FROM VOLUNTARY TO MONITORED: THE DEVELOPMENT OF THE COMMISSION FOR THE CONSERVATION OF SOUTHERN BLUEFIN TUNA

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Introduction

Environmental problems, particularly on an international scale, can typically be categorized as either upstream/downstream problems, or "Tragedies of the Commons" (Mitchell 2010). According to Garrett Hardin (1968), the "commons" is any environmental resource which all members of a community may access and utilize, and the tragedy that befalls the commons is the use of the finite resource by all individuals seeking to gain maximum benefit from it, which reduces the overall supply or quality of the resource for everyone (Hardin 1968). Fisheries management is a prime example of Tragedy of Commons, especially those fisheries that occupy the "commons" of the high seas and can be easily accessed by any interested state. Hilborn *et al.* (2005, 47) describe most fisheries as "race-to-fish" scenarios in which countries compete to fish their demand of the stock before other states take those resources. As a result, states often have high incentive to cheat fishing agreements by overfishing and misreporting their catch because the economic benefits of harvesting more fish are greater than any potential repercussive costs to breaking the fisheries rules (Polacheck 2012). The challenge for international fishing agreements, then, is to sufficiently incentivize states to reduce short-term fishing levels in order to avoid stock crashes and permit future sustainable catch levels.

As is the case with many commercial fish species, Southern Bluefin Tuna (SBT), a highly migratory fish species that occupies the waters of the southern temperate oceans, have suffered from intense overfishing ever since the 1950s (Kolody *et al.* 2008). The nature of high seas fisheries as a Tragedy of the Commons necessitates international agreements to regulate fishing behavior to preserve the stock. The Commission for the Conservation of Southern Bluefin Tuna is an international fisheries agreement that took effect in 1994, but it began as a voluntary agreement between three major fishing nations. The CCSBT provides a unique opportunity to

assess changes in state fishing behavior as the agreement progressed through three different stages: the adoption of a voluntary fishing agreement in 1985, the formal CCSBT treaty implemented in 1994, and the subsequent addition of stricter monitoring provisions beginning in 2008. By analyzing the SBT fishing behavior of states throughout these phases, I will use the CCSBT to answer two primary questions: 1) Is the adoption of a formal international treaty more effective than a non-binding voluntary agreement? and 2) Does the addition of stricter monitoring practices improve the performance of a binding treaty?

While the CCSBT's specific goal for the recovery of SBT stocks has not yet been achieved, my analysis shows that this treaty has effectively reduced SBT catch, my measure for this treaty's success, in member countries below what it would have been otherwise. The treaty's capacity to do so has increased with its formalization and with the adoption of improved monitoring efforts. These outcomes are visible through the assessment of member state compliance to annual fishing quotas, and the analysis of counterfactual estimates of fishing behavior by states if the treaty did not exist.

Background of the CCSBT, and Relevant Definitions

After recognizing that the SBT fishery was on the verge of collapse, the primary fishers of this species, Japan, Australia, and New Zealand, implemented a voluntary agreement in 1985 in which they established annual global total allowable catch (TAC) and national quotas within the global TAC (Bergin and Haward 1994). However, in 1994 the agreement was formalized in the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), an international treaty between the three major SBT fishing states which aimed to "ensure, through appropriate management, the conservation and optimum utilization of southern bluefin tuna" (CCSBT 1994, Article 3). After about 14 years in effect, the Commission implemented further monitoring

provisions including a Catch Documentation Scheme (CDS) and a Vessel Monitoring System (VMS) in an effort to reduce Illegal, Unreported, and Unregulated (IUU) fishing that was not accounted for in reported catch (OECD 2012).

The CCSBT created the CCSBT Commission ("the Commission") tasked with setting annual global TAC and national allocations according to member self-reported catch data and based on recommendations by the Scientific Committee (CCSBT 1994). The CCSBT applies to SBT fishing in any ocean, as the species is managed as one stock (IOTC 2008; OECD 2009). "SBT catch" refers to the biomass (in tons) of Southern Bluefin Tuna caught in a year. "Stock" refers to the available quantity of SBT of reproductive maturity in the ocean at a given time.

Goals

The long-term goal of the CCSBT is "to ensure, through appropriate management, the conservation and optimum utilisation of southern bluefin tuna" (CCSBT 1994, Article 3). Though never directly stated, this is inferred to also be the broad goal of the voluntary agreement that preceded the formal CCSBT. The Commission has set "interim objectives" to restore the SBT stock (or spawning biomass, which is surely lower than the pre-exploitation SBT stock size but a more certain value on which to base management) to a certain level by specified deadlines (IOTC 2008). Initially, the Commission aimed to restore SBT stock to the 1980 level by the year 2020 (Sato 2002; Kolody *et al.* 2008; Garcia and Koehler 2014, 57). However, members quickly realized that this goal was impossible, even if members ceased fishing entirely (Kolody et al. 2008), so this objective was subsequently lowered to restoring the SBT stock to "20% of the unexploited spawning stock biomass by 2035" (Garcia and Koehler 2014, 57).

The primary means by which the CCSBT aims to impact member behavior is by

setting total allowable catch (TAC) quotas each year. TACs can be viewed as an alternative rendition of the broader goals described above; they represent the annual amount of fish catch permitted in order to restore SBT stocks to the desired level and permit successful recruitment (OECD 2012). Because TAC goals and the compliance of member countries to these TACs occurs annually, and because the 2035 deadline for the stock restoration goal has not yet arrived, I will assess compliance with annual TACs and trends in SBT catch over time as measures of goal achievement.

Dependent Variable (DV)

In order to adequately assess the effectiveness of the CCSBT and earlier efforts to manage SBT, I will analyze member SBT fishing behavior as measured by total annual catch (in tons of SBT). While the goals of the CCSBT pertain to the health of the SBT stock, tuna population surveys are difficult and the data on actual stock size is uncertain (Peterson 1993). Therefore, analysis must focus on state behavior, which is more easily observable than the environmental impact intended by the agreement (Keohane *et al.* 1996). By measuring the effects of *outputs* of a treaty on its *outcomes* (changes in human behavior), I estimate the effectiveness of an agreement on the desired environmental impacts (Underdal 2001). As SBT catch increases, it is assumed that stock decreases, and vice versa, so "success" of this treaty is typically defined as a decline in a member nation's SBT catch below what it would have without regulation. Eventual increases in SBT can reflect success if TACs permit higher fish catch due to restored stocks.

Hypotheses

Voluntary agreements have been used throughout the international political arena due to their usefulness in allowing governments to coordinate action without legally "binding"

obligations (Lipson 1991). The success of such environmental agreements depends on the fact that they arise out of shared concern over an environmental problem, and can be particularly useful in bringing about change quickly without political deadlock (Lipson 1991). This suggests that while agreement members have no economic repercussions to fear from failing to comply with the agreement, shared concern may motivate states enough to at least attempt to comply. I hypothesize, then, that the voluntary agreement between Japan, New Zealand, and Australia would decrease SBT catch relative to their catch without this agreement.

