Constructing Killable Whales : Historical Formation of Japanese Cetology and Scientific Whaling

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Constructing Killable Whales: Historical Formation of Japanese Cetology and Scientific Whaling

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1. Introduction: Hunting Whales for Science

Since the International Whaling Committee (IWC) suspended commercial whaling in 1987, Japan had conducted controversial scientific whaling (*Chosa Hogei* in Japanese) in the Antarctic and North Pacific Ocean. The scientific whaling was arranged in ambiguous public/private collaborations: a quasi-governmental organization, the Institute of Cetacean Research (ICR), carried out the "lethal" research under the auspices of the Fishery Agency and commissioned a de facto whaling company, Kyodo Senpaku, to hunt whales for its research. Until 2019 when Japan finally withdrew from IWC and resumed commercial whaling, this practice continued for nearly three decades.

Drawing on literatures in social studies of science and technology (STS), this paper explores the historical formation of Japan's cetology, tracing how its form of knowledge production emerged in the early period of commercial whaling in the 1960s, and eventually led to scientific whaling. After reviewing theoretical frameworks, this paper first traces the larger context of the IWC where its Scientific Committee (SC) started problematizing the stark overexploitation of whales in the 1960s. The second section investigates the domestic processes in which Japanese cetologists in Whale Research Institute, the private research center preceding the current ICR, responded to this lacuna of empirical data necessary for the population statics. The third section will discuss how Japanese statisticians and cetologists formulated schemes of scientific whaling in response to the IWC's ban in the mid-1980s. By carefully examining the historical continuity between commercial and scientific whaling periods, this paper will illustrate how Japanese cetology played a dual role in constructing authoritative knowledge and legitimizing the lethal research in the controversy over the global conservation.

In particular, this paper will focus on the institutional history of a somewhat awkward material—the ear plug of the baleen whale.[1)] This fragile material equivalent to human ear wax has laminae like tree rings.[2)] Since the laminating pattern was discovered in the early 1960s, ear plugs became an indispensable tool to determine the age of caught whales,[3)] and, thereby, calculate key biological rates used in population assessment. During the commercial whaling period, collaborating with pelagic whalers, Japanese cetologists played a critical role in collecting, interpreting, and redefining this material

for the IWC's management of whales. After the moratorium was imposed, the extraction of ear plug became a core practice to delineate and legitimize the hunting of whales as "science." A close, diachronic study of Japanese cetologists indicates, I argue, that their scientific practices helped co-produce both natural and political order in the global whale dispute.

2. Theoretical Consideration: Actor Network and Boundary Work

In 1987, the Japanese government started the lethal research program, called JARPA, by exercising its right under Article VIII of the International Convention on Regulations of Whaling. This article allows contracting governments to unilaterally grant permits to its nationals to kill, take or treat whales for the purposes of scientific research. It also permits the sale of the whale meat, stating that "any whale taken under these special permits shall so far as practicable be processed and the proceeds be dealt with in accordance with directions issued by the Governments." The Japanese government legitimized its lethal research to "collect necessary biological and statistical data" for the comprehensive assessment of Antarctic minke whale population stocks. This scientific justification enabled Kyodo Senpaku to continuously catch whales and openly defy the legal effect of the moratorium, at least until 2014 when International Court of Justice ruled that the second scientific program, JARPA II, was not for the purposes of scientific research.

To analyze the continuation of Japan's scientific whaling, most of the social and political scientists focused on the ICR's institutional entanglements (Morikawa 2009; Kagawa-Fox 2009), its use of scientific rhetoric (Blok 2008), and political manipulation of scientific uncertainty in the IWC (Heazle 2006).[4)] Indeed, scientific whaling may be seen as a typical example of such industry/government-sponsored research. As a handmaiden for Fishery Agency and Kyodo Senpaku, the ICR denies the risk of whale endangerment, creates an imagery of whale abundance, and provides data needed to justify whaling in defiance of the moratorium (Blok 2010; Peace 2010). What underlies these studies is a dominant assumption that the relationship between stakeholders (industry, government, NGOs, etc) and scientists shapes the content and outcome of science in environmental politics.

Yet, it is important to avoid reducing the complex processes of knowledge production into exogenous interests and institutional bases. If scientific data and claims produced by the ICR were unassailable, or at least, robust enough to legitimize the exercise of lethal research, it is necessary to look closely at social conditions in which they got made. Instead, this paper closely examines historical trajectories with selected accounts of technical achievements—collecting information about whales in the messy field, ascribing meanings to biological data, and producing claims acceptable to the IWC—that enabled scientific whaling. To do so, it employs two notions from the STS.

