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Published

2022

Journal Title

World Archaeology

Version

Accepted Manuscript (AM)

DOI

10.1080/00438243.2022.2077821

Island tales: culturally-filtered narratives about island creation through land submergence incorporate millennia-old memories of postglacial sea-level rise

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Contents

Abstract

In many long-enduring coastal cultures, there are stories – sometimes mythologized – about times when pieces of land became separated from mainlands by submergence, a process that created islands where none existed before. Using examples from northwest Europe and Australia, this paper argues that many such stories recall times, often millennia ago, when sea level in the aftermath of the Last Glaciation (last ice age) was rising and transforming coastal landscapes and their human uses in exactly the ways these stories describe. The possibility that these may have arisen from eyewitness accounts of these transformative processes, hitherto thought to be understandable only by scientific (palaeoenvironmental) reconstructions, should encourage more systematic investigations of such stories by scientists. It also suggests that science has traditionally underestimated the capacity of oral (pre-literate) cultures to acquire, encode and sustain their observations of memorable events with a high degree of replication fidelity.

1. Introduction

The details of much human history can be found only on formerly inhabited now-submerged lands that lie off the modern coastline (Gaffney, Fitch, and Smith 2009; Bailey et al. 2020; Benjamin et al. 2011). For decades, archaeological investigations have increasingly improved our knowledge of these places and cogently explained their role in the emergence of modern societies. Yet only comparatively recently has attention been given to the complementary data that can be found in ancient stories, culturally-filtered and often mythologized, which sometimes appear to recall the nature of land submergence and the societal disruptions that accompanied it (Nunn 2021; Nunn and Reid 2016; Nunn et al. 2021).

One of the more memorable (and least-studied) types of coastal-landscape transformation attributable to postglacial sea-level rise is the process of islandization, whereby the neck of a mainland peninsula becomes submerged to create an offshore island on which people may become isolated. Much has been written about what it means to live on an island and how island livelihoods invariably differ from continent-based ones (Kelman 2018; Nel et al. 2021; Stratford 2008) but little about what it means for a group of people to become 'islandized': in other words, to occupy somewhere that is becoming an island, being transformed from a larger to a much smaller ocean-bounded landmass.

This paper combines these two themes – information from ancient stories and islandization – to show that incidences of island formation and associated population isolation were widespread during the main period of postglacial sea-level rise, approximately 15,000-6000 BP (Lambeck et al. 2014). As archaeological research can demonstrate, islandization may have been uniquely traumatic, something that has implications for managing the present-day dilemma of island peoples threatened by climate change and rising sea level (Nunn 2020; Janif et al. 2016; McLaughlin, Stoddart, and Malone 2018).

The next section gives some background on the process of postglacial sea-level rise and what we know – from both archaeological investigations and (oral) narratives – about the effects it had on coastal-dwelling humans. This is followed by case studies of islandization informed by such narratives from two areas of Australia and two areas of northwest Europe. Discussion focuses on measuring the trauma associated with islandization and on how memories of this process have been preserved in contrasting cultural contexts.

2. Postglacial sea-level rise and its effects on coastal humans

The growth of land-based ice during the Last Glaciation was accompanied by a fall of global sea level, which dropped to 125-134 m below its present level during the Last Glacial Maximum (or LGM) ~21-19,000 BP (Fox-Kemper et al. 2021). Subsequently for at least 8000 years the ocean surface rose as a result of terrestrial meltwater inputs, a process that submerged coastal fringes in almost every part of the world. Exceptions occurred where land that had been depressed by ice sheets during the Last Glaciation rose more rapidly than sea level in its aftermath, a result of glacial isostatic adjustment (GIA).

GIA variations also explain why the histories of postglacial sea-level change in the two case study regions (see following sections) are so different. Australia is typical of far-field sites where sea-level rise from land-ice melt ended about 6000 BP. In contrast, the two areas of northwest Europe discussed below are both near-field sites that were not ice-covered during the Last Glaciation but which were raised at that time owing to lithosphere under ice sheets being pushed beneath them. In these areas, after the ice sheets started melting, lithosphere flowed back, causing them to subside, a process which explains why (relative) sea-level rise here continues today (Milne et al. 2009).

In terms of impacts on coastal humans, the distinction is important. For while coastal Australians were forced to accommodate the effects of rising sea level for around nine millennia (typically 15-6000 BP), coastal dwellers in parts of northwest Europe have had to contend with a rising sea level for at least 15,000 years. This plausibly explains why there are so many more traditions about 'sunken cities' and submerged lands along the coasts of Brittany (France), Cornwall and Wales (UK) compared to most other coasts in this region (Nunn 2021, 2020).

While not all the world's coasts were so densely populated in the distant past (>3000 BP) as they are today (Gillis 2013), archaeological research shows that in almost every part of the world, people were displaced repeatedly from coastal lands by postglacial sea-level rise (Hale et al. 2021). For example, the distribution of the Muge Mesolithic shell middens inland of Lisbon (Portugal) has been interpreted as a response to sea-level rise (Bicho and Haws 2008), a similar situation to that of the Ertebølle Mesolithic middens in Denmark (Astrup et al. 2021). There is abundant evidence of the repeated displacement of coastal populations in the late Pleistocene and early Holocene from the shores of the eastern Mediterranean and Black Sea, variously interpreted as a result of sea-level change (Turney and Brown 2007; Bikoulis 2015; Herrle et al. 2018). And in large East Asian deltas, the interplay of sea-level rise, deltaic subsidence and aggradation explains their Holocene history of alternating land-surface emergence and submergence, persuasively linked to alternating cultural efflorescence and collapse (Chen et al. 2008; He et al. 2020; Zhang et al. 2005).

For most of the Holocene (last ~11,650 years), a considerable proportion of the world's population occupied coastal lands or had livelihoods that involved periodic interaction with coastal places. They could not have failed to notice the changes in coastal landscapes, generation upon generation, caused by the rise in the ocean surface. The effects would have been particularly memorable when the rate of sea-level rise increased sharply, as it did during meltwater pulses (MWPs) attributed to the rapid and catastrophic draining of massive meltwater lakes on continents (Harrison, Smith, and Glasser 2019), or when the sea surface overtopped the edge of a low-lying coastal area, inundating it rapidly. It seems reasonable to suppose that the affected people would have encoded memories of these landscape changes, especially the catastrophic ones, within their oral traditions and passed these on from one generation to the next. Thus, any scepticism about whether these memories may have reached us today, perhaps several thousand years later, rests solely on judgements about the ability of pre-literate (oral) societies to retain information this long. There is considerable evidence that this was possible (Nunn 2018; Barber and Barber 2004; Kelly 2015) and some have argued that oral traditions can actually survive far longer (Echo-Hawk 2000; Matchan et al. 2020).

Preserved in oral traditions, memories of land submergence, plausibly attributed to multi-millennial postglacial sea-level rise, are now known from 27 sites along every part of the Australian coast (Nunn and Reid 2016); all traditions are contained in stories repeatedly communicated between generations that recall when the coast was further out to sea, when people utilized the now-submerged land, and where what are now offshore islands were contiguous with the mainland. They include stories about the inundation of Spencer Gulf and the creation of islands therein, including Wardang Island (Waraldi) that became an island 8500-7400 cal BP, an event recalled in various extant Narungga (Aboriginal) stories (Roberts et al. 2020). Memories of submergence communicated in comparable ways in Haida Gwaii and Heiltsuk (Canada) traditions are likely to have originated more than 9000 years ago while those represented by the Lyonesse stories (Southwest England), if applied to the submergence of the Scilly Islands, must have been passed down for more than 7700 years (Nunn 2021; Nunn et al. 2021; Gauvreau and McLaren 2016; Gauvreau et al. 2017).

