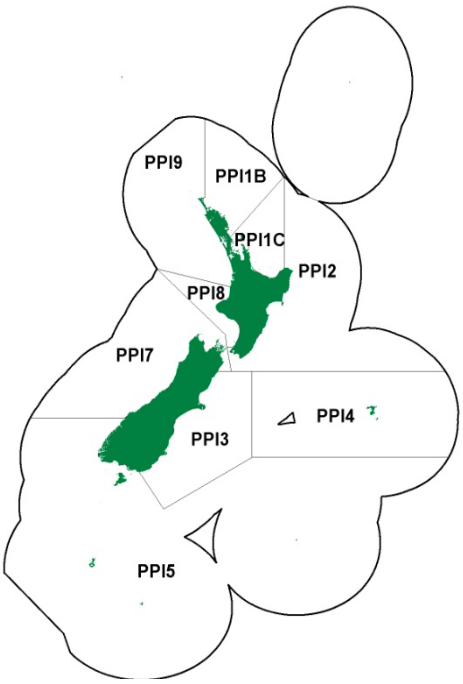
Pipi (PPI)

(*Paphies australis*)
Pipi



1. FISHERY SUMMARY

Pipi are important shellfish both commercially and for non-commercial fishers. PPI 1A (which is located in Whangarei harbour and mapped in the following PPI 1A section) was introduced into the Quota Management System (QMS) on 1 October 2004, the other PPI stocks listed in Table 1 were introduced in October 2005. The total TAC introduced to the QMS was 713 t. This consisted of a 204 t TACC, an allocation of 242 t for both recreational allowance and customary allowance and 25 t allowance for other sources of mortality (Table 1). No changes have occurred to the TAC since. The fishing year is from 1 October to 30 September and commercial catches are measured in greenweight. The largest commercial fishery is in PPI 1A and the largest recreational fishery is in PPI 1C.

Table 1: Recreational, Customary non-commercial allocations, TACs and TACCs (t) for pipi.

Fishstock	Recreational Allowance	Customary non-commercial allowance	Other sources of mortality	TACC	TAC
PPI 1A	25	25	0	200	250
PPI 1B	76	76	8	0	160
PPI 1C	115	115	10	3	243
PPI 2	3	3	1	0	7
PPI 3	9	9	1	0	19
PPI 4	1	1	1	0	3
PPI 5	1	1	1	0	3
PPI 7	1	1	1	1	4
PPI 8	1	1	1	0	3
PPI 9	10	10	1	0	21
Total	242	242	25	204	713

Regulations require that all commercial gathering is to be done by hand. Fishers typically use a mask and snorkel. There is no minimum legal size (MLS) for pipi, although fishers probably favor larger pipi (over 60 mm shell length). There is no apparent seasonality in the pipi fishery, as pipi are available for harvest year-round. Some commercial catch is taken from PPI 1C (Table 2 and Figure 1) but the great majority of commercial catch is reported from PPI 1A and this will be dealt with in a separate section.

New Zealand operates a mandatory shellfish quality assurance programme for all areas of commercially growing or harvesting bivalve shellfish for human consumption. Shellfish caught outside this programme can be sold only for bait. This programme is based on international best practice and is managed by MPI in cooperation with the District Health Board Public Health Units and the shellfish industry[1]. Before any area can be used to grow or harvest bivalve shellfish, public health officials survey both the water catchment area to identify any potential pollution issues and microbiologically sample water and shellfish over at least a 12-month period, so that all seasonal influences are explored. This information is evaluated and, if suitable, the area classified and listed by NZFSA for harvest. There is then a requirement for regular monitoring of the water and shellfish flesh to verify levels of microbiological and chemical contaminants. Management measures stemming from this testing include closure after rainfall, to deal with microbiological contamination from runoff. Natural marine biotoxins can also cause health risks so testing also occurs for this at regular intervals. If toxins are detected above the permissible level the harvest areas are closed until the levels fall below the permissible level. Products are also traceable so the source and time of harvest can always be identified in case of contamination.

