

(BBRG-3)

**Interactive Session on billfish:  
Present knowledge - current and future research - priorities.**

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## **Interactive Session on billfish: Present knowledge - current and future research - priorities.**

**Objective:** To review/tabulate current billfish research and monitoring, identify information gaps and problems and suggest future work.

**Methods:** The attached table is for an interactive discussion at the forthcoming SCTB. The intent is for participants to update this table prior to the meeting with relevant information.

At present most of the information and proposed research work described here is SPC's – the intent is for other organisations to add their current and proposed research to this document so that it can be updated prior to the meeting. The purpose being so that all organisations and countries are made aware of current and proposed research. The intent of this table is to then allow the meeting to focus on present research shortcomings and to suggest future research priorities.

The table might then become a 'living document'—reviewed and updated each year and thereby providing a handy guide to current knowledge and future work.

Please provide whatever information you can and feel free to correct, add or delete any of the information I have put forward.

### **Considerations:**

- Data Requirements – Farman (1989) and Uozumi (1999) point out that much of the required data for assessment and management of the billfish stocks is presently insufficient or inadequate. Below is a potential list of the main data requirements to help estimate abundance and to assist in stock assessments;
  - complete catch and effort statistics, including an estimate of total catch, spatial distribution of stock or stocks and standardization for the various fishing gears and techniques. This requires information on gear configuration that is available only from log sheets (probably not that accurate) or extensive observer programmes (deployment of hook monitors etc).
  - Recruitment can be estimated from age composition data so consequently validated age length data is required.
  - Yield per recruit analysis also requires weight at age and the catch at age. Estimates of mortality may be obtained from length frequencies, age distribution of the catch, or tagging data – there is a paucity of all of this.
  - Knowledge of the vertical distribution of the species in relation to longline configuration – does this vary with abundance and environmental factors.

## Species – Striped marlin

Subject	What is known (include references)	Who is presently doing what?	Who plans to do what?	Priority?
<b>Fishery (description &amp; importance)</b>				
<b>Commercial</b>	<ul style="list-style-type: none"> <li>• Are the 12th ranked species (relative occurrence) caught by commercial longliners (MHLC WP1 1999).</li> <li>• Unknown re commercial value, though the price in Japan has increased significantly over recent decades (Ueyanagi et.al. 1989).</li> <li>• Annual catch ~17,000 tonnes</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	
<b>Longline</b>	<ul style="list-style-type: none"> <li>• Pre-spawning striped marlin often fetch high prices on sashimi markets and are caught in the eastern areas of the WSP in the latter part of the year (Bailey, Williams &amp; Itano 1996).</li> <li>• Ward (1996) describes the Japanese longline fishery which sometimes targets striped marlin in eastern Australian waters.</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	
<b>Pole-and-line</b>	<ul style="list-style-type: none"> <li>• Not caught (Bailey, Williams &amp; Itano 1996).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	
<b>Purse seine</b>	<ul style="list-style-type: none"> <li>• Only recorded rarely, though are more common in NZ EEZ (occur in 1.8% of sets; Bailey, Williams &amp; Itano 1996).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection</li> </ul>	
<b>Troll</b>	<ul style="list-style-type: none"> <li>• Seldom landed, occasional hookups – not significant (Bailey, Williams &amp; Itano 1996).</li> </ul>			
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• One of the main target gamefish species, where present (usually sub-tropical areas), especially NZ.</li> <li>• West (1990) and Campbell et al. (1996) Describe the recreational gamefishery in SE Australia, where striped marlin became the most common billfish catch during the 1990s.</li> </ul>	<ul style="list-style-type: none"> <li>• Good data collected by Aust gamefishing clubs. Some data to NSWFR. Others?</li> <li>• NZ - Good Wt data for 95% of recreational catch (NZ Big Game Fishing Council).</li> <li>• Annual Recreational CPUE indexes from charter skippers, (NZ Marine Research Foundation).</li> </ul>	<p>SPC trying to coordinate data collection – all assistance appreciated. Aust – analysis on impact of recreational catch on resource - BRS</p>	
<b>Targeting</b>	<ul style="list-style-type: none"> <li>• 3 main fisheries; longline, purse seine, and sport fishing.</li> <li>• Longline fishery sometimes targets this species specifically</li> </ul>			