3. Case studies from Australia

The history of postglacial sea-level rise, totalling around 125 m, around Australia is representative of most parts of the world's coast in that it effectively ended around 6000-7000 years BP, since which time the ocean surface has fluctuated within 1-2 m of its present position (Lewis et al. 2013). This fact means that all Australian stories recalling coastal submergence are therefore more than 7000 years old (Nunn and Reid 2016). Two examples of islandization, both the memories of this and the processes involved, are discussed below, chosen because they are better documented than most.

3.1. The Wellesley Islands (Queensland)

The island group known as the Wellesley Islands (Figure 1) in the southern part of the Gulf of Carpentaria is home to four groups of Indigenous (Aboriginal) Australians. Of these, Kaiadilt and Lardil stories about the islands' formation have been published and are analysed here.

During the Last Glaciation until ca. 11,700 cal yr BP, the Gulf of Carpentaria was a freshwater lake within a land bridge connecting Australia to New Guinea that is considered to have played a central role in the subsequent dispersal of people throughout Australia (Malaspinas et al. 2016; McConvell 1996). Specifically, the effect of the breaching of the Arafura Sill by sea-level rise allowed ocean water in 11,700 cal yr BP and the attainment of full marine conditions by approximately 10,000 cal yr BP (Sloss et al. 2018). A plausible supposition is that within subsequent millennia some groups of people came to occupy what are now the Wellesley Islands when they were contiguous with what is now the Australian mainland. As appears to be the case with other islands off the coast of northeast Australia (Rowland, Wright, and Baker 2015), it is possible that these islands were abandoned by people when they began to become separated from the mainland and then recolonized later (Moss et al. 2015; Rosendahl et al. 2015) although the existence of narratives predating separation suggests "a relatively lengthy occupation since at least mid-Holocene" (Memmott et al. 2006, 1076). For this study, the question of whether these islands were continually occupied or not since they first showed signs of islandization is unimportant, because it is possible that stories about this process continued to be told wherever the storytellers lived.

Acclaimed Lardil storyteller, Dick Roughsey (Goobalathaldin) explained how "in the beginning, our home islands, now called the North Wellesleys, were not islands at all; but were part of a peninsula running out from the mainland … the Balumbanda people came along that peninsula long before it was cut up into islands" (1971, 20). Roughsey continued; "our people say that the channels [between Mornington and the mainland] were caused by Garnguur, a sea-gull woman who dragged a big *walpa* or raft, back and forth across the peninsula" (p 20), a detail possibly based on observations of the sea-floor corrugations (shown in Figure 1) in this area before it was submerged. Additional details were reported by Memmott (1979) including the details that (a) Garnguur punished her brother Crane by pulling her *walpa* back and forth across the land separating Francis and Forsyth islands to create the >10-m channel that now exists there; (b) the sweet-potato woman Puri created the passage (named *purikal*) between Forsyth and Andrew islands as she fled from Crane; and (c) how the channel between Denham and Mornington islands was made by a shark panicked by lightning.

The Kaiadilt people have stories recalling how they came to occupy Bentinck Island, an environment that lent itself to seafood consumption, facilitated by the use of fish traps (*ngarruwarr*) for which the Kaiadilt are renowned (Rowland and Ulm 2011). Of note is the unpublished claim by Australian anthropologist Norman Tindale that on Bentinck Island, several periods of fish-trap construction representing adaptation to sea-level changes were observable in the 1940s (Memmott, Robins, and Stock 2008), a comparable situation to that along the sides of the Gulf of St Malo in northern France (Langouet and Daire 2009). Kaiadilt origin stories suggest that people carrying water lilies (at sea, searching for land to occupy) landed on a beach on Bentinck and encountered "a sand hill way to the north" (Evans 1995, 257) where the people "dug and dug" (Evans 1995, 599) to find fresh water, a discovery that enabled their subsequent occupation of this uncommonly dry island.

While the Lardil stories are all undoubted memories of the process of islandization, the Kaiadilt stories are more likely to be those of (newly-created?) island discovery, plausibly by people displaced from the last remnants of the former Australia-New Guinea land bridge by postglacial sea-level rise. Similar 'origin stories' are found elsewhere in this part of northern Australia, notably from the Sir Edward Pellew Islands (Bradley 1998), the Goulburn Islands (Veland et al. 2013), and Cape Don where the Gunwinggu people trace their origin to an island named Aragaládi that is said to have sunk (Berndt and Berndt 1994).

3.2. Kangaroo Island (South Australia)

Many Indigenous groups in South Australia, including the Ngarrindjeri, Ramindjeri and Jarildekald, have told stories about a time when the (now-) offshore island named Kangaroo Island was connected to the mainland and how the land connection became severed to create Backstairs Passage, now 30-35 m deep, that separates the two today (Figure 2). Most narratives follow Ngarrindjeri man David Unaipon in stating that "at the time of this story this island was connected with the mainland, but during a severe southerly storm the sea would cover the connecting strip of land" (Smith 1930, 328) or that the land connection amounted to "a line of partly submerged boulders" (Roberts and Mountford 1989, 24) or that it was passable "by walking and wading" (Campbell 1967, 477).

The essence of the Aboriginal narrative referring to the crossing of Backstairs Passage is that the two wives of a "strong powerful man" named Ngurunduri ran away from him along the south coast of the Fleurieu Peninsula. He pursued them past Tunkalilla but when he reached a hill above Tjirbuk (Blowhole Beach), he saw they were halfway across (then-dry) Backstairs Passage heading towards (now) Kangaroo Island. Ngurunduri started singing the Wind Song –

> *Pinkell lowar mia yound, Tee wee warr, La rund, Tolkamia a tren who cun, Tinkalla!* (Fall down from above, oh thou mighty Wind; swiftly run and display thy fleetness! Come thou down from the Northern sky, oh water of the deep! Come up in a mighty swell!) (Unaipon 2001, 132).

A storm arose, "the sea lifted itself from its bed and surged across the isthmus" (Reed 1993, 64-5) and the women drowned. Their bodies were swept south, becoming (with the bag they carried) the islands known as The Pages (or Metalong). Ever since that time, Backstairs Passage has been ocean filled. In some versions of the story, Ngurunduri subsequently dived into the water to swim to Kangaroo Island; one account states that he saw 'a great fire under the sea' (Taplin 1873), conceivably a memory of contemporary volcanic activity in the

Newer Volcanics Province 320 km southeast which features in oral traditions at least 5000 years old (Wilkie, Cahir, and Clark 2020).

3.3. Dating Australian stories

Ages for 'submergence stories' of the kinds recounted above can be estimated by plotting the shallowest range of shoreline depths at which stories would be true against the range of known sea level during postglacial times (Figure 3). Pioneered by Nunn and Reid (2016), this method gives crude minimum ages for stories, particularly the length of time they must have endured in largely oral contexts. In this way, the Lardil stories from the Wellesley Islands could have been true only when sea level was 5-10 m lower than today, a condition achieved most recently 7500-9100 BP. The stories about the crossing of Backstairs Passage could have been true only when sea level was 32-35 m lower, a condition last achieved 10,100-11,000 BP.

These ages are representative of the larger datasets analysed elsewhere (Nunn and Reid 2016; Nunn 2018; Nunn et al. 2021) and consistent with others' inferences about submergence stories from Australia (Roberts et al. 2020; Flood 2006; Cane 2002). Nevertheless, there are many potential sources of error implicit in such estimates, especially those associated with estimating shoreline depth from ancient narratives that cannot avoid assumptions about other causes of changes in the land-sea interface.

