

From exploitation to care: The Anthropocene & sea cucumber aquaculture in Northeast Asia

해삼은 보편적으로 양식되는 어종과는 거리가 멀지만, 동북아시아 지역에서는 고급 수산물이자 고부가가치 상품으로의 특수성으로 인해 집약적 양식의 대상이 되었다. 동북아시아, 특히 중국의 해삼 양식의 변천을 이해하기 위해 이 글은 해삼의 역사적·문화적 지위, 해삼의 대규모 양식을 추구하는 이들이 경험하는 해삼의 기묘한 생태, 근래 들어 발생하고 있는 폭염으로 인한 양식 해삼의 대량 폐사를 조망한다. 인간에 의해 지구가 영향을 받고 그 영향이 예측할 수 없는 방식으로 인간에게 돌아오는, 이른바 ‘인류세’를 사는 우리에게 인간과 비인간의 공존은 더 이상 간과할 수 없는 화두다. 끊임없이 변화하는 환경에서 인간과 해삼이 함께 살아나가기 위해서는 양식의 개념이 경제적인 효율성만을 중시하는 ‘이용’에서 해삼의 생태와 행동을 이해하고 반영하는 ‘돌봄’으로 변화될 필요가 있다. 비인간인 해삼의 관점을 통한 사고는 인간과 비인간이 어떻게 지속가능한 관계를 유지하면서 살아갈 수 있을지에 대한 질문에 하나의 답을 제시한다.

Sea cucumbers are not a typical aquaculture species globally. In the Northeast Asian region, however, they enjoy a unique and privileged status as a high-value seafood product and hence a profitable trade commodity, subject to ceaseless attempts for intensive culture. This essay explores sea cucumber aquaculture, focusing on sea cucumber’s historical and cultural status, its peculiar ecologies that simultaneously fascinate and frustrate humans who strive to understand them for mass production, and recent heatwave events that led to the mass deaths of cultured sea cucumbers. Thinking with sea cucumbers, I question how sustainable relationships can be cultivated between humans and nature as we enter the Anthropocene, an era defined by the predominance of us, i.e., humans as a species, and our irreversible impacts on Earth that come back to us with severe consequences. The notion of the Anthropocene alerts us that it is time to think seriously about the collective survival of humans and nonhumans. Seeing through ‘the eyes of sea cucumbers,’ I ask how sea cucumbers and humans can live together as the environments surrounding us are entering into a new, uncertain phase.

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The Anthropocene and sea cucumber

As a descriptor of the world we are living today, the term ‘Anthropocene’ is gaining popularity. Scientifically, the Anthropocene is a new geological epoch followed by the Holocene, the latest epoch that began about 12,000 years ago. The baseline of the Anthropocene is a source of ongoing debate among scientists. Some argue that the Anthropocene began with the industrial revolution in the late 18th century that led to the unprecedented use of fossil fuel. Some point to World War II during which the use of nuclear bombs left universal radioactive marks in the soil for the first time in the history of Earth.

Despite the various views on the Anthropocene’s geologically verifiable point of departure, however, there is an increasing consensus that we are already living the new epoch. For example, Waters and his colleagues, members of the Anthropocene Working Group of the

International Commission on Stratigraphy, suggest “unprecedented combinations of plastics, fly ash, radionuclides, metals, pesticides, reactive nitrogen, and consequences of increasing greenhouse gas concentrations” as material evidence of the Anthropocene that is “functionally and stratigraphically distinct from” the Holocene (Waters et al., 2016; Also see, Waters et al., 2018).

As its name suggests, the Anthropocene is a human-epoch, defined by the predominance of humans as a species and their irreversible impacts on Earth. The notion of the Anthropocene often arouses an apocalyptic future. Extreme weather events such as super-typhoons and hurricanes—becoming more frequent and powerful every year—are called by the media to remind us that what we have produced comes back to us with severe consequences. Plastics stuffed in the stomachs of sea mammals and birds starving them to death are another image of the tragic consequences that man-made materials bring to the critters on Earth.

The Anthropocene, however, does not always bring such an anthropocentric view. As a counter-response, the Anthropocene is also cultivating perspectives that attend to nonhumans and the interdependent relationships that humans make with them. Doing so, the Anthropocene concept usefully alerts us that it is time to think seriously about collective survival. We—both humans and non-humans—must live the Anthropocene together.

