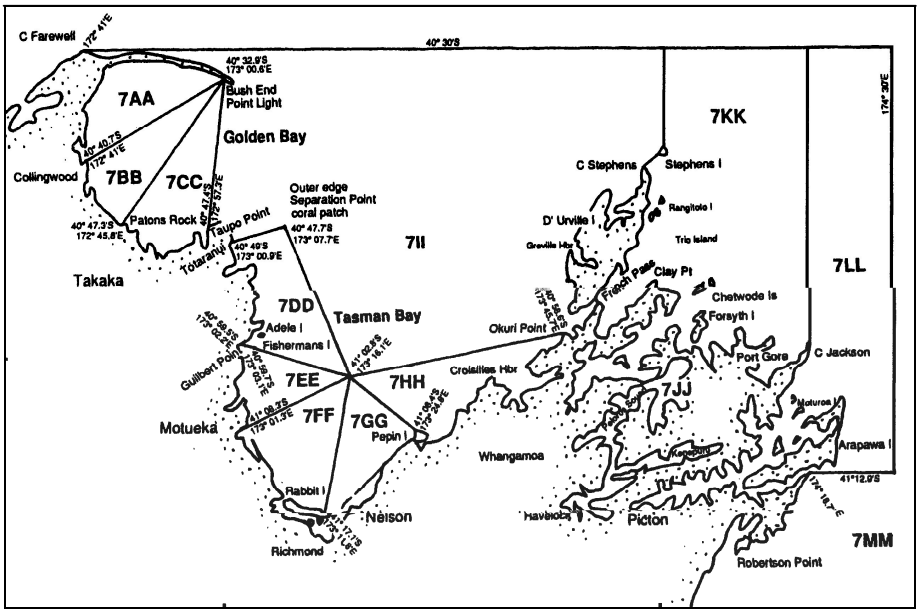
DREDGE OYSTERS (OYS7) – Nelson/Marlborough

(*Ostrea chilensis*)



1. FISHERY SUMMARY

1.1 Commercial fishery

The dredge oyster *Ostrea chilensis* is widespread throughout New Zealand and is the target of commercial fisheries in Foveaux Strait and the Nelson/Marlborough (Challenger) fishery area. Dredge oysters are landed as a bycatch of the Chatham Islands scallop fishery. The Challenger fishery comprises areas OYS 7 from Cape Farewell in Golden Bay, throughout Tasman Bay and the Marlborough Sounds to West Head, Tory Channel, and area OYS 7C which encompasses an area from West Head, Tory Channel in the north to Clarence Point in the south including Cloudy Bay and Clifford Bay. OYS7 and OYS 7C are considered as separate fisheries on the basis of differences in habitat and environmental parameters.

Dredge oysters in the Nelson/Marlborough area were first exploited in 1845. From 1963 to 1981 oysters were landed mainly as bycatch, firstly by the green-lipped mussel (*Perna canaliculus*) dredge fishery and subsequently by the scallop (*Pecten novaezelandiae*) fishery (Drummond 1994a). In 1981 the Challenger scallop fishery was closed, and commercial dredge operators targeted oysters.

Shellfish dredging in Tasman Bay, Golden Bay, and the Marlborough Sounds is a multi-species fishery with oysters, scallops, and green-lipped mussels caught together. Until 1999, oyster and scallop seasons did not overlap, preventing both species being landed together. Since then a relaxation of seasonal restrictions has meant there is now potential for overlap.

In 1983, fishery regulations and effort restrictions were updated (Drummond 1994a). Fishery regulations included a minimum size (legal sized oysters could not pass through a 58 mm internal diameter ring), an open season (1 March to 31 August), area closures, and a prohibition on dredging at night. A 500 t (green weight) catch restriction was implemented for Tasman Bay in 1986 and extended to include Golden Bay in 1987 (Drummond 1987). The 500 t catch restriction was revoked in 1996 and a TACC of 505 t set when oysters were brought in to the Quota Management System (Annala *et al*. 1998). The commercial oyster season was extended to 12 months from the 1999–00 fishing year. Fishers have been required to land all legal sized oysters, but approval has recently been given to return such oysters to the sea as long as they are likely to survive.

