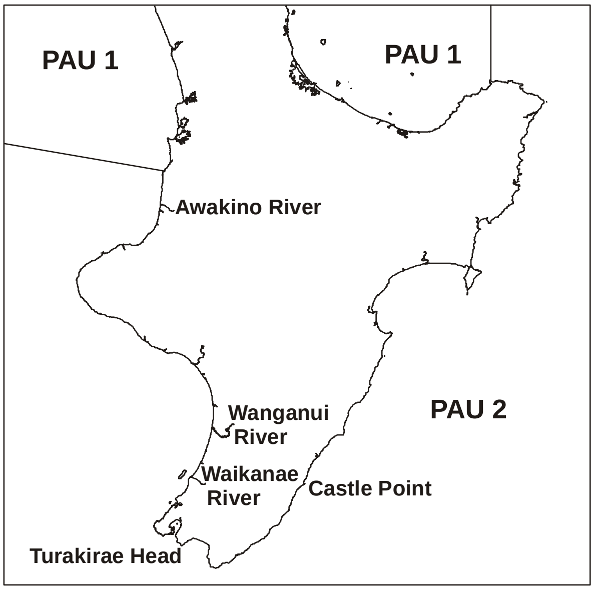
PAUA (PAU 2) – Wairarapa / Wellington / Taranaki

(*Haliotis iris*)
Paua



1. FISHERY SUMMARY

PAU 2 was introduced into the Quota Management System in 1986–87 with a TACC of 100 t. As a result of appeals to the Quota Appeal Authority, the TACC was increased to 121.19 t in 1989 and has remained unchanged to the current fishing year (Table 1). There is no TAC for this QMA: before the Fisheries Act (1996) a TAC was not required. When changes have been made to a TACC after 1996, stocks have been assigned a TAC.

Table 1: Total allowable catches (TAC, t) allowances for customary fishing, recreational fishing, and other sources of mortality (t) and Total Allowable Commercial Catches (TACC, t) declared for PAU 2 since introduction to the QMS.

Year	TAC	Customary	Recreational	Other mortality	TACC
1986–1989	-	-	-	-	100
1989–present	-	-	-	-	121.19

1.1 Commercial fisheries

The fishing year runs from 1 October through to 30 September. Most of the commercial catch comes from the Wairarapa and Wellington South coasts between Castle Point and Turakirae Head. The western area between Turakirae Head and the Waikanae River is closed to commercial fishing.

On 1 October 2001 it became mandatory to report catch and effort on PCELRs using the fine-scale reporting areas that had been developed by the New Zealand Paua Management Company for their voluntary logbook programme (Figure 1).

1.2 Recreational fisheries

The most recent recreational fishery survey "The National Panel Survey of Marine Recreational Fishers 2011–12: Harvest Estimates (2014)", estimated about 80 t of paua were harvested by recreational fishers in PAU 2 in 2011–12.

Because paua around Taranaki are naturally small and never reach the minimum legal size (MLS) of 125 mm, a new MLS of 85 mm was introduced for recreational fishers from 1 October 2009. The new length is on a trial basis for five years and applies between the Awakino and Wanganui rivers.

