Ministry of Fisheries
Te Tautiaki i nga tini a Tangaroa

Appendix 1: Information Summary

Draft Coromandel scallop fisheries plan

May 2007

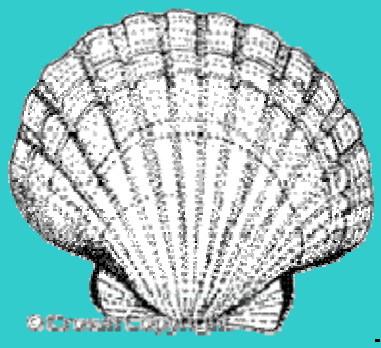

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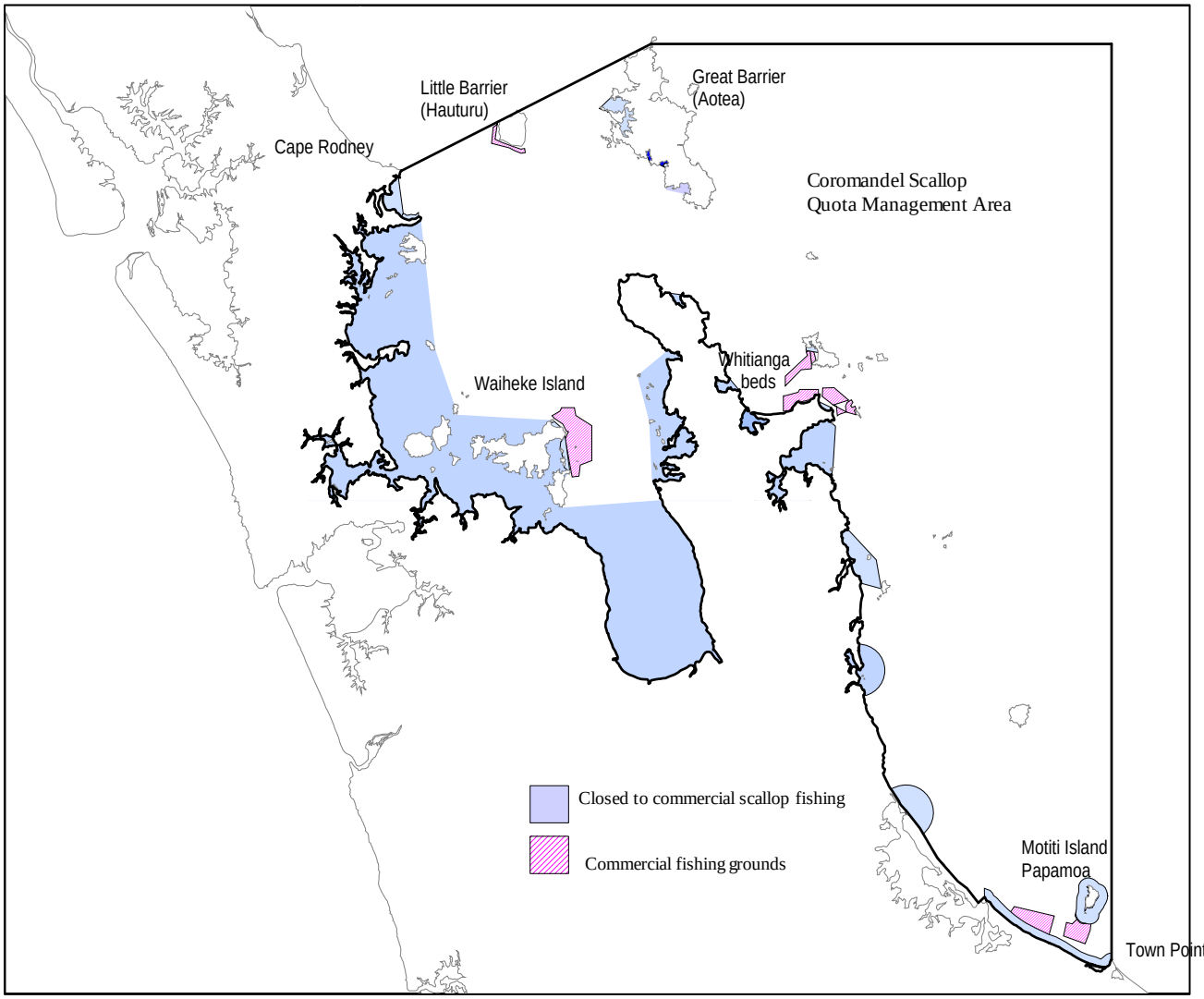
Figure 1: Boundary of the Coromandel scallop (SCA CS) quota management area, areas closed to commercial scallop fishing, and the location of the main beds fished by commercial scallop fishers. Some commercial fishing has also occurred off Cape Colville and off Waihi Beach. Popular non-commercial fishing areas include many of the bays and harbours closed to commercial fishing.



Biological and Environmental Information

Ecological context

1 Scallops live in waters to about 60 m deep, but are more common in the Coromandel fishery in depths of 10 to 30 m.

2 A larval scallop is initially sustained in the plankton by a very small yolk sac from the egg stage (see figure 2: scallop life cycle). Once the larval scallop has consumed the nutrients from the yolk sac, it must begin actively feeding on phytoplankton in the plankton. If the larval scallop does not encounter sufficient phytoplankton and cannot feed enough, then the larval scallop will die. Lack of food is thought to be one of the main factors contributing to the very high mortality rates suffered by scallops during the larval stages. Scallop eggs and larvae are also prone to predation by bigger zooplankton such as larval fish.

3 Juvenile and adult scallops are filter feeders that feed on microscopic particles called phytoplankton[1] in the water column. Phytoplankton are not capable of active mobility and are carried about in the currents. A scallop opens its shells for feeding. The "filter feeding" gills inside the scallop shell filter the phytoplankton out of the water as the water passes through the open shell.

4 Juvenile scallops (5-30mm) are vulnerable to a range of smaller invertebrate predators (e.g. hermit crabs, whelks) on the seafloor. As scallops grow, they are less vulnerable to these smaller species, but then attract the attention of larger predators such as starfish, octopus, and rock lobster. Juvenile scallops are also vulnerable to snapper predation, but this is likely to decline as the scallop increases in size and shell thickness.

5 Mature scallops will often exhibit an escape response as a starfish advances. The scallop will rapidly open and close the bivalve shells to swim actively up (usually about 200mm off the seafloor) into the water column to escape the predator. Mature scallops are generally capable of only moving 2-3 metres each swim, and then appear to settle back on the seafloor to a more sedentary existence. However, underwater observations by research scientists indicate that juvenile scallops (5-10mm) may be much more mobile and capable of movement over 10-100 metres at a time, depending on the speed of bottom currents.

6 Adult scallops often appear to have been collected by large octopus and rock lobster. Large octopus will often create a depression (up to a metre in diameter and 150mm deep) in the sand or mud in the middle of a scallop bed. Adult scallops are carried back to the "lair" where they are consumed by the octopus. Similarly, large rock lobster will make foraging trips away from the rocky reef environment (where lobster are normally found) out on to the sand flats to collect scallops. Aggregations of scallops can be found at the back of a "crayhole", suggesting that the rock lobster has actively collected the scallops for feeding at a later stage.

Basic biology

7 Scallops generally take 1.5 to 3.5 years to reach the recreational size limit of 100 mm. In unfished populations, the maximum age is thought to be about 6 or 7 years. Growth rates vary both between areas and over time. Some scallops may become sexually mature at about 40 mm, but

[1] There are two main types of plankton in the water column: phytoplankton and zooplankton. Phytoplankton is the "plant" plankton that is the primary producer (along with macroalgae such as Ecklonia) that does most of the photosynthesis in the marine environment. Zooplankton are microscopic animals such as copepods, and fish eggs and larvae that are abundant in the plankton. Both phytoplankton and zooplankton are sampled by scientists using very fine meshed plankton nets towed through the water column.

most individuals are sexually mature at about 60 mm. The minimum size limit (90 mm for commercial fishers; 100 mm for recreational fishers) ensures that most scallops have at least one spawning season before reaching the size limit. Larger scallops produce substantially more eggs and sperm than smaller scallops.

8 Scallops are very productive, producing up to 40 million eggs per spawning individual. Scallops may spawn several times each year (although not all of these spawning events lead to successful spat settlement). Spawning from September to late December is thought to account for most new scallops entering the fishery. Larval development lasts about three weeks, depending on sea temperature. Figure 2 shows the life cycle of a scallop.

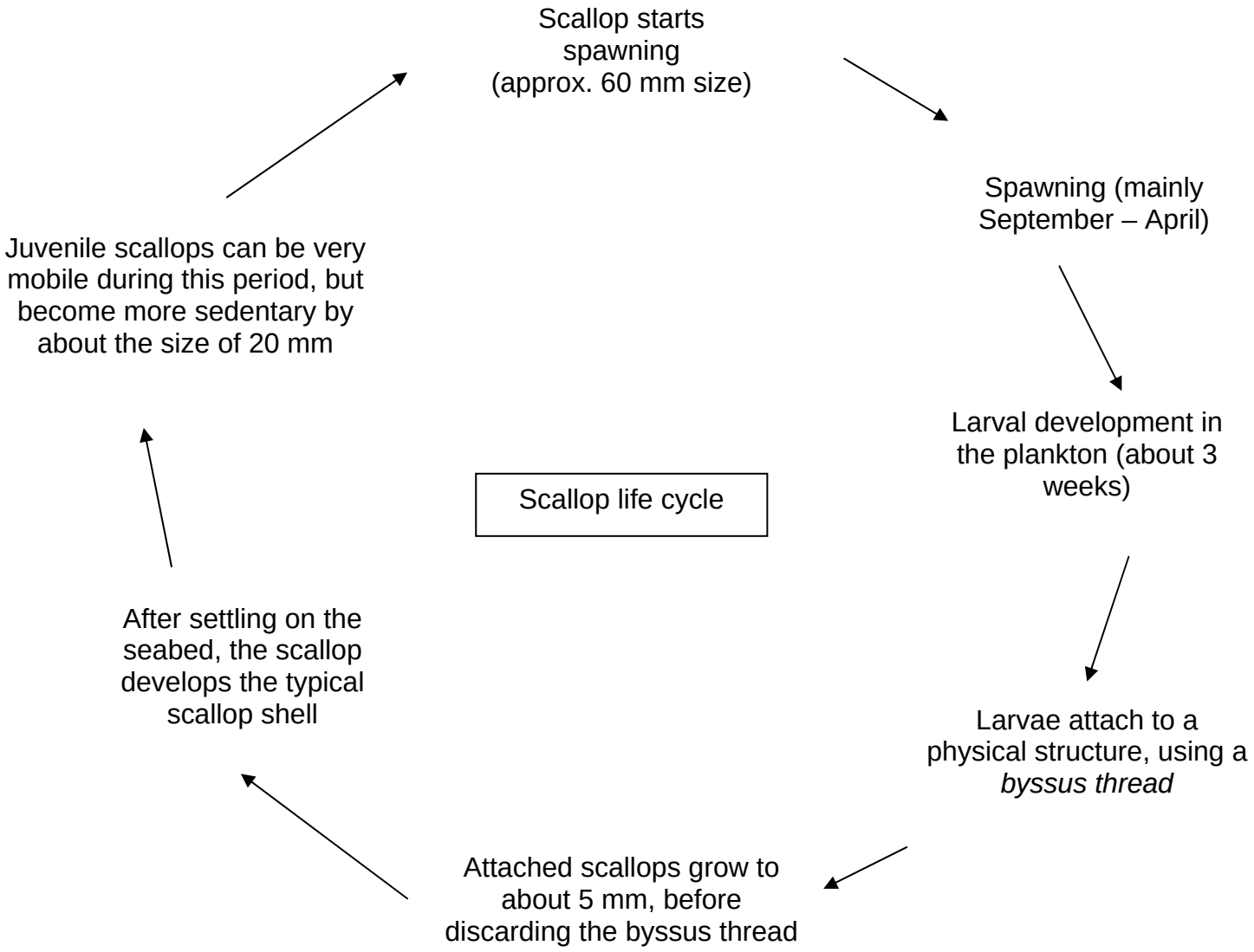
9 Several features of scallop biology contribute to variable biomass and catches, including:

- Scallops grow rapidly (although with considerable variation between sites and over time);
- Natural mortality is high. That is, high numbers of scallops die from causes other than fishing, such as predation, storms, 'old age';
- Recruitment (the number of new scallops in a given year) varies greatly from year to year. This is because recruitment is sensitive to environmental factors e.g. water temperature, phytoplankton growth.

10 As Figure 3 shows, only a very small proportion of scallop eggs survive to become adult scallops. Large numbers die as planktonic larvae and during the stage when larvae settle and attach to the seabed. Over the three week period following spawning, up to 99.8% of scallop eggs will have died. Management cannot affect survival during the planktonic phase. However, management during the early benthic phase can affect scallop survival in several ways. For example, enhancement measures can add new recruits (potentially increasing overall numbers growing to adulthood). Human intervention can also change habitat types available. The survival of young scallops during the early benthic phase (i.e. the phase in which scallops start to settle on the seabed) can vary greatly between sites. Survival may be higher on sites on the seabed that have more structure (e.g. reefs, rocks, other plants or animals on which spat can settle). The section on the effects of dredging discusses this further.

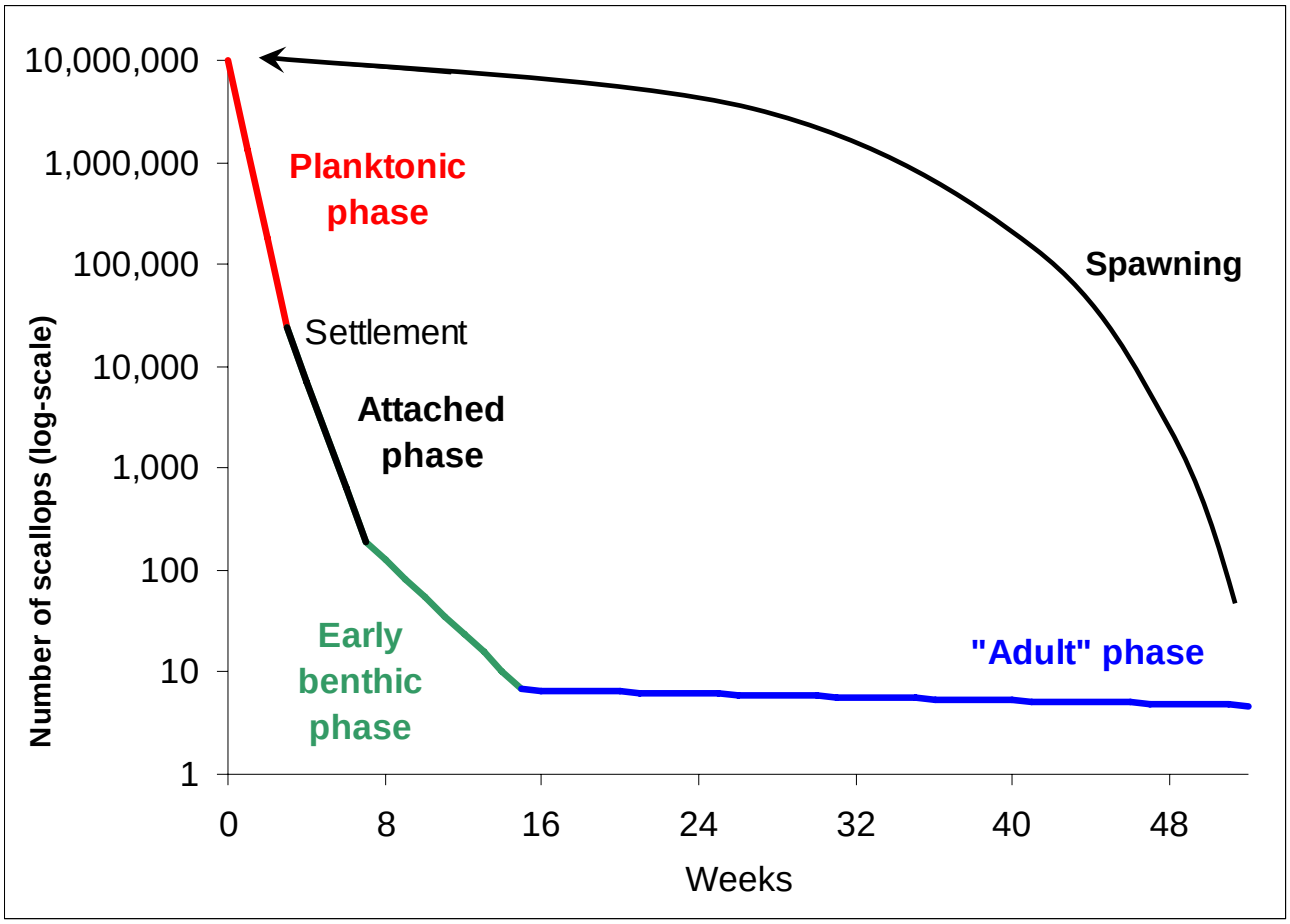
11 Because scallops are relatively short-lived, and recruitment is variable, the scallop fishery is based on only a few year-classes. A year class describes fish in a stock that are born in the same year. Occasionally, a stock produces a very small or very large year class that can be pivotal in determining stock abundance in subsequent years.