From 1980, catches of oysters, scallops, and mussels from Tasman Bay, Golden Bay, and the Marlborough Sounds were recorded on weekly dredge forms for each Shellfish Management Area. In

1992, the Nelson-Marlborough scallop and dredge oyster statistical areas were established (see area map) by adopting the scallop reporting areas for both fisheries. The oyster season ran over 1 March to 31 August until 1999 and these data are presented by calendar year. Thereafter reported landings are given by fishing year, 1 October to 30 September. Data from 1989 to 1999 show oysters landed out of season and these data have been included in the summaries shown in Tables 1–3. An historical record of landings and TACC values is also depicted in Figure 1. Most of the catch comes from Tasman Bay, with small landings from Golden Bay.

In recent years, the industry has voluntarily restricted catch levels according to the biomass and distribution of the population estimated in the annual biomass survey, and the economics of catch per unit effort during the season.

Table 1: Reported and adjusted catch (t, greenweight) in the Challenger fishery, 1963–1988 (from Annala *et al.* 2001). Sourced from MAF Marine Dept. Report on Fisheries between 1963 and 1980, the FSU database between 1981 and 1986, and Quota Monitoring System (QMS) in 1987 and 1988. Catches adjusted to account for non reporting of factory reject oysters (16.2% by number) and use of an incorrect conversion factor.

Year	Reported catch	Adjusted catch	Year	Reported catch	Adjusted catch	Year	Reported catch	Adjusted catch
1963	3	3	1972	65	82	1981	389	492
1964	6	8	1973	190	240	1982	432	546
1965	0	0	1974	78	99	1983	593	750
1966	24	33	1975	136	172	1984	259	328
1967	44	57	1976	392	496	1985	405	512
1968	69	87	1977	212	268	1986	527	667
1969	22	28	1978	40	51	1987	380	–
1970	74	94	1979	83	105	1988	256	–
1971	34	43	1980	160	202			

Table 2: Reported landings (t, greenweight) in the Challenger fishery for the 1989–1999 oyster seasons (1 March to 31 August). Sources: Quota Monitoring Returns (QMR) and landings data from MFish (RDM) database.

Year	QMR	Landings data	Year	QMR	Landings data
1989	538	–	1995	694	745
1990	208	175	1996	572	674
1991	185	206	1997	554	600
1992	289	294	1998	398	404
1993	476	497	1999	300	332
1994	584	598			

Table 3: Reported landings (t) in the Challenger fishery after October 1999 when the fishing season was extended to a full year (1 October–30 September). Reported catch is landed green weight reported from Quota Monitoring Returns (QMR) 1999-00 and 2000-01 and Monthly Harvest Returns (MHR) thereafter.

Fishing year	QMR	MHR
1999–00	132	-
2000–01	25	-
2001–02		1.4
2002–03		183.0
2003–04		97.5
2004–05		146.8
2005–06		170.9
2006–07		132.1
2007-08		20.9

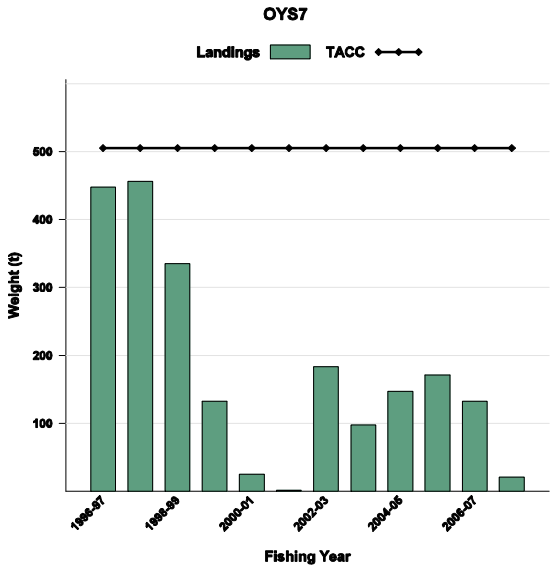


Figure 1: Historical landings and TACC for OYS7 (Nelson Marlborough). Note that this figure does not show data prior to entry into the QMS.

1.2 Recreational fishery

The recreational daily bag limit for oysters in the Challenger fishery area is 50 per person. Oysters that cannot pass through a 58 mm internal diameter solid ring are deemed legal size. The recreational season for dredge oysters in the Challenger area is all year round. Oysters must be landed in their shells. Recreational fishers take oysters in Tasman and Golden Bays by diving and dredging. A survey of the recreational catch of scallops and dredge oysters in Golden and Tasman Bay conducted in 2003-04 estimated that 5800 (95% CI 3800-8400) oysters were taken recreationally during that season (Cole et al. 2006).