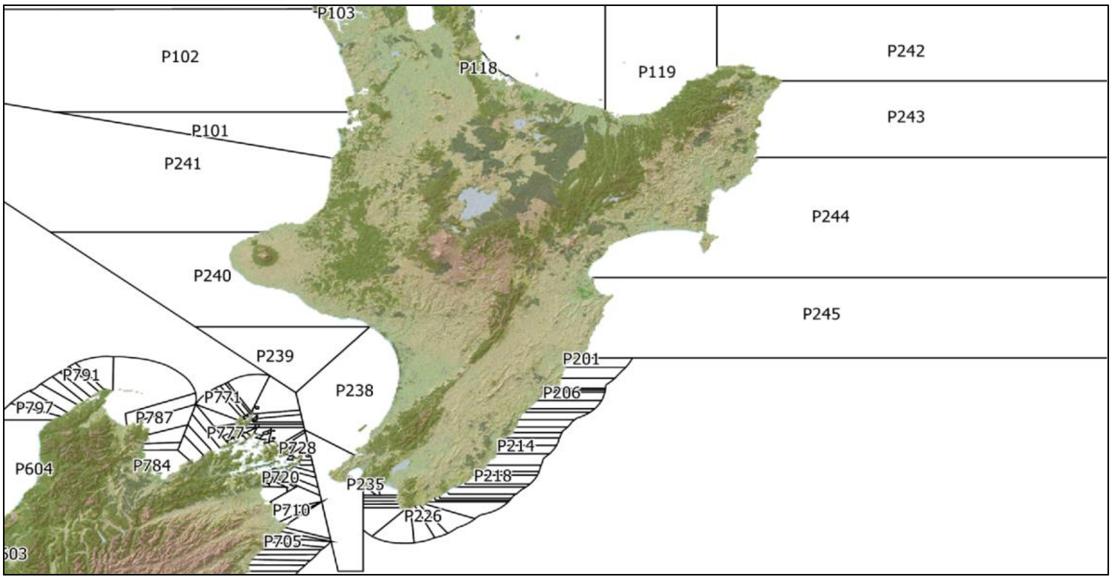


Figure 1: Map of fine scale statistical reporting areas for PAU 2.

Landings for PAU 2 are shown in Table 2.

Table 2: TACC and reported landings (t) of paua in PAU 2 from 1983–84 to present.

Year	Landings	TACC
1983–84*	110	–
1984–85*	154	–
1985–86*	92	–
1986–87*	96.2	100
1987–88*	122.11	111.33
1988–89*	121.5	120.12
1989–90	127.28	121.19
1990–91	125.82	121.19
1991–92	116.66	121.19
1992–93	119.13	121.19
1993–94	125.22	121.19
1994–95	113.28	121.19
1995–96	119.75	121.19
1996–97	118.86	121.19
1997–98	122.41	121.19
1998–99	115.22	121.19
1999–00	122.48	121.19
2000–01	122.92	121.19
2001–02	116.87	121.19
2002–03	121.19	121.19
2003–04	121.06	121.19
2004–05	121.19	121.19
2005–06	121.14	121.19
2006–07	121.20	121.19
2007–08	121.06	121.19
2008–09	121.18	121.19
2009–10	121.13	121.19
2010–11	121.18	121.19
2011–12	120.01	121.19
2012–13	122	121
2013–14	120	121

* FSU data.

1.3 Customary fisheries

For further information on customary fisheries refer to the introductory PAU Working Group Report.

1.4 Illegal catch

It is widely believed that the level of illegal harvesting is high around Wellington and on the Wairarapa coast. For further information on illegal catch refer to the introductory PAU Working Group Report.