At first glance, sea cucumber may not be seen as an adequate candidate to discuss human-nature relations in the Anthropocene. Belong to the phylum of echinoderms along with sea urchins and starfish, sea cucumber is an ancient creature that has preserved its current body architecture since the Cambrian Period (Li et al., 2018).

However, as anthropologist Yoshiyuki Tsurumi argues, sea cucumber has made intimate relationships with humans in history (Tsurumi, 2004). In Northeast Asia, in particular, sea cucumber has enjoyed a unique and privileged status as a high-value seafood product and hence a profitable trade commodity, subject to ceaseless attempts for intensive culture.

Among numerous sea cucumber species consumed by humans, *Apostichopus japonicus*, commonly known as Japanese spiky sea cucumber, is native to and the only cultured species in the region (Figure 1). During the past decade, *Apostichopus japonicus* became the most economically valuable aquaculture species in China, while neighboring countries also attempt to raise and process high-quality *Apostichopus japonicus* for export to China.



[Figure 1: *Apostichopus japonicus* (credit: author)]

This essay explores sea cucumber aquaculture, focusing on sea cucumber's historical and cultural status, its peculiar ecologies

that simultaneously fascinate and frustrate humans who strive to understand them for mass production, and recent heatwave events that led to the mass deaths of cultured sea cucumbers. Thinking with sea cucumbers, I question how sustainable relationships can be cultivated between humans and nature as we enter the Anthropocene.

Cultural and ecological history of sea cucumber in Northeast Asia

The fundamental relationships that humans make with sea cucumbers is that of eating and being eaten (Probyn, 2016). In Northeast Asia, sea cucumber is part of traditional culinary culture. The ways in which it is consumed vary by places. In Japan, fermented sea cucumber intestines called konowata is enjoyed as a seasonal delicacy. Sea cucumber represents winter food around Honshu, while it is caught between June and September in Hokkaido. In Korea, sea cucumber is most commonly eaten raw as a side dish, dipped in hot chili sauce. China has developed the most sophisticated taste on sea cucumber. Dried sea cucumber restores its gelatinous properties when soaked in water, which then is served in various ways (Figure 2).



[Figure 2: Ready-to-cook sea cucumber in a Chinese restaurant (credit: author)]

The English term 'sea cucumber' does not fully reflect its value appreciated in Northeast Asia. Especially in China, sea cucumber is much more than seafood. It is well-known for its health benefits. Rich in protein, amino acids, mucopolysaccharides, collagen, and other trace elements, sea cucumber is sought as a tonic effective for preventing illnesses and as a medicine to cure cancer, arthritis, ulcer, etc. (Chen, 2005; Chen and Chang, 2015).

China and Korea share a common name for sea cucumber: 海参 (haishen/haesam translated as sea ginseng). According to Tsurumi, the

name should have been derived from its pharmaceutical association with Goryeo ginseng(人蔘), a highly valued traditional medicine native to the Korean peninsula and Manchuria. Recent studies support this association scientifically. Saponin, an active ingredient that gives to ginseng its tonic effect, is also synthesized in sea cucumber. According to Li et al., “saponins are widespread in plants but are rarely found in the animal kingdom, and how sea cucumbers gained the ability to synthesize saponins remains enigmatic” (2018).

In his book *The Eyes of Sea Cucumber*, Tsurumi traces how sea cucumber served as an important cultural artifact that connected people, things, and knowledge across the region for centuries—not only in Northeast Asia but across the South Pacific and the Indian Ocean.

His archival research demonstrates that Japan’s official record of sea cucumber trade goes back to the 8th century. In China, the Han elites during the Ming Dynasty refined the taste of sea cucumber, acclaiming it as the top of the ‘eight sea treasures’ (Ru et al., 2019). Sea cucumber’s peculiar ecology is also documented in Jibongyuseol, Korea’s first encyclopedia published in the 17th century during the Joseon Dynasty. Jasaneobo (1814) describes sea cucumber as one of ‘three (sea) valuables’ along with abalone and mussel.

Sea cucumber was a valuable trade commodity. Since around 1695, Tokugawa Shogunate that ran out of gold, silver, and copper bartered dried sea cucumber for silk products from the Ming and Qing dynasties (Tsurumi, 2004). The Han elites also embarked a search for sea cucumber to the South Pacific. In the mid-17th century, the Makkasans, a Muslim sea-tribe originated from Celebes, today’s Sulawesi, began to fish sea cucumber in the northern coasts of Australia for Chinese merchants. The fact that Vladivostok used to be called 海参崴 (haishenyv), literally translated as ‘sea cucumber hill/high’ in Chinese, also demonstrates a long history of sea cucumber trade between China and Russia.