Figure 2: Life cycle of a scallop



Byssus thread: a tuft of strong filaments by which shellfish (e.g. a mussel) holds itself secure to a hard surface such as a rock or a fragment of shell

Figure 3: Relative proportions of scallops at each lifecycle stage (log-scale). Note that numbers decline steeply during the planktonic phase, attached phase and early benthic phase (i.e. early phase on seabed).



Environment

Climatic features

12 There may be a relationship between scallop recruitment and the Southern Oscillation Index. The Southern Oscillation Index is related to changes in ocean temperatures across the eastern tropical Pacific. When sea temperature is colder than normal across the eastern tropical Pacific, Southern Oscillation Index values are positive. This pattern is typical of La Niña episodes. Northeasterly winds and wet humid weather are typical of a La Niña summer in northern New Zealand. An El Niño summer provides opposite conditions: southwesterly winds prevail, with dry but cooler than average weather. Scallop recruitment appears to be higher during La Niña periods (**Figure 4**). However, the pattern was disrupted from 1998, possibly due to the "blackgill" disease and tubeworm outbreak (discussed below) that affected the fishery for three years around 2000.

13 The relationship between the Southern Oscillation Index and catches is less apparent following 2002, when the fishery was introduced into the QMS. This may be because commercial catches since 2002 have been more constrained than they were before QMS introduction. **Figure 5** may show the relationship after 2002 between fishery biomass and the Southern Oscillation Index more clearly. Figure 5 plots the Southern Oscillation Index against biomass estimates (rather than against commercial catches as in Figure 4) for the Whitianga and Mercury Island beds (statistical area 2L). The series of biomass estimates available is most complete for these beds.

Figure 4: Reported scallop catch by area (estimated catches in tonnes greenweight, pro-rated to sum to the CELR landed greenweight), for the Coromandel scallop fishery and the Southern Oscillation Index (with a 2-year lag). The Hauraki Gulf catch for 1991 includes a substantial catch taken from near Colville township (around 45 meatweight tonnes) that was mis-recorded as catch from the eastern Waiheke Island statistical area (2X (see figure 8)).

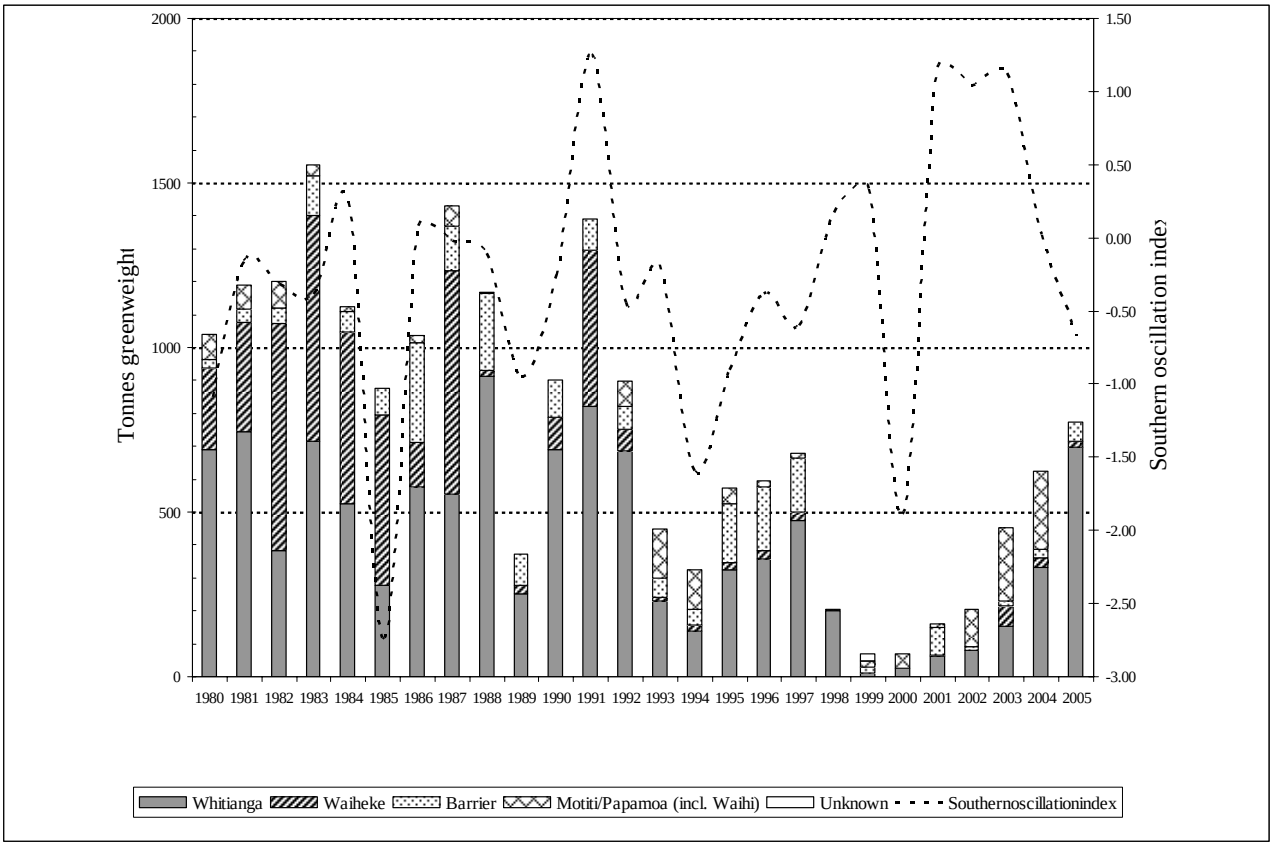
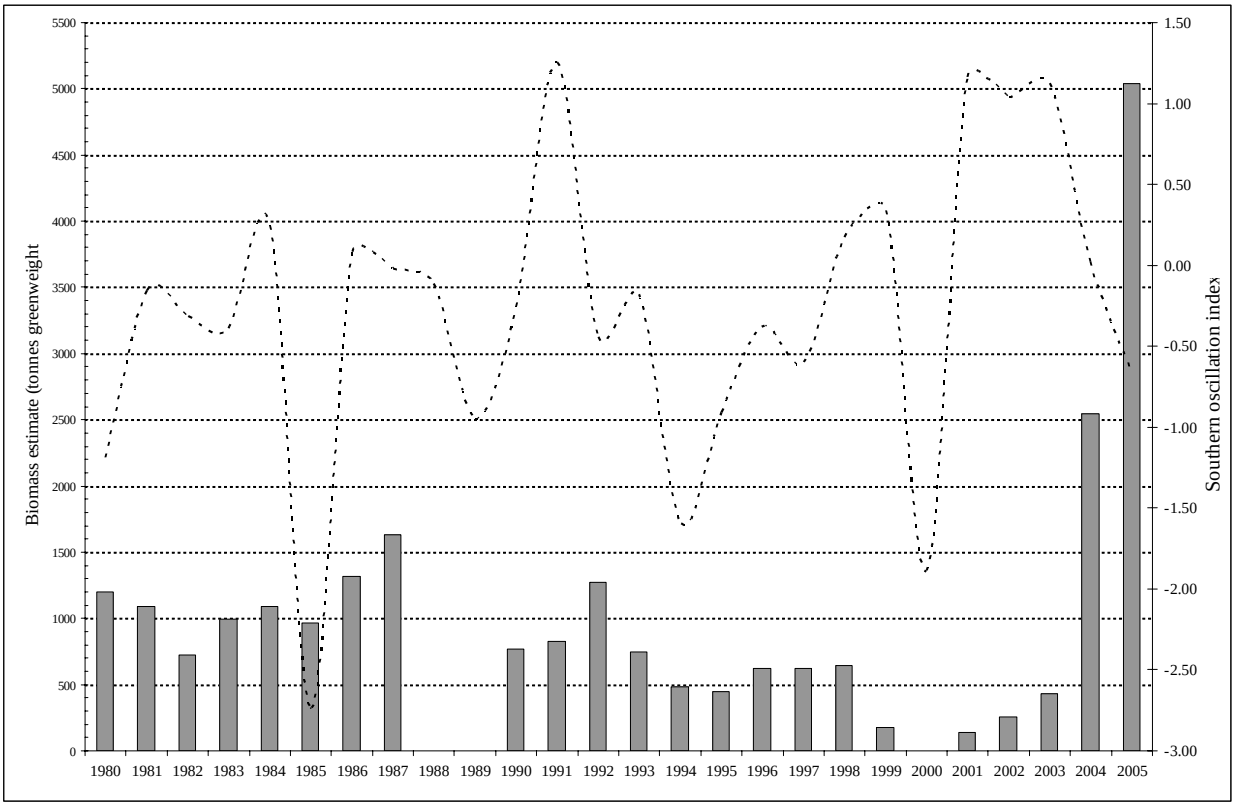


Figure 5: Estimated recruited biomass (at the time of surveys) of scallops of 95 mm or greater shell length in the Whitianga beds of the Coromandel fishery (statistical area 2L) since 1980 using historical average dredge efficiency, and the Southern Oscillation Index (2-year lag). Only Whitianga biomass estimates are shown, because this is the most complete series.



Land use

14 Land use practices in coastal areas may affect scallop populations. Land uses such as construction work, forest clearance, and sub-division result in increased suspended sediment in the water. Suspended sediments affect coastal ecosystems in a variety of ways, including:

- ❖ smothering plants and animals on the sea floor;
- ❖ coating or burying hard substrates in mud;
- ❖ blocking sunlight; and
- ❖ transporting pollutants and (excess) nutrients. Associated nutrient loading tends to degrade nearshore water and habitat quality, and can lead to excess growth of phytoplankton (e.g. harmful algal blooms) and water-borne bacteria.

15 The Ministry of Fisheries has not done research on the impacts of sediment on scallops. Studies on other shellfish including mussels, oysters, sponges, kina, and paua indicate a range of impacts. One of the conclusions of one study was that the combined impacts of suspended sediment loading on nearshore and coastal environments are poorly understood and are probably substantially underestimated.

Disease

16 The 1999 and 2000 scallop seasons were very poor, with periods of the season not fished (voluntarily) because of "blackgill" condition in the scallops. In these years, most scallops in Northland and Coromandel had black-coloured gills (as distinct from the normal brown-pink

colour), watery white flesh, and a bitter taste. The scallops were also in generally poor condition. Later, marine farmers around the Coromandel Peninsula found similar discolouration in oysters and mussels.

17 A NIWA report considered that the scallops had a moderate to heavy infection of a form of bacteria. However, the bacteria are normally harmless, and were not necessarily the cause of the disease. No large-scale scallop deaths were associated with the discolouration. It was thought the poor condition of scallops could have been associated with a combination of spawning stress and a possible reduction in food supply in the water column (linked to oceanographic abnormalities and reduced nitrate availability in the region).

Biosecurity

18 In recent years, there have been two possible biosecurity situations that could have affected the Coromandel scallop fishery. The most recent situation was the spread of the C*haetopterus* tubeworm into some areas that affected commercial dredging between 1998 and 2000. The tubeworm builds large clumps of parchment-like tubes that make dredging for scallops impossible because the dredge fills with tubes, and cannot catch scallops. However, it is not known whether tubeworms had an adverse effect (e.g. smothering, competition for space) on scallops *per se*. Numbers of tubeworms declined through the early 2000s, and tubeworms were very rare during 2005.

19 It has been speculated that the tubeworm may have been introduced into New Zealand from log-carrier ships travelling from Asia. Some of these log-carrier ships are thought to have illegally dumped ballast water in the outer Hauraki Gulf before docking at either the Port of Auckland or Tauranga.

20 The earlier situation involved the spread of starfish during the 1990s in the main Whitianga commercial scallop area between the mainland and the Mercury Islands. The starfish rapidly increased in abundance from an area near Otama Beach. As the starfish spread into new areas, fishers reported that scallop abundance declined, because starfish are active predators of scallops. The starfish remained in the general Whitianga area for all the 1990s, but declined in the 2000s, with fishers now reporting the starfish to be at low abundance levels.

21 In both situations, the rapid proliferation of the tubeworm and starfish caused fishers to believe that both may have been new invasive introduced species. However, the starfish is actually a large (growing up to 250mm wide) native New Zealand species known as the eleven-armed starfish (*Coscinasterias calamaria*). Taxonomists examined the tubeworm and could not decide whether it was a native or introduced species. Therefore, it is not known whether the tubeworm was a biosecurity breach. Nonetheless, both situations indicate how the Coromandel scallop fishery could be vulnerable to a biosecurity threat from a new introduced species.

Stock Assessment

22 Since 1978, research surveys have estimated recruited biomass of Coromandel scallops at the start of the season in most years. The text boxes below outline the process of how the number of scallops in the commercial beds is estimated, and how this is converted to an estimate of sustainable harvest for that season. The final text box summarises the results for the May 2006 survey.

23 Survey sites include Whitianga/Mercury Islands, Waihi Beach, Motiti/Papamoa, Little Barrier, Cape Colville, and eastern Waiheke Island. Areas where commercial fishing is prohibited have not been included in recent research surveys.

How the scallop beds are surveyed

Timing

The pre-season biomass survey is normally conducted in May each year. The choice of when to do the survey involves balancing constraints like weather and sea conditions against the fact that the closer the survey is done to the start of the season, the more accurate it is likely to be.

Selection of areas to survey

All sampling in recent surveys of the “commercial” areas has been using a dredge towed from a commercial scallop fishing vessel. The same vessel and skipper have been used since 1990. The main commercial scallop fishing areas are generally surveyed each year: eastern Waiheke Island, Colville, Little Barrier Island, Mercury Islands, Waihi Beach, and Motiti Island/Papamoa Beach.

Each of these areas is drawn on a chart, and latitude and longitude points defining the boundaries/corners of each area are entered into the computer. It is then straightforward for the computer software to calculate the area covered (in square metres) for each area. For each area, the computer randomly selects the latitude and longitude starting point for 15-30 sampling positions (termed stations) for the dredge. Up to 25 stations can be completed in a day if the stations are close together and there are not many problems with the gear.

