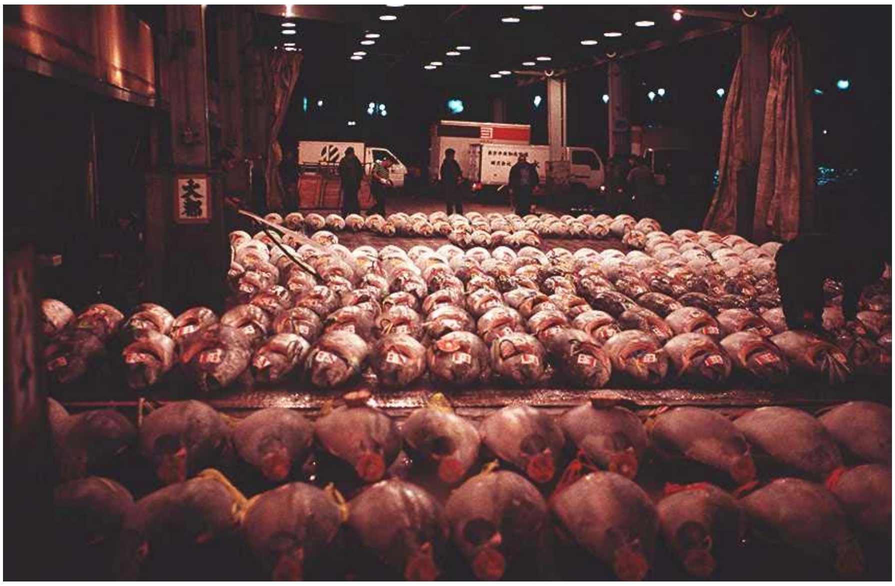
IOTC-2008-WPTT-INF01

Considerations of Implications of Large Unreported Catches of Southern Bluefin Tuna for Assessments of Tropical Tunas, and the Need for Independent Verification of Catch and Effort Statistics

Tom Polacheck
Campbell Davies
CSIRO Marine and Atmospheric Research Paper 023
March 2008



National Library of Australia Cataloguing-in-Publication entry

Author:	Polacheck, Tom.
Title:	Considerations of implications of large unreported catches of Southern Bluefin tuna for assessments of tropical tunas, and the need for independent verification of catch and effort statistics / Campbell Davies.
Publisher:	Hobart, Tas. : CSIRO Marine and Atmospheric Research, 2008.
ISBN:	9781921424212 (pbk.)
Series:	CSIRO Marine and Atmospheric Research paper , ISSN 1833-2331 ; 023.
Notes:	Bibliography.
Subjects:	Fish population--Measurement--Australia. Overfish--Australia--Research. Longlining (Fisheries)--Australia. Tuna--Australia--Research. Tuna--Australia--Statistics. Tuna--Monitoring. Southern bluefin tuna.
Other Authors/Contributors:	Davies, Campbell R. (Robert), 1968- CSIRO. Marine and Atmospheric Research
Dewey Number:	639.30994

Enquiries should be addressed to:
Tom Polacheck, Campbell Davies
CSIRO Marine and Atmospheric Research
1 Castray Esplanade, Hobart, Tasmania, 7000
03-6232 5222
Tom.Polacheck@csiro.au
Campbell.Davies@csiro.au

Cover photo courtesy of John Gunn, CSIRO Marine and Atmospheric Research.

Important Notice

Use of this Report

Contents

List of Figures

List of Tables

ABSTRACT

Japanese catch and effort data provided through commercial log books constitute a central component of most stock assessments for the world's major tropical tuna and billfish fisheries (e.g. yellowfin tuna, bigeye tuna and swordfish). A review of Japanese market statistics was undertaken in 2006 by Australia and Japan in relation to catches of southern bluefin tuna (SBT). On the basis of this review, the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) concluded that very substantial and continuous over-catches of SBT had been occurring by longline vessels since at least the early 1990s (Anon., 2006a, b, c, d). While there is uncertainty about the identity of fleets contributing to the over-catch, the assumption used within the CCSBT and its Scientific Committee is that a significant proportion of these unreported over- catches were taken by Japanese longliners. If this assumption is correct, estimates of Japanese catches have exceeded officially reported catches by at least a factor of 2 (Anon., 2006a, c, d) over this period. This paper discusses potential implications of the large, unreported catches of SBT on Japanese longline catch and effort data for other tuna and billfish species, and for stock assessments that are dependent upon these data.

Analysis of the available data and information indicate it is plausible that the large unreported over-catches of SBT may have resulted in the misreporting of catches of other tuna species and/or misreporting of the location of fishing effort. Both of these hypotheses, if true, would bias CPUE indices and the stock assessments for other species of tuna. The magnitude and extended period of the over-catches of SBT highlight the significant and wide-spread risks of relying on fishery dependent data from commercial logbooks as the primary source of stock abundance indices for stock assessments in the absence of appropriate verification. There is an urgent need for the fisheries science community to be more pro-active in the development and implementation of independent ways to monitor and verify catches and fishing effort (e.g. scientific observers, video monitoring, port sampling, etc) and international standards for their use in scientific assessments.

1. INTRODUCTION

Log book data supplied by Japanese longline vessels are a central component of stock assessments for most of the world's major tropical tuna and billfish fisheries (e.g. yellowfin tuna, bigeye tuna and swordfish) conducted by regional fishery management organizations (RFMO) (i.e. ICCAT, IATTC, WPFC, IOTC). In particular, the catch per unit effort (CPUE) indices estimated from these data are either the sole, or one of the principle, measures of relative abundance used in these assessments. This primary reliance on logbook data stems from:

1) The logbook data provide a long time series of catch and effort data often commencing prior to the start of any significant commercial catches;

2) The logbook data provide both wide-spread geographic and seasonal coverage across the major ocean basins;

3) The Japanese longline fleet has generally been one of the major harvesters of the species being assessed, at least for the longline sector of the fisheries;

4) The difficulties and expense of obtaining fishery independent relative abundance indices for these large wide-ranging pelagic species has resulted in a reliance on fishery dependent CPUE in the stock assessments; and

5) A perception has existed that there is a high degree of accuracy and reliability in the reporting of the catches and fishing effort by Japanese fishermen.

These five factors have also been important in the reliance on these data in recent debates on the worldwide status of large pelagic fish resources (Myers and Worms, 2003, 2005; Walters, 2003, Hampton et al, 2005, Polacheck, 2006, Sibert et al, 2006).

Despite the central importance of the Japanese longline logbook data in the monitoring and assessment of these major international fisheries, there is very little information available that can be used to evaluate their accuracy. To our knowledge, little verification (e.g. through independent monitoring and/or cross checking of landings) have been undertaken.

In 2006, a review of catches of SBT sold in the principal Japanese tuna markets was undertaken by Australia and Japan in relationship to potential catch anomalies (Anon., 2006b). This review revealed that there has been very substantial and continuous unreported longline over-catches of SBT since at least the early 1990s (Anon., 2006a, b, c, d)[1]. As discussed below, a working assumption within the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) and its Scientific Committee (SC) is that a significant proportion of these catches were taken by the Japanese longline fleet (Anon., 2006a, b, c, d). In the case of the scenarios developed by the SAG (Stock Assessment Group)[2] and SC to investigate the implications of the unreported catches on CPUE,, a range of proportions of the unreported catches were allocated to the Japanese longline fleet in the main SBT fishery grounds during the principle fishing season.

The standardised CPUE series derived from the data from this fleet are the primary index of abundance used in previous stock assessments and in the conditioning of the operating model used to evaluate potential management procedures (Anon., 2005b). This same CPUE series was a central component in the decision rules for the management procedure adopted but not implemented by the CCSBT (Anon., 2006a). If correct, this assumption for the source of the unreported catch would suggest substantial underreporting in the officially reported Japanese catch statistics and the associated log book data used for stock assessment purposes.

