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# **The Complex Evolution of Japan's Distant Water Fisheries**

Sara Dreijer

# The Complex Evolution of Japan's Distant Water Fisheries

*Exploring the evolution of Japan's distant water fisheries from  
1950-2014*

Sara Dreijer

Supervisor: Robert Blasiak  
Co-supervisor: Henrik Österblom  
Examiner: Örjan Bodin

## Abstract

Fisheries are dynamic social-ecological systems shaped by the interplay of diverse political, economic, social and ecological factors. Recently, recognition has grown that fisheries are complex adaptive systems and warrant examination within a broader social-ecological context. While there has been a recent trend within fisheries science and management towards embracing more holistic approaches, research on global fisheries rarely addresses the complexities that shape large-scale fishing patterns. In this thesis I adopt a complex systems perspective with the ambition of understanding the complex and context-specific nature of global fishing by exploring the evolution of the Japanese distant water fishery (DWF). By combining investigation of global catch statistics with a review of associated primary, secondary and grey literature, I produce a narrative of how the Japanese DWF has expanded and contracted between 1950 and 2014, its geographical extent, and the factors that have contributed to these patterns. The results illustrate how complex and context-specific the DWF system is in the case of Japan. Using this in-depth study, I then address recent publications on global fisheries that use approaches that tend to minimise complexity through generalisations rather than seeking a deeper understanding of how this complexity shapes global fisheries. Finally, based on the exploratory findings of this thesis, I suggest that to better understand the complex dynamics inherent to global fisheries, further research informed by complexity thinking is needed on distant water fishing nations.

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## List of Abbreviations

DWF – Distant water fishery

DWFN – Distant water fishery nation

EEZ – Exclusive Economic Zone

FAO – Food and Agriculture Organisation

FFA – Pacific Islands Forum Fisheries Agency

FSM – Federated States of Micronesia

MAFF – Ministry of Agriculture, Forestry and Fish (of Japan)

nei – Not elsewhere included (category of fishes in SAU dataset)

ODA – Official development assistance

OECD – Organisation for Economic Co-Operation and Development

PIC – Pacific island country

PNA – Parties to the Nauru Agreement

PNG – Papua New Guinea

RFMO – Regional fisheries management organisation

RQ – Research question

SAU – Sea Around Us

UNCLOS – United Nations Convention on the Law of the Sea

USSR – The Union of Soviet Socialist Republics (also known as the Soviet Union)

US – United States (of America)

WCPO – Western Central Pacific Ocean

WWII – Second World War

## 1. Introduction

Fishing is one of the most widespread activities in which humans harvest natural resources around the world (Swartz et al. 2010). Globally, fish account for 17% of animal protein consumed by humans, and more than 3 billion people rely on fish as an important source of animal protein (FAO 2018). So fisheries provide important resources for food and livelihood. The fishing industry as a whole has changed dramatically over the last few decades. From relatively small-scale fisheries that mainly provided for coastal fishing communities and human populations close to the fishing waters, fisheries worldwide have become heavily industrialised (Pauly et al. 2005). Fish markets have also become increasingly interconnected and globalised (Vannuccini 2003).

However, today it is also recognised that global fisheries are in a state of crisis (The World Bank 2004; Pauly et al. 2005; Mahon et al. 2008; Pitcher & Cheung 2013). Global catches have stagnated since the early 1990s (Watson & Pauly 2001; World Bank 2017), and patterns of overexploitation and stock depletion have become increasingly evident (FAO 2012; World Bank 2017; Ye & Gutierrez 2017). Sustainability in global fisheries has become a growing concern (Pauly et al. 2002). Historical examination of fisheries has suggested that over-fishing by humans has shaped fish stocks, as well as the dynamics of ecosystems and the social system (Jackson et al. 2001; Pauly et al. 2002; Frank et al. 2007; Österblom & Folke 2015). These ideas challenge the traditional notion that the fisheries crisis is largely due to environmental changes beyond the influence of human activity, and also highlight the complexity that surrounds these issues. This way of thinking of human activities and environmental conditions as linked has been supported in sustainability research, but adoption of such perspectives into fisheries science has been slower (Pitcher & Cheung 2013).

Although complexity and unpredictability is something that fisheries researchers and managers have had to struggle with for a long time, the conventional perspective on fisheries systems has been that they are ultimately predictable and controllable. This belief underpins the assumption that sustainability can be achieved provided there is

enough information to determine adequate regulatory measures (Wilson 2006; Mahon et al. 2008). As a result of this underlying belief the focus has been on collecting more data, constructing more complex models and refining regulatory systems of control (Mahon et al. 2008). Conventional fisheries assessments have focused on key variables, such as catch, fishing mortality and biomass to make quantitative predictions about how different management options impact specific fish stocks (e.g. see Hilborn & Walters 1992). But these approaches have seldom been successful in achieving long-term sustainability in fisheries. And as conventional measures have failed the most recent trend within fisheries science and management has moved towards more holistic views, recognising fisheries as complex adaptive systems (Mahon et al. 2008; Arlinghaus et al. 2017) and advocating investigation of fisheries in a broader context as social-ecological systems (Österblom & Folke 2015).

In complex systems the components of the system interact and change over time, and the system is inherently unpredictable (Cilliers 2008). Complexity thinking recognises non-linear dynamics and uncertainty, and advocates that the system is ultimately unknowable (Rogers et al. 2013). One way of understanding a complex system is by recognising patterns of change within that particular system. These patterns can be seen as historical events and by understanding the mechanisms that led to a particular outcome we can better understand the system (Wilson 2002).

In this thesis I will look at the Japanese distant water fishery (DWF) from a complex systems perspective to better understand the evolution of Japan's DWF over time. The Japanese distant water fleet is an interesting case as Japan has been recognised as a major actor in global fisheries over the last few decades. Fisheries have played a significant role in Japanese history and culture for a long time but after the Second World War Japanese distant water fishing expanded worldwide (Bestor & Bestor 2011). Due to this global reach Japanese distant water fisheries shaped marine resource exploitation in places all around the world.

Japan's distant water fishing has been the focus of several publications over the last few decades, but the focus of English-language literature on Japanese distant water fishing has usually fallen into one of two categories (although the literature can overlap between the two). The first deals with foreign policy perspectives of Japan's distant water fisheries. This type of literature often discusses Japan's distant water

fisheries through the development of international ocean law or Japan's role in fisheries negotiations (e.g. focus on process or policy making, see Teiwaki 1987; Akaha 1993; Scheiber et al. 2007; Hayashi 2008; Masahiro 2013) or Japan's diplomatic motivations and strategies (e.g. why have Japan acted as they have, see Chapman et al. 1982; Inada 1990; Stokke 1991; Tarte 1997; Miller & Dolšak 2007; Drifte 2016). The second type of literature tends to focus on specific fisheries in relation to Japan's distant water fishing. Significant attention has been paid to tuna fisheries, as well as whaling. But other fisheries, such as pollock, salmon, crab, squid and krill, have also been covered to a lesser extent. These works have commonly covered detailed accounts of the specific fishery, its historical development or international management issues of that specific fishery (e.g. see Matsuda & Ouchi 1984; Wespestad 1993; Bergin & Haward 1994; Haward & Bergin 2001; Ono 2004; Hemmings 2006).

Both these areas of literature contribute to an understanding of how the Japanese distant water fishery as a whole has changed over the last decades, but generally very little has been written about the Japanese distant water fishery system from a macro-scale perspective. Some work, such as Kasahara's (1972) review of Japan's distant water fisheries, and Smith's (2014) book on Japan's international fisheries policy have contributed to filling this gap. But Kasahara's account is getting dated, and although Smith attempts to contextualise his investigation, the work (perhaps influenced by traditional reductionist thinking) tends to reduce the drivers of the entire Japanese DWF development into a few key factors, i.e. primarily a desire for food security.

So although Japan has been described as a major actor in global fisheries and one of the largest exploiters of fish worldwide these accounts provide limited understanding of the social and political contexts that have shaped such global exploitation patterns. Furthermore, the Japanese distant water fishery has seldom (and to my knowledge never explicitly) been considered from a complex systems perspective. The aim of this thesis is to explore how the Japanese distant water fishery, in its complexity, has evolved since the end of WWII. This will be done through a data-driven exploratory study. The exploration starts in the investigation of quantitative catch statistics and is

complemented by reviewing other sources in order to contextualise the patterns and changes that have occurred as the Japanese DWF evolved over time.

### **1.1. Research questions**

Two research questions were identified as a starting point for the investigation into the evolution of the Japanese distant water fishery:

RQ 1. *How has the geographical expansion of Japan's distant water fishery changed over time?*

RQ 2. *What political, economic, institutional, socio-cultural, or other factors have driven these changes?*

### **1.2. Structure of thesis**

I begin Chapter 2 by going into the theoretical framework of my thesis, followed by the analytical approach that I outline in Chapter 3.

Setting the scene for the results section I briefly describe the background of Japanese fisheries in Chapter 4, outlining its historical importance, institutional structure and how the Second World War affected the fishery.

In Chapter 5 I present the results, first answering RQ1 by outlining the spatial expansion and evolution of Japan's DWF (in 5.1.). This is followed by a narrative section describing events and changes that have shaped Japan's DWF in a few select places around the world (in 5.2.). I then answer RQ2 by describing factors that have shaped the Japanese DWF (in 5.3.).

Insights gained from the exploration are discussed in Chapter 6, where I focus on the exploitation pattern of Japan's DWF and how it differs from other DWF nations (in 6.1.), the Japanese DWF as a complex system (in 6.2), and lastly I reflect on scales (in 6.3.).

Finally, the thesis is concluded in Chapter 7.

## 2. Theoretical framework

### 2.1. Complex systems theory

Historically, traditional “scientific” knowledge (i.e. verifiable knowledge) has been regarded as the most reliable form of knowledge (Cilliers 2008). This traditional style of scientific thinking, also referred to as reductionism, seeks to objectively understand the world as a set of separable components (Rogers et al. 2013). By breaking down the system into its simplest components it is presumed that it can be explained and understood by analysing the different components that make up the whole. A linear cause-and-effect relationship is assumed between these individual parts, and thus the structure and behaviour of the system is believed to be ultimately knowable (Rogers et al. 2013). This way of thinking has been (and to a large extent still is) the predominant way of thinking within fisheries.

But recently, in the face of a prevailing fisheries crisis and failure of conventional reductionist approaches, a completely different mindset has gained traction. Increasingly fisheries have been characterised as complex systems and complexity thinking has been advocated as an alternative in fisheries research (Mahon et al. 2008; Arlinghaus et al. 2017). In complexity thinking the system is not knowable, and variability and uncertainty are taken as part of the system (Cilliers 2008; Rogers et al. 2013). This way of thinking acknowledges that the components of the system interact in complicated, unpredictable ways (Rogers et al. 2013). This has been argued to allow for an understanding that better reflects the realities of systems and phenomena in the real world (Mahon et al. 2008; Rogers et al. 2013; Arlinghaus et al. 2017).

Some have highlighted that a commonly agreed definition of complexity theory has not formed, and also argue that complex systems by definition defy definition (Cilliers 2008). But some common characteristics are highlighted among different authors as key features in complex systems, including a focus on *relationships and interaction* of the components of the system rather than the components themselves; *feedbacks* that can either promote or inhibit change in the system; *non-linearity* that

limit back-tracing of causal links and means system changes may be irreversible; *emergence* that stems from interaction of the micro-scale components that give rise to macro-scale patterns; and *self-organisation* when new structure develops from within the system as micro-scale components interact. These characteristics and how a few different authors have described them, as well as my interpretation of these in relation to fishery systems are compiled in Table 1.

Table 1. Characteristics of complex systems as described by different authors (Arlinghaus et al. 2017; Cilliers 2008; Ramalingam et al. 2008) as well as an explanation of my own interpretation of those characteristics with regard to commercial capture fisheries.

