Considerations of the 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

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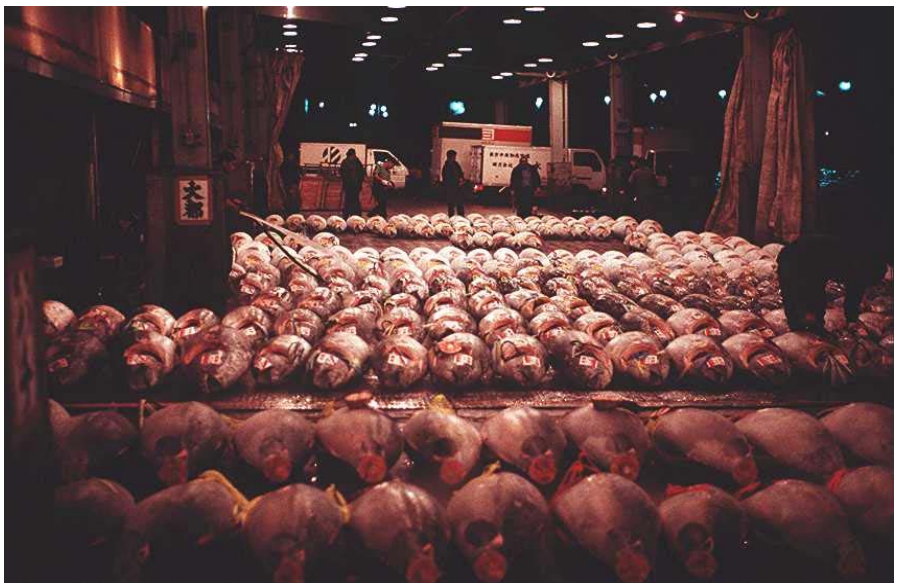

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ABSTRACT

Japanese catch and effort data provided through commercial logbooks 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 an independent panel 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 unreported catches of SBT had been occurring by longline vessels since at least the early 1990s. While there is uncertainty about the identity of fleets contributing to the unreported catches, an assumption used within the CCSBT Scientific Committee is that a significant proportion of these unreported catches were taken by Japanese longliners. If this assumption is correct, estimates of Japanese catches of SBT have exceeded reported catches by at least a factor of 2 over this period. This paper discusses potential implications of these 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 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 unreported 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

Logbook 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 principal, 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 Worm, 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) has been undertaken.

In 2006, an independent review of catches of Southern Bluefin Tuna (SBT) sold in the principal Japanese tuna markets was undertaken in relation to potential market anomalies (Anon., 2006b). The review revealed that there has been very substantial and continuous unreported longline catches of SBT since at least the early 1990s (Anon., 2006a, c, d)[1]. As discussed below, it appears that a working assumption within the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Scientific Committee (SC) and its Stock Assessment Group (SAG) is that a significant proportion of these catches were taken by the Japanese longline fleet (Anon., 2006a paragraphs 57 and 66 and attachment 4, b paragraphs 14-15 and attachment 7, c (attachment 4), d (paragraphs 16, 22, attachment 5)). In the case of the scenarios developed by the SAG[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 (Anon 2006c (attachment 4), d (paragraphs 16, 22, attachment 5)). The standardised CPUE series derived from these data from this fleet is 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 logbook data used for stock assessment purposes.

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:

[1] The report of the independent review of Japanese market statistics is confidential under the rules of procedure of the CCSBT. This paper refers to information on the unreported catches contained in the official reports from the CCSBT Commission, Scientific Committee (SC) and Stock Assessment Group (SAG) meetings (Anon., 2006a, b, c, d), which are in the public domain and available either by request from the CCSBT Secretariat or, alternatively, can be downloaded from the CCSBT website (http://www.ccsbt.org/docs/meeting_r.html).

[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.

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. 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 CCSBT in 1993 (Caton, 1991; Anon., 1994). Total allowable catch (TAC) limits were introduced in 1985 under the informal tri-nation arrangement and were divided into national allocations. The TAC 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, both informal catch limits under the tri-nation agreement and formal catch limits under the CCBST essentially remained fixed until the 2007 fishing year[3].

