Japan’s Total Allowable Catch Systems in Fishery Resource Management

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Abstract

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The fishing industry is one of the important industries, and seafood is an essential source of animal protein in Japan. However, declines of some fishery resources are causing socioeconomic problems in the fisheries. In order to suggest ways to improve this situation, this study examines Japan's fishery resource management focusing on Total Allowable Catch (TAC) systems. I use a multiple case study approach about the fishery resource management systems for four stocks, i.e., chub mackerel, walleye pollock, bluefin tuna and ocellate puffer in the context of a Social-Ecological Systems framework.

The analysis of the four cases shows that (1) TAC should be set following scientific advice for separate stocks; (2) TAC should be allocated to fishermen's groups in which members can share a common interest; and (3) management measures to comply with catch quota and to avoid a race-to-fish, such as Individual Transferable Quota (ITQ) programs and cooperative management, can be selected by each group to achieve their objectives.

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Glossary of Abbreviations

ABC: Allowable Biological Catch

AFCC: Area Fisheries Coordinating Committee

CDQ: Community Development Quota

CMM: Conservation and Management Measure

CPUE: Catch Per Unit Effort

EEZ: Exclusive Economic Zone

En-Maki: Japan Far Seas Purse Seine Cooperative

EPO: Eastern Pacific Ocean

FAJ: Fisheries Agency of Japan

FAO: United Nation Food and Agriculture Organization

FCA: Fisheries Cooperative Association

FMO: Fisheries Management Organization

FRA: Fisheries Research Agency of Japan

FRMG: Fishery Resource Management Guideline

FRMP: Fishery Resource Management Plan

GRT: Gross Registered Tonnage

HCCAP: Hazard Analysis and Critical Control Point

IATTC: Inter-American Tropical Tuna Committee

IQ: Individual Quota

ISC: International Scientific Committee on tuna and tuna-like species in the North Pacific

ITQ: Individual Transferable Quota

JES stock: Japan Sea - East China Sea - Seto Inland Sea stock

Kisen-Ren: Hokkaido Trawl Fisheries Cooperative Federation

Kita-Maki: North Pacific Federation of large and medium scale purse seiners

MAFF: Ministry of Agriculture, Forestry and Fishery

MCS: Monitoring, Control and Surveillance

RFMO: Regional Fisheries Management Organization

RRP: Resource Restoration Plan

SESs: Social Ecological Systems

SSB: Spawning Stock Biomass

TAC: Total Allowable Catch

TAE: Total Allowable Effort

VMS: Vessel Monitoring System

WCPFC: Western and Central Pacific Fisheries Commission

WFCC: Wide-Area Fisheries Coordinating Committee

WPO: Western Pacific Ocean

Zen-Maki: All Japan Purse Seine Fisheries Association

Zen-Soko-Ren: National Federation of Medium Trawlers

Chapter 1 Introduction

1.1 Overview of Japan's Fisheries and Discussion about its Recent Policies

Japan is surrounded by a very productive ocean, making the fishing industry one of its most important industries. In 2012, Japan with its approximately 200,000 fishers, produced 4.86 million tons of fish, the 8th largest in the world, with a total ex-vessel price of 1.4 trillion yen (US$ 12 billion). Even though fish consumption has slightly decreased in recent years, Japan is still one of the biggest consumers of seafood in total volume in the world. Fish provides more than 40% of animal protein consumed per capita and Japan as a whole consumed 8.17 million tons of seafood in 2012 (Fisheries Agency of Japan 2014a).

The Master Plan for Fisheries that provides the objectives to be achieved in the next 5 years was compiled in 2002, and was revised in 2007 and 2012. The current Master Plan for Fisheries lists four main objectives of fishery policy: (1) the recovery from the earthquake and tsunami disaster on March 11, 2011, (2) the sustainable development of the fishing industry, (3) an increase of seafood consumption, and (4) the revitalization of fishing communities (Fisheries Agency of Japan 2012a). Under the second objective, fishery resources are managed through both official management measures, such as limited entry and Total Allowable Catch (TAC) systems, and autonomous initiatives by fishermen (Fisheries Agency of Japan 2014b). In Japan, local resource users have been principal decision makers in fishery resource management (Makino and Matsuda 2005). For example, a part of mackerel TAC decided by the government is allocated to a group of purse seine fishermen (Fisheries Agency of Japan 2014b). The group of purse seine fishermen coordinates its operations to comply with its quota and other regulations, and to maximize profit.

This management system is called co-management. Fishery co-management is defined as an arrangement where responsibility for fishery resource management is shared between the government and resource users (Sen and Nielsen 1996). It is well recognized that resource user's participation is very effective for the management of common pool resources, because cooperative management by fishers, managers and scientists often results in sustainable fisheries (Jentoft 1989; Gutiérrez et al. 2011; Sen and Nielsen 1996). Gutiérrez et al. (2011) state that co-management is the only realistic solution for the majority of the world's fisheries. Many studies report the success of Japan's co-management of fishery (Makino 2011; Makino and Matsuda 2005; Sakai et al. 2010; Uchida and Makino 2008).

Chapter 1 Introduction

However, Mora et al. (2009) concluded overall management effectiveness in Japan's Exclusive Economic Zone (EEZ) to be very low, due to limited transparency, high reliance on subsidies, overcapacity and low sustainability of fishery resources. Many fishery resources are declining and causing socioeconomic problems at the national scale, even though there are some successes at the local level. Fishery production by Japan was more than 10 million tons in the past, but it decreased to around 5 million tons in recent years. The closure and decline of some far seas fisheries and the impact of the huge tsunami and earthquake in 2011 could be seen to contribute to this reduction, but the main driver is the decline of some of fish stocks offshore Japan (Ad-hoc Task Force on Fishery Resource Management 2014). In 2012, 36 stocks out of 84 commercially important stocks in Japan's EEZ were designated as low abundance stocks. Also, 27 out of 84 stocks were in classified as stocks with decreasing trends (Fisheries Agency of Japan and Fisheries Research Agency of Japan 2014a). These issues affect the fishermen as much as the fish. For example, the number of fishermen continues to decline and fishermen are aging. Fishing companies are in chronic deficits. Although seafood processing is a key industry in fishing communities, the number of employees, facilities and product volume and value are decreasing (Fisheries Agency of Japan 2014a). There is no doubt that the fishery resource management system should be changed to improve both stock status of fishery resources and the socioeconomic situation of the fishing industry.

The TAC system is the key tool in Japan's fishery resource management system for some species. For the last couple of years, setting TACs, the introduction of individual quota (IQ) and individual transferable quota (ITQ) systems were the dominant topics in the discussion about reform of Japan's fishery resource management system. Two government task forces convened in 2008 and 2014 to discuss these issues as prescriptions for the current severe situations of Japan's fishing industry (Ad-hoc Task Force on TAC System 2008; Ad-hoc Task Force on Fishery Resource Management 2014).

TACs are set annually by the Ministry of Agriculture, Forestry and Fishery (MAFF) in consultation with the Fishery Policy Council, taking into account results of the stock assessments and the socioeconomic situation of fishing industries (Fisheries Agency of Japan 2014b). Several problems arose in TAC setting in recent years. In some stocks, TACs are set higher than Allowable Biological Catches (ABCs) calculated by scientists, in order to reduce socioeconomic impacts on fishing industry. ABC is the allowable catch of a stock to achieve its management objective. Therefore, TAC that is higher than ABC means that TAC is not designed to achieve management objectives. TACs were higher than ABCs in 9 stocks (4 species) in 2007. Even in 2013, TACs were higher than ABCs in 3 stocks (2 species) (Fisheries Agency of Japan 2014b). Also, TACs are set only for 8 species. It has been discussed whether more species should be managed through TAC systems (Ad-hoc Task Force on TAC System 2008; Ad-hoc Task Force on Fishery Resource Management 2014).

Questions about the feasibility of IQ and ITQ systems prompted extensive discussion in Japan as well. The central tenet of IQ systems is to allocate shares of TAC to individual fisherman, instead of pooled fleet-wide TAC. IQ systems allow individual fishermen the flexibility to test various patterns of harvesting and marketing to increase the income from his/her quota share rather than race-to-fish (Huppert 2005). ITQ systems further allow quota shares to be sold or leased. Under ITQ systems, efficient boats can pay more to obtain quota. Only the efficient boats will continue to fish, so that it will result in a more cost effective fishing industry (Anderson 1986). Successful examples of fishery management systems using IQ and ITQ systems are reported in Canada, Iceland, New Zealand, Norway, the US[1] and other countries (Costello et al. 2008; Huppert 2005; Grafton et al. 2006; Munro et al. 2009; Sutinen et al. 2014). The Japan Economic Research Institute, an influential economic think tank, published a report suggesting that Japan introduce IQ and ITQ systems (Japan Economic Research Institute 2007). Some researchers advocate for the introduction of IQ or ITQ systems to Japan (Katsukawa 2010; Komatsu 2010; Yagi and Managi 2011), and others state that IQ or ITQ systems might work in some fisheries in Japan (Makino and Saito 2014; Yagi et al. 2012). However, two task forces concluded that IQ systems might work in some fisheries, but introduction of ITQ systems was premature (Ad-hoc Task Force on TAC System 2008; Ad-hoc Task Force on Fishery Resource Management 2014). The Japanese government has not adopted IQ and ITQ systems with the exception of southern bluefin tuna (*Thunnus maccoyii*), Atlantic bluefin tuna (*Thunnus thynnus*) and red snow crab (*Chionoecetes japonicus*) that are managed by IQ systems (Fisheries Agency of Japan 2014b).

[1] The US sometimes uses “Individual Fishery Quota (IFQ)”, instead of “ITQ”. In this paper, ITQ is used to avoid confusion.

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Incentives to amend the current fishery resource management system should focus on both improving fish stocks and the socioeconomic situation of the fishing industry. The two task forces in 2008 and 2014 did not achieve any clear policy innovation for Japan's fishery resource management systems, although the Ad-hoc Task Force on Fishery Resource Management in 2014 provided clear policy direction for some species.

1.2 Goal of This Study

The goal of this study is to make recommendations for Japan's fishery resource management policy and it focuses on the TAC systems at the national level. Improvement for fisheries stocks will also improve socioeconomic conditions for fishermen, because fishery resources are embedded in complex Social-Ecological Systems (SESs) (Ostrom 2009). Therefore, this paper discusses the Japan's fishery resource management policy through the framework of SESs suggested by Ostrom (2009).

The recommendations for policy innovation take into account learning lessons from successful fisheries around the world. While many fishery resources are declining worldwide, some are managed sustainably (Hilborn and Ovand 2014; Worm et al. 2009). Similarly, some fishing industries and fishing communities are successfully achieving their socioeconomic objectives (Gutiérrez et al. 2011; Hilborn et al. 2005; Huppert 2005).

I conducted species targeted case study analyses in this research for four representative fisheries in Japan, e.g., on chub mackerel (*Scomber japonicas*), walleye pollock (*Theragra chalcogramma*), Pacific bluefin tuna (*Thunnus orientalis*) and ocellate puffer (*Takifugu rubripes*), in order to make recommendations for Japan's national fishery resource management policy. These four species are of particular importance due to their relevance to the task force discussions in 2014 (Ad-hoc Task Force on Fishery Resource Management 2014). The recommendations for the general policy innovation for national government are extracted from the discussions about how the particular fisheries in these case studies should be improved.

To arrive at these recommendations, the research for this paper takes the following approach. Chapter 2 details the analytical framework applied in this paper. Chapter 3 describes Japan's general fishery resource management systems and the discussions of the 2014 Task Force. Case studies for the four representative species are presented from Chapter 4 to Chapter 7. The possible policy innovations are discussed at Chapter 8, and the recommendations are then summarized in Chapter 9.

Chapter 2 Research Design and Analytical Framework

The final goal of this project is to make recommendations for Japan's fishery resource management policy, focusing on its TAC system. The basic structure of Japan's TAC system is as follows; (1) TAC is set at the national level based on the ABC calculated by scientists in the Fisheries Research Agency of Japan; (2) TAC is allocated to the national licensed vessels groups and the prefectural governments; and then (3) regulations are established by fishermen groups to comply with the TAC in individual groups. The general structure of Japan's fishery resource management system is described in Chapter 3 in detail.

In order to make recommendations, case studies are conducted for four stocks that the Fisheries Agency of Japan (FAJ) as introduced in the new fishery management policies in 2014 and 2015. The fishery resource management system is discussed through the viewpoints of the SESs framework. Each case study answers the following research questions; (a) how would the new management policy impact the SESs; (b) how should the management system be further amended? Then, based on the case studies of the four stocks that discuss regulations for individual stocks, the recommendations for Japan's fishery management system are discussed holistically.

2.1 Analytical Theory

2.1.1 Social Ecological System Framework

An essential law for Japan's fishery resource management is the Fisheries Act of 1949. Its objective is to promote the development of the fisheries and encourage the democratization of fishermen (Koya 1993). The Fisheries Act mainly focuses on common pool resource users, but it does not mention the ecosystem. Fishery management policies, however, have impacts not only fishermen's revenue, but also the SESs as a whole. As all common pool resources are embedded in complex SESs, many scholars have discussed fishery management issues through the framework of SESs (Basurto et al. 2013; Gutiérrez et al. 2011; Soliman 2014). In the study about the ITQ systems, Soliman (2014) states that applying the SESs framework to any particular policy proposal enables policy makers to see what its limitations are likely to be, and to identify possible ways to improve it. In this paper, the impacts of the Japan's fishery management policy are studied through the framework of the SESs that is proposed by Ostrom (2009).

Chapter 2 Research Design and Analytical Framework

In Ostrom's SESs framework, four components: Resource System, Resource Unit, Governance System and Resource Users, interact with each other to produce outcomes at the SESs level (Ostrom 2009). The Japanese fishery resource management systems for four case study stocks are analyzed following the Ostrom's framework. In each case study, a Resource Unit is defined as a target fish stock, a Resource System is defined as an ecosystem surrounding target stocks, a Resource User is defined as fishermen and fishing communities, and a Governance System is defined as governing organizations encompassing the ecosystem.

The concept of Resource System is not discussed in each case study, because each case is only dealing with an individual fish stock. However, the concept of Resource System will be discussed in the final discussion section, in order to make holistic recommendations for the Japan's fishery resource management system.

2.1.2 Theoretical Perspective of Policy Innovation

Analyzing internal factors and external factors for policy innovations can answer the following research questions: (a) how would the new management policy impact the SESs; and (b) how should the management system be further amended?

There are two general drivers for policy innovations: external and internal factors (Dolšak and Sampson 2012; Kent 2012). Internal factors may include problem severity and institutional capacity. The problem severity variable in fisheries is related to severe situations, such as overfishing and overcapacity. Institutional capacity is also an important internal factor for policy innovation, because existing management structures and regulations have significant influence on the introduction of the new policy (Kent 2012).

Scholars have conceptualized the external factors in two ways: horizontal diffusion and vertical diffusion (Dolšak and Sampson 2012; Kent 2012). Horizontal diffusion is the concept that policy makers learn from earlier adopters of policies and tools (Dolšak and Sampson 2012). Vertical diffusion is defined as top-down pressures to the Regional Fishery Management Council, such as national laws or political pressure, from the context of research about policy diffusion in the US fishery management (Kent 2012).

However, the top-down pressures on the FAJ are relatively weak. Therefore, only horizontal diffusion is discussed as an external factor.

2.2 Case Study Design

The multiple case study approach is the basic research design of this thesis. A case study is a good tool to address “how” and “why” types of questions like those of this project. A case study allows researchers to retain a comprehensive, real-world perspective (Yin 2014). It is the appropriate tool to holistically discuss the fishery resource management systems in Japan.

2.2.1 Case Selection

Four stocks, chub mackerel Pacific stock, walleye pollock Northern Japan Sea stock, Pacific bluefin tuna, and ocellate puffer Japan Sea - East China Sea - Seto Inland Sea stock (JES stock) are selected for these case studies. Only four stocks out of 84 stocks whose status are assessed by the Fisheries Research Agency of Japan (FRA) are selected for these case studies, but this case study selection is representative enough to holistically discuss Japan’s fishery resource management policy as outlined below. First, new fishery resource management policies are introduced for only four stocks in 2014 and 2015. Secondly, as described in “2.1.2 Theoretical Perspective of Policy Innovation”, the internal drivers for policy innovations are problem severity and institutional capacity. These four stocks can be seen as representatives of fish stocks in Japan, in terms of both problem severity and institutional capacity. Yin (2014) explained that cases may be selected to predict contrasting results for anticipatable reasons. In terms of problem severity, the FAJ stated that walleye pollock Northern Japan Sea stock, Pacific bluefin tuna and ocellate puffer JES stock were selected, because their stocks were in serious decline and immediate actions were required, whereas chub mackerel Pacific stock was selected as the representative of stocks that were presently in increasing in size (Fisheries Agency of Japan 2014c).

With respect to institutional capacity, case studies for four representative stocks cover a variety of governance systems. The chub mackerel Pacific stock fishery mainly consists of the fisheries licensed by the national government. The MAFF has responsibility to manage this fishery. The fishery for walleye pollock Northern Japan Sea stock consists of both fisheries licensed by the MAFF and the fisheries licensed by a prefectural government. The Pacific bluefin tuna fishery consists of both a nationally licensed fishery and prefectural governments' licensed fisheries all over Japan, while the ocellate puffer JES stock fishery is only subject to prefectural governments' fisheries management. Importantly, chub mackerel Pacific stock and walleye pollock Northern Japan Sea stock are managed through the TAC systems, while Pacific bluefin tuna is managed by the catch limit established by the international organization, Western and Central Pacific Fishery Commission (WCPFC). However, there is no catch limit or TAC for ocellate puffer. Overall, the case selection is representative enough of the fishery resource management systems of Japan for the purpose of this study.

2.2.2 Case Study Elements

For the individual SESs component in each case study, problem severities are analyzed in the context of Resource Unit and Resource Users, while institutional capacity is analyzed in the context of Governance System.

(1) Resource Unit

Stock status of target species can be a key factor for changing fishery resource management policy, as the Japanese government clearly states that fishery resources within Japan's EEZ have to be utilized sustainably in the Master Plan for Fisheries (Fisheries Agency of Japan 2012a).

The common long term target of stock status, such as B_{MSY} or X% of B_0 (Hilborn 2002) is not an established concept in Japan. Instead, maintaining the stock biomass above B_{limit} is the basic long term objective of Japan's fisheries resource management. B_{limit} is the lowest Spawning Stock Biomass (SSB) that is expected to produce a good and stable recruitment (Fisheries Agency of Japan and Fisheries Research Agency of Japan 2014b). The short term management objectives are set for individual species by the FAJ in the Fishery Resource Management Guideline (FRMG) (Fisheries Agency of Japan 2013). In each case study, this research analyzes the differences between B_{limit}, the short term management objective, the current stock status and the projected stock trend after the introduction of the new policy recognizing that there is only a short time period to monitor effect.

(2) Resource Users

The Master Plan for Fisheries states that the principles of Japan's fishery resource management policy are: (a) the recovery from the earthquake and tsunami on March 11, 2011; (b) the sustainable development of fishing industry; (c) an increase of seafood consumption; and (d) the revitalization of fishing communities (Fisheries Agency of Japan 2012a). Based on the Master Plan for Fisheries and discussions in the Ad-hoc Task Force on Fishery Resource Management in 2014 (herein after Task Force), this paper discusses the impacts of the new fishery management policy on boats owners, communities and equity concerns.

(i) Impacts on Boat Owners

Maintaining or increasing the profit of fishermen was designated as one of the principles of the fishery resource management policy (Fisheries Agency of Japan 2012a), and it was discussed in the Tasks Force as well (Ad-hoc Task Force on Fishery Resource Management 2014). The profit of a fishery is a function of value of fish and cost for operation, so both value of fish and cost of fishing are discussed in this study. The Task Force also pointed out the impact of fishery management policy on fleet dynamics (Ad-hoc Task Force on Fishery Resource Management 2014). In this project, fleet dynamics is defined as the change in the number of fishing vessels and size of the fleet, and change of target species. In each case study, the possible changes of the fishery's operation cost and the value of fish, and the possible changes of the number of vessels and size of the fleet after the introduction of the new policies are analyzed.

(ii) Impacts on Communities

The Master Plan for Fisheries states that the revitalization of small fishery communities is important issue for Japan's fishery policy, and the recruitment of young fishermen is also priority issue (Fisheries Agency of Japan 2012a). There are many fishery communities where people do not have access to alternative sources of income and employment. The Task Force states that the impacts on fishery communities have to be considered, and it raises concern about the adverse effect of ITQ systems on small fishing communities including their social capital (Ad-hoc Task Force on Fishery Resource

Management 2014). The changes of fishery management policy might impact social capital, here defined as the value of the relationship among the communities, including their degree of trust and ability to collaborate (Holland et al. 2013). In this project, the impacts on communities are defined as the changes in employment in fishery and fishery related business and changes in social capital.

<u>(iii) Impacts on Equity</u>

Throughout the Task Force's discussion, the Task Force members and representative of fishermen invited to the Task Force meetings repeatedly pointed out the equity issues (Ad-hoc Task Force on Fishery Resource Management 2014). It is well recognized that the equity among stakeholders is an important factor to introduce into the new fishery management policy. In each case study, two types of the equity issues are discussed; the equity of burden among governance types (MAFF licensed fisheries vs prefectural licensed fisheries), and the equity of burden among fishery operation types (fishing ground, target species and fishing gear).

(3) Governance System

In Japan, the responsibility for governance of fishery resource management system is shared by the FAJ, prefectural governments, fishermen associations and other committees such as the Wide-Area Fisheries Coordinating Committees (WFCCs), which are described in the following chapter. Responsibility of governance system differs depending on the individual fishery. If a management measure is changed, additional Monitoring, Control and Surveillance (MCS) and additional coordination among stakeholders may be required. Because individual organizations have limited budgets, human resources, and authority, their capacity can influence the scope of policy innovation. In each case study, the MCS capacity of the organizations, including coordination issues required by the new policy, are analyzed.

2.2.3 Learning from Successful Fisheries

Taking into account the analysis about the impacts of the Japan's new fishery resource management policy on the SESs, the possible amendments to Japan's new management policy are discussed.

In an individual case study, if negative impacts on Resource Units, Resource Users, and/or Governance Systems are projected by the introduction of the new policy, or the positive impacts on them seem to be small, alternative measures to improve the situation would be recommended. For policy innovations, learning lessons from successful innovations that overcame similar problems in other fisheries would be a good basis for alternative measures (Hilborn 2007a; Kent 2012). In each case study, therefore, the alternative fishery management policies are discussed based on the fishery management policy tools that have been implemented in other places that used to have the similar problems as in case studies. Also, all the elements listed in “2.2.2 Case Study Elements” will be covered through this discussion.

2.3 Final Discussion and Recommendations

The recommendations for the whole Japanese fishery resource management system are discussed focusing on the TAC systems. Through case studies, the impacts of the Japan’s new fishery resource management policies introduced in 2014 and 2015 for individual fishery are analyzed. Also, case studies discuss how the policies should be amended. In Chapter 8, the results of the case studies are synthesized to provide the recommendations that the FAJ should implement, not only for these four stocks, but also for all commercially important stocks to improve overall Japan’s fishing industry.

Chapter 3 Fishery Resource Management in Japan

In this chapter, Japan's general fishery resource management systems and the discussions about the new management policy in the Task Force are described. As a division of the MAFF, the FAJ is the national government's agency responsible for fishery resource management in cooperation with prefectural governments.

3.1 Fishery Resource Management System in Japan

Japan's fishery resource management system consists of official management measures and autonomous management initiatives (Fisheries Agency of Japan 2014b). Both official management measures and autonomous management initiatives are based on annual stock assessments conducted by the FRA. Fisheries in the high seas and foreign countries' EEZs are managed by both domestic law and international regulations. Only marine fishery resource management within Japan's EEZ is explained in this chapter.

3.1.1 Official Management Measures

Japan's fisheries are mainly managed under the two laws; the Fishery Act and the Law Regarding Preservation and Management of Living Marine Resources. The Fishery Act was enacted in 1949, and has since had several amendments. Under this Act, fisheries are managed by fishing rights and licensing. In 1996, the Law Regarding Preservation and Management of Living Marine Resources introduced the TAC system. In addition to official management measures, fishermen's autonomous management initiatives have been implemented all over Japan (Fisheries Agency of Japan 2014b).

(1) Fishery Act

Under the Fishery Act, marine fisheries are classified as fisheries with fishing rights, fisheries with licensing, or open access fisheries. The impact of the open access fishery is very low in general (Ministry of Agriculture, Forestry and Fishery 2014a). Therefore, this chapter focuses only on fisheries with fishing rights or licensing. Example of open access fisheries include trolling for skipjack and handlining for puffer fish.

Chapter 3 Fishery Resource Management in Japan

(a) Fishing Rights

Some coastal fisheries are managed by fishing rights. Fishing rights are classified into common fishing rights, large scale set-net fishing rights and aquaculture fishing rights (Fishery Act 1949). Fishing rights grant exclusive access to fishery resources within designated coastal area. Examples of common fishing rights are fishing rights for abalone, sea urchin and small scale set net fisheries. Fisheries within common fishing rights area are managed by autonomous regulations established by local Fisheries Cooperative Associations (FCAs) (Makino and Matsuda 2005). FCAs are composed of local fishers and rooted in each fishing community (Makino 2011).

(b) Licensing Systems

Licensing systems employ three types of licenses: licensing by the MAFF, licensing by prefectural governments supervised by MAFF, and licensing exclusively by prefectural governments (Fisheries Agency of Japan 2014b). There are 47 prefectural governments in Japan and within them, 39 prefectures are located along the coast. These 39 prefectures issue licenses for their fishing vessels.

Fishing vessels such as large scale purse seiners, large scale trawlers and tuna longliners are licensed by the MAFF, because their operations straddle multiple prefectural waters and/or their fishing pressure significantly impacts fishery resources. The MAFF licensed fishermen establish Fisheries Management Organizations (FMOs). FMOs are associations of the same fishing gear groups, for example, “All Japan Purse Seine Fisheries Association (Zen-Maki)” and “National Federation of Medium Trawlers (Zen-Soko-Ren)”. They determine autonomous measures including TAC allocation among members (Yagi et al. 2012).

Prefectural fishing vessels are managed according to characteristics of each region in relation to total national fishing capacity. They are licensed by prefectural governments supervised by the MAFF. In this category, prefectural governments issue licenses and establish regulations for them, but the MAFF limits the number of vessels for individual prefectures. Small scale purse seiners and small scale trawlers are examples of this category. Other small scale fisheries, such as small scale drift net fishery and small scale squid jigging fishery are exclusively licensed and regulated by prefectural governments (Fisheries Agency of Japan 2014b).

These licenses are accompanied by several conditions such as vessel size limits, seasonal and/or area closures, and gear restrictions, which accounts for characteristics of each region and fishing gears (Fisheries Agency of Japan 2014b). The fishing grounds of MAFF licensed fisheries and prefectural government licensed fisheries are partially overlapping.