1.3 Customary non-commercial fisheries

There are no data available on the customary non-commercial catch. Kaitiaki are being established throughout the Challenger area and estimates of customary harvest can be expected in the future.

1.4 Illegal catch

There are no data available on illegal catch.

1.5 Other sources of mortality

The Nelson/Marlborough area occasionally experiences blooms of diatoms, which result in an anaerobic slime that smothers benthic fauna (Bradford 1998, Mackenzie *et al*. 1983, Tunbridge 1962). The level of dredge oyster mortality from this source is unknown.

Bonamia exitiosus caused catastrophic mortality in the Foveaux Strait oyster fishery and is endemic in oysters in the Challenger area (Hine *pers. comm*.). *Apicomplexan* has also been identified in poor condition oysters dredged from Tasman Bay. The level of mortality caused by disease is unknown.

Drummond & Bull (1993) reported low incidental mortality from dredging. No other data are available on incidental mortality of oysters caused by fishing.

2. BIOLOGY

The biology of *O. chilensis* was summarised by Handley and Michael (2001), and further biological data was presented in Brown *et al.* (2008). Most of the parameters required for management purposes are based on the Foveaux Strait fishery described by Cranfield and Allen (1979). See also the OYS 5 report.

Oyster stocks in the Challenger area are generally low and seasonally variable suggesting high variability in recruitment (Osborne 1999). Challenger oysters are reported to spawn at temperatures above 12°C (Brown *et al.* 2008). In Tasman and Golden Bay, significantly smaller and less developed larvae have been collected in the plankton than those collected from Foveaux Strait, implying Challenger oysters appear to release their larvae into the plankton for longer periods (Cranfield & Michael 1989). Cranfield and Michael (1989) estimated that the larvae could disperse 20 km in 5–12 days, but a more recent study concluded that, although a small proportion may travel several kilometres, the majority of the larvae disperse no further than a few hundred meters from the parent population (Brown *et al.* 2008). Tunbridge (1962), Stead (1976) and Drummond (1994a) all pointed out that the productivity of the fishery is likely to be limited by a paucity of settlement substrate in the soft sediment habitat of Tasman and Golden Bay. A recent study demonstrated increased oyster productivity where shell material was placed on the seabed as a settlement substrate for oyster larvae (Brown *et al.* 2008).

The variability in shell shapes and high variability in growth rate between individuals, between areas within the Challenger fishery, and between years require careful consideration in describing growth. Assuming minimum legal size equals 58–65 mm in diameter, data from Drummond (1994b) infer Tasman Bay oysters could grow to legal size in two to three years. Modelling of limited data from Tasman Bay in Brown *et al.* (2008) indicated that 77% of three year old oysters and 82% of 4 year old oysters would attain lengths greater than the minimum legal size of 58 mm length at the start of the fishing season. Osborne (1999) analysed results from a MAF Fisheries study conducted between 1990-1994 to construct a Von Bertalanffy equation describing oyster growth in the Challenger fishery. Estimated biological parameters including instantaneous natural mortality (M) from Drummond (1993, 1994) and growth parameters for Von Bertalanffy equations from Osborne (1999) and from Brown *et al.* (2008) are given in table 4. Mortality estimates by Drummond (1994) and growth parameters in Osborne (1999) were derived from a tagging study conducted in Tasman Bay between 1990 and 1992 (Drummond 1993). Von Bertalanffy growth parameters in Brown *et al.* (2008) were estimated based on a limited data set from enhanced habitat experiments, and describe growth of young oysters.

Table 4: Estimated biological parameters for oysters in Oys 7. Mortality (M) estimates from Drummond (1993,1994). Parameters derived for Von Bertalanffy equations describing growth of oysters (mm diameter) in Tasman Bay from Osborne (1999) and Brown et al. (2008).