Characteristic	Arlinghaus et al 2017	Cilliers 2008	Ramalingam et al 2008	My interpretation (with regard to commercial capture fisheries)
Fundamentals of the system and its components	<ul style="list-style-type: none"> <li>• Diversity and individuality of components</li> </ul>	<ul style="list-style-type: none"> <li>• Complex systems are open systems</li> <li>• Consists of many components. Components themselves are often simple (or can be treated as such)</li> </ul>		<p>Fisheries can be considered complex social-ecological systems made up of diverse set of components. The fishery system includes both natural components, (e.g. the fish stock) and social components (e.g. fishers/fishing fleets, fishing companies, fisheries managers etc.). The system is open because it is influenced by its environment and by other systems that it interacts with, i.e. markets, political systems, other fishery systems etc. Thus, defining the boundary of a complex fishery system can be tricky and depend on the problem/purpose of study.</p>
Relationships and interaction of components		<ul style="list-style-type: none"> <li>• The state of the system is determined by the values of the inputs and outputs</li> <li>• Interactions are defined by actual input-output relationships and these are dynamic (the strength of interactions change over time)</li> <li>• Components, on average, interact with many others. There are often multiple routes possible between components, mediated in different ways.</li> </ul>	<ul style="list-style-type: none"> <li>• A complex system is one made up of multiple elements (which may be elements or processes), which are connected to and interdependent on each other and their environment.</li> </ul>	<p>In a fishery system the components interact with one another, e.g. fishers/fishing fleets interact with fish stocks by extracting fish, they also interact with other fishery businesses by selling that fish to retailers/processors, government authorities interact with fishing fleets by regulating their activities and restricting/incentivising certain behaviour. Managers interact with political authorities by lobbying for certain policies etc. These interactions are dynamic and determine how the system as a whole behaves.</p>

Feedbacks		<ul style="list-style-type: none"> <li>• Many sequences of interaction will provide feedback routes, whether long or short.</li> </ul>	<ul style="list-style-type: none"> <li>• At its most basic, feedback can be amplifying, or positive, such that a change in a particular direction or of a particular kind leads to reinforcing pressures which lead to escalating change in the system.</li> </ul> <p>Feedback can also be damping, or negative, such that the change triggers forces that counteract the initial change and return the system to the starting position, thereby tending to decrease deviation in the system.</p>	<p>Feedbacks occur when interactions between components mutually influence one another. In fisheries systems feedbacks can occur in interaction between e.g. fishing fleet and fishes, one fishing fleet to another, fishing fleets and other fisheries stakeholders (e.g. government agencies, management agencies, fishing companies etc.), or fisheries stakeholders and other non-fisheries stakeholders.</p>
Non-linearity		<ul style="list-style-type: none"> <li>• Output of components is a function of input. At least some of these functions must be non-linear.</li> </ul>	<ul style="list-style-type: none"> <li>• Nonlinearity is a direct result of the mutual interdependence between dimensions found in complex systems. In such systems, clear causal relations cannot be traced because of multiple influences.</li> <li>• The behaviours of complex systems are sensitive to their initial conditions. Simply, this means that two complex systems that are initially very close together in terms of their various elements and dimensions can end up in distinctly different places. This comes from nonlinearity of relationships – where changes are not proportional, small changes in any one of the elements can result in large changes regarding the phenomenon of interest</li> </ul>	<p>Nonlinear dynamics of fisheries systems mean that simple changes in one part of the system can create complex effects throughout other parts of the system. It is not only referred to in the context of nonlinear relationship between two variables, e.g. stock size and harvesting rates (see Anderson et al. 2008), but for complex systems nonlinearity means that interactions change as the system evolves and develops, e.g. unexpected establishment of a fish can completely alter social and ecological interactions and processes throughout the system (see Arlinghaus et al. 2017)</p>

Emergence	<ul style="list-style-type: none"> <li>Localised micro-scale interactions lead to emergent macro-scale patterns</li> </ul>	<ul style="list-style-type: none"> <li>Complex systems display behaviour that results from the interaction between components and not from characteristics inherent to the components themselves. This is sometimes called emergence.</li> </ul>	<ul style="list-style-type: none"> <li>Emergent properties are often used to distinguish complex systems from applications that are merely complicated. They can be thought of as unexpected behaviours that stem from basic rules which govern the interaction between the elements of a system.</li> </ul>	In fisheries systems the local behaviour of fishers/fishing fleets can affect large-scale patterns such as spatial pattern of fishing effort and regional patterns of overharvesting etc. (e.g. see Arlinghaus et al. 2017).
Adaptive agents			<ul style="list-style-type: none"> <li>Complex systems made of adaptive agents are distinguished by the term complex adaptive systems, and they exhibit a number of specific phenomena [...]. The ability of adaptive agents to perceive the system around them and act on these perceptions means that their view of the world dynamically influences, and is influenced by, events and changes within the system.</li> </ul>	In fisheries different actors can react to changing circumstances as they become aware of them (i.e. changes in environmental, social, political, economic circumstances). This leaves room for adaptation, e.g. fishers may adapt to changing conditions e.g. availability and quality of resources, (e.g. move or change target species) or changing management regimes (e.g. decide to renew operating licence or not). So adaptation can both be influenced by as well as influence changes in the system.
Self-organisation	<ul style="list-style-type: none"> <li>Autonomous, self-organised process that uses outcomes of local interactions as feedback for adaption through selection and evolution</li> </ul>	<ul style="list-style-type: none"> <li>Complex systems generate new structure internally. It is not reliant on an external designer. This process is called self-organisation.</li> </ul>	<ul style="list-style-type: none"> <li>Self-organisation is where macro-scale patterns of behaviour occur as the result of the interactions of individuals who act according to their own goals and aims and based on their limited information and perspective on the situation</li> </ul>	One example of self-organisation process related to fisheries has been described in fisheries governance in areas of shared common resources, such as the Central Arctic Ocean, where existing means of governing commons, i.e. privatisation or government control, is not possible/appropriate. The alternative is described as a self-organisation process where stakeholders negotiate management regimes among themselves as a result of compromise between all when no one is in a dominant position (see Pan & Wang 2016).

### 3. Methodology

#### 3.1. Ontological and epistemological position

In this thesis I hold a complex realist ontological position. Complex realism draws from a combination of ideas from complexity science and critical realism (Bevan 2010). Although complex realism sits on the realist spectrum, it sits much closer to relativism in the sense that it lacks conviction in one's ability to define the true nature of reality and that reality can change as humans' capacity to understand or describe it changes (Moon & Blackman 2014)(Figure 1). Complex realism presumes that reality is not completely knowable and is constantly shaped by social, political, cultural, economic, ethnic, and gender values etc. This supports the idea of the evolution of a fishery system, i.e. the Japanese DWF, as a complex system that is also influenced by environmental and socio-economic dynamics that has shaped how it evolved over time.

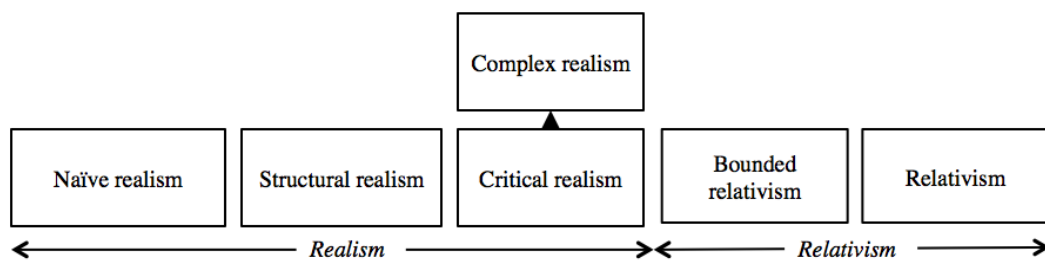


Figure 1. Spectrum of different ontological positions between realism and relativism. Adapted from Moon & Blackman 2014, p. 1169 (original without complex realism included)

As for epistemology of the thesis, I hold a more agile position. As I apply a systems perspective considering to some degree both natural and social aspects of the Japanese DWF, I believe knowledge about some aspects of the system, e.g. the patterns of fishing activity, can be objectively determined. Thus in answering RQ1 I take a more objectivist stance as I attempt to map out patterns based on quantitative data. However, investigating other aspects of the system draw on more interpretivist epistemology. Knowledge about social system dynamics is influenced by my

interpretation of the cultural and historical context in which these have been described (Moon & Blackman 2014). Even trying to explore RQ2 as objectively as possible, my own values and understanding of the system will influence the narrative I present to answer it (Bryman 2012). But in this thesis I also recognise that different ways of knowing, i.e. epistemological pluralism (Miller et al. 2008) could lead to more complete understanding of complex phenomena, such as the evolution of the Japanese DWF.

## **3.2. Methodological approach**

I used an exploratory approach to investigate the evolution of Japan's distant-water fishery. I did this by using quantitative catch data as the starting point of the exploration (see Section 3.3.1.). To answer RQ1 I mapped out temporal and spatial patterns of Japan's DWF through analysing the quantitative data (see Section 3.4.1. and 3.4.2.).

From the quantitative data exploration I selected areas that showed interesting patterns (selection process outlined in Section 3.4.3.). I used these areas as 'anchor points' to guide the complementary phase of the investigation that focused on reviewing qualitative sources to explore why these patterns emerged (see Section 3.3.2. and 3.4.4.). To answer RQ2 and to illustrate factors that shaped the evolution of Japan's DWF operations I used the selected areas to frame my analysis.

## **3.3. Data collection**

### **3.3.1. Quantitative data: Sea Around Us database**

I used national catch data from the Sea Around Us (SAU) project ([www.seaaroundus.org](http://www.seaaroundus.org)). Sea Around Us provides global fisheries and fisheries-related data that has been spatially disaggregated and assigned to finer spatial scales. SAU use FAO (Food and Agriculture Organization of the United Nations) officially reported statistics together with other databases to cross-reference landings with species distributions and records of access arrangements to improve spatial precision of the data (for detailed information on SAU methods for spatial disaggregation, see Lam et al. 2015). In addition, SAU data has been reconstructed to provide a globally

consistent time-series of catch data from 1950 until 2014 (Zeller et al. 2016). This has been done through a seven-step approach to reconstruct catches (for detailed explanation of the SAU reconstruction approach, see Zeller & Pauly 2015).

I chose to investigate the catch data at the scale of “Exclusive Economic Zones”<sup>a</sup>. This scale was most relevant when considering factors (e.g. social or political) that are usually associated with administrative units at similar scales.

### 3.3.2. Qualitative data: Literature

The qualitative data used in the complementary phase includes primary literature (peer-reviewed papers), secondary literature (review papers; monographic books), and grey literature (Government documents; Parliamentary debate records; organisational and institutional reports; working papers; theses and dissertations; online news articles). I opted for a variety of source materials in order to open for more perspectives and input for my analysis. This also increased the input into areas where scholarly material was scarce. Furthermore, examining a variety of sources is common in historical research where the researcher wants to verify different sources, as well as navigate biases and different perceptions of an event (Saucier Lundy 2012). This also seemed appropriate in my attempt to reflect complexity in the analysis. However, my study relies heavily on English language sources, and Japanese language material was accessed second-hand through English language material, or via available translations (e.g. some journal articles) or English language versions, (e.g. Japanese Government documents, i.e. White Paper on Fisheries, available 2002-2014).

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<sup>a</sup> As defined by SAU. This includes EEZs, EEZ-equivalent waters (for years pre-dating the declaration of the country’s EEZ), or a sub-unit of the country’s EEZ (i.e. some large or geographically separated sections of EEZs have been split in the SAU dataset to provide a finer resolution global grid, e.g. the EEZ of the US mainland has been split into 5 separate sub-units (“East Coast”; “West Coast”; “Gulf of Mexico”; “Alaska, Arctic”; and “Alaska, Subarctic”). For specification of each EEZ area, see [www.seaaroundus.org](http://www.seaaroundus.org)

### 3.3.3. Scope

I found that defining the scope of the investigation was challenging, as the boundaries of exploration were largely undefined from the start. The SAU dataset formed some practical boundaries to the work from the beginning, e.g. as the SAU dataset is available from 1950 and Japan was under fishing restrictions post-WWII until then. Therefore I concluded that 1950-2014 was an appropriate time frame to work with. As it is impossible to explore all places across all times the real challenge was to determine how much to look at and how deep to dig. It was only through the process of exploration that I could start setting up limits to my study.

Although distant water fishing also includes fishing on the high seas, I decided to exclude the high seas from my investigation due to time limitations and because catch levels from high seas constituted a relatively small proportion of Japan's overall catch (at most 6.7% of total catch from all high sea areas globally in any given year). Illegal, unreported, unregulated (IUU) fishing was also excluded due to time constraints and limited relevant material. I also excluded whaling from the scope of this study, partly because whale catch is not included in the SAU data that I have been working with, and whaling is also treated as a fishery independent from ordinary fisheries in Japan, and statistical records also differ (Makino 2004), i.e. whale catch is recorded as number of whales instead of catch weight. Therefore I concluded that Japanese whaling practices lacked relevance for my investigation of Japan's industrial distant-water fishing operations. (See Epstein 2008 for an interesting perspective on the evolution of the (anti-) whaling regime, and some insight into Japanese whaling).

## 3.4. Data analysis

### 3.4.1. Visual pattern identification

I used visual exploration of the SAU data to identify interesting patterns. Visual exploration of large datasets can be advantageous when little is known about the dataset and the final goals of the exploration are vague (Keim 2001). Visual exploration was also suitable as the SAU dataset proved quite noisy and mathematical or statistical exploration was not useful. Visual exploration is an intuitive process that can still provide a high degree of confidence in the findings (Keim 2001). Similar to

my approach to the quantitative data exploration, visual data exploration usually involves three steps: overview, zoom and filter, and detailed dive (Keim 2001).

### 3.4.2. QGIS

I used QGIS to map out Japan's spatial expansion patterns. The EEZ vector shapefiles were obtained from Flanders Marine Institute (Flanders Marine Institute 2018), but I modified the EEZ vector layer manually to spatially match the areas of SAU fisheries data. These vector layers were used because they are freely available and were also the original source for maritime boundaries used by the SAU. I do not take any position on marine boundary disputes or maritime claims.

### 3.4.3. Selection of interesting areas

The process of selecting areas of interest was done through different steps. It was a highly iterative process as the inclusion and exclusion of areas were reconsidered throughout the process of digging into and learning more about different places.

In the first step I excluded all areas where no catch had been recorded. This left me with 181 EEZ areas where Japan had recorded catch at some point in time. I began the process of narrowing down the remaining EEZ areas by excluding all EEZs where total catch was so low that it made no significant contribution to the Japanese DWF enterprise. I set a threshold of 100,000 tonnes as the criteria for exclusion. I concluded that EEZ areas where total catch was below that threshold were insignificant and could be excluded because the aggregated total catch for all those EEZ areas combined made up only 1.8% of total catches. This led to a remaining 46 EEZ areas to work with. For all the 46 remaining EEZ areas I plotted catch over time. I also plotted other aspects of the fishery, such as species caught and use of gear.