4. Case studies from Northwest Europe

Unlike most other parts of the world's coastline (including Australia) where submergence ceased around 6000-7000 BP, many coasts in northwest Europe have experienced continuous submergence since the Last Glaciation. As explained in Section 2, this is because sea-level rise associated with ice melt has been prolonged here (and in equivalent geophysical contexts) by the still-continuing collapse of the peripheral bulges that formed in these places during the Last Glaciation (Kiden, Denys, and Johnston 2002).

Two areas where there are several stories of islandization are discussed in the following subsections, one from the few areas of Scotland that was not covered by ice during the Last Glaciation, the other from a classic bulge site on the fringes of the English Channel (La Manche).

4.1. Islands off North Uist, Outer Hebrides (Scotland)

Unlike the Inner Hebrides, which were ice-covered for much of the Last Glaciation, the islands of the Outer Hebrides (Figure 4) were not and consequently exhibit geomorphological evidence for postglacial submergence that is echoed in the archaeological record. To a geomorphologist, the widespread presence of submerged peats, machair plains, and indications of recent loch (coastal lakes/inlets) formation are clear signs of submergence (Ritchie 1985; Whittington and Edwards 1997). To an archaeologist, the fact that coastal sites like Eilean Domhnuill show signs of progressive inundation and the existence of others like An Doirlinn has become directly threatened by sea-level rise lead to a similar conclusion (Sharples 2015; Garrow and Sturt 2017b).

There are numerous stories that recall (or can be interpreted as recalling) the effects of sea-level rise on submerging coastal lowlands and creating islands where none existed before, particularly off the coast of North Uist (Figure 4).

A good example refers to the now-uninhabited Monach (or Heisker) Islands, where its 19th-century residents recounted oral traditions about the time when these islands were contiguous with North Uist. A clue lies in the origin of the name Heisker, from the Gaelic *aoi-sgeir* meaning isthmus-skerry, but

> partly through the gradual subsidence of the land, and partly owing to the gradual dislodgment of the friable sand forming the isthmus, the isthmus by degrees gave way to fords, and the fords broadened into a strait … tradition still mentions the names of those who crossed these fords last, and the names of persons drowned in crossing (Carmichael 1884, 464).

Closer to the North Uist mainland is the island of Baleshare where there are legends recalling “the walls of ruined cottages … underwater off the western shore” (James and Duffy 2003, 43). On nearby Kirkibost Island, “the sea now occupies fields which formerly produced fine crops of bear or barley” (McRae 1845, 163).

Off the north coast of North Uist, there are comparable stories about most of the islands. For example, one of the small bays on the north coast of Vallay Island is called Bàgh nan Craobagh or “bay of small trees” (Elton 1938, 283) which, given the presence on the sea floor here of submerged peats containing “the roots and branches of trees” (Beveridge 1911, 6), is a likely recollection of a time of lower relative sea level. Another example concerns the now-disappeared island of Eilean nan Uan where the people of neighbouring Boreray once grazed their sheep (Beveridge 1911).

A better-documented example refers to the tradition among the people of Berneray and Pabbay Islands, today separated by 3.5 km of ocean, that “in former times the two islands were only separated by a very narrow channel, so that people could shout across and be heard, or even throw things across” (Elton 1938, 287), a story obtained in 1935 from three independent sources. All this is consistent with the geological evidence of submergence from sea-floor peats which has long been interpreted to mean "that the land must have [once] largely extended its bounds beyond the present limits" (MacRae 1845, 168).

4.2. The Channel Islands

Given that the entire English Channel was dry land during the Last Glacial Maximum (Gupta et al. 2007), the modern Channel Islands (Îles de la Manche) would have first been occupied by people when they were part of mainland Europe, as the well-documented megafauna kill site at La Cotte de St Brelade on Jersey shows (Smith 2015). Much later, these islands became separated from the mainland, probably retaining a human presence (Garrow and Sturt 2017a). There are several stories from these islands (Figure 5) that can be interpreted as human memories of the process of their islandization.

Among the more recent stories, the veracity invariably supported by their tellers with observations of tangible evidence for submergence, is one almost seven centuries old from the island of Jersey,

> part of the great Bay of St. Oûen was a rich Vale, which the Sea has swallowed up. Not only ancient Records speak of a People inhabiting that Tract, but to this day at Low-water great Stumps of Oaks shew themselves in the Sand, with evident Marks of buildings among the Rocks (Falle 1734, 113).

On neighbouring Guernsey, the largest island in the group, "traditions resting on a historical foundation" recall a "convulsion of nature which resulted in the destruction by the sea of the forest lands on the northern and western sides of the island, and in the separation of tracts of considerable magnitude from the mainland" (Anonymous 1889, 4-6).

One of the most repeated and most pilloried stories is about people once able to walk between Jersey and Normandy, using a bridge to traverse the only sizeable river encountered. This story has become linked to the travels of a 7th-century Bishop of Coutances (France) and in many recent versions the bridge has become a 'plank', neither of which feature in the earliest (1682) written account of this story (Poingdestre 1889). In 1835, the idea that people ever walked between Jersey and Normand was adjudged "too ridiculous to merit examination. Marvels are always popular; and the people of Jersey are no less credulous than their neighbours" (Inglis 1835, 50), a view subsequently sustained in both popular and academic accounts.

Although Guernsey became separated from mainland France more than 9000 years ago (Sebire and Renouf 2010), Jersey is likely to have remained connected longer, the land connection becoming impassable on foot perhaps only within the last 6000 years (Garrow and Sturt 2017a, 10). There are precedents for oral traditions being preserved this long, especially those recalling memorable events like volcanic eruptions and meteorite impacts, and this has numerous implications for our current understanding of oral (pre-literate) societies and the knowledge still held in ancient cultural stories (Nunn 2018), Through time, these traditions were repeatedly associated with new cultural contexts and heroes, such as Christian bishops who gained influence through bridge construction and maintenance (Bowman 2002).

There is also evidence from some of the smallest habitable islands in the Channel Islands group that draws on archaeology and tradition to argue for a lengthy human occupation of these islands as their size was being progressively reduced in area by rising sea level. Archaeological investigations in the Écréhous and Minquiers – today too small to be permanently habitable - show these islands were occupied by 6500 BP when their land areas were far larger (Fleury and Johnson 2015) and it may be that, as elsewhere in the southern Channel Islands, they remained occupied until recent times. Clues also lie in island names, such as La Marmotière (Écréhous) which translates as "the monastery by the sea", and the suffix -*hou* in the names of many of the now-uninhabited islands (like Brecquou, Burhou, Jethou) that means "dwelling" in Jèrriais, and on archaeological evidence for former more extensive occupations (Sebire and Renouf 2010).

4.3. Dating European stories

Unlike Australia for which a single postglacial sea-level envelope can be used to represent coastal changes, site-specific sea-level curves must be used for this in northwest Europe because of spatial variations associated with glacial isostatic adjustment (Yokoyama and Purcell 2021). GIA-based sea-level reconstructions for the two areas discussed above are shown in Figure 6 for the past 10,000 years when relative sea level was around 20 m lower.

In Figure 6A, two alternative sea-level curves are shown for the North Uist area (Bradley et al. 2011; Kuchar et al. 2012). The stories linking Berneray and Pabbay could have been true only when sea level was about 5 m lower than today; those linking the Monach Islands to North Uist would have been true only when sea level was some 7 m lower. Plotting the depth range 5-7 m allows the calculation of age ranges of 7400-7900 BP (Bradley) or 6800-7300 (Kuchar), a combined age range of 6800-7900 BP.

Figure 6B utilises the ICE-6G reconstruction (Peltier, Argus, and Drummond 2015). The stories linking Jersey to Normandy, considered to be the youngest and least ambiguous from the Channel Islands, would have been true when sea level was 10-12 m lower than today, a condition last achieved 8000-8700 BP.