Parameter	Estimate	Uncertainty		Source
	mean	sd	95CI	
M	0.92	-	0.48	Drummond (1994)
M	0.2	-	-	Drummond (1993)
k	0.99	0.16	-	Brown *et al*. (2008)
k	0.597	-	-	Osborne (1999)
L_{inf}	67.52	3.91	-	Brown *et al*. (2008)
L_{inf}	85.43	-	-	Osborne (1999)
t_0	0.11	0.02	-	Brown *et al*. (2008)

3. STOCKS AND AREAS

Patches of commercial densities of oysters within the OYS 7 fishery are largely restricted to Tasman Bay. The stock is likely to be biologically isolated from the Foveaux Strait population on the basis of geographical distance. The population in OYS 7 and OYS 7C are probably biologically and genetically linked because the boundaries are adjacent. Oysters in OYU 5 (Foveaux) and OYS 7C (Cloudy Bay/Clifford Bay) comprise rather discrete patches of oysters on a predominantly sandy substrate whereas OYS 7 (Tasman Bay) oysters tend to be more uniformly distributed at a lower density on muddy habitat. Environmental factors such as hydrodynamics, seasonal water temperature and riverine inputs differ substantially among the OYS 7, OYS 7C and OYU 5 areas and will influence the biological characteristics of those oyster populations.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

Surveys of oysters have been carried out in 1961, 1969–75, 1984–86, 1989 and 1998–2008. The results from the early surveys are not directly comparable.

Estimates of the numbers of recruits (oysters unable to pass through a 58 mm ring) and pre-recruits (less than 58 mm) from Tasman Bay, Golden Bay and the Marlborough Sounds since 1998 are shown in Table 5.

Table 5: Relative estimates (millions) uncorrected for dredge efficiency of recruited and pre-recruit of oysters in Tasman and Golden Bays from comparable surveys (1998–2004).

	Tasman Bay				Golden Bay			
Year	Recruits	CV	Pre-recruits	CV	Recruits	CV	Pre-recruits	CV
1998	28.7	7.3	30.4	10.1	1.4	13.3	0.4	18.7
1999	24.7	8.6	39.6	13.6	1.9	23.7	1.2	24.8
2000	21.8	8.9	33.5	9.9	1	14.3	0.5	17.6
2001	17.8	9	23.1	9.1	0.4	20.1	0.4	28.1
2002	15.9	10.6	24.5	11.2	0.4	21.4	0.3	27.1
2003	12.4	9.7	34.3	13.4	0.4	27.1	0.4	27.6
2004	10.9	6.7	16.1	8.1	0.4	25.4	0.2	18.8
2005	11.3	10.2	25.2	17.7	0.3	38.8	0.3	41.6
2006	10.7	8.6	18.5	14.8	0.1	29.1	0.04	46.6
2007	14.8	14.3	6.5	19.4	0.1	32	0.04	32.3
2008	9.6	20.5	8.9	25.2	0.04	47.1	0.01	39.5

The number of recruited dredge oysters in the Marlborough Sounds was estimated at 0.013 million in 2008. Estimates of pre-recruits were 0.017 million in 2008.

4.2 Biomass estimates

Estimates of the recruited biomass (≥58 mm) of oysters in both Tasman Bay and Golden Bay (made from surveys of oysters and scallops combined) show a general decline from 1998 to 2008 (Table 6).

Table 6: Estimates of relative biomass (t) of recruited oysters from Tasman and Golden Bays, 1998–2008.

	Tasman Bay		Golden Bay			
Year	Biomass (t)	CV	Biomass (t)	CV	Total biomass (t)	References
1998	2 214	7.3	113	11.5	2 327	Osborne (1999)
1999	2 012	8.1	151	22.1	2 163	Breen & Kendrick (1999)
2000	1 810	8.8	86	15.4	1 895	Breen (2000)
2001	1 353	9.7	25	20.3	1 378	Horn (2001)
2002	1 134	10	28	21.9	1 162	Horn (2002)
2003	1 019	10	23	26.6	1 042	Horn (2003)
2004	894	6.9	28	22.4	921	Horn (2004)
2005	932	11.3	24	30.8	956	Horn (2005)
2006	817	26.1	10	8.0	827	Horn (2006)
2007	1 275	13.5	10	31.4	1 285	Brown (2007)
2008	744	20.8	3	52.0	747	Tuck & Brown (2008)

4.3 Estimates of Maximum Constant Yield (MCY)

Drummond (1994) estimated a MCY of 300 tonnes using method 4 in Annala *et al*. (2001), but Osborne concluded that catch levels in Challenger appear to be driven by the economics of the catch rates (Osborne 1999). She used equation 2 of Annala *et al.* (2001) to estimate MCY (Table 6):

$$MCY = 0.5F_{0.1}B_{AV}$$

Where B_{AV} = 1337 tonnes (from relative biomass estimates from CSEC surveys 1998 - 2008). These estimates are not corrected for dredge efficiency (assumed to be 100%) and are likely to be conservative.