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

[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 voluntarily agreed to keep their catches at their past level except in 1998 and 1999 when Japan unilaterally increased its catches to undertake an "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).

brief overview here. Concerns about potential unreported catches of SBT began to be raised in the early 1990s – i.e. shortly after the informal catch limits agreed for SBT under the tri-nation agreement 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-nation and subsequent CCSBT, there was also concern about the incentive that restrictive quotas generate for under-reporting and discarding of catches (e.g. Polacheck and Klaer, 1991; Pascoe, 1997), Direct evidence of IUU (illegal, unreported and unregulated) fishing by SBT longline 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 SC 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 was one of the issues preventing agreements within the SC on the stock assessments throughout the late 1990s.

In the late 1990s 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 under the CCSBT. The SC 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 but was subsequently withdrawn due to concerns about the reliability of the market statistics and difficulties associated with their interpretation (Anon., 2000a). 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 analysis of the Japanese auction market data. Based on these analyses, Australia tabled documents at the CCSBT Scientific Committee (Anon2005b, paragraph 27[5]) and Commission meetings (Australia,

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

[5] The paper tabled by Australia at the Scientific Committee was produced and presented during and not prior to the meeting, (Anon., 2005b, paragraph 27). Although the paper was referenced in the Report of the 11th Scientific Committee and was used to support the agreed conclusions from the meeting, there was not agreement for it to become a formal meeting document (see Polacheck et al, 2006).

2005),which suggested that there had been 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. 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 (Anon., 2005a, paragraph 129). The purpose of the review was to determine whether or not unreported catches had occurred relative to the total allowable catch, and if so, over what period and what was its source (Anon., 2005a, paragraph 129)[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 in Japan (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 or other 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 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.

[6] Concurrent with the review of the Japanese market data anomalies, 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).

The independent panel for the Japanese market review was not able to agree on a number of details about the likely magnitude of the unreported catches given the sorts of issues listed above. As a result, it provided two sets of estimates for the magnitude of the unreported catches referred to as Case 1 and Case 2 (Anon., 2006b paragraphs 7, 17-19, attachment 7). 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 reported catches) clearly shows a very large discrepancy (Anon., 2006c (attachment 4, figures 2 and 3)). This discrepancy amounts to approximately 178,000 tonnes of unreported catches over the period 1985-2005. In the period following the establishment of the CCSBT (1994 – 2005), the market anomalies equate to approximately 133,000 tonnes above the agreed national allocations to members (Anon., 2006c (attachment 4, figures 2 and 3)).

Uncertainty exists about the identity of fleets contributing to the unreported catches (Anon., 2006 b attachment 7). The possibility exists that some portion of the unreported catches may be due to catches by non-parties, although there are no reports of substantial fishing activity in the main SBT fishing grounds by vessels other than by vessels of the current CCSBT members. Discussion and decisions within the CCSBT and its subsidiary bodies appear to suggest that a substantial proportion is assumed to have been taken by the Japanese longline fleet. For example, Japan has acknowledged that a substantial unreported catch occurred in the 2005 fishing year (2006 a attachment 4-5 paragraph 3). The CCSBT agreed to substantial reductions (~50% of the previous Japanese annual TAC) in the catches of Japan at their thirteenth annual meeting (Anon., 2006a). The assumption is also supported by recent statements from the Japanese fishing industry acknowledging the unreported catches[7]. The assumption within the CCSBT that a significant proportion of the unreported catches were 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 (Cases 1 and 2) for the magnitude of the unreported catches developed by the market review panel to the CCSBT SC and requested it 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 developed estimates of the annual longline catches (Anon., 2006c, (paragraph 51 and attachment 4)). The estimates are based on the assumption that the catch caught in any given year was sold over the subsequent 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 unreported 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 on the Japanese longline fleet in terms of reported catches under the informal tri-nation agreement, the market statistics suggest small or no net unreported catches from 1984-1988 (i.e. -3% or 7% depending upon the scenario considered) (Anon., 2006c, attachment 4, figure 3 & 4, table 1).

