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## *The Role of Traditional Knowledge About and Management of Seaworms (Polychaeta) in Making Austronesian Worlds*

Written by Cynthia Fowler (Wofford College) and Presented at the Society for Applied Anthropology Meeting on March 30, 2016

\*Highlighted text indicates points in the presentation when the PowerPoint slides advance.

### *INTRODUCTION*

In this presentation, I discuss traditional ecological knowledge about seaworms in Kodi culture and describe traditional resource and environmental management of seaworm swarms and swarming sites on Sumba Island in eastern Indonesia. My main purpose in today's presentation is to demonstrate how Traditional Ecological Knowledge (TEK) and Traditional Resource and Environmental Management (TREM) are potentially practical frameworks for contemporary sustainable resource use and Indigenous wellbeing. In this presentation I focus on human interactions with seaworms in order to illustrate that TEK and TREM are associated with ecological sustainability and the wellbeing of Indigenous peoples. The Indigenous peoples whose TEK and TREM I describe here in this presentation are the people who self-identify as "Kodi." The Kodi live on the west end of seasonally-arid Sumba Island in the monsoonal Eastern Indonesia Northern Australia (EINA) zone.

### *DATA SETS*

In this presentation, I will point to three valuable types of data that could help answer questions about the endurance of TEK and TREM and that could facilitate applied research in the face of accelerated changes in marine ecosystems: 1) the state-of-the-science on polychaetes globally and in the seas surrounding Sumba, 2) TEK about seaworms and TREM of seaworm swarming sites, and 3) the spatiotemporal contexts of human-seaworm relationships. I'll discuss these in reverse order.

#### 3) Spatiotemporal Context of Human-Seaworm Relationships

The relationships between humans and seaworms in the Indo-Pacific and Pacific regions have deep historical roots as evidenced by the Austronesian societies who, throughout these regions, express the value of seaworms in similar ways. Bold manifestations of the value of seaworms in Austronesian cultures are found in linguistic and ritual practices.

#### 'Seaworm' Taxonomy

Linguistic patterns related to 'seaworms' in the Indigenous languages of the Austronesian world reflect ancient trade, migration, and settlement patterns. While patterns are not evident at the Language Family scale – no single ancient term and its cognates span the entire Austronesian Family – smaller clusters of languages contain cognates.

'Seaworms' has cognates at the level where Sumba's languages cohere into a Language Group. (Table 1) *Nale* or *nyale* is the term for 'seaworms' in at least 5 of the languages in western and central Sumba: Kodi, Bukambero, Wejewa, Wanokaka, and Laboya. *Nyeli* or *ngeli* is the variant in Kampera, the language spoken by the majority of people in eastern Sumba (Gregory Forth, personal communication). Sumba's 8 languages belong to the Sumba Hawu subgroup of the putative CEMP group of the Malayo-

Polynesian branch of the Austronesian Family. The Sumbanese languages are supposed to have all descended from ancient Proto Sumba and, prior to that, from Proto Macro-Sumba, which descends from Proto CEMP and PAN (Blust 2008; Norquest and Downey 2013). The roots of *nyale* are in Proto Sumba.

The most widespread term for ‘seaworms’ in the Austronesian language family may be *palolo* and its cognates. Kirch and Green (2001) call *palolo* “one of the most intriguing terms in PPN” (Kirch and Green 2001:100). Seaworms are known as “*palolo*” or one of its cognates in Fiji (where the cognate is *balolo*), Futuna, ‘Uvea, Tuvalu, Tokelau, the Cook Islands, the Society Islands, Tonga (the cognate is also *balolo*), Samoa, French Polynesia, Hawai’i, and perhaps additional locations. *Palolo* is an ancient term that was in the Proto Central Pacific (PCP) lexicon that preceded PPN, and that survives in contemporary Oceanic languages. *Palolo* serves as linguistic evidence for reconstructions of ancient human migrations across Oceania (Kirch and Green 2001:100).

At the sub-family level of CEMP languages in Eastern Indonesia and EINA, ‘seaworms’ do not exhibit similar consistency and therefore do not evidence historical linguistic connections. While *nale* or *nyale* is also the term for seaworms among Sasak speakers on Lombok (Eklund 1977) and Tongo villagers in northwest Sumbawa (Welker 2009), distinctly different terms found elsewhere in Eastern Indonesia: *wawo* and *laor* in Ambon; *oelie* or *oelie* on Banda; *mechi* in the Austronesian Tetum language of East Timor (Palmer and de Carvalho 2008); and *mechi boot* in the Papuan Fataluku language spoken in East Timor (McWilliam 2006). The lack of consistency across languages supports doubters who question whether CEMP is a valid clade of the Austronesian Family. The variety of terms for seaworms in EINA and Eastern Indonesia languages, instead, reflects the non-Austronesian/Papuan origins of many Indigenous languages and, more generally, the great ethnolinguistic diversity in this geographical region.