Legally binding treaties are a common method by which to tackle international environmental problems because of their ability to establish precise obligations and coordinate the efforts of member countries (Jacobsen & Brown Weiss 1998). According to Miles (2001), a binding international treaty can clarify the intentions of participating countries and add credibility to the minimum terms and conditions of an agreement. Furthermore, formal institutions can enable cooperation and make agreements more effective (Underdal 2001). The primary output (provision) of most international fisheries treaties is the creation of a Commission comprised of delegates from some or all member states which provides the central organization and leadership for the agreement (Peterson 1993; Jacobsen and Weiss 1998; Beddington *et al.* 2007). Furthermore, the central Commission typically fosters the collection and compilation of scientific information, often through Scientific Committees (Peterson 1993), and is responsible for enforcing the expectations for member state behavior. Fishing treaties are unique in relation to other environmental agreements in that goals and regulations for fishing levels must be assessed on an annual basis due to changing stock sizes; because of this, the incorporation of scientific information on stock status and fishing levels to create quotas is particularly essential for fishing treaties (OECD 2009; Mitchell 2010). These features of binding treaties suggest that

SBT catch levels under the formalized, binding CCSBT treaty should be lower than catch during the voluntary agreement.

Finally, international fisheries treaties with strict reporting and monitoring provisions can more effectively impact state behavior than those without (Jacobsen & Brown Weiss 1998). Treaties can work to remove uncertainty about the behavior of other states through measurements and observations of state policy and behavior, as well as the environment itself (Levy *et al.* 1993). Such monitoring practices may include vessel lists, catch documentation, and other protocol which make international fishing treaties more effective (OECD 2009). Requirements for reporting are "one of the few instruments available for assessing the extent of implementation and compliance," and can educate and engage members as well as reveal illegal cheating of the agreement (Jacobsen & Brown Weiss 1998, 525). I hypothesize SBT catch levels will decrease for CCSBT members during years in which additional monitoring provisions were put in place, relative to CCSBT members prior to these provisions.

Case Selection

In my analysis, I will primarily focus on the annual catch of the three founding members of the CCSBT: Japan, Australia, and New Zealand. Additional states joined the treaty in 2001 (Korea), 2002 (Taiwan), and 2008 (Indonesia). New member states are incorporated into my analysis in the appropriate stages, and I use the SBT catch of future member states before they became members as an estimation for the counterfactual of member state behavior had the treaty not been implemented. The Philippines (a cooperating non-member), as well as members of the Extended Commission, South Africa and the European Union, are not included in this analysis.

Phase 1: SBT Voluntary Agreement (1985)

Compliance with Voluntary Agreement

The first means by which to assess the effectiveness of the voluntary SBT agreement is to determine whether or not SBT catch of member states complied with the established TAC. According to Joyner (1998, 274), "compliance is the process of conforming to official requirements and reflects behavior by an actor that demonstrates adaptation" to established rules and "remains critical if high seas fisheries are to be successfully conserved." Beginning in 1985, Japan, Australia, and New Zealand voluntarily established annual global TAC, and allocated portions of this quota to each of the three countries (Kolody *et al.* 2008; OECD 2012). Throughout the 1980s, these TACs were gradually lowered, with a marked 50% reduction in 1989 (Kolody *et al.* 2008; OECD 2012).

Following the adoption of the voluntary agreement, Australia SBT catch exceeded TACs slightly in 1986 and by 69% in 1988 (Table 1). However, Australia complied with TAC limits for a consistent period from 1989 through the adoption of the CCSBT treaty in 1994 (Figure A).

Table 1: Relationship between catch and TAC for voluntary agreement members.

State	Year								
	1985	1986	1987	1988	1989	1990	1991	1992	1993
Australia	-2%	9%	-6%	69%	-4%	-7%	-26%	-2%	-7%
Japan	N/A	-49%	-38%	20%	21%	25%	0%	-17%	-15%
New Zealand	-89%	-92%	-96%	-83%	-93%	-55%	-92%	-92%	-88%

Values represent percentage above (+) or below (-) TAC catch levels. (TAC data over time was compiled from the following sources: Campbell et al. 2000, IOTC 2004, Australian Department of Energy and the Environment 2005, OECD 2009, OECD 2012).

Following the 50% reduction in TAC in 1989, Japan catch exceeded the TAC by 20-25% until 1991 (Table 1). This year was the first in which Japan's TAC was restrictive (it easily met its demand within the allotted TAC in years prior) (Polacheck 2012). However, Japan SBT catch complied with TACs beginning in 1992 and continued to do so through incorporation of the CCSBT in 1994 (Figure B). New Zealand has consistently complied with TACs since the voluntary agreement (Figure C), catching an average of 87% less SBT than the TACs allowed during this time period (Table 1). Collectively, compliance with voluntary TACs under this

agreement was spotty in the two larger countries, Japan and Australia, which likely inspired the creation of a formalized treaty through which states could be held accountable for reducing their SBT catch. However, the eventual compliance of members with TACs under the voluntary agreement when they were known to limit member catch shows that the agreement influenced state behavior.

Effectiveness – Counterfactual Analysis

Even if members states comply completely with TACs, this does not necessarily mean that the desired change in fishing behavior has occurred—the treaty might have unambitious quotas that did not significantly reduce member SBT catch (Underdal 2001). Conversely, even if states failed to comply with the TACs established by the voluntary SBT agreement, the agreement still may have reduced SBT fishing levels of member states. As such, the second means by which to assess the effectiveness of the agreement is to compare observed changes in fishing levels to the fishing levels we would expect in an identical world in which the agreement does not exist, the counterfactual (Mitchell & Bernauer 1998).

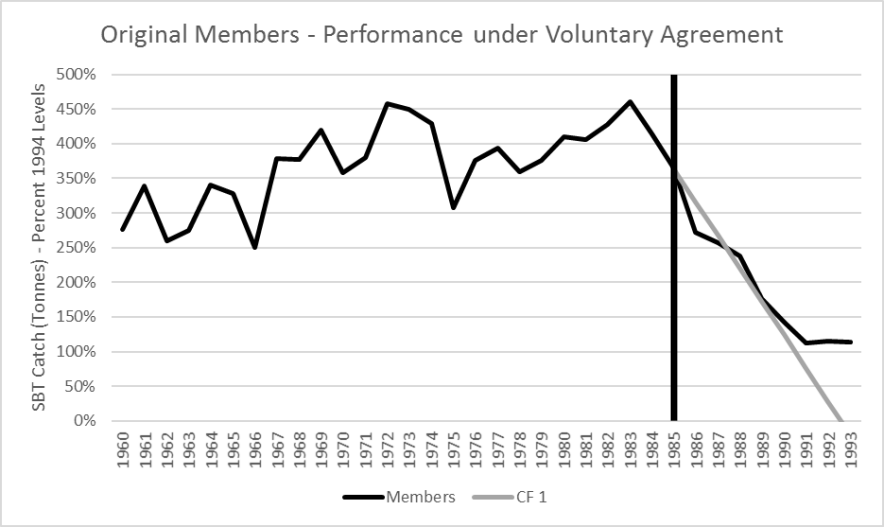

Figure 1: Annual southern bluefin tuna catch of original members (New Zealand, Australia, and Japan) in the years prior to and after the implementation of the voluntary SBT fishing agreement in 1985. Data shown in percent of 1994 catch levels. Grey counterfactual line predicts catch outcomes after each change to the SBT agreement based on the behavior of the member states prior to voluntary agreement.

