DREDGE OYSTERS (OYS 7C) – Challenger Marlborough

(Ostrea chilensis)

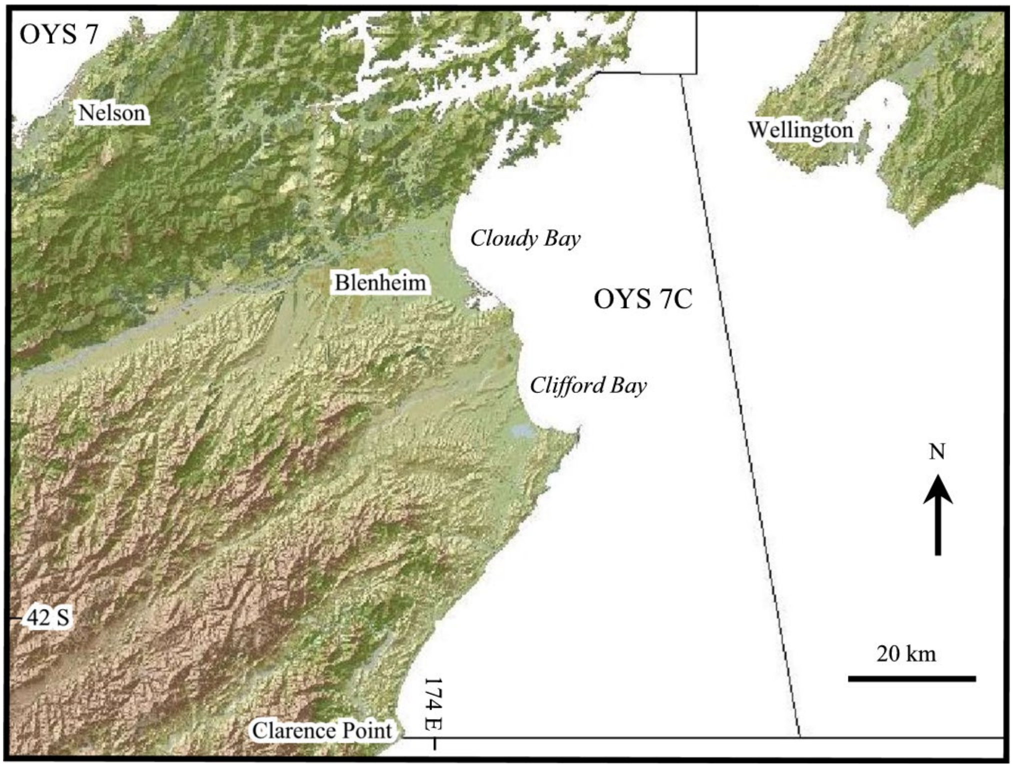


Figure 1: OYS 7C dredge oyster stock boundary.

1. FISHERY SUMMARY

OYS 7C encompasses an area from West Head, Tory Channel in the north to Clarence Point in the south including Cloudy Bay and Clifford Bay in the southern part of Cook Strait (see Figure 1). OYS 7C is considered a separate fishery from OYS 7 (Golden Bay, Tasman Bay, and Marlborough Sounds) on the basis of differences in habitat and environmental parameters.

OYS 7C was introduced into the QMS on 1 October 2005 with a TAC of 5 t and a TACC of 2 t. Following a survey in April 2007, the TAC was increased to 50 t with a TACC of 43 t on 1 October 2007. In 2009, with information from CPUE and catch data, the TAC was reviewed again and resulted in a TAC increase to 72 t in October 2009 (Table 1). At the time of the review the Shellfish Working Group suggested that raising the TACC by a further 15–20 t was unlikely to be detrimental to the fishery in the short term; however, without improved estimates of mortality, growth, and dredge efficiency, it was difficult to predict the effects that an increased TACC would have on the status of the fishery in the medium to long term, and that a research strategy for improved assessment was required.

Table 1: Total Allowable Catch (TAC, t), Total Allowable Commercial Catch (TACC, t), and other allowable catches (t) declared for OYS 7C since introduction into the Quota Management System (QMS) in 2005.

Fishing year	TAC	TACC	Customary	Recreational	Other
2005–07	5	2	1	1	1
2007–09	50	43	1	1	5
2009–present	72	63	1	1	7

1.1 Commercial fishery

Commercial landings for OYS 7C are reported in greenweight. The fishing year runs from 1 October to 30 September and fishers can harvest year-round (there is no oyster season defined by regulations).

There is historical evidence of limited exploitation of oyster beds within Port Underwood as early as the 1800s (K. Wright, pers. comm., see Drummond 1994a). Limited fishing under a special permit took place south of Tory Channel off the east coast of the South Island in 1990 and 1991.