First, the notion of actor-network draws attention to associations of heterogeneous elements—humans, their tools, and non-human interlocutors—that come together in constructing scientific facts (Callon 1986; Latour 2005). It emphasizes the mutual shaping

and contingent connection of different elements which knowledge production rests on. The notion captures the real-world heterogeneity in making scientific knowledge of whales. Throughout the history of commercial whaling, most biological and statistical data were produced by cetologists who collaborated with industrial whalers (Horwood 1989; Burnett 2012).[5] In practice, this collaboration was the only means to have access to remote Antarctica where cetologists stayed in either whaling fleets or whaling stations, examining carcasses of whales. Thus, the notion of actor-network draws our attention to hybrid configuration and flow of technoscientific knowledge, which are more complex than what the institutional analysis of interest presumes.

Second, scholars in science studies have placed their emphasis on controversies and disagreements in the scientific project. Instead of portraying scientific truth as a product of consensus, they have shown the active role of scientists in defending their position and privilege to maintain their authority. To describe this constant process of negotiations, Gieryn (1983) developed the idea of "boundary work". This concept refers to the ways in which scientists rhetorically draw and police boundaries, and thereby defend their autonomy and differentiate it from what is not science. By doing so, they present their claims and practices as legitimate by locating them within the boundaries they have constructed as science. The notion of boundary work sheds light on how Japanese cetologists have defended their scientific authority in the transition from commercial to scientific whaling. The particular historicity of commercial whaling placed Japanese cetologists in a paradoxically advantageous position: after other whaling nations stopped their operations in the early 1970s, they became the sole provider of biological data on Antarctic whales.

Taking these notions of actor-network and boundary work as the general framework, this paper looks closely at the historical formation of scientific whaling mainly in two different periods, before and after the imposition of the 1982 moratorium. The first section traces the larger context of the IWC where its SC started problematizing the stark overexploitation of whales in the 1960s. This problematization established the need to identify maximum sustainable yield (MSY) by incorporating a new mathematic model from the field of population dynamics. It proved, however, notoriously difficult to implement the abstract model in concrete reality. In contrast to other animals and fish, there was little or no basic information about whales. For instance, the inability to identify the age of caught whales made it impossible to calculate the mortality rates and reproduction rates, let alone sustainable yield. The Japanese cetologists in Whale Research Institute, the private research center preceding the current ICR, responded to this lacuna of empirical data as well as to the controversy over the age determinacy method. Although the method of counting ear plug laminations was already in use, it remained uncertain as to how to interpret whether each layer represented a half or one year. What led Japanese cetologists to solve this controversy was a particular network of cetologists, whalers, and (dead) whales. Specifically, commercial practices of flensing whale meat for food consumption encouraged Japanese cetologists to extract a large amount of ear plugs and translate them into biological information.

In the second section, I will discuss how Japanese statisticians and cetologists

formulated schemes of scientific whaling in response to the IWC's ban in the mid-1980s. In order to continue whaling in the name of science, this reconfiguration centered on the same old practice of the population cetology, that is, extraction of ear plugs. The major difference was to reduce the annual catch and randomize the catching method, so the ICR scientists could claim that its age data could be statistically used without threatening the population level of Antarctic minke whales. By adopting this "lethal research", they could legitimate whaling as science, ensuring that Kyodo Senpaku could catch a limited number of minke whales under the moratorium. The important point is that this shift to scientific whaling did not (or rather could not) aim at proving the abundance of whales or convincing their opponents that commercial whaling could be resumed. It rather entailed a protective boundary work in which the ICR scientists defended their lethal research by retaining control over the scientific domain, and, thereby, preventing their opponents from disproving its alleged science.

3. Japanese Cetology in Commercial Whaling Period

3.1 Problematizing the Overexploitation in the IWC

The development of Japan's cetology is inseparable from the historical and political context of the IWC in the post-war period. Despite its proclaimed science-based management, the IWC's SC was unable to provide conclusive advice about conditions of Antarctic whales. This was partly because its epistemic authority was challenged by the political influence of powerful whaling industries, but mainly because the SC could not gather adequate and reliable information about Antarctic whales. Even though conservation-minded members in the SC were keenly aware of the need to implement a new management model, the combination of insufficient research and complexity of whales' ecology delayed such a strong intervention. It was this problematization of overexploitation—the acute need to apply the abstract management model and lack of concrete information about whales—that largely shaped subsequent developments of Japan's cetology.

As in many other cases of resource management, the overexploitation of Antarctic whales became a pressing problem not because of scientific management, but because the pelagic whalers started failing to meet their quotas. Up until the early 1960s, the logic of the management was shaped by the economic criteria of whaling industries rather than the biological limit of whale stocks. Five whaling nations—Great Britain, Norway, Dutch, Soviet, and Japan—continued to intensify their competitiveness, sending fleets of catcher boats and factory ships to the Antarctic water. At that time, the IWC was using the Blue Whale Unit (BWU) as a standard measure to set annual quotas. This measurement was calculated according to how much oil one blue whale can produce, and the total quota was set in a way to regulate the price of whale oil rather than the overexploitation of whales. The political body of the IWC, which was dominated by whaling nations, did not respond to the SC's call to reduce the BWU quota, but instead kept it as high as 15,000 until 1962. By then, the overexploitation proved dramatically severe because whaling nations were not even reaching the set annual quota set by themselves.