Table 2: Reported commercial landings of pipi (t greenweight) from PPI 1C from 2004–05 to present.

Year	Reported landings (t)	Limit (t)
2004–05	0	3
2005–06	0.86	3
2006–07	1.69	3
2007–08	1.80	3
2008–09	0.38	3
2009–10	0.62	3
2010–11	0	3
2011–12	0	3
2012–13	0	3

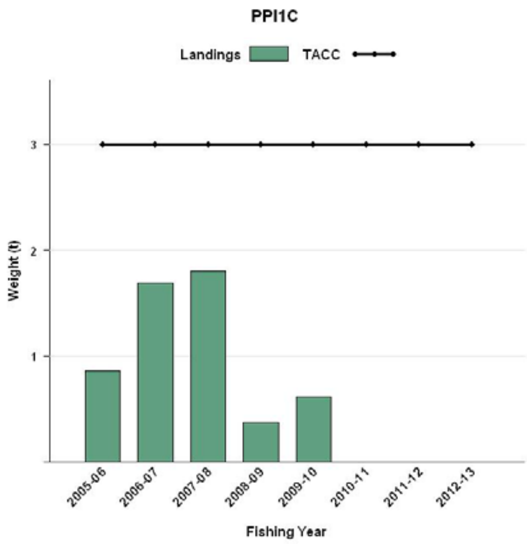


Figure 1: Historical landings and TACC for PPI 1C (Hauraki Gulf and the Bay of Plenty). Note that this figure does not show data prior to entry into the QMS.

[1]. 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.foodsafety.govt.nz/industry/sectors/seafood/bms/growers-harvesters.htm

1.2 Recreational fisheries

The recreational fishery is harvested entirely by hand digging. Large pipi 50 mm (maximum shell length) or greater are probably preferred. The 1996, 1999–00, and 2000–01 National Marine Recreational Fishing Surveys recorded recreational harvests for pipi in FMA 1. The estimated numbers of pipi harvested were 2.1, 6.6, and 7.2 million respectively but no mean harvest weight was available to convert these harvest estimates to tonnages. The Recreational Technical Working Group concluded that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and, c) the 2000 and 2001 estimates are implausibly high for many important fisheries. No recreational harvest estimates specific to the Mair Bank pipi fishery are available but the recreational harvest of pipi is likely to be small compared with commercial landings there.

1.3 Customary fisheries

In common with many other intertidal shellfish, pipi are very important to Maori as a traditional food. However, no reliable quantitative information on the level of customary take is available.

1.4 Illegal catch

No quantitative information on the level of illegal catch is available.

1.5 Other sources of mortality

No quantitative nationwide information on the level of other sources of mortality is available.

2. BIOLOGY

The pipi (*Paphies australis*) is a common burrowing bivalve mollusc of the family Mesodesmatidae. Pipi are distributed around the New Zealand coastline, including the Chatham and Auckland Islands (Powell 1979), and are characteristic of sheltered beaches, bays and estuaries (Morton & Miller 1968). Pipi are tolerant of moderate wave action, and commonly inhabit coarse shell sand substrata in bays and at the mouths of estuaries where silt has been removed by waves and currents (Morton & Miller 1968). They have a broad tidal range, occurring intertidally and subtidally in high-current harbour channels to water depths of at least 7 m (Dickie 1986a, Hooker 1995a), and are locally abundant, with densities greater than 1000 m^{-2} in certain areas (Grace 1972).

Pipi reproduce by free-spawning, and most individuals are sexually mature at about 40 mm shell length (SL) (Hooker & Creese 1995a). Gametogenesis begins in autumn, and by late winter many pipi have mature, ready-to-spawn gonads (Hooker & Creese 1995a). Pipi have an extended breeding period from late winter to late summer, with greatest spawning activity occurring in spring and early summer. Fertilised eggs develop into planktotrophic larvae, and settlement and metamorphosis occur about three weeks after spawning (Hooker 1997). In general, pipi have been considered sedentary when settled, although Hooker (1995b) found that pipi may utilise water currents to disperse actively within a harbour. The trigger for movement is unknown, but this ability to migrate may have important implications to their population dynamics.