Since 2005, landed catch has been reported via Monthly Harvest Returns (MHR, Table 2), although landings were negligible until 2007–08 when the recent commercial operation was initiated. During 2007–08 fishing took place over 30 fishing days from December to February and in 2008–09 fishing took place from January to April. Landings were at about the level of the TACC up to and including 2010–11. They were lower between 2012–13 and 2015–16 due to oyster grading and marketing requirements (less than 6 tonnes each year) and there has not been any report of commercial catch since 2016–17 (Figure 2, Table 2).

Table 2: Reported landings (t) in the OYS 7C fishery since October 2005 (QMS). Reported catch is landed greenweight summarised from Monthly Harvest Returns.

Fishing year	TACC	Reported landings (MHR)
2005–06	2	0.1
2006–07	2	0
2007–08	43	40.9
2008–09	43	38.2
2009–10	63	62.7
2010–11	63	62.5
2011–12	63	39.9
2012–13	63	5.9
2013–14	63	2.8
2014–15	63	3.1
2015–16	63	5.3
2016–17	63	0.0
2017–18	63	0.0
2018–19	63	0.0
2019–20	63	0.0
2020–21	63	0.0
2021–22	63	0.0
2022–23	63	0.0
2023–24	63	0.0
2024–25	63	0.0

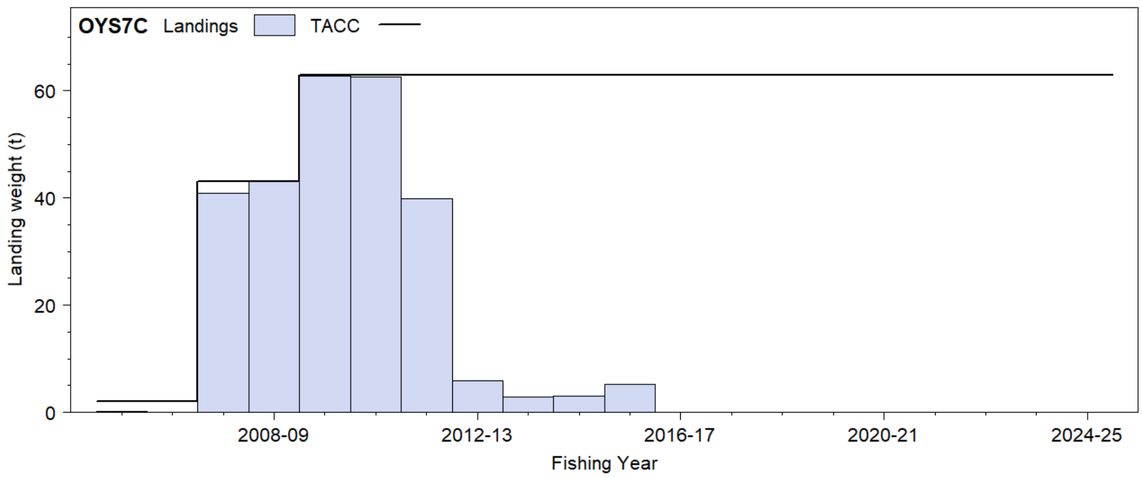


Figure 2: Reported landings (t) and TACC for OYS 7C from 2005–06 to present.

1.2 Recreational fishery

The recreational catch allowance for OYS 7C is 1 t. 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. Recreational fishing for dredge oysters in the Challenger area is permitted year-round. Oysters must be landed in their shells. National panel surveys of recreational harvest were conducted throughout the 2011–12, 2017–18 and 2022–23 fishing years (Wynne-Jones et al. 2014, 2019, Heinemann & Gray 2024). An estimated 17 000 oysters were harvested from OYS 7C in 2011–12 (CV = 1.06) but no panellists reported harvesting oysters from OYS 7C in 2017–18 or 2022–23.

1.3 Customary fisheries

There are no data available on the customary catch.

1.4 Unreported catch

There is no quantitative information on the level of unreported catch.

1.5 Other sources of mortality

Bonamia exitiosa (Bonamia) is a haemocritic, haplosporid parasite (infects mainly haemocytes or blood cells) of flat oysters and is known to infect *Ostrea chilensis* in New Zealand and Chile and various other species of *Ostrea* in other countries. Bonamia has caused catastrophic mortality in the Foveaux Strait oyster fishery and is endemic in oysters in the OYS 7 area (Hine, pers. comm.). The level of mortality caused by disease is unknown.

An allowance of 7 t for other mortality (including incidental fishing mortality, heightened natural mortality such as disease mortality, and unreported harvest) is included in the TAC.