	<ul style="list-style-type: none"> <li>• purse seine not at all</li> <li>• recreational all the time.</li> </ul>			
<b>Data holdings</b>				
<b>Commercial (logbook, landings, observer)</b>	<ul style="list-style-type: none"> <li>• SPC Catch and effort data back to 1962, Observer data from 1994 (limited), unloading data (from 1993) (Anon 1998)</li> <li>• Data collected by observers on Japanese longliners in the eastern AFZ held by AFMA.</li> <li>• Size monitoring of catches landed by Australian longliners 1998? held by AFMA.</li> </ul>	<ul style="list-style-type: none"> <li>• SPC (OFP section) is responsible for compiling regional tuna fisheries data. (Anon 1998).</li> </ul>	SPC will continue carrying out this activity; AFMA plans to continue size monitoring.	
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• Some holdings within national gamefishing clubs (limited and disjointed), Aust, NZ &amp; US good.</li> <li>• Good Wt data for 95% of recreational catch for Bay of Islands Swordfish Club New Zealand since 1924 (NZ Big Game Fishing Council). Also good data in Australia.</li> <li>• Some holdings by national fisheries management bodies (even more limited).</li> <li>• West (1991) provides estimates of catches by recreational anglers in eastern Australian in 1989.</li> <li>• Pepperell collected data from tournaments (1993?-present) – data @ NSWFRF</li> </ul>	<ul style="list-style-type: none"> <li>• SPC trying to coordinate holdings onto SPC database (preliminary stages)</li> <li>• CSIRO &amp; Pepperell collating some historical charter boat data for NE Australia</li> </ul>	SPC wanting to coordinate with IGFA and gamefishing clubs to standardise data – ‘log sheet’. Data entry?	Everybody should be involved
<b>Research (e.g. tagging, length-weight data sets)</b>	<ul style="list-style-type: none"> <li>• SPC - length frequency &amp;/or weight data from 1991 (port sampling and observers) – total number 4,581. (SPC data)</li> <li>• NSW Gamefish Tagging Program (1973–present).</li> <li>• Pepperell – historic &amp; current wt data</li> </ul>	<ul style="list-style-type: none"> <li>• SPC - ongoing</li> <li>• NSW Gamefish Tagging Program – ongoing.</li> <li>• NMFS – ongoing</li> </ul>	SPC - ongoing	
<b>Biological</b>				
<b>Age and growth</b>	<ul style="list-style-type: none"> <li>• <b>No validated age analyses</b> (Radtko 1983; Davie &amp; Hall 1990). Aged to 9 years?</li> <li>• Little sexual dimorphism in growth.</li> <li>• Growth slows with age (Ueyanagi &amp; Wares 1975). Young fish ~30cm/year, old fish ~13cm/year.</li> <li>• Length weight relationship for NZ recreational catch (NZBGFC records). L/W analysis by Pepperell (Aust).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC presently carrying out a feasibility study for ageing dorsal &amp; anal spines</li> </ul>	SPC? Others?	