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

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

(known as “LL1”) used in the stock assessment and Management Procedure (MP) designed to set future catch levels to rebuild the stock. In short, if a large proportion of the unreported catches came from reported effort used in this series 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 unreported catches were taken by reported effort from the LL1 series then the CPUE series could continue to be used as an index of abundance and the additional catches incorporated into the catch series.

The SAG and SC explored a range of scenarios for the proportion of the unreported catches that arose from the LL1 fleet. 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., 2006d, 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 registered fleet was considered most realistic (Anon., 2006c attachment 4, appendix 1, sections 2, p 308-316). 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 stock status indicators over the period of the unreported catches, and zero could not be considered implausible (Anon., 2006c), but was considered unlikely.

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 catches and reported Japanese longline catches for tropical tuna might seem unlikely, given the general perception of spatial separation between the fisheries. However, 27% or more of the registered 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 tuna species, principally tropical tunas. As such, depending on how the actual unreported catches were taken and how the catch and effort associated with these were reported (or not) 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 whether the large unreported catches stemmed from under-reporting of 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 unreported catches, they may have decided to report at least a fraction of the unreported SBT as other species (e.g. bigeye) to avoid a large discrepancy between the quantity of fish being landed and the quantity reported in the logbook

(under-reporting of total catch would be easier to detect than the misreporting of the species composition). An alternative hypothesis is that, the large unreported catches of SBT were the result of vessels fishing in areas and times 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 while on the grounds or long periods of fishing with no catch).

Another alternative hypothesis is that a substantial fraction of the unreported SBT catches were 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 the Japan government to regulate the activities of their SBT fleet. 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 - either to those vessels with authorization to fish for SBT or the remainder of the longline fleet (see section 4.3 for a specific example).

4.1 Observer Data

We examined available observer data in relation to the hypothesis that unreported catches may have stemmed from 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. For this hypothesis to be supported, vessels would in some years have been achieving catch rates 2-3 times greater than those reported to account for the size of the unreported catches.

There are three sources of observer data available for Japanese longline vessels fishing for SBT: (1) Australian observers on vessels fishing within 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 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 catch rates reported by vessels with observers tend to be somewhat higher than the catch rates reported by the observers. There is little difference in the vessel reported catch rates between vessels with and without observers (e.g. Figure 3). In the case of New Zealand, observer coverage has generally been near 100% in recent years. Therefore, direct comparisons of observed and unobserved vessels is not 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 in the order of the 150-200% or more that would have been required to produce the estimated unreported 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 Unreported Catches

One hypothesis for a potential source of unreported SBT catches is from registered Japanese SBT 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 interpreted as targeted at these species. One measure of the potential for this to have occurred is to determine how much potential latent longline effort existed in the SBT longline fishery. The number of fishing days that existed each year outside of the official Japanese SBT season, combined with the number of Japanese SBT vessels, provides an indication of the potential for fishing outside of the official season to be a potential source of unreported catches.

We have calculated the number of available fishing days for authorized SBT vessels that fell within the official Japanese SBT fishing season during a given year based on the number of registered vessels and fishing days allocated to different areas. Based on these calculations[8], no more than 36% of the available fishing days for registered Japanese SBT vessels would have fallen within official SBT seasons (Figure 4). As such, substantial latent effort existed within the Japanese SBT fleet for conducting fishing outside the official season. Given the observed IUU fishing in 1996 (Anon., 1997a, b and section 2), it is plausible that such fishing activity was a source of the unreported SBT catches. If this were the case, and assuming that some level of catch and effort was reported for these fishing activities, it is possible that these vessels over reported both catch and targeted effort for other species of tuna.

[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 to the east of South Africa in any given year, and 70 vessels went to the southeast Indian Ocean. These values were based on the pattern seen in other years.

