

Fall of Easter Island Civilization and Toxic Prion Exposures

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Environmental man-made disasters due to physical interventions have been proposed as a cause for the fall of civilizations due to declining resources. Among them, the fall of the Chilean Easter Island civilization in the southeastern Pacific Ocean is well recognized.

Polynesian inhabitants arrived on the remote Easter Island (Figure 1) around 1200 AD according to carbon dating studies, where the nearest inhabited land is over 2,000 kilometers away. Early Easter Island inhabitants were distinguished for carving and transferring over 900 monumental statues, Moai, (Figure 2) with rather primitive instruments. The tallest among them was almost 10 meters (33 ft) high.

The island's population was less than 4,000 when Europeans arrived in the 18th century, which was a quarter of their maximum estimated population of 15,000 a couple of hundred years earlier, when they stopped carving Moais. The reason of a massive drop in the population before European arrival is complex and overwhelmingly attributed to

deforestation and soil erosion (1). One theory suggests that deforestation resulted from the use of trees as rollers to move statues to their place of erection.

Deforestation and soil erosion, combined with overharvesting of fields and overhunting of birds and fish led to famine that consequently resulted in tribal competition, widespread conflicts and lack of social order, and finally a collapse of their civilization. Climate change due to presence of a minor ice age at the time may have also contributed to their decline. It is suggested that lack of food and social unrest may have led to cannibalism among inhabitants to sustain food security for the population that in turn accelerated their decline, the extent of which is not clear (2). Why did they lose the social stamina, coping strategies and man power to regenerate?

Cannibalism

Cannibalism, consuming all or part of an individual as food by other individuals of the same species, is frequently reported among insects, fish and amphibians. Even sexual

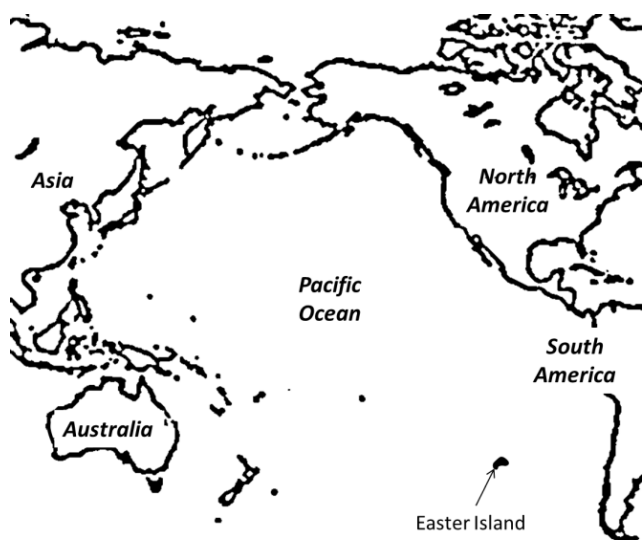


Figure 1. Location of Easter Island in southeastern Pacific Ocean. RA[©]



Figure 2. Moai, monumental statues in Chilean Easter Island. RA[©]

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cannibalism during reproduction in the funnel web spiders and spider mothers carry their offspring on their back and offer their own flesh to them in a process called Matrophagy; the mother dies, while the offspring survive (3, 4)! In mammals, however, cannibalism is very rare, sometimes found in circumstances of stress, as is the case for rabbits. Archeological studies have shown that cannibalism was historically practiced among Neanderthals as well as hominids and more recently for ritualistic medical reasons in Africa (5, 6). Even today, Malawian albinos are murdered in hunt for their bones that are thought to be medicinal, according to media report (7). The United Nations warned that Malawi's albinos are at risk of "total extinction" as body parts of abducted albinos are sold to witchdoctors hoping to make quick money.

Cannibalism in Easter Island

Today's inhabitants of Easter Island deny their ancestors' involvement in cannibalism. However, the existence of cannibalism among old inhabitants of Easter Island has been suggested as a ritualistic act and also theorized as a means to sustain the starved population (2). When a population is trapped in civil strife or depletion of natural resources, they are unable to cooperate owing to mutual distrust, even if cooperation would benefit all (8). As already discussed, the end for the Easter Island's inhabitants was starvation followed by a severe population crash and descent into cannibalism (8). Their glorious days of making giant Moai monuments were over, and the built ones were no longer effective!

Human bones have been found in religious platforms in Easter Island, which supports the cannibalism theory. It is also well known that cannibalism was a popular ritual practice among Polynesian populations, such as residents of Papua New Guinea (9).

Cannibalism as a cause of diseases

Although cannibalism contributed to population decline, it is generally believed that it was not a popular routine practice and was limited to ritual traditions and for preparing special feasts. Having said that, if cannibalism is related to certain diseases including toxic exposures, it could have led to the spread of diseases, although it was not a popular practice.

