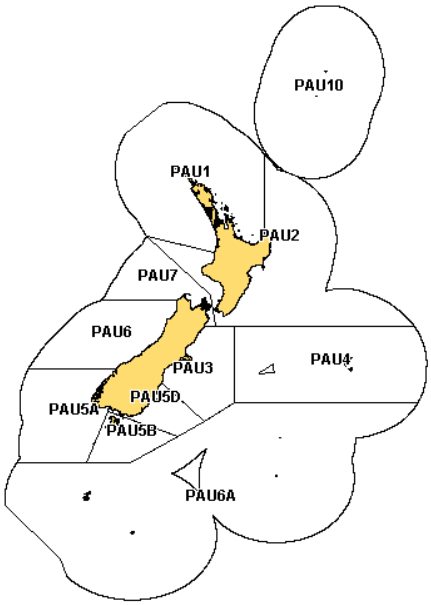
PAUA (PAU)

(*Haliotis iris, Haliotis australis*)



1. INTRODUCTION

Quantitative stock assessments are available for PAU 4, 5A, 5B, 5D and 7 and these are given separately.

(a) Commercial fisheries

Paua inhabit shallow waters (generally less than 6 m) off the coastline of New Zealand. The commercial fishery for paua dates from the mid-1940s, when shell was marketed and the meat generally discarded. Both meat and shell were sold from the late 1950s. Since the 1986–87 fishing season, the fishery has been managed with an individual transferable quota system and a total allowable commercial catch (TACC) for each of eight Quota Management Areas. Total reported landings of paua and TACCs are shown in Table 1.

Fishers gather paua by hand while free diving (use of underwater breathing apparatus is not permitted). Most of the catch is from the Wairarapa coast southwards: the major fishing areas are in the South Island (PAU 7), Stewart Island (PAU 5) and the Chatham Islands (PAU 4). Virtually the entire commercial fishery is for the black-footed paua, *Haliotis iris*, with a minimum legal size for harvesting of 125 mm shell length. The yellow-footed paua, *H. australis* is less abundant than *H. iris* and is caught only in small quantities; it has a minimum legal size of 80 mm. Catch statistics include *H. iris* and *H. australis*.

(b) Recreational fisheries

There is a large recreational fishery for paua. Estimated catches from telephone and diary surveys of recreational fishers (Teirney et al., 1997; Bradford, 1998; Boyd & Reilly, 2004; Boyd et al., 2004) are shown in Table 2. In 1996–97 sufficient diary data are available for an estimate in PAU 5D only (Bradford, 1998; NIWA unpublished data). The Marine Recreational Fisheries Technical Working Group (RFTWG) has reviewed the harvest estimates from the national surveys. Due to a methodological error in the methodology, the harvest estimates for 1991-92 to 1993-94 and 1996-97 are not considered to be reliable. The harvest estimates for the 1999-2000 and 2000-2001 surveys may be very inaccurate and some implausibly high. This may be due to a number of factors including the accuracy of the mean weight used to derive total harvest weight from the estimated numbers of paua caught by diarists, and the small number of diarists harvesting the stock in some areas. However relative comparisons can be made between stocks within the surveys.

Table 1: TACCs and reported landings (t) of paua by Fishstock from 1983–84 to 2005–06. Note, PAU 5 was subdivided into PAU 5A, 5B and 5D on 1 October 1995 and reported landings for these Fishstocks are given in the 3rd section of this table.