#### Seaworms in Traditional Calendars

Seaworms appear in the traditional calendars of many Austronesian societies. The names of some months refer to seaworms in all of the Sumbanese languages, in East Timor’s Tetum, native languages on Ambon, and Futuna, and more. In contemporary Kodi, one season and three months contain the local word for seaworms (Table). The month names are *Wulla Nale Kiyō* (Little Seaworms Month), *Wulla Nale Bokolo* (Big Seaworms Month), and *Wulla Nale Wallu* (Return of the Seaworms or Last/Final Seaworms Month). The new year begins when Little Seaworms Month commences.

This practice of naming units of time after ‘seaworms’ and using seaworm swarming behaviors as temporal cues is evident in ancient calendars – further supporting the proposition that the strong cultural value for seaworms has deep historical roots. The cross-cultural, cross-regional tradition of naming units of time according to when the seaworms swarm may stretch back to PAN. Indigenous terms for ‘seaworms’ continue to be used to identify “lunar [months] in the calendric system[s]” (Kirch and Green 2001:100) of some contemporary Polynesian languages, CEMP, and Papuan languages.

#### Seaworm Rituals

Seaworm gathering is ritualized in many Austronesian communities. Among the numerous islands whose inhabitants perform rituals when seaworms swarm are Sumba, Lombok (Eklund 1977), Sumbawa (Welker 2009), Ambon (Pamungkas and Glasby 2015), East Timor (McWilliam 2006; Palmer and de Carvalho 2008), Savu, Roti, Fiji, Futuna, Gilbert Islands, Tonga, Samoa, and elsewhere in the Eastern

Pacific (Kirch and Green 2001). In western Sumba, East Timor, and Ambon people perform seaworm rituals in January, February, March, and/or April (McWilliam 2006; Palmer and de Carvalho 2008; Pamungkas and Glasby 2015; Radjawane 1982; Rumphius 1705). In the western Central Pacific and into Eastern Polynesia, communities (e.g., in Fiji and Futuna) perform seaworm rituals in September, October, or November.

## 2) TREM of Seaworm Swarming Sites

### a. *The Basics of Seaworm TREM and Key Points Supporting Argument that TREM is Sustainable*

Where the gathering of seaworms is ritualized, such as in Kodi on Sumba Island, people have embedded marine conservation mechanisms into the relationships they have with polychaetes. Traditional forms of governance (*adat* in Indonesian, or *patana* in Kodi) structures Kodi people's interactions with seaworms and their activities at seaworm spawning sites. Two Seaworm Priests --- the two highest politico-religious figures in Kodi's Indigenous Marapu religion -- oversee TREM related to seaworms, and they possess the most specialized TEK related to seaworms.

TREM rules permit seaworm harvests from the tidal reefs at only one or two specific locations (Halete and Tossi) on only one or two specific days of the lunar year (6-7 nights after the full moons of the Return of the Seaworms Month). People are prohibited from harvesting seaworms from those reefs on any other days of the year. The harvest taboos are backed by the belief that people who gather seaworms at non-sanctioned times will be bitten by the *bangga marapu* (spirit dogs) who guard the seaworm spawning sites. Conservation mechanisms -- these few examples and others -- could be translated into formal regulations for governing the reefs if their protection were recognized by more powerful neo-colonial governmental offices.

Although Kodi people do not use the rhetoric of cultural and environmental politics when they talk about their TEK and TREM related to seaworms, some other communities in the Indo-Pacific and Oceania regions promote the ritualized gathering and consumption of seaworms as examples of sustainable traditional resource management (Palmer and Carvalho 2008). But the sustainability of harvesting practices is uncertain, and probably varies depending on the location and species in question. Mining officials, in an attempt to deflect blame for their own environmentally destructive practices, according to Welker (2009), accuse villagers on the neighboring island of Sumbawa of overharvesting *nyale* nearly to the point of extinction, and damaging coral reefs through the use of destructive techniques for harvesting fish, octopus, shellfish, and seaweed.

