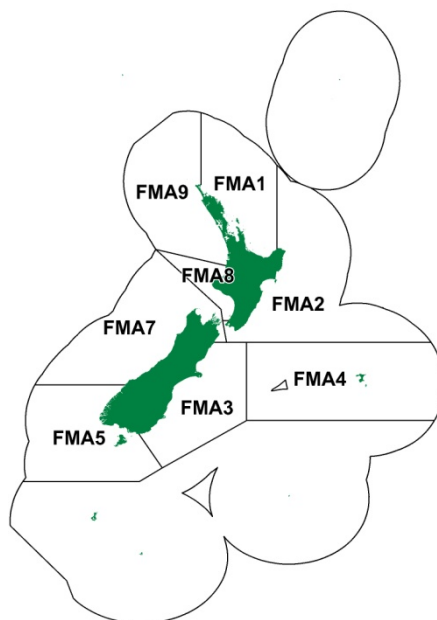


## SURF CLAMS

Surf clam is a generic term used here to cover the following seven species:

Deepwater tuatua	<i>Paphies donacina</i>	(PDO)
Fine (silky) dosinia	<i>Dosinia subrosea</i>	(DSU)
Friiled venus shell	<i>Bassina yatei</i>	(BYA)
Large trough shell	<i>Mactra murchisoni</i>	(MMI)
Ringed dosinia	<i>Dosinia anus</i>	(DAN)
Triangle shell	<i>Spisula aequilatera</i>	(SAE)
Trough shell	<i>Mactra discors</i>	(MDI)

The same FMAs apply to all these species and this introduction will cover issues common to all of these species. Each species has its own Working Group report.



## 1. INTRODUCTION

All surf clams were introduced into the Quota Management System on 1 April 2004. The fishing year is from 1 April to 31 March and commercial catches are measured in greenweight. There is no minimum legal size (MLS) for surf clams. Surf clams are managed under Schedule 6 of the Fisheries Act 1996. This allows them to be returned to the sea soon after they are taken, provided they are likely to survive.

Commercial surf clam harvesting before 1995–96 was managed using special permits. From 1995–96 to 2002–03 no special permits were issued because of uncertainty about how best to manage these fisheries. Fishing subsequently resumed.

New Zealand operates a mandatory shellfish quality assurance programme for all bivalve shellfish grown and harvested in areas for human consumption. Shellfish caught outside this programme can only be sold for bait. This programme is based on international best practice and is managed by New Zealand Food Safety, in cooperation with the District Health Board Public Health Units and the shellfish industry<sup>1</sup>. This involves surveying the water catchment area for pollution, sampling water and shellfish microbiologically over at least 12 months, classifying and listing areas for harvest, regular monitoring

<sup>1</sup> For full details of this programme, refer to the Animal Products (Regulated Control Scheme-Bivalve Molluscan Shellfish) Regulations 2006 and the Animal Products (Specifications for Bivalve Molluscan Shellfish) Notice 2006 (both referred to as the BMSRCS) at: <http://www.nzfsa.govt.nz/industry/sectors/seafood/bms/page-01.htm>

of the water and shellfish, biotoxin testing, and closure after rainfall and when biotoxins are detected. Products are traceable by source and time of harvest in case of contamination.

## 2. BIOLOGY

Three families of surf clams dominate the biomass in different regions of New Zealand. At the northern locations, the venerids *D. anus* and *D. subrosea* make up the major proportion of the surf clam biomass, and *D. anus* is abundant at all other North Island locations. The mactrids and mesodesmatid become increasingly abundant south of Ohope (Bay of Plenty). The mesodesmatid *P. donacina* is most abundant around central New Zealand from Nuhaka on the east coast south to the Kapiti Coast, Cloudy Bay, and as far south as Pegasus Bay. The mactrids *M. murchisoni* and *M. discors* dominate in southern New Zealand (Blueskin Bay, Te Waewae, and Oreti), where they account for more than 80% of the total biomass (Cranfield et al 1994, Cranfield & Michael 2001).

Each species grows to a larger size in the South Island than in the North Island (Cranfield & Michael 2002). Growth parameters are available for many surf clam species from up to two locations. Length frequencies of sequential population samples were analysed by Cranfield et al (1993) using MULTIFAN to estimate the von Bertalanffy growth parameters (Table 1). MULTIFAN simultaneously analyses multiple sets of length frequency samples using a maximum likelihood method to estimate the proportion of clams in each age class and the von Bertalanffy growth parameters (see Fournier et al 1990).

Incremental growth of recaptured marked clams at Cloudy Bay was analysed using GROTAG to confirm the MULTIFAN estimates (Cranfield et al 1993). GROTAG uses a maximum-likelihood method to estimate growth rate (Francis 1988). The estimates and annual mean growth estimates at lengths  $\alpha$  and  $\beta$  are shown in Table 2.