From the graphs produced I noted "interesting features" in the fishing pattern for each individual EEZ area. Features that I considered interesting included sudden increase or decline in catch levels, high peak catch levels relative to other EEZs, periods of interruption in catch, changes in target species, or sudden changes in gear. These 'interesting features' then guided the investigation process into the different areas.

I started by scoping what literature was available and tried to situate the ‘interesting feature’ within a temporally and spatially defined context. Through the scoping process I could also start to prioritise areas that I thought were worth digging deeper into first. This was an iterative process as I went back over different areas repeatedly throughout the whole process and the list of areas was reconsidered as I learned more and discovered different aspects of the different areas where Japan had been fishing.

This step in the process was also more subjective, influenced by interpretivist epistemology, as my own interpretation and understanding of the literature may have shaped the process and the direction of the investigation. The final selection of 10 EEZ areas was determined to reflect important events and changes in the expansion of Japanese DWF operations. The whole process of selecting areas is outlined in Figure 2.

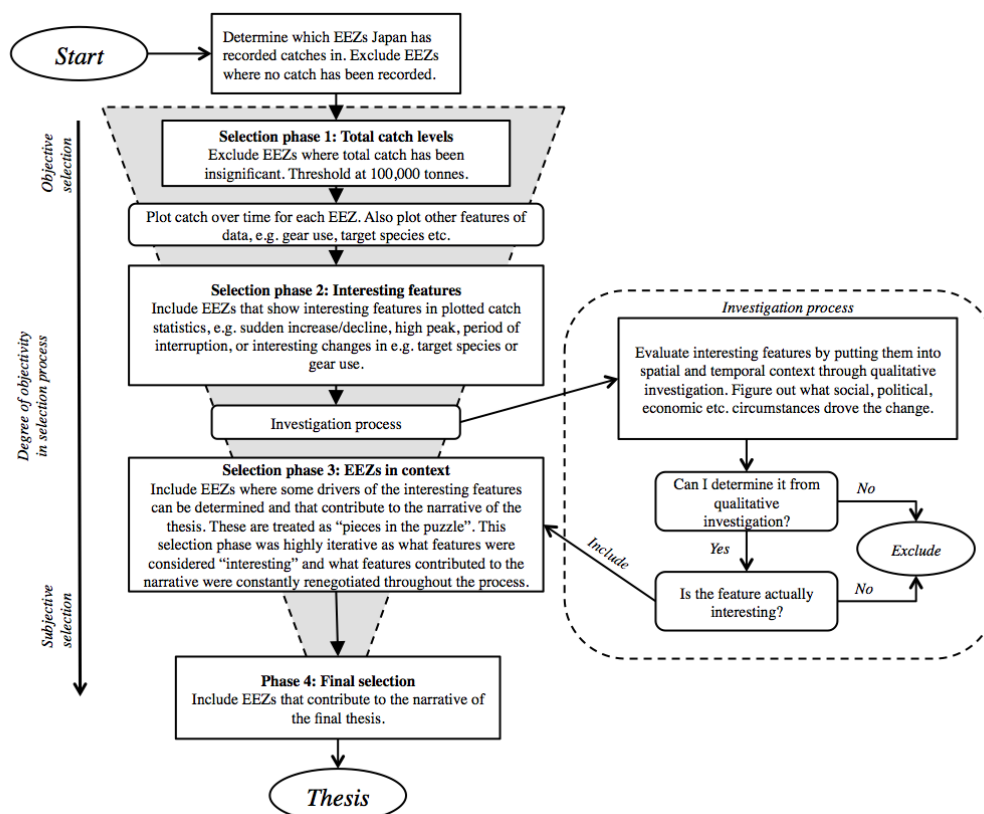


Figure 2. Schematic outline describing the process of narrowing down the selection of interesting areas

#### **3.4.4. Reviewing the literature**

Reviewing literature for the selected areas in this thesis are more similar to narrative reviews than other types of rigidly structured reviews. Unlike systematic reviews that are comprehensive and highly structured, the process of narrative review is less focused, less explicit about the criteria for exclusion and inclusion, and tends to have a wider scope (Bryman 2012). Because the purpose of the narrative review is to generate understanding instead of gathering knowledge, the process is more open. “The process of reviewing the literature [in narrative reviews] is thus a more uncertain process of discovery, in that you might not always know in advance where it will take you!” (Bryman 2012, p. 110). I opted for this approach because it is flexible and suited the explorative and more interpretative nature of my study.

Departing from the ‘interesting features’ that I identified in the quantitative data I focused my search on, e.g. the place, the year, target species etc. As I learned about the ‘case’ and Japan’s DWF practices in that place, the review was expanded and guided by the discoveries in the review process.

### **3.5. Reflections**

#### **3.5.1. Reflection on data quality**

Global fisheries data is notoriously uncertain and officially reported catch statistics have been shown to contain substantial biases (Watson & Pauly 2001). The SAU project was developed to identify the gaps in these official data kept by the FAO in an attempt to correct the dataset by filling these gaps in world fisheries statistics. Although praised as a valuable asset by many, the SAU dataset and the methodology it is based on have received criticism too. A number of assumptions used in the reconstruction have been questioned (e.g. Chaboud et al. 2015). Reconstructions have also been criticised for being significantly overestimated because they are extrapolated from “extremely small samples” and “unreliable numbers” (Cressey 2015, p. 282). Fisheries science is often highly localised, but one of the strengths of the SAU dataset is that it provides an opportunity to take a broad view on global fisheries. In this thesis I use the dataset, despite its possible shortcomings, as a tool to investigate Japanese distant water fisheries from a large-scale perspective too. The

SAU catch data are used to facilitate the exploration and as a means to illustrate the changes in Japan's distant water fisheries.

Among the investigated areas, the SAU data in African countries is of the poorest quality. A majority of catch statistics are reconstructed and underlying reported national catch statistics are fewer or unreliable due to limited record keeping in many African countries (Belhabib & Divovich 2014). For example, from the SAU dataset the majority of Japanese catches in Mauritania are unreported (reconstructed) estimates. Information on DWF activities in Africa has also been most difficult to find, and particularly material on Japanese DWF activities from the region, making it the most difficult area to investigate using secondary data. The data available is also of varying quality, and I had to rely on more grey literature than elsewhere as peer-reviewed material was more limited.

### **3.5.2. Reflection on methodological approach**

In this thesis I have applied a methodological approach that do not minimise the complexity of the system, but instead try to emphasise it. I tried to keep a wide systems view with detailed empirical analysis of quantitative data, while linking other types of data in order to provide a more holistic representation of the processes underlying the evolution of the Japanese DWF system.

My main challenge throughout the investigation was time management, as the iterative process between quantitative and qualitative data exploration was time consuming and difficult to plan in advance. Because the literature reviews in this study have not been systematic there is a risk that relevant information have been missed. The areas where supporting information was scarce, or of dubious quality, were also more difficult to investigate. Uneven availability and quality of information may have influenced the perceived importance of certain aspects that may have been missed out on in the analysis, potentially limiting the study.

At first I had concerns about doing this research from the "outside", looking at the Japanese DWF system as a researcher with limited prior experience of Japanese society, culture and language in general, and Japanese fisheries in particular. The prevalent use of English language sources, and relying on secondary accounts and

interpretations from others, also inevitably shaped the narratives produced. However considering the need for and importance of different knowledge perspectives in complexity thinking (e.g. as stressed by Miller et al. (2008) arguing for epistemological pluralism in understanding complexity), I do not believe research from an “outside” perspective is necessarily less valuable than other perspectives. By focusing on this topic, in spite of my own biases and limitations, this thesis could deepen understanding on a topic that may perhaps otherwise most comprehensively be studied from “inside” by Japanese researchers with their own sets of biases.

## 4. Setting the scene

### 4.1. Brief background on Japanese fisheries

Japan has been described as “a small island nation, poor in natural resources” (Bestor & Bestor 2011, p. 50). But as an archipelago made up of thousands of islands, Japan’s riches have always been tightly linked to the surrounding sea. The sea is said to play an enormous role in Japanese culture, history, society, art and identity (Bestor & Bestor 2011; Smith 2014). Isolated by the surrounding sea this has shaped Japanese national character as a maritime nation and Japan has relied heavily upon the ocean for livelihood, security and transport (Barclay 2008; Smith 2014). Fish is a prominent feature in Japanese food culture and has traditionally been the major source of protein in the diet (Bergin & Haward 1996; Smith 2014). So Japanese fishing has a long history and marine resources have been widely exploited for centuries (Bestor & Bestor 2011).

### 4.2. Institutional structure

Marine fisheries in Japan are broadly categorised into three classifications: coastal, offshore, and distant water fisheries (Makino 2004). This thesis will only focus on Japan’s distant water fisheries, thus all fishing within Japan’s own waters, i.e. its exclusive economic zone (EEZ), is not considered within the scope of the thesis. Distant water fisheries are defined as those operating outside the EEZ of their country of origin (Sumaila & Vasconcellos 2000). This includes high seas and foreign EEZs. Industrial distant water fisheries in Japan are regulated under the control of the central government under a licencing system (Kasahara 1972; Yagi n.d.). The Fishery Agency, *Suisancho*, under the Ministry of Agriculture, Forestry and Fisheries (MAFF) controls all major distant water fisheries. The government controls overseas fishing activities through restrictions on the total number of issued licenses, which limits the number of vessels; size of vessels; area of fishing; and gear/method of fishing.

Internationally, many fish stocks (particularly highly migratory species) are currently managed through regional fishery management organisations (RFMOs). RFMOs are made up of coastal states and DWF nations to cooperatively manage the resources of the high seas. RFMOs typically focus either on a species, e.g. tuna, or a particular region. Japan is a member of many RFMOs, including all the tuna RFMOs (Martí et al. 2017).

### **4.3. Impact of World War II**

Japan was already an important fishing nation before WWII, but the war brought devastation to the Japanese fishing industry. When the war ended Japan came under Allied occupation (Scheiber & Jones 2015). After Japanese surrender in 1945 fisheries activities stopped completely and a total ban on maritime navigation was imposed (Swartz 2004). More than half of the Japanese deep water fishing fleet had been lost during the war (Scheiber & Jones 2015). Facing the post-war devastation and impending food scarcity the Allied authority targeted rebuilding the fishing industry as one area of the recovery process (Matsuda 1987). Restrictions on Japanese fishing activities around Japan, known as the MacArthur Line, were extended in steps (see Figure 3) and the restrictions were completely abandoned when Japan regained its sovereignty in 1952 (Tarte 1998; Swartz 2004). This is the starting point of the investigation of this thesis.

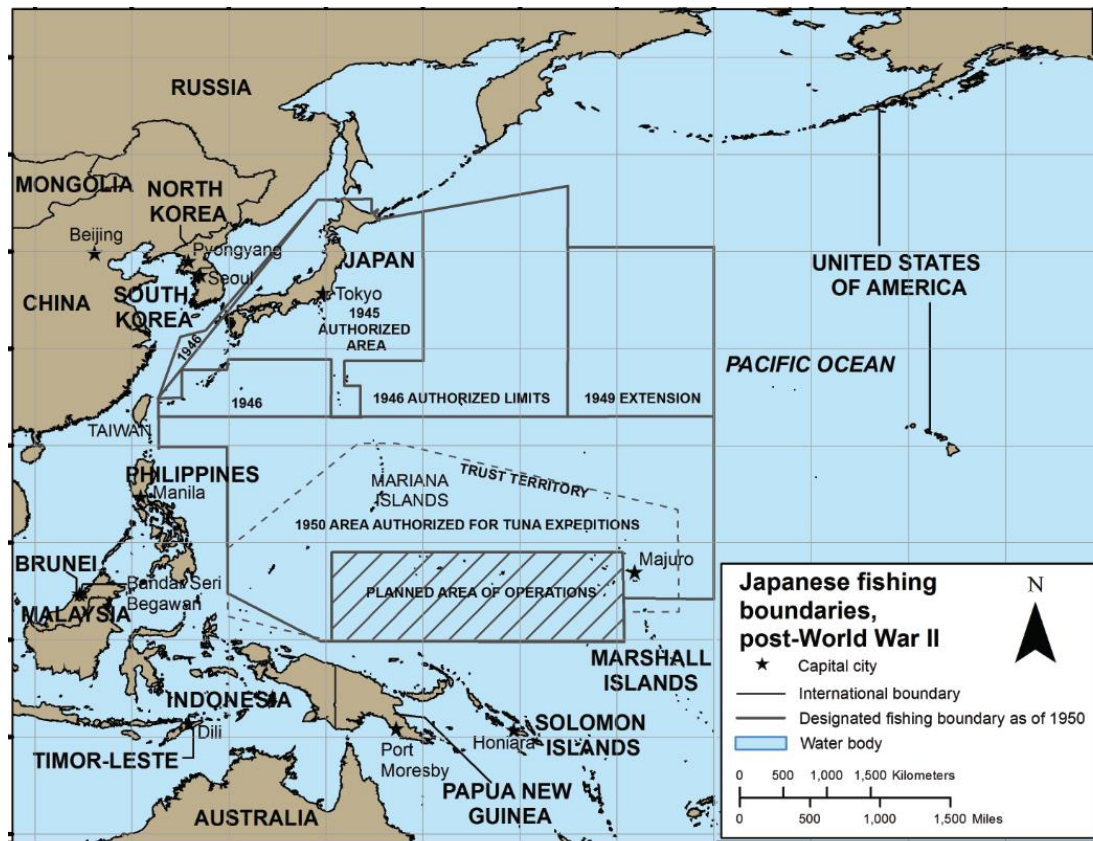


Figure 3. Map illustrating the extensions of the MacArthur Lines in post-WWII occupied Japan. From Scheiber & Jones 2015

## 5. Research findings

### 5.1. RQ1: Pattern of Japan's DWF

In the beginning of the 1950s, when the post-WWII restrictions imposed by the Allied Powers on Japan's overseas maritime activities were lifted, the Japanese DWF fleet expanded rapidly across the western Pacific Ocean, down south through Oceania and westward into the Indian Ocean (Figure 4). By the end of the 1950s Japanese fishing also occurred on the opposite side of the Pacific around the west coast of North- and Central America, as well as in the Atlantic Ocean around the west coast of Africa. By the 1970s Japanese catches were also recorded in the Caribbean and the south Atlantic.

