Cardno Ecology Lab

Shaping the Future

Marine and Freshwater Studies

Southern Bluefin Tuna

Species Impact Statement

Job Number: EL0910048

Prepared for NSW DPI (Fisheries)

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Cover Image: Southern Bluefin Tuna. Source: The We (http://www.thewe.cc/)

Executive Summary

Southern Bluefin Tuna (*Thunnus maccoyii*) (SBT) were listed as a threatened species under the NSW *Fisheries Management Act 1994* in 2004. Harming threatened species is an offence, and consequently, once listed, SBT may not be taken in commercial or recreational fisheries managed under NSW law. The New South Wales Minister for Primary Industries has prepared a draft Order authorising limited recreational fishing for SBT. Before making an Order, a person appointed by the Minister must prepare a Species Impact Statement (SIS) in relation to the activities being authorised by the Order. Cardno Ecology Lab was commissioned by NSW DPI (Fisheries) to prepare the SIS to assess the impacts of limited recreational fishing for SBT in accordance with the terms of the draft Order and to evaluate potential management and mitigation measures. The existing and proposed controls are summarised in **Table ES1**.

SBT are a large, migratory pelagic species that form a single population throughout its range. SBT are distributed throughout the temperate southern oceans and undertake a migration to a single spawning ground located in the north-east Indian Ocean between Java and Australia. Although the species is long-lived and highly fecund, characteristics such as slow growth, late onset of maturity, the presence of a single spawning ground and a highly migratory behaviour (exposing the stock to state, national and international fishing fleets) make it vulnerable to exploitation and potentially slow to recover from fishing.

SBT are in high demand from high-priced world sashimi markets and are fished commercially by Australia, New Zealand, Japan, Taiwan, Indonesia, Korea, South Africa and the Philippines. Commercial fishing for SBT is managed internationally by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) which determines global total allowable catch (TAC) and allocates national quotas to member nations. Global stocks of SBT have declined to a small proportion of pre-exploitation levels, leading to its listing as threatened by the NSW, Victorian and Commonwealth governments and critically endangered by the IUCN.

Very few data are available on SBT recreational catch rates in Australia and specifically in NSW. The data that are available suggest that recreational catches of SBT in Australia have been a small proportion of the global commercial catch, and that catches in NSW are relatively small compared with most other states. Evidence suggests that the availability of SBT to NSW recreational fishers may be increasing, potentially resulting in an increase in recreational catch. No accurate estimate of the recreational catch is currently available; however, SBT mortality in the NSW recreational fishery will depend generally on several factors, including:

- Availability of SBT to recreational fishers, which shows large spatial and temporal variation;
- Fishing effort, influenced by availability and limited by distance to fishing grounds, affordability of adequate equipment etc.;
- Release rates (as anglers may choose to release, rather than take caught SBT); and,
- Other forms of fishing related mortality such as hooking mortality (post release mortality).

Accurate estimates of recreational catch are needed to fully assess the potential impact on the global SBT population due to continued recreational fishing for SBT in NSW. Historical recreational fishing is unlikely to have affected the current status of SBT stock because this fishery is extremely small compared with other fisheries (commercial and artisanal) throughout the distribution of SBT. Notwithstanding this, an increase in mortality due to recreational fishing may have some cumulative impact on an already vulnerable standing stock.

The Ministerial Order should not result in any detrimental economic or social impact. If managed effectively, the authorisation of recreational fishing for SBT should result in an economic benefit to associated businesses and economies.

The reduction in bag limits contained in the Ministerial Order is expected to result in a reduction in the recreational take of SBT in NSW. However, by themselves, bag limits are unlikely to be completely effective in controlling recreational take. There are a number of alternatives to the Ministerial Order which could allow more control over recreational catch; however these are more likely to have significant economic and social considerations. They are also likely to be more complex to manage.

A cost effective monitoring programme should be undertaken to accurately estimate the recreational take of SBT and also meet Australia's commitments with the CCSBT. Without such information, management arrangements could struggle to meet their objectives and may fail to result in ecologically sustainable development.

The management arrangements contained in the Ministerial Order should be re-assessed once accurate estimates of recreational SBT catch and effort become available. Additions and / or modifications should be made in light of these findings, together with the most recent stock assessments and predictions from the CCSBT, so that effective control over the recreational SBT take is achieved. This will help ensure that efforts to rebuild the global SBT stock are successful and help ensure the species is conserved for future generations.

Table ES1: Current and proposed recreational take limits for Southern Bluefin Tuna

Current Recreational Take Limits	Proposed Recreational Take Limits
Bag Limit	
Seven*	One
Boat Limit	
N/A	Two
Charter Boat Limit	
N/A	Six
Size Restrictions	
No more than two ≥ 90cm No more than five < 90cm	No size restrictions

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1 Introduction

1.1 Background

In 2004 Southern Bluefin Tuna (*Thunnus maccoyii*) (SBT) was listed as an endangered species in Schedule 4 of the NSW *Fisheries Management Act 1994* (FM Act). In the final recommendation for the listing of SBT made by the Fisheries Scientific Committee (FSC) (2004) it was determined that SBT was likely to become extinct in NSW unless threats to its survival or evolutionary development cease. Harming a threatened species is an offence under the FM Act, and once listed, threatened species are fully protected. However, under section 221IG of the FM Act the Minister for Primary Industries made a series of Interim Orders authorising continued recreational fishing of SBT. Interim Orders may be used to permit the continuation of an existing activity if considered necessary to reduce social or economic impacts during the assessment of a proposed Ministerial Order. Before making an Order, a person appointed by the Minister must prepare a Species Impact Statement (SIS) in relation to the activities being authorised by the Order. In the current absence of an Interim Order, no recreational fishing for SBT should be permitted in NSW.

Cardno Ecology Lab was commissioned by NSW Department of Primary Industries (Fisheries) (NSW DPI (Fisheries)) to prepare a preliminary environmental assessment (PEA) and the SIS.

The PEA was completed in 2010 (Cardno Ecology Lab 2010). The aim of the PEA was to review available literature and data on the extent and impact of recreational fishing on SBT in NSW and adjacent Commonwealth waters. The findings helped inform the development of the proposed management arrangements by NSW DPI (Fisheries) to ensure any detrimental impacts from recreational fishing for SBT are mitigated as far as possible. The proposed management changes were subject to consultation with the FSC and the Advisory Council on Recreational Fishing (ACoRF) and guided the final details of the proposed Ministerial Order.

1.2 The Proposal

NSW currently allows a personal bag limit of 7 mixed tuna per day (i.e. 7 of up to 5 species of tuna – comprising of Albacore (*Thunnus alalunga*), Big-eye (*Thunnus obesus*), Southern Bluefin and Yellowfin Tuna (*Thunnus albacares*), which effectively constitutes a possible maximum take of 7 SBT per day (**Table 1**). The FM Act contains provisions that allow the Minister to make an Interim Order to permit the continuation of an existing activity if the Minister considers that the making of the Interim Order is reasonably necessary to reduce social or economic impacts during the assessment of a proposed Ministerial Order.

The proposed Ministerial Order (The Proposal) would permit the continued recreational take of SBT in NSW and adjacent Commonwealth waters. The Proposal would also reduce the personal bag limit to 1 SBT, and introduce boat (2 SBT) and charter boat (6 SBT) limits (**Table 1**). Size restrictions would be removed for SBT. The proposal would apply to all recreational anglers and boats fishing in NSW and adjacent Commonwealth waters, regardless of their state of residence. The current recreational management arrangements in other states are included in **Table 2** for comparison.

1.3 Aims of the SIS

The objective of the SIS is to assess the potential impact of The Proposal on SBT. The findings of the SIS, together with advice from the Fisheries Scientific Committee and other relevant advisory councils, public submissions, and a range of other matters must be taken into account by the Minister before making an Order. The SIS specifically addresses the requirements for threatened species contained in Part 7A, Division 6, Sub-Division 2, Section 221K of the FM Act. The specific contents of the SIS stated in the FM Act are as follows:

1. A full description of the actions proposed, including its nature, extent, location, timing and layout.

2. A general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action;
3. An assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action;
4. For each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it;
5. An estimate of the local and regional abundance of those species or populations,
6. A full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region;
7. A full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region;
8. A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development;
9. A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations, including a compilation (in a single section of the statement) of those measures; and,
10. A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population.

In addition, the SIS must comply with the Director-General's Requirements (**Appendix 1**).

2 Description of Southern Bluefin Tuna

2.1 Taxonomy and Characteristics

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Perciformes

Family: Scombridae

Genus: *Thunnus*

Species: *maccoyii*

Species Authority: Castelnau, 1872

Standard Common Name (Australian Fish Names Standard AS SSA 5300-2007): Southern Bluefin Tuna

CSIRO CAAB number (Codes for Australian Aquatic Biota): 37 441004

Southern Bluefin Tuna (SBT) are a large pelagic marine fish species (**Figure 1**). The body is deepest near the middle of the first dorsal fin base (25 – 29% of fork length (FL)). The upper surface of the body is dark blue (without dark spots or stripes) and the lower sides and belly are silvery white with colourless transverse lines alternating with rows of colourless dots (Yearsley *et al*. 1999, Gomon *et al*. 2008). Small scales are present on the posterior half of the body. The mouth reaches to the front half of the eye, which is large. Pectoral fins are relatively short and do not reach back to the origin of the second dorsal fin, and there is a pronounced thickened scale patch at the pectoral fin base (Yearsley *et al*. 1999). The first dorsal fin is yellow or bluish and the second dorsal is barely taller than the first dorsal fin in adults (Yearsley *et al*. 1999). There are a number of dorsal and anal finlets (yellow with dark tips) leading to the caudal peduncle and a lunate tail (caudal fin) (Gomon *et al*. 2008). SBT have a large fleshy keel on their caudal peduncle with two small posterior keels. There are 31 – 43 gill rakers on the first gill arch and the top of the tongue has two longitudinal ridges (Yearsley *et al*. 1999, Gomon *et al*. 2008).

2.2 Distribution

SBT are a widely distributed highly-migratory pelagic species, considered to form a single population (stock) throughout its range (Robins *et al*. 1998). The species is predominantly distributed throughout the cool waters of the southern temperate oceans (Indian, Atlantic and Pacific Oceans) between 30^0 S and 50^0 S, but are rarely seen in the eastern Pacific Ocean (BRS 2008) (**Figure 2**). A spawning migration takes SBT through warm temperate and into tropical waters to the only known spawning ground in the north-east Indian Ocean, located between Java and Australia (~ 10 - 20^0 S and 105 - 120^0 E) (BRS 2008). Within the Australian Fishing Zone (AFZ) the species is found from northern Western Australia and around the south of the continent to northern NSW (~ 30^0 S) (Pogonoski *et al*. 2002).

2.3 Growth

SBT can attain a maximum length of 225 cm FL and a weight of over 200 kg, although they more commonly reach 180 cm FL and 100 kg (Yearsley *et al*. 1999, BRS 2008). The species displays relatively slow growth and is long-lived (Pogonoski *et al*. 2002, BRS 2008).

Recent growth studies analysing the annual bands laid down on sagittal otoliths have increased longevity estimates for SBT and improved estimates of length-at-age (Gunn *et al*. 2008). SBT display rapid early growth and at the age of 9 – 12 months individuals reach a size of approximately 55 cm FL and 3 kg (BRS 2008). By 3 – 4 years of age they have (on average)

attained 100 cm FL, weigh 15 – 30 kg (**Figure 3**) (at which point they are targeted by the purse seine fishery in South Australia and long-line fisheries in the AFZ and the high seas) (Gunn *et al*. 2008). Research has suggested that the growth rate of juvenile SBT has increased significantly over the last forty years as a density dependent response to overexploitation (Leigh and Hearn 2000, Hearn and Polacheck 2003, Polacheck *et al*. 2004, Farley and Gunn 2007). Growth rates slow significantly as the fish approaches maturity and diverts energy to the production of somatic tissue. The maximum age for the species is estimated to be at least 40 years and the age distribution of SBT catches by the Japanese longline fishery in the Tasman Sea indicate that a significant proportion of the SBT larger than 160 cm are older than 25 years (Gunn *et al*. 2008).

Gunn et al. (2008) estimated SBT Von Bertalanffy parameters (L_∞ = asymptotic length; k = growth rate; t_0 = size at time zero) from their otolith-based length-at-age data: L_∞ = 183.18 (± 0.523 S.E.), k = 0.185 (± 0.003 S.E.) and t_0 = - 0.923 (± 0.038 S.E.). Polacheck *et al*. (1996) obtained similar estimates for the Von Bertalanffy growth parameters using tagging and length data: L_∞ = 183.9, k = 0.180 and t_0 = - 1.322.

There is some evidence of size sexual dimorphism in SBT (Farley *et al*. 2007, Gunn *et al*. 2008). Older males have a higher mean length-at-age than females and fish greater than 160 cm FL are more likely to be male than female although females live as long as males (Gunn *et al*. 2008). At a fork length greater than 185 cm, the ratio of males to females is 2:1. Researchers have suggested that the sexual dimorphism may be due to high fecundities and long reproductive lives (Gunn *et al*. 2008).