2. BIOLOGY

There are no biological studies of *O. chilensis* specific to the OYS 7C area. In the absence of area-specific estimates, parameters required for management purposes are based on the Foveaux Strait fishery described by Cranfield & Allen (1979) or the OYS 7 (Tasman Bay) fishery. The biology of oysters in the neighbouring area of OYS 7 (Tasman Bay and Golden Bay) was summarised by Handley & Michael (2001), and further biological data were presented by Brown et al. (2008). All this work is summarised below.

Oysters in OYS 7C (Cloudy Bay/Clifford Bay) and OYU 5 (Foveaux Strait) 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 are likely to influence the biological characteristics of those oyster populations. Oysters in OYS 7C are generally more abundant and occur at higher densities than in OYS 7 (Brown & Horn 2007).

The variability in shell shapes and high variability in growth rate between individuals, between areas within the OYS 7 fishery, and between years, require careful consideration in describing growth. Assuming the minimum legal size could range in diameter (1/2 length + height) from 58 mm to 65 mm, data from Drummond (1994b) indicated that Tasman Bay oysters could grow to legal size in two to three years. Modelling of limited data from Tasman Bay by 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) used results from a MAF Fisheries study conducted between 1990 and 1994 to construct a von Bertalanffy equation describing oyster growth in the OYS 7 fishery. Estimated biological parameters including instantaneous natural mortality (M) from Drummond (1994b) and growth parameters for von Bertalanffy equations from Osborne (1999) and from Brown et al. (2008) are given in Table 3. Mortality estimates by Drummond (1994b) and growth parameters by Osborne (1999) were derived from a tagging study conducted in Tasman Bay between 1990 and 1992 (Drummond & Bull 1993). Von Bertalanffy growth parameters from Brown et al. (2008) were estimated, based on a limited data set from enhanced habitat experiments, and describe growth of young oysters. Estimates of M based on experimental data from Foveaux Strait and Tasman Bay ranged from 0.042

(Dunn et al. 1998) to 0.92 (Drummond et al. 1994a). However, after some discussion the Shellfish Working Group concluded that those figures were not realistic, and that *M* was more likely to lie between 0.1 and 0.3.

Table 3: Estimated biological parameters for oysters in OYS 7 and OYU 5. In the absence of data specific to OYS 7C these estimates are used for management purposes in OYS 7C.

1. Natural Mortality (*M*)

Area	Estimate	Source
Tasman Bay	0.920	Drummond (1994b)
Foveaux Strait	0.042	Dunn et al. (1998)
Foveaux Strait	0.100	Allen (1979)

2. von Bertalanffy growth (change in diameter mm) parameter estimates from OYS 7 (t_0 not provided by Osborne 1999)

K	L_{inf}	t_0	Source
0.597	85.43	–	Osborne (1999)
0.99 +/- 0.16 (s.d.)	67.52	0.11	Brown et al. (2008)

3. STOCKS AND AREAS

Commercially exploited beds of oysters occur in Foveaux Strait (OYU 5), Tasman Bay (OYS 7), and Cloudy Bay and Clifford Bay (OYS 7C). Beds at the Chatham Islands (OYS 4) have potential for commercial exploitation. Fishing within OYS 7C has been limited to two discrete areas; one in parts of Clifford Bay and Cloudy Bay and the other immediately south of Tory Channel, and commercial oyster fishing has not extended south of Cape Campbell. The oyster population in OYS 7C is likely to be biologically isolated from populations in Foveaux Strait (OYU 5) and the Chatham Islands (OYS 4) on the basis of geographical distance. The populations in OYS 7C and OYS 7 could also be biologically distinct due to their geographical separation, which quite likely leads to limited dispersal of larvae between the two areas.

4. STOCK ASSESSMENT

4.1 Estimates of fishery parameters and abundance

A survey of OYS 7C was carried out in 2007 (Brown & Horn 2007) and estimates of the number of recruits (oysters unable to pass through a 58-mm ring) and pre-recruits (less than 58 mm) from Clifford Bay and Cloudy Bay are given in Table 4. Dredge efficiency was assumed to be 100% for the purposes of the survey.

Table 4: Estimate of number of recruit and pre-recruit oysters from Brown & Horn (2007).

		Recruit no.		Pre-recruit no.	
Year	Area (Ha)	Estimate	CV %	Estimate	CV %
2007	43 709	19.5 million	19	14 million	19

4.2 Biomass estimates

Estimates of recruited biomass, from the 2007 survey are given in Table 5.

Table 5: Estimate of relative recruited (≥ 58 mm) oyster biomass (t greenweight) in OYS 7C (Brown & Horn 2007).

