Bay.[65] Comparison of his estimates of present dugong herd sizes with the catch rates published in the Annual Reports of the Queensland Inspectors of Fisheries, therefore, suggests that the commercial dugong fishery caused a significant reduction in the dugong population during the years of its operation. Those impacts probably represented occasional, severe impacts on localised dugong populations, the effects of which were apparent to some observers as early as the 1880s, since by 1888 the species had required legislative protection. In general, the dugong fishery remained a small industry during most of the period of European settlement that operated in response to a limited market for dugong oil; however, due to the low fertility rate of the species, even a relatively small dugong fishery apparently caused a decline in dugong numbers and contributed to the reported scarcity of the animals. Furthermore, large harvests of the animals, especially during the 1930s, probably increased the vulnerability of dugongs in the southern Great Barrier Reef to subsequent impacts.[66]

7.2.2 The supply of dugong oil to Aboriginal settlements, 1940-1970

In addition to the impacts of the commercial dugong fishery for the Brisbane, interstate and overseas markets, an additional fishery existed in order to produce dugong oil for medicinal use in Aboriginal settlements. This activity took place between at least 1940 and 1970, as indicated by documentary records found in the QSA; a brief outline of the evidence contained in these files is presented below. Dugongs were caught in areas near Palm Island and in Torres Strait, and the oil was sent to at least six Aboriginal settlements: Woorabinda, Palm Island, Yarrabah, Cherbourg, Lockhart River and Doomadgee. However, the records contained in these files begin abruptly and refer to earlier instances of the use of dugong oil in Aboriginal settlements; the account given here therefore is most likely incomplete.

[65] OHC 34, 12 October 2003, pp. 12-13; however, H. Marsh and I. Lawler, *Dugong distribution and abundance in the southern Great Barrier Reef Marine Park and Hervey Bay: results of an aerial survey in October-December 1999*, Final Report to the GBRMPA, Townsville, GBRMPA, 2001, estimated that the population of dugongs in Hervey Bay in November 1999 was 1654 (± s.e. 248) animals.
[66] See G. C. L. Bertram and C. K. Ricardo, 'The dugong', *Nature*, Vol. 209, 26 February 1966, pp. 938-939, p. 938.

In 1940, Matron Peatry at Woorabinda hospital wrote that dugong oil was used in the hospital as an embrocation, with camphor oil in lieu of olive oil. She stated that about one hundred children from the dormitories and camps at the settlement received a daily issue of the oil, which amounted to a 5 lb tin of dugong oil per day and about 4 gallons per month, although by the winter months of 1941 the latter amount had increased to 8 gallons. On 21 February 1941, C. G. Brown, the Superintendent at Yarrabah Mission, requested a further delivery of dugong oil for that community. At Cherbourg, the Deputy Director of Native Affairs (DDNA) reported, approximately 240 people were receiving one tablespoon of dugong oil weekly; a similar daily dose was being given to the dormitory and camp children at Woorabinda, and to both the children and the adults at Palm Island. Peatry also stated that the dugong oil was used for cooking at Woorabinda settlement in addition to its medicinal use; the use of dugong oil for cooking was also reported by the Superintendent of Cherbourg, bringing the total weekly consumption of dugong oil to approximately 4 gallons at that settlement. The Superintendent of Doomadgee Mission also requested a case of dugong oil, stating that the product 'would be of great benefit to our people if procurable.'[67]

To supply the dugong oil, small fishing operations commenced, which were based at Palm Island and in Torres Strait. In 1940, from 15-20 December, the crew of the *Wanderlust* turtle-fishing boat, based at Palm Island, caught 240½ lbs of 'Dugong without bone', valued at 4d per lb, totalling £4.0.1.[68] The dugongs caught were butchered and boiled down in steam-powered plants located at several stations, such as the plant at Cape Bedford (near Hope Vale), which is mentioned in this account:

[67] Superintendent, Woorabinda Aboriginal Settlement to DNA, Brisbane, 30 December 1940, SRS505/1 Box 662 Item 4493, Correspondence Files (Alphanumeric), Woorabinda – Medical – Supplies, Dugong Oil, QSA; C. G. Brown, Superintendent, Yarrabah Mission, Cairns to DNA, Brisbane, 21 February 1941, SRS505/1 Box 1028 Item 7033, Correspondence Files (Alphanumeric), Administration – Yarrabah – Supplies, Dugong Oil, QSA; DDNA to AS, Cherbourg Aboriginal Settlement, 12 March 1941, SRS505/1 Box 585 Item 4027, Correspondence Files (Alphanumeric), Cherbourg – Medical – Supplies, Dugong Oil, QSA; AS, Cherbourg Aboriginal Settlement, to DNA, Brisbane, 24 March 1941, SRS505/1 Box 585 Item 4027, QSA; Superintendent, Woorabinda Aboriginal Settlement to DNA, Brisbane, 14 June 1941, SRS505/1 Box 662 Item 4493, QSA; Matron Peatry, Woorabinda Hospital, 13 September 1941, SRS505/1 Box 662 Item 4493, QSA; Superintendent, Cherbourg Aboriginal Settlement to DNA, Brisbane, 29 September 1941, SRS505/1 Box 585 Item 4027, QSA; Superintendent, Doomadgee Mission to DNA, Brisbane, 1 November 1941, SRS505/1 Box 698 Item 4740, Correspondence Files (Alphanumeric), Doomadgee Missions – Dugong Oil Issues, QSA.

[68] AS, Palm Island Aboriginal Settlement, 9 January 1941, 'State of Receipts, Expenditure and Earnings of 'Wanderlust' Turtle Fishing Crew for month ended 31/12/40 including Trip ended 22/11/40', SRS505/1 Box 520 Item 3625, Correspondence Files (Alphanumeric), Palm Island – Industrial – Fishing Industry – Production Turtle Meat, QSA.

> It is understood that suitable plant for this purpose [extracting dugong oil] has been in operation at Cape Bedford Mission for some time, and I would be glad to have brief particulars as to cost and capacity of suitable plant similar to this one, which apparently has proved most successful. A plant of moderate capacity and reasonable cost would be preferred to a big plant so that one can be established at each of the four main Western Islands, Saibai, Boigu, Mabuiag and Badu.[69]

By July 1941, a processing station had been established at Badu Island and a steam jacket plant for extracting dugong oil had been delivered to the island at the request of the Island Industries Board (IIB).[70]

Dugong oil produced at Badu Island was transported to Thursday Island before being shipped to the mainland ports in eight-gallon cases. By the end of 1941, at least 160 gallons had been sent to Cherbourg, 60 gallons to Woorabinda, 50 gallons to Palm Island, 48 gallons to Yarrabah, and 8 gallons to Doomadgee: a total of 326 gallons. Shipments of oil to those Aboriginal settlements during 1941 are shown in Table 7.1. By 1942, the supply of oil to the three settlements with the largest requirements had been organised into a system of standing orders placed with the IIB: Cherbourg received a regular delivery of 16 gallons of oil per month, Palm Island 8 gallons per month, and Woorabinda 4 gallons per month.[71] By January 1942, oil supplies at Thursday Island were almost exhausted, although the Protector of Islanders predicted an increase in supply, as more dugong fishing took place during the Christmas period, and as more crews would probably commence dugong-catching as the pearl-shell industry declined. The Second World War disrupted that predicted increase in dugong fishing and by 1944 the Queensland Director of Native Affairs (DNA) wrote that the small amount of dugong oil being produced in Torres Strait was insufficient to meet local requirements. However, after 1945, production of dugong oil resumed; by 1949, supplies of oil had been obtained from Boigu and Saibai Islands, including one shipment of 136 gallons.[72]

[69] Protector of Islanders, Thursday Island to DNA, Brisbane, 27 March 1941, SRS505/1 Box 795 Item 5434, Correspondence Files, Torres Strait – Industrial – Plant for Extraction – Dugong Oil, QSA.
[70] R. W. Stephenson, IIB, Badu Island to DNA, 16 July 1941, SRS505/1 Box 795 Item 5434, QSA.
[71] DDNA, Thursday Island to Protector of Islanders, Thursday Island, 23 October 1941, SRS505/1 Box 585 Item 4027, QSA.
[72] DDNA, Thursday Island to AS, Palm Island, 9 January 1942, SRS505/1 Box 585 Item 4027, QSA; DNA, Brisbane to Man., Qld. Pastoral Supplies Pty. Ltd., Brisbane, 18 April 1944, SRS505/1 Box 823 Item 5623, Correspondence Files (Alphanumeric), Torres Strait – Production – Disposal of Dugong Oil – Sales Southern Firms, QSA; DNA, Brisbane to Man., IIB, Thursday Island, 21 April 1949, RSI15058/1 Item 1346, General Correspondence, Islands – Marine Produce – Dugong Oil Industry, C. Turner to DNA, Thursday Island, 4 November 1949, RSI5058/1 Item 1346, QSA; Chairman, Saibai Island to DNA, 16 March 1950, RSI15058/1 Item 1346, QSA.

Date	*Destination*	*Quantity of dugong oil (gal.)*
28 April 1941	Cherbourg	16
24 June 1941	Palm Island	50
Early June 1941	Woorabinda	12
24 June 1941	Woorabinda	16
1 July 1941	Cherbourg	48
11 July 1941	Woorabinda	32
17 July 1941	Yarrabah	24
22 August 1941	Cherbourg	48
15 October 1941	Cherbourg	48
27 October 1941	Yarrabah	24
18 November 1941	Doomadgee	8
TOTAL		326

Table 7.1. Supplies of dugong oil to the Aboriginal settlements at Cherbourg, Woorabinda, Palm Island, Yarrabah and Doomadgee in 1941. A. J. Smith, 'An ethnobiological study of the usage of marine resources by two Aboriginal communities on the east coast of Cape York Peninsula, Australia', PhD Thesis, Department of Zoology, James Cook University of North Queensland, December 1987, p. 59, indicated that approximately 4 gallons of oil could be obtained from a large female dugong; hence, the quantities of oil contained in Table 7.1 required the capture of more than 80 animals.
Source: Compiled from archival files found in SRS505/1 (various Boxes), QSA.

By 1950, another dugong processing station was operating at Saibai Island. In that operation, the dugongs were captured using nets – which were inspected each morning – and the animals were either drowned or killed using a rifle before they were towed to the beach, where the butchering of the animals commenced and the blubber was removed.[73] The method of rendering dugong flesh to produce the oil at Saibai Island was described in the following terms:

> Take one clean empty 44 gallon drum, cut dugong meat into fairly small pieces and place inside empty drum. Assuming that the drum is half filled with meat. Add fresh water until meat is covered at least 6". Then add ¼ tin (Kerosene tin) of sea water. When it begins to boil, oil will rise to the surface. This is then skimmed off either by a ladle or small pannikin. Meat is boiled until quite soft. Oil is afterwards strained out in clean containers [*sic*].[74]

The dugong oil from Saibai Island supplemented that of Boigu Island and was used to supply the mainland Aboriginal settlements. In 1951, however, the DNA reported that the only dugong oil produced in Torres Strait had been obtained from Boigu Island. By that year, a small trade in shark oil supplemented the dugong produce.[75]

The Torres Strait stations not only supplied the mainland settlements with dugong oil, but also delivered dugong meat to local markets. In 1951, the DNA described these additional markets for dugong meat; although he regarded the harvest of dugongs as sustainable, he stated that:

> all Torres Strait Islanders utilise the dugong as food. This prevails on the Western Islands of Saibai, Boigu, Dauan, Mabuiag, and Badu to a greater extent than applies with the Eastern Islands of Murray and Darnley in that the Western Island Section of Torres Strait has better feeding grounds than the Eastern, nevertheless all islands participate in the consumption of dugong. Likewise Lockhart River Mission and the Missions on the west coast of the Peninsula as far south as Mornington Island depend on the dugong for food.[76]

[73] Report Ref. 39/434 Med. & San., 'Dugong oil: its source and therapeutic qualities', *c.*1951, RSI15058/1 Item 1346, QSA, pp. 1-3, p. 2.
[74] C. Turner, Welfare Officer, QDNA, Thursday Island, 'Saibai method rendering dugong meat for dugong oil', 30 October 1950, RSI5058/1 Item 1346, QSA.
[75] DNA, Thursday Island to Superintendent, Yarrabah, 16 December 1950, RSI5058/1 Item 1346, QSA; DNA to Superintendent, Mornington Island, 16 March 1951, RSI5058/1 Item 1346, QSA; DNA to Superintendent, Mornington Island, 2 April 1951, RSI5058/1 Item 1346, QSA; DNA to Director-General of Health and Medical Services, QDHHA, Brisbane, 2 July 1951, RSI5058/1 Item 1346, QSA.
[76] DNA to Director-General of Health and Medical Services, QDHHA, Brisbane, 2 July 1951, RSI5058/1 Item 1346, QSA.

An account by Rohde, published during the same year, indicates that some Aboriginal settlements also traded in dugong meat and oil as a source of income; he claimed that, at Cape Bedford, dugong oil and meat – as well as bêche-de-mer and trochus – were fished using a kerosene-powered boat and sold for the benefit of the Mission, and that dugong oil represented the most valuable of those commodities.[77]

The archival evidence found at the QSA indicates that the production of oil in Torres Strait was variable during the two decades after 1951. In 1955, the DDNA advised Mrs. Lambert of Brisbane that dugong oil supplies at Thursday Island were exhausted, but that the oil could be obtained from Pastoral Supplies Ltd., in Brisbane. In 1958, Chemist Roush of Brisbane reported being unable to obtain supplies of dugong oil, although previously that retailer had purchased large quantities of the oil. Yet by 1960 the drug store at Boigu Island reported receiving fresh stocks amounting to 140 gallons of dugong oil. The following year, two dugong fishers in Torres Strait reported that the animals had been 'scarce in their area', but they expected an improvement in their numbers during the north-west monsoon season and an order for 100 gallons of dugong oil had been placed. By 1963, supplies of dugong oil had been replenished and the DNA wrote to the Chairman of Boigu Island stating that no more dugong oil would be required 'for some months.'[78]

Fluctuations in the supply and demand of dugong oil continued during the 1960s. In 1966, the DDNA wrote to the Chairmen of each of the Torres Strait Islands, stating that dugong oil was urgently required at Thursday Island for medical purposes; the price paid to dugong fishers for the oil was consequently increased to £1 per gallon and the Chairman of Boigu Island Council ordered 'all men [*sic*] out to get dugong oil for the drug store'.[79] By 1970, a surplus of dugong oil had accumulated, as the Regional District Offices of the Queensland Department of Aboriginal and Island Affairs (QDAIA) reported:

[77] R. T. Rohde, *A visit to 'Boiling Springs': the Hope Vale (U.E.L.C.A.) Lutheran Mission (re-established), Cooktown, Queensland*, n.p., North Ipswich, Qld., 1951, p. 8.
[78] DDNA to Mrs. Lambert, Brisbane, 22 May 1955, SRS505/1 Box 823 Item 5623, QSA; A. D. Love, Manager, Chemist Roush Incorporating Modern Laboratories, 5 February 1958, RSI5058/1 Item 1346, QSA; E. Turner to DNA, Thursday Island, 9 May 1960, RSI5058/1 Item 1346, QSA; DDNA, Thursday Island, Memo, 19 December 1961, RSI5058/1 Item 1346, QSA; DNA to Chairman, Boigu Island, 26 August 1963, RSI5058/1 Item 1346, QSA.
[79] DDNA to Chairmen – all Islands, 18 February 1966, RSI5058/1 Item 1346, QSA; Chairman, Boigu Island to Deputy Chairman, Boigu Island, 8 May 1966, RSI5058/1 Item 1346, QSA.

> Periodically supplies of Dugong Oil are purchased from persons at Boigu Island. The Oil is held in the Drug Store Stocks for distribution to Medical Aid Posts as required. Small quantities are also supplied to the outpatients Cottage for cooking purposes. Due to a very limited demand for this item an accumulation of 123 gallons has resulted in stocks and it is extremely unlikely that anything approaching this quantity will be used in the foreseeable future.[80]

In contrast to the abundance of dugong oil in Torres Strait, the product was reported to be out of stock at pharmacist shops in Cairns, and one individual sought a supply of the oil from Lockhart River Mission, which she stated had for some time boiled its own stocks of dugong blubber.[81]

In 1969, the dugong was legally protected in Queensland waters and by 1970 the commercial production of dugong oil for Indigenous communities had almost ceased, with the exception of small quantities of oil traded between several Torres Strait Islands. In 1970, the remaining commercial stocks of 123 gallons of dugong oil at Boigu Island were sold. In place of the commercial dugong fishery, the introduction of a system of permits for Indigenous communities to harvest a limited numbers of dugongs and marine turtles was receiving consideration; by 1971, arrangements to allow Indigenous people who did not usually live on Reserves to take thirty dugongs and sixty turtles in any year were being debated.[82] A small fishery for dugong oil continued in Torres Strait; for example, in September 1971, the Manager of the QDNA at Thursday Island ordered 100 gallons of dugong oil that had been produced at Boigu Island. A small trade in dugong oil between those islands continued until at least 1976, with additional dugong fishing taking place at Mornington Island in the Gulf of Carpentaria.[83] Nevertheless, these small fishing operations fell outside the main period of the commercial fishing of dugongs – and also outside the scope of my research.

[80] Regional District Offices, QDAIA, Thursday Island to Dir., QDAIA, Brisbane, 11 February 1970, SRS505/1 Box 823 Item 5623, QSA.
[81] Mrs. I. Clark, Earlville, Cairns to Superintendent, Lockhart Mission, 21 January 1971, SRS505/1 Box 1150 Item 7762, Correspondence Files (Alphanumeric), Lockhart River – Industrial – Dugong Oil Industry, QSA; Stan Rogers, Man., QDAIA, Lockhart Mission to Mrs I. Clark, Earlville, Cairns, 29 January 1971, SRS505/1 Box 1150 Item 7762, QSA; Stan Rogers, Manager, QDAIA, Lockhart Mission to Dir., QDAIA, Brisbane, 29 January 1971, SRS505/1 Box 1150 Item 7762, QSA.
[82] J. M. Harvey, Director-General, QDPI, Brisbane to Dir., QDAIA, Brisbane, 29 March 1971 SRS505/1 Box 823 Item 5623, QSA; Dir., Qld. Dept. of Aboriginal and Islander Advancement, Brisbane to Mrs. F. G. Fisher, St. Lucia, Queensland, 9 October 1979, SRS505/1 Box 823 Item 5623, QSA.
[83] Man., Thursday Island to Chairman, Boigu Island, 20 September 1971, RSI5058/1 Item 1346, QSA; Man., Thursday Island to Chairman, Boigu Island, 20 December 1971, RSI5058/1 Item 1346, QSA; Man., Thursday Island to Chairman, Boigu Island, 6 July 1976, RSI5058/1 Item 1346, QSA; *Torres Strait Turtle Farmers' Newsletter*, No. 4, April 1972, RSI15058/1 Item 1346, QSA.

7.2.3 Indigenous hunting of dugongs

In addition to the impacts of the commercial fishing of dugongs described in Sections 7.2.1 and 7.2.2, other harvests of dugongs have taken place since European settlement, including hunting of dugongs by Indigenous people. Some details of the methods of dugong hunting by Indigenous communities on the east coast of the Cape York Peninsula have been provided by Smith; additional evidence of the impacts of Indigenous hunting of dugongs is presented below.[84] Indigenous hunting of dugongs pre-dates European settlement in Queensland; this activity also continued throughout the period of European settlement and after 1969, when the commercial harvest of dugongs was prohibited. Indigenous hunting of dugongs is recorded in documentary sources since at least 1893, when Saville-Kent cited the ethnographic observations of dugong hunting in the western Torres Strait Islands made by Professor A. C. Haddon; one of Haddon's photographs is reproduced in Figure 7.7. Haddon provided additional details of the methods used by Indigenous dugong hunters from Mabuiag to capture two animals during an earlier hunt, in October 1888, which exploited extensive fishing grounds at Orman's Reef – between Mabuiag and the coast of New Guinea – and he also described the earlier practice of constructing a bamboo platform (*nēĕt*) on the reef from which dugongs were speared, as Figure 7.8 illustrates.[85]

Other documentary evidence of the Indigenous hunting of dugongs is found in Banfield's account of 1908, in which he acknowledged that the 'rapacity' of Indigenous hunters had become a diminishing factor in the reduction of dugong numbers; his account included the photograph shown in Figure 7.9.[86] In addition to the method of harpooning described by Haddon, Banfield referred to the practice of constructing and setting nets for dugongs, and he also provided the following account of Indigenous hunting:

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[84] A. J. Smith, 'An ethnobiological study of the usage of marine resources by two Aboriginal communities on the east coast of Cape York Peninsula, Australia', PhD Thesis, Department of Zoology, James Cook University of North Queensland, 1987; extensive descriptions of the capture of dugongs at Cape Bedford (Hope Vale) and Lockhart River are also provided in A. J. Smith, *Usage of marine resources by Aboriginal communities on the east coast of Cape York Peninsula: report to the GBRMPA, June 1987*, Research Publication No. 10, GBRMPA, Townsville 1987.

[85] A. C. Haddon, *Head-hunters: black, white and brown*, Watts and Co., London, 1901, pp. 148, 152-153.

[86] Examples of documentary references to Indigenous hunting of dugongs include Banfield, *Confessions*, p. 162; C. H. Holmes, *We find Australia*, Hutchinson, London, 1933, pp. 126-128; and D. C. Tilghman, *The Queen State: a handbook of Queensland compiled under authority of the government of the State*, John Mills Himself, Brisbane, 1933, p. 59.

NATIVE CHIEF, NOMOA, OF JERVIS ISLAND, MABUIAG, ARMED WITH LONG SPEAR, OR "WAP," WITH WHICH HE KILLED THE TWO PROSTRATE DUGONG.

Figure 7.7. Traditional hunting of dugongs at Mabuiag, Torres Strait, 1893.

Source: Photograph by Professor A. C. Haddon, reproduced in Saville-Kent, *Great Barrier Reef*, p. 329.

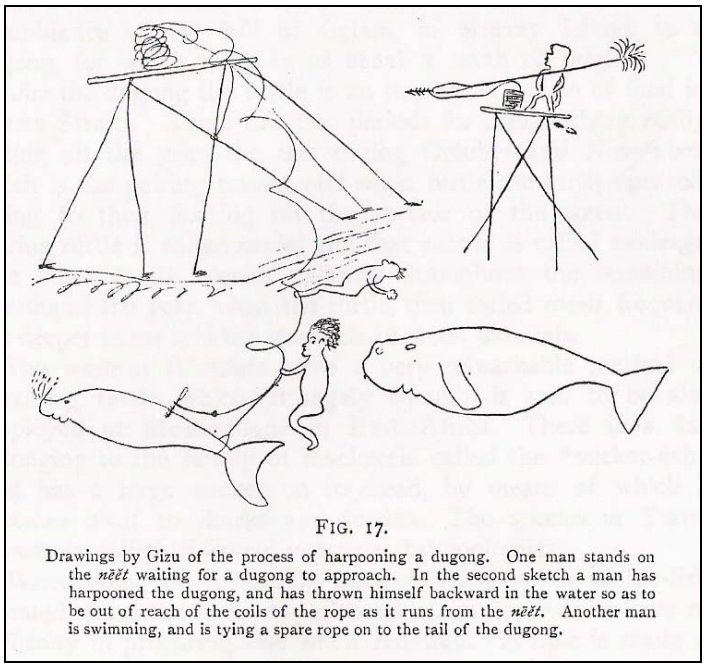


FIG. 17.

Drawings by Gizu of the process of harpooning a dugong. One man stands on the *nēēt* waiting for a dugong to approach. In the second sketch a man has harpooned the dugong, and has thrown himself backward in the water so as to be out of reach of the coils of the rope as it runs from the *nēēt*. Another man is swimming, and is tying a spare rope on to the tail of the dugong.

Figure 7.8. Illustration of a platform (*nēēt*) used for spearing dugongs in Torres Strait.

Source: Haddon, *Head-hunters*, p. 153.

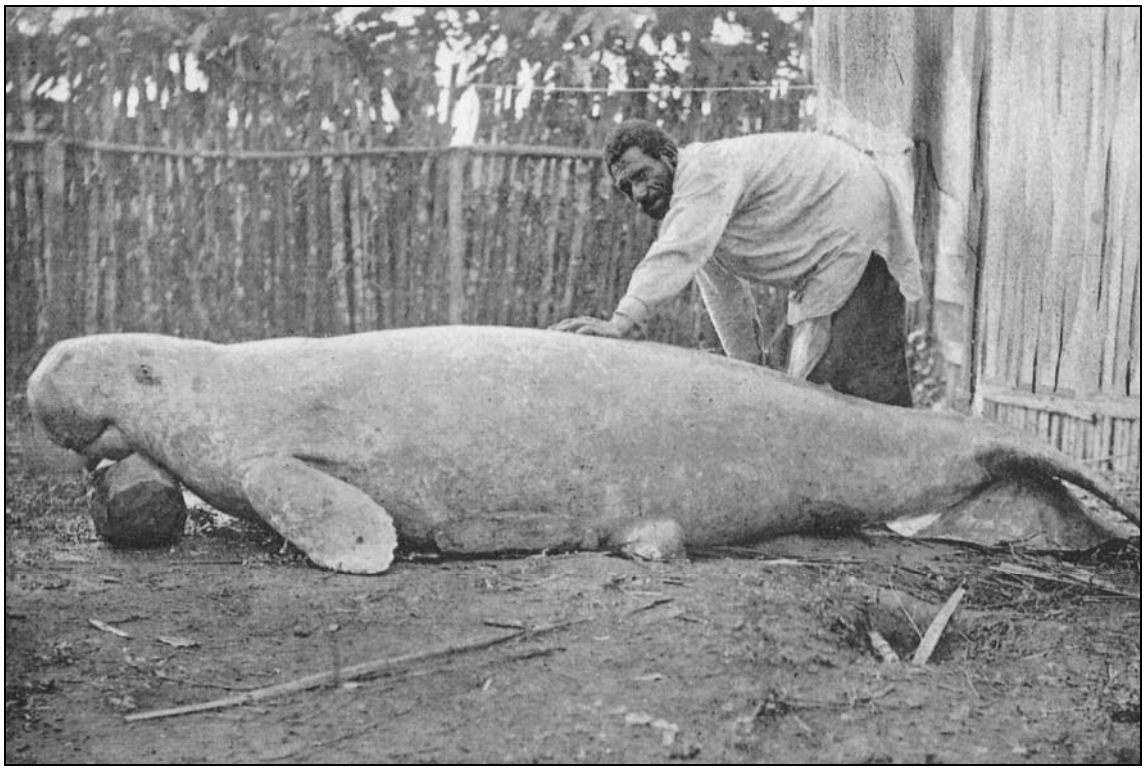


Figure 7.9. A dugong captured near Dunk Island, 1908.

Source: Banfield, *Confessions*, facing p. 162; a copy of this print was obtained from Image No. P03156, Image Library, CHS. Note also the turtle's carapace beneath the dugong's tail.

> Blacks [*sic*] harpoon dugong as they do turtle, but the sport demands greater patience and dexterity, for the dugong is a wary animal and shy, to be approached only with the exercise of artful caution. […] To be successful in the sport the blacks must be familiar with the life-history of the creature to a certain extent – understanding its peregrinations and the reason for them – the strength and trend of currents and the locality of favourite feeding-grounds. Fragments of floating grass sometimes tell where the animal is feeding. An oily appearance on the surface of the sea shows its course, and if the wind sits in the right quarter the keen-scented black detects its presence when the animal has risen to breathe at a point invisible to him. He must know also of the affection of the female for her calf, and be prepared to play upon it implacably.[87]

A similar, early account of Indigenous hunting of dugongs, by Wandandian (Richard Dyatt) was published in 1912, in which he described the capture of a dugong cow in Trinity Bay and the butchering of the animal to produce 528 lb of meat. Wandandian also referred to the spearing of seven dugongs in 90 minutes by one dugong hunter in Trinity Bay.[88]

By 1936, Sunter provided an account of the hunting of a dugong by Indigenous people several years previously at Bowen Straits; he also acknowledged the apparent increasing scarcity of the animal in coastal Queensland waters. The hunt took place using a canoe that was equipped with a harpoon, and the implements used were described as follows:

> The harpoon was a circular piece of steel, half an inch in diameter, and six inches in length. One end was sharpened to a fine point, while the other was flat at the top; two inches from the sharp end, it was half-cut through, with the cut slanting upwards towards that end; this would assist in holding the creature once it was struck. The rope, thirty fathoms, was made fast to the non-business end; it was half-inch line; the rest of it was neatly coiled in the bows of the canoe. The haft of the spear was about ten feet long; the harpoon fitted into the thicker end.[89]

Sunter reported that the canoe was paddled towards a dugong; when the animal was within range, the harpoon was thrust into its body and the boat was towed by the captive dugong. Eventually, exhausted, the dugong rose to the surface and was pulled into the

[87] Banfield, *Confessions*, pp. 164-165.
[88] Wandandian (R. Dyatt), *Travels in Australasia*, Cornish Brothers, Birmingham, 1912, pp. 145-146 and 148-149.
[89] G. H. Sunter, 'The dugong', *Walkabout*, 1 March 1936, pp. 47-48, p. 47; see also G. H. Sunter, *Adventures of a trepang fisher: a record without romance, being a true account of trepang fishing on the coast of northern Australia, and adventures met in the course of the same*, Hurst and Blackett, London, 1937, p. 60.

canoe; the dugong was later butchered on the shore. Sunter stated that dugong meat was cooked either by being thrown into a fire or by being boiled in a tin of water.

Another method of Indigenous dugong hunting was described by Smart, in an account of 1951, who stated:

> [the dugong] was hunted mainly from a raft of mangrove cedar called a Walpa. These rafts were very primitive, being simply the trunks of mangrove denuded of bark and branches and lasted together in a rough bundle. A heap of dried grass was placed on the top of this, and the hunters then propelled the clumsy craft from a kneeling position, using mangrove roots for paddles.[90]

Smart described the way in which hunters used the sound of the dugong exhaling to locate the animals; the dugongs were then speared when the raft was within striking range. In addition to the use of rafts, Smart described the method of fishing for dugongs using a system of wooden barriers and bark nets that were constructed across the entrances of small rivers. The dugongs were then driven into the nets using 'Walpas'. Once caught, the animals were drowned by holding them beneath the water, and rolled up the beach, before being butchered using sharp shells. This process involved removing the head and tail, opening the belly, removing the entrails and, finally, roasting the remaining flesh on the hide. The bones of the animal were smashed and, Smart reported, the blood was used for medicinal purposes.[91]

Smart also described an alternative method of dugong hunting and butchering used at Mornington Island, where the dugongs were harpooned from a canoe, towed in the water and drowned using a rope. At the beach, the head of the animal was removed and two cuts were made along the length of the spine; the hide between these cuts was then removed. The underlying flesh was cut down to the ribs and vertebrae; those bones were cut using an axe and the two halves of the carcass were separated. The animal meat was then carved, and Smart noted that no part of the animal was wasted, including the flippers and the tail, which were roasted. His account suggests that almost all of the butchered dugong was used for food rather than for the production of oil. Further details of Indigenous methods of capturing and butchering the dugong were provided in studies by the anthropologist, Donald Fergusson Thompson, who investigated dugong hunting

[90] P. Smart, 'The dugong', *Walkabout*, 1 November 1951, pp. 34-35, p. 34.
[91] Smart, 'The dugong', p. 35.

in Cape York; in addition to those details, Thompson also referred to the Indigenous hunting of dugongs at several locations, including Princess Charlotte Bay, the Stewart River, Temple Bay, Cape Direction (Lockhart River) and Cape Sidmouth.[92]

In addition to these documentary sources, many oral history informants expressed concerns that the rate of Indigenous hunting of the animal has become unsustainable, given the vulnerable status of the species.[93] Informants reported that dugongs were once seen near Green Island, Hinchinbrook Island, Corbett Reef, Port Douglas, Cooya Beach, Wentworth Reef and the Mowbray River, at various times between the 1930s and the 1970s, and that dugongs had apparently become scarcer in those places.[94] However, this evidence is not unequivocal; other impacts have occurred concurrently with Indigenous hunting. For example, one informant reported that there used to be 'stacks' of dugong in the waters around Hinchinbrook Island before the Second World War; the same informant observed a decline in seagrass abundance after the war, which he attributed to the activities of trawlers in the Cardwell area. Another informant reported the disappearance of nine dugongs that used to visit seagrass beds between Port Douglas and Cooya Beach, near Mossman, in the 1960s and 1970s, but he acknowledged that, in addition to Indigenous hunting, dugongs had become entangled in commercial fishing nets on occasions; two oral history accounts of changes in dugong populations at Green Island, between the mid-1930s and the 1970s, also related the apparent occurrence of dugongs to the abundance of seagrass.[95]

Although the Indigenous hunting of dugongs, as described in this section, has impacted Torres Strait and the Great Barrier Reef, this impact has occurred along with multiple impacts upon dugongs, including the substantial harvests of dugongs made by commercial dugong fishers prior to 1970; in addition, dugongs have been caught in shark nets, set in Queensland for bather protection, which have resulted in the deaths of 654 dugongs in Queensland since 1962, and as a result of boat strikes. Due to these

[92] D. F. Thomson, 'The fishermen and dugong hunters of Princess Charlotte Bay', *Walkabout*, Vol. 22, No. 11, 1 November 1956, pp. 33-36; D. F. Thomson, *Donald Thomson's mammals and fishes of northern Australia*, ed. J. M. Dixon and L. Hurley, Nelson, Melbourne, 1985, pp. 14-15 and 156-162.
[93] For examples, see OHC 16, 2 September 2003, pp. 7 and 12; OHC 22, 12 September 2003, pp. 8-9; OHC 23, 15 September 2003, pp. 5-6; OHC 28, 19 September 2003, pp. 9-10; and OHC 38, 10 November 2003, p. 8.
[94] Relevant accounts include OHC 16, 2 September 2003, p. 12; OHC 22, 12 September 2003, pp. 8-9; OHC 23, 15 September 2003, p. 9; and OHC 28, 19 September 2003, p. 10.
[95] OHC 2, 9 November 2002, p. 8; OHC 16, 2 September 2003, p. 12; OHC 22, 12 September 2003, p. 9; OHC 38, 10 November 2003, p. 4.

other, anthropogenic factors, dugong populations are now considerably influenced by harvesting by Indigenous hunters. Since the decline of commercial dugong fishing, the impact of Indigenous hunting now represents one of the most critical management issues for dugongs in Queensland and the hunting of dugongs probably occurring at unsustainable rates in Torres Strait and the northern GBRWHA.[96] However, as Marsh *et al.* have shown, the various impacts on dugong populations cannot easily be quantified, and any interpretation of historical evidence relating to changes in dugong populations involves assumptions that must be made explicit.[97] Therefore, the evidence presented in this section indicates that significant changes in dugong populations may have occurred since European settlement, but that those changes must be placed in the context of the species' biology – particularly its tendency to undertake large-scale movements – and the multiple impacts on the species that must be elucidated using scientific monitoring and research.[98] In addition, the implications of this evidence for the contemporary management of dugongs in the GBRWHA are considered in Section 8.5.

7.3 Impacts on marine turtles

Of the seven species of marine turtle found in the world, six occur in the GBRWHA: the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), flatback (*Natator depressus*), olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*) turtles. Dobbs has provided an overview of the conservation status of each of those six species, which is shown in Table 7.2 and which indicates that all are defined either as endangered or as vulnerable at the Commonwealth and Queensland levels; furthermore, Dobbs acknowledged that these marine turtle species have been listed in those various categories either as a result of the cumulative effects of anthropogenic impacts or because the current impacts are likely to

[96] CRC Reef Research Centre, *Dugongs in the Great Barrier Reef: the current state of research*, CRC Reef Research Centre, Townsville 1998); Marsh *et al.*, *Dugong: status report*, pp. 119 and 128.
[97] H. Marsh *et al*., 'Historical marine population estimates: triggers or targets for conservation? The dugong case study', *Ecological Applications*, Vol. 15, 2005, pp. 481-492, p. 481.
[98] H. Marsh *et al.*, 'Aerial surveys and the potential biological removal technique indicate that the Torres Strait dugong fishery is unsustainable', *Animal Conservation*, Vol. 7, 2004, pp. 435-443, p. 441; in this article, Marsh *et al*. acknowledged that long-distance movements are made by individual dugongs.

Common Name	**Scientific Name**	**IUCN (World Conservation Union)**	**Commonwealth *Environment Protection and Biodiversity Act, 1999***	**Queensland *Nature Conservation (Wildlife) Regulation, 1994***
Family: Chelonidae				
Loggerhead	*Caretta caretta*	Endangered	Endangered	Endangered
Green	*Chelonia mydas*	Endangered	Vulnerable	Vulnerable
Hawksbill	*Eretmochelys imbricata*	Critically Endangered	Vulnerable	Vulnerable
Flatback	*Natator depressus*	Vulnerable	Vulnerable	Vulnerable
Olive Ridley	*Lepidochelys olivacea*	Endangered	Endangered	Endangered
Family: Dermochelidae				
Leatherback	*Dermochelys coriacea*	Endangered	Vulnerable	Endangered

Table 7.2. The conservation status of the six marine turtle species of the GBRWHA. This table lists the status of these species according to the criteria used by the IUCN, and in Commonwealth and Queensland Government legislation.

Source: K. Dobbs, *Marine turtles in the GBRWHA: a compendium of information and basis for the development of policies and strategies for the conservation of marine turtles*, GBRMPA, Townsville, 2001, p. 5.

cause species to become endangered.[99] As a result of numerous natural and anthropogenic pressures – including predation of nests by feral foxes and pigs, incidental catches in fishing and shark control nets, ingestion of litter, boat strikes, Indigenous hunting, habitat destruction, prawn trawling and tourism – declines in many turtle populations for which data exist have been acknowledged. In particular, marine turtles are vulnerable to such impacts as a result of their life history, which is based on a very high natural mortality of hatchlings and of small juvenile turtles and, consequently, a very low mortality of large juveniles and adults, a limited number of nesting beaches, high fidelity to nesting sites and feeding grounds, limited interaction between genetic stocks, and long maturation periods. Consequently, the actual magnitude of anthropogenic impacts on turtles is not likely to be apparent for decades after such impacts occur.[100]

One characteristic of the life history of marine turtles that makes significant historical anthropogenic impacts on turtles in the GBRWHA possible is that mature female turtles come ashore at nesting sites located at numerous beaches in the GBRWHA, in order to lay several (2-7) large clutches of eggs in a single nesting season. Dobbs has explained the management implications of this characteristic in more detail, and further discussion of the management implications of changes in marine turtle populations is also found in Section 8.5.[101] Several of the historical activities described below – especially the commercial turtle fisheries (described in Section 7.3.2) and turtle-riding (Section 7.3.3) impacted disproportionately on mature female turtles at the times when they came ashore to lay eggs. Given the long-lived, slow-maturing nature of marine turtles and their need for high adult survivorship, such impacts probably exceeded the sustainable harvests of green and hawksbill turtles, as Dobbs' analysis of the exploitation of those species suggests. In addition, she argued that the long-distance movements made by turtles – both within and outside of the GBRWHA – necessitate integrated management initiatives at local, state, national and international levels.[102]

[99] K. Dobbs, *Marine turtles in the GBRWHA: a compendium of information and basis for the development of policies and strategies for the conservation of marine turtles*, GBRMPA, Townsville, 2001, pp. 5-6.
[100] Dobbs, *Marine turtles in the GBRWHA*, *passim*; see also Limpus, 'Marine turtles of the GBRWHA', pp. 256-258.
[101] Dobbs, *Marine turtles in the GBRWHA*, p. 6.
[102] Dobbs, *Marine turtles in the GBRWHA*, p. 8 and 38.