How sampling occurs

Using a GPS, the skipper moves the vessel to each randomly selected sampling station. The skipper is instructed to tune the gear (selected course, speed, warp length, etc.) to maximise the total catch at each station. The dredge used has a width of 2.0 metres. Each dredge tow is around 600-1000 metres long. The exact length of each tow can be determined from the GPS. By knowing the length of the dredge tow and the width of the dredge, the actual area covered by each tow can then be calculated by the computer.

At the end of each tow, the dredge is retrieved and emptied onto the sorting tray on the boat. All live scallops are then measured to the maximum width in millimetres. The scallops are measured on an “electronic” measuring board whereby the length measurement for each scallop is automatically entered into the computer. Occasionally, large catches are randomly sub-sampled for length. All unmeasured scallops are counted.

The computer can then calculate the density of scallops (per square metre) for each tow station. For example, if the tow length for a particular tow station was 800 metres, then the area of seabed sampled by that tow station would be 1600 square metres. If 800 scallops were sampled by that tow station, then the scallop density for that station was 0.5 scallops per square metre.

The computer calculates the average scallop density per square metre for all of the sample stations in each area (e.g. Little Barrier). It is assumed that the average scallop density obtained from the sample stations is typical of the scallop density in the overall area. The average density is then multiplied by the overall square metre coverage of each area to provide an estimate of the total number of scallops in each area.

With this information, an estimate of sustainable harvest for that season is calculated in the way shown in the text boxes on the following page.

Fishery assessment methodology

Counts of scallops above a critical size at each survey site are converted to numbers per square metre of seabed, according to the area the dredge sweeps (as outlined above).

The numbers of scallops are calculated by multiplying the mean scallop density by the overall area of each area surveyed.

The absolute density of scallops is estimated by correcting for the efficiency of the dredges (because the number sampled depends on how efficient the dredge used is). Experiments using divers and dredges during the 1990s have established dredge efficiency.

The average weight of a scallop is obtained and used to calculate biomass.

To estimate sustainable yield, the biomass at the time of the survey (May) is projected forward to what it will be at the start of the season (July). Information on growth rates (from previous research) and natural mortality (how many scallops die from natural causes in a given period) is used.

The sustainable yield – a constant portion of total biomass – is then calculated. The portion of total biomass that can be harvested sustainably depends on the characteristics of the particular species. Different estimates are calculated, based on different assumptions; some estimates are more conservative than others.

Meatweight is calculated from greenweight based on an average recovery rate between 1995 and 2002 for getting scallop meat from the whole scallop shell in processing sheds (12.6%).

Recent research has indicated dredging may have indirect effects on scallop recruitment: through sub-lethal effects of disturbance on adults developing gonads prior to spawning, or through the removal of foliose material used as spat settlement surfaces.

Commercial fishing only occurs in places where scallop density is high enough to make it viable. MFish uses a 'critical density' estimate of one legal sized scallop per 25 m^2 (this closely relates to a catch rate of 50kg greenweight per hour). Allowing for fishing only at critical density reduces the estimate by around 15%.

May 2006 survey results

The average number of 90mm+ scallops per square m surveyed was 0.1991.

For the six areas surveyed, it was estimated there were **31.8 million** scallops at or above a size of 90 mm at the time of the survey.

Correcting for average historical dredge efficiency, the number of scallops above 90 mm is estimated at **126.4 million**.

The total greenweight biomass (90 mm+ scallops) is calculated by multiplying the estimated number of scallops by the average weight of a scallop at the time of the survey – 87g. This provides an estimate of **10, 996 tonnes** in May 2006.

Biomass at the start of the season (July 2006) is projected to an estimate of **12, 203 tonnes**.

The basic estimate of sustainable yield is **3, 918 tonnes** greenweight, based on a proportion of total biomass that can be sustainably harvested.

The *greenweight* estimate converts to a *meatweight* estimate of **488 tonnes.**

If the indirect effects of dredging on scallop recruitment are included, then the sustainable yield estimate would reduce to **333 tonnes**.

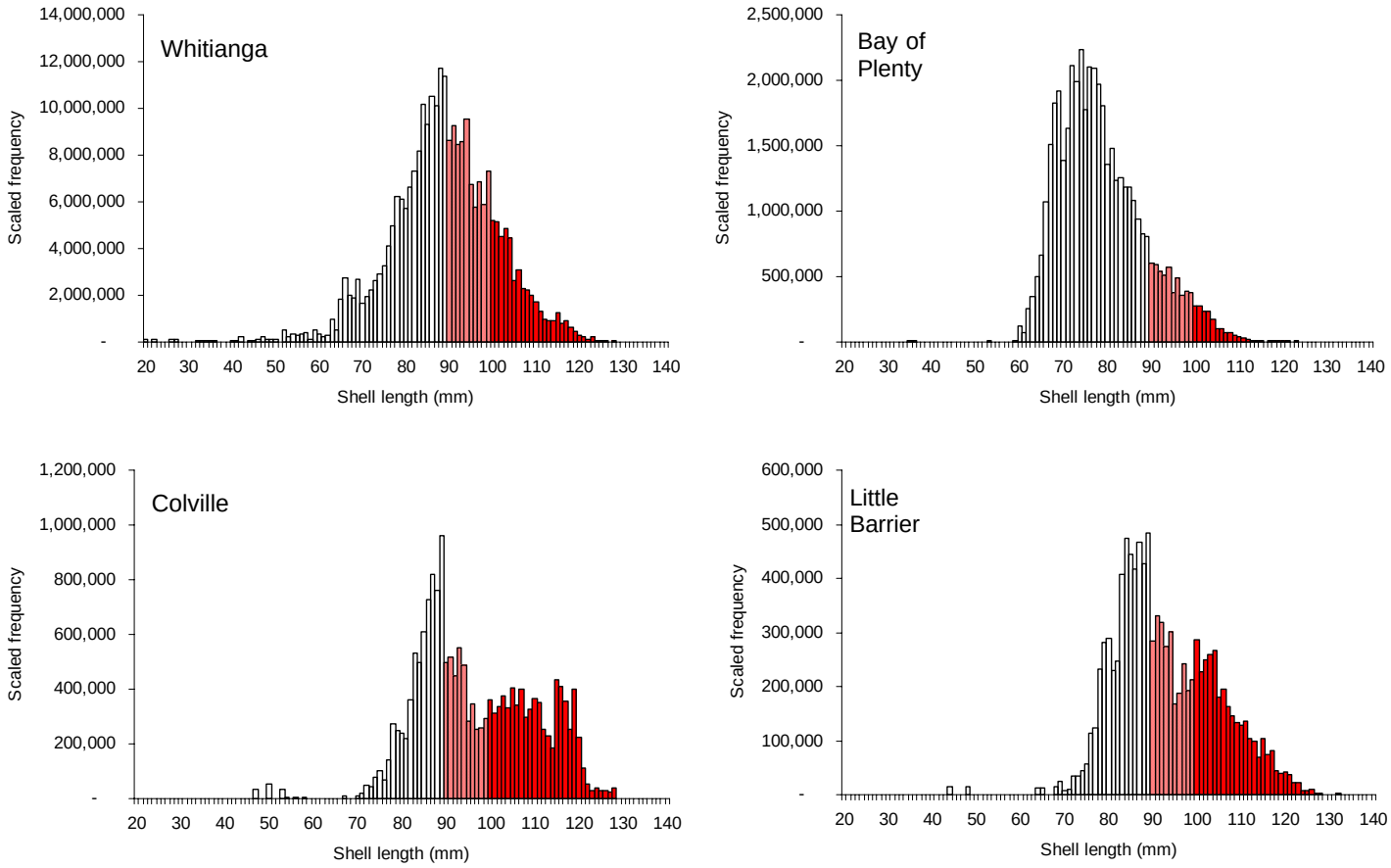
Allowing for fishing only at or above the critical density reduces the estimate of sustainable yield to **425 tonnes** for the basic estimate, or **290 tonnes** when the indirect effects of dredging on recruitment are included.

Greenweight is the weight of the whole scallop, including the shell, before it is processed.

Meatweight is the weight of the processed scallop flesh.

24 During the survey in May 2006, 24 446 scallops were measured (of the 61 018 scallops caught, in 122 tows sweeping 0.164 km^2). **Figure 6** shows approximate pooled length frequency distributions, scaled to estimated population size for the four major areas. The length frequency distributions assume historical average dredge efficiency for each substrate type (either sand or silt/mud). The beds at the Mercury Islands (to the north of Whitianga), and at Little Barrier Island and Colville had relatively higher proportions of large scallops than those in the Bay of Plenty (off Motiti Island, Papamoa Beach, and Waihi). However, there were reasonable proportions of smaller scallops (less than 90 mm shell length) in all beds, suggesting good recruitment for 2007.

Figure 6: Length frequency distributions for major survey areas (corrected for historical average dredge efficiency), May 2006. Shaded bars show scallops bigger than 90 mm and red bars show scallops bigger than 100 mm. NOTE: DIFFERENT SCALES ARE USED.



25 **Figure 7** (below) shows the results of biomass surveys in the Mercury Island (7a), Little Barrier (7b), Waiheke Island (7c), and Motiti/Papamoa beds (7d) between 1993 and 2005. The survey results show how much biomass can change from year to year in a given area. It is also evident that within a year, biomass at different beds can vary substantially. Note that different scales are used for the different beds.

Figure 7: Length frequency distributions for major survey areas, 1993 to 2005. NOTE: DIFFERENT SCALES ARE USED.

Figure 7a

Figure 7b

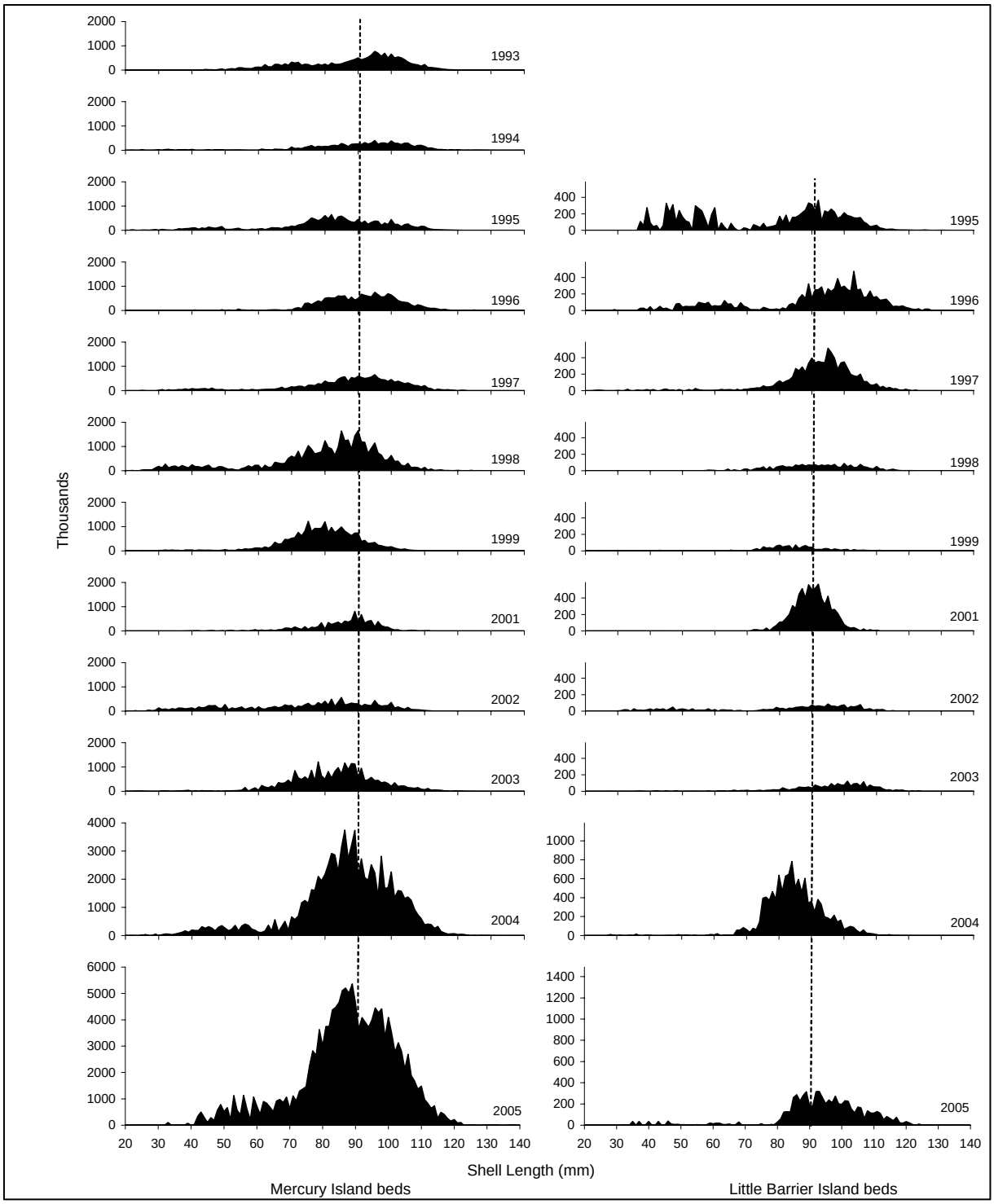
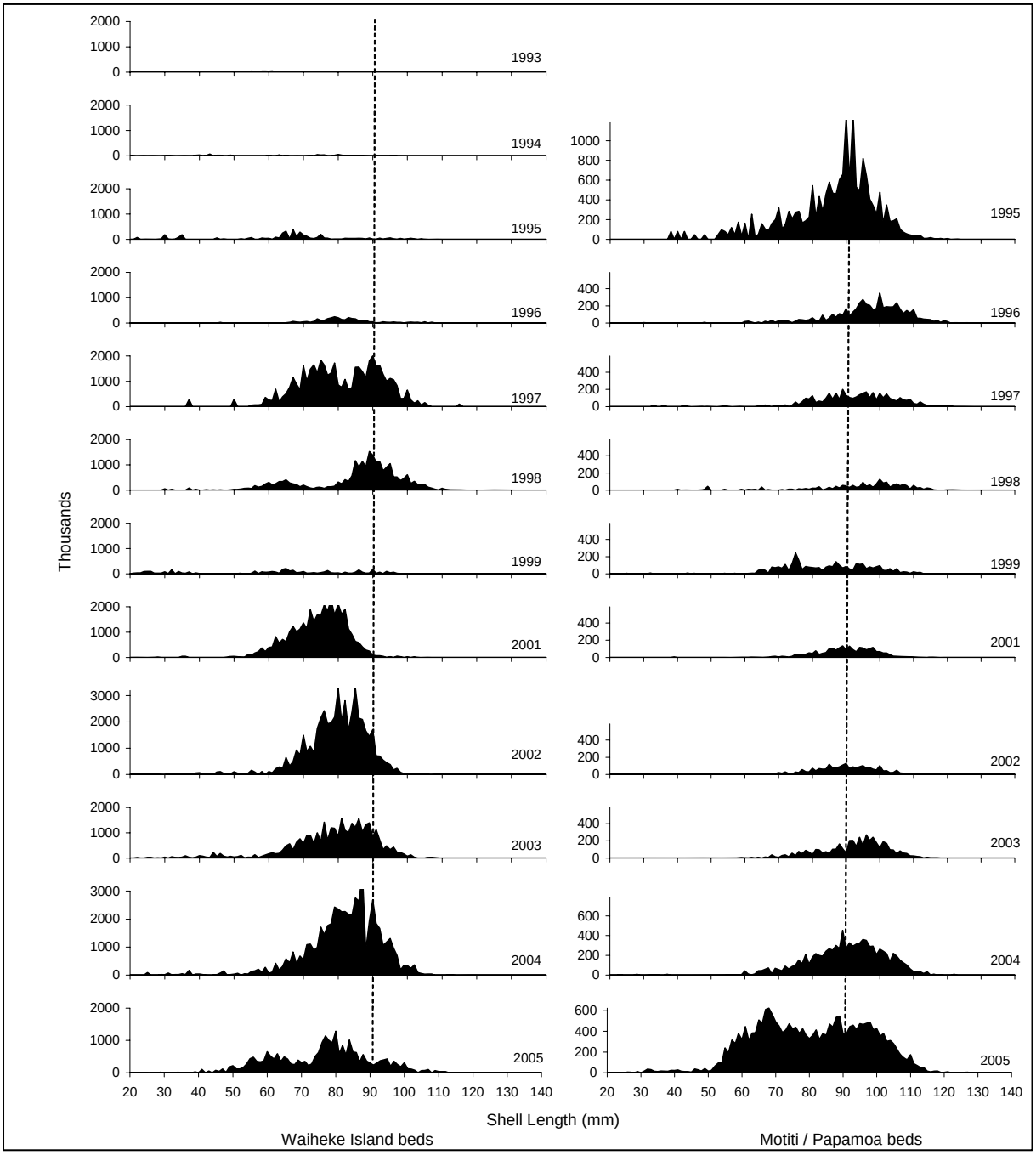


Figure 7c

Figure 7d



Social, Cultural, and Economic Information

Fishery characteristics

26 Large parts of the Hauraki Gulf and many inshore scallop beds around the Coromandel Peninsula are closed to commercial scallop fishing by regulation (**see map – figure 8**). The main beds in the commercial fishery are found north of Whitianga (near the Mercury Islands), east of Waiheke Island, around Little Barrier, Cape Colville, and in the Bay of Plenty, principally around Motiti Island and Papamoa Beach (**see map – figures 1, 10**).

