2017 SMALL BIVALVE FISHERY ASSESSMENT
Venerupis largillierti - Northern Zone, Georges Bay
Katelysia scalarina - Ansons Bay

John Keane and Caleb Gardner

June 2017

Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 49,

Hobart TAS 7001

Enquires should be directed to:
Dr John Keane
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 49, Hobart, Tasmania 7001, Australia
John.Keane@utas.edu.au
Ph. (03) 6226 8265

Citation: Keane, J.P. and Gardner, C. (2017), 2017 Small Bivalve Fishery Assessment. Institute for Marine and Antarctic Studies Report. University of Tasmania, Hobart. 18 p.

Executive Summary

In 2017, stock assessments with total allowable commercial catch recommendations (TACC) ware conducted for the Georges Bay Northern Zone Venus Clam, *Venerupis largillierti,* fishery and the Ansons Bay Vongole, *Katelysia scalarina,* fishery.

Venus Clam, *Venerupis largillierti* - Georges Bay Northern Zone

A survey conducted in the Georges Bay Northern Zone in 2017 estimated the fishable Venus clam beds to be 80,759 m^2 and these contained an estimated total biomass of 76.2 tonnes with lower and upper 95% confidence limits of 54.7 t and 97.6 t. An estimated 65% (49.4 t) of the biomass was above the legal size limit of 40 mm. A TACC based on 10% of the total biomass would be 7.6 t, however, the estimated biomass is below the Biomass limit reference point (B_{LIM}) of 107.5 t recommended by IMAS in the last assessment (Jones and Gardner, 2016). The total biomass is 15% of that than when last surveyed in 2014 (463 t), due to decreases in clam density, the area of fishable clam beds, and the size of clams. Large numbers of pre-recruits were observed in length frequency distributions with cohorts of clams around 24 and 40 mm. In terms of total abundance, 69% of the estimated population is under the minimum size limit of 40 mm. The apparent strength of sub-legal size classes suggests there will be increases in fishable biomass in coming years. Given the estimated biomass is below the B_{LIM}, but strong sub-legal size classes persist, we recommend a conservative TACC be set at 4.9 t, or 10% of the fishable biomass.

Vongole, *Katelysia scalarina* - Ansons Bay

A survey conducted in Ansons Bay in 2017 resulted in a biomass estimate of 30.73 tonnes of Vongole in the fished area, with lower and upper 95% confidence limits of 26.17 – 35.28 t. An estimated 98.5% (30.26 t) of the biomass was above the legal size limit of 32 mm. A TAC of 10% of total biomass would therefore be 3.1 t. However, the estimated biomass is below the Biomass limit reference point (BLIM) of 40 t recommended by IMAS (Tarbath and Gardner, 2015). The biomass estimate is similar to the 2015 survey of 27.15 (22.85 - 31.45) t, but greatly reduced compared with the 2012 estimate of 133.32 (106.62 – 161.03) t. The size structure of the fishery indicates aging stocks with minimal recruitment; the modal size of 42mm is the highest recorded for the stock. Given the fishery was closed following this stock decline, no evidence of stock recovery and the apparent aging of the population, we recommend that this stock remains closed.

Stock status – small bivalves

The four commercial small bivalve fisheries in Georges Bay and Ansons Bay are surveyed every two to three years for the purposes of estimating total biomass and assessing fishery status in order to assist with the allocation of quota for the forthcoming fishing years.

The status of Tasmania's small bivalve's fisheries have been assessed in terms of the lower acceptable limit of the stock, which is the point where recruitment overfishing occurs. Recruitment overfishing implies that the mature adult (spawning biomass) is depleted to a level where the future productivity of the stock is diminished. Recruitment overfished stocks have not necessarily collapsed, but do have fewer recruits than a healthy stock.

It's important to note that fishery management generally includes both limit reference points that define the lower acceptable point for the stock plus target reference points, which are the ideal level for the stock. In this report we assess bivalve fisheries against only the limit reference point, which is also the process used nationally for stock status reporting.

Stock status of these bivalve fisheries was based on density and size composition data from the most recent surveys, plus consideration of trends in catch and CPUE data.