Indigenous people exploited all species of marine turtles for their eggs – and green and hawksbill turtles for their meat – for thousands of years before European contact. The exploitation of at least two species (green and hawksbill turtles) by Europeans occurred in the Great Barrier Reef region since the earliest period of European exploration. The crews of vessels since the *Endeavour* caught green turtles in the Great Barrier Reef as a supply of fresh meat; by the mid-nineteenth century the hawksbill turtle was sought as a source of tortoise-shell for export. By 1930, substantial harvests of green turtles had been made in the Great Barrier Reef for the manufacture of turtle soup, with concentrations of turtle harvesting in the Capricorn-Bunker Group and in Torres Strait, and the introduction of refrigeration facilities also encouraged the increased consumption and export of green turtle meat. Other interference with turtles – including turtle-riding at tourist resorts and the manipulation of turtles and turtle eggs in Torres Strait by turtle farmers – represent other types of anthropogenic disturbance of these animal, although other impacts such as boat strikes and the by-catch of turtles in fishing nets have also been sustained. Added to those impacts is the Indigenous hunting of turtles that pre-dates the period of European settlement in Queensland. The combined effect of all of these activities represents a significant impact on turtles in the Great Barrier Reef and Torres Strait, with the result that, by 1997, all six species of marine turtle found in the GBRWHA were classified as either endangered or vulnerable.[103]

However, the impacts on turtles species varied by species, by historical period and by geographical location; documentary and oral evidence indicates that particular exploitation of green turtles took place during the 1920s in Capricorn-Bunker Group, and of green and hawksbill turtles during the 1970s in Torres Strait, and those impacts are emphasised in this section. Some stocks of turtles migrate far beyond the boundaries of the GBRWHA to Torres Strait, the Coral Sea and neighbouring Asian and Pacific countries. Impacts of turtles that occurred in Torres Strait are considered in this environmental history narrative as they directly influence the status of turtle populations in the Great Barrier Reef. The account of turtle farming presented in Section 7.3.5 also extends beyond the main historical period considered in my research, for reasons that have been explained in Section 7.1.

[103] C. Limpus, 'Marine turtles of the Great Barrier Reef World Heritage Area', in D. R. Wachenfeld *et al.* (eds), *State of the GBRWHA Workshop*, pp. 256-258.

7.3.1 The tortoise-shell industry, 1871-1940s

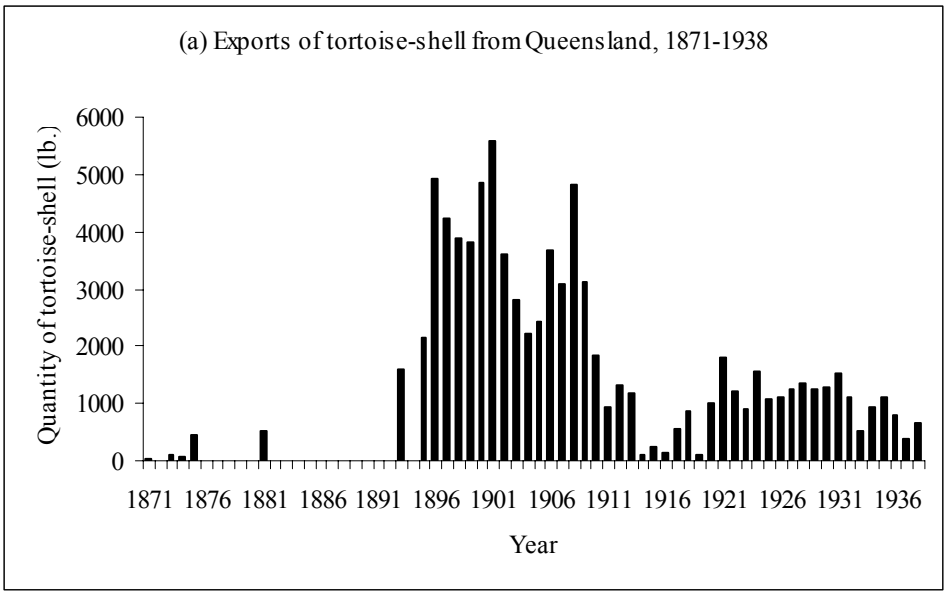
The tortoise-shell industry commenced early in the period of European settlement. In 1871, 20 lbs. of tortoise-shell were exported to Great Britain; the weights of tortoise-shell exported from Queensland from that year until 1938 are shown in Figure 7.10 (a), which indicates that the industry took place on a comparatively small scale until 1893. The industry was based on the thick, overlapping scales that were removed from the carapace of the hawksbill turtle (*Eretmochelys imbricata*), which formed an ideal export commodity as the shell could be dried and stored easily. Saville-Kent indicated that small quantities of tortoise-shell were also obtained from the green turtle, although those animals yielded a material of lower quality. Tortoise-shell production operated concurrently with bêche-de-mer fishing, with the same crews and vessels being engaged in both trades; in addition, some crews were also involved in the pearl-shell and oyster fisheries, with the result that considerable overlap occurred between tortoise-shell production and the other early European reef fisheries that have been described in Section 5.3.[104] The harvest of turtles for the tortoise-shell trade was concentrated in the northern Great Barrier Reef; in 1888, Campbell, a Queensland Inspector of Fisheries, reported that the hawksbill turtle – 'the tortoise from which the shell of commerce is taken' – was very rare, in contrast, in Moreton Bay.[105]

By 1889, Saville-Kent reported, the trade in tortoise-shell had increased, although the production statistics for tortoise-shell for that year were not published in the Annual Reports of the QDHM or in the *SCQ* (Figure 7.10 (a)). Yet in 1893 Saville-Kent stated:

> The average annual value of [tortoise-shell] exported from Queensland within the past ten years has slightly exceeded £400. A higher figure, and one that indicates that the trade in tortoise-shell is increasing, was, however, reached in the year 1889, when it amounted to as much as £1,705.[106]

Saville-Kent reported that high-quality tortoise-shell reached a price of between £1 and £1 5s per imperial pound. One type of turtle with a characteristic, yellow-coloured shell,

[104] The connections between various fisheries were acknowledged by Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 733; and by Bennett, AR, Fisheries, 1898, *QVP*, 1899, p. 1048; see also Saville-Kent*, Great Barrier Reef*, p. 322 for an account of the use of the Green turtle (*Chelonia mydas*) in the production of an inferior type of tortoise-shell.
[105] F. T. Campbell, 'Report on the oyster fisheries of Moreton Bay', *QVP*, Vol. 4, Part 1, 1887, pp. 115-129, p. 123.
[106] Saville-Kent, *Great Barrier Reef*, p. 322.



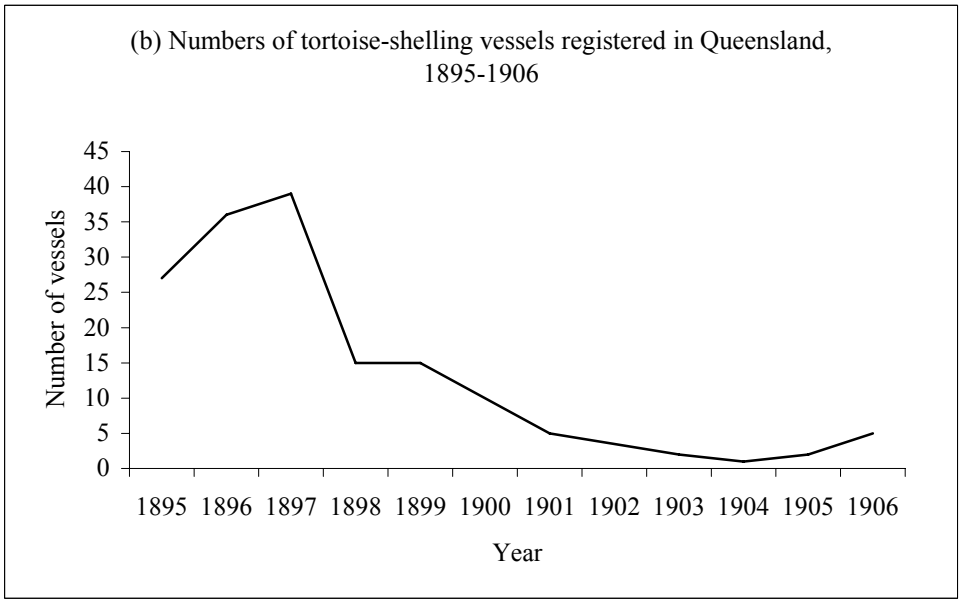


Figure 7.10. (a) Exports of tortoise-shell from Queensland, 1871-1938; (b) Numbers of tortoise-shelling vessels registered in Queensland, 1895-1906.

Source: Compiled from data provided in AR, QDHM, 1895-1938, *QVP*, 1896-1900; in *QPP*, 1901-1939, *passim*; in *SCQ*, 1871-1900, *passim*; and in *SSQ*, 1901-1903, *passim*. The statistics found in the Annual Reports of the QDHM were sometimes inconsistent with those published in the *SCQ* and the *SSQ*; where a discrepancy occurred, the data from the Annual Reports were used, as that time series spanned a longer period and those statistics were presented in a more consistent form. The statistics found in *SCQ* and *SSQ* present some values in imperial pounds and others in 'packages'; *cf. SSQ*, 1901, p. 234 and *SSQ*, 1902, p. 214.

which Saville-Kent regarded as a variant of the hawksbill turtle, however, was highly sought after and obtained a price of £20 per imperial pound.

Figure 7.10 (a) indicates that very large quantities of tortoise-shell were exported from Queensland during the two decades from 1890 and 1910, and rapid expansion of the industry had taken place by 1897; the increase in the number of tortoise-shelling vessels registered in Queensland between 1895 and 1897 is shown in Figure 7.10 (b). In 1899, George H. Bennett, a Queensland Inspector of Fisheries, stated: 'The supply of shell turtle seems to continue much the same, year by year, and affords an easy means of livelihood to the few coloured men [*sic*] engaged in it'; the following year, Bennett reported that:

> [tortoise-shell] is so valuable that shell-turtle is captured, when possible, by anyone who sees it, and has the means of attacking it – *i.e.*, a boat and a spear. How the shell-turtle maintains its number in spite of all the enemies that pursue it – from the time the egg (an esteemed article of food) is laid on the sand beach through all the stages of its existence – is something of a mystery; but the fact remains that the shell-turtle appears to be as plentiful as even, and its pursuit furnishes occupation and subsistence to a number of men [*sic*].[107]

His account suggests that, as early as 1900, the hawksbill turtle had experienced considerable exploitation and that some doubts may already have been raised about the sustainability of the fishery. In 1901, the quantity of tortoise-shell exported from Queensland reached 5,579 lb, as Figure 7.10 (a) shows; by the end of the following year, tortoise-shell had been shipped to New South Wales, Hong Kong, Ceylon and Germany in addition to Great Britain.[108]

However, by 1908 concerns had been expressed about the extent of exploitation of hawksbill turtles, as evidence collected for the inquiry of the Royal Commission into the pearl-shell and bêche-de-mer industries reveals. Herbert Bowden, a pearl-sheller and merchant, reported that 'more notice should be taken of the present criminal action of men slaughtering turtle in the way they are doing'; and he stated: 'There is an enormous market for the turtle-shell itself. Hawksbill turtle is slaughtered wholesale for it.'[109] Another pearl-sheller and merchant, Kenneth Ord Mackenzie, reported to the Royal

[107] Bennett, AR, Fisheries, 1898, *QVP*, 1899, p. 1048; Bennett, AR, Fisheries, 1899, *QVP*, 1900, p. 1319.
[108] See the export statistics published in *SCQ*, 1875-1900; and in *SSQ*, 1901-1902, *passim*.
[109] Mackay *et al.*, *Report*, p. 197.

Commission that the shell was removed from the backs of turtles using hot water while the animals were still alive, with the result that the shell was allowed to re-grow.[110] However, the Royal Commission also heard evidence that the tortoise-shell industry had experienced a recent decline due to low prices for the product. Mackenzie reported that he had fished for tortoise-shell for a period of about six months and exported the material to London, but he stated that the catches were smaller and the market value was lower than he had anticipated, resulting in a small loss for his firm, Bowden and Mackenzie. One other merchant, Arthur Thomas Sullivan, also reported that the price of tortoise-shell was very low, although he argued that the industry remained profitable.

The declining profitability of the industry resulted in a contraction in fishing effort after 1897 and the reduction in tortoise-shell vessels registered in Queensland from 1897-1904 is shown in Figure 7.10 (b); the associated decline in tortoise-shell exports from Queensland after 1908 is illustrated in Figure 7.10 (a). However, changes in fishing practices may also have occurred in the industry after 1897, as the initial reduction in the number of vessels registered did not immediately cause tortoise-shell exports to decline. Instead, the industry may have become less specialised and hawksbill turtles were probably harvested in an opportunistic manner by the crews of vessels registered for other fisheries, such as the bêche-de-mer fishery. Additional markets for tortoise-shell were found in Japan and the United States of America, although Great Britain remained the main destination for the product, and a small quantity of tortoise-shell was also exported to New South Wales.[111] Nonetheless, the price of tortoise-shell remained low and a sharp decline in the trade took place after 1908. Exports of tortoise-shell were particularly low during the years of the First World War (Figure 7.10 (a)) and, in 1915, J. R. Smith, an Inspector of Fisheries, stated: 'There is scarcely any demand for this shell at present, and consequently little attention is given to this branch of the industry.' By 1917, the Queensland Inspector of Pearl-Shell Fisheries, R. Holmes, reported: 'The trade in connection with tortoiseshell has declined to such an extent that it is now a negligible quantity so far as the industry is concerned.'[112]

[110] Mackay *et al.*, *Report*, p. 129.
[111] The destinations for the product are listed in *SSQ*, 1916-1924, *passim*.
[112] J. R. Smith, AR, QDHM, 1915, *QPP*, Vol. 3, 1916, pp. 1635-1668, p. 1666; R. Holmes, AR, Pearl-shell fisheries, 1917, *QPP*, Vol. 1, 1918, pp. 1667-1669, p. 1668.

A small revival of the tortoise-shell trade took place after the end of the First World War, which persisted until at least the outbreak of the Second World War. By June 1929, the value of tortoise-shell exports was £1,643, and Barrett wrote that in several years the annual revenue of the industry reached £2,000 or £3,000.[113] However, although exports of tortoise-shell continued until at least 1938, the trade never again took place in Queensland on a scale comparable to that of the period prior to 1908, and during the 1950s synthetic materials replaced the use of tortoise-shell and the market for the product collapsed. Yet the evidence presented above indicates that by 1938 at least 86,020 lb (over 38 tons) of tortoise-shell had been exported from Queensland, representing a considerable number of animals. As a result of the scale of this fishing effort, the tortoise-shell industry probably represented a significant impact on hawksbill turtle populations in the northern Great Barrier Reef and in Torres Strait, particularly since an incentive existed to harvest larger animals that yielded greater quantities of shell and that were more easily captured in the vicinity of traditional breeding sites, and also because of the low rates of growth and recruitment to adult populations that characterise the species.[114]

7.3.2 Commercial turtle fishing, 1867-1962

The commercial exploitation of the green turtle (*Chelonia mydas*) occurred in the Great Barrier Reef – particularly in the Capricorn-Bunker Group and in Torres Strait (which reflects the fact that two genetic stocks of green turtle exist, which nest in the Capricorn-Bunker Group, and at Bramble and Pandora Cays, respectively) – in several episodes between 1867 and 1962; a considerable amount of documentary and oral evidence describes the operation and impacts of this fishery. However, the opportunistic exploitation of green turtles for food extended beyond these dates. Early European explorers harvested turtles as a supplement to the ship's diet; the crew of the *Endeavour*, for example, took 21 large turtles in 27 days, near the Endeavour River, while the ship was being repaired.[115] The opportunistic harvesting of turtles in the Bunker Group commenced in 1803, during a voyage made by Ebenezer Bunker, in

[113] C. Barrett, *Australia's coral realm: wonders of sea, reef and shore*, Robertson and Mullens, Melbourne, 1943, pp. 40-41.
[114] Limpus, 'Marine turtles of the GBRWHA', p. 256.
[115] C. J. Limpus, 'The Green turtle, *Chelonia mydas* in eastern Australia', *Management of turtle resources: proceedings of a seminar held jointly by Applied Ecology Pty. Ltd. and the Department of Tropical Veterinary Science at Townsville, Queensland, Australia, 28 June 1979*, JCU Research Monograph 1, JCU, Townsville, 1980, p. 5.

order to complement the provisions of sailing ships; this practice continued throughout the remainder of the nineteenth century. In 1843, for example, *H.M.S. Fly* was stocked with turtles at Heron Island, and Jukes stated that in the Bunker Group turtles 'in the greatest abundance were taken […]. Turtle-soup, turtle-steaks, turtle-pie, and stewed flippers were our regular food for some time.'[116] In about 1865, one report acknowledged the prevalence of turtles in Queensland bays; however, the earliest evidence of the commercial harvest of turtles for food is found in the export statistics published in the *SCQ*, which indicate that the export of turtles from Queensland commenced in 1867; another report, of 1872, described a large harvest of 122 green turtles at Lake Creek, near Rockhampton, by one or two turtle-fishing boats.[117] Exports of turtles from Queensland for the period since 1867 are shown in Figure 7.11.

In 1886, Cecil S. Fison, a Queensland Inspector of Fisheries, reported that turtles were 'most plentiful in the summer months' in Moreton Bay. Another report, by F. T. Campbell, indicated that the harvest of green turtles had already occurred for turtle soup manufacture; he stated that, of the four types of turtles found in Moreton Bay:

> The green turtle of turtle-soup fame is the only valuable one of the lot, and is far the most abundant. They are caught in nets of a large mesh, and are mostly used in Brisbane at the hotels, and also preserved in tins as soup by Skinner of the Valley and other meat preservers. They are most common in the southern parts of the Bay, such as Russell Island, Swan Bay, and Broadwater, where a couple of men working industriously may take eight or ten per week. They are of large size and sometimes weigh 5 cwt.[118]

His account suggests that a considerable industry had been established in the Moreton Bay area by 1886 in order to process and distribute green turtle meat and soup.

A decade later, by 1896, the commercial turtle fishery had expanded in the Moreton Bay area. In that year, Saville-Kent indicated that preserved turtle meat was sought for the Chinese and other markets; in addition, Fison stated that Peter Tuska had carried

[116] Jukes, *Letters and extracts*, p. 172.
[117] SPCK (Society for the Promotion of Christian Knowledge), *Australia; a popular account of its physical features, inhabitants, natural history and productions: with the history of its colonization*, SPCK, London, *c.*1865, p. 254; *The Rockhampton Bulletin*, 7 January 1872, cited in *Pugh's almanac*, 1872; *SCQ*, 1870-1900, *passim*; and *SSQ*, 1901-1902, *passim.*
[118] Fison, AR, Fisheries, 1885, *QVP*, 1886, p. 835; Campbell, 'Report on the oyster fisheries of Moreton Bay', *QVP*, 1887, p. 123.

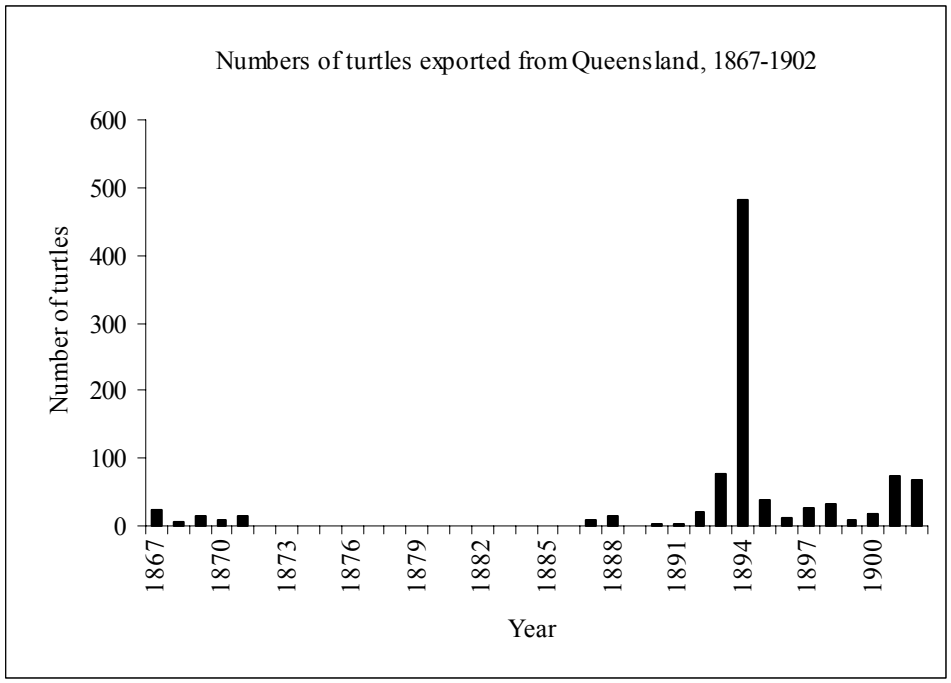


Figure 7.11. Exports of turtles from Queensland, 1867-1902.

Source: Compiled from data provided in *SCQ*, 1870-1900, *passim*; and in *SSQ*, 1901-1902, *passim.*

out a turtle fishing operation in the Central-Moreton districts, where the supply of turtle meat was found to be 'sufficient for the moderate demand of the Brisbane Preserving Works'.[119] In an account of his travels in Australasia, Michael Davitt provided the following account of turtles in the Fitzroy River estuary:

> On rising early in the morning to enjoy the view of the estuary of the Fitzroy, I was made aware of our having shipped several new passengers somewhere during the night. These were huge turtles, enormous monsters, so heavy that a sailor could not lift one of them. They are plentiful off the coast, inside the Barrier Reef, from Keppel Bay up northwards. They are, of course, cheap owing to their numbers, and it is customary, I was told, for drinking salons in the coastal towns to have turtle soup 'on tap' in the drinking bars, as appetisers for the votaries of 'shandy-gaffs' or 'long' drinks; just as cheese and scraps are made to answer a similar purpose in some English public houses.[120]

By 1899, Fison reported, the green turtles were still 'in fair supply when required'; and the following year, James H. Stevens, the next Inspector of Fisheries, stated that a 'good supply of turtle can nearly always be obtained when required.'[121]

In 1900 and 1901, the turtle industry expanded in response to the introduction of refrigeration facilities, which allowed the exports of frozen turtle meat. Stevens stated:

> A very promising trade in turtle has been opened up during the year, several fair consignments having been placed in London and Vancouver by the Brisbane Fish Agency Company, and if regular supplies can be maintained this company anticipate securing regular orders.[122]

The Brisbane Fish Agency Company alone handled 70 green turtles during that year, obtaining a value of £70 for the animals. Over the following two years, the orders for turtles were easily met by that company – 53 animals being ordered in the first year – and 14,766 lbs of frozen turtle meat, in addition to 142 green turtles, were exported from Queensland; moreover, the animals were reported to occur in large numbers in the Moreton Bay area, in spite of the increasing size of the harvest.[123]

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[119] Fison, AR, Fisheries, 1896, *QVP*, 1897, p. 637.
[120] M. Davitt, *Life and progress in Australasia*, Methuen and Co., London, 1898, pp. 261-262.
[121] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 733; C. S. Fison, AR, Fisheries, 1898-1899, *QVP*, Vol. 3, 1899, pp. 1039-1040, p. 1040; J. H. Stevens, AR, Fisheries, 1899-1900, *QVP*, Vol. 5, Part 2, 1900, pp. 997-998, p. 998.
[122] J. H. Stevens, AR Fisheries, 1900-1901, *QPP*, Vol. 3, Part 2, 1901, pp. 1321-1325, p. 1325.
[123] *SSQ*, 1901, pp. 219 and 226; *SSQ*, 1902, pp. 196 and 205; J. H. Stevens, AR, Fisheries, 1900-1901, *QPP*, 1901; J. H. Stevens, AR, Fisheries, 1901-1902, *QPP*, Vol. 3, 1902, pp. 965-968, p. 967.

During the first decade of the twentieth century, more extensive exploitation of the turtle resources of Queensland was anticipated, stimulated by the increasing demand for turtle products in London. In 1906, discussing the possibility of establishing an international market for turtle products, the Inspector of Fisheries wrote:

> This I also begin to foresee in the valuable but as yet undeveloped trade in turtle, sun-dried samples of which, as required by the London buyers, I have already received. And I am pleased to state that we have since been able to produce similar samples from Moreton Bay quite equal to if not surpassing those send from London for standard comparison. These particular Moreton Bay samples I am despatching to London, in order to test their value there, and possible return per lb. to our own local fishermen; and if results are satisfactory, which I have every reason to believe will be the case, I see an opening for the expansion of a large industry in this particular product, also, not confined to Moreton Bay only, but extending right along the Northern coastline of our State.[124]

A later account describing the export of green turtles to London, by Holmes, stated: 'One year several hundred turtles were exported shell and all to the London market, and I believe they were a feature of the Lord Mayor's banquet'.[125] During this decade, green turtles were harvested from Masthead Island, as Figures 7.12 and 7.13 indicate.

In 1908, the inquiry by the Royal Commission into the pearl-shell and bêche-de-mer industries also collected oral information about the commercial turtle fishery that, by that year, was regarded as a promising industry. Bowden, the pearl-sheller and merchant, reported that turtle fishing and turtle breeding could be profitably carried out alongside pearl-shelling and he stated:

> There is a big market for the green turtle, and for the calipash [the breast meat] and the calipee [the flippers]. […] The calipash and the calipee have always a good value, and the fat is of good quality; but we have not yet learned how to cure it, with the result that it arrives in a condition which destroys its value very largely.[126]

Nevertheless, Bowden reported that he had invested significantly in the industry. In addition, the merchant, Mackenzie, stated that he caught turtles and sold their shells, calipee, calipash and fat to another merchant, in London, who also purchased turtles

[124] Stevens, AR, Fisheries, 1905-1906, *QPP*, 1906, p. 1419.
[125] C. H. Holmes, *We find Australia*, Hutchinson, London, 1933; cited in Limpus, 'The Reef: uncertain land of plenty', p. 220.
[126] Mackay *et al*., *Report*, p. 197.

Figure 7.12. The capture of green turtles at Masthead Island, 1900s.

Source: Negative No. AP3:470, Robert Etheridge Collection, Photograph Archives, AM.

Figure 7.13. Loading a green turtle onto a boat using a winch, near Masthead Island, 1900s.
Source: Negative No. AP3:469, Robert Etheridge Collection, Photograph Archives, AM.

that had been imported from the West Indies; Mackenzie indicated that the problem of preserving the turtle meat had been overcome by keeping the animals alive on the decks of the ships. Mackenzie stated that the turtle fat was used 'mainly in making a soap lately introduced on the London market – turtle-oil soap of very high quality'; furthermore, he reported that a turtle-tinning factory was operating at Rockhampton and that another works was run by Skinner in Brisbane, but he indicated that the turtles that he had exported were obtained from Torres Strait rather than from the southern fishing grounds. As the animals appeared to be abundant, Mackenzie argued that no protection of the species was necessary.[127]

On 1 December 1904, North-West Island was leased under SL 901 to Thomas Owens, who established a turtle factory with a 3,000-gallon water tank; on 30 November 1909, that lease was renewed until 30 November 1914.[128] After Owens' death in 1912, his wife, Sarah Owens, continued that operation, and correspondence between her agent and a London firm that sought a supply of turtle soup, cited by Limpus, provides evidence of an initial order for one ton of turtle soup. In response, Mrs. Owens stated:

> To make one ton of extract it takes 440 turtles at 12 a day or 36 days. 100 cases of soup takes 228 turtles at 8 cases a day or 36 days. I propose taking 50 cases of extract and 50 cases of 1 lb. soup to Brisbane. The wages and keep would amount to £19 a week […].[129]

However, the merchants in London replied that the demand for turtle soup was unreliable, stating: 'the last lot [of turtle soup] is very difficult to move; in fact, it is described as turtle stew, and is not at all liked.' In 1911, Stevens reported that there was little demand for turtles besides that of the Sydney market, and that situation prevailed throughout the following decade, in spite of an apparent abundance of turtles in the waters of Queensland; in 1919, Stevens acknowledged that 'only a few' turtles were harvested as no demand existed for turtle products.[130]

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[127] Mackay *et al*., *Report*, pp. 128-129.
[128] Golding, *Beyond horizons*, pp. 48-49; Limpus, 'The Reef: uncertain land of plenty', pp. 220-221.
[129] 'Extracts of 1913 correspondence in relation to Owens, North West Island turtle factory, Mrs. P. Land, Brisbane'; cited in Limpus, 'The Reef: uncertain land of plenty', p. 221; Golding, *Beyond horizons*, pp. 50-51 indicates that this letter was written on 5 December 1913.
[130] See the details provided in Stevens, AR, Fisheries, 1909-1910, *QPP*, 1910, p. 927; Stevens, AR, Fisheries, 1910-1911, *QPP*, 1911, p. 1192; Stevens, AR, Fisheries, 1912-1913, *QPP*, 1913, p. 1033; J. H. Stevens, AR, Fisheries, 1918-1919, *QPP*, Vol. 3, 1919, pp. 340-344, p. 342; Stevens, AR, Fisheries, 1919-1920, *QPP*, 1920, p. 570.

Expansion of the turtle industry occurred, however, during the 1920s, with the resumption of turtle-soup production at North-West Island and the establishment of another factory at Heron Island. The former island was leased under SL 2843 to Cristian Poulsen on 27 March 1923.[131] By May 1924, Poulsen had constructed a canning works on the cay – including a wharf and a rail track, shown in Figure 7.14, to facilitate the transport of the tins from the factory – and his company, Barrier Reef Trading Co., had already commenced the manufacture of turtle soup.[132] The scale of Poulsen's operation was unprecedented in the Great Barrier Reef; during 1924-1925 alone, 1,220 turtles were processed at North-West Island and V. Forrester, in the Annual Report of the Queensland Marine Department for that year, stated: 'A turtle-canning factory has been operating at Nor'West Island for the past twelve months, the soup turned out being of excellent quality; the output for the year was approximately 36,000 tins.'[133] In 1925, the second factory commenced operations at Heron Island, after a lease (SL 4555) for that island was issued to Loyal Clifford Marsh, who formed the Australian Turtle Co. Ltd. and whose lease was transferred to Percy Friend in 1928. From 1925-1926, the combined harvest of the two factories was 2,500 green turtles.[134]

Roughley described the methods used to produce turtle soup at these islands as follows:

> The turtles come ashore at night […] and the hunters patrol the beach surrounding the island for their tell-tale tracks; these are followed till the turtle is located when it is turned on its back, for in this position it cannot right itself, and it is allowed to remain there till the following daylight high tide. The turtles are then loaded into boats or punts and taken to the jetty where they are transferred to trucks which run them into the factory. After decapitation, the flippers and plastron (breast plate) are cut away, the entrails extracted, and the flesh and the greenish coloured fat removed. The flesh, the fat, and the flippers are all used for the manufacture of soup; they are boiled in steam vats for about eighteen hours and then strained into concentrating vats where further boiling reduces the soup to the requisite density. It is then ready for canning.[135]

[131] Special Lease SL 2843 was subsequently replaced by SL 3949 and then by SL 4834.
[132] Golding, *Beyond horizons*, p. 51, provides more details of the turtle soup factory at North-West Island.
[133] V. Forrester, AR, Marine Department, 1924-1925, *QPP*, Vol. 3, 1925, pp. 291-300, p. 295; see also Papers of Isobel Bennett, Box 6 Folder 10, Manuscript Collection, NLA; C. Barrett, 'The Great Barrier Reef and its isles: the wonder and mystery of Australia's world-famous geographical feature', *The National Geographic Magazine*, Vol. 58, No. 3, September 1930, pp. 354-384, p. 375.
[134] V. Forrester, AR, Qld. Marine Dept., 1925-1926, *QPP*, Vol. 2, 1926, pp. 925-934, p. 929; Golding, *Beyond horizons*, pp. 61-62; Commissioner of Police to US, Qld. Home Dept., Brisbane, 11 March 1925, Qld. Police Dept., Commissioner's Office, Miscellaneous correspondence and reports, PRV10729/1 Box 169, Correspondence and reports – Inquiries re. turtles in Queensland, QSA.
[135] Roughley, *Wonders of the Great Barrier Reef*, p. 254.

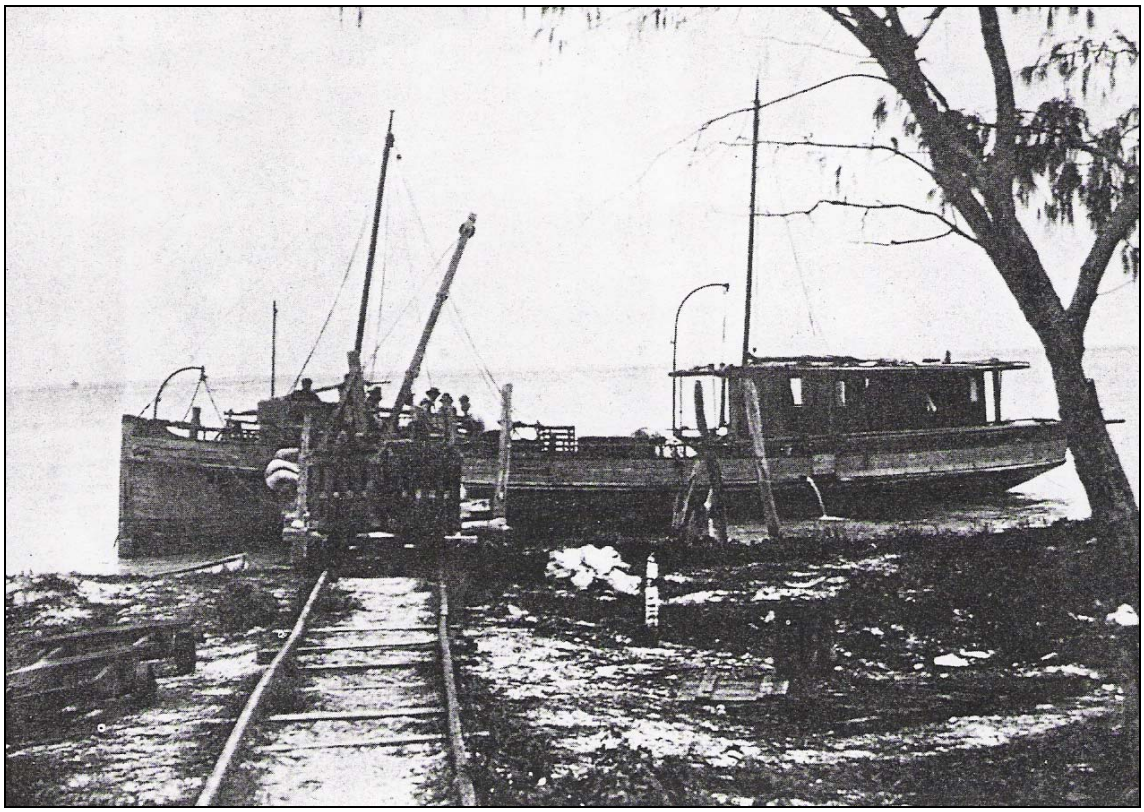


Figure 7.14. The wharf and rail track at North-West Island, showing the *M.V. Ethelbert*, *c.*1924.
Source: Golding, *Beyond horizons*, facing p. 54.

A daily catch of about 25 turtles yielded around 900 tins of turtle soup; however, only female turtles were taken since only those animals came ashore (in order to lay their eggs). The harvests took place during the summer months of November to January; in addition to soup, tortoise-shell was sold, the shells and bones were used for the production of fertiliser, and the eggs were sold to biscuit manufacturers (Figure 7.15).[136]

The operations took place intensively; as early as 1925, Forrester had reported that the regulation of the industry was necessary; in 1926, Musgrave and Whitley expressed their concern that the excessive harvest of female green turtles at the two islands was threatening the species with extinction.[137] From 1926-1927, 2,475 turtles were taken, and 1,622 animals were harvested during the following year. These harvests, and the smaller catches of the following years, are shown in Figure 7.16, which illustrates the very large catches that were made from 1925-1928; during that period, Roughley reported, the equivalent of 136,000 twelve-ounce tins of turtle soup had been produced at North-West Island, and that at least 33,000 tins of soup were produced between 1926 and 1929 at Heron Island using a harvest of 435 turtles. By the latter year, Forrester reported: 'The turtle-canning factory of North-West Island had a fairly good return for the year's output.'[138] In addition to these two factories, Barrett suggested in 1930 that turtles were found in abundance at Masthead Island – which was known as 'Turtle Island' – and that around 300 animals were counted on the western beach of that island in one morning, as well as many turtle nests; those turtles were also harvested by the turtle hunters to produce turtle soup.[139]

[136] A. Musgrave and G. P. Whitley, 'From sea to soup: an account of the turtles of North-West Islet', *The Australian Museum Magazine*, Vol. 2, 1926, pp. 331-336, p. 336; this article contains additional details of the process of capturing and butchering the turtles, based on the observations of two members of the Royal Zoological Society of New South Wales, during their visit to North-West Island in November 1925; see also QGTB, *The Great Barrier coral reef, Queensland*, QGTB, Brisbane, 1931, p. 14.
[137] Forrester, AR, 1925-1926, p. 929; Musgrave and Whitley, 'From sea to soup', p. 336; see also Roughley, *Wonders of the Great Barrier Reef*, pp. 254-255.
[138] V. Forrester, AR, Qld. Marine Dept., 1926-1927, *QPP*, Vol. 2, 1927, pp. 949-958, p. 953; V. Forrester, AR, Qld. Marine Dept., 1927-1928, *QPP*, Vol. 1, 1928, pp. 1181-1190, p. 1185; V. Forrester, AR, Qld. Marine Dept., 1928-1929, *QPP*, Vol. 2, 1929, pp. 949-958, p. 953; Roughley, *Wonders of the Great Barrier Reef*, pp. 253-254; Dick, AR, Acting CIF, 1929-1930, *QPP*, 1930, p. 39.
[139] Barrett, 'Great Barrier Reef and its isles', pp. 374-375.

Figure 7.16 indicates that, by 1929, the number of green turtles harvested in the Capricorn-Bunker Group had declined markedly; several reasons explain this contraction of the industry. First, as Limpus acknowledged, a lack of reliable supplies of

Figure 7.15. Turtle butchers removing the eggs from the carapace of a green turtle. Golding, *Beyond horizons*, p. 54 states that the turtles were supplied by the four Hack brothers of Gladstone, who used their own launch.
Source: Napier, *On the Barrier Reef*, facing p. 136.

