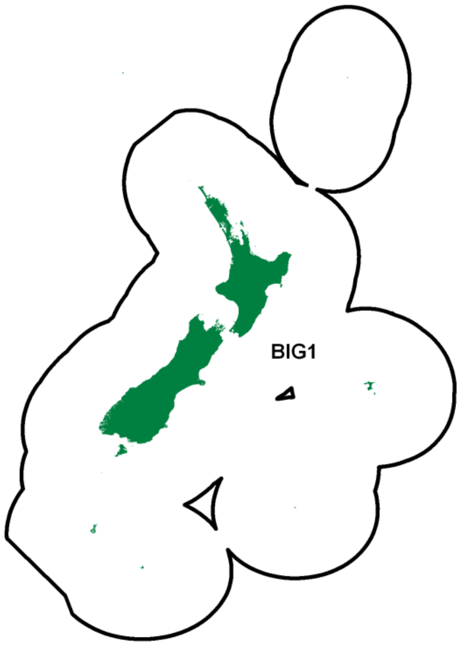
BIGEYE TUNA (BIG)

(Thunnus obesus)



1. FISHERY SUMMARY

Bigeye tuna were introduced into the QMS on 1 October 2004 under a single QMA, BIG 1, with allowances (t), TACC, and TAC in Table 1.

Table 1: Recreational and Customary non-commercial allowances, TACC and TAC (all in tonnes) by Fishstock.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other mortality	TACC	TAC
BIG 1	8	4	14	714	740

Bigeye were added to the Third Schedule of the 1996 Fisheries Act with a TAC set under s14 because bigeye is a highly migratory species, and it is not possible to estimate MSY for the part of the stock that is found within New Zealand fisheries waters.

Management of the bigeye stock throughout the Western and Central Pacific Ocean (WCPO) is the responsibility of the Western and Central Pacific Fisheries Commission (WCPFC). Under this regional convention New Zealand is responsible for ensuring that the management measures applied within New Zealand fisheries waters are compatible with those of the Commission.

At its second annual meeting (2005) the WCPFC passed a Conservation and Management Measure (CMM) (this is a binding measure that all parties must abide by) relating to conservation and management of tunas. Key aspects of this resolution were presented in the 2006 Plenary document. That measure was reviewed by the Scientific Committee (SC) and further recommendations were made such that at its third annual meeting (2006) the WCPFC passed a new CMM relating to conservation and management of bigeye tuna (http://www.wcpfc.int). A further measure CMM2008-01 was agreed to in December 2008, the aim of which was to:

- "Ensure through the implementation of compatible measures for the high seas and EEZs that bigeye and yellowfin tuna stocks are maintained at levels capable of producing their maximum sustainable yield; as qualified by relevant environmental and economic factors including the special requirements of developing States in the Convention area as expressed by Article 5 of the Convention.

- Achieve, through the implementation of a package of measures, over a three-year period commencing in 2009, a minimum of 30% reduction in bigeye tuna fishing mortality from the annual average during the period 2001–2004 or 2004;
- Ensure that there is no increase in fishing mortality for yellowfin tuna beyond the annual average during the period 2001–2004 average or 2004; and
- Adopt a package of measures that shall be reviewed annually and adjusted as necessary by the Commission taking account of the scientific advice available at the time as well as the implementation of the measures. In addition, this review shall include any adjustments required by Commission decisions regarding management objectives and reference points."

This measure is large and detailed with numerous exemptions and provisions. Despite this effort reductions are being attempted through seasonal fish aggregating device (FAD) closures, and high seas area closures (in high seas pockets) for the purse seine fleets, longline effort reductions as well as other methods. At the 2009, 2010 and 2011 meetings the Scientific Committee recommended that this measure would need to be strengthened if it was to achieve its objectives.

1.1 Commercial fisheries

Commercial catches by distant water Asian longliners of bigeye tuna, in New Zealand fisheries waters, began in 1962 and continued under foreign license agreements until 1993. Bigeye were not a primary target species for these fleets and catches remained modest with the maximum catch in the 1980s reaching 680 t. Domestic tuna longline vessels began targeting bigeye tuna in 1990. There was an exponential increase in the number of hooks targeting bigeye which reached a high of approximately 6.6 million hooks in 2000–01 and then declined thereafter.

Catches from within New Zealand fisheries waters are very small (0.2% average for 2001–2009) compared to those from the greater stock in the WCPO (Tables 2 and 3). Figure 1 shows historical landings and TACC values for BIG 1 and BIG ET. Figure 1 shows historical longline fishing effort. In contrast to New Zealand, where bigeye are taken almost exclusively by longline, 40% of the WCPO catches of bigeye are taken by purse seine and other surface gears (e.g., ring nets).

1.2 Recreational fisheries

Recreational fishers make occasional catches of bigeye tuna while trolling for other tunas and billfish, but the recreational fishery does not regularly target this species. There is no information on the size of the catch.

1.3 Customary non-commercial fisheries

An estimate of the current customary catch is not available, but it is considered to be low.

1.4 Illegal catch

There is no known illegal catch of bigeye tuna in the EEZ.

1.5 Other sources of mortality

The estimated overall incidental mortality rate from observed longline effort is 0.23% of the catch. Discard rates are 0.34% on average (from observer data), of which approximately 70% are discarded dead (usually because of shark damage). Fish are also lost at the surface in the longline fishery, 0.09% on average (from observer data), of which 100% are thought to escape alive.

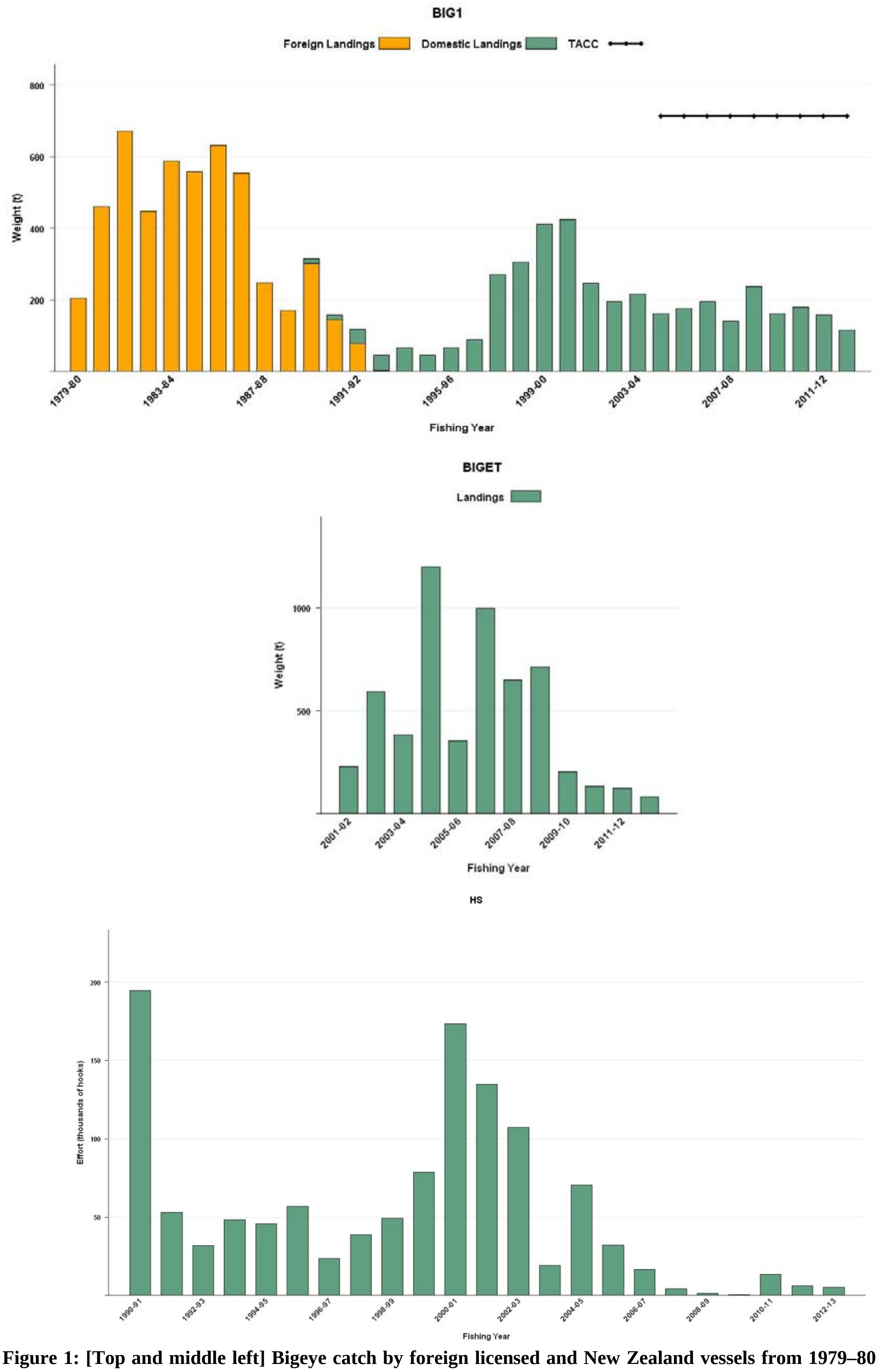


Figure 1: [Top and middle left] Bigeye catch by foreign licensed and New Zealand vessels from 1979–80 to 2012–13 within New Zealand waters (BIG 1) and 2001–02 to 2012–13 for New Zealand vessels fishing on the high seas (BIG ET) (Anon 2012). [Bottom] Fishing effort (number of hooks set) for all high seas New Zealand flagged surface longline vessels from 1990–91 to 2012–13. [Figure continued on next page].

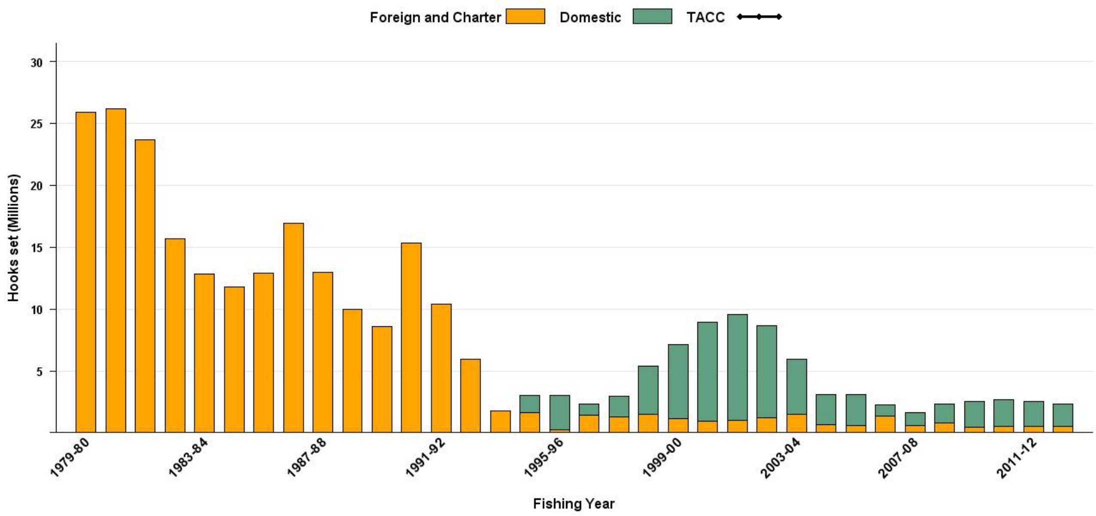


Figure 1 [Continued]: Fishing effort (number of hooks set) for all domestic vessels (including effort by foreign vessels chartered by NZ fishing companies), from 1990–91 to 2012–13.