5. Discussion

Many instances of memorable environmental change are noted in oral traditions and are likely to have been intended to recall and rationalize these events. For example, many Australian Aboriginal myths reviewed by Tindale (1946) refer to “some half-remembered cataclysm of nature, or an eclipse, or meteoric shower” (p 76). Innumerable stories of volcanic eruption were told by the Aboriginal people in southern Victoria (Australia) included one about the Pentland Hills being *Willum-a-weenth*, the “place of fire”, that had formerly exuded “smoke and steam” (Wilkie, Cahir, and Clark 2020, 3). Similar volcano and earthquake and meteorite stories are told in many parts of the world and have likely been passed down orally for thousands of years (Nunn et al. 2019; Masse and Masse 2007; McMillan and Hutchinson 2002).

Where such knowledge could not be written down, it was spoken (and sung or recited or performed) but in colonizers’ worldviews, this was not history but fable, akin to the tales of the Brothers Grimm and Hans Christian Andersen (Mahuika 2019). Western epistemologies divided history into prehistoric (non-literate) and historic (literate), creating a hierarchy with the former deemed inferior. Science — universal, written and codified — assumed legitimacy (Ong 1982). But just as western science may dismiss local, oral traditions as “vague, subjective and context-dependent”, this same criticism is levelled at science by Indigenous people, reflecting sometimes diametrically opposed world views (Cruikshank 2001, 390). While early archaeologists drew on Indigenous oral traditions, they learned to become sceptical about their trustworthiness as they rarely conformed to the linear chronologies accepted in Western culture (Zedeño, Pickering, and Lanoë 2021; Yunkaporta 2019). In contrast, in Australia, “dreaming tracks” or songlines that told stories of creation and sacred sites are considered by Indigenous knowledgeholders as timeless, not locked in the past or present. Songlines are a complex system of telling stories that enable Aboriginal people to know their world and belief systems (Morrison 2019).

As these oral accounts could vary in the telling, something unusual in literate contexts, some dismissed their objectivity and veracity on that basis. Yet by definition such stories were dynamic, not “static narratives locked in a primitive form” (Wilkie, Cahir, and Clark 2020, 9), the storyteller preserving the “root and core message” while refreshing the lessons to be gained from them (Urwin 2019). Rather than weaken their significance, the variations and multiple repetition augment their significance and reflect broadly shared deep-time experiences (Nabokov 2002). In contrast, in his study of the history of his Māori tribe Ngaa Rauru Kiitahi (New Zealand), Broughton (1983) found that oral “compositions” within tribal communities were “transmitted orally almost word-perfect down the generations and their content, therefore, remained unaltered in most cases” and much should be “regarded as factual material, whether biographical, historical, [or] genealogical” (Mahuika 2019, 23). Navajo Indians (USA) acknowledge variations in the re-telling of oral traditions but the core values and messages are constant (Schaafsma 2004).

To make it memorable for listeners, elements were often exaggerated and enlivened by storytellers in ways that make extant stories appear to modern literate people as fictions

(Ong 1982; Nunn 2018). Stories that were colourful, as well as explanatory, were more likely to survive for millennia (Echo-Hawk, 2000). Alternative views about the replication fidelity of these stories do not really bear on their veracity as eyewitness accounts. Indigenous wisdom is not "ahistorical, timeless, abstract data" but like all forms of knowledge reflect "specific political and historical circumstances" (Cruikshank 2001, 390). Neither oral nor written accounts should claim to be authoritative; they are all cultural productions.

Oral traditions are best used as complementary historical information and other ways of knowing that can be used to add "new dimensions about already perceived pasts" (David et al. 2004, 159). Oral traditions are more than alternative sources or perspectives, they have their own purposes and contain multiple levels of meaning (Cruikshank 2007). They speak to how "indigenous people make sense of the unpredictable destructive natural forces in their landscape" (McMillan and Hutchinson 2002, 44).

Arguments over the fidelity of oral histories, especially when offered as testimony in land disputes, have become increasingly common over the past few decades (Kenyon 2016). Critics argue that oral histories are shaped by social, economic, political and cultural factors that make them unreliable sources (Portelli 2015). Scholars of collective memory also acknowledge that memories are not exact but selective naratives "enacted, consumed, modifed or rejected according to their present-day usefulness or applicability" (McKinnon and Cook 2020b, 2). But this does not invalidate the information obtained but simply counsels caution as to how it should be interpreted or used. Increasingly oral history is used as a research method by historians to document how people "make sense of their past"and interpret their "lives and the worlds around them" (Portelli 2015, 4). For environmental historians, oral history offers a means to analyse human perceptions of environmental change and unpack relationships between humans and the natural world over time (McKinnon and Cook 2020a; Holmes and Goodall 2017).

Although reconstructions of submerged lands have been available in many parts of the world for several decades (Benjamin et al. 2011; Bailey et al. 2020; O'Leary, Paumard, and Ward 2020), scientific interest has tended to focus on mapping change rather than understanding the site-specific effects of change. For instance, palaeoenvironmental 'time slices' encourage us to think iteratively about past change, comparing the situation at Time A to that at Time B; the discovery of a site from a certain period encourages a focus on this. In contrast, ancient stories of the kinds described here focus more on process: for example, the submergence of the Monach-Uist isthmus which "by degrees gave way to fords, and the fords broadened into a strait four and a half miles wide and four fathoms deep" (Carmichael 1884, 464) and the observation that Backstairs Passage "at the time of this story this island was connected with the mainland, but during a severe southerly storm the sea would cover the connecting strip of land" (Smith 1930, 328). Such minutiae can rarely be supplied by retrodictive scientific investigation alone.

The study of ancient stories of islandization, grounded in place and culture, allows insights into two understudied aspects of this phenomenon – trauma and response – discussed in the following subsections. It is possible that the degree of cumulative societal trauma associated with continuous coastal land-loss in postglacial times has been underestimated in our efforts to understand societal evolution in many parts of the world (Gillis 2013; Cunliffe 2001; Nunn 2021). In the next subsection, some of the evidence pointing to such trauma is reviewed. The subsection which follows it discusses some ways in which humans coped with this trauma.

5.1. The trauma of land loss and islandization

Thousands of years ago it is likely that people, accustomed for generations to living on an extensive (continental) landmass, would have become increasingly anxious as their part of this slowly showed signs of being cut off from the mainland. This would likely have created mental trauma for many such people, especially in crowded or bounded coastal contexts where moving inland was not a readily available adaptation. We may never fully understand the depth and breadth of this trauma or the degree to which it moulded the worldviews and belief systems of the affected peoples, but there is some evidence this occurred.

It could be argued that the longevity of memories of profound landscape-altering events (like progressive land loss from submergence) is a measure of the trauma associated with these. For Australian submergence stories, at least 27 groups of which have reached us today across the six thousand years during which submergence has *not* been occurring, this seems likely; why else would people assiduously and effectively preserve stories of land submergence long ago unless this event was so profoundly disruptive and disturbing that successive generations regarded it as imperative to pass on memories of it? In many Aboriginal Australian cultural traditions, "catastrophe is a dominant theme, casting a cloak of gloom over nearly all the tales" (Berndt and Berndt 1996, 391); catastrophe in these contexts including land loss from sea-level rise, volcanism, tsunamis and drought in particular.

Australian submergence stories also contain details about that trauma and the extreme measures it elicited. For example, an Aboriginal story from the coastal fringe of south Australia talks about how, having experienced long-term encroachment of the sea across the fringes of the land and fearing it would submerge it all, people expressed their anxiety.

> From each side the sea water flowed in, filling the creek and flooding the country. "We'll die, we'll die!' cried the Bird Men. As the flood spread and the water become deeper, they changed their shape and really did become birds (Berndt and Berndt 1996, 400).