Table 7: Estimates of $F_{0.1}$ and MCY for M 0.1–0.9. MCY 1 was estimated using $F_{0.1}$ 1 from Osborne (1999), MCY 2 from $F_{0.1}$ 2 estimated from von Bertalanffy growth parameters estimated by Osborne (1999), growth data from Drummond (1994b) and Foveaux Strait oyster size weight data, and MCY 3 from $F_{0.1}$ 3 estimated von Bertalanffy growth parameters from GROTAG using the same growth and size weight data.

M	$F_{0.1}$ 1	MCY 1	$F_{0.1}$ 2	MCY 2	$F_{0.1}$ 3	MCY 3
0.1	0.29	194	0.17	114	0.22	147
0.2	–	–	–	–	0.38	254
0.3	0.45	301	0.38	254	0.55	368
0.4	–	–	–	–	0.71	475
0.5	0.67	448	0.62	414	0.88	588
0.6	–	–	–	–	1.04	695
0.7	0.93	622	0.89	595	1.21	809
0.8	–	–	–	–	1.37	916
0.9	1.22	816	1.19	796	1.54	1029

4.4 Estimation of Current Annual Yield (CAY)

In 2009 CAY was estimated using Method 1 (Annala *et al*. 2001) assuming dredge oysters are landed over the year and $F_{0.1}$ estimated by the three methods and the 2008 estimate of biomass (Table 7).

$$CAY = F_{REF} / (F_{REF}+M) * (1 - e^{-(F_{REF}+M)}) * B_{BEG}$$

Table 8: Estimates of $F_{0.1}$ and CAY for M 0.1–0.9. CAY 1 was estimated using $F_{0.1}$ 1 from Osborne (1999), CAY 2 from $F_{0.1}$ 2 estimated from von Bertalanffy growth parameters estimated by Osborne (1999) using growth data (Drummond, 1994b) and Foveaux Strait oyster size weight data, CAY 3 from $F_{0.1}$ 3 estimated von Bertalanffy growth parameters from GROTAG using the same growth and size weight data.

M	$F_{0.1}$ 1	CAY 1	$F_{0.1}$ 2	CAY 2	$F_{0.1}$ 3	CAY 3
0.1	0.29	179	0.17	111	0.22	141
0.2	–	–	–	–	0.38	215
0.3	0.45	236	0.38	206	0.55	277
0.4	–	–	–	–	0.71	320
0.5	0.67	295	0.62	279	0.88	357
0.6	–	–	–	–	1.04	382
0.7	0.93	343	0.89	333	1.21	403
0.8	–	–	–	–	1.37	418
0.9	1.22	378	1.19	373	1.54	430

The risk to the stock associated with harvesting at the estimated CAYs cannot be determined.

4.5 Other yield estimates and stock assessment results

There are no other yield estimates and stock assessments

4.6 Other factors

The challenger dredge oyster fishery is thought to be recruitment-limited. Drummond (1994a) Stead (1976) and Tunbridge (1962) attributed the lack of dense aggregations of oysters in the Challenger fishery (compared to Foveaux Strait) to a scarcity of suitable settlement surface. Challenger Oyster Management Company initiated habitat enhancement trials in 2008, aimed at boosting productivity of the fishery (Brown *et al.* 2008).