The projected counterfactual is shown in grey in Figure 1, and conveys the likely trajectory of SBT fishing levels based on catch prior to the 1985 voluntary agreement. Consistent with discussion of rapidly-declining stocks after decades of overfishing (Bergin and Haward 1994; Campbell *et al.* 2000), this counterfactual projects a plummeting crash in SBT stocks which would likely have occurred without action to restrict SBT catch by major fishers.

In the two years immediately following the adoption of the voluntary agreement, SBT catch decreased to levels below those predicted by the counterfactual. However, beginning in 1988 (shortly before TACs were lowered considerably), SBT catch occurred at levels above those predicted by the counterfactual and declined until 1991 at about the same rate of decline that the counterfactual predicts. In a Tragedy of the Commons scenario, it is in the interest of states to fish for the largest portion of fish available, and the immediate reduction of fish catch after the voluntary agreement took effect suggests that the agreement inspired member states to reduce their catch below the rate they would likely have fished if it weren't for the agreement, further evidenced by general compliance with the initial TACs. However, it appears this only delayed a steady decline in fish catch which occurred as the largest fishing state, Japan, exceeded "progressively lowered" TACs under the voluntary agreement. Fish catch levelled off from 1991-1993, during which time all three members were compliant with TACs, indicating that the agreement prevented the complete crash of the SBT fishery. While Keohane *et al.* (1996) argue that a contractual treaty is necessary to solve Tragedy of the Commons problems, the SBT agreement shows that progress toward sustainable fisheries can occur without the presence of a binding international treaty. However, that member states felt the necessity to establish a formal agreement through the CCSBT confirms that these declines in fishing levels had not restored SBT stocks to desired levels and therefore the voluntary agreement did not achieve SBT stock

sustainability.

Phase 2: CCSBT Treaty Implementation (1994)

Formation of the CCSBT

Due to dissatisfaction with the ability of the voluntary agreement to restore SBT stocks, Japan, Australia, and New Zealand formalized their voluntary agreement to become the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) in 1994. The requirements of members in the CCSBT did not differ much from the voluntary agreement; the major expectation for member countries was compliance with the established annual TACs. The treaty did not provide for any punishment or reward system for compliance. The major novelty of the CCSBT was the Commission itself, which "collects scientific information and information on laws, regulations pertaining to SBT fisheries" and was supposed to "develop systems to monitor SBT fishing to enhance scientific info for management and to achieve effective implementation" (CCSBT 1994). Because the CCSBT did not add additional requirements for members to participate, a comparison of fishing levels under the voluntary agreement to those under the early years of the CCSBT provides a perfect assessment of whether simply the presence of a legally binding treaty changes state behavior as opposed to a more casual agreement.

Compliance with CCSBT Treaty

Compliance of Australia, Japan, and New Zealand with TACs during the years following the implementation of the CCSBT (here defined as 1994-2008) is shown in Figures A-C. There are two gaps in the TAC data of member states during this period, as conflict within the Commission meant TACs could not be determined from 1997-2002 (Australian Department of Energy and the Environment 2005), and information for the TACs in 2005 and 2006 are not available. Given the available TAC information, it is clear that the extent to which member states

complied with the established TACs varied among states (Table 2).

Table 2: Relationship between catch and TAC for CCSBT members.

State	Year					
	1994	1995	1996	2003	2004	2007
Australia	-11%	7%	5%	7%	-1%	-8%
Japan	-31%	-19%	-6%	-41%	-22%	-7%
New Zealand	-88%	-57%	-81%	-7%	-6%	-10%
Korea				-81%	-93%	-67%
Taiwan				-2%	100%	-26%

Values represent percentage above (+) or below (-) TAC catch levels. 1997-2002 omitted because member nations could not establish TACs during this period. Data for 2005-2006 TACs could not be found. (TAC data over time was compiled from the following sources: Campbell et al. 2000, IOTC 2004, Australian Department of Energy and the Environment 2005, OECD 2009, OECD 2012).

Reported SBT catch levels of New Zealand and Japan complied with TACs throughout this entire period, by a substantial margin in most years. Australia complied with the TAC in 1994, the first year of the treaty, but it exceeded the TAC (when there was one) until 2004. It is important to note here that TACs and catch levels could be related in two different ways. In my assessment of compliance, I assess the degree to which TAC dictated each year's catch, as the intention of the quotas was to limit the SBT catch of member countries. It is possible that, conversely, catch could have dictated the following year's TAC, but the CCSBT TAC establishment process suggests that this was not the case. TACs were periodically decreased over time under the treaty, but they were set for years at a time, based on past national allocations, scientific recommendations, and a desire for consistent annual expectations (Patterson & Résimont 2007; CCSBT Performance Review Working Group 2008). Therefore, TACs reflect goals informed by scientific information on the SBT stock and overall member compliance with past TACs, not necessarily the previous year's catch.

In 2001 and 2002 respectively, Korea and Taiwan joined the CCSBT, and their compliance is shown in Figures D and E. The global TAC was increased during this time in order to accommodate the addition of new members to the CCSBT (OECD 2012). Levels of SBT

catch by Korea fell far below the established TAC (Table 2), and the fact that Korea's TAC was set at a fishing level the country had not reached since 1998 indicates that compliance is less informative here because the TAC was set much higher than necessary as part of Korea's demands for joining the agreement (Sato 2002). The steady decrease in SBT catch in the years immediately following Korea's membership to CCSBT suggests that the agreement may have influenced Korea's fishing behavior. However, an increase from 2005 to 2008, because it was well within the presumed TACs during those years, demonstrates limitations of the treaty, as implemented, to create long-term fishing reductions. Unlike Korea, TACs for Taiwan were set at a level significantly lower than SBT catch levels in the several years prior to Taiwan joining the CCSBT. Taiwan complied with the TAC in 2003, but doubled the TAC level in catch for 2004 before returning to compliance in 2007 (Figure E). Nonetheless, overall member compliance with TACs under the CCSBT shows that the treaty effectively regulated reported SBT catch.

Effectiveness

It should be noted that TAC compliance data under the CCSBT has since been recognized to obscure the true level of fishing that several members engaged in during the early years of the CCSBT. According to Polacheck (2012, 1150), a 2006 review of Japanese market statistics lead the CCSBT to conclude that "very substantial and continuous unreported catches of SBT had been taken by longline vessels since at least the early 1990s," meaning at least one member state actually exceeded their TACs during the early years of the CCSBT. Fishing reductions of compliant states likely encourage other states to fish more, a feature of Tragedy of the Commons problems (Hardin 1968; OECD 2012). Despite this, it is still informative and even more critical to assess the effectiveness of the implementation of the CCSBT using comparisons of fish catch to counterfactuals of behavior without the treaty.