Populations of some seaworm species may indeed be diminishing. One species whose populations are suspected of being depleted by human predation is *Palolo viridis*, which occurs in Indonesia's Lesser Sunda Islands, Samoa, American Samoa, Rarotonga, Kiribati, Fiji, the Solomon Islands, Vanuatu, Papua New Guinea, and elsewhere. The IUCN Redlist shows palolo as a Threatened species, but IUCN qualified this designation with a statement about insufficient data that prevents certainty about its status. The tentative listing is based upon evidence from Samoils and Carlos (1990) who found that overconsumption may have caused local extinction of the species on Samoa's Upolu Island (World Conservation Monitoring Centre 1996).

So some communities' traditional ecological management systems do include mechanisms to regulate harvests that would hypothetically prevent the depletion of species. The traditional resource management system in communities like Kodi may be examples of a sustainable systems, but the science to support that proposition is not available yet.

### 3) State-of the Science on Polychaetes

#### a. Globally

What is the state of the science on polychaetes?

Polychaetes inhabit benthic/seabeds and pelagic/open water; salt brackish or fresh water; oceans, estuaries, lakes and rivers; mud and sand; hydrothermal vents and cold seeps (Glasby and Fauchald 2007; Read and Fauchald 2015). Polychaetes “are one of the most commonly encountered and abundant animal groups in the benthos of coastal regions” (Glasby and Fauchald 2007:n.p.). Polychaetes are also found in coral reefs, fore-reefs, back-reefs, reef slopes, tide pools, seagrass beds, lagoons, and mangroves.

The **Polychaeta Class** includes 82 families (Glasby and Fauchald 2007), and about 1,000 genera. The Polychaeta Class has about 1,000 genera and 13,000 species that have been identified thus far; potentially thousands more species likely exist, but have not yet been identified (Halanych, Cox, Struck 2007). Seventy-eight taxa of polychaetes are known from the Indo-Pacific region alone (Glasby and Fauchald 2007).

The Polychaeta Class is divided into the Subclass Sedenataria, whose members are tube dwellers, and the Subclass Errantia, whose members are free swimmers. Some of the diagnostic features of polychaetes are segmentation, parapodia (flat outgrowths), chaetae/setae (small, moveable bristles, and the source of the name “Polychaeta” meaning “many bristles”), and tube construction. Head morphology is another diagnostic feature with the character of the antenna and the palps – which are sensors – serving to identify species. Because polychaetes are so diverse, however, many taxa have modified or no segmentation, parapodia, and/or chaetae, and many do not produce tubes. Some polychaete species are as long as 3 meters (10 feet) and some species are as short as 0.1 mm (0.004 inches).

At least 18 families in the Polychaeta Class swarm when they breed, including the **Eunicidae, Nereididae, and Syllidae** (Pemungkas and Glasby 2015). Combined external and internal mechanisms prompt marine taxa to swarm and thus coproduce the temporality of spawning. Mercier and Hamel (2015:107) list “temperature...lunar irradiance...lunar photoperiod...tidal levels...seasonal photoperiod...and twilight chromaticity” (Mercier and Hamel 2015) as the documented external circadian and circalunar mechanisms associated with mass spawning. Among the internal mechanisms that regulate polychaete spawning is the endocrine system (Australian Museum n.d.; Wu 2014).

The specific timing of polychaete spawning varies depending on location (**Table**). Variations in the “annual, seasonal, monthly, and daily” cycles (Sweeney et al. 2011:770) of polychaete spawning occur across space and even in the same space across time. The variations may depend on the Moon’s phase, day length, seawater temperature, solar radiation, light:dark cycles, photosynthates from zooxanthellae, and cryptochrome cycles (Sweeney et al. 2011) at specific sites. I wonder if human activities have any effects on spawning patterns, or if they will at some future point in the Anthropocene?

Like scientists, Kodi recognize the effect of the Moon on the reproductive ecology of seaworms. Among other things, the Moon signifies to the Seaworm Priests when the seaworms will swarm. Both scientists and Kodi observe that seaworms begin swarming at dusk on the nights after full Moons. As a rule of thumb, Kodi say the swarming occurs six or seven nights after the full Moons of the seaworm months, and so that is when the ritual gatherings take place in Kodi. The full Moon of the Return of Seaworm Month marks the start of the counting of nights until the **seaworm pilgrimage** occurs to the Kodi region’s

reefs. The exact number of nights after the full Moon remains a question the Seaworm Priests are tasked with predicting each year. In 1998, the maximum illumination of the Moon was on 13 March and the ritual seaworm harvest took place seven days later on 20 March at Halete Beach. Then, the Moon was 22 days old, in its waning gibbous phase, and 59% of the half facing Earth was illuminated.

