

*A short historical investigation into cross-cultural Australian ideas about
the marine animal group Teredinidae, their socioecological consequences
and some options ¹*

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Abstract: How are contemporary multicultural coastal Australians, Aboriginals and settlers alike, to develop wiser ideas and practices towards marine animals as well as each other? To illustrate the importance and complexity of this question, I offer a short historical investigation of some contrasting ideas and practices held by Australian Aboriginal and settler cultures about marine animals of the group Teredinidae. I present two “screenshots”: one from the period 1798-1826 and another from 1970-2012. The first period examines a negative but influential interpretation by Thomas Malthus of a cross cultural encounter featuring Australian Aboriginal consumption of local Teredinidae known as “cobra”. While this cultural tone remains largely unchanged in the second period, the biological understanding of the marine animals has developed greatly. So has awareness of the socioecology of Teredinidae: their estuarine habitats and cultural significance. Their potential role as subjects of community based monitoring is undeveloped but could serve overlapping concerns of environmental justice as well as the restoration and “future proofing” of habitats. Such a new composite of ideas and practices will rely on better integration of biology with community based social innovations. A symbolic beginning would be a change in Australian English colloquialisms for Teredinidae, from the erroneous “shipworm” or “mangrove worm” to the more accurate “burrowing clam”.

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(Photograph by Mary Gardner)

Introduction

Intimate knowledge of wild estuarine and marine animals, their lifecycles and their interrelationships has been a vital part of the culture and sustenance of every coastal human society for millennia (Roberts, 2012). Archaeologists are now re-evaluating the importance of coastal areas over inland ones as preferred habitats for anatomically modern humans. Early humans may have grown in numbers due to a good diet which relied on seafood, not only terrestrial meat. They may have migrated throughout the world along the coasts while exploring new sources of seafood. They may even have made their first adverse ecological impacts by over-harvesting coastal species such as shellfish (Mannino and Thomas, 2002).

Then, as now, humans mix lore with data to create guides for their practices in gathering, hunting, cultivating and interacting with aquatic animals, much the same as they do with terrestrial animals. These guides, bound together with a society's ethics and economics, become powerful with tradition, custom, taboo, law, science and religion. They are specific to places, helping create what Swyngedouw calls "socio-nature". He sees the result as "landscapes that are simultaneously physical and social... a restless 'hybrid' quasi-object in which material, representational and symbolic practices are welded together" (Swyngedouw, 1999).

More recently, Gu and Subramanian identify socio ecological production landscapes (SELPS), a term which also includes waterscapes. SELPS are centuries in the making, involve plant, animal and other species, and support local communities' material, social and spiritual needs. In their review, they explain they are not promoting "nostalgic traditionalism" but rather "innovative resource management ... that respects the needs and rights of local communities" (Gu and Subramanian, 2012).

The guides informing SELPS or other productions of socionature are based on what a group of humans hold as available facts. These in themselves are composites of observation and theory (Fleck, 1935). Some are apropos and others outmoded. In the present world of human migration and resettlement, of ecosystem degradation and collapse, of transition and reorganization, how to refresh and update the multicultural collection of guides held by humans currently residing in any locale? This urgent open-ended question relies on renewed and updated understanding of not only humans but animals. Also required is a living sense of the place itself, that unique awareness offered by geographic and biological context

To illustrate some of the complexity and importance in addressing this question, I offer a short historical investigation of some contrasting ideas and practices held by Australian Aboriginal and settler cultures about one group of marine animals, the Teredinidae. I present two “screenshots”: one from the period 1798 to 1826 and another from 1970 to 2012.

Screenshot 1798 to 1826

The contrasting ideas and practices held by Australian Aboriginal and British settler cultures about Teredinidae are vividly depicted in the written report by David Collins, published 1798. Collins was the judge advocate and secretary of the British colony known as Port Jackson, New South Wales, set in the Aboriginal land of Eora (now Sydney). As a member of a party exploring the Hawkesbury River, he meets with a “native and child” who flees, leaving “behind him a specimen of his food and the delicacy of his stomach; a piece of water-soaked wood (part of the branch of a tree) full of holes, the lodgment of a large worm, named by them cah-bro, and which they extract and eat; but nothing could be more offensive than the smell of both the worm and its habitation. There is a tribe of natives dwelling inland, who, from the circumstance of their eating these loathsome worms, are named Cah-bro-gal” (Collins, 1798).