Table 2: Reported total New Zealand within EEZ landings* (t), landings from the Western and Central Pacific Ocean (t) of bigeye tuna by calendar year from 1991 to present, and NZ ET catch estimates from 2001 to present.

Year	NZ landings (t)	Total landings (t)	NZ ET SPC estimate	Year	NZ landings (t)	Total landings (t)	NZ ET SPC estimate	Year	NZ landings (t)	Total landings (t)	NZ ET SPC estimate
1991	44	96 324		1999	421	143 588		2007	213	141 494	651
1992	39	114 452		2000	422	128 641		2008	133	151 268	713
1993	74	97 960		2001	480	131 459	230	2009	254	155 679	204
1994	71	113 309		2002	200	158 582	593	2010	132	133 841	134
1995	60	100 878		2003	205	130 526	383	2011	174	154 798	125
1996	89	99 601		2004	185	172 012	1 198	2012	154	157 615	85
1997	142	144 678		2005	176	145 839	353				
1998	388	161 572		2006	178	157 195	997				

Source: Licensed Fish Receiver Returns, Solander Fisheries Ltd, Anon. (2006), Lawson (2008), WCPFC5-2008/IP11 (Rev. 2), Williams & Terawasi (2011) and WCPFC Yearbook 2012 Anon (2013).

*New Zealand purse seine vessel operating in tropical regions also catch small levels of bigeye when fishing around Fish Aggregating Devices (FAD). These catches are not included here at this time as the only estimates of catch are based on analysis of observer data across all fleets rather than specific data for NZ vessels. Bigeye catches are combined with yellowfin catches on most catch effort forms.

Table 3: Reported catches and landings (t) of bigeye tuna by fleet and Fishing Year. NZ: New Zealand domestic and charter fleet, ET: catches outside these areas from New Zealand flagged longline vessels, JPNFL: Japanese foreign licensed vessels, KORFL: foreign licensed vessels from the Republic of Korea, and LFRR: Estimated landings from Licensed Fish Receiver Returns.

	BIG 1 (all FMAs)					
Fishing Year	JPNFL	KORFL	NZ/MHR	Total	LFRR	NZ ET
1979–80	205.8			205.8		
1980–81	395.9	65.3		461.2		
1981–82	655.3	16.8		672.1		
1982–83	437.1	11.1		448.2		
1983–84	567.0	21.8		588.8		
1984–85	506.3	51.6		557.9		
1985–86	621.6	10.2		631.8		
1986–87	536.1	17.6		553.7		
1987–88	226.9	22.2		249.1		
1988–89	165.6	5.5		171.1	4.0	
1989–90	302.7		12.7	315.4	30.7	0.4
1990–91	145.6		12.6	158.2	36.0	0.0
1991–92	78.0		40.9	118.9	50.0	0.8
1992–93	3.4		43.8	47.2	48.8	2.2
1993–94			67.9	67.9	89.3	6.1
1994–95			47.2	47.2	49.8	0.5
1995–96			66.9	66.9	79.3	0.7
1996–97			89.8	89.8	104.9	0.2
1997–98			271.9	271.9	339.7	2.6
1998–99			306.5	306.5	391.2	1.4
1999–00			411.7	411.7	466.0	7.6
2000–01			425.4	425.4	578.1	13.6
2001–02			248.9	248.9	276.3	2.0
2002–03			196.1	196.1	195.1	0.6
2003–04			216.3	216.3	217.5	0.8
2004–05*			162.9	162.9	163.6	0.7
2005–06*			177.5	177.5	177.1	0.14
2006–07*			196.7	196.7	201.4	0.05
2007–08*			140.5	140.5	143.8	0
2008–09*			237.2	237.2	240.2	0
2009–10*			161.2	161.2	169.7	9.9
2010–11*			181.1	181.1	201.0	20.3
2011–12*			174.0	174.0	276.5	125.0
2012–13*			154.0	154.0	148.0	85.0

*MHR rather than LFRR data.

The majority of bigeye tuna (88%) are caught in the bigeye tuna target surface longline fishery (Figure 2). While bigeye are the target, albacore make up the bulk of the catch (34%) (Figure 3). Longline fishing effort is distributed along the east coast of the North Island and the south west coast of the South Island. The west coast South Island fishery predominantly targets southern bluefin tuna, whereas the east coast of the North Island targets a range of species including bigeye, swordfish, and southern bluefin tuna (Figure 4).

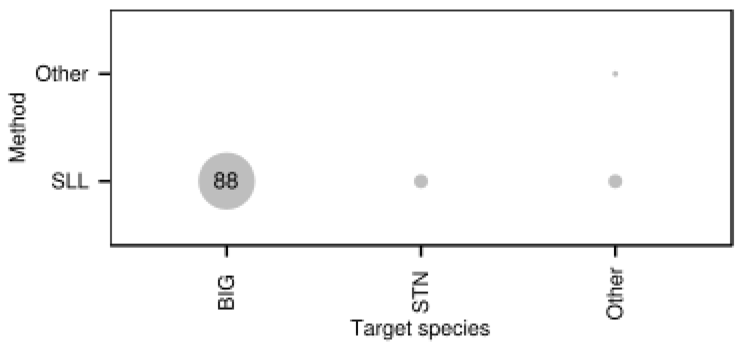


Figure 2: A summary of the proportion of landings of bigeye tuna taken by each target fishery and fishing method. The area of each circle is proportional to the percentage of landings taken using each combination of fishing method and target species. The number in the circle is the percentage. SLL = surface longline (Bentley et al 2013).

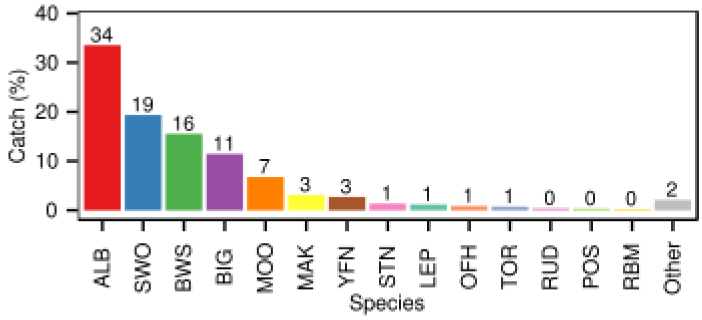


Figure 3: A summary of species composition of the reported bigeye target surface longline catch. The percentage by weight of each species is calculated for all surface longline trips targeting bigeye tuna (Bentley et al 2013).

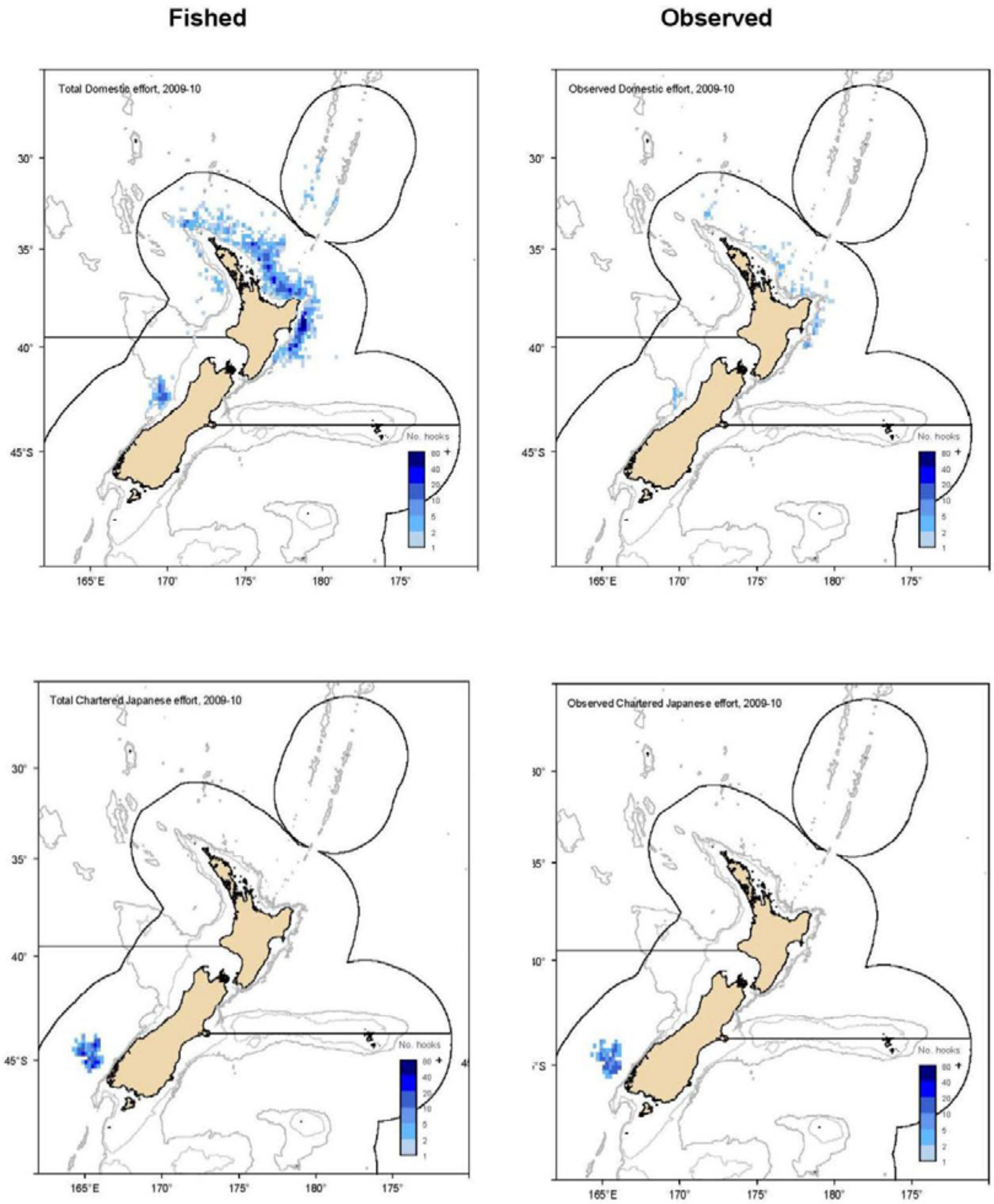


Figure 4: Distribution of fishing positions for domestic (top two panels) and charter (bottom two panels) vessels, for the 2009–10 fishing year, displaying both fishing effort (left) and observed effort (right).