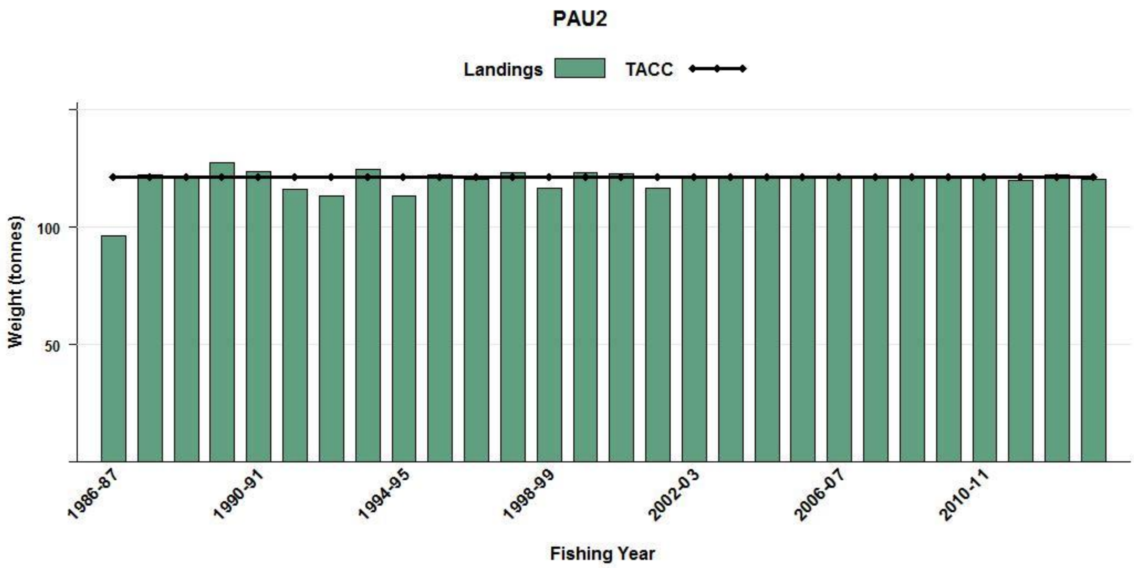


Figure 2: Historical landings and TACC for PAU 2 from 1983–84 to present. QMS data from 1986–present.

1.5 Other sources of mortality

For further information on other sources of mortality refer to the introductory PAU Working Group Report.

2. BIOLOGY

For further information on paua biology refer to the introductory PAU Working Group Report. A summary of published estimates of biological parameters for PAU 2 is presented in Table 3.

Table 3: Estimates of biological parameters (*H. iris*)

Area		Estimate	Source
1. Size at maturity (shell length)			
Wellington	50% mature	71.7 mm	Naylor et al. (2006)
Taranaki	50% mature	58.9 mm	Naylor & Andrew (2000)
2. Fecundity = a (length)^b (eggs, shell length in mm)			
Taranaki	a = 43.98	b = 2.07	Naylor & Andrew (2000)
3. Exponential growth parameters (both sexes combined)			
Wellington	g_{50}	30.58 mm	Naylor et al. (2006)
	g_{100}	14.8 mm	
Taranaki	G_{25}	18.4 mm	Naylor & Andrew (2000)
	G_{75}	2.8 mm	

3. STOCKS AND AREAS

For further information on stocks and areas refer to the introductory PAU Working Group Report.

4. RELATIVE ABUNDANCE INDEX

A standardised CPUE index based on commercial catch was constructed covering the 1990 to 2014 fishing years (McKenzie in press). Two separate indexes were estimated, the first was estimated from CELR data for the fishing years 1989–90 to 2001–02, and the second was estimated from PCELR data for the fishing years 2002–03 to 2013–14. FSU data covering the period from 1983 to 1988 was not used in the standardisation due to problems with this data including: 1) a high proportion of missing values for the vessel field; 2) ambiguity and inaccuracies in what is recorded for the important fishing duration field and 3) low coverage of the annual catch.

There was little evidence of serial depletion over the past 13 years (Figure 3).