<b>Maturation &amp; spawning (location, period, size &amp; age at maturity, fecundity, sex ratio)</b>	<ul style="list-style-type: none"> <li>• Egg distribution unknown.</li> <li>• Some larvae work carried out (Squire &amp; Suzuki 1990).</li> <li>• Seasonal spawning in early summer?</li> <li>• Females reach sexual maturity @ 23-36kg (Hanamoto 1977) – age ?</li> <li>• Thought to spawn once per season (Pillai &amp; Ueyanagi 1978).</li> <li>• Spawning areas not fully known.</li> <li>• Fecundity ?</li> </ul>	?	?	Batch or multiple spawners?
<b>Diet</b>	<ul style="list-style-type: none"> <li>• Feed on pelagic species, mostly in morning (Ueyanagi &amp; Wares 1975) and epipelagic species (Nakamura 1985).</li> <li>• Food of marlins from NZ waters(Baker, A.N. 1966).</li> <li>• Almost any species of suitable size may be taken, tend to take one or two species only on any particular day (Saul 1984)</li> </ul>	<ul style="list-style-type: none"> <li>• SPC – examined some stomachs collected by SPC observers</li> </ul>	SPC minimal – ongoing.	
<b>Movement</b>	<ul style="list-style-type: none"> <li>• Little known</li> <li>• tagging shows some extensive and limited horizontal movement around Hawaii and from California to Hawaii (Holts &amp; Prescott 1994-8), also around Australia (n=2) and extensive movements to the north of NZ (Henry and Thompson 1998; Holdsworth and Saul 1998; Davies and Hartill 1998 and Hartill and Davies, in prep).</li> <li>• Vertical movement – ultrasonic telemetry (Brill et.al. 1993; Holland, Brill &amp; Chang 1990). Fish spend much time near surface. Mostly in waters 25-27<sup>0</sup>C, though reportedly in cooler waters off California.</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing tagging by game fishers in Australia, NZ &amp; USA. Some tagging carried out by island gamefishing clubs.</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing recreational tagging; Australia, NZ &amp; USA – some carried out by island gamefishing clubs.</li> <li>• More analysis required!</li> <li>• Pop-up satellite tags?</li> <li>• Observer tagging?</li> </ul>	
<b>Mortality</b>	<ul style="list-style-type: none"> <li>• <b>Unknown.</b></li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing conventional recreational tagging - minimal. (NSWFR, NMFS, NIWA)</li> </ul>	?	
<b>Other:</b>				
<b>Tagging-related mortality and tag loss</b>	<ul style="list-style-type: none"> <li>• Unknown mortality – differing results</li> <li>• potentially high tag-loss</li> <li>• tag reporting rates probably low.</li> </ul>	?	?	
<b>Survival of longline-caught marlin</b>	<ul style="list-style-type: none"> <li>• Small amount of observer data from NZ (Francis et al 1999) – also other countries.</li> </ul>	?	?	

<b>Stock</b>				
<b>Assessment</b>	<ul style="list-style-type: none"> <li>Shomura 1980<sup>1</sup> and Skillman 1989<sup>2</sup> suggest Pacific stock had a MSY of 24,000mt<sup>1</sup> and in good condition<sup>2</sup></li> </ul>	?	Needs updating – looking at ‘core’ areas.	
<b>Structure</b>	<ul style="list-style-type: none"> <li>most recent work, based on mtDNA (Graves and McDowell 1997) identified 3 stocks</li> <li>previous studies suggested single stock or 2 stocks separated at the equator (Bartoo &amp; Ueyanagi 1980). Squire &amp; Suzuki (1990) suggested single stock with ‘semi-independent subpopulations’</li> <li></li> </ul>	?	DNA study?	
<b>Stock size – Catch and CPUE trends</b>	<ul style="list-style-type: none"> <li>Stock size <b>unknown</b>.</li> <li>Total catch decreased from 40,000 tonnes in 1960’s to ~ 15,000 tonnes in 80’s and 90’s, now fairly stable (Williams, Bigelow &amp; Whitelaw 1999)</li> <li>CPUE decreased from 0.18 fish/100hooks to present value of .04 (SPC database).</li> <li>Fishing strategies have also altered over time – more deep fishing, possibly more so in the tropics.</li> </ul>	<ul style="list-style-type: none"> <li>SPC –ongoing catch and effort data collection.</li> <li>Commercial and recreational data collected in Aust, NZ and US.</li> </ul>	SPC –ongoing catch and effort data collection. Look at core areas	
<b>Management</b>				
<b>Gear restrictions</b>				
<b>Area restrictions</b>	<ul style="list-style-type: none"> <li>None?</li> <li>Longline off NZ?</li> </ul>			
<b>Catch limits</b>	<ul style="list-style-type: none"> <li>Commercial fishers are not permitted to keep marlin in the New Zealand EEZ.</li> </ul>			
<b>Size restrictions</b>	<ul style="list-style-type: none"> <li>NZ - Voluntary Recreational min. size of 90kg.</li> <li>voluntary size or retention restrictions in Australia for recreational fishermen (80kg).</li> </ul>			

