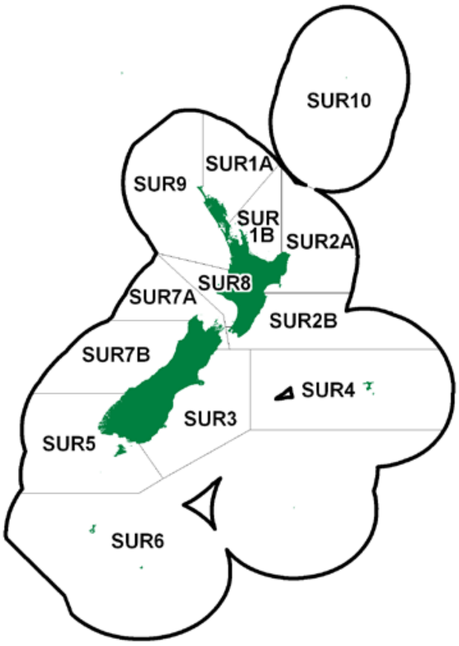
KINA (SUR)

(*Evechinus chloroticus*)
Kina



1. FISHERY SUMMARY

South Island kina was introduced into the Quota Management System in October 2002. North Island kina was introduced into the Quota Management System from October 2003. Five Quota Management Areas based on the FMAs 3, 4, 5, 7A (Marlborough Sounds) and 7B (west coast) were created in the south island, and current allowances, TACCs, and TACs are summarised in Table 1. Seven Quota Management Areas based on the FMAs 1A (Auckland-North), 1B (Auckland-South), 2A (Central (East-North)), 2B (Central (East-South)), 8, 9 and 10 were created in the north island, and the current allowances, TACCs and TACs are summarised in Table 2. The historical landings and TACC values for the main SUR stocks are depicted in Figure 1.

Table 1: Recreational and customary non-commercial allowances, TACCs and TACs (t) for kina Fishstocks 3, 4, 5, and 7 for the latest fishing year.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other Mortality Allowance	TACC	TAC
SUR 3	10	10	1	21	42
SUR 4	7	20	3	225	255
SUR 5	10	10	5	455	480
SUR 7A	20	80	3	135	238
SUR 7B	5	10	1	10	26

Table 2: Recreational and customary non-commercial allowances, TACCs and TACs (t) for kina Fishstocks 1,2,8,9 and 10 for the latest fishing year.

Fishstock	Recreational Allowance	Customary non-commercial Allowance	Other Mortality Allowance	TACC	TAC
SUR 1A	65	65	2	40	172
SUR 1B	90	90	4	140	324
SUR 2A	60	60	4	80	204
SUR 2B	35	35	2	30	102
SUR 8	12	12	1	1	26
SUR 9	11	11	1	10	33
SUR 10	0	0	0	0	0

1.1 Commercial fisheries

Most kina are found in waters less than 10 m deep and are harvested by breath-hold diving, although about 10% of the total catch in 1998-99 was by taken by dredge in SUR 7. Some target dredging also occurs in SUR 7. There is no minimum legal size for kina. Almost all of the roe harvested in this fishery is consumed on the domestic market. In 1988-89, competitive TACCs were established in the more important FMAs but not in east Northland (SUR 1) or at the Chatham Islands (SUR 4), both of which developed into productive fisheries in the 1990s (Table 3). On 1 October 1992 the Ministry of Fisheries placed a moratorium on the issue of permits to commercially harvest kina. The kina fishery has evolved considerably since the imposition of the moratorium. Where present, the competitive TACCs were either not caught or were exceeded, both by wide margins. Much of the increase in catch observed in SUR 5 in the early 1990s can be attributed to an experimental fishery developed in SUR 5, between Puysegur Point and Breaksea Island. The short-lived Kina Development Program harvested kina from Dusky Sound in 1993 under special permit.

Table 3: Total reported catch (t greenweight) of kina (SUR) by FMA and fishing year by all methods and target species.