Species	Status	Comments
Northern Zone Georges Bay - Venus Clam **Venerupis largillierti**	ENVIRONMENTALLY LIMITED	Biomass in the Venus Clam fishery is estimated at 76.2 t based on quadrat counts that are extrapolated across the defined fishable beds. The stock extends beyond the boundaries of the fished beds so the fishery biomass is less than the total biomass of clams in Georges Bay. The current low biomass combined with declines in CPUE in 2015 and 2016 provides evidence that the stock is at an unusually low level. Fishing has been low with less than 8% of the estimated biomass taken as catch from 2015 to 2017. This is evidence that the stock has not been reduced by excess fishing mortality. Previous information on length frequency distribution indicated that a settlement pulse had occurred but this has failed to translate to significant recruitment to the fishery. On the basis of patterns in length frequency data, the low fishing mortality, and the low estimated biomass, the stock is classed as environmentally limited.
Ansons Bay - Vongol **Katelysia scalarina**	ENVIRONMENTALLY LIMITED	Biomass in the Vongol Clam fishery is estimated at 30.7 t based on quadrat counts that are extrapolated across the defined fishable beds. This stock was classified in 2015 as environmentally limited on the basis of severe declines in biomass associated with a flood event (Tarbath and Gardner 2015). This fishery is currently closed to commercial catch.

Georges Bay – Native Flat Oyster Ostrea angasi (NOT ASSESSED IN THIS DOCUMENT)	SUSTAINABLE	The fished biomass of Flat Oyster has been stable and there is additional biomass outside of the fished area in Georges Bay. Fishing mortality is low based on the TACC of 10%, plus total catch that is typically below the TACC due to market limitation. Length frequency data shows that there is large proportion of stock below the LML, which shows recruitment is being maintained. The evidence of high biomass and low fishing mortality supports the classification of this stock as sustainably fished.
Southern Zone Georges Bay - Venus Clam Venerupis largillierti (NOT ASSESSED IN THIS DOCUMENT)	ENVIRONMENTALLY LIMITED	This stock was last surveyed in 2013 (Tarbath and Gardner 2013). It was classified as environmentally limited on the basis of severe declines in biomass that appeared unrelated to fishing mortality. This fishery is currently closed to commercial catch.

Venus Clam - Northern Zone Georges Bay

Background

A commercial dive fishery has operated for the Venus Clam, (commonly known as Venerupis; (*Venerupis largillierti*) in Georges Bay, north-east Tasmania since approximately 1985. The Venus Clam is endemic to New Zealand but was found in Tasmania in 1963. It remains indistinguishable from New Zealand populations, on the basis of allozyme analysis (Macguire, 2005). Venus Clams grows to a length of 70 mm and are found in the intertidal zone and subtidally in both muddy and sandy substrates in shallow estuarine waters on parts of Tasmania's east and south-east coasts (Grove, 2011). Experimental estimation of growth rates indicate growth increments at 1.3 $mm.month^{-1}$ at 27 mm and 0.5 $mm.month^{-1}$ at 43.5 mm (Kent et al., 2005; Maguire, 2005). Sexual maturity is estimated to occur below 27 mm (Maguire, 2005). Georges Bay is the only commercial fishery for this species in Tasmania, where the species forms beds on both intertidal sandbars and in subtidal deeper channels subjected to tidal flow. The Georges Bay Venus Clam Fishery is subdivided into two zones (Northern and Southern) with two licences in the Northern Zone and one in the Southern Zone (DPIPWE, 2007).

The Northern Zone fishery operates on mixed species shellfish beds in the bay with the area harvested varying between years. Until 2007 the fishery was managed principally through the allocation of half yearly or yearly permits. From 2007 a formal TACC structure was introduced with two associated commercial licences (DPIPWE 2007). TACC allocation is based on fishery dependent surveys of estimated available biomass conducted every two or three years with the TACC set as equal to 10% of the estimated biomass. Legal minimum length of *V. largillierti* is set at 40 mm shell length on the basis of market demand (DPIPWE 2007). Total catch and catch per unit effort data are available for this fishery from 1st September 2007 onwards, with the fishing year operating from 1st September to 31st August.

For the 2015-2016 fishing year, the two licensees implemented a voluntary reduction in TACC to 3 t as a consequence of low biomass. Due to continued low biomass and catch, an independent biomass survey was not requested by DPIPWE for 2016. This 2017 assessment is the first full survey since the stock decline.

The objective of this survey was to estimate the biomass of Venus Clams within the Georges Bay, Northern Zone to update TACC setting information for the 2017/18 season.

2017 assessment

This survey used a systematic random sampling design that covered the portion of the seabed containing significant Venus Clam resource. The perimeter of commercially fished beds were mapped using the vessel's GPS unit on advice of the fisher. This was conducted following reported changes in clam distribution and seagrass beds since previous surveys. Two key beds were identified, one overlapping previously surveyed areas and one occurring in a previously unsurveyed area (see below for details). The two beds covered an area of 80,759 m^2.

Within the identified clam beds, transects of 100 m in length were laid randomly from the vessel. Samples (0.25 m^2 quadrats) were collected by a commercial diver and IMAS researcher at 0 m and every 25 m along the transect (i.e. 5 samples per 100 m transect). A total of 16 transects and 78 quadrats were sampled within the identified beds. Two quadrats on one transect fell outside of the mapped area and were omitted from the analysis; they contained zero clams.