Pipi growth dynamics are not well known. Growth appears to be fairly rapid, at least in dynamic, high-current environments such as harbour channels. Hooker (1995a) showed that pipi at Whangateau Harbour (northeastern New Zealand) grew to about 30 mm in just over one year (16–17 months), reached 50 mm after about three years, and grew very slowly after attaining 50 mm. There was a strong seasonal component to growth, with rapid growth occurring in spring and summer, and little growth in autumn and winter. Williams et al (2007) used Hooker's (1995a) tag-recapture and length frequency time series data to generate formal growth estimates for Whangateau Harbour pipi (Table 3). Estimates are also available from time series of size frequencies on sheltered Auckland beaches (Table 3; Morrison & Browne 1999, Morrison et al 1999), although these were likely to have been poorly estimated due to variability in the length data. Growth on the intertidal section of Mair bank was estimated by (Pawley et al 2013) using the results of a notch-tagging experiment in 2009–10.

These estimates are likely to underestimate growth of pipi in the commercial fishery because tagged shells came from the intertidal zone wheras commercial harvesting is conducted primarily in the subtidal (where growth is expected to be quicker).

Little is known about the natural mortality or maximum longevity of pipi. Haddon (1989) suggested that pipi are unlikely to live much more than 10 years, and used assumed maximum ages of 10, 15 and 20 years old to estimate maximum constant yield for Mair Bank pipi in 1989. The estimation of the rate of instantaneous natural mortality (M) is difficult for pipi owing to the immigration and emigration of individuals from different areas. As the timing and frequency of these movements are largely unknown, the separation of mortality from movement effects is likely to be problematic. Williams et al (2007) assumed values of M = 0.3, 0.4, and 0.5 to estimate yields for Mair Bank in 2005–06.

Table 3: Estimates of biological parameters for pipi.

Growth		Location	Year	Source
L_∞ (mm SL)	K			
57.3	0.46	inner Whangateau Harbour site	1992–93	Williams et al (2007)
63.9	0.57	Whangateau Harbour entrance	1992–93	Williams et al (2007)
41.1	0.48	Cheltenham Beach, North Shore	1997–98	Morrison et al (1999)
58.9	0.15	Mill Bay, Manukau Harbour	1997–98	Morrison et al (1999)
84.6	0.09	Mill Bay, Manukau Harbour	1998–99	Morrison & Browne (1999)
Natural mortality				
M = 0.3–0.5 (assumed values)		-	-	Williams et al (2007)
Size at maturity				
40 mm SL		Whangateau Harbour	-	Hooker & Creese (1995a)

3. STOCKS AND AREAS

Little is known of the stock structure of pipi. A study of biological connectivity that is currently underway includes pipi, but no results have been reported at the time of this report.

4. STOCK ASSESSMENT

There is a stock assessment for PPI 1A.

5. STATUS OF THE STOCKS

There were negligible reported landings in 2012–13 for any PPI stocks except PPI 1A (which is reported separately). The status of all PPI stocks other than PPI 1A are unknown, but are assumed to be close to virgin biomass.