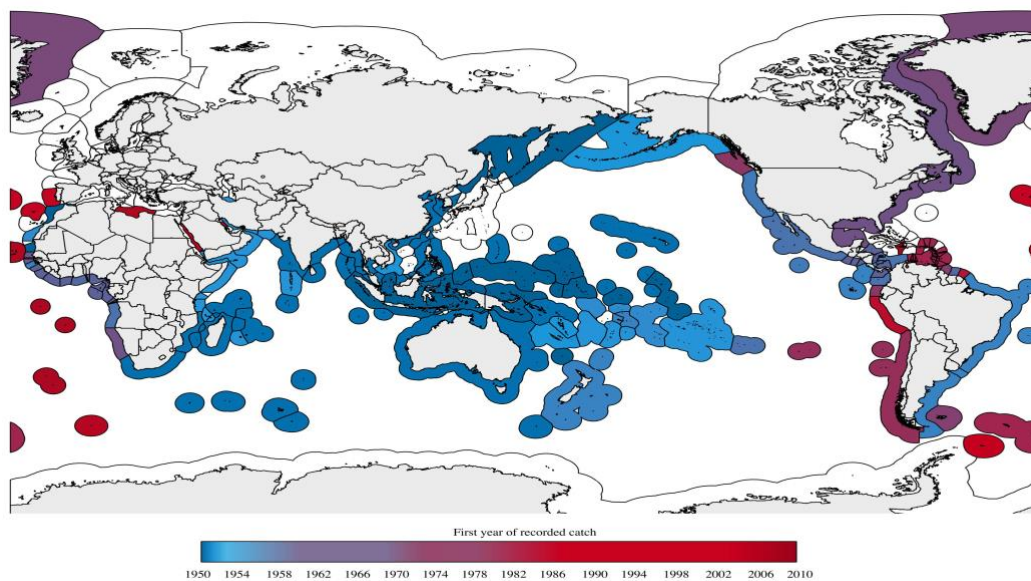


Figure 4. First year that Japan recorded catch in EEZ areas around the world, based on SAU data

By the mid-1950s Japan's catches totalled more than 4.8 million tonnes, corresponding to 12.5% of the global total, making them the largest producer of fish at that time (ahead of both the US and the Soviet Union<sup>b</sup>, harvesting 10.4% and 10% respectively of the global total). Of this total, Japan's DWF fleet contributed 21% in 1955 (including high seas). Although the largest share of Japanese total catches has always derived from within their own waters, throughout the 1960s the importance of Japan's DWF increased and the catches from DWF operations grew relative to its overall fishing. By 1970 DWF catch<sup>c</sup> made up 47% of Japan's total catch. But from 1970 the DWF began declining (Figure 5). And after peaking in 1984 the whole Japanese fishing industry has seen declining catches until today.

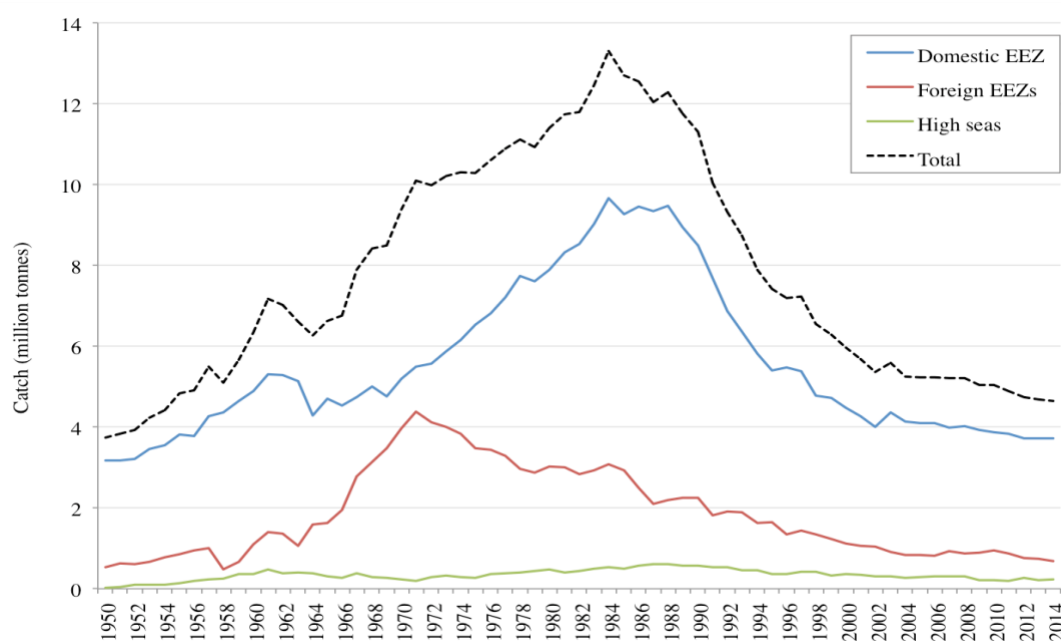


Figure 5. Volume of catch derived from different Japanese fisheries sectors: Domestic waters (blue), foreign EEZs (red), and high seas (green). Japan's total catch from all three sectors is indicated with black dotted line

<sup>b</sup> As catches from the Soviet Union have been split into separate countries in the SAU dataset, when making comparisons with catches from the Soviet Union before its dissolution (before 1991) I have pooled catches from Estonia, Georgia, Latvia, Lithuania, Russian Federation, and Ukraine as was done in Österblom & Folke (2015).

<sup>c</sup> DWF catch including high seas. In 1970 total DWF catch (from foreign EEZ areas and high seas) made up 47.49% of Japan's total. DWF catch excluding high seas made up 45.47%.

The early geographical expansion of Japanese DWF was rapid. The SAU dataset showed Japanese catches were derived from 11 EEZ<sup>d</sup> areas in 1951, but their global presence expanded to more than 100 EEZ<sup>d</sup> areas in a decade, and peaked at 141 EEZ<sup>d</sup> areas in 1973. However, although Japanese presence was global in scope, a large proportion of their recorded catches has been concentrated in a fewer number of EEZs (Figure 6a).

The length of time Japanese DWF has been active in different areas has also varied greatly in a global sense (Figure 6b). The combination of brief presence and relatively high total catch levels opens questions about the exploitative nature of Japan's fishing expansion, and was noted in areas such as the Falklands Islands and some African states, such as Namibia.

The time of peak catch levels, i.e. in which year Japanese catches peaked in a certain area, has also shifted widely from place to place (Figure 6c), suggesting that various factors have influenced the patterns of operations. This will be discussed further later in the thesis.

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<sup>d</sup> SAU defined EEZ zones

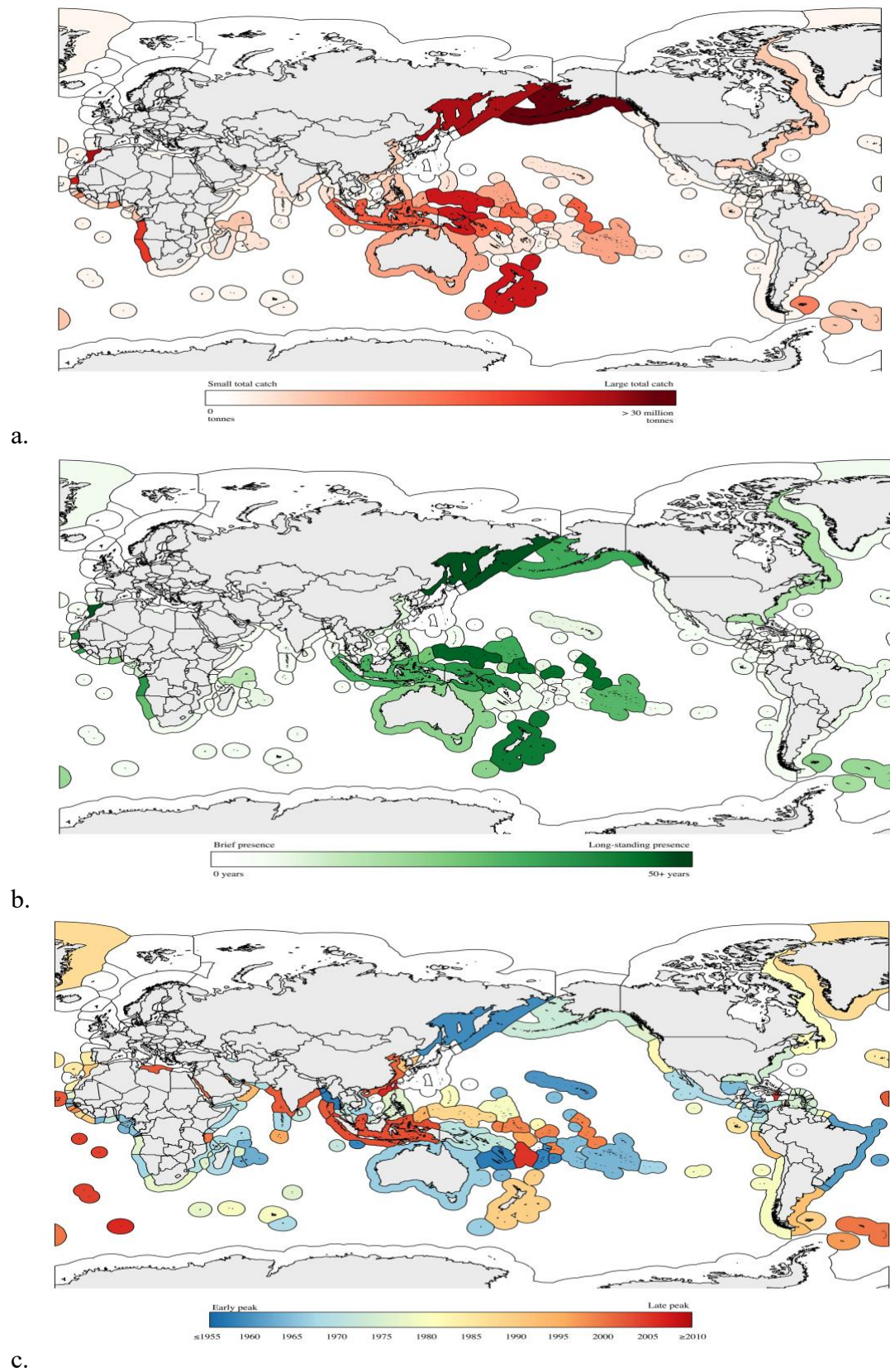


Figure 6. a) Total catch volume aggregate over time (in tonnes); b) Presence (in years) (how long they were in the place); c) Operational peak (year of recorded peak catch)

## 5.2. Stories behind the pattern

The following chapters take a deeper look at what Japanese DWF operations have looked like in selected areas and events that have shaped Japanese fishing in these places.

### 5.2.1. Far Eastern Russia

Japan has had a long history of fishing in the North-Western Pacific waters around Russia, which has been characterised by both cooperation and conflict between the two countries since before WWII (Ohira 1958; Tanaka 1979). After WWII Japan mainly targeted salmon in Russian waters. Japan caught 330,000 tonnes of salmon in 1952, which rapidly increased to more than 460,000 tonnes in 1956 (Figure 7, pooled ‘salmon, trout’ and ‘pink salmon’). But as Japanese catches increased rapidly, so did Russian concern over Japan’s growing fishing (Mathieson 1958; Tanaka 1979). So in 1957, arguing that salmon stocks were deteriorating under Japanese fishing pressure, Russia took unilateral action by closing Peter the Great Bay to foreign vessels (Akaha 1993a). The 1956 Bilateral Fisheries Convention between Japan and the Soviet Union specified quotas and seasonal limitations to salmon fishing in the area, which resulted in an abrupt drop in Japanese catches (Figure 7). To accommodate reemployment of the Japanese salmon fishing workforce who were displaced by the agreement with the Soviet Union, the Japanese government decided to authorise expanded tuna fishing in 1959 (Scheiber et al. 2007). This effectively reduced the long-term extent of Japanese salmon fishing in the northern Pacific (Mengerink et al. 2010).

In the early 1960s new developments in at-sea processing methods for Alaskan pollock, which had previously not received much attention due to its thin body with little meat, suddenly came in great demand for the Japanese *surimi* market (Tanaka 1979; Yamamoto & Imanishi 1992; Wespestad 1993; Bakkala 1993). Unable to process all their pollock, the Soviet Union agreed to let Japan fish Alaskan pollock in exchange for access to mackerel and sardine in Japanese waters (Stokke 1991). Thus, Japan’s catch of Alaskan pollock in Russian waters increased rapidly in the 1960s (from just under 50,000 tonnes in 1960 to 350,000 tonnes in 1969) and became the most important species from the area until the late 1980s (Figure 7).