A total 1,704 clams were collected and measured to the nearest 1 mm using electronic measuring boards before being returned to the fishing grounds. The weight of clams per quadrat was then calculated using a length-weight relationship derived from 295 clams set aside for the purpose (see below for details). The mean density of clams per quadrat (g/m^2) was estimated and from this, the total biomass as the product of the mean density and the area of the productive seabed. Estimates were made of the total biomass (all clams in the fished area) and the legal-sized biomass (all clams greater than the legal minimum length (LML) of 40 mm in the fished area).

The estimated total biomass was 76.2 t, with lower and upper 95% confidence limits of 54.7 t and 97.6 t respectively. Fishery policy specifies a TACC of 10% of biomass (DPIPWE, 2007), which in this case is 7.6 t.

The estimated legal-sized biomass greater than the LML was 49.4 t, with lower and upper 95% confidence limits of 33.7 t and 65.0 t respectively.

Table 1. Total catch and percentage of total allowable commercial catch (TACC) in parenthesis, TACC, estimated fishery area, estimated total biomass (m^2) and estimated mean biomass (Kg) per m^2 for Venus Clams in Georges Bay Northern Zone. For each Fish Year, catch represents the total caught to the end of August of that year. Catch prior to 2008 is derived from permit reports held by DPIPWE (2007), catch 2008 onwards taken from DPIPWE database catch records. There was no formal TACC set prior to 2008. Data prior to this survey sourced from Haddon (2003), TAFI (2009), Tarbath and Gardner (2012, 2014).

Fish Year	Catch (t; % of TACC)	TACC (t)	Fishery Area (m^2)	Total Biomass (t)	Biomass (Kg per m^2)	Density (no./m^2)
2003	43.2		176,258	366.5	2.1	
2004	26.4					
2005	26.4					
2006	26.4					
2007	26.4					
2008	24.0 (100)	24				
2009	23.9 (99.6)	24	121,111	284.7	2.4	134.0
2010	28.4 (99.6)	28.5				
2011	27.8 (97.5)	28.5				
2012	27.8 (97.5)	28.5	121,111	537.4	4.4	198.2
2013	42.2 (78.6)	53.7				
2014	39.9 (74.3)	53.7	96,393	463	4.8	180.0
2015	24.3 (52.5)	46.3				
2016	0.93 (31)	3.0				
2017		3.0	80,759	76.2	0.9	87.4

Survey area

The two beds that are currently fished were mapped with the guidance of the commercial fisher. Bed 1 (blue outline, Fig. 1, Tab. 2) overlapped that of the area mapped in 2014, while Bed 2 (green outline) had previously not been included in biomass surveys. The beds covered an area of 80,759 m^2. A third area (red outline) which was fished previously, but not recently, was also mapped. No clams were recorded in the five quadrats sampled in this bed and it was not included in the analysis.

The area of fished beds in this survey was reduced from previous surveys (Table 1). The fisher suggests this is attributed to a combination of the recent stock decline and expansion of seagrass beds.

The 2009 and 2012 fishery assessments assumed a fished area of 121,111.08 m^2 based on the area of four clam beds measured by D. Tarbath and defined by G. Forsyth and D. Allen in 2008. The position of the beds are shown in grey in Figure 1.

Figure 1. Georges Bay, showing the position of the two clam beds mapped in 2017 (blue 43,607 m^2 and green 37,152 m^2 polygons). The sum of the two areas was 80,759 m^2. A third area sampled (red polygon) contained no clams and was excluded from area estimates. Grey polygon shows the location of clam beds surveyed in 2008.

Length-weight relationship.

A sample of 295 clams, collected from across the entire size range, were measured following harvest. The clams were alive, whole and their shells unbroken. Length and weight data were fitted to the allometric length to weight model $W=a*Lb$, where W is weight, L is length and a and b are the fitted parameters. Parameter values are shown in Table 2, together with those from previous samples from this fishery. Small changes in length-weight parameter estimates are apparent, due to slight random and sampling variation (Fig. 2). The clams from 2017 fall with the range previously reported, and almost identical to 2003.