In face of this rapidly worsening situation, the SC decided in 1960 to invite three external scientists from non-whaling nations, who were specialized in the field of population dynamics. Before this, most of the members in the SC were so-called "the hip-booted biologists" (Burnett 2012: 171): cetologists who are specialized in whale biology and anatomy, collecting specimen and biological data by staying at whaling fleets and land stations. Indeed, at the time when the Committee of Three was established, the SC was still setting priorities in organismal biological research. Although these cetologists acknowledged the need for assessing the Antarctic whale populations, they lacked both conceptual and mathematic tools to implement such assessment.

It was in this absence of the management model that the Committee of Three adopted the concept of Maximum Sustainable Yield, or so called MSY, in order to incorporate biological data into management procedures. The purpose of this approach was to allow the maximum number of whales to be taken from any stock without endangering the health of the stock until an optimal level is achieved. In order to calculate the MSY (at what levels of populations could support renewed commercial hunt), it was necessary to identify the recruitment rates (the number of whales entering the youngest age group), mortality rates (the chance of a whale not reaching the next age group), the current size of the stock (how many whales there are in the sea), and the original size of the stock prior to the exploitation (how many whales there were before commercial whaling began). Although the Blue Whale Unit was still in use at that time, the SC was hoping to provide persuasive scientific advice by introducing the MSY approach.

Once the MSY concept was put into practice, however, difficulties arose. The largest obstacle was agency of whales—as a highly migratory, gigantic, marine mammal, whales are extraordinarily elusive, defying the efforts to gain basic knowledge that would be otherwise available in other animals. For instance, unlike other land mammals, it is nearly impossible to count whales directly (except their spouts and fins submerging on the surface), or, unlike other fish, it is impossible to observe their life history in an artificial setting like an aquarium. Until the method of age determinacy was established with the ear plugs, it was not even known as to when whales start giving birth or die even though these biological data were crucial for the population assessment. Thus, from the very beginning of Antarctic whaling, the assessment of whale population has been foreclosed by the lack of elementary rates in population models.[6)]

The formation of the Committee of Three was a big step toward the conservation of whales with its application of the mathematical analysis of the latest population dynamics. Yet, regardless of how mathematically sophisticated their analytical approaches might be, their analysis still depended on biological data derived from the work of old-fashioned cetologists. In fact, there was still an ongoing controversy over the age determination method. Cetologists debated what material could be the best source to identify the age of captured whales. In 1962, when the age determination method was first discussed in the Ad Hoc SC, the Committee decided that the count of the laminations of the ear plug was the most reliable method. Its members, however, expressed a concern about absolute time scale. It remained unclear as to whether one or two laminations are

laid down every year, but the committee suggested as a working hypothesis that there are two per year. Depending on the interpretation, the resulting outcome of the population assessment and annual quota changed. The IWC's SC, however, agreed in 1970 that each layer represents one year of whale's age after Japanese cetologists and whalers had collected abundant samples from the whales hunted for the commercial operation. Since then, this method of age determinacy enabled international scientists to calculate a "sustainable" quota based on the mortality and reproduction rates of hunted whales.

3.2 Assembling Whales, Whalers, and Cetologists in Japan

While the IWC's SC was plagued by the lack of biological information in the age determination method, it was relatively easier for Japanese scientists to collect samples of whale ear plugs and use it to challenge existing interpretations of whale growth. Two social factors drove them to commit to such empirical research. First, their research institute was fully sponsored by the private whaling industry, which enabled them to participate in the voyage. Second, in contrast to other whaling nations that used hunted whales mainly to produce oil, Japanese whalers slaughtered and butchered them into smaller pieces for food consumption. Therefore, even though the ear plug is a fragile and easily broken material like human ear wax, Japanese cetologists were able to collect as many as one thousand samples in one year. This development needs to be understood in relation to the heterogenic configuration of knowledge making practices, or how scientific activities are done and coordinated between Japanese whalers and cetologists to successfully extract ear plugs.

Japanese cetology emerged out of a hybrid community that combined scientists, governmental officials and industrial whalers. The Japan Whale Research Institute was first established in 1948 as a branch organization of Taiyo Gyogyo, one of the three Japanese whaling companies operating in the Antarctica. During its early development, this industry-sponsored institute mainly focused on technical aspects of preserving and processing whale meat for human consumption. For example, one of their research agenda was to identify how whale meat perishes more quickly than other types of meat, or why it tends to make unpleasant taste. However, after Hideo Omura, a former bureaucrat in Fishery Agency became its chief director in 1954, their research agenda gradually shifted to incorporate biological protocols required for the population assessment (Omura 1969). Omura himself had participated in whaling voyages as an official supervisor of operations since the pre-war period, and this experience led him to encourage other scientists to conduct direct fieldwork on whaling fleets. In addition, Omura rigorously incorporated British methods of anatomical research which was known as the school of "knife and notes" among whale researchers at that time.