**Table 1: Von Bertalanffy growth parameter estimates from Cranfield et al (1993) for surf clams estimated using MULTIFAN (SE in parentheses). – Indicates where estimates were not generated.**

Stock	Site	$L_{\infty}$ (mm)	$K$
BYA 7	Cloudy Bay	–	–
BYA 8	Kapiti Coast	–	–
DAN 7	Cloudy Bay	0.10 (0.03)	77.5 (0.71)
DAN 8	Kapiti Coast	0.13 (0.02)	58.7 (0.28)
DSU 7	Cloudy Bay	–	–
DSU 8	Kapiti Coast	–	–
MDI 7	Cloudy Bay	0.41 (0.03)	68.0 (0.35)
MDI 8	Kapiti Coast	0.42 (0.02)	56.0 (0.95)
MMI 7	Cloudy Bay	0.57 (0.01)	88.0 (0.44)
MMI 8	Kapiti Coast	0.35 (0.01)	75.2 (0.30)
PDO 7	Cloudy Bay	0.33 (0.01)	94.1 (0.29)
PDO 8	Kapiti Coast	–	–
SAE 7	Cloudy Bay	1.01 (0.02)	60.3 (0.92)
SAE 8	Kapiti Coast	0.80 (0.03)	52.1 (0.25)

The maximum ages for these species were estimated from the number of age classes indicated in MULTIFAN analyses, and from shell sections. Estimates of natural mortality come from age estimates (Table 3). Higher mortality is seen where the surf clams are subject to higher wave energies, e.g., *S. aequilatera* and *M. murchisoni* are distributed within the primary wave break and hence show higher mortality (Cranfield et al 1993). Kapiti shells show higher mortality than Cloudy Bay, perhaps because these shells have a higher chance of being eroded out of the bed by storms because the Kapiti Coast is more exposed (Cranfield et al 1993). Surf clam populations are subject to catastrophic mortality from erosion during storms, high temperatures and low oxygen levels during calm summer periods, blooms of toxic algae, and excessive freshwater outflow (Cranfield & Michael 2001).

Less confidence should be placed in the estimates from MULTIFAN for Cloudy Bay relative to the Kapiti Coast because there was a small sample size at Cloudy Bay and a lack of juveniles.

**Table 2: Mean annual growth estimates (mm/year) at lengths  $\alpha$  and  $\beta$  (95% confidence intervals in parentheses for mean growth values) from Cloudy Bay (Cranfield et al 1996).  $L^*$  is the transitional length, at which point the model allows an asymptotic reduction in growth rate and values of  $L_\infty$  are included for reference.**

Species	$\alpha$ (mm)	$g_\alpha$ (mm year <sup>-1</sup> )	$\beta$ (mm)	$g_\beta$ (mm year <sup>-1</sup> )	$L^*$ (mm)	$L_\infty$ (mm)	Residual error (mm)
<i>Paphies donacina</i>	50.0	10.26 (9.7 – 10.8)	80.0	1.41 (1.1 – 1.7)	80.0	84.8	1.25
<i>Spisula aequilatera</i>	30.0	22.71 (22.2 – 23.0)	50.0	6.23 (6.0 – 6.4)	55.0	57.6	2.04
<i>Mactra murchisoni</i>	40.0	17.83 (17.4 – 18.2)	70.0	4.65 (4.3 – 4.9)	80.0	80.6	1.42
<i>Mactra discors</i>	35.0	11.01 (10.5 – 11.7)	55.0	2.69 (2.4 – 2.9)	62.0	61.5	0.63
<i>Dosinia anus</i>	20.0	12.5 (12.0 – 13.2)	55.0	1.99 (1.8 – 2.2)	63.0	61.6	0.44

**Table 3: Estimates of the instantaneous natural mortality rate,  $M$ . A = minimum number of year classes indicated by MULTIFAN; B = maximum age indicated by shell sections; M1 = mortality range estimated from using two equations:  $\ln M = 1.23 - 0.832 \ln(t_{max})$  and  $\ln M = 1.44 - 0.9821 \ln(t_{max})$ , (Hoenig 1983); M2 mortality estimated from  $M = \ln 100 / (t_{max})$ ;  $t_{max}$  is the estimate of maximum age.**

Cloudy Bay	A	B	M1	M2
<i>Mactra murchisoni</i>	8	11	0.40–0.46	0.42
<i>Mactra discors</i>	7	14	0.32–0.38	0.33
<i>Spisula aequilatera</i>	5	7	0.63–0.68	0.66
<i>Paphies donacina</i>	10	17	0.26–0.32	0.27
<i>Dosinia anus</i>	16	22	0.20–0.26	0.21
Kapiti Coast	A	B*	M1	M2
<i>Mactra murchisoni</i>	8	11	0.40–0.46	0.42
<i>Mactra discors</i>	8	16	0.28–0.34	0.29
<i>Spisula aequilatera</i>	3	5	0.87–0.89	0.92
<i>Paphies donacina</i> <sup>†</sup>				
<i>Dosinia anus</i>	19	26	0.17–0.23	0.18

\*Shell sections not yet examined. Ages are inferred from Cloudy Bay data.