2. BIOLOGY

Bigeye tuna are epi-pelagic opportunistic predators of fish, crustaceans and cephalopods generally found within the upper few hundred meters of the ocean. Tagged bigeye tuna have been shown to be capable of movements of over 4000 nautical miles over periods of one to several years. Juveniles and small adults school near the surface in tropical waters while adults tend to live in deeper water. Individuals found in New Zealand waters are mostly adults. Adult bigeye tuna are distributed broadly across the Pacific Ocean, in both the Northern and Southern Hemispheres and reach a maximum size of 210 kg and maximum length of 250 cm. The maximum reported age is 11 years old and tag recapture data indicate that significant numbers of bigeye reach at least 8 years old. Spawning takes place in the equatorial waters of the Western Pacific Ocean (WPO) in spring and early summer.

Natural mortality and growth rates are both estimated within the stock assessment. Natural mortality is assumed to vary with age with values about 0.5 for bigeye larger than 40 cm. A range of von Bertalanffy growth parameters has been estimated for bigeye in the Pacific Ocean depending on area (Table 4).

Table 4: Biological growth parameters for bigeye tuna, by country.

Country	L_∞ (cm)	K	t_0
Mexico	169.0	0.608	
French Polynesia	187.0	0.380	
Japan	195.0	0.106	-1.13
Hawaii	196.0	0.167	
Hawaii	222.0	0.114	
Hawaii	220.0	0.183	

3. STOCKS AND AREAS

There are insufficient data available to determine whether there are one or more stocks of bigeye tuna in the Pacific Ocean. The present information, based on tagging data, is summarized in Davies et al (2011) as follows: "Bigeye tuna are distributed throughout the tropical and sub-tropical waters of the Pacific Ocean. There is little information on the extent of mixing across this wide area. Analysis of mtDNA and DNA microsatellites in nearly 800 bigeye tuna failed to reveal significant evidence of widespread population subdivision in the Pacific Ocean (Grewe & Hampton 1998). While these results are not conclusive regarding the rate of mixing of bigeye tuna throughout the Pacific, they are broadly consistent with the results of SPC's and IATTC's tagging experiments on bigeye tuna. Bigeye tuna tagged in locations throughout the tropical Pacific have displayed movements of up to 4000 nautical miles over periods of one to several years, indicating the potential for gene flow over a wide area; however, the large majority of tag returns were recaptured much closer to their release points. Recent tagging of bigeye tuna in the central Pacific has shown a similar pattern. The majority of tag returns with verified recapture positions show displacements of less than 1000 nm (SPC, unpubl. data). In addition, recent tagging experiments in the eastern Pacific Ocean (EPO) using archival tags have so far not demonstrated long-distance migratory behaviour (Schaefer & Fuller 2002) over time scales of up to 3 years; however one recent four-year archival tag return displayed long-distance movements from the EPO to the central Pacific and back in years 3 and 4 of the archival tag record (Schaefer, pers. comm). In view of these results, stock assessments of bigeye tuna are routinely undertaken for the WCPO and EPO separately, however, current bigeye tuna tagging efforts in all areas of the tropical Pacific will provide further opportunity to examine this hypothesis."

4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was updated for the November 2013 Fishery Assessment Plenary after review by the Aquatic Environment Working Group. This summary is from the perspective of the bigeye tuna longline fishery; a more detailed summary from an issue-by-issue perspective is available in the Aquatic Environment and Biodiversity Annual Review where the consequences are also discussed (http://www.mpi.govt.nz/Default.aspx?TabId=126&id=1644) (Ministry for Primary Industries 2012).

4.1 Role in the ecosystem

Bigeye tuna (*Thunnus obesus*) are epi-pelagic opportunistic predators of fish, crustaceans and cephalopods generally found within the upper few hundred meters of the ocean. Bigeye tuna are large pelagic predators, so they are likely to have a 'top down' effect on the fish, crustaceans and squid they feed on.

4.2 Incidental catch (seabirds, sea turtles and mammals)

The protected species, capture estimates presented here include all animals recovered onto the deck (alive, injured or dead) of fishing vessels but do not include any cryptic mortality (e.g., seabirds caught on a hook but not brought onboard the vessel).

4.2.1 Seabird bycatch

Between 2002–03 and 2011–12, there were 71 observed captures of birds in bigeye target longline fisheries (Table 5). Seabird capture rates since 2003 are presented in Figure 5. Seabird bycatch occurs predominantly off the east coast of the North Island (Figure 6). The analytical methods used to estimate capture numbers across the commercial fisheries have depended on the quantity and quality of the data, in terms of the numbers observed captured and the representativeness of the observer coverage. Ratio estimation was historically used to calculate total captures in longline fisheries by target fishery fleet and area (Baird 2008) and by all fishing methods but recent estimates are either ratio or model based as specified in the tables below (Abraham et al 2010).

Through the 1990s the minimum seabird mitigation requirement for surface longline vessels was the use of a bird scaring device (tori line) but common practice was that vessels set surface longlines primarily at night. In 2007 a notice was implemented under s 11 of the Fisheries Act 1996 to formalise the requirement that surface longline vessels only set during the hours of darkness and use a tori line when setting. This notice was amended in 2008 to add the option of line weighting and tori line use if setting during the day. In 2011 the notices were combined and repromulgated under a new regulation (Regulation 58A of the Fisheries (Commercial Fishing) Regulations 2001) which provides a more flexible regulatory environment under which to set seabird mitigation requirements.

Table 5: Number of observed seabird captures in bigeye tuna longline fisheries, 2002–03 to 2011–12, by species and area. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures. The risk ratio is an estimate of aggregate potential fatalities across trawl and longline fisheries relative to the Potential Biological Removals, PBR (from Richard and Abraham (2013) where full details of the risk assessment approach can be found). It is not an estimate of the risk posed by fishing for bigeye tuna using longline gear but rather the total risk for each seabird species. Other data, version 20130305.

Albatross species	Risk ratio	Kermadec Islands	Northland and Hauraki	Bay of Plenty	East Coast North Island	West Coast North Island	Total
Salvin's	Very high	0	1	1	2	0	4
Southern Buller's	Very high	0	3	0	4	0	7
NZ white-capped	Very high	0	1	0	0	0	1
Gibson's	High	0	9	0	1	1	11
Antipodean	High	0	5	1	0	1	7
Antipodean and Gibson's	High	0	2	0	0	0	2
Northern royal	Medium	0	0	1	0	0	1
Southern royal	Medium	0	1	0	0	0	1
Campbell black-browed	Medium	0	3	0	0	1	4
Unidentified	N/A	0	1	0	0	1	2
Total	**N/A**	**0**	**26**	**3**	**7**	**4**	**40**
Other seabirds							
Black petrel	Very high	1	8	1	0	0	10
Flesh-footed shearwater	Very high	0	0	0	9	2	11
White-chinned petrel	Medium	0	2	3	0	3	8
Grey-faced petrel	Very low	0	0	1	0	0	1
Unidentified	N/A	0	1	0	0	0	1
Total other seabirds	**N/A**	**1**	**11**	**5**	**9**	**5**	**31**

Table 6: Effort, observed and estimated seabird captures by fishing year for the bigeye tuna fishery within the EEZ. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); the capture rate (captures per thousand hooks); and the mean number of estimated total captures (with 95% confidence interval). Estimates are based on methods described in Thompson et al (2013) and are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002–03 to 2010–11 are based on data version 20120531 and preliminary estimates for 2011–12 are based on data version 20130305.

	Fishing effort			Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	5 186 507	80 640	1.6	0	0	1 567	1 094–2 281
2003–2004	3 503 857	120 740	3.4	1	0.008	975	696–1 354
2004–2005	1 644 781	33 116	2	2	0.06	392	269–568
2005–2006	1 866 486	45 100	2.4	6	0.133	525	372–748
2006–2007	1 532 071	84 150	5.5	5	0.059	483	337–713
2007–2008	967 829	26 455	2.7	10	0.378	298	214–411
2008–2009	1 565 517	91 095	5.8	9	0.099	441	320–599
2009–2010	1 247 437	80 009	6.4	34	0.425	520	358–764
2010–2011	1 644 556	87 730	5.3	15	0.171	518	350–761
2011–2012†	1 269 823	39 210	3.1	7	0.179	364	249–542

†Provisional data, model estimates not finalised.

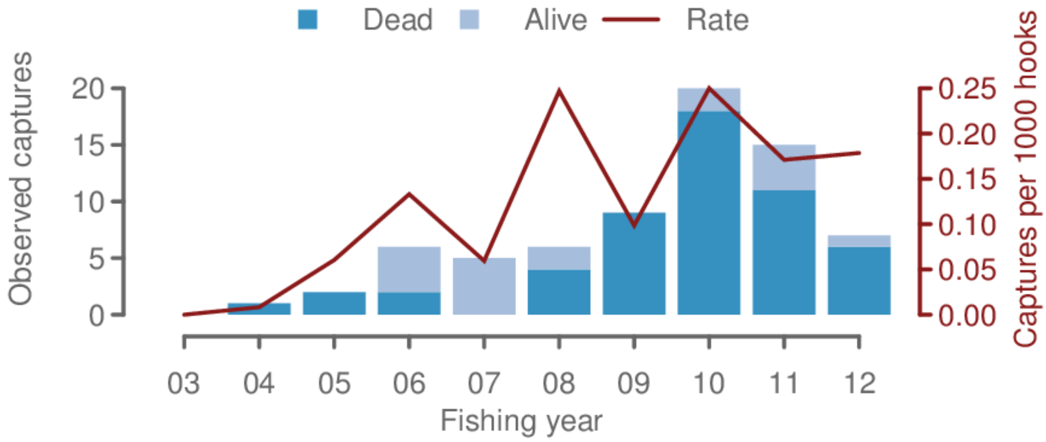


Figure 5: Observed captures of seabirds in bigeye tuna longline fisheries from 2002–03 to 2012–13.