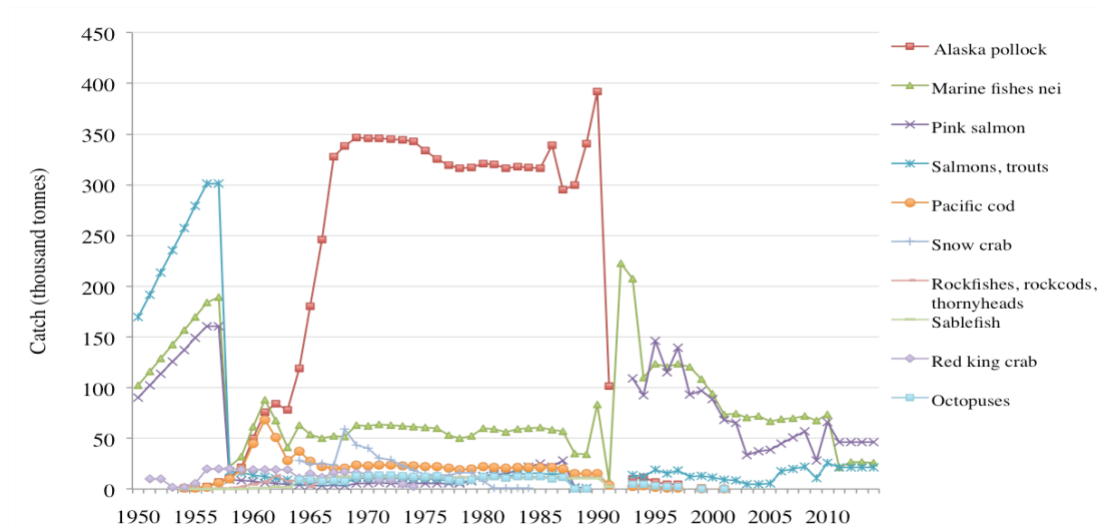


Figure 7. Volume (in metric tonnes) of Japan's catch of different species in the Russian EEZ. Nei = not elsewhere included, i.e. Marine fishes nei are unspecified marine fishes that have not been included in other categories.

But in the late 1980s Soviet attitudes changed. Quotas were cut, ground trawl was prohibited, and the Soviet Union insisted on equal exchange of resources, as previous exchange had profited Japan more, because Alaskan pollock caught in Soviet waters was more valuable than Soviet catch in Japanese waters (Stokke 1991). According to Toda (1988) this change in Soviet attitudes was due to rising Soviet fears of marine resource depletion, as well as a rise of resource nationalism, i.e. contending that sovereign rights to natural resources should grant priority in exploiting them.

In line with specifications of the 1982 United Nations Convention on the Law of the Sea (UNCLOS), a new agreement on salmon in the area came into force in 1985, the Japan-Soviet Fisheries Cooperation Agreement of 1985. The new agreement stipulated that the Soviet Union had primary right to harvest species originating in its own waters. Under the agreement salmon from Soviet waters could only be fished within their 200-mile zone. Additionally, based on the 'state of origin principle', control of salmon fishing beyond the Soviet 200-mile zone was also granted to the Soviet Union, effectively cutting Japan's total salmon quotas. Japan managed to lessen the impact of the ban by negotiating increased access to salmon fishing within Russia's 200-mile zone in exchange for developing joint ventures in Russian salmon hatcheries (Akaha 1993a). In the early 1990s Japanese factory vessels were also used

to engage in joint ventures in Russian waters, as Russia had great harvesting capacity but not the logistical abilities to process and market the catch (Stokke 1991; Akaha 1993b). However, since the late 1990s Japan's fishing operations in Russian waters have decreased steadily.

### 5.2.2. Subarctic Alaska

Japan's DWF operation in the North-Eastern Pacific around the Alaskan coast was mainly concentrated on Alaskan pollock (Dickinson 1966). Japan's Alaskan pollock fishery took off in 1960 and peaked at over 1.6 million tonnes in 1972 (total catch peaked over 2 million tonnes including all species caught in the US Alaskan area at the time) (Figure 8). At that time it was the largest total amount caught outside Japan's own waters.

The intensification of Japanese fishing of pollock, as in the Russian case, raised concern in the US too. But Japan's growing fishing was not the only concern, as international recognition of deteriorating global fisheries and overexploitation of many fish stocks became a growing concern. In the mid-1970s the US Congress recognised that certain stocks in its coastal waters had been severely overexploited, partly due to rapid growth of fishing pressure, as well as inadequate fisheries management (Sproul & Queirolo 1994). So in 1976 the US Congress decided to set up a national conservation and management program, The Magnuson Fishery Conservation and Management Act of 1976 (Queirolo & Johnston 1989). Through the Act the US extended its coastal jurisdiction. US fisheries policy in the years that followed aimed to facilitate 'Americanisation' of the fishery within its newly established 200-mile EEZ (Sproul & Queirolo 1994; Mansfield 2001). The goal was to protect utilisation of well-established US fisheries, but also aimed at developing fisheries that were underutilised by US fishermen. Pollock had not attracted US fishermen and the US fishing industry was geared towards other species, such as the Alaskan salmon fishery and crab fisheries around Alaska and the East Bering Sea (Criddle 2012). Following dramatic declines in crab stocks in Alaskan waters in the late 1970s, Alaskan fishermen turned to pollock fishing. However, unable to process and market their pollock catch, US trawl boat owners, newly-turned-pollock fishermen, lobbied for foreign quotas to remain in exchange for at-sea processing and marketing services by Japanese (and Soviet) vessels (Stokke 1991). Consequently the

intended phasing out of foreign participation in Alaskan waters was not immediate, and Japanese fishing continued.

However, this was a fleeting achievement. In order to advance the US pollock fishery, and prevent the well-established Japanese pollock fishery from inhibiting growth of the US newcomers, US fishery policies in the 1980s were designed to boost the domestic industry by conditioning access rights with different forms of assistance. These could include handover harvesting or processing technologies, or investment in the domestic industry, among other measures (Mansfield 2001). And as the US factory fleet developed in the later 80s it became untenable for Japanese vessels to persist (Stokke 1991). Japan, and all foreign DWFs, were finally phased out and Japan's Alaskan pollock fishery in the US ended in 1988 (Figure 8).

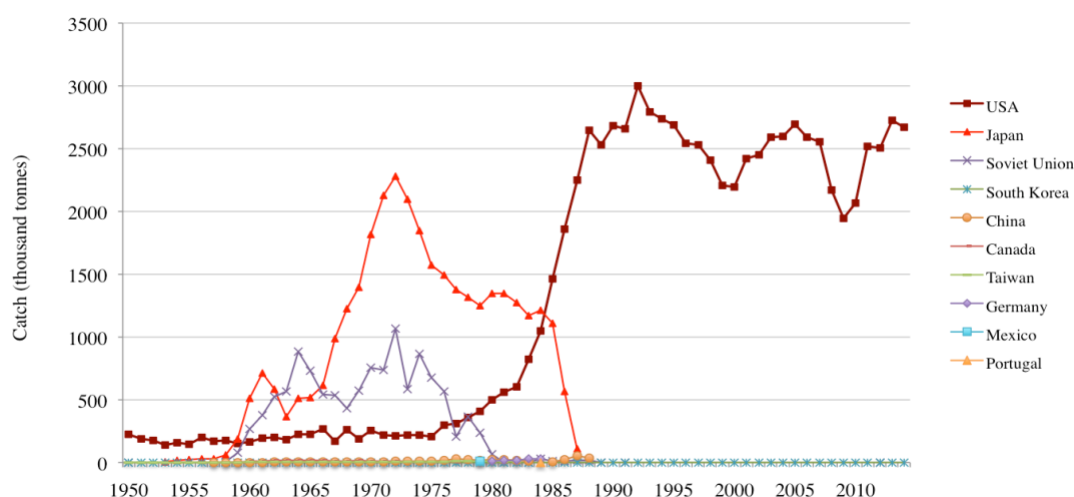


Figure 8. Catch (volume in metric tonnes) of top 10 largest fishing entities operating in the US Alaskan subarctic EEZ area

### 5.2.3. Pacific Islands

Large tuna resources exist around many of the Pacific Island countries (PIC) in the southwest and central Pacific Ocean (Micro-, Melan- and Polynesia)(Petersen 2003). It is an internationally important tuna fishing ground, and tuna has been the most lucrative stock for many DWFs in the region (Alexander 1997; Gillett 2007). Japan's DWF enterprise in the Western Central Pacific region has almost exclusively focused on tuna fishing (constituting over 90% of recorded catch volume for the areas

described below). As soon as the post-WWII restrictions on the Japanese fishing were lifted the DWF moved down into the Western Central Pacific Ocean (WCPO). The Japanese longline tuna fishery spread quickly across the Pacific islands and was the main fishery in the area. However even though tuna proved lucrative, it was also industrially difficult to exploit in the area. With the expanding demand for low-price canned tuna the tuna purse-seine fishery started growing in the 1970s. But wanting to expand the tuna purse-seine fishery the Japanese DWF operators soon found that tuna fishing in tropical waters was different from back in temperate waters off Japan. The tropical Pacific waters were clear with a deep thermocline, and tuna schools were smaller, moved faster, and could dive deeper. Despite these unfavourable conditions for purse-seine fishing, the Japanese government (and subsequently the US) sponsored many experimental purse-seine expeditions to the equatorial Pacific region in the 1960s (Matsuda & Ouchi 1984). As the Japanese DWF fleet persisted they were also the first to develop a tuna purse-seine fishery in the region (Gillett 2010). By the late 1970s Japan had several fully commercial purse-seine operations in the WCPO (Gillett 2007). From the 1980s tuna fishing in the region turned from a longline fishery to a purse-seine fishery (Figure 9).

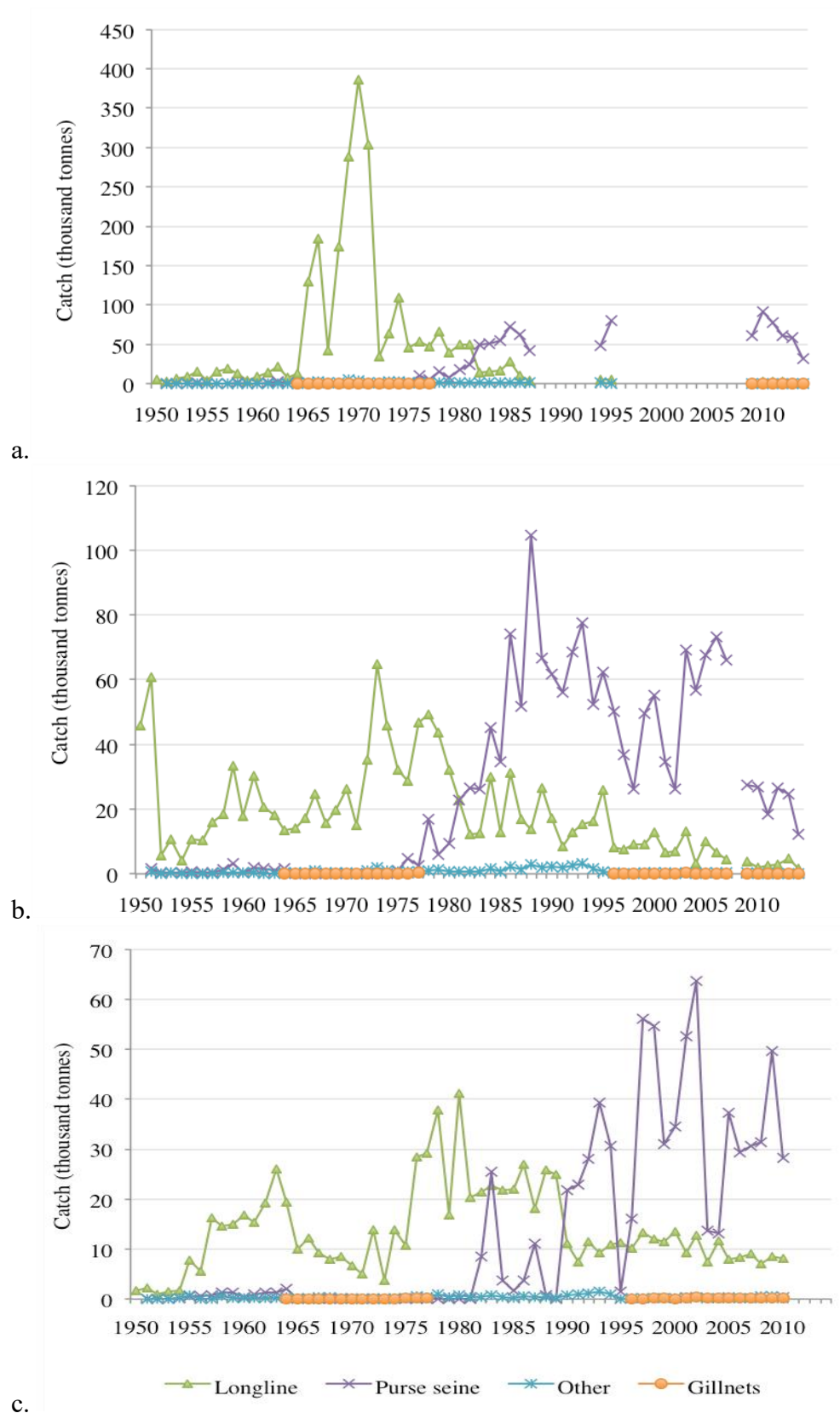


Figure 9. Gear use of Japan's DWF in a) Papua New Guinea, b) Federated States of Micronesia, and c) Kiribati (all islands). Note that y-axis scale differ between graphs

Early tuna exploitation was characterised by open access, the idea that the ocean resources were there for whoever was able to take them. However, all Pacific island states and territories declared EEZs between 1977 and 1984, requiring DWF fleets to negotiate access to fishing within their EEZs. But even under the jurisdiction of the different national authorities in the region it was soon recognised that management of straddling tuna stocks required a higher level of interdependent cooperation (Alexander 1997). In order to protect and manage the tuna fishery, the South Pacific Forum Fisheries Agency (FFA) was established in 1979 among 16 Pacific island states that had a stake in the tuna fishery (Tarte 1997). In the late 1980s, concerns over over-exploitation of tuna (Pacific yellowfin in particular) led to an alliance among the FFA member states controlling the majority of the region's tuna supply (i.e. Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands, and Tuvalu). Through the FFA access regimes and control of foreign fishing operations were harmonised between the member states, and its members started cooperating on regional surveillance and enforcement (Mizukami 1991).