(c) Coordinating Organization

In order to coordinate fishing operations within a prefecture or among prefectures, coordination organizations are established. At the prefecture level, Area Fisheries Coordinating Committees (AFCCs) are organized to make recommendations to the prefectural governments and to issue Committee Directions about fishing rights and licensing in their jurisdiction (Fishery Act 1949). For example, the AFCCs make recommendation about the allocation of fishing rights and licenses in their jurisdiction. Similarly, WFCCs are organized to coordinate resource utilization of migratory pelagic fish stocks across the prefectural jurisdictions (Fishery Act 1949). There are three WFFCs: Pacific WFCC, Sea of Japan and Western Kyushu WFCC, and Seto Inland Sea WFCC. They issue Committee Directions based on the authorities as described in the Fishery Act. For example, the limited entry system was introduced to open access fisheries targeting Pacific bluefin tuna by the Committee Directions of WFCCs (Fisheries Agency of Japan 2014d).

(2) Law Regarding Preservation and Management of Living Marine Resources

The Law Regarding Preservation and Management of Living Marine Resources, more commonly known as the "Law of TAC", was enacted in 1996. Under this Act, a TAC system was introduced in 1997, and a Total Allowable Effort (TAE) system was introduced in 2003 following the amendment of this Act in 2001.

(a) TAC Systems

A TAC is a catch limit established for a particular fish stock for a year (Law Regarding Preservation and Management of Living Marine Resources 1996). Since 1996, TACs have been set for 8 species in

Japan: Pacific saury (*Cololabis saira*), Japanese jack mackerel (*Trachurus japonicus*), walleye pollock, Japanese sardine (*Sardinops melanostictus*), chub mackerel, spotted chub mackerel (*Scomber australasicus*)), Japanese common squid (*Todarodes pacificus*), and snow crab (*Chionoecetes opilio*). These 8 species were designated as TAC-managed species, because these species were very important socially and economically, and had sufficient data (Fisheries Agency of Japan 2014b).

TAC for individual species is annually set by the MAFF in consultation with the Fishery Policy Council, taking into account results of the stock assessments and socioeconomic situation of the fisheries (Fisheries Agency of Japan 2014b). Next, TAC is allocated not to individual vessels but collectively to FMOs and prefectural governments. Then, FMOs coordinate with their members to ensure that total catch of their member boats falls within the allocated limit (Yagi et al. 2012). For example, FMOs voluntarily establish measures such as allocation of quota to individual vessels, and landing limits for each fishing trip (Fisheries Agency of Japan 2014b). Regarding prefectural government quota, individual prefectural governments establish TAC management plan to ensure that total catch falls within limit allocated to the prefectural governments. As managers, the FAJ monitors catch amount of TAC species harvested by MAFF licensed vessels, and issues advice or instruction to them, if necessary. Prefectural governments do the same thing to vessels licensed by them (Fisheries Agency of Japan 2014b).

Under TAC systems, IQ and ITQ systems have not been introduced in Japan, although the Law Regarding Preservation and Management of Living Marine allows the FAJ to allocate quota to individual fishermen (Law Regarding Preservation and Management of Living Marine Resources 1996). However, the IQ system officially regulates three non-TAC species: southern bluefin tuna, Atlantic bluefin tuna and red snow crab (Fisheries Agency of Japan 2014b). Regarding southern bluefin tuna and Atlantic bluefin tuna, the total national quotas are set by international conventions, instead of national TACs. In the case of red snow crab, 90% of catch amount in 2006 is allocated as catch quota to individual vessel, instead of the TAC calculated by scientists (Fisheries Agency of Japan 2014b).

(b) TAE Systems

A TAE is a fishing effort limit, i.e., days fished by gear types, set for a particular fish stock for a year (Law Regarding Preservation and Management of Living Marine Resources). Since 2003, TAEs have been set for 9 species: ocellate puffer (*Takifugu rubripes*), flathead flounder (*Hippoglossoides dubius*), littlemouse flounder (*Pseudopleuronectes herzensteini*), marbled flounder (*Pleuronectes yokohamae*), willowy flounder (*Tanakius kitaharai*), roughscale sole (*Clidoderma asperrimum*), Japanese sand lance (*Ammodytes personatus*), Japanese Spanish mackerel (*Scomberomorus niphonius*) and spear squid (*Loligo edulis*).

TAE systems have been implemented in a similar way to the TAC systems. The MAFF sets TAEs and allocates to the FMOs and prefectural governments. FMOs and prefectural governments work with fishermen to comply with their allocated TAE, and then the FAJ and prefectural government conduct monitoring.

3.1.2 Autonomous Management Initiatives

In 2011, the framework for the FRMGs and Fishery Resource Management Plans (FRMPs) was established to encourage reasonable and appropriate fishery resource management that accounted for special circumstance in individual region (Fisheries Agency of Japan 2014b). Under this framework, the FAJ and individual prefectural government have developed their FRMGs. Then, in MAFF licensed fisheries, FMOs developed and implemented FRMPs according to the FRMG developed by the FAJ. Similarly, in prefectural governments licensed fisheries, FCAs developed and implemented FRMPs according to FRMGs developed by prefectural governments. As of March 2013, 14 FRMPs have been developed and implemented by MAFF licensed fishery groups and 1,691 FRMPs have been established and implemented by prefectural governments licensed fishermen groups. These 1,705 FRMPs covered 78% of total national fishery production (Fisheries Agency of Japan 2014b). Each FRMP includes several autonomous measures, such as individual quotas, seasonal closures, area closures, size limits and restoration of fishing ground.

Before 2011, Resource Restoration Plans (RRP) were implemented to restore overexploited fish stocks. Under this scheme, the MAFF and prefectural governments established Resource Restoration

Plans in cooperation with AFCCs and WFCCs. Sixty six Resource Restoration Plans were implemented in 2010. Now, the framework of FRMGs and FRMPs has replaced it and covers a large variety of species and fisheries.

3.2 The Task Force's Discussion about the New Fishery Resource Management Policies

In March 2014, the Task Force was organized to make recommendations to rebuild fish stocks and to maintain or increase fisheries production in Japan. Its main topics of discussion were: the review of current fishery resource management system, prescriptions for four important stocks (i.e., chub mackerel Pacific stock, walleye pollock Northern Japan Sea stock, Pacific bluefin tuna and ocellate puffer JES stock), and the future of fishery resource management policy (Fisheries Agency of Japan 2014c). The Task Force held six meetings from March through July in 2014 and published its report in July 2014 (Ad-hoc Task Force on Fishery Resource Management 2014).

The Task Force made three recommendations: enhancement of the official management measures, enhancement of the autonomous management initiatives, and prescriptions on the resource management of four specific fish stocks (Ad-hoc Task Force on Fishery Resource Management 2014). Prescriptions on the resource management of four specific fish stocks are described in Chapter 4, 5, 6 and 7.

Regarding official management measures, the Task Force stated that TACs should conform to the ABCs calculated by the FRA. Unfortunately, TACs were sometimes larger than ABCs in the past. The Task Force recommended that even when TACs would exceed ABCs for some reasons, the gap should be minimized. On one hand, the Task Force states that IQ systems may work well in Japan, because it secures the compliance to total catch limit rather than current collective TAC system in which responsibility of individual fishermen is less apparent. Also, it enables fishermen to operate with their own strategy rather than race-to-fish, which may result in cost reductions and safer operations. On the other hand, the Task Force states that IQ system may induce confusion in customary fishing operations which consist of coordination among all fishermen through FCAs and FMOs. Also, it may cause inefficient quota use. The fishermen in the North consume all of their quota in a few month, for example, but the fishermen in the South harvest just 20% of their quota, because actual fishery operations depend on migration of fish. Therefore, the Task Force argues that IQ systems need to be introduced on an experimental basis to analyze feasibility and to estimate its benefit. The Task Force concludes that the introduction of an ITQ system is premature due to following concerns about unresolved questions: Is it appropriate for fishermen to sell quota to get money?; Can ITQ systems be a barrier to the new entrants?; Will reductions of TACs be strongly opposed due to the value of quota?; Does consolidation occur and adversely affect local fishing communities (Ad-hoc Task Force on Fishery Resource Management 2014)?

As for autonomous management initiatives, the Task Force recommended that individual FRMPs should be reviewed, because three years have passed since this framework started. This review should be conducted by the fishermen themselves who developed and implemented their FRMPs in cooperation with the FAJ and relevant prefectural governments (Ad-hoc Task Force on Fishery Resource Management 2014).

In reaction to the Task Force report, the FAJ issued a press release in August 2014. The FAJ stated that the FAJ had already requested prefectural governments and FMOs to review the status of their FRMPs. The FAJ received the reviews at the end of February in 2015, and then the FAJ has them under review them with an eye toward how they may improve the current framework of FRMGs and FRMPs. The FAJ also explained the new management policy for the four specific fish stocks as discussed in Chapter 4, 5, 6 and 7. The FAJ did not state that how the FAJ would make progress on official management measures, such as IQ and ITQ systems, but they mentioned about the IQ system in the new management measure for chub mackerel that is discussed in Chapter 4 (Fisheries Agency of Japan 2014e).

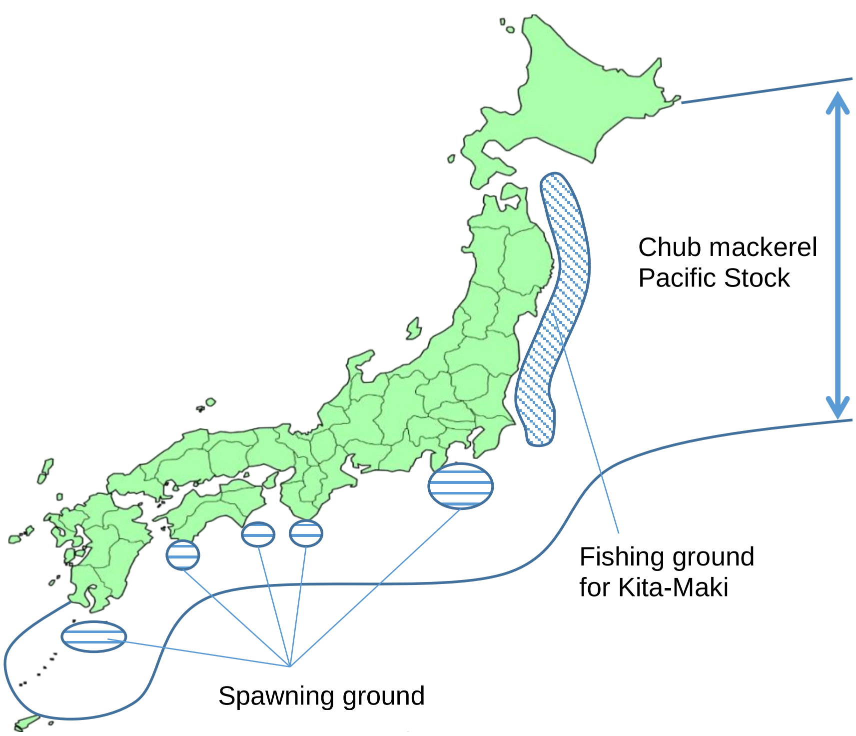
Chapter 4 Chub Mackerel Pacific Stock Case Analysis

4.1 Background of Chub Mackerel Pacific Stock Fishery

4.1.1 Stock Status

Around Japan, there are two mackerel species, *Scomber japonicas* and *Scomber australasicus*. *S. japonicas* is called chub mackerel in a common name, and divided into two separate stocks, Pacific stock and Tsushima current stock. *S. australasicus* is called spotted chub mackerel, and also divided into two separate stocks, Pacific stock and East China Sea stock (Fisheries Agency of Japan 2014f). In this chapter, fishery resource management for the chub mackerel Pacific stock is discussed. Chub mackerel's longevity is about 7-8 years. It matures at age two with 50% and matures at age three with 100%. Chub mackerel Pacific stock ranges off the east coast of Japan, from Kyushu Island in South to Hokkaido Island in North, and migrates farther to Russian EEZ and the high seas. The main fishing ground is off the coast of Northeast Japan, i.e., from Aomori to Chiba Prefectures. Spawning ground of this stock is coastal area in south part of their range. The main spawning ground is around Izu Islands, and off the coast of Kagoshima, Kochi and Wakayama Prefectures (See Figure 1) (Kawabata et al. 2014).

Figure 1. Distribution and fishing and spawning grounds of chub mackerel Pacific stock



(Modified from Kawabata et al. 2014)

The biomass of chub mackerel Pacific stock is 1,090,000 tons in 2012. This is about the historical mid-level of abundance, and it has increased recent years. Biomass of chub mackerel Pacific stock was more than 3,000,000 tons in 1970's. It declined to less than 2,000,000 tons in 1980's, to less than 1,000,000 tons in 1990's and dropped to 150,000 tons in 2001. Since the mid-2000's, the biomass started recovering, and it reached 1,090,000 tons in 2012 (Kawabata et al. 2014). Matsuda et al. (1992) stated that environmental variability and interspecific competitions affected long-term fluctuations of pelagic fish including chub mackerel in the east coast of Japan. Their data showed that chub mackerel was replaced by sardine, sardine was replaced by anchovy (*Engraulis japonicus*), Pacific saury and jack mackerel, and then they were replaced by chub mackerel again (Matsuda et al. 1992). Yatsu et al. (2005) stated that environmental conditions shifted from unfavorable to favorable for chub mackerel during 1969-70 and 1988-1992. However, chub mackerel Pacific stock could not recover even in favorable environmental conditions in the 1990's and early in 2000's, due to high fishing mortality, especially for juveniles (Kawai et al. 2002; Yatsu et al. 2005; and Makino 2011).

In government statistics, a chub mackerel and a spotted chub mackerel are counted as same category, namely "mackerel species", so that the catch data estimated by Kawabata et al. (2014) are used in this thesis. Kawabata et al. (2014) estimate the catch amount of chub mackerel Pacific stock based on the data obtained in sampling survey at fishing port.

4.1.2 Description of the Fishery

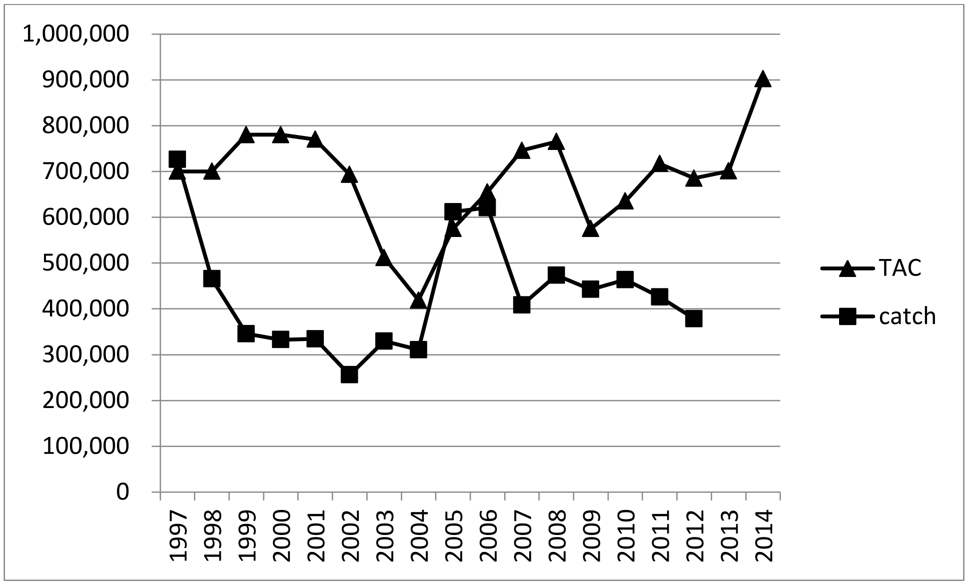
In the FRMG, the FAJ states that the management objective of chub mackerel Pacific stock is maintaining SSB of greater than B_{limit} that equals to 450,000 tons (Fisheries Agency of Japan 2013). In 2012, SSB of this stock was 472,000 tons that was slightly higher than B_{limit} (Kawabata et al. 2014). In the FRMG, the FAJ states that the SSB should recover more, because current environmental conditions are good for this stock (Fisheries Agency of Japan 2013).

Chub mackerel fisheries are managed under a TAC system combined with limited entry, licensing condition and autonomous initiatives by industry. The TAC for chub mackerel Pacific stock is not set as a single stock's TAC, but one TAC for mackerel species includes both chub mackerel and spotted chub mackerel (Fisheries Agency of Japan 2014f). The FAJ explains that this is because these two species are sold as a same category lot in markets, and it is hard to distinguish between them especially in their juvenile stage (Ad-hoc Task Force on TAC System 2008).

Mackerel species TAC in 2014 is 902,000 tons and it is composed of simple summation of ABCs of 4 stocks. ABCs of chub mackerel Pacific stock, Tsushima current stock, spotted chub mackerel Pacific stock and East China Sea stock are 478,000 tons, 133,000 tons, 243,000 tons and 48,000 tons, respectively (Fisheries Agency of Japan 2014f). The ABC for chub mackerel Pacific stock is calculated based on the management objective that is maintaining SSB of greater than B_{limit} (Fisheries Agency of Japan 2013). For this species, B_{limit} is defined as the lowest SSB that is expected to produce a good and stable recruitment and to achieve sustainable utilization of this stock (Kawabata et al. 2014). In order to achieve this management objective, Kawabata et al. (2014) estimates the ABC for this stock. This is calculated by means of the following formula: F_{med} is multiplied by 0.8, where F_{med} is the fishing mortality to maintain current SSB that almost equals to B_{limit}. Then, F_{med} is multiplied by 0.8 to ensure the recovery of SSB. To achieve $0.8F_{med}$, ABC is calculated at 478,000 tons. ABCs of three other mackerel stocks are estimated based on the individual management objectives (Fisheries Agency of Japan 2014f).

Figure 2 shows that TAC and total catch for mackerel species from 1997, the first year for Japan's TAC system, to 2012. In 2012, total catch of mackerel species was 378,351 tons. In 1997 and 2005, catches exceeded TACs, and 95% of TAC was harvested in 2006 (Fisheries Agency of Japan 2014g). The reason of this was that there was very high recruitment of chub mackerel Pacific stock in 1996 and 2004 (Fisheries Agency of Japan 2014b). Except 1997, 2005 and 2006, 40-60% of TAC was harvested (Fisheries Agency of Japan 2014g). This means that the consumption rate of mackerel species' TAC depends primarily on the catch of chub mackerel Pacific stock.

Figure 2. Catch and TAC for mackerel species



(Source: Fisheries Agency of Japan 2014g)

4.1.3 Current Fishery Resource Management System

During the past five years (2008-2012), the average annual catch of chub mackerel Pacific stock was 131,770 tons. The major harvest (more than 80%) of chub mackerel Pacific stock was harvested by purse seiners in the North Pacific region. Catch by the purse seine fishery in the North Pacific region, the set net fishery in the North Pacific region, the purse seine fishery in the Middle Pacific region, all fisheries in the South Pacific region, and the scoop net fishery[2] in the North and Middle Pacific region are 108,049 tons (82%), 12,031 tons (9%), 6,630 tons (5%), 3,162 tons (2%) and 1,899 tons (1%), respectively (Kawabata et al. 2014). Among these fisheries, purse seiners in the North Pacific and Middle Pacific regions are licensed by the MAFF, whereas others are licensed by prefectural governments. With respect to catch statistics, the Pacific coast is divided into three regions - north, middle and south Pacific. Because more than 80% of chub mackerel Pacific stock is harvested by purse seiners in the North Pacific region, the management system for this fishery is described in more detail.

TAC for mackerel species is allocated to MAFF licensed fisheries and prefectural government licensed fisheries, same as other species' TAC. In 2014, 523,000 tons of mackerel species TAC was

[2] A scoop net fishery is the fishery that fishermen scoop fish, mainly mackerel species, using hand nets.

allocated to the MAFF licensed fishery and 379,000 tons of TAC was allocated to the prefectural government licensed fisheries (Fisheries Agency of Japan 2014g). The MAFF licensed fisheries group and individual prefectural governments coordinate their vessels to ensure that their catches fall within quota allocated to them. No TAC is set for sports fishing, but the national mackerel species catch by sports fishing was 997 tons (0.1% of TAC) in 2008 (Ministry of Agriculture, Forestry and Fishery 2009), so small that it can be ignored in this paper.

(1) Purse Seine Fishery

Large and medium scale purse seiners are licensed by the MAFF. Mackerel species constitutes 46% of total catch of large and medium scale purse seine fisheries in 2013, in terms of weight (Ministry of Agriculture, Forestry and Fishery 2014a). Purse seiners organized the national scale FMO, namely, Zen-Maki (Fisheries Agency of Japan 2014b). Zen-Maki is composed of 12 regional purse seine fisheries cooperatives and covers all MAFF licensed large and medium scale purse seine fishing vessels in Japan. Zen-Maki coordinates with regional purse seine fisheries cooperatives and decides quota allocation to them. Then, individual regional cooperatives implement their own autonomous measures, such as IQ-like system to allocate quota to them and time closure, to comply with their quota (Fisheries Agency of Japan 2014b).

The name of the regional purse seine association in the North Pacific region is the North Pacific Federation of Large and Medium Scale Purse Seiners (Kita-Maki). The member vessels of the Kita-Maki operate off the east coast of Hokkaido, Aomori, Iwate, Miyagi, Fukushima, Ibaraki, and Chiba Prefectures. Their operation is a group operation. Their typical group composition is one net boat (catcher boat), one search boat, and two carrier boats. The license is not granted for individual vessels, but for individual groups. As of 2011, 34 groups belonged to Kita-Maki (Makino and Saito 2014). Total number of licenses and size of vessels for each license are limited by the MAFF. The number of licenses is decided by the MAFF, and it is allocated to individual prefectures to secure that individual prefectures can keep its fishing industry. Also, licensing imposes several regulations on them, such as the limited number of carrier vessels for each group, area closures and time closures.

In addition to these official management measures, the Kita-Maki has implemented its own autonomous management initiatives since 2003. In the 2013 fishing season, they implemented an IQ-like system, “huge catch suspension”, and “bad weather suspension”. The IQ-like system has been introduced since 2007 and this scheme distributes fishing quotas to individual vessels by month. In order to reduce catch of juveniles, the allocation of quota is reduced in the season when juvenile catch is large (Fisheries Agency of Japan 2014b). In this paper, this scheme is called “IQ-like” system instead of IQ system, in order to distinguish between quota allocation to the individual by government and quota allocation to individual by fishermen’s autonomous measure. Huge catch suspension means that all members would not operate in the following day, if their total catch of mackerel species exceeds 3,000 tons in a day (Fisheries Agency of Japan 2014b). Bad weather suspension means that all member vessels do not operate, when small vessels cannot operate due to bad weather, even if larger vessels have no problems (Fisheries Agency of Japan 2014e).

(2) Other Fishery

Twenty nine prefectural governments across Japan receive quota of mackerel species (Fisheries Agency of Japan 2014g). Prefectural government authorizes fisheries, such as set net fishery, scoop net fishery and small scale purse seine fishery. Their total catch consists of 13% of chub mackerel Pacific stock catch (Kawabata et al. 2014). Fishing capacity of those fisheries are restricted through the licensing system by prefectural governments, and some fisheries implement their autonomous measures. For example, the small scale purse seiners in Shizuoka Prefecture have a 14 day closure during fishing season, and operation is prohibited on Fridays in the scoop net fishery in Chiba prefecture (Fisheries Agency of Japan 2003).

4.1.4 The New Management Policy

Regarding chub mackerel Pacific stock fishery management, the Task Force only discussed fishery management of purse seiners in the North Pacific region, because they catch more than 80% of this stock. The Task Force stated that purse seine fishery for chub mackerel in the North Pacific region was a good case to experimentally implement an IQ system, because this fishery could select their target species;

they had already implemented the IQ-like system; and the number of fishing vessels and landing ports were relatively small (Ad-hoc Task Force on Fishery Resource Management 2014).

After the Task Force report appeared, the FAJ announced that the upcoming trial management measures for the purse seiners in the North Pacific region for their chub mackerel operation in August, 2014 (Fisheries Agency of Japan 2014e). The detail of the new trial measures are as follows.

- Ten groups are selected for this experiment. The FAJ and the FRA will compare 5 groups with the IQ system and 5 groups without the IQ system. Five groups mean that 5 net boats with their support vessels such as carrier vessels.
- The trial IQ system starts October 1, 2014 until June 30 2015, because TAC management year for mackerel species is from July 1 to June 30 in following year and main fishing season starts in October.
- Allocation is calculated based on their individual historical catch ratio before the tsunami and earthquake disaster in 2011. Their historical catch ratio is multiplied by TAC in the 2014 management year, and it is multiplied by the catch ratio of October to June out of a whole year. Then, 85% of it becomes individual quota.
- Trial vessels are exempted from the “bad weather suspension.”, so they can operate during suspension.
- All vessels are monitored by the Vessel Monitoring System (VMS) which is the system to monitor the real-time position of individual vessels via satellite. Sales slips, log book information, data about operational cost and landing information including the ratio between chub mackerel and spotted chub mackerel are submitted to the FAJ. These data is compared between trial groups and control groups.
- Landings are periodically inspected by the FAJ. Monitoring and inspection cost paid by the FAJ is calculated.
- In a case of overage of individual quota, the license would be revoked.

4.2 The Impacts of the New Policy

The impacts of the new policy on SESs components, i.e., resource unit, resource user and governance are discussed.

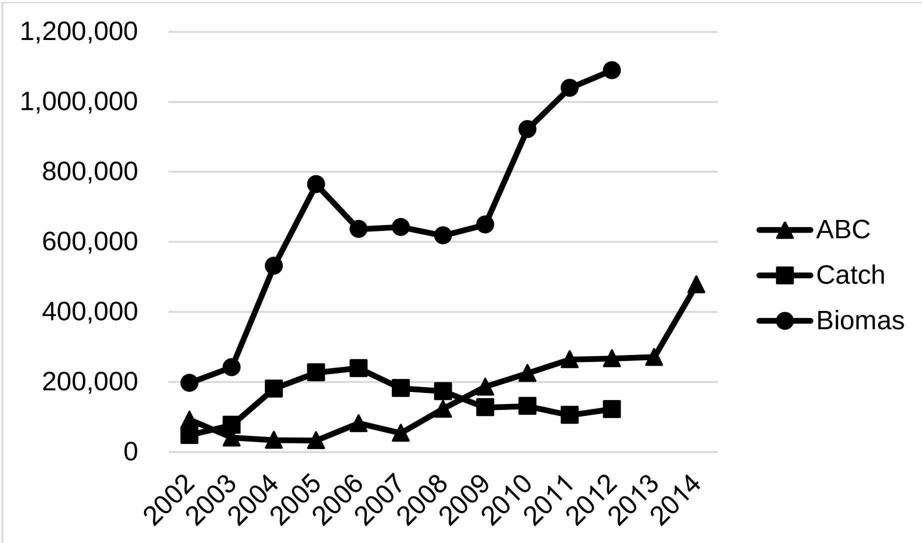
4.2.1 Resource Unit

The main point of the new management policy is that TAC is officially allocated to individual vessels. Some researchers argue that IQ and ITQ systems work well to prevent TAC overage by clarifying the responsibility of individual vessels (Bromley 2009; Munro et al. 2009). However, if TAC can be complied with, the impacts on resource unit would depend on the size of TAC, regardless whether the TAC is allocated to individuals or not (Bromley 2009; Dewees 1998; Melnychuk et al. 2012).