Table 2. Allometric length to weight model parameters for Venus Clam recorded between 2003 and 2017.

year	a	b	R^2	number
2003	0.000129	3.155182	0.98	unknown
2009	0.000122	3.126062	0.99	150
2012	0.000146	3.153012	0.99	249
2014	0.000157	3.132715	0.99	135
2017	0.000162	3.099680	0.99	295

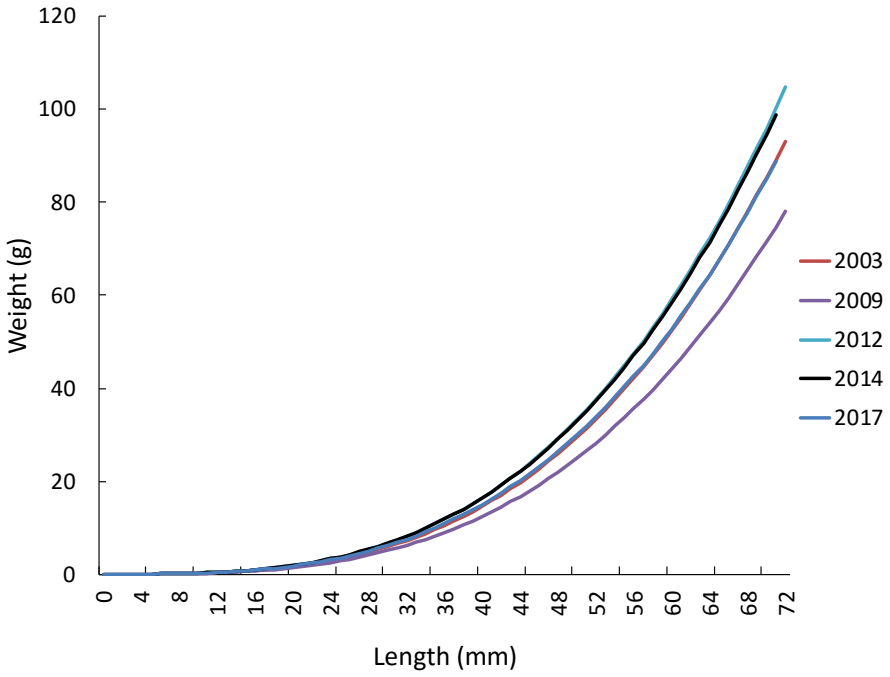

Figure 2. Length-weight relationships, 2003-2017, Georges Bay Northern Zone Venus Clam Fishery.

Length frequency

Two cohorts of clams were recorded in 2017, with modal peaks in abundance observed at 24 and 40 mm which appear to be consecutive year classes, given estimates of growth rates at 1.3 mm.month^{-1} at 27 mm and 0.5 mm.month^{-1} at 43.5 mm (Fig. 3; Kent et al., 2005, Maguire and Paturusi 2005). Sixty nine per cent of clams were under the legal size of 40 mm. This compares to 2012 when the modal peak was 52 mm and only 11% of clams were < 40 mm. In 2017, there were few clams remaining from the large cohorts that produced the large biomass estimates in 2012 and 2014.

From the modal length of 24 mm there is a 5-fold increase in clam weight to the LML of 40 mm, and a further two fold increase over the size range 40 to 50 mm (Tab. 3). The number of clams per kilogram haves from 66 to 33 with growth from 40 to 50 mm.