	PAU 1		PAU 2		PAU 3		PAU 4		PAU 5	
Fishstock	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**
1983–84*	1.0	–	110	–	114	–	409	–	550	–
1984–85*	0	–	154	–	92	–	278	–	353	–
1985–86*	0	–	92	–	51	–	221	–	228	–
1986–87*	0.01	1.00	96.20	100.00	54.02	57.00	267.37	261.00	418.90	445.00
1987–88*	0.98	1.00	122.11	111.33	62.99	60.49	279.57	269.08	465.00	448.98
1988–89*	0.05	1.93	121.50	120.12	57.55	66.48	284.73	270.69	427.97	449.64
1989–90†	0.28	1.93	127.28	121.19	73.46	69.43	287.38	287.25	459.46	459.48
1990–91†	0.16	1.93	125.82	121.19	90.68	77.24	253.61	287.25	528.16	484.94
1991–92†	0.27	1.93	116.66	121.19	90.25	91.5	281.59	287.25	486.76	492.06
1992–93†	1.37	1.93	119.13	121.19	94.52	91.5	266.38	287.25	440.15	442.85
1993–94†	1.05	1.93	125.22	121.19	85.09	91.5	297.76	287.25	440.39	442.85
1994–95†	0.26	1.93	113.28	121.19	93.26	91.5	282.10	287.25	436.13	442.85
1995–96†	0.99	1.93	119.75	121.19	92.89	91.62	220.17	326.54	N/A	N/A
1996–97†	1.28	1.93	118.86	121.19	89.65	91.62	251.71	326.54	N/A	N/A
1997–98†	1.28	1.93	122.41	121.19	93.88	91.62	301.69	326.54	N/A	N/A
1998–99†	1.13	1.93	115.22	121.19	92.54	91.62	281.76	326.54	N/A	N/A
1999–00†	0.69	1.93	122.48	121.19	90.30	91.62	321.56	326.54	N/A	N/A
2000–01†	1.00	1.93	122.92	121.19	93.19	91.62	326.89	326.54	N/A	N/A
2001–02†	0.32	1.93	116.87	121.19	89.66	91.62	321.64	326.54	N/A	N/A
2002–03†	0	1.93	121.19	121.19	90.92	91.62	325.62	326.54	N/A	N/A
2003-04†	0.05	1.93	121.06	121.19	91.58	91.62	32.5.85	326.54	N/A	N/A
2004-05†	0.27	1.93	121.19	121.19	91.43	91.62	319.24	326.54	N/A	N/A
2005-06†	0.45	1.93	121.14	121.19	91.60	91.62	320.82	326.54	N/A	N/A

Fishstock	PAU 5A		PAU 5B		PAU 5D	
	Landings	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**
1995–96†	139.53	148.98	143.66	147.66	146.60	147.66
1996–97†	141.91	148.98	142.30	147.66	146.02	147.66
1997–98†	145.22	148.98	145.34	148.98	148.72	147.66
1998–99†	147.36	148.98	148.26	148.98	148.70	147.66
1999–00†	143.91	148.98	118.19	143.98	147.90	148.98
2000–01†	147.70	148.98	89.26	112.19	148.81	148.98
2001–02†	148.54	148.98	89.96	112.19	148.74	148.98
2002–03†	148.76	148.98	89.86	90.00	111.69	114.00
2003-04†	149.10	148.98	90.00	90.00	88.02	89.00
2004-05†	148.95	148.98	89.97	90.00	88.82	89.00
2005-06†	148.92	148.98	90.47	90.00	88.93	89.00