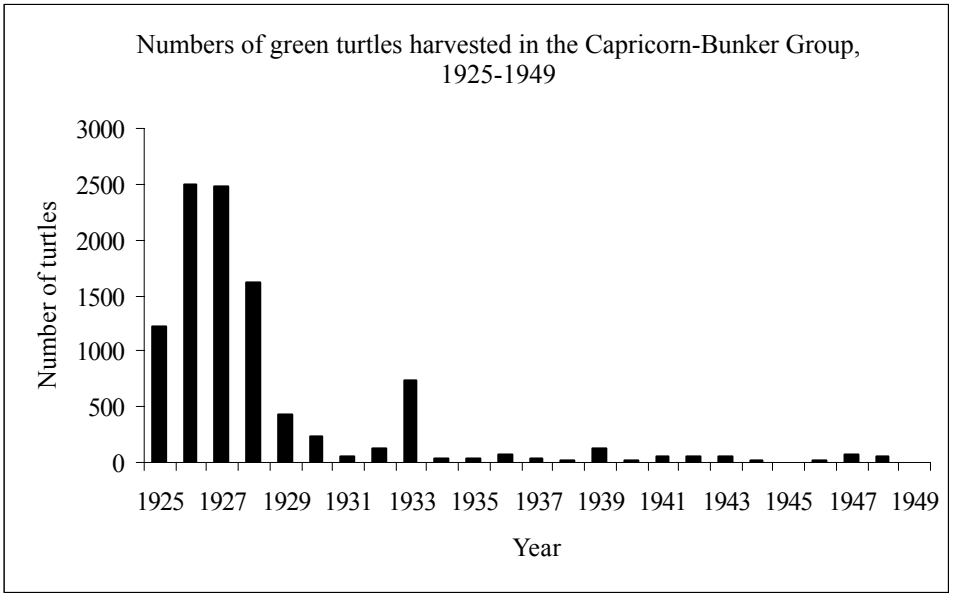


Figure 7.16. Numbers of green turtles harvested in the Capricorn-Bunker Group, 1925-1949.
Source: Compiled from data provided in AR, QDHM, *QPP*, 1926-1950, *passim*.

freshwater on the cays hindered the boiling-down of the animals; Musgrave and Whitley and Golding, similarly, acknowledged these problems of inadequate freshwater supplies, including those caused as a result of *Pisonia* leaves falling into the tanks at Heron Island, resulting in brackish water supplies.[140] Second, the quality of the tinned product was low, as J. Huxham, the Queensland Agent-General reported: the twelve-ounce tins were too small, the consistency of the soup was too thin, the content of green meat was too low, and the packaging was too drab, he argued, for the London market. Third, the factory at North-West Island was described as 'a somewhat ramshackle affair', and legal and financial difficulties also hindered the operation of Barrier Reef Trading Co. Fourth, as a report by F. W. Moorhouse, of the GBRC, acknowledged, turtles had become scarce in the waters around Heron Island as a result of unsustainable fishing practices, including the capture of the turtles before they had laid their eggs. Fourth, as Limpus *et al.* have demonstrated, there exist large natural variations in the proportions of green turtle populations nesting in any one year.[141] Consequently, the 1929-1930 turtle-canning operation was not completed; by 1932, the factories on both cays had closed and, during 1934 and 1935, the Heron Island factory was converted into a tourist resort, operated by Poulsen.[142]

On 15 December 1932, in response to Moorhouse's report recommending the protection of turtles at Heron Island, the Queensland Government prohibited turtle fishing during the months of October and November in waters to the south of latitude 17°S. However, some turtle fishing continued elsewhere, and at other times of the year.[143] Commercial turtle fishing continued in order to supply turtle soup and frozen turtle meat to the Brisbane and overseas markets. In 1932, J. D. W. Dick, the CIF, stated: 'During the turtle 'laying' season a number of turtles were captured on the islands off the coast, near Gladstone, and shipped to Brisbane for use in soup manufacture', and in 1936 Roughley

[140] Limpus, 'The Reef: uncertain land of plenty', p. 220; Musgrave and Whitley, 'From sea to soup', p. 336; Golding, *Beyond horizons*, p. 62.
[141] C. J. Limpus *et al*., 'The green turtle, *Chelonia mydas*, in Queensland: population structure in a warm temperate feeding area', *Memoirs of the Queensland Museum*, Vol. 35, No. 1, 1994, pp. 139-154; C. J. Limpus *et al.*, 'The green turtle, *Chelonia mydas*, population of Raine Island and the northern Great Barrier Reef: 1843-2001', *Memoirs of the Queensland Museum*, Vol. 49, No. 1, 2003, pp. 349-440, p. 397; see also Dobbs, *Marine turtles in the GBRWHA*, p. 8.
[142] J. Huxham, AR, Agent-General, 1924-1925, *QPP*, Vol. 3, 1925, pp. 1-23, p. 15; J. Huxham, AR, Agent-General, 1927-1928, *QPP*, Vol. 2, 1928, pp. 653-680, p. 678; Napier, *On the Barrier Reef*, p. 91; F. W. Moorhouse, 'Notes on the Green turtle (*Chelonia mydas*)', *Reports of the GBRC*, Vol. 4, Part 1, 1935, pp. 1-22, p.20.
[143] Roughley, *Wonders of the Great Barrier Reef*, p. 255; to the north of latitude 17ºS, turtles were found to breed as late as May each year, so remained without legal protection.

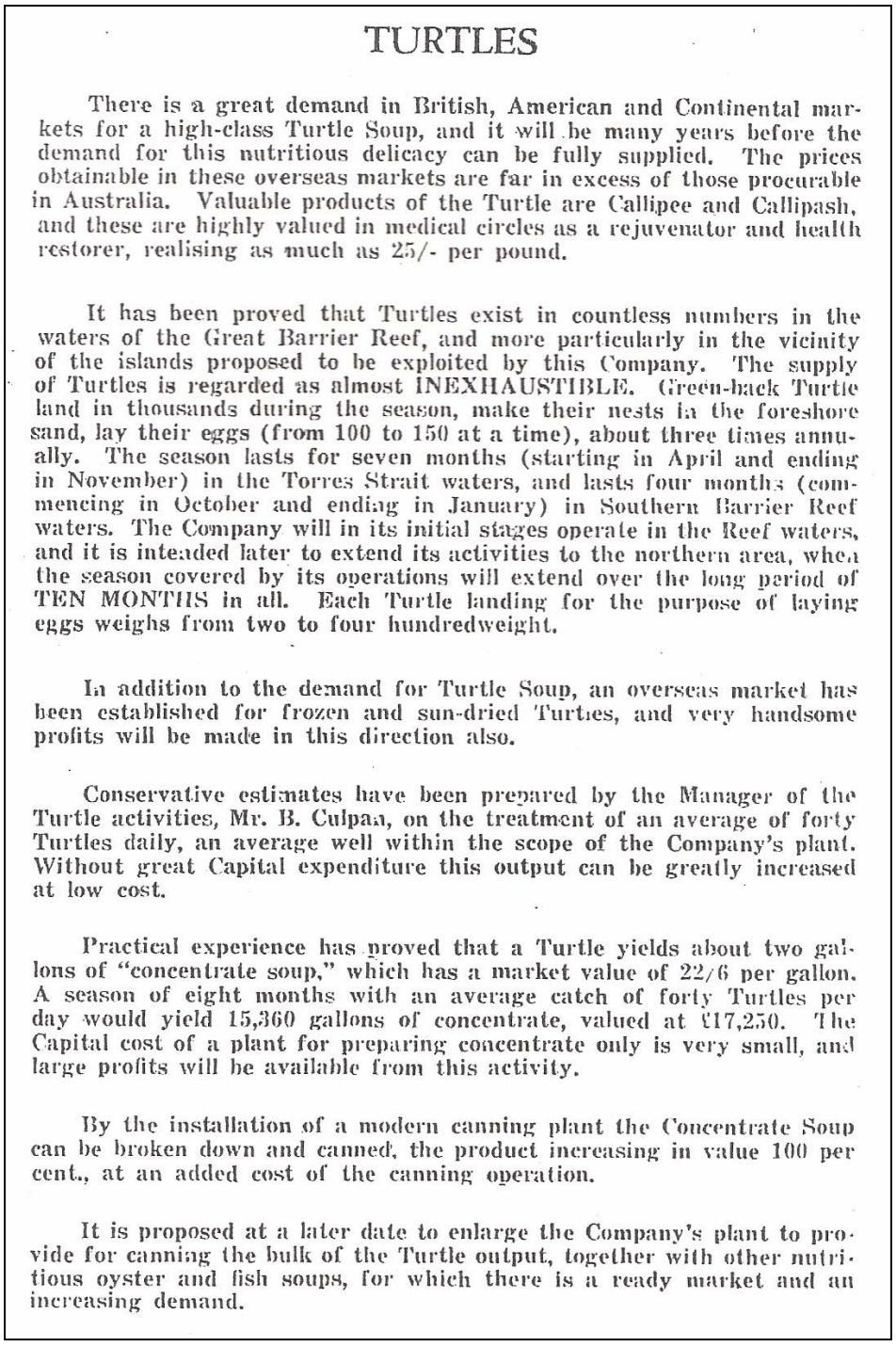
wrote that 'a few turtles have been intermittently forwarded alive to hotels in Brisbane and Sydney for conversion into soup'; green turtles were also captured at North-West Island and transported alive up the Fitzroy River to the Lakes Creek Meatworks, in Gladstone, in order to supply orders for green turtle meat to the Central Queensland Meat Export Co. Ltd., and a photograph of that turtle-fishing operation is shown in Figure 7.17.[144] The existence of an additional market for turtle soup and frozen and sun-dried turtle meat was acknowledged by two companies: Great Barrier Reef Fisheries Ltd., in 1929, and Queensland Marine Industries Ltd., in 1932; an advertisement published by the latter business is reproduced in Figure 7.18.

Turtle fishing continued throughout the 1930s although, by the end of that decade, the industry had declined in the Gladstone area and became concentrated in Torres Strait. The turtle harvesting in Torres Strait was focused at Bramble Cay, as Benham has documented, where turtles that came ashore to lay their eggs were overturned in a similar way to those at North-West Island. During the year 1935-1936, Dick reported that 73 turtles were caught from the islands near Gladstone and in Torres Strait; in 1937-1938, he stated that turtle-fishing was confined to Torres Strait, where 30 animals were harvested.[145] Production statistics for turtle-shell were published by the QDHM for the years 1933-1938, during which period a total of 17 cwt of turtle-shell was produced in addition to over 18 tons of shell-meat. During the 1940s, in contrast to the relatively small catches of turtles in the Capricorn-Bunker Group that are shown in Figure 7.16, more extensive catches were made in Torres Strait, with the result that the total harvest of turtles, as reported by the Queensland Fish Board, for the period 1938-1952 was 492 animals; however, the catch rates were highly variable from one year to the next during that period, as the Annual Reports of the Queensland Fish Board demonstrate.[146]

[144] Roughley, *Wonders of the Great Barrier Reef*, pp. 253-254; Golding, *Beyond horizons*, p. 56; J. D. W. Dick, AR, CIF, 1931-1932, *QPP*, 1932, p. 6.
[145] C. Benham, *Diver's luck: a story of pearling days*, Angus and Roberston, Sydney, 1949, facing p. 130; Dick, AR, CIF, 1935-1936, *QPP*, 1936, p. 1142; Dick, AR, CIF, 1937-1938, *QPP*, 1938, p. 1283.
[146] D. Fison, AR, QHDM, 1934-1935, *QPP*, Vol. 1. 1935, pp. 1083-1104, p. 1104; D. Fison, AR, QHDM, 1935-1936, *QPP*, Vol. 1, 1936, pp. 1133-1156, p. 1155; D. Fison, AR, QHDM, 1936-1937, *QPP*, Vol. 1, 1937, pp. 1393-1415, p. 1414; D. Fison, AR, QHDM, 1937-1938, *QPP*, Vol. 1, 1938, pp. 1271-1296, p. 1295; AR, Qld. Fish Board, *QPP*, 1940-1952, *passim*.

Some archival evidence describes the operation of several Indigenous commercial turtle fisheries, from 1940-1962, at Bramble Cay and also in the Palm Island Group. One operation was carried out by the Genami Gia Turtle Fishing enterprise using a turtle trap

Figure 7.17. A turtle-fishing party on the Fitzroy River, *c.*1930.
Source: Negative No. 13994, Historical Photographs Collection, JOL. Additional photographic evidence of turtle fishing, including the sale of animals at Brisbane markets in 1934, exists in the JOL; see Negative Nos. 21319, 158369 and 106337, Historical Photographs Collection, JOL.



TURTLES

There is a great demand in British, American and Continental markets for a high-class Turtle Soup, and it will be many years before the demand for this nutritious delicacy can be fully supplied. The prices obtainable in these overseas markets are far in excess of those procurable in Australia. Valuable products of the Turtle are Callipee and Callipash, and these are highly valued in medical circles as a rejuvenator and health restorer, realising as much as 25/- per pound.

It has been proved that Turtles exist in countless numbers in the waters of the Great Barrier Reef, and more particularly in the vicinity of the islands proposed to be exploited by this Company. The supply of Turtles is regarded as almost INEXHAUSTIBLE. Green-back Turtle land in thousands during the season, make their nests in the foreshore sand, lay their eggs (from 100 to 150 at a time), about three times annually. The season lasts for seven months (starting in April and ending in November) in the Torres Strait waters, and lasts four months (commencing in October and ending in January) in Southern Barrier Reef waters. The Company will in its initial stages operate in the Reef waters, and it is intended later to extend its activities to the northern area, when the season covered by its operations will extend over the long period of TEN MONTHS in all. Each Turtle landing for the purpose of laying eggs weighs from two to four hundredweight.

In addition to the demand for Turtle Soup, an overseas market has been established for frozen and sun-dried Turtles, and very handsome profits will be made in this direction also.

Conservative estimates have been prepared by the Manager of the Turtle activities, Mr. B. Culpan, on the treatment of an average of forty Turtles daily, an average well within the scope of the Company's plant. Without great Capital expenditure this output can be greatly increased at low cost.

Practical experience has proved that a Turtle yields about two gallons of "concentrate soup," which has a market value of 22/6 per gallon. A season of eight months with an average catch of forty Turtles per day would yield 15,360 gallons of concentrate, valued at £17,250. The Capital cost of a plant for preparing concentrate only is very small, and large profits will be available from this activity.

By the installation of a modern canning plant the Concentrate Soup can be broken down and canned, the product increasing in value 100 per cent., at an added cost of the canning operation.

It is proposed at a later date to enlarge the Company's plant to provide for canning the bulk of the Turtle output, together with other nutritious oyster and fish soups, for which there is a ready market and an increasing demand.

Figure 7.18. An advertisement for the turtle industry, 1932.

Source: Queensland Marine Industries Ltd., *Sharks and turtles for profit*, Queensland Marine Industries Ltd., Brisbane, 1932, p. 12.

in the Halifax area; that scheme was managed by the Palm Island Aboriginal Settlement although, in 1941, the success of the operation was constrained by bad weather.[147] More successful operations were carried out by the turtle fishing crew of the *Wanderlust*, based at Palm Island; the catches made by that vessel between 18 November 1940 and 29 March 1941 are listed in Table 7.3, which indicates that 6,652 lb of turtle meat without bone and 939 lb of turtle flippers were taken during that period, in addition to some dugong meat.

At the other commercial turtle-fishing operation, at Bramble Cay, A. Mellor, the Master of the *Melbidir*, reported that the 'large scale killing of green turtles' had occurred; his report, written in 1953, stated:

> Whilst waiting [for the] ANA plane at Thursday Island this morning, Mr 'Snowy' Whittaker, owner/master of the fishing vessel *Trader Horn*, informed me that he had witnessed several large scale killings of green turtles on Bramble Cay. He informed me that killing of green turtles is taking place on a large scale, and expressed his views in these terms, 'It's absolute slaughter, it is nothing for each of the four boats to load 50 or 60 turtles during the night.'
>
> He further states, 'I have seen as many as ten full sized turtles dead on the Cay, where crews have turned them on their backs from previous raids, and departed loaded.' The vessels are manned by coloured [*sic*] crews, and seem to work under the direction of a white man. Two vessels had Port of Registry, 'Port Moresby'.[148]

Mellor also claimed that his observations of the large-scale killing of turtles at Bramble Cay could be confirmed by Mr. Ivor Wardrop, a professional fisherman and the owner of the *Vyallo*, living at Thursday Island, who also witnessed the destruction of the animals.

Other accounts of considerable destruction to turtles by commercial fishers were written in 1950. In March of that year, for example, F. A. McNeill, the Curator in Invertebrates at the Australian Museum wrote to the Honorary Secretary of the GBRC, complaining about the exploitation of green turtles that he and Professor P. D. F. Murray had witnessed on 27 January 1950; a section of McNeill's letter is quoted at length below because of the evidence of impacts on turtle numbers that it contains:

[147] SRS505/1 Box 520 Item 3625, QSA.
[148] A. Mellor, Master, QGPV 'Melbidir', Thursday Island to Mr. C. O'Leary, DNA, Thursday Island, 22 December 1953, RSI5058/1 Item 1346, QSA.

Trip	*Catch*	*Value* (*£. s. d.*)
18-22 November 1940	813 lbs turtle meat without bone 155 lbs flippers	13.11.0 1.12.3
25 November – 2 December 1940	208 lbs turtle meat without bone 28 lbs flippers	3.9.4 5.10
3-6 December 1940	746 lbs turtle meat without bone 89 lbs flippers	12.8.8 18.7
9-13 December 1940	929 lbs turtle meat without bone 187 lbs flippers	15.9.8 1.18.11
15-20 December 1940	240½ lbs dugong without bone 502 lbs turtle meat without bone 61 lbs flippers	4.0.1 8.7.4 12.9
Sub-total		62.14.5
12-15 January 1941	367 lbs turtle meat without bone 55 lbs flippers	6.2.4 11.5
19-28 January 1941	178 lbs turtle meat without bone 46 lbs flippers	2.19.4 9.7
30 January – 6 February 1941	57 lbs turtle meat without bone 14 lbs flippers	19.0 2.11
Sub-total		11.4.7
7-13 February 1941	846 lbs turtle meat without bone 51 lbs flippers	14.2.0 10.7½
17-22 February 1941	709 lbs turtle meat without bone 61 lbs flippers	11.16.4 12.8½
24 February – 1 March 1941	484 lbs turtle meat without bone 121 lbs flippers	8.1.4 1.5.2½
Sub-total		36.8.2
10-15 March 1941	282 lbs turtle meat without bone 71 lbs flippers	4.14.0 14.9
24-29 March 1941	531 lbs turtle meat without bone	8.17.0
Sub-total		14.5.9
TOTAL	6,662 lbs turtle meat without bone 939 lbs flippers	124.12.11

Table 7.3. Summary of turtle catches by the crew of *Wanderlust*, 18 November 1940 – 29 March 1941. *Source:* Compiled from data provided in the Reports of the AS, Palm Island Aboriginal Settlement, 'State of Receipts, Expenditure and Earnings of *Wanderlust* Turtle Fishing Crew, SRS505/1 Box 520 Item 3625, QSA.

> We saw on the jetty a batch of helpless live captives, eleven in number and all turned on their backs. Inquiry elicited the fact that sixteen to eighteen turtles come through Gladstone every week during the long summer egg-laying season, and are sent alive (continually on their backs) to Brisbane for slaughter and export. […] Regarding the senseless depletion of the green turtle population, the fact is emphasised that only females are being captured for trading. […] The hunting is *not* policed, and it is therefore certain that no opportunity is given the turtles to fulfil their mission of egg-laying. […]
>
> It is well known that over the past forty years the green turtle population of the Capricorn Group area has been periodically exploited. The general effect has been a marked reduction in numbers, slow but inexorable. No sooner has the population partially recovered from one period of butchering than another has begun. […] In the past five years two reliable observers have told me of the conspicuous numerical dominance of males over females in the initial mating season, when there very shallow inshore reef-flat waters of the islands of the Capricorn Group are favoured meeting places.[149]

A similar account of the excessive destruction of green turtles by commercial fishers was also written in 1950 by the QGTB. On 9 September 1950, in response to such concerns about the depletion of turtle populations, the removal of green turtles or their eggs from Queensland waters and foreshores was entirely prohibited by an *Order in Council*; this legislation extended the earlier protection that was afforded to the species in 1932.[150]

In 1950, therefore, the commercial green turtle fisheries that had operated for almost five decades in the southern Great Barrier Reef ceased; the remainder of Queensland's turtle species were protected under the *Fisheries Acts* by 18 July 1968. Limpus has pointed out that green turtles – particularly older animals – are faithful to their migration patterns and to localised feeding grounds, with the result that turtle populations are highly vulnerable to overfishing; he also reported anecdotal reports of the increasing scarcity of green turtles in the Great Barrier Reef.[151] The evidence presented above indicates that such anecdotal reports may be justified; considerable harvests of green turtles took place in Queensland between 1904 and 1952, with thousands of animals – predominantly females – being harvested for the production of turtle soup and turtle meat. This narrative of the commercial turtle fisheries illustrates

[149] F. A. McNeill, Curator in Invertebrates, Australian Museum, Sydney to Hon. Sec., GBRC, Brisbane, 3 March 1950, RSI920/1 Item 9, General correspondence batches – General Tourist Bureau matters, QSA, pp. 1-4.
[150] Dir., QGTB, Brisbane to US, QDHM, Brisbane, 16 March 1950, RSI920/1 Item 9, QSA.
[151] Limpus, 'The Green turtle, *Chelonia mydas* in eastern Australia', p. 7; Limpus, 'The Reef: uncertain land of plenty', pp. 219-220.

the need for regulation of industries that exploit long-lived species, as Roughley has acknowledged:

> If we must have an industry, however, let us so regulate it that all unnecessary cruelty is eliminated and that the animals are sufficiently protected to avoid their decimation as has happened to so many creatures man [*sic*] has exploited for his personal gain.[152]

In 1999, the QNPWS reported that the contemporary population of *Chelonia mydas* in the Capricorn-Bunker Group displays 'some characteristics consistent with excessive loss of adult turtles from the population'; that loss of adult turtles may be attributed partly to the influence of the commercial turtle fisheries.[153]

7.3.3 Turtle-riding in the Capricorn-Bunker and Whitsunday Groups, 1900s-1960s

The sport of turtle-riding is included in Section 7.3 about impacts on marine turtles since it represents a form of interference with turtles, although the intention of this activity was not to cause mortality of the animals. Nevertheless, some evidence indicates that the death of turtles may have occurred in connection with the capture and use of turtles for sport at some of the tourist resorts of the Great Barrier Reef. The material presented here provides a brief overview of the nature and extent of turtle-riding, and it suggests some of the impacts that this activity may have had on turtles. Turtle-riding was geographically concentrated in the Capricorn-Bunker group, because that area included large green turtle populations and contained several tourist resorts; turtle-riding was particularly associated with the tourist resorts at Heron, Masthead and Lady Musgrave Islands. In addition to these locations, some turtle-riding took place in the Whitsunday Islands, including South Molle Island.

The origins of turtle-riding were attributed to Louis de Rougement, who first popularised accounts of this activity; in 1930, Barrett stated: 'De Rougement's exploits were remembered, and we tried turtle rides, with less success, but more fun perhaps, that Louis enjoyed, according to his famous story.'[154] However, an earlier occurrence of turtle-riding was documented at Masthead Island in the 1900s, where the photograph

[152] Roughley, *Wonders of the Great Barrier Reef*, p. 255.
[153] QNPWS, *Capricornia Cays NP and Capricornia Cays NP (Scientific) management plan*, QNPWS, Brisbane, 1999, p. 6.
[154] Barrett, 'Great Barrier Reef and its isles', p. 375.

reproduced in Figure 7.19 was taken by the palaeontologist and Director of the Australian Museum, Robert Etheridge Junior. Referring to the commencement of turtle-riding at Masthead Island, Barrett stated:

> The [green turtle] became famous when tourists discovered the Great Barrier Reef and flocked to the holiday islands. Turtle riding became a popular sport. Naturalists who pioneered it at Masthead Island may have smiled, recalling how their story of turtle-back rides was ridiculed in the South. Moving pictures taken at Heron Island and elsewhere have convinced even the most sceptical stay-at-homes that at least one of Louis de Rougemont's yarns was not fiction.[155]

His account acknowledges that the occurrence of turtle riding increased alongside the development of the major tourist resorts in the Great Barrier Reef; that development took place at an increasing rate from the 1920s, particularly in the Capricorn-Bunker and Whitsunday areas, as explained in Section 6.7.2.

In 1926, when members of the Royal Zoological Society of New South Wales visited North-West Island, Musgrave and Whitley stated that, at that island, green turtles were put to another use besides the manufacture of turtle soup: 'By kneeling on their backs and clinging to the edges of the carapaces, we were able to ride them down to the beach and into the water'.[156] In 1930, Barrett provided additional details of the activity; he reported that female turtles were captured at night as they came ashore to lay their eggs. The animals were overturned to prevent them from escaping and were left on the beach in that position until the following morning. At Heron Island, Barrett stated, the 'turtle-strewn' beach and the spectacle of the animals, after their release, attempting to reach the sea 'provided the cameraman with an excellent shot'.[157] The turtles were mounted by riders as they made their way down the beach to the sea. At Masthead Island, a 'Turtle Derby' had been instigated, as Barrett described:

> The united strength of three men [*sic*] was needed often to overturn a turtle caught napping on the sand. Grasping flippers and tail and the edge of the shield, we gave a sharp heave, and our friend was lying helpless on its back. The Turtle Derby of Masthead Islet was a memorable event! The jockeys wore bathing suits, and the 'winning post' was just the sunlit sea.[158]

[155] Barrett, 'Great Barrier Reef and its isles', pp. 40-41.
[156] Musgrave and Whitley, 'From sea to soup', p. 336.
[157] Barrett, 'Great Barrier Reef and its isles', p. 360.
[158] Barrett, 'Great Barrier Reef and its isles', p. 375.

Figure 7.19. An early example of turtle-riding at Masthead Island, 1900s.

Source: Negative No. AP3:475, Robert Etheridge Photographs, Museum Archives, AM.

The establishment of the 'Turtle Derby' reflected the popularity of this sport; and one account of the Great Barrier Reef, published in *Cummins and Campbell's Monthly Magazine* (*CCMM*) in January 1932, referred to 'training a turtle for the Barrier Reef Sports Meeting'.[159] Photographs of the sport are reproduced in Figures 7.20 and 7.21.

A lengthy discussion of the sport of turtle riding was published by the QGTB in 1931, which stated:

> A turtle carries a man or woman with ease and, particularly on islands of the Capricorn and Bunker Groups, full advantage is taken of this by visitors to indulge in the sport of turtle-riding. […] The turtles have little to complain of, for those who are not turtle riders are often turtle butchers, cruelly turning the clumsy things on their backs and leaving them thus helpless until enough have been arrested in their journey towards the sea to commence converting them into meat for turtle soup and shell for ornaments.[160]

Another account, of 1937, stated: 'Turtle riding is a favourite sport amongst ladies, especially in the presence of cameramen.'[161] However, by 1940, concerns had been expressed that the use of turtles by tourists constituted cruelty to the animals. When an officer of the QGTB visited Lady Musgrave Island in 1940, he drew attention to 'the need for action to prevent the cruelty and destruction which some tourists are causing to turtles and other wildlife on the island'; he reported that the island contained thousands of turtle nests on the eastern, western and northern sides of the island, and he stated: 'Turtle life is so prolific on Lady Musgrave that Mrs. Bell [the Caretaker] is taxed to the utmost in her endeavours to prevent cruelty to them by thoughtless tourists.'[162]

The impacts of turtle-riding on the animals – in particular, the habit of overturning the creatures during the preceding night – were considered in 1944 by A. M. Lewis, who had recently visited Heron Island and who wrote to the Queensland Society for the Prevention of Cruelty to Animals (QSPCA), stating:

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[159] For example, QGTB, *The Great Barrier coral reef, Queensland*, QGTB, Brisbane, 1931, p. 14; Anon. ('Viator'), 'The Great Barrier Reef: the world's greatest coral banks', *CCMM*, Vol. 5, No. 57, January 1932, pp. 76-77, p. 77.
[160] QGTB, *Great Barrier coral reef*, p. 14.
[161] Anon. ('Investigator'), 'The Great Barrier Reef: one of the world's greatest wonders', *CCMM*, Vol. 5, No. 124, July 1937, pp. 38-39, p. 38.
[162] In-letter Ref. L40.2373.11, Sec., Qld. Office of the Commissioner for Railways, Brisbane to Sec., QDHM, Brisbane, 22 May 1940, PRV8340/1 Item 1, QSA.

Figure 7.20. Turtle-riding at Heron Island, *c.*1930.
Source: Photograph, Ref. 2849TB, QS57/1, Item 22, QSA.

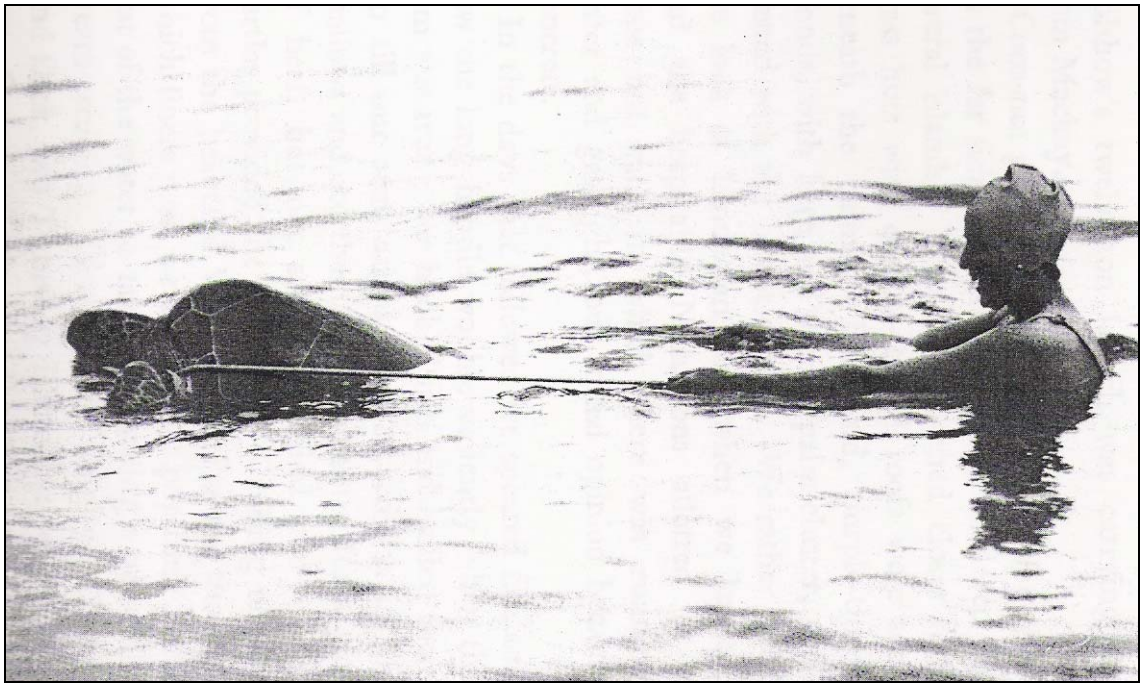

Figure 7.21. Turtle-riding, *c.*1930.
Source: C. H. Holmes, *We find Australia*, Hutchinson, London, 1933, facing p. 207.

> The so-called 'sport' of turtle riding was indulged in and in order to capture their mounts for the next morning's ride, people would turn these poor defenseless creatures on their backs for the whole night. Often the turtles were forgotten and were left in blazing sunlight which, I understand, blinds them.[163]

Referring to Lewis' letter, A. E. Cole, the Director of the QSPCA, wrote to the Secretary of the QDHM, stating that: 'I have personally seen turtles turned on their backs and left on the beach at Heron Island.'[164]

In 1944, complaints were made by visitors to Heron Island to the Director of the QGTB that 'turtles have been killed by the Management of the Tourist Resort on the Island and the remains have been allowed to remain on the beach, [and] that turtles were ill treated'.[165] The death of turtles had aroused curiosity among some visitors to the Great Barrier Reef; the death of a green turtle was filmed, with a narration, by Noel Monkman in a 1933 film, entitled *Ocean Oddities*, and that species aroused interest since it was apparently difficult to kill; Monkman documented the turtle's heart beating outside the animal and reported that the organ continued to pump in that condition for three days.[166] In another account of green turtles, written in 1938, Glenne stated:

> These creatures, imprisoned all their lives under a carapace, are remarkably tenacious of life. The turtle is one of the most difficult things to kill. Cut out its heart and it will beat on; if you throw this vital part into a pond it will pump water in and out as if it were its accustomed blood. Every bit of its flesh will, when severed, live on for an agonizing time.[167]

While the behaviour of turtle-riders did not cause this mortality to the animals directly, these accounts suggest that some individuals inflicted cruelty on turtles during their captivity on the islands, and that the ready availability of animals for turtle-riding probably increased the prevalence of those impacts.

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[163] A. M. Lewis to QSPCA, 22 January 1944, cited in A. E. Cole, Dir., QSPCA to Sec., QDHM, 28 January 1944, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA.
[164] A. E. Cole, Dir. to Sec., QDHM, 28 January 1944, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA.
[165] US, Treasury, Brisbane to Sec., Qld. Land Admin. Board, Brisbane, 30 March 1944, SRS5416/1 Box 10 Item 61, NP231, Bunker – Heron Island, QSA.
[166] N. Monkman, *Ocean Oddities*, Film recording, Australian Educational Films, Canberra, 1933, Title No. 18188, ScreenSound Australia, National Screen and Sound Archive, Canberra; see also Love, *Reefscape*, p. 119.
[167] Glenne, *Great Australasian mysteries*, p. 192.

Turtle-riding did not cease with the introduction of legal measures to protect the green turtle in the Great Barrier Reef, in 1950; the activity was not included under the prohibition of the taking of green turtles, since the animals were not considered to be 'caught' as they were eventually allowed to return to their habitat. Turtle-riding in the Great Barrier Reef persisted until at least 1964, when turtles were used for that purpose at South Molle Island; evidence of the use of 'resort turtles', whose carapaces were marked with paint, is shown in Figure 7.22. However, the activity has since been prohibited and all marine turtles now receive protection from human interference in the GBRWHA. The precise extent of the impacts of turtle riding on the populations of the green turtle in the southern Great Barrier Reef, between the 1900s and the 1960s, is not known; however, the cessation of turtle-riding removed a source of interference with female green turtles during egg-laying and probably reduced the availability of captive turtles that were vulnerable to other acts of cruelty or exploitation. The main period of turtle riding coincided with the most intensive period of operation of the commercial green turtle fisheries, described in Section 7.3.2, and the associated decline in numbers of green turtles.

7.3.4 Turtle farming in Torres Strait, 1970-1979

Although the commercial taking of turtles or their eggs in the Great Barrier Reef has been prohibited since 4 September 1962, the harvest of the animals and eggs by Aboriginal and Torres Strait Islander people formed an exception to that legislation, provided that the harvest took place for consumption only and without the use of explosives or poisons.[168] The form of that harvest was disputed, especially as Indigenous methods of butchering the animals were culturally different from European methods; one source stated that 'some complaints had been received that turtles were being cut up while still alive.'[169] An attempt to regulate the supply of turtle meat to Indigenous communities took place during the 1970s, when attempts to farm turtles in Torres Straits were made, and large numbers of turtles were manipulated as a result of this activity. The turtle farming enterprise in Torres Straits were organised by Applied Ecology Pty. Ltd. with the encouragement of the Queensland Department of Native Affairs; the enterprise was expected to provide a source of employment for Torres Strait

[168] *Order in Council*, 4 September 1962, RSI15058/1 Item 1386, General Correspondence, Marine Produce – Turtle Fishing – General Admin. Only File No. 1, QSA.
[169] 'Extract: Minutes Councillors' Conference, 1961', Ref. 9T/50. RSI15058/1 Item 1386, QSA.

Figure 7.22: Turtle riding using 'resort turtles' at South Molle Island, December 1964.
Source: SRS189/1 Box 17 Item 73, Queensland Industry, Services, Views, People and Events; Photographic Proofs and Negatives; Islands – Barrier Reef, QSA.

Islander people who adopted turtle farming, in addition to providing a sustainable source of a culturally-important food item.

The attempts to farm turtles in Torres Strait were based on an assessment, made by the Chairman of Badu Island Council, that numbers of both turtles and dugong in the waters around Badu Island appeared to have been constant during the decade prior to 1962. The Chairman reported, however, that such an assessment was based on the size of the annual catch of the animals for food, not on scientific monitoring.[170] Nonetheless, the proposal to farm turtles was approved and Applied Ecology Pty. Ltd., under the direction of Dr. Robert Bustard of the Australian National University (ANU), assumed the management of the scheme. By 1971, Bustard had received an allowance to travel to Heron Island in order to remove baby turtles for the turtle farmers, since the juvenile animals were thought not to be available in sufficient numbers at Murray Island or Bramble Cay.[171] As the proposed turtle farming did not fall under the exemption to the harvest of turtles permitted by Indigenous people for consumption only, a permit system was introduced, and arrangements were made for the Queensland Minister for Primary Industries to delegate authority to the Queensland Director of Aboriginal and Island Affairs to issue permits allowing Indigenous people who did not normally live on reserves to harvest thirty dugongs and sixty turtles in any year.[172]

Bustard undertook a research visit to Torres Strait in December 1969 as part of a survey of the marine turtle resources of Queensland and, by December 1970, turtle farming had commenced in Torres Strait. Turtle pens, which were made of mangrove wood and which extended into the sea, were constructed to contain the animals. Green turtle eggs were imported to the farms, although Bustard reported that the eggs did not hatch as reliably after they had been moved. Since the failure of eggs to hatch was attributed to the fact that the baby turtle attaches itself to the inside of the top of the shell, Bustard directed that the tops of the eggs should be marked with a biro pen so that they could be re-buried with the same orientation. Bustard commented that already, by June 1971, an overseas dealer had been found for turtle products: the British soup maker and turtle

[170] In-letter Ref. 9T/50. Chairman, Badu Island Council to DDNA, Thursday Island, 30 September 1962, RSI15058/1 Item 1386, QSA.
[171] Memo Ref. 23/11/1, Dr. Bustard, Darnley Island, 11 January 1971, RSI15058/1 Item 1386, QSA; Memo Ref. 37/13/1. Dr. Bustard, Darnley Island, 13 January 1971, RSI15058/1 Item 1386, QSA.
[172] In-letter Ref. 71/7387. J. M. Harvey, Director-General, QDPI, Brisbane to Dir., QDAIA, Brisbane, 29 March 1971, SRS505/1 Box 823 Item 5623, QSA.

merchant, John Lusty.[173] Soon afterwards, in September 1971, the turtle farms at Darnley Island received a visit from the consultant to the Food and Agriculture Organisation (FAO) of the United Nations, Professor John Hendrickson, who recommended that captive breeding of green turtles should be attempted in Torres Strait. Captive breeding was regarded as an alternative to the practice of importing turtle eggs; by September 1971, 2,000 green turtle eggs had been transported from Bountiful Island, near Mornington Island, to Darnley Island.[174]

The process of collecting, transporting and re-burying the turtle eggs was described in the *Torres Strait Turtle Farmers Newsletter* in the following terms:

> On arrival at Darnley the eggs were divided equally among the five farmers and carefully reburied in the ground, care being taken to keep them the same way up as when placed in the containers for shipment from Bountiful. The eggs had been collected behind individual turtles as they were laid and were placed directly into polythene bags. These were sealed as soon as they were full and placed in foam coolers to stop them becoming overheated and to reduce temperature changes during the twenty-four hour period. [...]
>
> The eggs were taken from Bountiful Island to Mornington Island by speedboat, then down the length of Mornington Island by Land Rover, flown to Thursday Island, taken by boat from Thursday Island to Darnley Island, and reburied there. When the eggs were reburied, each site was enclosed to trap the hatchlings. The hatchlings will immediately be transported to dinghies for 'baby care' before being placed in the pens out on the reef flat.[175]

In this newsletter, Bustard also provided more details of the intended markets for the turtle products: the Master Foods Corporation, which had been manufacturing turtle soups at a Sydney factory since around 1958, and which had received between 23 and 30 tons of produce; and the British merchant, John Lusty, who wished to launch turtle steaks on the London market.