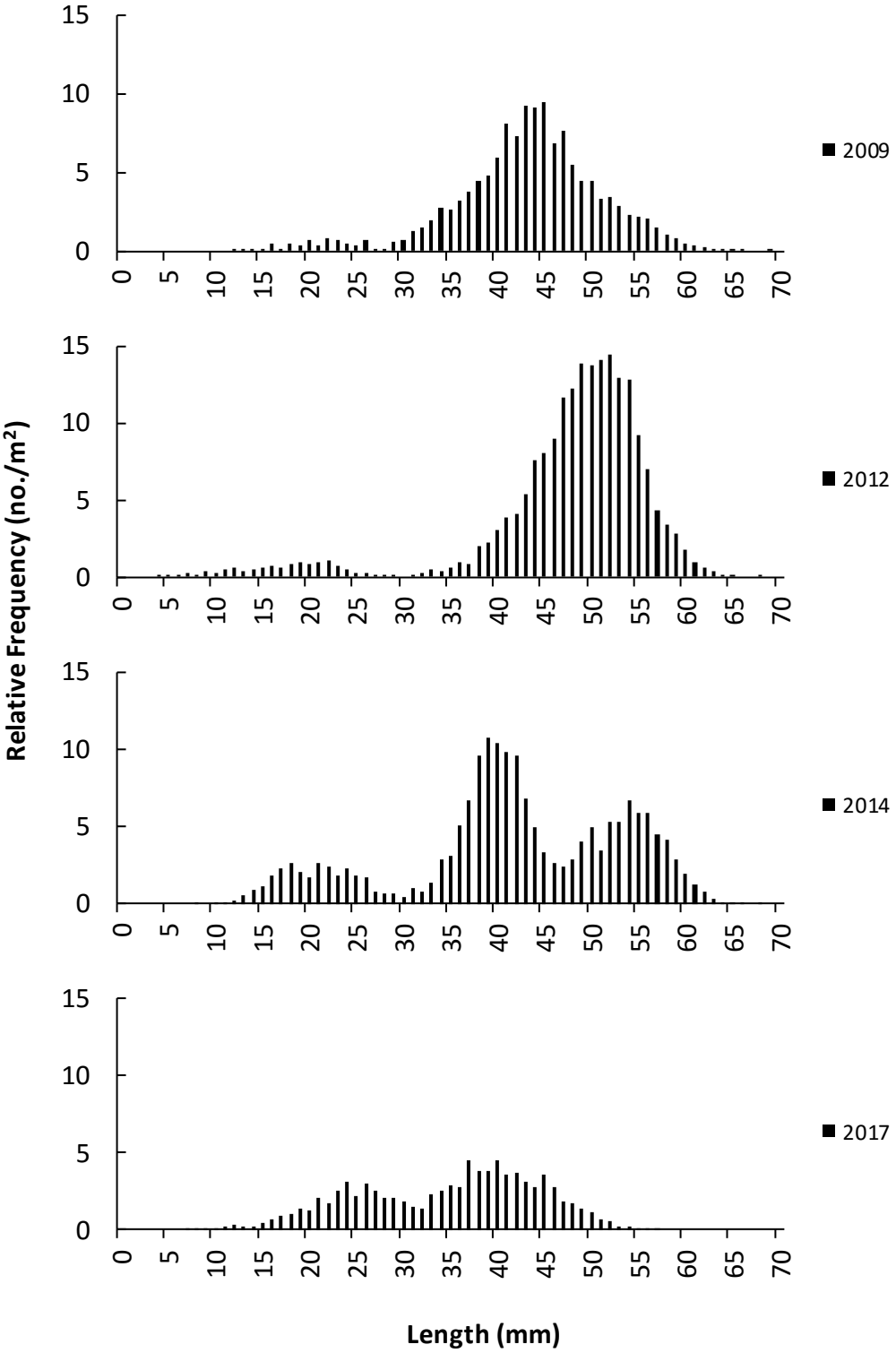

Figure 3. Relative length frequency (no./m^2) distribution of Venus Clams from the fished beds within Georges Bay Northern Zone between 2009 and 2017.

Table 3. Predicted numbers per kg of clams at various lengths and relative weight in relation to the modal cohort lengths of 24 mm.

Length (mm)	Clams / kg	Relative weight (to 24mm)	Relative weight (to 40 mm)
40	66.6	4.9	1.0
45	46.3	7.0	1.4
50	33.4	9.7	2.0
55	24.8	13.1	2.7
60	19.0	17.1	3.5
65	14.8	23.0	4.7

Discussion and recommendations.

The Georges Bay Venus Clam stock is categorised as environmentally limited. Environmental processes, especially freshwater pulses, have altered recruitment and natural mortality to atypical levels so productivity has declined (Maguire, 2005; Jones and Gardner, 2016). The 2017 survey estimated the total biomass in the fished area to be 76.2 t, substantially lower than that of the three prior surveys: 284.7 t in 2009, 537.4 t in 2012 and 463.0 t in 2014. The estimated biomass is below the biomass limit reference point (B_{LIM}) of 107.5 t (20% the maximum recorded biomass) recommended by IMAS (Jones and Gardner, 2016).

The decrease in biomass post 2014 has largely been attributed to higher than average natural mortality, most likely driven by environmental influences given low levels of fishing mortality (Jones and Gardner, 2016). Length frequency distributions show that the large cohort of legal sized stock in 2012 and 2014 has all but disappeared. The 2017 survey showed that 69% of the population in terms of abundance, equating to 35% of the biomass, is under the LML of 40 mm. The two cohorts observed had modal lengths at or below the LML. The strongly represented smaller successive year-classes gives confidence that stock levels have the potential to rebuild in the short term.

Given the estimated total biomass is below the recommended B_{LIM}, we recommend a conservative TACC be set at a level lower than the 10% of the total biomass (76.2 t) as described in Shellfish Fishery Policy Document (DPIPWE 2007), which would equate to 7.62 t. A more conservative TACC could instead be based on the legal sized biomass. Ten percent of the legal sized biomass (i.e. the biomass greater than the LML of 40 mm), equates to a TACC of 4.9 t. This low level of harvesting is conservative because : (i) it is based only on the legal sized portion of the stock; (ii) there is evidence of strong future recruitment from the length frequency data; and (iii) additional, unmeasured biomass is known to exist outside of the survey areas and would contribute to the spawning biomass of the region.

Slight various to the methodology were applied during this survey, with quadrats (n = 5) taken at intervals along a randomly laid 100m transect in a single dive. In previous surveys one quadrat was taken per dive, resulting in up to 100 dives per survey (2 days). The adjusted methodology resulted in an 80% reduction in the number of dive events, reduced the amount of swimming in strong currents, which greatly increased safety.