---

[1] The actual report of the Japanese market review has not been placed in the public domain by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), which is the international regional fisheries management organization for SBT to which the review was presented. As such, it is considered to be confidential and can not be directly referenced. However, a number of reports and papers of the CCSBT and its Scientific Committee (SC) and Stock Assessment Group (SAG) provide information on relevant results from the market review and on the implications of the over-catch for the use of the Japanese catch and effort data and for stock assessment purposes. As such, this paper only refers to information on the over-catches contained in the official reports from the CCSBT Commission, SC and SAG meeting (Anon., 2006a, b, c, d). These CCSBT reports are publicly available either by request from the CCSBT Secretariat or alternatively, can be downloaded from the CCSBT website.

[2] The SAG is a technical group under the CCSBT Scientific Committee that undertakes and reviews the technical and analytical aspects of the SBT stock assessments.

While the review of the market statistics was confined to an examination of the amount of SBT being sold in wholesale auction markets in Japan, the existence of these large unreported catches of SBT potentially has wider implications for the reliability of Japanese tuna longline catch and effort data and for the stock assessments that are dependent upon them. The purpose of the current paper is four fold:

i) to summarise the history of the issue in the scientific bodies of the CCSBT to demonstrate the difficulty of addressing such a sensitive issue in an objective scientific manner,

ii) discuss some of the potential implications of the unreported catches of SBT for monitoring and assessment of other highly migratory stocks,

iii) raise awareness of the responsibility of fisheries scientists to require verification of the data used in stock assessments and the provision of management advice, and

iv) emphasise the need for the development of international standards for the provision and verification of catch and effort data for use in assessments of international fisheries, such as tuna, so that scientific bodies can provide robust, credible advice on sustainable levels of harvest.

2. BACKGROUND ON SBT FISHERY AND UNREPORTED CATCHES

SBT is a long lived, migratory, high valued fish found throughout most of the southern temperate oceans except in the more easterly regions of the South Pacific. Surface and longline commercial fisheries for SBT began in the 1950s and the stock has been very heavily fished (Caton, 1991) and is currently at historically low levels (Anon., 2006b). A major component of the surface fishery (that off the southeast coast of Australia) collapsed in the late 1970s and tagging studies demonstrated very high exploitation rates on juveniles in the 1980s. In response, beginning in 1984, Australia markedly reduced its catch of juveniles in the surface fishery. Informal international management arrangements involving Australia, Japan and New Zealand were initiated in the early 1980s and were subsequently formalised with the establishment of the Commission for the CCSBT in 1993 (Caton, 1991; Anon., 1994). Total allowable catch limits (TAC) were introduced in 1985 under the informal tri-nation arrangement and were divided into national allocations. The TACs were progressively lowered with a major reduction of around 50% for the 1989 fishing year. The early limits resulted in reductions in catches from the surface fisheries beginning in 1984 (Caton, 1991). However, it was not until the 1989 fishing year that the catch limits became restrictive for the Japanese longline fleet (i.e. the Japanese longline fishery reported that it was not able to catch its limit prior to this year (Caton, 1991)). From 1989, formal catch limits essentially remained fixed until 2007[3].

[3] The catch levels set for Australia, New Zealand and Japan by CCSBT remained at their 1989 levels except for years (1998-2003 and 2007) in which the CCSBT was unable to agree on a global TAC. In these years, the three parties voluntary agreed to keep their catches at their past level except in 1998 and 1999 when Japan unilateral increased its catches to undertake an

The background of how the issue of unreported catches has been dealt with by the CCSBT has implications for dealing with this difficult and sensitive issue in other RFMOs. We provide a brief overview here. Concerns about potential unreported over-catches for SBT began to be raised in the early 1990's – i.e. shortly after the agreed catch limits for SBT became restrictive on the Japanese longline fleet (Anon., 1990, 1991; Polacheck and Klaer, 1991). While a primary focus of these early concerns was on potential increase in catches by non-parties to the informal tri-lateral and subsequent CCSBT convention, there was also concern about the incentive that restrictive quotas generate for under-reporting and discarding of catches (e.g. Anon., 2001b, Polacheck and Klaer, 2001), Direct evidence of IUU (illegal, unreported and unregulated) fishing by Japanese vessels became available in 1996. In December of that year, at least 50 tuna longline vessels fishing in a prime SBT fishing area that had been officially closed by the Japanese government were detected by a surveillance flight. Forty vessels were identified as Japanese, several as Korean[4] and the reminder were unidentified (Anon., 1997a). This surveillance flight did not provide a direct measure of the extent of illegal fishing as it only provided information for one day of activity in a limited area. However, it did provide concrete evidence of the potential for large catches of SBT to be taken and not reported to the CCSBT. Substantive follow-up procedures were not taken by the CCSBT to improve monitoring, compliance or provide independent means of verifying catch statistics used for assessment or reporting purposes. However, Japan did institute some additional regulations on its fleet (Anon., 1997a).

One consequence of this incident was recognition and agreement within the CCSBT Scientific Committee that the actual level of SBT catches was a major source of uncertainty that needed to be addressed when conducting SBT stock assessments (Anon., 1997b). Subsequently some stock assessments included catch scenarios that allowed for catches to be above those officially reported (e.g. Polacheck et al, 1996, 1998, 2001; Polacheck and Preece, 2001), while others only utilized the official statistics (Takeuchi et al, 1996; Tsuji and Takeuchi, 1997, 1998; Hiramatsu and Tsuji, 2001). However, given the sensitivity of this issue, the SC was unable to reach consensus on any specific scenarios that included unreported catches to use in the stock assessment process. This lack of consensus was one of the reasons preventing agreements within the Scientific Committee on the stock assessments throughout the late 1990s.

In the late 1990's concerns were raised that the Japanese market statistics indicated that the amount of SBT being sold was substantially more than the total national catch allocations. CCSBT Scientists encouraged the tabling of actual analyses demonstrating this (e.g. Anon., 1997c) so that they could be formally incorporated in the stock assessment process. An initial analysis was provided (Jeffries, 2000) but was subsequently withdrawn due to concerns about the reliability of the market statistics and difficulties associated with their interpretation (Anon., 2000b). Nevertheless, concerns persisted about the potential for large unreported catches. In 2005, these concerns along with further documented sources and analyses provided by Australian industry, resulted in the Australian government undertaking an independent analyses of the Japanese auction market data. Based on these analyses, Australia tabled documents at the CCSBT Scientific Committee and Commission meetings which suggested that there had been

---

"experimental fishing program" (Polacheck, 2002). Also, the CCSBT increased its global TAC to accommodate new member catches and to acknowledge the existence of non-member catches (Anon. 2003).

[4] Note that Korea was not a member of the CCSBT at this time.

substantially more SBT sold in the Japanese wholesale fish markets than could be accounted for in official catch statistics for an extended number of years (Australia, 2005[5]). The papers tabled by Australia resulted in Australia and Japan agreeing to undertake an independent review of the Japanese SBT market data anomalies and to report back to the Commission in 2006. The purpose of the review was to determine whether or not over-catches had occurred relative to the total allowable catch, and if so, over what period and what was its source (Anon., 2005a)[6].

3. ESTIMATION OF UNREPORTED CATCHES BASED ON MARKET STATISTICS

Japan is the primary market for SBT, with a very high percentage of the world catches consumed as sashimi within Japan. A large fraction of this SBT is sold as whole fish through auctions at more than 14 wholesale markets (Anon., 2006b). Statistical data on the amount of SBT sold at auction are available for a large number of these with Tokyo's Tsukiji market being the largest of them. However, access and interpretation of these market data are not straightforward. The marketing and distributional system is complex (Williams, 1986). Interpretation of these market statistics in terms of catches taken by the Japanese longline fleet is confounded by a number of factors including:

1) Only a fraction of the frozen wild whole tuna sold in Japan actually goes through these wholesale markets. There are direct sales of tuna that by-pass the wholesale market system (e.g. bulk purchases by supermarket chains);

2) The complex distribution and market systems result in some tuna being included in the sales statistics for more than one wholesale market (i.e. double counting exists in the simple sum of the total SBT sold across all markets);

3) A fraction of the wild caught frozen imported longline catches from other countries (e.g. Korea and Taiwan) are also sold in the wholesale markets;

4) A large fraction of the farmed SBT caught by the Australian surface fishery are frozen and a portion of these are sold in the wholesale market auctions;

5) There can be a substantial time lag between when an SBT was caught and when it is actually sold at Japanese markets, as a result of the long length of longline cruises and

[5] The paper tabled by Australia at the Scientific Committee was produced and presented during and not prior to the meeting, (Anon., 2005b). Although the paper was referenced in the Scientific Committee report and was used to support the agreed conclusions from the meeting, there was not agreement for it to become a formal meeting document - i.e. it is not publicly available from the CCSBT Secretariat (see Anon., 2005b, Anon., 2006c and Polacheck et al, 2006).

