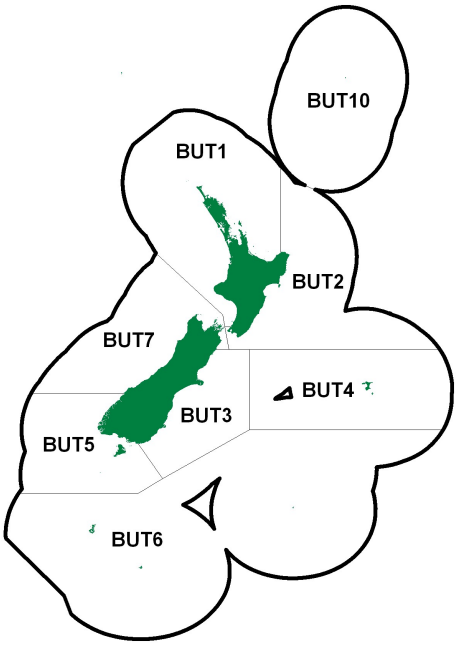
BUTTERFISH (BUT)

(*Odax pullus*)
Marari



1. FISHERY SUMMARY

Butterfish was introduced into the QMS in 1 October 2002 with allowances, TACCs and TACs as follows (Table 1).

Table 1: Summary of recreational and customary non-commercial allowances, TACs, and TACCs.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	TACC	Other Mortality	TAC
BUT 1	10	10	3	1	24
BUT 2	80	80	63	2	225
BUT 3	65	65	3	1	134
BUT 4	4	4	10	0	18
BUT 5	10	10	45	1	66
BUT 6	0	0	0	0	0
BUT 7	15	15	38	1	69
BUT 10	0	0	0	0	0

1.1 Commercial fisheries

Butterfish is targeted by setnets in shallow coastal waters, principally around kelp-beds. The main fishery is centred on Cook Strait, between Tasman Bay, Castlepoint, and Kaikoura. There is also a smaller fishery around Stewart Island. A minimum setnet mesh size of 108 mm and a minimum fish size of 35 cm apply to commercial and recreational fishers; additional regional netting restrictions may also apply.

Hector's dolphin setnet closure areas were introduced on 1 October 2008 as part of the implementation of a Hector's and Maui dolphin Threat Management Plan. On 18 March 2011 the Minister decided to provide an exemption to the setnet prohibition on the East Coast South Island to allow commercial fishers targeting butterfish to use setnets in a defined area at the top of the East Coast South Island.

In line with the acceptable risk of mortality associated with butterfish fishing by commercial fisheries at the top of the East Coast of the South Island, given the type of fishing gear they use and the size of the area and the numbers of Hector's dolphins, recreational fishers are also allowed to target butterfish by method of set net from 1 January–30 April (inclusive). Set netting can only be undertaken if fishers stay with their nets at all times, the net is set no more than 200 m from the shore and it does not exceed 60 m in length.

Table 2: Reported domestic landings (t) and TACCs of butterfish by Fishstock from 2001–02 to present.

Fishstock	BUT 1		BUT 2		BUT 3		BUT 4		BUT 5	
FMA	1,8&9		2		3		4		5	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACC
2001–02	0.7	3	64	63	0.4	3	13	10	19	45
2002–03	2.0	3	58.2	63	2.8	3	4.0	10	34.6	45
2003–04	1.4	3	52.6	63	2.1	3	2.6	10	42.6	45
2004–05	1.5	3	62.9	63	2.4	3	5.3	10	35.4	45
2005–06	2.9	3	44.5	63	1.8	3	0.1	10	21.8	45
2006–07	2.4	3	55.5	63	1.8	3	0.1	10	30.1	45
2007–08	1.0	3	46.3	63	2.0	3	0	10	35.9	45
2008–09	2.1	3	55.5	63	0.6	3	0.6	10	36.9	45
2009–10	2.5	3	45.3	63	< 0.1	3	0.2	10	33.3	45
2010–11	3.1	3	42.4	63	0.1	3	0.2	10	47.0	45
2011–12	2.7	3	48.3	63	< 0.1	3	0.8	10	46.3	45
2012–13	2.1	3	53.8	63	0	3	0.1	10	34.5	45
2013–14	3.0	3	42.0	63	< 1	3	< 1	10	33.3	45
2014–15	2	3	36.3	63	< 1	3	0	10	37.1	45
2015–16	1.4	3	38.1	63	< 1	3	0	10	35.2	45
2016–17	2.8	3	44.4	63	< 1	3	0	10	48.9	45
2017–18	2.4	3	47.3	63	0.7	3	0	10	36.2	45
2018–19	1.6	3	48.0	63	< 0.1	3	0	10	37.1	45
2019–20	3	3	54	63	< 1	3	0	10	21	45
2020–21	2	3	29	63	< 1	3	0	10	31	45