Year	Area (Ha)	Biomass (t)	CV
2007	43 709	1 778	0.19

4.3 Yield estimates and projections

For new fisheries where there are insufficient data to conduct a yield per recruit analysis, yield can be estimated using the formula from Mace (1988) recommended by the Ministry of Fisheries Science Group (Ministry of Fisheries Science Group 2008) for calculation of Maximum Constant Yield (*MCY*):

$$MCY = 0.25MB_0$$

where B_0 is an estimate of virgin recruited biomass (here assumed to be equal to the recruited biomass estimate from the 2007 survey (1778 t, Brown & Horn 2007) divided by dredge efficiency) and *M* is an estimate of natural mortality. A range of *MCY* estimates are given in Table 6 using values for dredge efficiency of 100% and 64% (Bull 1989) and values for *M* ranging from 0.1 to 0.3 taken from studies conducted in the Foveaux and Nelson/Marlborough oyster fisheries.

Table 6: Estimates of *MCY* for *M* of 0.1–0.3. *MCY* 1 was estimated using a dredge efficiency of 64% from Bull (1989) and *MCY* 2 was estimated assuming a dredge efficiency of 100%.

M	*MCY* 1	*MCY* 2
0.1	69	44
0.2	139	89
0.3	208	133

There are no *CAY* estimates for OYS 7C.

4.4 Other yield estimates

There are no other yield estimates for OYS 7C.

4.5 Other factors

Dredging for oysters will have an impact on the soft sediment habitats within Cloudy Bay and Clifford Bay and will affect both the dredge oyster beds and other species found in association with these beds. In addition, various areas within the fishery (mainly around coastal rocky reefs) are understood to support a range of sensitive invertebrate species including soft corals, large erect and divaricating bryozoans, starfish, horse mussels, and crabs. The impacts of dredging are likely to be more severe on these habitats than on soft sediments and will increase with increasing fishing effort, but there is insufficient information to quantify the degree of impact under any given TAC. There may be some overlap with other fisheries that contact the bottom in this area, but this has not been quantified.

Industry has proposed to voluntarily restrict fishing to two discrete areas to mitigate the effects of fishing. These areas are where oyster densities are highest. Bycatch of benthic invertebrates was collected during the biomass survey and could be analysed to help to determine the distribution of sensitive habitats.

5. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

A broader summary of information on a range of issues related to the environmental effects of fishing and aspects of the marine environment and biodiversity of relevance to fish and fisheries is available in the Aquatic Environment and Biodiversity Annual Review 2021 (Fisheries New Zealand 2022).

5.1 Role in the ecosystem

Dredge oysters (*Ostrea chilensis*) are benthic, epifaunal, sessile bivalve molluscs that have a relatively limited pelagic larval dispersal phase. They are patchily distributed around the New Zealand coast on a variety of substrates (biogenic reef, gravel, sand, mud) in intertidal to subtidal inshore waters, commonly in depths of up to 60 m or more. Oysters play important roles in the ecosystem that include influencing water quality by filtering phytoplankton and other suspended particles from the seawater, linking primary production with higher trophic levels, and acting as ecosystem engineers by stabilising sediments and providing structural habitat (biogenic reef) for other taxa (e.g., algae, ascidians, bryozoans, sponges, echinoderms, worms, molluscs, crustaceans, fish).

5.1.1 Trophic interactions

Oysters are active suspension feeders, consuming phytoplankton suspended in the water column. Their diet is the same as or similar to that of many other suspension feeding taxa, including other bivalves such as scallops, clams, and mussels. Oysters are probably prey for a wide range of invertebrate and fish predators, but published records of known or suspected predators are limited. Reported invertebrate predators of *O. chilensis* include brittle stars (*Ophiopsammus maculata*) (Stead 1971), starfish (*Coscinasterias calamaria* and *Astrostole scabra*) (Cranfield 1979), and flatworms (*Enterogonia orbicularis*) (Handley 2002); suspected invertebrate predators include octopus (*Pinnoctopus cordiformis*) and shell boring gastropods (*Poirieria zelandica*, *Xymeme ambiguous*, and *Xymenella pusillis*) (Brown 2012). Predators of oysters probably change with oyster size. Most mortality of oyster spat (small juveniles) during their first winter appears to result from predation by polychaetes, crabs, and gastropods (Ministry for Primary Industries 2013).

5.2 Non-target catch of fish and invertebrates

A range of non-target fish and invertebrate species are caught and discarded by dredge fisheries for *O. chilensis*, but no data are available on the level or effect of this non-target catch and discarding. Invertebrate non-target catch data are available from dredge surveys of the oyster stocks, and the non-target catch of the fisheries is likely to be similar to that of the survey tows conducted in areas that support commercial fishing. Fish non-target catch data are generally not recorded on surveys, presumably because fish constitute a small fraction of the total non-target catch.