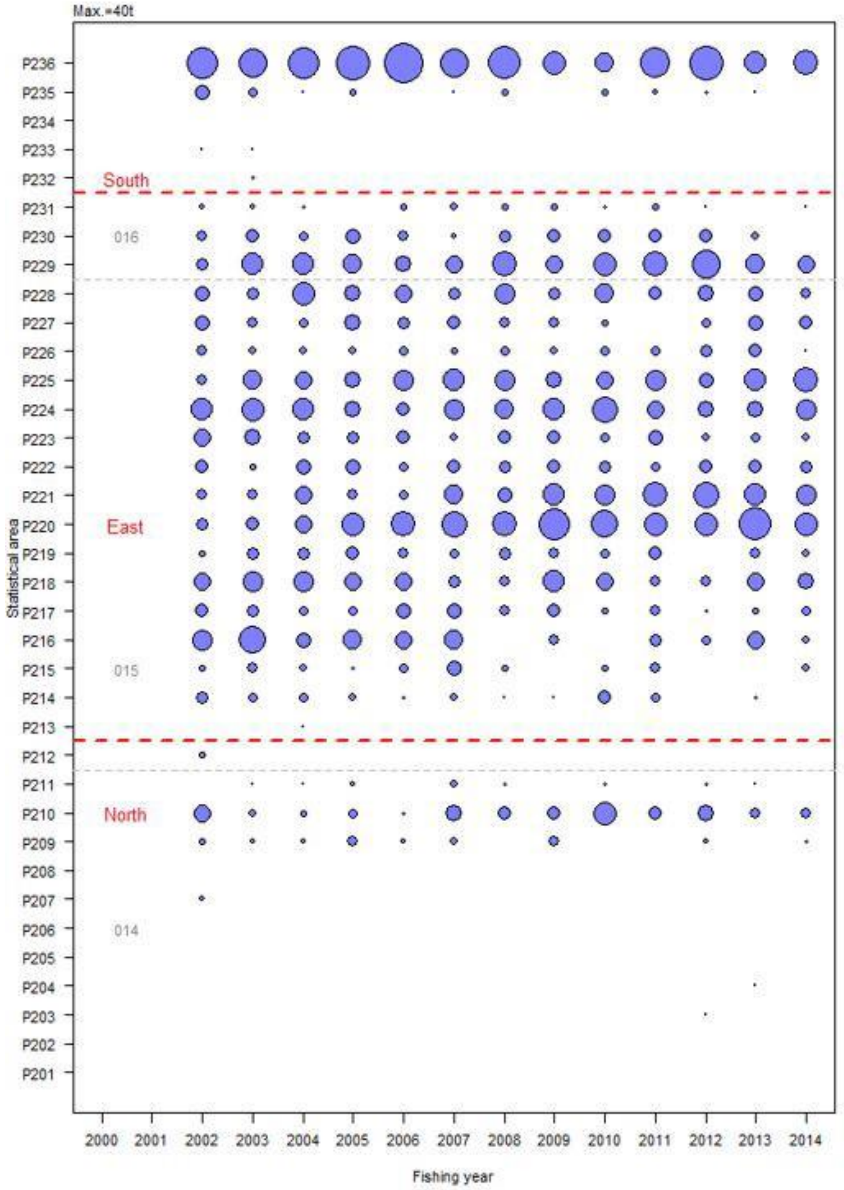


Figure 3: Annual estimated catch by fine-scale statistical area in PAU 2 for fishing years 2002–2014. The size of the circle is proportional to the catch. The red dashed lines delineate different regions.

The CPUE standardisations used the following criteria:

- To restrict the catch-effort records to those from the old statistical areas 014, 015, 016 (CELR data) and zones P201–P236 (PCELR data). These areas contain most of the commercial catch.
- For the CELR data standardisation to use a subset of the groomed data for which the recorded duration would be less ambiguous. The criteria to be used to subset the data are: (i) just one diver, or (ii) fishing duration ≥ 6 hours and number of divers ≥ 2. For this subsetted data set, offer both number of divers and duration (as a polynomial) to the model.
- Do a sensitivity CELR data standardisation where the fishing duration cut-off is 4 hours: (i) just one diver, or (ii) fishing duration ≥ 4 hours and number of divers ≥ 2.
- To use Fisher Identification Number (FIN) in standardisation procedures instead of vessel.
- Not to put in a year and area interaction in the standardisations (which would be used in a single area assessment), but to explore area differences in catch rates by doing separate standardisations where a year and area interaction is forced in at the start. For the CELR data

the smallest possible area sub-divisions are 014, 015, and 016. For the PCELR data a close, but more natural division of the areas is South, East, and North (Figure), where the large East area can be broken up further based on the strata used for length-frequencies.

4.1 CELR: the standardisation

CPUE was defined as daily catch. Year was forced into the model at the start and other predictor variables offered to the model were FIN, statistical area (014, 015, 016), month, fishing duration (as a cubic polynomial), number of divers, and a month:area interaction. Following previous standardisations, no interaction of fishing year with area was entered into the model, however, a separate standardisation is also done where a year:area interaction is forced in at the start.