This same passage was cited by Thomas Malthus in 1826. The third chapter of his sixth and final edition of “*An essay on the principle of population or a view of its past and present effects on human happiness*” is a survey of reports from around the world titled “*The lowest stage of human society*”. He ranks the “inhabitants of New Holland” (now Australia) as third from the bottom, barely above the “natives of van Diemen’s land” (now Tasmania) and the “wretched inhabitants of Tierra del Feugo”. He reconstructs the original passage from Collins. He includes the sketch of the incident and observations, using again key phrases such as “the delicacy of his stomach” and “a large worm”. He declares that the smell of the marine animal and its waterlogged habitation “was in the highest degree offensive.” Finally, he explains that this country is of such poor quality that its inhabitants are “driven to such resources for subsistence” (Malthus, 1826).

Concurrently, a scientific taxonomy of life was being developed by European scholars. The relationships among plants and animals were slowly clarified using observations and theories creating a tradition of taxonomy, which continues to the present day. In 1809, the French biologist Lamarck built on the groundbreaking work of the Swedish

taxonomist Linneaus with a more detailed classification of the latter's group Bivalvia, of the larger group Mollusca. His observations of his own dissections convinced him to support the theories about bivalve family groupings as proposed by Sellius, rather than Linneaus. This explained what were colloquially called "shipworms" were instead "burrowing clams" (Sigerfoos, 1897). Lamarck suggested a grouping titled Pholodoidea. By 1815, another French biologist, Rafinesque, further refined understanding of this group and proposed the term Teredinidae. This is the label still in use at the level of family (ITIS, 2012).

Since 1733, these "shipworms" were the centre of European scandal, when they were blamed for the catastrophic collapse of dykes in Holland. They were considered to be invasive species, brought by wooden Dutch ships returning from India (Sigerfoos, 1897). Differentiating all the species in the waters of Northern Europe was a painstaking task. The animals can be several millimeters to a metre in length. Juveniles must be distinguished from adults. The principal identifying characteristics include variations of small calcareous plates known as pallets and features of the calcium tubes lining the tunnels formed as the animals burrow through wet wood (Encyclopedia Britannica, 1911).

By 1928, a summary of Teredinidae off the British coast recognizes eleven species (Russell and Yonge, 1928). This fact would be the result of several generations of work by taxonomists and could not be known in the timeframe of this screenshot 1798-1826. Nor was it known that some species are global oceanic travelers while others are regional inhabitants or even more tightly restricted geographically.

Even by 1962, the global distribution of all species is still under investigation.

The species *Teredo navalis*, once labeled the foreign invader of Holland, is considered widespread in Northern Europe, North America, Japan, India and Philippines (Edmonson, 1962). By 2012, the Australian National System for the Prevention and Management of Marine Pest Incursions (NIMPIS) labels this particular species as invasive. A leading international species register states its origin as Northeast Atlantic (Harms, 1993). *T. navalis* may simply have taken advantage of the bonanza of wood used in 16th-17th century Dutch reclamation projects. They proliferated and then went globetrotting as stowaways in the hulls of the ships leaving the North Atlantic for other oceans.

Although the turn of 18th century Teredinidae taxonomy was nascent, Collins or Malthus do not indicate in their works any familiarity with these natural history issues of their day. They could not improve their understanding of their observations of Australian Aboriginals and this food item. Perhaps they avoided French authors as a matter of rivalry and patriotism. At the time, the new French Consulate was establishing itself after the French Revolution and Reign of Terror. Maybe the works were difficult to locate. But English specialists had access, as is illustrated by the reading lists of Charles Darwin, included recent French works and also works by Malthus himself (Darwin Correspondence Project, 2012).