5. STATUS OF THE STOCKS

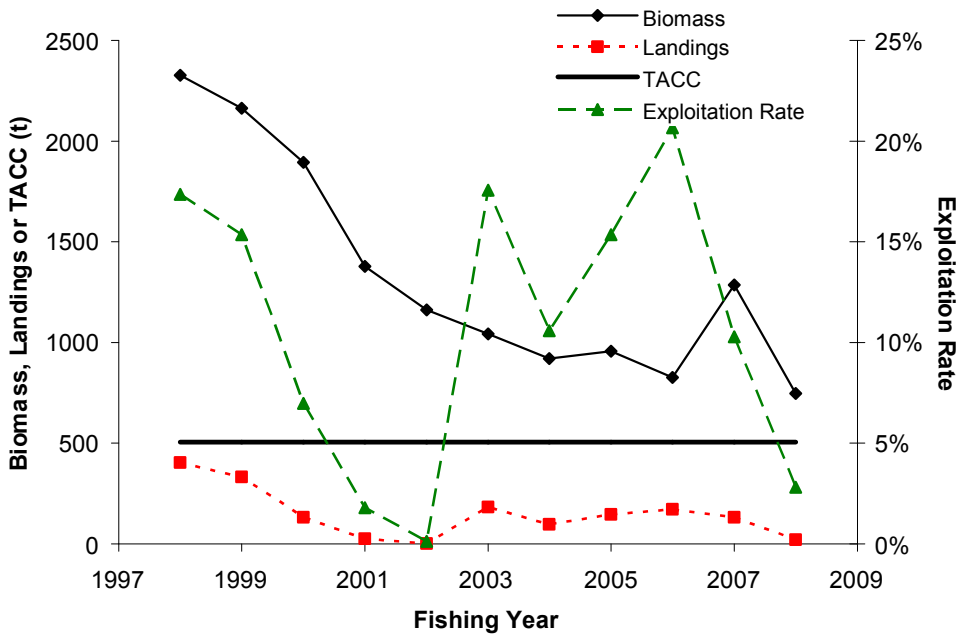
Stock Structure Assumptions

Patches of commercial densities of oysters within the OYS 7 fishery are largely restricted to Tasman Bay. The stock is likely to be biologically isolated from the Foveaux Strait population on the basis of geographical distance. The population in OYS 7 and OYS 7C are very likely genetically linked because of gene flow between these different stocks.

Stock Status	
Year of Most Recent Assessment	2009
Reference Points	Target: Not established Soft Limit: not established Hard Limit: not established
Status in relation to Target	Unknown
Status in relation to Limits	Unknown

Fishery and Stock Trends	
Trend in Biomass or Proxy	In combined Tasman and Golden Bays, biomass estimates derived from annual surveys decreased from 2327 t in 1998 to 747 t in 2008. Recent landings have been lower than yield estimates.
Trend in Fishing Mortality or Proxy	Variable without trend with a maximum exploitation rate near 20%.

Historical Biomass, Catch, TACC and Exploitation Rate Trajectories.



Biomass, landings, TACC and exploitation rate from 1998 to 2008 for combined Tasman and Golden Bays.

Other Abundance Indices	Pre-recruits have declined at similar rate to the recruited population.
Trends in Other Relevant Indicator or Variables	None

Projections and Prognosis	
Stock Projections or Prognosis	Stock projections are unavailable. The declining trend in abundance estimated from the biomass surveys needs monitoring in the future.
Probability of Current Catch causing decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of TACC causing decline below Limits	**Soft Limit: The TACC is higher than the maximum estimates of CAY and MCY and catches at this level are Very Likely to cause the biomass to drop below the Soft Limit in the near term.** Hard Limit: Catches at the level of the TACC are also Likely to cause the stock to drop below the Hard Limit in the near term.

Assessment Methodology		
Assessment Type	Level 2: Partial Quantitative Stock Assessment - annual random stratified dredge surveys.	
Assessment Method	Yields are estimated as a proportion of the survey biomass for a range of assumed values of natural mortality and dredge efficiency.	
Main data inputs	Biomass survey: 2008	
Period of Assessment	Latest assessment: 2009	Next assessment: 2010
Changes to Model Structure and Assumptions	The natural mortality (M) values used in the yield calculations were restricted to the range 0.1 to 0.3. This was reduced from the previous range of 0.042 to 0.9 because the extreme values were considered very unlikely.	
Major Sources of Uncertainty	Natural mortality (M) and dredge efficiency are poorly known but are integral parameters of the method used to estimate yield.	

Qualifying Comments
The Challenger dredge oyster fishery has a lack of dense aggregations of oysters (compared to Foveaux Strait), this is attributed to a scarcity of suitable settlement surface.

Fishery Interactions

TACC and reported landings for the 2007–08 fishing year are summarised in Table 9.

Table 9: Summary of TACC (t) and reported landings (t) for the 2007–08 fishing year for OYS 7.

QMA	TAC	Actual TACC	Reported commercial landings
OYS 7	–	505	20.9

6. FOR FURTHER INFORMATION

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