### *Papua New Guinea*

Japan's DWF saw great catches in Papua New Guinea (PNG) early in its expansion and Japanese catches peaked in 1970. Until the 1970s Japanese purse-seine vessels had practically exclusive access to the WCPO, only restricted by the Japanese government that constrained the activities of its purse-seine fleet in order to promote its longline fleet in the area (Aqorau & Bergin 1997). But in the late 1970s US 'super seiners' began relocating to the WCPO, followed by Taiwanese and South Korean DWF fleets in the 1980s (Matsuda et al. 1990). After declaring its own EEZ, PNG was the first Pacific island nation to sign an intergovernmental fishing access agreement with Japan in 1978 (Matsuda & Ouchi 1984).

Throughout the 1980s rivalry grew between the US and Japanese DWFs in terms of getting access to PNG waters and developing a tuna fishing industry there. However, the tactics to gain access differed between the two. While the US was open to sweeping multilateral agreements covering access to multiple Pacific island states, Japan was reluctant to enter into such arrangements and favoured individual nation-by-nation negotiations (Matsuda 1992). The first US-PICs multilateral fisheries

access treaty was concluded in 1986. Because the US government subsidised the access fees paid by their DWF industry, an important change in this arrangement was that it generated far higher rates of return to PICs in the region (an increase from 2-3% to about 10%)(Tarte 1997). This raised the expectations for improvements in other bilateral agreements, such as existing access agreements with Japan. After Japan was unwilling to agree to the rate of return that PNG demanded negotiations were deadlocked in the late 1980s (as seen in no-catch periods in Figure 9a).

Besides these events, Japanese domestic political division also shaped Japan's fisheries negotiations in PNG. The Japanese government was reluctant to directly subsidise fisheries access, as the US government had. Instead the Japanese government has preferred to use fisheries aid as an indirect subsidy and diplomatic tool in negotiations to gain fisheries access (Petersen 2003). Because PNG is a large recipient of Japanese official development assistance (ODA) fisheries aid has been useful to encourage PNG to comply with Japanese terms and conditions for access (Tarte 1997). However, in the 1980s opposing views among Japanese policymakers led to obstruction of use of fisheries aid integrated in access fees and the access agreement between Japan and PNG was terminated in 1987.

### *Federated States of Micronesia*

Japan has had a long history of fishing in the waters around the Federated States of Micronesia (FSM) since before WWII (Higuchi 2007). Japan's catches in FSM were relatively modest after the war in the 1950s–1960s, but the fishery took off later in the 1970s. It grew especially after a switch of predominant longline gear use to purse-seine in the 1980s and the DWF peaked in 1990 (Figure 9b). Competition increased around 1980s in FSM too (Diplock 1993). Catches from other DWF countries in FSM increased significantly and thus Japan went from being the only major fisher nation (taking 60-80% of total catch in 1960) to being one among many taking large amounts (Japan's share ~30% of total catch around 1990).

The Japanese have used fisheries aid tied to access arrangements to gain access after the declaration of the EEZ in FSM as well. However, the use of aid has been criticised as being clumsy and local conditions were not always fully investigated before aid has

been distributed (Mizukami 1991), e.g. in FSM fishing boats were left unused on one of the islands.

### *Kiribati*

The Japanese DWF enterprise in Kiribati has shown similar trends to Micronesia. The DWF started out with modest catches that then increased from 1980s to 1990s. A similar transition from longline fishing to purse-seine fishing occurred in Kiribati as well (Figure 9c). And the Japanese DWF fleet also faced growing competition from other DWF nations for access. The number of foreign purse-seiners licenced to operate in the region increased from 94 (41 from Japan) in 1983 to 161 purse-seiners (32 from Japan) in 1995 (Tarte 1997). This meant that the demand for fish and accessible fishing grounds increased, and at the same time tuna stocks were under increasing exploitation pressure. These trends led to an important change in the relationship between Pacific island states and foreign DWF nations. With growing demand and shrinking supply this transferred bargaining power towards the supply side, i.e. the island states (Matsuda 1992; Tarte 1998).

### **5.2.4. West Africa**

Most Japanese DWF operations in Africa have been concentrated along the west coast of the continent. The West African region is a highly productive marine area due to upwelling along the west coast. Consequently, despite its geographical distance from Japan high catch levels in West African waters made fishing more profitable. Following saturation and overexploitation of traditional Japanese distant water fishing grounds closer to Japan (i.e. the East China Sea, Yellow Sea, and South China Sea) Japanese exploratory operations spread further afield in the 1960s (Kasahara 1972; Swartz 2004). The expansion into West African waters was also to some extent driven by the uncertain future of the salmon fisheries in the North Pacific (Swartz 2004).

### *Namibia*

Japan started fishing in Namibia in 1963. After WWII locally based fisheries in Namibia slowly expanded the hake fishery throughout the 1950s. By 1960 knowledge of vast hake resources in the region reached DWF nations, and during the 1960s fleets from Japan and Spain started exploratory fishing for hake in the region (Griffiths et al.

2005). As DWF fleets entered the fishery unchecked it quickly became overexploited and soon collapsed (Gordoa et al. 1995). The pelagic fishery off Namibia experienced the same pattern of boom and bust as large foreign factory ships drastically reduced the stock by the early 1970s (Griffiths et al. 2005).

### *Angola*

The Japanese DWF operations in Angola took off in 1964 when abundant resources of hake were established. Japan was among the first major DWF nations to substantially expand the hake fishery in Angolan waters. Angola's own fishing industry was also quite well developed under Portuguese colonial rule. But after it won independence in the mid-1970s Angola erupted in civil war, and under such unstable socio-political conditions Angola's domestic fishing industry collapsed (Belhabib & Divovich 2014). In the absence of domestic fishing or any form of management control DWF activities thrived during the civil war (Belhabib & Divovich 2014). Hake catches quickly rose to unsustainable levels and the fishery collapsed within a decade.

After the boom and bust of the hake fishery, Japanese DWF operations in Angola have been relatively modest. Generally, Japanese engagement such as joint ventures has been low in Africa. Due to political and economic instability Japan has been hesitant to invest in African states (Bergin & Haward 1996). However, Japanese engagement in Angola has also been shaped by the direction of Japan's aid diplomacy and Angola has been the target of Japanese aid investment since the 1950s (de Medeiros Carvalho 2011).

### *Mauritania*

Japanese DWF trawl operations moved into waters off Mauritania in the 1960s, but operations were limited when Mauritania declared a 12 nautical mile exclusive fishery zone in 1967 (Kasahara 1972). However, Japanese vessel owners decided to arrange private negotiations to continue fishing by paying the Mauritanian government for access (Swartz 2004). 24 trawlers were paying to continue operating in the area (Swartz 2004). However, because of poor monitoring and enforcement capabilities,

even after its declaration of exclusive fishery zone, several DWFs continued to fish unchecked for many years in Mauritanian waters (Bonfil et al. 1998).

The Japanese DWF fleet introduced the cephalopod fishery (i.e. squid and octopus) when it arrived in the 1960s. A few Japanese tuna fisheries have also been operating off the coast of Mauritania (Kasahara 1972; Martin 2010). Tuna fishing there was mainly active in 1970s and 1980s but gradually decreased after that (AU-IBAR 2015).

#### **5.2.5. New Zealand**

Unlike in many other EEZs where one or a few species was the main target, Japanese DWF has targeted a greater number and variety of different species around New Zealand. After having conducted extensive fisheries research that identified new stocks in the 1970s, Japanese DWF activities in New Zealand waters increased in different fisheries (Figure 10). Japanese developed the squid fishery in 1969 (Gibbs 2008), and the hake (also known as blue hake, hoki, or Blue grenadier) fishery developed by Japanese and Soviet trawlers in the early 1970s (Colman 1995). Japan's catches peaked in 1977 around 150,000 tonnes, before it dropped to 32,000 tonnes in 1978 when New Zealand declared their 200-mile EEZ. In the late 1980s when the Japanese DWF enterprise was otherwise in overall decline, Japan's DWF in the New Zealand waters expanded suddenly. Catches in the EEZ peaked in 1989 just below 700,000 tonnes. This contributed the largest share of Japan's DWF catches among all EEZ areas at the time, as 24.7% of Japan's DWF catches (including high seas) came from the New Zealand EEZ. High demand from the sashimi market made hake especially attractive to trawl operators (Gibbs 2008), and when boats moved into deep waters where they found new hake stocks the fishery expanded quickly (Walrond 2006). Because access was restricted to foreign fleets that had to operate under bilateral agreements there was also a growing trend towards forming joint-venture arrangements between New Zealand companies and Japanese companies (Colman 1995).

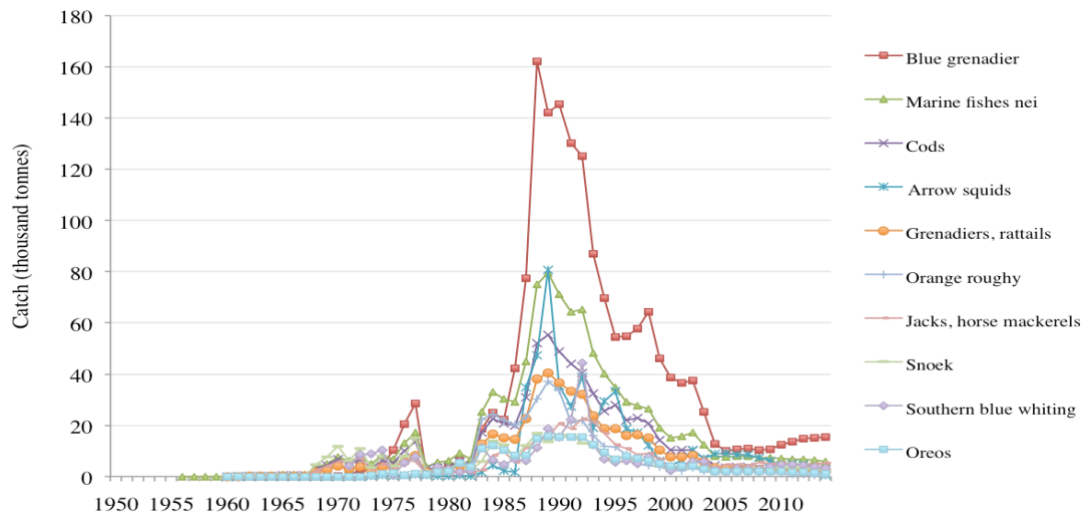


Figure 10. Volume (in metric tonnes) of Japan's catch of top 10 species in the New Zealand EEZ. Nei = not elsewhere included, i.e. Marine fishes nei are unspecified marine fishes that have not been included in other categories

#### 5.2.6. Falkland Islands

The Falkland Islands have been one of the most geographically distant of the Japanese DWF expansion. Even so, Japan was one of the largest DWF nations in the waters around the Falklands in terms of catch volume (Villasante & Sumaila 2009). The Japanese fishery began in 1978 and squid was the chief interest to Japan's DWF in the waters around the Falkland Islands. The Argentine shortfin squid in particular saw a rapid increase in exploitation from the Japanese DWF fleet in the 1980s (Figure 11).

A long-standing territorial dispute between Argentina and the UK over the sovereignty of the Falkland Islands culminated in armed conflict in 1982. The end of the hostilities left a fisheries management vacuum as neither Argentina nor the UK regulated fisheries activities in the region (Bisbal 1993). This was a golden opportunity for DWF fleets that were struggling with increasingly restricted access to coastal waters as more and more countries established their own EEZs (Villasante & Sumaila 2009). Economically this also presented an advantageous prospect for DWF operators that were aware of the large squid stocks in the area. The accessible resource combined with good selling prices and several Asian markets for squid resulted in serious interest in the exploitation of squid, which attracted Japan, among

other DWF nations, to relocate their fleet around the Falklands (Bisbal 1993). This led to significant increases in squid catch volume in a short time. For Japan catches increased rapidly and peaked in 1989 (Figure 11).

The rapid increase in squid catch volume of foreign fleets started to concern Argentine, Falkland and UK fishery sectors, and attempts at managing and restricting DWFs were made. But taking managerial control and monitoring vessels in the area proved difficult (Bisbal 1993; Arkhipkin et al. 2013). The Falkland Islands Conservation Zone (FICZ) was established, and fishing seasons and licence allocation were put in place by 1987 (Aguilera 2018). But because many fish stocks migrate into the Argentinian EEZ, management of such stocks in the FICZ was largely ineffective without closer coordination with Argentinian management measures (Churchill 1997). Furthermore, a large amount of squid was still fished by foreign fleets within the Falkland 200-mile EEZ beyond the FICZ (Churchill 1997). Other DWF nations, primarily South Korea, also moved in to take part in the squid fishery (from SAU data), and soon saturation of squid markets was becoming evident (Bisbal 1993). Perhaps this is the reason why Japan's squid enterprise was so brief.