[6] Concurrent with the review of the Japanese market data, it was also agreed to undertake an independent review of possible anomalies in the Australian SBT farming operations at Port Lincoln to determine whether or not over-catches had occurred in this fishery relative to the total allowable catch (Anon., 2005b, JFA, 2005). As the anomalies in SBT farming operations have no direct implications for tropical tuna assessment, this review is not discussed here (see Anon,, 2006a for more details on the outcomes of this review)

because tuna can be held in frozen storage for extended periods (several years). This time lag is also likely to have varied over time with changes in technology, fleet operations and market practices.

The panel for the Japanese market review was not able to agree a number of details about the likely magnitude of the over-catches given the sorts of issues listed above. As a result, it provided two sets of estimates for the magnitude of the over-catches referred to as Case 1 and Case 2 (Anon., 2006b). Nevertheless, comparison of the cumulative total reported Japanese longline catches over this period and the estimates of the total longline caught SBT sold at market from either scenarios (discounted for non-Japanese catches) clearly shows a very large discrepancy (e.g ~178,000 tonnes above Japan's national allocation of ~133,000 tonnes for the period 1985-2005, or an estimated total catch of ~2.4 times above their national allocations (Hurry, 2006)).

Uncertainty exists about the identity of fleets contributing to the over-catch (Anon. 2006c,d). The possibility exists that some portion of the over-catch may be due to catch by non-parties although there is no reports of substantial fishing activity in the main SBT fishing grounds by vessels other then by vessels of the current CCSBT members. Discussion and decisions within the CCSBT indicate that a significant proportion is assumed to have been taken by the Japanese longline fleet. For example, Japan has acknowledged that substantial over-catch occurred in at least the most recent year (i.e. 2005). Additionally, the CCSBT agreed to substantial reductions (~50% of previous Japanese TAC) in the catches of Japan at their thirteenth annual meeting (Anon., 2006a). This assumption is also supported by recent statements from the Japanese fishing industry acknowledging the over-catch[7]. The assumption within the CCSBT that a significant proportion of the over-catch was taken by the Japanese longline fleet is used in this paper to explore the implications of the use of Japanese catch and effort statistics in the monitoring and assessments of other tuna stocks.

The Commission provided the two alternative cases for the magnitude of the unreported over-catches developed by the market review panel to the CCSBT SC and requested it to consider the implications of these two cases for past scientific advice on stock status, stock productivity and a management procedure for the SBT fishery (Anon., 2006b). From the two cases, the CCSBT SAG (Anon., 2006c) developed estimates of the annual longline catches based on the Case 1 and 2 provided by the Commission. The estimates are based on the assumption that the catch caught in any given year was sold over the subsequent next two years in an approximate 70/30% split. Based on this assumption for the lag between catch and time of sale, the market statistics indicate that there have been substantial over-catches since 1990, relative to Japan's reported catches (i.e. >100% in total and over 200% in some years) irrespective of which of the Commission scenarios is used (Figures 1-2). Prior to 1989 and the time when catch limits were not restrictive in terms of reported catches, the market statistics suggest small or no net over-catches from 1984-1988 (i.e. -3% or 7% depending upon the scenario considered) (Anon., 2006c).

In the context of the stock assessment for SBT, a key question is what proportion of the over-catch came from the reported effort used to calculate the standardized CPUE series used in the

[7] Interview with Mr Ishikawa of the Japan Tuna and Bonito Fisheries Coop Union, *Suisan Keizai* newspaper, 30 July 2007.

assessment and Management Procedure designed to set future catch levels to rebuild the stock. In short, if a large proportion of the unreported catches came from reported effort then it seriously compromises the use of these data as an index of abundance in the stock assessment and as an input to the MP adopted by the Commission. If none, or only a small fraction of the over-catch, was taken by reported effort then the CPUE series could continue to be used as an index of abundance and the additional catches incorporated into the catch series. To date the Scientific Committee has not had sufficient data or time to provide a satisfactory answer to this question and it remains a priority for their work program (Anon., 2007). It is worth noting however, that the SAG and SC concluded that of the alternative CPUE scenarios considered the range of 25-75% of the unreported catches coming from the reported effort for the LL1 (Japanese) fleet was considered most realistic. A 100% proportion was considered unrealistic, given that it would imply catch rates similar to those seen in the 1970's and this was inconsistent with most other indicators over the period of the over-catches, and zero could not be considered implausible (Anon., 2006c).

4. POSSIBLE SOURCES OF THE UNREPORTED CATCHES OF SBT AND THEIR IMPLICATIONS FOR TROPICAL TUNA CATCH STATISTICS AND CPUE ANALYSES

On first consideration, a substantial direct link between unreported SBT over-catch and reported Japanese longline catches for tropical tuna might seem unlikely, given the general spatial separation between the fisheries. However, 30% or more of the Japanese longline fleet is reported to have participated in the SBT fishery in every year since 1983 (Table 1). These vessels report that they are fishing for SBT for only part of the year and during the rest of the year, they report changing fishing grounds to target other tunas species, principally tropical tuna. As such, depending upon how the actual unreported catches were taken and how the catch and effort associated with these were reported in the logbooks from the vessels involved, the catch and catch rate data for other tuna species could be greatly affected. As many of these vessels also spend substantial periods of the year fishing for tropical tunas, in particular bigeye and yellowfin, there is the potential for the reporting practices to impact directly or indirectly on the vessel reported catch and effort data for tropical tuna fisheries in addition to those for SBT.

There are several alternative hypotheses that need to be considered to adequately deal with the uncertainty arising from the unreported SBT catches. One is that the large over-catches stemmed from an under-reporting of the actual SBT catches while vessels were legally fishing for SBT (i.e. by vessels authorized to fish for SBT during the official Japanese SBT season). In this case, the vessels may simply have decided to report only a fraction of the actual amount caught. However, given the magnitude of the over-catches, they may have decided to report at least a fraction of the unreported SBT catch as other species (e.g. bigeye) so as to avoid a large discrepancy between the quantity of fish being unloaded and the quantity reported in the log book (under-reporting of total catch would be easier to detect then the misreporting of the species composition). An alternative hypotheses is that, the large illegal catches of SBT were the result of vessels fishing in areas and time periods when fishing for SBT was closed. In this case, both the locations and actual catches are likely to have been misreported (e.g. it would be highly suspicious if a vessel were to report long periods of non-fishing or long periods of fishing with no catch).

An additional hypothesis is that a substantial fraction of the SBT over-catch was taken by vessels fishing legally outside of the SBT regulated fishing areas but misreporting SBT catches as other species. This situation can arise because there are large areas where SBT are known to occur that are not used by Japan for regulating the activities of their SBT fleets. Some of these areas (particularly in the Indian Ocean) have historically been the source of large catches of SBT and have never been closed to longline fishing by Japan - both those vessels with authorization to fish for SBT and the remainder of the fleet (see section below on Area 2 (Figure 5) for a specific example).

4.1 Observer Data

We examined available observer data in relationship to the hypothesis that unreported catches stemmed from an under-reporting of the actual SBT catches while vessels were legally fishing for SBT. Under this hypothesis, the unreported catches would have no direct effects on the data used in tropical tuna assessments. Under this hypothesis, vessels would have been achieving catch rates 2-3 times greater then those reported in some years.