The model explained 77% of the variability in CPUE with fishing duration (70%) explaining most of this followed by FIN (3%). The effects appear plausible and the model diagnostics were good.The standardised index declines for the first four years, then increases, with a drop in the last year (Table 4, Figure 4).

Table 4: Standardised CELR index, lower and upper 95% confidence intervals, and CV.

year	index	lower.CI	upper.CI	CV
1990	1.01	0.88	1.17	0.07
1991	0.94	0.81	1.07	0.07
1992	0.89	0.78	1.02	0.07
1993	0.89	0.78	1.01	0.06
1994	0.87	0.76	0.99	0.06
1995	0.91	0.80	1.03	0.06
1996	0.99	0.87	1.12	0.06
1997	0.98	0.86	1.13	0.07
1998	1.08	0.92	1.27	0.08
1999	1.19	1.02	1.39	0.08
2000	1.21	1.03	1.42	0.08
2001	1.13	0.97	1.31	0.08

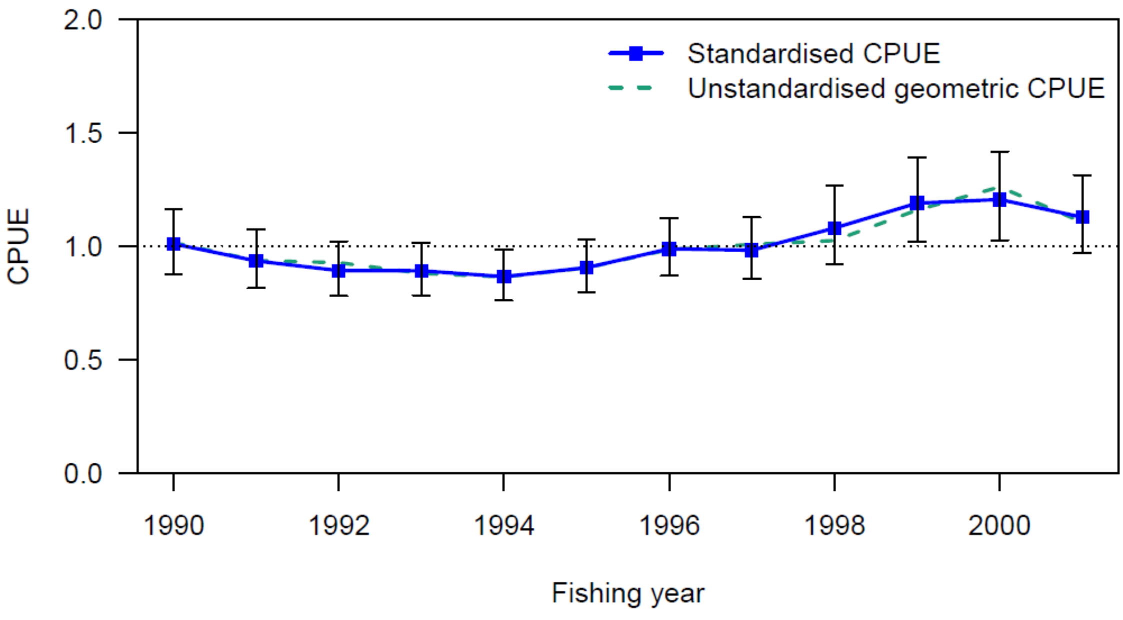


Figure 4: The standardised CPUE index with 95% confidence intervals. The unstandardised geometric CPUE is calculated as daily catch divided by daily fishing duration

As a sensitivity to the filtering criteria for the subsetted data set (in which the fishing duration field should be less ambiguous), another standardisation was done in which when the number of divers was

≥ 2 then the fishing duration has to be ≥ 4 hours (instead of 6 hours). The resulting index is very similar to that when 6 hours is used (Figure 5).