6. FOR FURTHER INFORMATION

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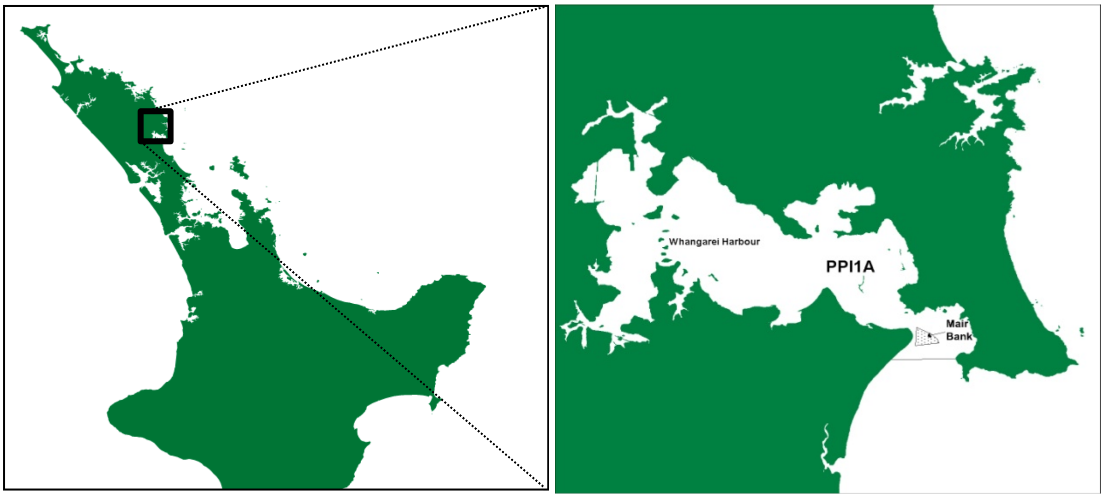
PPI (PPI 1A) Mair Bank (Whangarei Harbour)

(*Paphies australis*)
Pipi



1. FISHERY SUMMARY

Pipi 1A was introduced into the Quota Management System (QMS) on 1 October 2004 with a TAC of 250 t, comprising a TACC of 200 t, and customary and recreational allowances of 25 t each. These limits have remained unchanged since.

1.1 Commercial fisheries

Prior to the introduction of pipi, in Whangarei Harbour (PPI 1A) and FMA PPI 1, to the QMS in 2004, the commercial fishery area was defined in regulation as that area within 1.5 nautical miles of the coastline from Home Point, at the northern extent of the Whangarei Harbour entrance, to Mangawhai Heads, south of the harbour. Commercial fishers tend to gather pipi from the seaward edge of Mair Bank, particularly the southern end, and avoid the centre of the bank itself where there is a lot of shell debris. Regulations require that all gathering be done by hand, and fishers typically use a mask and snorkel. There is no minimum legal size (MLS) for pipi, although a sample measured from the commercial catch in PPI 1A in 2005 suggested that fishers favour larger pipi (over 60 mm SL, Williams et al 2007). Pipi are available for harvest year-round, so there is no apparent seasonality in the fishery.

Over 99% of the total commercial landings of pipi in New Zealand have been from general statistical area 003 and PPI 1. In the most recent years, where a distinction has been made, virtually all the landings have been from PPI 1A (Whangarei Harbour). Total commercial landings of pipi reported on Licensed Fish Receiver Returns (LFRRs) have remained reasonably stable through time, averaging 187 t annually in New Zealand since 1986–87 (Table 1). The highest recorded landings were in 1991–92 (326 t). There is no evidence of any consistent seasonal pattern in either the level of effort or catch per unit effort (CPUE) in the pipi fishery. CPUE in the pipi targeted fishery increased between 1989–90 and 1992–93, was then relatively stable up to 2002–03 but increased in 2003–04 and 2004–05 (Williams et al 2007). No CPUE information has since been analysed.

Prior to the introduction of PPI 1A to the QMS there were nine permit holders for Whangarei Harbour. No new entrants have entered the fishery since 1992 when commercial access to the fishery was constrained by the general moratorium on granting new fishing permits for non-QMS fisheries. Access to the fishery has, however, been restricted through other regulations since the mid-1980s, and more formally since 1988. Under previous non-QMS management arrangements, there was a daily catch limit of 200 kg per permit holder, meaning that, collectively, the nine permit holders could, theoretically, take 657 t of pipi per year. The permit holders have indicated that annual harvest quantities have been considerably less than the potential maximum, because of the relatively low market demand for commercial product rather than the availability of the resource. On 1 October 2004, pipi in Whangarei Harbour (PPI 1A) were introduced into the QMS, and the nine existing permits were replaced with individual transferable quotas. The 200 kg daily catch limit no longer applies. A total allowable catch (TAC) of 250 t was set, comprised of a total allowable commercial catch (TACC) of 200 t, a customary allowance of 25 t, and a recreational allowance of 25 t. Figure 1 shows the historical landings and TACC values for PPI 1A.