Counterfactual #1: Members Pre-CCSBT vs. Members Post-CCSBT

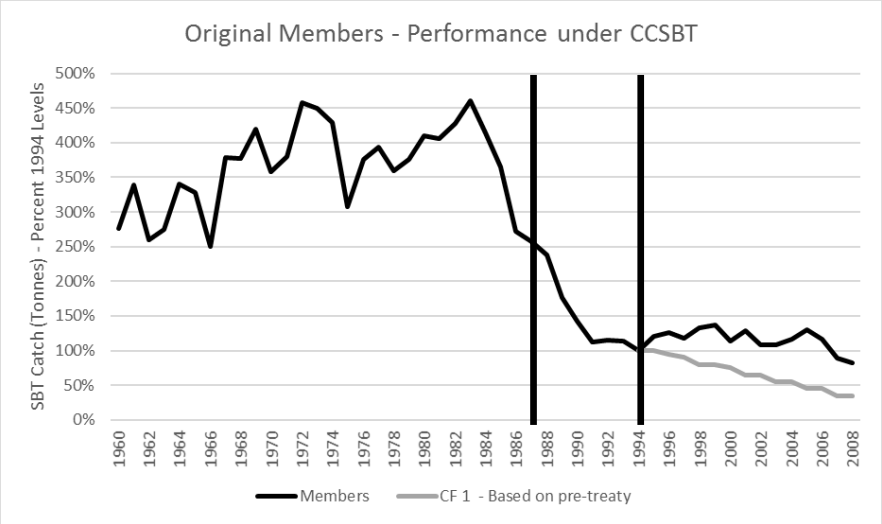

Figure 2: Annual SBT catch of original members (New Zealand, Australia, and Japan). Data given in percent of 1994 catch levels. Grey counterfactual lines predict catch outcomes after each change to the SBT agreement based on the behavior of the member states during the voluntary agreement.

The first counterfactual that can be used to assess the SBT catch performance of CCSBT members projects expected fishing levels based on SBT catch by member countries prior to the implementation of the formal treaty. This is shown in Figure 2, in grey, and assumes that while TACs under the voluntary agreement might have ultimately reduced SBT fishing in a continued attempt to save the stocks, continued fishing of the overexploited stock would have led to continuing declines in available fish to catch.

After the CCSBT began in 1994, actual fish catch by member states rose slightly and then remained at a relatively constant level above that which is predicted by the counterfactual. This suggests two key points. One, even though the CCSBT member states could not agree on TACs from 1997-2002, the reported catch of members voluntarily remained near the TAC compliance levels of 1994-1996 ad 2003. Secondly, it shows that SBT catch remained relatively constant for the first time in the history of the SBT fishery, demonstrating the cessation of rampant overfishing and the establishment of more stable annual fish catch consistent with TACs which remained unchanged from the end of the voluntary agreement through the first few years of the

CCSBT. If actual SBT catch had fallen very far below the counterfactual line in this case, it would have indicated near calamitous fish stocks; stable catch levels indicate some stability in the stock and in fishing behavior that can be considered a major success of the treaty. While the ultimate goal of this treaty is to eventually lead to an increase in fish catch associated with restored stocks and a higher level of sustainable fishing, an increase in fishing in the years immediately following the adoption of the CCSBT would have meant states were not complying with TACs and that the treaty did not influence state behavior. By comparing SBT catch under the CCSBT to predicted levels during that time without the treaty, it appears that the CCSBT restrained SBT catch in member countries to levels that could remain constant, even if low.

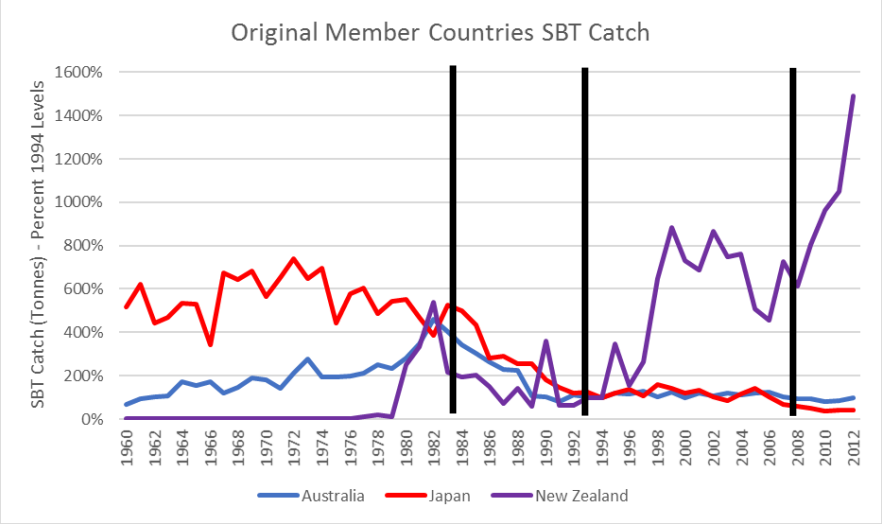

Figure 3: Annual southern bluefin tuna catch of the three founding members of CCSBT. Data given in percent of 1994 catch levels.

Furthermore, Figure 3 shows how SBT fish catch changed over time for each of the three original member states of the CCSBT. Fish catch in Australia and Japan after 1993 reached a relatively constant level, with no additional dramatic decreases until 2007-2012, while New Zealand catch increased dramatically in the period following 1993. Domestic longline fishing developed in New Zealand in the early 1990s, and from the late 1990s through 2000 "tuna fisheries were among the few open access fisheries in New Zealand at that time" (WCPFC

Technical and Compliance Committee Working Group – New Zealand 2005, 3). This was well within the TAC for this country, and suggests that reductions in SBT catch by other, larger fishing states under the CCSBT provided New Zealand the available fish to expand their catch to satisfy domestic demand; Japan and Australia behaved contrary to the expectation that states will race to fish as much of a commons as they can (Hilborn *et al.* 2005). Absolute SBT catch in New Zealand is much smaller than catch loads in Australia and Japan, so the stark increase over time depicted in Figure 3 (represented in percent of each country's 1994 catch levels) is small relative to the available stock.

Counterfactual #2: Members vs. Non-Members

The second counterfactual that can be used to assess the fishing behavior of member states from 1994-2008 projects member state SBT catch based on SBT catch by non-member states during the first decade of the CCSBT. The only three countries for which suitable data on SBT catch is available are Korea, Indonesia, and Thailand, so they make up the non-member comparison even though these states later became CCSBT members.

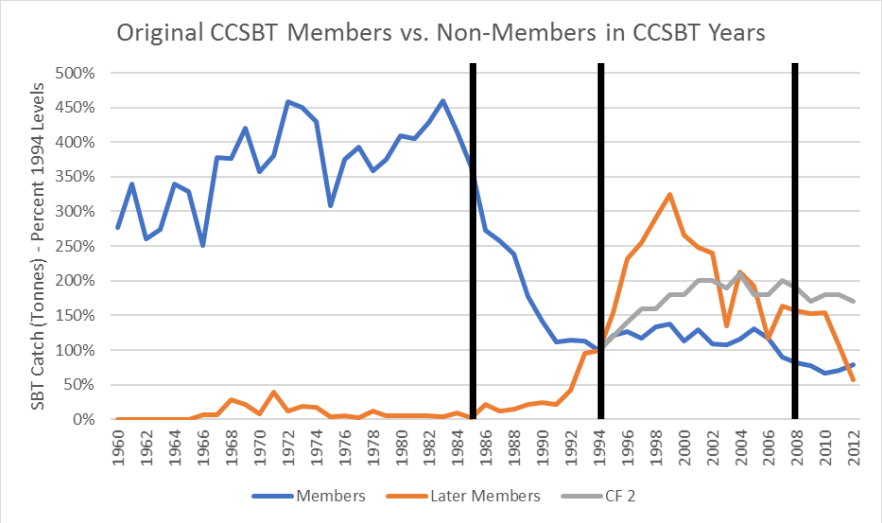

Figure 4: Annual southern bluefin tuna catch of original members (New Zealand, Australia, and Japan) and members that joined later (Korea, Indonesia, and Taiwan). Data given in percent of 1994 catch levels. Counterfactual of member state SBT catch post-1994 based on the behavior of non-members is shown in grey.