In addition to the farming of green turtles for food, Bustard proposed farming the hawksbill turtle for the manufacture of curios. He stated that 'the hawksbill turtle has been heavily over-exploited and is held to be rapidly reaching a position where it is

[173] *Torres Strait Turtle Farmers Newsletter*, No. 1, June 1971, pp. 1-3, RSI15058/1 Item 1386, QSA.
[174] *Torres Strait Turtle Farmers Newsletter*, No. 2, September 1971, pp. 7-8, RSI15058/1 Item 1386, QSA.
[175] *Torres Strait Turtle Farmers Newsletter*, No. 2, pp. 8-10.

directly threatened with worldwide extinction.'[176] Bustard argued that the conservation of this species could be promoted by farming the animals in a sustainable manner and establishing a viable trade in hawksbill turtle products. He acknowledged that commercial interest in the hawksbill turtle – in the form of a stuffed, whole turtle, sold as a curios object – could support an industry. Furthermore, Bustard claimed, the hawksbill turtle was ideally suited for such a trade, because the young turtles would reach the ideal size for the market in less than one year; consequently, he argued, the production of tortoise-shell as an export material could also profitably be developed.

The method in which the Torres Strait turtle farming industry was established involved two pilot schemes, operating for a period of three years each, based at two Torres Strait islands; these farms were constructed at Darnley and Murray Islands, and they commenced operating in December 1970. If those farms proved to be successful, Bustard announced, he would recommend the introduction of extensive turtle farming in Torres Strait. The two pilot farms employed six people on a full-time basis. Bustard expressed considerable optimism about the success of the industry, since the turtle could supply a diverse range of products. He stated:

> Turtles have many uses apart from meat. Probably the most important is turtle oil which is used in large quantities by the cosmetics industry. There is also demand for turtle leather (the skin from the soft parts is sold salted) and for calipee (the cartilage between the breast plates of the under shell) for making of turtle soup.[177]

The turtle skins were also potentially valuable for the export trade; one skin buyer in Cairns reported that he had already found 'a ready market for turtle skins.'[178]

In April 1972, the pilot farms at Darnley and Murray Islands were judged to have been successful and an expansion of the industry commenced. New farms were established at Boigu, Yorke, Coconut, Yam and Stephen Islands, bringing the total of turtle farmers operating in Torres Strait to twenty-eight. In addition, two turtle farmers commenced working at Mornington Island. These farms were stocked by collecting baby turtles

[176] *Torres Strait Turtle Farmers Newsletter*, No. 2, p. 12.
[177] 'Torres Strait Turtle Farming', *c.*1972, RSI15058/1 Item 1386, QSA.
[178] B. L. Venables, Agent for Nederveen and Co. Pty. Ltd., Skin Buyer, Cairns to Man., QDAIA, Brisbane, 10 January 1972, RSI15058/1 Item 1386, QSA.

from wild nests and introducing them to the pens constructed at the islands. Referring to the perceived social benefits of the expansion of the industry, Bustard wrote:

> This project will be good for the future of the islands and I hope that it will stop the people from leaving their island to go and seek work in the south. Anyone who is prepared to work can make much more than he [*sic*] would in the south and be his own boss. The industry is based on supplying a food item, turtle meat and soup which will never be replaced by man-made goods (this is what ruined the pearl and trochus industry).[179]

Despite Bustard's description, reproduced in this extract, many of the turtle farmers were women; the scheme was popular with those farmers since it promised excellent returns for those who adopted the new form of employment.

However, Bustard recognised that capital was required to start turtle farming, since no commercial income was obtained for the period before the first turtles reached maturity. In addition, some investment in the infrastructure of the turtle farms was required to be made: black mangrove wooden poles, obtained from Long Island, were needed to make the turtle pens, and the nets were purchased from Japan. Bustard suggested that large turtles were not to be kept permanently on the islands; instead, he stated: 'We intend to start baby turtles on the land and then house them in enclosures on the reef platform.' On the reefs, the turtles were contained in permanent concrete pools that measured between six and twelve feet square. The investment required was offset by the Commonwealth Government, which paid new farmers every fortnight while they were establishing their farms. Once those farms had been constructed, stocks of baby turtles were required, which were taken from the nests made by wild turtles. However, the collection of baby turtles proved to be difficult due to the natural variability of turtle laying; at Murray Island, for example, Bustard reported that 'although twelve turtles came ashore to lay eggs they all returned to the water after trying to dig nests as the sand was very dry.'[180]

Nevertheless, a large number of wild turtle eggs were collected and transported to the turtle farms and wild turtles were also taken directly from the sea. One Murray Island turtle farmer, after collecting wild green turtle eggs in August 1971, obtained 181

[179] *Torres Strait Turtle Farmers' Newsletter*, No. 4, April 1972, p. 2, RSI15058/1 Item 1386, QSA.
[180] *Torres Strait Turtle Farmers' Newsletter*, No. 4, pp. 3-4.

healthy baby turtles for her farm. At Mornington Island, Bustard reported that one turtle farmer had caught many turtles and dugongs, and that another farmer already had 25 green turtles.[181] Bustard described a turtle egg collecting trip as follows:

> On 13th March 1972 the Darnley Island turtle scheme chartered the *Ina* in order to visit Bramble Cay and collect this year's crop of hatchling turtles for the turtle farmers. We arranged to arrive at Bramble Cay in the early afternoon so that we could detect nests about to hatch and dig up the hatchlings. Baby turtles break out of their egg shells several days before they emerge on the sand surface. The baby turtles take up less space in the sand than the round eggs which do not pack closely together. This means that after hatching the sand in the neck of the nest falls down slightly so there is a small hollow. One can soon learn to detect these and dig straight down to the hatchlings which are making their way through the sand to the surface.
>
> In this way we secured over 500 baby turtles before darkness. [...] After dark we maintained constant patrols of all the beaches using pressure lamps and by 1.00am when the bulk of the hatchlings had emerged we had over 2,000. It then rained heavily for the rest of the night, low tide prevented us from getting back to the boat, but by the time we left shortly after dawn our total take of turtles had grown to slightly over 2,500 baby green turtles.[182]

The activities of the turtle farmers at Bramble Cay, during this season, resulted in considerable depletion of baby turtles in addition to the high natural mortality of hatchlings.

Bustard continued to promote the turtle farming industry and attempted, through scientific research, to expand the resources available to the turtle farmers. He wrote:

> We need to find out all the important shell [hawksbill] turtle nesting beaches in the Torres Strait area in the course of the next year. This is important as we wish to Government to grant permits to farm shell turtles too. We intend to stuff these and sell them as curios which is a very profitable form of employment both for the shell turtle farmer and the person who makes the finished animal ready for sale.[183]

Scientific knowledge developed alongside the possibilities for the commercial development of the turtle industry. At Long Island, for example, Bustard claimed to have found the first recorded nesting rookery for the hawksbill turtle in Australian waters. He monitored the number of hawksbill turtles nesting, concluding that Long

[181] *Torres Strait Turtle Farmers' Newsletter*, No. 4, p. 3.
[182] *Torres Strait Turtle Farmers' Newsletter*, No. 4, pp. 7-8.
[183] *Torres Strait Turtle Farmers' Newsletter*, No. 4, p. 8.

Island represented a highly significant nesting site for this species: up to 75 hawksbill turtles nested there in a single 24-hour period and, despite poor weather, 210 animals were recorded nesting during a 10-day period.[184]

The scientific knowledge developed in this way was required to expand the turtle farming industry significantly. By April 1972, Bustard described the scale of the industry, and the scope for its expansion, stating:

> The total number of turtles in the farms is now between 5,000 and 6,000. The target for the end of the year is between 12,000 and 15,000 turtles, subject to Government approval of the permit requests. We also hope that during the course of this year the Government will approve our shell turtle farming plans.[185]

Bustard claimed that the plans for the further expansion of the industry had already been approved by the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources (IUCN), when Bustard addressed a meeting of the Sea Turtle Specialists Group in Morges, Switzerland, in March 1971. By April 1972, however, the first indications appeared that turtle farming was not taking place in conditions that promoted the survival of the animals, and 30 cases of fungus were reported to exist among captive turtles.[186]

The collection of wild turtle resources to stock the turtle farms continued. In May 1972, the Chairman of Stephen Island received an instruction for the island's boat to catch 'about 300 or 400' baby green turtles from the waters around the island; these eggs were to be used to allow two turtle farmers to begin operations at Stephen Island.[187] By that time, the industry had become regulated to the extent that farmers only received payment if they held at least 250 turtles. One farmer, for example, received a letter from Bustard informing him that he would not receive payment since he had only acquired 232 turtles.[188] Another received an instruction that stated: 'Essential you collect more

[184] *Torres Strait Turtle Farmers' Newsletter*, No. 4, p. 8.
[185] *Torres Strait Turtle Farmers' Newsletter*, No. 4, p. 9.
[186] Letter Ref. 9T/50/24/4, 101/26/4, Chairman, Coconut Island to Dr. Bustard, Thursday Island, 26 April 1972, RSI15058/1 Item 1386, QSA.
[187] Letter Ref. 9T/50 'A', 1/2/5, Chairman to Chairman, Stephen Island, 2 May 1972, RSI15058/1 Item 1386, QSA.
[188] Letter Ref. 9T/50(A), 60/12/5, Dr Bustard, Thursday Island to [turtle farmer], 12 May 1972, RSI15058/1 Item 1386, QSA.

turtles'.[189] In fact, more than 250 turtles were required by each farmer, since some would die in captivity. Bustard made the regulation of the industry explicit in the following telegraph to the Chairman of Murray Island:

> Farming regulations framed by me and approved by Director require all farmers to have 250 baby turtles at end 3 months period. To ensure continued employment each farmer should have about 330 turtles as some will die. If number falls below 250 then wages will normally cease.[190]

At the same time, Bustard attempted to expand the turtle farming scheme further; he investigated the possibility of turtle farming at Hammond Island.[191]

By May 1972, the problem of excessive mortality of turtles in captivity had become prominent in the correspondence about the turtle farming scheme. Bustard stated that, prior to 12 May 1972, five incidents of high turtle mortality had occurred at Darnley Island, with the loss of over 500 turtles. Bustard claimed that the deaths could be attributed to poisoning or theft since, he believed, the turtle farms were vulnerable to 'Eastern Island rivalry'.[192] He attempted to solve this problem by appointing night watchmen; he suggested that if the mortality was not reduced then turtle farming at Darnley Island would cease completely. By this date, the problem was not confined to the green turtle population, since the farming of hawksbill turtles had commenced at Boigu Island. Other islands, besides those with established turtle farms, had also become involved in the industry: as sources of baby turtles for the islands with farms. For example, in June 1972, the Chairman of Sue Island referred to the transfer of 156 baby turtles to the farms at Coconut Island.[193]

By 1973, the turtle farming industry was well-established. Sheds were constructed for the turtles, using island timber with roofs made of coconut leaves. Whole, mounted

[189] Letter Ref. 9T/50(A), 61/12/5, Dr. Bustard, Thursday Island to [turtle farmer], 12 May 1972, RSI15058/1 Item 1386, QSA.
[190] Letter Ref. 9T/50(A), 62/12/5, Dr. Bustard, Thursday Island to [8 turtle farmers] and Chairman, Murray Island, 12 May 1972, RSI15058/1 Item 1386, QSA.
[191] In-letter Ref. 9T/50/18/5, JCM:PBT, Dr. Bustard, Darnley Island to Dir., QDAIA, 18 May 1972, RSI15058/1 Item 1386, QSA.
[192] In-letter Ref. 9T/50, Dr. Bustard, Thursday Island to Dir., QDAIA, Brisbane, 26 May 1972, RSI15058/1 Item 1386, QSA.
[193] Letter Ref. 9T/50/14/6, RY:PBT, Dr. H. R. Bustard, Thursday Island to [*Name withheld*], Boigu Island, 14 June 1972, RSI15058/1 Item 1386, QSA; Letter Ref. 30/28/6. Dr H. R. Bustard, Thursday Island to Chairman, Sue Island, 28 June 1972, RSI15058/1 Item 1386, QSA; the name of the first of these addressees has been withheld in order to comply with the conditions of access for these archival materials at the QSA.

turtles, with shell lengths of between six and nine inches, were sold for the curios market. By that year, both green and hawksbill turtles were farmed for the curios trade. A company had been formed – A. and I. Products Pty. Ltd. – that purchased the turtles for a price of one dollar per inch of shell length.[194] The scale of the operation was by then large; turtle farms had been established at Warraber, Yorke, Kubin and Mabuiag Islands, and turtle farming had been expanded at Coconut Island. Bustard stated that he intended to bring between 2,000 and 3,000 baby green turtles from Bramble Cay to supply the northernmost Western Islands in March 1973. The Kubin Island farm had been established with 150 turtles; the farm at Mabuiag already contained 290 turtles. On 8 February 1973, the Hon. Gough Whitlam, Prime Minister, wrote: 'Some sixty turtle farms have now been established in North Queensland and three in Western Australia against a planned total of seventy-eight for the current financial year.'[195]

Also in 1973, however, concerns about the conservation of the species led to an attempt to adjust the industry so as to ensure the sustainability of the wild turtle populations that were being depleted in order to stock the farms. The Queensland Minister for Primary Industries wrote to the Queensland Minister for Conservation, Marine and Aboriginal Affairs, stating that the QDPI had:

> no objection to the removal for marketing purposes, of 5,000 of the hawksbill turtles currently held on turtle farms [...] provided that [...] at least 800 of the batch would be released into the wild when they reach the age of one year.[196]

By May 1973, the Chairman of Darnley Island reported that over 20,000 turtles were being farmed on several of the Torres Strait Islands and that the Islanders involved in the trade were 'now ready to start making stuffed curios out of about 5,000 small

[194] Dr. Bustard, Applied Ecology Pty. Ltd., 'Torres Strait Turtle Farming Industry' (*c.*1973), pp. 2-3, RSI15058/1 Item 1387, General Correspondence, Marine Produce – Turtle Fishing – General Admin. Only File No. 2, QSA.
[195] Dr. H. R. Bustard to [*Name withheld*], Western Islands Representative, Badu Island, 24 February 1973, RSI5058/1 Item 1387, QSA; Letter Ref. 9T/50(A), 23/15/3, Dr. Bustard, Darnley Island to Man., Thursday Island, 15 March 1973, RSI5058/1 Item 1387, QSA; Letter Ref. 9T/50(A), 5/2/4, Dr. Bustard, Darnley Island to Man., Thursday Island, 2 April 1973, RSI5058/1 Item 1387, QSA; In-letter, Hon. E. G. Whitlam, Prime Minister, Canberra to Hon. J. Bjelke-Petersen, Premier of Qld., Brisbane, 8 February 1973, RSI14900/1 Item 48, Ministerial Correspondence, Turtle Farming, QSA; the name of the first addressee has been withheld in order to comply with the conditions of access for these archival materials at the QSA.
[196] In-letter Ref. 9T/50(A), Qld. Min. for Primary Industries, QDPI, Brisbane to Hon. N. T. E. Hewitt, Qld. Min. for Conservation, Marine and Aboriginal Affairs, Brisbane, 18 April 1973, RSI5058/1 Item 1387, QSA.

turtles.'[197] The size of the farms on other islands was also increasing. During the same month, a turtle farmer at Yam Island reported holding over 400 baby turtles; another farmer at Moa Island reported stocking 250 baby turtles.[198] Bustard's plans to enlarge the industry were received favourably in Brisbane. In August 1973, he was informed that green turtles as well as hawksbill turtles would be included in the annual quota of 5,000 recently approved for the turtle farming scheme. However, a condition was attached: that at least 10 per cent of the farmed turtles should be released to the sea once they had attained a size 'adequate to ensure their safety from predators.'[199]

At around this time, problems that had previously been overlooked in the industry became apparent. The turtle farming scheme was discussed in the Senate and attracted strong criticism. First, statistics used to describe the scale of the industry were disputed; claims that 100 turtle farmers held 29,000 turtles were found to be inaccurate, as stocktaking found that around 19,000 turtles were held on the farms, suggesting that the mortality of farm turtles had been extremely high.[200] One reason for this mortality was the cannibalism that had been observed amongst turtles kept in crowded pens. In a critique of the conditions in which the turtles were farmed, Senator Georges stated:

> I have not gone into the story of what was intended or how they were going to raise the turtles to 120 lb. in congested pens with the water being changed by hand. I could take Honourable Senators to Murray Island and as we approached we would see figures forming a chain on the beach to carry 5-gallon buckets of water in order to change the water in the pens. The bigger the monsters become, the more they excrete, the more they foul the water and the higher the mortality rate becomes.[201]

The Senate concluded that the evidence provided in support of the turtle farming industry was 'grossly misleading'; an estimated 120 farmers were inflicting excessive mortality on the animals. Particular concern was expressed about the impacts of the industry on the hawksbill turtle, which had become 'almost extinct in Australia.'[202]

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[197] In-letter, Chairman, Darnley Island to Hon. Mr. Bjelke-Petersen, Premier of Qld., Brisbane, 1 May 1973, RSI14900/1 Item 48, QSA.
[198] Letter Ref. 9T/50A, 25/2/5, Man., Thursday Island to Dr. Bustard, Darnley Island, 2 May 1973, RSI5058/1 Item 1387, QSA.
[199] Out-letter, Dir., QDAIA, Brisbane to Man., QDAIA, Thursday Island, 9 August 1973, RSI5058/1 Item 1387, QSA.
[200] 'Adjournment: Aboriginal Affairs Ministry', 9 October 1973, Senate, pp. 1071-1081, p. 1073, RSI14900/1 Item 48 Turtle farming, QSA.
[201] 'Adjournment: Aboriginal Affairs Ministry', p. 1075.
[202] 'Adjournment: Aboriginal Affairs Ministry', p. 1080.

In November 1973, the turtle farming industry was completely reorganised in response to the criticisms of the Senators. A report by the House of Representatives Standing Committee on Environment and Conservation, which considered the future of turtle farming in Torres Strait, described the development of the activity and evaluated its impacts upon turtle populations. The Committee referred to the operation of 112 cottage industry farms in Torres Strait, farming around 29,000 turtles; but it acknowledged that a high mortality of turtle eggs and hatchlings had resulted from the activities of poorly-trained farmers. The Committee stated:

> The present system whereby Islanders establish themselves as turtles farmers by collecting sufficient eggs from rookeries to obtain 150 hatchling turtles, appears to be causing harm to wild turtle populations. Some Islanders harvesting eggs from wild rookeries have reported a hatchling result as low as 4 from 700 eggs. Of those which do hatch only about 20% can be expected to survive.[203]

Particular failings of the industry included the fact that no records of turtle eggs removed – or of hatch rates – had been taken; turtle farmers were unsupervised and tended to exploit rookeries throughout the nesting season; and the rate of successful hatchling emergence in captivity was much lower than that found in wild turtle populations. In Torres Strait, captive turtles experienced a mortality rate of 80 per cent during the first month of their lives; larger turtles kept in overcrowded conditions succumbed to sickness and death from bloat.[204]

Referring to the earlier attempt to introduce a greater emphasis on the conservation of the species in turtle farming, the Committee stated that the efforts to ensure that ten per cent of hatchlings were returned to the sea were minimal; only eighteen turtles had been returned by mid-July 1973. Furthermore, those turtles that were returned were not healthy and undamaged; rather, blemished turtles that could not be sold as curios were returned and these experienced increased vulnerability to predation after their release. The Committee found that, in any case, given the excessive mortality rates that characterised the industry, a ten per cent return rate of animals was far too low. In its evaluation of the overall impacts of the industry, the report stated: 'it appears to the Committee that the commercial aims of the enterprise have dwarfed the conservation

[203] 'Turtle farming in the Torres Strait Islands: Report from the House of Representatives Standing Committee on Environment and Conservation', November 1973, p. 17, RSI15058/1 Item 1387, QSA.
[204] 'Turtle farming in the Torres Strait Islands', p. 17.

aims.' Therefore, the Committee made the following recommendations: (a) that turtle farming should cease as a commercially-orientated undertaking; (b) that the activity should be re-established with an emphasis on research into the ecology of green and hawksbill turtles and on conservation *per se*, rather than on the exploitation of these species; and (c) that particular attention should be given to the conservation of the hawksbill turtle, which had become 'seriously depleted' throughout its range.[205]

Subsequently, the industry was restructured to incorporate a greater emphasis on research into, and conservation of, the marine turtles. In a report of 6 December 1973, the new manager of Applied Ecology Pty. Ltd. reported that monitoring of turtle numbers and nests had commenced; 1,870 turtles and twelve nests were reported.[206] No further evidence illuminates the period between the restructuring of the industry and 1977, but by the latter date, new practices appeared to characterise the turtle farming scheme. A turtle research biologist, C. J. Parmenter, had been employed and was alert to the depredation of turtle populations at Bramble Cay by the crew of a foreign ship; he reported that on 13 January 1977 the hands of the *M.V. Julie Ross*, registered in Papua New Guinea and operated by the China Transport Company of Daru, took at least one, and probably two, turtles as well as turtle eggs. That vessel returned on 1 February 1977 and its crew raided 'about 4 turtle nests but also destroyed at least one other nest that had near full term embryos' before departing for the Gulf of Papua.[207] Applied Ecology Pty. Ltd. was, by 1977, monitoring the abuses inflicted on turtles by others.

The collection of wild turtle eggs and hatchlings by Applied Ecology Pty. Ltd. continued; but in 1977 the nature and purpose of that activity changed. G. W. Stapleton, the Projects Co-ordinator, stated:

> Last year you approved the taking of 5,000 eggs and 2,000 hatchlings for the season; this season we do not propose taking any hatchlings but wish to collect 5,000 eggs for our turtle research project.[208]

[205] 'Turtle farming in the Torres Strait Islands', pp. 1, 6 and 17-18.
[206] Letter Ref. 143/30/11, Man. to Chairman, Mabuiag, 6 December 1973, 'Turtle farming report', RSI5058/1 Item 1387, QSA.
[207] C. J. Parmenter, Turtle Research Biologist, Applied Ecology Pty. Ltd., 'Report on the Activities of the crew of the *M.V. Julie Ross* at Bramble Cay 22/12/76-11/2/77', 24 February 1977, RSI15058/1 Item 1389, General Correspondence, Marine Produce – Turtle Fishing General (Applied Ecology) – File No. 4, QSA.
[208] Letter, G. W. Stapleton, Projects Co-ordinator, Torres Strait, Applied Ecology Pty. Ltd. to Dir., Qld. Fisheries Service, Brisbane, 7 September 1977, RSI15058/1 Item 1389, QSA.

Stapleton also sought approval to take eggs from Bramble Cay for the production of an Environmental Impact Statement for the area. With the shift in emphasis in the organisation from commercial to research activities, interest in turtle farming declined in Torres Strait. In December 1978, E. Gibson wrote that the farms at Kubin, Coconut and Yam Islands had closed; that all large turtles – those more than three years old – had been moved to Badu Island; and that all younger turtles had been moved to the Murray Islands. Yorke and Warraber Islands were to concentrate entirely on hatchlings, and Gibson stated that these islands were to be given 'a large number of eggs from Bramble Cay to see just how many healthy hatchlings can be looked after at each farm.'[209] Darnley Island received a small number of turtle eggs in order to maintain turtle stocks at that farm while the larger turtles were transported to Badu Island.

Despite the reorganisation of the industry, concerns about the status of the turtle populations persisted. Limpus stated: 'Through most of its range the hawksbill turtle is considered a conservation problem'; as such, the species was considered to be endangered and actively threatened with extinction.[210] The turtle farming operation – even if it was intended for purposes of scientific research – was by 1979 regarded as incompatible with the aims and methods of wildlife conservation. On 4 September 1979, the Badu Island Council wrote to the Hon. Charles Porter, the Queensland Minister for Aboriginal and Islanders Advancement, referring to the closure of the turtle farming operation and the demise of Applied Ecology Pty. Ltd. Instead, the Councillors were forced to consider alternatives to turtle farming, including fishing, although the latter activity was reported to be poor; the Council stated: 'Southern trawlers have been stripping these reefs of everything they can get over the past few years. They have cleared out many of the reefs.'[211] The cessation of turtle farming in Torres Strait left social and economic challenges to be faced by the former turtle farmers and their dependents; yet with the passing of this industry a source of disturbance to vulnerable turtle populations was removed.

[209] E. Gibson, 'Turtle talk', December 1978, RSI15058/1 Item 1389, QSA.
[210] C. J. Limpus, *Observations of the hawksbill turtle Eretmochelys imbricata (l.), nesting in north-eastern Australia*, QNPWS, Townsville, *c.*1979, RSI15058/1 Item 1389, QSA.
[211] In-letter, Chairman, Deputy Chairman and Third Councillor, Badu Island Council, Badu to Hon. Charles Porter, Qld. Min. for Aboriginal and Islanders Advancement, Brisbane, 4 September 1979, p. 4, RSI15058/1 Item 1389, QSA.

7.3.5 *Indigenous hunting of turtles*

The hunting of turtles is a culturally-significant activity among some Aboriginal and Torres Strait Islander groups. Some documentary material relating to the hunting of turtles by Indigenous people is presented in this section; this evidence indicates that some Indigenous people had developed considerable expertise in hunting turtles by the time of European settlement. For example, McCarthy acknowledged that Indigenous hunting of turtles occurred prior to European settlement and probably amounted to many hundreds of animals per week; he stated that:

> Turtles and tortoises provide a tasty and much relished food for the Aborigines [*sic*] of Australia and they are eagerly sought by both the men and the women. In the days when native culture was undisturbed by the white man [*sic*], the killing of many hundreds of these animals every week by the Aborigines exercised a considerable check on their numbers.[212]

After European settlement, in 1890, Saville-Kent acknowledged the skill possessed by Torres Strait Islanders in capturing turtles; he described the use of 'sucking fish, *Echineis naucrates*' that were kept alive in the bottoms of canoes, fastened to pieces of line and released when a turtle was sighted; the fish secured themselves to the carapace of the turtle and could be used to haul in the catch.[213]

Additional details about Indigenous turtle hunting, including the methods of the fishery and the use of turtle products, were provided by Haddon in 1901. He reported that two main turtle harvesting seasons occurred. The first season included October and November, when the turtles mated and could easily be speared at the surface. Haddon reported that a mating turtle was known as *surlal* and its associated season was called *surlangi*. The second season extended for the remainder of the year; during that season, turtles were known as *waru* and were found in deeper waters and in channels between coral reefs. Haddon also described the method of catching turtles using the sucker fish, which was known as *gapu* by the fishers.[214] He reported that the turtles were brought ashore to be butchered. This process took place while the turtles were still alive; he stated:

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[212] F. D. McCarthy, 'Aboriginal turtle hunters', *The Australian Museum Magazine*, 15 March 1955, pp. 283-286, p. 284.
[213] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 733.
[214] A. C. Haddon, *Head-hunters: black, white, and brown*, Methuen, London, 1901, p. 155.

> The native [*sic*] method of cutting up living turtle is a ghastly sight. The poor beast lies on its back and beats the air with its flappers, boys and girls, even naked little things that can scarcely toddle, stand round fingering and patting the bleeding flesh, or poke their fingers in the eyes of the turtle, or scoop up handfuls of clotted gore, ladling it into large shells.[215]

After the capture and butchering of the turtle, Haddon described the use of the turtle shells, which were placed as ornaments on decorative platforms aboard the fishers' canoes.

An alternative method of capturing turtles was mentioned in 1912 by 'Wandandian', who referred to the use of spears to catch the animals.[216] In another account, published in 1937, Sunter described the capture of turtles by Indigenous hunters using spears and 'throwing-sticks (wommeras)', but he indicated that the method of harpooning also had been adopted in order to catch turtles; Sunter stated that the turtles – if covered with wet bags – could survive for days after being harpooned and reported that he had carried the animals in that condition often aboard his lugger. The traditional method of capturing turtles using the sucking fish, however, was not abandoned, as Glenne reported in 1938; in addition, spearing of the animals still was practiced in 1949, as Benham documented in the vicinity of Lindeman Island and as Figure 7.23 illustrates.[217] The diverse methods of turtle hunting were described in detail by McCarthy, who stated that the use of sucking fish to catch turtles was still practiced by Aboriginal hunters between the Tully River and Cape York, although he claimed that the fish used was known as *Remora* rather than *Echineis naucrates*; McCarthy also argued that the sucking fish was used only to provide an indication of the movement of the turtle and not to haul in the animal.[218]

McCarthy also described the use of dugout canoes, such as the example shown in Figure 7.24, which were paddled or sailed to the turtle feeding grounds. Aboard these canoes, one of the crew operated a harpoon, which was described in the following terms:

[215] Haddon, *Head-hunters*, p. 157.
[216] 'Wandandian', *Travels in Australasia*, p. 145.
[217] Sunter, *Adventures of a trepang fisher*, pp. 61-62; Glenne, *Great Australasian mysteries*, p. 155; Benham, *Diver's luck*, facing p. 131.
[218] McCarthy, 'Aboriginal turtle hunters', p. 284.

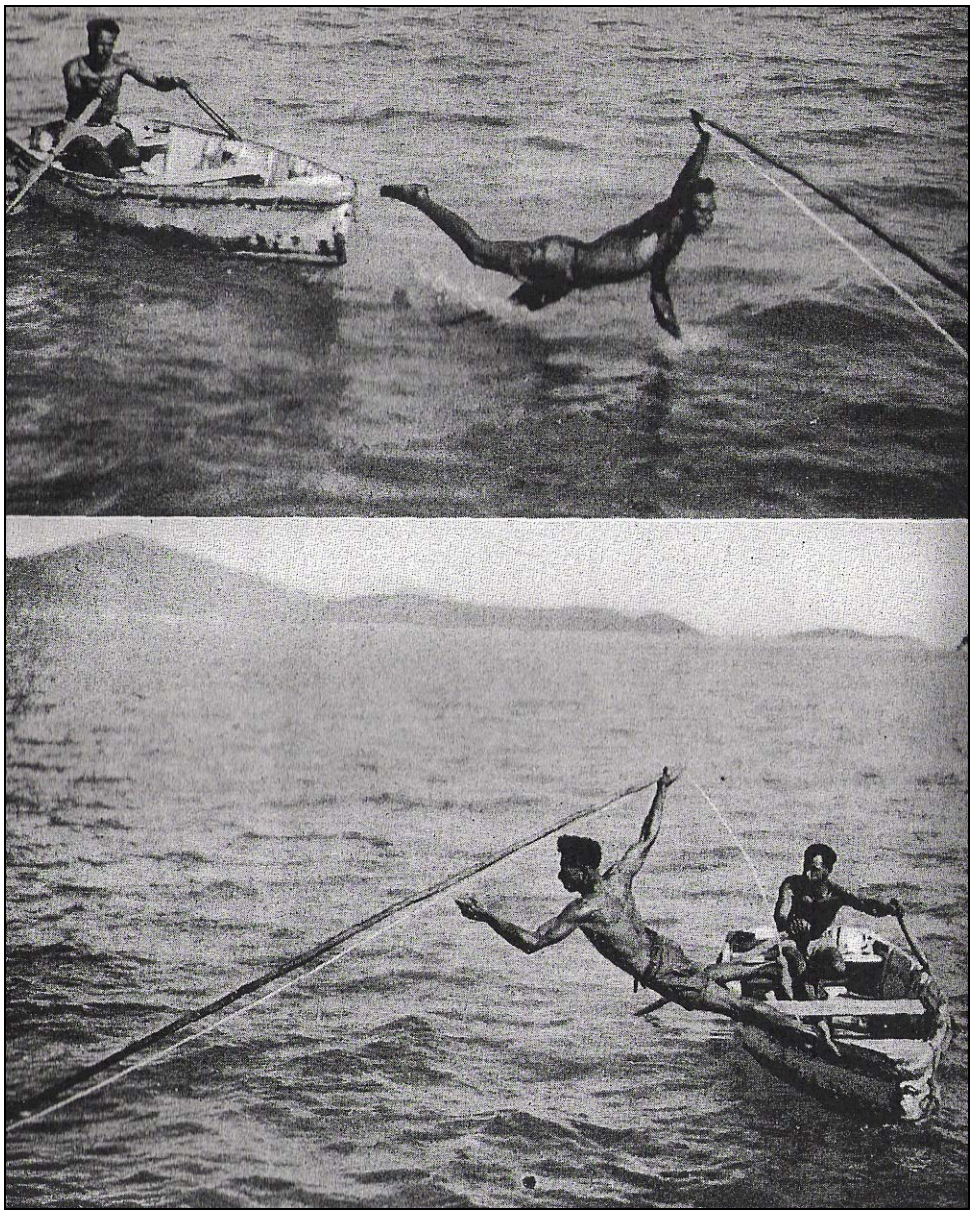

Figure 7.23. Spearing turtles near Lindeman Island.

Source: Benham, *Diver's luck*, facing p. 131.

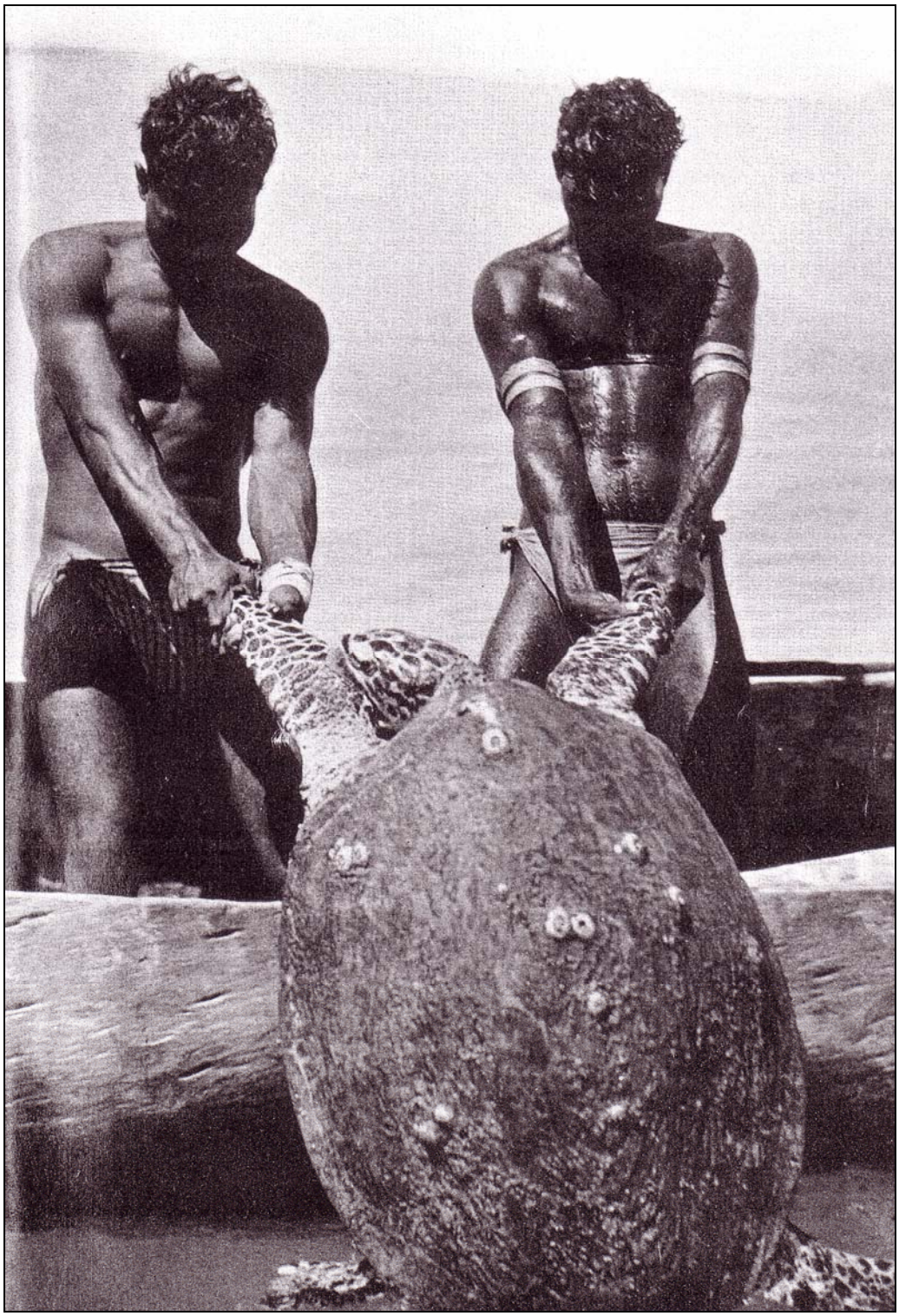

Figure 7.24. Indigenous turtle hunting, *c.*1939.

Source: P. McGuire, *Australian journey*, William Heinemann Ltd., London, 1939, facing p. 196.

The harpoon consists of a wooden or metal head attached to a line and set in a socket at the head of a soft-wood shaft about fifteen feet long. It lies along the seats beside the gunwale; the thick two-ply cord is coiled in the bow, and several spare harpoon heads are stuck in the front seat, the great thus being ready for instant use.[219]

McCarthy stated that, when the feeding grounds were approached, the sail was lowered and the fishers waited for turtles to break the surface. When a turtle was sighted, the harpoon was thrown from a distance of approximately twenty feet away. If the turtle was harpooned, the rope would be played by one or two of the fishers until the animal became exhausted; a second harpoon was used to secure large turtles. The process of capturing a turtle using the harpoon took between one and five minutes. After the turtle had been pulled into the boat, the turtle was killed aboard the canoe using a short club.[220]

McCarthy's account indicates that in 1955 Indigenous hunting of turtles remained an important activity and he argued that the European harvest of the animals should be regulated in order to conserve their populations; he stated that:

> the natives [*sic*] still hunt turtles at Palm Island and along the northern coast from eastern Cape York to north-western Australia and in these areas white exploitation of turtles should be rigidly controlled so that this source of food for the Aborigines [*sic*] is protected.[221]

Therefore, McCarthy implied, turtle populations might not sustain additional pressure by European settlers and the protection of turtle species was required. He claimed that green, hawksbill and leatherback (or luth) turtles represented the most vulnerable marine species of turtles, since the fishing of those species by Indigenous hunters had been 'one of the commonest sights in the old days, although not so much nowadays'. Another account of the harpooning of turtles, which described the use of the 'long harpoon' in Princess Charlotte Bay, was provided by Thomson in 1956; the capture of a green turtle near the Stewart River is illustrated in Figure 7.25.[222]

[219] McCarthy, 'Aboriginal turtle hunters', pp. 283-284.
[220] McCarthy, 'Aboriginal turtle hunters', pp. 284-285.
[221] McCarthy, 'Aboriginal turtle hunters', p. 284.
[222] McCarthy, 'Aboriginal turtle hunters', p. 283; D. F. Thomson, 'The fishermen and dugong hunters of Princess Charlotte Bay', *Walkabout*, Vol. 22, No. 11, 1956, pp. 33-36, p. 33.