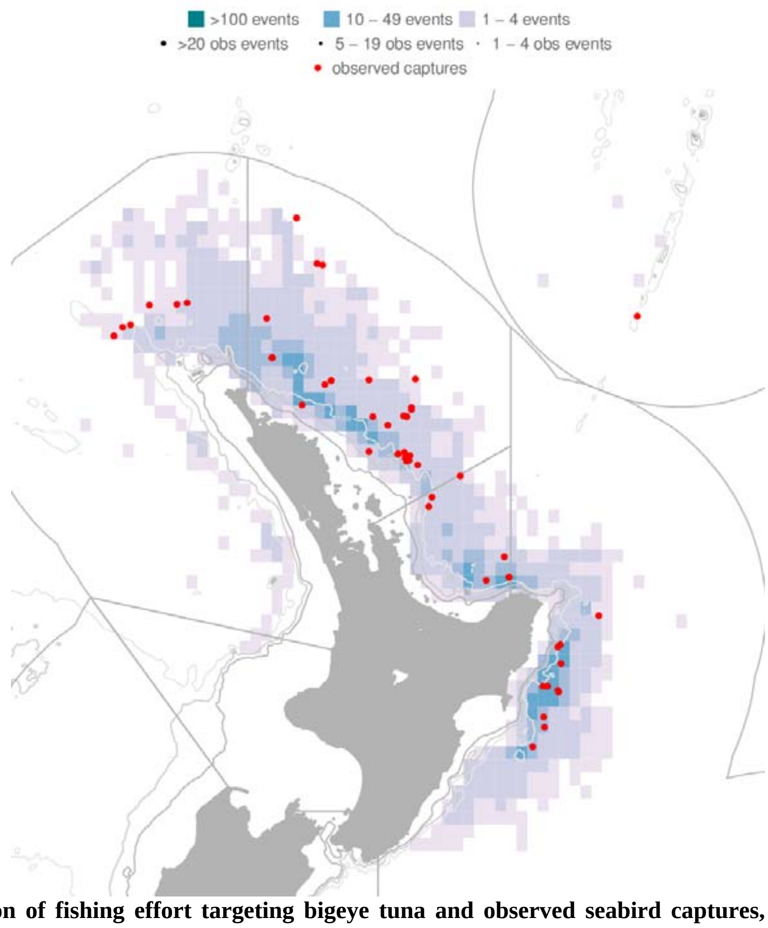


Figure 6: Distribution of fishing effort targeting bigeye tuna and observed seabird captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.2% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.2 Sea turtle bycatch

Between 2002–03 and 2011–12, there were eight observed captures of turtles in bigeye tuna longline fisheries. Observer recordings documented all sea turtles as captured and released alive. Sea turtle capture distributions are more common on the east coast of the North Island (Figure 8).

Table 7: Number of observed sea turtle captures in bigeye tuna longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	East Coast North Island	Kermadec Islands	West Coast North Island	Total
Leatherback turtle	3	1	3	7
Unidentified turtle	1	0	0	1
Total	4	1	3	8

Table 8: Fishing effort and sea turtle captures in bigeye tuna longline fisheries by fishing year. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data see Thompson et al (2013).

	Fishing effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	5 186 507	80 640	1.6	0	0
2003–2004	3 503 857	120 740	3.4	1	0.008
2004–2005	1 644 781	33 116	2.0	2	0.060
2005–2006	1 866 486	45 100	2.4	1	0.022
2006–2007	1 532 071	84 150	5.5	1	0.012
2007–2008	967 829	26 455	2.7	0	0
2008–2009	1 565 517	91 095	5.8	2	0.022
2009–2010	1 247 437	80 009	6.4	0	0
2010–2011	1 644 556	87 730	5.3	1	0.011
2011–2012	1 269 823	39 210	3.1	0	0

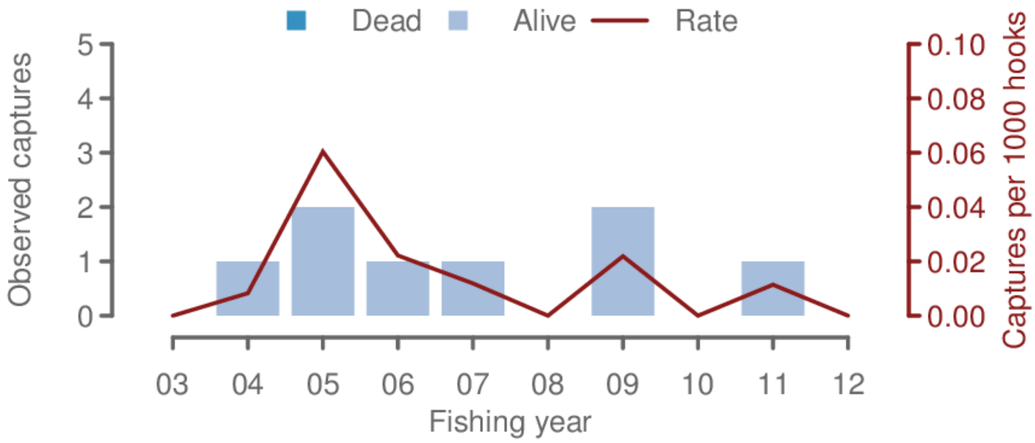


Figure 7: Observed captures of sea turtles in bigeye tuna longline fisheries from 2002–03 to 2012–13.

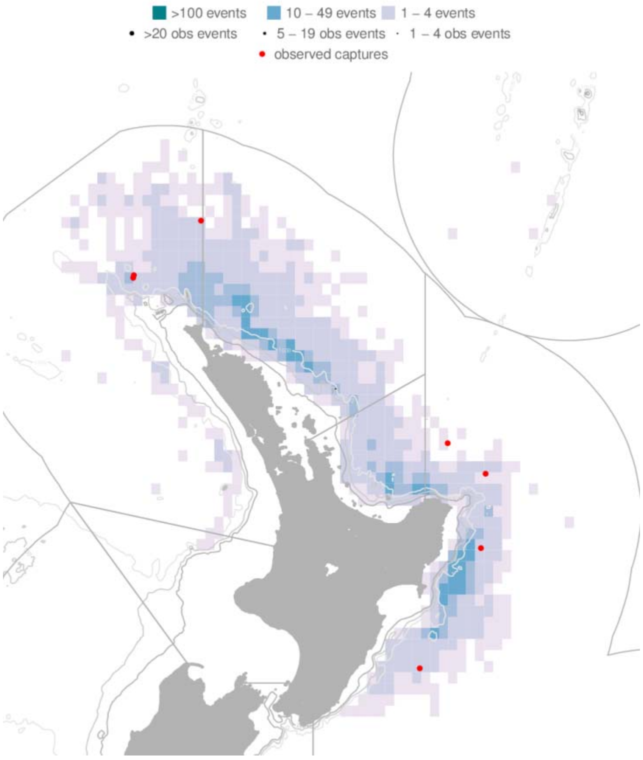


Figure 8: Distribution of fishing effort targeting bigeye tuna and observed sea turtle captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.2% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

4.2.3 Marine Mammals

4.2.3.1 Cetaceans

Cetaceans are dispersed throughout New Zealand waters (Perrin et al 2008). The spatial and temporal overlap of commercial fishing grounds and cetacean foraging areas has resulted in cetacean captures in fishing gear (Abraham & Thompson 2009, 2011). The analytical methods used to estimate capture numbers across the commercial fisheries have depended on the quantity and quality of the data, in terms of the numbers observed captured and the representativeness of the observer coverage. Ratio estimation is used to calculate total captures in longline fisheries by target fishery fleet and area (Baird 2008) and by all fishing methods (Abraham et al 2010).

Between 2002–03 and 2011–12, there was one observed unidentified cetacean capture in bigeye longline fisheries. This capture took place on the west coast of the North Island (Figures 9 and 10) (Abraham & Thompson 2011). The captured animal recorded was documented as being caught and released alive (Thompson & Abraham 2010).

Table 9: Number of observed cetacean captures in bigeye tuna longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

Species	West Coast North Island	Total
Unidentified cetacean	1	1

Table 10: Effort and cetacean captures by fishing year in bigeye tuna fisheries. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). For more information on the methods used to prepare the data, see Thompson et al (2013).

	Fishing effort			Observed captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate
2002–2003	5 186 507	80 640	1.6	0	0
2003–2004	3 503 857	120 740	3.4	1	0.008
2004–2005	1 644 781	33 116	2.0	0	0
2005–2006	1 866 486	45 100	2.4	0	0
2006–2007	1 532 071	84 150	5.5	0	0
2007–2008	967 829	26 455	2.7	0	0
2008–2009	1 565 517	91 095	5.8	0	0
2009–2010	1 247 437	80 009	6.4	0	0
2010–2011	1 644 556	87 730	5.3	0	0
2011–2012	1 269 823	39 210	3.1	0	0

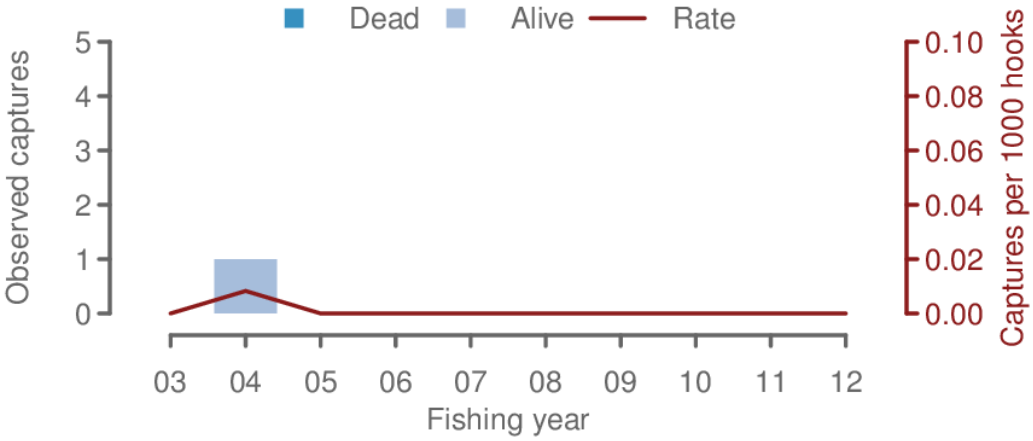


Figure 9: Observed captures of cetaceans in bigeye longline fisheries from 2002–03 to 2011–12.

4.2.4 New Zealand fur seal bycatch

Currently, New Zealand fur seals are dispersed throughout New Zealand waters, especially in waters south of about 40º S to Macquarie Island. The spatial and temporal overlap of commercial fishing grounds and New Zealand fur seal foraging areas has resulted in New Zealand fur seal captures in fishing gear (Mattlin 1987, Rowe 2009). Most fisheries with observed captures occur in waters over or close to the continental shelf, which around much of the South Island and offshore islands slopes steeply to deeper waters relatively close to shore, and thus rookeries and haulouts. Captures on longlines occur when the seals attempt to feed on the fish and bait catch during hauling. Most New Zealand fur seals are released alive, typically with a hook and short snood or trace still attached.