The current SSB of chub mackerel Pacific stock is 472,000 tons, and is slightly higher than B_{limit} (Kawabata et al. 2014). The FRMG states that maintaining SSB of greater than B_{limit} is a long-term objective and SSB should be recovered more as the short-term objective, because current environmental conditions are good for this stock (Fisheries Agency of Japan 2013). Following this management objective, the ABC of chub mackerel Pacific stock was calculated to secure the increase of SSB in 2014 fishing season (Kawabata et al. 2014).

This combination of management objective and ABC calculation can probably achieve the sustainable use of this fishery resource, however, a problem exists in TAC setting process. There is no separate TAC for chub mackerel Pacific stock. Instead, TAC of mackerel species is set as a simple summation of ABC of four separate stocks (chub mackerel Pacific stock and Tsushima current stock, spotted chub mackerel Pacific stock and East China Sea stock). In 2012, the stock abundances of three other stocks are as follows; chub mackerel Tsushima current stock is at low abundance; spotted chub mackerel Pacific stock is at high abundance; and spotted chub mackerel East China Sea stock is at medium abundance (Fisheries Agency of Japan and Fisheries Research Agency of Japan 2014a). Logically, chub mackerel Pacific stock or other individual stock can be harvested beyond their own ABC level, even if TAC as a whole is complied with. While it has not happened recently, chub mackerel Pacific stock had been harvested beyond ABC level in the past (Figure 3), even though TAC as a whole had been more or less complied with (Figure 2). Also, it was observed that the biomass rapidly started recovering after the catch amount was maintained at a level lower than ABC (Figure 3). Separate TACs for each of the four mackerel stocks have to be established to prevent the situation that catch amount exceeds ABCs.

Figure 3. ABC, catch and total biomass for the chub mackerel Pacific stock



(Source: Marine Fisheries Stock Assessment and Evaluation for Japanese waters (2001-2014))

The managers do not have to be concerned about the shift of fishing effort to other target species or increase of bycatch. The purse seine fishery can select its target species and have very low bycatch (Ad-hoc Task Force on Fishery Resource Management 2014). Their targets other than mackerel species are sardine, skipjack, jack mackerel and anchovy. Sardine and jack mackerel are managed under TAC systems, and the skipjack fishery is regulated by the days at sea under the Conservation and Management Measures (CMM) of the WCPFC (WCPFC 2013a). These regulations can serve to prevent increasing of catch and fishing effort to these species. There are no particular regulations for anchovy. The fishing effort toward anchovy is not expected to increase significantly, because the number of IQ groups is five, the harvest amount by Kita-Maki vessels consists of only 10% of national catch of this stocks (Watanabe et al. 2014), and price is lower than other species. In 2013, the ex-vessel price of mackerel, sardine, jack mackerel, skipjack and anchovy were 108 yen/kg, 57 yen/kg, 185 yen/kg, 319 yen/kg and 49 yen/kg, respectively (Ministry of Agriculture, Forestry and Fishery 2014b).

4.2.2 Resource User

(1) Boat Owners

More than 80% of the chub mackerel Pacific stock is harvested by the MAFF licensed purse seiners in the North Pacific region (Kawabata et al. 2014). All purse seiners operating in the North Pacific region are part of an organized cooperative, Kita-Maki. They operations are group operations, and 34 groups belonged to Kita-Maki as of 2011 (Makino and Saito 2014).

The IQ system will be experimentally introduced to five purse seine groups belonging to Kita-Maki, as the new policy. The FAJ and the FRA compare five IQ groups with non-IQ groups. The IQ groups are exempted from “bad weather suspension” (Fisheries Agency of Japan 2014e), so that they can enjoy some flexibility. Also, they can eliminate a race-to-fish among themselves. In the current IQ-like system, quota is allocated every month (Fisheries Agency of Japan 2014b). If a fishing vessel does not catch up to its individual quota, this quota would be returned to the common pool quota in Kita-Maki, and then it would be equally allocated next month. Therefore, the race exists under the current situation, although it does not seem like a serious threat.

Many researchers suggest several advantages of IQ and ITQ systems;[3] (a) price of products is improved due to improved quality and avoidance of market gluts; (b) economic stability is obtained by securing individual quota; (c) improvement of safety, because they do not have to go fishing in bad weather; (d) they can eliminate a race-to-fish and fishing season can be extended by securing individual quota; (e) TAC overage can be avoided by clarifying the responsibility of individual fishing vessels (Huppert 2005; Munro et al. 2009; Sutinen et al. 2014). These points can be achieved to a certain degree, but the magnitude of improvement in Japanese fisheries will be small. In the halibut fishery in British Columbia in Canada, season length was only 6 days in 1990, one year before the introduction of IQ system (Munro et al. 2009). However, the race is not so serious in the chub mackerel purse seine fishery compared with the BC halibut fishery, because Kita-Maki and the government already have implemented several measures including IQ-like system, “bad weather suspension” and “huge catch suspension” to mitigate race and market gluts. Therefore, the positive impacts for (a), (c) and (d) will not be significant.

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[3] In some papers, researchers discuss ITQ, but point out that such output can occur regardless of transferability of quota are which is focused here.

The new IQ system is conducted only by five groups and it is not permanent but experimental, so that the short term advantage of (b) and (e) will be small, too.

(2) Community

As stated in (1), the operation patterns of purse seiners in Kita-Maki will not be changed significantly. Therefore, no significant effect on fishery communities along the North Pacific coast is expected. At first, capacity reduction is not expected, so that employment will not be affected. Second, landing location will not be significantly changed, although the landing dates will be spread out to a certain degree. Purse seiners in Kita-Maki land their fish at about 10 fishing ports from Kushiro in Hokkaido Prefecture in the north to Choshi in Chiba Prefecture in the south. Fishermen chose landing sites based on the distance from fishing ground, species, historical relationships and the market situation. For example, fishing ground for chub mackerel is located in the north in the autumn, so that almost all boats bring fish to Hachinohe. In winter, the fishing ground moves to the south, so that the landing port moves to the south, as well. Also, most of skipjack is landed at Kesennuma, and sardine is mainly landed at Hasaki and Choshi (Makino and Saito 2014). Third, other fishery related businesses do not seem to be impacted for the same reasons.

(3) Equity

No serious conflicts between MAFF licensed purse seiners and other fisheries will be caused by the new policy, because the new policy is just allocating quota into individual boats within the quota allocated to the MAFF licensed purse seiners. TAC is divided among the MAFF licensed fishermen group and individual prefectural governments that have management responsibility for small scale fisheries within their jurisdiction. Table 1 shows the catch amount, quota allocation and catch/quota ratio of mackerel species in prefectures that small scale fishermen can catch chub mackerel Pacific stock. Table 1 shows that only 33% – 64% of their quotas are harvested by prefectural government licensed fishery.

Table 1. Catch, quota and catch/quota ratio of mackerel species by prefecture

	2013		
Prefecture	Catch (t)	Quota (t)[4]	Ratio (%)
Hokkaido	6,680		
Aomori	557		
Iwate	11,858		
Miyagi	5,349		
Ibaraki	117		
Chiba	4,732		
Tokyo	9,761	21,000	46
Kanagawa	2,979		
Shizuoka	6,247	19,000	33
Aichi	113		
Mie	23,966	43,000	56
Wakayama	4,904	12,000	41
Tokushima	92		
Ehime	3,676		
Kochi	5,724	9,000	64
Oita	2,150		
Miyazaki	10,138	16,000	63
Kagoshima	9,782	17,000	58

(Source: Fisheries Agency of Japan 2014g)

Quota allocation among IQ vessels seems fair, because it is based on historical practice. The Law Regarding Preservation and Management of Living Marine Resources allows the FAJ to allocate quota both to group of fishermen and individual fisherman, although it does not allow transferability of quota. This act also states that quota shares have to be decided taking into account both the size of vessels and their catch histories (Law Regarding Preservation and Management of Living Marine Resources 1996). In the new policy, quota share is calculated based on the historical catch before earthquake and tsunami disaster. From the data in the last five years before tsunami, the catch in highest year and lowest year are removed, and then the average catch of middle three years is used for the calculation of historical share.

[4] For some prefectures, quota is not allocated, because the fishing mortalities in these prefectures are considered relatively low. In these prefectures, fishing effort is not allowed to increase, and catch amount has to be maintained at similar levels. In the 2013 fishing season, total quota for prefectural government was 300,000 tons, and 240,000 tons is allocated to 9 prefectures and 60,000 tons is pooled. The prefectures without quota use this pooled quota. This system has been implemented for 18 years, and catch amount has never exceeded quota allocated to prefectural governments as a whole.

Finally, the average of the middle three years is multiplied by 0.85, to encourage the effectiveness of individual operation under the low quota, for the purpose of experiment (Fisheries Agency of Japan 2014e). This “three middle out of five” rule is used in many fisheries management policies in Japan, such as mutual insurance among fishermen and buyback with subsidies. This system also used to account for the damage by tsunami. Multiplying by 85% can be accepted for one-year experiment, but this point might be discussed, if IQ system is introduced to all vessels.

Among MAFF licensed purse seiners, owners of non-IQ groups accept this system, because the individual quota for IQ groups is 85% of IQ-group’s historical catch. However, some owners in Kita-Maki or owners in other regional cooperatives would argue that IQ system should be comprehensively introduced, if this experimental IQ system looks positive.

4.2.3 Governance System

This new system does not require additional coordination among stakeholders, but the effort required to coordinate among fishermen is decreased. For mackerel species TAC, Zen-Maki,, coordinates allocation of quota among 12 regional cooperatives including Kita-Maki (Fisheries Agency of Japan 2014b). Then, Kita-Maki allocates quota to member vessels in its IQ-like system (Fisheries Agency of Japan 2014c). Kita-Maki still has to coordinate its autonomous management initiatives among non-IQ groups, but at least their coordination effort is not increased. If an IQ system is implemented for all member vessels, their effort would be significantly reduced.

Management cost and effort does not increase significantly except for landing inspection cost. In terms of monitoring and surveillance, the FAJ stated three points. First, all vessels’ position are monitored by VMS. Second, sales slips, log book information, data about operational cost and landing information including the ratio between chub mackerel and spotted chub mackerel is submitted to the FAJ. These data are compared between IQ groups and non-IQ groups. Third, landings are periodically inspected by the FAJ and inspection cost is calculated. VMS has been already implemented and sales slips and log book information have been submitted for a long time. The information about operation cost and landing information can be gathered through the same scheme as sales slip and log book information. The implementation cost of landing inspection must be discussed after the one-year experiment.

4.3 Discussion about the Policy Innovation

The new policy for the purse seine fishery in the North Pacific region targeting chub mackerel Pacific stock will examine cost and benefit of IQ system by comparing between trial IQ groups and non-IQ groups. It is a unique approach. When Canada, Iceland, New Zealand, Norway and the US introduced IQ, IFQ or ITQ systems, they did not perform trial fisheries, although their IQ or ITQ systems started in a couple of fisheries and then they spread out other fisheries. Through this experimental IQ system, the FAJ and the FRA can assess the positive and negative socioeconomic effects of the IQ system. Negative impacts can be minimized, and the policy can be modified, if necessary. Therefore, it might be a good idea to discuss the further policy innovation after the trial IQ fishery. However, it is a good time to start careful discussion about the policy innovation to establish the Japanese style IQ or ITQ program using the chub mackerel purse seine fishery as a case study. The policy innovation requires long time. As for west coast ground fish IFQ program in the US, the Pacific Fisheries Management Council took seven years to establish it (Sylvia et al. 2014). Since the first IQ system started in the Icelandic herring purse seine fishery, it took 11 years to start uniform ITQ systems in all regions (Arnason 1996). Because the biomass of chub mackerel Pacific stock is above its B_{limit} and has an increasing trend, it is not urgent to implement the new policy, such as IQ, ITQ and cooperative systems, which is the case for Pacific bluefin tuna or walleye pollock Northern Japan Sea stock discussed later in this paper.

At first, separate TAC for each mackerel stock has to be established, because chub mackerel Pacific stock or other individual stock can be harvested beyond its own ABC level, even if TAC as a whole is complied with. Two points have to be considered to do this; whether TAC can be divided by geographical subpopulations (Pacific stock and Tsushima current stock) and by species (chub mackerel and spotted chub mackerel). Regarding geographical subpopulations, the range of chub mackerel Pacific stock and the range of Tsushima current stock are only overlapping off the coast of Kagoshima Prefecture in the southern part of Japan (Kawabata et al. 2014). The overlapping area is not the main fishing ground for the MAFF licensed purse seine fisheries, so that TAC can be divided by sub populations with special treatment for fisheries in Kagoshima Prefecture. The FAJ maintains that it is hard to distinguish between these two species, especially in their juvenile stages, and they are sold as the same species lot in markets (The Ad-hoc Task Force on TAC System 2008). The landing information about the ratio between chub mackerel and spotted chub mackerel is collected throughout the experimental IQ system (Fisheries Agency of Japan 2014e). Taking into account this result, the TAC separation between stocks should be considered.

Next, the new management system for 34 purse seiners in Kita-Maki is discussed. The long-term fluctuation of chub mackerel Pacific stock biomass has been affected by environmental conditions and competition with other pelagic species (Matsuda et al. 1992). Sooner or later, the abundance of chub mackerel Pacific stock may decline, even if the catch amount is smaller than its ABC. Therefore, to reduce the likelihood and severity of collapse, it is important to reduce fishing effort for this stock and to avoid a race-to-fish when this stock is in a period of decline. Also, to enhance recovery, the expansion of fishing effort to this stock has to be controlled when the biomass starts increasing (Kawai et al. 2002; Yatsu et al. 2005; Makino 2011). The tools to do this are target shifts, measures to mitigate race-to-fish and, when necessary, capacity reduction.

The new management system for Kita-Maki has to be holistic and cover all relevant species. The multi-species IFQ such as US West Coast groundfish fishery and New England groundfish fishery are good examples for them. Matsuda et al. (1992) showed that the dominant pelagic species had changed on the east coast of Japan. Chub mackerel was replaced by sardine, sardine was replaced by anchovy, Pacific saury and jack mackerel, and then they were replaced by chub mackerel again. Except for Pacific saury that is exclusively harvested by another fishery, all of the small pelagics are main target species for purse seiners in Kita-Maki. Therefore, a target shift to a more abundant species is a good idea. At the same time, the fishing efforts for these species have to be sustainable, too. Hilborn (2007a) stated that multispecies dedicated access systems at the group of fishermen can be a sustainable approach to fluctuating stocks. The design of the multi-species purse seine fishery management system should include mackerel species, sardine, jack mackerel, anchovy and skipjack. Jack mackerel and sardine are managed through the TAC system, but anchovy is not. Although the introduction of TAC to anchovy has been discussed in the WFCCs for a couple of years, a final decision has not been reached (Fisheries Agency of Japan 2014i). One additional important species for purse seiners in North Pacific region is skipjack. Skipjack is managed by the days at sea limit following the CMM of the WCPFC, because it is a highly migratory species (WCPFC 2013a).

Chapter 4 Chub Mackerel Pacific Stock Case Analysis

It is widely recognized that incentive-based fishery management or right-based fishery management, such as community based management, IQ and ITQ systems and cooperative management can be good tools to satisfy social, ecological and economic objectives, and the simple combination of TAC and input control measure cannot stop overfishing and a race-to-fish (Grafton et al. 2006; Hilborn 2007a; Huppert 2005). IQ and ITQ systems and a cooperative management can be options for the future management system for Kita-Maki. A form of cooperative management represents the status quo. Cooperative management system is that management authority grants limited privilege, such as catch quota, to cooperatives that are groups of fishermen. Members of cooperatives cooperate to manage their fishery, to improve market values and to reduce cost (Huppert 2005). Target shift, mitigation of the race-to-fish and capacity reduction could be achieved by all of the multi-species IQ, ITQ or cooperative management systems if appropriately designed. The FAJ has to discuss with Kita-Maki (involving all stakeholders) whether to select IQ, ITQ, or a cooperative system, and to design the whole program, taking into account factors raised in the following paragraphs. Also, the current strict capacity limit system including limited access and vessel size limit have to be maintained to avoid expansion of fishing capacity and to maintain current order of fishing communities in this area.

If positive results are obtained by the trial IQ system, the FAJ could decide to introduce an IQ system for all Kita-Maki purse seiners. An IQ system is a good tool to stop the race-to-fish, by allowing individual fishermen the flexibility to test various patterns of harvesting and marketing (Huppert 2005). An IQ system also gives incentives to comply with their individual quota by clarifying the responsibility of individual vessels (McCay 1995).

In some cases, once the IQ system was introduced, the industry required transferability to get more flexibility for their operations. For example, in Iceland, IQ systems were introduced at first, and then they morphed in ITQ systems a couple of years later (Arnason 1996). Norway's fishery management system was the IQ system, but transferability of quota has gradually been granted with some limitations, e.g., geographical limitation and prohibition of leasing (Gullestad et al. 2014; Hannesson 2013).

An ITQ system provides more economic benefits to fishermen who remain in the program. Many success stories of ITQ systems are reported, such as Canada, Iceland, New Zealand and the US (Annala 1996; Arnason 2005; Fina 2011; Huppert 2005; Munro et al. 2009; Sutinen et al. 2014). Yagi et al. (2012)

stated that for some Japanese offshore fisheries whose goal is economic efficiency, an ITQ system may be effective. Grafton and McIlgorm (2009) presented that factors to assist in the transition to an ITQ system and to increase the benefit from the ITQ system as follows; (a) the larger gross value of fishery; (b) the greater ability of fishers to target individual species; (c) the smaller number of fishers; (d) many fishers are able to receive a higher price for their product by catching at different times and improving quality; and (e) the stock-recruitment relationship relative to the harvest-effort relationship is less variable. The purse seine fishery in the Kita-Maki fits all of them except the variability of the stock-recruitment relationship (Kawabata et al. 2014), although the room to produce higher price for their products from their individual strategy is small.

Although this fishery looks appropriate to be managed by an ITQ system, very careful discussion is required before introduction of an ITQ system. As Copes and Charles (2004) point out, ITQ systems are expected to be difficult to dismantle later. Once in place, the government would be reluctant to dismantle it, because many fishermen who already buy or sell quotas feel quotas are their own property. Also, many researchers point out that the initial allocation is the key and controversial issue to have successful ITQ systems (Eythórsson 2000; Grafton et al. 2006; McCay 1995; Pinkerton and Edwards 2009).

The impacts of the trial IQ system on boat owners, communities and equity issues are expected to be small as explained in “4.2 The Impact of the New Policy”, but these points have to be carefully discussed for the further policy innovation, especially for the introduction of an ITQ system. At first, if an ITQ system is in place, the consolidation or geographical concentration might occur and some boat owners and communities might be impacted as reported in Iceland (Eythórsson 2000). Community Development Quota (CDQ) program in Alaska (Haynie 2014) or geographical limitation of quota transferability in Norway (Standal and Hersoug 2014) can be options to deal with this community issue. Secondly, unlike fleet-wide TACs and IQ systems, the initial allocation is very important in ITQ systems in terms of equity, because the system is difficult to be amended once in place. Because the chub mackerel TAC system has long history of allocation between the MAFF licensed fishery and the fisheries licensed by prefectural governments, the conflict with this issue looks small between them. However, in order to protect small scale fisheries, the Norwegian allocation system that allocates more quotas to coastal fisheries when TAC is small and allocates more quotas to large scale fishery when TAC is large (Standal and Hersoug 2014) can be considered as a possible option. Finally, the Law Regarding Preservation and Management of Living Marine Resources would have to be amended if an ITQ system is introduced, because it just allows the FAJ to allocate annual quota to individual fishermen and does not allow the transfer of quota (this issue is discussed in detail in Chapter 8).

Cooperative management, i.e., the status quo is another option. Many successful examples are reported especially in the West Coast of the US (Criddle and Macinko 2000; De Alessi et al. 2014; Deacon et al. 2008; Fina 2011). In many cooperatives, prevention of the race-to-fish, capacity reduction, improvement of products quality, effective utilization of quota including sharing of bycatch quota, cost reduction have been achieved. Huppert (2005) stated that cooperative management can accomplish what the IQ or ITQ systems does by government regulation. Also, cooperative management can mitigate equity issues and persistent rent-seeking behavior of fishermen that are raised by ITQ systems, in other words, cooperative management can be more focused on the merit of cooperative as a whole rather than individual economic benefit that is the goal of ITQ system (Criddle and Macinko 2000). However, it has to be noted that the TAC overages occurred in the current cooperative management systems. In IQ and ITQ systems, the motivation to comply with quota is strong because the responsibility of individual fishermen is clear (McCay 1995). If the cooperative management is introduced, the quota allocated to the Kita-Maki and its responsibility should be open to public to highlight its responsibility to comply with catch limit. In the current system, the quota allocated to the Kita-Maki is not clear.

For a sustainable chub mackerel Pacific stock fishery, the appropriate setting of TAC and compliance is the necessary first step. Next, how to manage the purse seine fishery has to be considered. For a sustainable purse seine fishery in the North Pacific region, the management system should be a multi-species program, using IQ, ITQ systems or cooperative management. An IQ system is less flexible but the burden is proportionate among fishermen. An ITQ system is the most flexible and economically effective for individual fishermen. Cooperative management can take into account the profit of groups rather than individual. The best choice for the Kita-Maki depends on their social and economic objectives. The FAJ, purse seine fishing industry, local governments and other stakeholders, such as processors, wholesalers in the fish market should carefully discuss the options and then select one of them, or a combination of them, and design the new program to achieve their goals.

4.4 Summary

The biomass of the chub mackerel Pacific stock is slightly higher than B_{limit}, and the 80% of this stock is harvested by the purse seine fishery in the North Pacific region. This stock has been managed under the TAC system and strict licensing system. All purse seine fishermen in the North Pacific region are organized into a cooperative, Kita-Maki, and they have implemented several autonomous initiatives to comply with their quota. A trial IQ system started in October 2014 to assess the costs and benefits of an IQ system.

The biomass of pelagic species including chub mackerel Pacific stock has fluctuated over time, so that the multi-species program involving all main target species should be considered for the sustainable purse seine fishery in the North Pacific. The new multi-species system should include current TAC system and licensing system, and TAC for chub mackerel Pacific stock should be a separate TAC, instead of a mackerel species' collective TAC. Then, the objective of this purse seine industry and the appropriate management measure to achieve it should be carefully designed. All type of IQ, ITQ systems, cooperative management or combination of them can be options for the management measure depending on their objectives.

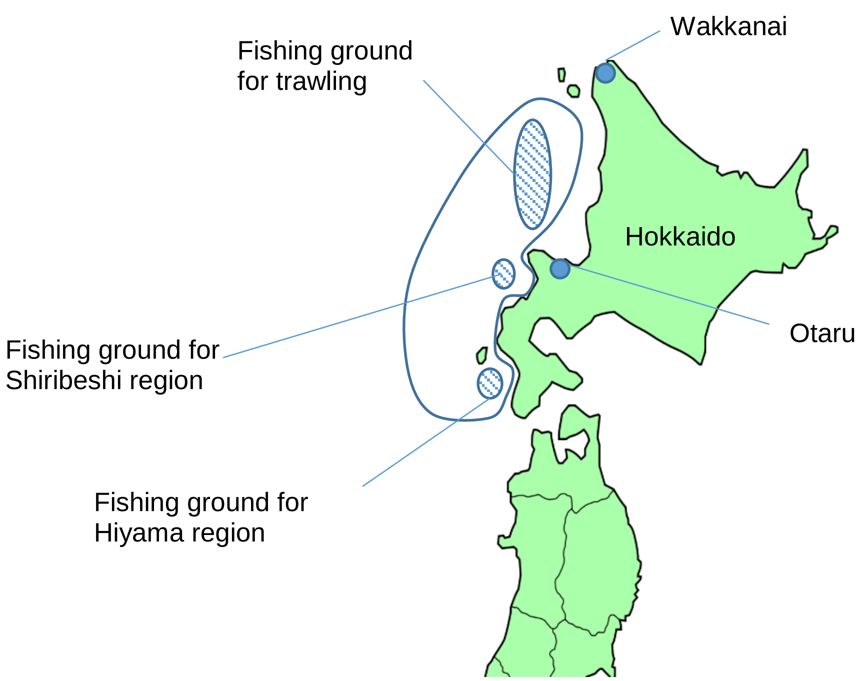
Chapter 5 Walleye Pollock Northern Japan Sea Stock Case Analysis

5.1 Background of Walleye Pollock Northern Japan Sea Stock Fishery

5.1.1 Stock Status

Around Japan, walleye pollock are divided into four separate stocks, Northern Japan Sea stock, Pacific stock, Nemuro Channel stock and Okhotsk stock (Fisheries Agency of Japan 2013). Walleye pollock's longevity is more than 10 years. About one third of walleye pollock is mature at age three, and all fish are mature at age six. In this chapter, fishery resource management for the most depleted stock, i.e., walleye pollock Northern Japan Sea stock is discussed. Walleye pollock Northern Japan Sea stock ranges off the coast of North Western side of Japan, from Noto Peninsula in Ishikawa prefecture in the south to Hokkaido area in the north. The main fishing ground is off the west coast of Hokkaido. The spawning grounds of this stock are found in Iwanai Bay and the Hiyama region (See Figure 4) (Chimura et al. 2014).

Figure 4. Distribution and fishing grounds of walleye pollock Northern Japan Sea stock



(Modified from Fisheries Agency of Japan 2014l; Ishida et al. 2014)

The biomass of walleye pollock Northern Japan Sea stock is 78,000 tons in 2012. In the 1980s, the biomass of walleye pollock Northern Japan Sea stock fluctuated but its biomass was at least 500,000 tons. It was stable at high abundance about 800,000 tons, during the period from 1987 to 1991. However, it started declining in 1991, and declined to about 100,000 tons in mid-2000s. Finally it dropped to 78,000 tons in 2012. The biomass in 2012 was the historical lowest level (Chimura et al. 2014).

Katsukawa (2010) and the Task Force (2014) stated that high fishing mortality was the reason of this stock decline. They argued that this overfishing occurred because TAC was set higher than ABC. Funamoto (2011) argued that the recruitment decline since 1990 was caused by warm water temperature, strong Tsushima Warm Current and weak Asian monsoon, in addition to high fishing mortality. Funamoto (2011) also states that even if the environmental conditions are ideal for the recruitment of walleye pollock Northern Japan Sea stock, the recruitment recovery would be restricted as long as SSB remains at its current low level.