Species – **Blue marlin**

Subject	What is known (include references)	Who is presently doing what?	Who plans to do what?	Priority?
<b>Fishery (description &amp; importance)</b>				
<b>Commercial</b>	<ul style="list-style-type: none"> <li>• Are the 6th ranked species (relative occurrence) caught by commercial longliners (MHLC WP1 1999).</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing – SPC data collection.</li> </ul>		
<b>Longline</b>	<ul style="list-style-type: none"> <li>• Is a by-catch of the longline fleets.</li> <li>• Highest catch rates occur around northern waters of the Marshall Islands though they show a preference for warmer offshore waters of the WTP and northern areas of WSP (warm pool; Bailey, Williams &amp; Itano 1996).</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing – SPC data collection.</li> </ul>	Need for better identification	
<b>Pole-and-line</b>	<ul style="list-style-type: none"> <li>• Not caught (Bailey, Williams &amp; Itano 1996).</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing – SPC data collection.</li> </ul>		
<b>Purse seine</b>	<ul style="list-style-type: none"> <li>• Occur in 1.2% of sets in NZ EEZ</li> <li>• are common (1-10 per set) in the WTP (Bailey, Williams &amp; Itano 1996).</li> <li>• These are the most often caught billfish in purse seine sets.</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing – SPC data collection.</li> </ul>		
<b>Troll</b>	<ul style="list-style-type: none"> <li>• Seldom landed (Bailey, Williams &amp; Itano 1996), though are landed and sold in Hawaii.</li> </ul>	<ul style="list-style-type: none"> <li>• Ongoing – SPC data collection.</li> </ul>		
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• Major recreational fishery throughout the Pacific, especially Hawaii, east coast Australia, PNG, Micronesia.</li> </ul>			
<b>Targeting</b>	<ul style="list-style-type: none"> <li>• Within the WCPO there are three main fisheries which blue marlin can recruit to, being; a) longline, b) purse seine and c) sport fish.</li> <li>• It is only the sport fish fishery, which actually targets this species, both of the other fisheries only catch blue marlin as a by-catch.</li> <li>• Quite often, especially if small, the fish are not retained or included on commercial log sheets.</li> <li>• The average size of fish caught by longline in the WCPO is 184cm.</li> <li>• It is thought that fish caught in purse seines are smaller, usually males.</li> </ul>			

<b>Data holdings</b>				
<b>Commercial (logbook, landings, observer)</b>	<ul style="list-style-type: none"> <li>• SPC Catch and effort data back to 1962,</li> <li>• Observer data from 1994 (limited),</li> <li>• unloading data (from 1993) (Anon 1998)</li> </ul>	<ul style="list-style-type: none"> <li>• SPC/OFP is responsible for compiling regional tuna fisheries data for SPC area (Anon 1998).</li> <li>• IATTC</li> </ul>	SPC will continue this activity	
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• Some holdings within national gamefishing clubs (limited and disjointed).</li> <li>• Some holdings by national fisheries management bodies (even more limited)</li> </ul>	<ul style="list-style-type: none"> <li>• SPC trying to coordinate holdings onto SPC database (preliminary stages).</li> <li>• NSWFRI – ongoing</li> <li>• Pepperell</li> </ul>	SPC wanting to coordinate with IGFA and gamefishing clubs to standardise data – ‘log sheet’.	
<b>Research (e.g tagging, length-weight data sets)</b>	<ul style="list-style-type: none"> <li>• SPC - length frequency &amp;/or weight data from 1991 (port sampling and observers) – total number 10,961. (Anon 1998).</li> <li>• NSW Gamefish Tagging Program (1973–present)</li> </ul>	<ul style="list-style-type: none"> <li>• SPC – ongoing</li> <li>• NSWFRI</li> <li>• NMFS</li> </ul>	SPC – ongoing NSWFRI NMFS Aust study on impact of recreational fishing on resource	
<b>Biological</b>				
<b>Age and growth</b>	<ul style="list-style-type: none"> <li>• <b>No validated age work.</b></li> <li>• Indications they can live to 30 years (Hill et al. 1989; Nakamura 1985; Wilson et. al. 1991).</li> <li>• Daily ageing study in Atlantic.</li> <li>• Growth - sexually dimorphic. Growth rate of females remains fairly constant to around 360cm, males appear to plateau at around 230cm.</li> <li>• Sex-related size differences are related to differential growth and not due to differential mortality (Wilson et al. 1991).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC presently carrying out feasibility study for ageing spines and some otoliths.</li> <li>• Others??</li> </ul>	SPC?	
<b>Maturation &amp; spawning (location, period, size &amp; age at maturity, fecundity, sex ratio)</b>	<ul style="list-style-type: none"> <li>• Spawning not properly documented, believed to occur year-around in equatorial waters (10<sup>0</sup>S - 20<sup>0</sup>N) and during summer periods in the southern (10<sup>0</sup>S - 30<sup>0</sup>S) and northern (20<sup>0</sup>N - 30<sup>0</sup>N) hemispheres, though others, notably Nishikawa et.al. (1985) and Hopper (1990) have questioned the concept of year around spawning.</li> <li>• Howard and Ueyanagi (1965) suggest that peak concentrations of spawning fish probably occur around Micronesia in the northwest and French Polynesia in the southeast.</li> <li>• Appear to be determinate, serial spawners.</li> </ul>			