Table 1: Reported commercial landings (from Licensed Fish Receiver Returns; LFRR) of pipi (t greenweight) in New Zealand since 1986–87. Prior to the introduction of PPI 1A to the QMS on 1 October 2004, the fishery was limited by daily limits which summed to 657 t greenweight in a 365 day year, but there was no explicit annual restriction. A TACC of 200 t was set for PPI 1A on 1 October 2004.

Year	Reported landings (t)	Limit (t)	Year	Reported landings (t)	Limit (t)
1986–87	131	657	1999–00	143	657
1987–88	133	657	2000–01	184	657
1988–89	134	657	2001–02	191	657
1989–90	222	657	2002–03	191	657
1990–91	285	657	2003–04	266	657
1991–92	326	657	2004–05	206	200
1992–93	184	657	2005–06	137	200
1993–94	258	657	2006–07	135	200
1994–95	172	657	2007–08	142	200
1995–96	135	657	2008–09	131	200
1996–97	146	657	2009–10	136	200
1997–98	122	657	2010–11	87	200
1998–99	130	657	2011–12	55	200
			2012–13	0	200

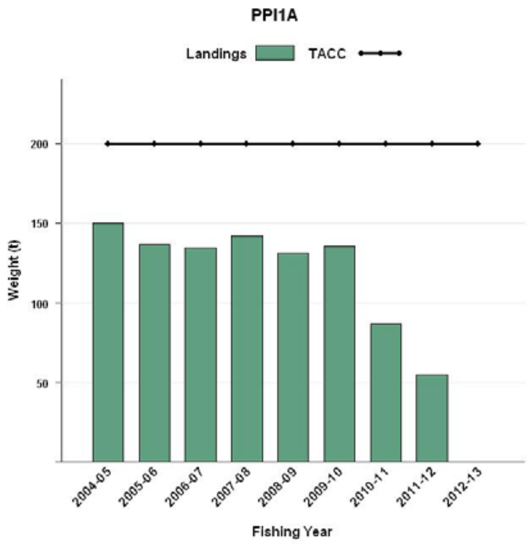


Figure 1: Historical landings and TACC for PPI 1A (Whangarei Harbour). QMS data from 2004–05 to present.

1.2 Recreational fisheries
This is covered in the general pipi section.

1.3 Customary non-commercial fisheries
This is covered in the general pipi section.

1.4 Illegal catch
This is covered in the general pipi section.

1.5 Other sources of mortality
There is some concern about the possibility of changes in bank stability that could arise from operations other than fishing in Whangarei Harbour (e.g., harbour dredging, port developments), which could lead to changes in the pipi fishery. Radical changes to the local hydrology could affect the size or substratum of Mair Bank with consequent effects on its pipi population. Also, as suspension feeders, pipi may be adversely affected by increased sediment loads in the water column.

2. BIOLOGY
This is covered in the general pipi section.

3. STOCKS AND AREAS
Little is known of the stock structure of pipi. A study of biological connectivity that is currently underway includes pipi, but no results have not been finalised at the time of this report. The commercial fishery based on Mair Bank in Whangarei Harbour (PPI 1A) forms a geographically discrete area and is assumed for management purposes to be a separate stock.

4. STOCK ASSESSMENT
Stock assessment for Mair Bank pipi was conducted in 2005 and 2010 using absolute biomass surveys, and yield per recruit and spawning stock biomass per recruit modelling.

4.1 Estimates of fishery parameters and abundance
Estimates of the fishing mortality reference point $F_{0.1}$ are available from yield per recruit modeling (Table 2). Parallel spawning stock biomass per recruit modeling was conducted to estimate the SSBPR corresponding with each estimate of $F_{0.1}$. These estimates are sensitive to the assumed value of natural mortality (*M*) and uncertainty in pipi growth parameters.