5.1.2 Description of the Fishery

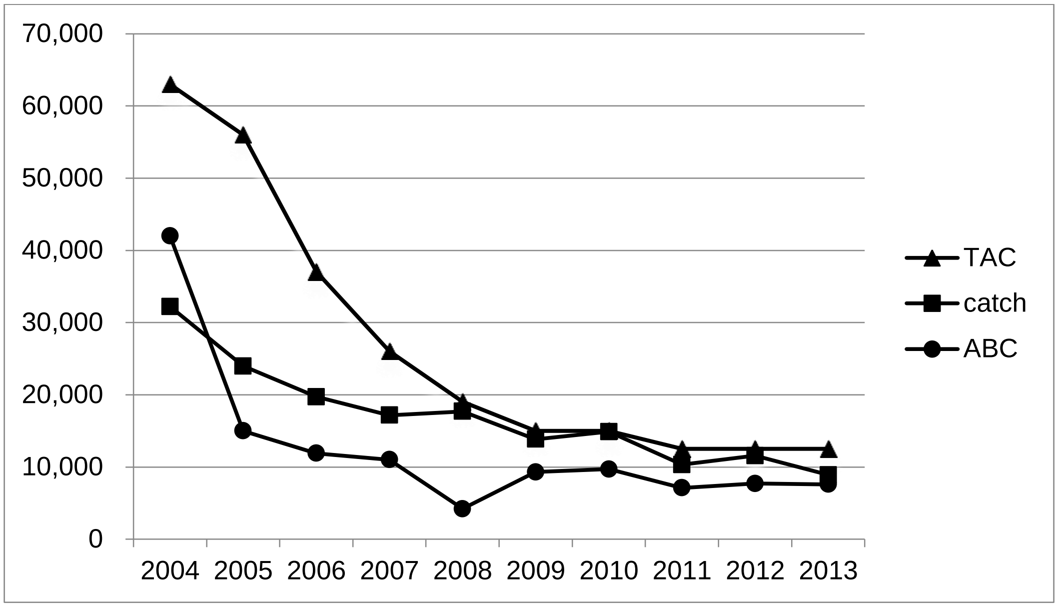
The major products of walleye pollock in Japan are surimi and fillet, but bo-dara (dried products), tarako (salted roe) and mentaiko (roe treated with chili peppers) are popular, too. These products have long histories, for example, bo-dara has a history of 300 years. Today, most walleye pollock harvested by coastal fisheries is exported to Korea and China in fresh or frozen form at a higher price than in the domestic market (Hirota et al. 2014).

In its FRMG, the FAJ states that the short term management objective of walleye Pollock Northern Japan Sea stock is ending further decline of the SSB (Fisheries Agency of Japan 2013). B_{limit} is the lowest SSB that is expected to produce a good and stable recruitment of this stock. It was estimated B_{limit} was set at 140,000 tons of SSB, because recruitment was significantly decreased, when the SSB was lower than 140,000 tons. In 2012, SSB of this stock is 47,000 tons. It is slightly higher than the historical lowest level, but it is much lower than B_{limit}. For this stock, B_{ban} is also set at 30,000 tons of SSB. B_{ban} is defined as the threshold of SSB to suspend its fishery (Chimura et al. 2014).

Walleye pollock fisheries are managed under a TAC system combined with licensing and autonomous initiatives by industry. Walleye pollock TAC is set for four individual stocks. Figure 5 shows that TAC, ABC and catch for walleye pollock Northern Japan Sea stock from 2004 to 2013. In 2013, the total catch of walleye Pollock Northern Japan Sea stock was 11,564 tons - equal to 89% of TAC. By gear type, the MAFF licensed trawl fishery's catch reached 97% of its quota, and catch by the small scale fisheries licensed by Hokkaido Prefecture reached 87% of their quota (Chimura et al. 2014). From 2008 to 2012, more than 90% of TAC was harvested except in 2011 (83%). Exceeding the TAC has not occurred since the TAC system was implemented in 1997 (Fisheries Agency of Japan 2014g).

As Katsukawa (2010) and the Task Force (2014) pointed out, the TAC for this stock has been set higher than ABC, so that catch has exceeded ABC. In Japan, TACs are set based on both ABCs estimated by the FRA and socioeconomic situation of fishing industry (Law Regarding Preservation and Management of Living Marine Resources 1996). According to the meeting minutes of the Fisheries Policy Council that decided TACs, walleye pollock Northern Japan Sea stock TAC that was larger than its ABC was set to avoid serious damage on economy in the fishing communities in the Western Hokkaido in which industries including large scale trawlers, small scale fisheries, processors and other fishery related industries heavily rely on this stock (Fisheries Agency of Japan 2014j). In 2012, the TAC for walleye pollock Northern Japan Sea stock was at 13,000 tons, although the ABC was 7,800 tons. As a result, in the 2012 fishing season, the total catch of this stock was 89% of the TAC, but it was higher than the ABC by 48% (Chimura et al. 2014). Similarly, the TAC in 2014 fishing season is 13,000 tons, despite the fact that ABC is 6,500 tons (Fisheries Agency of Japan 2014k). Chimura et al. (2014) state that if current fishing mortality is maintained, the SSB would fall below B_{ban} in 2015 with 50% probability and the fishery would be closed.

Figure 5. TAC, ABC and catch for walleye pollock Northern Japan Sea stock



(Source: Marine Fisheries Stock Assessment and Evaluation for Japanese waters (2001-2014))

In addition to the problem that the TAC of walleye pollock Northern Japan Sea stock is higher than the ABC, this ABC is calculated based on the least ambitious management goal. Four alternative ways to calculate ABC were estimated, i.e., (i) ABC to recover SSB to B_{limit} in 10 years (ABC_{rec10}); (ii) ABC to recover SSB to B_{limit} in 20 years (ABC_{rec20}); (iii) ABC to recover SSB to B_{limit} in 30 years (ABC_{rec30}); and (iv) ABC to slightly increase SSB (ABC_{si}). The value of (i), (ii), (iii) and (iv) are 200 tons, 3,400 tons, 4,600 tons and 6,500 tons, respectively. ABC to slightly increase SSB is calculated as F_{sus} multiplied by 0.9. In this calculation, F_{sus} is the fishing mortality to maintain current SSB, and then F_{sus} is multiplied by 0.9 to ensure the minimum recovery of the SSB (Chimura et al. 2014). The short-term management objective of this stock is ending further decline of SSB (Fisheries Agency of Japan 2013). Therefore, the FAJ picked up ABC_{si} as the ABC to set TAC and the Fishery Policy Council adopted it (Fisheries Agency of Japan 2014j).

5.1.3 Current Fishery Resource Management System

During the past five years (2008-2012), the average annual catch of walleye pollock Northern Japan Sea stock was 14,131 tons. By gear type and by region, catch by the MAFF licensed large scale trawling in Hokkaido, small scale fisheries in Hokkaido and all fisheries in outside of Hokkaido are 7,763 tons (55%), 5,823 tons (41%) and 545 tons (4%), respectively (Chimura et al. 2014). Approximately 96% of the walleye pollock Northern Japan Sea stock is fished at off the coast of Hokkaido. Therefore, fishery management measures only for the MAFF licensed trawling in Hokkaido and small scale fisheries licensed by Hokkaido Prefectural government are explained in this chapter.

The TAC is allocated to the large scale trawl fishery (MAFF licensed fishery) group and five prefectures which manage the small scale coastal fisheries (Fisheries Agency of Japan 2014b). In 2014, 6,600 tons of walleye pollock Northern Japan Sea stock TAC is allocated to the MAFF licensed fisheries and 5,900 tons is allocated to the fisheries licensed by Hokkaido prefectural government. The remaining 500 tons of TAC is collectively allocated to small scale coastal fisheries in the other four prefectural governments (Fisheries Agency of Japan 2014k).

Both the MAFF licensed fisheries group and individual prefectural governments coordinate their licensed vessels to comply with allocated quota. They have implemented autonomous initiatives, following the walleye pollock Northern Japan Sea stock Resource Restoration Plan. It contains the autonomous measures for both fisheries. Also, the Plan’s measures became legally binding measures through certification by the WFCC.

(1) MAFF Licensed Trawl Fishery

The trawl fishery is the only MAFF licensed fishery to harvest this stock. In terms of catch volume, walleye pollock consists of 55% of total national catch of MAFF licensed trawl fishery in 2013 (Ministry of Agriculture, Forestry and Fishery 2014a). Fishermen have organized themselves in a FMO, namely the National Federation of Medium Trawlers (Zen-Soko-Ren). Zen-Soko-Ren is composed of 22 regional trawl fishery associations and covers all MAFF licensed trawling vessels (Zen-Soko-Ren website). The Zen-Soko-Ren allocates catch quota to regional associations to ensure that total catch by the Zen-Soko-Ren members falls within allocated quota. Then, during the fishing season, allocation is reconsidered and redistributed if necessary, taking into account the latest landings. Each regional organization implements its autonomous measures to prevent harvesting beyond its quota. The Zen-Soko-Ren allocates the TAC to five regional trawling fishery associations, i.e., Hokkaido, Aomori, Akita, Yamagata and Niigata

(Fisheries Agency of Japan 2014l). Among MAFF licensed trawl fisheries, catch in Hokkaido consists of 97% in 200-2012, whereas total catch in other prefectures is just 3% (Chimura et al. 2014).

The name of the regional trawl fishery association in Hokkaido is the Hokkaido Trawl Fisheries Cooperative Federation (Kisen-Ren). Kisen-Ren covers all (51) MAFF licensed trawlers in Hokkaido Prefecture. The walleye pollock Northern Japan sea stock quota is further allocated from Kisen-Ren to two regional cooperatives, Otaru-Kisen in Otaru City and Wakkanai-Kisen in Wakkanai City. As of 2014, Otaru-Kisen has four trawlers and Wakkanai-Kisen has seven trawlers. Trawlers in the two cooperatives use same fishing ground. The size of the trawlers in this region is about 160 Gross Registered Tons (GRT), and about 17 crew member are on board in each vessel (Fisheries Agency of Japan 2007).

As official management measures, the total number of licenses and size of boats is limited by the licensing system, and license imposes several regulations, such as closed areas. TAC management year for walleye pollock is from April to March and 70% of TAC is fished in the first quarter of TAC management year (April to June) (Chimura et al. 2014).

In addition to these official management measures, trawling vessels in two cooperatives have implemented autonomous management measures according to the walleye pollock Northern Japan Sea stock RRP adopted in 2007 (Fisheries Agency of Japan 2007). In 2013 fishing season, trawlers in both Otaru-Kisen and Wakkanai-Kisen implemented following autonomous measures: (i) if walleye pollock smaller than 30cm compose 20% of their catch, this fishing ground is closed to preserve juveniles; (ii) if total catch by all trawlers exceeds 800 tons in a day, fishing is suspended for the following day; and (iii) a limit of days-at-sea is established (Fisheries Agency of Japan 2014m and 2014n).

(2) Coastal Fishery Licensed by Hokkaido Prefecture

Regarding the TAC allocated to prefectural governments, 5,900 tons out of 6,400 tons is allocated to the coastal fishery in Hokkaido Prefecture, and the catch amount was 5,102 tons (86% of TAC) in 2012 (Fisheries Agency of Japan 2014l). Hokkaido Prefectural government coordinates with small scale fishermen groups to comply with their quota.

Within quota in Hokkaido coastal fishery, approximately 94% (average in the past 10 years) of the walleye pollock Northern Japan Sea stock is fished in the Shiribeshi and Hiyama regions (Fisheries

Agency of Japan 2014l). Both Shiribeshi and Hiyama regions are the spawning ground for this stock (See Figure 4) (Chimura et al. 2014). In Shiribeshi region, 50 gill net and longline fleets are licensed by Hokkaido Prefectural government, while there are 67 longline fleets licensed by Hokkaido Prefectural government in Hiyama region. Their fishing season for walleye pollock is from November to February (Fisheries Agency of Japan 2014l). The size of the vessels is less than 20 GRT, and about 3-5 crew members are on board each vessel (Fisheries Agency of Japan 2007).

Fishermen in each region implemented several autonomous measures based on the walleye pollock Northern Japan Sea stock RRP adopted in 2007 (Fisheries Agency of Japan 2007): (i) they establish a closure area to protect the spawning ground, (ii) if walleye pollock smaller than 30 cm compose 20% of their catch, this fishing ground is closed to preserve juveniles, (ii) if 5% of females start spawning, fishing is closed, (iii) total days-at-sea is reduced by 15%, and (iv) in some fishing communities within Hiyama region, catch is pooled and total gain is distributed to individual fishermen in order to avoid a race-to-fish (Fisheries Agency of Japan 2014m and 2014n).

5.1.4 The New Management Policy

The Task Force discussed fishery resource management of the MAFF licensed trawl fishery and small scale coastal fisheries (gillnet and longline) in Hokkaido, because their catch consists of 96% of total catch of this stock (Ad-hoc Task Force on Fishery Resource Management 2014). Taking into account the Task Force's recommendation published in July 2014, the FAJ released "the reaction to the report of the Task Force" in August 2014 (Fisheries Agency of Japan 2014e).

In this press release, the FAJ presented the direction of future management measure (Fisheries Agency of Japan 2014e). It was not a concrete new management measures like the new management measure for Pacific bluefin tuna and chub mackerel Pacific stock, but it was the agenda to be discussed in the near future. Cited below are the details of the FAJ's statement (Fisheries Agency of Japan 2014e). The FAJ's statement completely followed the recommendations by the Task Force:

- The TAC of walleye pollock Northern Japan Sea stock would be set equal to the ABC, otherwise it should be set as close as possible in 2015 fishing season (April 2015 - March 2016)

- As for MAFF licensed trawl vessels, the TAC would be allocated to the management unit rather than single vessels in 2015 fishing season, in order to maximize the profit obtained from limited quota. The optimal management unit will be discussed, but companies and communities are candidates for consideration. The allocation would be decided by the fishermen themselves, but it should be approved and monitored by the FAJ. The trawl fishery's dependency on walleye pollock should be reduced and ways to increase price should be considered, too.
- As for Hokkaido Prefecture licensed gillnet and longline vessels, Hokkaido Prefectural government should coordinate the allocation of the TAC to the operational unit such as groups based on fishing gears and/or communities in 2015 fishing season, in order to maximize their profit obtained from limited quota. Regional councils will be established in each community to discuss the restructuring of fishing communities, including target species change and diversification of fishery businesses.

5.2 The Impacts of the New Policy

5.2.1 Resource Unit

The main point of the new management policy in terms of Resource Unit is "TAC would conform to the ABC; otherwise, the TAC should be set as close as possible to the ABC" (Ad-hoc Task Force on Fishery Resource Management 2014). The biomass of walleye pollock Northern Japan Sea stock in 2012 was 78,000 tons and it was at the historical lowest level. It was lower than B_{limit} (140,000 tons) and close to the B_{ban} (30,000 tons) (Chimura et al. 2014). The urgent action has to be taken to achieve the log-term management objective of this stock, i.e., the recovering SSB to B_{limit}. TAC for walleye pollock Northern Japan Sea stock in 2014 was set at 13,000 tons (Fisheries Agency of Japan 2014k), despite the fact that Chimura et al. (2014) estimated ABC_{si} at 6,500 tons and that the SSB would keep decreasing and fall below B_{ban} in 2015 with 50% probability with current fishing mortality, i.e., catching about 10,000 tons of this stock. Therefore, the TAC should not be set "as close as possible to the ABC", but rather, should be set at least same as the ABC.

For the 2015 fishing season, TAC for walleye pollock Northern Japan sea stock is set at 7,400 tons. It equals to ABC_{rec30} (Fisheries Agency of Japan 2015), and TAC is reduced by 43% from the previous year. Conforming the TAC to the ABC is the essential first step, but the next question is the appropriateness of ABC that is referred to set TAC. ABC_{rec30} was selected to achieve the short term management objective described in the FRMG, i.e., ending further decline of SSB. However, this means that if the catch amount was maintained at TAC, the SSB recovers to B_{limit} level 30 years later with high probability (Fisheries Agency of Japan 2015). ABC_{rec30} level can be an option for future fishery resource management. However, B_{limit} is the lowest SSB that is expected to produce a good recruitment of this stock. In other words, when the SSB is lower than B_{limit}, recruitment would be small and biomass to be harvested would be small, too. Therefore, ABC_{rec10} or ABC_{rec20} can be a better option. If ABC_{rec10} or ABC_{rec20} is selected to calculate TAC, TAC will be 1,500 tons and 5,800 tons, respectively (Fisheries Agency of Japan 2015).

5.2.2 Resource User

(1) Boat Owners

The direct impacts for boat owners are as follows: TAC is reduced by 43%; and TAC is allocated to “management unit” that generally is located in a community. The Task Force stated that the TAC would be allocated to the management units to encourage them to cooperate for more cost effective operation within management unit (Ad-hoc Task Force on Fishery Resource Management 2014).

The important point for the new management policy is that TAC allocations decided by industry are certified by governments. The responsibility of management units to manage their fishery becomes clearer by government’s certification. Each management unit has to improve its fishing industry involving the community and taking into account the limited quota of walleye pollock.

This new management scheme is a combination of community based co-management and cooperative management. The new management system allocates quota to the groups of fishermen in an individual community. Community based management is defined as a management system in which harvesters and community interests have a significant role in the management of fishery resource (Copes and Charles 2004). Cooperative management is defined as groups of fishermen who cooperate to reduce cost and improve market value within allocated quotas (Huppert 2005). In the new management policy, groups of fishermen have to cooperate to manage their fishery within limited quota taking into account their communities.

(1-a) Trawl Fishery

The definition of operational unit is not published yet, but the FAJ states that a couple of vessels can form one management unit (Fisheries Agency of Japan 2014e). It is expected that the four trawlers in Otaru-Kisen forms one management unit. Seven vessels in Wakkanai-Kisen form one management unit, too. The allocation of the TAC is decided by the Zen-Soko-Ren and the Kisen-Ren through the existing scheme, and then certified by the FAJ as an official quota. Within this quota, each management unit has to take some rationalization measures and/or additional autonomous measures.

It is difficult for fishery participants to shift to other species. Atka mackerel (*Pleurogrammus azonus*) and Japanese sand lance are other important target species for trawlers in Wakkanai-Kisen (Wakkanai city 2014). The stock status of both species is low abundance level and a decreasing trend now (Fisheries Agency of Japan and Fisheries Research Agency of Japan 2014a). For trawlers in Otaru-Kisen, Atka mackerel, Pacific cod (*Gadus macrocephalus*) and pointhead flounder (*Cleisheres pinetorum*) are other important target species (Otaru-Kisen website). The stock status of both Pacific cod and pointhead flounder is medium abundance. However, the catch of pointhead flounder is higher than its ABC, and the catch of Pacific cod is very close to its ABC (Chimura and Tanaka 2014). Fishing effort for Japanese sand lance is regulated under TAE scheme, and fishing effort for Atka mackerel is reduced by 30% through the FRMP (Morita 2014). Therefore, there are no alternative species for them to target.

The fishermen have already implemented many autonomous measures; (i) if walleye pollock smaller than 30cm compose 20% of their catch or more, this fishing ground is closed to preserve juveniles; (ii) if total catch by all trawlers exceeds 800 tons in a day, fishing is suspended for the following day; and (iii) the limit of days-at-sea is established (Fisheries Agency of Japan 2014m and 2014n). Also, they already cooperate to reduce costs. For example, trawl boat owners in Otaru-Kisen and processors organized Sea Net Otaru-Kisen Limited Liability Partnership (LLP). They share information at sea, costs and revenue, and they conducted a buyback of vessels and licenses in the past. They also cooperate to produce higher quality products for processors (Otaru Working Group for Regional Fishery Innovation

Project Consultation of Kisen-Ren 2010). Therefore, the room for additional autonomous measures looks small. Additional rationalization measures have to be considered. For example, three out of four trawlers will operate in walleye pollock fishing season. Also, a buyback of vessels and licenses using government's fund is another option.

(1-b) Small Scale Fisheries

The FAJ states that the management unit is the community for small scale fisheries (Fisheries Agency of Japan 2014e). The FCAs in each community can be a management unit. A couple of FCAs in Shiribeshi region and Hiyama region are the main players for small scale walleye pollock fisheries. In Shiribeshi region, 50 gill net and longline fleets are licensed by the Hokkaido Prefectural government, while there are 67 longline fleets licensed by Hokkaido Prefectural government in Hiyama region (Fisheries Agency of Japan 2014l). The TAC will be allocated to each region, but it may be further allocated to individual FCAs (small community level). The allocation of TAC is decided by the Hokkaido Prefectural government in coordination with industry. This process is same as in the past, but the difference is that this will be a legally binding quota in each management unit. Within this quota, each FCA has to take some rationalization measures and/or additional autonomous measures in cooperation with the Hokkaido Prefectural government.

The fishing season for walleye pollock is from November to March for the small scale fisheries. Other than walleye pollock season, they are engaged in several fisheries, such as shrimp pot fishery, set net fishery for salmon, gillnet fishery, sea urchin and sea cucumber fishery and squid jigging (Fisheries Agency of Japan 2014l). All of their alternative fisheries are limited entry fishery with strict regulations. Salmon and squid, for example, can be harvested only in a limited season. Overall, they do not have any good alternative fisheries.

The fishermen have already implemented many autonomous measures, e.g., (i) they established a closure area to protect spawning grounds, (ii) if walleye pollock smaller than 30cm compose 20% of their catch or more, this fishing ground is closed to preserve juveniles, (iii) if 5% of females start spawning, fishing is closed, (iv) total days-at-sea is reduced by 15%, and (v) in some FCAs within Hiyama region, individual catch is pooled and total revenue is distributed to individual fishermen in order to avoid race-to-fish (Fisheries Agency of Japan 2014m and 2014n). The room for additional autonomous measures seems small, and the rationalization measures, such as a buyback with subsidiary have to be considered.

(2) Community

On the west coast of Hokkaido, the fishing industry including processing is a very important industry, and walleye pollock is an important species. For example, catch by four trawlers composes 80% of total fish landing in Otaru city, in terms of volume. Their total catch of walleye pollock was 2,958 tons and it was 16% of total fish landed value in Otaru City in 2013 (Otaru City 2014). Although walleye pollock catch in Hiyama region has dropped from 11,731 tons in 2002 to 1,305 tons in 2011, it still composed 11% of total fish landing in Hiyama region in 2011 (Hokkaido Prefectural Government Hiyama Subprefectural Bureau 2012).

Through the new management systems, the FAJ handed more responsibilities to the communities. TAC is reduced by 43%, and quotas are allocated to the groups of fishermen in each community. This allocation system prevents the disappearance of particular communities, and the burden is proportionate among communities. Each community is expected to design its future, taking into account the limited quota of walleye pollock.

(3) Equity

The new policy allocates quota to management units, and requires a rationalization program to improve their efficiency within limited quota. The assumption is that conflict about equity would not emerge if the allocation is fair.

At first, the TAC is allocated to the group of MAFF licensed trawlers and small scale fishermen licensed by Hokkaido Prefectural government. Their fishing grounds do not overlap. Also, the main fishing season for the trawl fishery is from April to June, whereas small scale fisheries target walleye pollock from November to February (Chimura et al. 2014). Hence, there are no conflicts about market gluts. TAC of walleye pollock has been managed through this allocation system for 18 years. Also, they have discussed walleye pollock management in the WFCC to establish the RRP. Therefore, the conflict about equity between MAFF licensed fishermen and fishermen licensed by Hokkaido Prefectural government is not serious.

Next, the quota is allocated to the management units. Within MAFF licensed fishermen, quotas are further allocated to Otaru-Kisen and Wakkanai-Kisen in coordination with Kisen-Ren. Within small scale fisheries, the quotas are further allocated to Shiribeshi region and Hiyama region in coordination with Hokkaido Prefectural government. These schemes are not changed by the new policy. If quota is further allocated within Hiyama region or Wakkanai-Kisen, the conflict about equity might emerge. However, they have long history of cooperation, so that the conflict will not be serious.

5.2.3 Governance System

The new management system is implemented through an existing scheme, but the responsibility of individual management units becomes clearer. Under the current management scheme, the TAC is allocated under the scheme described in above “(3) Equity”, and the autonomous measures are discussed through the WFCC.

Management cost and effort does not increase significantly because of the introduction of the new policy. The FAJ and the Task Force did not state anything about MCS (Fisheries Agency of Japan 2014e; Ad-hoc Task Force on Fishery Resource Management 2014). The landings have been monitored through the submission of log book and sales slips, so that no additional measures may be required. Generally speaking, however, a very tight quota can be an incentive for cheating, such as misreporting and discarding. Holland and Wiersma (2010) stated that cooperative management can give incentive for cheating, although the incentive is smaller than under the ITQ or IQ systems. This is because cooperative members have responsibility to other cooperative members, and it increases peer pressure for compliance.

5.3 Discussion about the Policy Innovation

The fishing effort for walleye pollock Northern Japan Sea stock has to be reduced immediately. The SSB of this stock is much lower than B_{limit}, and is close to B_{ban} (Chimura et al. 2014). In order to rebuild this stock, the fishing effort has to be reduced rapidly and substantially, because prolonged overexploitation increases the uncertainty in its recovery due to the erosion of population resilience (Hutchings and Reynolds 2004; Keith and Hutchings 2012; Neubauer et al. 2013). It was reported that some species have not recovered for more than decades even if fishing mortality rates were significantly reduced, once collapse occurred (Neubauer et al. 2013). For example, even though an ITQ system with strict TAC was introduced in the cod fishery in Iceland, the cod stock recovered by just 10% for the last 10 years and it remained much lower than target level (Arnason 2005).

This failure of fishery management derives from inappropriate TAC setting. TAC setting is the key to secure sustainable fishery in terms of stock status, regardless whether TAC is allocated to individuals or not (Bromley 2009; Dewees 1998; Melnychuk et al. 2012). The TAC for this stock had been set higher than its ABC (Katsukawa 2010), but the TAC for 2015 fishing season was set at ABC_{rec30} (Fisheries Agency of Japan 2015).

Two points have to be considered to determine whether a TAC setting is appropriate; the appropriateness of ABC; and relationship between ABC and TAC. First, the appropriateness of ABC has to be considered. ABC_{rec30} is the calculated catch to achieve recovery of SSB to B_{limit} in 30 years. “Recovery in 30 years” sounds less ambitious, but it is expected to increase SSB for a certain amount and is a practical objective. $ABCr_{ec30}$ requires 43% catch reduction, so that further reduction is not a practical. Secondly, the relationship between ABC and TAC has to be considered. In the past, TAC was higher than ABC taking into account the social and economic situation as stated in the Law Regarding Preservation and Management of Living Marine Resources. The clear rule to secure that TACs are set at equal to or lower than ABCs should be established. In the US, TAC is established taking into account social and economic factors, too. However, TACs are decided to be equal to or less than ABCs taking into account social and economic factors (NOAA 2009). In other words, TACs can be decreased, but not be increased due to social and economic factors. The amendment to the Law Regarding Preservation and Management of Living Marine Resources or the adoption of operational guideline similar to the US’s guideline is necessary to secure that TACs are set lower than ABCs.

The Task Force recommended the allocation of quota to management units (Ad-hoc Task Force on Fishery Resource Management 2014). It is stated that the management unit is a community or a group of fishermen, so that it is the combination of community-based management and cooperative management. Groups of fishermen in individual communities have to cooperate to manage their fishery taking into account their communities as a whole. For example, fishing industry including seafood processing is one of the most important industries in Otaru city. Trawl catch consists of 80% of total landings in this city, and landing of walleye pollock consists of 16% of total landing in this city (Otaru City 2014). Similarly, many communities in this region heavily rely on this stock. It is very important to consider the welfare of communities as a whole, when management measures are discussed. Copes and Charles (2004) states that community based management is a good framework to seek welfare, sustainability and equity of communities. Hilborn (2007a) stated that local control of exclusive access by local fishermen is a key to a sustainable fishery in coastal small scale fisheries. Many cooperative managements achieved prevention of race-to-fish, capacity reduction, improvement of products quality, effective utilization of quota including sharing of bycatch quota, and cost reduction (Criddle and Macinko 2000; De Alessi et al. 2014; Deacon et al. 2008; Fina 2011). Also, the new management policy can be introduced by existing the governance scheme and fishermen organizations.