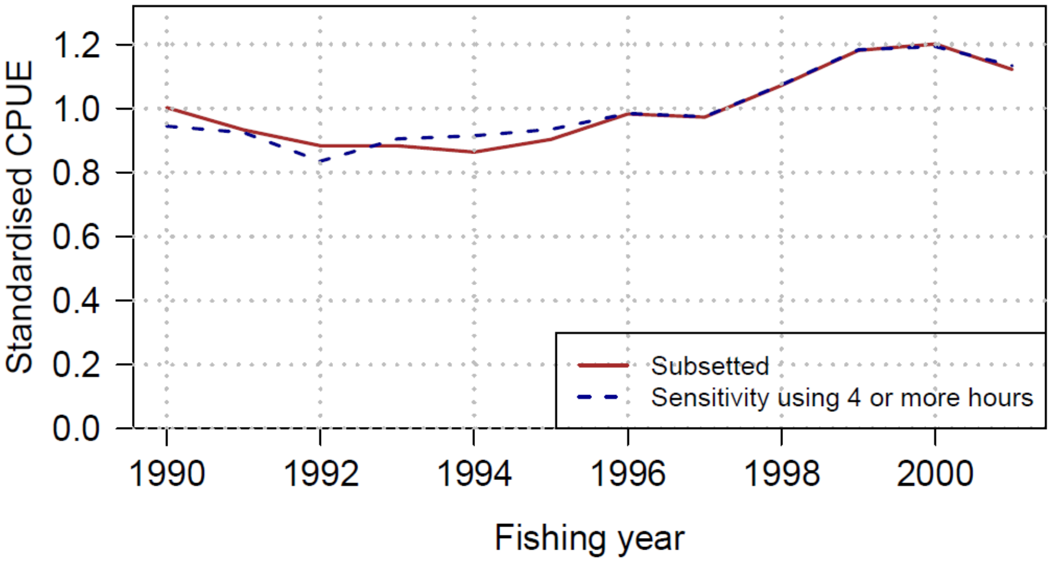


Figure 5: Sensitivity using four hours or more (for two or more divers).

4.2 PCELR: the standardisation

For the standardisation model CPUE (the dependent variable) was modelled as log of the diver catch with a normal error distribution. Fishing year was forced into the model at the start. Variables offered to the model were month, diver key, FIN, statistical area, duration (third degree polynomial), and diving condition. Following previous standardisations, no interaction of fishing year with area was entered into the model however, a separate standardisation is also done where a year:area interaction is forced in at the start.

Except for month, all variables were accepted into the model, which explained 73% of the variability in CPUE. Most of the variability was explained by duration (56%) and diver (9%). The effects appear plausible and the diagnostics were good. There is an apparent increasing effect for the catch taken after a fishing duration of 10 hours, although for the majority of records fishing duration is less than 10 hours.

The standardised index shows a slow decline from 2002 to 2012 with a slight increase since then (Table 5, Figure 6). As the standardised index shows little contrast since 2002, and there is little growth data available for PAU 2, stock assessment model estimates of biomass would be highly uncertain and not useful for management purposes. Because of this it was decided by the Shellfish Working Group that a full stock assessment should not be undertaken for PAU 2.

Table 5: Standardised index for the PCELR data set, lower and upper 95% confidence intervals and CV.

year	index	lower.CI	upper.CI	CV
2002	1.13	0.99	1.28	0.06
2003	1.05	0.94	1.16	0.05
2004	1.05	0.95	1.16	0.05
2005	1.01	0.92	1.11	0.05
2006	1.04	0.94	1.15	0.05
2007	0.95	0.86	1.05	0.05
2008	0.94	0.86	1.04	0.05
2009	0.99	0.89	1.10	0.05
2010	0.97	0.88	1.08	0.05

Table 5 [Continued]

year	index	lower.CI	upper.CI	CV
2011	0.95	0.86	1.05	0.05
2012	0.95	0.86	1.05	0.05
2013	1.01	0.90	1.12	0.05
2014	0.98	0.86	1.11	0.07