	<p>Females may spawn a number of times during the spawning season.</p> <ul style="list-style-type: none"> <li>• Preliminary estimates of total reproductive output (Hopper 1990) range from 31.5 million (female; 127kg) to 98.9 million eggs (female; 420kg).</li> <li>• Size at maturity for females is around 80kg (Hopper 1990) and for males around 31kg. Kume and Joseph (1969), report for the eastern Pacific, that females may mature at 47kg and males at 35kg.</li> </ul>			
<b>Diet</b>	<ul style="list-style-type: none"> <li>• Not a lot of research carried out.</li> <li>• Feeds in or near surface waters, sometimes in deep water also.</li> <li>• Feeds on squid and tuna like species (Nakamura 1985).</li> </ul>			
<b>Movement</b>	<ul style="list-style-type: none"> <li>• There have been long distance tag recoveries, which indicates that the species is potentially wide ranging (Holts and Prescott 1994-1998; TRCC 1999).</li> <li>• Vertical movement shows that they prefer water temperatures in the range of 23-27°C (TRCC 1999).</li> </ul>		Archival?	
<b>mortality</b>	<ul style="list-style-type: none"> <li>• There is no estimate of natural or fishing mortality.</li> <li>• Limited tag returns (&lt; 1%).</li> </ul>			
<b>Other</b>				
<b>Tagging-related mortality and tag loss</b>	<ul style="list-style-type: none"> <li>• Tag related mortality unknown</li> <li>• potentially high tag-loss,</li> <li>• tag reporting rates probably low.</li> </ul>			
<b>Survival of longline-caught marlin</b>	<ul style="list-style-type: none"> <li>• Around 60% alive after 12h on a longline (Berkeley &amp; Edwards 1998)</li> </ul>			
<b>Stock Status</b>				
<b>Assessment</b>	<ul style="list-style-type: none"> <li>• Earlier stock assessments (Yuen and Miyake 1978), suggested stock had been substantially overfished since the early 1960s.</li> <li>• CPUE has decreased from around 0.3 fish per 100 hooks in the 1950's to 0.08 in 1995.</li> <li>• Skillman (1990) fitted a surplus production model to adjusted catch and effort data (1952-1980) and concluded that the stock is overfished.</li> <li>• More recent work (IATTC, 1999) suggests stock is in a healthy position</li> </ul>	<ul style="list-style-type: none"> <li>• Assessment presently being carried out by IATTC/NMFS</li> </ul>		

<b>Structure</b>	<ul style="list-style-type: none"> <li>• <b>Little known.</b></li> <li>• Is the most tropical of the billfish species.</li> <li>• Some assume one stock for the Pacific (Suzuki 1989) and that the populations in the Pacific and Indian oceans are separate (Shomura 1993).</li> <li>• There have been long distance tag recoveries, which indicate that the species is wide ranging (Holts &amp; Prescott 1994-1998; TRCC 1999).</li> </ul>			
<b>Stock size – Catch and CPUE</b>	<ul style="list-style-type: none"> <li>• Stock size unknown.</li> <li>• Taken mainly in tropical oceanic waters.</li> <li>• Catch shows some fluctuations and is presently around 16,000 tonnes.</li> </ul>	?		
<b>Management</b>				
<b>Gear restrictions</b>				
<b>Area restrictions</b>				
<b>Catch limits</b>	<ul style="list-style-type: none"> <li>• Commercial fishers are not permitted to keep fish in the New Zealand and Australian EEZ. Bag limits in some Australian states.</li> </ul>			
<b>Size restrictions</b>	<ul style="list-style-type: none"> <li>• Voluntary minimum size for retention for gamefishing in Australia (80kg).</li> </ul>			