With this empiricist spirit, Japanese cetologists sought to identify the most reliable body part in whales to estimate their age even before the ear plug method was established in 1962. They were examining various parts of the whale body that showed any sign of countability, including laminations in ovaries, length of baleen plates, transparency of the eye lens, and even scratches left on the surface of the skin. None of them, however, proved satisfactory. This is because these parts stop growing at a certain point in the life

cycle or they indicate only a relative scale of time. In 1955, however, a British zoologist accidently discovered a laminating pattern on a whale's ear plug while he was studying the auditory capacity of whales. Since the whale's ear is enclosed under the skin and the ear plug keeps growing internally inside the ear bone, he suggested that this could be used for determining age. Ear plugs then came under scrutiny by the Japanese as well as other cetologists. There remained, however, a fundamental question: how much time does each lamination really represent?

As mentioned earlier, the SC decided to accept a working hypothesis that each lamination represents two years of a whale's age. On the other hand, Seiji Ohsumi, a cetologist working at the Japan Whale Research Institute, refuted this interpretation in 1964, claiming that each layer represents only one year. What supported his argument was a distinctive Japanese method of extracting ear plugs, which was largely shaped by commercial practices of processing whale meat for food. The first difference between Japanese method and that of others was that, because some flesh inside the head of whale was considered a delicacy, Japanese whalers usually took out the edible parts such as the tongue, cartilage in the nose or meat behind the eyeballs. Therefore, the head was stripped before Japanese cetologists extracted ear plugs inside the skull. In contrast, whalers in other nations only peeled off the blubber of the whale without touching the head. Because it took more time and effort to extract the ear plug from the entire head, only a small number of the carcasses were selected for that purpose.

The second major difference was that Japanese whalers had a higher chance of discovering a mark left inside whale's body. In the 1920s, British scientists used this marking method by shooting a numbered stainless tube into a living whale for it to be later discovered. By recovering the marks, they aimed at studying migrating patterns of whales. The SC suggested that this technique should be used to figure out not only how whales came and went, but as a method for confirming aging estimates. Again, because Japanese whalers flensed bodies of whales into smaller pieces, they had a greater chance of discovering the mark. Moreover, Japanese flensers were encouraged to find these marks because whaling companies offered financial rewards to whoever found them. Eventually, Ohsumi correlated the number of laminations on the ear plugs with the number of years in which marked whales had survived since the marks were shot into their bodies. Based on this and other evidences, Ohsumi reached the conclusion that a whale grows only one lamination each year on its ear plug (Ohsumi 2008).

In 1969, the SC adopted this new interpretation of ear plug growth and announced that it had found errors in earlier estimates of some whale species. This change left two major consequences. First, because the life expectancy of whales had been redefined, the previously accepted "sustainable yield" quota proved to be too high. For instance, if a whale has 30 layers in its ear plug, it used to be regarded as 15 years old, but now it is redefined as 30 years old and supposed to be reproducing more children in its life history. Although the IWC decided to drastically reduce the annual quota two years later by abolishing the Blue Whale Units, the change brought a short relief for whaling nations.

The second more important outcome was that it repositioned Japan's status as the

sole provider of "empirical data." By this time, it was only Norway, the Soviet and Japan that were operating in the Antarctic water. While the Soviet was not cooperative in providing the age data, Japanese cetologists kept extracting ear plugs from almost all the hunted whales.[7] In 1968, Japan Whale Research Institute was downsized due to financial difficulties of sponsoring whaling companies. Ohsumi and other cetologists were also laid off by the institute but reassigned to another public research institute managed by the Fishery Agency, National Research Institute of Far Seas Fishery. However, because of his new status as a "public" scientist, he could request all the Japanese whaling companies to extract ear plugs as a research duty. Now it was not cetologists, but whalers who systematically conducted this empirical research and brought back samples of ear plugs to Ohsumi's laboratory. Therefore, in an interview with a journalist in 1977, one Japanese cetologist pointed out this paradoxical situation in which whale science became completely embedded in the Japanese whaling industry (Asahi Sinbun 1977):

> The Soviet Union also submits its reports, but they do not give as detailed data as Japanese. Cetologists in other countries are doing their research based on the data provided by Japanese whaling. This means that once Japanese whaling is completely banned, studies on whales will be stopped, too.