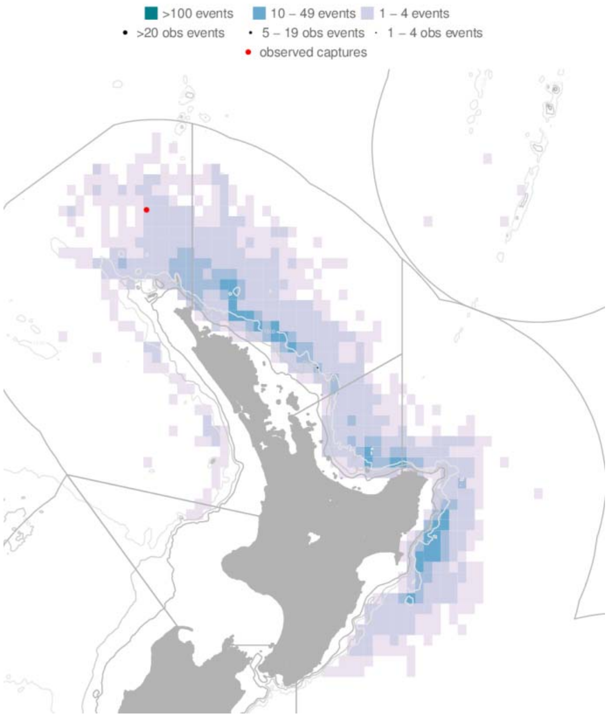


Figure 10: Distribution of fishing effort targeting bigeye tuna and observed cetacean captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.2% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

The analytical methods used to estimate capture numbers across the commercial fisheries have depended on the quantity and quality of the data, in terms of the numbers observed captured and the representativeness of the observer coverage. New Zealand fur seal captures in surface longline fisheries have been generally observed in waters south and west of Fiordland, but also in the Bay of Plenty-East Cape area when the animals have attempted to take bait or fish from the line as it is hauled. These capture rates include animals that are released alive (100% of observed surface longline capture in 2008–09; Thompson & Abraham 2010). Between 2002–03 and 2011–12, there were two observed captures of New Zealand fur seals in bigeye longline fisheries (Tables 11 and 12, Figures 11 and 12).

Table 11: Number of observed New Zealand fur seal captures in bigeye tuna longline fisheries, 2002–03 to 2011–12, by species and area. Data from Thompson et al (2013), retrieved from http://data.dragonfly.co.nz/psc/. See glossary above for a description of the areas used for summarising the fishing effort and protected species captures.

	West Coast North Island	Total
New Zealand fur seal	2	2

Table 12: Effort and captures of New Zealand fur seal by fishing year in bigeye tuna longline fisheries. For each fishing year, the table gives the total number of hooks; the number of observed hooks; observer coverage (the percentage of hooks that were observed); the number of observed captures (both dead and alive); and the capture rate (captures per thousand hooks). Estimates are based on methods described in Thompson et al (2013) are available via http://www.fish.govt.nz/en-nz/Environmental/Seabirds/. Estimates from 2002-03 to 2010-11 are based on data version 20120531 and preliminary estimates for 2011-12 are based on data version 20130305.

	Fishing effort			Observed captures		Estimated captures	
Fishing year	All hooks	Observed hooks	% observed	Number	Rate	Mean	95% c.i.
2002–2003	5 186 507	80 640	1.6	0	0	3	0–6
2003–2004	3 503 857	120 740	3.4	0	0	2	0–5
2004–2005	1 644 781	33 116	2.0	0	0	1	0–4
2005–2006	1 866 486	45 100	2.4	0	0	0	0–2
2006–2007	1 532 071	84 150	5.5	0	0	0	0–2
2007–2008	967 829	26 455	2.7	2	0.076	2	2–4
2008–2009	1 565 517	91 095	5.8	0	0	1	0–3
2009–2010	1 247 437	80 009	6.4	0	0	0	0–2
2010–2011	1 644 556	87 730	5.3	0	0	0	0–2
2011–2012†	1 269 823	39 210	3.1	0	0	1	0–2

†Provisional data, model estimates not finalised.

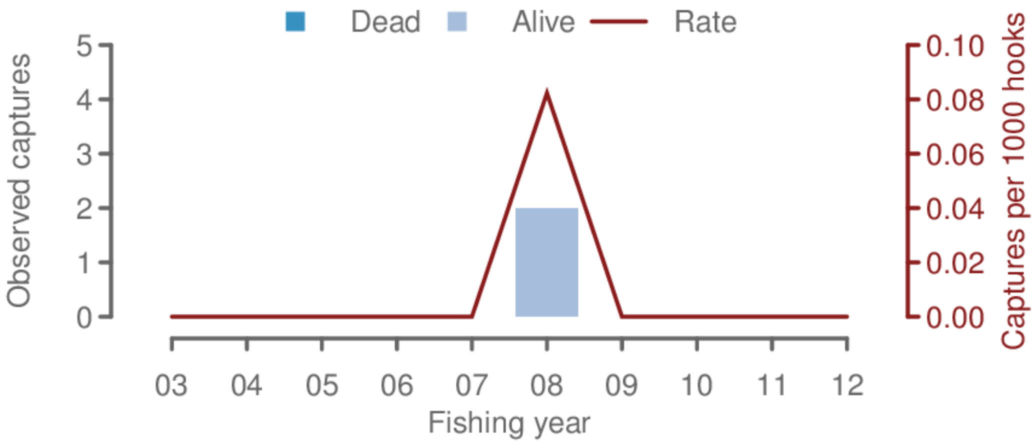


Figure 11: Observed and estimated captures of New Zealand fur seal in bigeye tuna longline fisheries from 2002-03 to 2011-12.

4.3 Incidental fish bycatch

Observer records indicate that a wide range of species are landed by the longline fleets in New Zealand fishery waters. Blue sharks are the most commonly landed species (by number), followed by Ray's bream (Table 13). Southern bluefin tuna and albacore tuna are the only target species that occur in the top five of the frequency of occurrence.

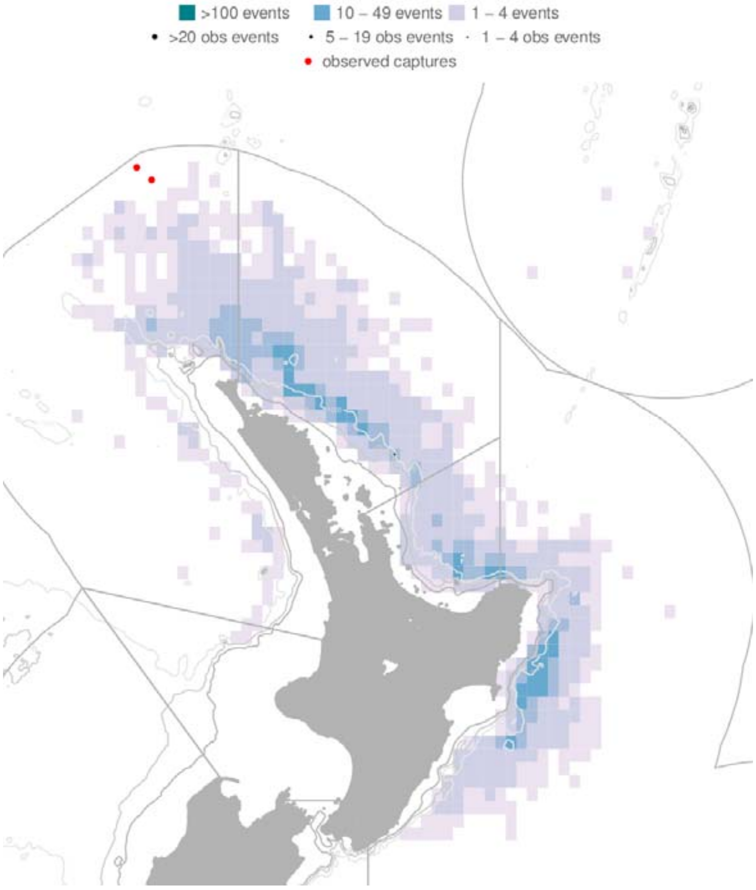


Figure 12: Distribution of fishing effort targeting bigeye tuna and observed New Zealand fur seal captures, 2002–03 to 2011–12. Fishing effort is mapped into 0.2-degree cells, with the colour of each cell being related to the amount of effort. Observed fishing events are indicated by black dots, and observed captures are indicated by red dots. Fishing is only shown if the effort could be assigned a latitude and longitude, and if there were three or more vessels fishing within a cell. In this case, 94.2% of the effort is shown. See glossary for areas used for summarising the fishing effort and protected species captures.

Table 13: Numbers of the most common fish species observed in the New Zealand longline fisheries during 2009–10 by fleet and area. Species are shown in descending order of total abundance (Griggs & Baird 2013).

	Charter	Domestic		Total
Species	South	North	South	number
Blue shark	2 024	4 650	882	7 556
Ray's bream	3 295	326	88	3 709
Southern bluefin tuna	3 244	211	179	3 634
Lancetfish	3	2 139	1	2 143
Albacore tuna	90	1 772	42	1 904
Dealfish	882	0	7	889
Swordfish	3	452	2	457
Moonfish	76	339	6	421
Porbeagle shark	72	328	20	420
Mako shark	11	343	7	361
Big scale pomfret	349	4	0	353
Deepwater dogfish	305	0	0	305
Sunfish	7	283	5	295
Bigeye tuna	0	191	0	191
Escolar	0	129	0	129
Butterfly tuna	15	100	3	118
Pelagic stingray	0	96	0	96
Oilfish	2	75	0	77
Rudderfish	39	20	2	61
Flathead pomfret	56	0	0	56

Dolphinfish	0	47	0	47
School shark	34	0	2	36
Striped marlin	0	24	0	24
Thresher shark	7	17	0	24
Cubehead	13	0	1	14
Kingfish	0	10	0	10
Yellowfin tuna	0	9	0	9
Hake	8	0	0	8
Hapuku bass	1	6	0	7
Pacific bluefin tuna	0	5	0	5
Black barracouta	0	4	0	4
Skipjack tuna	0	4	0	4
Shortbill spearfish	0	4	0	4
Gemfish	0	3	0	3
Bigeye thresher shark	0	2	0	2
Snipe eel	2	0	0	2
Slender tuna	2	0	0	2
Wingfish	2	0	0	2
Bronze whaler shark	0	1	0	1
Hammerhead shark	0	1	0	1
Hoki	0	0	1	1
Louvar	0	1	0	1
Marlin, unspecified	0	1	0	1
Scissortail	0	1	0	1
Broadnose seven gill shark	1	0	0	1
Shark, unspecified	0	1	0	1
Unidentified fish	2	30	8	40
Total	10 545	11 629	1 256	23 430

4.4 Benthic interactions
N/A

4.5 Key environmental and ecosystem information gaps
Cryptic mortality is unknown at present but developing a better understanding of this in future may be useful for reducing uncertainty of the seabird risk assessment and could be a useful input into risk assessments for other species groups.

The survival rates of released target and bycatch species is currently unknown.

Observer coverage in the New Zealand fleet is not spatially and temporally representative of the fishing effort.

5. STOCK ASSESSMENT

With the establishment of the WCPFC in 2004, future stock assessments of the WCPO stock of bigeye tuna are undertaken by the Oceanic Fisheries Programme (OFP) of Secretariat of the Pacific Community under contract to WCPFC. As noted above, there is continuing work on a Pacific-wide bigeye assessment.

No assessment is possible for bigeye within the New Zealand EEZ as the proportion of the total stock found within New Zealand fisheries waters is unknown and is likely to vary from year to year.

A summary of the 2011 assessment undertaken by OFP and reviewed by the WCPFC Scientific Committee in August 2011 is provided below (from Davies et al 2011).