There are three sources of observer data available for Japanese longline vessels fishing for SBT: (1) Australian observers on vessels fishing with in the Australian Fishing Zone; (2) New Zealand observers on vessels fishing in the New Zealand exclusive economic zone (EEZ) and (3) a combination of Australian, Japanese and New Zealand observers on vessels fishing on the high seas collected under a collaborative project among these three countries known as the Real Time Monitoring Program (RTMP). The first two are limited in their spatial extent but cover long time spans (i.e. for Australia from 1979-1997 with detailed data from 1991 and for New Zealand from 1990-2006). The RTMP data provide the broadest spatial coverage but are limited to the years 1991-1994.

Direct comparison of the observed catch rates from the RTMP and Australian observer data with either those reported from logbooks by the vessel when they had observers or in the logbook data for vessels without observers fishing in the same area and time period indicate that vessel reported catch rates tend to be somewhat larger than the rates observed by observers; while there is little difference in the reported catch rates between vessels with and without observers (e.g. Figure 3). For New Zealand, observer coverage has generally near 100% in recent years. Direct comparisons of observed and unobserved vessels would not be informative. However, the CPUE levels reported by New Zealand observers are similar to, or less, than those reported in general by the Japanese fleet for the Tasman Sea or the general SBT fishing grounds (i.e. Areas 4-9) (e.g. Polacheck et al, 2004; Basson et al, 2005). In short, the available observer data do not suggest any substantive under reporting of the SBT catch rates in the vessel reported logbook data.

The lack of any substantial discrepancy between the observed and logbook reported catch rates could occur if vessels with observers deliberately fished ineffectively (e.g. by choice of set location, depth fished, baiting practices, etc.). For the Australian and New Zealand data, this seems unlikely. In Australia, observer coverage was relatively high (usually 20% or greater) and vessels underwent pre- and post- inspection of the catches in their freezers. Large discrepancies between observed and reported catches on the order of the 200% or more that would have been required to produce the over-catches would have been apparent. The 100%

observer coverage in New Zealand waters means that deliberately poor fishing can not explain why catch rates here have been similar to or less than those reported in nearby waters. In addition, if substantial underreporting of catch rates was not occurring within Australian and New Zealand waters, there is the question of why vessels would have been willing to both pay access fees and spend considerable amounts of time fishing there if substantially higher catch rates were achievable on the high seas.

4.2 Latent Effort and Effort Required to Catch the Over-catch

One hypotheses for the source of SBT over-catch is from Japanese SBT registered vessels fishing for SBT outside of the official Japanese SBT season and failing to report their catch or misreporting the species. This could result in substantial catches of species, such as bigeye and/or yellowfin, being over reported (i.e. SBT reported as these species) and considerable amounts of effort incorrectly being judged as targeted at these species. One measure of the potential for this to have occurred is to determine how much potential latent effort existed in the fishery. The number of available fishing days that existed each year outside of the official SBT season, combined with the number of SBT vessels, provides an indication of the extent that fishing outside of the official season could have been a potential source of significant over-catch.

We have calculated the number of available fishing days for authorized SBT vessels that fell within the official SBT fishing season during a given year based on the number of vessels and fishing days allocated to different areas. Based on these calculations[8], no more than 36% of the available fishing days for registered SBT vessels would have fallen within official SBT seasons (Figure 4). As such, substantial latent effort existed within the SBT fleet for conducting fishing outside the official season. Given the observed IUU fishing in 1996 (Anon., 1997a, b and see above), it is plausible that such fishing activity was a source for the SBT over-catch. If this were the case, and assuming that some level of catch and effort was reported for these fishing activities, it is likely that these vessels over reported both catch and targeted effort for other species of tuna.

4.3 Reported Catch and Effort in Area 2

SBT statistical Area 2 (Figure 5) in the eastern Indian Ocean is one area that is never closed to longline fishing for tuna by Japan where substantial quantities of SBT have been caught in the past. It is located to the north of Area 8 which is one of the primary fishing grounds for high quality SBT. Area 2 is recognized as a staging ground for SBT spawners (“the “Oki” grounds). The largest reported catches of SBT in Area 2 occurred during the early 1960s when over 75% of the annual reported Japanese SBT catch in some years was caught in this one statistical area. In 1971, much of this area was voluntarily closed by the Japanese industry to SBT fishing between December and March as a measure to protect migrating spawning fish. Since then,

[8] Note that for the years 1990-92 and 1995-98 detailed information was not available on the number of vessels by fishing area. For these years, it was assumed that 40% of the available SBT vessels went to the Tasman Sea and 60% went to the Off Cape area in any given year, and that 70 vessels went to the southeast Indian Ocean. These values were based on the pattern seen in other years.

reported SBT catch rates in Area 2 have always been low, except for an increase reported in 2005 (Figure 6).

While reported catch rates of SBT remain low in Area 2, the amount of reported effort increased dramatically after catch quotas became restrictive on the Japanese fleet in 1989 (Figures 6). This could reflect a displacement of effort towards bigeye (which are also found in this area) when the SBT fishery was closed or an area where catches (given the large historical catches of SBT from this area) and possibly location of effort were misreported. In terms of considering the plausibility of alternative hypotheses for the source of the over-catch, it is informative to explore the extent to which the large increases in reported effort in Area 2 could have accounted for them. Figure 7 compares the amount of reported effort in Area 2 and the amount of effort required to have caught the over-catch[9]. Figure 7 indicates that the increasing effort in Area 2 between 1989 and 1995 would have been sufficient to explain a large fraction of the over-catch in those years. Subsequently, this depends on the assumption made for what catch rate is assumed to apply for the over-catch but in all cases, the reported effort in Area 2 was still sufficient to have been a potentially important source of the over-catch. As such, it may also be a factor affecting the reported catch and catch-rate data for other species, particularly bigeye considering the difficulty in distinguishing between frozen gill and gutted bigeye and SBT.

4.4 Summary of Implications

In summary, the large unreported over-catches of SBT have two direct implications for tropical tuna assessments: (1) on the actual catch estimates used in the assessments and (2) on the effort used in calculation of CPUE. Determining the actual implications for individual stocks and assessments is beyond the scope of this paper as it would require detailed analyses of the catch and effort data and subsequent re-runs and comparisons of the individual assessments. We consider this to be the responsibility of the scientific committees of the respective RFMOs responsible for providing advice on these stocks. Given their familiarity with the data and assessments, they are best placed to interpret any potential inconsistencies. Nevertheless, we note that while the magnitude of the SBT over-catch is large relative to the official SBT catches, it is small relative to the total magnitude of the catches for the two species it is most likely to have been misreported as (i.e. bigeye and yellowfin). As the misreporting is likely to be for larger fish in more southern regions, it is not obvious what magnitude of misreporting would be significant in terms of the older age component of the stock (and therefore estimates of spawning biomass) and for interpretation of spatial impacts of the current fisheries. In terms of effort, the potential amount of misreporting of locations is significant relative to global Japanese reported longline effort . Thus, misreporting of effort associated with the SBT over-catch potentially could have substantial effects on the current estimates of CPUE for other

---

[9] The average number of total fishing days per boat required to have caught the official Japanese catch plus the over-catch can be approximately calculated by dividing the total annual catch by estimates of the catch per day. This in turn can be derived from estimates of the CPUE in hooks divided by the number of hooks per set (vessels set at most one set per day). Finally, this figure can be divided by the number of SBT vessels to give the number of fishing days per year. In doing these calculations, we assume that on average 3,000 hooks were used in each set. We explored three different values for the catch rate (see Figure 7).

species (particularly for the estimates in more southern waters) and how these are integrated into overall estimates for different stocks.