4.3 Reported Catch and Effort in Area 2

SBT statistical Area 2 (Figure 5) in the eastern Indian Ocean is one area where substantial quantities of SBT have been caught in the past that has never formally been closed to longline fishing for tuna by Japan. 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 statistical area. In 1971, much of this area was voluntarily closed to SBT fishing by the Japanese industry between December and March as a measure designed to protect fish migrating to the spawning ground (Area 1). Since then, 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 have remained low in Area 2, the amount of reported effort increased dramatically after catch quotas as part of the informal tri-nation agreement 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 the plausibility of this alternative hypothesis for the source of the unreported catches, it is informative to explore the extent to which the large increases in reported effort in Area 2 could have accounted for the unreported SBT catches. Figure 7 compares the amount of effort reported in Area 2 and the amount of effort required to have caught the unreported catches[9]. Figure 7 indicates that the increasing effort in Area 2 between 1989 and 1995 could explain a large fraction of the unreported catch in those years. Subsequently, this depends on the assumption made for the catch rate that applies for the unreported catches, but in all cases the reported effort in Area 2 was sufficient to potentially account for all, or a large prortion of, the unreported catches. As such, it may also have been 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 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 as an index of stock abundance. Determining the actual implications for individual stocks and related assessments is beyond the scope of this paper, as it would require

[9] The average number of total fishing days per boat required to have caught the official Japanese catch plus the over-catch can be calculated approximately by dividing the total annual catches 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 average 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).

detailed analyses of the catch and effort data and subsequent re-runs and comparisons of the individual stock assessments. We consider this to be the responsibility of the scientific committees of the respective Regional Fisheries Management Organisations (RFMO) responsible for providing advice on these stocks. Given their familiarity with the data and assessments, they are best placed to interpret any potential inconsistencies. We note that while the magnitude of the SBT unreported 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 have been for larger (most valuable) fish in more southern regions, it is not obvious whether this magnitude of misreporting would be significant in terms of the older age component of the stocks of bigeye and yellowfin (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 fishing location is significant relative to reported global Japanese longline effort. Thus, misreporting of effort associated with the unreported SBT catches potentially could have substantial effects on the current estimates of CPUE for other species (particularly for the estimates for more southern waters) and therefore the impacts on overall estimates of abundance and yield for different tropical stocks.

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

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

A general question about the reliability of logbook data is whether issues of reliability should only be a concern in situations and time periods for which restrictive quotas apply (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 unreported catches was associated with the timing of informal catch quotas becoming restrictive on the Japanese fleet as part of the tri-nation agreement. However, estimates of the actual magnitude of the unreported catches, 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 of these is the assumed proportion of SBT that by-pass the wholesale market system (i.e. direct sales). If the proportion was greater than that used in estimating the unreported catches, then the market statistics would suggest substantial unreported 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. Tax concerns could have been an issue for the SBT fleets, and if so, they would also apply equally to all fleets harvesting

tropical tuna. Such issues raise questions about the general reliability of logbook data and not simply those for SBT. Given the apparent lack of effective independent monitoring of the high seas fleets in the past, demonstrated by the large SBT unreported 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. This is particularly the case for the Japanese fleets, given the central role of Japanese CPUE time series as the primary index of abundance in most tuna and billfish assessments.

The large unreported catches for SBT and reliance on unverified logbook data also raise general questions about the lack of rigour, standards and quality assurance processes for data used in fishery stock assessments and the provision of "the best 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 generally requires independent review and evaluation of the objectivity and accuracy of the data before they are used in the provision of scientific advice. For example, compare the lack of standards in international 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 in the catch series (and potentially CPUE) revealed in the case of SBT (Anon., 2006c attachment 4, figures 2 and 3; and d paragraph 54-59 and table 2). 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.

[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 reduced the IUU catches of toothfish in the Southern Ocean.

United Nations 1995; FAO, 1996; Anon., 2000b). 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 stock assessment scientists 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 results and advice. 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 to play in the design and implementation of such data collection programs to ensure that the resulting data series are reliable and meet the needs of the scientific monitoring and assessment processes. 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

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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 (See Figure 5).

3: The total number of Japanese high sea longline vessels which reported operating in the statistical areas 4-9 (See Figure 5) and reported catching more then 100 tonnes of SBT.