"The assessment includes a series of model runs describing stepwise changes from the 2010 assessment (run 3d) to develop a new reference case model (Run3j – Ref.case) and then a series of one-off sensitivity models that represent a single change from the Ref.case model run. A sub-set of key model runs was taken from the sensitivities that represent a set of plausible model runs and were included in a structural uncertainty analysis (grid) for consideration in developing management advice.

Besides updating the input data, the main developments to the inputs compared to the 2010 assessment were: including tagging data from the 2007–2010 PTTP program; standardised CPUE time series derived from operational-level catch-effort data for Japanese longline fisheries; weighting the Japanese longline size frequency data according to the estimated population relative abundance within regions; adjusting purse seine size frequency data using spill-samples to correct for grab-sample bias; and, including more reliable size composition data for Philippines and Indonesian domestic purse seine catches in offshore waters. The main developments to model structural assumptions were to define a separate Indonesian Philippines-based domestic purse seine fishery that operates beyond the national archipelagic waters and to the east of 125° E longitude.

During the Pre-Assessment Workshop held in April 2011 (PAW, SPC 2011), the key assumptions from the base case model from the 2010 assessment were reviewed in light of the developments proposed for the Ref.case model for the 2011 assessment. These and the alternative assumptions in the other key model runs are provided below (Table 14):

Table 14: Key and alternative assumptions from the base case model from the 2010 assessment.

Component	2010 assessment (run 3d)	2011 assessment (run 3j)	2011 alternatives
Longline CPUE	Aggregate indices	Operational indices, temporal weighting of standardised effort	- Exclude all CPUE prior to 1975 - Aggregate indices
Steepness	Estimated	Fixed = 0.8	0.65, 0.95, and estimated
Purse-seine catches	Spill sample corrected	Spill sample corrected (including size data)	Grab sample (SBEST)
Tagging data	Excluded PTTP	Included PTTP	Exclude PTTP
Longline size data	Down-weighted	Full weight	Down -weighted
Natural mortality	Base	Base	Increased for juveniles

In comparing the 2011 Ref.case model results with the 2010 assessment, the decision to fix steepness at a more plausible value (0.8) to that estimated in recent assessments must be considered. Whereas the Ref.case estimates of stock status are not dissimilar from the 2010 base case estimates, the 2011 model most comparable to an update of the 2010 base case was Run15 in which steepness was estimated, and which provided a more optimistic stock status. This difference indicates the effects of the new inputs (in particular the operational CPUE indices). If one compares $F_{current}/F_{MSY}$ and $SB_{current}/SB_{MSY}$ between a straight-forward update of the 2010 model (Run2b) and Run15, the values are 1.49 and 1.33 versus 1.13 and 1.54, respectively.”

The main conclusions of the current assessment (based upon the median of the uncertainty grid estimates, and the sensitivity model runs) are as follows.

i. “The estimated increasing trend in recruitment from recent bigeye assessments appears to have been addressed to a small extent in the current assessment, but remains an issue in region 3 and is primarily the result of conflict (disagreement) among the various data sources, in particular between the longline CPUE indices and the reported catch histories, and between and within some of the size composition data sets. The current assessment has indentified some of these conflicts and includes some model runs that begin to address them.

ii. As in previous assessments, recruitment in almost all models is estimated to have been high during 1995–2005. As suggested in the 2010 assessment, an analysis is presented that estimates the stock-recruitment relationship (with steepness fixed) for this latter period and applied it in the yield analyses. If one considers the recruitment estimates in the second half of the time series to be more plausible and representative of the overall productivity of the bigeye stock, the results of this analysis (Run21) could be used for formulating management advice. In this case $F_{current}/F_{MSY}$ was 1.58 and $SB_{current}/SB_{MSY}$ was 0.61 indicating that we would conclude that the stock is overfished and overfishing is occurring under this productivity assumption. The main reason for the much lower estimate of $SB_{current}/SB_{MSY}$ is that SB_{MSY} is approximately doubled because of the higher levels of recruitment being used to estimate it.

iii. Total and spawning biomass for the WCPO are estimated to have declined to about half of their initial levels by the mid-1970s, with total biomass remaining relatively constant since then ($B_{current}$ / B_0= 44%), while spawning biomass has continued to decline ($SB_{current}/SB_0$=35%). Declines are larger for models that exclude the early periods of the CPUE time series.

iv. When the non-equilibrium nature of recent recruitment is taken into account, we can estimate the level of depletion that has occurred. It is estimated that spawning potential is at 26% of the level predicted to exist in the absence of fishing considering the average over the period 2006–09, and that value is reduced to 23% for the 2010 spawning potential levels.

v. The attribution of depletion to various fisheries or groups of fisheries indicates that the purse seine and other surface fisheries have an equal or greater impact than longline fisheries on the current biomass. The purse seine and Philippines/Indonesian domestic fisheries also have substantial impact in region 3 and to a lesser extent in region 4. The Japanese coastal pole-and-line and purse-seine fisheries are also having a significant impact in their home region (region 1). For the sensitivity analysis with lower purse seine catches, the longline fisheries are estimated to have a higher impact.

vi. Recent catches are well above the *MSY* level of 74 993 t, but this is mostly due to a combination of above average recruitment and high fishing mortality. When *MSY* is re-calculated assuming recent recruitment levels and recent mix of fisheries persist, catches are still around 7% higher than the re-calculated *MSY* (131 400 mt). **Based on these results, we conclude that current levels of catch are unlikely to be sustainable in the long term even at the recent [high] levels of recruitment estimated for the last two decades**.

vii. Fishing mortality for adult and juvenile bigeye tuna is estimated to have increased continuously since the beginning of industrial tuna fishing. For all of the model runs $F_{current}/F_{MSY}$ is considerably greater than 1. For the grid median, the ratio is estimated at 1.42 indicating that a 30% reduction in fishing mortality is required from the 2006–09 level to reduce fishing mortality to sustainable levels. Using the Ref.case, if we consider historical levels of fishing mortality, a 39% reduction in fishing mortality from 2004 levels is required, and a 28% reduction from average 2001–04 levels. Larger reductions in fishing mortality are indicated when lower values of steepness are assumed. **Based on these results, we conclude that overfishing is occurring in the bigeye tuna stock**.

viii. The reference points that predict the status of the stock under equilibrium conditions are $B_{Fcurrent}/B_{MSY}$ and $SB_{Fcurrent}/SB_{MSY}$. The model predicts that biomass would be reduced to 65% and 60% of the level that supports *MSY*. In terms of the reduction against virgin biomass the declines reach as low as 15% of spawning potential. Current stock status compared to these reference points indicate the current total and spawning biomass are higher than the associated MSY levels ($B_{current}/B_{MSY}$ =1.34 and $SB_{current}/SB_{MSY}$ = 1.37). The structural uncertainty analysis indicates a 13% probability that $SB_{current} < SB_{MSY}$. **Based on these results above, and the recent trend in spawning biomass, we conclude that bigeye tuna is approaching an overfished state. We note however, that if recent recruitment is assumed to represent the true productivity of the bigeye stock (Run21), then the higher levels of Bmsy and SBmsy implied would mean that bigeye tuna is already in an overfished state ($B_{current}/B_{MSY}$ =0.67 and $SB_{current}/SB_{MSY}$ = 0.61).**

ix. Analysis of current levels of fishing mortality and historical patterns in the mix of fishing gears indicates that MSY has been reduced to less than half its levels prior to 1970 through harvest of small juveniles. Because of that and overfishing, considerable potential yield from the bigeye tuna stock is being lost. **Based on these results, we conclude that MSY levels would rise if mortality of small fish were reduced which would allow greater overall yields to be sustainably obtained.**"

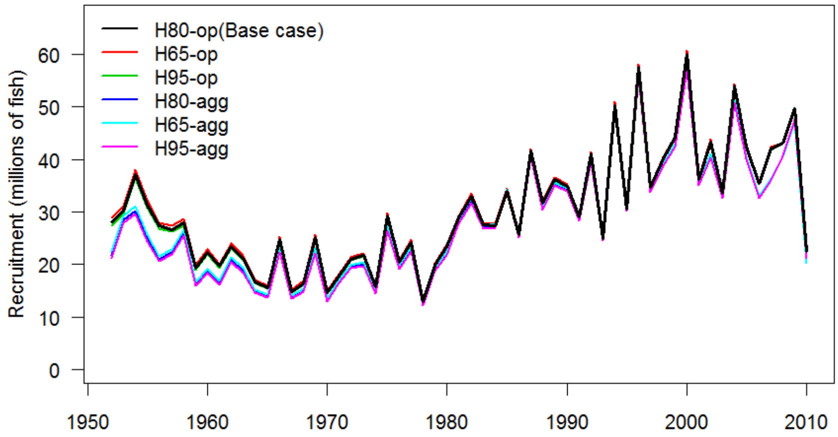


Figure 13: Estimated annual recruitment (millions of fish) for the WCPO obtained from the base case model (run 3j – H80-opp (black line)) and the five combinations of steepness and longline CPUE series.

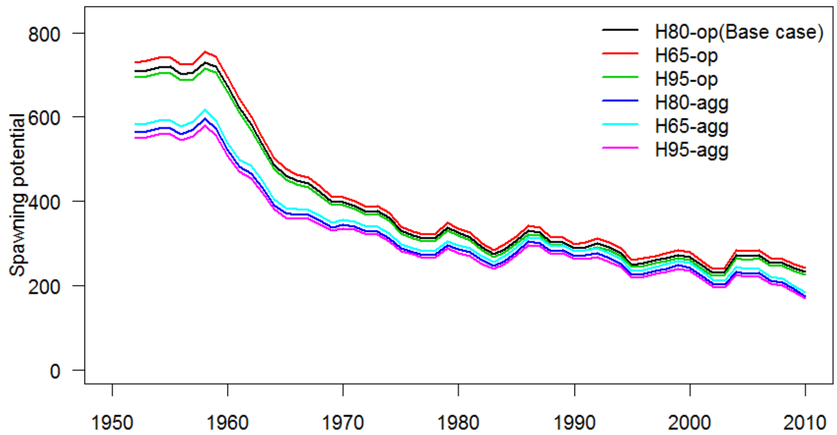


Figure 14: Estimated average annual average spawning potential for the WCPO obtained from the base case model (run 3j – H80-opp (black line)) and the five combinations of steepness and longline CPUE series.

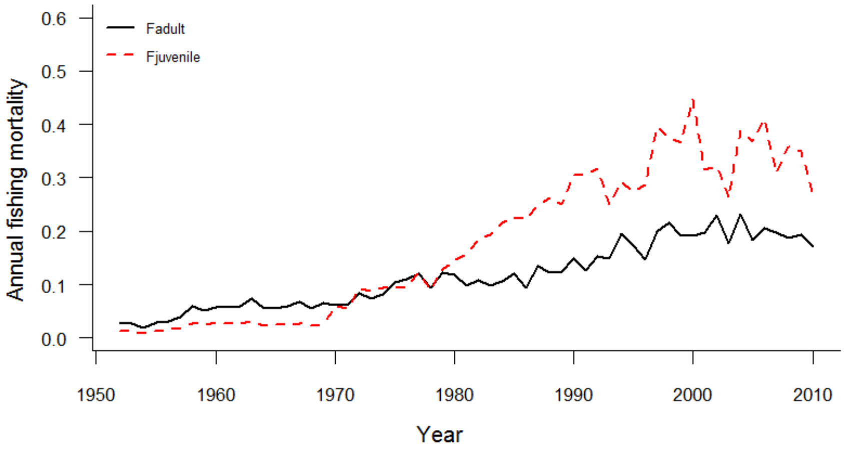


Figure 15: Estimated annual average juvenile and adult fishing mortality for the WCPO obtained from the base case model (run 3j - H80-op).