While Collins and Malthus mislabeled these unusual clams as worms, they also expressed a disgust that may well have been influenced by their Christian religion. At the time, common practice considered insects and worms as prohibited foods. They may not refer to the exact passages of the Bible (Lev. 11:42, The King James Bible), but their strong judgmental responses could be considered in keeping with this precept. Bivalves were also prohibited (Lev 11:10) but this restraint was not generally practiced at the time.

For many reasons synergistic and untraceable, Collins and Malthus relied on only part of their culture's knowledge to frame their understanding of novel marine animals. Consequently, they missed opportunities both practical and theoretical. Collins writes that the colony experienced severe food shortages and relied on imported food from overseas. Even so, he rejects investigating this native foodstuff (Collins, 1798). Malthus was developing an argument that the foodstuff of the Aborigine "is so extremely scanty and the labour necessary to procure it so severe ... the population must be thinly scattered." (Malthus, 1826). But his portrayal of the Aboriginal socio ecological production land- and water-scapes is based on an uncritical acceptance of reports which, even by the state of knowledge at the time, were inaccurate and incomplete.

Screenshot 1970s to 2012

In Australia, during the 1970s, the Commonwealth Scientific and Industrial Research Organizaton (CSIRO) hosted Ruth Dixon Turner, from Harvard, whose primary specialty is Teredinidae. She worked as a team member surveying dozens of coastal sites around the country. They examined the colonization of artificial substrates the team had set in place as test plates for a certain period of time (CSIRO, 1972). The team did not record information about any investigations of specimens in "wild" settings or abundances "in situ" occupying substrates such as logs or trees. Although the investigative format of the report may have precluded wider discussion, there is no consideration of the species as a foodstuff.

About the same time, Turner wrote *Australian Shipworms* for *Australian Natural History*. In this review, she reveals the impetus for the CSIRO study as the "unexpected failures of wharves" in Bowen, Queensland and Port Huon, Tasmania. She also describes the delight of Northern Australian Aboriginals in response to her search for specimens. This time, the horror is expressed by Australian Aboriginals who are dismayed that their best offerings were not eaten but pickled in preservatives (Turner, 1971).

Turner went on to become the first woman professor to receive tenure at Harvard. On her webpage, the colloquialism for the Teredinidae is "termites of the sea" (Early, 2012). Although Teredinidae eat wood and could be considered to function in the aquatic ecosystem as do termites on land, this comparison is with the animal group Arthropoda, not Mollusca. It speaks of Turner's professional interest in the impact these marine animals have on boats, docks and other wooden structures. Among her extensive

publications, she lists a number of works identifying several new species and groups of Teredinidae unique to both New Zealand and Australia.

In 2011, Margaret Somerville, an academic researcher, and Tony Perkins, Aboriginal community activist, published *Singing the Coast*. This bicultural study shared knowledge used by the Gumbaynggir, the coastal Aboriginal group in which Perkins was raised during 1950s-70s. The group lived in an area called “No Man’s Land” (near Corindi Lake and Red Rocks, New South Wales). For food, they relied heavily on harvesting local marine and freshwater animals and plants. Cash for supplemental goods such as flour, sugar and tea was sometimes raised by seasonal work and small enterprises such as selling beach worms to tourists (Somerville and Perkins, 2010).

Teredinidae feature in the section *River* of chapter four, *Eating place*. They are called “cobra or sea worm”. The reported oral histories describe in great detail the practices of “the Old People” in locating and harvesting these marine animals. Although highly prized, they are not often found in recent times because the best locations are now private property, fenced off from “No Man’s Land”. Procedures are given for their preparation and use “raw or cooked or used as medicine” (Somerville and Perkins, 2010).

The detailed descriptions of variations in cobra habitats, appearance and taste, may be indicative of age, condition, water pollution or even different species. But these distinctions cannot be drawn from the text. Given Turner’s identification of several species unique to Australia, there may be a correlation with certain species, environmental conditions, seasons and taste.