Fishstock	BUT 6		BUT 7		BUT 10			
FMA (s)	6		7		10		Total	
	Landings	TACC	Landings	TACC	Landings	TACC	Landings	TACCs
2001–02	0	0	25	38	0	0	121	162
2002–03	0	0	28.5	38	0	0	130.1	162
2003–04	0	0	24.8	38	0	0	126.1	162
2004–05	0	0	24.5	38	0	0	132.0	162
2005–06	0	0	23.7	38	0	0	94.8	162
2006–07	0	0	26.9	38	0	0	116.8	162
2007–08	0	0	29.4	38	0	0	114.6	162
2008–09	0	0	26.3	38	0	0	122.0	162
2009–10	0	0	16.5	38	0	0	97.9	162
2010–11	0	0	23.3	38	0	0	116.2	162
2011–12	0	0	21.4	38	0	0	119.5	162
2012–13	0	0	19.9	38	0	0	110.4	162
2013–14	0	0	16.7	38	0	0	95.1	162
2014–15	0	0	21.8	38	0	0	97.1	162
2015–16	0	0	19.3	38	0	0	94.5	162
2016–17	0	0	18.2	38	0	0	114.3	162
2017–18	0	0	18.7	38	0	0	102.9	162
2018–19	0	0	24.2	38	0	0	110.8	162
2019–20	0	0	26	38	0	0	105	162
2020–21	0	0	27	38	0	0	88	162

Total reported landings from 1982–83 to 2000–01 ranged between 105 and 193 t. Butterfish was introduced into the QMS in 2002. Reported landings and TACCs are given in Table 2, while Figure 1 shows the historical landings and TACC values for the main BUT stocks.

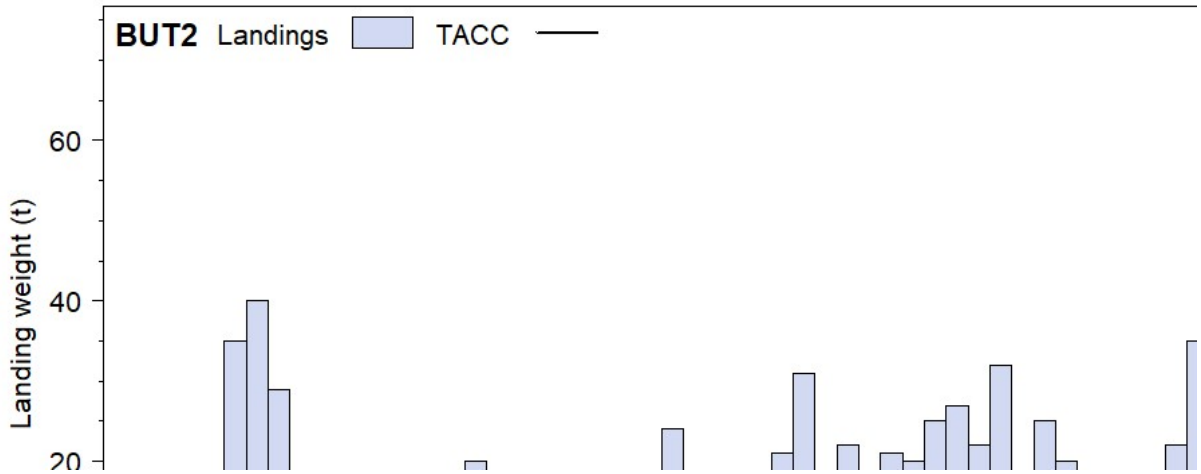


Figure 1: Reported commercial landings and TACC for the four main BUT stocks: BUT 2 (Central East). **[Continued on next page]**