Vongole - Ansons Bay

Background

The commercial fishery for Vongole (*Katelysia scalarina*) clams takes place on an inter-tidal sandbar in Ansons Bay, North East Tasmania. The current management strategy includes limited entry (three licences), a LML of 32 mm, a TACC set at 10% of the most recent total biomass estimate and a resurvey of biomass every two to three years. Since 2007, fishing has been restricted to a defined zone within Ansons Bay as a further measure to protect the clam stocks, and birdlife from indirect effects of fishing (Maguire, 2005). Formerly, fishing occurred to the north of this zone along the bayhead spit to Shark Bay, and eastwards in the channel towards the sea. Apart from daily bag limits, there is no limit to the annual recreational catch, but it is understood that the recreational catch is insignificant in the context of the total catch. Anecdotally, concerns about recent severe harmful algal blooms in the region has deterred harvesting.

A rapid and extreme decline in abundance of Vongole at Ansons Bay was apparent in 2014, with the 2015 biomass estimate of 27 t being 13% of the peak recorded biomass of 202 t in 2002. The most probable cause for the population collapse appeared related to both the low levels of pre-recruits observed in the 2006, 2012 and 2015 surveys, exacerbated by sporadic events of high natural mortality and ongoing fishing mortality of recruited Vongole (Tarbath and Gardner, 2015). It was noted during the 2015 survey that the density of non-commercial bivalve species (e.g. *Katelysia rhytiphora*, *Paphies sp.*, *Callista sp.*) was remarkably low compared with previous years, indicating that an environmental factor had increased mortality of Vongole and other bivalves, rather than fishing mortality (Tarbath and Gardner, 2015). The fishery was closed in 2015 following the stock decline.

2017 assessment

The survey was conducted by sampling from quadrats placed randomly at regular (approx. 30 m) intervals over the fished area (estimated area 149,049 m^2) over two days in April and June 2017. The tide was low, and the entire area of the fishery was surveyed. The position of each quadrat was recorded using a GPS receiver. 153 quadrats of area 0.25 m^2 (i.e. a square sided 500 mm) were sampled, from which a total of 405 clams were recovered (Fig. 4.). The clams were measured, and a subsample weighed (n = 221) to develop a length-weight relationship (weight = a*$length^b$, where a = 0.00012, b = 3.27794). It was estimated the biomass of clams in the area was 30.73 tonnes (95% confidence limits of 26.17 – 35.28 tonnes).

The results from the current and past surveys are presented below for comparison (Tab. 4). The 2017 estimate is slightly greater than but not significantly different to the 2015 estimate. Both the 2015 and 2017 surveys represent an approximate 80% fall in biomass compared to the 2012 survey, and is an abrupt departure from the range of biomass estimates from between 1997 and 2012. The current density of clams at 10.6/m^2 is around 20% of that estimated between 1997 and 2012 (Fig. 5).

Few pre-recruits or juveniles were found in the 2017 survey, with an increase in average size relative to previous surveys (Fig. 6). By comparison, in 2002 there were two distinct groups of pre-recruits modal at 10 mm and 26 mm. The 2009 distribution also shows one group of pre-recruits, modal at 27 mm. Pre-recruits were poorly represented in the 2006 and 2012 distributions,

similar to the 2017 survey, and entirely absent in the 2015 sample distribution. The modal length of 42 mm recorded in the 2017 survey was greater than that of all previous surveys (36-38 mm), suggesting an aging of the population and/or lower levels of recruitment in recent years.

Figure 4. Ansons Bay, showing the position of the 153 sites sampled in the 2017 biomass estimation survey. Yellow polygon indicates the fished area defined by fishers in 2008.

Table 4. Comparison of results obtained from biomass surveys of Vongole beds at Ansons Bay: 1997 to 2017, coupled with commercial fishery data. The fished area was remeasured in 2008, causing a reduction. Between 1997 and 2006, the TACC was derived by summing the weights specified on each fisher's permit. In 2007 and 2008, the TACC was assumed to be 10% of biomass, as it was thereafter. Estimated catches between 2001 and 2005 were reported in the fishery's policy document (DPIPWE, 2007), and between 2008 and 2014 were supplied by DPIPWE. Prior to 2001, catch weights are unknown.