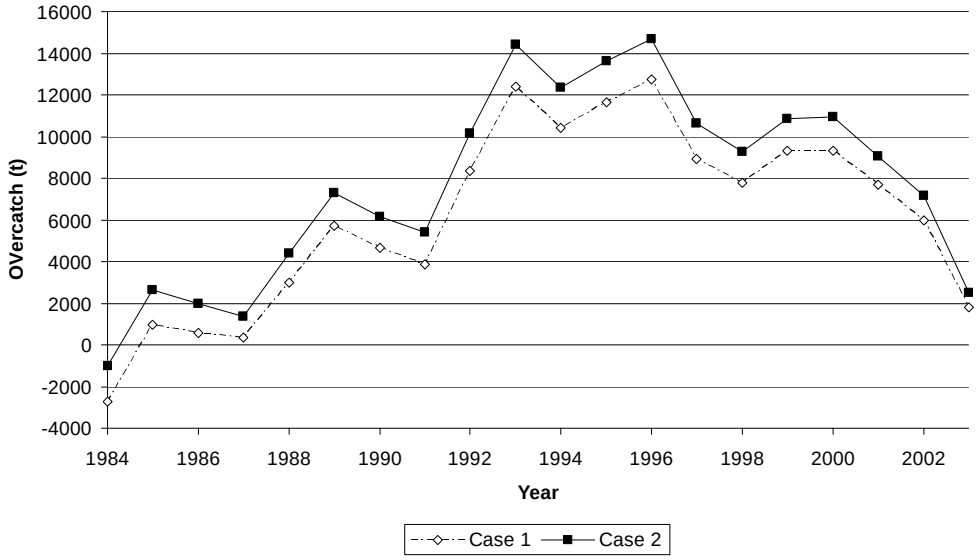

Figure 1: Estimated amount of unreported catch in a year taking into account the lag between time of capture and time of sale for the Case 1 and Case 2 scenarios provided by the CCSBT Commission to the Scientific Committee. This figure is based on Figures 2 and 3 in attachment 4 from Anon. 2006c..

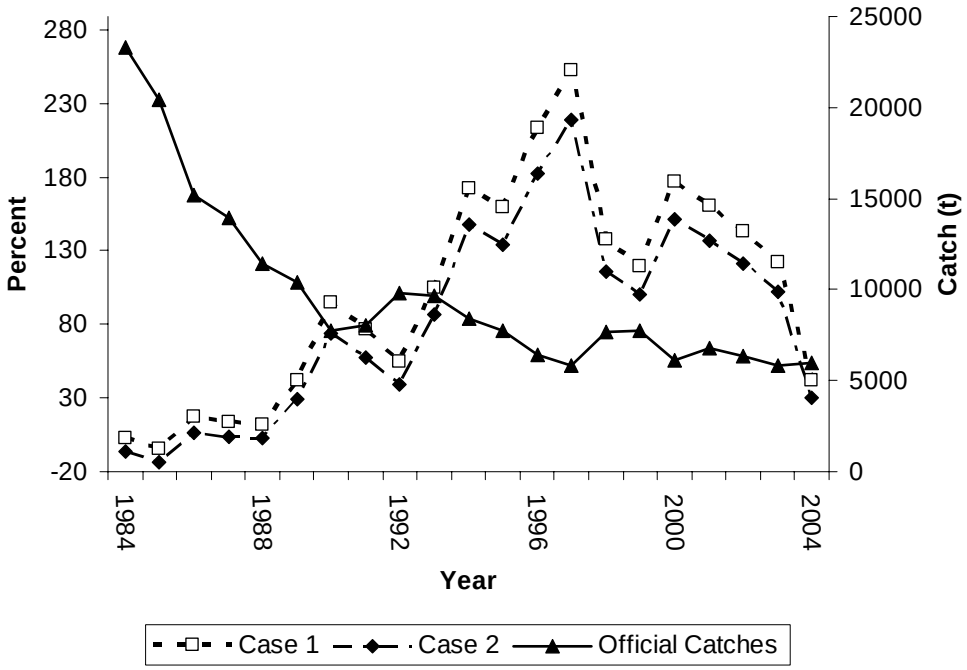

Figure 2: Japanese official catches of SBT as reported to the CCSBT for years 1984-2004 including RTMP and EFP catches and the percentage unreported catch for the Case 1 and Case 2 scenarios provided by the CCSBT Commission to the Scientific Committee and lagged as in Figure 1. This percentage figure is based on using the numerical values for the unreported catch in Figures 2 and 3 in attachment 4 from Anon. 2006c.