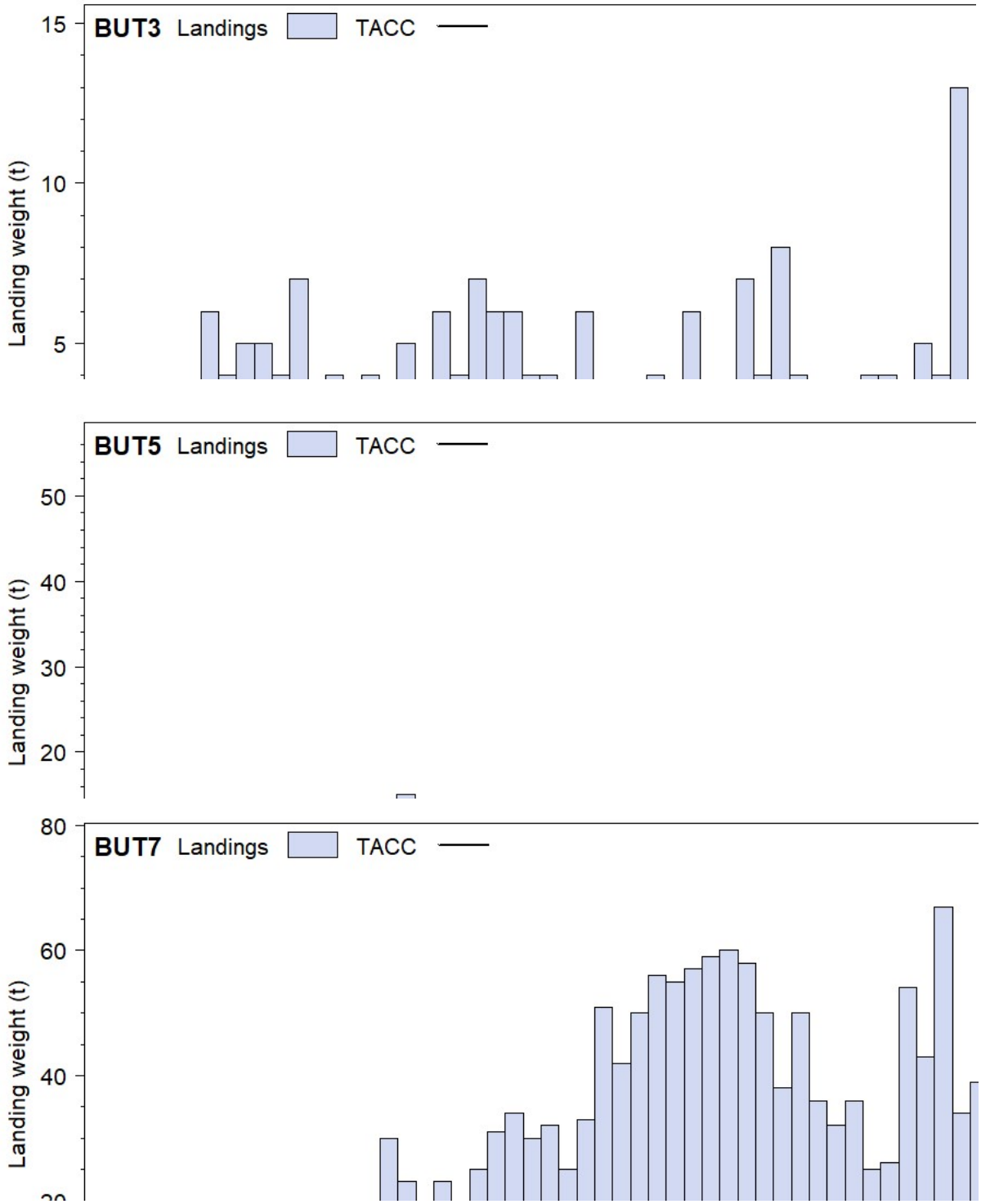


Figure 1 [Continued]: Reported commercial landings and TACC for the four main BUT stocks. From top, BUT 3 (South east coast), BUT 5 (Southland) and BUT 7 (Challenger).

From 2001–02 to 2018–19 total annual landings have averaged 112 t, with the highest proportion of landings being recorded for BUT 2, 5, and 7. Landings have consistently been below the TACC in all QMAs except for BUT 5, where landings slightly above the TACC of 45 t were recorded in 2010–11, 2011–12, and 2016–17.

1.2 Recreational fisheries

Butterfish is a popular recreational catch, and is taken mainly by setnet and spear. Recreational daily bag limits were set at 30 fish in 1986, but subsequently reduced to 20 for Northern and Central and Challenger (1995), and 15 for South (1993). Survey estimates indicate that the recreational catches appear to be of similar magnitude to those of the commercial fisheries in QMAs 1, 2, 5 and 7, and substantially higher in QMA 3 (Tables 3a and 3b).

Table 3a: Estimated recreational harvest of butterfish by QMA and survey.