These three later member states showed large increases in SBT catch between 1992 and 1999, so the counterfactual of member state behavior based on this growth incorporates an increase in SBT catch relative to the levels prior to the implementation of the treaty, shown in grey in Figure 4. Large increases in non-member SBT show that SBT were available for potential fishing by member states (particularly from 1998-2003, when no TACs were established). The counterfactual line increases with a more gradual slope than that of the non-member line due to the fact that large percentage increases in SBT catch by these later member states actually reflect relatively small increases in absolute catch amounts compared to member countries. Actual fish catch of member countries after 1994 was lower than the projected counterfactual based on future member state performance, suggesting that the formal CCSBT treaty worked to minimize the SBT catch of member states.

Conclusions of Counterfactual Analysis

Based on the analysis of two counterfactuals, comparing member state SBT catch under the CCSBT to catch under the voluntary agreement and to catch by future member states during the time period in which the CCSBT entered into force shows that the formalization of the voluntary agreement into the CCSBT reduced member SBT catch (though it may have fostered an increase in IUU fishing, discussed below). Revelations about the extent of IUU fishing and the continuing decline of SBT fisheries lead the CCSBT to add several monitoring provisions beginning in 2008, suggesting that again, the treaty impacted state behavior but not enough to satisfy the broader goals of the CCSBT.

CCSBT "Reform" - The Addition of Monitoring Practices (2008)

Added Monitoring Provisions

In the midst of conflict within the CCSBT regarding illegal fishing practices, as well as

an SBT stock that remained low, albeit more stable, the CCSBT Compliance Committee noted that current management measures within the treaty had been "inadequate", and called for a better monitoring system that might "improve its capacity to achieve its fundamental goals (effectiveness) [and] the way it used its means to achieve them (efficiency)" (OECD 2012; Garcia and Koehler 2014, 23). In response, the Commission implemented stricter monitoring measures beginning in 2008: a catch documentation scheme (CDS) to improve documentation of SBT catch, a vessel monitoring system (VMS) to document fishing effort and location, and regulation of transshipments (IOTC 2008). Through these additions to the CCSBT, the Commission aimed to improve catch and fishing monitoring programs, combat issues of misreporting of fish catch (Beddington *et al.* 2007), and establish a structure that would encourage member states to further reduce fishing activity through treaty compliance (Jacobson & Brown Weiss 1998).

Compliance with Agreement Under New Provisions

The compliance of member countries from 2008-2012 is shown in Figures A-F. Indonesia became a member of the CCSBT in 2008, and compliance with TACs during the short period for which data is available for this state is shown in Figure F. Broadly, the reported SBT catch of all members since 2008 has complied with TACs (the two egregious exceptions being Taiwan in 2010, the same year as the implementation of the CDS, and Indonesia in 2008, its first year of CCSBT membership) (Table 3). This is noteworthy considering that TACs were reduced by about 20% for 2010-2011 (OECD 2012). Continued fish catch well below newly-lowered TACs in 2010 and 2011 suggest that TACs encouraged compliance and even greater reductions in reported fish catch. This does not suggest that catch dictated TAC, as fish catch would likely have fallen closer to the TAC level in the following year were this the case.

Table 3: Relationship between catch and TAC for CCSBT members after the implementation of additional monitoring provisions to the CCSBT.

State	Year				
	2008	2009	2010	2011	2012
Australia	-16%	-17%	-4%	0%	1%
Japan	-16%	-29%	-29%	-25%	-33%
New Zealand	-24%	0%	-29%	-23%	-3%
Korea	-62%	-48%	-57%	-68%	-66%
Taiwan	-23%	-21%	42%	-36%	-46%
Indonesia	19%	-15%	-13%	3%	-100%

Values represent percentage above (+) or below (-) TAC catch levels. (TAC data over time was compiled from the following sources: Campbell et al. 2000, IOTC 2004, Australian Department of Energy and the Environment 2005, OECD 2009, OECD 2012).

Effectiveness

Figure 4 shows the total SBT catch of original members and later members (Korea, Taiwan, and Indonesia) from 2008-2012 as compared to a counterfactual consistent with the fluctuations in reported SBT catch from 1994-2008. This counterfactual predicts that without the implementation of the VMS and CDS programs, SBT catch would have remained relatively steady under the original CCSBT provisions. Actual SBT catch of original member countries remained about steady with fishing levels pre-2008, even though fishing levels remained below the level predicted by the counterfactual. This suggests that the new provisions to the CCSBT did not reduce reported catch for member countries any more than the original CCSBT provisions more original member states. However, it is possible that the provisions may have made reported SBT catches more accurate and reduced unreported catch, thereby reducing overall SBT catch and improving the fishing behavior of members. Actual reported catch for new member states decreased sharply beginning in 2010, rather than remain stagnant like the counterfactual, suggesting that the CCSBT provisions (specifically the CDS) contributed to changed state fishing behavior. The limited nature of this dataset also means that longer trends in response to the new CCSBT have yet to be analyzed.

Goal Achievement

Considering the above discussion of compliance and effectiveness within the CCSBT treaty, it is important to acknowledge whether or not the CCSBT, through its several stages, achieved its goal of rebuilding the SBT stock. Several performance reviews have studied the CCSBT and the SBT stock, finding that despite positive progress towards effective monitoring and implementation of scientifically-informed TACs, the SBT fishery is still threatened. According to Garcia and Koehler (2014, 29), "the spawning biomass is still only 23% of the biomass at [Maximum Sustainable Yield] and about 5% of the estimated virgin stock biomass. This confirms—and is not a surprise—that the stock remains heavily overfished." However, the study recognizes some positive news about the SBT fishery as well; SBT recruitment is increasing and "the decrease in biomass seems to have been arrested. The projected increases in stock size would indicate (assuming that no other factor is acting) that the effects of the management measures of the last few years are going into the right direction, towards rebuilding" (Garcia & Koehler 2014, 31). As such, it appears that while the CCSBT has not yet met its stated goal of SBT stock restoration, and it has until 2035 to do so, its legal framework and additional monitoring provisions are slowly working to improve the sustainability of the SBT fishery.

Independent Variables

Above, I have discussed how a voluntary agreement and the subsequent CCSBT have impacted levels of SBT catch in member countries. However, it is important to consider other variables which might have impacted SBT catch. These independent variables (IVs) can vary in how much they contribute to changes in the dependent variable (SBT catch), but nonetheless can clarify processes that create changes (or no changes) in state behavior (Underdal 2001). The

CCSBT treaty text outlines a number of "non-treaty" influences on the behavior of member states, including fishing technology, tuna price, fleet size, demand, natural fluctuation in fish recruitment from year to year, drastic declines due to past overfishing, and climatic variation (La Nina/El Nino, etc.) (CCSBT 1994). Two of these, fish price and fleet size, may provide the greatest independent contribution to SBT catch in a given year.