## Species – Black marlin

Subject	What is known (include references)	Who is presently doing what?	Who plans to do what?	Priority? (to be discussed at SCTB)
<b>Fishery (description &amp; importance)</b>				
<b>Commercial</b>	<ul style="list-style-type: none"> <li>• Are the 14th ranked species (relative occurrence) caught by commercial longliners (MHLC WP1 1999).</li> <li>• Unknown commercial value – supposedly quite low.</li> <li>• Sold as sashimi in Japan.</li> </ul>	<ul style="list-style-type: none"> <li>• SPC –ongoing catch and effort data collection, also Australia, NZ and US.</li> </ul>		
<b>Longline</b>	<ul style="list-style-type: none"> <li>• Potentially there is some over-reporting (mis-identification with blue marlin) fom some fleets.</li> <li>• Caught more coastal.</li> <li>• Usually not targeted - catches around 1-2 fish per 10,000 hooks in WSP (Bailey, Williams &amp; Itano 1996).</li> </ul>			
<b>Pole-and-line</b>	<ul style="list-style-type: none"> <li>• Not caught (Bailey, Williams &amp; Itano 1996).</li> </ul>			
<b>Purse seine</b>	<ul style="list-style-type: none"> <li>• Occur in 1% of sets in NZ EEZ;</li> <li>• rare in WTP (&lt;1/set; Bailey, Williams &amp; Itano 1996).</li> </ul>			
<b>Troll</b>	<ul style="list-style-type: none"> <li>• Seldom landed - occasionally hooked (Bailey, Williams &amp; Itano 1996).</li> <li>• Is some artisinal fishing, especially in PNG, Kiribati and Solomons.</li> </ul>			
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• One of the main target gamefish species, where present (especially in Australia). A multi-million \$ industry.</li> </ul>	<ul style="list-style-type: none"> <li>• data collected by gamefishing clubs in Australia.</li> </ul>		
<b>Targeting</b>	<ul style="list-style-type: none"> <li>• Are only targeted by recreational fishermen and some artisinal fishermen.</li> <li>• Are a by-catch for commercial longline and purse-seine fisheries.</li> </ul>			
<b>Data holdings</b>				
<b>Commercial (logbook, landings, observer)</b>	<ul style="list-style-type: none"> <li>• SPC catch and effort data back to 1962,</li> <li>• SPC observer data from 1994 (limited),</li> <li>• unloading data (from 1993; Anon 1998)</li> </ul>	<ul style="list-style-type: none"> <li>• SPC/OFP is responsible for compiling regional tuna fisheries data. (Anon 1998).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC will continue carrying out this activity</li> </ul>	
<b>Recreational</b>	<ul style="list-style-type: none"> <li>• Some data holdings within national gamefishing clubs (very limited and disjointed).</li> <li>• Some data holdings by national fisheries management bodies (even more limited).</li> </ul>	<ul style="list-style-type: none"> <li>• SPC trying to coordinate holdings onto SPC database (preliminary stages).</li> <li>• Ongoing data collection in Aust,</li> </ul>	<ul style="list-style-type: none"> <li>• SPC wanting to coordinate with IGFA and gamefishing clubs</li> </ul>	