Somerville notes that that the Gumbaynggir have a special affection for cobra as a cultural food “because whites do not eat it”. She writes, “I can’t even imagine eating them, let alone the taste” and asks one of her interviewees for a description. He says, “no taste for it really – you can taste a little bit of salt in ‘em, not that much though, gotta little bit o’ wood taste in ‘em, in the woods all that time you can taste that bit of wood in ‘em” (Somerville and Perkins, 2010).

In 2012, I was a member of a predominantly Australian settler audience at a screening of the film *Our Generation*. This documentary film by Sinem Saban & Damien Curtis is described on the website with urgent words: “Australia’s First Peoples are fighting for freedom. ‘Our Generation’ is their call to the nation, a fresh and unflinching look at unresolved issues, driven by the Yolngu of Northeast Arnhem Land” (Our Generation, 2010). In one scene, a Yolngu woman harvests from a log a “mangrove worm” and eats it raw. Suddenly, the silence in the hall was broken by groans, gasps and nervous laughter from a large proportion of the audience.

The film is now being promoted for use in schools. Both curriculum study guides available on the website makes special mention of that same scene in the film. In the text, the marine animal is described as a “mangrove worm” (Lewis, 2011).

Discussion

The more recent screenshot echoes key features of the historical one. Then, social commentators who were specialists in law (as was Collins) and in mathematics (as was Malthus) assessed humans, animals and place without drawing on any contributions from biology. In the past few years, social commentators in the roles of academic writer and documentary filmmaker, observe the longstanding practices of Australian Aboriginals yet again without the insights of basic taxonomy. The Yolngu and Gumbaynggir involved with the commentators use colloquial English terms such as “mangrove worm” and “sea worm”. No one is using the label “burrowing clam”.

Teredinidae and Social Justice

The contrasting visceral reactions of Australian Aboriginal and Australian settler cultures are surprisingly consistent over time. Set in the 21st century contexts of both “Australia’s First Peoples fight for freedom” and Australian Reconciliation, the continued use of an inaccurate colloquial English phrase for Teredinidae may be an unexpected issue involving social justice. In Australia, cultural diversity is celebrated nationally by sharing different foods during a festival day called “A Taste of Harmony”. Although recipes on the official website are public contributions rather than representative selections, there are two recipes for seafood curries. They suggest fish or different shellfish such as pipi (*Donax* species) may be used (A Taste of Harmony, 2012). Pipi are well known to be clams. Cobra, sea worm or mangrove worm are not mentioned as alternatives, although Australian Aboriginals do use them for curries. Somerville and Perkins record such a recipe (Somerville and Perkins, 2010).

Perhaps this omission represents a genuine gap in the understanding of multiculturalism. This could be addressed by replacing a colloquialism. Such a change in language is an exercise in re-framing that is used by many social justice campaigns throughout the world.

Teredinidae and Environmental Justice

The abundance and health of Teredinidae as well as free access by Australian Aboriginals and others to populations unaffected by pollution may also be seen as an issue of environmental justice. Now, the Anglican Church, (of which Collins and Malthus were members), and many other Protestant religious organizations discuss ethical eating and environmental justice. Of special interest is a study guide produced by the Unitarian Universalists Association. Environmental justice is said to be “like other social justice movements ... that focus on structural oppression”. In the section *Trade and Neocolonialism*, this religious group explains links between globalization and poor health of “indigenous and poor populations who lack access to traditional hunting, gathering and farming lands ... [who] must resort to foreign diets ... [which] lead to nutrition related diseases” (Unitarian Universalist Association, 2010). This may be a

contributing factor to the poor health of Australian Aboriginals, who are still the least healthy sub-population in the country (Thomson, 2012).

Teredinidae and Uncultivated Biodiversity

The Teredinidae could be seen as members of a range of uncultivated biodiversity, a term introduced by Mazhar et al. This phrase describes “uncultivated plants and animals [that] constitute a prominent place in local food systems” such as those they studied in Bangladesh and India. These supply 65% of the food weight for the landless very poor and 34% for better-off landed households. Through use, harvest and translocation, these foods may be tended in ways that so contrast with agricultural management that they are altogether overlooked as a practice (Mazhar et al., 2007).