27 The different sectors have different minimum legal size limits: 90 mm for commercial fishers, and 100 mm for recreational fishers. Customary non-commercial fishers taking scallops with a permit issued under Regulation 27A of the Fisheries (Amateur Fishing) Regulations 1986 may have a different size limit specified on their permit by the issuing authority.[†] Regulation 27A allows for fisheries resources to be taken for hui or tangi outside of the usual controls placed on amateur fishing in the regulations (e.g. bag limit, size limit, season).

28 The commercial size limit was reduced to 90 mm in 1995, in line with a management plan that the Coromandel Scallop Fishermen's Association developed in conjunction with non-commercial fishers. As part of the agreement, various areas important to recreational and customary non-commercial fishers were set aside as voluntary closures. These areas were subsequently closed by fishery regulation, following a dispute about the closures.

29 Regulations set the length of the fishing season as follows:

- Recreational fishers: 1 September to 31 March (inclusive) of the following year.[‡]
- Commercial fishers: 15 July to 21 December (inclusive). The shortened commercial fishing season was introduced at the request of the Coromandel Scallop Fisherman's Association due to their concerns about potential damage to newly settled scallop spat in late December and January.
- Customary fishers: if specifically authorised by a permit issued under Regulation 27A of the Fisheries (Amateur Fishing) Regulations 1986, customary take could occur outside of the season specified in the amateur regulations.

30 During the fishing season, both commercial and non-commercial fisheries may be closed under shellfish sanitation requirements.

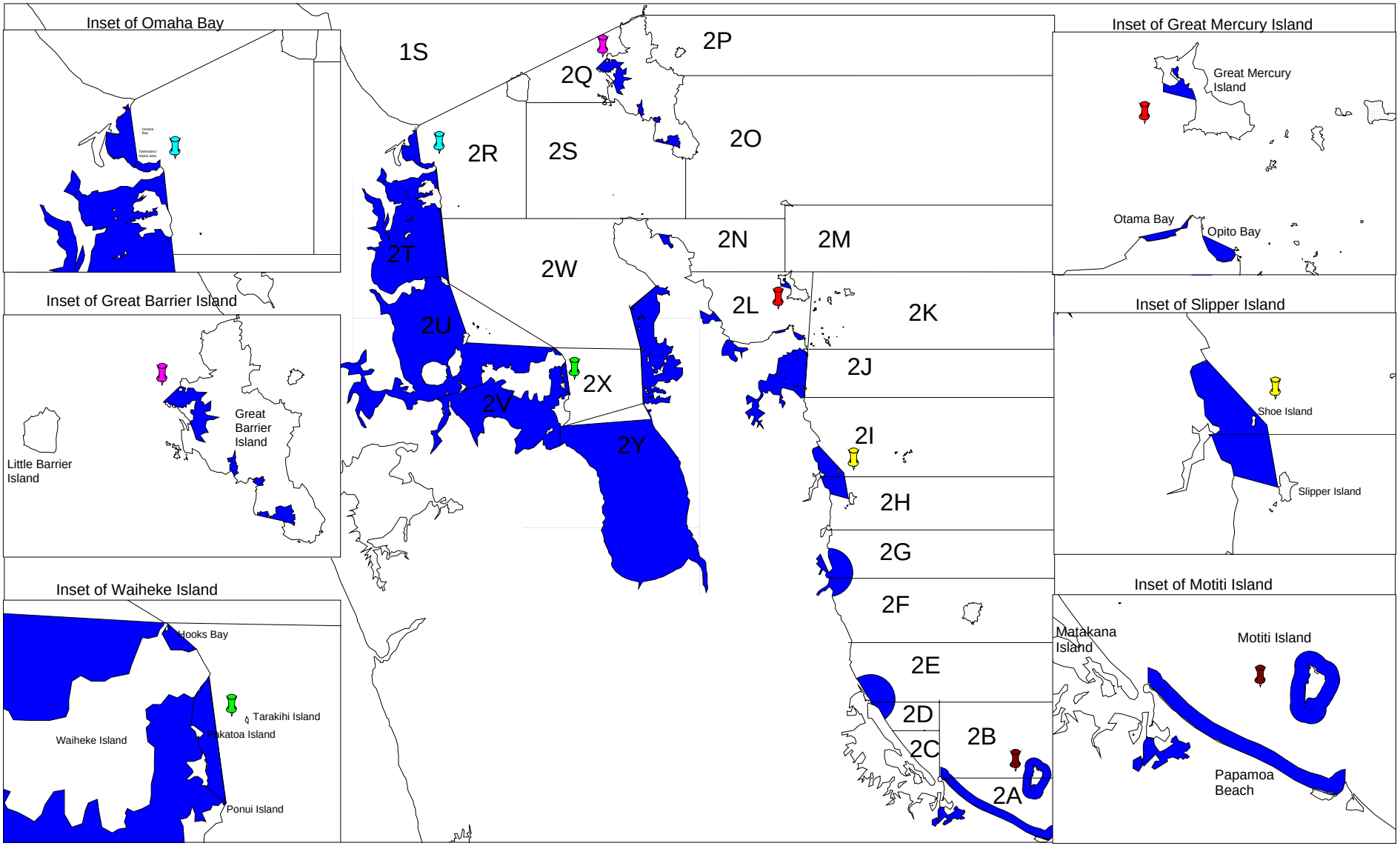
31 The recreational daily bag limit is 20 scallops per fisher per day.

32 As noted, Maori customary fishers can take scallops for hui and tangi in accordance with Regulation 27A of the amateur fishing regulations. No Tangata Kaitiaki/Tiaki are currently appointed in the area under the Kaimoana Regulations. Tangata Kaitiaki/Tiaki are appointed under the Kaimoana Regulations, as members of the tangata whenua or tangata whenua organisations. The Kaimoana Regulations outline various roles for Tangata Kaitiaki/Tiaki (**see text box, page 29**).

33 Annex one outlines more of the commercial and amateur regulations in place in this fishery.

[†] The issuing authority may be: any Maori Committee constituted by or under the Maori Community Development Act 1962; any marae committee that is an incorporated society under the Incorporated Societies Act 1908; or any kaitiaki of the tangata whenua.
[‡] The recreational scallop season was previously from 15 July to 14 February. The shift of the season by six weeks was introduced in 2007.

Figure 8: Statistical reporting areas and regulated closures (blue areas) in the Coromandel Scallop fishery
(Coloured pins relate insets to main map)



Commercial Fishery

History

34 Commercial scallop fishing has been carried out around the Coromandel Peninsula and in the Hauraki Gulf since the late 1960s. After a rapid escalation of fishing effort during the 1970s, the Coromandel Controlled scallop fishery was declared in 1978.[§] Under the controlled fishery, access was determined by the Fisheries Authority, which was independent of the Minister and Ministry. Commercial access was restricted to 21[**] license holders who were permitted to take scallops for sale in the controlled fishery area. The license could not be sold by the license holder, but could be surrendered to the Fisheries Authority if the license holder did not want to fish for scallops. The Ministry's role was mainly to provide advice to the Fisheries Authority on appropriate levels of access, especially regarding the amount of catch each licensee could take.

35 The reported commercial catch has varied considerably ranging from a high of 203 tonnes meatweight in 1991 to 6.6 tonnes meatweight in 2000 (landed catches) (**Table 1**). A fluctuating catch is expected for short lived species in general, and is especially typical of scallop fisheries worldwide. During the 1980s, a wide variety of effort controls (e.g. regulations specifying the daily commercial catch limit, and days fished) and daily catch limits were imposed as a way of indirectly restricting the scallop catch to sustainable levels. Some of these effort controls remain in place (including controls on the days on which fishing can occur; controls on dimensions of commercial dredges – see annex one).

36 As discussed more fully later, a key input control was to reduce the minimum legal size limit from 100 mm to 90 mm for commercial fishers. This change occurred in 1995. The rationale for the change was to reduce the amount of wastage of scallops that had been caught in the 90-100 mm size range that were returned to sea as under-size, but would have been unlikely to survive the return due to damage by the dredge.

37 Since 1992, explicit limits on the overall commercial catch for each year have been determined from the results of dredge and dive biomass surveys undertaken before the start of each fishing season. The full commercial catch limit was often not caught, notably in 1998, 1999, and 2000 (**Table 1, Figure 9**). One of the reasons commercial fishers do not always catch the full commercial catch limit is that scallop biomass can change quite quickly. For this reason, the biomass surveys are done as close as possible to the expected start of the commercial season. Another reason commercial fishers may not catch their full limit is because the total allowable commercial catch is set in meatweight, but the meatweight to greenweight ratio varies throughout the year (i.e. the weight of scallop flesh in relation to the weight of the scallop shell changes over the season). Actual yields depend on scallop condition, natural mortality, and scallop growth.

[§] The controlled fishery was defined as the area from Cape Rodney (including the Hauraki Gulf) to Town Point (near Tauranga).

[**] One of the license holders had a double allocation, so there were 22 shares in the fishery. One license was cancelled in the 1990s due to the death of the license holder.

Table 1: Catch limits and landings (t greenweight or meatweight) from the Coromandel fishery since 1974. Data before 1986 from Fisheries Statistics Unit (FSU) forms. Landed figures come from the landed section of the Catch Effort and Landing Returns (CELR) form and from Licensed Fish Receiver Returns (LFRR), whereas "Estimated" figures come from the CELR effort section and are pro-rated to sum to the CELR landed greenweight. "Hauraki" = 2X and 2W, "Mercury" = 2L and 2K, "Barrier" = 2R, 2S, and 2Q, "Plenty" = 2A–2I. Seasonal catch limits (since 1992) are specified in meatweight ("Green" assumes the gazetted conversion factor of 12.5% and probably overestimates the actual greenweight taken in most years).

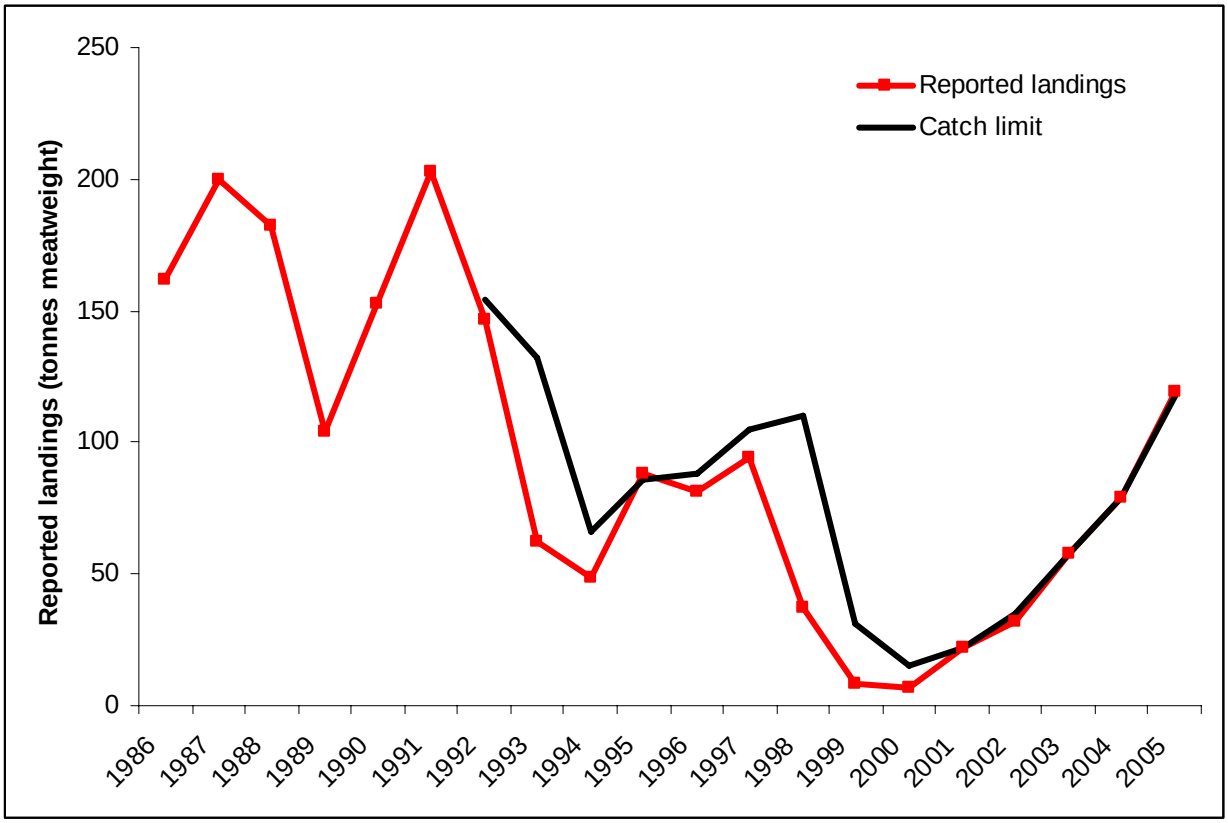
			Landings (t)						
	Catch limits		LFRR	CELR		Estimated catch (t greenweight)			
Season	Meat	"Green"	Meat	Meat	Green	Hauraki	Mercury	Barrier	Plenty
1974	–	–	–	–	26	0	26	0	0
1975	–	–	–	–	76	0	76	0	0
1976	–	–	–	–	112	0	98	0	14
1977	–	–	–	–	710	0	574	0	136
1978	–	–	–	–	961	164	729	3	65
1979	–	–	–	–	790	282	362	51	91
1980	–	–	–	–	1 005	249	690	23	77
1981	–	–	–	–	1 170	332	743	41	72
1982	–	–	–	–	1 050	687	385	49	80
1983	–	–	–	–	1 553	687	715	120	31
1984	–	–	–	–	1 123	524	525	62	12
1985	–	–	–	–	877	518	277	82	0
1986	–	–	162	–	1 035	135	576	305	19
1987	–	–	384[6]	–	1 431	676	556	136	62
1988	–	–	182	–	1 167	19	911	234	3
1989	–	–	104[7]	–	360	24	253	95	1
1990	–	–	153	–	903	98	691	114	0
1991	–	–	203	–	1 392	472[8]	822	98	0
1992	154	1 232	147	–	901	67	686	68	76
1993	132	1 056	62	–	455	11	229	60	149
1994	66	528	49	–	323	17	139	48	119
1995	86	686	88	79	574	25	323	176	50
1996	88	704	81	80	594	25	359	193	18
1997	105	840	94	89	679	26	473	165	15
1998	110	880	37	19	204	1	199	2	1
1999	31	248	8	7	47	0	12	17	18
2000	15	123	7	10	70	0	24	2	44
2001	22	176	22	20	161	1	63	85	12
2002	35	280	32		204	0	79	12	112
2003	58	464	58		451	63	153	13	223
2004	79	632	79		624	27	333	27	237
2005	118	944	119						

[6] The combined commercial catch for 1987 from the Licensed Fish Receiver Returns is reported as 384 tonnes meatweight, but the Ministry and the commercial fishers consider this catch total is unreliable due to catch reporting problems. There were general reporting problems in many commercial fisheries immediately following the introduction of the Quota Management System in 1986. The Ministry considers that a more reliable estimate of the commercial catch based on a review of the commercial catch-effort data for that year is around 200 tonnes.