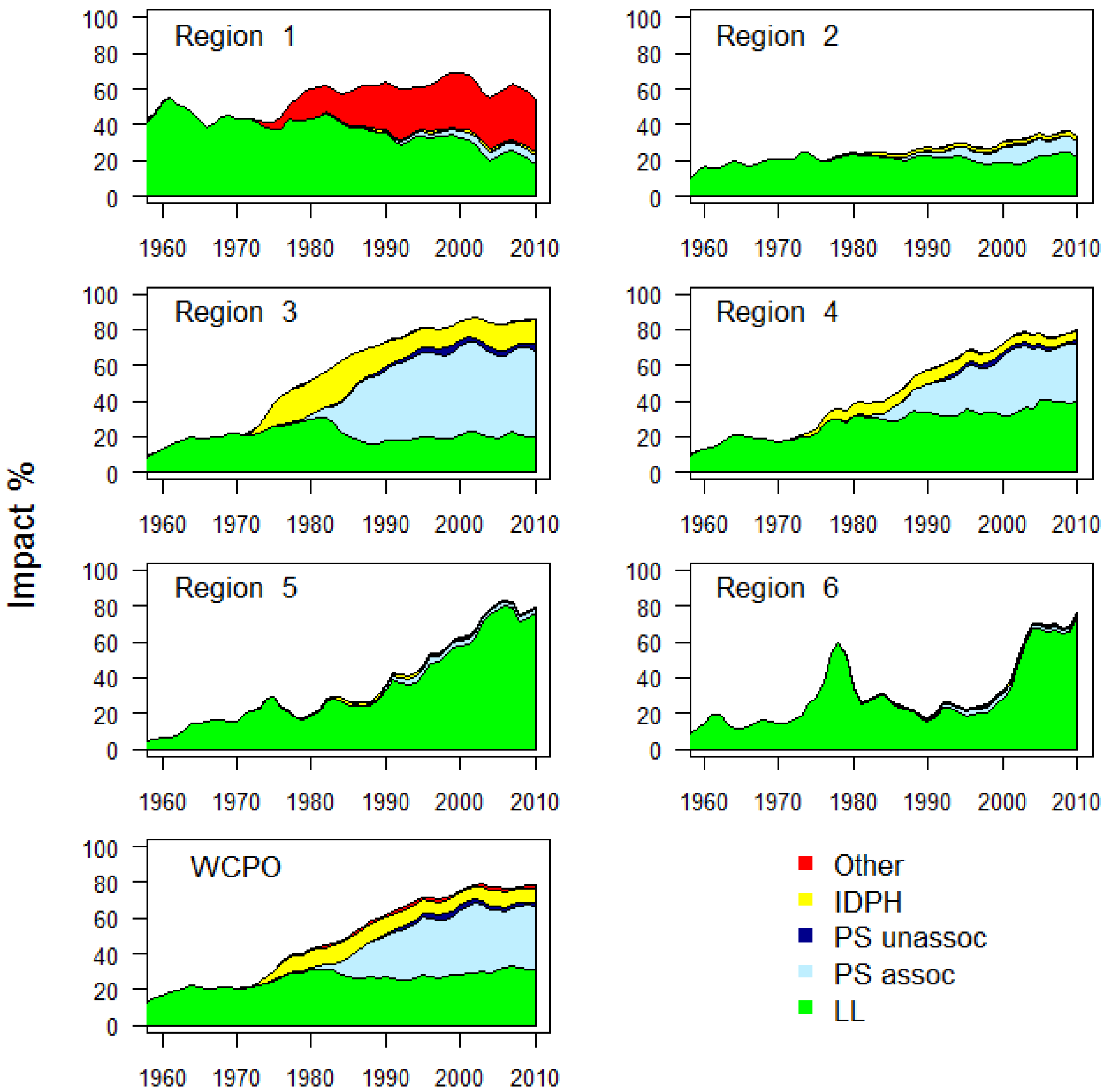


Figure 16: Estimates of reduction in spawning potential due to fishing (fishery impact = 1 – $SB_t/SB_{tF=0}$) by region and for the WCPO attributed to various fishery groups (base case model). LL = all longline fisheries; IDPH = Philippines and Indonesian domestic fisheries; PS assoc = purse-seine log and FAD sets; PS unassoc = purse-seine school sets; Other = pole-and-line fisheries and coastal Japan purse-seine.

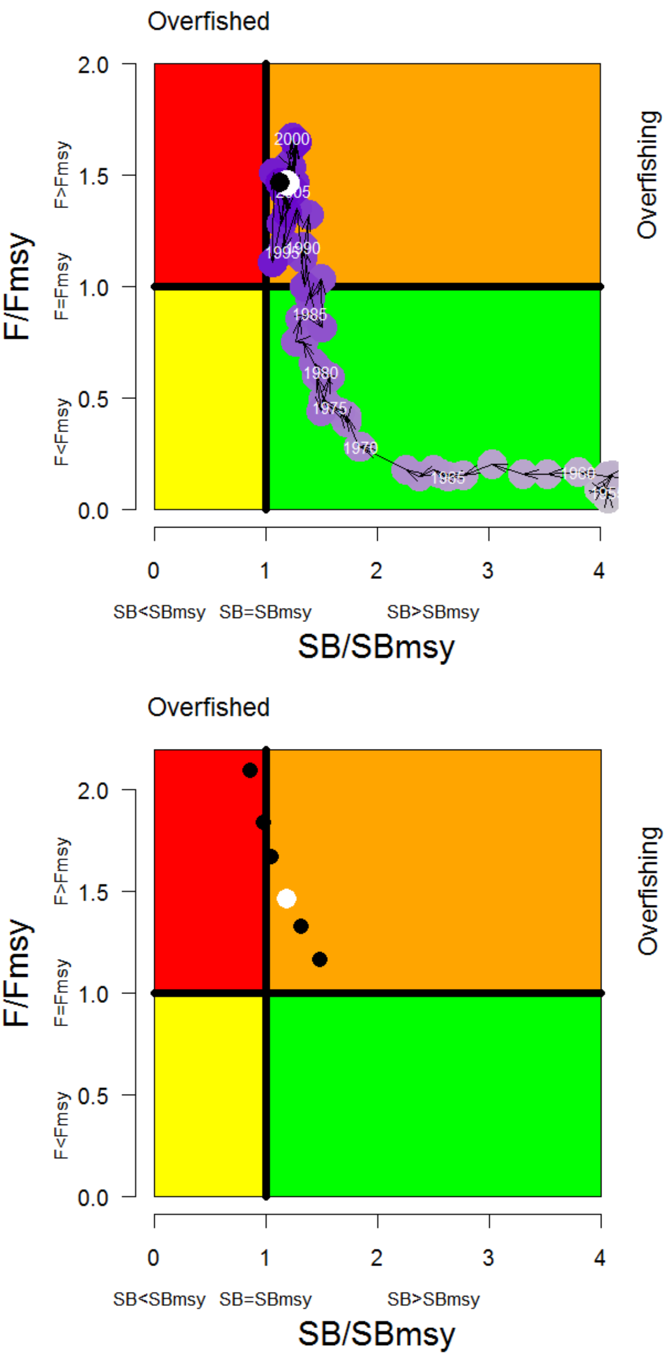


Figure 17: Temporal trend in annual stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points for the base case (top) and $F_{current}/F_{MSY}$ and $SB_{current}/SB_{MSY}$ for the base case (white circle) and the five combinations of steepness and longline CPUE series. See Table 14 to determine the individual model runs.

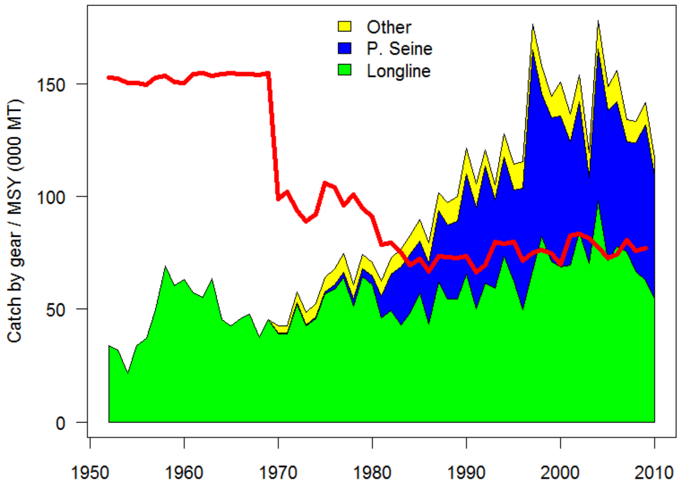


Figure 18: History of annual estimates of MSY compared with catches of three major fisheries sectors. Declining MSY results from the change in selectivity of fishing gear and increases in catches of small bigeye.

Table 15: Estimates of management quantities for selected stock assessment models from the 2011 base case model (run 3j – H80-op) and the five combinations of steepness and longline CPUE series. For the purpose of this assessment, "current" is the average over the period 2006–2009 and "latest" is 2010 [*C* = catch; F_{mult} - The amount that $F_{current}$ needs to be scaled to obtain F_{MSY}].

	H80-op (Base case)	H65-op	H95-op	H80-agg	H65-agg	H95-agg
$C_{current}$	141 160	141 365	141 029	141 561	141 805	141 356
C_{latest}	116 868	117 118	116 712	117 558	117 843	117 320
MSY	76 760	70 080	83 720	74 120	68 360	80 360
$C_{current}/MSY$	1.84	2.02	1.68	1.91	2.07	1.76
C_{latest}/MSY	1.52	1.67	1.39	1.59	1.72	1.46
F_{mult}	0.68	0.54	0.86	0.60	0.48	0.75
$F_{current}/F_{MSY}$	1.46	1.84	1.16	1.67	2.10	1.33
SB_0	739 900	810 000	698 500	688 400	762 000	644 200
SB_{MSY}/SB_0	0.29	0.33	0.24	0.29	0.33	0.24
$SB_{current}/SB_0$	0.35	0.33	0.36	0.30	0.29	0.32
SB_{latest}/SB_0	0.31	0.30	0.32	0.26	0.24	0.26
$SB_{current}/SB_{MSY}$	1.19	0.98	1.49	1.05	0.86	1.32
SB_{latest}/SB_{MSY}	1.08	0.89	1.36	0.88	0.72	1.10
$SB_{curr}/SB_{curr_{F=0}}$	0.23	0.23	0.22	0.20	0.20	0.19
$SB_{latest}/SB_{latest_{F=0}}$	0.21	0.22	0.21	0.17	0.18	0.17
Steepness (h)	0.80	0.65	0.95	0.80	0.65	0.95

Table 16: Comparison of WCPO bigeye tuna reference points from the 2011 reference case model and the range of the six models in Table 14; the 2010 base case model (steepness estimated as 0.98) - shown in parentheses is the alternative 2010 run (steepness assumed as 0.75); ranges of six sensitivity analyses in the 2009 assessment; and the base model and sensitivity analyses from the 2008 assessment.