Turner reports a reference from 1866 by N. Taylor, describing “an incident of acclimatization by natives” in which a colony of temperate burrowing clams called “warragara” was translocated from Genoa to grow as new source of food in the Snowy River (Turner, 1971).

More written information about care of Teredinidae by Australian Aboriginals across the country is hard to find. Gammage has published an extensive work cataloguing the many ways Aboriginal society deliberately managed the entire Australian landscape as a SELP. He lists many examples in which landscapes were modified to enhance the habitats of selected species and meet their special requirements (Gammage, 2011). But he admits locating historical information about coastal and marine practices is difficult (Gammage, 16 July 2012, personal communication). Perhaps there is time to collate this practical knowledge that may still be held and used by different groups of Australian Aboriginals who still eat Teredinidae.

Somerville and Perkins describe the loss felt by Gumbaynggir when Australian settlers' fences were erected along “No Man's Land”, closing waterways to foraging walks. (Somerville and Perkins, 2010). This notion of private property together with practices of clearing of logs from waterways and draining wastes into estuaries, work against this specific Australian Aboriginal use and maintenance of uncultivated biodiversity. These same practices are also increasingly understood as environmental degradation, detrimental to the geographic and biological place itself. These Australian settler ideas and practices are working against the basic interests of both Australian Aboriginals and settlers themselves.

Teredinidae, Food Security and Future Proofing

In the 1970s, biological research of Teredinidae was framed as investigations leading to control of a major marine pest or at least mitigation of its impacts. When Turner wrote about their populations, abundance and lifecycles, she recommended periodic sampling of the plankton so as to achieve an “estimate of ‘spat-fall’”, helping “sound prediction “ in advance of an ‘attack in an area’”. She speculates about the role of marine bacteria or

fungi. She wonders if they hinder larval settlement as test plates frequently held few specimens even though nearby wharf pilings were inhabited by adults of various species. Perhaps the “ultimate control” may be possible by preventing “the attachment of certain bacteria to the wood surface” (Turner, 1971). Was she advocating for a future bio-control rather than more use of toxic chemicals that kill indiscriminately?

But if biological research is framed as investigations in a “wild fishery”, the conservation of “ecosystem engineers”, or the monitoring of “indicator species”, more than simply language changes. A species is described as more or less productive, succeeding or failing in colonizing new areas. It is seen as efficient or disabled in delivering ecosystem services. It acts as an alert to dangers or a signal of wellbeing. These heroic tones influence researchers, funders, legislators, industry and the general public. They set into motion different types of investigations and actions that have ripple effects throughout the socioculture. The local SELPs can be influenced, revived or created anew. In coastal contexts, this has the potential to rework relationships among humans and marine animals.

Consider Turner’s suggestions about monitoring inshore zooplankton. Australian scientists contributing to the government’s Marine Climate Change 2009 Report Card explained the urgency of long-term marine plankton monitoring (Richardson et al., 2009). By the next Report Card in 2012, a national coastal plankton monitoring programme utilizing a network of survey stations was underway and planned for perpetuity (Richardson, 2012). Important as is this development, there is still a need for small scale inshore and estuary monitoring. The distribution and abundance of Teredinidae would be only one of a number of species that could be better understood with such localized long term monitoring.

Teredinidae could be seen as one foodstuff in a wider network of food security or as part of future proofing coastal areas. This view could spark a new line of not only academic or government research but community based citizen science which meets traditional Aboriginal practice as equals. Field identification might include matching species and habitats with tastes. Practices that encourage larval settlement, establish species in waterways, easily evaluate spat-fall and track the ranges of species over seasons would become useful local knowledge. The creation and maintenance of this knowledge could also be new employment in communities, in partnership with universities or with stand-alone independent organizations.

Of course, damage by Teredinidae to wooden coastal structures will still be a concern. But the monitoring that Turner proposed could perhaps inform opportunities for enhancement as well as signal attacks. It could also distinguish between the species, which may not all equally destructive. To be able to target local knowledge and actions as required for multiple uses and concerns would be a wiser practice.