Furthermore, the monopoly was not limited to the biological data acquired from whales' carcasses; it included the data derived from a non-lethal, sighting survey conducted to estimate the abundance of Antarctic minke whales.[8] When the SC decided to launch the International Decade of Cetacean Research (IDCR) in 1978, it was Japanese whaling vessels and crews that were hired to work for the transnational group.[9] Although these scientists designed and supervised the research, it was Japanese whalers who did most of the manual labor with their experienced skills—navigating the research vessels, finding whales' spouts and fins in the rough, icy Antarctic water. As such, whether the data sets came from dead or living whales, Japanese whalers did most of the invisible work to generate the data used for the population assessment.

As such, somewhat paradoxically, it was industry-supported Japanese cetologists who could offer series of data related to the problem of calculating the sustainable yield formulated by the IWC. What made this knowledge production possible was the peculiar assemblage—or what STS scholars may call actor-network—of whalers, cetologists and dead whales. The aging method was established as a mutual result of commercial practices of flensing whales and scientific practices of extracting ear plugs. Moreover, the technical dependency on whalers became increasingly systematized and stabilized after the late 60s: now Japanese whalers, with their capacities to find and capture whales in Antarctica, could solely provide biological sample and empirical data for international cetologists. This contingent formation of the actor-network was a critical preset when commercial whaling was reconfigured into scientific whaling.

4. Countering the Conservation in the Post-Moratorium Period

4.1 Protective Boundary Work: Purifying the Method, Mathematizing the Data

In 1982, the IWC adopted the moratorium on commercial whaling. Although the SC did not support the bracket ban, the decision was made with a promise to conduct comprehensive assessment on Antarctic minke whales in 1990.[10] In response, as mentioned earlier, the Japanese research plan was organized around the same old practice—extraction of ear plugs. The major difference between commercial and scientific practices was the way whales were randomly hunted and applied as statistically viable data. The extraction of ear plugs was transformed into a robust ideology that legitimized its lethal research, securing a channel for Japanese whalers to hunt whales under the moratorium. The shift to scientific whaling entailed what may be called "protective boundary work" whereby Japanese cetologists tried to retain dominion over their traditional study in collaboration with whalers. To understand how this shift took place, it is important to see the kinds of politics and procedures involved in the process of designing the lethal research.

The moratorium was made primarily on the political ground. While the decision itself was a result of power politics, opponents of whaling had used a discourse of scientific uncertainty as a major reason to cease all commercial whaling. Within the IWC's SC, critiques were raised against the "biased" nature of the data collected by highly selective operations of Japanese whalers. Because "these data were collected from the restricted geographical locations and times convenient for whaling operations…they neither provide a random sample of the population nor generally cover the total distribution of the whales" (Horwood 1989: 199). In other words, because Japanese whalers normally hunted bigger whales at limited hunting grounds to maximize their production, the resulting data were regarded as "biased" regardless of how many ear plugs Japanese cetologists counted. Thus, during the 1970s, some of the biological parameters needed to calculate MSY-based quotas—recruitment rates and natural mortality rates—were in severe disputes between pro- and anti-whaling scientists. Moreover, the U.S. and other anti-whaling nations started directly questioning the SC's ability to advice on management proposals (Heazle 2006: 141). It was in this absence of reliable data and scientific advice when the moratorium was justified and eventually adopted.

In designing a plan for scientific whaling, Japanese pro-whaling protagonists acutely acknowledged this concern about scientific uncertainty. The point was raised when Kyodo Hogei (the whaling company), Whale Research Institute and Fishery Agency (hereafter called three groups) began discussing the research plan in 1985. At one of the first meetings, Ikuo Ikeda, a chief scientist who took the initiative in designing the plan and later became the first director of the ICR, frankly admitted that more than 60% of the data concerning the whale age had been useless. If this sampling method was problematized as the reason to suspend commercial whaling, the solution could only be drawn from the same ingredients that created the problem. This was the basic approach of the program's designer to construct the legitimacy to launch scientific whaling. Instead of debating over the actual number of existing minke whales, or calculating the level of

sustainable yield, what he did was to make input data properly adjusted for such calculations. This "erasure of the noise," as one bureaucrat put it, proved suitable for the scope of the comprehensive assessment since it could leave the task of calculating the population of whales to other scientists in the IWC.

Under this new plan, two critical sets of modifications were incorporated in the already existing scientific practices. First, the method of catching whales was modified: in order to reduce the "bias" of selective operations, whales were hunted in an as random manner as possible. This was done by drawing zigzag track lines on which whaling ships must sail, so that they do not only go to abundant whaling grounds. In addition, even if whalers find a pod of whales along the track lines, they are required to use a table of random numbers in order to avoid selecting bigger whales. By incorporating this "random sampling method," it was possible to take a wide range of whales that represent the entire distribution. Secondly, it was decided that the main objective of the lethal research was to obtain the estimation of biological parameters to improve stock management of the Southern Hemisphere minke whales. To highlight key issues in this objective, "the biological parameters" basically mean natural mortality rates or how many whales die naturally within a particular demography. Similar to the idea of the population pyramid, this estimation was done by identifying the abundance of whales in different age cohorts (e.g. if there are more whales in older age cohorts, the natural mortality rate will be higher). As a way to achieve this goal, the collection of ear plugs became "necessary" in order to identify the age distribution of whales.