Figure 7.25. A captured green turtle near the Stewart River, Princess Charlotte Bay, 1956.
Source: D. F. Thomson, 'Fishermen and hunters of Princess Charlotte Bay', *Walkabout*, Vol. 22, No. 11, 1956, pp. 33-36, p. 33.

The impact of Indigenous turtle hunting is difficult to assess from the documentary record; no evidence was found to indicate whether or not that harvest was ecologically sustainable. One account of a turtle hunt, by James, claimed that Torres Strait was once 'crowded with outriggers scouring the warm waters for turtles, but those days are gone'; yet the same author claimed:

> For hundreds, perhaps thousands of years, the [Torres Strait] islanders have hunted and killed turtles selectively, knowing that if they destroyed too many their food supply would diminish. Balanced killing indeed extended to all marine life in the [Torres] Strait.[223]

In contrast to the actions of Indigenous turtle hunters, James suggested that no concern for sustainability was shown by European settlers, 'who embarked on a systematic slaughter of the turtles [that] has continued practically to this day.' He acknowledged that the introduction of legislation by the Queensland Government was necessary in order to prevent the extermination of turtles in Queensland waters; however, that legislation was not always enforced, and James stated that 'a white fisherman boasted to me recently that he killed them whenever he saw them.'

Temporal variation existed in the Indigenous hunting of turtles; the animals were more readily caught during the mating season. Furthermore, during that season, females were reported to be easier to capture than males: one factor which may have exacerbated the depletion of the species.[224] One factor that sometimes acted in favour of the captured turtles was the appearance of 'tears' around the eyes of the animals as mucus was exuded. James reported: 'Two friends of mine have admitted they returned turtles to the sea once they started crying'; in contrast, he stated:

> Torres Strait islanders are made of sterner stuff. They flipped the turtles on their backs and quickly butchered them. They carefully prized the under shell away from the top shell, being careful not to spill any blood which they would use to thicken stews.[225]

When female turtles were caught, Mass observed, they almost always contained soft-shelled eggs: sometimes around 50 or 60 in number, which were also eaten.[226]

[223] G. James, 'Turtle hunt', *Walkabout*, Vol. 28, No. 3, March 1962, pp. 15-17, p. 15.
[224] O. Mass, *Dangerous waters*, Rigby, Adelaide, 1975, p. 166.
[225] James, 'Turtle hunt', p. 17.
[226] Mass, *Dangerous waters*, p. 167.

Since European settlement, the impacts of Indigenous hunting of turtles have occurred alongside other impacts on turtles. Interference with turtle eggs, for example, was described in the accounts by Musgrave and Whitley, and by Mass; that interference occurred as nests were excavated, either in order to eat the eggs or for scientific research; the destruction of a green turtle and its eggs for scientific research was documented by Monkman in his film of 1933, entitled *Ocean Oddities*. Another impact on turtles was the litter that was left on tourist resort islands by visitors; in 1969, Booth reported that turtles were being badly injured by broken glass that had been discarded on the beach at Fairfax Island as they attempted to dig their nests.[227] Numerous other impacts on marine turtle populations have occurred since European settlement, including the disorientation of hatchlings caused by artificial lighting, damage to turtle nests by domestic and wild animals, turtle by-catches in fishing nets, marine pollution, international trade in turtle products, and boat strikes. However, following the introduction of restrictions of other forms of destruction of turtles, Indigenous hunting now represents the most significant threat to turtle populations in the GBRWHA, especially to green and hawksbill turtles.[228]

Oral history evidence indicates that the impact of Indigenous hunting on turtles is compounded by habitat change, particularly at nesting sites. One expert informant, a marine biologist, stated that Raine Island functions as the most important marine turtle rookery in the world; for example, an estimated 11,800 turtles came ashore at Raine Island to lay their eggs during one night in 1974.[229] However, the suitability of Raine Island as a green turtle rookery is increasingly uncertain, since erosion of the cay has reduced the ability of the turtles to dig nests that lie above a level that is inundated by the sea. He stated:

> Green turtles, when they dig a nest, have a standard length flipper that they can dig with. They sit on the beach and dig a hole; they dig to as far as the flipper will reach. In the early years of our visits [to Raine Island], we never encountered turtles having problems digging. And we'd measured the nest depths of lots of the nests and, probably, seventy-something centimetres would be an average from the top of the beach to the bottom of the nest. If you go to Raine Island today, it's unusual for a

[227] Musgrave and Whitley, 'From sea to soup', p. 334; Mass, *Dangerous waters*, p. 138; N. Monkman, *Ocean Oddities*, Film recording, Australian Educational Films, Canberra, 1933, available from Screensound Australia, National Screen and Sound Archive, Cover Title No. 18188; J. Booth, Fairfax Island to W. Wilkes, 20 March 1969, SRS5416/1 Box 10 Item 58, NP220, Bunker, QSA.
[228] Limpus, 'Marine turtles of the GBRWHA', pp. 256-257.
[229] OHC 33, 19 September 2003, p. 10; see also the account provided in Love, *Reefscape*, p. 121.

> turtle to be able to be able to dig a nest that deep. They're hitting a rock layer under the beach. [...] In addition, in those early years, it was extremely rare to encounter water inside the nest chambers, whereas these days it's quite common. The overall impression that I've got is that the depth of sand overlaying the rock layer of the beach has become shallower. The rock layer hasn't shifted its depth. That means we've lost a substantial amount of sand off the beach.[230]

This informant argued that the loss of sand from Raine Island has resulted in the nests occurring at the same depth as the water table; additional inputs of water – for example, during rain showers – now result in significant mortality to the embryonic turtle hatchlings. The informant stated that 'in six out of the last seven nesting seasons – which included three of the biggest nesting populations ever recorded – there's been no significant hatchling production'; as a result of sand erosion, he suggested, Raine Island may no longer function as a suitable incubation site for green turtle eggs. This situation is potentially disastrous as Raine Island is the largest green turtle rookery in the world.

The evidence presented in this section has suggests that the marine turtles of the Great Barrier Reef and Torres Strait – especially green and hawksbill turtles – have experienced considerable exploitation since European settlement; Indigenous hunting, which now forms the most significant of the remaining impacts, also predated that period, although technological changes – in particular, the availability of modern outboard-powered vessels – have increased the capacity of Indigenous people to over-harvest the animals. As a result of the tortoise-shell industry, commercial turtle fishery, and the effort to farm turtles in Torres Strait, thousands of green and hawksbill turtles have been destroyed and additional damage has occurred to turtle nests and eggs. A variety of other forms of destruction of, and interference with, turtles – including turtle-riding – has also taken place. Limpus acknowledged that the populations of four of the five marine turtle species in the GBRWHA for which scientific observations exist have declined; Limpus attributed those declines to the impacts of various anthropogenic pressures.[231] The evidence presented in this section suggests that the declines in the populations of green and hawksbill turtles have been exacerbated by historical activities, especially the tortoise-shell industry, commercial turtle fishing, and turtle farming in Torres Strait. As those species are long-lived, slow-reproducing animals, the

[230] OHC 33, 19 September 2003, pp. 10-11.
[231] Limpus, 'Marine turtles of the GBRWHA', p. 258; no data about changes in the population of Olive Ridley turtles (*Lepidochelys olivacea*) were published.

impacts of such large harvests of marine turtles have probably been considerable. Management implications of the changes described above are discussed in Section 8.5.

7.4 Impacts on humpback whales, 1952-1962

While several species of cetaceans are found in the GBRWHA, little is known about these animals and the population sizes of all species except for humpback whales (*Megaptera novaeanglia*) are unknown. This section focuses on changes in humpback whales in the Great Barrier Reef, which are listed as vulnerable to extinction at by the IUCN, and for which some documentary evidence illuminates the period 1952-1962.[232] Yet the animals found in the Great Barrier Reef migrate between feeding grounds in Antarctic waters and breeding areas in coastal Queensland; along parts of the Queensland coast, their migration routes bring the animals close to the shore. At these parts of their migrations, humpback whales are particularly vulnerable to anthropogenic impacts on the adjacent coast. Furthermore, the species is characterised by a long-lived, slow-reproducing life history, with high investment by lactating cows in their calves. These characteristics impose additional vulnerability on the species in Queensland waters where cows and calves are susceptible to human impacts. GBRMPA has listed numerous anthropogenic impacts on cetaceans, including commercial whaling, harassment, vessel strikes, entanglement in nets, ingestion of litter, underwater explosions, pollution, disease, live capture and habitat degradation.[233]

As a result of the large migratory range of humpback whales, the animals found in the waters of the Great Barrier Reef have been affected by historical activities outside the boundaries of that ecosystem; in particular, the commercial humpback whale fishery that operated from 1952-1962, based at the Tangalooma whaling station, on Moreton Island, resulted in severe depletion of the species in east Australian waters.[234] A brief overview of the impacts of that fishery is provided below. That account belongs in the context of the development of Australian whaling, described for the period between 1791 and 1934 by the marine biologist, Dakin. That study indicated that an increase in

[232] GBRMPA, *Whale and dolphin conservation in the GBRMP*, Policy Document, April 2000, GBRMPA, Townsville, 2000, pp. 18 and 21.
[233] GBRMPA, *Whale and dolphin conservation*, *passim*.
[234] R. Paterson *et al.*, 'The status of Humpback whales *Megaptera novaeanglia* in east Australia thirty years after whaling', *Biological Conservation*, Vol. 70, 1994, pp. 135-142, p. 135.

Australian whaling took place between 1800 and 1803; by 1837, the industry had developed into a major industry, based at ports in southern Australia, including Sydney, and carried out by companies such as the South Australian Company and Whale Products Pty. Ltd.[235] The earliest operations of the industry were characterised by opportunistic harvesting of whales, and whaling ships sometimes worked the waters of the Great Barrier Reef; however, greater impacts were sustained by the whales of the Great Barrier Reef during their southwards migrations. Scarce documentary evidence illuminates the earliest period of Australian whaling and its impacts; in 1997, Corkeron reported that the status of cetaceans in the GBRMP remained poorly understood.[236]

The east Australian humpback whale fishery was created in response to an increased demand for whale oil, following the Second World War, and in 1949 the Australian Whaling Commission was formed to co-ordinate Australian whaling, with the intention of generating significant exports of the produce from Australia.[237] One company, Whale Products Pty. Ltd., was established in 1950 in order to develop the fishery on the east Australian coast. On 1 January 1952, Whale Products Pty. Ltd. was issued with licences to operate in Queensland coastal waters for a period of five years; the licences permitted that company to kill and process up to 500 humpback whales during the season extending from 1 May until 31 October in each year. The Annual Report for that year by E. J. Coulter, the Queensland Chief Inspector of Fisheries, stated:

> The first whale was killed on 6 June, and 600 hundred whales were dealt with between that date and 7 October, a permit being given to take an additional 100 whales which had been allotted to another company which did not commence operations.[238]

The animals were processed at the Tangalooma whaling station and at a smaller station in Byron Bay. The following year, the quota was increased to 700 animals, which were obtained between 21 May and 19 September.[239]

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[235] W. J. Dakin, *Whaleman adventures: the story of whaling in Australian waters and other southern seas related thereto, from the days of sail to modern times*, Angus and Robertson, Sydney, 1934, pp. 18, 53.
[236] For example, the whaling ship, *Duke of York*, was wrecked near Port Curtis (Gladstone) in July 1837; D. Jones, 'The whalers of Tangalooma 1952-1962', in M. Johnson (ed), *Brisbane: Moreton Bay matters*, p. 87; see also D. Jones, *The whalers of Tangalooma*, The Nautical Association of Australia, Melbourne, 1980; P. Corkeron, 'The status of cetaceans in the GBRMP', in D. R. Wachenfeld *et al.*(eds), *State of the GBRWHA Workshop*, pp. 283-286.
[237] Jones, 'The whalers of Tangalooma', p. 87.
[238] E. J. Coulter, AR, CIF, 1951-1952, *QPP*, Vol. 1, Part 2, 1952, pp. 1009-1012, p. 1012.
[239] E. J. Coulter, AR, CIF, 1952-1953, *QPP*, Vol. 1, Part 2, 1953, pp. 1012-1016, p. 1016.

In 1954, the quota of 600 animals was again achieved without difficulty; the captures were made between 31 May and 15 September of that year. During that year, Coulter reported:

> An officer of the Commonwealth Fisheries Office is stationed at Tangalooma during the season to ensure that the provisions of *The Whaling Act* are observed. An officer of the Fisheries Division of CSIRO is stationed there also and collects data and makes observations on the whales that are handled. Such information is summarised in the reports presented each year to the Scientific and Technical Sub-Committee of the International Whaling Commission.[240]

This report is significant as it indicates that the harvest of humpback whales was both legally regulated and scientifically monitored; unlike the previous European fisheries that had taken place in Queensland waters described in Sections 5.3, 7.2 and 7.3, the operation of the commercial humpback whale fishery was accompanied by the collection of ecological data about the catches.

In 1955, Coulter reported that the east Australian humpback whale population 'appeared to be still in a reasonably stable condition', although a decline in the numbers of that species had been observed by that year in the west Australian fishery. In spite of those reports of over-exploitation of the animals, no reduction in the quota was made; another 600 animals were captured during the season with, as Coulter reported, 'the 1995 catch even showing some improvement'; in 1956, the fifth season of operation of the fishery, 600 humpback whales were caught between 11 June and 13 August.[241] In 1957, a further 600 animals were caught and processed, between 10 June and 11 August, and Coulter stated that the CSIRO 'determined that the catch composition of the eastern Australian coast has improved in 1955 and 1956, probably as a result of more careful selection of larger whales'; during that year, the legal regulation of the fishery was also consolidated by means of *The Fisheries Act of 1957*.[242]

However, in 1957, as a result of the scientific monitoring of the harvest undertaken by the CSIRO, the lack of ecological sustainability that characterised the fishery was acknowledged and Coulter stated that 'the combined catch of the east Australian

[240] E. J. Coulter, AR, CIF, 1953-1954, *QPP*, Vol. 1, Part 2, 1954, pp. 1001-1006, p. 1005.
[241] E. J. Coulter, AR, CIF, 1955-1956, *QPP*, Vol. 1, Part 2, 1956, pp. 1014-1019, pp. 1017-1018.
[242] E. J. Coulter, AR, CIF, 1956-1957, *QPP*, Vol. 1, 1957, pp. 1012-1016, p. 1014.

humpbacks of the Australian coast and of Antarctic waters will not withstand continuous fishing above the 1956 level.'[243] Nevertheless, no reduction in the quota allocated to Whale Products Pty. Ltd. was made and another 600 humpback whales were caught between 1 June and 7 August of that year; subsequently, in 1959, the CSIRO reported that 'the population of humpback whales along the eastern Australian coast continues to be in a fairly sound condition' and, for the years 1959-1961, the quota was increased to 660 animals.[244] However, by 1960, changes in the behaviour of the humpback whales were apparent, as Coulter stated:

> Recoveries from whale markings show that during the summer of 1958-1959 the eastern population had spread further westwards in the Antarctic than usual, and some mingled and remained with the western population.[245]

The harvests for the years 1959 and 1960 were obtained successfully, although with increasing difficulty, and by 1961 three whaling ships worked to secure the catches; one of those vessels is shown in Figure 7.26. By the latter year, an aircraft was also used to assist in locating the whales.

In 1961, the collapse of the east Australian humpback whale population was acknowledged; A. J. Peel, the Director of the QDHM reported that only 591 whales of the permitted quota of 660 animals had been achieved by Whale Products Pty. Ltd. by 30 October, when the season closed, and he stated that the harvest had taken place at an average weekly catch rate of 28 animals, compared with 60 animals during the previous year.[246] The report of the CSIRO stated:

> Catch composition studies show that the decline of the population of humpback whales of the western coast continued unchecked during 1960, and that of the eastern coast has begun to decline, although as yet this stock is larger than the remnant of the western coast population.[247]

[243] Coulter, AR, 1956-1957, p. 1014.
[244] E. J. Coulter, AR, CIF, 1957-1958, *QPP*, Vol. 1, 1958, pp. 1012-1016, p. 1015; E. J. Coulter, AR, CIF, 1958-1959, *QPP*, Vol. 1, 1959, pp. 1093-1098, pp. 1096-1097; E. J. Coulter, AR, CIF, 1959-1960, *QPP*, Vol. 1, 1960, pp. 1149-1154, p. 1153; A. J. Peel, AR, QDHM, 1960-1961, *QPP*, Vol. 1, 1961, pp. 745-754, p. 750.
[245] Coulter, AR, 1959-1960, p. 1153.
[246] Peel, AR, 1960-1961, p. 750.
[247] Cited in Peel, AR, 1960-1961, p. 751.

Figure 7.26. A whale captured in Queensland waters by a whaling vessel, 1950s.
Source: Negative No. 43701, Historical Photographs Collection, JOL.

The following season, only 68 humpback whales had been captured between 18 June and 5 August 1962, and the whaling station at Tangalooma ceased operations on the latter date; by 1963, the infrastructure at Tangalooma station had been sold by Whale Products Pty. Ltd. and a tourist resort was subsequently constructed in its place.[248]

Hence, the impacts of the whaling industry were severe. The statistics presented above indicate that, during the decade of the operation of the eastern fishery, 6,179 humpback whales were killed at the Tangalooma station. One estimate of the impact of the fishery suggests that around 10,000 humpback whales migrated along the east Australian coast at the commencement of the Tangalooma fishery, in 1952; a decade later, less than 500 animals were thought to survive in that population.[249] Corkeron reported that the size of the remaining east Australian population of humpback whales in 1993 was estimated to be approximately 2,500 individuals; he stated that this figure had been achieved after an annual rate of increase in the population of around 10 per cent per year, yet the total estimated population is nonetheless far smaller than the total harvest of the Tangalooma station. Corkeron also acknowledged that the mortality of the species has also been increased by the activities of illegal Soviet whalers, which he stated have 'killed far more whales than previously thought.'[250] In spite of the regulation and scientific monitoring of the fishery, and its short duration in comparison with the other European fisheries described in Sections 5.3, 7.2 and 7.3, commercial whaling resulted in a severe reduction in the humpback whale population of the east Australian coast; some management implications of that change are considered in Section 8.5.

7.5 Impacts on sharks

Commercial exploitation of sharks in the Great Barrier Reef for the collection of shark fins and the production of shark oil was described in 1890 by Saville-Kent, who stated:

> At one of the bêche-de-mer curing stations in the Great Barrier district, I was informed that a curer had experimentally sent in some dried sharks' fin to Cooktown, and which had readily realised among the Chinese residents a price of no less than 19d per pound. […] The livers of sharks […]

[248] A. J. Peel, AR, QDHM, 1961-1962, *QPP*, Vol. 1, 1962, pp. 757-764, p. 763; A. J. Peel, AR, QDHM, 1962-1963, *QPP*, Vol. 2, 1963, pp. 827-838, p. 833.
[249] M. B. Orams and P. H. Forestell, 'From whale harvesting to whale watching: Tangalooma 30 years on', in O. Bellwood, H. Choat and N. Saxena (eds), *Recent advances in marine science and technology, '94*, JCU, Townsville, 1994, pp. 667-673.
[250] Corkeron, 'Status of cetaceans', p. 283.

> yield a valuable oil, while their carcasses, in combination with the waste products from the bêche-de-mer, would make excellent manure, akin to guano and particularly rich in phosphates.[251]

However, the next documentary evidence of the commercial production of shark products dates to 1929, when one company, Great Barrier Reef Fisheries Ltd. acknowledged the existence of a large market for shark fins, tails, oil, leather, teeth, dried steaks and manure; that company reported that shark fins were sold from between 2s 6d to 10s per imperial pound in China, shark meat obtained £25 per ton, and shark leather was used to manufacture shoes, handbags and wallets.[252]

In 1932, the increasing prospects of the Queensland shark fishery were discussed by Dick, the Queensland CIF, in his Annual Report; he stated:

> From time to time inquiries are received by the [QDHM] as to sources of shark skins, shark oil, and fins, and there is evidently a growing demand for these products. Some action to test the commercial possibilities of shark products has been taken during the year by a company established at Wynnum, which has also shown a considerable amount of enterprise in the manufacture of edible fish products.[253]

Dick acknowledged in his Annual Report of 1935 that interest in the shark fishery remained high; in 1937, he reported that commercial shark fishing occurred near Bowen, and he stated that those operations were 'in charge of a well-known exponent of that type of fishing, who has had experience in dealing with shark products'. That individual was probably Norman W. Caldwell, a renowned commercial shark fisher employed by Queensland Marine Industries Ltd. of Brisbane; the prospectus of that company stated that Caldwell had fished commercially for sharks for many years.[254]

By 1933, sharks were being exploited commercially for an increased range of products, as Figure 7.27 exemplifies. Shark-fin was used to manufacture soups; shark-oil was used as a medicine, in the production of cooking oil, in the tanning industry and as a lubricant on ship-ramps; shark meal was used in the manufacture of agricultural

[251] Saville-Kent, 'Bêche-de-mer and pearl-shell fisheries', p. 733.
[252] Great Barrier Reef Fisheries Ltd., *Tapping the wealth*, pp. 5, 7 and 15.
[253] Dick, AR, QDHM, 1931-1932, *QPP*, 1932, p. 6.
[254] Dick, AR, QDHM, 1934-1935, *QPP*, 1935, p. 1091; Dick, AR, QDHM, 1936-1937, *QPP*, 1937, p. 1404; Qld. Marine Industries Ltd., *Sharks and turtles*, p. 6.

(a)

HIDES.—A very attractive leather is obtained from the hide of a shark after being tanned, being extremely pliable and durable. Shoes, bags, wallets, and other fancy leather goods have already commanded large sales in the capital cities of Australia, and an English and Continental demand for the leather is certain. Prices obtainable average three shillings per square foot.

FINS.—Shark fins, dried, which in the past have been termed a delicacy in the East, have now become a daily necessity, and there is an UNLIMITED DEMAND ALL THE YEAR ROUND for this product, at prices ranging from 3/- to 6/- per lb. according to whether the fins are white or black.

OIL.—Medicinal Oil, extremely rich in Vitamins A and D, is obtained from the livers of the shark by a special process. There is a steady demand for the oil amongst dairy farmers and pig breeders. The oil increases the body weight, prevents disease, and promotes growth of bones and teeth.

FLESH.—An excellent fertilizer can be produced from the offal, head, and remains of the carcass after the hide, fins and liver have been removed. A splendid meal with a protein content of 88.9 per cent. can also be manufactured from the flesh. There is a ready market for both meal and fertilizer in Australasia and the rest of the world.

(b)

LEATHER—840 square feet at 3/-	£126	0	0
FINS—240 lbs. at 3/-	36	0	0
OIL—200 gallons at 3/-	30	0	0
FLESH—8 tons of raw material converted into 2 tons of fertiliser at £6	12	0	0
LIVER RESIDUE—¼ ton of meal at £10	2	10	0
	£206	10	0

Figure 7.27. (a) Some uses of shark products; (b) Values of a weekly catch of sharks, at an average total weight of 12 tons, in 1932.

Source: Qld. Marine Industries Ltd., *Sharks and turtles for profit*, p. 8.

fertilisers; and shark leather was sold for the curios trade. Like many other marine resources, the sharks of the Great Barrier Reef were considered to be 'practically inexhaustible'. The operation carried out by Queensland Marine Industries Ltd. was based on an average weekly catch of twelve tons of sharks, although a large by-catch of other species also resulted from that operation, and by 1933 another company, Ford Sherrington Ltd., had purchased shark leather from Queensland Marine Industries Ltd. for over eighteen months; the leather was produced from the skins of tiger, whaler and nurse sharks.[255] In one book, entitled *Fangs of the sea*, Caldwell and Ellison referred to the export of hundreds of tons of shark fins annually to China and Malaysia; he also mentioned the manufacture of leather products from shark hides and the production of oil from the shark livers. Another book, by Caldwell, *Titans of the Barrier Reef*, contained additional descriptions of the capture of sharks in the Whitsunday Group, including the destruction of the animal shown in Figure 7.28.[256]

During the 1930s, the fishing of sharks for sport, described by Lamond, had commenced; that activity occurred alongside the commercial shark fishery. Lamond's account contained evidence of the destruction of tiger and hammerhead sharks using lines. In addition, sharks were destroyed by other fishers who regarded the predators as a nuisance because they interfered with the fish catches.[257] One account of 1933, by Northman, described the destruction of sharks while fishing:

> But do not bother too much about killing a shark. Just give him [*sic*] a bullet, and that will be sufficient. His friends will do the rest. As soon as he is wounded, he is attacked by others.[258]

Several of these popular accounts refer to the occurrence of very large sharks in the Great Barrier Reef; for example, Lamond described the capture of a sixteen-foot shark, and Caldwell referred to a hammerhead shark with a hammer six feet across.[259]

[255] Qld. Marine Industries Ltd., *Sharks and turtles*, pp. 7-8 and 11; additional evidence of the manufacture of shark products in Queensland is provided in E. J. Goddard, 'The economic possibilities of the Great Barrier Reef', in D. C. Tilghman (ed), *The Queen state: a handbook of Queensland compiled under authority of the Government of the State*, John Mills Himself, Brisbane, 1933, pp. 217-222, p. 221; Roughley, *Wonders of the GBR*, p. 252 also describes commercial shark fishing in the Great Barrier Reef.
[256] Caldwell, *Fangs of the sea*, pp. 11, 16 and 19; Caldwell, *Titans of the Barrier Reef*, pp. 28-29 and 72.
[257] See, for example, Anon., 'Piscatorial: big fish in Townsville Harbour', *CCMM*, Vol. 5, No. 74, June 1933, pp. 33-35; H. G. Lamond, 'Sharking', *Walkabout*, 1 March 1936, pp. 23-25; Caldwell, *Fangs of the sea*; Caldwell, *Titans of the Barrier Reef*.
[258] J. Northman, 'Magnetic Island: novel fishing: larks with sharks', *CCMM*, Vol. 5, No. 74, June 1933, p. 39.
[259] Lamond, 'Sharking', p. 25; Caldwell, *Fangs of the sea*, p. 91.

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Figure 7.28. A shark caught in the Whitsunday Group, 1930s.
Source: Caldwell, *Titans of the Barrier Reef*, frontispiece.

Sharks have also been depleted since 1962 as a result of the nets and drum lines set for bather protection. Following two fatal shark attacks in the summer of 1962, A. J. Peel, the Director of the QDHM, stated: 'Tenders have now been called for long-term shark fishing contracts on the South, near North and Cairns coast which are due to commence on 1 November 1962.' From that date until 31 May 1963, Peel reported, 1,073 sharks and 910 shark pups were captured, figures which 'far exceeded the most optimistic estimates of the probable take'; Peel also stated that 26 grey nurse sharks, which previously had been regarded as rare in Queensland waters, were caught.[260] Catches of similar magnitudes were made for the remainder of that decade; the numbers of sharks and shark pups caught between 1963 and 1970 are shown in Figure 7.29. In 1964, of a total catch of 1,056 sharks, Peel reported that most animals were caught in northern coastal waters, with 295 sharks being destroyed in the vicinity of the Cairns beaches alone. By 15 June 1970, a total of 10,622 sharks and 5,643 shark pups had been caught since the introduction of the shark control program in 1962.[261]

7.6 Impacts on fish

Fishing has taken place in the Great Barrier Reef since the earliest period of European exploration. A large number of documentary and oral sources describe this activity; those sources exhibit a vast diversity of opinions and perceptions about the nature, methods, extent and impacts of fishing on the resources of the Great Barrier Reef. Furthermore, extensive debates have taken place about the relative impacts of commercial and recreational fishing, and anecdotal reports of decline of fish stocks as a result of both of these layers of fishing effort have been made. In this section, those debates are not reviewed in detail, nor are the vast quantities of empirical materials about fishing reviewed systematically; the enormous amount of documentary and oral history evidence that relates to fish species in the Great Barrier Reef precludes exhaustive consideration of the impacts of fishing in this thesis. Indeed the history of fishing in the GBRWHA merits detailed separate treatment. Instead, this section presents a small amount of documentary and oral history evidence about selected impacts of fishing, in order to provide an overview of the perceived depletion of fish stocks; the account presented here suggests that the cumulative effect of various impacts

[260] Peel, AR, QDHM, 1961-1962, *QPP*, 1962, p. 764.
[261] A. J. Peel, AR, QDHM, 1963-1970, *QPP*, 1963-1970, *passim*.

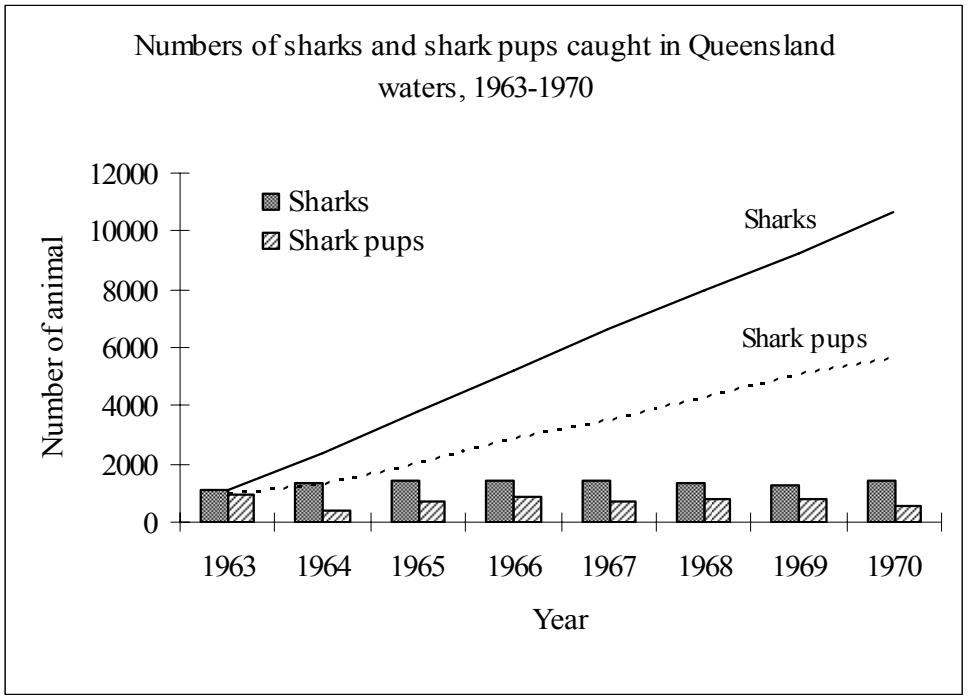

Figure 7.29. Numbers of sharks and shark pups caught in Queensland waters, 1963-1970.
Source: A. J. Peel, AR, QDHM, 1963-1970, *QPP*, 1963-1970, *passim.*

on fish may have been significant for some species, and that significant degradation has probably occurred to some fish habitats.

Although fish have been taken from the Great Barrier Reef by Europeans since the arrival of the *Endeavour*, early European fishing took place on an opportunistic basis; in general, in the early period of European settlement in Queensland, fishing was restricted to the coastal zone, since plentiful catches could be obtained from the shore without the use of boats. However, the twentieth century has been characterised by an overall dramatic increase in fishing effort in the Great Barrier Reef, and more systematic manipulation of fish stocks had commenced by the 1920s; in 1925, for example, Taylor referred to fish breeding in the Great Barrier Reef.[262] Yet during the first half of the twentieth century, the pelagic fisheries of the Great Barrier Reef were assumed to be secure and many accounts describe the abundance of fish that was available. For example, one account of 1929 stated that, at Lindeman Island:

> Mackerel or king fish trailing during the cooler months is unsurpassed in any part of Queensland. Fifteen mackerel have been landed in one hour, each weighing from seven to thirty-five pounds, with the spinner.[263]

The same account stated: 'An abundant supply of fresh fish for the table is to be obtained with net and trap.' During the 1920s, the tourist resorts of the Great Barrier Reef were promoted by the quality of recreational fishing at popular islands.

The availability of good fishing was described by several documentary sources in 1933.[264] One account considered that the waters of Queensland contained at least one thousand fish species, and that more were being discovered yearly: the best-known fish included the snapper, swordfish (*Tetrapterus*), groper (*Epinephelus lanceolatus*), bream, whiting, mullet, mackerel, flathead, tailor, jew-fish, trevally, emperor, clupeid, sole and flounder.[265] Despite this abundance of species, Stoddart claimed that Australia imported about one-third of a million cwt of fish, annually, at a cost of around £1,700,000; he

[262] Taylor, *Australia in its physiographic and economic aspects*, p. 217.
[263] Anon., *Lindeman Island Tourist Resort, Whitsunday Passage, North Queensland*, A. D. Nicolson, Lindeman Island, 1929.
[264] F. Reid, 'Angling thrills in coral waters', *CCMM*, Vol. 5, No. 75, July 1933, pp. 37-41; Northman, 'Magnetic Island'.
[265] Tilghman, *The Queen state*, pp. 63-64.

advocated the expansion of the Great Barrier Reef fisheries instead. In particular, Stoddart acknowledged the potential of the area between Townsville and Bowen, which was characterised by a muddy bottom, and he argued that this area could support rich trevally and prawn fisheries: in particular, large tiger prawns were found in this area. In contrast, Stoddart suggested that the area between Townsville and Cairns was unsuitable for trawling; but this area could instead be exploited for the profitable king snapper (*Lutianus sebae*), king-fish and mackerel. Stoddart reported that, further north in the Great Barrier Reef, huge shoals of Murray Island sardines could be found throughout the year; and that mullet and garfish were available throughout the reefs.[266]

If by 1933 the commercial fisheries of the Great Barrier Reef remained under-exploited, the possibilities offered by game fishing were already being explored, and Reid reported that increasing numbers of tourists from New South Wales and Victoria were visiting the Great Barrier Reef to pursue that activity.[267] An advantage of the Great Barrier Reef for this sport was that it contained sheltered fishing grounds, close to continental islands, in which game fishing could be carried out in poor weather. Tilghman reported that in 1933 game fishing took place from Lady Elliot Island to Torres Strait and the sport was concentrated in the vicinity of coral reefs; the base of the activity, however, was located at Hayman Island, where very large catches were obtained. Tilghman stated:

> During the winter season these two fishing skippers [Bert Hallam and Boyd Lee] have each taken enough big mackerel in a morning to fill the ton ice boxes in their launches. They used three heavy hand lines of course, and anglers would view such fishing as slaughter, but it shows the fish there are.[268]

The game fishermen landed very large specimens; swordfish, blue pointer sharks, leaping-tuna and giant turrum were sought eagerly in the waters near the Whitsunday Islands and the islands offshore from Gladstone and Bundaberg. Large stingrays, such

[266] E. J. Stoddart, 'The economic possibilities of the Great Barrier Reef', in D. C. Tilghman (ed), *The Queen State: a handbook of Queensland compiled under authority of the government of the State*, John Mills Himself, 1933, pp. 217-222, pp. 217 and 219-220.
[267] Reid, 'Angling thrills', p. 39.
[268] D. C. Tilghman, 'Game fishing on the Great Barrier Reef: playing big fish with rod and reel', in D. C. Tilghman (ed), *The Queen State: a handbook of Queensland compiled under authority of the government of the State*, pp. 223-227, pp. 223 and 225.

as the animal shown in Figure 7.30, were also sought by game fisherman, such as an 800-pound specimen that Tilghman reported was taken near Hayman Island.[269]

During the 1930s, with increasing access to the resorts of the Great Barrier Reef – and with increasing boat ownership, which allowed fishing parties to have direct access to the reefs – the incidence of fishing increased. Some popular books describing fishing in the Great Barrier Reef were published and several individuals became celebrities as a result of their promotion of fishing near the reefs and cays, including Zane Grey, Bert Hallam and Boyd Lee; in 1937, Caldwell referred to Boyd Lee as a 'Barrier Reef celebrity' and a professional fisherman. Caldwell also described a seasonal variation in the most abundant fishing; he stated:

> Winter months are [north Queensland's] great harvest time, when the immense schools of striped tuna, locally called 'kingies' (kingfish) work into the warmer waters from the south. The boats bring back huge hauls of this excellent table-fish. Townsville and Cairns absorb large quantities, the rest being railed to the Brisbane markets.[270]

In part, however, the success of the fishermen could be attributed to fishing methods which are now regarded as unsustainable, such as the blocking of creek mouths using fishing nets, which was a practice recommended by Boyd Lee. Another destructive practice was the shooting of fish in rocky pools on coral reefs, using pea-rifles, which was advocated by Northman at Magnetic Island.[271]

By 1939, the resources of the Great Barrier Reef fisheries were no longer perceived as being unlimited, and restrictions on the pelagic fisheries had been introduced. On 20 July 1939, an *Order in Council* prohibited 'the taking of all or any kind of fish as defined by those Acts in any Queensland waters specified in the Order'; those restrictions were enacted under the *Fish and Oyster Acts, 1914 to 1935*.[272] Subsequently, reports of damage to fish populations were received by the Queensland Department of Fisheries. One example of destruction concerned the sardine stocks at Green Island, which were reported to be experiencing increasing pressure as the number

[269] Tilghman, 'Game fishing', pp. 224-225 and 227.
[270] Caldwell, *Fangs of the sea*, pp. 23 and 90.
[271] Caldwell, *Fangs of the sea*, facing p. 118; Northman, 'Magnetic Island', p. 39.
[272] *Order in Council*, Brisbane, 20 July 1939, PRV8340/1 Item 1, QSA.