A dredge survey of oysters in Cloudy Bay and Clifford Bay in OYS 7C was conducted in 2006, and the survey skipper recorded qualitative comments on the non-target catch of each tow, which included “coral”, “sticks and seaweed”, shells, volutes, “red weed”, horse mussels, shell with worm, small crabs, mussels, and scallops (Brown & Horn 2006).

5.2.1 Non-target catch in other oyster stocks

The macrofaunal non-target catch of oyster fishing in a ‘near virgin’ area of the fishery was sampled in OYU 5 (Foveaux Strait) in 1950 (Fleming 1952). More recently, presence-absence data on the non-target catch of oyster dredging have been recorded during surveys and in fishers’ logbooks (Michael 2007). Fishery-independent bycatch sampling was undertaken in February 2020, 2021, and 2022 to satisfy requirements for the Integrated Electronic Monitoring and Reporting System regulations. The frequency of dredge tows does not allow for tow-by-tow reporting of bycatch and oyster discards. These surveys described bycatch and oyster discards from fishery areas with high, moderate, and low or no fishing effort during the 2019, 2020, 2021, and 2022 oyster seasons (Michael 2022a, 2022b, 2023a).

In a specific study of the benthic macrofauna non-target catch of the 2001 oyster dredge survey in Foveaux Strait, Rowden et al. (2007) identified at least 190 putative species representing 82 families and 12 phyla; ‘commercial’ survey strata were principally characterised by the families Balanidae (barnacles), Mytilidae (mussels), Ophiodermatidae (brittle stars), Ostreidae (oysters), and Pyuridae (tunicates). For the 2007 survey of OYU 5, Michael (2007) listed the percentage occurrence of sessile and motile species caught as non-target catch in the survey dredge tows. The five most commonly caught sessile species (excluding oysters) were hairy mussels *Modiolus areolatus* (80% occurrence), barnacles *Balanus* sp. (61%), kina *Evechinus chloroticus* (61%), nesting mussels *Modiolarca impacta* (53%), and ascidians *Pyura pulla* (51%). The five most commonly occurring motile non-target catch species were brittle stars *Ophiopsammus maculata* (90% occurrence), circular saw shells (gastropods) *Astraea heliotropium* (80%), hermit crabs *Pagurus novizelandiae* (80%), eight armed starfish *Coscinasterias muricata* (63%), and brown dipple starfish *Pentagonaster pulchellus* (54%). Common non-target catch species of oyster dredge surveys in Foveaux Strait were reported by Michael (2007) and are listed in Table 7.

Table 7: Invertebrate species commonly caught as non-target catch in dredge surveys of oysters (*O. chilensis*) in Foveaux Strait (Michael 2007).

Type	Species
Infaunal bivalves	*Glycymeris modesta* (small dog cockle), *Tawera spissa* (morning star shell), *Tucetona laticostata* (large dog cockle), *Pseudoxyperas elongata* ('tuatua'), *Venericardia purpurata* (purple cockle)
Epifaunal bivalves	*Modioilus areolatus* (hairy mussel), *Modiolarca impacta* (nesting mussel), *Aulacomya atra maoriana* (ribbed mussel), *Barbatia novaezelandiae* (ark shell), *Pecten novaezelandiae* (scallop), *Chlamys zelandiae* (lion's paw scallop), *Neothyris lenticularis* (large lantern shell), *N. compressa* (compressed lantern shell)
Sponges	*Chondropsis* topsentii (cream sponge), *Crella incrustans* (red-orange sponge), *Dactylia palmata* (finger sponge)
Ascidians	*Pyura pachydermatina* (kaeo), *P. pulla*
Bryozoans	*Celleporaria agglutinans* (hard/plate coral), *Cinctipora elegans* (reef-building bryozoan), *Horera foliacea* (lace coral), *Hippomenella vellicata* (paper coral), *Tetrocycloecia neozelanica* (staghorn coral), *Orthoscuticella fusiformis* (soft orange bryozoan)
Barnacles and chitons	*Balanus decorus* (large pink barnacle), *Cryptochonchus porosus* (butterfly chiton), *Eudoxochiton nobilis* (noble chiton), *Rhyssoplax canaliculata* (pink chiton)
Starfish, brittlestars, and holothurians	*Coscinasterias muricata* (eight-armed starfish), *Pentagonaster pulchellus* (brown dipple starfish), *Ophiosammus maculata* (snaketail brittlestar), *Australostichopus mollis* (sea cucumber)
Crabs	*Pagurus novaezelandiae* (hermit crab), *Eurynolambrus australis* (triangle crab), *Metacarcinus novaezelandiae* (cancer crab), *Nectocarcinus* sp. (red crab)
Urchins	*Evechinus chloroticus* (kina), *Apatopygus recens* (heart urchin), *Goniocidaris umbraculum* (coarse-spined urchin), *Pseudechinus novaezelandiae* (green urchin), *P. huttoni* (white urchin), *P. albocinctus* (red urchin)
Gastropods	*Astraea heliotropium* (circular saw shell), *Alcithoe arabica* (volute), *Argobuccinum pustulosum tumidum, Turbo granosus, Cabestana spengleri, Charonia lampras*
Octopuses	*Pinnoctopus cordiformis* (common octopus), *Octopus huttoni* (small octopus)