Year	SUR 1	SUR 1A	SUR 1B	SUR 2	SUR 2A	SUR 2B	SUR 3	SUR 4	SUR 5	SUR 6, 8, & 9	SUR 7	SUR 7A	SUR 7B	Total
1983	66.2	-	-	33.0	-	-	4.8	11.3	0.5	3.6	26.3	-	-	157
1984	81.4	-	-	180.3	-	-	14.4	4.0	0.9	0.3	55.1	-	-	342
1985	64.5	-	-	83.8	-	-	4.0	7.4	4.6	0.9	99.6	-	-	275
1986	72.0	-	-	139.1	-	-	6.2	52.7	0.2	2	86.6	-	-	360
1987	52.1	-	-	142.6	-	-	2.4	28.4	4.3	0.1	52.6	-	-	283
1988	22.1	-	-	154.1	-	-	1.7	76.5	2.3	-	175.6	-	-	432
1989	35.5	-	-	92.8	-	-	0.8	216.6	19	1.5	6.2	-	-	372
1990	10.0	-	-	282.4	-	-	4.1	190.0	13.4	6.5	41.5	-	-	548
1991	71.5	-	-	87.2	-	-	21.3	35.3	166.9	4.4	56.3	-	-	443
1992	78.7	-	-	37.3	-	-	15.8	192.9	272.2	5	114.4	-	-	717
1993	89.7	-	-	170.4	-	-	9.9	21.8	*530.3	-	210.2	-	-	1 032
1994	150.7	-	-	176.7	-	-	8.8	55.3	327.2	2.3	98.2	-	-	820
1995	155.9	-	-	129.7	-	-	7.1	100.7	342.9	89.5	149	-	-	975
1996	174.5	-	-	41.2	-	-	6.0	99.5	446.4	0.1	142.2	-	-	910
1997	161.6	-	-	49.9	-	-	5.4	225.7	171.6	0.2	121.7	-	-	736
1998	134.8	-	-	36.5	-	-	3.8	303.1	91.2	1.4	144.7	-	-	716
1999	201.4	-	-	20.2	-	-	38.4	168.2	120.6	0.5	113.9	-	-	663
2000	297.4	-	-	14.5	-	-	50.4	396.5	106.3	0.1	87.9	-	-	956
2001	184.5	-	-	11.4	-	-	11.2	472.6	69.8	3.1	80.1	-	-	832
2001-02	237.0	-	-	3.0	-	-	5.2	368.0	184.9	-	31.7	-	-	829.7
2002-03	211.2	-	-	30.4	-	-	0.3	167.3	132.5	0.9	1.3	63.2	0	607.4
2003-04	1.7	26.9	111.0	0	14.5	4.6	0.3	114.8	199.1	3.8	0	85.4	0	562.3
2004-05	-	20.9	131.1	-	6.5	1.4	0.5	91.7	350.4	0.9	-	101.3	-	704.7
2005-06	-	41.0	138.6	-	22.1	0.2	< 0.1	70.2	473	4.0	-	72.1	5.3	826.5
2006-07	-	37.1	147.3	-	13.8	< 0.1	3.2	108.3	423	8.6	-	117.3	9.2	868
2007-08	-	31.7	140.4	-	18.0	0.2	2.1	147.4	276.2	5.8	-	134.6	6.5	762.9
2008-09	-	30.5	130.6	-	19.8	< 0.1	4.2	135.6	294.9	3.4	-	128.7	6.1	753.8
2009-10	-	40.8	129.9	-	0.1	0.3	5.1	89.7	320.4	2.3	-	119.7	3.5	711.9
2010-11	-	31.7	122.1	-	4.1	< 0.1	5.2	134.9	339.2	0	-	97.4	7.2	741.9
2011-12	-	37.9	134.2	-	5.9	1.1	4.3	137.7	402	0	-	131.6	6	862.1

Data from 1989 and 1990 are combined from the FSU and CELR databases. – indicates no recorded catch. Data for the period 1983 to 1999 are from Andrew (2001), and have been groomed. Catch estimates for 2000 and 2001 are taken directly from MFish. * includes 133 t caught in Dusky Sound experimental fishery. Catches from SUR 6, 8, and 9 have been pooled because too few permit holders recorded catches in these FMAs to report them singly.