Inevitably, however, the long historical pursuit of sea cucumber as a valuable delicacy led to the sharp decline of wild sea cucumber populations in the region. Already established as an export-oriented industry in China’s neighboring countries, sea cucumber fisheries intensified with the introduction of modern diving gear by the end of the 19th century. Once the stocks of Japan and Russia collapsed and the

use of diving gear was banned in those waters, Japanese fishers flocked to Korea. The ‘far-ocean fisheries promotion law’ enforced in 1897 further encouraged them to come and fish in the Korean waters.

As a result, sea cucumbers became “historical seafood along with abalone that became almost extinct with the introduction of diving gear by the Japanese” in the Korean waters.¹ In the 20th century, the region’s intense modernization and development at the expense of environmental degradation placed sea cucumber under serious threat. In addition to habitat destruction, sea cucumbers were particularly vulnerable to oil exposure. Numerous oil spill accidents during the period are responsible for today’s biodiversity crisis of wild sea cucumber species.

Apostichopus japonicus, the first and only cultured sea cucumber in Northeast Asia

Being a highly sought species whose natural supply could not keep up with growing demand, sea cucumber was subject to constant attempts for aquaculture. *Apostichopus japonicus*, in particular, is the only species that is artificially inseminated and widely cultured in Northeast Asia. The spiky sea cucumber species was selected for mass-culture due to its higher economic value in comparison to other sea cucumber species, which comes from its historical reputation for excellent medicinal effects.

A medical document from the Qing Dynasty describes that “the sea cucumber with black thorns produced in Liaodong is the best, which benefits to promote spermatogenesis and hematopoiesis” (Ru et al., 2019). According to Tsurumi, Japanese shogunates also deemed spiky sea cucumber from Hokkaido the best of all its kinds, “which when dried preserves the thorny forms” (2004). Today, the growing number of Chinese middle-class consumers drives the increase in demand for *Apostichopus japonicus*. As a result, it has the highest price tags amongst all the sea cucumber species traded in the world. In Dalian, for example, well-preserved, thorny, and kelp-fragrant spiky sea cucumbers are being sold at up to 2,500 yuan (equivalent to 350 US dollars) per 100 grams (Figure 3).



[Figure 3: Dried sea cucumber with the price tag of 2,480 yuans/100 grams (credit: author)]

Aquaculture, the idea of intervening to marine life for mass production, requires an intimate understanding of an organism's behavior and ecology. Humans have studied and raised sea cucumbers to understand the peculiar ecologies of sea cucumber that are radically different from that of humans. In the case of *Apostichopus japonicus*, it was the 1950s that modern fisheries scientists first attempted growing them in laboratories. Scientists were amazed by the unique properties that sea cucumber has such as aestivation (summer and winter hibernation), evisceration (ejection of internal organs for defense), autolysis (self-digestion), and self-regeneration.

Scientists of earlier generations learned to utilize these properties for multiplication. For example, Sang Choi, one of the first-generation fisheries scientists in post-independent South Korea, invented a method to remove intestines from sea cucumbers and release them for second-harvest the next year. "Sea cucumbers survive when cut in half; when their intestines are removed, they fully recover within three months," says a news article published in 1963 introducing his contribution to Korea's sea cucumber aquaculture development.²

Today, sea cucumbers continue to fascinate and frustrate humans who have a close encounter with them. Dr. Yang from the Institute of Oceanology Chinese Academy of Sciences (IOCAS) who apply molecular biology techniques to identify sea cucumber's genetic mechanisms of color expressions says that she is particularly attracted to sea cucumber because it is an environment-friendly organism: "Sea cucumbers do not cause any harm to the environment. Rather, they are bottom feeders who filter organic nutrients and clean up the sea bed."

Meantime, she also explains how naturally existing varieties of

Apostichopus japonicus challenge the notion of species itself, as they are considered as the same species for interbreedability despite different color morphs, sizes, environmental preferences, and other characteristics that make them distinguished from one another. The case of sea cucumber supports the broader claim that the concept of species may have to be redefined in terms of gene clusters rather than the ability of interbreeding.