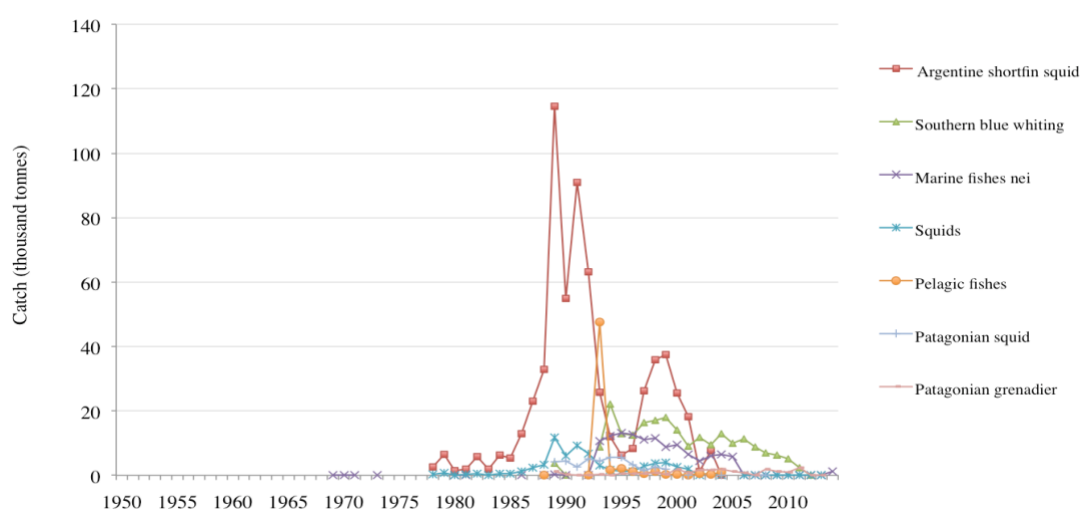


Figure 11. Catch volume (in metric tonnes) of main seven species caught by Japan's DWF in the Falklands islands EEZ area. Nei = not elsewhere included, i.e. Marine fishes nei are unspecified marine fishes that have not been included in other categories

### 5.3. RQ 2: Factors shaping Japan's DWF

The following chapters outline factors that I have identified in the literature which have shaped Japanese DWF. They are separated into three sections. First I outline some consideration of scale in the analysis. The sections that follow first describe the factors identified in this study to have contributed to the expansion of Japan's DWF, and the final section describe factors that have shaped the DWF during contraction.

#### 5.3.1 Multiple scales of factors

Exploring the factors in this study the focal scale was on the selected areas. However, considering the factors only tied to a certain spatial or temporal context could exclude factors that have shaped Japan's DWF less directly or that have gradually emerged which make them less clear in exploring factors tied to a certain 'event' observed in the fisheries data. In an attempt to elaborate on the distinction of different scales in the context of Japan's DWF evolution I have used the conceptualisation of proximate and remote factors, used by Boonstra and Österblom (2014) in tracing the processes that produce overfishing.

'Proximate factors' are described as causes that are temporally and/or spatially close to an outcome (Boonstra & Österblom 2014). In social systems proximate factors are typically human activities at local scales, including choices, strategies and actions, e.g. political leaders that change direction of marine governance, or adoption of new gear. In ecological systems proximate factors can be an external, sudden shock, e.g. natural disasters or disease outbreak.

'Remote factors' are remote in time and space from the outcome (Boonstra & Österblom 2014). These factors may be noted over a range of case studies, which make them more general. They are also more difficult to address directly, and have been described as 'causes of causes' because they are social and ecological factors that influence the occurrence of proximate factors. In social systems remote factors are gradual changes in social structures, e.g. cultural or institutional changes that influence fishing practices, marine governance or technological progress. Factors of Japanese DWF evolution as proximate or remote factors have been described in Table 2.

Table 2. Proximate and remote factors in expansion and contraction of the Japanese DWF enterprise.

	Proximate factors	Remote (structural) factors
Expansion	<ul style="list-style-type: none"> <li>• Food security</li> <li>• New processing techniques</li> <li>• Motherships</li> <li>• Gear advancement</li> <li>• Growing demand for fish</li> </ul>	<ul style="list-style-type: none"> <li>• Economic growth</li> <li>• Changing consumption trends</li> </ul>
Contraction	<ul style="list-style-type: none"> <li>• Extension of territorial sea by coastal states</li> <li>• New competition</li> <li>• Domestic political division</li> <li>• Establishment of regional fishery management organisations</li> <li>• Companies in transition</li> <li>• Stagnation of fish prices</li> <li>• Cost increase of fuel and wages</li> <li>• Fish stock collapse</li> <li>• Natural disasters</li> </ul>	<ul style="list-style-type: none"> <li>• Ocean enclosure movement</li> <li>• Declining position of power</li> <li>• Changing consumption trends from fish food culture to meat eating</li> </ul>

### 5.3.2. Factors of expansion

In the following section I describe some of the political, economic, technological and social factors that have contributed to the global expansion of Japan's distant water fisheries. An overview of different factors associated with each selected area is summarised in Table 3.

Table 3. Summary of factors identified to have shaped expansion of Japan's DWF enterprise based on the selected area.

		Russia, Far Eastern	Alaska, US	Papua New Guinea	Micronesia (Fed. States of)	Kiribati	Angola	Namibia	Mauritania	New Zealand	Falkland Islands
Political	Food security										
	Compensate loss of other fishing grounds										
Technological	New processing techniques										
	Use of motherships										
	Gear advancement										
Economic	Growing demand for fishery products										
	Good market conditions, i.e. high selling prices										
	Increase employment										
	Government financial support										
Social/cultural	Changing consumption trends										

### *Government involvement and incentivised expansion*

When the post-WWII occupation ended and Japan regained its sovereignty the Japanese government quickly launched policies promoting fisheries expansion. The expansion policy under the slogan “from coast to offshore, from offshore to distant water” (Bergin & Haward 1996, p. 13) aimed to expand fishing grounds and diversify fishing activities. Thus the Japanese government was closely involved in the initial expansion of the DWF industry. The government encouraged expansion for multiple reasons, including ensuring food security, boosting the economy, and creating employment.

After the post-war occupation Japan struggled with widespread food shortage. In order to tackle food scarcity the government sought to diversify food supply from overseas. Japan’s aim for food security has thus been attributed as an important reason for the speed and extent of Japan’s DWF enterprise post-WWII (see Tanaka 1979; Matsuda and Ouchi 1984; Campbell & Owen 1994; Barclay & Epstein 2013; Smith 2014).

The war also left Japan in economic devastation. The need to rebuild was great, and the government implemented economic and industrial reforms across different sectors in order to stimulate economic growth and productivity of the industry (Yoshioka & Kawasaki 2016). This also included structural reforms and government intervention in the fisheries industry (Barclay & Koh 2008). The DWF industry received government funding to rebuild and the enlargement of the Japanese fisheries industry was also motivated by the need to increase employment opportunities (Akaha 1993a). Consequently, the post-WWII expansion has also been attributed to this close relationship between the government and fisheries industry (Bergin & Haward 1996; Barclay & Koh 2008).

### *Technological improvements*

Government support to construct new fishing vessels and develop new technology also made Japanese DWF expansion possible. The development of mother ships and on-board processing made it possible to go out and stay out for longer (Tanaka 1979;

Matsuda & Ouchi 1984; Haward & Bergin 2001). Freezer technology improvements in the 1960s also made it possible to target and preserve species, such as tuna, in distant waters to be sold back in Japan (Bergin & Haward 1996). Other developments, such as improvements in certain fishing gear and processing techniques also made it possible for Japan to break into and increase capacity in certain successful fisheries, e.g. the North Pacific pollock fishery (Tanaka 1979; Yamamoto & Imanishi 1992; Wespestad 1993), and the tropical Pacific purse-seine tuna fishery (Matsuda & Ouchi 1984; Gillett 2007).

### *Increasing demand for fish and changing consumption trends*

With industrialisation, urbanisation, and a growing population after WWII domestic fisheries were insufficient to meet increasing demand for food, which further encouraged expansion (Barclay & Epstein 2013). As the Japanese economy stabilised and started growing in the 1960s and 1970s, quantity was no longer the main food supply issue, and instead consumers started demanding high-quality, high-value products, such as fresh and frozen tuna *sashimi* (Haward & Bergin 2001; Barclay & Koh 2008).

### 5.3.3. Factors of contraction

In the following sections I describe some of the political, institutional, economic, social and ecological factors that have shaped the global expansion of Japan's distant water fisheries. An overview of different factors for each selected area is summarised in Table 4.

Table 4. Summary of factors identified to have shaped contraction of Japan's DWF enterprise based on the selected area.

		Russia, Far Eastern	Alaska, US	Papua New Guinea	Micronesia (Fed. States of)	Kiribati	Angola	Namibia	Mauritania	New Zealand	Falkland Islands
Political	Ocean enclosure movement										
	Declining position of power										
	New competition										
	Domestic political division										
Institutional	Extension of territorial sea by coastal state										
	Joint fishery management organisation										
	Other bi-/multilateral arrangements										
	Tightening control on fisheries										
Economic	Stagnation of fish prices										
	Operational cost rise (incl. fuel costs, labour costs)										
	Increasing access fees										
	Fisheries companies in transition										
Social/cultural	Disinterest in fishing as occupation										
	Food culture: From fish to meat										
Ecological	Declining fish stocks										
	Stock collapse										

## Political

### *Ocean enclosure movement*

During the 1970s international discussions on sustainable development of fisheries grew, and the recognition of fishing as a trans-boundary issue (Oei 1998). There was a global scale "ocean enclosure" movement where one state after another declared extended jurisdiction for fishing in their coastal waters (Mengerink et al. 2010). The issues and causes that led to enclosure of the ocean are multifaceted and complex (Oei

1998), but the impact of Japanese and Soviet fisheries expansion, whether real or imagined, has been highlighted as an important factor motivating unilateral jurisdictional claims by coastal states (Kasahara 1972; Österblom & Folke 2015).

Many ascribe the decline of Japanese DWF operations to international developments such as the formalisation of EEZs that restricted access for Japanese DWF to many countries' coastal waters (Sproul & Queirolo 1994; Gagern & van den Bergh 2013; Tickler et al. 2018). The Government of Japan describe this as the reason for the decrease of Japan's DWF after 1989 in its 2009/2010 White Paper on Fisheries, stating that "[t]he fisheries industry shrank due to the strengthening of international regulations, such as the introduction of the 200-nautical-mile exclusive economic zone for coastal nations." (MAFF 2009).

However, others suggest this is only one among several factors (Stokke 1991), and some stress that formalisation of EEZs is a less important factor that has been somewhat overemphasised (Bergin & Haward 1996). At first Japan's DWF appear not to have been too affected by the extension of coastal jurisdiction. Because Japan engaged in negotiations for access and moved into different areas there was no immediate impact on total catch levels. Also, in some areas, such as the US, Alaskan area decline started before the introduction of EEZs, so the establishment of EEZs was not a determining factor everywhere. However, it may have acted more as a compounding factor that combined with other, e.g. economic and political factors that constrained the Japanese DWF, which has resulted in its decline over time.

### *Declining position of power*

For a while after its peak years, and despite shrinking open access to DWFs, Japan was able to retain access to global fish resources even in foreign EEZs because they were in a position of political and economic power. By controlling markets, goods, or services that were of interest to coastal states, Japan could use that as bargaining chips in access negotiations. However, this position of power was eventually eroded, which ultimately affected Japan's ability to persuade coastal states in access negotiations (Stokke 1991). Multiple drivers contributed to Japan's declining power: i) Coastal states became increasingly aware of declining environmental conditions and need for resource conservation and were therefore more reluctant to negotiate continued access

for DWFs, such as in the Russian EEZ with the decline of salmon stocks. ii) Coastal states started increasing their own capacity to harvest resources within their EEZ, e.g. the US built up harvest and processing facilities for the pollock fishery, and could therefore phase out Japanese (and other DWFNs) vessels; the Soviet Union also facing restrictions on their DWF fleet, returned back home to increase their own capacity to harvest resources in their own waters; developing nations started developing their domestic fishing industries as well, either with help from the World Bank or FAO, or as a consequence of learning from joint ventures and receiving aid and development support as terms of access agreements. iii) Increasing competition among DWFNs shifted the balance of power away from DWFNs in favour of coastal states. These trends eventually led to a weakening of Japan's leverage in access negotiations (Stokke 1991; Tarte 1997).

### *New competition*

As mentioned above, Japan's DWF industry has faced increasing competition from other nations developing their own DWF fleets, e.g. South Korea, China, Taiwan, Spain have all developed strong DWF fleets travelling further in recent decades (Tickler et al. 2018). The EU, also pressed by overcapacity in domestic waters intensified fishing in foreign coastal waters (Stokke 1991). Thus when negotiating for quotas in foreign EEZs more DWF fleets competed for quotas and coastal States found themselves in a stronger bargaining position.