2.4 Reproduction

SBT are believed to mature at 157 cm FL (Davis 1995) and the application of recent length-at-age estimates indicates that age-at-maturity is 10 -12 years (Gunn *et al*. 2008). They have only one known spawning ground between Australia and Java (see **Section 2.2**). Spawning generally takes place from September to April but adult females have been observed on the spawning grounds in all months except July (Farley and Davis 1998). SBT are highly fecund and large adults can spawn millions of eggs (Collette and Nauen 1983). Batch fecundity increases with size (Farley and Davis 1998). Females are capable of multiple spawning events and once in prime spawning condition probably spawn daily (Farley and Davis 1998). SBT do not spawn over the entire season, nor is spawning synchronised for the stock as a whole, therefore there is a turnover of fish on the spawning grounds throughout the season.

Larvae hatch in spring and summer, with January and February being the months of highest larval abundance (Farley and Davis 1998). The early life history of SBT is restricted to the warm waters of the spawning grounds but after a few months juveniles leave and move south along the continental shelf of Western Australia assisted by the Leeuwin Current (Farley and Davis 1998). SBT first appear in the Great Australian Bight at one year old.

It is assumed that adult SBT make an annual migration to spawn but Patterson *et al*. (2008) have speculated that the wide dispersion of SBT, lack of coherency in their movements and the duration of residency in the Southern Ocean and Tasman Sea relative to the spawning ground abundance peak, hint at the possibility that SBT may not spawn annually.

2.5 Mortality

Natural mortality for SBT is non-linear and age dependent, being larger for young fish and smaller for older fish (Gunn *et al*. 2008). The Extended Scientific Committee of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) uses three estimates of natural mortality for each of (i) one year olds (M_1 = 0.30, 0.35 and 0.40) and (ii) 10 year old (M_{10} = 0.07, 0.1 and 0.14) during simulations as part of SBT stock assessment (CCSBT 2009a). The rate of natural mortality declines from age one year (M_1) to age 10 years (M_{10}), where it remains constant again till increasing rapidly at age 25 years (CCSBT 2009a).

2.6 Diet

Juvenile and adult SBT are polyphagous opportunistic feeders, eating cephalopods, crustaceans, fish and salps (Kailola *et al*. 1993). The primary forage of juvenile (two - four year old) SBT in the Great Australian Bight during the summer months is pilchards (*Sardinops sagax*) augmented by regular and probably opportunistic supplement of squid (e.g. *Nototodarus gouldi*) and benthic prey such as crustaceans (Kemps *et al*. 1998, Ward *et al*. 2006). Adult SBT feed primarily on finfish (Kailola *et al*. 1993).

2.7 Migration

SBT are highly migratory. Adults are widely distributed across the southern hemisphere oceans (30^0 S and 50^0 S) and make long distance migrations to a single spawning ground in the north-east Indian Ocean (~ 10 - 20^0 S and 105 - 120^0 E) (BRS 2008). Assisted by the Leeuwin Current, juveniles move south along the continental shelf of Western Australia inhabiting shelf and inshore waters between Perth and Esperance between December and April (DEH 2004, Dell and Hobday 2008, Farley and Davis 1998).

Juvenile SBT have a divergent migration path at southern Western Australia with an unknown proportion heading westwards towards South Africa and the others travelling east along the continental shelf of Australia (DEH 2004, Farley *et al*. 2007). As a consequence two - four year old SBT can be found in the Atlantic and Indian Oceans south of Africa and Australia. Two - four year old SBT school near the surface in the coastal waters of the Great Australian Bight during the Australian summer months (December – April) where they are targeted by the South Australian purse seine fishery. These fish tend to spend winters in deeper, temperate waters and some young SBT migrate seasonally between the south coast of Australia and the central Indian Ocean. Others follow cold winter currents around Tasmania and then northwards along the continental shelf of the NSW coast. After five years of age SBT generally move offshore to deeper waters, moving in and out of the AFZ, and are seldom found north of 35^0S (except when adults are migrating to spawning grounds) (Farley *et al*. 2007). Commercial SBT catch in the Southern Ocean can be dominated by immature fish but the majority of SBT caught off north eastern New Zealand are of spawning age, suggesting the Tasman Sea may be an eastern boundary for juvenile migration (Farley *et al*. 2007).

2.8 Habitat

SBT are a pelagic species predominantly found in temperate waters of the southern hemisphere. Although very young juveniles occasionally inhabit inshore waters, SBT are most frequently found in deeper offshore waters along the continental shelf and beyond (BRS 2008, AFMA 2009). SBT are rarely observed within the NSW State waters boundary of three nautical miles (FSC 2004). Tagging studies of large adult SBT in the Tasman Sea found that they spent 84 % of their time within the AFZ in the proximity of the continental shelf (Patterson *et al*. 2008).

The species is found at depths from 0 to 500 m, from the surface of the ocean but the majority of time is spent in the top 200 m of the water column, with the highest proportion shallower than 50 m (Patterson *et al*. 2008). Juvenile SBT have been associated with on-shelf topographic features which may be important habitat for forage species, aid in SBT navigation or function as aggregation sites where schools of juvenile SBT form, potentially for hunting (Willis and Hobday 2007).

SBT have been associated with ocean frontal systems and are believed to have preferences for water temperature of approximately 18 - 20^0C. Temperature-based habitat models have been developed to predict SBT distributions for decisions about dynamic fisheries management boundaries (Hobday and Hartmann 2006). SBT water temperature preferences have been assumed to be determined by environmental tolerances but recent studies have suggested that SBT spatial and depth distributions may be more influenced by proximate factors such as forage availability or even forage environmental tolerances (Patterson *et al*. 2008, Bestley *et al*. 2009).

The single spawning ground of SBT is not declared critical habitat for this species, although it is essential for its reproductive success. The spawning ground is a relatively broad expanse of open ocean not associated with any benthic habitat features as SBT appear to spawn near the surface.

3 The Conservation Status of Southern Bluefin Tuna

Whilst SBT are long-lived and highly fecund, their high economic value combined with a number of life history characteristics make them vulnerable to overexploitation and slow to recover (Pogonoski *et al*. 2002, DEH 2004). The decline of SBT stocks has generated increasing concern about its conservation status and led to listings as a threatened species by a number of Australian states and international NGOs.

3.1 Australian States

SBT are listed as a threatened and / or endangered species in New South Wales and Victoria only.

3.1.1 New South Wales

In 2004 SBT was listed as an endangered species in Schedule 4 of the NSW *Fisheries Management Act 1994* (FM Act). The supporting information used in the determination of SBT as a threatened species by the NSW Fisheries Scientific Committee (FSC 2004) included:

- Slow growth;
- Late onset of maturity;
- Highly migratory species;
- Western boundary of SBT migratory path lies within NSW State waters;
- The species forms a single population worldwide;
- Single spawning ground;
- Dramatic decline of SBT abundance in international and Australian waters (to 7 – 15% of unfished spawning stock biomass);
- SBT reach the northern extent of their distribution in the Pacific Ocean off northern NSW at 30°S.

Commercial landings of SBT in NSW State waters are not permitted.

There are currently no recovery or threat abatement plans approved for SBT under the FM Act. The draft NSW DPI (Fisheries) Priorities Action Statement has identified priority recovery strategies for SBT under the following categories; (i) Research – conduct research into the biology and ecology of SBT; (ii) Fisheries management regulations – promote compliance with existing fishing regulations; and, (iii) Community and landowner liaison, awareness and education – improve community awareness about the endangered status of SBT in NSW.

3.1.2 Victoria

The *Flora and Fauna Guarantee Act 1988* lists threatened species of fish in Victoria. These fish may not be taken without authorisation. SBT are listed, however, recreational fishing is permitted under an exemption. An Action Statement for SBT under the Victorian *Flora and Fauna Guarantee Act 1988* was published in 2003 (Department of Sustainability and Environment 2003). The Action Statement highlighted the need for co-operative management arrangements at the international, national and state level if effective protection and sustainable use of SBT was to be achieved. The objectives of the Action Statement were to minimise any impacts on SBT due to Victorian managed activities and to formalise jurisdictional arrangements with the Commonwealth Government with regard to the management of recreational and charter boat SBT fishing. These were to be achieved through reviewing state Southern Bluefin Tuna Fishery arrangements in light of management decisions made by the Commonwealth and by the CCSBT and by supporting the Commonwealth's participation in the CCSBT for pursuing global sustainability of the species.

3.2 Commonwealth

In a review of threatened and potentially threatened marine and estuarine fish Pogonoski *et al.* (2002) suggested a conservation status of Lower Risk (near threatened) for SBT on an Australia-wide basis.

In 2003 SBT was nominated as a threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In 2005, the Threatened Species Scientific Committee (TSSC) recommended the Minister for the Environment and Heritage, to amend the list referred to in Section 178 of the EPBC Act and include SBT in the Endangered category.

The TSSC determined SBT eligible for listing as Endangered under Criteria 1: that the species has undergone a very severe, severe or substantial reduction in numbers. The Minister considered the advice of the TSSC and decided not to list the species. The Minister concluded that "the listing of the Southern Bluefin Tuna as a threatened species under the EPBC Act would be detrimental to the survival of the species, as it may weaken Australia's ability to influence both the management of the global fishing effort and the global conservation of the species. As a result, conservation of the Southern Bluefin Tuna in Australian waters could not be achieved" (DEWHA 2009).

In 2007 SBT was renominated as a threatened species under the EPBC Act, this time within the 'Conservation Dependent; category (AFMA 2009). 'Conservation Dependent' is a relatively recent category added to the listed threatened species and ecological communities under the EPBC Act. A conservation dependent species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years. Species in this category are not considered matters of national environmental significance (protected matters) under the EPBC Act.

The Australian Fisheries Management Authority (AFMA) did not support the listing of SBT as Conservation Dependent, claiming that it would not provide any greater protection for the species relative to the measures already in place or available to fisheries management (AFMA 2009). Whilst acknowledging that SBT had experienced a decline in stocks, AFMA cited that recent efforts by Australia at CCSBT had led to a reduction in global catch and adoption of compliance measures to combat Illegal Unregulated and Unreported (IUU) fishing (AFMA 2009).

In 2010, following an extension granted to the Commonwealth TSSC by the Minister for the Environment, Heritage and the Arts for their advice on the SBT nomination, the Minister granted threatened species status to SBT under the Conservation Dependant category. The listing does not prevent or restrict recreational or commercial fishing, but it sets a legal requirement that the species must remain under a management plan that seeks to ensure its survival and long term recovery. Species listed as Conservation Dependent are not nationally protected, so do not trigger the offence provisions under national environment law. SBT is currently subjected to both Australian (i.e. The Southern Bluefin Tuna Fishery Management Plan 1995), and international management plans under the CCSBT (see **Section 4**). The Minister also made the decision to re-accredit the Australian SBT Fishery for export until 2013. It was decided that a ban on commercial fishing would limit Australia's influence on the CCSBT which could compromise steps to ensure fishing of SBT remains sustainable. There would also be no guarantee of a reduction in global catch as the Australian catch could be re-distributed among other SBT fishing nations.

3.3 International Non-Government Organisations

3.3.1 International Union for the Conservation of Nature (IUCN) Red List of Threatened Species

SBT was listed as Critically Endangered (A1bd) on the IUCN Red List of Threatened Species in 1996 (IUCN 2008). A taxon is considered critically endangered (A1bd) when it is facing an extremely high risk of extinction in the wild in the immediate future. Criteria A1 is an observed,

estimated, inferred or suspected population reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) the following:

(b) An index of abundance appropriate for the taxon; and,

(d) Actual or potential levels of exploitation.

3.3.2 Convention on International Trade in Endangered Species (CITES)

SBT was proposed by the Humane Society International (HSI) for consideration by the Australian government as part of its approach to the 11th, 12th and 13th Conference of the Parties (CoP) to the CITES (DEH 2004). The Australian government decided in each case not to proceed with such a nomination (DEH 2004).

CITES Appendix I include species that are the most endangered (considered at risk of extinction) and bans international trade for commercial purposes. The relevant criteria for determining if SBT qualify for an Appendix I listing is establishing a "marked decline in population size in the wild, either ongoing or past, or inferred or projected". The Food and Agriculture Organisation of the United Nations (FAO) reviewed CITES criteria and provided recommendations with respect to the application of CITES criteria to commercially exploited aquatic species (FAO 2012a). FAO noted that the guidelines relating to the extent of historical decline for an Appendix I listing should depend on species productivity: 5 - 10 % decline for high productivity species, 10 - 15 % decline for medium productivity, and 15 - 20 % decline for low productivity species. Accepted SBT age-at-maturity and *k* growth parameter estimates (Gunn *et al*. 2008) and the most recent estimates of spawning biomass at 3 – 8 % of unfished biomass (CCSBT 2009a) would be sufficient to qualify SBT for Appendix I listing.