Similar hints of trauma may be represented by the sadness that pervades many such submergence stories. For example, in telling of the formation of the Sir Edward Pellew Islands in the Gulf of Carpentaria (Australia), Yanyuwa elder Sam Birribirrikama explained that "it was salt water it kept rising and the country was underwater, it was drowned completely the poor thing" (Personal communication, John Bradley, 2018). In southern India, Tamil literature contains many poignant references to the submerged land Kumari Kandam, such as the 1950s reflection of Mutthuvirasami Naidu.

> Alas! What can one say about the suffering heaped upon the ancient Tamil land which gave birth to the arts and to world civilization? What can one say about the cruelty of the ocean that caused all this? What can we say about the state of the Tamil-speaking land that today stands shrunken and emaciated.... How much distress and loss has all this caused? Can we even measure this? (in translation in Ramaswamy 2000, 576).

And of the allegedly submerged city of Cantre'r Gwaelod in Cardigan Bay (Wales), formerly the seat of King Gwyddno, a 13th-century poet wrote of "the lament of Gwyddno … over whose land God turned the sea" (quoted in North 1957, 150). Such sentiments might plausibly represent the lingering remnants of a once-profound anxiety that affected coastal peoples displaced from their drowning lands in every part of the world.

Archaeological research on the prehistory of Australia's smaller offshore islands (Bowdler 1995; Sim and West 1998; Rowland, Wright, and Baker 2015) has led to a model suggesting that as sea level rose in the early Holocene and islandization was imminent, most of these islands were abandoned by their human inhabitants in favour of the security of mainland environments. Many such islands were reoccupied during the later Holocene.

> While it is clear that sea-level rise was the prime mover behind the initial Holocene abandonment of plains areas that subsequently became offshore islands, the underlying motivation for the mid-Holocene (re)colonisation of Australia's offshore islands (as islands *per se*) is somewhat obscure (Sim and Wallis 2008, 96).

The answer might lie in the growth and the waning of trauma. The abandonment of nascent Australian islands is commonly explained in resource terms, namely that imminent islandization would leave island peoples with insufficient resources to survive if they elected not to move. Yet in some cases, archaeological investigations have shown that groups of people remained on islands after they were effectively cut off from the mainland, sometimes leading to their extirpation. A well-studied example is Kangaroo Island (southern Australia), which was largely abandoned around the time of incipient islandization perhaps 8-9000 BP but where a residual population remained until about 4000 BP when they either succeeded in moving to the mainland or died in place (Lampert 1981). This is a comparable situation to that with the smaller islands (like Flinders and Hunter) in the Bass Strait (between mainland Australia and Tasmania) where people remained after its submergence at the start of the Holocene, surviving until about 4000 BP and then probably dying out (Sim and West 1998; Bowdler 2015).

Finally, it is noted that many offshore islands, once inhabited but later abandoned, have sometimes been considered 'islands of the dead', a description often applied to Kangaroo Island and other islands off the Australian mainland (Draper 2015). The former interpretation of British offshore islands, like Alderney (Channel Islands) and the Scilly Isles off the Cornish mainland, as dedicated burial sites or necropolises (Coysh 1974, 42; Hencken 1932, 38), may also have arisen from a similar belief, namely that 'small' offshore islands with abundant indications of former human occupation may have become by default 'places of the dead', entering as such into the narratives of both culture and science. Yet rather than signifying the use of islands as burial sites, the unusually high densities of 'tombs' on offshore islands like Alderney and Guernsey (Hawley 2017, 1) and the Scillies (Charman et al. 2016, 206) may be an expression of the trauma being felt by their inhabitants initially as a consequence of islandization but also – in the case of northwest Europe islands – as a result of continued land loss linked to unceasing sea-level rise. On the smallest such islands, like the Écréhous and Minquiers (Channel Islands), the trauma that the inhabitants must have felt in seeing their large islands steadily reduced in size to the point of near-uninhabitability must have been profound, even though any material expression of this must be largely underwater (Rodwell 1996).

5.2. Memories of islandization

Many stories recalling memorable, sometimes catastrophic, events – including islandization - have been passed down across sometimes hundreds of generations, leading one to ask "why"? The answer plausibly lies in risk management, the need to enlighten future generations about the dangers associated with occupying particular places, dangers that ranged from short-term challenges such as those associated with storm and drought to traumatic longer-term ones such as those associated with land loss linked to multigenerational sea-level rise. Ancient pre-literate societies were probably no less risk-averse than modern societies, understanding the practical benefits of ensuring that each member of every successive generation was educated as fully as possible to maximise their tribe's chances of survival. These stories offered ways of explaining landscape evolution and how change had been negotiated, providing a cultural context in which to understand and navigate the environment (Zedeño, Pickering, and Lanoë 2021; Jones and Russell 2012). For example, research in both Solomon Islands and Vanuatu (Southwest Pacific Ocean) found that their stories culturally embedded accounts of earlier disasters, especially earthquakes and tsunamis, and played a part in local residents' survival responses (Lauer 2012; Walshe and Nunn 2012; Petterson et al. 2003).

In oral societies, history was context, a lens through which it was essential to view knowledge about place and how it had changed. Oral traditions enable the "meaningful historicizing of the past" (David et al. 2004, 159). Māori scholar Nēpia Mahuika (2019) notes that for her people (in New Zealand) narratives passed intergenerationally through *whakatauākī* (proverbs), *mōteatea* (chants), and *kōrero tuku iho* (stories handed down) were intended to ensure cultural survival, assert ownership and boundaries, "power and belonging", and testify to "grievance and trauma"; they recorded "relationships across time and space to land, sea, sky, and each other" (p 5).

In such situations, it was important to know that islands had not always been islands, perhaps in case one day in the future they should once again become part of larger landmasses or, conversely, further islandized. It was important to know that such an occurrence had precedents and how its consequences – typically around subsistence strategies or land ownership – had been managed.

Such reasons appear to be plausible explanations for the preservation of stories about islandization over sometimes thousands of years. Of interest also are the ways other than storytelling in which memories of islandization were sustained in largely oral contexts. One way was in the names of places, a good example being the alternative name for the Monach Islands (Scotland) as Heisker or *aoi-sgeir* (isthmus-skerry). Off the south coast of Cornwall (England), the Cornish name for St Michael's Mount is *Carreg Coedh yn Clos*, the 'grey rock in the wood', which recalls the time when this (now-) island was a hill within a forested part of the mainland (Curran 2000). In northeast Australia, the Aboriginal name *mudaga* (the pencil pine *Athrotaxis cupressoides*) refers to a place (now underwater) between Fitzroy Island and the mainland where these trees grew when sea level was lower (Dixon 1977), perhaps more than 9000 years ago (Nunn 2018).

More tangible ways of recalling islandization may be, as suggested above, the comparatively high densities of monuments on offshore islands such as Alderney and the Scillies which may have evolved as tangible expressions of remembered islandization, maybe even as memory aids. This is a role increasingly acknowledged for rock art in pre-literate societies (Kelly 2015; Brady, Bradley, and Kearney 2016; Nyland and Stebergløkken 2020). For Murujuga (Dampier Archipelago) in Western Australia, rock art tracks environmental change including islandization associated with postglacial sea-level rise (McDonald and Berry 2016). Elsewhere in Australia, tangible responses to rising sea level, which could be regarded as spiritual (mitigation) rather than practical (adaptation), includes the creation of stone arrangements intended perhaps for the ritual control of sea-level rise (McNiven 2008). Elsewhere in the world, lines of standing stones in places like Carnac (Brittany, France) have been interpreted "as a 'cognitive barrier' … [they] should be considered as a mineral fence that could stop, impede, or filter movement or passage" (Cassen et al. 2011, 100).