QMA	Survey	Number caught	Survey harvest (t)	Fishstock harvest (t)
				1991–92
QMA 7	South	6 000	10	
QMA 7	South	4 000	5	15
QMA 3	South	36 000	65	65
QMA 5	South	8 000	10	10
				1993–93
QMA 2	Central	61 000	80	80
				1993–94
QMA 1 + 9	North	9 000	10	10
TOTAL		124 000		180

*Surveys were in different years: South 1991–92; Central 1992–93: and North 1993–94 (Teirney et al 1997). Many of these estimates have high CVs, and the estimate of total harvest is a guide only because of the different survey years. Line-caught 'butterfish' in QMA 3 and QMA 5 are excluded because of apparent species misidentification; these survey totals should be slightly higher.

Table 3b: Estimated number and weight of butterfish harvested by recreational fishers by Fishstock and survey. Surveys were carried out nationally in 1999–2000 (Boyd & Reilly 2002).

Fishstock	Survey	Number	CV%	Survey harvest (t)
BUT 1	National	1 000	71	< 1–3
BUT 2	National	23 000	39	16–36
BUT 3	National	45 000	47	27–76
BUT 5	National	17 000	42	11–27
BUT 7	National	18 000	41	12–29
BUT 8	National	1 000	100	0–2

The harvest estimates provided by telephone-diary surveys between 1993 and 2001 are no longer considered reliable for various reasons. A Recreational Technical Working Group concluded that these harvest estimates should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and c) the 2000 and 2001 estimates are implausibly high for many important fisheries. In response to these problems and the cost and scale challenges associated with onsite methods, a National Panel Survey was conducted for the first time throughout the 2011–12 fishing year. The panel survey used face-to-face interviews of a random sample of 30 390 New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and harvest information collected in standardised phone interviews. The national panel survey was repeated during the 2017–18 fishing year using very similar methods to produce directly comparable results (Wynne-Jones et al 2019). Recreational catch estimates from the two national panel surveys are given in Table 4. Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

Table 4: Recreational harvest estimates for butterfish stocks (Wynne-Jones et al 2014, 2019). Mean fish weights were obtained from boat ramp surveys (Hartill & Davey 2015, Davey et al 2019).

Stock	Year	Method	Number of fish	Total weight (t)	CV
BUT 1	2011–12	Panel survey	27 488	29.4	0.64
	2017–18	Panel survey	13 769	14.5	0.30
BUT 2	2011–12	Panel survey	13 892	15.6	0.33
	2017–18	Panel survey	20 478	25.8	0.30
BUT 3	2011–12	Panel survey	13 637	15.3	0.42
	2017–18	Panel survey	15 217	19.2	0.40
BUT 5	2011–12	Panel survey	188	0.2	0.74
	2017–18	Panel survey	8 411	10.6	0.65
BUT 7	2011–12	Panel survey	14 625	16.4	0.94
	2017–18	Panel survey	9 615	12.1	0.61

1.3 Customary non-commercial fisheries

There is no quantitative information on the current level of customary non-commercial catch.

1.4 Illegal catch

Because this is a localised small-scale fishery, some sales from fishers directly to retailers may have gone unreported, but no quantitative estimate of this are available.

1.5 Other sources of mortality

There is no quantitative information on other sources of mortality. In the past butterfish has been used as rock lobster bait and not reported.

2. BIOLOGY

Butterfish are endemic to New Zealand, and occur from North Cape to the Snares Islands. The species is also reported from the Chatham, Bounty and Antipodes Islands. Butterfish are more common from Cook Strait southwards. They inhabit rocky coastlines, and are commonly found among seaweed beds in moderately turbulent water. Their main depth range is 0–20 m. They occur shallower (to 10 m) in the north than in Cook Strait (to 20 m) and in southern waters they can be found as deep as 40 m.

Adult butterfish average 45–55 cm (FL) in length. Their maximum size is approximately 70 cm. Length/weight data are not available for whole fish, but as an interim measure a length/gutted weight relationship is given in Table 5.

Butterfish are almost exclusively herbivorous, feeding on several of the larger seaweeds. The diet of butterfish varies regionally and is largely determined by the species composition of the local seaweed beds. Feeding activity is greatest early in the day, and the tidal state controls the accessibility of intertidal seaweeds; fish were found to feed more actively in summer than winter (Trip 2009).

Fish were aged using sectioned sagittal otoliths, validated using daily growth (Trip 2009). Growth varies with latitude due to temperature difference, and local ecological factors such as diet and fish density.

Trip (2009) found that size and age differ significantly with latitude. Environmental temperature is the primary driver underlying the difference in life histories across latitudes, and affects growth rate, size-at-age and longevity. Butterfish living in colder temperatures (higher latitudes) grow slower, live longer, attain a greater average size and delay the onset of maturity (Trip 2009). Butterfish in Hauraki Gulf (BUT 1) reach 70% of their mean asymptotic size by the age of two, and have reached 90% of their maximum size by age 4. In the southern areas butterfish grow slower and reach a maximum size at about 75 % of their life span. The maximum age ranged from 11 years in the north (Hauraki Gulf) to 19 years in the south (Stewart Island) (Trip 2009). There are no significant differences in growth rates or mean adult body size between sexes, yet with the exception of the Hauraki Gulf, the oldest and largest fish (FL) sampled in all areas were females (Trip 2009).