Tuna Price

As a staple food source in Japan, demand for tuna there and in other member states remains high and is growing globally as the population rises and new markets for SBT open in other countries (OECD 2009; Ariji 2010). Closely related to the demand for a commodity is a commodity's price, and because global demand for SBT and other tuna species exceeds the supply available, fish prices remain firm relative to other meat products (Delgado *et al.* 2003). Skipjack tuna prices over the past several decades (used here as a proxy for SBT price in the absence of that data) are shown in Figures 5 and 6.

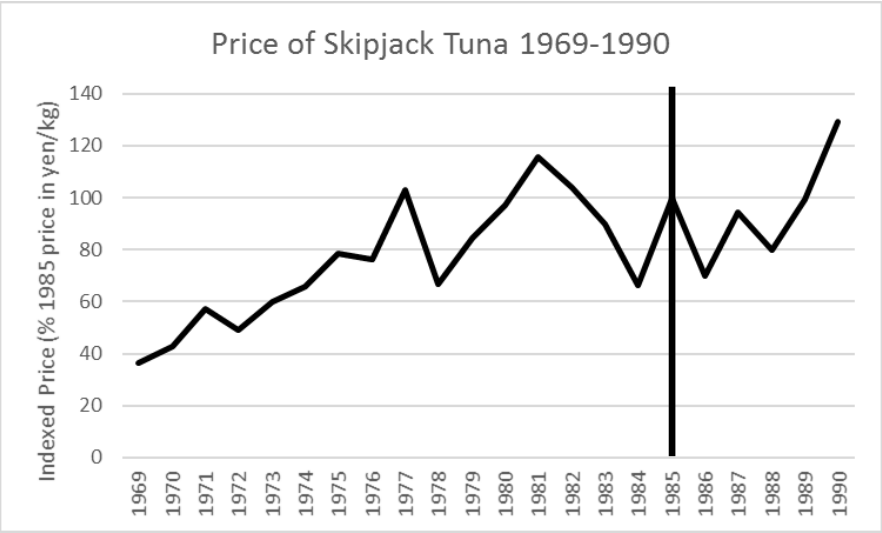

Figure 5: Annual Skipjack tuna prices from 1969-1990, indexed to percent 1985 prices in yen/kg.

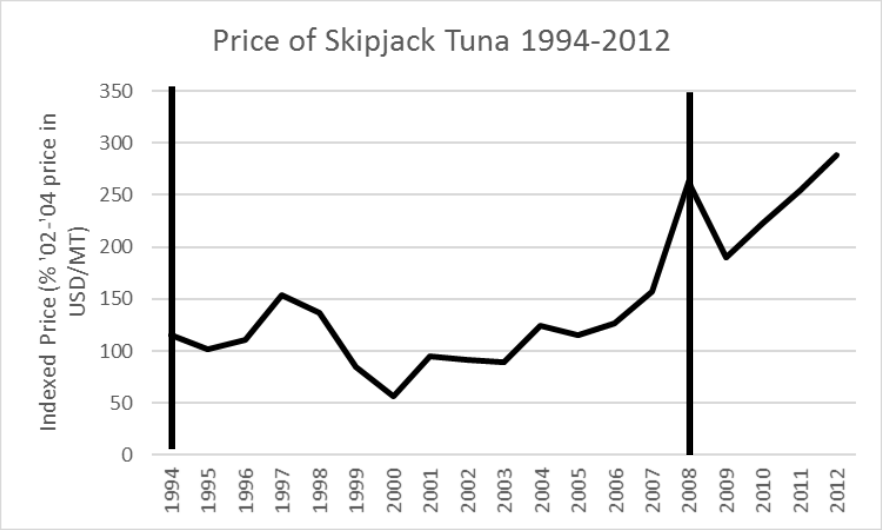

Figure 6: Annual June Skipjack tuna prices from 1994-2012, indexed relative to 2002-2004 averages in USD/MT.

According to Delgado *et al.* (2003, 11), "higher prices indicate relative scarcity and lessen the ability of consumers to purchase the commodity, while lower prices represent increased availability to consumers." As SBT catch has decreased since 1983 (Figure 4), tuna fish prices (estimated using Skipjack data) has broadly increased over time, reflecting price increases as a result of less SBT "reaching the market…due to the imposition of quotas" (Bergin & Hayward 1994, 271).

Now, the ability to score larger prices on the SBT market may encourage fishers to increase fishing effort, when fishing costs are low relative to profit (Hilborn *et al.* 2005). Price is closely related to the size of the fish; price increases dramatically for large SBT, which creates high incentives for IUU fishing (Bergin & Hayward 1994; Polacheck 2012). If price declined despite ever-increasing TACs (while demand remained high), it would suggest that IUU fishing occurred at a high rate because it would mean that despite restrictions, a high amount of tuna reached the market. However, prices remained high, indicating that the CCSBT restricted fishing activity because market tuna remained scarce, even if some IUU fishing occurred due to the incentive of high prices. Therefore, Skipjack tuna price data suggests that price cannot explain

the reduced fishing levels of CCSBT members; rather, the relationship appears to function in the opposite direction.

Fleet Size

Related to demand and technological developments is the fleet size, or the number of boats that fish for SBT, which can contribute greatly to overfishing. Japan greatly increased its number of boats on the water during the 1950s and 1960s, a major contribution to its huge peak in SBT catch during this time (Campbell *et al.* 2000). Under the CCSBT, there are fewer SBT permitted for Japan and other members to catch, but states maintain a fishing capacity that exceeds this lower level of fishing. This overcapacity is a "main factor responsible for overfishing and IUU" (Beddington *et al.* 2007; Garcia and Koehler 2014, 10). As the CCSBT does not address issues of capacity, instead choosing to focus on TACs, fishing activity remains high due to the economic incentive to utilize the full fleet size states have developed. Fleet size for CCSBT member states is shown in Figure 7. Longline fishing is the primary method of SBT fishing in Japan and New Zealand, but purse-seines are the method of choice in Australia, so both longline and purse-seine fleet size are shown for Australia.

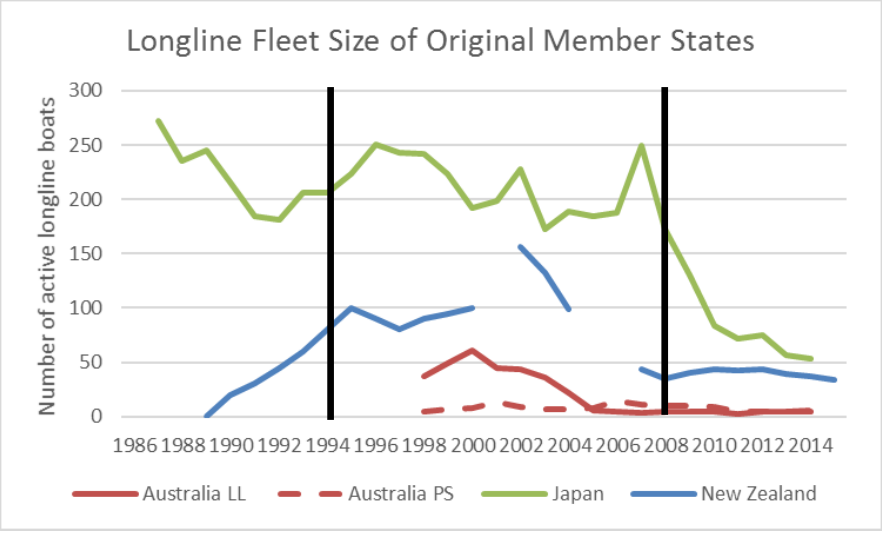

Figure 7: Fleet size for original CCSBT member states over time.