Finally it is plausible to suppose that memories of islandization and even the submergence of entire islands may be preserved in various cultural protocols, ranging from the ceremonies that once routinely took place above the site of the submerged city of Ys in Douarnenez Bay in Brittany (France) (Davies 1918) to the protocols of respect that continue to be observed in many parts of the Pacific Islands when sailing today over the sites of submerged lands (Nunn 2021).

6. Conclusions

The likelihood that ancient stories, commonly disregarded as sources of empirical data by scientists, may contain information that adds to our knowledge of the past should encourage their more rigorous interrogation. In the geosciences, recent research has shown that indigenous/traditional knowledges contain abundant information about volcanic eruptions and meteorite falls, for example, that could not be obtained from any other source (Nunn et al. 2019; Wilkie, Cahir, and Clark 2020; Masse and Masse 2007). Similar research has been carried out in the archaeological sciences although, perhaps because of the comparative recency of the events involved, the crossover between science and 'tradition' appears to have been less (Garofoli 2017; Bednarik 2013).

Ancient stories can help the reconstruction of the human past because they contain details about landscape evolution that may also have been deduced by scientific investigations; the one validates the other, but the stories are older (Nunn 2018). These stories then represent an opportunity to humanize the past in ways that retrodictive science cannot, by talking about the memorable (and less memorable) effects of land submergence, for instance. What appears important to us from a distance in time was not necessarily the same preoccupation as that of the affected people and their immediate descendants. For example, the Monach Island traditions privileged the names of the people who last crossed the isthmus and those who subsequently died trying, not the fact of islandization that appears most conspicuous to us today. This insight also feeds into current archaeological and historical debates about whose past represents the legitimate one and whose should be privileged/taught in particular contexts today (Panja 2021; Maddison 2019).

There is a growing acceptance among scholars of the validity and importance of oral traditions as historical sources, a non-literary archive of stories "encoded in ecological, paleontological and archaeological localities" (Zedeño, Pickering, and Lanoë 2021, 7). Indigenous scholars have been advocating for the inclusion of their ways of knowing in scholarship for decades, calling for the decolonizing of historical methods and the rejection of the perception of oral traditions as an inferior source of knowledge. Citing the scholarship of different academic disciplines that advocate the legitimacy of oral tradition, Lilomaiava-Doktor (2020) argues that "incorporating storytelling into the social-scientific toolbox is no longer up for debate" (p 136). By embracing and critiquing a plurality of sources — oral traditions, written accounts and science among them — scholars will produce richer histories of deep time.

Finally, there are lessons from the understanding of ancient traditions that can help us cope with the future, something that has typically been recognized with the study of traditional ecological practice in resource-constrained environments like islands (McMillen, Ticktin, and Springer 2017; Janif et al. 2016). Yet, as discussed above, many stories of islandization allow us to infer something of the trauma affected people felt, across tens of generations, as a result of continuous land loss, islandization, and perhaps even island shrinkage and loss, necessitating out-migration wherever possible. Today people on many (low) islands are experiencing similar feelings of trauma, unthinkingly exacerbated by generalized global narratives of vulnerability and legal barriers to out-migration (Kelman et al. 2021; Bordner, Ferguson, and Ortolano 2020). People are relocating in such contexts, something which is often wrongly considered as unprecedented and requiring novel solutions (McMichael and Katonivualiku 2020; Nunn and Campbell 2020). So it does help to know these things happened before and to learn that, while adjustments were needed, the affected peoples were able to adapt and eventually to endure (McLaughlin, Stoddart, and Malone 2018; Nunn 2020; Kelman 2020).

List of Figures

boxes represent the estimated minimum depths of coastlines reconstructed from the two groups of stories from which they can be assigned minimum ages.

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Figure 1. Map of the Wellesley Islands, southern Gulf of Carpentaria, Australia showing localized bathymetry (Nunn and Reid 2016) and the approximate distribution of the four Aboriginal groups occupying the area (after Memmott et al. 2006).

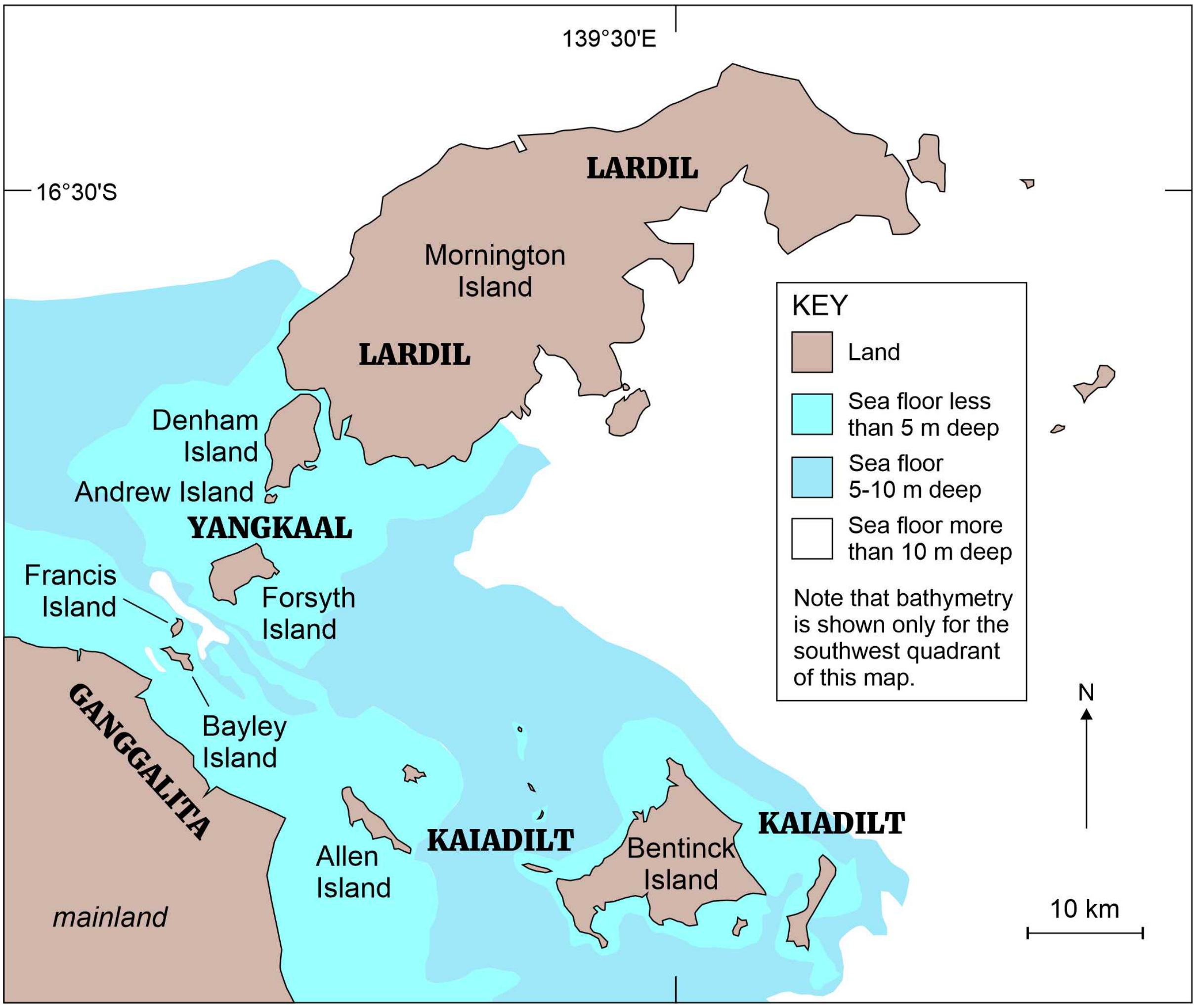

Figure 2. Map of the Fleurieu Peninsula and Kangaroo Island, Australia showing localized bathymetry (Nunn and Reid 2016) and the approximate distribution of the four Aboriginal groups occupying the area.