		NZ and US.	to standardise data – ‘log sheet’.	
<b>Research (e.g. tagging, length-weight data sets)</b>	<ul style="list-style-type: none"> <li>• SPC - length frequency &amp;/or weight data from 1991 (port sampling and observers) – total number 4,767 (Anon 1998).</li> <li>• NSWFRI tagging program</li> </ul>	<ul style="list-style-type: none"> <li>• SPC – ongoing</li> <li>• NSWFRI – ongoing</li> <li>• NMFS - ongoing</li> </ul>	SPC – ongoing Aust study on impact of recreational fishermen on resource.	
<b>Biological</b>				
<b>Age and growth</b>	<ul style="list-style-type: none"> <li>• Some validated ageing carried out by AIMS for small fish (AIMS 1999).</li> <li>• The maximum recorded total length is 448cm and 708kg (Nakamura, 1985).</li> <li>• They show strong sexual dimorphism in growth - males rarely exceed 180kg.</li> <li>• Juvenile growth rates is fast and appear to be the same for both sexes. Males slow at maturity while females continue; females reach around 450kg (1000 lb) after about 10 years (Williams unpl).</li> <li>• Black marlin off eastern Australia shows the following presumed age-weight relationship: 1-year old fish average 15-20kg, 2-year-olds average 30kg, 3-year-olds average 50-55kg and 4-year olds average 70kg (length frequency analysis, Williams unpl.; Pepperell, 1990).</li> <li>• Cyr et.al. (1990) provided unvalidated ages of black marlin up to 20 years.</li> </ul>	<ul style="list-style-type: none"> <li>• AIMS – OTC tagging study – results?</li> <li>• Daily ageing of juveniles – Pepperell / NMFS</li> </ul>	Early growth rates derived from length frequency data - NSWFRI	
<b>Maturation &amp; spawning (location, period, size &amp; age at maturity, fecundity, sex ratio)</b>	<ul style="list-style-type: none"> <li>• East Australian studies suggest a spawning area in the Coral Sea during October- December.</li> <li>• age at maturity remains uncertain though it appears that males mature around 3-4 years (60kg) while females mature around 4-5 years (70kg).</li> <li>• No significant spawning observed in eastern Pacific (Williams unpl.)</li> </ul>			
<b>Diet</b>	<ul style="list-style-type: none"> <li>• Tuna like fishes, scad, queenfish (Williams unpl.)</li> </ul>			
<b>Movement</b>	<ul style="list-style-type: none"> <li>• Tag recaptures suggest that there is a high degree of mixing throughout the entire Pacific (Campbell et al. 1998) but it is important to verify this with genetic studies (currently underway – (Graves et.al.?).</li> <li>• Black marlin are highly mobile but do not appear to follow clear migration routes (Pepperell 1990)</li> </ul>	Genetic studies underway (Graves)		

<b>Mortality</b>	<ul style="list-style-type: none"> <li>Unknown</li> </ul>			
<b>Other</b>				
<b>Tagging-related mortality</b>	<ul style="list-style-type: none"> <li>Unknown – tagging data insufficient</li> </ul>			
<b>Survival of longline-caught marlin</b>	<ul style="list-style-type: none"> <li>~60% alive after 16 hours (Campbell et.al. 1998)</li> </ul>			
<b>Stock</b>				
<b>Assessment</b>	<ul style="list-style-type: none"> <li>Due to uncertainty in total catch figures and stock structure, there have been no attempts to fit production models or estimate MSY.</li> <li>Catch has been sustained between 1,000-2,000 tonnes since 1980..</li> <li>AIMS, on their web site, state that the stock is stable or recovering in recent years (AIMS 1999). This needs to be verified.</li> </ul>			
<b>Structure</b>	<ul style="list-style-type: none"> <li>Suggestions of 3 stocks – SW Pacific, eastern Pacific and Indian Ocean.</li> <li>Potentially some fish move between the SW Pacific and Indian stock (AIMS 1999) – stocks linked?</li> </ul>			
<b>Stock size – Catch and CPUE trends</b>	<ul style="list-style-type: none"> <li>Catch has decreased slightly since 1980 while CPUE has remained fairly constant (Williams, Bigelow &amp; Whitelaw 1999).</li> </ul>		Need to look at 'core' areas.	
<b>Management</b>				
<b>Gear restrictions</b>	<ul style="list-style-type: none"> <li>Domestic vessels (Australia) limited to 500 hooks in Coral Sea area.</li> </ul>			
<b>Area restrictions</b>	<ul style="list-style-type: none"> <li>Some areas closed to Australian fishermen in the Coral Sea.</li> <li>Some areas of AFZ closed to Japanese.</li> </ul>			
<b>Catch limits</b>	<ul style="list-style-type: none"> <li>Not allowed to be retained by commercial fishermen in Australia or NZ</li> </ul>			
<b>Size restrictions</b>	<ul style="list-style-type: none"> <li>Voluntary minimum size (80kg) of retention in Australia (recreational).</li> </ul>			

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