5. THE NEED FOR INDEPENDENT VERIFICATION CATCH AND EFFORT STATISTICS AND INTERNATIONAL STANDARDS FOR DATA FOR STOCK ASSESSMENT IN FISHERIES

The unreported SBT over-catches and IUU fishing highlight the dilemma and risks of relying predominantly on data from vessel-supplied logbook for conducting stock assessments. That a large incentive for fishermen to misreport when restrictive quotas exist is obvious. Without effective independent monitoring of vessel activities and landings, it is not surprising, at least in retrospect, that large over-catches occurred in the SBT situation – particularly given the high value associated with individual fish and limited or lack of real-time verification of landings and reported catches.

One question about the reliability of the Japanese log book data is whether issues of reliability should only be seen as a concern in situations and time periods for which restrictive quotas have been in place (e.g. for SBT, NBT and bigeye in the Atlantic). The estimates considered by the CCSBT and SC based on the market review suggest that the beginning of the over-catch was associated with the catch quota becoming restrictive on the Japanese fleet. However, the estimates of the actual magnitude of the SBT over-catch, particularly pre-2000, depend upon a number of assumptions for which there are little direct data to base estimates and to bound the likely uncertainty. One of the most critical is the assumed value for the proportion of SBT that by-pass the wholesale market system (i.e. direct sales) (Australia, 2005). If the proportion was greater then that used in estimating the over-catches, then the market statistics would suggest substantial over-catches of SBT were occurring during most of the 1980s and prior to catch quotas becoming restrictive.

The motivation for this potential source of misreporting is not clear. Taxes concerns could have been an issue for the Japanese fleet and if so, they would also apply to fleets harvesting tropical tuna. Such issues raise questions about the general reliability of the Japanese logbook data and not simply those for SBT. Given the apparent lack of effective independent monitoring of the Japanese fleet in the past and the large SBT over-catches, independent assessment of the reliability of these data for other species and time periods (e.g. additional market reviews) would seem warranted and urgent – particularly given the central role of Japanese CPUE time series in most tuna and billfish assessments.

The large over-catches for SBT and reliance on unverified logbook data raise general questions about the lack of rigour, standards and quality assurance processes for data that have been used in fishery stock assessment and in the provision of “scientific” advice for management of highly migratory species. It must be stressed that while this paper has focussed on the implications of under/misreporting of catches from the Japanese SBT longline fleet, the same issue applies to all international tuna longline and other fleets that do not have independent means for observing and verifying catch and effort statistics. Accepting logbook data for use in stock assessments without independent monitoring and verification is standard practice in many fora. This is particularly the case at the international level where the ability for scientific bodies to critically evaluate "official" statistics is limited and implementation of independent monitoring of fishing activities requires consensus and significant resources[10]. When there are conflicts of interest (or at least perceived conflicts of interest) combined with the potential use of the data for compliance, management and/or science; standard scientific practice would generally require independent review and evaluation of the objectivity and accuracy of such data before they were used in the provision of scientific advice (e.g. compare the lack of standards in fisheries with the requirement for double blind administration of drugs in medical trials, or the standard requirement of independent audits of corporations to report to shareholders). Of course the problem in many fisheries (particularly tuna fisheries) is that without the logbook data, there would be little or no basis for conducting a scientific assessment (due to the operational difficulties and lack of investment in fisheries independent monitoring). In general, scientific committees have not been willing to advise Commissions that they cannot provide robust assessments with the available, inadequately verified data – pragmatism has prevailed.

Any analysis or assessment is conditional on the accuracy and reliability of the data used. While the potential for bias and precision in input data can be accommodated to a degree (i.e. via sensitivity analyses), such approaches cannot account for the scale of bias revealed in the case of SBT. Given the scale of the unreported catch revelations described above, it is important to ask: At what point, is the appropriate response for requests for scientific advice to reply that it is not possible to provide meaningful advice based on unverified and potentially unreliable and biased data? The alternative of having no "scientific" advice or basis for making management decisions is not desirable and would be considered in direct contradiction of current international agreements and fisheries management norms (e.g. United Nations 1995; Anon., 2000a; FAO, 1996). Nevertheless, where the uncertainties are both large and unquantifiable, any advice will have a large subjective element as a consequence of the choice of hypotheses selected to represent the uncertainty and relative weights given to them (e.g. in many assessments, a zero weight is implicitly given to all hypotheses about catch levels except for the officially reported ones). Given these issues it would seem, at the very least, that there is a need to ensure that concerns about the lack of verification of logbook data are clearly raised and addressed as a matter of priority. The experience in CCSBT indicates that this is likely to be a difficult and protracted process.

It is not the role or responsibility of science to take on the management roles of compliance and enforcement. However, scientists do have a responsibility to ensure that the data they use in scientific analyses are reliable and the uncertainties associated with them are explicitly incorporated into assessments. In some cases, there will be an overlap between the scientific need for reliable, verified data and management's need for compliance and enforcement. When data can be used for these dual purposes (e.g. observer or port sampling data), it is important for transparency and the acceptability of the data collection programs that the intended uses of the data are clearly specified. If the data are intended to be used in the scientific process, scientists have an important role in the design and implementation of such data collection programs to

[10] There are some exceptions. For example CCAMLR which has 100% observer coverage on the legal vessels fishing for toothfish. However, in the case of toothfish there were substantial illegal catches initially for which there was little scientific monitoring nor effective enforcement and compliance. A range of integrated measured implemented by CCAMLR and Members have significantly reduce the IUU catches of toothfish in the southern Ocean.

ensure that the results are reliable and meet the needs of the scientific process. In this context, there is a strong and urgent need for the fisheries science community to be more pro-active in the development and implementation of independent ways to monitor and verify catches and fishing effort for scientific purposes (e.g. scientific observers, video monitoring, port sampling, etc,) and to impress upon managers and policy makers the limitations of many of the current systems.

6. ACKNOWLEDGEMENTS

We appreciate the critical reviews of an earlier draft of this manuscript provided by Tony Smith, Cathy Dichmont, John Gunn and David Smith. The views expressed, however, are those of the authors.

7. LITERATURE CITED

Anon. 1990. Report of the ninth meeting of Australian, Japanese and New Zealand scientists on southern bluefin tuna. 17-22 September 1990. Hobart, Australia.

Anon. 1991a. Report of the tenth meeting of Australian, Japanese and New Zealand scientists on southern bluefin tuna. 17-22 September 1991. Wellington, New Zealand.

Anon. 1991b. Report of the tenth meeting of Australian, Japanese and New Zealand scientists on southern bluefin tuna: Minutes of the Meeting. 17-22 September 1991. Wellington, New Zealand.

Anon. 1994. First Meeting of the Commission for the Conservation of Southern Bluefin Tuna. May 1994. Wellington, New Zealand.

Anon. 1997a. CCSBT Report of the Resumed Third Annual Meeting (Revised). 18 – 22 February 1997. Canberra, Australia.

Anon. 1997b. Report of the Third Scientific Committee Meeting of the CCSBT. 28 July – 8 August 1997. Canberra, Australia.

Anon. 1997c. Outcomes of discussions of the informal scientist workshop 13 May 1997. Coogee Bay Hotel Sydney, Australia.

Anon. .a Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western Central Pacific Ocean. http://www.wcpfc.int/

Anon. 2000b. AFMA SBTMAC FAG Meeting Report: Report of the Special 2000 SBT FAG Meeting. 7-8 September 2000. Hobart, Tasmania.

Anon. 2003. CCSBT Report of the Tenth Annual Meeting of the Commission. 7-10 October 2003. Christchurch, New Zealand.

Anon. 2005a. CCSBT Report of the Twelfth Annual Meeting of the Commission.15 October 2005. Narita, Japan.

Anon. 2005b. CCSBT Report of the Tenth Meeting of the Scientific Committee. 9 September 2005. Narita, Japan.

Anon. 2006a. CCSBT Report of the Thirteenth Annual Meeting of the Commission. 10 – 13. October 2006. Miyazaki, Japan.

Anon. 2006b. CCSBT Report of the Special Meeting of the Commission. 18-19 July 2006. Canberra, Australia.

Anon. 2006c. CCSBT Report of the Seventh Meeting of the Stock Assessment Group. 4 - 11 September 2006. Tokyo, Japan.