Bycatch sampling in 2020 (Michael 2022a) found live bycatch generally accounted for a small percentage of the dredge contents, 4.0% of all the catch (including oysters) by weight. Median bycatch weight of all live bycatch species for all tows was 3.0 kg per tow. Of the weight of live bycatch combined, 83.2% was non-fish non-QMS species. Four species accounted for 60.1% of live bycatch: *Astraea heliotropium*, *Ophiopsammus maculata*, *Pyura pachydermatina*, and *Modiolus areolatus*. Relatively high catches of *P. pachydermatina* and *M. areolatus* were recorded from individual tows. Catches of QMS fish species, QMSR_ONG (Sponges), and QMSR_COZ (Bryozoans) were low, regardless of region and fishing effort. Bycatch sampling in 2021 (Michael 2022b) found the same non-fish non-QMS species accounting for 61.4% of bycatch by weight and the bryozoan *Cinctipora elegans* accounted for a further 29.1% of bycatch, mainly from one station. QMS species represented an additional 5.2%, mostly kina (*Evechinus chloroticus*, 4.89%) and sea cucumbers (*Australostichopus mollis*, < 0.1%). Bycatch was less diverse in 2022 than in previous surveys, and no large catches of sponges, bryozoans, or stalked ascidians were taken. Live bycatch was on average 4.0% of the total unsorted catch. The top ten species ranked by weight (86.2% of bycatch in 2022) were non-fish non-QMS species that are ubiquitous throughout the fishery area. Two of these species, *Astraea heliotropium* and *Modiolus areolatus,* accounted for 51.1% of all bycatch. QMS species accounted for 11.4%; kina (*Evechinus chloroticus*) accounted for 10.9%. Bycatch of bryozoans and porifera combined accounted for a further 2.4% of all bycatch. The bushy bryozoan *Othoscuticella fusiformis* accounted for most of this bycatch. Bycatch by each region and fishing effort were mostly similar and generally comprised mobile species *A. heliotropium*, *Ophiopsammus maculata*, *E. chloroticus*, and *Pagurus novaezealandie*, and the sessile species *M. areolatus* accounted for the highest catches across all effort strata and regions (Michael 2023a).

In OYS 7 (Tasman Bay/Golden Bay), data on the non-target catch of the 1994–2014 dredge surveys have been collected but not analysed, except for preliminary estimation of the 1998–2013 non-target catch trajectories (Williams et al. 2014b). The surveys record the non-target catch of other target species of scallops (*Pecten novaezelandiae*) and green-lipped mussels (*Perna canaliculus*), and various other non-target catch in nine categories (Williams et al. 2014b). Analysis of the 2014 survey sampling identified a problem with the way the categorical non-target catch data have been recorded, which limits their utility (Williams et al. 2014a).

In OYS 4 (Chatham Islands), data on the non-target catch of a 2013 dredge survey of oysters off the north coast of Chatham Island were recorded (as estimated volumes of different non-target catch categories) but not analysed (Williams & Williams 2013).

5.3 Incidental catch of seabirds, mammals, and protected fish

There is no known incidental catch of seabirds, mammals, or protected fish species from *O. chilensis* oyster fisheries.