Figure 7.30. A large stingray captured in the Great Barrier Reef, *c.*1930.
Source: Negative No. 44419, Historical Photographs Collection, JOL.

of visitors to the resort increased. In 1941, the lessees of that cay, Hayles Magnetic Pty. Ltd., complained about the destruction of sardines at Green Island.[273] The company stated:

> We would like to stop the destruction of Sardines which visit the shores of Green Island in large shoals, and [are] an attraction for tourists. It has been known people throwing cast-nets from the Jetty will catch ¾ of a sugar bag of Sardines in one cast. After this happening for a month or so the Sardines disappear for from three to twelve months. We would not like to stop people securing sufficient bait for fishing while they were on the Island, but to fill cases and bags of Sardines to take away should be stopped.[274]

The Queensland CIF responded to this complaint, reiterating that the use of cast nets was illegal throughout Queensland; the caretaker at Green Island, W. D. Scott, who was also a Queensland Honorary Inspector of Fisheries, was instructed to seize cast nets under Section 44 (1) (d) of *The Fish and Oyster Acts*.[275]

If the increasing exploitation of the Great Barrier Reef fisheries had become a cause for concern by the end of the 1930s, the intensity of fishing in these waters nevertheless increased in the subsequent decades: this increase was a consequence of the economic importance of the commercial fisheries to the development of the State. In addition, the significance of charter operations for fishing parties increased. For example, the charter fishing industry expanded during the 1960s, stimulated by the growth of the black marlin (*Makaira indicus*) fishing industry; this industry commenced in 1966 in the waters between Cairns and Lizard Island.[276]

Another type of fishing that grew in popularity between 1930 and the 1960s – with severe consequences for fish populations – was spearfishing. This activity was controversial since it was regarded as an easy method of wreaking significant destruction on large fish; nevertheless, spearfishing was pursued at many resort islands and reefs in the Great Barrier Reef. As recently as 1969, complaints were received

[273] In-letter, Sec., Qld. Sub-Dept. of Forestry, Brisbane to Sec., QDHM, Brisbane, 19 December 1941, PRV8340/1 Item 1, QSA.
[274] In-letter, Sec., Sub-Dept. of Forestry, Brisbane to Sec., QDHM, Brisbane, 5 September 1941, PRV8340/1 Item 1, QSA.
[275] Out-letter Ref. 3740, Qld. CIF, Brisbane to Insp. of Fisheries, Cairns, 11 September 1941, PRV8340/1 Item 1, QSA.
[276] D. R. Dodds, 'The Cairns Black Marlin industry', CHS Bulletin No. 509, CHS, Cairns, February 2004, p. 1.

about the damage caused by spearfishers to coral reef fish, although the problem was difficult to address since the offshore reefs lay outside the jurisdiction of the Queensland authorities; in any case, supervision of the more remote reefs was difficult.[277] Some evidence of the impacts of spearfishing at Heron Island was provided in the following account of 1969 by Peel, the Director of the QDHM, who stated that:

> prior to June 1963, spear-fishing was permissible in the vicinity of Heron Island. It was then claimed by the management of the tourist resort, and supported by the Great Barrier Reef Committee, that it was no longer possible for tourists in the glass-bottomed boats to view larger groper: as fast as such fish were located, they fell prey to spear-gunners.[278]

Damage also occurred at Green Island where, in 1972, objections were raised to the 'wilful destruction of coral and the use by spear fishermen of bullets fired underwater', as the Hon. J. Herbert, Queensland Minister for Labour and Tourism, acknowledged.[279]

In a letter describing the destruction caused by spearfishers at Lizard Island, in 1974, the coral reef photographer, 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. [...] On the reef at North East Point, a colony of large coral trout, *Plectropoma maculatum* lived for many years. These were huge specimens, 30-40 lbs and it was the only part of the Great Barrier Reef where I had seen 10 or more big specimens living together in such a tiny area.
>
> These fishes were the subject of many photos as they were unique due to the fact that I had tamed them as they would readily approach a diver to collect food prepared for them. This colony of fishes has entirely disappeared in the last couple of year. A camp was made nearby for several months by a group making a film and conversation led me to believe they had initiated the killing of these unusually tame fishes. I believe a great opportunity has now been lost to study such magnificent specimens in their natural habitat. I partially blame myself for feeding them and winning their trust so as to make them un-missable targets for spear-guns of irresponsible people.[280]

[277] Out-letter Ref. 9-1-17, A. J. Peel, Dir., QDHM to Under-Treasurer, Brisbane, 17 March 1969, SRS31/1 Box 33 Item 573, General correspondence files – Licences to remove coral, QSA, p. 1.
[278] Out-letter Ref. 9-1-17, A. J. Peel to UT, Brisbane, 14 February 1969, SRS31/1 Box 33 Item 573, QSA, p. 1.
[279] Hon. J. Herbert, Qld. Min. for Labour and Tourism, Brisbane to Hon. V. B. Sullivan, Qld. Min. for Lands, Brisbane, 22 February 1972, SRS5416/1 Box 66 Item 447, NP836, Trinity 'R' – Green Island – Protection of Marine Life, QSA.
[280] R. Steene, Cairns to S. Domm, Dir., Museum Research Station, Lizard Island, 20 May 1974, pp. 1-2, p. 1, SRS5416/1 Box 28 Item 179, NP153, Flattery 'A' – Lizard Island, QSA.

The impacts of spearfishers were pronounced since the largest fish were targeted by the divers; this concentrated the mortality among the larger species of reef fish, and among the larger individuals within populations, leading to a progressive reduction in the size of fish apparent on popular coral reefs.

Another fishing activity that has caused degradation in the Great Barrier Reef is the collecting of aquarium fish. Steene reported that at Lizard Island, during the same visit, an abundance of valuable species of aquarium fish was found; he stated:

> In my present study of *Chaetodontidae* and *Pamacanthidae*, I made an exciting and important discovery during my recent stay. In shallow, protected water in the lagoon, I located an area which apparently is a prolific breeding ground for several rare species of fishes. This included different types, but most importantly, I found fourteen juveniles of *Heniochus singularius* a species which was previously known from only two specimens in Australian waters.
>
> Similarly *H. monocerus* and *C. bennetti* were abundant in juvenile form. Neither of these is a common species and would be considered a 'gem' to aquarists. In the same locality, I also found and photographed a species of *Solenichthys* that is so rare that only four specimens are held in museums in the world. This also would be a 'gem' for an aquarium and would fetch a handsome price.
>
> With the ever increasing popularity of salt water aquariums in the home, I consider the lagoon at Lizard a 'golden egg' for professional aquarium fish collectors. Since my return to Cairns, I have met two different fish collecting parties, apparently with big budgets and well organized, who plan working northern waters making Lizard Island their base.[281]

However, several oral history informants reported that as a result of the collection of coral reef fish for the aquarium trade, the abundance of the most popular fish has declined.[282]

The decline of many of the commercial and recreational fisheries of the Great Barrier Reef as a result of over-exploitation of fish has been described by Love, who stated:

> Live coral reef fish, from the Great Barrier Reef and Pacific Island nations, are air-freighted to Asia for restaurants, where they fetch large prices as status symbols. In 1995 the live fish trade brought 25,000 tonnes of live coral reef fishes into Southeast Asia. In 1996, a live groper sold in Hong Kong for US$10,256.[283]

[281] Steene to Domm, SRS5416/1 Box 28 Item 179, NP153, Flattery 'A' – Lizard Island, QSA, pp. 1-2.
[282] Examples include OHC 21, 10 September 2003, pp. 1-2 and OHC 31, 4 October 2003, pp. 7-8.
[283] Love, *Reefscape*, p. 98.

Numerous oral history informants provided additional anecdotal reports of overfishing and the depletion of fish stocks in the Great Barrier Reef; those reports, in addition to the documentary evidence presented above, suggest that impacts on fish in the Great Barrier Reef since European settlement may have been considerable and should be the subject of separate investigation.[284]

7.7 Conclusion

This chapter has outlined many changes in the marine wildlife of the Great Barrier Reef since European settlement; several activities responsible for those changes commenced soon after European settlement, including the commercial dugong and turtle fisheries and the collection of tortoise-shell. As a result of more recent activities, such as the commercial humpback whale fishery, the production of dugong oil for Indigenous communities, and turtle farming in Torres Strait, the impacts on some species – in particular, dugongs and green and hawksbill turtles – have been sustained over many decades; localised depletions of those species have been reported at various times. In contrast to those sustained fisheries, humpback whales were exploited much more intensively until the east Australian population of those animals collapsed, over a period of less than a decade. The various examples of decline in marine wildlife species presented in this chapter, then, suggest that diverse fishing practices characterised the harvest of marine wildlife species of the Great Barrier Reef since European settlement, although many of those practices led to observable depletion of resources.

Moreover, the account of the commercial humpback whale fishery presented in Section 7.4 exemplifies that severe depletion of marine wildlife occurred in spite of the legal regulation and scientific monitoring of that fishery; for other fisheries, which operated without such regulation and scientific monitoring – at least in their earliest periods – the accurate reconstruction of the extent of decline of marine wildlife species is not possible from the documentary records, especially for fisheries for which no production statistics were published, or those records are incomplete. For example, incomplete records of dugong and turtle catches mean that estimates of the former sizes of the populations of those animals, based on documentary and oral history sources, are contingent and

[284] For examples, see OHC 5, 11 February 2003, pp. 4 and 6; OHC 6, 17 February 2003, p. 1; OHC 8, 27 February 2003, p. 4; OHC 21, 10 September 2003, p. 1; OHC 23, 15 September 2003, pp. 9-11; OHC 29, 24 September 2003, pp. 4-11; OHC 40, 12 November 2003, pp. 4-5 and 7-8.

require careful interpretation in the light of current scientific knowledge of the ecology of those species; Marsh *et al*., for example, have investigated the assumptions involved in reconstructing past sizes of dugong populations in the southern coastal waters of Queensland.[285] The evidence presented above indicates that considerable changes in some marine wildlife species have probably occurred, but those changes require cross-verification with the literature of environmental management (Section 8.5).

[285] H. Marsh *et al.*, 'Historical marine population estimates'.

8. CONCLUSIONS AND IMPLICATIONS FOR CONTEMPORARY MANAGEMENT

In this concluding chapter, I present several implications for the contemporary environmental management of the GBRWHA that I have derived from the environmental history narratives presented in Chapters 5-7. Those narratives indicate strongly that scientific monitoring of the coral reefs, islands and marine wildlife species of the Great Barrier Reef is necessary. In this chapter, I have identified several test sites and marine wildlife species for which scientific monitoring could be based on historical baselines, as I have reconstructed the locations and dates of specific human activities. In general, the narratives presented in Chapters 5-7 suggest that the Great Barrier Reef has been exploited earlier, for a longer period, in more locations and more intensively than has previously been documented. I have also derived several implications of the use of qualitative sources – especially oral history sources – in reconstructing the environmental history of the Great Barrier Reef: and also implications of the use of a narrative approach. I present two ‘best case’ scenarios, in which reliable descriptions of changes in a coral reef, and of the protection of coral, respectively, are described in qualitative sources; yet those sources provide little indication of the causes of environmental change. Consequently, scientific monitoring – linked with performance indicators – is required in order to ensure the conservation of the GBRWHA.

8. CONCLUSIONS AND IMPLICATIONS FOR CONTEMPORARY MANAGEMENT

8.1 Introduction

The narratives presented in the preceding three chapters suggest several implications for the management of the GBRWHA. These implications form the focus of this chapter. The material presented here is intended to be relevant to environmental managers of the GBRMPA as well as to other professionals with an interest in the management of protected areas. Since the GBRWHA represents a marine ecosystem of global significance, the management responsibilities that apply to this area have necessitated the development of a distinctive policy framework, as Bowen and Bowen and Lawrence *et al*. have acknowledged.[1] Yet the management of the GBRWHA has been hindered by the relatively short period over which systematic scientific research and monitoring has taken place; in this chapter, I argue that further scientific research and monitoring of the GBRWHA – linked with agreed performance indicators – is necessary for the effective management of the ecosystem.

The chapter is organised in the following way: first, some aspects of the contemporary management of the GBRWHA are considered, including the nature of adaptive management and some areas in which my research can contribute to that process (Section 8.2). Second, the management implications of my narrative of changes in coral reefs are discussed (Section 8.3), followed by some implications of changes in islands (Section 8.4) and in marine wildlife species (Section 8.5); those three sections are based on the narratives that have been presented in Chapters 5-7. Some methodological and philosophical implications have also been derived from my research. Section 8.6 contains an evaluation of the use of qualitative methods in environmental history research into a marine environment, focusing especially on the use of oral history interviews; that task, as I have described in Section 1.3, was one of the specific research objectives. Other, philosophical implications that are raised by my research are discussed next, in Section 8.7, including some issues involved in storytelling, and the acceptance of shifting baselines in environmental history research.

[1] Bowen and Bowen, *Great Barrier Reef*; Lawrence *et al*., *Great Barrier Reef*.

8.2 The contemporary management of the GBRWHA

Lawrence *et al.* have described many details of the contemporary management of the GBRWHA.[2] In particular – and as a result of the lack of systematic scientific research and monitoring of the Great Barrier Reef for the period before 1970 – one emphasis in the contemporary management of the GBRWHA is the assessment of the status of many aspects of the ecosystem; that emphasis is reflected in the many studies found in the compilations by Wachenfeld *et al*. that investigated and described the status of the GBRWHA.[3] Such an approach is characteristic of a process of adaptive management, in which environmental management aims and policies must be responsive to learning from experience: a process that requires a supply of reliable information about the condition of the environment. Harvey and Caton acknowledged this requirement in the following terms:

> Management, which includes the active protection of ecosystems, requires information on change in the environment as a high priority. Monitoring of change is commonly carried out to establish a trend, or to establish the 'normal' range of seasonal, annual or interannual change. Management needs are to establish baselines, to show trends, to show the effects of management actions, and to establish targets and triggers for action.[4]

These authors argued that the adaptive management process responds to the fact that management decisions must be made while considerable uncertainty about the condition of ecosystems – and about the extent of changes in those ecosystems – exists.

The collection of information about the status of many aspects of the GBRWHA, as part of the adaptive management of the ecosystem, informs the 'pressure-state-response' model developed by the Organisation for Economic Co-operation and Development (OECD), which is illustrated in Figure 8.1. The use of this model is valuable since it permits State of the Environment (SoE) reporting by the Commonwealth Government, which in turn informs environmental decision-making. Many of the indicators used in the process of SoE reporting, however, relate to the status of parts of ecosystems: as, for

[2] Lawrence *et al*., *Great Barrier Reef*.
[3] Wachenfeld *et al.*, *State of the GBRWHA workshop*; Wachenfeld *et al.*, *State of the GBRWHA*.
[4] N. Harvey and B. Caton, *Coastal management in Australia*, Oxford University Press, South Melbourne, 2003, pp. 259-260; see also C. S. Holling, *Adaptive environmental assessment and management*, Wiley, New York, 1978.

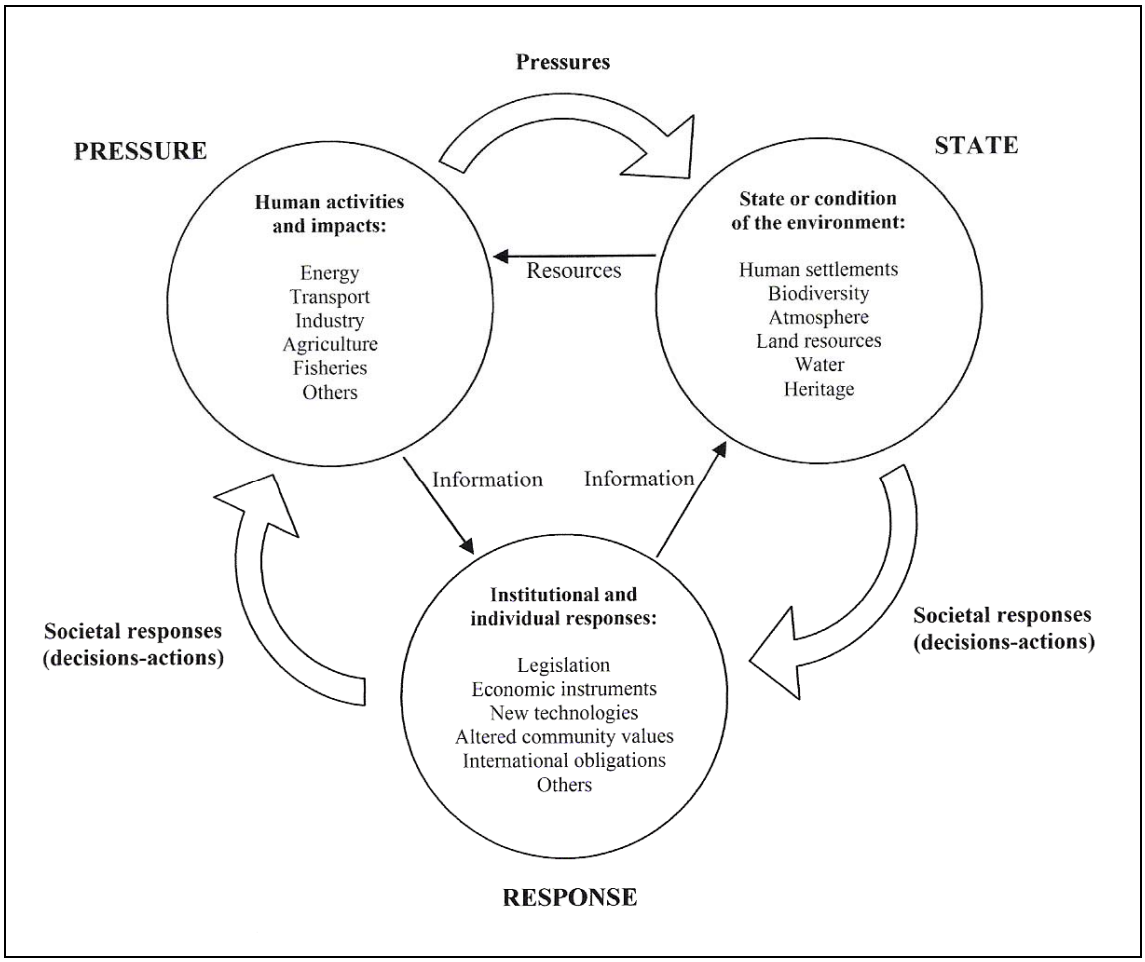

*Figure 8.1.*The OECD pressure-state-response model. In relation to the Great Barrier Reef, this model indicates the importance of scientific monitoring, because adequate knowledge about the pressures on the ecosystem – and about the effectiveness of any management responses – can only be derived from accurate monitoring of the state of that ecosystem.

Source: Based on Harvey and Caton, *Coastal management*, p. 261.

example, in the cases of threatened or endangered marine wildlife species and of seabird populations; hence, accurate information about the condition of the GBRWHA, and about changes in the ecosystem, is critical if appropriate management aims and policies are to be derived.[5] Harvey and Caton have acknowledged that such an approach is important as means of identifying areas of particular human impact on the environment and situations where the condition of the environment is of concern.[6]

Lawrence *et al.* have acknowledged the complexity of the process of management of the GBRWHA: in particular, because of the need to balance multiple uses of the ecosystem with the conservation obligations that result from World Heritage status. However, these authors acknowledged that lack of information hinders the task of balancing these conflicting demands; they stated:

> The management of human use [of the GBRWHA] seeks to minimise ecological impacts and to contain them within levels that can be sustained by the resilience of the ecological systems. The complex questions of the extent to which human use and environmental protection can be compatible remain difficult to answer. […] But to the extent that we do not know the limitations of the resilience of the natural systems in the face of the complete range of human and non-human impacts, it is not possible to be certain of the actual levels of use which are reasonable and sustainable.[7]

In response to this uncertainty, Lawrence *et al*. have emphasised the need to adopt the precautionary principle in the contemporary management of the GBRWHA.

The three environmental history narratives presented in Chapters 5-7 provide information about the historical extent of human use of the reef, as well as some examples of environmental protection. Consequently, as I argue in the remainder of this chapter, some ecological baselines may be reinterpreted and additional information about the type of historical impacts that have been sustained by coral reefs, islands and marine wildlife species is now available to environmental managers. The narratives found in Chapters 5-7 indicate that parts of the Great Barrier Reef have been exploited earlier, for a longer period, in more locations, and more intensively than has been

[5] H. Marsh *et al*., 'Historical marine population estimates: triggers or targets for conservation? The dugong case study', *Ecological Applications*, Vol. 15, 2005, pp. 481-492, p. 489, acknowledged the criticisms of the GBRMPA made by the Australian National Audit Office (ANAO) in relation to the problem that performance indicators for the management of the GBRWHA had not been devised.
[6] Harvey and Caton, *Coastal management*, pp. 262-263.
[7] Lawrence *et al*., *Great Barrier Reef*, pp. 63-64.

previously documented. The precautionary principle suggests that, where assumptions about the nature and extent of historical human activities must be made by environmental managers, those assumptions should not include excessive scepticism about the possibility of considerable historical degradation of the Great Barrier Reef.

In the paragraphs that follow, I frequently conclude that my research indicates that further scientific research and monitoring of coral reefs, islands and marine wildlife species is required in order to derive conclusions and management implications that are satisfactory from the point of view of environmental managers. Scientific monitoring can be defined as the systematic collection of scientific data, either in a laboratory or in a field situation, and the analysis of those data.[8] Marsh has argued that, in an environmental context, quantitative data are normally collected so as to reveal temporal trends, using standardised measurement techniques; often, those techniques involve elaborate instrumentation. Uncertainties in measurement, including biases, are accounted for and are minimised, and the reliability of the data is explicitly examined as part of the research process. Such scientific monitoring is generally accompanied by power analysis: a statistical technique that measures the capacity of the monitoring program to detect temporal trends in the data. Marsh acknowledged that the reasons for linking scientific monitoring to performance indicators is to establish *a priori* triggers for management intervention and targets for recovery. While the responsibility of the GBRMPA is to conserve the outstanding natural values of the GBRWHA, those values remain undefined and, in 1998, the Australian National Audit Office (ANAO) criticised the GBRMPA for having inadequate data to determine whether or not it is achieving 'its primary objective of protecting, conserving and allowing for reasonable use of the Great Barrier Reef Marine Park'.[9] In a follow-up report, however, the ANAO acknowledged that the required performance information was being developed by the GBRMPA.[10]

[8] For this point, and for the material found in the subsequent paragraphs in this section, I am grateful to H. Marsh, School of TESAG, JCU, Townsville, 6 May 2005, pers. comm.
[9] GBRMPA, *Nomination of the Great Barrier Reef by the Commonwealth of Australia for inclusion in the World Heritage List*, GBRMPA, Townsville, 1981.
[10] ANAO (Australian National Audit Office), *Commonwealth management of the Great Barrier Reef: GBRMPA*, comp. P. J. Barrett, ANAO, Canberra, 1998, n. 23; ANAO, *Commonwealth management of the Great Barrier Reef follow-up audit: the GBRMPA*, Audit Report No. 8, 2003-2004, comp. P. Nicoll and J. Robinson, ANAO, Canberra, 2003, n. 2.4 and 2.19.

However, scientific monitoring is, of itself, not enough, since the documentation of a long-term trend does not usually identify the reasons for that trend. For example, Marsh *et al.* investigated the catch per unit effort of dugong by-catch in a Queensland Government shark control program on the east coast of Queensland; their analysis indicated that the catch rate of dugongs caught in shark nets at six locations between latitudes 16.5°S and 28°S declined at an average of 8.7% per year between 1962 and 1999 (95% CI = 7.1, 10.6), which represents a decline to 3.1% (1.4, 6.1) of initial catch rates during the sampling period.[11] The relative importance of the various causes of this long-term decline in dugong numbers along the urban coast of Queensland cannot be quantified and probably varies in both space and time, as Marsh *et al.* have acknowledged. The likely causes of this decline, however, include the commercial dugong industry, traditional hunting, poaching, vessel strike, habitat loss, and incidental drowning in commercial gill nets and in shark nets set for bather protection.[12]

The only certain way to determine the reason for a changed environmental state is to conduct a manipulative experiment. For example, Hughes has carried out complex experiments to determine effects on coral reefs when herbivores are excluded by caging part of the reef; those experiments simulate the effects of anthropogenic overfishing of herbivores.[13] Such an approach requires suitable controls and Underwood has discussed issues relating to the design of powerful ecological experiments of this type. However, suitable experiments are often not possible for logistical and ethical reasons, as Marsh and Kenchington have argued.[14] Scientific monitoring of the impacts of specific anthropogenic impacts also requires suitable control sites to be identified so that the effect of any impact can be separated from natural changes.[15] For example, Brodie *et al.* conducted a baseline study of the effects of the harbour works at Nelly Bay, using control sites that were unaffected by the harbour works in the same area to increase the

[11] Marsh *et al.*, 'Historical marine population estimates', p. 484.
[12] H. Marsh *et al.*, *The status of the dugong in the southern Great Barrier Reef Marine Park*, Research Publication No. 41, GBRMPA, Townsville, 1996.
[13] T. P. Hughes, 'Catastrophes, phase shifts and large-scale degradation of a Caribbean reef', *Science*, Vol. 265, 1994, pp. 1547-1551.
[14] A. J. Underwood, *Experiments in ecology: logical design and interpretation using analysis of variance*, Cambridge University Press, Cambridge, 1997; H. Marsh and R. Kenchington, 'The role of ethics in experimental marine biology and ecology', *Journal of Experimental Marine Biology and Ecology*, Vol. 300, No. 1, 2004, pp. 5-14, p. 5.

likelihood that the environmental changes they observed could be attributed to the harbour works rather than to natural factors.[14]

Information collected by oral historians, as well as a significant proportion of the data that I collected from the QSA, is essentially anecdotal and does not meet the usual criteria for scientific monitoring. Hence, those qualitative sources cannot provide the GBRMPA with adequate information to determine whether or not the GBRMPA is protecting the outstanding natural values of the GBRWHA. However, qualitative sources can inform the results of scientific monitoring in two ways. First, as shown in the example of declining dugong numbers discussed above, qualitative sources can indicate likely causes of change; the existence and scope of the Queensland commercial dugong fishery is known only from historical sources, because that fishery ceased in 1969. Second, anecdotal information found in some qualitative sources can provide insights into the situation before scientific monitoring commenced; in the case of the GBRMP and the GBRWHA, for instance, scientific evidence of environmental change informs only the period since the 1970s. Jackson *et al.* acknowledged the problem of shifting baselines in ecological research and the lowering of observers' expectations because those individuals do not know – or do not recall accurately – the former state of the environment.[15]

Marsh *et al.* argued that qualitative historical information is important in informing or challenging such expectations and perceptions of past environments. As these authors have demonstrated, comparisons between contemporary and historical environmental states can function as powerful qualitative triggers for conservation.[16] Such comparisons also have the potential to inform the development of targets for the recovery of degraded environments or of depleted populations of marine wildlife species. However, historical accounts should not be used to derive quantitative targets for recovery without: (a) making the assumptions underlying these estimates explicit and systematically testing them; (b) conducting scientific research so as to estimate

[15] For other perspectives towards the problems involved in separating natural from anthropogenic changes in environmental history research, see Cronon, 'Cutting loose or running aground?'; and also Demeritt, 'Ecology, objectivity and critique'; these issues are discussed in more detail in Section 2.3.4.
[16] J. D. Brodie *et al.*, *Magnetic Quay water quality and sediment baseline study*, Research Publication No. 18, GBRMPA, Townsville, 1989.
[17] Jackson *et al.*, 'Historical overfishing'
[18] Marsh *et al.*, 'Historical marine population estimates', p. 481.

current

carrying capacity and pressures on the relevant species and their habitats; and (c) taking part in consultation with a broad range of stakeholders with regard to removing these environmental pressures. As Agardy *et al.* argued, over-enthusiastic prescription of simplistic targets for solving marine conservation problems risks polarizing competing interests, and may ultimately stymie progress in achieving conservation aims.[17] Instead, conservation targets which allow environmental managers to balance human well-being and the conservation of biodiversity are required; hence, for example, the social and cultural values with which dugongs and turtles are invested by Indigenous communities require management along with the conservation requirements of those animals.

8.3 Implications of changes in coral reefs

Many implications for the contemporary management of the GBRWHA are raised by the narrative of changes in coral reefs presented in Chapter 5. As a result of the Holocene evolution of the east Australian continental shelf, the coral reefs of the Great Barrier Reef have declined for geomorphological reasons over the last 6,000 years (Section 5.2.1); in particular, many nearshore reefs now exist close to thresholds of mortality and some reefs, such as Stone Island and Goold Island reefs, now appear to exist in a significantly degraded condition. Other atmospheric and ecological effects, including coral bleaching, cyclones and COTS, have compounded the deterioration of the most vulnerable reefs, especially in the Cairns Section of the GBRWHA (Sections 5.2.2-5.2.4). Historical human activities represent an additional layer of impact upon those reefs that already exist in marginal conditions; for example, coral mining at Yule Point reefs and at Kings Reef has contributed to the significantly degraded appearance of those reefs (Section 5.4). Overall, the geomorphological context of the evolution of the Great Barrier Reef suggests that many coral reefs were probably far from pristine at the time of the formation of the GBRMP in 1975, and that some reefs have been significantly degraded. The evidence presented in Section 5.2, therefore, suggests that some nearshore reefs – especially in the Cairns area – require considerable protection from remaining human impacts if the World Heritage values of the region are to be conserved.

[19] A. Agardy *et al.*, 'Dangerous targets? Unresolved issues and ideological clashes around marine protected areas', *Aquatic Conservation*, Vol. 13, 2003, pp. 353-367.

The early European reef fisheries described in Section 5.3 – the bêche-de-mer, pearl-shell and trochus fisheries – caused sustained and intensive impacts on the marine resources used by those industries. The earliest period of operation of these fisheries, which dated from at least 1827, is not illuminated by production statistics, and was neither regulated nor monitored, with the result that the uncontrolled exploitation of resources took place. By 1890, Saville-Kent had reported the depletion of bêche-de-mer in Queensland; in 1898, the Queensland Inspector of Pearl-Shell Fisheries had acknowledged the scarcity of pearl oysters. In 1908, the Royal Commission into the workings of the bêche-de-mer and pearl-shell industries found that severe depletion of bêche-de-mer and pearl oysters had occurred and that restrictions of the fisheries were necessary. Thousands of tons of bêche-de-mer were removed from the reefs, and early descriptions of the harvesting of these animals with ease from the reef flats at low water suggests an abundance that has not been described since 1922 (Section 5.3.1). Several contractions of these industries – each related to depletion of the marine resources – had occurred by 1950, after which date the fisheries declined to very low levels. By that time, coral reefs throughout the Great Barrier Reef had been harvested extensively by bêche-de-mer and trochus crews, and the reefs of the northern Great Barrier Reef had been exploited systematically for pearl-shell.

As a result of the extended period of operation of these fisheries, the bêche-de-mer, pearl-shell and trochus resources of the Great Barrier Reef were almost certainly significantly degraded from their status at the time of European contact by 1950. One recent scientific study of holothurian populations indicates that two species – the black teatfish (*Holothuria whitmaei*) and the surf redfish (*Actinopygia mauritania*) – are now regarded as overexploited; in addition, the sandfish (*H. scabra*) has not yet recovered from fishing to very low levels.[18] The authors of that study, Skewes *et al*., argued that holothurians are especially susceptible to exploitation because they are large and easily fished; and they stated: ‘Experience elsewhere has demonstrated that bêche-de-mer fisheries are extremely prone to overexploitation, and the recovery of depleted

[18] 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, p. 11.

populations is slow and sporadic'.[19] Skewes *et al*. acknowledged the particular depletion

[19] Skewes *et al*., *Stock survey and sustainable harvest strategies,* p. 14.

of the sandfish (*H. scabra*) as a result of overfishing in Torres Strait and in eastern coastal Queensland waters. However, they considered only recent (since the mid-1980s) fishing for bêche-de-mer. As Uthicke has shown, in the Great Barrier Reef, the extent of the historical exploitation was very much larger than the recent fishery. In another study Uthicke *et al*. indicated the depleted status of black teatfish (*H. nobilis*) in the Great Barrier Reef; those authors acknowledged the very slow recovery of holothurian populations – which may take several decades – and advocated an extremely conservative management plan for that species.[20]

The effects of coral mining in the Great Barrier Reef are described in Section 5.4; as a result of this industry, between 1900 and 1940, at least twelve reefs were modified and thousands of tons of coral were removed from some reefs: particularly at Snapper Island, Upolu Cay, the North Barnard Islands and Kings Reef. Several of these reefs – especially Kings Reef and Yule Point reefs – now appear highly degraded. Furthermore, all of the coral mining locations described in Section 5.4 may have become more vulnerable to other impacts, including natural changes, and experienced a reduced capacity to recover from other environmental stresses as a result of coral mining. Although the practices of coral miners varied in different locations – with gelignite being used at Kings Reef and crowbars being employed at Snapper Island, for example – the use of the precautionary principle suggests that all of the coral reefs and cays described in Section 5.4 could have been seriously degraded. The twelve coral mining sites that have been reconstructed in that narrative may require complete protection from other impacts if they are to achieve conditions similar to those that existed before this industry began – or are to be resilient to the effects of climate change. In addition, because the dates and locations of coral mining have been established with relative precision, these sites could also be used as test sites for monitoring the recovery of coral reefs from mining, if suitable control sites can be identified.

[20] S. Uthicke, 'Overfishing of holothurians: lessons from the Great Barrier Reef', in A. Lovatelli *et al.* (eds), *Advances in sea cucumber aquaculture and management*, FAO Fisheries Technical Paper 463, FAO, Rome, 2004, pp. 163-171; pp. 164-165; S. Uthicke and J. A. H. Benzies, 'Effect of bêche-de-mer fishing on densities and size structure of *Holothuria nobilis* (Echinodermata: Holothuroidea) populations on the Great Barrier Reef', *Coral Reefs*, Vol. 19, 2000, pp. 271-276, p. 271; S. Uthicke *et al.*, 'Slow growth and lack of recovery in overfished holothurians on the Great Barrier Reef: evidence from DNA fingerprints and repeated large-scale surveys', *Conservation Biology*, No., 18, No. 5, 2004, pp. 1395-1404, p. 1395. As Skewes *et al.*, p. 14, acknowledged, the taxonomy of commercial holothurians is not consistent; those authors use the term *H. whitmaei* instead of *H. nobilis* to refer to the black teatfish; Saville-Kent's term for the same organism was *H. mammifera* (Section 5.3.1).

The impacts of coral mining in the Great Barrier Reef have not yet been the subject of scientific investigation, although some impacts of coral mining have been documented for other coral reefs. Gomez, for example, referred to the removal of large quantities of coral from Pacific Island reefs – in a largely uncontrolled and unmonitored manner – for construction purposes. In particular, Gomez referred to the destruction of '*Porites* and *Goniopora* which are sawed into tiles for use in buildings' in the Philippines, and provided the following description of coral mining impacts:

> In Indonesia, corals are used in the construction of jetties, walls, fishing weirs, roads, and are burned as a source of lime […]. Coral mining is believed to have caused the reduction in size to about one-half the original of the coral islands Ubi Besar and Niwana […]. In Bali, the collection of corals for lime has resulted in serious environmental degradation […]. Extensive coral mining has also been cited as a problem in the Spermonde Archipelago. The use of corals as building materials occurs in many coastal towns in Malaysia […]. The extent of damage to reefs in Sabah inflicted by such an activity was estimated to be a loss in the order of 6.8 km of reef front per year […]. In Papua New Guinea, the deterioration of reefs around Rabaul is attributed to the collection of corals for lime […]. This is also said to have affected fish abundance in some areas. Problems of reef degradation brought about by mining are not confined to the Pacific region. In the Maldives, for example, a large percentage of all building materials is derived from the surrounding reefs […]. Serious environmental problems are foreseen within a generation if no management is introduced.[21]

Additional evidence of the impacts of coral mining was provided by Soekarno, who stated that records of historical coral mining in the Seribu Islands, in the Java Sea, indicate that between 8,500 and 25,000 cubic metres of coral were mined annually during the early twentieth century, and that the rate of extraction had since escalated. Soekarno also stated that the most severe coral mining in the Bay of Jakarta occurred around the islands of Air Kecil and Ubi Kecil where, as 'a result of subsequent erosion both islands have now disappeared.'[22] These studies indicate that considerable, permanent impacts on coral reefs can result from coral mining. On the basis of the above evidence, therefore, it is reasonable to assume that irreversible impacts may also have occurred, at least in some parts of the Great Barrier Reef.

[21] E. D. Gomez, 'Perspectives on coral reef research and management in the Pacific', *Ocean Management*, Vol. 8, 1982-1983, pp. 281-295, pp. 283 and 288-289.
[22] R. Soekarno, 'Comparative studies on the status of Indonesian coral reefs', *Netherlands Journal of Sea Research*, Vol. 23, No. 2, 1989, pp. 215-222, p. 217.

Coral collecting, described in Section 5.5, has resulted in cumulative impacts which were reported to have been severe at the major tourist resorts of the Great Barrier Reef, including those resorts at Heron, Green, Lady Musgrave and Lizard Islands; those impacts have been sustained over more than fifty years and have been concentrated in the most accessible parts of the most frequently visited reefs. The damage caused by coral souveniring at the tourist resorts extended beyond the period when coral specimens could be legally removed, as numerous documentary and oral history sources indicate. In addition to the souveniring of coral by many visitors, the coral collecting industry – regulated by the Queensland Government – caused the removal of large amounts of the most attractive coral from at least twelve coral reefs. The evidence presented in Section 5.5 indicates that coral collecting has contributed to the decline of many coral reefs: particularly nearshore and fringing reefs, and reefs in the Cairns area. Again, the damage caused by coral collectors can be identified with the most accessible parts of specific coral reefs, and to particular decades, with the result that those reefs could theoretically be used as sites for the scientific monitoring of the impacts of coral collecting. However, it would be difficult to distinguish the impacts of coral collecting from other confounding impacts on these reefs without appropriate control sites.

Along with coral collecting, the impacts of shell collecting in the Great Barrier Reef have been widespread, long-term and cumulative. The evidence presented in Section 5.6.1 indicates that a reduction in the average size of some species has taken place since extensive recreational shell collecting commenced, suggesting that some species have been collected excessively. Particular depletion of shell populations was reported at Green, Heron, Lady Musgrave and Fairfax Islands, at Wistari Reef, and at Michaelmas Cay, although other reefs that are easily accessible from the Queensland coast also have been exploited by shell collectors, including Yule Point Reefs. In the context of other anthropogenic and natural pressures since European settlement, shell collecting represents a further source of disturbance to those reefs. The account of shell collecting provided in Section 5.6.1 has indicated that some shell collectors operated without regard for the sustainability of shell populations, for the damage caused to coral reefs while obtaining specimens, or for prohibitions on the removal of marine species from protected reefs. Particular impacts have been sustained by giant clams (*Tridacna gigas*) as a result of clam fishing, the use of giant clam shells as curios and ornaments, and the destruction of the animals by divers and bathers. As giant clams are long-lived, slow-

growing organisms, the giant clam populations in the GBRWHA have probably been considerably depleted since European settlement (Section 5.6.2); however, some rehabilitation has been attempted as a result of successful aquaculture of giant clams.[23]

In common with coral mining, the activities of coral and shell collecting in the Great Barrier Reef have not received extensive scientific investigation. Gomez acknowledged the general scarcity of scientific data about coral and shell collecting, stating that 'the long-term effects of such removal have not yet been documented, either for corals or molluscs'; however, Gomez stated, 'little attempt has been made to control trade, or even to regulate the harvesting of stony corals anywhere else [besides the Philippines] in the Pacific.'[24] Instead, Gomez argued, significant ecological impacts of these activities must be reconstructed based on intuitive knowledge and scientific knowledge of reef dynamics; for example, localised depletions of particular species of corals, larger fish and molluscs – especially giant clams (*Tridacna gigas*), which Gomez argued have become scarce throughout the Pacific – can be partly attributed to coral and shell collecting. Gomez also evaluated various scenarios for the conservation of coral and shell populations, emphasising the importance of effective marine protected areas.

Many other impacts on coral reefs have been described in Section 5.7, including the dynamiting of reefs for fish, the clearing of access channels and tracks, military impacts and reef-walking. All of these activities have resulted in physical damage to coral reefs. The use of dynamiting for fish in the Great Barrier Reef took place more extensively than has previously been documented and inflicted severe damage on accessible reefs between at least 1913 and 1970; as a result of fishing using explosives, the degradation of coral reefs between Fitzroy Island and Oyster Cay had become a source of particular

[23] T. Elfwing *et al.*, 'A comparison between sites of growth, physiological performance and stress responses in transplanted *Tridacna gigas*', *Aquaculture*, Vol. 219, No. 4, 2003, pp. 815-828; P. J. Clarke *et al.*, 'Combined culture of *Trochus niloticus* and giant clams (Tridacnidae): benefits for restocking and farming' *Aquaculture*, Vol. 215, No. 1, 2003, pp. 123-144; J. A. H. Benzie and S. T. Williams, 'Limitations in the genetic variation of hatchery produced batches of the giant clam, *Tridacna gigas*', *Aquaculture*, Volume 139, No. 3, 1996, pp. 225-241; E. G. Boglio and J. S. Lucas, 'Impacts of ectoparasitic gastropods on growth, survival, and physiology of juvenile giant clams (*Tridacna gigas*), including a simulation model of mortality and reduced growth rate', *Aquaculture*, Vol. 150, No. 1, 1997, pp. 25-43; C. A. Tisdell *et al.*, 'Economics of ocean culture of giant clams, *Tridacna gigas*: internal rate of return analysis', *Aquaculture*, Vol. 110, No. 1, 1993, pp. 13-26; J. S. Lucas *et al.*, 'Environmental influences on growth and survival during the ocean-nursery rearing of giant clams, *Tridacna gigas* (L.)', *Aquaculture*, Vol. 80, No. 1, 1989, pp. 45-61.