Anon. 2006d. CCSBT Report of the Eleventh Meeting of the Scientific Committee. 12-15 September 2006. Tokyo, Japan.

Anon. 2007. CCSBT Report of the Twelfth Meeting of the Scientific Committee, 12-18 September 2007. Hobart, Australia.

Australia. 2005. Comparison of CCSBT catch data with Japanese auction sales of frozen SBT. CCSBT-EC/0510/25.

Basson, M., J. Hartog, D. Kolody and T. Polacheck. 2005. Fishery indicators for the SBT stock 2004/05. CCSBT-SC/0509/25.

Caton, A.E. 1991. Review of aspects of southern bluefin tuna biology, population and fisheries. pp181-357. In: World Meeting on stock assessment of bluefin tunas: strengths and weaknesses. Special report. Edited by R.B. Deriso and W.H. Bayliff. La Jolla, California: Inter-American Tropical Tuna Commission.

FAO. 1995. Precautionary approach to fisheries. Part 1:Guidelines on the precautionary approach to capture fisheries and species introductions. FAO (Food and Agriculture Organisation of the United Nations) Fisheries Technical Paper, 350/1.

JFA. 2005. Preliminary analysis on growth rates of farmed SBT through trade data and other related information. CCSBT-EC/0510/29.

Hampton, J., J. R. Sibert, P. Kleiber, M. N. Maunder and S. J. Harley. 2005. Fisheries: Decline of Pacific tuna populations exaggerated? Nature 434 (E1-E2) doi: 10.1038/nature03581.

Hiramatsu, K. and S. Tsuji. 2001. Stock assessment and future projection of the southern bluefin tuna based on the ADAPT VPA. CCSBT-SC/0108/31.

Hurry, G. 2006. Opening Statement by Australia. CCSBT Report of the Thirteenth Annual Meeting of the Commission. 10 – 13. October 2006. Miyazaki, Japan.

Itoh, T. and K. Miyauchi. 2005. Review of Japanese SBT Fisheries in 2004. CCSBT-ESC/0509/SBT Fisheries/Japan.

Myers, R.A. and Worm, B. 2003. Rapid worldwide depletion of predatory fish communities. Nature 423: 280-283.

Myers, R.A. and B. Worm. 2005. Fisheries: Decline of Pacific tuna populations exaggerated? Myers and Worm reply. Nature 434 (E2) doi:10.1038/nature03582.

Polacheck, T. 2002. Experimental catches and the precautionary approach: The Southern Bluefin Tuna Dispute. Marine Policy.26:283-294.

Polacheck, T. 2006. Tuna longline catch rates in the Indian Ocean: Did industrial fishing result in a 90% rapid decline in the abundance of large predatory species? Marine Policy 30:470-482.

Polacheck, T. and N. Klaer. 1991. Assessment of the status of the southern bluefin Tuna Stock using virtual population analysis - 1991. 10th Trilateral Scientific Meeting on SBT SBFWS/91/6.

Polacheck, T., A. Preece, A. Betlehem and K. Sainsbury. 1996. Assessment of the status of the southern bluefin Tuna Stock using virtual population analysis - 1996. CCSBT/SC/96/26.

Polacheck, T., Preece, A. and Klaer, N. 1998. Assessment of the Status of the Southern Bluefin Tuna Stock using Virtual Population Analysis - 1998. CCSBT-SC/9807/17.

Polacheck,T., A. Preece and D. Ricard. 2001. Assessment of the the Status of the Southern Bluefin Tuna Stock Using Virtual Population Analysis – 2001. CCSBT-SC/0108/20.

Polacheck, T. and A. Preece. 2001. An Integrated Statistical Time Series Assessment of the Southern Bluefin Tuna Stock based on Catch at Age Data. CCSBT-SC/0108/20.

Polacheck, T., D. Kolody, M. Basson and J. Gunn. 2004. Fishery indicators for the SBT stock 2003/04. CCSBT-SC/0409/21.

Polacheck, T., M. Basson, D. Kolody and J. Hartog. 2006. The Status of cited working papers and attachment 3 from working paper 1 from the 2005 extended scientific committee meeting: CCSBT-ESC/0609/27.

Sibert, J., J. Hampton, P. Klieber and M. Maunder. 2006. Fishery induced changes in biomass, size structure and tropic status of top-level predators in the Pacific Ocean. Science 314: 1773 – 1776.

Takeuchi, Y., S. Tsuji and Y. Ishizuka. 1996. Assessment of the southern bluefin tuna stock - 1996. CCSBT/SC/96/23.

Tsuji, S. and Y. Takeuchi. 1997. Stock Assessment and Future Projection of Southern Bluefin Tuna – 1997. CCSBT/SC/9707/17.

Tsuji, S. and Y. Takeuchi. 1998. Stock Assessment and Future Projection of Southern Bluefin Tuna – 1998. CCSBT-SC/9807/27.

United Nations. 1995. Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks. (*http://daccessdds.un.org/doc/UNDOC/ GEN/N95/274/67/PDF/N9527467.pdf?OpenElement*.)

Walters, C. 2003. Folly and fantasy in the analysis of spatial catch rate data. Canadian Journal of Fisheries and Aquatic Science 60: 1433-1436.

Williams, S.C. Marketing tuna in Japan. Queensland Fishing Industry Training Committee. Brisbane, Australia.

Table 1: Number of Japanese longline vessels, the number that reported catching some SBT, and the number that caught more than 100t. The data in recent years are preliminary (modified from Itoh and Miyauchi, 2006).

Year	All longline[1]	SBT>0[2]	SBT>100[3]	Percent of Global fleet SBT>0[2]	Percent of Global fleet SBT>100[3]
1983	770	270	265	35	34
1984	761	287	276	38	36
1985	773	293	275	38	36
1986	771	271	253	35	33
1987	770	276	248	36	32
1988	759	255	223	34	29
1989	764	256	229	34	30
1990	758	250	240	33	32
1991	737	196	187	27	25
1992	723	205	192	28	27
1993	722	209	186	29	26
1994	716	201	193	28	27
1995	703	210	201	30	29
1996	674	230	218	34	32
1997	661	213	205	32	31
1998	663	220	205	33	31
1999	528	188	183	36	35
2000	529	180	168	34	32
2001	529	196	187	37	35
2002	523	176	168	34	32
2003	517	173	162	33	31
2004	506	169	165	33	33

1: The total number of Japanese high sea longline vessels.

2: The total number of Japanese high sea longline vessels which reported operating in the statistical areas 4-9.

3: The total number of Japanese high sea longline vessels which reported operating in the statistical areas 4-9 and reported catching more then 100 tonnes of SBT.

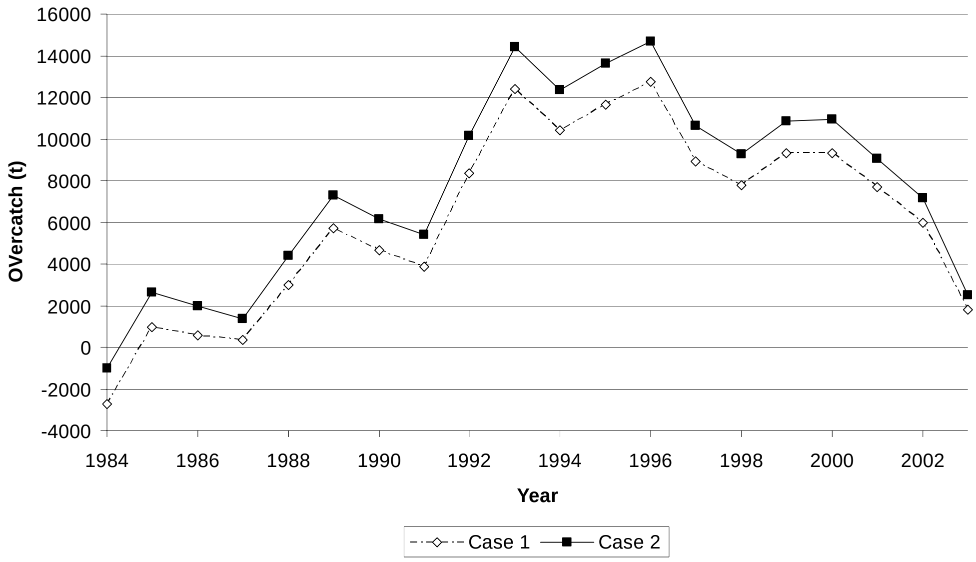


Figure 1: Estimated amount of over-catch in a year taking into account the lag between time of capture and time of sale for the Case 1 and Case 2 scenarios provided by the CCSBT Commission to the Scientific Committee. This figure is based on Figures 2 and 3 in attachment 4 from Anon. 2006c. Note the numerical values are approximate as they were taken from estimating the values based on reading the y-axes in these figures.