Management quantity	2011 assessment Base case (uncertainty)	2010 assessment Run3d (Run4b)	2009 Assessment	2008 Assessment
Most recent catch	116 868 mt (2010)	126 769 mt (2009)	134 315 mt (2008)	143 059 mt (2007)
MSY	76 760 mt (68 360 – 83 720)	73 840 mt (65 640 mt)	Range: 52 120 ~ 67 800 mt	Base case: 64 600 mt Range: 56 800~65 520 mt
$F_{current}/F_{MSY}$	1.46 (1.16–2.10)	1.41 (1.97)	Range: 1.51 ~ 2.55	Base case: 1.44 Range: 1.33 ~ 2.09
$B_{current}/B_{MSY}$	1.25 (0.96–1.48)	1.39 (1.09)	Range: 1.11 ~ 1.55	Base case: 1.37 Range: 1.02 ~ 1.37
$SB_{current}/SB_{MSY}$	1.19 (0.86–1.49)	1.34 (0.97)	Range: 0.85 ~ 1.42	Base case: 1.19 Range: 0.76 ~ 1.20
$Y_{Fcurrent}/MSY$	0.89 (0.34–0.99)	0.94 (0.56)	Range: 0.12 ~ 0.92	Base case: 0.94 Range: 0.50 ~ 0.97
$B_{current}/B_{current, F=0}$	0.29 (0.25–0.30)	0.23 (0.24)	Range: 0.18 ~ 0.29	Base case: 0.26 Range: 0.20 ~ 0.28
$SB_{current}/SB_{current, F=0}$	0.23 (0.19–0.23)	0.17 (0.18)	Range 0.11 – 0.19	Not available

5.1 Estimates of fishery parameters and abundance

There are no fishery independent indices of abundance for the bigeye stock. Relative abundance information is available from longline catch per unit effort data, though there is no agreement on the best method to standardise these data and several methods are compared. Returns from a large scale tagging programme undertaken in the early 1990s, and an updated programme from 2007–2009 undertaken by the SCP provide information on rates of fishing mortality which in turn has improved estimates of abundance.

5.2 Biomass estimates

The stock assessment results and conclusions of the six-region model show $B_{current}$ / B_{MSY} estimated at 1.25 in 2010. This estimate applies to the WCPO portion of the stock or an area that is approximately equivalent to the waters west of 150°W. Total biomass for the WCPO is estimated to have declined to about half of its initial level by about 1970 and has continued to decline since then.

5.3 Yield estimates and projections

No estimates of *MCY* and *CAY* are available.

5.4 Other yield estimates and stock assessment results

Although no reference points have yet been agreed by the WCPFC, stock status conclusions are generally presented in relation to two criteria. The first reference point relates to “overfished” which compares the current biomass level to that necessary to produce the maximum sustainable yield (MSY). The second relates to “over-fishing” which compares the current fishing mortality rate to that which would move the stock towards a biomass level necessary to produce the MSY. The first criteria is similar to that required under the New Zealand Fisheries Act while the second has no equivalent in our legislation and relates to how hard a stock can be fished.

Because recent catch data are often unavailable, these measures are calculated based on the average fishing mortality/biomass levels in the ‘recent past’, e.g., 2006–2009 for the 2011 assessment.

Recent catches (116 868 t in 2010) are well above the MSY level of 76 760 t, this is mostly due to a combination of above average recruitment and high fishing mortality. When MSY is re-calculated assuming recent recruitment levels, catches are still around 20% higher than the re-calculated MSY. The ratio of $F_{current}$ compared with F_{MSY} (the fishing mortality level that would keep the stock at MSY) is greater than 1.0 in all model runs indicating that current fishing mortality levels are high and there is a very high chance that $F_{current}$ is greater than F_{MSY} and that over-fishing is occurring.

5.5 Other factors

There are three areas of concern with the bigeye stock:

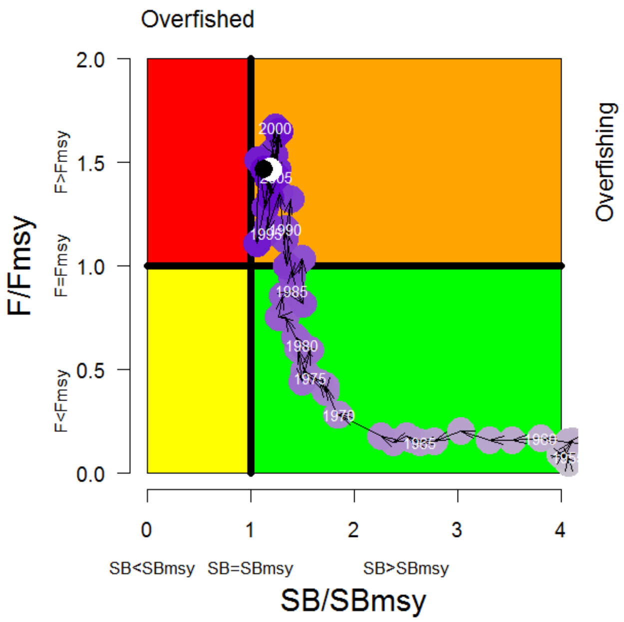
- juveniles occur in mixed schools with small yellowfin and also with skipjack tunas throughout the equatorial Pacific Ocean. As a result, they are vulnerable to large-scale purse seine fishing, particularly when fish aggregating devices (FADs) are set on. Catches of juveniles can be a very high proportion of total removals in numbers from the stock;
- the historic and continuing large catch of adults by the longline fishery that dramatically reduced the spawning stock over time. At present, there is uncertainty about some of the key data inputs to the assessment and as a result the true stock status could be better or worse than currently estimated; and
- several consecutive weak year classes have been observed in the neighbouring 'stock' of bigeye tuna in the EPO leading to a dramatic decline in abundance. A similar decline in recruitment in the WCPO or a shift of effort from the EPO would increase the risk to the WCPO stock.

6. STATUS OF THE STOCKS

Stock structure assumptions

Western and Central Pacific Ocean
All estimates of biomass in this table refer to spawning biomass (SB)

Stock Status	
Year of Most Recent Assessment	A full stock assessment was conducted in 2011.
Assessment Runs Presented	Base case model only
Reference Points	Target: SB > SB_{MSY} and F < F_{MSY} Soft Limit: Not established by WCPFC; but evaluated using HSS default of 20% SB_0 Hard Limit: Not established by WCPFC; but evaluated using HSS default of 10% SB_0 Overfishing threshold: F_{MSY}
Status in relation to Target	About as Likely as Not (40–60%) that SB > SB_{MSY} and Very Unlikely (< 10%) that F < F_{MSY}
Status in relation to Limits	Soft Limit: Unlikely (< 40%) to be below Hard Limit: Unlikely (< 40%) to be below
Status in relation to Overfishing	Overfishing is Very Likely (> 90%) to be occurring

Historical Stock Status Trajectory and Current Status

Temporal trend in annual stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points. The colour of the points is graduated from mauve (1972) to dark purple (2010). The black circle represents the B_{2010}/B_{MSY} and the F_{2010} / F_{MSY} the white circle represents the $B_{2006\text{-}2009}$ / B_{MSY} and $F_{2006\text{-}2009}$ / F_{MSY} (Davies et al 2011).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Biomass has decreased consistently since the 1950s to levels below SB_{MSY} in recent years. Total and spawning biomass for the WCPO are estimated to have declined to about half of their initial levels by about 1970, with total biomass remaining relatively constant since then ($B_{current}/B_0$ = 0.44) where "current" is the average over the period 2006–2009, while spawning biomass has continued to decline ($SB_{current}/SB_0$ = 0.35).
Recent Trend in Fishing Intensity or Proxy	Fishing mortality has generally increased and has recently escalated to levels near or above $F_{current}/F_{MSY}$ = 1.46
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	Recruitment in all analyses is estimated to have been high during the last two decades. This result was similar to that of previous assessments, and appears to be partly driven by conflicts between some of the CPUE, catch, and size data inputs.

Projections and Prognosis	
Stock Projections or	The bigeye stock status is concluded to not be

Prognosis	overfished but overfishing is taking place; under current levels of effort the stock is expected to fall below B_{MSY} in the next few years.	
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Likely (> 60%) in the next five years Hard Limit: About as Likely as Not (40–60%) in the next five years	
Probability of Current Catch or TACC causing Overfishing to continue or to commence	Very Likely (> 90%)	
Assessment Methodology and Evaluation		
Assessment Type	Level 1- Quantitative Stock Assessment	
Assessment Method	The assessment uses the stock assessment model and computer software known as MULTIFAN-CL.	
Assessment Dates	Latest assessment: 2011	Next assessment: 2014
Overall assessment quality rank	1 - High Quality	
Main data inputs (rank)	- Catch and effort data - Size data - Growth data; and tagging data	1 - High Quality 1 - High Quality 1 - High Quality
Data not used (rank)		
Changes to Model Structure and Assumptions	Changes to the data from the 2010 assessment included: • tagging data from the 2007–2010 Pacific tuna tagging programme (PTTP); • standardised CPUE time series derived from operational-level catch-effort data for Japanese longline fisheries; • weighting the Japanese longline size frequency data according to the estimated population relative abundance within regions; • adjusting purse seine size frequency data using spill-samples to correct for grab-sample bias; and • including more reliable size composition data for Philippines and Indonesian domestic purse seine catches in offshore waters. The main developments to model structural assumptions were to define a separate Indonesian Philippines-based domestic purse seine fishery that operates beyond the national archipelagic waters and to the east of 125° E longitude.	
Major Sources of Uncertainty	Catch estimated from the most recent years is uncertain as some catch has still not been reported.	

	There are high levels of uncertainty regarding the recruitment estimates and the resulting estimates of steepness.

Qualifying Comments
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Fishery Interactions
Interactions with protected species are known to occur in the longline fisheries of the South Pacific, particularly south of 25°S. Seabird bycatch mitigation measures are required in the New Zealand and Australian EEZs and through the WCPFC Conservation and Management Measure CMM2007-04. Sea turtles also get incidentally captured in longline gear; the WCPFC is attempting to reduce sea turtle interactions through Conservation and Management Measure CMM2008-03. Shark bycatch is common in longline fisheries and largely unavoidable; this is being managed through New Zealand domestic legislation and to a limited extent through Conservation and Management Measure CMM2010-07.

7. FOR FURTHER INFORMATION

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