What endowed the research plan with unassailable authority was the mathematization of biological knowledge, which means attributing a higher, mathematic order to the relationship (Greenhalgh 2008: 196). The three groups invited a few external fishery statisticians who had never dealt with the whaling issue before. The need for their mathematic input was acute because previously Japanese scientific knowledge was narrowly limited to biological aspects of whales. In the deeply politicized and polarized discussions at the IWC's SC, Japanese cetologists failed to comprehend and dispute against highly technical and mathematized criticisms raised by their opponents. Thus, by incorporating the mathematic technique of fishery statisticians into the existing biological research agenda, the three groups aimed at making a sound research plan that would withstand their opponents' criticisms. The statistic estimation for the natural mortality rate was made by Shoichi Tanaka, Japan's foremost fishery statistician who had just retired from University of Tokyo. What he did was creating a visual projection that could forecast the accuracy of the rate in future, which would result from continuous sampling of a certain number of whales. This projection involved a series of complex mathematic operations that would process a large amount of age data provided by Japan's scientific whaling. Although the internal mechanism of his mathematic technique was only comprehensible to fishery statisticians, it established one simple trajectory: the more whales were sampled, the more accurate the natural morality rate would become. Wrapped in the purified forms of the mathematic projection and catching method, their research plan cemented the legitimacy of its paradoxical goal: Antarctic minke whales need to be hunted in order to "improve the stock management of" Antarctic minke

whales.

The three groups agreed on this research plan at an early stage of the discussion. However, they continued to disagree over the number of annual catches. In September 1985, the three groups organized a meeting to discuss an annual catch agreeable from scientific, political, and corporate perspectives (National Graduate Institute for Policy Studies 2002). From the scientific perspective, even catching 2,000 whales, which was the quota allocated for Japan's commercial whaling in the last season, was considered too small to figure out the mortality rate. To make statistically viable data, Tanaka insisted, at least 1,600 minke whales should be taken each season. For members in Kyodo Hogei, the minimum number should be set between 1,400 and 1,500 whales in order to maintain their ships and crews. The main concern for the corporation was to cover the increasing costs for the inefficient operations and the newly established ICR. On the other hand, a bureaucrat from the Fishery Agency argued that the research program was not meant to save the whaling company, and, thus, the annual quota should be politically appropriate, which he thought would be around 500 whales a year. Following the examples of scientific whaling done by Korea and Iceland, the new quota should be less than half of that of the commercial operation. Otherwise, it would not appear acceptable to the IWC. In response, Kyodo Hogei members acknowledged the political need to reduce the quota but asked for monetary compensation to cover the cost overrun. The number of the quota, therefore, had to be made as a rough compromise among the vested interests, balancing science, economy, and politics on the edge of potential breakdown.

Eventually, in early 1987, the first research proposal was submitted to the IWC, calling for the catch of 825 minke whales and 50 sperm whales each year until 2000. However, right before the whaling fleets departed from a Japanese port in December, another proposal was drafted in October, calling for 300 minke whales a year and no sperm whales until 2005. The reduction from 825 to 300 minke whales was primarily motivated by political considerations. On the international level, the IWC adopted a resolution to implement strict criteria for scientific whaling, requesting the Japanese government not to issue a scientific permit. On the domestic level, Prime Minister Nakasone actively intervened into the policy because of his fear for the negative international response.[11] According to a high-ranked bureaucrat in the Fishery Agency, who was involved with designing the program, Nakasone publicly stated that "catching 800 whales is too high, and even if it is reduced to half, it's still too high." The same bureaucrat interpreted this statement as indicating the upper limit of the catch, and, subsequently, requested scientists to draft a new proposal. Upon this request, Tanaka, reluctant to change the integrity of the already established research plan, told the bureaucrat that scientists needed to carry out the research with a scientifically meaningful quota. Nonetheless, he drafted a new proposal with the reduced quota, making it appear to be devoid of the political negotiations by stating that the reduced quota would not harm the abundance of minke whales. In late December, the whaling ship finally set on sail to Antarctica after Kyodo Hogei was dissolved and reestablished as Kyodo Senpaku (the term Senpaku or chartering ships is deliberately used to erase whaling from the

company's name and make it appear completely vague). Joined by only three researchers from the newly established ICR, the first voyage was done in the name of investigating the feasibility of the research program, catching only 144 minke whales.