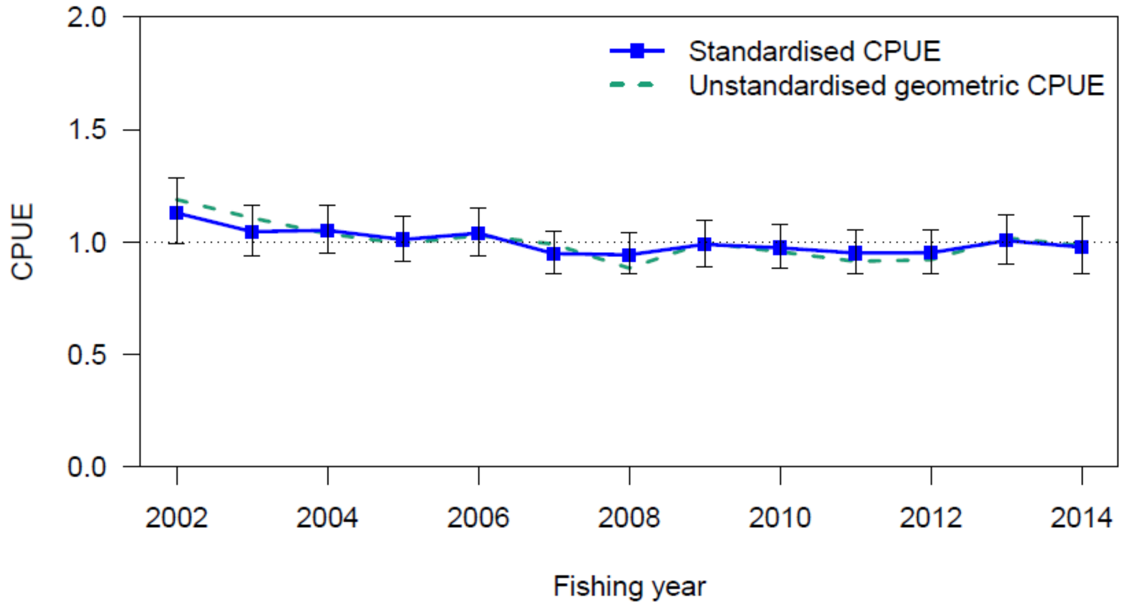


Figure 6: The standardised CPUE index for the PCELR dataset with 95% confidence intervals. The unstandardised geometric CPUE is calculated as daily catch divided by daily fishing duration.

It should be noted that a large amount of literature on abalone suggests that any apparent stability in CPUE should be interpreted with caution; and CPUE may not be proportional to abundance as it is possible to maintain high catch rates despite a falling biomass. This occurs because paua tend to aggregate and in order to maximise their catch rates divers' move from areas that have been depleted of paua, to areas with higher density. The consequence of this fishing behaviour is that overall abundance is decreasing but CPUE is remaining stable. This may not be such a large problem in PAU2 because distribution of catch has been consistent for many years and there is little evidence of serial depletion occurring (Figure 3).

5. STATUS OF THE STOCKS

Stock Structure Assumptions

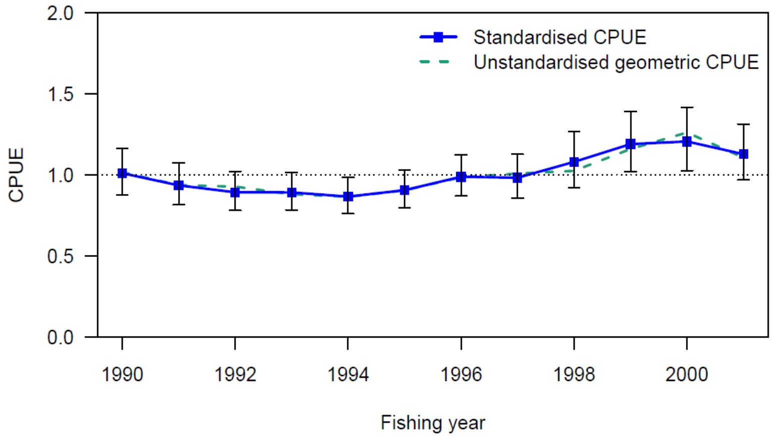
A genetic discontinuity between North Island and South Island paua populations was found approximately around the area of Cook Strait (Will & Gemmell 2008).