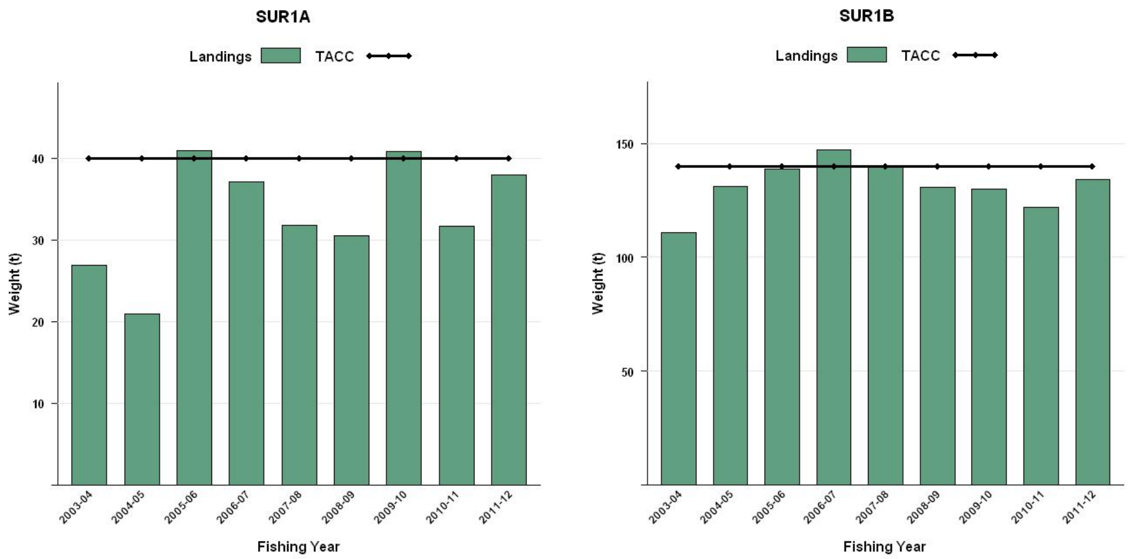


Figure 1: Historical landings and TACC for the nine main SUR stocks. From left to right: SUR1A (Northland) and SUR1B (Hauraki Gulf, Bay of Plenty. [Continued on next page].