[7] The catch for 1989 may have been under-reported due to mis-recording problems involved with the transition between the Ministry's commercial catch reporting systems in 1989.

[8] The Hauraki Gulf catch for 1991 includes a substantial catch taken from near Colville township (around 45 meatweight tonnes) that was mis-recorded as catch from the eastern Waiheke Island statistical area (2X (see Figure 8)).

Figure 9: Reported commercial landings (tonnes meatweight) in the Coromandel scallop fishery from 1986 to 2004, with the commercial catch limits from 1995 to 2004.



38 **Table 2** and **Figure 10** show the main sub-areas the commercial fishery is based on since 1990. This information shows that around 60% of the commercial catch has been taken from statistical area 2L (Whitianga Islands area), with area 2R the next most important with the 13% of the catch – most of this catch would have been taken from the beds around the south-western quadrant of Little Barrier. In the 1980s, the Hauraki Gulf catch was important (around 30% of the overall Coromandel scallop catch (**Table 1**)), but since then very few scallops have been taken from the beds at the eastern end of Waiheke Island. **Figure 4** (page 8) also shows changing proportions of catch from the sub-areas of the fishery.

Current commercial fishery

39 The Coromandel scallop fishery was introduced into the quota management system on 1 April 2002. The allocations of individual transferable quota to quota-holders at the time of QMS introduction were the same for each quota-holder, because under the controlled fishery, the overall commercial catch limit had always been allocated in equal[9] amounts to the license holders. Following QMS introduction, quota was rationalised between quota-holders, as some of the older fishers who had been in the fishery for many years took the opportunity to sell their quota.

40 There are now 10 quota-holders in the fishery. When Coromandel scallops were introduced into the QMS, 20% of the quota was allocated to Te Ohu Kaimoana, in partial fulfillment of the Fisheries Deed of Settlement. The number of quota owners will increase as Te Ohu's holdings are allocated to individual iwi over time.

[9] Except that one of the license holders had a double allocation.

41 Some of the QMS management arrangements for the Coromandel scallop fishery are somewhat different to the main QMS finfish stocks. The major difference is that the scallop fishing year is from 1 April to 31 March of the following year because the traditional finfish fishing year which starts on 1 October would effectively straddle the Coromandel scallop fishing season for commercial fishers (14 July to 21 December). Another difference is that weights (kg) are recorded as meatweight (only the processed weight of the actual scallop meat), rather than the more commonly used greenweight (which would include the weight of the shell, gills, and digestive system which are not eaten by people).

42 The official greenweight to meatweight recovery rate is 12.5%. However, the average recovery rate based on the weights of scallops measured as greenweight and meatweight in the processing factories from 1995 to 2002 is 12.7%. Moreover, commercial fishers have indicated that they now frequently achieve recovery rates of 13.5-14%.

43 Seven vessels are involved in the fishery, most of which are around 40 foot (12 metres) in length. Nineteen fishers are employed on the boats. All commercial fishing is done using dredges. The main landing points are Whitianga and Whangamata. The processing sector employs 67 people (most as seasonal labour for the 24-week scallop season). Jobs include drivers, openers, graders, packers, cleaners, and management. Two processing sheds operate.

44 Port price is currently set at $14.17 per kg (2006/07). It has declined somewhat since 2002-03, when it was $18.00 per kg. Most scallops from the Coromandel scallop fishery are sold on the domestic market. However, an export market may develop for Coromandel scallops in the future. In 2004, 115 tonnes of scallops were exported nationally, with an FOB value of $2,567,846.[10] In 2003, more than twice this amount was exported, and the value was $5,899,641. Most of this would have been scallops produced in the Southern Scallop fishery in Nelson and Marlborough. France is the main importer of New Zealand scallops (~70%).

[10] FOB - Free on board. The value of export goods, including raw material, processing, packaging, storage and transportation up to the point where the goods are about to leave the country as exports. FOB does not include storage, export transport or insurance cost to get the goods to the export market.

Figure 10: Percentage commercial catch by statistical area in the Coromandel scallop fishery (1990-2006) (based on estimated catches).

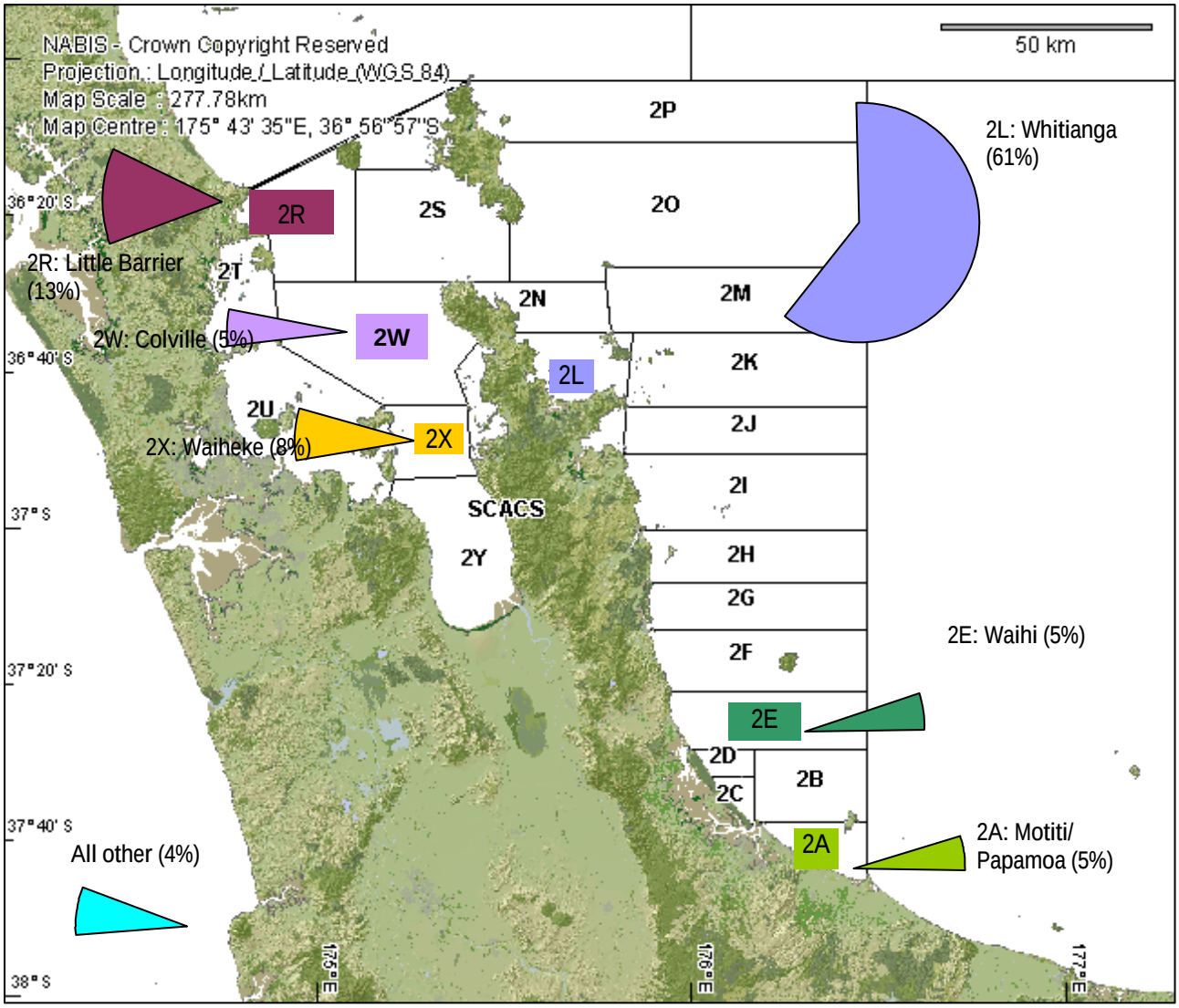


Table 2: Estimated catch of scallops (meatweight tonnes) reported by commercial fishers from Catch Effort Landing Returns (CELRs) from the Coromandel scallop fishery by statistical area. For explanation of area codes, see Figure 10 above. The reported catch (meatweight tonnes) from the Licensed Fish Receiver Returns (LFRRs) is also provided. Year '1990' is fishing year 1990/91 (1 April 1990 to 31 March 1991).

Area	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total	% of total
2A	0.00		1.32	3.22	11.13	4.84	0.02		0.40	2.26	5.24	1.51	6.45	2.02	2.51		40.92	5%
2B				0.46													0.46	0%
2C	0.08			0.45		0.11	0.22	1.53	0.04	0.25	0.31		0.57				3.54	0%
2D				1.75										3.83	6.00		11.58	1%
2E			6.23	5.53	1.82								4.12	14.46	10.83		43.00	5%
2F			0.63	1.75	0.09								1.45	0.17	0.02		4.11	0%
2G							0.18				0.01				4.57		4.76	1%
2H			0.23	3.17	1.83	0.59	0.84	0.09	0.14						0.26		7.15	1%
2I				0.41	0.06	0.60	0.42										1.49	0%
2J								0.00									0.00	0%
2K			1.07	0.23	1.05	0.12											2.47	0%
2L	63.73	85.93	58.25	10.75	16.58	36.40	40.86	48.19	28.11	1.67	3.01	7.90	8.99	14.27	34.05	87.24	545.93	61%
2M					0.02												0.02	0%
2N	0.08		0.49	0.70													1.27	0%
2P															0.02		0.02	0%
2Q				0.01	0.03			0.08									0.12	0%
2R	8.37	10.04	7.44	4.83	5.69	16.76	20.01	15.58	0.27	2.18	0.22	10.64	1.36	1.20	2.71	7.36	114.65	13%
2S	0.23			0.54	0.28	2.99	0.89	0.21		0.15			0.09				5.37	1%
2W	4.34	18.12	3.30	0.16	2.14	2.68	3.05	2.27	0.52					4.57	2.61	2.05	45.79	5%
2X	13.93	44.31	0.34	0.08				0.39	1.33			0.11		1.31	0.14		61.94	7%
2Y									0.05						0.04		0.08	0%
Total	90.74	158.40	79.30	34.04	40.72	65.08	66.48	68.35	30.85	6.50	8.79	20.16	23.02	41.84	63.75	96.65	894.67	100%
LFRR[11]	153	203	146	62	49	88	81	94	37	8	7	22	32	58	79	119		

[11] There are differences between the LFRR catch column the estimated CELR catch because of the different ways the weights are reported. The total catch is based on estimates of the weight of the catch made by the fishers as the scallops are caught at sea. The LFRR catch is obtained from the weighed catch reported by fish processors from the Licensed Fish Receiver Returns (LFRR). The LFRR catch is the more reliable record of weight, but the LFRRs do not provide more detailed catch-effort data e.g. reporting the catch by sub-areas. These figures differ from those presented in Table 1, because the figures in Table 1 have been pro-rated to the landed weight on the CELR forms.

Recreational Fishery

45 Telephone/diary surveys have been used to estimate how many scallops recreational fishers take (**Table 3**). There are difficulties in collecting accurate information on recreational take. In December 2003, technical members of the Recreational Working Group examined the methodologies used for the 1996, 1999-00 and 2000-01 surveys. The working group considered the 1996 (and the 1993-94 survey) survey should not be used for absolute estimates of recreational catch, because the survey contained methodological problems. The group also considered that the estimates of recreational catch from the 1999-00 and the 2000-01 surveys may be implausibly high for some important fisheries, and have cautioned against their use.

Table 3: Estimates of recreational catch in the Coromandel scallop fishery

Year	Harvest estimate (number of scallops)	Harvest estimate (tonnes meatweight)	Harvest range (tonnes meatweight)
1993-94	614,000	7.8	7.6-7.8
1996	626,000	8.1	7.5-8.8
1999-00	257,000	3.8	0-7.5
2000-01	472,000	6.9	3.7-10.2

46 In 2001, the Minister set the recreational allowance at 7.5 tonnes, based largely on the 1996 catch estimate as the most recent estimate available at that time. The 1999-00 catch estimate was not available in 2001 when the Coromandel scallop fishery was introduced into the QMS. Recreational fishers generally consider that scallop fishing has improved significantly since 2001. Recreational fishers note that catch per unit effort strongly influences non-commercial catches in the fishery. If non-commercial fishers are finding it difficult to take their bag limits, they may limit or stop their fishing for scallops until the fishery improves. Anecdotal evidence suggests recreational catches are now higher than at the time of the diary survey.

47 Similar to the commercial scallop fishery, the diary surveys show that the eastern Coromandel area (Cape Colville – Waihi Bluffs zone) accounts for nearly 50% of the recreational scallop catch (**Table 4**). From local knowledge, it is likely that most of the recreational catch reported from the Cape Colville – Waihi Bluffs zone is taken from the Mercury Islands – Whitianga area. The western Gulf zone (primarily the scallop beds inside Kawau Island and around Tiri Island) accounted for around 20% of the recreational catch.