The new management system looks great, however, it is not enough to absorb the economic loss of 43% TAC reduction, because walleye pollock fishermen in Hokkaido have already implemented several official and autonomous management measures. Many successful experiences have been reported in the world, for the management system that allocates quota to group of fishermen. For example, economic gain was drastically increased by advantageous marketing timing changes brought by the introduction of sector management system in New England groundfish fishery (Scheld and Anderson 2014). The sector management system in New England allocates catch limits to 17 sectors, i.e., groups of fishermen, so that it is very similar to the new management system of Japanese walleye pollock fishery. Also, in the salmon fishery in Chignik, Alaska, forming a cooperative improved their revenue. By securing their quota share, they succeeded to prevent the race-to-fish. They agreed to pool the catch and only 22 vessels operated on behalf of 77 member vessels in a particular fishing season (Deacon et al. 2008). However, similar measures have been already conducted by both small scale fishermen and trawl fishermen in Hokkaido regions under the current RRP. Longliners in Hiyama region and trawlers in Otaru-Kisen and Wakkanai-Kisen pool their landing to prevent race-to-fish to reduce cost and they share information (Fisheries Agency of Japan 2014m; Otaru Working Group for Regional Fishery Innovation Project Consultation of Kisen-Ren 2010; Wakkanai Working Group for Regional Fishery Innovation Project Consultation of Kisen-Ren 2013). Also, they improve price of products. For example, fishermen cooperate with community and local governments to advertise their products and increase export to China and Korea in order to obtain a higher price (Fisheries Agency of Japan 2014m; Otaru Working Group for Regional Fishery Innovation Project Consultation of Kisen-Ren 2010). Because they have conducted several measures, room for further improvement is limited.

Within the quota allocated to communities, each community has to manage its fishery. It can select the management tool that is the most appropriate for its objectives. Its options are official IQ system, ITQ system or their autonomous IQ system. Therefore, each community (Otaru, Wakkanai, Hiyama and Shiribeshi) should design the objective of its fishing industry that accounts for significant reduction of walleye pollock quota. The grand designs of its fishing industry should not only focus on the harvesting sector, but also cover processing, marketing and other seafood related industry. The multi species management system has to be considered in each community to prevent overfishing of other species and to effectively utilize all available fish resources. Not only walleye pollock, but also other target species offer key opportunities to improve efficiency. For example, when Otaru-Kisen thinks about the future of trawl fishing in Otaru region, all target species (walleye pollock, Atka mackerel, Pacific cod and pointhead flounder) have to be included. After the reduction of walleye pollock TAC, the fishing effort toward other species may be increased. Although Atka mackerel is managed by days-at-sea limit, there are no schemes for Pacific cod and pointhead flounder. Atka mackerel and pointhead flounder are harvested beyond ABC level, and Pacific cod is harvested at ABC level (Chimura and Tanaka 2014; Morita 2014; Tanaka and Funamoto 2014). Therefore, Otaru-Kisen has to consider the new management measures for those species in cooperation with other stakeholders to make their fishing industry more sustainable. In all relevant communities, such as Otaru, Wakkanai, Hiyama and Shiribeshi, there are no alternative species, so that they have to reduce or at least maintain their fishing capacities.

In the grand design of each community's fishing industry, the additional capacity reduction is necessary, because the resource is not sufficient to maintain current capacity and room to reduce cost and to improve products quality is limited. A buyback and an ITQ system are candidates of tools for capacity reduction. ITQ systems are often advocated by economists as a solution to the overcapacity. Under an ITQ system, efficient boats can pay more to obtain quota, so that only the efficient boats will continue to fish (Anderson 1986). For example, in the Iceland capelin and herring purse seine fisheries, the number of vessels was halved after 14 years implementation of ITQ system (Arnason 1996). The number of active vessels for the halibut fishery in BC was also halved since ITQ system was introduced in 1991 (Munro et al. 2009). At the same time, capacity reduction through an ITQ system may result in consolidation and significant adverse impact on particular communities (Copes and Charles 2004). For example, all fishing vessels in some small communities sold their quota, and some communities were marginalized in Iceland (Eythórsson 2000). Therefore, interests of communities have to be taken care of if that is one of the goals. One option is to give part of a quota to a community, like the Alaskan halibut and sablefish fishery through CDQ program (Kent 2012), or limiting permanent transfer of quota across groups of fishermen, like the New England groundfish fishery (Kent 2012) and the Alaskan pollock fishery (Fina 2011) are good options.

Buybacks of fishing vessels or licenses are also key management tools to address overcapacity (Squires 2010). For example, 25 licenses were bought back in the Alaskan crab fishery in 2004 using a government loan to the fleet and processors (NPFMC 2010), and 87 tuna longliners were scrapped through the buyback program using both government funds and funds established by industry (Fisheries Agency of Japan 2009). Buyback is a fishery management tool in which fishing vessels are purchased by the governments or by the industry to remove fishing vessels from fishery to reduce fishing capacity and to increase benefit accruing to remaining fishermen. In an ITQ system, boat owners who get quota can exclusively use it, whereas the benefit resulting from capacity reduction is shared by all vessels that continue fishing in a buyback program. The FAJ already has a buyback program supported by governmental funds. In the Japanese buyback program, an industry pays 5/9 of buyback price calculated according to the national guideline, and 4/9 is paid by the national government funds, in case of MAFF licensed vessels. For prefectural government licensed vessels, each of industry, prefectural government and national government pays 1/3 of buyback price. Because quotas are allocated to communities, the vessels to be bought would be selected in each community to maximize the interest of communities. Grafton et al. (2006) argued that the ability of buyback to reduce long-term fishing effort was limited because higher profit encourages further investment and effort creep, after buybacks successfully increased returns to harvesters in a short term. However, Japanese buyback program is conducted only when the vessels are scrapped and licenses are permanently removed. Also, the strict licensing system does not allow remaining vessels to increase their fishing capacity. Both an ITQ system and a buyback program require transition cost by harvesters, but it is smaller in buyback program, because it is supported by government funds.

For a sustainable walleye pollock Northern Japan Sea stock fishery and a sustainable fishing industry of each community relying on this stock, the appropriate setting of TAC and its compliance is the necessary first step. TAC in 2015 fishing season is set at ABC level, but the clear scheme to ensure that TAC equals to or is less than ABC should be established. Next, each community should design the future of its fishing industry involving all target species and all relevant sectors, such as marketing and processing, to maximize their benefit from limited quota. In this process, the objectives of the fishing industry have to be clearly stated and management of their fishery should be designed according to their objectives. Because stock status of target species is not good, and room to reduce cost and to increase price is limited, capacity reduction is an essential option. It can be achieved through an ITQ system or a buyback program depending on their objectives. If they chose an ITQ system, it should be carefully designed.

5.4 Summary

The SSB of walleye pollock Northern Japan sea stock is much lower than B_{limit} and is close to B_{ban}, so that fishing effort has to be reduced immediately. The problem in the past was that TAC was higher than ABC, so that SSB was declining. This stock is harvested by trawls in Otaru and Wakkanai region and small scale fisheries in Shiribeshi and Hiyama region in Hokkaido Prefecture. For the 2015 fishing season, TAC is reduced by 43% and it is allocated to four communities.

Because all of these communities rely on walleye pollock stock, the reduction of TAC significantly impacts on community economy. Therefore, each community should design the future of its fishing industry. It should include; (1) objectives of their fishing industry; (2) management measures, such as IQ system, ITQ system, effort limit, autonomous IQ system, for all target species; (3) the tool for capacity reduction; and (4) other measures for all fishery related business to revitalize communities' economy. At national level, a scheme to ensure that TACs are equal to or less than ABC should be established.

Chapter 6 Pacific Bluefin Tuna Case Analysis

6.1 Background of Pacific Bluefin Tuna Fishery

Under the United Nation Convention on the Law of the Sea, highly migratory species like Pacific bluefin tuna (hereinafter bluefin tuna) are internationally managed through Regional Fisheries Management Organizations (RFMOs). Bluefin tuna has a single Pacific-wide stock managed by both the WCPFC in Western Pacific Ocean (WPO) and the Inter-American Tropical Tuna Commission (IATTC) in Eastern Pacific Ocean (EPO). The stock assessment of bluefin tuna is conducted by the International Scientific Committee for tuna and tuna-like species in the North Pacific (ISC). This species is harvested not only by fishermen in Japan but also by fishermen in other countries such as Mexico and Korea. For the purpose of this study, Japan's fishery management is explained in detail, but international management of Pacific bluefin tuna fishery is briefly described as well.

6.1.1 Stock Status

Although bluefin tuna migrates across the Pacific Ocean, it mainly ranges north of the equator from around Japanese and Korean EEZ to around Mexican and US's EEZ. Spawning grounds of this stock are observed only in the WPO, mainly in Japan's EEZ. The main commercial fishing grounds are Japan's EEZ, Korean EEZ and Chinese Taipei's EEZ[5] in the WPO, and Mexican EEZ in the EPO. In Japan, almost all of bluefin tuna is harvested within Japan's EEZ in recent years (Fisheries Agency of Japan 2014d).

According to the report of 14th plenary meeting of the ISC in 2014, bluefin tuna stock is overfished and experiencing overfishing, based on the reference points commonly used in many tuna species. The SSB in 2012 was 26,324 tons and it was close to the historical lowest level. Also, the recruitment in the most recent five years was significantly lower than the historical average level (ISC 2014).

6.1.2 Description of the Fishery

As a contracting party of the WCPFC, Japan manages the bluefin tuna fishery according to the CMM adopted by the WCPFC. The current (2014) management measure was adopted in 2013, and

[5] Chinese Taipei is the official name of Taiwan in both WCPFC and IATTC, so that the name "Chinese Taipei" is used in this chapter.

came into effect in 2014. This measure requests individual member country not to increase fishing effort in total and to limit their juvenile (less than 30kg) catch to be lower than 85% of their average juvenile catch in 2002-2004 (WCPFC 2013b). Also, as the largest bluefin tuna fishing country, Japan has implemented some voluntary measures (Fisheries Agency of Japan 2014d).

During the past five years (2009-2013), the average annual catch of bluefin tuna by Japan's fisheries was 10,120 tons. The bluefin tuna catch has fluctuated between 34,267 tons in 1956 and 6,282 tons in 1990, but the catch levels in recent years are very low. Catch in 2013 (7,014 tons) was the third lowest in its history, and catch in 2012 (6,662 tons) was the second lowest (ISC 2014). Although a national catch limit in 2014 is established only for juvenile fish at 6,813 tons, catch data about juveniles are not available yet for 2014 fishing season. Catch of juveniles in 2012, 2011 and 2010 was 3,815 tons, 9,127 tons and 5,500 tons, respectively (Fisheries Agency of Japan 2014o).

Both adult and juvenile bluefin tuna are consumed as sashimi or sushi. While a very high price is recorded for adult bluefin tuna, juvenile bluefin tuna is sold at a relatively low price (Takeuchi et al. 2014a). In Japan, 66% of bluefin tuna was harvested when they were juveniles from 2008 to 2012 in terms of weight (Fisheries Agency of Japan 2014o). In terms of number, no data are available for the Japanese fishery. However, all over the Pacific Ocean, 98.8% of total bluefin tuna catch was juvenile fish (0-1 years old), whereas only 1.2% of bluefin tuna catch was high value adults from 2001 to 2010 (Fisheries Agency of Japan 2014p). Some of these juveniles were captured and then reared in ocean farms.

6.1.3 Current Fishery Resource Management System

Arranged by gear type, catch by purse seine, set net, trolling, longline and others were 5,078 tons (50%), 1,800 tons (18%), 1,376 tons (14%), 946 tons (9%) and 919 tons (9%), respectively, from 2009 to 2013 (ISC 2014). For the 2014 fishing season, the WCPFC's CMM requires member countries to reduce juvenile catch by 15% and not to increase fishing effort in total (WCPFC 2013b). The FAJ established the catch limit only for the purse seine industry to comply with this measure, because it was believed that current effort limit for other fisheries was strict enough to comply with national catch limit. Individual Japanese bluefin tuna fisheries are managed as follows.

Chapter 6 Pacific Bluefin Tuna Case Analysis

(1) Purse Seine

Catch by purse seiners contributes about half of national bluefin tuna catch. However, bluefin tuna is not a main target species for purse seiners, and it is fished only in the season that bluefin tuna migrates through their fishing ground. Juveniles are mainly fished by purse seiners in Western Japan fishing ground, whereas adults are harvested in the Japan Sea and Pacific Ocean (Fisheries Agency of Japan 2014d). Seventy one per cent of catch by purse seiners was juveniles from 2008 to 2012, in terms of weight (Fisheries Agency of Japan 2014o).

The purse seine fishery is managed through licensing system set by the MAFF. The total number of vessels is limited, and many licensing conditions, such as area closures, are applied. Based on the CMM of the WCPFC, the catch limit for juvenile (less than 30kg) in 2014 is set as 4,250 tons that is 85% of purse seine catch in 2002-2004. Japan Far Seas Purse Seine Cooperative (En-Maki) is the regional purse seine association in the Western Japan fishing ground. It has coordinated and monitored the compliance with this catch limit through autonomous measures including an IQ-like system. In addition to the juvenile catch limit required by the WCPFC, the catch limit for adult fish is voluntarily set as 2,000 tons that is the 2002-2004 average catch amount (Fisheries Agency of Japan 2014d).

(2) Set Net Fishery

There are 1,800 set net fisheries operating all over Japan (Fisheries Agency of Japan 2014d), although the number of set nets actually harvesting bluefin tuna is unknown. A set net fishery is the fishery in which fishermen set trap nets near the coast line and wait for fish to swim into it. The set net fishery is a passive fishery, so that it is not easy to exclude bycatch of bluefin tuna.

Set net fishing is managed by each prefectural government (Fishery Act 1949). In 2011, the MAFF issued the administrative instruction not to increase the number of set nets for bluefin tuna to all relevant prefectural governments. Since then, the number of set nets that registered for bluefin tuna has not increased (Fisheries Agency of Japan 2014d).

(3) Longline Fishery

Regarding longlines, 688 longline vessels have licenses to catch tuna species including bluefin tuna around Japan. Some of them target bluefin tuna seasonally (Fisheries Agency of Japan 2014d).

Longline fishing is managed by the MAFF and the number of licenses is limited. The number of vessels and their catch has declined in recent years. They catch only adult fish, so no further measures have been introduced to limit harvest of juveniles (Fisheries Agency of Japan 2014d).

(4) Artisanal Fishery

The artisanal fishery, mostly trolling, catches bluefin tuna with one or two fishermen on board. As an artisanal fishery, 24,086 vessels have licenses to catch bluefin tuna and they target it seasonally. Artisanal fishing is conducted by small vessels, so that their fishing ground is mainly within territorial waters. Therefore, their fishing operations depend on the yearly fluctuating migration route of bluefin tuna (Fisheries Agency of Japan 2014d). Juvenile fish is the main target for artisanal fisheries. Some trolling vessels provide juveniles fish for farming.

The artisanal fishery for bluefin tuna was open access fishery in the past. The registration system was introduced in 2011 to gather more data, under the scheme of the WFCC described in Chapter 3. Then, the licensing system by the WFCC commenced in April 2014 to limit the number of fishing vessels (Fisheries Agency of Japan 2014d).

(5) Aquaculture

Bluefin tuna is farmed mainly in the southern part of Japan, and the average production from 2011 to 2013 was 10,086 tons. Fifty seven per cent of juveniles for farming was provided by trolling, and 43 % of it was provided by hatcheries in 2013, in terms of number (Fisheries Agency of Japan 2014q).

Aquaculture is managed by the prefectural governments. In order to prevent an increase of juvenile catch for the purpose of aquaculture, the MAFF instructed all relevant prefectural governments not to increase the capacity for bluefin tuna farming except the farms which exclusively use juveniles from hatcheries (Fisheries Agency of Japan 2014d).

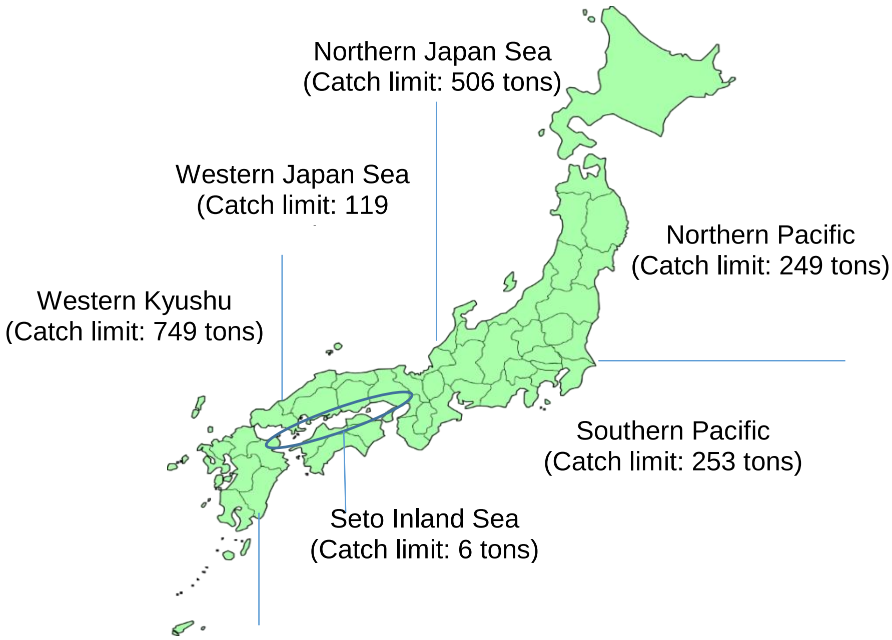
6.1.4 The New Management Policy in Japan

In December 2014, WCPFC adopted the provisional multi-annual rebuilding plan for bluefin tuna. The initial goal of the rebuilding plan is to rebuild the SSB to the historical median level (42,592 tons) within 10 years with at least a 60% probability of success. In this provisional rebuilding plan, the catch limit for juveniles in 2015 is set at the 50% of the 2002-2004 annual average juvenile catch. Any overage of the catch limit is deducted from the catch limit for the following year. Also, the adult catch is not to exceed the 2002-2004 annual average (WCPFC 2014).

Following the WCPFC's decision, Japan's bluefin tuna fisheries are managed in 2015 as follows; the catch limit of juveniles for purse seine fishery is 2,000 tons (4,250 tons in 2014); the catch limit of juveniles for other fisheries, such as set net and artisanal fishery is 2,007 tons (no catch limit in 2014); and in order to comply with and to monitor the catch limit for other fisheries, the catch limit is distributed to six regions based on the historical catch (See figure 6) (Fisheries Agency of Japan 2014p).

The discussion process for management of bluefin tuna is different from the other three case study species, because domestic discussion has progressed on a parallel track with international discussions. The domestic discussions are explained in this section, and then international discussions are briefly described in the next section.

Figure 6. Six regions for bluefin tuna management and respective catch limits



(Modified from Fisheries Agency of Japan 2014p)

In February 2014, the ISC reported that the bluefin tuna stock was overfished and experiencing overfishing, based on the reference points commonly used in many tuna species. The ISC also projected that the SSB of bluefin tuna would not be expected to increase; rather the risk of SSB falling below the historical lowest would increase if the current management measures were continued (ISC 2014). The ISC projection showed that only the scenario reducing catch limit for juvenile by 50% from 2002-2004 average level can recover the SSB to its historical median level in 10 years with 85% probability (ISC 2014; Takeuchi et al. 2014b). It is also highlighted that catching too many juvenile resulted in a greater impact on this stock than fishing adults (WCPFC Northern Committee 2014).

After the ISC's report, the FAJ announced that it intended to reduce Japan's juvenile bluefin tuna catch by 50% from 2002-2004 in 2015, regardless of the WCPFC's decision. The FAJ requested three WFCCs to discuss the specific measures to achieve 50% reduction (Fisheries Agency of Japan 2014r).

The bluefin tuna management issue was discussed in the Task Force, too. At the third Task Force meeting in May 2014, the FAJ explained that national catch for juvenile bluefin tuna should be reduced by 50%, and the Task Force discussed the future management measures on bluefin tuna. In July, The Task

Force released its report and recognized the necessity to reduce the national juvenile catch to recover the SSB. They also recommended that the catch limit for other fisheries to be distributed to six regions based on the historical catch because it made monitoring easier (Ad-hoc Task Force on Fishery Resource Management 2014).

The FAJ convened the meeting about the new bluefin tuna management scheme, so-called "National Meeting for Fishery Resource Management of Pacific Bluefin Tuna" with 300 participants from all over Japan. From June to August 2014, the FAJ has had meetings in more than 50 fishing villages and fishing ports to explain the current stock status and to ask for support for the introduction of the new regulation (Fisheries Agency of Japan 2014d). The new management measure explained in these meetings by the FAJ followed the Task Force's recommendation and ISC's scientific advice.

Finally, the new management measure was adopted by the WCPFC as described in the first paragraph of this section in December 2014. The management measures that the FAJ explained in the domestic meeting could cover the all requirements of this new measure adopted by the WCPFC.

6.1.5 International Fishery Management of Pacific Bluefin Tuna

Bluefin tuna is harvested by many countries. In this section, bluefin tuna fisheries in other countries and the discussion about management measures in the WCPFC and the IATTC are briefly presented.

In the Pacific Ocean, total annual average catch of bluefin tuna was 16,797 tons in the past 5 years (2009-2013), and 69% was fished in the WPO and 31% was fished in the EPO. Also, from 2009 to 2013, average catch of bluefin tuna of Japan, Mexico, Korea, the US and Chinese Taipei were 10,120 tons (60%), 5,261 tons (28%), 966 tons (6%), 597 tons (4%) and 432 tons (3%), respectively. In Mexico, juvenile bluefin tuna is fished by purse seine fishery for aquaculture, and then products are exported to Japan. The purse seine fishery mainly catches juvenile bluefin tuna in Korea, and most of them are exported to Japan, too. In the US, Pacific bluefin tuna is mainly fished by sports fishermen (ISC 2014). In Chinese Taipei, only adult fish is caught by longline, and consumed domestically (Chinese Taipei Fisheries Agency 2014).

In the WPO, the WCPFC is the RFMO to be responsible for the management of bluefin tuna fishery. Bluefin tuna is designated as "Northern Stock" which means this species mainly ranges in the band from the Equator to 20 degrees North in Pacific Ocean, so that its management measures are discussed in the Northern Committee first, and then approved in the plenary meeting of the WCPFC. The Northern Committee is a subsidiary body of the WCPFC (WCPFC 2004). In the WCPFC, the first management measure for bluefin tuna came into effect in 2010 (WCPFC 2009), and since then, it has been revised every year.

In order to comply with these management measures, each country implements own measures. In the WPO, Japan, Korea and Chinese Taipei are the fishing countries for bluefin tuna. In Korea, bluefin tuna is fished by purse seine fishery. Fishing effort is limited by a licensing system, and the national catch limit for juveniles is set according to the WCPFC's CMM (Government of Korea 2014). In Chinese Taipei, the number of vessels is limited by the licensing system. Chinese Taipei's longline fishery does not catch juveniles, so that no catch limit is established for juveniles (Chinese Taipei Fisheries Agency 2014).

In September 2014, the Northern Committee adopted the draft CMM to establish a multi-annual rebuilding plan for bluefin tuna (WCPFC Northern Committee 2014). This draft management measure was officially adopted in the WCPFC plenary meeting in December 2014 (WCPFC 2014).

In the EPO, IATTC is the RFMO to be responsible to the management of bluefin tuna fishery. In the IATTC, the first management measures for bluefin tuna came into effect in 2012, and were revised in 2013. The current (2014) management measure established total catch limit of 5,500 tons in the EPO in total (IATTC 2013).

In the EPO, Mexico is the only major fishing country and they must stop operation if the total catch in this region reaches its limit. Also, a small amount of bluefin tuna is fished by sports fishing in the US (ISC 2014). The US prohibits sale of bluefin tuna from sports fishing, and is now discussing the introduction of bag limits[6] (WCPFC Northern Committee 2014).

In July 2014, the 87th meeting of IATTC was held in Peru, but they could not reach a consensus on the new management measures for bluefin tuna in 2015, due to strong objection by the major fishing country, Mexico (Fisheries Agency of Japan 2014s). In October 2014, the IATTC meeting was convened again and adopted the management measure to set catch limit at 3,300 tons in the EPO for the 2015 fishing season (Fisheries Agency of Japan 2014t).

[6] Bag limit is the limitation for possession of fish by a person in a recreational fishing trip.

6.2 The Impacts of the New Policy

The impacts of the new policy on SESs components: Resource Unit, Resource User and Governance are discussed.

6.2.1 Resource Unit

The stock status of bluefin tuna is very serious; current SSB in 2012 is about the historical lowest and is 4% of unfished SSB (B_0); it is overfished and experiencing overfishing; and the recruitment in recent years is low (ISC 2014). In this situation, the initial goal of the rebuilding plan was established to rebuild the SSB to the historical median level within 10 years with at least a 60% probability of success. To achieve this goal, catch limit for juvenile was set at the 50% of the 2002-2004 annual average catch for the 2015 fishing season (WCPFC 2014). Therefore, bluefin tuna is expected to increase with high possibility in the future.

Although this new management policy is expected to improve stock status of bluefin tuna, two questions have arisen about the catch limit and the goal of CCM. First, how about other types of catch limits? A catch limit is halved only for juveniles in bluefin tuna, whereas collective catch limits are set for chub mackerel, walleye pollock and many other species in Japan. This catch limit was adopted according to the future projection conducted by the ISC. The ISC conducted future projection for seven scenarios, (1) J15, (2) J15+A15, (3) J15+A15+E15, (4) J15+E15, (5) J25+E25, (6) J50+E50 and (7) J25+E25, where J15 is 15% catch reduction of juvenile in the WPO from base year (2002-2004[7]), J25 is 25% catch reduction of juvenile in the WPO, J50 is 50% catch reduction of juvenile in the WPO, A15 is a 15% catch reduction of adults in the WPO, and E15 is 15% catch reduction in the EPO, E25 is 25% catch reduction in the EPO and E50 is 50% catch reduction in the EPO. These seven scenarios were designated by the Northern Committee in its 2013 meeting, and the ISC conducted future projections following the instruction of the Northern Committee. The ISC projected that only the scenario (6), i.e., the combination of 50% reduction of juvenile catch from 2002-2004 average in the WPO and 50% reduction from 2013 catch limit in the EPO, can achieve recovery of the SSB to historical median level in 10 years with more

[7] When the CMM for bluefin tuna was established for the first time in 2009 at WCPFC, the latest data used in the latest stock assessment were the data in 2002-2004. Since then, the 2002-2004 average catch has been used as the base catch amount to calculate the catch limit.

than 60% probability (ISC 2014). There is no additional information, such as the effectiveness of further reduction of adult catch in the WPO, but it is true that scenario six can achieve the management objective. Also, the Chair of the ISC stated that fishing too many juveniles resulted in a greater impact on this stock than fishing adults (WCPFC Northern Committee 2014).