5.4 Benthic interactions

There are a variety of benthic habitats in the different oyster fisheries areas, which generally occur either on coarse substrates usually found in areas of high natural disturbance (Foveaux Strait, Cloudy Bay and Clifford Bay, and the Chatham Islands) or on fine substrates typical of sheltered areas (Tasman Bay). Benthic habitats within the Foveaux Strait oyster fishery area were classified by Michael (2007)T and comprise a variety of sand/gravel/shell flats and waves, rocky patch reef, and biogenic areas. Cranfield et al. (1999) referred to the latter as epifaunal reefs that he defined as "tidally oriented, linear aggregations of patch reefs formed by the bryozoan *Cinctipora elegans*, cemented by encrusting bryozoans, ascidians, sponges and polychaetes". Cranfield et al. (1999, 2001, 2003) suggested that epifaunal reefs are oyster habitat, but Michael (2007, 2010) stated that commercial fishing for oysters is mainly based on sand, gravel, and shell habitats with little epifauna. In Foveaux Strait, commercial oyster dredging occurs within an area of about 1000 kmP^{2}P (although only a portion of this is dredged each year), which is about one-third of the overall OYU 5 stock area (Michael 2010). Habitats within the Cloudy Bay/Clifford Bay and the Chatham Islands fishery areas have not been defined. The benthic habitat within the Tasman Bay oyster fishery area is predominantly mud, although to some extent this may have been affected by land-based sedimentation into the bay and homogenisation of the substrate by dredging and trawling (Brown 2012).

It is well known that fishing with mobile bottom contact gears such as dredges has impacts on benthic populations, communities, and their habitats (e.g., Kaiser et al. 2006, Rice 2006). The effects are not uniform, but depend on at least: "the specific features of the seafloor habitats, including the natural disturbance regime; the species present; the type of gear used, the methods and timing of deployment of the gear, and the frequency with which a site is impacted by specific gears; and the history of human activities, especially past fishing, in the area of concern" (Department of Fisheries and Oceans 2006). In New Zealand, the effects of oyster dredging on the benthos have been studied in Foveaux Strait (OYU 5) (Cranfield et al. 1999, 2001, 2003, and Michael 2007) and Tasman Bay/Golden Bay (OYS 7) (Tuck et al. 2017). The results of these studies are summarised in the Aquatic Environment and Biodiversity Annual Review 2021 (Fisheries New Zealand 2022) and are consistent with the global literature: generally, with increasing fishing intensity there are decreases in the density and diversity of benthic communities and, especially, the density of emergent epifauna that provide structured habitat for other fauna.

The effects of dredging (Fisheries New Zealand 2022) may be more severe in sheltered areas (e.g., Tasman Bay) than in exposed areas (e.g., Foveaux Strait, Cloudy Bay/Clifford Bay, Chatham Islands). Dredging damages epifauna, and erect, structured habitats such as biogenic/epifaunal reefs are the most sensitive to dredging disturbance. Dredging destabilises sediment/shell substrates, suspends sediments, and increases water turbidity; the sensitivity of habitats to suspended sediments and their deposition probably varies depending on the prevailing natural flow regime, being greater in muddy sheltered areas than in high flow environments. Habitats disturbed by dredging tend to become simpler, more homogenous areas typically dominated by opportunistic species. Dredging generally results in reduced habitat structure and the loss of long-lived species.

For studies of the effects of oyster dredging in Foveaux Strait, interpretation of the authors differ (Fisheries New Zealand 2022). Cranfield et al. (1999, 2001, 2003) concluded that dredging biogenic reefs for their oysters damages their structure, removes epifauna, and exposes associated sediments to resuspension such that, by 1998, none of the original bryozoan reefs remained. Michael (2007)T concluded that there are no experimental estimates of the effect of dredging in the strait or on the cumulative effects of fishing or regeneration, that environmental drivers should be included in any assessment, and that the previous conclusions cannot be supported. The authors agree that biogenic bycatch in the fishery has declined over time in regularly fished areas, that there may have been a reduction in biogenic reefs in the strait since the 1970s, and that simple biogenic reefs appear able to regenerate in areas that are no longer fished (dominated by byssally attached mussels or reef-building bryozoans). There is no consensus that reefs in Foveaux Strait were (or were not) extensive or dominated by the bryozoan *Cinctipora*.

Some areas of the Foveaux Strait (OYU 5) oyster fishery are also commercially fished (potting) for blue cod (*Parapercis colias*), and Cranfield et al. (2001) presented some evidence to suggest that dredged benthic habitats and blue cod densities regenerated in the absence of oyster dredging. Bottom trawling also occurs within the OYU 5 area, but there is little overlap with the main areas fished for oysters. In OYS 7, other benthic fisheries (e.g., bottom trawl, scallop, green-lipped mussel) occur and probably also interact with oysters and their habitats.

5.5 Other considerations

5.5.1 Spawning disruption

Fishing during spawning may disrupt spawning activity or success. In the Foveaux Strait fishery, the traditional harvesting period (1 March to 31 August) occurs after the main spring and summer peaks in oyster spawning activity (Jeffs & Hickman 2000). Fishing-induced damage to oysters incurred during the period before spawning could interrupt gamete maturation. Oyster fishing also targets high-density beds of oysters, which are disproportionately more important for fertilisation success during spawning.