Animal and human remnants are considered biohazards for people who are in close contact, such as people embalming bodies and forensic pathologists. Therefore, using personal protective equipment is strongly recommended for people who work with corpses. Viruses and bacteria would not survive in corpses long after death, but chemicals including heavy metals remain for ages to come. Have you ever visited the Catacombs of Paris? If not, I would suggest googling it; so scary! Catacombs of Paris hold the remnants of more than six million people in a small tunnel network built to consolidate Paris' ancient stone mines. Although transmission of microbial diseases due to visitors' exposure to these bones are highly unlikely, such a large volume of bones consist of many chemicals, including heavy metals, that do not decay even as centuries pass and are a continued source of exposure (field accumulation), and potentially could be a source of exposure. Heavy metal exposure as a result of contacts to body parts is not a fantasy! --- Predatory and scavenging birds for example are exposed to high levels of lead when they

ingest shot or bullet fragments embedded in the tissues of animals injured or killed with lead ammunition. They bioaccumulate the poisons. It has even been shown that blood lead concentrations in golden eagles and turkey vultures in California declined significantly when the use of lead ammunition for hunting was banned in 2008 (10). A report from British Columbia in 2017 noted eagle becoming ill and dying as a result of lead poisoning, gasping for breath and unable to eat as the law was not fully enforced on both sides of the border (11, 12). To note, in case of chemical transmission of a poison we do not use the term "infectious" but rather "transmissible". Therefore and although farfetched, it can be presumed that cannibalistic behaviours of Easter Islanders may have led to heavy metal exposures and related consequences such as anemia, kidney failure and encephalopathy (13, 14).

Cannibalism and toxic prions

Cannibalism may contribute to spreading blood borne diseases such as hepatitis immediately after death. It may also lead to transmission of notorious toxic proteins, prions, by exposure to contaminated body parts such as the cannibalized brains among trapped inhabitants of Easter Island!

Prions are proteinaceous toxic particles that cause fatal neurodegenerative illnesses such as mad cow disease, in which an abnormal isoform of a prion protein accumulates in the brain (15-18). In this process, normal cellular prion protein is converted into modified protein (19). Prions are not viruses, viroids, bacteria, fungi, or parasites (20). Diseases related to prions are overwhelmingly genetic and sporadic but also transmissible (21). Prions are not contagious from person-to-person by routine contact such as airborne droplets similar to influenza or by blood or sexual contacts such as hepatitis and AIDS. They are, however, transmissible during invasive medical procedures involving exposure to contaminated brain tissue. Preparing or eating diseased brain tissues as a part of cannibalism could transmit the toxic prions. Human prion diseases are generally referred to as "kuru".

Debilitating and fatal kuru

Kuru is a debilitating and fatal disease, and is almost distinct in 21st century. Kuru was often associated with uncontrollable and inappropriate episodes of laughter, which gave rise to the phrase "laughing death" (Figure 3) (20).

Kuru was once the most common cause of death among Papua New Guinea population in the Fore region of the Highlands (23). It is the only prion disease known to reach epidemic proportions (24). It is reported that more than 2500 died of kuru in New Guinea between 1957 and 1982 (25).

The disease appeared at around the end of the 19th century when the local population started cannibalistic practices, and lasted until the late 20th century when ritual killings, sorcery and cannibalism, including eating of many of those who died, were discouraged by the government (23, 26, 27). Following the cessation of ritualistic cannibalism in the area, kuru disappeared (28).

Cannibalism, kuru and fall of the Easter Island civilization

The theory that is examined in this article for the first time is that the early Easter Island inhabitants, finding themselves trapped in the middle of nowhere, were challenged by a lack



Figure 3. A child with advanced kuru who could neither stand nor sit without support. Courtesy of Dr. Liberski PP, Poland from late D. Carleton Gajdusek (22).

of resources including deforestation. At that led to an epidemic of debilitating and fatal kuru similar to what happened in Papua New Guinea in the early 20th century. There is a long time gap between exposure (eating foods during certain feasts) to occurrence of symptoms that would have prevented finding the cause and effect associations. The mentality of 16th century remote Easter Islanders would have blamed the disease on failing Moais and other supernatural causes anyway. Transmissible toxic prion exposure would have accelerated their decline. --- All the justifying pieces of evidence are there!

The prion gene distribution in human populations suggests that prion diseases were widespread early in human history. Researchers have theorized that perhaps epidemics of prion diseases may have ravaged pre-historic human populations whenever cannibalism started (24, 26). This article argues that collapse of Easter Island civilisation may have been another example.

Why did kuru not eradicate Easter Island civilization?

It is justified to ask why the proposed epidemic did not fully exterminate their civilization. Their population fell to a quarter of that of their glorious days, but survived. There was no government discouragement in Easter Island for the

practice to be stopped such as was the case for the Fore people of Papua New Guinea and controlled the epidemics. What was the reason?

It is amazing to look at another study. When researchers comparing elderly survivors of the kuru epidemic in New Guinea, who had multiple exposures at mortuary feasts, and younger unexposed Fore people, it became clear that Kuru disease imposed a strong balancing selection, essentially eliminating PRNP 129 homozygotes (26). Balancing selection, a series of selective processes by which multiple alleles are actively maintained in the gene pool of a population, could occur in Easter Island inhabitants after a couple of generations.

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