Second, there is a question of whether the recovery of SSB to the historical median in the WPO is appropriate nor not. The rebuilding plan for bluefin tuna adopted by the WCPFC states that the initial goal of this plan is rebuilding the SSB to the historical median level within 10 years with at least 60% probability, and the management objective for long term management will be determined in 2015 or 2016 (WCPFC 2014). The US government proposed 20% of B_0 to be achieved in 10 years as the management objective (WCPFC Northern Committee 2014). The SSB in 2012, 26,324 tons, is estimated as 4% of B_0. Therefore, 20% of B_0 equals to 131,620 tons. The SSB of 131,620 tons is the historical 3rd highest level, following 140,148 tons in 1961 and 139,344 tons in 1960 since 1950 (ISC 2014). At the same time, however, the historical median, SSB of 43,000 tons is 6.5% of unfished SSB. Setting a goal around the historical highest level is not realistic, however, 6.5% of unfished biomass looks less ambitious as a long term management objective.

6.2.2 Resource User

(1) Boat Owners

The important points of the new policy for boat owners in Japan are; the quota for juveniles is reduced from 85% of average catch in 2002-2004 to 50% of average catch in 2002-2004 (41% reduction). The juvenile catch limit is 4,007 tons. It is divided among purse seiners (2,000 tons) and other fisheries (2,007 tons). Out of 2,007 tons of other fisheries’ quotas, 19 tons are reserved by the FAJ for emergency use, and 106 tons are reserved for MAFF licensed fisheries, such as pole and line. The remaining 1,882 tons is divided to six regions, and it is shared by other fisheries, such as set nets and trolling. Purse seine industries have managed their fishery to comply with quota for a couple of years, but other fisheries do not have a pre-existing scheme to coordinate. The race-to-fish might occur.

The catch limit for adult that is average catch in 2002-2004 is the same as previous year. There is no change for the adult catch, so that there are no impacts for longline fisheries targeting only for adult bluefin tuna. The impacts on the fisheries targeting juveniles are discussed as follows.

(1-a) Purse Seine Fishery

Juvenile quota for purse seiners is divided to three cooperatives, En-Maki in Western Kyushu, Japan Sea Purse seine association in Japan Sea, and Kita-Maki in Pacific. However, the main fishing ground for juvenile bluefin tuna is the Western Kyushu, and 18 purse seiners in Japan Sea and 26 purse seiners in Pacific Ocean are mainly harvesting adult tuna. Therefore, the majority of juvenile quota is allocated to En-Maki that has 22 purse seiners as members. For purse seiners belonging to En-Maki, mackerel and jack mackerel are the main target, but they are harvesting juvenile bluefin tuna (Fisheries Agency of Japan 2014o).

En-Maki manages its member vessels by the combination of race-to-fish system and its autonomous IQ-like system (Fisheries Agency of Japan 2014r). Also, a part of quota is reserved for the bycatch that might be happen when they operate for mackerel or other species. En-Maki receives catch reports from both boat owners and fish markets operated by local governments, and En-Maki checks the landing amount. The fishermen and the fish markets also report the landing to the FAJ as well, and catch amount is double checked.

For the purse seine fishery in Japan, bluefin tuna is not a main target species and its catch is 0.4% of their total catch in terms of weight (Ministry of Agriculture, Forestry and Fishery 2014a). However, it is an important species for particular purse seiners (Fisheries Agency of Japan 2014r). The juvenile catch limit for purse sein fishery will be 2,000 tons in the 2015 fishing season (July 2015 - June 2016). This is a 52% reduction from catch quota in 2014. The juvenile catch by purse seiners was 7,193 tons, 5,983 tons, 2,669 tons, 6,129 tons and 1,422 tons in 2008, 2009, 2010, 2011 and 2012, respectively (Fisheries Agency of Japan 2014o). The catch amount in 2008-2011 implies that the purse seine industry would have significant damage by the reduction of quota. However, the catch in 2012 was 1,422 tons. The precise data in 2013 are not available yet, but it seems like it may prove smaller than catch in 2012 (ISC 2014). Also, the recruitment in 2014 is considered to be seriously low (Fisheries Agency of Japan 2014u), so that the juvenile catch in 2014, 2015 and 2016 would be small. It is expected that the quota reduction does not induce serious damage on purse seine industries, because the serious decline of stock and recruitment is already reflected in low catches in previous years.

(1-b) Artisanal Fisheries and Set Net Fishery

The catch quota for artisanal fisheries and set net fishery is divided to six regions. There is no separation between artisanal fishery quota and set net fishery quota. Unlike the purse seine fishery, there is no organization for coordination within regions. There is no information about the number of vessels in individual regions, but 24,000 artisanal vessels and 1,800 set nets are operating across Japan. It is very difficult to coordinate within regions. Artisanal fisheries will start a race-to-fish style fishery to maximize their catch within limited common pool quota, and cost for fishery might be increased.

The juvenile catch by artisanal fisheries and set net fisheries was 4,116 tons, 3,277 tons, 2,425 tons, 2,725 tons and 1,843 tons in 2008, 2009, 2010, 2011 and 2012, respectively (Fisheries Agency of Japan 2014o). Taking into account the low catch amount in 2012 and low recruitment in 2014, the impacts of the new management policy looks small. Unlike the purse seine case, however, the regional quota is established and there is no re-allocation scheme within one fishing season. Because the catch by artisanal fisheries and set net fishery are dependent on a yearly fluctuating migration pattern, the catch/quota ratio is disproportionate among regions, and the quota will not be fully utilized in some regions. Overall, the landings will be restricted in some regions.

There is no precise information available how much each artisanal fisherman and set net fisherman relies on bluefin tuna, but this new policy significantly impacts on some artisanal and set net fishermen. In the past 5 years, bluefin tuna catch consists of 10% of troll fishery's total landing by volume (Ministry of Agriculture, Forestry and Fishery 2014a). However, target species for the troll fishery is different in region by region. For example, bluefin tuna is the target species for troll fishermen in Nagasaki Prefectures and it consists of 77% of their catch in 2013, whereas the target species for troll fishermen in Okinawa Prefecture is other tuna species, such as yellowfin tuna (Ministry of Agriculture, Forestry and Fishery 2014a). Also, troll fishermen based in remote islands in Nagasaki Prefecture target bluefin tuna throughout the year (Fisheries Agency of Japan 2014o). In contrast, some artisanal fishermen are engaged in trolling only when bluefin tuna migrates, and they do other fisheries, such as squid jigging and bottom longline in other seasons (Fisheries Agency of Japan 2014d). Similarly, bluefin tuna is an important species for some set net fishermen and not so important a species for some set net fishermen. Overall, this quota reduction will induce serious impact on particular artisanal and set net fishermen.

The set net fishery is a passive fishery and cannot select the species to be harvested. If the bluefin tuna catch exceeds the quota, the overage of the catch limit is deducted from the catch limit for the following year. When their catch hits the limit, set net fishermen have three options; they release bluefin tuna; they keep fishing and the overage is subtracted from the quota in the following year; and they stop fishing. Because bluefin tuna is not a main target species for many set net fishermen and quota is shared with artisanal fishermen, the second and third options are unrealistic. Releasing bluefin tuna overage seems the practical option. Although no academic paper is available about release of bluefin tuna from set nets, the some fishermen and local government staff stated that the live release of this species must be difficult, at the Task Force meeting (Fisheries Agency of Japan 2014r).

(1-c) Aquaculture

More information is required to discuss the impacts of the new policy on aquaculture industries, but it is expected to be not very serious. In 2013, 57% of bluefin tuna juveniles for aquaculture are wild caught juveniles (FAJ 2014q). The fishermen might increase their effort for juveniles for the purpose of aquaculture to maximize their revenue within limited quota. At the same time, aquaculture industries can buy more hatchery origin juveniles.

(2) Community

The reduction of catch limits in artisanal and set nets fishery impacts on some coastal communities, especially on the communities that rely on this stock. The information about artisanal fishermen and set net fishermen’s dependence on bluefin tuna is not available, because there is huge diversity. In many artisanal fishermen, bluefin tuna trolling is one of their fishing activities, and bluefin tuna is one of the target species for set net fishermen. However, in some communities, artisanal fishermen heavily rely on this stock. For example, the more than half of the revenue of artisanal fishermen in Goto islands in

Nagasaki Prefecture relies on bluefin tuna landing (Fisheries Agency of Japan 2014o). Also, trolling for bluefin tuna is actively operated in isolated islands and remote peninsulas where fishing is the only industry in communities (Fisheries Agency of Japan 2014d).

Unlike the walleye pollock fishery in Hokkaido, there is no coordination scheme across the communities. The communities may cooperate to establish autonomous measures. Because the quota is shared by all fishermen in one of six regions, autonomous measures by one community do not work well. They do not have a place to discuss autonomous measures at neither the region level nor prefectural level. Under the current situation, the race-to-fish within regions cannot be avoided.

(3) Equity

There are four types of equity issues about quota allocation in this new management policy: i.e., purse seine vs. fisheries using other gears; among fisheries other than purse seiners; fisheries targeting adults vs. fisheries targeting juveniles; and domestic fisheries vs. foreign fisheries.

First, there is an equity issue about catch limit allocation between the purse seine fishery and other fisheries. Catch limit for purse seine is 2,000 tons that is 56% reduction from base catch (2002-2004 average catch), whereas catch limit for other fisheries is 2,007 tons that is 42% reduction from base catch (Fisheries Agency of Japan 2014p). On one hand, purse seine fishermen may argue that it is unfair. On the other hand, fishermen in other fisheries may argue that the purse seine fishery should have smaller quotas, because purse seine can harvest alternative species, such as mackerel and jack mackerel, but artisanal fishermen have much less opportunity for alternative species due to their limited mobility.

Second, there is conflict about catch limit within other fisheries. The catch limit for other fisheries is 2,007 tons and it is further divided to six regions. This allocation is based on historical catch of each region, and the percentage of reduction is same among all regions. This implies that the conflicts about allocation among regions are not very serious. However, the equity issue emerges within regions, because of migration route of this species. For example, in the north Japan Sea region, bluefin tuna migrates to the Noto Peninsula at the western extent of the region in May. Later, it migrates toward the north, and reaches the west coast off Hokkaido at the north end of the region in September or October (Fisheries Agency of Japan 2014v). This means that fishermen on the Noto Peninsula can harvest bluefin tuna up to quota before tuna migrate to Hokkaido area. As for the purse seine quota, purse seiners have organized cooperatives and have managed their catch for the last couple of years, so that they can solve equity issues among themselves.

Third, there is equity issue between fisheries targeting adults and fisheries targeting juveniles. The new policy only reduced the catch limit for juvenile tuna by 41% (50% reduction from base year), whereas the catch limit for adult is same as catch in the base year. The adult catch limit is much higher than the catch amount in 2009-2012, so that it does not seriously restrict fishing activity. Therefore, if the juvenile catch is reduced, the surviving juveniles could be harvested in the following year by unrestricted fisheries targeting adults.

Lastly, there is international equity issue about bluefin tuna fisheries. Bluefin tuna is a highly migratory species and its fishery has to be managed internationally. Because it migrates across the Pacific Ocean, the WCPFC and the IATTC are the RFMOs that have responsibility to manage this stock. The Japan's new policy is compatible with the measures in the WCPFC (WCPFC 2014). In the IATTC, the catch limit is 3,300 tons. Although the IATTC's catch limit does not have separation between juveniles and adults, the degree of catch limit reduction is similar between the IATTC and the WCPFC[8]. Therefore, there is no serious international equity issue, but the compliance by all member countries has to be monitored.

6.2.3 Governance System

Regarding Japanese artisanal and set nets fisheries, there is no coordination scheme within regions. The coordination among fishermen is necessary, because the catch limit can be hit by fishermen in a particular area before bluefin tuna migrate to other area. As for purse seine fisheries, they can coordinate their fishery through the existing scheme.

In order to monitor the catch of other fisheries, the new catch monitoring system will be introduced. The catch amount will be reported frequently to the FAJ through the prefectural governments and FCAs in communities. The FAJ will distribute cautionary notice to fishermen and public, when the accumulated

[8] In combination of juveniles and adults, the catch limit in 2015 is 31% reduction from base year in WCPFC, whereas the catch limit in 2015 is 29% reduction from base year in IATTC (ISC 2014).

catch amount will reach 70%, 80% and 90% of quota in individual region. Then, the FAJ would issue request to refrain from fishing toward fishermen, if accumulated catch amount reaches 95% of quota (Fisheries Agency of Japan 2014p).

6.3 Discussion about the Policy Innovation

Japan should lead the discussion in both the WCPFC and the IATTC to rebuild the bluefin tuna stock. In March 2014, the FAJ announced that it intended to reduce Japan's juvenile bluefin tuna catch regardless of WCPFC's decision. Japan has the strongest responsibility to manage this stock, as the biggest bluefin tuna consuming country, the biggest fishing country and the country that has spawning ground within its EEZ. In 2013, Japan harvested 7,014 tons of bluefin tuna and it was 58% of world catch (ISC 2014). Japan imported 4,116 tons of bluefin tuna 2013, too (Fisheries Agency of Japan 2014d). In rough estimates, about 90% of bluefin tuna was consumed in Japan.

The stock status is poor, so that the juvenile catch limit for 2015 is set at the 50% of 2002-2004 level (WCPFC 2014). In order to rebuild this stock, the fishing effort has to be reduced rapidly and substantially, because prolonged overexploitation increases the uncertainty in its recovering due to the erosion of population resilience (Hutchings and Reynolds 2004; Keith and Hutchings 2012; Neubauer et al. 2013). Quota is divided to purse seine industry and other fisheries, and quota for other fisheries is further divided to six regions. As discussed in "6.2 The Impact of the New Policy", issues to be discussed are the appropriateness of management objective and catch limit and the governance scheme to mitigate a race-to-fish and to treat equity issue for small scale fisheries.

There is no agreed long term management objective and biological reference point to indicate the achievement of the objective for bluefin tuna. In most fisheries management systems, the management process has the following steps: (i) estimate virgin and current stock size, (ii) calculate the target catch for the fishery using accepted reference point, such as B_{MSY} and 20% of B_0, and (iii) manage the fishery to achieve the target catch by using a variety of tools (Hilborn 2002). The setting limit reference point and/or target reference point is an important step. In many of Japan's domestic fishery resources, the long term management objective is to secure the stable recruitment and reference point is B_{limit} that is the lowest SSB that is expected to produce a good and stable recruitment (Fisheries Agency of Japan 2013). For bluefin tuna, the current initial goal is that the rebuilding the SSB to its historical median that is 6.5% of B_0. It sounds and is less ambitious as a management objective. At the same time, 20% of B_0 that the US proposed at the WCPFC as a reference point was about historical highest, so that it, too, sounds unrealistic as a management objective.

Can using 10% of B_0 be an option instead of 20%? It is not a good option because it is very difficult to estimate reliable B_0 because it includes highly arbitrary calculations (Hilborn 2002). If the value of reference point is easily changed with arbitrary calculation, it would be very hard to explain it to fishermen. For example, the 1997 and 1998 stock assessments for sablefish on the west coast of the US differed 10-fold in estimated stock size, because of a difference in the assumptions in the models. Since the stock size was needed to calculate reference points, the reference point was significantly different over two years (Hilborn 2002). Also, the stock sizes of rock lobster and snapper in NZ have been 10% or less of B_0 for the last 30 years, but they have been sustainably managed and produced near maximum sustainable yield at this level (Hilborn 2002). MSY, another popular reference point, is a function of B_0, so that it includes same problem as B_0 (Hilborn and Stokes 2010). Therefore, Hilborn and Stokes (2010) suggested that one approach was to use empirical reference points, such as (a) historical stock size, (b) Catch Per Unit Effort (CPUE) and (c) the relationship between historical stock size and surplus production, instead of model based reference points, such as X% of B_0 and MSY. Historical stock size, such as the historical median, and CPUE should be discussed as options in the ISC. As for the relationship between historical stock size and surplus production, it is similar to the Japan's domestic reference point that uses B_{limit}. B_{limit} is defined by three ways in Japan, depending on biological characteristics of individual stocks; (i) the lowest SSB to secure the stable recruitment, (ii) the SSB to produce 50% of maximum yield, and (iii) the lowest SSB to secure high recruitment with good environmental conditions (Fisheries Agency of Japan and Fisheries Research Agency of Japan 2014b). Therefore it may not be a good option, because the relationship between SSB and recruitment is very weak in this stock (ISC 2014), but further discussion is required in the ISC.

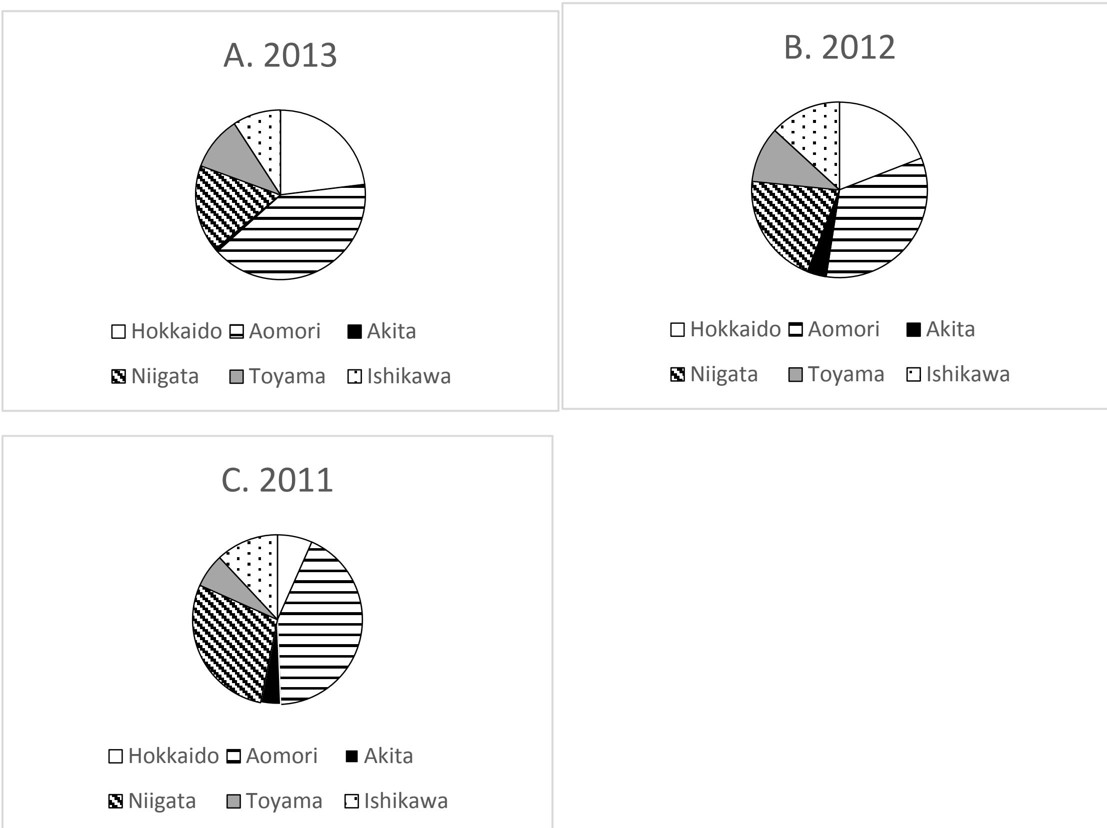
The next issue to be discussed is the appropriateness of catch limit that is 50% of catch in 2002-2004 for juvenile and catch limit that is same as catch in 2002-2004 for adult (WCPFC 2014). It was true that this combination of catch limits was expected to result in the recovery of SSB to the historical median with 85% probability (ISC 2014). Although it is true that this catch limit has no problem scientifically, the equity issue exists. Under the current catch limit, the fishermen targeting only adult fish, such as purse seiners operating in the Japan Sea do not have to reduce their catch, whereas the fishermen targeting only juvenile fish, such as troll fishermen have to reduce their catch significantly. Therefore, the FAJ, as a member of the Northern Committee of WCPFC, should request the alternative combinations of catch limit that requires same amount of reduction for both adults and juveniles by each gear type, and that is expected to result in the stock rebuilding. If the reduction of juvenile is much more effective than reduction of adult harvest, the current catch limit system would be the best option. In addition to seven scenarios, i.e., (1) J15, (2) J15+A15, (3) J15+A15+E15, (4) J15+E15, (5) J25+E25, (6) J50+E50 and (7) J25+E25, other combinations, such as J25+A25+E25 should be assessed by the ISC. If J50+E50 and J25+A25+E25 are the scenario to achieve management objectives, for example, the next step would be the discussion as a social, economic and political issue. Member countries can discuss which scenario can maximize its fishing industry's benefit and fairness among members.

The race-to-fish will occur and equity issue will emerge after the introduction of catch limit to set nets and artisanal fisheries. The catch limit is allocated across six regions, but at least more than 1,000 boats can harvest bluefin tuna in each region and there is no scheme to coordinate their operations within the region. Artisanal fisheries may start a race-to-fish fishery to maximize their catch within the limited common pool quota, and cost for fishery is expected to increase. Also, because both artisanal fishery and set net fishery rely on the migration of bluefin tuna, fishermen in a particular communities may lose a chance to harvest it if the quota is harvested by downstream communities. Therefore, the equity issue is critical, too. The emergence of a race-to-fish and equity issues may adversely impact some boat owners and communities, such as villages in the Goto Islands that heavily rely on trolling for bluefin tuna. Although economic loss due to reduction of catch limit is significant, the purse seine industry in the Western Kyushu fishing ground is not likely to start a race-to-fish and will not have equity issues. The difference between purse seine fishery and artisanal and set net fisheries is that the number of purse seine vessels is 22 (Fisheries Agency of Japan 2014d), they have an organized cooperative, En-Maki, and they have already coordinated their fishing operation using their autonomous IQ-like system

(Fisheries Agency of Japan 2014r). The purse seine industry can avoid the race-to-fish and utilize limited quota effectively.

A program to coordinate fishing operations is necessary to mitigate a race-to-fish and equity issues. Many researchers suggest that incentive-based approaches that provide catch quota or other types of fishing rights to individual fishermen, group of fishermen or communities is a good tool to mitigate a race-to-fish, because they can operate by themselves or cooperate to maximize their profit within their quota (Grafton et al. 2006; Hilborn et al. 2005; Huppert 2005). Also, by securing appropriate quota to individual or groups, equity issues are mitigated. However, the allocation is very difficult in this case. It may be a good idea to allocate the quotas to six regions, because this is the unit of the WFCCs. However, it is still too big. Each region consists of 5-10 prefectures, has tens or hundreds of communities, and has more than 1,000 fishing boats. Quota allocation to individual fishermen is not practical, because there are more than 25,000 set nets and artisanal fishermen and quota is just 2,007 tons. Allocation to prefectures is reasonable. Because set net fishery is authorized by prefectural government and artisanal fishery gets its licenses from the MAFF through prefectural governments. It is relatively easy to organize the program to coordinate fishing operation within a prefecture. Each prefecture has from a couple of to tens of communities, so that they can allocate further to communities, and re-allocation taking into account the latest bluefin tuna migration is easy at the prefecture level, too. The problem is initial allocation to prefecture governments, because the catch ratio is fluctuating. For example, Figure 7 shows the catch ratio by set net fisheries in individual prefecture are different in each year in the Northern Japan Sea region. The allocation has to be carefully decided taking into account the result of first year operation of this catch limit system, and in-season reallocation system can be considered.

Figure 7. Set net fishery bluefin catch by prefectures in the Northern Japan Sea region



(Source: Ministry of Agriculture, Forestry and Fishery 2014a)

For sustainable bluefin tuna fishery, the appropriate setting of management goal and catch limit to achieve it are a first step. The reference point must be robust, such as an empirical reference point, rather than a model-based reference point that is easily changed by model assumptions. When catch limits are calculated, the scenario that both juvenile and adult catch limits are reduced should be added to options. Next, among small scale fishermen, the measures to mitigate a race-to-fish and equity issues should be considered. In order to mitigate race-to-fish, the quota should be allocated to smaller units, such as prefectures, and then fishermen should coordinate their operation to reduce the cost, to be fair within group, and to effectively utilize the allocated quota.

6.4 Summary

The SSB of Pacific bluefin tuna is close to the historical lowest level, and the recruitment in recent five years was significantly lower than the historical average level (ISC 2014). Immediate actions were required to rebuild this stock. The WCPFC and the IATTC agreed to more strict management measures among their member countries. Following the WCPFC's decision, Japanese fishermen have to reduce their juvenile catch by 50% from 2002-2004 level, and cannot increase their adult catch from the 2002-2004 level in the 2015 fishing season (WCPFC 2014).

The appropriate management goal and catch limit to achieve it should be adapted in the international organization level. Defining an empirical reference point, such as historical stock size, CPUE and the relationship between historical stock size and surplus production can be good options for selecting a management goal. Also, a variety of scenario analyses including the scenario that both juvenile and adult catch limit are reduced should be discussed in the ISC to decide catch limit. The governance scheme to mitigate race-to-fish and treatment of the equity issue for small scale fisheries should be established. The quota should be allocated to smaller units, such as prefectures, and then the FAJ and prefectural governments coordinate fishermen to mitigate the tendency toward race-to-fish and disproportionate burden within them.

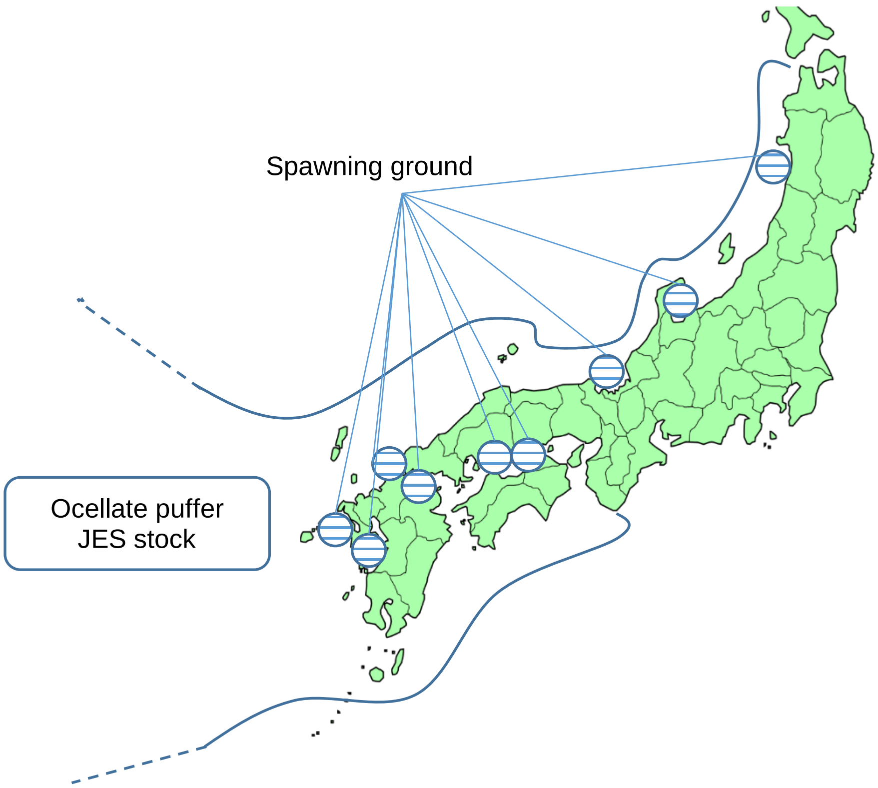
Chapter 7 Ocellate Puffer Japan Sea - East China Sea - Seto Inland Sea Stock Case Analysis

7.1 Background of Ocellate Puffer Japan Sea - East China Sea - Seto Inland Sea Stock Fishery

7.1.1 Stock Status

Around Japan, ocellate puffer is divided into two separate stocks, Japan Sea - East China Sea - Seto Inland Sea stock (JES stock) and Ise - Mikawa Bay stock (Fisheries Agency of Japan 2005). In this chapter, fishery resource management about ocellate puffer JES stock is discussed. Ocellate puffer JES stock ranges Japan Sea, East China Sea, Yellow Sea and Seto Inland Sea. The spawning grounds of this stock are recognized as at Nanao Bay and Wakasa Bay along the Japan Sea, Fukuoka Bay, Ariake Sound and Yatsushiro Sound around Kyushu Island, and Seto Inland Sea (See Figure 8). Also, there are supposed to be other spawning grounds around the Korean Peninsula and in China (Katamachi and Ishida 2014).