Fishstock	PAU 6		PAU 7		PAU 10		Total	
	Landings	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**
1983–84*	0	–	306	–	0	–	1409	–
1984–85*	3	–	1.08	–	0	–	881.08	–
1985–86*	0	–	145.92	–	0	–	737.92	–
1986–87*	0	1.00	242.18	250.00	0	1.00	1 078.68	1 261.00
1987–88*	0	1.00	244.94	250.00	0	1.00	1 175.59	1 269.08
1988–89*	0	1.00	246.03	250.00	0	1.00	1 137.83	1 270.69
1989–90†	0	1.00	267.05	263.53	0	1.00	1 214.91	1 287.25
1990–91†	0.23	1.00	273.25	266.24	0	1.00	1 271.91	1 287.25
1991–92†	0	1.00	268.31	266.17	0	1.00	1 243.84	1 287.25
1992–93†	0.88	1.00	264.80	266.17	0	1.00	1 187.23	1 238.04
1993–94†	0.10	1.00	255.47	266.17	0	1.00	1 205.08	1 238.04
1994–95†	18.21 H	1.00	247.11	266.17	0	1.00	1 190.35	1 238.04
1995–96†	28.62 H	1.00	268.74	267.48	0	1.00	1 160.95	1 253.72
1996–97†	0.106	1.00	267.59	267.48	0	1.00	1 159.43	1 257.69
1997–98†	0	1.00	266.66	267.48	0	1.00	1 225.20	1 256.36
1998-99†	0	1.00	265.05	267.48	0	1.00	1 200.02	1 256.36
1999–00†	1.04	1.00	264.64	267.48	0	1.00	1 210.71	1 252.70
2000–01†	0	1.00	215.92	267.48	0	1.00	1 145.69	1 220.91
2001–02†	0	1.00	187.15	240.73	0	1.00	1 102.87	1 194.16
2002–03†	0	1.00	187.22	187.24	0	1.00	1 075.26	1 083.50
2003- 04†	0	1.00	159.55	187.24	0	1.00	1 025.12	1 083.50
2004- 05†	0	1.00	166.94	187.24	0	1.00	1 026.81	1 058.50
2005- 06†	0	1.00	183.36	187.24	0	1.00	1 045.69	1 058.50

* FSU data, † QMS data, H experimental landings.

Table 2: Estimated annual harvest of paua (t) by recreational fishers. 1991-1995 Regional telephone/diary estimates, 1995/6, 1999/00 and 2000/01 National Maine Recreational Fishing Surveys.

Fishstock	PAU 1	PAU 2	PAU 3	PAU 5	PAU 5D	PAU 6	PAU 7
1991–92	–	–	35–60	50–80	–	–	–
1992–93	–	37–89	–	–	–	0–1	2–7
1993–94	29–32	–	–	–	–	–	–
1995–96	10–20	45–65	–	20–35	–	–	–
1996–97	–	–	–	N/A	22.5	–	–
1999-00	40 - 78	224 - 606	26 - 46	36 - 70	26 - 50	2 - 14	8 - 23
2000-01	16 - 37	152 - 248	31 - 61	70 - 121	43 - 79	0 - 3	4 - 11

(c) Maori customary fisheries

There is an important customary use of paua by Maori for food, and the shells have been used extensively for decorations and fishing devices. Current levels of Maori customary take have not been estimated. However, Kaitiaki are now in place in the many areas and estimates of customary harvest can be expected in the near future.

(d) Illegal catch

Current levels of illegal harvests are not known. In the past, annual estimates of illegal harvest for some Fishstocks have been provided by MFish compliance, based on seizures. In the current paua stock assessments, nominal illegal catches are used.

(e) Other sources of mortality

Gerring (2003) observed paua (from PAU 7) with a range of wounds in the laboratory and found that only a deep cut in the foot caused significant mortality (40% over 70 days). In the field this injury reduced the ability of paua to right themselves and clamp securely onto the reef, and attracted predators. The tool generally used by divers in PAU 7 is a custom made stainless steel knife with a rounded tip and no sharp edges. This design makes cutting the paua very unlikely (although abrasions and shell damage may occur). Gerring (2003) estimated that in PAU 7, 37% of paua removed from the reef by commercial divers were undersize and were returned to the reef. His estimate of incidental mortality associated with fishing in PAU 7 was 0.3% of the landed catch. Incidental fishing mortality may be higher in areas where other types of tools and fishing practices are used. Mortality may increase if paua are kept out of the water for a prolonged period or returned onto sand. To-date, the stock assessments developed for paua have assumed that there is no mortality associated with capture of undersize animals.

2. BIOLOGY

Paua are herbivores which can form large aggregations on reefs in shallow subtidal coastal habitats. Movement is over a sufficiently small spatial scale that the species may be considered sedentary. Paua are broadcast spawners and spawning is thought to be annual. Habitat related factors are an important source of variation in the post-settlement survival of paua.