Unsurprisingly, the execution of scientific whaling immediately attracted intense criticisms and debates both inside and outside the IWC. While most of them were raised against the "disguised nature" of Japan's scientific whaling, some specialists openly challenged the scientific validity of the program itself. Interestingly, shortcomings of Japan's scientific whaling were mainly attributed to the scant feasibility in achieving the set goal or possible biases embedded in collecting and interpreting ear plugs. The following statement posted by a British biologist in the journal *New Scientist* (1987: December 10, p.12) exemplifies the first point:

> Leaving aside the question of whether the Japanese could do, mathematically, what they claimed, 825 whales is a very small sample indeed if the scientists want to extract from it estimates that they can rely on. How much flimsier is a sample of only 300? If the Japanese had the courage of their scientific convictions, they would have asked for more whales, not fewer. The truth is, of course, whales are not going to be killed for science. They are going to be killed for commerce.

This statement openly accuses the "true" intention behind the science, but also assumes that the accurate estimation would be impossible with what is considered *too small* samples of whales. Other scientists pointed out possible bias in procedures of empirical methods, such as sampling whales (e.g. smaller whales are excluded from the lethal research), treatment of ear plugs (e.g. a large number of ear plugs are broken or incomplete), and interpretation of laminae on ear plugs (e.g. unskilled readers cannot count the laminating patterns accurately). As for the last point, a British scientist suggested at a SC meeting that some layers of ear plugs make confusing patterns that may lead to different interpretations and conclusions based on differences in the readers' experiences. To counter this argument, three Japanese cetologists made an inter-calibration study among themselves, demonstrating that their counting of ear plugs did not make a meaningful gap and was not biased (Kato et al. 1991). As seen in these exchanges of arguments inside and outside the IWC, once the research plan was framed with a law-like, quantitative statistics, it became increasingly difficult to disprove the scientific scheme. In this rendering, the validity of hunting whales to extract their ear plugs was rather unquestioned[12] although there has been considerable debate and dispute inside the SC.[13]

In sum, despite routine criticisms, Japanese cetologists protected their scientific authority by maintaining their status as providers of reliable and rigorous knowledge. This empiricist self-validation was backed by the combination of "unbiased" sampling methods and complex mathematic models, which rendered the practice of collecting ear plugs *and* hunting whales as an inevitable procedure. Although their research findings and scientific claims would not persuade their opponents, their protective boundary work —the ways in which scientists prevent external interventions into their privilege and

authority—was successful in its minimum sense. As a result, it became difficult or nearly impossible to disprove that hunting whales can generate scientific facts.

5. Conclusion

This paper traced the formation of Japanese cetology in a larger historical, political, and economic context. First, I explored the interactive processes between the IWC's management and Japanese cetology in the construction of a particular problem and solution during the commercial whaling period. The IWC's problematization of rapid depletion of whales generated a demand for stronger scientific intervention in the late 1960s. Yet, the IWC still lacked critical biological information about whales, that is, the age data, which prevented its statistical experts from fully estimating the maximum sustainable yield.

Second, this paper traced how Japanese cetologists in the industry-sponsored Whale Research Institute succeeded in establishing the aging method by collecting and interpreting ear plugs to fill this absence of biological knowledge. What enabled them to do so was the heterogeneity of elements involved in their research project: constellation of commercial practices of flensing whale meat and scientific practices of extracting earplugs. One social outcome of this assemblage was that the scientific work became increasingly systematized and dependent on "invisible" skills of whaling crews. This gradual articulation of the relationship between whales, whalers, and cetologists was a critical premise for Japanese whaling to transition from the commercial to scientific project.

Finally, this paper reconstructed the detailed processes in which the research plan for scientific whaling was drafted, negotiated, and eventually formulated by the three groups of bureaucratic, corporate, and scientific actors. The shift to scientific whaling was primarily driven by political judgments, but the reconfiguration was fundamentally based on the same practice of extracting ear plugs. By randomizing the hunting method and mathematizing the value of the age data, this practice was transformed into a robust ideology that legitimized hunting whales in the name of science. In this way, though forced in a reactive mode, the ICR could defend its monopolization over the expertise by preventing criticisms from invalidating its scientific work.

Notes

1) I am fully aware of the risk in narrowly focusing on this biological material while disregarding other topics that Japanese cetologists have investigated and that IWC's SC has debated. To list a few examples, other topics include the stock boundary, DNA sampling, feeding patterns, validity of computer modeling, "humane" methods of hunting whales, etc. Due to the space limit, it is impossible to describe the development of each of these topics. Each of these topics is heavily disputed inside the IWC SC.
2) Because baleen whales' ears are enclosed under the surface of the skin, it keeps accumulating

layers. Harwood (1989: 68) explains the mechanism of laminae as following: "(t)he ear plug is a waxy structure, of a flattened conical shape, found in the external auditory meatus, and is 1 to 7cm in length…The central core of the ear plug sits on the glove finger. It is composed of columns of keratinized epithelial cells which appear as series of light and dark zones, as in the rings of trees. Roe found that the light zone was formed from round cells full of intracellular fat, which, as the plug grew and the cells were pushed from below into the core, were flattened and keratinized, and the fat was squeezed out into a layer. After longitudinal sectioning, the laminae can usually be seen by eye and can be counted with the aid of a low-power binocular microscope."