3.3.3 Greenpeace International

Several species of tuna, including SBT, are listed on the Greenpeace International Seafood Red List (Greenpeace 2011). According to Greenpeace the list contains species that are commonly sold in supermarkets around the world, and which have a very high risk of being sourced from unsustainable fisheries. The fish species are on the list for one or more of the following reasons:

- They have a life history that makes them very vulnerable to fishing and there is little or no data available to show that the stocks are healthy and are being fished at a sustainable rate;
- They are commonly sourced from overfished and depleted stocks, or are being fished at such a high rate that stocks are being depleted rapidly; and,
- The fishing methods used to catch the fish are often highly destructive to other oceans creatures and/or habitats.

4 Management of Southern Bluefin Tuna

4.1 International

Commercial fishing for SBT is managed internationally by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). The CCSBT sets the global allowable catch for SBT and allocates TAC for member states. Members of the extended commission comprise Australia, Japan, the Fishing Entity of Taiwan, Indonesia, Republic of Korea and New Zealand. Cooperating Non-Members comprise the Philippines, South Africa and the European Union. The CCSBT headquarters are in Canberra, Australia. The CCSBT was established in 1994 following the formalisation of the collaborative management arrangements between Australia, Japan and New Zealand.

The objective of the CCSBT is to ensure, through appropriate management, the conservation and optimum utilisation of SBT based on the best available scientific advice (CCSBT 2011c). Roles of the CCSBT include the coordination of scientific research, provision of a forum for discussion between member states, the conservation of ecologically related and bycatch species and the setting of TACs. The Commission and the Scientific Committee (which provides advice on research outcomes and priorities to the commission) meet each year and discuss recent research, catch estimates and management options in order to meet these objectives.

Over the last ten years the CCSBT has been working to develop an adaptive Management Procedure (MP) based on a pre-agreed set of rules that is able to specify changes to TACs based on recent monitoring data (CCSBT 2011c). The CCSBT tested a variety of MPs with the aid of an operating model of the fishery that simulated the characteristics of the SBT stock and fishery. At the meeting of the Commission in October 2011 (CCSBT 2011d) the 'Bali Procedure' was adopted as the MP following its recommendation by the CCSBT's Scientific Committee. The following associated management parameters were also adopted:

- The MP will have a 70% probability of rebuilding the stock to 20% of the original spawning stock biomass by 2035;
- The minimum TAC change is 100 mt and the Maximum 3,000 mt (increase or decrease);
- TACs will be set for three year periods; and,
- National allocations of the TAC within each three year period will be apportioned according to the Resolution on the Allocation of the Global Allowable Catch (CCSBT 2011a). This resolution details the specific allocation of the global TAC to each member or cooperating non-member country.

The MP was used to guide the global TACs for the three year period 2012 to 2014 (**Section 5.1.2**).

4.2 Australia

4.2.1 Commercial Management Arrangements

Under an Offshore Constitutional Settlement agreement the Commonwealth has management over SBT for commercial fishing in all waters inside the Australian Fishing Zone, except in NSW state waters (DSEWPC 2010). The NSW Government has protected SBT from all commercial fishing inside its three nautical mile waters through the NSW *Fisheries Management (General) Regulation 2010*.

The Department of Agriculture Fisheries and Forestry (DAFF) is the lead agency in Australia's involvement with the CCSBT. Its long-term goal within the CCSBT is to develop policies to help rebuild the SBT spawning stock biomass to above 20% of its unfished level (DAFF 2011). The Australian Fisheries Management Authority (AFMA) determines the total domestic SBT catch based upon Australia's CCSBT allocation and sets individual transferable quotas, or Statutory

Fishing Rights (SFRs). Each SFR entitles the holder to receive an equal portion of the total domestic catch. SFR holders must report to AFMA on their SBT catch through a series of logbooks and other records which enable the monitoring of catch against quota holdings. SFR holders can take their TAC by any fishing method as there is no allocation between sectors in the SBT fishery.

The Commonwealth *Fisheries Management Act 1991* and the *Southern Bluefin Tuna Fishery Management Plan 1995* provide a supporting framework of regulations, SFR conditions, fishing permits and directions (AFMA 2011a). The *Southern Bluefin Tuna Management Plan 1995* is the instrument through which Australia implements the resolutions of the CCSBT in the domestic fishery and it provides AFMA with the ability to determine the domestic SBT catch. The AFMA Commission met on 25 October 2011 and agreed to determine Australia's national catch allocation for the season (commencing 1 December 2011) in line with the proportional settings made by CCSBT. In making this determination AFMA considered the most recent estimates of the standing stock biomass whilst also noting recent positive signals from recruitment and stock data. AFMA concluded that determining a domestic TAC lower than that allocated by the CCSBT would have no benefit to the rebuilding of the stock as any increase in spawning biomass resulting from lower Australian catches would be detected by the MP and result in higher future allocations to other CCSBT members.

At the fifteenth annual meeting of the Commission, the Extended Commission adopted the recommendation of the Compliance Committee that members with a recreational catch should report estimates of their recreational catch to the Extended Commission on an annual basis (CCSBT 2008). A Bureau of Rural Sciences review (Rowsell *et al.* 2008) of existing State data sources and monitoring programs found they were inadequate for providing accurate estimates of SBT recreational catch and effort. According to DSEWPC (2010), DAFF and AFMA are to develop a methodology for obtaining statistically robust estimates of recreational and charter fishing catch of SBT in Australian waters, and work towards progressing a first round of data and information collection in 2012. Also, DAFF and AFMA are to develop a framework for consistent management of the take of SBT by recreational and charter fishing that represents best-practice fisheries management and includes effective monitoring, compliance and enforcement activities.

AFMA also manages the bycatch of SBT in the Eastern Tuna and Billfish Fishery (ETBF) by restricting access of ETBF fishers to designated areas where SBT are more likely to occur (based on information from a variety of sources including a SBT habitat preference model, sea surface temperature and landings data). AFMA annually institutes core and buffer zones for restricted access in the ETBF. Fishers must have a minimum SBT quota of 0.5mt to enter these zones, the required level of observer coverage (dependent upon quota held and zone of operation) and must comply with the CCSBT Catch Documentation Scheme which came into force on 1 January 2010 and will enable more precise tracking of individual SBT (AFMA 2011b).

4.2.2 Recreational Management Arrangements

The NSW FM Act establishes extra-territorial powers so far as the laws of the State permit, especially in relation to recreational fishing. The Commonwealth *Fisheries Management Act 1991* does not exclude or limit the concurrent operation of a State law, and does not apply to recreational fishing unless a temporary order or plan of management has been prepared. No temporary order or plan of management under the Commonwealth *Fisheries Management Act 1991* has been made in respect of recreational fishing for SBT in Commonwealth waters. Accordingly NSW has legal authority to regulate the management of recreational fishing for SBT within Commonwealth waters adjacent to NSW State waters.

In 2004 a Memorandum of Understanding between the Commonwealth and state governments was signed agreeing that state governments were better placed to manage non-commercial fishing in Commonwealth waters (DAFF 2004). Each state has management controls for recreational fishing for SBT (**Table 2**).

Under a licensing scheme for charter boat operators introduced by NSW DPI (Fisheries) on 13 November 2000, all charter boat operators in NSW require a licence to operate their business.

Following the completion of the licensing and review process in 2003, a total of 276 charter boat fishing licences were issued. Licenses were only issued to people who were charter boat operators prior to the scheme. Of these 276 licences, 32 are non-transferable and must remain with the current owner and cannot be sold or changed in any way. The licensing scheme was introduced to help ensure fish stocks are managed in an economically sustainable way and to ensure there are no uncontrolled increases in charter boat fishing pressure on fish stocks (NSW DPI (Fisheries) 2012). Charter businesses may operate full or part time and are able to access the fishery along the whole of the NSW coast. Other management arrangements for the marine and estuarine charter boat fishery include the following:

- The number of licences is restricted to the level that operated historically and no new licences are available to be issued;
- The number of recreational fishers permitted on each charter boat is also restricted to the number allowed by NSW Maritime survey classification for the original vessel as at 4 August 1999;
- Restrictions on the type and amount of gear allowed by each fisher;
- Temporal and spatial closures;

Charter boats are also required to complete a log-book, recording catch and effort for each fishing trip.

The charter boat licences issued were eligible for the following endorsements, depending on the original vessel's NSW Maritime Authority survey classification and the activities requested by the applicant:

- Estuarine Fishing (211 endorsements);
- Nearshore Bottom Fishing and Sportfishing (233 endorsements);
- Gamefishing (221 endorsements); and,
- Deep Sea Bottom Fishing (193 endorsements).

Around 205-215 of the 276 licenses issued have been active at any one time (Nick James, NSW DPI (Fisheries), Pers. Comm.). In April 2012 there were 62 inactive licences (around one quarter of the total number of licences), 26 of these were non-transferable. Clause 236 of Part 13 of the Fisheries Management (General) Regulation lists the species permitted to be targeted under each endorsement (**Appendix 2**). Clause 236 also restricts the catch of specified species to a maximum of 1 per person if a charter fishing boat does not have the appropriate endorsement type and therefore provides very limited by-catch provisions.

While recreational fishers must pay the NSW recreational fishing fee to fish in public waters of NSW, licensed charter fishing boat operators may pay for an exemption certificate (block licence), which allows anglers to fish on the operator's boat without the need to have paid the recreational fishing fee.

5 Threats to Southern Bluefin Tuna

The primary anthropogenic source of SBT mortality is fishing. SBT are taken by commercial, artisanal, scientific and recreational sectors. The greatest threat to SBT conservation is believed to come from commercial fishing (Pogonoski *et al*. 2002).

5.1 Commercial Fishing

SBT are in high demand from high-priced world sashimi markets and are fished by 20 nations (AFMA 2010), although predominantly by Australia, New Zealand, Japan, Taiwan, Indonesia, Korea, South Africa and the Philippines. Apart from the Australian purse-seine industry, the majority of SBT are caught on longlines. Longlines consist of a mainline kept near the surface or at a certain depth by means of regularly spaced floats with relatively long snoods (branch-lines connecting hooks to the mainline) with evenly spaced baited hooks (FAO 2012b). The longline used for tuna fishing is made up of units (sometimes known as "baskets"), each of which consists of a main horizontal line about 250 to 800 m long with 4 to 15 branch-lines, each with a wire leader and a hook. A typical set consists of 200 or more "units/baskets" connected together, with a buoy at each connection, and a total of about 3 000 hooks set over a total distance of about 100 km. The hooks fish in sub-surface areas and at depths of about 100 to 300 meters (maximum depths of 175 m for conventional longlines and of 300 m for deep longlines). (FAO 2012b). Caught fish are frozen and shipped to Japan. Longliners harvest fish from all age classes, from juveniles approximately three years old to adults over 12 years old (Phillips *et al.* 2009). Over the period 1952 - 2003, 79% of the reported catch was taken by longline and 21% using surface gears, primarily purse-seine and pole and line (CCSBT 2011a).

5.1.1 Historical Catch

Commercial fishing for SBT began in the 1930s with trolling catches reported along the coasts of NSW and Tasmania (AFMA 2002, BRS 2008). From 1952 onwards there was a sharp increase in the global catch of SBT (**Figure 4**, CCSBT 2011b). Japanese fishing vessels began targeting SBT in the Indonesian spawning grounds, eventually expanding into the Southern Ocean, and two – four year old SBTs were also been caught off NSW and SA by Australian vessels (AFMA 2002). During this period global fishing effort intensified (AFMA 2002; DEH 2004) and by 1961 global reported catch had peaked at 83,711 mt, an increase of over 3000% from 1952 levels. Recent estimates show this coincided with a marked reduction in the spawning stock biomass to just over 50% of the pre-fishing stock biomass (CCSBT 2011a, **Figure 5**). Following peak catch, there was a general decline in total global reported catch despite continued increases in fishing effort and the reporting of SBT catches by Taiwan, Indonesia and South Africa throughout the 1960s and 70s. In 1982 global catch had declined to nearly half that reported in 1961. The spawning stock biomass was estimated at just over 20% of the pre-fishing stock biomass and the pole and line surface fishery for SBT in NSW collapsed after surface schools virtually disappeared (AFMA 2002). The introduction of voluntary Total Allowable Catches (TACs) by Japan, Australia and New Zealand in 1983 may have contributed to further reductions in reported catch, which appears to plateau from 1990 onwards. The establishment and expansion of the Convention for the Conservation of Southern Bluefin Tuna (CCSBT) through the 1990s and early 2000s saw the introduction of more binding TACs to member states which sought to keep global SBT catch at sustainable levels. From 1994 to 1997 the CCSBT set the global TAC at 11,750 mt. However, by the end of the 1990s an increasing proportion of the global catch was been fished by non-members such as Taiwan, Indonesia and Korea. By 1999 the non-CCSBT catch was estimated to be in excess of 7,400 mt (BRS 2008). The CCSBT encouraged the membership of these countries and The Republic of Korea joined in 2001, the fishing entity of Taiwan joined the extended commission in 2002 and Indonesia joined in 2008. The Philippines, South Africa and the European Union were accepted as Cooperating Non-Members between 2004 and 2006.