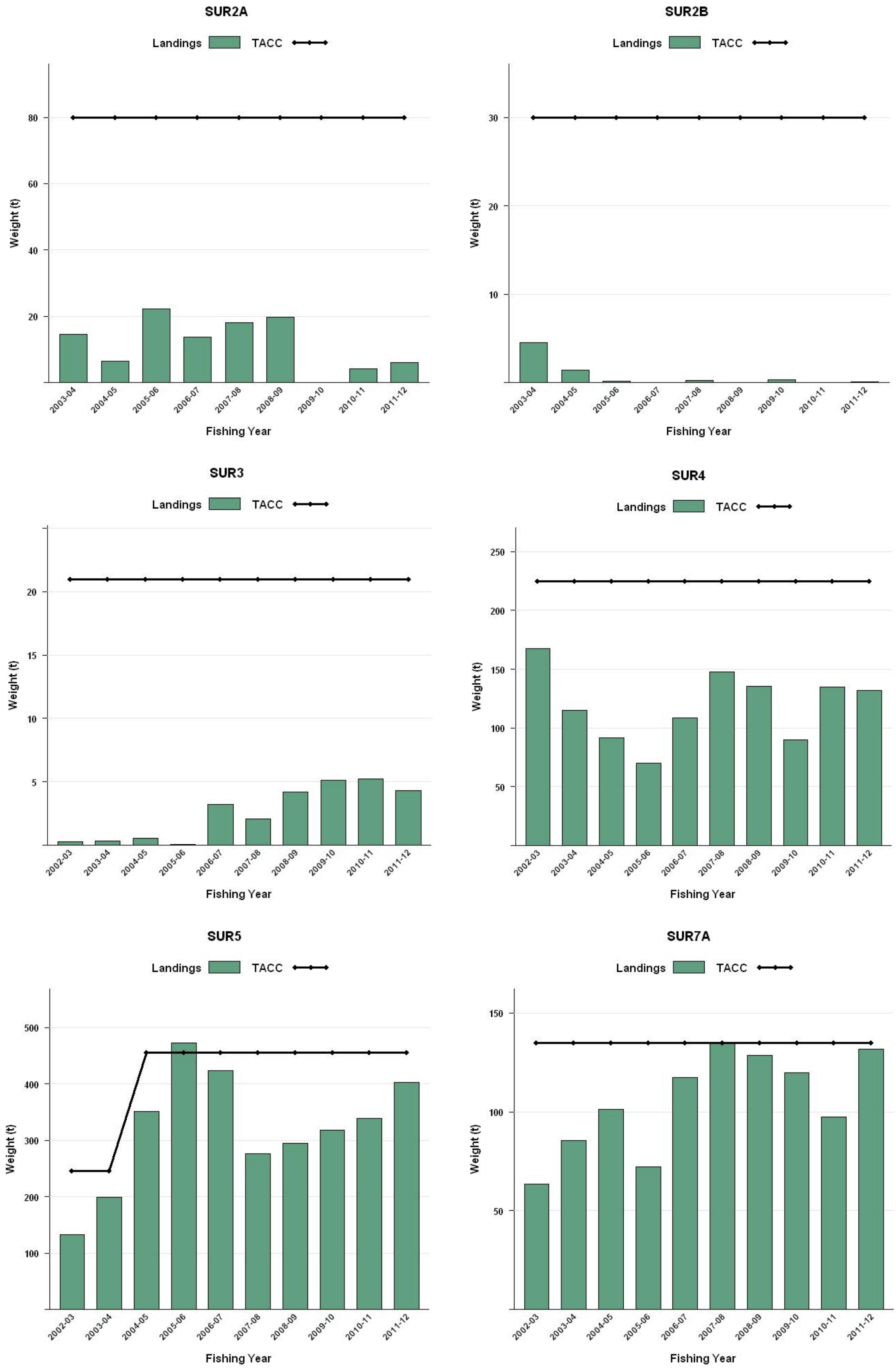


Figure 1 [Continued]: Historical landings and TACC for the nine main SUR stocks. From top left: SUR2A (East Coast), SUR2B (Wairarapa, Wellington), SUR3 (South East Coast), SUR4 (South East Chatham Rise), SUR5 (Southland), and SUR7A (Challenger Nelson Marlborough) [Continued on next page].

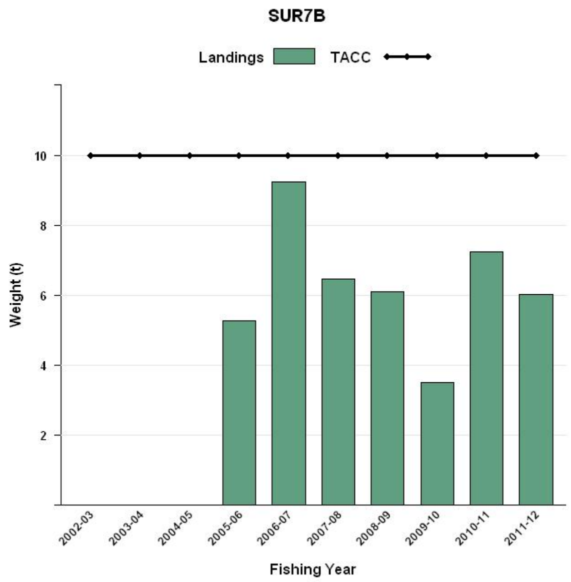


Figure 1 [Continued]: Historical landings and TACC for the nine main SUR stocks. Here: SUR7B (Challenger Westland). Note that these figures do not show data prior to entry into the QMS.

1.2 Recreational fisheries

Recreational catch was estimated in a national survey in 1996 (Fisher & Bradford 1998, Bradford 1998) and 2000 (Boyd & Reilly 2004) (Table 4). There are no estimates of recreational catch from the Chatham Islands. In many instances, insufficient kina were caught to provide reliable estimates of the error associated with the estimates of total harvest. The recreational harvest estimates for 1996 are not considered reliable as estimates of total harvest but provide relative estimates between areas. The harvest estimates for 2000 are considered to be more reliable as absolute estimates with the exception of SUR 2.

1.3 Customary non-commercial fisheries

There is an important customary non-commercial harvest of kina by Maori for food. Where data are available, only small catches of kina have been reported under the customary non-commercial harvest provisions of the Fisheries Act 1996. In SUR 3, 5, and 7, all catches were less than 1 t per year (Table 5). These catch estimates are probably under-estimates as an unknown proportion of the kina harvested by Maori is caught outside of Taiapure or Mataitai and not recorded as customary non-commercial harvest (P. Grimshaw, Ngai Tahu Development Corporation, pers. comm.). No data are available for other regions of New Zealand (S. Kerins, Te Ohu Kai Moana, pers. comm.).