*b. In the Seas Surrounding Sumba*

Studying human-seaworm relationships causes me to seek information about the polychaete species that inhabit the oceans surrounding Sumba Island. Several ocean research expeditions have collected seaworms in the waters around Sumba. (Table) Still, our knowledge about seaworm species that occur around Sumba is incomplete. Some of the polychaetes that have already been collected from the waters near Sumba have not yet been identified, and some polychaete families that are suspected to occur in the area have not yet been collected (Christopher Glasby, email communication 2016).

*APPLICATIONS TO SCIENCE and POLICY*

1) APPLICATIONS TO SCIENCE

A potential application of the anthropological data is to provide information about polychaetes to marine biologists who are conducting species inventories. The ethnographic data includes information about where and when seaworms swarm. The locations and times of seaworm rituals coincide with seaworm swarmings. The ethnographic information contributes information about spatial variations in swarming times, globally, regionally, and locally. This information will help scientists learn more about the range of reproductive behaviors in seaworms (how much variation exists at the global level in reproductive swarmings) and also the multiple factors that cause seaworm swarming (by examining the conditions [water temperatures, tide levels, currents, water composition and quality, etc.] that exists in specific locations and comparing them in different sites).

2) APPLICATIONS TO POLICY

The integration of anthropological data about human-seaworm interactions with information about seaworms from marine biology, and about changing marine ecosystems from other disciplines could be applied to constructing equitable management programs for seaworm swarming sites that could maximize the potential for sustaining seaworm populations at levels where they could continue contributing to the biophysical, emotional, and cultural wellbeing of Kodi people in the face of accelerated environmental change.

Anthropological information about traditional ecological knowledge combined with scientific data about polychaetes could be used to support the establishment of traditional resource management parks and marine conservation areas at seaworm swarming sites. The TEK and TREM that Kodi people have about polychaetes is both inherently valuable and also could potentially be used in the conservation of corals, polychaetes, other reef species, the reefs themselves, and ocean ecosystems farther from shore.

Based on the results of research about TEK and TREM related to seaworms in Kodi, the most urgent action needed is to protect seaworm swarming sites from being commodified by prohibiting their development for non-traditional purposes. Disallow the sale of all seaworm swarming sites on the island. Halete is for sale now. Remove Halete from the real estate market. Grant perpetual ownership and management rights to the communities who manage seaworm swarming locations as sacred places and ceremonial sites, and who collect resources from the reefs for ritualized consumption. Enable local people to formalize sustainable resource management regulations for those sites.

Government officials in local resource management and property services offices can optimize community wellbeing by applying *adat* (traditional) tenure systems to seaworm swarming sites, and by recognizing the Marapu beliefs and practices that shape traditional resource and environmental management. The protections and regulations need to enable the “traditional” and “Indigenous” systems to continue functioning so that people and seaworms – and all of their companions in the multispecies land- and sea-scapes – can continue co-evolving within the context of their rich ecological inheritance.

### *CONCLUSION*

A contemporary ethnobiological portrait of human-seaworm communities placed within its historical context provides a framework for producing a rich understanding of TEK and TREM systems and processes. For a very long time – perhaps 4875 years for the Austronesian component of island populations (Lansing et al. 2007) and much longer for the Papuan component – Sumbanese have been constructing their cognitive worlds as well as their biophysical landscapes whilst interacting with many other species – not only with seaworms, though they are the focal other species here in this presentation. For many generations, human-seaworm interactions have been crucial forces in the construction of landscapes and cultures on Sumba.

Human-seaworm-multispecies communities on Sumba nowadays face many threats. Land grabbing (a new-ish, very impactful process now occurring on Sumba) threatens traditional tenure regimes, resource management regimes, and access to cultural keystone species. To name just a few problems facing human-seaworm interactions: Overexploitation from commercial fishing threatens to reduce marine biodiversity. Global warming threatens to change marine habitats. If seaworms populations declined or breeding practices changed because of anthropogenic and climatic processes, seaworms breeding patterns could alter, TEK and TREM could shift, and the human-seaworm bond would change (but, then again, that is nothing new....it was never static).

Polychaete biology records the incredible diversity and fascinating behaviors of these marine fauna. Ethnographic evidence shows that seaworms continue to be crucial for the wellbeing of contemporary communities in the Indo-Pacific and Pacific. Historical linguistics and colonial documents attest to the deep history of the human-seaworm bonds. Why does TEK and TREM related to seaworms endure on Sumba? Why might it decline or perish, and how could we attempt to prevent its dissolution?

TEK and TREM endure on Sumba because people continue to believe in and practice the Indigenous Marapu religion, because Marapu followers have had continuous access to and have continuously collected resources from seaworm swarming sites, and because seaworms continue to breed on the island’s tidal reefs. All three of these conditions are tentative. None of them is guaranteed for the future.

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