Fleet size increased in Japan and New Zealand in the early years of the CCSBT. This likely contributed to the slightly higher, but relatively constant overall fish catch of member nations during this time, and this larger fleet size may have led to significant IUU fishing that was not captured in the reported SBT catch data. Fleet size in these three member nations began to decrease around the turn of the millennium, perhaps due to the CCSBT fishing regulations. Notably, the active tuna fleet in Japan showed marked reductions between 2006 and 2010, which have been attributed to "tighter international tuna fishing quotas and declining profits" (World Fishing and Aquaculture), but which also may have been due to the implementation of the Vessel Monitoring System and other monitoring provisions added to the CCSBT during this time. Therefore, reduced SBT catch by members after 2008 may have been due to either increased monitoring or due to reduced fleet size, but it is highly likely that sharp declines in Japanese fleet size were related to these additional CCSBT provisions. As such, fleet size likely worked against the treaty until recently, when declines in fleet size may have contributed to SBT catch declines in precisely the way the Commission intended.

Additional Rival Theories

Other factors that contribute to SBT catch levels, as described in the CCSBT treaty text, include natural fluctuation in fish recruitment from year to year and drastic declines due to past overfishing (CCSBT 1994). The high variability of recruitment can make it difficult to assess whether reductions in SBT catch are a result of effective management or a "bad year" where fewer fish were born and survived into adulthood (Hilborn & Walters 1992). As such, it is entirely possible that year-to-year increases and decreases in SBT catch during the voluntary agreement and the CCSBT treaty are due primarily to recruitment variation. However, long-term trends in catch, such as the relative stability in SBT catch levels following the implementation of

the CCSBT, suggest that despite slight annual fluctuations, catch did not continue to decline as had been the trend during the voluntary agreement. It is impossible to tell whether decreases in SBT catch during the first two years of the voluntary agreement are due to reduced fishing effort by members or continuing declines in stocks as a result of past overfishing and poor resulting recruitment; what is apparent is that SBT fish catch was above the counterfactual line of hypothetical stock decline beginning in 1988, indicating that at that point the agreement had worked to establish stable fishing levels suggesting the stock was, even if low, no longer drastically declining.

Conclusion

Performance reviews of the CCSBT have been quick to dismiss the treaty as a "failure" because it has not met its established stock restoration goals. However, analysis of the extent to which members complied with the treaty as well as comparison of SBT fishing trends over time to counterfactual estimates of non-treaty fishing levels show that the CCSBT has influenced SBT fishing behavior in member countries. Such changes in behavior occurred at every step in the development of the CCSBT: the voluntary agreement established by Japan, Australia, and New Zealand in 1985, the formalization of the CCSBT treaty in 1994, and the implementation of new monitoring provisions beginning in 2008. The adaptions of member states to each successive development in the treaty shows that the CCSBT has been a learning exercise in which members have explored solutions to insufficient stock restoration at each stage in the development of this treaty, an important process other environmental treaties can learn from (Underdal 2001). In forming a voluntary agreement, CCSBT member states worked to establish behavioral expectation of fishing restrictions and reporting SBT catch. They sought to complement this with binding expectations to follow established quotas under the CCSBT by organizing scientific

information through the Commission. Finally, additional monitoring practices were added to the agreement in order to make this binding treaty more effective, particularly for new members in the agreement. Collectively, this learning process has prevented the all-out collapse of the SBT fishery, reducing SBT fish catch more than if countries had continued to exploit SBT, selfishly motivated by the Tragedy of the Commons, without an international treaty to limit this behavior. My analysis of the effectiveness of the CCSBT has shown that a voluntary agreement of states to reduce an environmentally-degrading action can change state behavior, but that a legally binding treaty is more effective by creating a central Commission that gathers and disseminates scientific information for the establishment of quotas. Furthermore, stricter monitoring provisions can improve the effectiveness of a binding treaty and potentially reduce cheating that is common in Tragedy of the Commons problems. While SBT stocks remain low, the CCSBT continues to make progress toward sustainable fishing by setting and reducing TACs and garnering the support of additional fishing states.

Appendix

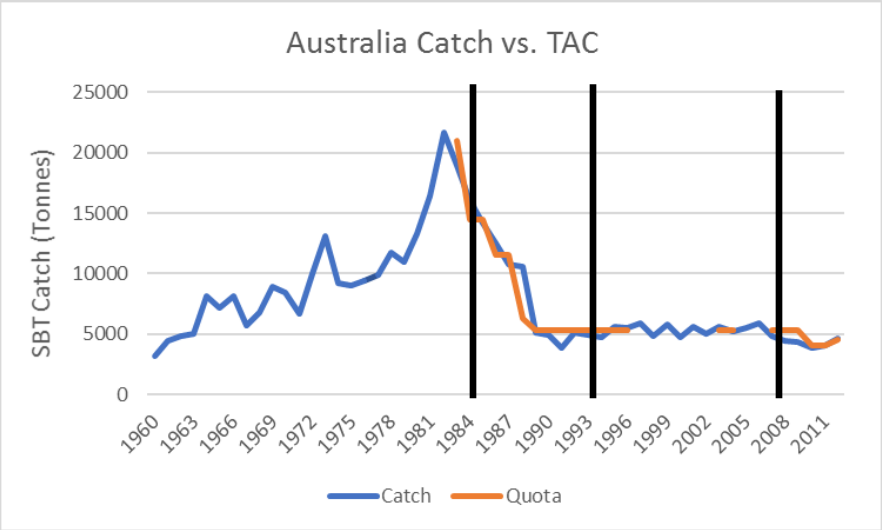

Figure A: Australian SBT catch (in tons) in comparison to TAC quotas.

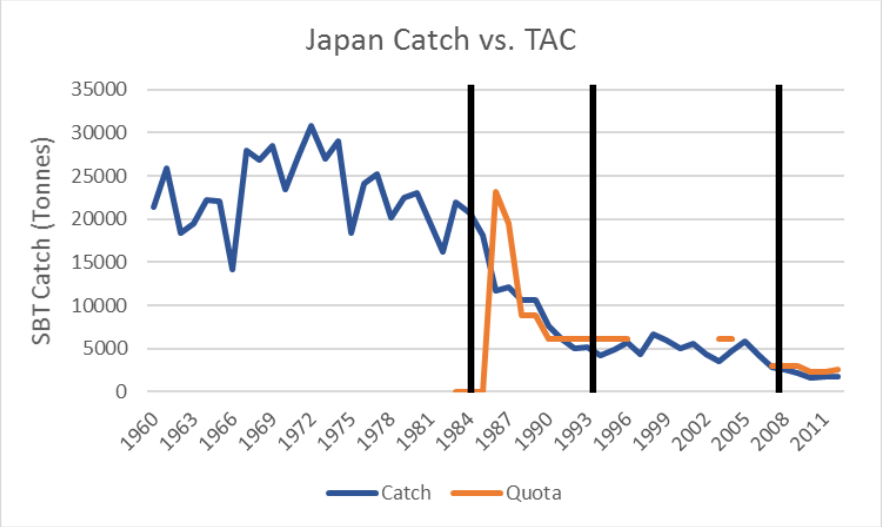

Figure B: Japanese SBT catch (in tons) in comparison to TAC quotas.