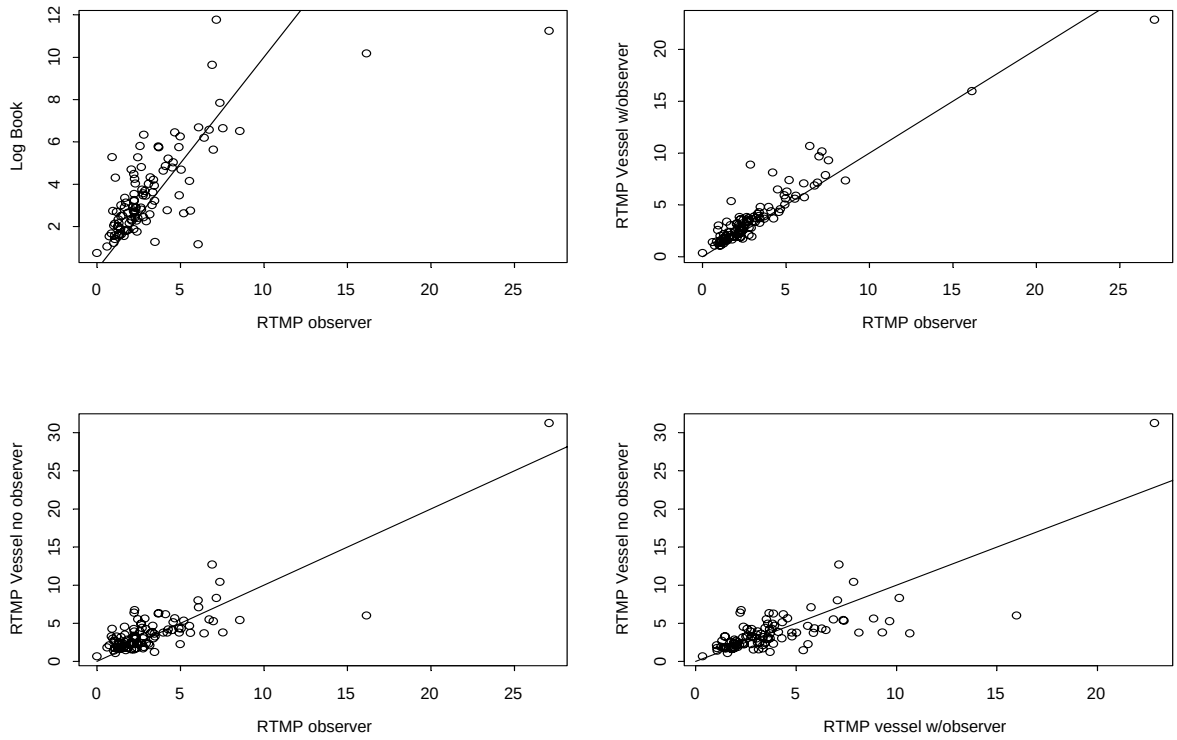

Figure 3: Comparison of the catch rates (number of SBT per thousand hooks) in a 5°square/month stratum based on different sources for the catch and effort data. Upper left: Japanese vessel reported logbook data compared to RTMP observer data; upper right: RTMP vessel reported data when observers were 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.

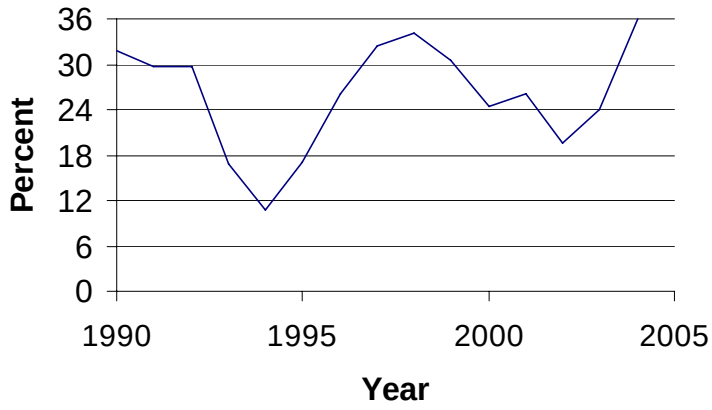

Figure 4: The percentage of available days within a year that Japanese SBT vessels could officially have fished for SBT within regulated SBT fishing grounds.