Table 4: Recreational harvest of kina for 1993-94 and 1996.

Area	Number of kina (x 1,000)	CV (%)	Catch (t)*
1993-94			
East Northland	109	60	27.1
Hauraki Gulf	14	-	3.5
Bay of Plenty	648	49	160.9
SUR 1	801	41	198.9
SUR 9	30	72	7.4
1996			
SUR 1	316	24	78.5
SUR 2	61	-	15.1
SUR 3	12	-	3.0
SUR 5	20	-	5.0
SUR 7	2	-	0.5
Area	Number of kina (x 1,000)	CV (%)	Catch (t)*
SUR 8	43	-	10.7
SUR 9	30	-	7.4
2000			
SUR 1	1 793	35	445.2
SUR 2	1 026	57	254.7
SUR 3	8	58	2.0
SUR 5	70	101	17.4
SUR 7	2	101	0.5
SUR 8	85	85	21.1
SUR 9	82	67	20.4

CVs are indicated only for those samples with adequate sample sizes. Data compiled from Bradford (1996, 1998) and Fisher & Bradford (1998).

Catches in numbers have been converted to catch in tonnes by assuming an average whole weight of 248.3 g per kina. In the absence of size-specific catch statistics, a parsimonious conversion assumes kina are caught in equal proportion across a size range of 60 to 110 mm TD. The lower size in this range is approximately the size-at-maturity (see Barker 2001) and the upper size is close to maximum harvested size. Weight-at-size was calculated using a test diameter-weight relationship ($W = (6.27 \times 10^{-4}) TD^{2.88}$) derived for kina of 60-110 mm TD from Dusky Sound (*n* = 1063, unpublished data). The estimates of total catch in tonnes should be considered as indicative only.

Table 5: Reported customary catch by FMA for SUR 3, 5, and 7.

Year	SUR	Count	Weight (kg)
1998-99	3	100	25
	5	1 522	433
	7	0	0
1999-2000	3	0	0
	5	1 631	405
	7	0	0

Data as numbers caught supplied by Ngai Tahu Development Corporation. Catch in kg was estimated using the same conversion rules as described in Table 2.

1.4 Illegal catch

Current levels of illegal harvest are not known.

1.5 Other sources of mortality

Although there is no minimum legal size for kina, some incidental mortality is likely because roe quality (recovery rate and colour) is commonly assessed by opening 'test' kina underwater. These animals are not subsequently landed. There are no estimates of the magnitude to this incidental mortality.

2. BIOLOGY

The biology and ecology of kina has been extensively studied; this literature has most recently been reviewed by Barker (2001). *Evechinus chloroticus* is found throughout New Zealand the sub-Antarctic Islands. Kina has an annual reproductive cycle which culminates in spawning between November and March (Dix 1970, Walker 1982, McShane *et al.* 1994 & 1996, Lamare & Stewart 1997, Lamare 1998). Size at maturity appears to vary considerably and may be as small as 30 mm and as large as 75 mm TD (Dix 1970, Barker *et al.* 1998). In Dusky Sound, kina are reproductively mature at 50-60 mm T.D. (McShane *et al.* 1996). Within these seemingly consistent patterns in the seasonality of the reproductive cycle there are many differences in the gonad size at small spatial scales.

Settlement is likely to be sporadic among years and appears to differ among locations and habitats (Dix 1972, Walker 1995). Laboratory work has shown that kina larval mortality increased with increasing concentrations of suspended sediment at realistic concentrations (Phillips & Shima 2006). In the field, but not in the laboratory, development abnormalities were found associated with suspended sediment concentrations, this suggests the importance of other environmental factors associated with terrestrial runoff (Schwarz *et al.* 2006). Juvenile settlement and mortality has also been increased by sediment at realistic concentrations in a size-specific manner in the laboratory; this agrees with juvenile patterns of distribution observed in the field (Walker 2007). Few small kina were observed in any of the surveys in Dusky Sound (McShane *et al.* 1993). These results suggest that the productivity of stocks in Fiordland may be low and that recruitment over-fishing is a real possibility.