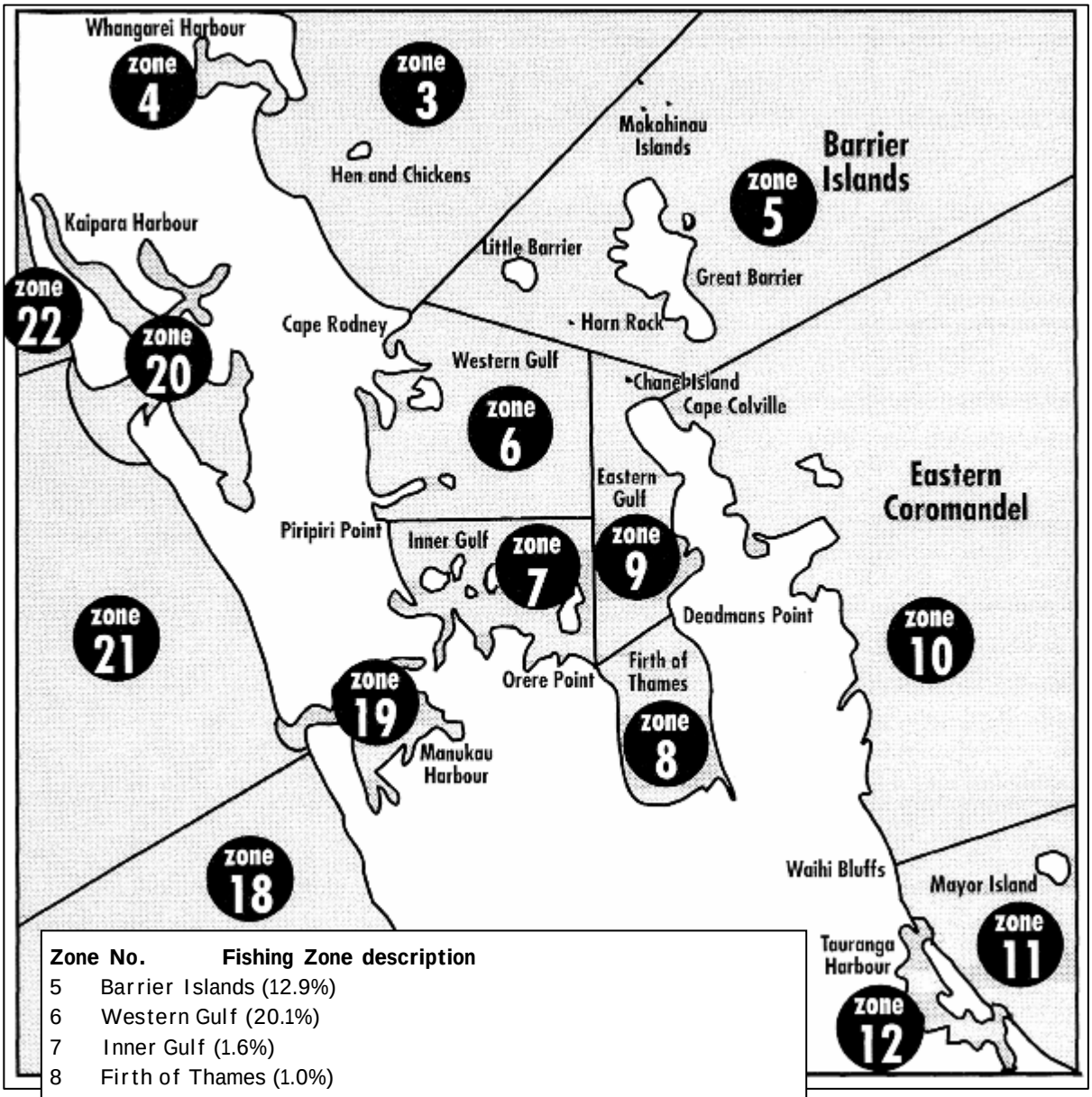
48 It is surprising that the recreational catch from the inner Gulf zone (mainly the beds at the eastern end of Waiheke) formed such a small proportion (1.6%) of the recreational catch. Scallop beds in the inner Gulf may be a more important component of the recreational catch in years when scallops are abundant. However, to some extent, the small proportion of the recreational catch from the inner Gulf is also consistent with the low commercial catch in this area since the late 1980s.

49 Most of the popular recreational and customary fishing areas (including inside Kawau Island, Omaha Bay, parts of Waiheke Island and the Firth of Thames, Otama Beach, Opito Bay, Slipper Island, and Motiti Island) have been closed to commercial scallop fishing. The closures protect key non-commercial scallop fishing areas from the effects of commercial scallop dredging. Some of these closed areas were initially agreed under a three-year plan negotiated by commercial and non-commercial fishers.

Table 4: Percentage of scallops caught by diarists by zone from the Coromandel scallop fishery. Data are summarised from the five large-scale fishing diary surveys: 1993/94, 1996, 1997, 1999/00, 2000/01.

Zone – see map (Figure 11) for areas.	Percentage
5 Barrier Islands	12.9%
6 Western Gulf (inside Kawau, and Tiri)	20.1%
7 Inner Gulf	1.6%
8 Firth of Thames	1.0%
9 Eastern Gulf to Cape Colville	6.4%
10 Cape Colville to Waihi Bluffs	49.7%
11 Waihi Bluffs to Tarawera River (excluding Tauranga harbour)	8.2%

Figure 11: Map showing recreational fishing zones used in recreational diary surveys.



50 Most (86%) of the recreational scallop catch is taken by diving from a boat (**Table 5**). Recreational dredging is less common in the Coromandel scallop fishery. This contrasts to other areas, notably the Manukau/Kaipara Harbours in the north and Tasman/Golden Bay in the south, where dredging accounts for around 90% of the amateur scallop catch. Amateur fishers rarely use beds where the depth is greater than 25 metres, or where currents are strong, or the underwater visibility is too low for diving. Most recreational scallop fishing occurs in December and January (**Table 6**).

Table 5: Percentage of scallops caught by diarists by method from the Coromandel scallop fishery.*

Method	Percentage
Diving from a boat	86.2%
Dredging	11.9%
Hand gathering from the shore	1.5%
Diving from the shore	0.5%

Table 6: Percentage of scallops caught by diarists by month from the Coromandel scallop fishery.*

Month	Percentage
July	4.9%
August	4.1%
September	4.9%
October	9.9%
November	6.4%
December	22.3%
January	34.7%
February	11.1%
Unknown	1.7%

Data are summarised from the five large-scale fishing diary surveys: 1993/94, 1996, 1997, 1999/00, 2000/01.

Scallop wash-ups

Large quantities of scallops are often washed ashore after north-easterly storms along surf-beaches such as Omaha, Onetangi, Otama, and Papamoa. People are allowed to take beach-cast scallops provided the scallops taken comply with size and bag limit regulations. People can also take beach-cast scallops during the scallop closed season, when taking scallops is normally prohibited. Regulation 29(3)(b) of the Fisheries (Amateur Fishing) Regulations 1986 provides the following defence:

"In the case of any person charged with taking or being in possession of scallops during a closed season, if that person satisfies the Court that the scallops were washed ashore".

Nonetheless, some people are not certain about whether they can harvest scallops washed ashore out of season. Other people believe the size and bag limits do not apply to scallops washed ashore. Further, some argue that because washed ashore scallops will die anyway, it is a waste for people to be restricted to the size and bag limits.

Customary Fishery

51 Tipa (scallops) are an important food source for tangata whenua. In the past, tipa were gathered by a number of means: collected by hand by free-diving, hand gathering of "wash-ups" after a storm, and "walk-out" gathering in intertidal areas at low tide. Maori also used a shellfish rake (te kapu) that was made of wood and similar in function to a dredge. The rakes were worked from a canoe and attached to a long pole. Fishers moved across the beds raking the scallops into shallow areas for collection. Traditionally, 'customary' Maori fishing encompassed a range of activities, including:

- Sustaining active protection and kaitiakitanga (environmental guardianship);
- Day-to-day papakäinga use, in which the fishing whanau (family) was responsible for collecting seafood for the papakäinga (village) on a regular basis, maybe 2-3 times per week (when fat);
- Seafood collected on behalf of extended kin living inland or elsewhere;
- Seafood collected as an exercise of manaakitanga (hospitality) for visitors;
- Provision of seafood for guests to support the mana of the marae;
- Seafood collected for hui/tangi;
- Expression of the customs and practice of harvest, preparation, exchange, and preservation of food.

52 In summary, the customary right was for hui, tangi, papakäinga and marae needs, and obligations to provide food for others. Most of these uses (except barter or trade) can occur to some degree under the amateur fishing regulations, but the quantity that a person can take is limited to 20 scallops per day. The collection of scallops for hui/tangi (more than the amateur daily bag limit of 20 scallops) can also occur using a permit under Regulation 27A of the amateur fishing regulations. The permit issuer specifies the number or weight of scallops that can be taken (see text box on provisions of Regulation 27A).

53 At present, the regulations do not fully reflect the other uses (e.g. day-to-day papakäinga use). Putting the Kaimoana Customary Fishing regulations in place will enable tangata whenua to take more than the amateur daily bag limit for a broader range of uses, other than just for a hui or tangi. Setting up the Kaimoana Regulations involves gazetting an iwi or hapu's rohe moana, and putting kaitiaki in place. Kaitiaki can then issue permits to tangata whenua (and others in the community) so they can use these provisions. Even day-to-day papakäinga use (if it is greater than the amateur daily bag limit) would require use of a permit.

54 Iwi and hapu groups with a direct interest in the Coromandel scallop fishery include the following:

- Ngati Wai Trust Board;
- Ngati Manuhiri and Ngati Rehua hapu of Ngati Wai;
- Ngai Tai ki Umupuia;
- Ngati Whatua ki Orakei;
- Ngati Whatua;
- Hauraki Maori Trust Board;
- Ngati Paoa;
- Ngati Tamatera;
- Ngati Hei Runanga;
- Ngati Whanaunga;
- Ngati Hako;
- Ngati Maru;
- Ngaiterangi;
- Patuwai.

55 The number of scallops people take using customary fishing permits is not known. The Minister has set the customary allowance at the level of the recreational allowance (7.5 tonnes).

CUSTOMARY FISHING (REGULATION 27 AND 27A)

The law allows fish to be taken for customary purposes in the following ways:

in accordance with the general limits applying to all amateur fishers; or
using a customary authorisation under the regulation 27 or 27A of the Fisheries (Amateur Fishing) Regulations 1986; or
using a customary authorisation under the Fisheries (Kaimoana Customary Fishing) Regulations 1998 or under the Fisheries (South Island Customary Fishing) Regulations 1999.

Regulation 27 provides for the taking of fish for a traditional non-commercial fishing purpose (but not Hui or Tangi) that has been specifically approved by the Chief Executive of the Ministry of Fisheries. Regulation 27 will now apply in limited circumstances, and the majority of customary fishing is expected to be carried out under regulation 27A.

Regulation 27A and the associated gazette notice provides for the taking of fish for the purposes of Hui or Tangi. Conditions apply to issuers and fishers, including:

- Fishers must have in their possession a written reg. 27A authorisation before going fishing;
- Fishers must have the authorisation in their possession during taking and transporting fish;
- Fishers must get a written authorisation from an Authorised Representative of a Marae Committee, Mäori Committee, Runanga or Trust Board that represents tangata whenua (the Iwi or Häpu who hold mana whenua over the area from which the fish are to be taken);
- The written authorisation must contain details including species and quantities to be taken; the occasion and place where the fish will be used; where the fish can be taken from and where they must be landed;
- The Authorised Representative can impose conditions on what fishing methods can be used to gather certain species and any size limits for any species.
- No fish taken under any authorisation can be sold, bartered, or exchanged for money or other items under any circumstances, including raffles or fundraising.
- The Authorised Representatives can also require that the harvesters inform them of actual quantities taken be provided to them. Quantities more than those authorised cannot be taken.
- If the authorised agents fill out the sections with these requirements then they become part of the legal conditions of harvest.

Offences and penalties: If a person is caught fishing without a reg. 27A authorisation or a valid authorisation from the Marae Committee, Mäori Committee, Runanga or Trust Board of Tangata Whenua, they will not have a defence of exercising a customary fishing right, and may be liable to prosecution if they are fishing in contravention of the provisions of the amateur fishing regulations.

If a person issues a reg. 27A authorisation in breach of the regulations, the Authorised Representative or issuer will have committed an offence and will be liable to prosecution.

Issuing an authorisation in breach of the provisions of reg. 27A can result in penalties of up to $10,000. Fishing in breach of the provisions of reg. 27A including provisions/conditions of the gazette notice can result in penalties of up to $10,000 and up to $20,000 for some species and quantities. Infringement notices with penalties of up to $500 can also apply. Fishing of a commercial nature, for financial gain or trade, will be subject to the provisions of the Fisheries Act, which allows for forfeiture of property and fines of up to $250,000.

What are the Fisheries (Kaimoana Customary Fishing) Regulations 1998?

The Kaimoana Regulations are a tool for tangata whenua to participate in management of non-commercial fishing. The Treaty of Waitangi and the 1992 Deed of Settlement (the 'Sealord deal') both confirm traditional rights, including the taking of fish, and managing the resource.

The Kaimoana Regulations are for whänau, hapu, or iwi who hold manawhenua / manamoana* over a particular area. The regulations apply in areas where tangata whenua have been appointed as Tangata Kaitiaki/Tiaki.

Tangata Kaitiaki/Tiaki are individuals or groups who can authorise customary fishing within their rohe moana*, in accordance with tikanga Maori*. Their appointments are notified by the tangata whenua of an area.

The main responsibilities for tangata kaitiaki/tiaki under the Kaimoana Regulations include:

- Issuing authorisations for customary fishing
- Giving directions to customary fishers about what types or sizes of fish they can take
- Meeting and reporting with tangata whenua and the Ministry
- Taking part in fisheries management processes (if desired)
- Preparing management plans for their rohe moana (if desired)

The Kaimoana Regulations also allow for establishment of various tools that tangata whenua can use to participate in management of their local fisheries once tangata kaitiaki/tiaki have been nominated and agreed upon (e.g. mätaitai reserves).

The regulations apply to the coastal and marine fisheries of Te-Ika-a-Maui (i.e. not freshwater; and not the South Island, where there are different customary regulations).

* Manawhenua and manamoana are customary authority over areas of land (whenua) and seas (moana).
* Rohe moana is the customary area over which an iwi, hapu or whanau has traditional management powers.
* Tikanga Maori are traditional Maori protocol/customs.

Environmental effects of fishery

Ecosystem effects

56 The section on the ecological context of the scallop fishery (page 6) outlines where scallops fit within a marine ecosystem. Given the natural variability of scallop populations, the trophic impacts of current harvest levels for scallops are probably low. That is, flow-on effects to the ecosystem and other organisms (that either eat scallops, or are eaten by scallops) are considered to be low.

Effects of dredging

Dredge characteristics

57 Commercial dredging in the Coromandel scallop fishery dates back to 1968. Trawling has occurred in the area since the late nineteenth century. The Coromandel fishery uses a self tipping box dredge, commonly used in depths of 0-30 metres. The box dredge generally has a width of up to 2 metres, length of 1.5-2 metres, height of 400 to 500 mm, and weighs about 150 to 200 kg (**see photos, page 32**).

58 The dredge has a bar fitted with tines that dig into the ground to a depth of about 5 cm (tooth bar). Dislodged scallops are lifted up and into the meshed box as the dredge moves forward. The way the tooth bar is set up can vary from fisher to fisher. The spacing between tines is normally around 90 mm, and a single dredge might have as many as 22 tines. The spacing between the tines was designed to allow scallops less than 90 mm (the then-minimum legal size) to escape.

59 Vessels normally tow one box dredge at a time, at a speed of about 2-4 knots. Tow length is about 5 to 30 minutes, depending on fullness of the dredge. The dredge is normally in contact with the bottom throughout the tow. It is retrieved when full, or when it loses contact with the bottom.

Performance of the box dredge compared to other dredges

60 Cryer and Morrison (1997) assessed how efficient the box dredge and other dredges are at catching scallops. The other dredges assessed were the ring bag dredge (without tines) as used in the Southern (Nelson) scallop fishery, and the Japanese Keti Ami dredge which is reputed to be one of the most efficient dredges in the world.

61 The study found the box dredge to be the most efficient (24-90% efficient, depending on estimation method and bottom type; midpoint 57%). This was consistent with another study that estimated the long-term average efficiency of the box dredge at about 40% in the area it passed over. The box dredge was more efficient than the Nelson ring bag (2-9% efficiency) and the Japanese Keti Ami dredge (5-20% efficiency) for legal sized scallops on the main sediment types found in the Coromandel scallop fishery.