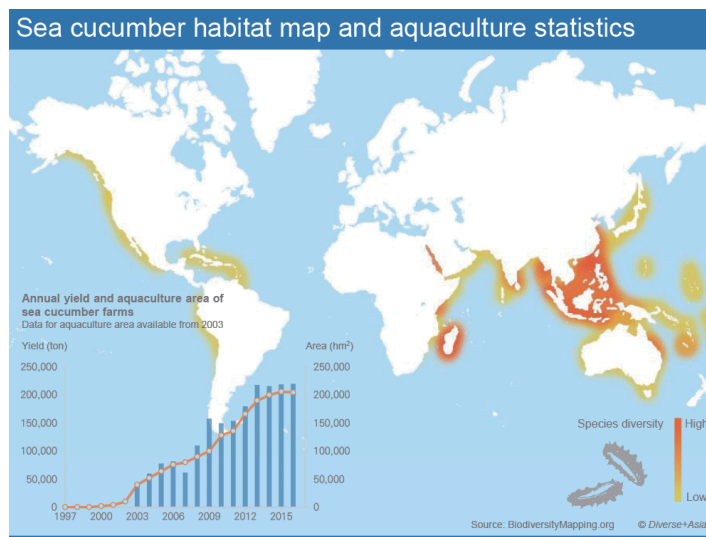
Like Dr. Yang, Dr. Seo from the Jeollanamdo Ocean & Fisheries Science Institute is amazed by the environmental adaptability of *Apostichopus japonicus*: "When sea cucumber juveniles collected in the West coast of Korea are transported to the East coast, they grow just like those native to the East coast." Such malleability, however, is also a source of frustration when he performs experiments. As they easily change color, size, form, and thorn-shape, it is almost impossible to identify individuals, ages, and origins by their appearances. Moreover, these properties make commercial production less cost-effective. For example, sea cucumbers whose body masses shrink during aestivation do not necessarily restore their size after they wake up. Sea cucumber larvae born by the same parents and raised in the same pool grow at vastly different rates. This way, sea cucumber resist control by humans.

Nevertheless, technologies today have advanced to mass-produce sea cucumber juveniles through artificial insemination and breeding. Scientists learned which types of stresses prompt mature *Apostichopus japonicus* to lay sperms and eggs and which environmental conditions and feed sea cucumbers prefer at each larval stage as they go through a series of metamorphosis. As a result, China's sea cucumber production has increased dramatically over the past decade.

From the perspective of biodiversity conservation, however, the expansion of *Apostichopus japonicus* aquaculture is introducing an interesting tension, as the release of seedlings not only to enclosed ponds but to open-water areas blurs the line between cultured and wild spaces. These 'marine ranches' are designed to provide suitable habitats for sea cucumber, e.g., by putting various types of substrates *Apostichopus japonicus* prefers to hide in.

The problem is that they hybridize with wild sea cucumber populations. According to Dr. Zhang from the IOCAS, who participated in a sea

cucumber genetic assessment project, wild populations of *Apostichopus japonicus*—genetically distinguished from cultured ones—become rarer in the Chinese waters. Accordingly, most of “wild sea cucumbers” sold at the market are the ones in effect hatched in seedling production facilities and released in open-water marine ranches. On the one hand, naturally endangered *Apostichopus japonicus* is thriving precisely because their ecologies have been intervened by humans. On the other hand, the species’ genetic diversity is declining for the very same reason.



(source: Ru et al., 2019/ Permission of re-use obtained from corresponding author and Springer Nature)

Heatwaves and mass-death events in recent years: Aquaculture as exploitation or care?

In July 2018, extraordinary heatwaves in northern China raised the water temperature of sea cucumber ponds to over 30 degrees Celsius for several days. The maximum temperature observed in several places in Dalian was about 36 degrees. In ordinary summers, sea cucumber ponds in the region maintain 26 degree on average, which is one degree above the threshold *Apostichopus japonicus* goes to aestivation. In 2018, however, sea cucumber woke up abnormally. As the water temperature reached 32 degrees and more, they started autolysis, destroying their own body walls composed of collagen fibers and microfibrils (Liu et al., 2018). Even when some sea cucumber growers poured ice to cool their ponds as an emergency treatment, dead sea cucumbers floated all over.