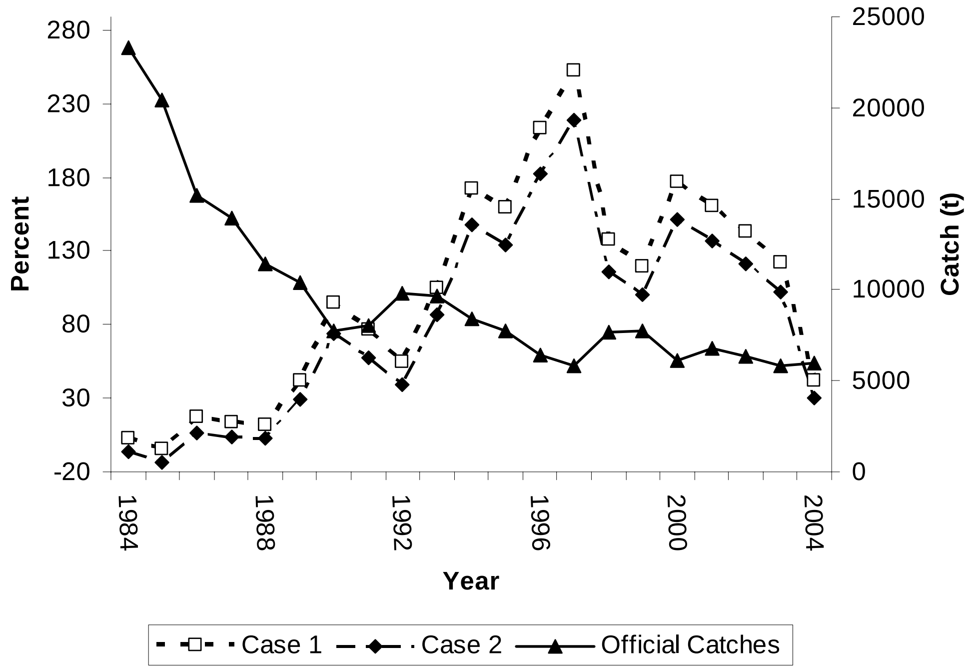


Figure 2: Japanese official catches of SBT as reported to the CCSBT for years 1984-2004 including RTMP and EFP catches and the percentage over-catch for the Case 1 and Case 2 scenarios provided by the CCSBT Commission to the Scientific Committee and lagged as in Figure 1. This percentage figure is based on using the numerical values for the over-catch in Figures 2 and 3 in attachment 4 from Anon. 2006c. Note the numerical values are approximate as they were taken from estimating the values based on reading the y-axes in these figures.

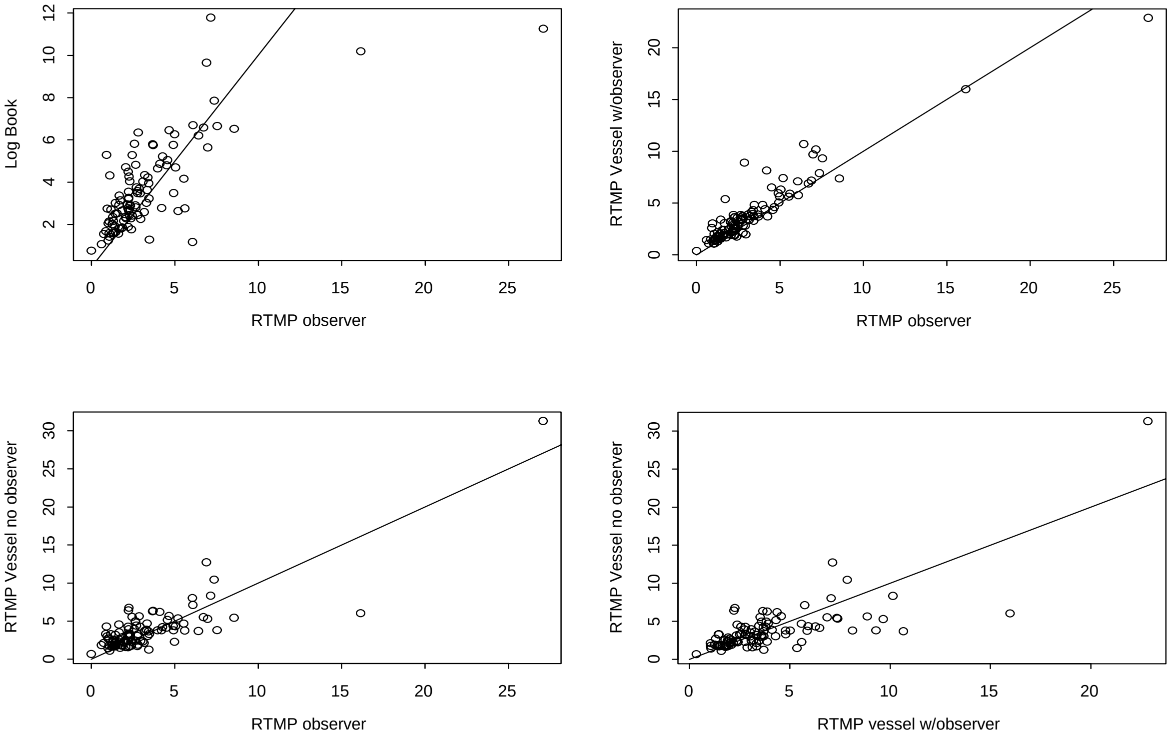


Figure 3: Comparison of the catch rates (number of SBT per thousand hooks) in a 5°square/month stratum based on different sources for the catch and effort data. Upper left: Japanese vessel reported log book data compared to RTMP observer data; upper right: RTMP vessel reported data when observers were present compared to RTMP observer data; lower left: RTMP vessel reported data when no observers were present compared to RTMP observer data and lower right: RTMP vessel reported data when no observers were present compared to RTMP vessel data when observers were present. The 45° line in each panel is the expected line if no difference existed between the two CPUE estimates being compared.

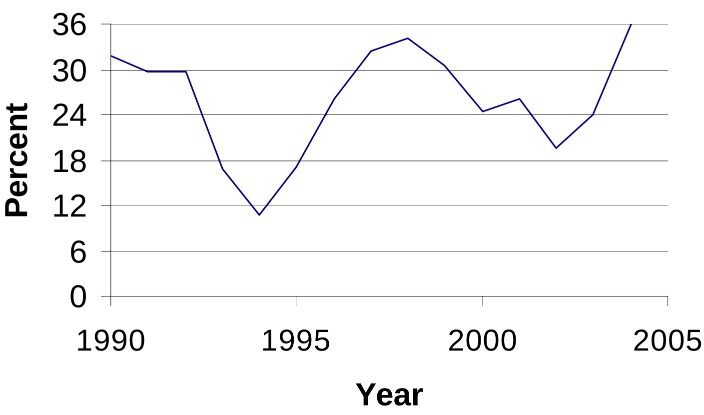


Figure 4: The percentage of available days within a year that Japanese SBT vessels could officially have fished for SBT within regulated SBT fishing grounds.