62 The study methodology probably underestimated the efficiency of the ring bag and Keti Ami dredges, and overestimated the incidental effects these dredges cause, because the dredges were not modified to suit the local conditions. By comparison, the box dredge used in the research was modified specifically for the conditions of the Coromandel scallop fishery. However, because the minimum legal size was reduced from 100 mm to 90 mm in the Coromandel fishery only a year before the survey was done, it is not known whether the box dredge used in the study was fully optimised for the smaller size limit. The Challenger fishery has operated to a size limit of 90 mm since 1989, so the ring bag dredge used may have been better optimised to catch scallops in that size range. It is also not known whether dredge configurations have changed substantially since the

survey was done in 1996, particularly in ways that would increase the overall efficiency of dredges. Anecdotally, commercial fishers consider their efficiency is likely to be higher than 40%.

63 Information on dredge efficiency is one of the inputs into stock assessment, which extrapolates from the number of scallops in research tows to estimate total numbers of scallops in a given area. The estimate of dredge efficiency used in stock assessment is based on 24 experiments in Coromandel, 19 on sand substrates and 5 on silt or mud. The average across all these experiments is between 40-45% efficiency. These experiments compare the number of scallops caught by dredge with the number of scallops caught by divers covering the same area.

64 The research also showed that a single pass of a ring bag dredge resulted in less damage to scallops and benthic epifauna (animals living on the surface of the sea floor) than a single pass of the box dredge. However, the review concluded that the box dredge's higher efficiency more than compensated for the rate of damage at each pass, and made the use of the box dredge preferable on the generally harder sandy substrates in the north. By comparison, in the Southern scallop fishery the seafloor is mostly a soft muddy substrate.

Further information:

- Cryer, M. and Morrison, M. (1997) Yield per recruit in northern commercial scallop fisheries: inferences from an individual-based population model and experimental estimates of incidental impacts on growth and survival. Draft New Zealand Fisheries Assessment Research Document 97/xx.

- Cryer, M. and Parkinson, D.M. (2005) Biomass surveys and stock assessments for Coromandel and Northland scallops, 2005. New Zealand Fisheries Assessment Report 2005/xx. 47 p.


INEDIBLE

Impacts on the environment

65 Both dredging and trawling are fishing methods that have some impact on the seabed. Land-based activities have also modified the sea floor within the Coromandel scallop fishery. Information from a study in the 1990s provides an indication of broad-scale changes in benthic communities in the Hauraki Gulf that can be directly related to fishing (Thrush *et al*., 1998).

66 Studies from around the world have shown that in general, dredging can have a variety of impacts, including:

- Reducing habitat structure (e.g. reducing the occurrence of reefs or sponge gardens);
- Reducing habitat complexity as sediment is mixed together and becomes the same in most areas, rather than having pockets of different sediment types in different areas;
- Reducing the numbers of plants and animals in the area that are large, live on the surface, or are fragile;
- Reducing how many different types of plants or animals are present (particularly those that are slow growing, long-lived, late maturing, or produce fewer offspring);
- Overall, dredging may reduce biodiversity (the number and variety of organisms within the area dredged).

67 A study of the effect of scallop dredging on the benthic (bottom-dwelling) communities around Coromandel Peninsula showed changes in the numbers of animals present, and the types of animals that were present (Thrush *et al.*, 1995). Most of the bottom-dwelling species in the dredged area were opportunistic taxa (e.g. polychaete tubeworms) or predator-scavenger species (e.g. whelks, starfish) that are not particularly rare or long-lived. The changes were still to be seen three months after dredging occurred.

68 The study also compared impacts between a site that was commonly dredged, and a site that is not dredged commercially. At the site that had not been commercially dredged in the past, the dredging carried out as part of the research project was seen to have more of a pronounced impact, and was more likely to have negative effects.

69 As well as catching scallops, dredging in the Coromandel scallop fishery may catch other epi-benthic species as a bycatch such as sponges, ascidians (sea squirts), horse mussels, and starfish. The sponges, ascidians, and starfish are not considered to be especially rare or long-lived. This is in contrast to the sponge and other encrusting species that were caught as a bycatch of dredging at Spirits Bay in the Far North. Dredging was subsequently prohibited by regulation in the most critical areas at Spirits Bay.

70 Horse mussels are relatively short lived and are generally considered to be common in many sandy seafloor areas throughout the Coromandel scallop fishery area. Populations of horse mussels are known to vary in abundance, and may experience widespread die-offs. Horse mussels can provide shelter and refuge for small invertebrates and fish. They provide a base on which epifauna such as sponges and soft corals can settle. Horse mussels also create favourable conditions for worms and other invertebrates to grow.

71 Horse mussels are vulnerable to dredging (and trawling) because of their brittle shells, and because they are firmly embedded in the substrate. Damaged mussels are not likely to survive, because even minor damage

Benthic – on the bottom (i.e. on the seafloor)

Opportunistic – taking advantage of the situation. An opportunistic feeder is one that will eat whenever food is available (rather than specialising in particular types of food).

Taxa – group of animals or plants. A taxa can be any one of the categories used in naming and classifying organisms, (including phylum, class, order, family, genus, and species).

Polychaete tubeworms – a class of mainly marine worms, often called bristle worms.

Predator – an animal that captures other animals and eats them.

Scavenger – an animal that eats dead animals.

makes them vulnerable to predation. However, large parts of the Hauraki Gulf and Coromandel area are protected from dredging and trawling by regulation.

72 Most of the areas where dredging (and trawling) take horse mussels as a bycatch occur in long-established fishing grounds where it is likely the original benthic community will have been modified by fishing over time. Commercial scallop fishers have stated that they do not want to catch horse mussels as they clog the dredge preventing the capture of scallops.

73 Numbers of starfish may increase in dredged areas, where scallops damaged by dredges provide an additional food source.

Further Information:

- Talman, S.G., Norkko, A., Thrush, S.F., and Hewitt, J.E. (2004) Habitat structure and the survival of juvenile scallops (*Pecten novaezelandiae*): comparing predation in habitats with varying complexity. Marine Ecology Progress Series 269: 197-207.

- Thrush, S.F., Hewitt, J.E., Cummings, V.J., Dayton. P.K. Cryer, M., Turner, S.J., Funnell, G.A., Budd, R.G., Milburn, C.J., and Wilkinson, M.R. (1998). Disturbance of the marine benthic habitat by commercial fishing: impacts at the scale of the fishery. Ecological Applications 8: 866–879.

- Tuck, I., Parkinson, D., Dey, K., Oldman, J., and Wadhwa, S. (2006). Information on benthic impacts in support of the Coromandel Scallops Fishery Plan. Research report for project ZBD2005-15.

Epi-benthic – living above the sea-bottom.

Ascidians – sea squirts. Most commonly, ascidians have sac-like bodies, and are firmly attached to the ground.

Encrusting species – are those that form a crust on surfaces such as rock, or on other plants or animals.

Epifauna – animals living on the seabed surface

Impacts on scallop populations

74 In addition to having an impact on the environment, dredging for scallops can have an impact on scallops that encounter the dredge but are not taken by it (called incidental mortality). In the 1990s, concerns were expressed about the incidental damage to scallops caused by dredging. Research was carried out to determine the level of incidental mortality the box dredges used in the Coromandel scallop fishery cause.

75 Three sites were chosen in the main commercial scallop bed in the Great Mercury Island to Opito Bay area to cover a range of seabed conditions where scallops are usually numerous within the fishery (Cryer and Morrison, 1997). Results included:

- Overall, mortality was found to be greater (up to about 50% greater) and growth slower (0.5-1mm compared with 1.5mm for controls) in the month following a scallop's encounter with a dredge.
- Effects were stronger for those scallops taken by the dredge but subsequently discarded by the fisher, than those scallops that were contacted by the dredge, but remained on the seabed.
- One of the conclusions of the study was that the commercial size limit of 90 mm would give a higher long term yield from the fishery than the previous commercial size limit of 100 mm. This is because commercial fishers catch a large number of scallops in the size class 90 mm to 100 mm. It is more efficient to retain these scallops, because many of them would die even if returned to the sea. A size of 90 mm is considered to be close to the optimum size limit for the commercial fishery. There are logistic problems with processing scallops much smaller than 90 mm, and there is less of a market for scallops of that size.

76 Commercial fishers note there are economic incentives for them to operate their dredges as efficiently as possible. Most fishers continually update their dredge configuration to increase its efficiency. Changes can be made to the length of runners and the angle of the tooth bar to make the

dredge as efficient as possible depending on the substrate. In addition, when full, box dredges lift from the seabed, rather than continuing to drag along it. Commercial fishers indicate they aim to minimise the number of broken scallops dredging causes.

77 It has also been suggested that dredging could affect recruitment of scallops (numbers of scallops entering the fishery). Recruitment of scallops could be affected in two ways:

- Scallops that are not killed by the dredge may fail to spawn properly; and
- Dredging could destroy and remove material necessary for spat to settle on. This change could be incremental, as dredging gradually decreases the amount of foliose or highly structured material on the seafloor.

78 A separate study investigated the relationship between habitat structure and predation rates on scallops (Talman *et al.*, 2004). This study found that areas exposed to fishing disturbance (mainly dredging) had less benthic structure and that predation rates were significantly greater compared to unfished areas. Benthic structure is the structure of the sea floor. Elements that make up benthic structure can include physical features (e.g. reefs, rocks), as well as living creatures.

79 Specifically, the experiments estimated that the proportion of juvenile scallops dying per week at two sites that were not dredged commercially was 15-24%. By comparison, at two sites that were commercially fished, the proportion of juveniles dying per week were 39 and 59% respectively. However, most of this research was done in the Tasman Bay and Kawau Bay area, and it is not certain how these findings might relate to the areas dredged by commercial fishers in the Coromandel scallop fishery.

Impacts of recreational dredging

80 In the mid 1990s, NIWA conducted an experimental study to examine the impact of recreational scallop dredging in the inner Kawau Bay area. Two sites were selected, and four amateur vessels were used to tow the amateur dredges. Baseline scallop densities that were obtained using divers were compared to the density estimates from the dredge vessels. In addition, scallops from the dredged tow paths and from non-dredged "control" areas were then transferred to a release area to assess the impact of dredging on the scallops. Scallops involved in the mortality and growth experiments were tagged using uniquely numbered tags.

81 The NIWA report concluded that: "experimental dredging using standard northern "box" type recreational dredges failed to demonstrate any adverse affects on scallop incidental mortality, growth rates, or fecundity. Recreational dredge efficiency was poor and very variable, both between tows and between different recreational vessels. Average dredge retention efficiency for a 100 millimetre scallop was 11%."

82 The NIWA study did not consider the impact of recreational dredging on the seafloor environment. However, NIWA noted that dredging often brought up bycatch of epibenthic species such as sponges, ascidians, and starfish, and sometimes caused extensive raking of the seafloor (although often "bouncing" also occurred). It was speculated that the potential loss of habitat structure and non-target species might be significant in heavily dredged areas. The Ministry notes that dredging accounts for only 12% of the recreational scallop catch in the Coromandel scallop fishery (see Table 5). In contrast, dredging provides the bulk of the recreational catch in other areas (e.g. Manukau Harbour, Tasman/Golden Bay – both areas around 91%).

Management

Quota Management System

83 Coromandel scallops were introduced into the quota management system on 1 April 2002. The total allowable catch is set based on the underlying principle of allowing for utilisation, while ensuring that use is sustainable.[12] The total allowable catch was set at 48 tonnes meatweight, and is allocated as follows:

Table 7: Total allowable catch and allowances for Coromandel scallops (tonnes meatweight)

	Total allowable catch	Recreational allowance	Customary allowance	Allowance for other sources of mortality	Total allowable commercial catch
Coromandel scallops	48 tonnes	7.5 tonnes	7.5 tonnes	11 tonnes	22 tonnes

Harvest Strategy

84 The current management approach is essentially a hybrid between "MCY" (Maximum Constant Yield) and "CAY" (Current Annual Yield) strategies – two different ways of harvesting the stock to try to achieve the goal of maximum sustainable yield. An MCY estimate provides the basis for the "baseline" TAC/TACC. A pre-season biomass survey and stock assessment then provide a CAY estimate as the basis for making an in-season increase in the TAC in some years.

85 MCY and CAY are the biological reference points most commonly used in New Zealand. They are derived from two ways of viewing the concept of the maximum sustainable yield – a static interpretation and a dynamic interpretation. Under a static interpretation, MCY is the largest constant commercial catch that may be taken sustainably every year, even if the number of recruits varies from year to year.

86 Under a dynamic interpretation, CAY is calculated as a constant proportion of the biomass – the amount of total biomass that can be taken to maximise sustainable yield. The proportion of total biomass stays the same each year, but the actual amount increases and decreases as the stock biomass changes from year to year. It is possible to estimate CAY only when the current stock size is known. This is possible for Coromandel scallops immediately after a biomass survey.

Baseline catch limit (TAC)

87 The current "baseline" total allowable catch for Coromandel scallops is from a maximum constant yield estimate when the fishery was introduced into the quota system. For most finfish species, the maximum constant yield is the level of constant commercial catch that is generally considered sustainable, with an accepted level of risk, at all probable levels of biomass. The

[12] Most stocks in the quota management system – including Coromandel scallops – are managed under section 13 of the Fisheries Act 1996. For stocks managed under section 13, the Minister of Fisheries must set a total allowable catch that:

a. Maintains the stock at or above a level that can produce the maximum sustainable yield; or
b. Enables any stock that is currently below a level that can produce the maximum sustainable yield to be restored to a level at, or above, that which can produce the maximum sustainable yield; or
c. Enables the level of any stock currently above the maximum sustainable yield to be altered in a way and at a rate that will result in the stock moving towards or above a level that can support the maximum sustainable yield.

The maximum sustainable yield is the greatest yield that can be achieved over time, while maintaining the stock's productive capacity, and having regard to the population dynamics of the stock, and any environmental factors that influence the stock. Relevant factors include the stock's population dynamics (for example, whether stock numbers vary greatly from year to year), and environmental factors that influence the stock. The level that can produce the maximum sustainable yield may be a dynamic target rather than a fixed point.

Shellfish Working Group did not discuss the estimate of maximum constant yield used as the basis for the baseline TAC/TACC. This group had also previously considered that 'maximum constant yield' was unsuitable as a yield estimator for scallops and that the maximum constant yield value was probably close to a zero catch for scallops. Due to the annual variation of scallop biomass, the Shellfish Working Group considers current annual yield to be the most appropriate estimate of yield on which to base any consideration for an in-season increase in the total allowable catch.

88 In 2001, prior to QMS introduction, the Coromandel scallop fishery was affected by black gill disease and a prolific tubeworm. Current annual yield estimates were not available, because a pre-season survey had not been commissioned. Therefore, MFish used an estimate of maximum constant yield as an interim measure for setting the total allowable catch when Coromandel scallops were introduced into the quota management system.

89 The estimate of maximum constant yield was largely based on a time series of commercial catch that would provide for utilisation, but with some level of risk to the stock. MFish used a standard equation to calculate the maximum constant yield: MCY = cY_{av}. The value '*c*' is the natural variability factor (i.e. how much is the stock likely to vary over time, due to natural factors – natural variability is high for scallops). The greater the variability in the stock, the lower the value of *c* is (within a range from 0 to 1.0). This value was set at 0.4 for Coromandel scallops. Setting *c* at 0.4 was conservative, but the Ministry considered it appropriate, given the Shellfish Working Group's opinion that maximum constant yield was actually close to zero for scallops.

90 The second part of the equation – Y_{av} – is the average catch over a given period. For Coromandel scallops, the period chosen was the average commercial catch reported from all beds during the previous ten years of fishing (1992-2001). Using the equation MCY = cY_{av}, the estimate of maximum constant yield is 22 tonnes.