There is relatively little information available on the interactions between kina and its predators and competitors. Although a wide range of fish and invertebrates eat kina, there is limited evidence that these species control or limit populations of kina in Fiordland. Work in a marine reserve, where large predators such as reef fishes and crayfish are abundant, indicates that predators can control numbers of kina surviving the transition from crevice-bound to open substratum grazing (Cole & Keuskamp 1998, Babcock *et al.* 1999). Babcock *et al.* (1999) have drawn a direct link between the increases in snapper and crayfish populations and the long-term decline in kina populations in the Leigh Marine Reserve. There is however, no evidence that high kina densities limit rock lobster populations (Andrew & MacDiarmid 1991). It is likely, however, that changes in the abundance of kina, and the consequent changes in habitat representation, are part of a complex set of interacting processes, including but not exclusively, increased predation.

Kina compete with a range of invertebrate herbivores, including paua. There is no published evidence that high densities of kina limit paua populations in Fiordland. McShane (1997) reported that paua are abundant in Dusky Sound, and in Chalky and Preservation Inlets, but are rare in the fjords.

Lamare & Mladenov (2000) estimate that kina grow 8-10 mm in their first year of life. Growth rates will vary considerably depending on local conditions but kina may take 8-9 years to reach 100 mm TD, and very large individuals may reach ages of 20+ years (McShane & Anderson 1997, Lamare & Mladenov 2000).

3. STOCKS AND AREAS

There appear to be few genetic differences in kina populations from Leigh (North Auckland) and Stewart Island (Mladenov *et al.* 1997) which suggests that there is at least some mixing among populations. There is no direct evidence that populations of kina at the Chatham Islands differ genetically from those on the mainland, nor is there evidence that "populations" of kina at the Chatham Islands are dependent on the dispersal of larvae from the mainland.

4. STOCK ASSESSMENT

Although there is a wealth of information on the biology and ecology of this species (*see* Barker 2001 for reviews), there is relatively little that can be used to assess the status of exploited stocks. There have been no assessments of sustainable yield nor are there estimates of biomass or trends in relative abundance for any Fishstock (Annala 1995).

4.1 Estimates of fishery parameters and abundance

Andrew (2001) reported catch rates from both dive and dredge fisheries but cautioned the interpretation of catch rate information of sedentary invertebrates, like kina, gathered at broad spatial scales.

Indices of relative abundance using timed swims have been reported for Ariel Reef in SUR 2 (Anderson & Stewart 1993), Chatham Islands (Schiel *et al.* 1995, Naylor & Andrew 2002), and D'Urville Island and Arapawa Island in SUR 7 (McShane *et al.* 1994). Numerous surveys of kina have been done over the last 30 years in fished areas, mostly by university-based researchers (e.g. Dix 1970, Choat & Schiel 1982, Schiel *et al.* 1995, Cole & Keuskamp 1998, Babcock *et al.* 1999, Wing *et al*. 2001). Andrew & Naylor (2002) reported a range of densities for kina around Chatham Island at 0.17/m^2 (northwest Chatham Island) to 1.6/m^2 (south east Chatham Island). These were generally lower than estimates made in the mid 1990s by Schiel *et al.* (1995) (0.2/m^2 to 6/m^2). By contrast, lower kina densities of around 0.1/m^2 were reported by McShane *et al.* (1994) for both Arapawa and D'Urville Island. Dix (1970) reported much higher mean relatively high densities of kina ranging from 2.2/m^2 in Queen Charlotte Sound to 6/m^2 at Kaikoura.

4.2 Biomass estimates

McShane & Naylor (1993) reported biomass estimates of 2500 and 500 t respectively for D'Urville and Arapawa Islands (SUR 7), presumably based on an expansion of density estimates reported in McShane *et al.* (1994) by an area estimate, however, the methods are not detailed.

Biomass has been estimated for Dusky Sound and Chalky Inlet (SUR 5) prior to Dusky Sound being opened as an experimental fishery in May 1993 (McShane & Naylor 1991, 1993). Productivity and biomass was to be estimated by depletion methods but this was unsuccessful because only 133 t of the projected 1000 t was caught (McShane *et al.* 1994b) and this catch was insufficient to cause a measurable change in the estimated biomass of kina.

4.3 Yield estimates and projections

MCY has not been estimated for any SUR fishstock. Within SUR 5, an *MCY* estimate of sustainable yield within Dusky Sound and Chalky Inlet was reported in Annala (1995). This estimate used Method one of Annala (1995) for new fisheries based on surveys done by McShane & Naylor (1991, 1993) and an estimate of a reference fishing mortality derived from McShane *et al.* (1994a). The estimated annual sustainable yield of 275 t for these two areas has never been harvested because they are closed to commercial fishing except under special permit.