Developing new guides to practices about Teredinidae must also account for presently unrealized ecological and symbolic uses as well as nutritional ones. Another species of bivalve, *Lithophaga lithophaga*, also known as date shells, range throughout the coastal Mediterranean. They also look like long worms, living as they do by boring tunnels into

coastal rocks. Years of over-harvesting damaged the physical shore as well as the local ecologies to such an extent that the species are now under EU protection (Appendix II, 1979). Nostalgic recipes describe cooking them in a broth of white wine, garlic and parsley. More about the socio-ecology and history of this species is beyond the scope of this paper. But every example of the changing significance of marine species is both a caution and an encouragement as multicultural settlers revamp their guides and practices in new places.

Valuing the Teredinidae as sources of uncultivated biodiversity, famine foods or ritual meals is a small socio-natural change. But in synergy with other new perceptions of local ecologies, more Australians across all groups in society may act on improving water quality and flow. They may also adjust riparian and in-stream management to leave wood in the water and remove fencing.

Conclusion

The current global transitions of climate and shifts in the ranges of many species including humans are creating a new socionature. Recognizing the histories of multicultural guides and adding multigenerational aims such as future proofing are a challenge. Considering the past, Gammage describes some Australian Aboriginal corroborrees as collective environmental management decision-making forums. Roles and responsibilities were not simply based on personal gain. For instance, caretakers of certain species were not to eat them (Gammage, 2012). Looking to the future, Daniel Pauly, a marine fisheries biologist with a long experience in artisanal and industrial fishing, speaks of the need for humans to create a third “operating system”. By analogy with computer programming, he suggests the third way can supercede both an earlier magical thinking system as well as the later overly arrogant industrial one (Pauly, 2009). This new way may be a path humans “lay down in walking” (Machado, 1987). The vital contribution that biology offers needs to be integrated in practical community-based social innovations. Such creation of knowledge and action must stay close to ethics informed by environmental justice. In many places of coastal Australia this would be an important change, however radical at first glance.

Singing the Coast concludes with a chapter *Spirits in places*. Tony recalls how his elders let their traditional initiation ceremonies lapse. As a young man, he undertook a different “process of initiation in the ways of the contemporary world” and finally “came back and gave birth to new forms of cultural transmission” (Somerville and Perkins, 2010). His group’s experience of resurgence after collapse may be a model for Australian multicultural coastal people. Mindful of both past and future, including a wider range of facts as knowledge, both Australian Aboriginals and Australian settlers may yet develop wiser ideas and practices towards marine animals as well as each other.

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Appendix: An observation on the availability of images and other taxonomic information about Teredinidae on the World Wide Web

Traditionally, taxonomic work of marine animals prepared for publication would include a detailed drawing of the species(s), highlighting the identifying characteristics, a view “in situ” and/or in lab and a labeled dissection. A less technical paper would include a photograph of the animals. Sometimes drawings or photographs of the habitat are also included. Further the purposes of this paper, I experimented accessing the World Wide Web for images and information by using the most popular search engine (Google) and three key words (“Teredinidae”, “Australia” and “cobra” in various combinations). Information suitable for understanding local species of burrowing clams, their ecology and monitoring is not easily available. In addition to sites mentioned in the references, some information and trustworthy images are found at the following three websites.

- Encyclopedia of Life: <http://eol.org/pages/2233/overview>
- Man and Mollusc:
http://www.manandmollusc.net/advanced_introduction/moll101pelecypoda.html
- Atlas of Living Australia: <http://bie.ala.org.au/species/TEREDINIDAE>

This quick check-up highlights the great potential of the Internet as a resource and nexus for institutional specialists and community-based science workers. But it also presents the limitations of material online to date. In particular, the Atlas of Living Australia is a foundation which could be important nationwide but it requires adaptations and participation from science workers, specialists or citizens, who live in specific places. One such example is the Bermagui NSW project Atlas of Life in the Coastal Wilderness www.alcw.org.au/. The community group is at the start of a ten-year programme. At this stage, the emphasis is on identification rather than monitoring.

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