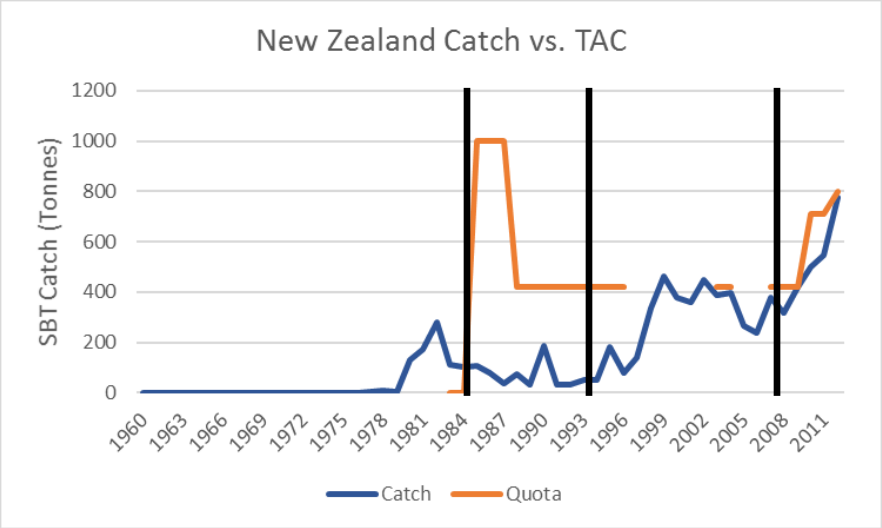

Figure C: New Zealand SBT catch (in tons) in comparison to TAC quotas.

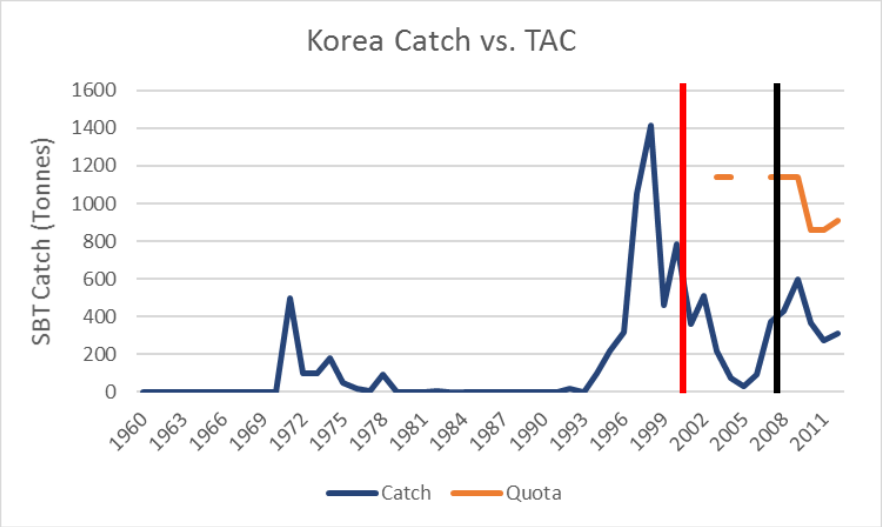

Figure D: Korean SBT catch (in tons) in comparison to TAC quotas. Red line indicates year Korea joined CCSBT.

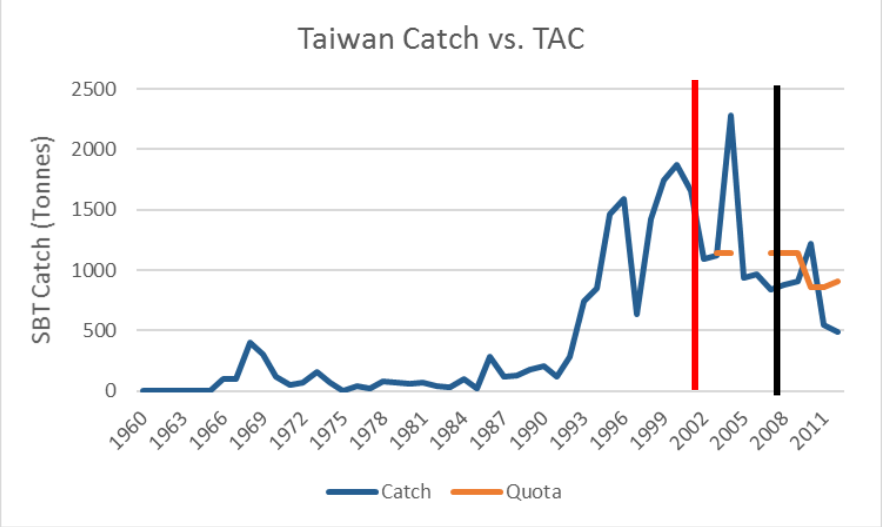

Figure E: Taiwanese SBT catch (in tons) in comparison to TAC quotas. Red line indicates year Taiwan joined CCSBT.

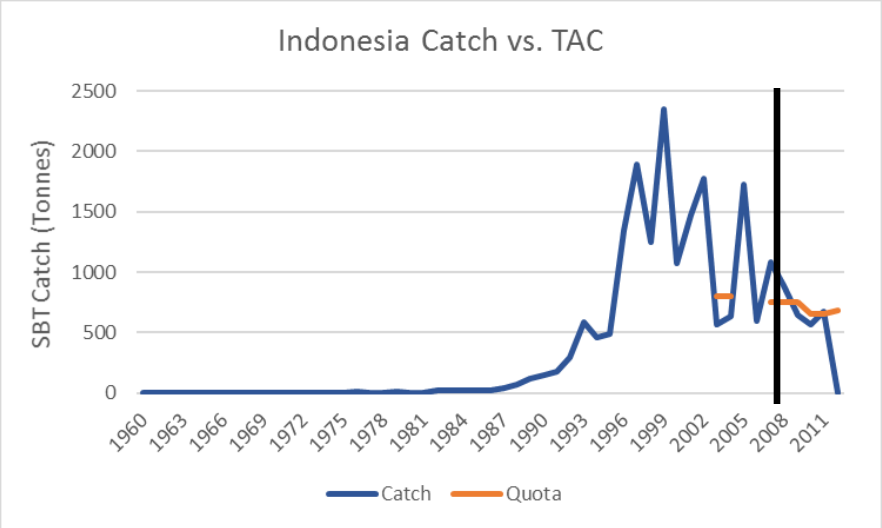

Figure F: Indonesian SBT catch (in tons) in comparison to TAC quotas. Indonesia joined the CCSBT in 2008.