- **PAU 2 -** *Haliotis iris*

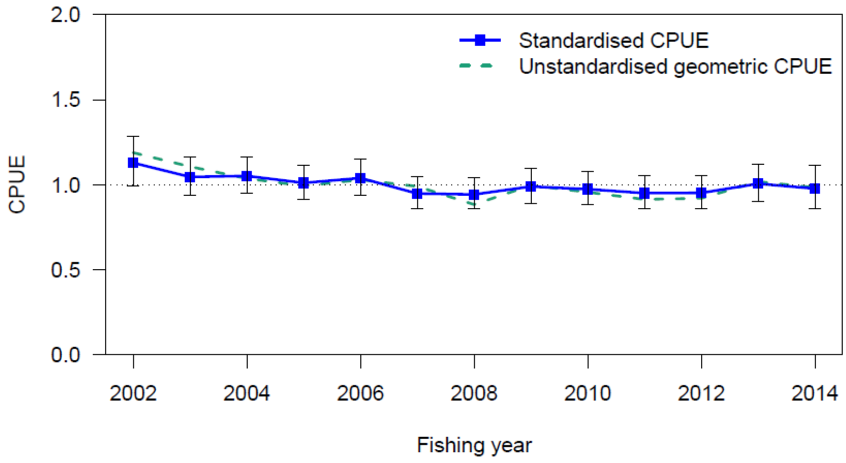
Stock Status	
Year of Most Recent Assessment	2014
Assessment Runs Presented	Standardised CPUE index
Reference Points	Target: 40% B_0 (Default as per HSS) Soft Limit: 20% B_0 (Default as per HSS) Hard Limit: 10% B_0 (Default as per HSS)

Status in relation to Target	Unknown
Status in relation to Limits	Unlikely (< 40%) to be below the Soft Limit Unlikely (< 40%) to be below the Hard Limit
Status in relation to Overfishing	Unknown: There are no data for recreational or illegal catch and both are likely to be significant.

Historical Stock Status Trajectory and Current Status



Standardised and unstandardized CPUE index for 1990–2001 with 95% confidence intervals. The unstandardised geometric CPUE is calculated as daily catch divided by daily fishing duration.



Standardised and unstandardized CPUE index for 2002–2014 using PCELR data, with 95% confidence intervals. The unstandardised geometric CPUE is calculated as daily catch divided by daily fishing duration.

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	From 1989–90 to 2001–02 the standardized CPUE index oscillates without any obvious trend, and from 2002–03 until 2013–14 the index is flat.
Recent Trend in Fishing Mortality or proxy	-
Other Abundance Indices	-
Trends in Other Relevant Indicators or Variables	-

Projections and Prognosis	
Stock Projections or Prognosis	No stock assessment has been undertaken for this stock
Probability of Current Catch or TACC causing Biomass to	Soft Limit: Unknown

remain below or to decline below Limits	Hard Limit: Unknown
Probability of Current Catch or TACC causing Overfishing to continue or commence	Unknown

Assessment Methodology		
Assessment Type	-	
Assessment Method	-	
Period of Assessment	Latest assessment: -	Next assessment: -
Overall assessment quality rank	-	
Main data inputs (rank)	-	-
Data not used (rank)	-	-
Changes to Model Structure and Assumptions	-	
Major Sources of Uncertainty	-	
Qualifying Comments		
CPUE is not generally considered to be a reliable indicator of the status of paua stocks and may not reflect abundance. A large portion of PAU 2, including the Wellington south coast, is closed to commercial fishing. This means that the CPUE series collected from the commercial catch and effort data are exclusive of this large area and therefore the abundance of paua in the fishery as a whole will not be captured well by the CPUE index.		

Fishery Interactions
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6. FOR FURTHER INFORMATION

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