Figure 8. Distribution and spawning ground of ocellate puffer JES stock



(Modified rom Katamachi and Ishida 2014)

Katamachi and Ishida (2014) explain that the stock status of ocellate puffer JES stock is in a critical situation, because biomass is at the historical lowest level. The biomass would keep declining if the current levels of fishing mortality and hatchery operations are maintained. The biomass estimate of this stock is only available from 2002 until 2012, because the data collection system was very poor before 2002. During this period, the highest biomass, 1,039 tons was recorded in 2006 and the lowest biomass, 717 tons was recorded in 2012. Since 2006, ocellate puffer JES stock has declined. Katamachi and Ishida (2014) also point out that the recruitment per spawning stock has decreased since 2006.

7.1.2 Description of the Fishery

TAC is not established for the ocellate puffer JES stock, so that fisheries are managed through other official and autonomous measures according to the Ocellate Puffer Fishery Resource Management Guideline established by the FAJ (Fisheries Agency of Japan 2012b). B_{limit} is not calculated for this stock (Katamachi and Ishida 2014). In this guideline, however, the FAJ states that the management objective of ocellate puffer JES stock is recovering biomass to 2006 level (1,039 tons) that is the highest value in the past 10 years (Fisheries Agency of Japan 2012b).

During the past five years (2008-2012), the average annual catches of ocellate puffer JES stock is 266 tons. By region, catches in the Japan Sea and East China Sea, and in Seto Inland Sea are 151 tons (57%) and 115 tons (43%), respectively. In government statistics, catch data have been available since 2002. There are no long term catch data for this stock, so landings at Haedomari fish market in Shimonoseki city is used as index of long term catch trend of this species. The Haedomari fish market has compiled landing data by harvested area since 1970s. The Haedomari fish market is the largest fish market for ocellate puffer. About half (49%) of national catch of this stock was landed in Haedomari in 2012. In the long term, the landing amount in the Haedomari fish market has fluctuated between 610 tons and 1,727 tons from 1971 until 1993. The landings have drastically declined since 1994, and then the landings have fluctuated between 106 tons and 313 tons since 1997 (Katamachi and Ishida 2014).

Ocelate puffer becomes mature at the age of two (male) and three (female), but 73% of them are harvested at the age of 1 and 0 in 2002-2012. In coastal areas, 1 and 0 years fish are the main target, whereas 1 and 2 years fish are the main target in offshore longline fishery (Fisheries Agency of Japan

2014w). Regardless of the small catch, ocellate puffer is an important species due to its high price (Katamachi and Ishida 2014). The average ex-vessel price at the Haedomari fish market was 4,824 yen/kg in 2014 (Fisheries Agency of Japan 2014w). It is roughly double the ex-vessel price of bluefin tuna that is very famous for its high price.

7.1.3 Current Fishery Resource Management System

Following the guideline established by the FAJ, ABC is defined as the allowable biological catch to recover its biomass to 1,039 tons in 2018. The biomass of 1,039 tons was the highest value in the past 10 years. Katamachi and Ishida (2014) calculated ABC at 112 tons for the 2014 fishing season. This means that the catch (266 tons in the average of 2010-2012) should be halved in order to achieve ABC. In the last three years, the average ratio of catch/ABC was 180%. This stock has actually been harvested 80% higher volume than its ABC, and biomass has declined (Katamachi and Ishida 2014). In the future projection, if a 20 % catch reduction is combined with hatchery improvement, the biomass could recover to 1,039 tons in 2022 (Fisheries Agency of Japan 2014w). Hatchery improvements are explained later.

There are two types of fishery harvesting ocellate puffer JES stock: puffer longline fishery in offshore area and small scale fisheries in coastal areas, such as handlines, set nets and small scale trawls. Although ABC is calculated, TAC is not established. Therefore, nobody has mandate to ensure that their catch amount is lower than ABC. On one hand, offshore puffer fish longline fishermen in the Western Kyushu fishing grounds organize a cooperative, Western Japan Longline Federation, to implement harmonized management measures among members. On the other hand, small scale fisheries harvesting this stock are managed by 20 prefectural governments. Individual prefectures have different management measures, therefore fishermen’s burdens and hatchery costs are varying among each prefecture.

(1) Longline Fishery in the Western Kyushu Fishing Ground

During the last theww years (2011 - 2013), average catch by puffer fish longline fishery in the Western Kyushu fishing grounds was 113 tons, and catch was stable in recent years. The catch ratio among prefectures of Fukuoka, Yamaguchi, Nagasaki, Saga, Kumamoto and Hiroshima prefectures are

31%, 52%, 8%, 8%, 3% and 2%, respectively. Ninety-eight percent of the catch is harvested from December to March (Fisheries Agency of Japan 2014x).

Ocellate puffer longline fishery in the Western Kyushu fishing grounds is managed by official management measures by the Sea of Japan and Western Kyushu WFCC. In the past, puffer longline fishery was open access fishery and there were no official regulations, but in 2005, industry from relevant prefectures organized Western Japan Longline Federation and established the Ocellate Puffer Resource Restoration Plan. Member vessels have followed the autonomous measures described in the Resource Restoration Plan, such as time closures and live-release of juveniles (Fisheries Agency of Japan 2005). It was replaced by the ocellate puffer Fishery Resource Management Plan in 2012. At the same time, these autonomous measures became legal binding measures by the decisions of the Sea of Japan and Western Kyushu WFCC (Fisheries Agency of Japan 2014w). Also, the Sea of Japan and Western Kyushu WFCC established a limited entry scheme. Now, all ocellate puffer longline vessels from six prefectures (Yamaguchi, Fukuoka, Saga, Nagasaki, Kumamoto and Hiroshima) are managed under this scheme, and offshore longline fishermen contribute toward hatchery costs (Fisheries Agency of Japan 2014r and 2014w).

The number of licenses for puffer longline vessels over 5 GRT is limited by the regulations of the Sea of Japan and Western Kyushu WFCC, and the limited number of licenses is divided to individual prefectures by size categories (over 10 GRT and less than10 GRT). The limit of total license is 271. In the 2014 fishing season, 185 vessels were registered and 107 vessels actually operated. There is no license limit on the number of puffer longline vessels less than 5GRT, but they are required to register to the Sea of Japan and Western Kyushu WFCC. In the 2013 fishing season, 69 longline vessels less than 5 GRT were registered and 24 vessels were actually operating. The number of licenses and registered vessels is declining. The number of licensed vessels has decreased from 257 to 176 in the last six years. The number of registered vessels has decreased from 148 to 61 over the same period (Fisheries Agency of Japan 2014x).

For this fishery, two main management measures were adopted by the WFCC in addition to limited entry. First is the time closures. The fishing ground is divided into five regions, and the closure durations range from 4 to 7 months in each region. For example, Region D which is located off the west coast of

Nagasaki Prefecture, the longline fishery for ocellate puffer is prohibited from April to October. The purpose of this closure is preservation of spawning stock. Second is the release of juveniles. Puffer longline vessels have to release the juveniles that are less than 25cm (less than 20cm in particular regions) (Fisheries Agency of Japan 2014w).

(2) Other Fisheries Managed by Prefectural Governments

Ocellate puffer JES stock is also harvested by several types of coastal fisheries, such as longline fishery[9], handline fishery, set net fishery and small scale trawling. There are no generic management measures across the region, but they are managed in individual prefectures. Twenty prefectures along the Japan Sea, East China Sea and Seto Inland Sea have implemented management measures for this species such as limited entry, live-release of juveniles and time and areas closures (Fisheries Agency of Japan 2014w). For example, time closures for longliners have been implemented in six prefectures along the Seto Inland Sea. The live-release of juveniles has been implemented in eight prefectures. The duration of closure and limit of size for release are different in each prefecture. Small scale trawling and the set net fishery are limited entry fishery in all prefectures, and they have implemented time and area closure as a licensing condition by prefectural government. Also, ocellate puffer is a prohibited species for some fisheries. For example, it is a prohibited species for the longline fishery and handline fishery in Ehime Prefecture (Fisheries Agency of Japan 2014y).

(3) Hatchery

Hatchery operation has been conducted for this stock by individual prefectural government for a long period. During the last three years (2011 - 2013), 1.76 million of juveniles were annually released by five prefectures, on average. Contributions of Nagasaki, Yamaguchi, Fukuoka, Saga, Kumamoto Prefectures are 38%, 32%, 24%, 4% and 2%, respectively (Fisheries Agency of Japan 2014x). It was estimated that 27% of total catch of this species originated from hatcheries in 2011 (Katamachi and Ishida 2014).

[9] The longline fishery in Seto Inland Sea fishing ground does not have management scheme like longline fishery in the Western Kyushu fishing ground, and is managed by individual prefecture.

In Ariake Sound which was one of the spawning grounds, Nagasaki Prefecture released 0.5 million juveniles that originated from hatcheries in 2004 and it was estimated that 7.7% of them were caught by fishermen. Released 0 years old juveniles stay within Ariake Sound for a couple of months, and then migrate to an offshore area off the Northwest coast of Kyushu Island when they are 1 - 2 years old. Then they come back to Ariake Sound when they are 2 and more years old and mature (Muramatsu 2008). Nagasaki Prefecture estimated that almost all juveniles released at Ariake Sound came back to Ariake Sound after they are matured (Fisheries Agency of Japan 2014w). In Ariake Sound, the catch of ocellate puffer originated from hatcheries was 18 tons and ex-vessel price was 67 million yen in total, whereas the cost to produce and release juveniles was 37 million yen (Fisheries Agency of Japan 2014w). In other research, among the harvested ocellate puffer originated from hatchery in Nagasaki Prefecture, only 26-43% of them were harvested by fishermen in Nagasaki Prefecture, and rest of them were harvested by the fishermen in other prefectures (Matsumura 2008).

In Ariake Sound, it was revealed that hatchery operations were the most effective when size of released juveniles was over 70mm without damage on their caudal fins, and when juveniles were released at the nursery ground for wild juveniles (Fisheries Agency of Japan 2014w; Muramatsu 2008). The juveniles that are larger than 70mm and have no damage on their caudal fins are called “effective juveniles”. However, the ratio of the release of the effective juveniles is about 60% of total hatchery operation (Fisheries Agency of Japan 2014x).

7.1.4 The New Management Policy

The Task Force discussed fishery management system of ocellate puffer JES stock. They did not recommend any specific management measures, but instead, recommended the establishment of a national framework to coordinate fishery management of ocellate puffer JES stock and the agenda to be discussed (Ad-hoc Task Force on Fishery Resource Management 2014).

Taking into account the Task Force’s recommendation, the FAJ released “the reaction to the report of the Task Force” in August 2014 (Fisheries Agency of Japan 2014e). In this press release, the FAJ revealed that they had already talked with every group of stakeholders, such as the Western Japan Longline Federation, 20 prefectural governments which were in charge of coastal fisheries management and hatchery operations, and fish markets and distributers. They agreed with the establishment of "National Meeting on the Ocellate Puffer Fishery Resource Management".

The first National Meeting was held in November 2014. The terms of reference and agenda of the National Meeting are as follows.

- The purpose of the meeting is to adopt the nation-wide uniform guideline to manage ocellate puffer JES stock.
- Working groups (WGs) are established in four regions. They will adopt and implement the specific management measures to achieve nation-wide guideline, taking into account the unique situation in each region.
- In particular, (i) release of juveniles, fishing gear limit and time and area closures to preserve juveniles; (ii) time and area closures to preserve spawning stock; and (iii) implementation of effective hatchery operations and appropriate distribution of cost; will be discussed in WGs taking into account the review of current individual autonomous measure.

7.2 The Impact of the New Policy

Unlike other three species, the new policy was not introduced in 2015 fishing season, although the national framework to coordinate fishery management was established and they started discussing the new management system. In this section, therefore, the appropriateness of the current management system and the agenda discussed in the National Meeting are discussed.

7.2.1 Resource Unit

The FRMG states that the current management objective of ocellate puffer JES stock is recovering biomass to 2006 level (1,039 tons) that is the highest value in the last 10 years (Fisheries Agency of Japan 2012b). This current management objective is reasonable as an interim goal, because the available data are too poor to calculate the B_{limit}. The biomass of this stock has been in decline since 1990's (Katamachi and Ishida 2014).

There is no doubt that current management measures have to be strengthened, because the biomass has to be increased by 45% to achieve this management objective. Since 2002, the biomass of this stock has declined. It is reported that recruitment per spawning biomass is declining, too. Although variety of measures, such as limited entry and time closure, has been implemented, there is no sign about recovery of the biomass. It is projected that the biomass would further decline, if the current level of fishing mortality and current level of hatchery operation are maintained (Katamachi and Ishida 2014).

It is calculated that the catch has to be reduced to 112 tons with current level of hatchery operation (Katamachi and Ishida 2014). This is equivalent to a 52% reduction from 2012. Katamachi and Ishida (2014) also calculated that the catch amount would have to be reduced by 20% to achieve the goal, if all juveniles originated from hatchery were effective juveniles that are larger than 70mm and have no damage on their caudal fins. However, it is explained that these two projections are not based on the assumption of low recruitment in the last couple of years, but rather, based on the assumption of average recruitment in the past 10 years (Fisheries Agency of Japan 2014r). Therefore, these future projections might be optimistic. Over all, the catch may have to be reduced further in addition to improving hatchery operations.

In order to rebuild this stock, the National Meeting was established to strengthen and/or coordinate the management measures implemented in each prefecture or industry, taking into account the situation in each region/fishery (Fisheries Agency of Japan 2014e). However, the agenda to be discussed concerned only effort limitation to reduce juvenile catch and to preserve spawning stock, and improvement of hatchery operations (Fisheries Agency of Japan 2014z). The introduction of TAC or other types of catch limit is not discussed.

7.2.2 Resource User

(1) Boat Owners

The FAJ convened the National Meeting in November 2014. The agenda was set as follows; (i) review of the current measure in each fishery, (ii) release of juveniles, fishing gear limit and time and area closures to preserve juveniles; (iii) time and area closures to preserve spawning stock; and (iv) implementation of effective hatchery operations and appropriate distribution of costs. Therefore, the introduction of TAC or catch limit would not be discussed, so that it was assumed that to strengthen and/or coordinate time and area closures for juveniles or spawning stock protection and release of juveniles would be possible for all the relevant fisheries.

(1-a) Longline fishery in the Western Kyushu fishing ground managed by the WFCC

The puffer longline fishery in the Western Kyushu fishing ground seasonally targets ocellate puffer. They are managed by official management measures by the Sea of Japan and Western Kyushu WFCC. First, puffer longline boats larger than 5 GRT are in limited entry fishery. The number of licenses for puffer longline boats smaller than 5 GRT is not limited, but they have to be registered. Next, there are two main management measures; one is the time and area closures to preserve spawning stock; and another is the release of juveniles (less than 25 cm) to preserve juveniles (Fisheries Agency of Japan 2014w). Also, the puffer longline industry has paid a part of hatchery cost (Fisheries Agency of Japan 2014r).

The fishing season for puffer longline is about 6 months in a year on average (Fisheries Agency of Japan 2014x). Although puffer longliners operate other fisheries during the closed season for puffer fish, the most important fishery for them is puffer longline (Fisheries Agency of Japan 2014r). They have already implemented several management measures listed on the National Meeting’s agenda, such as time and area closures and live-release of juveniles. Buybacks or other types of capacity reduction can be an option, too. The introduction of limited entry to puffer longline boats smaller than 5 GRT cannot be seen as an effective option, because the number of vessels is declining even without a lower limit. Also, a requirement that only active participants retain licenses can be added to reduce capacity.

(1-b) Other small scale fisheries managed by prefectural governments

No information is available how much ocellate puffer is important for these fisheries. The catch by small scale fisheries is relatively small. Except prefectures that have puffer longline fishery in the Western Kyushu fishing ground, the catch amount of ocellate puffer is less than 10 tons in most of prefectures in 2012. Exceptions are Oita and Ehime Prefectures, and about 20 tons of ocellate puffer was landed there (Katamachi and Ishida 2014). Therefore, the importance of this stock is very low in most of the prefectures, but it might be significant fish resource for particular fishermen. Also, there is no information about how much ocellate puffer is harvested as bycatch and how much is harvested as target species.

Ocellate puffer JES stock is harvested by several types of coastal fisheries, such as longline fishery, handline fishery, set net fishery and small scale trawl in 20 prefectures. A variety of measures, such as limited entry, release of juvenile and time and area closure have been implemented. The degree of these regulations is different in region by region, taking into account the unique situation of each fishery. For example, 30cm is the size limit in Ishikawa Prefecture, whereas 10cm is the size limit in a part of Okayama and Hiroshima Prefecture. The puffer longline is prohibited from April to August in Miyazaki Prefecture, whereas puffer longline is closed from April to June in Ehime Prefecture (Fisheries Agency of Japan 2014y). There is no data base that shows what kind of regulations individual fisheries have implemented. Also, there is no consistent information that shows individual fishery harvests broken down by juveniles or adults, and as bycatch or target. In order to strengthen the regulations, gathering these types of information must be first step.

(2) Community

The information about the impact of this stock on communities is limited. Generally speaking, the catch of this species is very small in most of the prefectures that have fisheries for this stock, although it might be important species for particular fishermen or communities. For puffer longliners, this stock is very important, and some communities that have many longline fishermen may be impacted if the management measures are strengthened. Because large volume of ocellate puffer is landed at Haedomari fish market, the impact of change of this stock’s landing volume is significant in this fish market.

(3) Equity

There are some equity issues among stakeholders, because the individual fisheries have been managed by different management measures. The puffer longline fishery in the Western Kyushu fishing ground originates from five different prefectures, but they have been managed by the same management measures among them under the WFCC scheme. In contrast, fisheries other than puffer longlines in the Western Kyushu fishing ground are managed by several types of management measures. Some fisheries have limited entry only, some fisheries are doing live-release of juveniles, and some fisheries have time and area closures. Even within the juvenile release measures, individual fisheries have different size limits. For example, the size limit is less than 10 cm in a part of Hiroshima and Okayama Prefectures, less than 15 cm in Yamaguchi, Ehime, and Hiroshima Prefecture, less than 20 cm in Oita Prefecture and set net fishery in Ehime Prefecture, less than 30 cm in longline fishery in Ishikawa Prefecture and less than 500 g in longline fishery in Tokushima Prefecture and a part of Wakayama Prefecture (Fisheries Agency of Japan 2014y). This difference is coming from the unique characteristics of individual fisheries. Some fisheries target this stock, whereas others catch it as bycatch. Some fisheries target juveniles only, whereas others target adults only due to the migration pattern of ocellate puffer JES stock. Therefore, establishing one universal measure is not a good idea, but the new management measures have to take into account both unique characteristics of individual fishery and equity issues at the same time.

There is also an equity issue about hatcheries. It is reported that 27% of total catch of this species originated from hatcheries (Katamachi and Ishida 2014), so that hatchery operations are very important for conservation of this stock. Recently, hatchery operations are conducted by local governments of five prefectures, Nagasaki, Yamaguchi, Fukuoka, Saga, Kumamoto Prefectures; their contributions are 38%, 32%, 24%, 4% and 2%, respectively (Fisheries Agency of Japan 2014x). The catch from Nagasaki, Yamaguchi, Fukuoka, Saga, Kumamoto Prefectures are7%, 17%, 25%, 3% and 3%, respectively (Katamachi and Ishida 2014). This difference in output does not necessarily mean that the hatcheries have to be managed at the same ratio as catch amount because the effectiveness of the hatchery is different in region by region. However, some prefectures may have a disproportionate burden for hatchery operations.

7.2.3 Governance System

There was no the scheme to comprehensively discuss the management measures of ocellate puffer JES stock, although only puffer longline fishery had been managed through the discussion in the WFCC. After the discussion in the Task Force, National Meeting was convened involving all stakeholders, i.e., 20 prefectural governments, the Western Japan Longline Federation, FCAs, FRA and fish markets in November 2014 (Fisheries Agency of Japan 2014z). The nation-wide management guideline for ocellate puffer JES stock will be adopted in the future meeting. The four WGs, Western and Central Japan Sea

WG, Kyushu and Yamaguchi WG, Seto Inland Sea WG and Ariake Sound WG, were established. The conservation on spawning stock, the catch reduction of juveniles, hatchery operation and preservation of spawning ground will be discussed in individual WG. These management measures have to be decided taking into account both the unique situation of each region and the nation-wide management guideline.

7.3 Discussion about the Policy Innovation

It is clear that the biomass of ocellate puffer JES stock has to be recovered as stated in the FRMG. The current management objective stated in the FRMG is recovering the biomass to the highest value in the last 10 years. To achieve this goal, the biomass has to be increased by 45%, from 717 tons to 1,039 tons. Therefore, there is no doubt that current management measures have to be strengthened. Catch reduction by 50% with current hatchery operations or catch reduction by 20% with improvement of hatchery operations are options to achieve management objectives (Katamachi and Ishida 2014).

Ocellate puffer JES stock is harvested by the puffer longline fishery authorized by or registered in the WFCC and other small scale fisheries authorized by each prefectural government. They are individually implementing variety of input control measure, such as limited entry, time and area closure and size limit. In November 2014, the National Meeting convened all stakeholders (Fisheries Agency of Japan 2014z). The adoption of the nation-wide management guideline for this stock is the primary goal of the National Meeting, and WGs have responsibility to adopt specific management measures to achieve uniform goal based on the unique situation of regions and fishing gears.

The problem of current system is that individual fisheries implement a variety of measures without coordination and a uniform quantitative goal. This is the reason why the stock keeps declining and equity issues exist. Now there is the management objective that is target biomass to be achieved, but there is no quantitative goal that fishermen should achieve by themselves, such as TAC or a percentage reduction of catch. The setting of qualitative goals for fishermen and delegating the responsibility to achieve it to WGs are two important points for the management of this stock.

First, the quantitative goal to achieve management an objective that is the highest biomass in the last 10 years has to be adopted at the National Meeting. TAC is set only for 8 species in Japan, and there is no TAC for this species. Now, the WFCCs are discussing whether more species should be managed through TAC systems or not. They are discussing five species, such as anchovy, Atka mackerel, Japanese amberjack (*Seriola quinqueradiata*), Pacific cod and round herring (*Etrumeus teres*) (Fisheries Agency of Japan 2014i). They do not mention ocellate puffer. The Law Regarding Preservation and Management of Living Marine Resources states that species that are very important in terms of amount of products and consumption, and which have sufficient data available for stock assessment are eligible to be managed by a TAC system (Law Regarding Preservation and Management of Living Marine Resources 1996), and ocellate puffer does not fit these criteria.

Although TAC cannot be used, the catch reduction to achieve management objective should be considered as an alternative option. Katamachi and Ishida (2014) calculated that catch reduction by 50% with current hatchery operation or catch reduction by 20% with improvement of hatchery operation are options to achieve management objectives. It is reported that catch limit is a better tool than input controls, such as effort limit, to stop overfishing, regardless of individual or collective action. For example, the combination of effort limit, area closure and trip limit could not stop overfishing in the New England groundfish fishery in the US (Acheson and Gardner 2010; Holland et al. 2013). In a mature fishery, such as ocellate puffer fisheries in Japan and New England groundfish fishery, input control measures are not expected to constrain actual fishing mortality. This results in less efficient fisheries in terms of both technical and economic efficiency, because they restrict methods of catching, instead of restricting catch amount directly (Branch et al. 2006). Melnychuk et al. (2012) reviewed the relationship between stock status and fishery management measures for 345 stocks around the world. They found that 41% of stocks managed by efforts limit were overexploited, whereas only 9% of stocks managed by an IQ system and 13% of stocks managed by a collective TAC were overexploited.

Allocating catch limits to fisheries in each WG is a next step, because Individual WG can coordinate their fishing operations to achieve it and to mitigate economic loss and conflicts about equity. For small scale fisheries, like all of ocellate puffer fisheries in Japan, it is anticipated in the literature that co-management in local governments and communities works very well to both conserve stock and achieve other social and economic issues (Copes and Charles 2004; Hilborn 2007a; Gelcich et al. 2010). In the co-management at local scale, the local control of exclusive access by local fishermen is the key point (Hilborn 2007a). In case of walleye pollock Northern Japan Sea stock in Chapter 5, for example, the 43% reduction of TAC significantly impacts on fishing industry targeting this stock. However, the responsibility of each player is clear, because catch quota is allocated to two MAFF licensed fishermen groups and two communities with small scale fisheries. Therefore, fishermen in each group can cooperate to maximize their benefit within their limited quota. Since 2010, the catch quotas have been allocated to groups of fishermen in the New England groundfish fishery. It is too early to assess the effectiveness of the new system to rebuild stock status, however, they succeeded to improve economic efficiency by implementing each group's own strategies (Scheld and Anderson 2014).

By providing exclusive access to the resource to groups of fishermen in WG, WG can coordinate their fishermen and fishermen can cooperate to comply with catch limits and maximize economic returns. Within allocated quota, WGs can strengthen the variety of current measures to reduce economic loss and to deal with equity issues, taking into account characteristics of fisheries in each WG. It is relatively easier for WG to coordinate their fishermen than to coordinate all relevant fishermen at the national level, because the variation among stakeholders is much smaller in WG than in national level. Similarly, it is relatively easier for WGs to coordinate each prefecture's hatchery operations. Regarding hatchery operations, two points should be discussed in WGs, i.e., the enhancement of the release of effective juveniles and proportionate burden among prefectures.

For a sustainable ocellate puffer JES stock fishery, the setting of quantitative goals, such as a percentatge reduction of juvenile catch, and allocating them to individual WG are two important steps. Catch limits are better than effort limit or other types of input control measures. By clear allocation of catch limit and duties to comply with it to individual WG, WGs can coordinate their fishery to comply with their goal, to minimize the economic loss and to deal with equity issue, taking into account the unique situation in WGs.

7.4 Summary

The biomass of ocellate puffer JES stock has continued to decline and has to be recovered. The current management goal stated in the FRMG is recovering the biomass to the highest value in the last 10 years. This stock is harvested by a variety of small scale fisheries authorized by each prefectural government and the WFCC. Individual fisheries have implemented a variety of autonomous measures, such as time and area closure and size limit, but there is no coordination among prefectures or fishing gear types. These measures could not stop overfishing and equity issues persisted.