Year	Total area of fishery (m^2)	Population size ('000s)	Density (no./m2)	Biomass (tonnes)	TACC (Tonnes)	Estimated catch (Tonnes)
1997	185,800	6,671	35.9	75.8	9.36	?
1998	185,800	11,890	64.0	98.7	9.36	?
1999					9.36	?
2000	185,800	11,261	60.6	148.6	9.36	?
2001	185,800	14,811	79.7	202.25	9.36	9.72
2002	185,800	10,598	57.0	159.87	9.36	8.77
2003					9.36	8.31
2004					9.36	5.71
2005					9.36	4.18
2006	185,500	9,483	51.1	157.64	9.36	3.01
2007					15.76	2.30
2008					15.76	8.27
2009	149,049	7,783	52.2	127.07	12.71	8.47
2010					12.71	12.58
2011					12.71	11.94
2012	149,049	7,196	48.3	133.32	13.33	12.90
2013					13.33	9.17
2014	149,049	1,391	9.3	27.15	13.33	0.46
2015					0	0
2016					0	0
2017	149,049	1,442	10.6	30.73	0	0

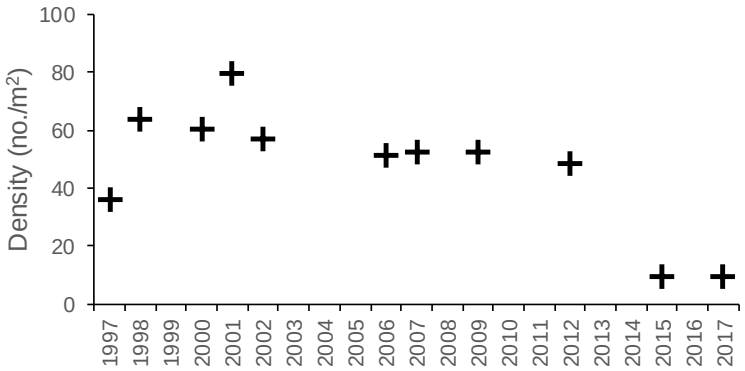

Figure 5. Estimated density (number per square metre) of Vongole collected from Ansons Bay in surveys between 1997 and 2017.