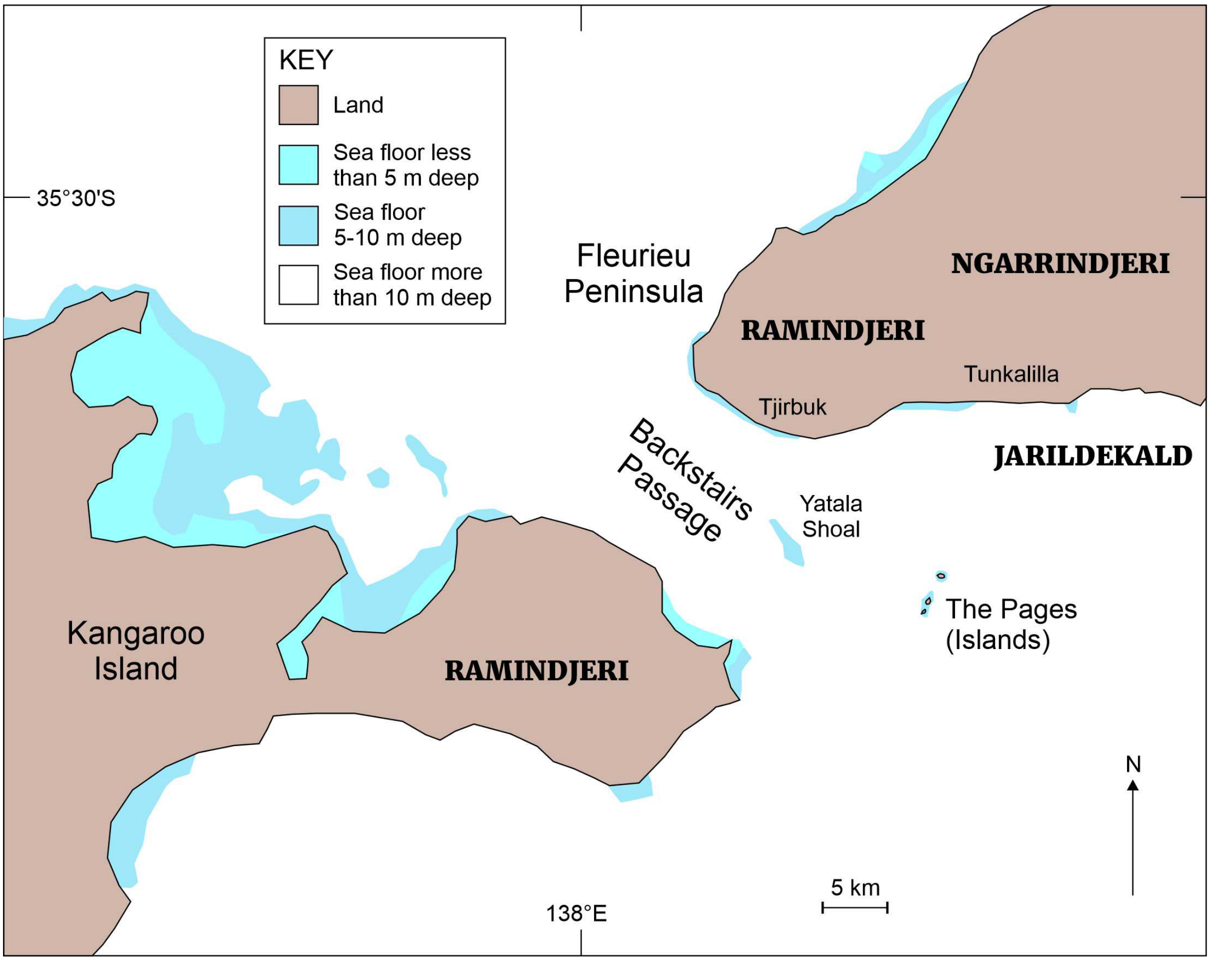

Figure 3. Postglacial sea-level change around Australia (after Lewis et al. 2013); the use of an envelope is to capture uncertainty. The shaded boxes represent the minimum depths at which the stories in the text about the Wellesley Islands and the crossing of Backstairs Passage could be true. Age ranges are calculated from the horizontal axis.

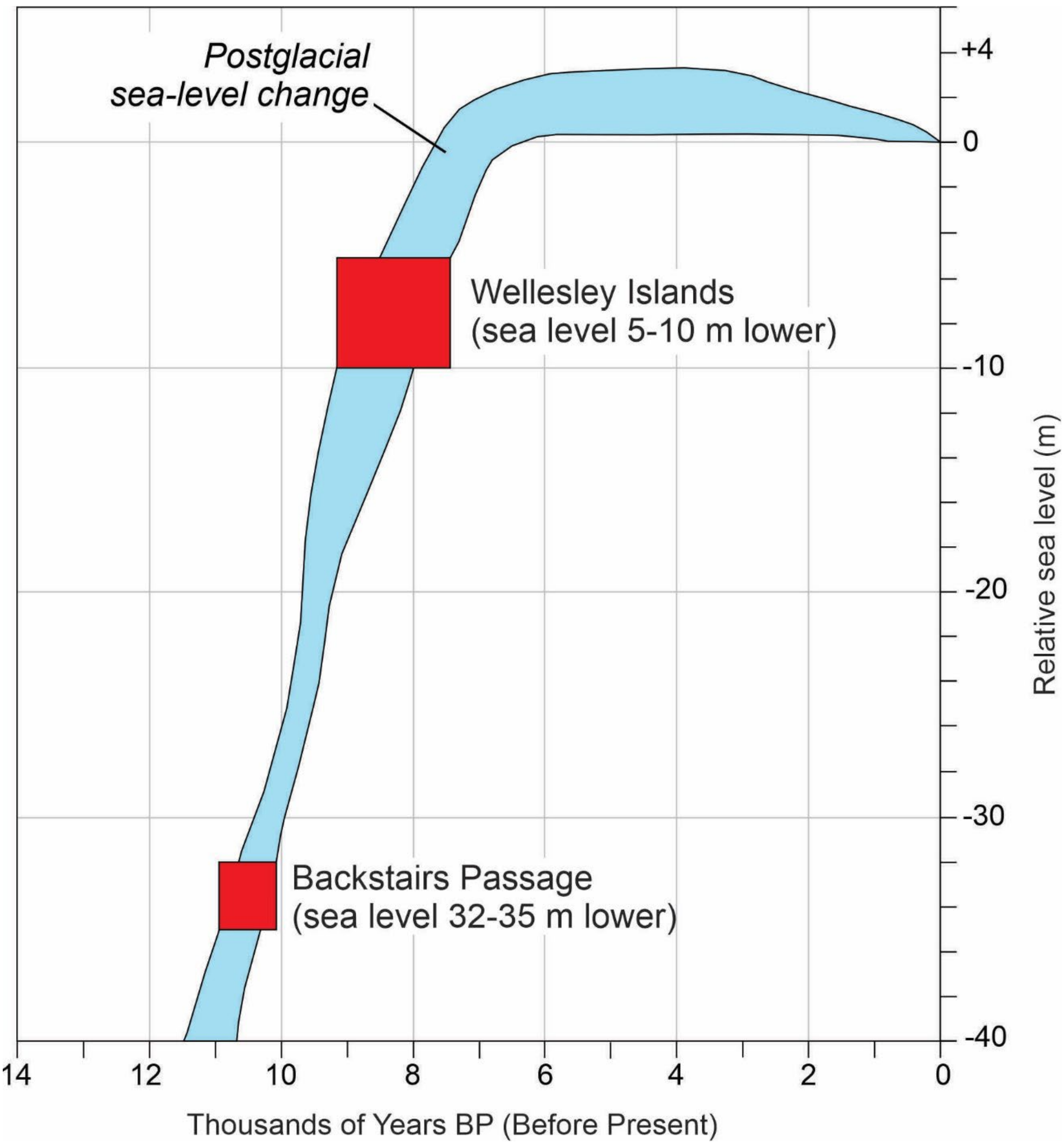

Figure 4. Map of North Uist, Outer Hebrides, Scotland, and nearby islands showing localized bathymetry.