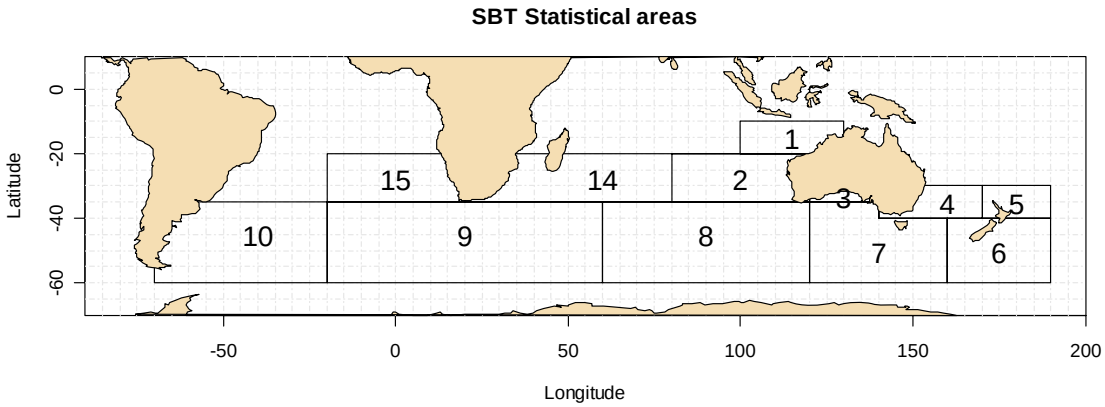

Figure 5: SBT statistical areas defined by the CCSBT. Note that areas 1-10 have been those traditionally used for Japanese longline data. Areas 14 and 15 are recently defined areas to encompass areas where there has been significant Taiwanese reported catch and effort. Japan does not provide complete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

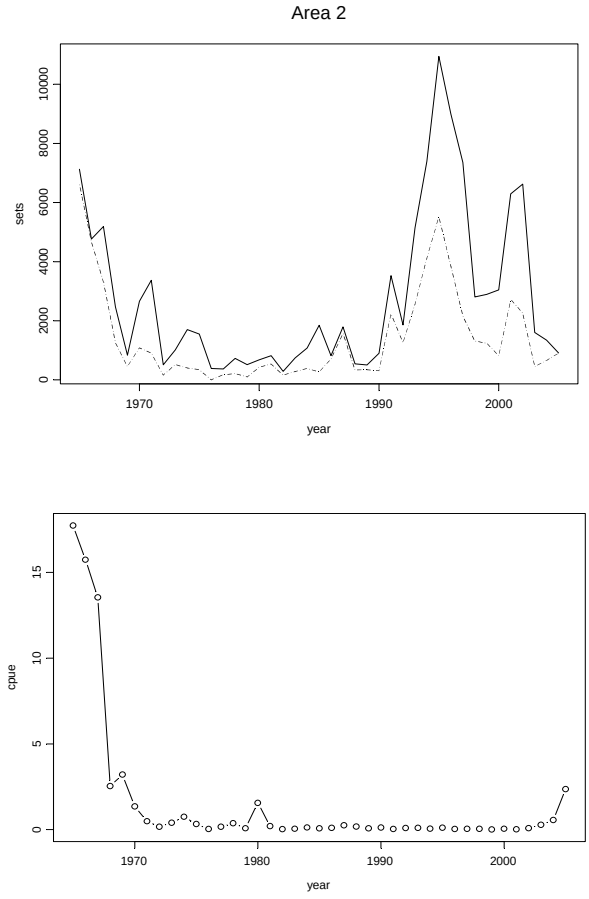

Figure 6: Annual number of reported longline sets (upper panel) and catch rates (number of SBT per 1000 hooks – lower panel) by Japanese vessels in Area 2. Number of reported longline sets was estimated based on assuming an average of 3,000 hooks per set. Dotted line is for months 1-3 or 10-12 (i.e.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