Table 5: Estimates of biological parameters for butterfish.

Fishstock	Estimate	Source
1. Natural mortality (*M*)		
Cook Strait	0.30–0.45	Paul et al (2000)

2. Weight = a(length)^b (Weight in g, length in cm fork length).

	Females		Males		Juvenile		
	a	b	a	b	a	b	
Cook Strait	67.699	1 947.8	67.034	1 885.9	21.205	362.28	Ritchie (1969)
Hauraki Gulf							
Stewart Is.							

Linear regression, b = constant. Weight is gutted weight.

3. von Bertalanffy growth parameters

	Both sexes			
	K	t_0	L_∞	
Cook Strait	0.23	-1.7	51.8	Paul et al (2000)
Hauraki Gulf	0.517	-0.23	457.36	Trip (2009)

Butterfish start life as female, some, but not all, undergo sex change where an estimated 50% of mature females develop into males. The size at sex change ranges between 37 to 45 cm FL. The length at which sex change occurs does not seem to differ between geographical areas, but age-at-sex change varies geographically. The mean age-at-sex change was found to be significantly lower in warmer latitudes, 2.5 yrs at the Hauraki Gulf, in comparison to 7 years old at Stewart Island. At D'Urville Island, in-between the two, fish changed sex at 5 years old (Trip 2009).

In the warm waters of the north females mature early and of the samples collected in the Hauraki Gulf 95% of females are sexually mature by two years old (29.7 cm FL). Females sampled at Stewart Island show delayed maturity with only 50% mature at an average age of four (25.2 cm FL) (Trip 2009).

The depth distribution of butterfish differs by size and sex. Juveniles (less than 30 cm) occur in the shallow weed beds (less than 15 m) and (outside the breeding season) males occur in deeper waters than females. Consequently, sex ratios vary with locality, but females often outnumber males.

In the North the spawning season occurs between July and November, with a peak in August. The spawning season extends from July to March in Cook Strait, peaking in September and October. In southern New Zealand the spawning season appears to be shorter (August to January, peaking in October–January).

3. STOCKS AND AREAS

There is no clear information on whether biologically distinct stocks occur, although there is some evidence of regional variation in meristic characters which suggests some separation of populations. The time larval butterfish spend in the plankton before settling out into the adult habitats as postlarvae is relatively short, a factor that may cause a high level of stock separation around coastal New Zealand. The only information on movement relates to feeding behaviour involving small-scale movements within seaweed beds. There is no information on movement along the coastline within a weed-bed habitat, or potentially longer migration between such habitats separated by open coast. However, the latter seems unlikely on any substantial scale, and as a result butterfish populations are probably quite localised. Butterfish populations at offshore islands (Chatham, Antipodes, Bounties, and Snares), have not been studied but may be distinct from the mainland population(s) simply because of their isolation.

4. STOCK ASSESSMENT

A yield per recruit analysis was undertaken in 1997 (Paul et al 2000). This report derived new estimates of growth and natural mortality from the Cook Strait which were incorporated into this analysis. Stock status was not determined by this analysis.

4.1 Estimates of fishery parameters and abundance

No information is available.

4.2 Biomass estimates

No information is available.

4.3 Yield estimates and projections

The method $MCY = cYav$ (Method 4) was evaluated. However, this method was rejected due to a lack of reliable information on changes in fishing effort and/or mortality over the history of the fishery. *MCY* for butterfish cannot be determined.

CAY cannot be determined.

4.4 Other yield estimates and stock assessment results

A study of setnet mesh selectivity in relation to the current legal minimum fish size showed that 108 mm mesh retained few undersized fish (immature). This provides a level of protection to butterfish stocks and their recruitment. A yield per recruit analysis showed that a modest yield increase could be obtained by using a smaller mesh and taking younger (2–3 year old) fish. However, this theoretical gain would be counter-balanced by the capture of relatively more juveniles and young females, and almost certainly a higher bycatch of other reef fishes. Butterfish populations are susceptible to localised depletion.

5. STATUS OF THE STOCKS

No estimates of current and reference biomass are available. It is not known whether recent catch levels will allow the stock to move towards B_{MSY}.

6. FOR FURTHER INFORMATION

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