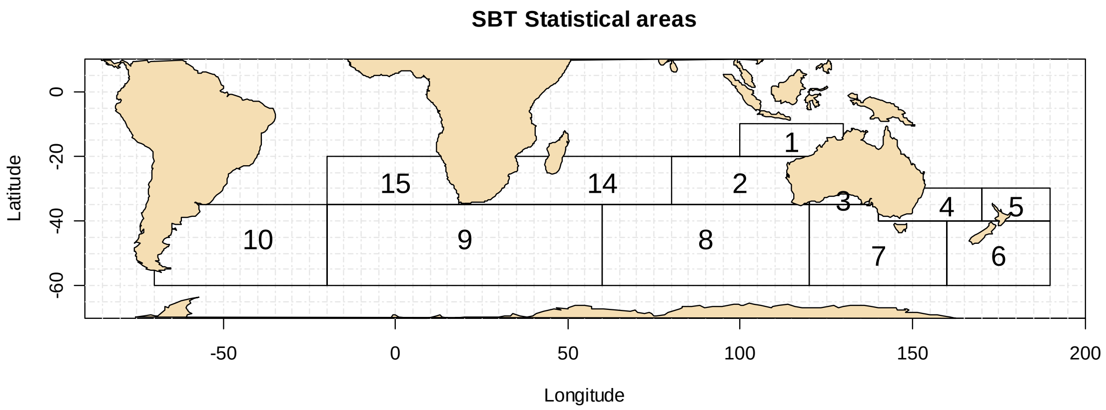


Figure 5: SBT statistical areas defined by the CCSBT. Note that areas 1-10 have been those traditionally used for Japanese longline data. Areas 14 and 15 are recently defined areas to encompass areas where there has been significant Taiwanese reported catch and effort. Japan does not provide complete catch and effort data to the CCSBT for these latter two areas.

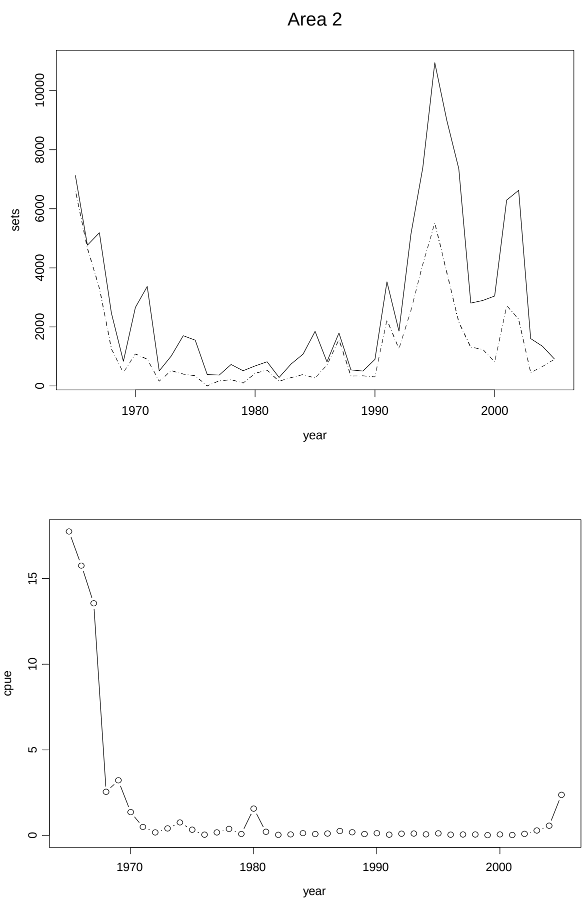
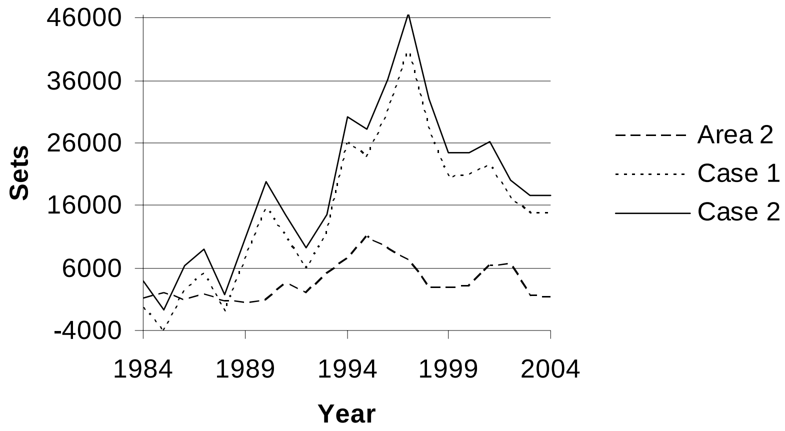
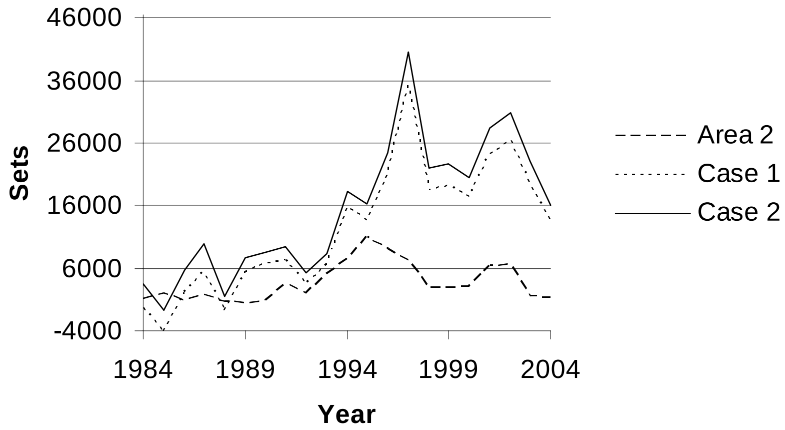


Figure 6: Annual number of reported longline sets (upper panel) and catch rates (number of SBT per 1000 hooks – lower panel) by Japanese vessels in Area 2. Number of reported longline sets was estimated based on assuming an average of 3,000 hooks per set. Dotted line is for months 1-3 or 10-12 (i.e. outside the main period of the normal official SBT fishing season) and the solid line is for all months.





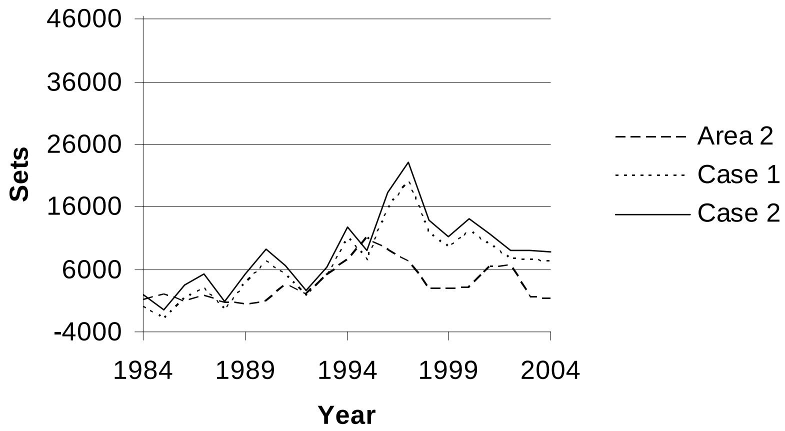


Figure 7: Comparison of the number of sets reported in Area 2 compared to the calculated number of sets required to account for the Case 1 and Case 2 over-catch scenarios provided by the CCSBT Commission to the Scientific Committee assuming that all of the over-catch came from unreported sets. Upper panel assumes the catch rates for the unreported catch equalled the nominal CPUE for SBT; mid panel that they equalled the maximum of the nominal rate in Area 7, 8 or 9 (the primary Japanese fishing areas for SBT) and lower panel that they equalled the average CPUE in the top 20% ranked 5°square/month strata (see footnote 11 for detail).

Contact Us
Phone: 1300 363 400
+61 3 9545 2176
Email: enquiries@csiro.au
Web: www.csiro.au