In 2006 a study of Japanese market data indicated that Japan had significantly under-reported SBT catch over at least 20 years (1985 – 2005) and some estimates of unreported catches

exceeded 178,000 mt (BRS 2007, 2008). This finding has caused a severe loss of confidence in the primary catch series (Japanese longline logbooks) used for stock assessment by CCSBT.

5.1.2 Current Status of the Commercial SBT Fishery

SBT has recently been assessed as severely overfished (BRS 2007, 2008, 2009). At the Sixteenth Annual Meeting of the CCSBT (CCSBT 2009a) it was estimated that:

- The SBT spawning stock biomass was 5% or less of the pre-exploitation level and well below the level that could produce maximum sustainable yield;
- Recruitments during the last two decades were well below levels over 1950-1980 and there was no sign of the spawning stock rebuilding; and,
- Fishing mortality was nearly double F_{msy} (the mortality that allows maximum sustainable catch).

The CCSBT concluded that to rebuild the spawning stock and thereby reduce the risk of further poor recruitments a reduction in the TAC was required. As a result, the global TAC for the 2010 and 2011 fishing seasons was reduced by 20%, from 11,810 to 9,449 mt.

The most recent stock assessment by the CCSBT estimated that the SBT spawning stock biomass remained at around 5% of pre-exploitation levels (CCSBT 2011a). However, according to The Extended Scientific Committee, there were several positive recent signals about the outlook for the spawning stock, including:

Stock:

- Reduction in the total reported global catch;
- Current fishing mortality reduced and now below F_{msy}; and,
- Confirmation of increases in longline CPUE since 2007.

Recruitment:

- Increased scientific aerial survey (both scientific and commercial spotting) and Surface Abundance Per Unit Effort (SAPUE) indices (reflective of potentially improved recruitment of recent year classes); and,
- Increased abundance of one year old SBT observed in the scientific aerial survey for the past three years and the troll survey in the most recent year.

As a result of the recent projections, at its eighteenth annual meeting the CCSBT increased the global TAC to 10,449 mt for 2012, 10,949 mt for 2013 and 12,449 mt for 2014 (CCBST 2011d). The Scientific Committee did not recommend that further reductions to the global TAC would be required to rebuild the spawning stock to the rebuilding target of 20% or pre-fishing levels. CCSBT (2011b) also announced the adoption of a Management Plan (see **Section 4**) to guide the TAC from 2012 onwards and to ensure that the SBT spawning biomass reaches 20% of the pre-fishing biomass by 2035.

5.1.3 Commercial Fishing in Australia

The value of the Australian SBT fishery for 2007, 2008 and 2009 was $ 42.4 million, $ 45.9 million and $45.3 million, respectively (BRS 2008, 2009). Around 98% of Australia's domestic quota is taken by 5-10 purse seine vessels fishing in the Great Australian Bight for 13-25 kg SBT from December to March (AFMA 2011c). These fish are towed alive to static grow out cages near Port Lincoln where they are fattened for up to six months before export, largely to Japan. The remainder are predominantly taken by longline fishers with SBT quota off the south east coast of Australia in the Eastern Tuna and Billfish Fishery (ETBF) (DEWHA 2008). A small amount is also taken by pole and line, and by trolling. The ETBF began as a domestic longline fishery for Yellowfin and Bigeye Tuna of the south coast of NSW in the early 1960s (BRS 2007). The incidental capture of SBT in the ETBF became problematic for managers of the SBT fishery. Levels of SBT discarding are now reduced through management arrangements implemented by AFMA (see **Section 4**).

5.2 Recreational Fishing

Recreational catches of SBT are reported primarily from New South Wales, South Australia, Tasmania and Victoria, although recreational catch is likely to have occurred in all States of Australia (AFMA 2009). Most recreational fishing grounds, with the exception of Tasmania, are located on the continental shelf break in 200-1000 m of water (AFMA 2009). For Portland (Victoria), Port MacDonnell (South Australia) and Eden (NSW) this means at least a 100 km round trip to the grounds. The distances that fishers have to travel and the sea conditions that are often encountered in the Southern Ocean mean that fishing is predominantly limited to larger trailer boats, motor cruisers and charter vessels.

5.2.1 Recreational Fishing for Southern Bluefin Tuna in New South Wales

5.2.1.1 Historic Fishing

The southern coast of NSW has been a traditional area for recreational SBT fishing since the late 1930s (Caton 1994). From July to January, fishers troll along the continental shelf targeting SBT migrating up the east coast of Australia, following cold water from the Southern Ocean. Anecdotal accounts of SBT surface schools within State waters (seaward to three nautical miles) were relatively rare and generally confined to the 1960s and 1970s (FSC 2004). Recreational fishing focussed predominantly on juvenile SBT, weighing 7 – 15 kg (Caton 1994).

Fishing for SBT became increasingly popular with the greater availability of inexpensive, ocean going trailer boats with improved navigation systems and weather prediction. However, following the collapse of the NSW commercial Pole and Line surface fishery in the mid to late1970s, the recreational catch declined to virtually nothing (Caton 1994). SBT began to reappear in the recreational catch during the 1990s but anecdotal accounts suggest that catch has been scattered and sporadic (Caton 1994, Rowsell *et al.* 1994). In very recent years catches of SBT in NSW appear to have markedly improved. Prior to this, the last significant catches of SBT by recreational fishers were in the early 1990s (AFMA 2009). In the past the season has run from June to December.

5.2.1.2 Techniques

The most popular method to catch SBT is trolling with lures. Lures such as Konahead-style lures, pushers, jet-heads, rubber squid, feathers, jigs and minnows are used (Sportsfish Australia 2012). Live bait (blue mackerel, yellow-tail scad and small tuna), dead bait and lure casting are also used. Un-weighted flesh-strip baits or whole and cut pilchards in conjunction with a berley trail of fish cubes may also be used for larger fish (cubing or strip baiting) (Sportsfish Australia 2012). Cubing for SBT has been shown to allow large catches of fish by holding the school of fish close to the boat for an extended period of time. This allows multiple hook-ups of fish whilst keeping the school close by using plentiful burley. This method enables fishers to easily attain their bag limit and is believed to have resulted in large catches of SBT off the coast of NSW in 2011 (Peter Gallagher, NSW DPI (Fisheries), Pers. Comm.). Most SBT are taken using specialist game fishing tackle with lines of 15 to 37 kg breaking strain. The New South Wales Game Fishing Association (NSWGFA) scores points for different line categories (4 kg, 6 kg, 8 kg, 10 kg, 15 kg, 24 kg, 37 kg and 60 kg). Charter boat operators generally use the same methods to target tuna species as recreational fishers, although they often have better equipped boats and are more highly skilled.

Spearfishing for SBT is known to occur in Australia and New Zealand with most activity in Victoria. At present the practice is still relatively uncommon in NSW.

5.2.1.3 Effort

According to Henry and Lyle (2003), approximately 19.5% of the national population participated in recreational fishing activity in the 12 months prior to May 2000 (i.e. 3.36 million people). NSW has the most recreational fishers (999,000), but has a participation rate of only 17.1%. About 30% of the total recreational fishing effort in NSW occurs in coastal waters

(shoreline out to 5 km) with only 2% taking place offshore (i.e. > 5km from the coast) which is where the majority of fishing for SBT would occur (Henry and Lyle 2003).

Of the total number of vessels used for fishing (nationally), 11% are > 6 m long which would be considered appropriate for use in offshore waters. In NSW, this would roughly equate to 17,523 vessels that could potentially fish offshore (assuming the proportion of vessels > 6 m is the same as the national average), but given that NSW has a relatively small recreational fishing participation rate in comparison with most other states, this figure is likely to be smaller. It is unknown what proportion of these vessels would be able to gamefish and potentially target SBT, particularly as the species is usually more common (if present) in the southern portion of the state. Over 15 years ago Caton (1994) estimated the size of the NSW fleet capable of operating in SBT fishing grounds as in the order of 1,000 vessels.

The largest proportion of fishing effort that occurred from a vessel in NSW was recorded as occurring from private vessels (92%), as opposed to hire and charter boats (Henry and Lyle, 2003). NSW is described in the survey as a 'net importer' of fishing effort. That is, 19% of people who fish interstate of their home state go to NSW to fish (Henry and Lyle, 2003).

Gamefishers target SBT in NSW and the NSWGFA maintains records for landed SBT and awards competition points for both tag and release and landed SBT. There are currently 24 gamefishing clubs registered with NSWGFA and visiting gamefishers from interstate (e.g. Victoria) travel to the southern NSW coastline to fish. There were 27 gamefishing tournaments held in the 2011/12 season. These events vary in size, the largest being the NSW Interclub Tournament held in Port Stephens that can have up to 220 boats participating. Charter boats can also take SBT.

5.2.2 Available Data on Australian Recreational Catch of Southern Bluefin Tuna

There are currently very few data available on recreational SBT catch rates and harvest patterns in Australia (DEH 2004, DEWHA 2008, Rowsell *et al*. 2008, AFMA 2009). **Table 3** presents all known recreational catch estimates of SBT made since 1993.

5.2.2.1 Total Australian Catch

Hobshawn *et al.* (2009) estimated Australia wide recreational catch based upon limited Tasmanian charter and gamefish club data extrapolated to total Australian catches using proportions of SBT tag and release data from each fishery area. Estimates ranged from 3-85 mt annually (**Table 3**). The estimates were meant to be indicative only and likely do not reflect current catches or fishing patterns (Rowsell *et al.* 2008). There was insufficient data to provide estimates for all years.

As part of its strategic assessment of the Southern Bluefin Tuna Fishery (SBTF), DEH (2004) reported that Australia had previously advised the CCSBT at the ninth meeting of the Commission that domestic recreational take was 18 mt, contrasting to an estimate of 120 mt purportedly provided by recreational fishers to the Southern Bluefin Tuna Management Advisory Committee (SBTMAC).

The National Recreational and Indigenous Fishing Survey conducted from May 2000 to April 2001 was predominantly an offsite survey whereby recreational fishers were identified randomly by telephone screening (Henry and Lyle 2003). This was followed by a 12 month survey using diaries and regular phone interviews. There was some on-site data collection (i.e. creel surveys) to evaluate the identification skills of recreational fishers and assess the size structure of the catch. The survey did not report the catch of individual tuna species because of the low frequency of reporting and the likelihood of incorrect identification (Rowsell *et al.* 2008). Thus, it is not possible to make accurate estimates of SBT recreational catch using data from this survey.

5.2.2.2 New South Wales

Aside from Cardno Ecology Lab (2010), there are no other known attempts at estimating the size of the NSW recreational catch of SBT. In the Preliminary Environmental Assessment for

SBT, Cardno Ecology Lab (2010) provided estimates for the NSW recreational catch of SBT. These estimates ranged from 13.3 mt in 2009, to between 0.39 and 1.64 mt in 2001. The 2009 figure was extrapolated from gamefish club records and NSW tagging data provided by NSW DPI (Fisheries), while figures for 2001 were extrapolated using data from the National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) and NSW tagging data. Both estimates were meant to be indicative only as they made many assumptions and thus had little confidence.

Limited data on SBT catch in NSW are available for some recreational sectors. These data sources include:

- Charter boat logbooks;
- Gamefish tournaments;
- Game fishing club records; and,
- NSW Game Fish Tagging Program.

Charter Fishing Monitoring Program

It is a compulsory requirement that all licensed NSW charter fishing operators record catch and effort data for each charter fishing trip in logbooks. The NSW Charter Fishing Monitoring Program was initiated in 2000 and since then 200 charter licenses have been issued. A total of 40 SBT have been recorded in the programme (**Table 4**). Seven of these (18%) were released after capture.

When compared with the total NSW charter catch, SBT comprise an extremely small percentage (**Table 5**). Over the period 2000 to 2009, SBT comprised just 0.0016% of the reported charter catch (by number). It should be noted, however, that during this time there was significant under-reporting of SBT in the NSW charter monitoring program (Phil Bolton, NSW DPI (Fisheries), Pers. Comm.).

According to ABARE (2004), for tuna as a group, 77% of those caught from NSW charter boats in 2001-2002 were subsequently released.

Gamefish Tournament Monitoring Program

Gamefishing clubs are usually affiliated with the New South Wales Game Fishing Association (NSWGFA) and operate from most major ports along the NSW coast (Pepperell Research & Consulting 2008). There are numerous gamefishing tournaments held in NSW each year, with 27 hosted by NSWGFA game fishing clubs for the 2011/12 season. There is no compulsory reporting from gamefish tournament organisers to fisheries management (Rowsell *et al.* 2008).