Table 2: Estimates of the reference rate of fishing mortality $F_{0.1}$ and corresponding spawning stock biomass per recruit at three different assumed rates of natural mortality (*M*) for two harvest strategies ('no restriction' and 'current'). SL, shell length (at recruitment). Estimates from Williams et al (2007).

'No restriction' strategy (harvest pipi of a size that maximizes YPR)					
Assumed M	Optimal age at recruitment (y)	SL (mm)	$F_{0.1}$	YPR (g)	SSBPR (%)
0.3	3	52	0.437	4.93	44
0.4	2.75	51	0.550	3.50	45
0.5	2.5	49	0.648	2.58	45
'Current' strategy (harvest pipi 60 mm and over)					
Assumed M	Age at recruitment (y)	SL (mm)	$F_{0.1}$	YPR (g)	SSBPR (%)
0.3	5	60	0.564	3.98	62
0.4	5	60	0.755	2.41	70
0.5	5	60	0.949	1.47	76

4.2 Biomass estimates
Virgin biomass (B_0) and the biomass that will support the maximum sustainable yield (B_{MSY}) are unknown for Mair Bank pipi. Only three biomass estimates have been made for the Mair Bank pipi population: in 1989 using a grid survey, in 2005 using stratified random sampling and in 2010 using a systematic random start. The 1989 estimate of 2245 t (± 10%) can be considered conservative because only the intertidal area of the bank was surveyed, and pipi are known to exist in the shallow subtidal area of the bank. Estimates of biomass are available for Mair Bank and are sensitive to the assumed size at recruitment (Table 3).

Table 3: Estimated recruited biomass (*B*) of pipi on Mair Bank in 2005 and 2010 for different assumed sizes at recruitment to the fishery. Source: Williams et al (2007) and Pawley et al (2013).

Year	Assumed shell length at recruitment (mm)	Intertidal stratum		Subtidal stratum		Mair Bank Total	
		B (t)	CV (%)	*B* (t)	CV (%)	*B* (t)	CV (%)
2005	1 (total biomass)	3 602	11.4	6 940	19.5	10 542	13.4
2005	40	3 569	11.4	6 922	19.5	10 490	13.4
2005	45	3 434	11.4	6 791	19.6	10 226	13.6
2005	50	2 986	11.3	5 989	20.1	8 975	14.0
2005	55	2 022	11.1	3 855	23.8	5 877	16.0
2005	60	1 004	13.1	2 013	37.5	3 017	25.4
2010	1 (total biomass)	2 233	17.4	2 218	33.0	4 452	15.2
2010	50	2 001	18.1	1 889	36.0	3 890	16.6
2010	60	1 751	18.3	1 393	33.7	3 145	17.4

4.3 Yield estimates and projections

Maximum Constant Yield (*MCY*) was estimated using method 2 (see the guide to biological reference points in the introduction chapter of this plenary document):

$$\mathrm{MCY} = 0.5 F_{0.1} B_{av}$$

where $F_{0.1}$ is a reference rate of fishing mortality and B_{av} is the historical average recruited biomass (estimated as the mean recruited biomass from the 2005 and 2010 surveys). *M* is assumed to be 0.3 and the corresponding $F_{0.1}$ is 0.564 (Williams et al 2007 revised version). The size at recruitment is assumed to remain at 60 mm and the corresponding B_{av} is 3081 t.

$$\mathrm{MCY} = 0.5 \times 0.564 \times 3081 = 869 \text{ t}$$

This estimate of *MCY* would have a CV at least as large as those associated with the 2005 and 2010 estimates of recruited biomass (17–25%), and is sensitive to the assumed size at recruitment to the fishery, the assumed natural mortality, and to uncertainty in $F_{0.1}$ (arising from the considerable uncertainty in model input values for growth and *M*) (Table 4).

Table 4: Sensitivity of maximum constant yield (*MCY*, method 2) to estimates of size at recruitment and the assumed natural mortality, *M*. B_{av}, the historical average recruited biomass, was estimated for two sizes at recruitment (50 and 60 mm SL) using the 2005 and 2010 survey data.