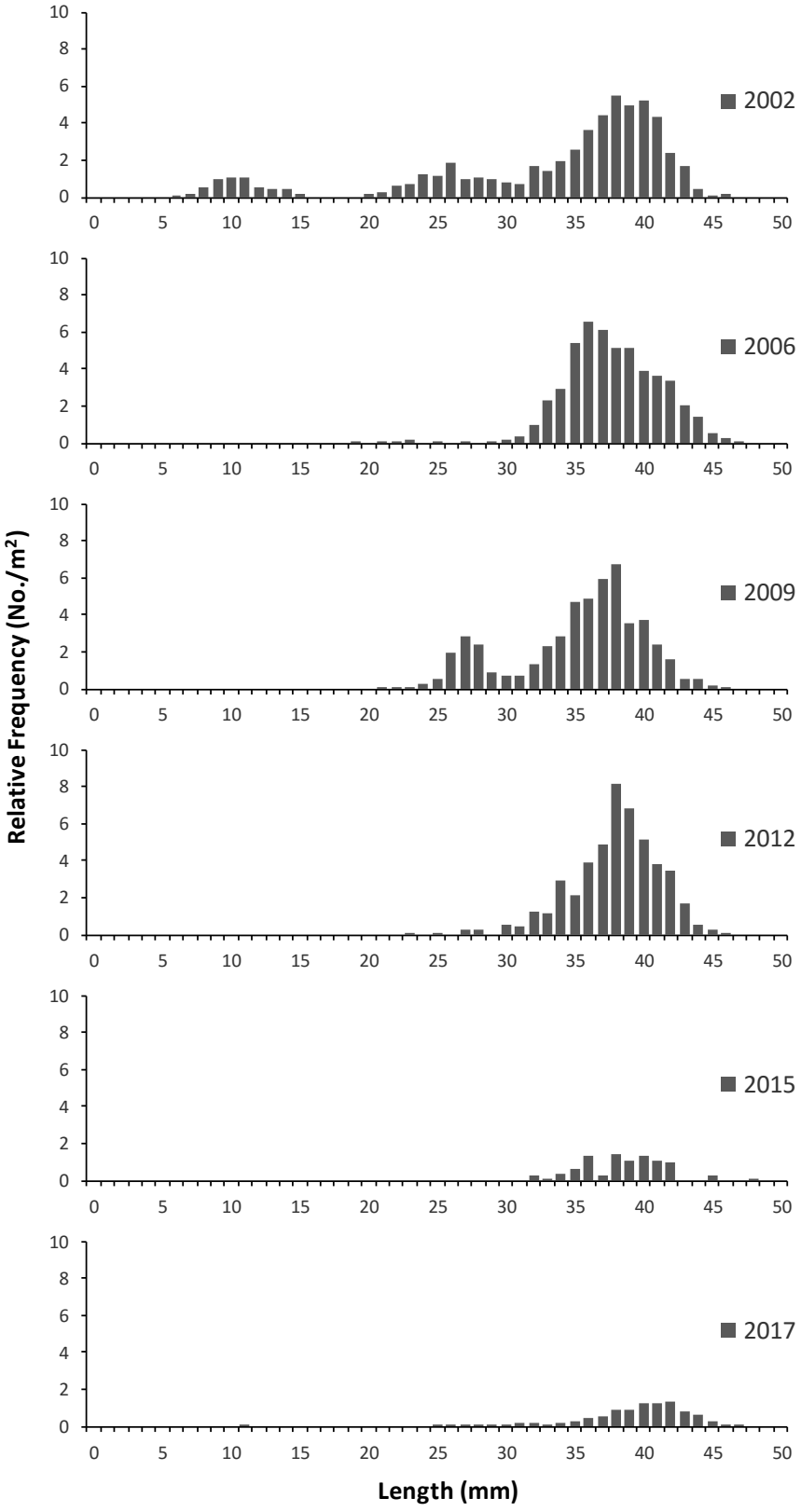

Figure 6. Relative length frequency (no./m^2) distribution of Vongole collected from Ansons Bay in surveys between 2002 and 2017.

Discussion and recommendations

The abundance of Vongole at Ansons Bay remains low, with the current biomass of 30.7 t at 15% of 2002 levels and below the limit reference point of 40 t recommended by Tarbath and Gardner (2015). The length frequency distribution indicates an aging of the population with few pre-recruits. The modal size of 42 mm is the highest recorded for the stock, which in combination with the low biomass is evidence of low recruitment. Natural mortality of the larger (older) size classes will be expected to reduce total biomass further unless recruitment recovers. Given that the fishery was closed following stock decline, and that there is no evidence of stock recovery, we recommend that this stock remains closed.

The population collapse appears to caused by several factors including low levels of pre-recruits as observed in the surveys post 2006, sporadic events of high natural mortality, and fishing mortality of recruited Vongole in 2012 and 2013 (Tarbath and Gardner 2015).

The harvest strategy for this fishery does not include a limit reference point for biomass at which fishing should operate. In the absence of a limit reference point, we recommend closing the fishery to harvests and developing an agreed biomass reference point above which the stock would be considered to have recovered.

References

Dent J., Mayfield S., Ferguson G., Carroll C., and Burch P., 2014, Harvestable biomass of *Katelysia spp.* in the South Australian commercial mud cockle fishery. Stock Assessment Report to PIRSA Fisheries and Aquaculture. SARDI Publication No. F2

DPIPWE, 2007, Shellfish Fishery Policy Document. Information Supporting the Shellfish Management Plan for the *Fisheries (Shellfish) Rules 2007.* Department of Primary Industries and Water, Hobart. Tasmania.

Grove S., 2011, The seashells of Tasmania: a comprehensive guide. Taroona Publications, Hobart.

Haddon M., 2003, Approximate Biomass Estimate for the subtidal *Venerupis* in George's Bay, East Coast Tasmania, 2003, Tasmanian Aquaculture and Fisheries Institute Technical Report. University of Tasmania, Hobart.

Jones, H. and Gardner, C., 2016, Small Bivalve Survey, Assessment and Stock Status Update. Institute for Marine and Antarctic Studies Report. University of Tasmania, Hobart.

Kent G. N., Maguire G. B., Duthie I. and Pugh R. 1999, Spawning, settlement, and growth of the New Zealand venerid *Ruditapes largillierti* (Philippi 1849) in culture. New Zealand Journal of Marine and Freshwater Research 33, 55-62.

Maguire, G. B., 2005, Enhancing Tasmanian Clam Resources. Fisheries Research and Development Corporation Project No. 93/232. Tasmanian Aquaculture and Fisheries Institute. University of Tasmania, Hobart.

TAFI, 2008, Small Bivalve Fishery – 2008. Technical Report, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

TAFI, 2009, Small Bivalve Fishery – 2009. Technical Report, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

Tarbath D., 2010, Small Bivalve Fishery - 2010. Institute for Marine and Antarctic Studies Report, University of Tasmania, Hobart.

Tarbath D. & Gardner C., 2012, Small Bivalve Fishery – 2012. Institute for Marine and Antarctic Studies Report, University of Tasmania, Hobart.

Tarbath D. & Gardner C., 2013, Small Bivalve Fishery – 2013. Institute for Marine and Antarctic Studies Report, University of Tasmania, Hobart.

Tarbath D. & Gardner C., 2014, Small Bivalve Fishery – 2014. Institute for Marine and Antarctic Studies Report, University of Tasmania, Hobart.

Tarbath D. & Gardner C., 2014, Small Bivalve Fishery – 2015. Institute for Marine and Antarctic Studies Report, University of Tasmania, Hobart.