[24] Gomez, 'Perspectives on coral reef research', pp. 285, 288 and 293.

concern by 1937. The clearance of access channels has caused extensive modification of the reefs at Lady Musgrave and Heron Islands, and at North Reef, and those reefs have probably experienced variations in coral cover and sedimentation patterns as a result, as both documentary and oral history sources indicate.[25] Military activities probably resulted in severe damage to several reefs, including Lady Musgrave and Fairfax Island reefs, when those two reefs were used for bombing practice during the Second World War; additional damage must have been sustained when explosive mines that had been laid in shipping channels were detonated on adjacent reefs. Reef-walking has also destroyed corals at major tourist resorts, including Heron and Green Islands, and probably caused cumulative damage to coral species.[26]

I argue that these activities, described in Sections 5.7.1-5.7.4, amount to considerable impacts on parts of some coral reefs in the GBRWHA; those impacts, also, have been dated and located relatively precisely. This history should be taken into account in the design of scientific monitoring programs. Again, however, scientific studies of the extent and impacts of these various activities for the Great Barrier Reef are comparatively scarce. Studies of other coral reefs indicate that such impacts, however, can be considerable. Several authors have documented the extensive damage to corals resulting from fishing using dynamite and cyanide. Paw and Chua, for example, identified those destructive fishing methods as a key management issue at Cilacap and Segara Anakan, in Indonesia, and at Lingayen Gulf, in the Philippines; as a result, they stated, the deterioration of coral reef and seagrass habitats had been observed, and they discussed many details of the management plan required to address the degradation of those reefs.[27] Blast fishing has also been documented for coral reefs of Papua New Guinea by Huber, who stated that the practice represented 'easily the most widely recognized threat to PNG reefs' and was concentrated in the vicinity of urban centres.

[25] 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, NP268, Bunker, QSA, p. 5; 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 ; 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.

[26] D. J. Woodland and J. N. A. Hooper, 'The effect of human trampling on coral reefs', *Biological Conservation*, Vol. 11, No. 1, 1977, pp. 1-4; M. J. Liddle and A. M. Kay, 'Resistance, survival and recovery of trampled corals on the Great Barrier Reef' *Biological Conservation*, Vol.42, No. 1, 1987, pp. 1-18.

[27] J. N. Paw and T.-E. Chua, 'Managing coastal resources in Cilacap, Indonesia, and Lingayen Gulf, Philippines – an ASEAN initiative', *Marine Pollution Bulletin*, Vol. 23, 1991, pp. 779-783, pp. 780-781.

However, Huber also acknowledged a scarcity of data about this issue, stating that that 'virtually no written information' describes the extent or distribution of damage from blast fishing. Nevertheless, he stated:

> My own observations indicate that in most areas explosions are infrequent enough that damage to reef systems is moderate, though there is usually serious damage at the blast site. I have, however, seen more widespread damage near Madang and Port Moresby, and heard reports of severe damage at other locations.[28]

The extent of physical impacts such as fishing using explosives, therefore, requires scientific investigation; an example of the geochemical analysis of impacts on coral reefs at Misima Island, in Papua New Guinea, provided by Fallon *et al.*, indicates the detailed reconstructions of environmental impacts that are possible using such an approach.[29] Several possible test sites for scientific research and monitoring of such impacts in the Great Barrier Reef, that have been derived from the evidence presented in Chapter 5, are listed in Table 8.1. Again, the usefulness of these sites would depend on locating appropriate control sites if the effects of these human activities are to be differentiated from other anthropogenic and natural changes.

These interpretations of changes in coral reefs presented above are consistent with the reconstructions of ecological changes produced by Pandolfi *et al*., who have argued that the coral reefs of both the inner and the outer Great Barrier Reef now exist in conditions that are far from pristine. Those authors stated:

> The overall historical trajectory of reef degradation across all cultural periods is markedly linear […]. Most importantly from the perspective of reef conservation and management, most of the reef ecosystems [considered in their study] were substantially degraded before 1900. Recent widespread and catastrophic episodes of coral bleaching and disease have distracted attention from the chronic and severe historical decline of reef ecosystems […]. However, all of the reefs in our survey were substantially degraded long before the first observations of mass mortality resulting from bleaching and outbreaks of disease.[30]

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[28] M. E. Huber, 'An assessment of the status of the coral reefs of Papua New Guinea', *Marine Pollution Bulletin*, Vol. 29, 1994, pp. 69-73, p. 71.
[29] S. J. Fallon *et al*., '*Porites* corals as recorders of mining and environmental impacts: Misima Island, Papua New Guinea', *Geochimica et Cosmochimica Acta*, Vol. 66, No. 1, 2002, pp. 45-62.
[30] J. M. Pandolfi *et al*., 'Global trajectories of the long-term decline of coral reef ecosystems', *Science*, Vol. 301, 2003, p. 957.

Location	***Dates of impact***	***Nature of change or impact***	***Type of monitoring***
Snapper Island (fringing reef on the south-western side of the island)	*c.*1900-1930	Coral mining using crowbars	Geochemical analysis
Low Isles (‘*Porites* Pond’)	1928-1954	Sedimentation of *Porites* micro-atolls	Geochemical analysis
Alexandra Reef (extending to Yule Point)	1929	Coral mining	Geochemical analysis
Kings Reef	1918-1930	Coral mining using gelignite	Geochemical analysis
Upolu Cay	1922-1940	Removal of coral and coral sand	Geochemical analysis; geomorphological modelling
Hutchinson Island (fringing reef at northern end of the island)	1900-1930	Coral mining	Geochemical analysis
Stone Island (fringing reef)	*c.*1920	Freshwater mortality of corals	Geochemical analysis
Holbourne Island (fringing reef)	*c.*1920	Cyclone damage to corals	Geochemical analysis; ecological monitoring/ modelling
Heron Island (reef on the south-western side of the cay, in the vicinity of the wreck of the *Sydney*)	1960-1966	Breaching of outer rim of reef and dredging of access channel	Geomorphological modelling; ecological monitoring/modelling
Lady Musgrave Island (southern edge of the reef)	By 1937	Breaching of outer rim of reef and formation of access channel	Geomorphological modelling; ecological monitoring/modelling
Lady Musgrave Island (entire reef)	1941-1945	Destruction of reef as a result of military bombing practice	Geochemical analysis; ecological monitoring/ modelling

Table 8.1. Possible sites for the scientific monitoring of coral reefs to determine rates of recovery from known and dated disturbances. The capacity of such monitoring to yield useful information would depend on the availability of suitable control sites.

Therefore, these authors argued that the contemporary management of the Great Barrier Reef should be concerned with 'restoring the reefs that are clearly far from pristine'; those reefs require to be 'promptly and massively protected from human exploitation' if they are to survive. The need for such protection was recognised in July 2004 when 33% of the GBRMP was closed to all extractive industries.[31]

8.4 Implications of changes in islands

Some islands – including Raine, Green, Magnetic, Heron, Fairfax, Lady Musgrave and Lady Elliot Islands – represent the most dramatically modified environments of the Great Barrier Reef. In contrast to coral reefs, at these locations, human activities were established on a semi-permanent basis; the establishment of guano mining infrastructure at Raine, North-West, Fairfax, Lady Musgrave and Lady Elliot Islands, for example, allowed the removal of all commercially viable guano from those cays by 1900 (Section 6.3). Other substantial changes to island geomorphology occurred at Raine Island, due to the construction of the navigation beacon using burnt lime; at Holbourne Island, as a consequence of the extraction of rock phosphate; and at Upolu and Oyster Cays, as a result of guano mining. The last two impacts had caused substantial modification of those islands by 1922, and the latter impact persisted until at least 1940. Therefore, the extraction of mineral resources from islands of the Great Barrier Reef persisted for almost a century and affected at least ten islands; those impacts ranged from the removal of thousands of tons of guano (at their most benign) to the complete alteration of the geomorphology of the cays (at their most extreme). In the cases of Raine and Lady Elliot Islands, the impacts of guano mining remain in the landscape; at Lady Musgrave Island, those landscape impacts became visible when as a result of another impact – over-grazing by introduced goats – the surface of that cay was exposed.

Further dramatic changes to island landscapes resulted from alterations of native island vegetation. An early form of this disturbance was the establishment of coconut plantations; between 1892 and 1900, around 500,000 coconut palms were planted on at least forty-six islands of the Great Barrier Reef, with concentrations of plantations on islands in the Mackay, Townsville, Cairns and Cooktown areas (Section 6.5.1). Further significant vegetation disturbance took place with the introduction of goats to many

[31] GBRMPA, *Great Barrier Reef Marine Park zoning plan 2003*, GBRMPA, Townsville, 2004.

islands – some of which held over 1,000 animals – that, in some cases, destroyed all of the grass and shrub vegetation and also impacted on *Pisonia* trees. The impacts of introduced goats were obvious until the eradication of the animals, after 1970; it is not known what residual impacts persist. Particular impacts were sustained at Lady Musgrave and Fairfax Islands, both of which were reportedly denuded of vegetation so that bare coral rubble was exposed (Section 6.5.2). The extent of the recovery of former island vegetation communities from these two impacts has not been documented; those communities have probably been significantly disrupted by over-grazing, while the establishment of coconut plantations has altered human perceptions of what is natural in island ecosystems of the Great Barrier Reef. Other modifications of island flora have been documented in Sections 6.5.3 and 6.5.4; and the disturbance of island faunal communities, similarly, has been outlined in Sections 6.6.1 and 6.6.2. I argue that such narratives of changes in island vegetation – which can be dated and located with relative precision – offer useful baselines for the ecological monitoring and modelling of vegetation and faunal change on islands. Again, suitable control sites would be necessary to interpret such changes.

Island landscapes have also been modified by the development of infrastructure, including lighthouses, jetties, tourist resorts, airstrips and research stations. Some islands – such as Green and Magnetic Islands – experienced early tourist resort development, during the 1920s, and by 1960 at least ten major resorts had been constructed on islands. Accounts of environmental decline associated with those resorts date to 1939, when damage to Heron Island was attributed to visitors. Nonetheless, major expansion of island tourist facilities took place during the 1940s and 1950s, including the development of the resort and airstrip at Dunk Island; and during the 1960s major resorts were constructed at Brampton and Hayman Islands (Sections 6.7.2 and 6.7.3). Other infrastructure development took place on islands for the construction of scientific research facilities; considerable degradation of the visual amenity of Heron and One Tree Islands, for example, has been attributed to the research stations on those islands. Possible sites for the scientific research and monitoring of anthropogenic impacts on islands are listed in Table 8.2.

Location	***Dates of impact***	***Nature of impact***	***Type of monitoring***
Raine Island (central cemented depression of cay)	1844	Mining of island for the construction of the navigation beacon	Geochemical analysis; geomorphological modelling
Raine Island (entire cay)	1890-1892	Guano mining	Geochemical analysis; geomorphological modelling
Michaelmas Cay	1901-1940	Guano mining	Geochemical analysis; geomorphological modelling
Oyster Cay	1901-1940	Guano mining	Geochemical analysis; geomorphological modelling
Upolu Cay	1901-1940	Guano mining	Geochemical analysis; geomorphological modelling
Holbourne Island	1918-1922	Rock phosphate mining	Geochemical analysis; geomorphological modelling
South Molle Island	Before 1940	Introduction of goats and *Lantana*	Ecological monitoring/ modelling
Lindeman Island	Before 1950	Introduction of goats and *Lantana*	Ecological monitoring/ modelling
Brampton Island	Before 1970	Introduction of goats and *Lantana*	Ecological monitoring/ modelling
North-West Island	1890-1900	Guano mining	Geochemical analysis; geomorphological modelling
Fairfax Island	1890-1900; 1943-1965	Guano mining; military bombing practice	Geochemical analysis; geomorphological modelling
Lady Musgrave Island	1890-1900; Before 1974	Guano mining; over-grazing by goats	Geomorphological modelling; ecological monitoring/ modelling
Lady Elliot Island	1863-1873; From 1863	Guano mining; over-grazing by goats	Geomorphological modelling; ecological monitoring/ modelling

Table 8.2. Possible sites for the scientific monitoring of the effects of human disturbance on islands, if suitable control sites can be identified.

In contrast to the relative paucity of historical studies of coral reefs, detailed scientific analyses of the status of many islands in the Great Barrier Reef have been undertaken, including the early survey by Steers, which documented many geomorphological aspects of islands; the more recent account of morphological changes in five islands of the Capricorn-Bunker Group, by Flood; and Heatwole's account of changes in the ecology of numerous islands of the Capricorn-Bunker Group.[32] Yet, in contrast to the comparatively rich scientific knowledge of changes in islands, the World Heritage status of those environments – in comparison with other parts of the GBRWHA – is poorly defined. Those values are now being negotiated for Magnetic Island, but the World Heritage status of many other islands in the GBRWHA could be evaluated in order to ensure that their remaining superlative natural phenomena receive adequate protection from human activities.[33]

8.5 Implications of changes in marine wildlife

In Chapter 7, many impacts upon marine wildlife species of the Great Barrier Reef have been described. These impacts have resulted in the depletion of dugongs, marine turtles, humpback whales and sharks; many other species have also been depleted as human activities in the Great Barrier Reef have increased. In particular, the evidence presented in Sections 7.2 and 7.3 indicates that excessive commercial harvests of dugongs and green turtles took place, in localised areas, during the early twentieth century; that exploitation was followed by more systematic and dramatic depletion of humpback whales between 1952 and 1962 (Section 7.4). This depletion was particularly serious because all the humpback whales that visit the Great Barrier Reef lagoon each winter migrate close to the coast in northern New South Wales and south-eastern Queensland, enabling a very high proportion to be killed without major effect on the Catch per Unit Effort until the population size has been drastically reduced.[34] As a result of their historical exploitation, the humpback whale population collapsed in east Australian waters, and dugong and turtle populations are now vulnerable to a range of human and

[32] Steers, 'Detailed notes'; Flood, 'Variability of shoreline position'; Heatwole, 'Cays of the Capricornia Section'.
[33] Magnetic Island Community Development Association, Inc. and Magnetic Island Nature Care Association, Inc., *Magnetic Island's World Heritage Values: a preliminary assessment*, Magnetic Island Community Development Association Inc. and Magnetic Island Nature Care Association Inc., Magnetic Island, 2004.
[34] H. Marsh, School of TESAG, JCU, Townsville, 6 May 2005, pers. comm.

natural impacts.[35] Further scientific research and monitoring, and the reduction of the remaining impacts, is now required in order to protect the viability of dugong and turtle populations in the GBRWHA. The evidence presented in Sections 7.5 and 7.6 indicates that the depletion of sharks and other fish species also took place in the Great Barrier Reef since European settlement; many of those species also require ecological research and monitoring, linked with agreed performance indicators, in order to ensure their conservation.

Section 7.2 contains a discussion of the impacts on dugongs that have taken place in Queensland waters since 1847. Commercial dugong fishing in the Moreton Bay area resulted in the reported local scarcity of the animals by 1888; by that year, the methods of catching dugongs were considered to have caused excessive destruction of the animals and restrictions had been introduced. In 1923, concerns about the survival of the species were reiterated. Nonetheless, commercial dugong fishing expanded in the 1930s and persisted until 1969, when the dugong received legal protection from commercial fishing; during the latter period, however, a single dugong fishing operation in Hervey Bay was responsible for a reported annual harvest of about 200 animals. Dugong populations were depleted by such commercial operations for more than eighty years after concerns for their numbers had first been expressed, and the surviving dugong population in the Toogoom-Burrum Heads Bay, in 2003, was estimated by one dugong fisher to be about 200-300 animals: approximately the size of the annual harvest of the Burrum Heads dugong fishery. However, in 1999, the dugong population of Hervey Bay was estimated by Marsh and Lawler to be of the order of 1654 (± s.e. 248) animals.[36]

In addition to the impacts of the commercial fishery, dugong numbers were also reduced in order to supply dugong oil to Aboriginal settlements, between 1940 and 1971. That activity allegedly took fewer dugongs from the more robust northern Great Barrier Reef population and produced smaller quantities of oil than the commercial industries, servicing local communities rather than the international markets that were

[35] Wachenfeld *et al*., *State of the GBRWHA*, pp. 2-3.
[36] H. Marsh and I. Lawler, *Dugong distribution and abundance in the northern Great Barrier Reef Marine Park, November 2000*, Draft Report to the GBRMPA, GBRMPA, Townsville, 2001; see also Marsh *et al*., *Dugong*, p. 125.

supplied by the commercial fisheries; nonetheless, this smaller fishery represented another layer of impact on the same stock that had already been depleted in the southern Great Barrier Reef. The effects of both fisheries were compounded by Indigenous hunting of dugongs, which still continues and is of cultural as well as economic significance to Aboriginal and Torres Strait Islander people. The degradation of some seagrass beds as a result of terrestrial run-off associated with extreme climatic events, the prevalence of accidental dugong mortality due to boat strikes, and the drowning of dugongs in shark control nets set for bather protection since the 1960s now form serious threats to the species; furthermore, Indigenous hunting, which now represents the largest single impact upon dugong populations in the GBRWHA, is largely unchecked.[37] Any additional activity that increases the mortality of this vulnerable, long-lived and slow-reproducing species is incompatible with the World Heritage values of the ecosystem.

Since the formation of the GBRMP, scientific knowledge of dugongs has greatly improved, however, enabling the narrative presented in Section 7.2 to be considered in a broader context. Heinsohn *et al.* indicated that a resident population of at least 300 dugongs remained in Moreton Bay in 1978; those authors also suggested that significant migrations of dugongs between feeding areas occur, although this suggestion had not been scientifically verified at that time.[38] A more recent study by Chilvers *et al.* described the existence of large populations of marine mammals, including dugongs, in Moreton Bay, adjacent to highly developed coastal environments and in spite of the historical exploitation of the animals.[39] These accounts suggest that caution is required in reconstructing the impacts of the commercial dugong fisheries, since the effects of over-exploitation may have been confounded by those of large scale movements of the animals. This confounding would account for the scarcity of dugongs reported in the historical literature at some locations, in some years, and the biologically-impossible apparent rapid recovery of the population. In particular, the fluctuations in dugong

[37] See A. Preen and H. Marsh, 'Response of dugongs to large-scale loss of seagrass from Hervey Bay, Queensland, Australia, *Wildlife Research*, Vol. 22, 1995, pp. 507-519, p. 518; R. Heinsohn *et al*., 'Unsustainable harvest of dugongs in Torres Strait and Cape York (Australia) waters: two case studies using population viability analysis', *Animal Conservation*, Vol. 7, 2004, pp. 417-425.
[38] G. E. Heinsohn *et al.*, 'Discovery of a large population of dugongs off Brisbane, Australia', *Environmental Conservation*, Vol. 5, 1978, pp. 91-92, p. 91.
[39] B. L. Chilvers *et al.*, 'Moreton Bay, Queensland, Australia: an example of the co-existence of significant marine mammal populations and large-scale coastal development', *Biological Conservation*, Vol. 122, 2005, pp. 559-571, p. 568.

numbers observed in Moreton Bay may be attributed to dugongs moving in response to changes in their food supplies, as Marsh *et al.* have suggested, as well as a response to exploitation.[40]

Reconstructions of historical marine wildlife species populations based only on documentary sources, as exemplified by Jackson *et al*. and by Pandolfi *et al*., are problematic. Marsh *et al.* have investigated the assumptions on which such reconstructions are based and argued that, while those estimates may be valuable triggers for conservation, they may be unrealistic as targets for the recovery of vulnerable populations.[41] In particular, greater scientific understanding of the diving behaviour of dugongs informs more accurate aerial survey estimates of the abundance of these animals. While such investigations reveal the lack of sustainability of current Indigenous hunting of dugongs in Torres Strait, those studies also indicate that the response of marine wildlife species to anthropogenic and natural pressures may be complex, and that further scientific research and monitoring of dugongs is required to understand local changes in dugong abundance.[42]

Similar caveats apply to the interpretation of the evidence presented in Section 7.3 about changes in marine turtles. Several impacts on marine turtles have been reconstructed in Section 7.3; those impacts commenced on a significant scale with the establishment of the tortoise-shell industry in the 1860s and, by 1900, large numbers of hawksbill turtles had been harvested for the production of tortoise-shell and, by 1908, many tons of this product had been exported from Queensland (Section 7.3.1). The trade in tortoise-shell continued until at least 1938; hawksbill turtles were harvested for tortoise-shell for more than seventy years. This harvest has presumably left this species more susceptible to other impacts, including boat strikes, by-catch in fishing nets and shark nets, marine pollution and Indigenous hunting. The hawksbill turtle is now listed as a vulnerable species in Australian waters, both in Commonwealth and in Queensland

[40] Marsh *et al.*, 'Historical marine population estimates', p. 487; H. Marsh *et al.*, 'Aerial surveys and the potential biological removal technique indicate that the Torres Strait dugong fishery is unsustainable', *Animal Conservation*, Vol. 7, 2004, pp. 435-443, pp. 441-442.
[41] Jackson *et al.*, 'Historical overfishing'; Pandolfi *et al.*, 'Global trajectories'; Marsh *et al.*, 'Historical marine population estimates'.
[42] B. L. Chilvers *et al.*, 'Diving behaviour of dugongs, *Dugong dugon*', *Journal of Marine Biology and Ecology*, Vol. 304, 2004, pp. 203-224, p. 222; H. Marsh *et al.*, 'Aerial surveys', p. 435.

legislation and as critically endangered at a global scale.[43] Further scientific research and monitoring is warranted to inform the conservation management of this species. However, Marsh *et al.* have acknowledged the difficulties involved in assessing the status of marine mammals and reptiles, because of the paucity of census data, the difficulties in evaluating the situation at localised feeding grounds when the animals undertake extensive movements, the heterogeneity of stocks in feeding areas, the long and poorly-known life history of many species, the inter-annual differences in the proportions of females making breeding migrations and nesting and the significant migrations made by many marine animals.[44] Consequently, the narrative presented in Section 7.3 should be interpreted with caution and further scientific research and long-term monitoring of marine turtles will be required to evaluate the status of the populations which occur in the GBRWHA for at least part of their life cycle.

Nevertheless, Limpus *et al.* have acknowledged that the operations of the commercial green turtle fisheries impacted significantly on nesting female green turtles at Heron and North-West Islands, and those authors reported anecdotal evidence that green turtles had become scarcer in Moreton Bay by the end of the Second World War.[45] The fishery depleted green turtle numbers in the southern Great Barrier Reef – particularly the animals nesting in the Capricorn-Bunker group – as a result of the manufacture of turtle soup at Heron and North-West Islands, between 1924 and 1931, at the Lakes Creek Meatworks and at another factory in Brisbane (Section 7.3.2). As this fishery harvested almost entirely adult female animals during egg-laying – a life stage that is particularly sensitive to changes in survivorship – a local collapse of the southern Great Barrier Reef green turtle fishery had occurred by 1932.[46] Despite concerns about the lack of sustainability that characterised commercial green turtle harvesting, the fishery continued in the southern Great Barrier Reef until 1950, by which time, the green turtle population would have been more susceptible to other anthropogenic influences, including boat strikes, marine pollution, Indigenous hunting, and the disorientation of

[43] Dobbs, *Marine turtles in the GBRWHA*, pp. 5 and 10; the hawksbill turtle is listed on the 'Red List' of critically endangered species by the IUCN.
[44] H. Marsh *et al.*, 'Conserving marine mammals and reptiles in Australia and Oceania', in C. Moritz and J. Kikkawa (eds), *Conservation biology in Australia and Oceania*, Surrey Beatty and Sons, Chipping Norton, 1993, pp. 225-244, p. 230.
[45] Limpus *et al.*, 'Green turtle, *Chelonia mydas*, in Queensland', pp. 150-152.
[46] F. W. Moorhouse, 'Notes on the green turtle (*Chelonia mydas*)', *Reports of the GBRC*, Vol. 4, Part 1, 1935, pp. 1-22, p. 20.

hatchlings by artificial lighting. Although the commercial fishery has now ceased, green turtles continue to require long-term scientific research and monitoring and effective management in the GBRWHA to reduce the mortality of animals that results from these factors, especially as they are one of the listed World Heritage values of the Great Barrier Reef.[47]

The impacts of commercial turtle fishing have been exacerbated by other impacts, described in Sections 7.3.3-7.3.5, including the interference with green turtles that accompanied turtle-riding at several major tourist resorts of the southern Great Barrier Reef, including Heron, Masthead and Lady Musgrave Islands, and at South Molle Island, in the Whitsunday Group. Turtle-riding took place in the southern Great Barrier Reef since before 1930 and continued until 1964, fourteen years after the earliest legislation to protect green turtles in this region was introduced. In common with the commercial turtle fishery, turtle-riding impacted disproportionately on female green turtles as they came ashore to lay eggs. The practice of overturning turtles so that they could be held on the beach until the turtle riding took place itself constituted cruelty and may have increased the vulnerability of the animals to predation when they returned to the sea. Furthermore, the availability of overturned turtles at the resorts provided opportunities for some individuals to inflict other forms of cruelty and vandalism upon the animals. Turtle-riding and turtle-turning, therefore, should be regarded as a further impact on the green turtles of the southern Great Barrier Reef that may have contributed to the susceptibility of these animals to other anthropogenic impacts.

Green and hawksbill turtles also suffered severe anthropogenic impacts in Torres Strait as a consequence of attempts to farm turtles for commercial purposes between 1970 and 1979. The industry involved the removal of wild turtle eggs and hatchlings; it resulted in extremely high mortality in a short period. By 1973, the destruction caused to turtle populations by the industry had been acknowledged by the House of Representatives Standing Committee on Environment and Conservation: of the 29,000 turtles that were kept in captivity, approximately 10,000 died. Such a high mortality rate, in a long-lived species with comparatively low lifetime reproductive success, represents a significant conservation concern for those species, as the report of the Standing Committee

[47] GBRMPA, *Nomination of the Great Barrier Reef*; see also Lucas *et al.*, *Outstanding universal value*, p. 163.

acknowledged. However, the impacts would have been much less serious than those caused by the turtle soup industry for several reasons: the mortality of turtle hatchlings is naturally high and, hence, anthropogenic mortality at this life stage is less significant; turtle farming in Torres Strait also impacted on a different stock of green turtles from the southern Great Barrier Reef population.[48] The account of turtle farming in Torres Straits serves as an example of the abuse of conservation and scientific principles which, in the turtle farming scheme, were neglected in favour of commercial objectives and attempts to generate employment for Torres Strait Islanders. In addition, the collapse of turtle farming in Torres Strait may have negated any social benefits that derived from the employment provided by the farms. The evidence presented in Section 7.3.4 suggests that such interference with wild turtle populations provides neither conservation nor social benefits.

The impacts on turtle populations discussed above occurred in addition to the Indigenous hunting of turtles: an activity that holds cultural as well as dietary significance for coastal Aboriginal and Torres Strait Islander communities. Given the extent of the historical impacts on turtle populations – and the continuing mortality that results from boat strikes, marine pollution, and drowning in fishing nets and shark nets – the sustainability of Indigenous hunting of turtles is now questioned.[49] The World Heritage values of the GBRWHA require that activities that increase the mortality of vulnerable or endangered species should be minimised: this applies to the culturally significant hunting of turtles as well as to the other anthropogenic influences on turtles. An area of growing concern is the degradation of the world's most important green turtle nesting habitat at Raine Island as a result of the erosion of sand from the cay; during six of the last seven years, erosion has resulted in the mortality of green turtle eggs, which are being flooded with sea water, and is of potentially critical significance for green turtle populations.[50] This issue also requires scientific investigation if strategies to ensure the continued reproductive success of green turtles are to be effective.

[48] M. Chaloupka, *Development of a population model for the southern Great Barrier Reef green turtle stock*. Research Publication No 81, GBRMPA, Townsville, 2003.
[49] Dobbs, *Marine turtles in the GBRWHA*, pp. 9-10.
[50] OHC 33, 19 September 2003, pp. 10-11.

The decline in humpback whales in the Great Barrier Reef from commercial harvesting have been described in Section 7.4, which narrated the collapse of the east Australian humpback whale population as a result of excessive exploitation between 1952 and 1962, by which time a total of 7,423 animals had been killed. The evidence presented in Section 7.4 indicates that the collapse of this fishery occurred in spite of the strict regulation of the industry, using a system of annual quotas, with scientific monitoring of the fishery by CSIRO, with accurate data about catch sizes, and in spite of the earlier, comparable decline of the west Australian humpback whale population as a result of over-exploitation.[51] This narrative demonstrates that scientific monitoring and regulation of commercial fisheries do not necessarily guarantee the conservation of species; monitoring and regulation must be linked, politically, to agreed performance indicators in order to ensure the ecological sustainability of wildlife populations. The excessive harvesting of humpback whales between 1952 and 1962, and the estimate of the population at that time, provides an ecological baseline that is being used for the scientific modelling of the recovery of that population; nevertheless, the species requires continued protection from anthropogenic impacts, including boat strikes, whale-watching, marine pollution, ensnarement in nets set for bather protection, and commercial whaling. The recovery of stock was delayed by illegal Russian whaling until the mid-1980s, although the stock is now experiencing a strong recovery.[52]

Impacts have also been sustained by sharks in the Great Barrier Reef; their numbers have been reduced as a result of fishing for sport, the harvest of animals for the manufacture of shark products – including oil, fins, leather, bone and meal – and the destruction of the animals by other fishers (Section 7.5). The status of shark populations in the Great Barrier Reef is insufficiently known and scientific research and monitoring is required in order to ensure the conservation of these species, in line with the World Heritage values of the GBRWHA. Many impacts have also been inflicted on other fish populations in the Great Barrier Reef due to the activities of commercial and recreational fishers. In particular, the stocks of larger edible fish have been depleted, including coral trout, which are now reported to be scarce in fishing grounds that were

[51] See the analysis by R. Paterson *et al.*, 'The status of Humpback whales *Megaptera novaeanglia* in east Australia thirty years after whaling, *Biological Conservation*, Vol. 70, 1994, pp. 135-142.
[52] P. Corkeron, 'The status of cetaceans in the GBRMP', in *State of the GBRWHA Workshop: Proceedings of a technical workshop held in Townsville, Queensland, Australia, 27-29 November 1995*, Workshop Series No. 23, ed. D. R. Wachenfeld *et al.*, GBRMPA, Townsville, 1997, pp. 283-286, p. 283.

previously well-stocked. The decline of coral trout species has been accelerated by the growth of the live trout export industry, which provides a significant economic incentive for their over-fishing. Other impacts on fish populations in the Great Barrier Reef have been caused by spearfishing, aquarium fish collecting, prawn trawling and the destruction of marine, estuarine and mangrove habitats. All of these impacts require additional scientific research and monitoring and, despite the economic importance of Great Barrier Reef fisheries, oral history evidence suggests that considerable restrictions of commercial and recreational fishing in the GBRWHA – and adequate enforcement of those restrictions – are required. Such restrictions were delivered in 2004 with the rezoning of the GBRWHA and the declaration of 33% of the region as 'no-take' areas, in which fishing is prohibited, and with other fisheries management initiatives such as the East Cost Trawl Management Plan.[53] Historical records of anthropogenic impacts that could inform an assessment of the status of marine wildlife species in the GBRWHA are shown in Table 8.3.

8.6 Implications of the use of qualitative methods

The material contained in this section is divided into a discussion of various methodological issues (Section 8.6.1) and a case study, which describes scientific observations of changes in corals at Low Isles to illustrate several issues in the use of qualitative sources in reconstructing the environmental history of the Great Barrier Reef (Section 8.6.2).

8.6.1 Methodological issues in the use of qualitative methods

I used an array of qualitative methods to reconstruct environmental changes in the coral reefs, islands and marine wildlife of the Great Barrier Reef since European settlement; any attempt to do so has implications for the ways in which qualitative methods can inform environmental research. First, general issues relating to the use of qualitative methods are discussed, including the availability or scarcity of data, the nature and quality of materials, and methods of ensuring accuracy and reliability. Second, some specific issues involved in the use of documentary sources are considered, such as the

[53] GBRMPA, *Overview: the current status of the Great Barrier Reef*, GRBMPA, Townsville, 2003, p. 2; GBRMPA, *Great Barrier Reef Marine Park zoning plan*.

Species	***Dates of impact***	***Nature of impact***	***Type of monitoring***
Dugong (*Dugong dugon*)	1847-1969	Commercial dugong fishing	Ecological monitoring/ modelling
Green turtle (*Chelonia mydas*)	1867-1962 (intensive harvesting in Capricorn-Bunker Group in 1904-1914 and 1924-1930)	Commercial turtle fishing	Ecological monitoring/ modelling
Green turtle	1970-1979 (Torres Strait)	Commercial turtle farming	Ecological monitoring/ modelling
Hawksbill turtle (*Eretmochelys imbricata*)	1871-1940s	Harvesting for tortoise-shell	Ecological monitoring/ modelling
Hawksbill turtle	1970-1979 (Torres Strait)	Commercial turtle farming	Ecological monitoring/ modelling
Humpback whale (*Megaptera novaeanglia*)	1952-1962	Commercial whaling	Ecological monitoring/ modelling

Table 8.3. Historical records of anthropogenic impacts which could be used to help interpret the status of stocks of marine wildlife species in the GBRWHA. The only quantitative baseline is for humpback whales, for which a population estimate at the closure of the fishery in 1962, and estimates of removals from the stock by the east coast fisheries and by Antarctic whaling are available.

fragmentary nature of archival time series and the inconsistencies found in those reports of the Queensland Government Departments used in my study. Third, oral history sources are discussed; those sources formed a distinctive source of information about environmental changes and they required particular interpretation. Since the evaluation of the potential of oral history sources was a specific objective of my research, as outlined in Section 1.3, those sources are evaluated below. I argue that qualitative methods – including oral history methods – can make valuable, but limited, contributions to environmental history research for marine environments, and that those sources should be interpreted with caution, and be triangulated with other sources where possible. In particular, although oral history sources can yield distinctive evidence of impacts, in general they yielded disappointing descriptions of changes in the Great Barrier Reef.

The use of qualitative methods in environmental history research faces particular challenges since many scientists tend to record environmental changes quantitatively, as exemplified by geochemical investigation of coral skeletons in order to reconstruct coral growth rates.[54] As a result, few qualitative records of environmental changes have been made, systematically, over extended periods of time, although one study, by Jackson *et al.*, was based essentially on anecdotal reports and on other qualitative evidence.[55] Consequently, the reconstruction of environmental changes using qualitative methods requires the use of proxies. For example, the narrative of the impacts of commercial dugong fishing in Queensland presented in Section 7.2.1, using qualitative sources, is based on the reconstruction of the scale of the fishery rather than on direct observations of dugong numbers. Similarly, my reconstruction of the impacts of coral mining, presented in Section 5.4, uses a proxy – the issue of coral licences – in addition to first-hand descriptions of this activity. While the use of proxies in environmental history research is valid – and is often the only way in which reconstructions of past environments can be made – the use of proxies requires caution in the interpretation of data; ideally, such reconstructions should be cross-referenced with quantitative data, although suitable quantitative data, unfortunately, are rarely available.

[54] For example, Lough, J. M. and Barnes, D. J., 'Centuries-long records of coral growth on the Great Barrier Reef', in *State of the GBRWHA Workshop: Proceedings of a technical workshop held in Townsville, Queensland, Australia, 27-29 November 1995*, Workshop Series No. 23, ed. D. R. Wachenfeld *et al.*, GBRMPA, Townsville, 1997, pp. 149-157.
[55] Jackson *et al.*, 'Global trajectories'.

Yet qualitative methods offer unique insights into environmental changes – and their historical contexts – that are not available using other sources. For example, the extent of the coral mining industry given in Section 5.4, based on the archival records of the QDHM, cannot be reconstructed using quantitative techniques: the effects of that industry could not have been distinguished from other mechanical impacts on the coral reefs that were mined. The transformation of some cays in the Great Barrier Reef as a result of the establishment of coconut plantations, discussed in Section 6.5.1, may not have been revealed without the evidence found in the Annual Reports of the QDAS and the Queensland Agent-General. Neither could the impacts of turtle farming in Torres Strait, described in Section 7.3.4, have been investigated using quantitative methods, since the ecological information that the proponents of turtle farming were required to collect was not gathered. In the absence of quantitative data, therefore, qualitative sources provide the only means of reconstructing some significant environmental changes. Furthermore, where qualitative sources appear to be incomplete – as in the surviving records of coral mining licences – then other qualitative materials, such as oral history interviews, can provide additional information.

Qualitative materials can also reveal the contexts of environmental changes and allow the production of rich descriptions of historical processes. For example, my research shows that the operations of both the commercial dugong and turtle industries in Queensland were motivated by influential individuals or companies, whose energetic promotion of the fisheries was critical in their development. Moreover, the development of both of these industries during the nineteenth century was connected to the emerging world economy: both industries shipped produce to Europe – particularly to London – where individual buyers could be found at the Expositions and exhibitions, and where the products could be promoted by the Agent-General for Queensland. Therefore, a postcolonial reading of these qualitative sources reveals that the Great Barrier Reef dugong and turtle fisheries did not operate independently of the emerging world economy, but were dependent upon distant markets and traders. In a similar manner, the operations of the early European reef fisheries for bêche-de-mer, pearl-shell and trochus were controlled by international markets; yet the influence of those economic forces varied between these resources. Hence, pearl-shell resources had failed before the demand for the product declined, while the demand for trochus had fallen before that

resource had been depleted. These historical contexts are revealed by qualitative materials and are not discerned using scientific methods.

However, while the potential of qualitative sources to reveal and explain environmental changes is considerable, many limitations also exist. First, many issues relating to the availability of data about environmental changes are found. Although some data, such as the annual harvests and values of bêche-de-mer and pearl-shell in Queensland, were provided consistently and reliably in documentary records, a significant lack of data exists for other species, such as giant clams. Additionally, these records provide details of catches but not of the effort expended to obtain those catches; hence, they are of limited value in estimating the catch per unit effort – a measure of the abundance of resources. Qualitative sources, in general, privilege those environmental resources that were beneficial to the development of Queensland; those sources were rarely intended to produce data for scientific analysis. Second, the relative lack of scientific knowledge that existed about the Great Barrier Reef, prior to the establishment of systematic scientific monitoring, limited the quality and extent of qualitative descriptions of the ecosystem. Prior to 1950, for example, a small number of generic terms – such as *Madrepore*, 'brain coral', 'branching coral' and 'plate coral' – were used to describe an abundance of coral species in a coarse fashion; more detailed scientific information about coral taxonomy was not available until the seminal work of Veron and other coral reef scientists since the 1970s.[56] Third, the difficulty in accessing the Great Barrier Reef in the period before the widespread use of motorised boats and underwater viewing equipment and modern scientific understanding limited the number of reefs and species that could be observed and described in qualitative sources. Furthermore, prior to the introduction of GPS technology, precise georeferencing of coral reef locations was difficult. Fourth, not all qualitative materials about the Great Barrier Reef have survived. As a result, there exists a scarcity of useful qualitative data about the Great Barrier Reef.