In 1994 NSW DPI (Fisheries) (then NSW Fisheries) initiated the NSW Gamefish Tournament Monitoring Program (GTMP) to better understand gamefishing and assist in the management of gamefish species (Ghosn 2010). Data are collected from radio “schedules” (scheds) and post-fishing interviews (Rowsell *et al*. 2008, Williams and Scandol 2008). Scheds are part of a mandatory radio reporting system used during tournaments affiliated with the New South Wales Gamefishing Association (NSWGFA) and they contain catch and effort information from each vessel participating in the tournament. Non-point score species may not be reported on scheds and nor do scheds contain accurate information about fish size (Williams and Scandol 2008). Post-fishing interviews were undertaken to provide information on non-reported catch and validate data from the scheds. Temporal coverage of port-fishing interviews has not been complete since the inception of the GTMP, and interviews were not conducted in 1997 and from 1999 to 2000.

The data contained in the Gamefish Tournament Monitoring Program have been collected from 16 NSW ports. Over the period 1994 to 2005, between 4 to 15 ports were monitored in any one fishing season, and up to 22 tournaments covered, representing up to 57 days in a season (for a total of 469 tournament days from 192 tournaments) (Park 2007; Williams and Scandol 2008). The number of boats in a tournament can be as high as 220 but more commonly less than 100.

A total of 7,979 angling party post-fishing interviews were conducted over 106 tournaments between 1994 and 2005.

The incidence of SBT captures in NSW tournaments is very low given the fishing effort (boat days) the survey represents (Rowsell *et al*. 2008). Since the start of the GTMP a total of eight SBT have been recorded from four tournaments (**Table 6**). At least seven of these fish were subsequently released. Six of the 22,065 fish caught during the period 1994 to 2005 were reported as SBT. This number is small considering the amount of tournament time and fishing effort the monitoring programme represents. Possible explanations for this may include:

1. Incomplete coverage of tournaments;
2. Absence of post fishing interviews in some years; and,
3. Incomplete coverage of access points by interviewers at larger tournaments (Williams and Scandol 2008).

The most likely explanation for the small SBT catch in tournament data is probably due to the scheduling of the majority of tournaments being during summer months, with a likelihood of fewer SBT occurring in NSW waters. Of the 27 events in the 2011/2012 season, 20 took place between January and May, during the period where SBT presence in NSW waters would be considered less likely and where lower numbers of tagged SBT have been recorded (see tagging (**Figure 8**) and gamefish data). It should also be noted, that common targeting practices in summer/autumn tournaments are generally not amenable to catching SBT, that the GTMP dataset prior to 2010 has not been verified and that SBT were likely incorrectly discriminated from Longtail Tuna (*Thunnus tonggol*) (Danielle Ghosn, NSW DPI (Fisheries) Pers Comm.) due to their morphological similarity and recognised availability in summer/autumn months. It is unlikely that SBT recorded in the NSW Game Fish Tagging Program in winter months were also misidentified from this species.

Game Fishing Club Records

There are 15 entries for record sized SBT caught and landed in NSW in Game Fish Association of Australia (GFAA) records between 1938 and 2011 (**Table 7**) (GFAA 2011). The largest was a 167.5 kg fish caught in 2009 (**Appendix 3**). Five of these records are from 2009 and five from 2011. The majority of SBT were caught from Bermagui and Tathra in either June or July. While gamefish club records do not allow any estimates of landed SBT catch to be made, they are probably a good representation of the size range of SBT historically available to recreational fishers. The absence of any records from 1970 to 2006 could reflect the absence of SBT in NSW waters, possibly linked with levels of commercial exploitation.

Some individual game fishing clubs maintain records for point-scoring fish landed each year. Bermagui Big Game Anglers Club records from 2003 to 2011 contain records for 39 landed SBT (**Table 8**). One SBT was reported from 2006, two SBT in each of 2007 and 2008, 16 SBT in the 2009 season, 6 SBT from 2010 and 12 SBT from 2011. Thirty five of the 39 fish were caught from June to July. The combined weight of the landed 16 SBT from 2009 was 1.378 mt (mean weight SBT = 85.8 kg ± 7.7 S.E.). The NSW Game Fish Tagging Program reports seven SBT tagged and released from Bermagui in 2009. The combined weight of the tagged fish was 0.197 mt (mean weight SBT = 28.143 kg ± 5.1 S.E.). The Bermagui BG & AG reported a landed catch 2.29 times the number of the tagged and released SBT and the landed fish had a mean weight approximately three times greater than tagged and released SBT. This disparity is because fishers are more likely to retain larger fish and discard (including tag and release) smaller fish, because (i) they only wish to retain large “trophy” fish, or (ii) point score for landed fish increases with size. Therefore it is likely that the NSW Game Fish Tagging Program records for NSW are biased towards smaller fish, particularly after November 2003 when the NSWGFA reinstated point score for landed SBT (NSWGFA only recognised point score for tag and release SBT from July 1989 to November 2003).

There were no reports of landed SBT in the Bermagui BG & AC records from 1993 to 2005, this may be associated with NSWGFA withdrawing point score for SBT landed between July 1989 to November 2003. Fish may however still have been taken and not presented for recording

during this period. NSW Game Fish Tagging Program reports 28 tag and releases from Bermagui over the period 1993 – 2005

The records of the Victorian Game Fishing Club from 1975 to 2009 reported a landed catch of 59 SBT. Of these, 21 were taken from NSW (all from Bermagui) over the period 1981 to 1988 (**Table 9**). There are two records for tagged and recaptured SBT at Bermagui from this same period. The data demonstrate that gamefishing within NSW State and adjacent Commonwealth waters are not restricted to local or NSW fishers. During episodic events such as this, the potential fishing effort can come from local, intrastate and interstate areas. There were no records of landed SBT from the Shoalhaven GFC from 1976 – 2001. 1989 – 2001 corresponds to the period of no point score for landed SBT, however there are no records for the preceding 13 years where points were available. There are a number of NSW Game Fish Tagging Records from that area. Records from South Gippsland GFC 1993 – 2001 (missing 1995/96 season report), Latrobe Valley GFC 1994 – 1999 and the Canberra GFC 1993 – 2001 (missing 1996/97 season report) all report no SBT landed catch.

NSW Game Fish Tagging Program

The NSW Game Fish Tagging Program was initiated in 1973 and operates throughout Australia. Data have been collected on the date, location, species and estimated size of tagged gamefish, including SBT. Since 2005, there has been a large increase in the number of tagged SBT in Australia relative to the number tagged SBT in previous years (**Figure 6b**) and total number of all tagged gamefish in previous years (**Figure 6a**). Numbers of tagged SBT in NSW were generally small, with occasional outlier years of relatively more tagging (**Figure 7**). In 2011, 518 SBT were tagged in NSW, more than the previous 37 years combined. Of the 518 SBT tagged in 2011, all but six were caught between 24 June and 2 July. In 2009, the year with second largest number of tagged SBT, all 67 tagged fish were caught from 8-11 June. Tagging generally occurred over a short period each year, from days to only a few weeks, this may indicate SBT are available to recreational fishers over narrow temporal windows. Monthly catch patterns (**Figure 8**) and concentrations of catch in the southern latitudes conform with gamefish club records and accepted patterns of SBT availability in NSW waters.

Tagging data include several records of SBT caught in Australian waters that have been recaptured thousands of kilometres away in South Africa. One SBT, tagged in 2001 off Tasman Island, Tasmania, was recaptured near Cape Town after travelling over 5000 km in 78 days. These data support the assertion that SBT constitute one interconnected population.

Tagging data do not have accompanying information on retained SBT catch, so they cannot be used to estimate total landed catch. However, some assumptions about fish availability can be made from the tagging data due to there being regular, year-round recreational game fishing effort in the South-East of Australia. Increases in the number of tagged SBT through time could also be linked to a tagging program initiated by AFMA and CCSBT over 2006-2008 involving recreational fishers from South Australia. One quarter of tagging done over the last four years is part of this program, which may also have had a concomitant effect on the existing NSW Game Fish Tagging Program by raising awareness and participation amongst recreational game fishers. Tagging data does indicate, however, that during periods of increased SBT availability, fishers can respond with a large effort response and catch many SBT over a relatively short period.

5.2.2.3 Other States

South Australia

In South Australia fishing for SBT takes place primarily around Port MacDonnell near the Victorian border, and Coffin Bay and Wedge Island near Port Lincoln (Rowsell *et al.* 2008). There is also some fishing effort further along the west coast into the Great Australian Bight. Late December to June is the main season for SBT in South Australia.

Caton (1984) estimated that the annual recreational catch in South Australia is unlikely to have exceeded 20 mt. The only other known estimate is in Rowsell *et al.* (2008) and AFMA (2009) which put the South Australian charter catch at 7.16 mt for 2006 and 10.02 mt for 2007 (**Table**

3). These estimates correspond to 358 and 501 retained fish, respectively (**Table 4**). The release rate for charter boat caught SBT in 2006 was 55%, in 2007 it was 69%.

SBT taken by recreational fishers in South Australia generally range from 5 – 30 kg (Caton 1994, FMA 2009). There are 25 gamefish records for SBT in South Australia with the largest fish (115 kg) caught in 1980 (GFAA 2011) (**Table 7**; **Appendix 1**).

New productive SBT grounds were discovered by recreational fishers in 2006 offshore from Portland (Victoria) and Port MacDonnell (South Australia). In the 2009 season, approximately 31 fish over 100 kg were taken from these grounds, corresponding to 3.4 mt of recreational take (AFMA 2009).

The results of a 2008 state wide study repeating the methodology of the National Recreational and Indigenous Fishing Survey were published in 2009 (Jones 2009). However, like the earlier survey, SBT were grouped with other tuna species and therefore estimates of SBT catch cannot be made using the data.

Tasmania

Recreational fishing for SBT in Tasmania is concentrated around the Tasman Peninsula. The main fishing season for SBT in Tasmania is between late January and August with April, May and June the most productive months (Rowsell *et al.* 2008). Catches have also been reported as far north as Flinders Island and in recent years there has been increased activity off southern Tasmania, particularly off Southport, south of Bruny Island and around Pedra Branca, approximately 20 nautical miles south of the coast (Caton 1994, Rowsell et al. 2008, AFMA 2009).

Caton (1994) estimated that the annual recreational catch in Tasmania is unlikely to have exceeded 25 mt. Caton (1994) and AFMA (2009) also report on one charter operator who maintained a logbook of SBT catch since 1965. His daily catch rate of 3.5 – 14.5 SBT declined until in 1984 when no SBT were caught (similar situation to NSW). Daily catch rates from 1985-1993 subsequently increased again but remained lower than the 1960s and 1970s (0.5 – 4.8 SBT).

A survey by Morton and Lyle (2003), with particular reference to SBT, incorporating on-site, logbook and diary surveys estimated the Tasmanian SBT catch for 2002 and 2003 to be 18.4 mt and 2.5 mt respectively (**Tables 3** and **4**). 2003 was regarded as a poor season. In 2002 and 2003 respectively, approximately 35% and 18% of SBT caught by on-site survey respondents were subsequently released. None of the 18 SBT caught by charter boats in 2003 were released. A similar 2008 survey by Forbes *et al.* (2009) also concentrating on SBT and incorporating boat ramp surveys (including gamefishing tournaments) and charter logbooks estimated the total Tasmanian recreational catch of SBT in 2008 to be 14.0 mt. This estimate was considered to be a minimum as the study did not have complete temporal or spatial coverage. Of the 395 SBT recorded from boat ramp surveys 48 (12%) were released. SBT caught from charter boats were released at a rate of 18%. Both these studies contain references to estimates of charter take made for 1993 and 1994, with 12.5 mt (678 fish) and 6.9 mt (295 fish), respectively (**Tables 3** and **4**).

Twenty-six gamefish records exist for SBT from Tasmania with the largest single fish 153 kg taken in 2007 (**Table 7; Appendix 1**).

Victoria

The south west coast of Victoria from Apollo Bay to the South Australian border is the main area of recreational fishing for SBT in Australia (AFMA 2009). Fishing effort is concentrated from Portland, Port Fairy and Warrnambool, with Portland being the most popular choice because of its closer proximity to the continental shelf (55 km). The Victorian SBT season runs from January to July, with the period from March to May being the most productive (Rowsell et al. 2008).

The Department of Primary Industries, Victoria, surveyed SBT recreational fishing over the 2011 season funded by the Recreational Fishing Licence Grant programme. This survey included

boat ramp surveys, charter boat observers and diary records. During the 2011 season, nearly 300 mt of SBT were taken from Victorian waters, this was considered to be a conservative estimate (James Andrews, Victoria DPI, Pers. Comm.). Charter boat catch made up a significant proportion of the total catch. Larger vessels would carry several angers and catch reports include events where each angler on a charter boat would catch their maximum allowed take (2 SBT in Victoria). This would result in total charter boat catches exceeding the proposed NSW charter catch limit of 6 SBT (no charter boat limits for SBT exist in Victoria). Charter boat SBT fishing also occurred primarily during February to April.

Victoria has 20 record SBT listed with the largest single record of 128 kg from 2010. Productive grounds have been discovered in 2006 offshore from Portland and Port MacDonnell (SA). In the 2009 season, approximately 31 fish over 100 kg were taken from these grounds, the largest being 128 kg (AFMA 2009). This area contributed 3.4 mt to the total recreational take (AFMA 2009).