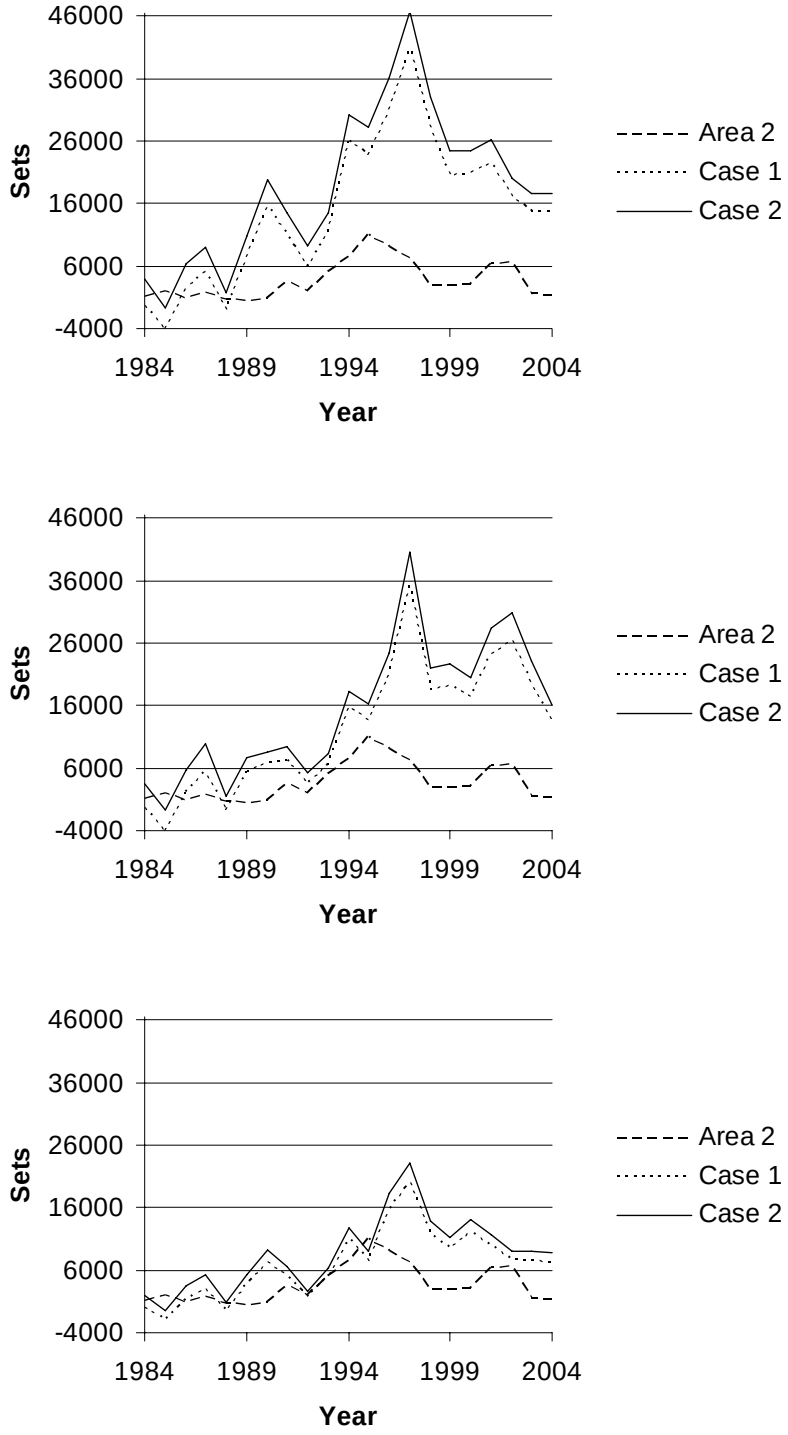

Figure 7: Comparison of the number of sets reported in Area 2 compared to the calculated number of sets required to account for the Case 1 and Case 2 unreported catch scenarios provided by the CCSBT Commission to the Scientific Committee assuming that all of the unreported catch came from unreported 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 9 for detail).

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