Growth, morphometrics, and recruitment can vary over short distances and may be influenced by factors such as wave exposure. Recruitment indices (i.e., the mean number of juveniles sampled in dive surveys) indicate a higher abundance of juveniles off D'Urville Island and in Cook Strait than in the wave exposed habitats of west coast Stewart Island, Fiordland and southern Otago.

3. STOCKS AND AREAS

The present fishstock boundaries may not represent discrete paua stocks. From 1 October 1995, PAU 5 was subdivided into three QMAs: Fiordland (5A); Stewart Island (5B); Catlins/Otago (5D), and from

1 November 1997 these areas were further subdivided, for reporting purposes only, into 17, 16, and 11 statistical areas, respectively.

4. STOCK ASSESSMENT

Stock assessments now exist for PAU 4, 5A, 5B, 5D and 7 and are reported separately. Summarised below is information relevant to the assessment of PAU 2, 3 and 6.

(a) Estimates of fishery parameters and abundance

In some circumstances commercial CPUE may not be proportional to abundance as it is possible to maintain catch rates of paua despite a falling biomass. This occurs because paua tend to aggregate and divers move among areas to maximise their catch rates. Any apparent stability in CPUE should therefore be interpreted with caution.

The relative abundance of paua has been estimated from surveys in PAU 4, 5A, 5B, 5D and 7, and are reported separately.

(b) Biomass estimates

In PAU 6, an estimate of current biomass for the area from Kahurangi Point to the Heaphy River was made in 1997 using a modification of the stock reduction method of Francis (1990) with a simplified population model. B_0 was estimated to be 141 t (95% C.I. = 89–404 t).

Apart from PAU 4, 5A, 5B, 5D and 7 (see separate sections) there are no biomass estimates for the other paua Fishstocks.

(d) Estimation of Maximum Constant Yield (MCY)

No estimates of MCY have been made except for the area from Kahurangi Point to the Heaphy River in PAU 6. MCY was estimated using the equation MCY = 0.25 * $F_{0.1} * B_0$, Method 1 (Annala et al., 1998), which applies to new fisheries. $F_{0.1}$ = 0.1 was estimated from a yield per recruit model. MCY for this area was estimated to be 3.53 t (95% C.I. = 2.2–10.1 t).

MCY was not estimated for any other fishstocks.

(e) Estimation of Current Annual Yield (CAY)

The only estimate of CAY available is for the area from Kahurangi Point to the Heaphy River in PAU 6. Using Method 1 (Annala et al., 1998), CAY for this area was estimated to be 13.1 t. The respective estimates of CAY based upon the 95% confidence limits of the B_0 estimate were 8.3 and 37.5 t.

CAY was not estimated for any other fishstocks.

5. STATUS OF THE STOCKS

The current TACC of 1 t for PAU 6 is sustainable.

For Fishstocks PAU 2 and 3 it is not known if recent catch levels or the current TACCs are sustainable, or if they are at levels which will allow the stocks to move towards a size that will support the maximum sustainable yield.

TACCs and reported landings for the 2005/06 fishing year are summarized in Table 3.

Table 3: Summary of TACCs (t) and reported landings (t) for 2005–06 fishing year.

Fishstock		FMA	2005-06 Actual TACC	2005-06 Reported landings
PAU 1	Auckland (East) (West)	1,9	1.93	0.45
PAU 2	Central (East) (West)	2,8	121.19	121.14
PAU 3	South-east	3	91.62	91.60
PAU 4	Chatham	4	326.54	320.82
PAU 5A	Southland	5	148.98	148.92
PAU 5B	Southland	5	90.00	90.47
PAU 5D	Southland	5	89.00	88.93
PAU 6	Sub-Antarctic	6	1.00	0
PAU 7	Challenger	7	187.24	183.36
PAU 10	Kermadec	10	1.00	0
Total			1058.50	1 045.69

6. FOR FURTHER INFORMATION

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