CAY has not been estimated for any SUR fishstock.

5. STATUS OF THE STOCKS

For all Fishstocks it is not known if current catch levels or TACCs are sustainable, or if they are at levels which will allow the stocks to move towards a size that will support sustainable yields.

Table 6: Summary of TACCs (t), and reported landings (t) of kina for the most recent fishing year.

Fishstock	QMA	2011-12 Actual TACC (t)	2011-12 Reported landings (t)
SUR 1A	Auckland (East - North)	40	37.9
SUR 1B	Auckland (East - South)	140	134.2
SUR 2A	Central (East - North)	80	5.9
SUR 2B	Central (East - South)	30	0.1
SUR 3	South-East (Coast)	21	4.3
SUR 4	South-East (Chatham),	225	131.7
SUR 5	Southland	455	402
SUR 6	Sub-Antarctic	-	0
SUR 8	Central (Egmont)	1	0
SUR 9	Auckland (West)	10	8.2
SUR 7A	Challenger (North)	135	131.6
SUR 7B	Challenger (South)	10	6
Total		1 147	862.1

6. FOR FURTHER INFORMATION

Anderson O., Stewart R. 1993. Gisborne kina survey. (Unpublished report held in the NIWA library, Wellington.) 2p.
Andrew N.L. 1986. The interaction between diet and density in influencing reproductive output in the echinoid *Evechinus chloroticus* (Val.). Journal of Experimental Marine Biology and Ecology 97: 63-79.
Andrew N.L. 2001. Sea urchin fisheries: their status and management with special reference to the New Zealand kina fishery. In*:* Unpublished report to the Ministry of Fisheries and Te Ohu Kai Moana. 124p.
Andrew N.L., Choat J.H. 1985. Habitat related differences in the survivorship and growth of juvenile sea urchins. Marine Ecology Progress Series 27: 155-161.
Andrew N.L., MacDiarmid A.B. 1991. Interrelations among sea urchins (*Evechinus chloroticus*) and spiny lobsters (*Jasus edwardsii*) in northern New Zealand. Marine Ecology Progress Series 70: 211-222.
Annala J.H. 1995. Report from the Fishery Assessment Plenary, May 1995. Stock assessments and yield estimates. 277p.
Babcock R.C., Kelly S., Shears N.T., Walker J.W., Willis T.J. 1999. Changes in community structure in temperate marine reserves. Marine Ecology Progress Series 189: 125-134.
Barker M.F. 2001. The ecology of Evechinus chloroticus. In: Lawrence, J. (ed.). Edible Sea Urchins: Biology and Ecology. Elsevier Science, Amsterdam. 245–260p.
Barker M.F., Keogh J.A., Lawrence J.M., Lawrence A.L. 1998. Feeding rate, absorption efficiencies, growth, and enhancement of gonad production in the New Zealand sea urchin *Evechinus chloroticus* Valenciennes (Echinoidea: Echinometridae) fed prepared and natural diets. Journal of Shellfish Research 17: 1583-1590.
Boyd R.O., Gowing L., Reilly J.L. 2004. 2000-2001 national marine recreational fishing survey: diary results and harvest estimates. Final Research Report for Ministry of Fisheries Project REC2000/03 (Unpublished report held by Ministry of Fisheries, Wellington).
Bradford E. 1998. Harvest estimated from the 1996 national marine recreational surveys. New Zealand Fisheries Assessment Research Document 1998/16: 27p.
Brewin P.E., Lamare M.D., Keogh J.A., Mladenov P.V. 2000. Reproductive variability over a four-year period in the sea urchin *Evechinus chloroticus* (Echinoidea: Echinodermata) from differing habitats in New Zealand. Marine Biology 137: 543-557.
Choat J.H., Schiel D.R. 1982. Patterns of distribution and abundance of large brown algae and invertebrate herbivores in subtidal regions of northern New Zealand. Journal of Experimental Marine Biology and Ecology 60: 129-162.
Cole R.G., Keuskamp D. 1998. Indirect effects of protection from exploitation: patterns from populations of *Evechinus chloroticus* (Echinoidea) in northeastern New Zealand. Marine Ecology Progress Series 173: 215-226.