Furthermore, competition from low-wage fleets, e.g. Taiwanese and South Korean DWF fleets, combined with economic conditions, such as rising wages for Japanese domestic labour, affected profitability of Japanese DWFs. These conditions, as well as international political pressure to reduce global fishing capacity led to the government supported restructuring of the Japanese DWF industry in the late 1970s and 1980s (Barclay & Koh 2008). Such restructuring included government support to reduce the fleet (Scheiber et al. 2007), e.g. buy-back schemes to scrap fishing vessels, while the government also provided financial support for upgrading higher-value tuna fleets (Bergin & Haward 1996) and investing in fuel-efficient vessels (Barclay & Koh 2008).

### *Domestic political division*

The domestic political environment also shapes DWF practices, e.g. conflicts between Japan's foreign policy and fisheries policy agendas have influenced DWF developments in the Western Central and South Pacific. Japanese policymakers have differed in their views on Japan's fisheries aid diplomacy. Because of such divides at times Japan's Ministry of Foreign Affairs have prevented fisheries policymakers' attempts to use fisheries aid to induce countries to comply with their terms and conditions of access (Tarte 1997). This was evident in negotiations between Japan and Papua New Guinea in the late 1980s, which ended in deadlock in 1990 (Tarte 1997).

## **Institutional**

### *International institutional developments*

In the late 1970s there was an emergence of intergovernmental bodies that facilitated regional co-operation and co-ordination on fisheries. DWF nations also faced increasing political pressure to accept and adhere to emerging international institutional structures, including the United Nations Convention on the Law of the Sea (UNCLOS), and related international and regional fisheries agreements (Mengerink et al. 2010). Joint fishery management organisations, such as the Pacific Islands Forum Fisheries Agency (FFA) and the fishery agreements that came out of it shaped Japan's engagement in the Western Pacific region (Tarte 1997), by complicating negotiations for Japan and hampering their ability to negotiate favourable arrangements.

In addition to bilateral agreements to maintain access to foreign coastal waters, Japan also participated in a number of multilateral regional arrangements (i.e. RFMOs) from the late 1960s. Through the RFMO forum other states have exerted pressure on Japan to reduce its fishing capacity, which Japan eventually did to some extent. But through the tuna RFMOs Japan has also pursued its own objectives to combat overcapacity in tuna longline fisheries (Scheiber et al. 2007).

## Economic

### *Energy crisis and hiked up fuel prices*

During the 1970s political instability triggered disruptions in Middle Eastern oil production, which led to a global energy crisis. Following the crisis the cost of fuel rose sharply between 1973 and 1978 (Macalister 2011). For energy intensive DWF fleets this price inflation were an important concern for operations (Campbell & Owen 1994; Gagern & van den Bergh 2013). As a significant cost component of DWF activities, increases in fuel prices have serious implications for economic profitability of the operations (Sumaila et al. 2008). To compensate for these negative impacts, subsidies in the form of fuel tax exemptions have been applied in Japan (Milazzo 1998). The fuel crisis also triggered structural reforms to the DWF fleet in the 1980s, such as investment in more fuel-efficient boats (Barclay & Koh 2008). Even more recently, the Japanese government have been discussing concerns with rising prices of oil, and efforts to “promote structural reforms” in order to conserve energy in the 2005 White Paper on Fisheries (MAFF 2005). This highlights that fuel costs are an important concern for Japanese fisheries and policymakers.

### *Increasing labour costs*

In addition to rising fuel costs and access fee payments, rising crew wages also added to increasing costs of operations. With growing wealth wages and cost of labour rose which also impacted the viability of DWF operations (Stokke 1991; Haward & Bergin 2001; Smith 2014). Furthermore, with broader education opportunities throughout Japan the younger generation has also increasingly turned away from occupations within primary industries such as the fishing industry, which created a labour shortage in the industry (Kasahara 1972; Stokke 1991; MAFF 2008)

### *Stagnating fish prices*

Increasing fuel costs was not the only concern brought on by the 1970s oil crisis. It also halted the growth of the Japanese economy, which hampered the domestic demand for fish products. Furthermore, the traditional Japanese fish food culture was also changing. Influenced by Western meat-eating culture, Japanese meat consumption was on the rise (Gadda & Gasparatos 2010; Guilbault 2015). These

changes caused domestic stagnation of fish prices, which then affected the profitability of Japan's DWF industry.

### *Seafood businesses in transition*

With overseas coastal states increasingly controlling marine resources, DWF nations have found themselves competing in the market place rather than on the ocean. This has meant DWF operators had to change approach to continue the enterprise and had to find new ways of doing business. An example of such adaptation is that Japanese seafood companies switched from extraction of resources to processing and/or focusing on sales and marketing (Stokke 1991). For example, as Japanese companies still had advantage over US companies in the Alaskan pollock fishery, such as preferred market access, knowledge in fish product processing they focused instead on going into that side of business.

Japanese seafood companies have adapted in two ways (Stokke 1991). The first adaptation strategy is to increase *vertical integration* of operations (i.e. the company engage in different parts of production, e.g. raw material extraction, manufacturing, transporting, marketing, retailing etc.). The second adaptation strategy is to *diversify operations* away from dependence on the harvesting sector (i.e. seafood companies branching into other business to compensate loss on fishery side).

These adaptations can be demonstrated in the transition of Japan's (and the world) largest seafood company Maruha Nichiro. The company began overseas fishing operations in 1951 after losing all overseas business and fishing vessels in WWII (Maruha Nichiro 2013). Since then Maruha Nichiro has expanded *vertical integration* of operations to include fishing, aquaculture, processing, distribution and marketing for pollock, tuna, salmon and many other species (Österblom et al. 2015).

In 1993 Maruha Nichiro changed its name from Taiyo Fishing company to better reflect the company's corporate interests, as fisheries products (in 1996) only accounted for less than 5% of the company's total sales (Bergin & Haward 1996). Nowadays it engages in meat production, pet foods, fine chemicals etc. (Maruha Nichiro 2013) reflecting *diversification* of operations.

## Ecological/environmental

Ecological or environmental factors are often tied with social, economic, political, and institutional factors, as changes in the latter have in many instances been reactions to changing environmental conditions, e.g. declining fish stocks, or even just the fear of it, has triggered institutionalising extended national waters (Kasahara 1972).

Another example is links between natural disaster events and political and socio-economic factors. Natural disasters (e.g. the tsunami and radiation contamination from Fukushima nuclear power plant in 2011) have exacerbated concerns with Japan's food security and self-sufficiency (Biggs et al. 2011). Natural disaster events have also influenced policy debate and generated reinforced commitment from Japan's government to support food-producing industries (Barclay & Epstein 2013).

## 6. Discussion

### 6.1. Patterns of exploitation

It has been suggested that global wild capture fisheries have generally followed a sequential exploitation pattern into new areas (Berkes et al 2006; Swartz 2010; Anderson 2011). Sequential exploitation has been defined as spatially expanding exploitation of species into new areas (Berkes et al 2006). This has been described to have serious consequences for individual fisheries, resulting in e.g. the collapse of crab fisheries in Alaskan waters (Orensanz et al 1998; Criddle 2012), cycles of collapse in global sea urchin fisheries (Berkes et al 2006), or historical boom-and-bust trends experienced in deep sea trawl fisheries (Victorero et al 2018). Sequential exploitation is generally problematic in global fisheries as it can mask patterns of local depletion (Berkes et al 2006). It is also problematic for governance responses that generally do not develop quickly enough to deal with such rapid resource exploitation (Berkes 2010).

Tickler et al (2018) suggest all of the worlds' top 20 DWF nations have followed sequential patterns of exploitation. The geographical expansion of the Japanese DWF is described to follow such sequential pattern, i.e. expanding throughout the world in the first decade after 1950. However, the Japanese DWF have been concentrated in a few EEZs seemingly not following the sequential trends described by Tickler et al (2018). Other aspects of the Japanese DWF development, such as focus on expansion of high-value tuna fisheries, are more similar with patterns of profit-driven exploitation, i.e. profit potential of species drive exploitation patterns (Sethi et al. 2010). From exploring the pattern of Japan's DWF evolution in this thesis I suggest that the Japanese DWF exploitation pattern does not readily fit into any single such exploitation pattern. Patterns of peak year of Japanese DWF activities suggest a more irregular and complex pattern (illustrated in Figure Zc in Chapter 5.1.).

I also suggest the Japanese DWF pattern is different in comparison with the exploitation patterns of some of the other top 20 DWF nations Tickler et al (2018) describe. In comparison with other DWFs such as the Soviet Union, that have

followed similar expansion trajectories, i.e. expansion followed by retrenchment, the evolution and expansion pattern of the two are still quite different. The global spread of the Soviet DWF was much more far-reaching than Japanese expansion. Furthermore, whereas Soviet expansion was tightly intertwined with politics of the Cold War and coloured by the ambitions of an aspiring hegemon (Österblom & Folke 2014), the Japanese enterprise was influenced by different political aspirations and shaped by a different set of economic motivations.

And unlike other DWFs that have also followed these patterns of sequential exploitation, as described by Tickler et al (2018), the Japanese DWF has evolved much different from those that subsequently emerged e.g. Spain, China, or South Korea. DWF nations such as China and South Korea, are becoming increasingly locked into expansionist strategies, with their DWF catches currently contributing 39% and 45% respectively to their overall catch (Tickler et al 2018). But as profitability and expansion potential of DWFs decline, these fisheries are facing increasing difficulties to sustain their activities. Under such conditions fishing patterns are instead being squeezed into areas of weaker regulation, such as EEZs with weaker enforcement or the high seas. Such destabilising “balloon effects” threaten sustainability of marine ecosystems, and potentially local communities that may rely on those ecosystems (Blasiak 2015). Whether it be strategic retrenchment, the Japanese government’s policy to reduce fleet size and tighten control of fishing activities which helped some parts of Japan’s DWF remain relatively profitable (Scheiber et al. 2007) or Japanese fishing corporations transforming and adapting into different business strategies (Österblom et al. 2015), Japan’s DWF strategies seem to differ from those of Chinese or South Korean DWFs.

This illustrates some inherent differences between Japan and other DWF nations and how they operate. My results show how complex and context-specific the DWF system is in the case of Japan. Although generalised approaches, such as those used by Tickler et al. (2018), provide some interesting insights, those approaches may not be useful for truly understanding the complexity inherent to these fisheries exploitation patterns.

## **6.2. The complex evolution of Japan's DWF**

Complex systems, as described in Chapter 2, can be characterised as a diverse set of components that interact in complicated, unpredictable ways that change over time, thus changing the system as a whole. The analysis presented in the previous chapter on 'stories behind the pattern' show some of the complexity of Japan's DWF expansion and contraction. The evolution of Japan's DWF in the Western and Central Pacific Ocean is an example of such complex dynamics. As described in Chapter 5.2.3, the fishing activities of the Japanese DWF in the WCPO have been influenced by a multitude of different political, institutional and economic factors. Developments in fishing gear and technology, the emergence of new fishing nations competing for the same resources, constantly evolving legal and institutional structures, as well as socio-economic, biological and political problems that arise from mismatches between straddling tuna stocks being exploited and the governance system trying to manage the fishery. The interactions between the Japanese distant water fisheries, Pacific Island states, and other DWFNs also shape Japan's pattern of exploitation.

## **6.3. Multiple scales and levels**

The importance of scale, both temporal and spatial, has often been emphasised in literature regarding social-ecological and complex adaptive systems (Mansfield 2001; Wilson 2006; Hentati-Sundberg 2015; Niiranen et al 2018). Dynamics of social-ecological systems often play out at different temporal and spatial scales, which can also make them more difficult to trace and connect (Wilson 2006). This was also noted in the exploration of factors in this thesis. Some factors were seemingly contained within a certain spatial context, or tied with a specific point in time, while others were not necessarily bound in the specific context of one of the described EEZ area cases. Yet some of these 'unbound/overarching' factors still came up throughout the exploration.

## 7. Conclusion

The past 70 years have seen Japan emerge from the devastation of WWII to become a global fishing power. The country's distant water fishing operations followed a trajectory of rapid expansion. From the outset in the early 1950s, Japan's global presence grew within a decade to include catches in more than 100 maritime zones that would eventually be formalised as EEZs. At the zenith of its DWF enterprise, in 1973, catches were coming from a total of 141 EEZs. Japan's global catch volume from distant waters peaked in 1971 totalling 4.8 million tonnes, corresponding to 47% of Japan's overall catch and making Japan the second largest global fishing nation after the Soviet Union. Political, economic, and institutional dimensions have influenced exploitation patterns of Japan's DWF fleet and shaped both its historical expansion and contraction. Based on the exploratory work in this thesis I suggest that the Japanese DWF enterprise has elements of a complex system. This is based on in-depth analysis of regions and jurisdictions in which Japan's DWF has shown remarkable patterns of exploitation.

Although distant water fishing nations are often dealt with as one homogenous entity in literature and policy discussions, this study has shown that distant water fishing nations are unique, diverse entities shaped by their own specific contexts. Because unique interactions between social systems, governance and power dynamics, market dynamics and economic tensions, technological developments and ecological dynamics potentially shape how major fishing nations or other stakeholders exploit marine ecosystems, adopting a complex systems perspective may be well suited to enrich our understanding of global exploitation of marine resources. The analysis in this thesis of one of the world's most active distant water fishing nations suggests that similar complexity-informed analyses of other major fishing nations would provide a rich source of insight into global fisheries. The resulting understanding of the strategies and actions of global fishing actors that have influenced the use of marine resources worldwide is an important starting point for working towards more sustainable management of global fisheries.

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## **Appendix 1. Ethics review**

There have been no changes in this thesis from the ethics review submitted before the submission of this thesis. I have acknowledged sources of where I have obtained the data and other material used in this thesis.