The damage was unevenly distributed. In comparison to Shandong, Liaoning had most of the damage. Within Liaoning, it was pond culture farms that suffered most harshly from the heatwaves. According to

the China Fisheries and Aquaculture Net, over 95% of Liaoning’s sea cucumber ponds, which is about 50% of the entire sea cucumber areas in the province, were affected. The mortality rate in those farms varied between 50% to 90%. In total, the economic loss was expected to reach 6.87 billion RMB.³

During similar events in the past years, it was climate change that was blamed for mass deaths. In 2018, however, the media pointed to pond culture. In comparison to marine ranching, pond culture is preferred as an economically efficient aquaculture method as it allows the raising of sea cucumber in much higher density and under tighter control of input and output such as seawater, feed, chemicals, and harvested sea cucumber. Because of this reason, pond culture used to be the most popular method of sea cucumber aquaculture in China and still accounts for a majority of sea cucumber production in Liaoning.

The downside of pond culture, however, is that it is extremely vulnerable to such uncontrollable environmental factors as heatwaves. The average depth of a pond is only about 2 meters, which contributes to the quick warming of the pond. As seawater input often relies upon the tidal clock, low-tide hours exacerbate the conditions.

With regards to climate change, Dr. Zhang explains that heatwaves are no longer ‘extraordinary.’ Such events have hit the region repeatedly in recent years. Most notably, the summer heatwaves 2013 and 2016 prompted sea cucumber farms in Shandong to turn from pond culture to marine ranching. In Liaoning, however, such a shift had not occurred yet. Pond culture remains as a major way of raising sea cucumber in the province. Dr. Guo from the Liaoning Ocean and Fisheries Science Research Institute expects that this year’s damage would finally make these practices to be significantly discouraged in the province.

Aquaculture in the changing environments cannot be solely about exploitation. It requires care, which demands careful attention on non-human life. To deal with potential heatwaves, the IOCAS developed numerous measures, including the covering of a pond with black curtains or the circulation of groundwater at the bottom of a pond. A sea cucumber aquaculture company in Weihai started applying those technologies, in addition to transporting sea cucumber from ponds to nearby indoor facilities during hot summer months (Figure 5).



[Figure 5: Black curtains to prevent heat damage (credit: author)]

Seeing Like Sea Cucumber

In *The Eyes of Sea Cucumber*, Tsurumi considers both humans and sea cucumbers as ‘tribes’ co-living on Earth. He juxtaposes the history of humans and the history of sea cucumbers on a horizontal plane, rather than creating a hierarchical order between them. “Borrowing the eyes of sea cucumber, I think of the history and life of human tribes,” he says, concluding that “colonial rule and order, in effect, remained incomplete” (2004). Following the movements of sea cucumber, he learns “how ambiguous such institutions as national borders are” and “how colonies existed not solely by their market relations with their metropole.”

What he suggests is the multiplicity of worldviews as well as the significance of peripheral perspectives, which he learns from seeing like sea cucumber. Sea cucumber, a peripheral animal that appears only sparsely in the historical records of Western colonizers who entered the South Pacific in the 16th century, “is a very useful theme to steer away from the colonialism-centered thoughts.”

Similarly, seeing through the eyes of sea cucumber allows us to think and act differently as we explore possible nature–society relations in the Anthropocene. Sea cucumber researchers, growers, and sellers I have met over the past years are in a way practicing such an alternative perspective already, as they keep fascinated and frustrated by the mysterious creature. The chameleon-like characteristics of sea cucumbers teach them to think like sea cucumbers, while they also understand that sea cucumbers do not easily yield to full control by humans. As we enter the new era in which uncertainties become a new norm, these tensions prompt aquaculture to turn from exploitation to

care—a necessary step for the sustainable interdependence between humans and sea cucumbers.

저자소개

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플로리다 국제 대학(Florida International University)에서 Department of Global and Sociocultural Studies의 지리학 전공 조교수로 재직 중이다. 연구 관심 분야는 동아시아의 해양 및 연안 지배에 초점을 맞춘 개발-보존 관계의 복잡성 및 상호 결합에 관한 것이다. 한국해양연구원에서 해양 정책과 해양 과학연구의 전략기획 업무를 맡았으며, 국가 보존 코디네이터로 세계자연보호 기금의 한국 측의 입장을 전달하는 역할을 수행하기도 하였다. 주요 논문들은 *Political Geography*, *Dialogues in Human Geography*, *Ocean & Coastal Management*, and *Marine Pollution Bulletin*에서 확인할 수 있다.

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* 본 기고문은 전문가 개인의 의견으로 서울대아시아연구소의 의견과 다를수 있습니다