Western Australia

The main centre for recreational SBT fishing in WA is offshore of Busselton (south of Perth), with smaller-scale activities off Albany and Perth, targeting 1 – 2 year old juveniles (Caton 1994). Rowsell *et al.* (2008) reports that juveniles are also caught as far north as Steep Point (Shark Bay).

Compulsory charter logbooks returned 13 SBT in 2005 and 17 in 2006 (Rowsell *et al.* 2008) (**Table 4**). A creel survey of boat-based fishers operating on the south-west coast between Augusta and Kalbarri estimated that 612 SBT weighing 2.3 mt were retained in this region during 2005/06 (Summer *et al.* 2008) (**Table 3**).

Western Australia has 10 record SBT listed with the largest fish (7.3 kg) caught in 2010.

5.3 Summary

Due to their highly migratory nature, SBT are considered to consist of one global population. Therefore no distinction can be made between local, regional or global populations. Any anthropogenic impact experienced at the local or regional level could affect the entire population. Similarly, even if data were available, estimates of abundance would be applicable to the whole population only.

5.3.1 Characteristics of the SBT NSW Recreational Fishery

SBT are targeted by recreational fishers, club-affiliated fishers and charter boat operators, primarily for sport rather than consumption. The ability of fishers to respond to increases in SBT availability with increased fishing effort, such as that observed in tagging and gamefish club data, suggests there is a large capacity to transfer effort to SBT according to their availability.

Other characteristics of the NSW SBT recreational fishery include:

- SBT are a pelagic species generally only available to recreational fishers many kilometres from shore near the break in the continental shelf. To be able to target SBT, recreational fishers must have access to relatively large offshore vessels with adequate navigation systems. Due to their size, SBT would also require specialised gear. Although such equipment may be becoming more available and affordable, the proportion of recreational fishers able to target SBT is probably relatively small; and,
- Tagging, gamefish records and gamefish club data suggest SBT are available to recreational fishers in NSW predominantly over June and July, and that the vast majority of fish are caught over a relatively short period of intensive fishing activity covering a few days to weeks. Most fish appear to be caught from a few popular ports, such as Bermagui and Tathra.

Thus, recreational fishing for SBT, at least in NSW, may be considered a niche fishery due to (i) only a small proportion of anglers have gear, time and skill to be able to respond to SBT arrival and target them effectively, and (ii) the extreme temporal and spatial variability in availability of

SBT. However, recreational fishers appear able to respond to increases in SBT availability with relatively large increases in catch and effort. During times of increased availability, techniques such as cubing can allow fishers to catch several SBT and attain their bag limit.

5.3.2 Estimating Recreational SBT Catch

Whilst surveys of recreational fishing for SBT have been done in other states, no targeted surveys have been done in NSW. Thus, it is impossible to accurately estimate the recreational take of SBT in NSW using current data sources. What data are available on Australian or NSW take may be extrapolated from studies not designed with SBT in mind, are incomplete or do not contain sufficient additional information in order to make accurate estimates of SBT take. Most of the available data suggest that the total Australian SBT recreational catch is a very small proportion of the total global commercial global catch. Inferred historical declines in NSW recreational catch, likely due to commercial exploitation, appear to have been relatively large. The limited data available from NSW indicate that SBT are a relatively rare component of the NSW recreational catch, catches are generally very small, with occasional years of relatively higher catch.

Surveys with particular reference to SBT have been undertaken in Tasmania and provide relatively accurate estimates, although these surveys may not have complete temporal or spatial coverage. Catches in Tasmania may also be higher than that in other states due to the relatively close proximity of the continental shelf. Strong inter-annual variability (i.e. Morton and Lyle 2003) suggest that one-off surveys are not representative of the fishery. The limited data available from SBT recreational fisheries in other states (aside from Victoria) suggest that catch is a very small proportion (typically less than 1%) of the total global commercial catch.

Charter catch data would seem to suggest that the NSW SBT charter catch is considerably smaller than that in other states. SBT appear to make up a small proportion of the total NSW charter catch, and in each year where SBT charter catch data is available from South Australia, Tasmania or Western Australia either none, or substantially fewer, SBT are reported from NSW. This observation could be explained by the availability of SBT to the NSW recreational fishing sector relative to that in other states and / or relative SBT fishing effort among states. However, doubts concerning potential underreporting in the NSW Charter Fishing Monitoring Programme mean that there can be little or no confidence in conclusions drawn from these data. Charter boat data may be useful in estimating release rates. The release rate for all NSW charter boat caught fish combined is lower than the release rates of SBT reported by Tasmanian recreational fishers and South Australian charter boats. This could suggest that SBT experience a greater release rate than the majority of other species targeted by the charter boat fishery.

Whilst recreational catch of SBT has historically been considered small, anecdotal evidence suggests a possible increase in catch and effort in recent years (Rowsell *et al*. 2008, AFMA 2009, Victoria DPI (Fisheries) 2011). Tagging data from NSW may also suggest an increase in availability and effort, but not conclusively. Projections by CCSBT (2011b; d) also suggest recent increases in recruitment and abundance of juvenile SBT (**Section 4.1.2**). The recent targeted SBT survey undertaken by Victoria DPI reported the recreational take of SBT in Victoria in 2011 was considerably higher than all previous state or Australia wide estimates. The reported take of 300 mt was just over 3% of the total global allowable catch for 2011 and greater than the annual SBT catch reported from the Eastern Tuna and Billfish Fishery (where a SBT quota is required) from 2007-2010 (**Table 3**). The SBT recreational catch in Victoria is a significant source of SBT mortality not reported to the CCSBT.

Although it is not possible to accurately estimate the recreational catch of SBT in Australia or NSW, the potential size of SBT mortality due to NSW recreational fishing will depend on several factors, including:

- Availability: The most important factor in determining catch is the availability of SBT to the recreational fishing sector, which in turn can be affected by distance to fishing grounds, surface weather conditions, sea temperature and SBT forage behaviour and regional abundance. The temporal availability of SBT to the NSW recreational fishery appears to have varied greatly through time, both inter and intra –annually, and at scales

of days to weeks. Large temporal variability is also reported in Tasmanian charter catch and survey data. The ability of anglers to respond to short term to increases in SBT availability is an important factor determining the total harvest.

- Fishing effort: Effort is linked with availability and constrained by the distance to fishing grounds and the availability of adequate vessels / equipment. As offshore vessels and equipment become more affordable, it is possible that more fishers will be able to target SBT, thereby increasing effort. Tagging data would suggest that when SBT are available fishing effort can be relatively large;
- The release rate of caught SBT. Over the last 20 years catch and release fishing has become more popular (AMFA 2009). Release rates reported for caught SBT have ranged from 0 to almost 100% (see **Section 4.2.2.3**). Tagging of SBT has been encouraged as a sustainable fishing method in gamefish club newsletters (Bermagui Big Game Anglers Club 2011). From 1989 to 2003 the NSWGFA removed point score for landed SBT due to concerns about its conservation status. A high proportion of released fish should result in lower overall mortality.
- Popularity. A real or perceived increase in the availability of SBT to recreational fishers could encourage more fishers to target the species (thereby increasing effort), where they may not have done so in the past due to its perceived rarity / absence in NSW waters.
- Other sources of mortality: Post-release mortality, or hooking mortality, would contribute to total mortality due to fishing activities, even in a no take fishery. Even a small hooking mortality can generate high total fishing mortality if effort is large (see Cox *et al.* 2002).

6 Assessment of Impacts

6.1 The Authorisation of Recreational Fishing for SBT in NSW

Under the Proposal, recreational fishing for SBT in NSW will be authorised in accordance with all applicable regulatory controls. Without accurate data on SBT mortality due to recreational fishing in NSW, it is impossible to determine the historical impact of recreational fishing for SBT in NSW, or to accurately predict the future impact of continued recreational fishing for SBT. Historical data suggests that the total Australian recreational catch of SBT represents a very small proportion of the total global commercial catch. Therefore it is highly unlikely that historical recreational fishing in Australia, or NSW, has contributed significantly to the current status of the SBT standing stock.

However, recent Victorian data suggest that the current SBT recreational catch in that state (estimated at approximately 3.5% of global commercial catch), and in Australia, could have a relatively large cumulative effect on the global stock, especially in the context of a very low standing stock biomass (around 5% of pre-exploitation levels). Further, there is also a risk that increases in recreational take may 'mop-up' recovery in standing stock achieved through reductions in commercial take implemented through the Commission for the Conservation of Southern Bluefin Tuna.

If the availability of SBT in NSW waters were to increase, a concurrent increase in effort and take may occur in the NSW charter boat sector. Take of SBT may be further increased if high levels of latent effort in the charter boat sector are activated.

Currently in NSW there are 276 charter boat licences. Of these, approximately 62 (22%) are inactive, and as such represent a significant amount of latent fishing effort that could enter the fishery. This may be further exacerbated if existing active operators opportunistically switch to SBT from other species. For example, temporarily or permanently relocating vessels to south coast ports to the target SBT during periods of increased availability if this is seen as more profitable.

Currently the charter boat sector is a restricted fishery (i.e. no new licences are issued) and as such the total effort (latent and active) is capped. However the fishery is not managed under a Fishery Management Strategy and has not been subject to any form of dedicated environmental impact assessment process. Further, there are no controls over the movement of charter boat licences along the NSW coast, and over time licences and business models are likely to move in response to economic signals.

Acknowledging that some doubts exist about the veracity of charter boat data (see Section **5.2.2.2**), the small number of SBT recorded in the charter boat monitoring program (32 fish over 10 years) suggests that the charter boat sector has not historically participated in the recreational fishery for SBT at any significant level.

While the level of latent effort is considered high, and could, if activated, result in a substantial increase in fishing pressure on SBT stocks (Nick James, NSW DPI (Fisheries), Pers. Comm.), a range of factors operate to mitigate the risk of this scenario emerging. Operations based on nearshore bottom and sportfishing, rather than gamefishing (which would include SBT targeting), are the predominant business model in the sector. Most ocean surveyed charter boat vessels and non-gamefishing boats would be unable to target SBT without modifications to equipment and targeting practices which would be considered unlikely with regard to the short term temporal and spatial availability of SBT (i.e. it is not economically viable to substantially modify business models and equipment given the short and unreliable periods of availability of SBT). Further, the consistently high level of latent effort in recent years suggests that the number of viable charter boat licences is less than the total number issued. These observations, together with the current management arrangements that place a ceiling on charter boat fishing effort, mean that the expected impact on SBT due to charter boat fishing would be minimal.

Notwithstanding this, levels of SBT take within the charter boat sector should be closely monitored and the regulations kept under review to prevent substantial increases in landings of SBT within the charter boat sector over historical levels.

The potential for increased catches by the recreational sector during periods of increased availability is probably higher. Effort controls such as those in the charter boat sector are not in place in the private sector, and surveys suggest that the private sector may be considerably larger than the charter sector, although increases in effort may be limited in a niche fishery. However, even during periods of high availability, not all charter operators or private fishers would be able to target SBT due to the large spatial and temporal variability of the NSW SBT fishery and other constraining factors such as weather and sea conditions, availability of vessels etc (i.e. a niche fishery).

SBT are considered to consist of one interconnected population throughout their range, thus any impact experienced in NSW waters could be translated to the entire population. Even though current CCSBT estimates suggest the standing stock may be recovering, it still remains at a level well below pre-exploitation levels, and therefore potentially vulnerable to even small increases in mortality.

6.2 Change in Recreational Take Limits

The SBT bag limits contained in the proposed Ministerial Order permit fewer SBT to be taken compared with those currently in place (**Table 1**). The personal daily bag limit would be reduced from seven to one, and limits would be imposed for boat and charter boats (two and six SBT, respectively). At present, there are no specific boat or charter boat limits for SBT in NSW. The proposed bag limit would result in NSW operating a take limit lower than that of any other state. At present, SBT boat limits exist in South Australia only, where a take of 6 SBT and / or Yellowfin Tuna is allowed (**Table 2**).

Although recreational fishing for SBT would still be permitted in NSW, the proposed take limits represent a large reduction in the permitted take. The effect that a reduced take limit will have on the actual mortality due to recreational fishing will depend on several factors, including:

- The number of fish that are taken by recreational fishers: If fish are harvested by fishers at, or close to, current take limits, then a reduction in permitted take should mean less fish will be retained (assuming the new limits are adhered too). If, however, current limits (or even the proposed limits) are rarely attained by anglers, the effect on the actual retained recreational catch of imposing stricter limits would be negligible and bag limits ineffective (Cox *et al.* 2002; Beard *et al.* 2003);
- The number of individual fishers who can potentially target the species: In open access sport fisheries, take limits have no effect on the number of fishers who do, or can potentially, target the species in question (i.e. the number of fishers and fisher days is unbounded). An increase in the number of fishers potentially able to target the species, for example due to more affordable / efficient boats / equipment, could offset any potential reduction in take due to reduced bag limits.
- Patterns of availability: Take limits may be more effective at reducing total catch if fish were available for capture during only short temporal windows associated with intense fishing effort. For example, if fish were available to fishers all year, fishing effort could be spread out through the year allowing a large total catch, even if take limits were low. However, if the same number of fish were available for capture, but over a short period of time once or twice per year (as is likely the case with SBT availability in NSW), take limits would restrict the number of fish that could be taken during these periods of relatively high availability, assuming the number of fishers present remained constant. In reality, the number of fishers able to target fish can and will fluctuate though time, possibly in response to availability. Although it would be unrealistic to expect total fishing effort accrued over a long period of time such as a year to match that possible over a relatively short period such as a few days to weeks.