Dix T.G. 1970. Biology of *Evechinus chloroticus* (Echinodermata: Echinometridae) from different localities. 3. Reproduction. *New Zealand* Journal of Marine and Freshwater Research 4: 385-405.

Fisher D., Bradford E. 1998. National marine recreational fishing survey 1996: catch and effort results by fishing zone. Unpublished Final Research Report for Ministry of Fisheries Research Project REC9701. 38p.

Lamare M.D., Mladenov P.V. 2000. Modelling somatic growth in the sea urchin *Evechinus chloroticus* (Echinoidea: Echinometridae). Journal of Experimental Marine Biology and Ecology 243: 17-43.

MacDiarmid A.B., Breen P.A. 1993. Spiny lobster population changes in a marine reserve. In Battershill, C.N., Schiel, D.R., Jones, G.P., Creese, R.G., & MacDiarmid, A.B. (eds.). Proceedings of the Second International Temperate Reef Symposium. 47-56p. NIWA Marine, Wellington.

McShane P.E. 1992. Sea urchins in Dusky Sound-Prospects for a major kina industry in New Zealand. New Zealand Professional Fisherman December 92: 34-40.

McShane P.E. 1997. A summary of commercial catch data and biological information for kina (Evechinus chloroticus). New Zealand Fisheries Assessment Research Document. 1997/16: 7p.

McShane P.E., Naylor J.R. 1991. A survey of kina populations (*Evechinus chloroticus*) in Dusky Sound and Chalky Inlet, southwest New Zealand. Unpublished report held in the NIWA library, Wellington. 34p.

McShane P.E., Naylor J.R. 1993. SUR 7 - Prospects for development of a kina fishery. Seafood New Zealand 1: 33-34.

McShane P.E., Anderson O.F., Gerring P.K., Stewart R.A., Naylor J.R. 1994a. Fisheries biology of kina (*Evechinus chloroticus*). New Zealand Fisheries Assessment Research Document. 1994/17: 34p.

McShane P.E., Stewart R., Anderson O., Gerring P.K. 1994b. Failure of kina fishery leaves bitter taste. Seafood New Zealand 2: 35-36.

Mead S. 1996. Fertilization success, sustainable management and commercial development of the New Zealand sea urchin, *Evechinus chloroticus*. *Unpublished M.Sc. Thesis,* University of Auckland.

Mladenov P.V., Allibone R.M., Wallis G.P. 1997. Genetic differentiation in the New Zealand sea urchin *Evechinus chloroticus* (Echinodermata: Echinoidea). New Zealand Journal of Marine and Freshwater Research 31: 261-269.

Naylor J.R., Andrew N.L. 2002. Biomass of kina (Evechinus chloroticus) in the Chatham Islands. New Zealand Fisheries Reserach Report. Held by the Ministry for Primary Industries, Wellington.

Phillips N.E. Shima J 2006. Differential effects of suspended sediments on larval survival and settlement of New Zealand urchins *Evechinus chloroticus* and abalone *Haliotis iris*. Marine Ecology Progress Series 314: 149-158.

Schiel D.R. 1990. Macroalgal assemblages in New Zealand: structure, interactions and demography. Hydrobiologia 192: 59-76.

Schiel D.R., Andrew N.L., Foster M.S. 1995. The structure of subtidal algal and invertebrate assemblages at the Chatham Islands, New Zealand. Marine Biology 123: 355-367.

Schwarz A., Cole R., Budd R., Taylor R., Hewitt J., Hunt L., Shima J., Phillips N. 2006. Impacts of terrestrial runoff on the biodiversity of rocky reefs, Aquatic Environment Biodiversity Report 7 109p.

Walker J. 2007.Effects of fine sediments on settlement and survival of the sea urchin *Evechinus chloroticus* in northeastern New Zealand. Marine Ecology Progress Series 331: 109-118.

Wing S.R., Lamare M.D., Vasques J. 2001. Population structure of sea urchins (*Evechinus chloroticus*) along gradients in benthic productivity in the New Zealand fjords. In: Barker, M.F. (ed.). Proceedings of the 10th International Echinoderm Conference. University of Otago, Dunedin. A.A. Balkema, Rotterdam. 569−576p.