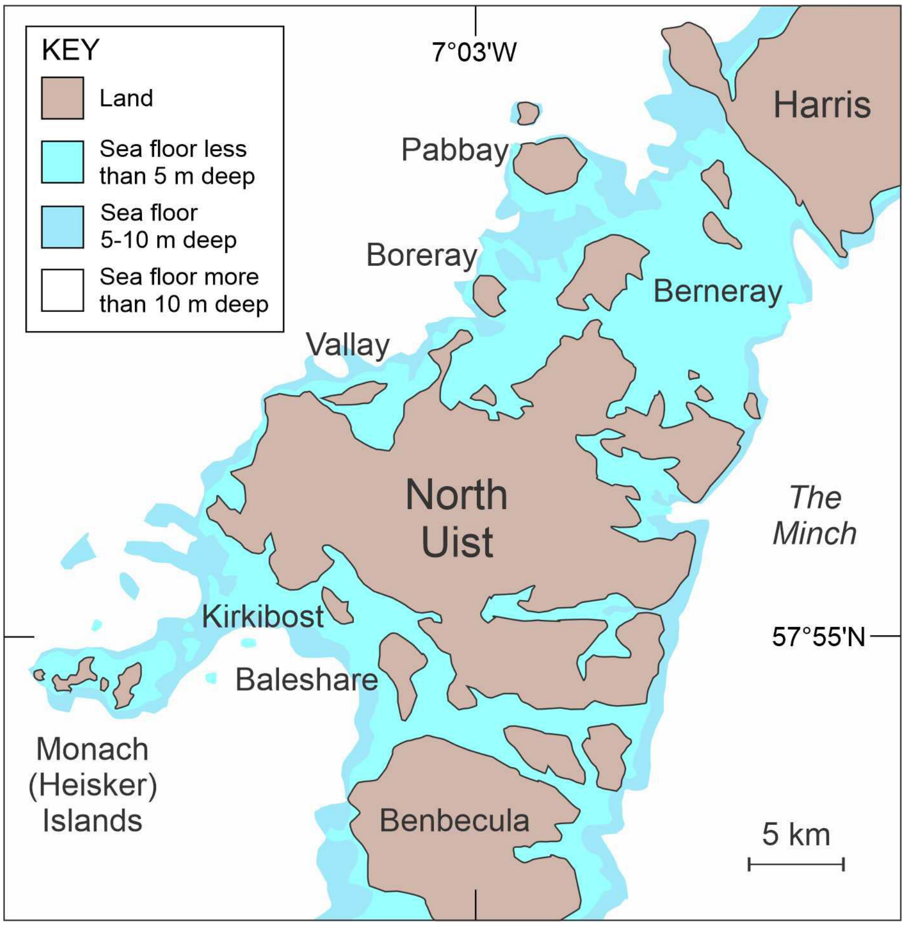

Figure 5. Map of the Channel Islands (Îles de la Manche) and the adjacent parts of France (mainland Europe) showing localized bathymetry.

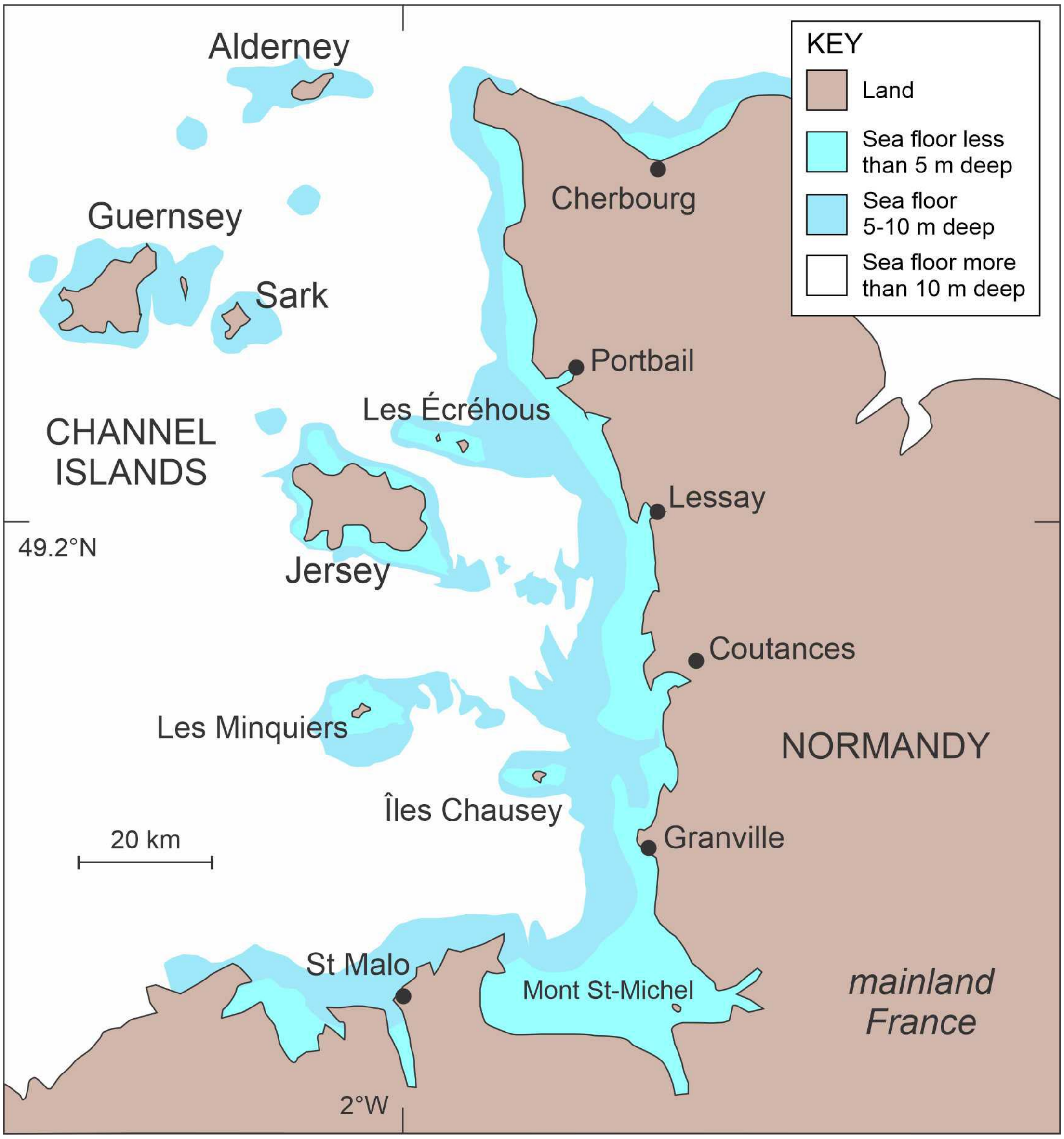

Figure 6. Sea-level change over the past 10,000 years for North Uist and the Channel Islands. For North Uist, GIA-based reconstructions come from Bradley (solid line) and Kuchar (dashed line) in Shennan et al. (2018); for the Channel Islands, the reconstruction is from the ICE-6G model of Peltier et al. (2015). Shaded boxes represent the estimated minimum depths of coastlines reconstructed from the two groups of stories from which they can be assigned minimum ages.