- Other sources of mortality: With a smaller bag limit and a high angler value on large trophy fish, there is probably a high likelihood of discarding (also known as 'high grading'). Fishers may release or discard small fish in order to keep a larger one. Similarly, landing / retaining catch might not be as important to sport fishers; therefore anglers may keep fishing and releasing / discarding. If there is high hooking mortality then even a catch-release fishery with a bag limit of zero could result in a significant mortality. For example, in 1998, estimated total hooking mortality losses of Atlantic striped bass (*Morone saxatilis*) were 1.2 million fish, compared with total recreational landings of 1.4 million fish (see Cox *et al.* 2002). This level of mortality, when combined with total commercial fishery losses, has led to a declaration of overfishing on striped bass. However at least one study has indicated good survival rates of released tuna. The post release mortality rate of Atlantic Bluefin Tuna (*Thunnus thynnus*) off the coat of Prince Edward Island, Canada, was estimated in an experimental recreational fishery by Stokesbury *et al.* (2011) using pop-up archival satellite tags. Fish were captured using bait on circle hooks, all fish were hooked in the jaw and not brought onboard the boat. If mortality occurred after 30 days, this was not considered to be related to hooking. (this was based on previous studies on Atlantic Bluefin Tuna that reported mortality due to catch and release occurred soon (minutes – hours) after release). Of the 59 fish caught, tagged and released, two fatalities were recorded within 30 days yielding a mortality rate of 3.4%. Alternative estimates of the rate of mortality that included the four tags that failed to report during the course of the study (3.6%) and the seven tags that detached prematurely (i.e. within 30 days) (4.2%) can also be calculated. The survival of juvenile Atlantic Bluefin Tuna was also investigated by Brill *et al.* (2002) using ultrasonic depth-sensitive tags. Of the seven fish caught, one died within two hours of release and a second was judged too badly injured to be released. Both these fish displayed bleeding from around the mouth and gills due to hook wounds. The remaining five fish survived for 48 hours following release (the limit of the survey period). The authors suggested that juvenile Atlantic Bluefin Tuna released from recreational trolling gear survive when hook wounds are not severe and handling time is minimal.

The effect of reduced bag limits on the recreational take of SBT in NSW is difficult to predict without reliable data on the actual take of recreational fishers, including personal catch and charter boat catch. Reduced bag limits are likely to be less effective at reducing total harvest if pre-existing bag limits were rarely attained by anglers. Indirect harvest controls such as bag limits can also never completely control harvest as they restrict individual daily catch, not potential fishing effort (i.e. the number of anglers, or the number of fishing days, is free to increase) (Cox *et al.* 2002). However, in the case of the SBT recreational fishery, anglers are believed to commonly attain their bag limit (see **Section 5.2.1.2**). Therefore, a move from a potential bag limit of 7 per person to 1, combined with a boat limit of 2 is likely to significantly reduce levels of harvest.

If total harvest, $H = hE$, where h is harvest per angler day and E is total angler days, H could be controlled by limiting h or E. A reduction in take limits, or h, would therefore be expected to result in a reduction in total harvest. However, if total angler days, or effort, are free to increase, then a reduction in h would not allow complete control over the SBT recreational catch. Tagging and gamefishing club data, and findings from the recent Victorian survey, suggest that during periods of increased SBT availability a relatively significant angler effort response can take place, potentially translating this increased availability into catch. Although, as recreational fishing for SBT could be considered a niche fishery, it is questionable to what extent fishing effort (E) may be unbounded. In this respect, compared with current limits, the proposed bag limits should result in a reduced recreational harvest during periods of relatively high availability.

Findings from the Victorian survey may also support this assumption. Anglers on charter trips frequently reached their personal bag limit of two SBT, and that on boats with several anglers this resulted in a total charter boat catch of well over six SBT (the proposed SBT charter limit for NSW). No boat or charter boat limits for SBT currently exist in Victoria. Based on these catch patterns, if the proposed NSW recreational take limits were theoretically applied to the Victorian SBT recreational fishery, then they should have resulted in a lower overall take (assuming no

additional charter boat trips were made). The Victorian and NSW recreational SBT fisheries appear similar in that SBT are available to anglers over only a short temporal window, and that this is associated with an intense fishing response. Although NSW charter boat data suggests that the NSW charter catch is relatively small, doubts over the accuracy of these data mean significantly more SBT may be caught than are reported. The websites of NSW charter operators may suggest SBT are a commonly targeted species, however catch reports from charter operators do not reflect this, suggesting either non-compliance with reporting obligations or that the sector has not historically taken many SBT, but have an aspiration to retain access to SBT for commercial purposes.

New simplified logbook arrangements were implemented by NSW DPI in July 2011. Regular audits of logbook returns are being undertaken and follow-up management action applied to ensure submission of logbooks for all completed trips. This should go some way to address the non-reporting issue for future management of the fishery.

6.3 Removal of Current Size Restrictions

Current NSW regulations restrict the number of landed SBT equal to, or over 90cm, to two, and the number of landed SBT under 90cm to five. The Proposal would remove all size restrictions for SBT. The removal of size restrictions is not expected to affect the recreational take of SBT, considering that only one SBT would be allowed to be taken per angler per day.

6.4 Alternatives

The proposed Ministerial Order will authorise recreational fishing for SBT in NSW subject to compliance with all applicable regulatory controls, albeit with a reduced take limit over pre-existing arrangements. Other potential management options relating to the management of the recreational SBT fishery are discussed below.

Do not make a Ministerial Order authorising recreational fishing for SBT

The greatest reduction in the mortality of SBT due to recreational fishing would be to not make the Ministerial Order authorising recreational fishing for SBT. Under this scenario, it would be an offence to harm, target or take SBT, and would reduce to the fullest extent possible mortality due to the landing and hooking of SBT. This is likely to have significant social and economic impacts and be unpopular with recreational fishers as it would prevent fishing for what could be regarded as a popular gamefish and ‘trophy’ species. It would also be unpopular with charter operators as it is likely that it would negatively affect their current and future business. Not authorising limited recreational fishing access to SBT is also difficult to defend given that recreational fishing has not been implicated in the historical global decline of SBT stocks; the continued commercial harvest of the species; and the adopted national position that Australia can be more effective at influencing the recovery of SBT stocks through continued participation in the commercial fishery and CCSBT. In turn, improved management of recreational fishing for SBT and improved estimation of recreational take will allow the impact of the recreational fishery to be factored into global TAC setting processes, and assist Australia meet its obligations to the CCSBT.

Catch and Release Only

A catch and release fishery where fishers are not permitted to land, but are allowed to target SBT, including tagging of SBT, would significantly reduce the level of mortality due to the harvest of SBT in the recreational fishery. A catch and release fishery would still allow the targeting of SBT by recreational fishers and charter operators and therefore minimise any economic impact, although a proportion of fishers may be discouraged if they are not permitted to land their catch. Considering that the release rates of SBT by recreational fishers and charter operators can be relatively high compared with other species, and the high number of tag and release SBT reported by the NSW DPI tagging program, a catch and release fishery may be tolerated by recreational fishers. However, this may still be unpopular with some fishers for the same reasons as a complete ban on all targeting and may also be seen as discriminating unfairly against spearfishers. Studies that have investigated the catch and release mortality of

Atlantic Bluefin Tuna, a closely related species to SBT (see Section **6.2**), suggest that survival rates following catch and release can be high. SBT also has exceptional eating qualities. A catch and release option would no longer allow fishers to target SBT for consumption and could therefore be unpopular with some fishers who wish to retain SBT for the table.

Direct Harvest Controls

Unlike indirect harvest controls, such as bag limits, which in some cases may not constrain total harvest, direct harvest controls (access controls) would allow a much greater control. The total allowable harvest could be allocated to permit holders, possibly by the means of a lottery. If the fishery remained open to all fishers, provided they release fish for which they had no permits, this would minimise the impact on participation rates and reduce any economic impact. This system would suffer from the problems discussed above regarding hooking mortality, but could effectively control mortality due to harvest. There would be a cost associated in setting up and administrating such a system, which is probably not feasible for a niche fishery. Some of these costs could potentially be recovered in the form of a licensing fee, although this is likely to be unpopular. Difficulties would also arise in assigning permits to commercial charter operators, especially using a lottery system, as some operators would rely more heavily on the SBT industry than others and would potentially become unviable if there were no longer able to take SBT.

Effort Controls

A limited-entry effort program also using a permit system, with rights assigned using a lottery, could also be effective in controlling total harvest, if it were combined with bag limits and the relationship between total mortality (including hooking mortality), effort, and bag limits were known (Cox *et al.* 2002). Bag limits would be more effective because total effort could be controlled. Such a system would also help reduce hooking mortality. However, it would limit fishers' rights to fishing opportunities and would likely be unpopular. Like direct harvest controls, effort controls would also be subjected to cost and economic considerations.

Charter boat operators in NSW are licensed to operate by NSW DPI (Fisheries). There are a number of catch and effort controls in place including:

- The number of boats permitted to conduct charter fishing activities (at a level that operated historically);
- The number of passengers that may fish from charter boats;
- The type and amount of fishing gear allowed by each angler;
- Species that may be taken by charter fishers (endorsement type); and,
- Areas that charter fishing may be conducted.

Charter boats have specific endorsements that allow them to target certain fish species, these endorsements are; estuarine, nearshore bottom and sportfishing, deep sea bottom, and gamefishing. The regulations list the species types that may be targeted for each endorsement type issued (there are also very limited by-catch provisions in place) (see Section **4.2.2** and **Appendix 2**). These licensing arrangements therefore prevent a charter boat with only a nearshore bottom and sportfishing endorsement from targeting SBT.

Effort and Direct Harvest Controls

A combination of effort and direct harvest controls would represent the most restrictive form of access control. It would help reduce for hooking mortality through the effort limit and any changes in catchability through limits on total harvest. This method would possibly be the only way to gain sufficient control of all mortalities due to recreational fishing.

Total allowable catches associated with effort and direct harvest controls could in theory be sourced from Australia's annual commercial Total Allowable Catch (TAC) assigned by the CCSBT. This would help ensure that Australia did not exceed its allowance, especially if the availability of SBT to the recreational fisheries were to increase. Although there would likely be significant problems in running such a system, not least of which would be the potential loss of income to commercial fishers due to a reduction due in their allowable catch.

Spatial and Temporal Closures

The ability of SBT to migrate large distances over short periods of time would make it difficult to implement spatial closures that were effective in reducing catch but still allowing a limited take (i.e. 1 fish per angler). SBT appearances in NSW waters are brief and unpredictable, and hence temporal closures would also be similarly ineffective.

Spatial controls are applied in the Eastern Tuna and Billfish Fishery (ETBF) and are outlined in Section **4.2.1**. It would likely be prohibitively complex to introduce such management arrangements in for the recreational sector.

New Size Restrictions

Maximum size limits would be unpopular among game fishers seeking trophy fish and those that support point score for landed SBT. It would unlikely have a significant effect on limiting landed catch given that two – four year old fish tend to dominate except during years of increased adult availability, as appeared to be the case in 2009 and 2011.

A minimum size limit set at size-at-maturity (e.g. 160 cm FL) would be impractical as it would exclude most SBT from the recreational catch. A smaller minimum size (e.g. 100 cm FL) would not protect all immature SBT but would exclude younger fish and allow a smaller proportion of larger fish to be retained.

6.5 Biophysical, Economic and Social Considerations

There is limited information on the economic characteristics of recreational fisheries in NSW (BRS 2007). According to BRS (2007) data from the National and Recreational and Indigenous Fishery Survey (Henry and Lyle 2003) showed that recreational fishing expenditure in NSW was approximately $554 million or $555 per fisher in 1999-2000. These figures included money spent during the survey period on directly related items, such as bait and boat hire, as well as indirect expenses such as travel and accommodation. While these expenditure figures provide some indication of the level of recreational fishing activity in NSW, they do not represent the gross value or economic value (in terms of net returns) of recreational fishing in NSW (BRS 2007).

The Australian Bureau of Agricultural and Resource Economics (ABARES) conducted an economic survey of charter boats that operate in the area of the Eastern Tuna and Billfish Fishery (ETBF) from April 2003 to March 2004 (ABARES 2004). The aim of the charter sector survey was to calculate the net benefit (net returns) to the charter sector. The estimated net return of NSW charter operators in the ETBF for this period was -$212 000, compared with -$225 000 for operators in Tasmania and $187 000 for operators in Queensland. Reasons accounting for these low estimates may have included lifestyle benefits, for example where owners derive satisfaction from fishing or taking people fishing, especially where charter fishing was not the primary source of income. ABARE (2004) also estimated the net return of recreational fishers in the ETBF, the estimate included fishers who use a private (either owned or leased) boat to fish the Commonwealth waters for tuna and billfish species. The estimated net return for the NSW recreational sector in 2001-2002 was $1.5 million, compared with $0.1 million in Tasmania and $3.3 million in Queensland. These estimates suggest the recreational sector has the potential to generate substantial net benefits from the fishery.