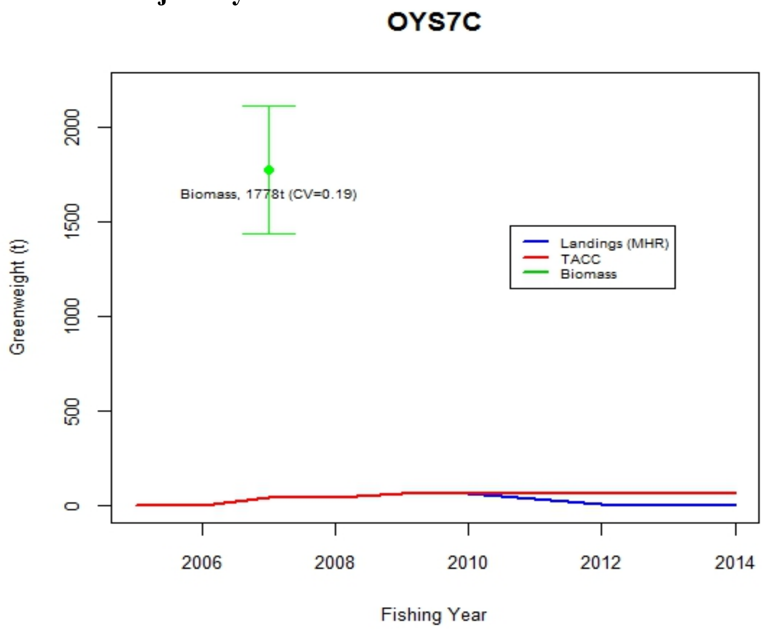
6. STATUS OF THE STOCKS

Stock structure assumptions

Current management assumes that the OYS 7C oyster fishery is separate from the other oyster fisheries (i.e., Challenger (OYS 7), Foveaux Strait (OYU 5), and the Chatham Islands (OYS 4)). The stock structure of OYS 7C is assumed to be a single biological stock. Survey data show that oysters are patchily distributed in the commercial fishery area of OYS 7C and it has been suggested that the oyster populations may be mainly self-recruiting.

Stock Status		
Most Recent Assessment Plenary Publication Year	2009 - now considered out of date	
Intrinsic productivity level	Low	
Catch in most recent year of assessment	Year:	Catch:
Assessment Runs Presented		
Reference Points	Target: Default = 40% B_0, with at least a 50% probability of achieving the target Soft Limit: 20% B_0 Hard Limit: 10% B_0 Overfishing threshold: F_{MSY}	
Status in relation to Target	Unknown	
Status in relation to Limits	Unknown	
Status in relation to Overfishing	No commercial fishing has occurred since 2016–17.	

Historical Stock Status Trajectory and Current Status



Estimated relative biomass (t greenweight) of recruited oysters (≥ 58 mm) (green point and error bars denoting CV), TACC (solid red line), and reported landings (blue line, t greenweight) since 1998. The biomass estimate is from a 2007 survey and is uncorrected for dredge efficiency. Landings data from MHRs. Fishing year beginning 2005–06 to 2014–15.

Fishery and Stock Trends	
Recent trend in Biomass or Proxy	Unknown
Recent trend in Fishing Intensity or Proxy	Unknown
Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	Unknown

Projections and Prognosis	
Stock Projections or Prognosis	Quantitative stock projections are unavailable
Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits	Soft Limit: Unknown Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or to commence	No commercial fishing has occurred since 2016–17

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment	
Assessment Method	Yields are estimated as a proportion of the survey biomass for a range of assumed values of natural mortality and dredge efficiency.	
Assessment Dates	Latest assessment Plenary publication year: 2009	next assessment: Unknown
Overall Assessment Quality Rank	1 – High Quality	
Main data inputs (rank)	Biomass survey: 2007	1 – High Quality

Period of Assessment	Latest assessment: 2009	Next assessment: Unknown
Data not used (rank)	N/A	
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	There has been only a single biomass survey of this fishstock and repeat surveys should be scheduled at regular intervals. Natural mortality (*M*) and dredge efficiency are poorly known but are integral parameters of the method used to estimate yield. There is also major uncertainty about the response of localised populations to fishing.	

Qualifying Comments
Some of the surveyed area was not actively fished up to 2009. There are areas of potential oyster habitat that are not fished due to sanitation concerns and substrate that is marginal for fishing. In 2009, the Shellfish Working Group was asked to evaluate the implications of raising the TACC (of 50 t) by 15–20 t. In 2009 it was considered Very Unlikely (< 10%) that an increase in the TACC of this amount would cause the biomass to decline below the Soft Limit in the next 3 to 5 years. On 1 October 2009 the TACC was changed to 63 t.

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