SL at recruitment (mm)	B_{av}	*M*	$F_{0.1}$	*MCY* (t)
50	6433	0.3	0.40	1 300
		0.4	0.54	1 729
		0.5	0.68	2 182
60	3081	0.3	0.56	869
		0.4	0.76	1 163
		0.5	0.95	1 462

CAY was not estimated because there is no estimate of current biomass.

4.4 Other factors

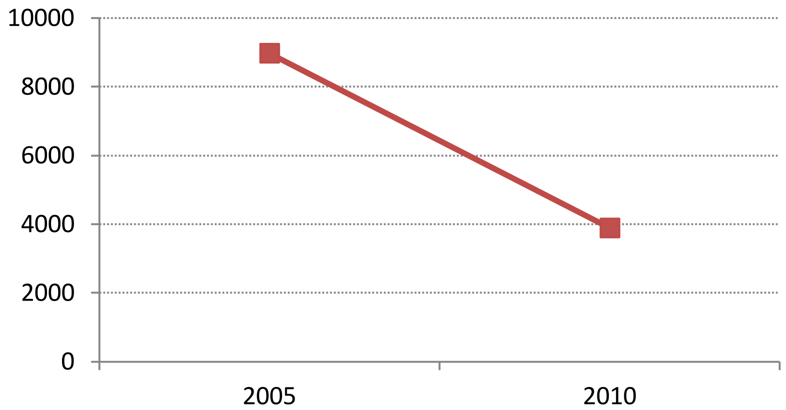
None

5. STATUS OF THE STOCKS

Stock Structure Assumptions
For the purpose of this assessment PPI 1A is assumed to be a discrete stock.

Stock Status	
Year of Most Recent Assessment	2012
Reference Points	Target(s): Default 40% B_0 Soft Limit: 20% B_0 Hard Limit: 10% B_0
Status in relation to Target	Likely (> 60%) to be above target
Status in relation to Limits	Soft Limit: Very Unlikely (< 10%) to be below limit. Hard Limit: Very Unlikely (< 10%) to be below limit.

Historical Stock Status Trajectory and Current Status



Biomass (t) of pipi ≥ 50 mm shell length from Moir Bank.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Complete surveys were conducted in 2005 and 2010. These surveys showed similar recruited biomass (>60 mm SL) but the total and spawning stock biomass (>40 mm SL) were both substantially higher in 2005 than in 2010
Recent Trend in Fishing Mortality or Proxy	Landings continue to be substantially less than estimates of *MCY*

Projections and Prognosis	
Stock Projections or Prognosis	Stock size is Likely (> 60%) to remain above the target biomass under current catches and TACCs.
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Unlikely (< 40%)

Assessment Methodology and Evaluation		
Assessment Type	Level 2: Partial Quantitative Stock Assessment	
Assessment Method	Reference rate of fishing mortality applied to absolute biomass estimates from quadrat surveys	
Assessment Dates	Latest assessment: 2012	Next assessment: Unknown
Overall assessment quality rank	1 – High Quality	
Main data inputs (rank)	- Two absolute abundance estimates (quadrat surveys). - Biological parameters for YPR/SSBPR models.	1 – High Quality 1 – High Quality
Data not used (rank)	-	

Changes to Model Structure and Assumptions	None since the 2005 assessment.
Major Sources of Uncertainty	Growth for the subtidal portion of this population is poorly known. The available data come from other areas or the intertidal portion, both of which can be expected to support slower growth than the area where the fishery occurs. This, together with poor information on M and the size at recruitment to the fishery, makes the YPR modeling and reference rate of fishing mortality very uncertain.
Qualifying Comments	
Recruitment appears from the 2005 and 2010 survey length frequency distributions to be variable. This may lead to larger variations in the spawning and recruited biomass than the estimates of biomass suggest.	
Fishery Interactions	
This is a hand-gathering fishery with no substantial bycatch or other interactions.	

6. FOR FURTHER INFORMATION

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