For a sustainable ocellate puffer JES stock fishery, the catch should be reduced. In 2014, the National Meeting on the Ocellate Puffer Fishery Resource Management convened all stakeholders, and WGs were established in four regions. The nation-wide management guideline for this stock will be adopted at the National Meeting. The setting of quantitative goals, such as a percentage reduction of juvenile catch, and allocating them to individual WG should be included the national guidelines. Many researchers reported that catch limits work better than effort limits or other types of input control measures. Once catch quota and authority to manage their fisheries are granted to individual WG, WGs can adopt and implement specific management measures their fishery and hatcheries to achieve a uniform goals based on the unique situations of regions and fishing gear types.

Chapter 8 Discussion

8.1. Summary of Case Studies

Throughout the four representative case studies, I discuss how fisheries management should be amended. In this Chapter, I discuss how lessons can be learned from case studies to conclude what the FAJ could do for all commercially important stocks in general to improve Japan's fishing industry overall.

Case studies reveal that the situation in Japan's fishery resource management is different from that of countries which have successful ITQ systems. In the US, for example, when the stock declined, TAC was significantly reduced, too. Because limited entry system or other effort limit system was insufficient, a race-to-fish was a seriously difficult consequence at that time. Then, ITQ systems or other types of right-based management were introduced. The Alaskan halibut fishery is often used as a successful example of an ITQ system. TAC was exhausted in a few days during the pre-ITQ era, due to overcapacity and lack of measures to mitigate a race-for-fish. Then, by the implementation of ITQ system, the number of vessels was reduced by 34%, fishing seasons were increased to 9 months, and the revenue for fishermen was increased because the bargaining power of the fishermen was increased and the market was not flooded in the short season (Carothers 2013). In Japan, in contrast, TAC was not significantly reduced (walleye pollock Northern Japan Sea stock in Chapter 5), TAC was not complied with (chub mackerel Pacific stock in the past in Chapter 4), and there was no catch limit (bluefin tuna in the past in Chapter 6 and ocellate puffer JES stock in Chapter 7), when stocks declined. It resulted in the failure of stock recovery. However, limited entry system and autonomous management measures worked well to prevent a race-to-fish, so that fishing industry and fish stocks did not collapse.

The Table 2 summarizes the results of case studies. There are three main differences among cases. First, only chub mackerel Pacific stock is ranked as at medium stock abundance. It started recovering a couple of years ago after its catch amount was maintained at lower than ABC. In contrast, the catch of walleye pollock and ocellate puffer have been higher than ABC. No ABC is calculated for bluefin tuna, but ISC states that bluefin tuna is overfished and experiencing overfishing, based on the reference points commonly used in many tuna species (ISC 2014). Maintaining catch amounts lower than ABC is important factor for maintaining or increase stock status with good environmental conditions. Second, among the four case studies, ocellate puffer is the only stock that is not managed using a catch limit. Because there is no quantitative goal, such as TAC, it is difficult to adopt concrete management measures for ocellate puffer and difficult to harmonize management measures to be implemented in multiple places. For the three case study species other than ocellate puffer, what should be done is clear. Since they have catch quotas, they can look for the measures to maximize their profit within limited quota. Third, quota is allocated to groups with a huge number of fishermen in small scale fisheries for bluefin tuna. It is almost impossible to coordinate thousands of fishermen over a wide geographic range. In contrast, 22 purse seiners in En-Maki receive the bluefin quota, so that they can cooperate to achieve their objectives. Once quota is allocated to groups with small number of fishermen, it is easier to manage their fishery as a general rule.

Table 2 Summary of case studies

	Stock Status	Catch Limit	Key resource user	How to improve fisheries
Chub Mackerel	Medium	Yes	- Co-ops (Kita-Maki)	- FAJ should consider a multi-species management system. - Kita-Maki should design their objectives and select the best management measures, such as IQ system, to achieve their objectives.
Walleye Pollock	Low	Yes*1	- Co-ops (Otaru & Wakkanai) - Communities (Hiyama & Iwanai)	- Individual coops and communities should design their objectives, select management measures and select the tool to achieve their objectives.
Bluefin Tuna	Low	Yes*2	- Co-ops (En-Maki) - Small scale fishermen	- WCPFC should design long term management goal and consider alternative catch limit. - En-Maki should coordinate their operation to achieve their objectives. - FAJ, prefectural governments and small scale fishermen should coordinate their operation to achieve their objectives.
Ocellate Puffer	Low	No	- Small scale fishermen	- FAJ and the National Meeting should set quantitative goal and allocated them to WG. - Prefectural governments and WG should adopt measures to achieve their assigned objectives.

*1: There was TAC, but higher than ABC. *2: Catch limit was introduced just a couple of years ago.

Overall, the basic recommendations obtained from the four case studies are (1) TAC/catch limit should be set following scientific advice; (2) TAC should be allocated to fishermen’s groups that should be small enough to allow cooperation among members; and (3) detailed management measures should be decided in each group to achieve their objectives.

Chapter 8 Discussion

8.2 Catch Limit Setting

A quantitative goals, such as TAC is very important. The setting and enforcing TAC have been suggested as an important measure to protect stocks from overfishing (Beddington et al. 2007). Case studies provide three important points for TAC setting. First, the chub mackerel and walleye pollock cases tell us that TAC should be smaller than ABC. The walleye pollock stock has never recovered with a TAC that was set higher than ABC. Chub mackerel kept declining when it was harvested beyond the ABC, but its biomass rapidly started recovering after the catch amount was maintained at the level lower than ABC. Similarly, it was reported that stocks kept declining when the TAC was set too high and overfishing continued in other fisheries, such as demersal fishery in Iceland, cod fishery in the eastern Canada and wreckfish fishery in the southeastern US (Arnason 1996; Vaughan et al. 2000; Walters and Maguire 1996). Secondly, a separate TAC has to be established for each stock as far as possible. TAC of mackerel species is set as a simple summation of ABC of four separate stocks and there is no assignment to specific stocks. Logically, chub mackerel Pacific stock or other individual stocks can be harvested beyond their own ABC level, even if TAC is complied with in total. Thirdly, without TAC or other types of quantitative goals, managers have difficulty to decide management measures that are effective and fair among stakeholders, as described in ocellate puffer case study.

The question is: Can effort limits and other input controls without catch limit or TAC work or not? Many fisheries targeting non-TAC species have implemented effort limits, such as the limited number of fishing days. Also, it may be argued that catch limit is not a perfect tool, because the dominant species and biomass can be heavily affected by environmental variability (Matsuda et al. 1992) and environmental changes can have major impacts on stock recovery (Hilborn et al. 2014). However, many scholars present that effort limit or other input controls are insufficient to reduce fishing mortality (Branch et al. 2006; Grafton et al. 2006; Jardine and Sanchirico 2012), and stocks with TACs showed much greater improvement in status than stocks without TACs (Hilborn and Ovando 2014; Neubauer et al. 2013). Melnychuk et al. (2012) estimated that 41% of stocks managed by effort limits were overexploited, whereas only 9% of stocks managed by an IQ system and 13% of stocks managed by collective TAC were overexploited among 345 fisheries all over the world. Also, Branch et al. (2006) further stated that input controls, such as effort limit, almost always resulted in a less efficient fishery, because they restricted methods.

TAC is only established for eight species in Japan. Many fishery resources in Japan have quantitative management objectives. For example, recovering the biomass to 1,039 tons is the management objective of ocellate puffer (Katamachi and Ishida 2014). However, there is no TAC to achieve this management objective. In recent years, WFCCs have discussed whether more species should be managed through TAC systems. They are discussing five species (12 stocks), such as anchovy, Atka mackerel, Japanese amberjack, Pacific cod and round herring. In order to introduce TAC systems to these five species, the FAJ listed the problems to be solved as follows; (1) large diversity of fishery operation; (2) necessity of review of current effort limit; (3) difficulty for set nets that cannot select fish; and (4) insufficient data to calculate ABC (Fisheries Agency of Japan 2014i). Current TAC species have same situations as (1) and (3), so that it is demonstrated that they can be overcome. As for (2) and (4), Ludwig et al. (1993) state that the uncertainty of fisheries requires managers to act before scientific consensus achieved. Overall, although it is not a perfect tool and some hurdles exists, it is believed that setting TACs that follow scientific advice is a good option for sustainable fisheries.

8.3 Allocation of Catch Quota

The next important step is an allocation of catch limits or TAC. Many researchers argue that catch limit should be allocated to groups of fishermen, communities or individual to provide them incentive to cooperate each other and fish sustainably (Branch et al. 2006; Hilborn et al. 2005; Grafton et al. 2006; Huppert 2005; Jardine and Sanchirico 2012). Cooperatives formed among fishermen are most likely to succeed under the following conditions; (a) their rights are clearly secured; (b) the number of members is small and fixed; (c) the members share common interests; (d) members have social capital, i.e., relationships to cooperate each other (Grafton et al. 2006; Holland et al. 2013; Huppert 2005; Sylvia et al. 2014).

Catch quotas should be allocated to fishermen groups where members share common interest, the number of members is small, and have social capital. It is not a good idea to allocate quotas to a group with thousands of boats like in the bluefin tuna case and to groups with a variety of interests in ocellate puffer case. Japan's TAC system has about 18 years of history. It has allocated quota to individual prefectural government and groups of MAFF licensed fishermen. For MAFF licensed fisheries, the quota is allocated to the national scale industry association. For example in the case of mackerel species, catch quota is officially allocated to All Japan Purse Seine Fisheries Association (Zen-Maki). Zen-Maki covers all over Japan, so that it is hard to share same interests among them. Zen-Maki has 12 regional associations as a member. Zen-Maki further allocates quotas to 12 regional purse seiners associations, such as Kita-Maki by their autonomous arrangement. However, there is little transparency in its operations as meeting are not open to public and even the FAJ does not know how decisions are made. This means that fishing rights of regional associations are not clearly secured. The allocation to regional associations should be authorized by the FAJ and to be open to public, although allocation rules can be decided via the coordination by the national scale associations.

In the case of MAFF licensed fisheries, regional fishermen associations, such as En-Maki and Kita-Maki represent the cooperatives to be granted catch quota. Since they are rooted in the same geographic regions and consist of fisheries using a same gear, they can share the common interest. Also, the number of members is relatively small. They have social capital that is coming from long history of their autonomous management. In prefectural licensed fisheries, the units to receive quotas can be decided by individual prefectures based on similar characteristics.

8.4 How to Manage Fishery in Cooperatives/Community/Individual

Once catch quota is allocated to the cooperatives or communities that share common interests, the next step is to select their management objectives. There are four major categories of fisheries objectives: biological, economic, social and political (Hilborn 2007b). The objectives are different among groups. One success in a group of large scale fishery may be a failure to fisheries in a small community. For example, flexibility, equity and infrastructure are primary objectives for commercial, recreational and charter communities, whereas consultation, transparency, economic opportunity and collaborative input are the primary objectives for indigenous communities in Australia (Pascoe et al. 2014). The management objective in Kita-Maki with large scale purse seiner operate across the north east coast of Japan can be different from that of Hiyama fishing communities in the west coast of Hokkaido with 70 small scale pollock longliners. Different management objectives need different management measures to achieve them (Hilborn 2007b; Yagi et al. 2012). For example, an ITQ system is a good tool for large scale industrial fishery, whereas local control of exclusive access by local fishermen is a good option for a small scale fishery (Hilborn 2007a). Setting clear management objectives is a very important step for all groups that receive catch quota or other types of fishing rights.

Once management objectives are agreed, the next step is selecting management measures, either individual or group rights, to achieve the objectives.

(1) IQ and ITQ Systems

There are many success stories of IQ and ITQ-managed fisheries in the world (Costello et al. 2008; Huppert 2005; Grafton et al. 2006; Munro et al. 2009; Sutinen et al. 2014). Many papers and books suggest the implementation of IQ and ITQ system to Japan’s fishery resource management (Japan Economic Research Institute 2007; Katsukawa 2010; Komatsu 2010; Yagi and Managi 2011). If fishermen groups decide their management objective is maximizing economic efficiency of individual boat owners, IQ and ITQ systems are good options (Hilborn 2007a). Some Japanese offshore fisheries can fit in this category (Yagi et al. 2012).

The Task Force argued that IQ system needed to be introduced on an experimental basis to analyze feasibility and to estimate its benefit. The Task Force anticipates that an IQ system secures the compliance with a total catch limit and enables fishermen to avoid the race-to-fish. However, IQ systems may induce confusion on current fishery operational customs, and induce inefficiency about quota use. Each fishermen group, the FAJ and local government cooperate for the experiments, and they can decide whether IQ systems is the best tool or not for their individual objectives (Ad-hoc Task Force on Fishery Resource Management 2014).

Once an IQ system was introduced, the industry required transferability of quota in some countries, such as Iceland and Norway (Arnason 1996; Hannesson 2013). By securing individual quota, fisherman can test various patterns of harvesting and marketing fish to maximize their profit, without race with other fishermen (Huppert 2005). By allowing quotas to be leased and sold, the efficient boats can pay more to obtain quota, and only the most efficient boats will continue to fish. Then, transferability will remove overcapacity and result in more effective fishing industry (Anderson 1986). Many positive outcomes, such as removal of overcapacity, increase of product quality, stability of industry, cost reduction, improvement of safety are reported in the countries that manage their fisheries using ITQ systems, such as Canada, Iceland, New Zealand, and the US (Annala 1996; Arnason 2005; Carothers 2013; Munro et al. 2009). These positive outcomes result in huge improvement of economic efficiency of fishing industry in all countries. For example, in the British Columbia halibut fishery, the season length increased from 6 days to 245 days, number of vessels was halved, the price to the fishermen increased from C$ 7.6 to C$ 10.4, and landed value increased from C$ 29 million to C$ 40 million. Also, catch amount was chronically higher than TAC in the pre-ITQ era, but overage has never been experienced since ITQ systems in place (Munro et al. 2009). There is no doubt that ITQ is a good option to improve economic efficiency of fishing industry.

If the fishermen groups and managers put priority on economic efficiency of individual and select an ITQ system as a management tool, ITQ programs have to be carefully designed, because ITQ systems are expected to be difficult to dismantle later (Copes and Charles 2004). Also, scholars argue that the ITQ systems have to be carefully designed to achieve not only economic objectives but also social objectives (Branch et al. 2006; Dewees 1998; Sumaila 2010). Many controversial impacts, such as concentration of quota, marginalization of fishing communities, loss of small scale fisheries, and loss of employment are reported in Iceland, New Zealand, and the US (Carothers 2013; Eythórsson 2000; Stewart and Callagher 2011). For example in New Zealand, the number of quota holders was reduced by 13% in deepwater fisheries and reduced by 30% in inshore fisheries. Also, restructuring of fishing industries occurred throughout the country. Some small scale fishers left the industry, and many rural communities lost traditional small fishing ports (Yandle and Dewees 2008). If the fishermen groups, communities or managers would like to avoid this situations, the ITQ programs have to be designed to avoid it.

Therefore, many countries include a variety of measures to achieve social objectives in their ITQ systems. For example, when ITQ system was introduced to the crab fishery in the Bering Sea and Aleutian Islands, concerns about negative impacts on processors, communities, and employment market were raised. Then, the North Pacific Fishery Management Council introduced processing quota and community quota, and 3% of quotas were granted to captains/crews (Fina 2005).

The Task Force pointed out four expected concerns about ITQ systems as follows; (a) does consolidation occur and adversely affect local fishing communities?; (b) can ITQ systems be a barrier to new entrants?; (c) are reductions of TAC strongly opposed due to the value of quota?; (d) is it appropriate for fishermen to sell quota to get money (Ad-hoc Task Force on Fishery Resource Management 2014)? These issues can be solved by designs of ITQ systems. As for first concern, extreme consolidation can be avoided by setting cap on individual quota shares, like they did for the crab fishery in the Bering Sea and Aleutian Islands (Kent 2012). Also, negative impacts on communities can be mitigated by securing quota for communities, like the crab fishery in the Bering Sea and Aleutian Islands and the Alaskan halibut and sablefish fishery (Kent 2012), or by the strict geographical limitation of quota transferability in the Norwegian IVQ system (Hannesson 2013). Second, under the Japan's strict limited entry system, new entrants can join fishing, only when they buy a vessel with a license or the old vessel is scrapped. Regarding third concern, it would not be a big problem if there is the strict rule about TAC setting. Also, it was reported that lower TAC was requested by industries to secure sustainable benefit from their quota in some ITQ-managed fisheries, such as the New Zealand east coast rock lobster fishery, the BC sablefish fishery in Canada and Tasmanian abalone fishery in Australia (Grafton et al. 2006).

In response to fourth question, the Japanese government has to discuss legal issues about ITQ systems. The Law Regarding Preservation and Management of Living Marine Resources allows the FAJ to allocate quota both to groups of fishermen and to individual fishermen. However, even if the quota is allocated to individuals, this quota is not property right, but it is similar to license or privilege. It means that transfer by quota holders is not allowed, although the FAJ can do re-allocation within one fishing year (Law Regarding Preservation and Management of Living Marine Resources 1996).

Ownership of public resources is controversial (McCay 1995; Macinko and Bromley 2002; Soliman 2014). The first argument is the acceptability of a system allocating public resources, such as fish to private interests. In the US, the Magnuson-Stevens Fishery Conservation and Management Act states that limited access privilege, quota share or other limited access systems do not create any rights, title or interest. They may be revoked, limited or modified at any time (Bromley 2009). This act describes ITQ explicitly as permits (Soliman 2014). Iceland took same strategy as the US (McCay 1995). According to the United Nation Food and Agriculture Organization (FAO), property rights have to have exclusivity, perpetuity, security of tenure and transferability. In that sense, the FAO concludes that ITQ systems do not create ‘pure’ property rights, because of lack of perpetuity and limitation of transferability (Soliman 2014). Same as the US and Iceland, Japan may be able to declare that these transferable quotas are not property rights, but just tradable privileges, so that public ownership of fish resources remains.

The second argument is about initial free allocations. Natural resources other than fish have not been given to somebody for free (Macinko and Bromley 2002). Also, Pinkerton and Edwards (2009) pointed out that initial free allocations resulted in significant wealth effects and only original recipients of ITQ could enjoy a huge advantages. In response to these arguments, Macinko and Bromley (2002) suggested an auction be used for initial allocation. Cost recovery implemented in New Zealand (Annala 1996) and Iceland (Arnason 1996), and landing tax and management fees in the Alaskan halibut and sablefish ITQ programs (Kent 2012) are another option to overcome this issue. Cost recovery and landing tax is the better idea than auction, because auction may exclude more current fishermen than cost recovery and landing tax, and may raise social impacts.

Overall, it is true that an ITQ system is a good management tool if the objective of fishermen group is economic efficiency. Therefore, it should not be excluded from candidates of management tools. Therefore, the legal discussion to introduced ITQ systems is required at the national government level. Even if ITQ systems are allowed as a management tool, however, its implementation has to be carefully discussed, because it is difficult to dismantle once in place. Also, it has to be well designed to remove or mitigate expected negative social impacts.

(2) Cooperative Management

Cooperative management should not be excluded from candidates of management tools. In cooperative management, cooperatives, i.e., a group of fishermen, receives a share of TAC, cooperates to halt the race-for-fish and prevent overcapitalization. They may allocate quota to individuals, or coordinate their harvest strategy to avoid racing for fish. The main difference between IQ and ITQ system and cooperative management is that IQ and ITQ systems focus on economic efficiency of individual, whereas cooperative management focus on economic efficiency and social objectives of the cooperative as a whole. Also, community or local values that may be insufficiently considered in IQ and ITQ systems can be given more weight when designing cooperative rules (Sylvia et al. 2014).

There are many success stories of cooperative management mainly in the west coast of the US (Branch et al. 2006; De Alessi et al. 2014; Grafton et al. 2006; Huppert 2005). Catch by cooperative-managed fisheries consists of 60% of total catch in Alaska and the west coast of the US (Alessi et al. 2014). Many fisheries achieved improvement of efficiency by avoiding race-for-fish through internal allocation of quota and sharing the profit. For example, in the Pacific whiting fishery, Pacific Whiting Conservation Cooperative allocated transferable quota among its members. After this implementation, the number of active vessels was dropped from 10 to 7, the recovery of products from landed weight increased from 17% to 24%, quality of products improved, bycatch was reduced and the fishing season lengthened by avoiding race-for-fish (Sylvia et al. 2014). In salmon fishery in Chignik, Alaska, a cooperative improved their total revenue. They agreed to share the catch to save cost. Only 22 vessels operated on behalf of 77 member vessels in a particular fishing season, so that they could significantly reduce operation cost (Deacon et al. 2008).

Cooperative management can accomplish what IQ and ITQ systems do by the government regulations, if well designed (Huppert 2005). Some scholars further argued cooperative management is superior to the IQ and ITQ systems as follows; community values that may be insufficiently considered in ITQ systems can be given appropriate weight; high transaction cost involved in trading ITQs is not necessary; incentive to cheating is weaker in cooperatives, because cooperative members have responsibilities to other cooperative members; it prevents both equity concerns and persistent rent-seeking behavior of fishermen; and decision making can be conducted by its members with shared interest, instead of involving legal process, such as the Regional Fisheries Management Councils in the US (Criddle and Macinko 2000; Sylvia et al. 2014).

When management measures are developed, adaptive management is an important idea, either in ITQ system or in cooperative management. Adaptive management is defined as a process of learning about system responses through the experience (Walters and Hilborn 1978). Management systems can be changed to track the moving ecological and socioeconomic variables. First, the management system can be changed to track the socioeconomic variables. For example, catch share programs have been developed through the adaptive management in the Alaskan halibut and sablefish fisheries. The quota holders in small communities sold their quota to others and the total amount of quota in some communities has substantially declined since the implementation of the halibut and sablefish ITQ programs. This became a serious problem in the communities that did not have alternative source of employment. In response, 10 years after its implementation, the ITQ program was revised to authorize certain communities to purchase and hold shares to ensure their access to resources (Fina 2011). The introduction of IQ system for purse seiners in Japan as a trial is the best example of adaptive management. The FAJ and the FRA can assess the actual impacts of IQ systems from experiments in the real world. As the Task Force mentioned, other fisheries should do the same thing to seek the best management measures that fits each fishery. For these experiments, strict monitoring scheme, getting rid of any preconceived ideas and strong leadership of the FAJ are the important factors for success (Walters 2007).

Second, the management systems should be changed to track ecological variables. It is important for multi-species pelagic fisheries, such as purse seiners in Kita-Maki. Matsuda et al. (1992) showed the transition of dominant species due to the environmental variability and the competition with other pelagic species in the east coast of Japan. Chub mackerel was replaced by sardine, sardine was replaced by anchovy, Pacific saury and horse mackerel, and then they were replaced by chub mackerel again. Although vessels and fishermen usually decides their entry or exit to a fishery based on the resource abundance and earning potential (Branch et al. 2006), sometimes fishing effort keep increasing toward one particular species, like failure of fishery management in 1990's and early 2000's in Japanese chub mackerel fishery (Kawai et al. 2002). Managers have to prevent continuing overfishing in declining stock and extreme transfer of fishing effort to alternative fish resources. Therefore, target shift to dominant species is a good idea. Katsukawa and Matsuda (2003) estimated that well-planed target switching increases total yields and decrease the risk of the stocks collapsing. Most of the Japan's fisheries are targeting multi-species, so that multispecies TAC management systems involving all target species at the groups of fishermen is a sustainable approach to fluctuating stocks (Hilborn 2007a).

8.5 Governance System

When the management measure is changed, additional coordination among stakeholders is required. This paper recommends three steps, catch limit setting, and allocation of quotas and management of fishery in each group. At the first step, it is recommended that introduction of TAC to more stocks and separate TAC for individual stocks. ABC is already calculated conducted in all 84 commercially important stocks. For these stocks, no additional cost and work are required. The next step is further divided by two steps: allocation between MAFF licensed fishermen and prefectures governments, and allocation among MAFF licensed fishermen. Regarding the former allocation, the allocations have to be decided carefully, to protect small scale fishermen. The Norwegian allocation system that allocates more quotas to coastal fisheries when TAC is low and allocates more quotas to large scale fishery when TAC is high (Standal and Hersoug 2014) can be considered. As for the latter allocation, there are two ways to allocate quotas. The first option is that the FAJ does the allocation using a pre-agreed formula. Second option is that national scale industry organization coordinates the allocation to regional associations. There is the long history of allocation of TAC by industry associations, so the second option is better to avoid confusion.

For the third step, management of the fishery in each group, the establishment of the scheme to discuss it is required, because it should be decided according to the groups' objectives that reflect opinions by all relevant stakeholders. The selection of future design of a fishing industry and choice of management tools, such as ITQ systems or cooperative management may significantly impact on people in communities. There are four major categories of fisheries objectives: biological, economic, social and political (Hilborn 2007b). The objectives are different among groups. One success in a group of large scale fishery may be a failure to fisheries in a small community.

Discussions at the local level and official approval at the national level are required. First, Regional Fishery Innovation Project Consultations are good organizations to discuss at the communities level. Regional Fishery Innovation Project Consultations involve all stakeholders, i.e., FCAs and its members, local governments, wholesalers, processors, academy and banks (Fisheries Agency of Japan 2006). This is not a forum to discuss the management measures, but is a forum to discuss the future of the fishing industry in communities. Regional Fishery Innovation Consultations have already been established in more than 60 fishing communities and cooperatives (Fishing Industry/Communities Promotion Organization 2015). Government funding supports this framework. For example, Hachinohe Regional Fishery Innovation Project Consultations decided that the objective was reducing cost and improvement of quality of products, even if the catch amount and the number of crews were reduced. As a first step, they decided to reform purse seine operations and fish markets. The group purse seine operation was changed from operation with four boats (1 net boat without freezer, 1 search boat and 2 carrier boats) to operations with two boats (1 net boat with freezer and 1 carrier boat), and the profitability was improved. Although they tried reforming the fish market to get certification of the Hazard Analysis and Critical Control Point (HACCP), it was not completed due to the earthquake and tsunami in 2011 (Regional fishery Innovation Project Consultation of Hachinohe 2011).This is a very good framework to discuss the objectives of fisheries and choice of management tools in communities.

The next step is approving the management measures at national level. WFCCs and AFCCs are the possible organizations to do this. WFCCs and AFCCs are authorized to make legal-binding fisheries management measures by the Fishery Act (Fishery Act 1949). WFCCs and its regional Working Group coordinate resource utilization of migratory pelagic fish stock across the prefectural jurisdictions. For example, the North Pacific Working Group of the Pacific WFCC can cover the purse seine fishery by Kita-Maki in the North Pacific, and all the communities related to Kita-Maki. The problem is that it consists of only the representative of fishermen, academic and the FAJ. It should involve processors, distributors and local governments. In the case stocks in the jurisdiction of a particular prefecture, such as walleye pollock, AFCCs can do this.

Chapter 9 Conclusion

The recommendations for Japan's fishery resource management policy are as follows.

(1) TAC Setting

- TACs should be set for more species.
- TACs should be set for individual stocks, as much as possible.
- TAC should conform to the ABC calculated by the FRA.

(2) TAC Allocation

- TACs should be allocated to fishermen's groups.
- The groups should small to cooperate each other, share the common interests and have social capital.

(3) Select Management Measures

- Each group should adopt their management objectives.
- Each group should design management measures, such as IQ, ITQ system and cooperative management to achieve their objectives. (The FAJ should allow them to select ITQ systems.)
- The management measures should include all target species for this fishery.
- The decision making should involve all stakeholders: fishermen, fishery relating industry, communities, local governments, and the FAJ.

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