In 2012 ABARES completed a report on the socioeconomic evaluation of three eastern Australian game-fishing regions – Mooloolaba (QLD), Port Stephens (NSW) and Bermagui (NSW). The report concluded that game fishing increases economic activity by attracting visitors to coastal communities. This activity is reported to be important to small regional centres that have low economic diversity and rely on accommodation and food service industries for employment. Total expenditure (including fuel, equipment, accommodation, travel, food and travel) reported by tournament participants for all their trips in 2011 to that site for Port Stephens (159 respondents) was estimated to be $19,983,171 whilst for Bermagui (158 respondents) was $7,066,224. The completed surveys showed that the most game fishers are

motivated by the challenge of catching large fish, relaxing with friends and other game fishers, and viewing marine wildlife. Many game fishers stated that they believed game fishing was central to their lives and that it contributed to their personal health and well being.

The proportion of charter boat operators or recreational fishers that fish in the area of the ETBF and target SBT is not known. SBT are not considered a primary target species in these fisheries by BRS (2007), however, they are considered one of the main targets for gamefishers by NSW DPI (Fisheries) (2012). Nevertheless, the websites of some charter boat operators in NSW contain references to SBT. SBT is a point score species in the NSWGFA, and after November 2003, the NSWGFA has awarded point score for both landed SBT and tag and release SBT. SBT are regarded as a highly valued, iconic, recreational species and although catches may be relatively low, the species can be important in attracting clients during a fishing period that traditionally is considered to be slow (even if actual take is low). Even though ABARE (2004) estimated the net return due to the NSW charter industry was negative, some individual operators, especially on the south coast, may rely significantly on SBT and may have made a positive return. Data from the charter boat monitoring program would suggest otherwise, however, as discussed, doubts over the accuracy of reporting mean there can be little confidence in conclusions drawn from these data. The effect that the authorisation of SBT targeting would have on other associated businesses such as tackle, bait shops etc. is also difficult to predict given the limited availability of SBT in most years, and the short temporal windows that SBT are available in during years of greater abundance, Without specific details of the proportion of fishers who would target SBT and their associated expenditure, among many other things, it is impossible to make accurate predictions of the contribution this species would make to local or regional economies, or to estimate the economic value of recreationally caught SBT compared with those caught in the commercial sector. An increase in the number of recreational fishers that target the species and an associated increase in expenditure could be expected if the real or perceived availability of SBT to recreational fishers were to increase; ultimately increasing the net return to the economy due to the targeting of SBT. Any potential management arrangement that sought to allocate part of the SBT resources to the recreational sector would be consistent with the objects of the FM Act (i.e. 'to conserve, develop and share the fishery resources of the State for the benefit of present and future generations').

SBT are important predators within the oceanic food web, the reduction or removal of this species could potentially alter food web interactions with flow on effects to other species such as prey. There has been little research on the ecosystem impacts of taking SBT in the commercial fishery, particularly the role of SBT within trophic levels and its relationship with ecological related species (DSEWPC 2010). The CCSBT's Ecologically Related Species Working Group is responsible for providing information and advice on issues relating to ecologically related species, however, little progress has been made on obtaining data and information on SBT's relationship with ecologically related species (DSEWPC 2010). Due to the relatively small SBT mortality linked with the recreational SBT fishery in Australia and NSW compared with global mortality caused by commercial exploitation, it is not thought that recreational fishing for SBT, by itself, would have any significant impact on oceanic food webs.

6.6 Summary

The Proposal will authorise recreational fishers to take SBT in NSW and adjacent Commonwealth waters subject to all applicable regulatory controls. Due to the pattern of availability of SBT in NSW (a limited temporal window in which SBT are within reach of recreational vessels), a reduction in bag limits, combined with the introduction of boat limits, are likely to reduce the overall recreational take of SBT over pre-existing arrangements, while minimising detrimental social and economic impacts. The reduction in take limits contained in the Ministerial Order would be unlikely to significantly impact angler participation as they would still permit SBT to be landed. Thus, the Ministerial Order is not expected to result in any negative impact to sectors of the economy linked with the NSW SBT recreational fishery, and in fact, may result in economic benefits to associated businesses and economies. The Proposal is also not expected to result in any major opposition from recreational fishing interest groups given that the default situation is that SBT are totally protected.

The impact on the global SBT stock due to the authorisation of recreational fishing for SBT in NSW is impossible to predict accurately with current data sources. The available information suggests that the NSW recreational catch of SBT is a very small proportion of the global commercial catch. Limited recreational fishing for SBT in NSW and adjacent Commonwealth waters in accordance with bag and boat limits established in The Proposal are not expected to detrimentally impact global stocks of SBT, and in fact should result in a significant reduction in potential recreational take within the NSW jurisdiction.

Alternative management arrangements discussed in this section could potentially be more effective at controlling catch but are likely have significant economic, social and / political considerations. In any case, efficient management cannot be achieved without accurate data on the catch and catch patterns within the recreational sector.

7 Recommendations

7.1 Monitoring Program

The lack of adequate information on the recreational take of SBT in NSW hinders any attempt at assessing the impact of the recreational fishery on the SBT population as a whole. Without accurate data on fishing effort, catch rates and catch patterns, it is impossible to estimate the SBT tuna mortality due to recreational fishing. Such information is essential for state and national governments attempting to assess the economic benefit and how to best manage this commercially important species. The effectiveness of any management decisions that attempt to control mortality due to recreational fishing activities will also depend on the availability of such information. Accurate recreational catch estimates should be determined and reported to the CCSBT, in line with Australia's commitments, so that its stock projections and allocations of total allowable catch reflect all sources of SBT mortality. This would help give SBT the best chance of ecological sustainability. NSW DPI (Fisheries) should work with DAFF and AFMA to develop a reliable and cost-effective monitoring program to accurately estimate the recreational catch of SBT. Important considerations when developing such a monitoring programme would include:

- The primary aim of the monitoring program would be to estimate the recreational catch of SBT. Previous estimates of recreational SBT catch are extrapolated from studies designed with other aims in mind and therefore these data may not provide an accurate estimate of SBT catch;
- The availability of SBT to recreational fishers is highly variable among years. Such variability could be linked to a variety of natural and anthropogenic influences, such as prey availability, environmental variables, recruitment events and exploitation. Monitoring programs must take this inter-annual variability into account and sample over a number of years to be able to provide accurate estimates. A single year by itself is unlikely to be representative of the fishery as a whole;
- The majority of SBT are also caught over a short period of days to weeks when conditions are suitable and fishing effort is relatively large. The success of any monitoring programme would depend upon its ability to detect and then respond quickly to events of relatively high recreational catch;
- Sufficient spatial coverage and prioritisation of important recreational SBT fishing ports. The examination of tagging and club record data would indicate popular SBT fishing ports where monitoring effort should be targeted. Reports from experienced fishes and charter boat operators may identify productive areas so that sampling effort could be directed accordingly; and,
- The choice of most appropriate sampling techniques should take into account their relative strengths, weaknesses and costs. Charter logbooks and gamefish angler diaries have the potential to assess catch and effort for these sectors; however, these methods do not provide complete coverage of the fishery, as they cannot be readily adjusted to take account of fishing by non-affiliated anglers (Morton and Lyle 2003). New log book reporting requirements for charter boats in NSW were implemented in July 2011, these are currently providing more accurate catch data for the charter boat industry (Phil Bolton, NSW DPI (Fisheries), Pers. Comm.). Telephone and mail surveys are inefficient methods for data collection due to the generally low frequency of tuna fishing and capture by recreational fishers (Rowsell *et al.* 2008). Targeted on-site surveys may provide the most cost effective method allowing coverage over a range of recreational fishing sectors.

A more detailed approach to the potential monitoring of the recreational catch of SBT is provided by Rowsell *et al.* (2008), including details of monitoring options, recommended methodology, pilot surveys and data collection. The findings and recommendations of

targeted surveys undertaken in other states, such as Tasmania (Morton and Lyle 2003; Forbes *et al.* 2009) and the recent SBT survey in Victoria would be valuable and aid in the development of targeted survey of recreational fishing for SBT in NSW. Indeed, it would appear that a wealth of information and experience is already available that would allow a cost effective monitoring program to be delivered successfully.

7.2 Other Recommendations

Another significant knowledge gap is the rate of post-release mortality in SBT caught in the recreational fishery. This is an unknown source of total SBT mortality that cannot be estimated from surveys. Tagging and re-capture data shows that some released SBT survive and are healthy enough to live several years and travel long distances, which in theory means that they are able to reproduce. Experimental studies to determine the proportion of SBT that do survive following release would potentially be prohibitively expensive to undertake; although a sea cage system similar to that used by the purse seine SBT fishery in South Australia may offer a potential opportunity to undertake this study. Studies utilising satellite tags could also offer potential.

The Institute of Marine and Antarctic Studies (IMAS) in Tasmania is assessing the post-release survival of SBT from recreational fishing (Tasmania DIPPWE 2012). The specific objectives of the project are too:

- Quantify post-release survival rates for SBT caught by recreational fishing;
- Determine key factors affecting post release survival of SBT from recreational fishing; and,
- Develop a 'Code of Practice' identifying strategies that have potential to minimise sub-lethal impacts and increase post release survival of SBT.

Any estimates of recreational landed catch of SBT should be taken as a conservative estimate considering that some tag / free release SBT may not survive to reproduce.

NSW DPI (Fisheries) could petition the NSWGFA to remove point score for landed SBT at NSWGFA tournaments and affiliated clubs. This may reduce SBT take by NSWGFA members.

7.3 Other Relevant Approvals

7.3.1 Commonwealth Approvals

The NSW recreational fishery for SBT is not a commercial fishery therefore is not subject to wildlife trade operating approvals issued by the Commonwealth Government. The listing of SBT as threatened under the conservation dependant category of the EPBC Act does not restrict or prevent recreational fishing for SBT, (DSEWPC 2012). Species listed as conservation dependant are not nationally protected; do not trigger offence provisions under the EPBC Act; and are not considered as matters of National Environmental Significance under the EPBC Act.

7.3.2 NSW Approvals

No temporary order or management plan in respect of recreational fishing for SBT has been made under Commonwealth legislation, and accordingly recreational fishing for SBT in NSW and adjacent Commonwealth waters may be regulated under NSW law. Recreational fishing in tidal waters of NSW is a common law right; does not require specific legal authority; is not a designated fishing activity (for the purposes of Part 1A of the NSW FM Act) and is not managed under a formal management strategy. The NSW Minister for Primary Industries is not a determining authority for the purposes of Part 5 of the Environmental Planning and Assessment Act 1979 when making an Order.

Recreational fishers will be required to comply with all other applicable regulatory controls when fishing for SBT, including being in possession of a valid recreational fishing fee receipt and compliance with bag and boat limits, and the general provisions of the NSW FM Act and *Fisheries Management (General) Regulation 2010*.

8 Conclusion

SBT are an important commercial species targeted by several nations. This species is also targeted by recreational fishers who are likely to make a positive contribution to local businesses and regional economies. Several life history characteristics, such as slow growth and late onset of maturity make SBT vulnerable to over-exploitation. Current estimates put the global SBT stock at a small proportion of pre-fishing levels and the species is now listed as threatened by governments and NGOs.

The single most important management objective at this stage is the accurate estimation of the recreational take of SBT in NSW and Australia. Without this information, management decisions aimed at preserving SBT stocks would be unlikely to achieve their desired outcomes. It is also essential for the economic sustainability of this resource, especially when considering the potential economic benefits to local businesses and economies linked to recreational fishing an increase in availability would represent. Collection of this information will also allow Australia to meet its commitments with the CCSBT and allow the CCSBT to take into account all sources of SBT mortality.

The Proposal will allow recreational fishing for SBT in NSW to take place. If managed effectively, this should result in an economic benefit to associated businesses and economies.

Due to the lack of data, accurate assessments of the impact on the global SBT stock due to recreational fishing for SBT in NSW cannot be made. Available information suggests that the NSW recreational catch of SBT is small in proportion to the global commercial catch, and that historical fishing is unlikely to have impacted global stocks. If the availability of SBT to the NSW recreational fishery were to increase, as some data suggests, a concurrent increase in catch could have a cumulative impact on global stocks. The management arrangements contained in The Proposal do not allow full control over the recreational take of SBT in NSW, however due to the patterns of availability of SBT in NSW, The Proposal is likely to reduce the overall take of SBT and thus provide some conservation benefit. Other management options are available that would could potentially allow for tighter control over the recreational catch, although these are likely to have significant economic, political and / social considerations and are therefore not realistic options.

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