3) It should be emphasized that ear plug is used as the most reliable, but not absolute, material to estimate the age of whales. In other words, there has been no direct verification to date to prove the absolute temporality of each lamination.
4) Most of the existing literatures on the IWC or Japan's whaling politics leave out the issue of scientific whaling. Even science-studies-oriented political scientists, like Heazle (2006), or historian of science like Burnnet (2012) trace the trajectory of scientific management of the IWC only up until the imposition of the moratorium.
5) On minke whales, Horwood (1989: preface), a British cetologist, states that "(i)n common with most studies on large whales, information on minke whales comes from samples taken by the industry. Commercial operations are highly selective in time, space and size, and they neither provide a random sample of the population nor generally cover the total distribution of the whales."
6) There was data about catch and catch per unit of whaling effort (known as CPUE), but this did not provide population estimates required for calculating the MSY. This statistical data was submitted by each whaling company to the Bureau of International Whaling Statistics in Norway.
7) On the high percentage of the ear plugs Japanese whalers extracted from caught whales, Horwood, a British cetologist specialized in minke whales, notes (1989: 69) as following: "More detailed information was provided of Japanese sampling from the Antarctic over the seasons 1971/1972 to 1980/1981. Over the last 3 seasons, the accumulated catch exceeded 9000, and from 91% of these, an ear plug was collected in reasonable condition. Of these collected, 81% were readable, 17% were damaged, and 2% were unreadable because of unusual growth layer patterns. An improvement in the proportion of the catch aged was shown over the period, from 49% in 1971 to 78% in 1980/1981. This was manly due to improved readability of those collected, associated with greater care taken over sampling sectioning."
8) Horwood (1989: 32) describes the significance of this sighting survey: "(t)he most useful body of data on the distribution of all large whales is that of sightings surveys carried out by the Japanese whaling industry…They were carried out using whale catcher boats with experienced whales as crew and were used in a strategic role by the industry. Although the methods of search were generally not random, the considerable effort expended makes these data invaluable, especially with respect to determination of spatial and temporal distribution."
9) This sighting research came out of a long dispute over the minke whale stock, the last and smallest species of baleen whales Japanese and Soviet whalers hunted until the end of commercial whaling. The dispute was primarily caused by the absence of sufficient data that

polarized the interpretations between pro- and anti-whaling scientists. There was a considerable disagreement over the MSY level of minke whales. While Ohsumi claimed in 1972 that it should be 12,230 animals, another British scientist, Chapman, insisted that the estimate was "much too large and that a more reasonable estimate on the basis of analogy with other species is about 5,000." The SC called for an international survey to solve this dispute as well as to respond to the growing pressure to implement the moratorium. See Heazle (2006: 142–143) for the details of this dispute.

10) This promise was used by the remaining whaling nations—Iceland, Korea, Norway, and Japan—to justify the practice of taking whales for scientific research. In the absence of clearly defined objectives for the future assessment, the agreement allowed them to catch whales to collect "biological data" although each country's research agenda and priorities varied (Heazle 2006: 176).

11) It is very unusual for Japanese Prime Minister to make public statement about a particular policy and intervene into the bureaucratic process. As Wong notes (2001: 121), "Japanese prime ministers have generally refrained from active involvement in policy making. However, in a rare move, Nakasone used his executive powers to override the powerful bureaucracy and acted personally to produce a policy decision he considered favorable for his own political agenda. Nakasone's independent and public proposal to remove sperm whales from the research whaling program as well as to reduce the number of minke whale catches forced the Fisheries Agency to modify its paths. This was something that he was unable to achieve through closed-door talks with the Fisheries Agency. Nakasone knew he could not please both the foreign critics and the Fisheries Agency, and he chose to present himself as a forceful, international-minded chief executive."

12) This point became more obvious when Japan's scientific whaling was compared with that of Korea, which only collected a very few ear plugs and other useful body parts from the hunted minke whales. The IWC's SC criticized the Korean research, conducted only once in 1986, for not having scientific value because it collected "only a fraction of the potentially available biological data" and "may have caused a further reduction of this depleted stock" (New Scientist 1987: 30).

13) These debates mainly focus on whether the research conducted by Japan meets the criteria developed. In addition to the methodological difficulties mentioned above, opponents have argued that none of the Japanese results to date have been used to improve the current management plan, which is RMS, except their data on stock identity. Moreover, the IWC's SC was criticized for not institutionalizing mechanism of review to control the scientific whaling programs.

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