Those historical data that exist are limited in several ways. Where observations of environmental changes have been made, such as the annual numbers of dugongs caught

[56] J. E. N. Veron, *Corals of Australia and the Indo-Pacific*, Angus and Robertson, Sydney, 1986; J. E. N. Veron, *Corals in space and time: the biogeography and evolution of the Scleractinia*, University of NSW Press, Sydney, 1995; J. E. N. Veron, *Corals of the world*, 3 Vols., AIMS, Townsville, 2000.

in Moreton Bay, the records are not always complete; for some years, the extent of this fishery was not reported by the Chief Inspector of Fisheries. A further difficulty with the use of long time series is the inconsistencies that were introduced as a result of different reporting procedures, the use of different units of measurement, the preferences of different officials, and the consolidation of analytical categories. These difficulties are revealed in the use of records such as the *SCQ* and *SSQ*, in which coral exports are measured in 'packages' of indefinite size, export values change from pounds sterling to dollars, tortoise-shell exports are given variously in imperial pounds and in monetary values, export quantities of dugong oil are merged with export quantities of other oils, and exports of turtle meat are not differentiated from exports of other meats. A further difficulty is the deflation of currency values that accompanied inflation during the historical period of my study. The integrity of historical time series, in general, is highest for discrete industries that operated for short periods, such as the humpback whale fishery, based at Tangalooma between 1952 and 1962, and the rock phosphate industry that was based at Holbourne Island from 1918 to 1921. The output of both of those industries is described in continuous time series. Nevertheless, the integrity of short data sets is not guaranteed: the removal of wild turtle eggs in Torres Strait between 1970 and 1979 by turtle farmers is illuminated by limited documentary evidence.

Consequently, the interpretation of such sources requires caution and, where possible, triangulation of sources is required in order to improve the accuracy and reliability of these data. In the narrative of changes in coral reefs presented in Chapter 5, the reconstruction of the impacts of coral mining, coral collecting and shell collecting cross-referenced both documentary accounts and oral history evidence; in Chapter 6, the accounts of guano mining, vegetation clearance, the planting of exotic vegetation species, the introduction of goats, and development of infrastructure on the islands of the Great Barrier Reef used both documentary and oral sources; and in Chapter 7, the accounts of human impacts on dugong and turtle populations were triangulated using the same means. Therefore, none of these accounts relies on a single source; some impacts, such as the changes resulting from the construction of the Heron Island boat channel, were described by many sources of evidence, including photographs. More specific comments about the nature, use and verification – of documentary and oral sources respectively – are provided below.

Several implications relating specifically to the use of documentary sources have been revealed by my research. Many early historical books and scientific papers relating to the Great Barrier Reef provide qualitative accounts of the geomorphology and evolution of the entire structure of the Great Barrier Reef, but provide scant information about individual corals or coral reefs. More valuable descriptions of particular coral reefs were found in the numerous accounts of Queensland description and travel; as that literature is vast, a sample was used and the narratives presented in Chapters 5-7 are based on only a portion of the available documentary sources of this kind. Further documentary research could be valuably carried out using this type of historical book. However, the accuracy and reliability of those accounts varies and further research is required in order to identify criteria for using historical books in environmental history research. In addition to those books, a variety of miscellaneous documentary sources – including promotional leaflets produced by the QGTB, newspaper reports, and the prospectuses of companies intending to operate in the Great Barrier Reef – provide information about the Great Barrier Reef; again, these vary in accuracy and reliability and should be used according to specific criteria. Newspaper reports form another source of documentary evidence that have not been used exhaustively in my research and could inform further research into the environmental history of the Great Barrier Reef. All of the sources described above, however, provide some useful evidence of the ways in which the Great Barrier Reef was used, valued and perceived.

The official documentary sources available in the reports and records of several Queensland Government Departments – including the QDAS, QDHM, QDNA and QEPA – provide, in general, greater accuracy and reliability than other historical documents; at least, those materials were subjected to public scrutiny and, during the many decades of their publication, considerable expertise in collecting and reporting these data was acquired. Therefore, the narratives presented in Chapters 5-7 have relied heavily on the archival sources held at QSA, on the Annual Reports of several Queensland Government Departments published in *QPP* and in *QVP*, and on other official sources such as *SCQ* and *SSQ*. For some environmental changes – such as the supply of dugong oil to Aboriginal settlements, and for turtle farming in Torres Strait – archival materials represented the only sources of evidence that were used. Some limitations applied to these sources: for example, both of the activities mentioned above were reconstructed using restricted files, for which official permission was required and

obtained, due to the cultural sensitivity of these materials. In other cases, the records of some Queensland Government Departments – including the QDHM and the QEPA – appeared to be incomplete: either because records may have been lost, or because some files were still active in Departmental offices. All of the above considerations imply that caution is required in the use and interpretation of official documents; those sources, like others, require triangulation with other materials in order to ensure the accuracy and reliability of data, and also to complete gaps in the time series.

Oral history evidence represents a significant source of data in my research; many implications result from the use of oral history sources to reconstruct environmental changes. By definition, oral histories are subjective: that is their strength, since they allow human perceptions and interpretations of environmental changes to be recorded and analysed. However, in order to ensure accuracy and reliability in the reconstruction of historical facts, oral history data should be triangulated with other sources where possible. The triangulation of one oral history source with another may not be sufficient to ensure the accuracy of data, because two independent informants may have simply recounted the same well-known story about environmental change, or both informants may have read the same documentary account. This difficulty is compounded by the observation by Cronon, explained in Section 2.2.3, that narrators of environmental change adopt either optimistic or tragic plots in their narratives, despite using the same historical evidence.[57] Therefore, oral history interviews should not simply record narratives of environmental changes, but should also probe the ways in which such narratives have been acquired. For example, several oral history informants who described coral mining in the Great Barrier Reef recalled details that had been published in a documentary account written by a local historian, Dorothy Jones; one informant acknowledged that his evidence was informed by Jones' account (Section 5.4).[58] These oral accounts were discounted since they appeared to add no original material to that written account.

However, some oral history informants provided unique evidence – that was not supported by any other source – yet which was apparently authentic. This observation

[57] Cronon, 'A place for stories'.
[58] OHC 19, 9 September 2003, p. 14; Jones, *Cardwell Shire story*; Jones, *Hurricane lamps and blue umbrellas*, p. 317.

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

Since many environmental changes occur over time scales longer than human life-spans, oral history evidence is not suitable for investigation of longer-term changes. Oral history evidence is limited by the scarcity of informants who can recall other changes of shorter duration, yet which require decades of observation, such as the recovery of massive corals from disturbances, or the impacts of the coral mining industry. For changes of this period, however, oral history evidence can valuably be cross-referenced with documentary sources. For shorter period – decadal – variations, oral history is highly effective, since that period coincides with the period for which many informants worked professionally in a single area, or visited the same locations on several occasions on a recreational basis. Therefore, for example, oral history evidence was particularly suitable for collecting detailed descriptions of decadal changes in coral cover, island vegetation and fauna, the development of infrastructure on islands, marine wildlife species abundance, and harvests of fisheries. Of particular suitability for oral history research are discrete, memorable environmental impacts of short duration, such as the dugong fishery at Burrum Heads (Section 7.2.1) and the operation of commercial turtle fishers at Masthead Island and the Fitzroy River (Section 7.3.2).

However, the use of oral history methods implies that the data obtained reflects the sample of informants whose knowledge is used; consequently, many perceptions are not represented in any oral history research. In the accounts presented in Chapters 5-7, the

views of Indigenous people, for example are not represented. Such omissions are significant limitations of any environmental history narrative, yet it is not possible to include every point of view; instead, those limitations should be acknowledged. The use made of oral histories in this research implies that further oral history research could be carried out with Indigenous informants, who may provide radically different narratives of environmental changes in the Great Barrier Reef since European settlement. The use of oral history methods also did not represent the evidence of those potential informants who were not willing to participate in my research – sometimes because they expressed fears that their evidence would be used to justify restrictions of their activities in the GBRWHA – and the evidence of those informants who would not allow key data to be recorded, including shell collectors who expressed concern about being blamed for the perceived depletion of shells. Other than assuring confidentiality to those informants, no other strategy to encourage disclosure of this information could be found. The most potentially valuable data, then, often proved to be sensitive and were not recorded.

Analysis of the value of the evidence used in my research suggests that variations exist with regard to the usefulness of oral history evidence in reconstructing changes in a marine environment. Such a continuum exists for numerous reasons: in addition to the issues discussed above – relating to those stories that were not included in my research – oral history evidence that was collected was frequently disappointing in its quality and coverage. Many informants could not provide details about the underwater environment, even if they regularly visited the Great Barrier Reef in boats. Where informants had not actually looked underwater with snorkelling or SCUBA equipment, or had not walked on coral reefs at low tide, their recollections of changes in coral reefs often lacked precision. The unwillingness of some observers to enter the water may be attributed to a fear of sharks or other marine organisms, or to poor swimming ability. In addition, prior to the development of coral taxonomy in the 1960s, few coral species could be identified with precision and descriptions of coral reef species were limited to terms such as *Madrepore*, *Acropora*, ‘staghorn’, ‘brain coral’ and ‘plate coral’.[59] In addition, comparatively few informants had re-visited coral reefs and had looked for environmental changes; where informants had done so, few had kept systematic, detailed records of those changes, their locations and their dates. Furthermore,

[59] Examples occur in OHC 1, 30 October 2002, p. 7; OHC 4, 14 January 2003, p. 2; OHC 12, 2 July 2003, p. 4; OHC 24, 15 September 2003, p. 3.

observations of environmental changes may have contained inaccuracies or ambiguities. Frequently, for example, oral history informants could not remember at which of several coral reefs they had actually observed an environmental change.

These considerations imply that the usefulness of oral history evidence could be evaluated according to several criteria, as represented in Table 8.4. Although these criteria are indicative only, as a result of the diverse nature of oral history materials, the most valuable oral history evidence is characterised by geo-referenced observations to specific parts of coral reefs, or to precise marine locations, at specific dates, and contains observations made by competent scientists. At best, this type of evidence permits the species-level identification of organisms and reveals environmental changes observed during several successive visits to specific coral reef locations. The best oral history informants displayed sensitivity to the appearance of marine environments and awareness of the possibility – but not the inevitability – of environmental change; these informants also demonstrated critical awareness of observer biases, errors in their recollection, and the subjectivity of their observations. An alternative, but equally valuable, type of oral history evidence contains information about critically endangered species, which may provide data of considerable conservation value. In contrast, the least valuable oral history evidence is characterised by few or none of these attributes, and may also reflect positions of political or environmental advocacy held by informants.

8.6.2 Case study: observations of changes in corals at Low Isles

Extensive scientific observations were made of the coral reef at Low Isles during the 1928-1929 Great Barrier Reef Expedition; those observations were recorded in detail and a map of the reef was produced. In August 1954, a group of scientists re-visited Low Isles for the purpose of investigating changes in the reef since the earlier expedition. One expert oral history informant interviewed during my research, a marine biologist, took part in the 1954 research trip; she then returned to the reef in 1969, aboard the *Cape Moreton*, and later aboard the *Marco Polo*, with Professors Yonge and Steers – who had also been to Low Isles previously – during the Second International Coral Reef Symposium, and made further comparisons of the condition of the corals. The informant reported observing ‘very significant differences’ at Low Isles; especially,

Category	*Criteria*	*Examples*
I. Most valuable	Geo-referenced observations to specific parts of coral reefs or to precise marine locations Observations made by competent scientists Dates of observations recorded and provided Species-level identification of organisms Several successive visits to specific locations Sensitivity to appearance of marine environments Critical awareness of observer biases, errors in recollection, and subjectivity Information about critically endangered species	OHC 4 OHC 15 OHC 20 OHC 30 OHC 35 OHC 44
II. Highly valuable	Geo-referenced observations to individual coral reefs or to general marine locations Observations made by competent observers (non-scientist professionals with relevant expertise) Some dates of observations recorded and provided (at least to year-level) Genus-level identification of organisms Information about endangered species	OHC 1 OHC 12 OHC 41
III. Moderately valuable	Geo-referenced observations to regions (or Sections) of the Great Barrier Reef (or GBRMPA/GBRWHA) Observations made by proficient amateur observers with some relevant expertise Some dates of observations recorded and provided (at least to decade-level) Accurate identification of organisms to Order-level or using common names Information about vulnerable species	OHC 19 OHC 27 OHC 34
IV. Least valuable	Geographical locations not identifiable from observations Amateur observations Dates of observations not recorded or provided No taxonomic information available Little sensitivity to appearance of marine environments No critical awareness of observer biases, errors in recollection, or subjectivity Informants committed to positions of political or environmental advocacy	OHC 3 OHC 28 OHC 25

Table 8.4. Some criteria for the evaluation of oral history evidence in environmental history research for the Great Barrier Reef. These criteria are indicative only, as a result of the diverse nature of oral history materials.

she acknowledged that considerable changes had occurred to *Porites* micro-atolls in the vicinity of T. A. Stephenson's '*Porites* Pond', located on the north-eastern part of the reef, illustrated in Figure 8.2.[60] She stated:

> that *Porites* colony was very much in existence at that time [August 1954]. You can see – that's one of the *Porites* micro-atolls there – and my feeling, my remembrance of these *Porites* micro-atolls was that around the perimeter of each there were masses of the tubeworm, *Spirobranchus*. And in 1969, […] I couldn't find anything, anywhere. To me, it was all dead coral. I thought I must have made a mistake. I don't think that any of the other people interested in coral reefs, like Stephenson and Endean and [Yonge and Steers], had been back to Low Isles from 1954 to 1969; and all of them expressed surprise at seeing what had happened in that time.[61]

The informant reported that the *Porites* micro-atolls had been covered in mud, which she attributed to sedimentation from the Barron and the Daintree Rivers. During a subsequent visit to Low Isles in July 2000, the condition of the *Porites* micro-atolls was photographed; two of those photographs are reproduced in Figure 8.3.

Several implications are derived from this account. The potential for research into changes in a coral reef using qualitative sources is exceptionally rich in this example. A particular area of one coral reef – the '*Porites* Pond' – was identified precisely as the location of change; that location can be identified on the map of Low Isles produced during the 1928-1929 Great Barrier Reef Expedition (Figure 8.2) and could be re-located, on subsequent visits, by scientists. The observations of changes in that area, also, can be identified with precision: those observations were made in 1928 and 1929, in August 1954, in 1969, and in July 2000. Scientific observations were made on each occasion by several expert observers who were highly competent in observing coral reefs: at least by contemporary standards at the times of their visits. The observations were recorded in detailed, written notes and were also documented in photographs. Corals and other species were identified to the genus level (including *Porites* and *Spirobranchus*) in these observations. The more recent observations could be compared with the published record of the 1928-1929 study, which served – for these scientists – as an ecological and geomorphological baseline. Several scientists visited the reef on each occasion, which allowed for discussion and comparison of their observations. The

[60] OHC 4, 14 January 2003, p. 5.
[61] OHC 4, 14 January 2003, pp. 5-6.

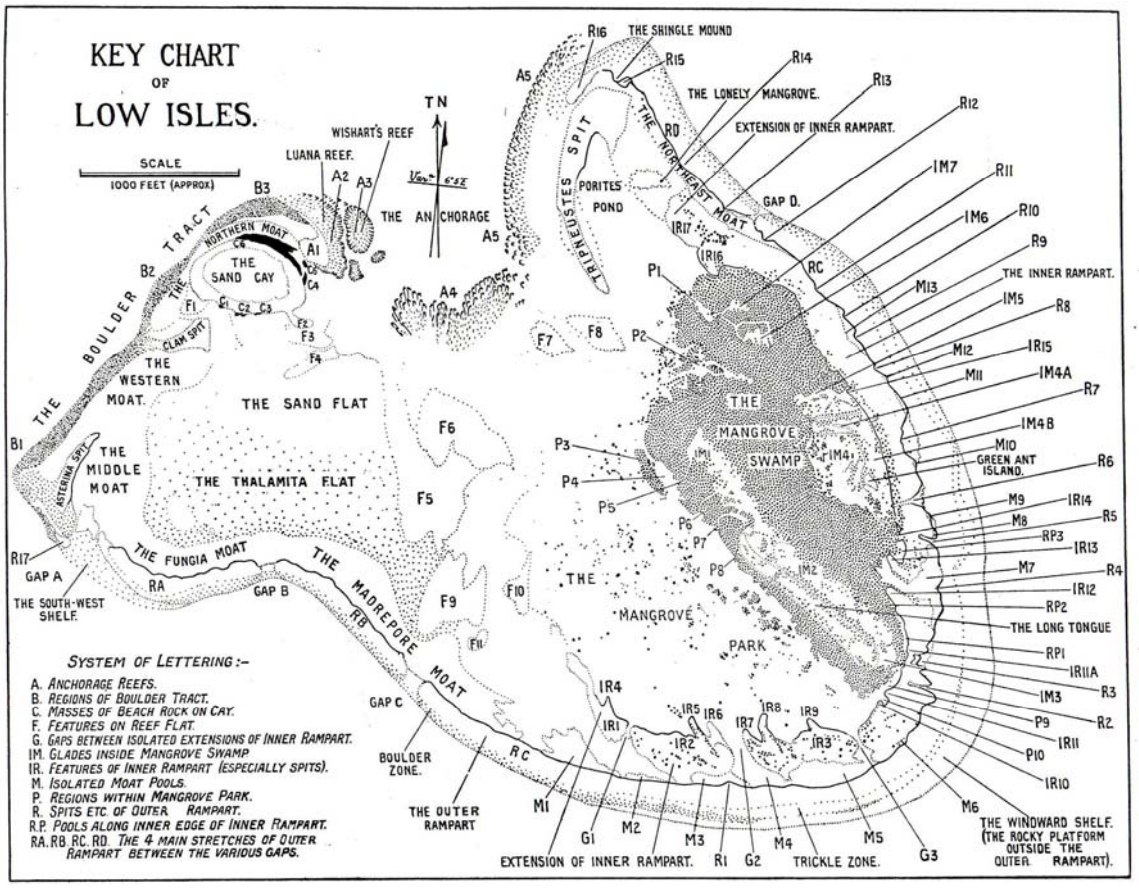

Figure 8.2. Map of Low Isles, showing the location of the '*Porites* Pond' near the northern extremity of the reef, adjacent to the '*Tripneustes* Spit', 1928-1929.

Source: T. A. Stephenson *et al.*, 'The structure and ecology of Low Isles and other reefs', in The British Museum (Natural History), *Great Barrier Reef Expedition 1928-1929: scientific reports*, Vol. 3, The British Museum, London, 1930-1940, pp. 17-112, p. 23.

Figure 8.3. Extensive row of dead *Porites* micro-atolls in the former '*Porites* Pond', Low Isles, July 2000.

Source: Photographs courtesy of Len Zell.

informant who participated in the oral history interview had her written and photographic records available at the time of the interview for reference; a second oral history informant – also a competent marine scientist – also visited Low Isles separately in 1970 and reported the apparent degradation of that reef in comparison with the published records of the 1928-1929 Great Barrier Reef Expedition.[62] All of these factors suggest that the reliability of these observations is probably extremely high; indeed, this example represents probably the best imaginable scenario for the reconstruction of changes in a coral reef using qualitative sources. In spite of this, no information about the causes of the deterioration of the *Porites* micro-atolls – other than the suggestion that sedimentation from the Barron and Daintree Rivers may have been responsible – could be obtained. In spite of extensive qualitative descriptions of the deterioration of corals, scientific research and monitoring of coral reefs is required in order to elucidate the causes of those changes.

8.7 Implications of the use of a narrative approach

The material presented in this section is divided into a discussion of various philosophical issues (Section 8.7.1) and a case study, which uses an account of the protection of coral at Green Island to illustrate several issues involved in telling environmental history stories about the Great Barrier Reef (Section 8.7.2).

8.7.1 Philosophical issues in the use of a narrative approach

Recent studies of environmental history raise several implications for the management of the GBRWHA; those implications focus on the use of reconstructed historical baselines, the social construction of environmental knowledge, and the use of narrative approaches in environmental history. Each of these areas is problematic and requires consideration in further research into the environmental history of the Great Barrier Reef, and they are discussed in turn below. The narratives presented in Chapters 5-7 suggest that all historical reconstructions are, at best, approximations and accurate ecological baselines may be impossible to reconstruct. The attempt to reconstruct environmental changes in the Great Barrier Reef has illustrated the socially constructed nature of knowledge about the coral reefs and their associated species, and the

[62] OHC 44, 4 December 2003, pp. 3-4.

production of knowledge about the ecosystem both reflected the concerns of the early European settlers and was linked to the expansion of the world economy. In addition, many possible narratives about the environmental history of the Great Barrier Reef could be written; the accounts presented in Chapters 5-7 are partial. Consequently, the discussion presented in this section suggests that, if they are to be of relevance to contemporary management, studies of environmental history should focus on desired outcomes for specific issues, habitats and species. Environmental histories of the Great Barrier Reef should suggest implications for the ways in which desirable outcomes for the management of coral reefs, islands and marine wildlife species can be identified, negotiated and achieved.

The review of studies of environmental history presented in Chapter 2 indicates numerous difficulties that exist in the reconstruction of historical baselines for ecological systems. Since ecosystems are complex and interconnected, they can react in unpredictable ways to impacts; furthermore, because ecosystems are dynamic, they are characterised by constant changes at many geographical and temporal scales. To identify changes in the Great Barrier Reef, therefore, is problematic since changes are constantly taking place. Any attempt to establish a pre-European state of the Great Barrier Reef is probably futile, because such an attempt assumes a condition of equilibrium. In addition, the earliest European transformations of the Great Barrier Reef have probably been obscured by subsequent human activities. The best reconstruction that may be made using qualitative methods involves the attempt to try and identify likely human impacts and to evaluate those impacts, and the social contexts in which those impacts have occurred. This approach implies that environmental histories of the Great Barrier Reef must focus on the responsibilities and obligations that now exist as a result of the region's World Heritage status, and on the ways in which those responsibilities and obligations might be met, rather than on attempting to restore a hypothetical pre-European environment.

The material presented in Chapters 2 and 3 indicates that knowledge about the Great Barrier Reef is socially constructed. During the period of European settlement in Queensland, knowledge about the coastal waters was limited by the resources, concerns and technologies of the early settlers; the Great Barrier Reef was dangerous, but it was an environment that provided valuable resources for the developing colony of

Queensland. Subsequently, the development of scientific knowledge of the Great Barrier Reef took place, although that, too, was shaped by influential institutions and individuals, as the account by Bowen and Bowen has shown.[63] In addition, knowledge about the Great Barrier Reef was produced in the context of an emerging world economy in which commercial activities received privileged status. Knowledge about the Great Barrier Reef continues to be socially constructed in response to issues that are perceived as critical by the scientific and political communities. Indeed, Sammells and Kerridge have argued that all environmental knowledge is socially constructed; their argument implies that all accounts of the environmental history of the Great Barrier Reef are contingent and must be evaluated critically in relation to other accounts.[64] A further implication is that more research into the environmental history of the Great Barrier Reef is required, so that a rich diversity of narratives may be produced. A study of the history of commercial fishing might be particularly valuable. However, all environmental history narratives must be interpreted cautiously, since historical certainty is impossible in the reconstruction of past environments. The use of the precautionary principle implies that any such reconstructions should not used be to justify environmental exploitation, but to focus on the outcomes that are appropriate to the World Heritage status of the GBRWHA.

Narrative approaches to environmental history claim that many possible stories can be told about environmental changes in the Great Barrier Reef; my account represents only one story. Other narratives may adopt different emphases and reach different conclusions about the impacts of human activities in transforming the coral reefs, islands and marine wildlife of the Great Barrier Reef. This uncertainty highlights the need to avoid simplistic conclusions in evaluating the environmental history of the Great Barrier Reef; the ecosystem is complex, and so are human actions. Nevertheless, the narratives presented in Chapters 5-7 indicate that the Great Barrier Reef has been extensively modified and, despite conservation initiatives, the ecosystem is unlikely to achieve its pre-European state. Instead, following the argument of Demeritt, policy makers and environmental managers should focus on deciding which outcomes we desire for the GBRWHA, and to consider ways of negotiating and achieving those

[63] Bowen and Bowen, *Great Barrier Reef*, *passim*.
[64] N. Sammells and R. Kerridge, *Writing the environment: ecocriticism and literature*, Zed Books, London, 1998.

outcomes.[65] In the Great Barrier Reef, the impacts described in Chapters 5-7 cannot be reversed; yet the ecosystem remains diverse and rich in species, and progress is possible in conserving the World Heritage values of this environment. Furthermore, as Wilkinson's assessment of the status of the world's coral reefs suggests, the GBRWHA is valuable in a global context as many other reefs become significantly degraded.[66]

Environmental histories of the Great Barrier Reef, therefore, should point to the desired outcomes held by human societies for this ecosystem. The identification and negotiation of such outcomes is complex and contested, particularly for an environment that is characterised by multiple uses, that supports economically important and conflicting commercial interests, and that is of cultural significance to many groups of differing economic and political power. The management of the GBRWHA, consequently, presents ongoing challenges which require increased participation by user groups, and which demand that more attention be given to the inclusion of marginalised communities in the process of making and implementing decisions about the management of the Great Barrier Reef. Significantly, such participation urgently needs to occur within the wider framework of the responsibilities and obligations of the World Heritage status of the ecosystem.[67]

8.7.2 Case study: the protection of coral at Green Island, 1929-1940

Several issues raised by the use of a narrative approach are illustrated in the following account of early attempts to protect coral at Green Island, which commenced in 1929. From that year, concerns about the removal of coral from Green Island reef led to the formation of what became, effectively, the world's first marine protected area, and an intact record of the correspondence that led to the creation of that protected area survives in the QSA.[68] This sequence of correspondence is discussed here, and its implications for environmental management are considered, since the narrative forms an interesting account of that way in which an exploitative policy mechanism – the coral licence system – was used to promote conservation. Hence, the dominant narrative of

[65] Demerritt, 'Ecology, objectivity and critique', p. 22.
[66] C. Wilkinson (ed), *Status of coral reefs of the world: 2000,* AIMS, Townsville, 2000, *passim.*
[67] Lucas *et al., Outstanding universal value.*
[68] See the discussion found in Lawrence *et al., Great Barrier Reef,* pp. 26-28; the sequence of correspondence is found in numerous archival records of the QEPA, SRS146/1 Item 2, Correspondence Subject Files – Permit protecting coral and surrounds of Green Island, QSA.

unrestrained exploitation of the Great Barrier Reef during the period before the creation of the GBRMP is an over-simplification; a sub-plot exists, in which environmental 'champions' expressed their concern about the conservation of corals. This account also illustrates how the value of tourism can promote conservation; this point is relevant to the recent rezoning of the GBRWHA and is comparable with the willingness of contemporary governments to restructure the less valuable fishing industry in favour of the more valuable tourism industry.[69] These examples suggest the ongoing importance of economic arguments in promoting conservation in the Great Barrier Reef.

Although Green Island had been declared a Recreation Reserve and placed under the control of the Cairns Town Council in 1906, the Reserve status applied only to the island above high-water mark and did not extend to the surrounding coral reef.[70] Shortly after that declaration, the Cairns Harbour Board commenced the construction of tourist facilities at the island, including the first jetty; in 1924, Hayles commenced the first passenger ferry service between Cairns and Green Island. Within a short period of time, increasing concerns about the informal removal of coral from the Green Island reef led the Cairns Town Council, in 1929, to ask the Queensland Government for authority to protect the coral reef. The Town Clerk stated that:

> the matter of protecting the coral reefs adjacent to Green Island from destruction through coral shells and other marine specimens being taken away by people who may visit the reef, is under consideration by my Council. At the present time Green Island is vested in my Council as a Recreation Reserve and I am inclined to ask that the coral reefs adjacent to the same, which reefs could be termed the Island's home reefs, be vested in my Council so that the necessary protection could be given to same.[71]

Although the Under-Secretary to the Treasurer replied that the matter 'will receive consideration', by the following year, no action had been taken and the Cairns Town Council again requested to be given legal authority over the Green Island reefs.[72]

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[69] GBRMPA, *Overview: the current status of the Great Barrier Reef*, GRBMPA, Townsville, 2003, p. 2; GBRMPA, *Great Barrier Reef Marine Park zoning plan*.
[70] GBRMPA, *Green Island economic study*, SRS5416/1 Box 64 Item 434, NP836, Trinity 'B' Transfer Batch 4, QSA, Appendix A.
[71] In-letter, Town Clerk, Cairns to US, Qld. Treasury, Brisbane, 12 November 1929, SRS146/1 Item 2, QSA.
[72] Out-letter Ref. 29/9737 L.A.C.T. Gen., US, Qld. Treasury, Brisbane to Town Clerk, Cairns, 22 November 1929, SRS146/1 Item 2, QSA; In-letter, Town Clerk, Cairns to US, Qld. Treasury, Brisbane, 21 October 1930, SRS146/1 Item 2, QSA.

To this, the Under-Secretary replied that 'it is not considered advisable to comply with the request'; he argued that, although legal authority existed for placing the foreshore or an island under the control of a Local Authority, the Queensland Government had issued several licences for the removal of coral the reefs in the vicinity of Cairns. Furthermore, the Under-Secretary stated:

> These licences have been granted with a view to enabling a company to be formed for the purpose of manufacturing agricultural lime from the coral to be obtained from the licensed areas, an industry which the Government considers it advisable to encourage.[73]

In reply, the Cairns Town Council argued that Green Island was rapidly becoming one of the most popular tourist resorts in north Queensland – with the coral reefs being the main attraction – and that the Council was building tourist facilities on the island.

As a consequence, on 2 March 1931, the Town Clerk wrote to the Under-Secretary, stating:

> my Council desires to protect the reefs as much as possible and with this end in mind I am directed to ask that when further licences are granted for the removal of coral from off the reefs, particular attention be given to the protection of reefs in the vicinity of Green Island, and that provision be made for this protection in any licences which may be granted.[74]

By 21 August 1931, the concerns of the Cairns Town Council about the removal of coral from Green Island had been reiterated: both to the Queensland Marine Board and to the Queensland Commissioner for Railways. In the same month, the Queensland Commissioner for Railways, who was responsible for the QGTB, expressed concern about the destruction of the Green Island reef: 'an attraction which will increase in value as the tourist industry develops.' By that time, the Cairns Town Council had invested £1,600 in the jetty and other facilities at Green Island, and reported being 'fully alive to the necessity of preserving the reefs from a Tourist point of view'; and the Town Clerk continued to request 'action which the Council may consider desirable in order to preserve the natural attractiveness of the island.' In particular, the Cairns Town

[73] Out-letter Ref. 31/394 L.A.C.T. Gen. 402, US, Qld. Treasury, Brisbane to Town Clerk, Cairns, 22 January 1931, SRS146/1 Item 2, QSA.
[74] In-letter, Town Clerk, Cairns to US, Qld. Treasury, Brisbane, 2 March 1931, SRS146/1 Item 2, QSA.

Council sought to protect the area below the foreshore – the area below low-water mark – where the most attractive corals were found. [75]

In response, the Queensland Government issued a proclamation that placed 'Green Island and the Coral Foreshores thereof [...] under the management and control of the Council of the City of Cairns'; that proclamation was also published in the *Government Gazette* on 7 November 1931.[76] However, since most of the coral damage was taking place below low-water mark and not on the foreshore of the island, the Cairns Town Council argued that the proclamation did not provide the required protection for corals, and the Town Clerk once again requested protection of the remainder of the reefs at Green Island. He stated that:

> my Council is of the opinion that placing only the Coral Foreshores under its control would not give the desired protection, and the localities to which visitors to the Island are taken to view the Coral Reef through glass bottom boats and other apparatus, are all outside low water mark, consequently under the Proclamation in question my Council will have no authority to protect those portions of the Reef, with their many interesting and beautiful specimens of marine life. In view of this, I am directed to ask that my Council's management and control be extended to include the Coral Reef for a distance of one (1) mile outside low water mark all around Green Island.[77]

On 11 January 1932, the Under-Secretary of the Queensland Treasury replied to the Cairns Town Council, insisting that there was 'no statutory authority under which land below low water mark can be placed under the control of a Local Authority.'[78]

An unusual solution to this problem was found: the Cairns Town Council could be issued with an exclusive licence to remove coral from Green Island, in order to prevent others from doing so. The Under-Secretary of the Queensland Treasury wrote:

[75] Sec., Qld. Marine Board, Brisbane to Qld. Office of the Commissioner for Railways, Brisbane, 13 August 1931, SRS146/1 Item 2, QSA; Town Clerk, Cairns to Chairman, Qld, Marine Board Office, Brisbane, 26 September 1931, SRS146/1 Item 2, QSA; Town Clerk, Cairns to Qld. Marine Board Office, Brisbane, 21 August 1931, SRS146/1 Item 2, QSA.
[76] Out-letter Ref. 31.8190 Reserves, Assistant US, Qld. Home Secretary's Office, Brisbane to Town Clerk, Cairns, 6 November 1931, SRS146/1 Item 2, QSA.
[77] Town Clerk, Cairns to Assistant US, Qld. Home Secretary's Office, Brisbane, 18 December 1931, SRS146/1 Item 2, QSA.
[78] Out-letter, US, Qld. Treasury, Brisbane to Town Clerk, Cairns, 11 January 1932, SRS146/1 Item 2, QSA.

> In order to give the Cairns City Council power to prevent the removal of coral and other marine products from the reefs surrounding Green Island, it is suggested that a license to remove shell grit and coral from an area within one mile of low water mark around the island shall be granted to the Council, under Section 18 of *The Fish and Oyster Act of 1914*.[79]

Therefore, after a Council resolution of 19 January 1932, the Mayor of Cairns applied, on 18 March 1932, for a licence to remove coral from the reef surrounding Green Island. That licence was issued on 20 April 1932 and permitted the Cairns Town Council 'to remove shell grit or coral from an area contained within a radius of one mile from low water mark around Green Island' from that date until 31 December 1945, at a rate of £1 per year. The Cairns Town Council probably did not exercise the privileges of this licence; indeed, the Queensland CIF wrote to the Cairns Town Council, emphasising that 'the licence has been issued in order to give the Council power to prevent the removal of coral and other marine products from the reef surrounding Green Island.'[80]

Although the permit was issued until 1945, the protection it afforded became redundant earlier. On 8 May 1937, the Queensland CIF notified the Queensland Treasury that the coral licence issued to the Cairns Town Council had been cancelled, because the Queensland Forestry Department had assumed management responsibility for Green Island and could enforce stricter controls of the removal of coral and shellfish from the adjacent reefs under the *Fish and Oyster Acts, 1914-1935*.[81] On 29 October 1940, the Secretary of the QDHM announced new legislation that prohibited the taking of coral from the foreshores and reefs surrounding twenty-eight islands in the Great Barrier Reef, including Green Island. After almost a decade, a formal policy framework for the protection of coral at Green Island had been established. Nonetheless, the earlier arrangement – the protection of corals using a coral licence – was unique and probably represented the first legal means of protecting a marine area in the world.[82]

[79] Out-letter, US, Qld. Treasury, Brisbane to Town Clerk, Cairns, 11 January 1932, SRS146/1 Item 2, QSA.
[80] Out-letter, US, Qld. Treasury, Brisbane to Town Clerk, Cairns, 20 April 1932, SRS146/1 Item 2, QSA; Out-letter, CIF, QDHM, Brisbane to Town Clerk, Cairns, 4 May 1932, SRS146/1 Item 2, QSA.
[81] Letter Ref. 37/4592, CIF, QDHM, Brisbane to US, Qld. Treasury, Brisbane, 8 May 1937, PRV8340/1 Item 1, QSA.
[82] Letter Ref. 4868, Sec., QDHM, Brisbane to Sec., Qld. Sub-Dept of Forestry, Brisbane, 29 October 1940, PRV8340/1 Item 1, QSA.

A number of interesting points emerge from the records describing the protection of corals at Green Island. First, as early as 1929, the degradation of a coral reef – as a result of the removal of coral by visitors – had been observed. Second, although during most of the period of European settlement the Great Barrier Reef – like other Australian environments – was generally regarded as a resource for exploitation, the narrative presented above indicates that some individuals were concerned about environmental conservation, even if their concerns were motivated by a desire to promote tourism rather than by any ecological ethic. In this story, the Cairns Town Council emerges as an environmental 'champion' – not only because of its progressive stance towards coral conservation, but also because of its persistence in dealing with the Queensland Government to achieve its conservation aims. The sequence of correspondence preserved in these archival files indicates that on at least nine occasions the Cairns Town Council requested protection for the Green Island reef and eventually succeeded in obtaining legal authority over the submerged corals.

The negotiation between the Cairns Town Council and the Queensland Treasury reveals the tensions between, and the varying interests of, different levels of government in Australia at that time, which forms a third point of interest in the story. A state-level concern to promote sugar cane production conflicted, in this case, with the concerns of local officials to attract tourists to Cairns. Fourth, the account provides additional evidence that a system of licensed coral mining had been established, with the encouragement of the Queensland Government, by 1930. Fifth – ironically – the same exploitative policy instrument (the coral mining licence system) was used creatively, in this instance, for the purpose of protecting corals. The narrative indicates a certain amount of initiative on the part of the officials of the Queensland Government who recognised an opportunity to use the coral licence system as a means of coral protection. Sixth, this account reveals conflicting economic demands that were placed, as early as 1929, on a single coral reef: the demands of extractive industry and of commercial tourism. This account of the protection of corals at Green Island reef illustrates the earliest documented instance in which such conflicting economic interests in the Great Barrier Reef needed to be evaluated in the political arena; as such, that negotiation anticipated the more complex balancing of multiple economic interests that now characterises the management of the GBRWHA.

8.8 Conclusion

This chapter has explored some of the implications for contemporary environmental management that I have derived as a result of my research. Most significantly, my results indicate strongly the need for scientific research and monitoring of the coral reefs, islands and marine species of the GBRWHA. Particular test sites and marine wildlife species which could inform scientific research, monitoring and modelling could yield valuable information about historical changes have been identified in Tables 8.1-8.3; for those coral reefs, islands and marine wildlife species, the historical accounts presented in Chapters 5-7 could be linked with geochemical and ecological reconstructions of environmental change. My research has identified some baselines, since the locations and dates of various historical impacts have been reconstructed; those baselines suggest that the exploitation of the Great Barrier Reef took place earlier, for a longer period, in more locations and more intensively than has previously been documented. Consequently, GBRMPA inherited management responsibility for an ecosystem that was far from pristine in 1975.

I have attempted to draw out some of the management implications of the use of qualitative sources – especially oral history sources – in environmental history research for a marine environment, and also to consider some implications of the use of a narrative approach in this type of research. Documentary sources provide a rich source of historical data and could inform further environmental histories of the Great Barrier Reef. Oral sources, in contrast - while capable of yielding unique evidence of some environmental changes – were generally disappointing in my study, for reasons that have been discussed in Section 8.6.1. Yet in spite of the rich descriptions available from qualitative sources – exemplified in two ‘best case’ scenarios (Sections 8.6.2 and 8.7.2) – those sources offer little capacity for coral reef scientists and managers to identify the causes of environmental changes. For the latter task, scientific monitoring of coral reefs, islands and marine wildlife species is necessary. In addition, I suggest that scientific research and monitoring should be linked with agreed performance indicators in order to maximise the likelihood of achieving the political support required to ensure the conservation of the GBRWHA.