<sup>†</sup>Growth data could not be analysed.

### 3. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was first introduced to the May 2011 Plenary after review by the Aquatic Environment Working Group, and has been updated subsequently as relevant research has been undertaken and published. It was last updated in 2021. This summary is from the perspective of the surf clam fisheries; a more detailed summary from an issue-by-issue perspective is available in the Aquatic Environment and Biodiversity Annual Review 2019-20 (Fisheries New Zealand 2020), online at <https://www.mpi.govt.nz/dmsdocument/40980-aquatic-environment-and-biodiversity-annual-review-201920>.

#### 3.1 Ecosystem role

Only two published papers examine aspects of the role of surf clams in the ecosystem in New Zealand. Predation of *Dosinia* spp. by rock lobsters has been documented from the reef/soft sediment interface zones (Langlois et al 2005, Langlois et al 2006), notably surf clams are usually harvested from exposed beaches, not reef/soft sediment interface zones.

Surf clams are filter-feeders; recent research suggests that most of their food is obtained from microalgae from the top 2 cm of the sediment and the bottom 2–3 cm of the water column (Sasaki et al 2004). The effects of predation are difficult to study on exposed sandy beaches and it is believed internationally that there are no keystone species in this environment and predation is not important in structuring the community (McLachlan & Brown 2006).

#### 3.2 Fishery captures (fish and invertebrates)

The only bycatch caught in large quantities associated with surf clam dredging in New Zealand is *Fellaster zelandiae* — the sand dollar or sea biscuit (Haddon et al 1996, Triantafillos 2008a, Triantafillos 2008b, White et al 2012). Other species caught in association with surf clams include paddle crabs (*Ovalipes catharus*), a number of bivalves including the lance shell (*Resania lanceolata*),

otter clams (*Zenatia acinaces*), battle axe (*Myadora striata*), olive tellinid (*Hiatula nitidia*), the wedge shell (*Peronaea gairmadi*), and the gastropods the olive shell (*Baryspira australis*) and ostrich foot shell (*Struthiolaria papulosa*). Fish are rarely caught, but include juvenile common soles (*Peltorhamphus novaezeelandiae*) and stargazers (*Kathetostoma* spp.) (NIWA, unpublished data).

### 3.3 Fishery captures (seabirds and mammals)

Not relevant to surf clam fisheries.

### 3.4 Benthic impacts

Surf clams mainly inhabit the surf zone, a high-energy environment characterised by high sand mobility (Michael et al 1990). Divers observed that the rabbit dredge (which has been used for surf clam surveys) formed a well-defined track in the substrate, but within 24 hours the track was could not be distinguished, indicating that physical recovery of the substrate was rapid (Michael et al 1990). Commercially, a different dredge is used and its impacts should theoretically be less, but the impacts of this dredge have not been tested. Shallow water environments such as the surf zone or those subjected to frequent natural disturbance tend to recover faster from the effects of mobile fishing gears compared with those in deeper water (Kaiser et al 1996, Collie et al 2000, Hiddink et al 2006, Kaiser et al 2006).

Surf clam species show zonation by substrate type which is generally, although not always, correlated with depth and wave exposure. Species with good burrowing ability are generally found in shallow, mobile sediment zones (for example, *Paphies donacina*), and those species less able to burrow (for example, *Dosinia subrosea* and *Bassina yatei*) are generally found in softer, more stable sediments. The present high-value species (*Spisula aequilatera*, *Mactra murchisoni*, *Paphies donacina* and *Mactra discors*) generally occur in shallower zones. Mobile fishing gear effects will be primarily determined by the characteristics of the beach and target species. Little fishing presently takes place in the most vulnerable areas characterised by stable, soft fine sediment communities.

An Italian study showed that widespread intensive hydraulic dredging can adversely modify some depths within this environment (4–6 m), although recovery in this study occurred within 6 months (Morello et al 2006). Scottish (Tuck et al 2000; Hauton et al 2003a, 2003b) and American (Mercaldo-Allen et al 2017) studies detected benthic community and physical impacts, but survival of discarded bycatch was generally high. The applicability of these studies' finding to New Zealand is unknown, given the relatively sheltered nature of some of the habitats examined compared to surf beaches.

### 3.5 Other considerations

None.

### 3.6 Key information gaps

The impacts of widespread and intensive dredging in New Zealand, which is not presently occurring, are unknown.

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