Baseline allowances

91 The current "baseline" recreational allowance was set at 7.5 tonnes in 2002. The allowance was based on the 1996 diary estimate of the recreational catch, which was considered to be the most reliable information available in 2002. Only very preliminary results from the 2000 and 2001 diary surveys were available in 2002 when the baseline TAC was set.

92 The baseline customary allowance was also set at 7.5 tonnes. In common with many other shellfish, scallops were known to be important to Maori as a traditional food. However, no quantitative information was then (and currently) available on the level of customary take of scallops. In these situations, the Ministry has applied a general criterion that in the absence of information and where the fishery is of known importance to Maori, the recreational allowance is used as the benchmark to set the customary allowance.

93 The baseline allowance for other sources of fishing mortality was set at 11 tonnes. This was solely based on an allowance for incidental mortality from commercial dredging. In 2002, the Ministry considered the best available estimate of commercial incidental mortality from the box dredge was to allow 50% of the baseline TACC (which was set at 22 tonnes as outlined above). More recently, for the in-season TAC increase process described below, the Ministry has used an incidental mortality rate at 34.4% to set the other sources of fishing mortality allowance.

94 Only around 12% of the recreational scallop catch is taken by dredging. The information available in 2002 on recreational dredging suggested negligible incidental mortality. Consequently, no allowance was made for incidental mortality by recreational fishers. In addition, no allowance was made for the possibility of an illegal catch taken by commercial, customary, or recreational fishers.

In-season increases

95 Scallop numbers can vary highly from year to year. The baseline total allowable catch was set at a level fishery managers thought would be sustainable, even in years of low scallop numbers. However, in years when pre-season surveys show scallop numbers are higher, there is a provision for the total allowable catch to increase. **Figure 12** shows the process for that increase.

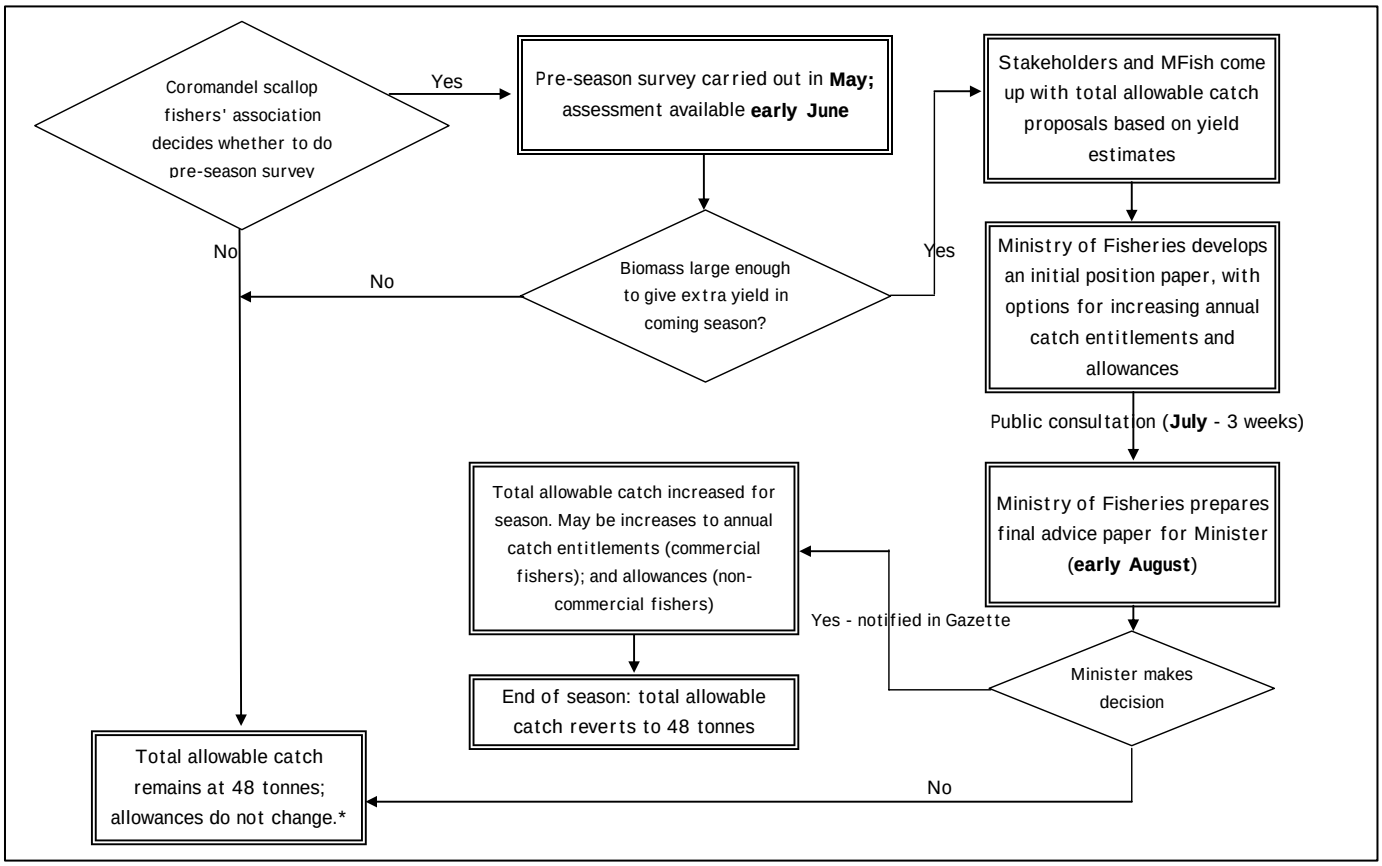
96 The provision for an in-season increase is available because Coromandel scallops are listed on the Second Schedule of the Fisheries Act 1996. This schedule can apply to any stock whose abundance may vary a lot from year to year. The total allowable catch of stocks listed on the Second Schedule can be increased during the fishing year, in years when the stock is particularly abundant. The aim of an in-season adjustment to the total allowable catch is still to manage a stock at, or above, a level that can produce the maximum sustainable yield.

97 For the 2006/07 fishing year (i.e. the fishing year from 1 April 2006 to 31 March 2007), the total allowable catch and allowances were increased in-season based on the information about scallop abundance provided by the pre-season scallop biomass survey (**Table 8)**.

Table 8: Total allowable catch and allowances for Coromandel scallops (tonnes meatweight) for 2006/07

	Total allowable catch	Recreational allowance	Customary allowance	Allowance for other sources of mortality	Total allowable commercial catch
Coromandel scallops	189	15	15	41	118

Figure 12: Process for in-season increase in the Coromandel scallop fishery



* In years of particularly low abundance, the total allowable catch could be reduced from 48 tonnes if necessary.

98 If the total allowable catch is increased during a fishing season, the increased catch can be made available to both commercial and non-commercial fishers:

- ❖ Commercial fishers: The Minister can create additional annual catch entitlements for fishers within a season after following the process outlined above.[13]
- ❖ Non-commercial fishers: if abundance of scallops is higher, non-commercial catches are likely to increase also. Fishers may go fishing more frequently, and they may catch their full bag limit more often. The Minister can choose to recognise increased non-commercial catches by increasing the customary and recreational allowances within season. This was done in the 2005-06 fishing year. The allowances will revert to their previous level at the end of the 2005-06 fishing year (31 March 2006).

99 Another proposal to allow non-commercial fishers to benefit in years when scallop numbers are higher is to increase the recreational daily bag limit. The Ministry of Fisheries prepared advice for the Minister on this topic in 2005, along with advice on various other recreational regulations affecting scallops. The Minister's decision at that time was not to increase the daily bag limit.

100 Over the last four years (**see Table 9 below**), the amount of the in-season increase in annual catch entitlements commercial fishers have requested has been considerably less than the current annual yield estimate obtained from the biomass survey (see **text boxes on pages 11 and 12** for how the estimate is calculated). The CAY estimates below include an allowance for excluding areas of low scallop density, but have not included modeling the indirect effects of dredging on scallop recruitment. The combined effect of these factors is to reduce the CAY estimate by nearly 40% (as explained by the text boxes in the Stock Assessment section near the front of this document).

101 The approach taken by the Coromandel scallop quota holders is broadly consistent with the agreement made when the scallop size limit was reduced to 90 mm in the mid 1990s. The agreement recommended that yields should be estimated on the basis of the availability of 100 mm scallops and that catch limits should be reduced by 25% to account for the smaller average size of 90 mm scallops and to introduce a "safety margin".

Table 9: Relationship between yield estimate and commercial catch limit

Year	Current Annual Yield[14]	Commercial catch limit[15]	% of CAY estimate
2002	35 tonnes meatweight	35 tonnes meatweight	100%
2003	58 tonnes meatweight	58 tonnes meatweight	100%
2004	302 tonnes meatweight	79 tonnes meatweight	26.2%
2005	487 tonnes meatweight	118 tonnes meatweight	24.2%
2006	425 tonnes meatweight	118 tonnes meatweight	27.8%

[13] The total allowable commercial catch during the fishing year does not increase, although additional annual catch entitlements are made available during the season under section 20(4) of the Fisheries Act. When deciding to increase annual catch entitlements, the Minister must consider all the factors he/she has to take into account when making any decision about setting or changing a total allowable commercial catch (section 68(1) of the Fisheries Act 1996).

[14] The CAY estimate includes a reduction to allow for scallops at less than a critical density of one scallop per 25m^2 (reduction ranges from 15-20%). The CAY is based on scallops that were predicted to be 90mm at the start of the scallop fishing season. The CAY estimate cited here does not include allowance for the indirect effects of dredging on recruitment.

[15] The commercial catch limit includes the baseline TACC level of 22 tonnes, plus the amount of ACE increased for that particular season.

Enhancement

102 The Coromandel scallop fishery is not currently an enhanced fishery, although various stakeholders have expressed an interest in enhancement. Scallop enhancement involves three key steps:

- settlement of large numbers of larval scallops from the plankton into "spat" collecting bags;
- on-growing the settlers to juvenile scallops in the bags;
- releasing or "seeding" the juveniles to the seafloor to areas that have not naturally received an adequate supply of juvenile scallops.

103 To collect juvenile scallops for seeding, artificial larval collectors ("spat bags") are suspended in the water column during the season when scallop larvae are abundant in the plankton (summer months). On an experimental scale, spat bags can be suspended from simple "droppers" (single ropes with a float and an anchor), but commercial operations require much more substantial sub-surface long-line systems supporting hundreds of bags each. Typically, long-lines are 200 metres long and support 100 droppers, each with 20 or more spat bags.

104 Scallop larvae naturally settle from the plankton onto various foliose surfaces (such as red seaweeds and hydroids (feather-like animal colonies)) as they move from a pelagic to a benthic existence. Collector bags mimic these natural settlement surfaces, and can attract hundreds or a few thousand scallop larvae. Once scallops settle, they are colloquially known as "spat", and remain attached to these surfaces using byssus threads. They remain byssus attached until around 3-5 mm, when they release themselves and adopt a free-living existence.

105 Collector bags are constructed of double bags of fine plastic mesh; the outer is a sock of finer mesh small enough to retain scallops after their byssus release, the inner is composed of a coarser mesh sock that is bunched up to provide a large surface area for settlement. Juvenile scallops grow quickly inside the bags, feeding on the passing plankton. As they release their byssus threads, they are retained inside the collector bags by the finer outer mesh.

106 When the juvenile scallops reach a suitable size for seeding, the bags are retrieved from the long-lines, and the small scallops removed from them and released to the seafloor at densities that aim to gain the best harvest per unit area of seafloor. Experience in the Challenger fishery (Golden and Tasman Bays) suggests that about six juveniles per square metre of seafloor is acceptable and leads to good growth and survival. After one or more years of growth, scallops can be harvested by dredging.

Previous programmes in the Coromandel area

107 Successful commercial scale scallop enhancement has been carried out in the Challenger fishery since 1983. However, past attempts to transfer these technologies to the Hauraki Gulf / Coromandel area have not been entirely successful. Spat were caught, sometimes in large numbers, but the survival of seeded juveniles was poor. The following studies have been carried out:

- Ministry of Agriculture and Fisheries – 1986-87 and 1987-88. Spat catches were variable, but showed that commercial levels of scallop spat catch could be achieved. Spat numbers per bag ranged from 10-1000, but numbers were lower than those caught per bag in Golden Bay.
- Releases of spat in the Firth of Thames (March 1988, 6 million spat) and Mercury Bay, Whitianga (1989, 13.7 million spat). Survival was fairly low, especially at Whitianga, although this is partly attributed to other factors including Cyclone Bola, poor handling of spat during seeding, inappropriate selection of release sites, and loss of badly stressed spat to bottom predators.

- Department of Marine Studies, Bay of Plenty Polytechnic, in association with the Coromandel Scallop Fisherman's Association (CSFA) – 1991-92. Small-scale spat catching trials close to Whitianga. The average catch of scallops was limited, partly because of problems with gear used.
- Spat catching trials in Omaha Bay and Kawau Bay, in the northern Hauraki Gulf – 1992-94. In 1992, high catches were taken across all five sites assessed, with catches ranging from 100 to 3000 spat per bag. In 1993, there was almost complete recruitment failure to the spat bags, and few spat were caught. This coincided with a large-scale algal bloom event, and heavy scallop mortalities throughout large parts of the Hauraki Gulf. In 1994, higher spat falls were again recorded, though lower than in 1992.
- Small scale scallop spat catching trials were carried out by northern scallop fishers in the mid 1990s, giving returns of 100s to 1000s per bag.
- Small-scale spat release trials in Omaha Bay. The trials showed that predation of scallops immediately following seeding can be very substantial. Careful treatment of spat during seeding, and selection of appropriate seafloor release areas, are probably central to maximising survival.
- Research in Omaha and Kawau Bays. Spat catches were very low, averaging 6-10 per bag. Spat were released onto two sites, one of sand, the other of shell gravel. Almost all of the spat had disappeared from both sites after two months. Aquarium trials using invertebrate predators occurring at these sites showed hermit crabs and starfish could successfully attack and consume most sizes of scallop spat used in the field experiments, resulting in up to 100% mortality over two weeks. Scallops of around 30-40 mm (depending on the predator) seemed less vulnerable to predation.

Further information:

- Bartrom, A. A. (1990). The Coromandel scallop enhancement project 1987 to 1989. MAF Fisheries North Internal Report. 23 p. (Unpublished report held at NIWA, Auckland.)

Research

108 The following research is currently programmed for Coromandel scallops:

- SCA2007/01 Stock assessment Coromandel scallops – including estimating abundance and sustainable yields. The project is estimated to cost $25,000 - $75,000. Next scheduled for May, 2007. This is an annual project.
- SCA2007/03 Scallop abundance in Northland and Coromandel recreational fishing areas – to establish a relationship between scallop abundance in the main commercial scallop beds estimated each year in pre-season surveys, and scallop abundance in recreational fishing areas in the Northland and Coromandel scallop fisheries. Scheduled for May/June 2007.
- REC2007/11 Recreational harvest in the Coromandel fishery – to conduct a pilot study to assess the feasibility of estimating the recreational catch in the main part of the Coromandel scallop fishery (SCA CS) from Cape Colville to Hot Water Beach. Scheduled for 1 July 2007 (season now starts September 2007).

Financial management

109 The text box below (page 43) explains some of the key management tools for this fishery:

- the annual catch entitlements – which are used to control the total volume of the commercial catch, and who is entitled to catch it; and

- ❖ deemed values – the penalty amount that commercial fishers must pay if they do not get enough annual catch entitlements to cover their catch.

110 The deemed value rates are set at an interim value of $18.50 per kg, and an annual value of $37 per kg (**table 10**). Almost all catches in this fishery are covered by annual catch entitlements. In 2004/05, no deemed values were paid. In both 2003-04 and 2002-03, $37 in deemed values were paid.

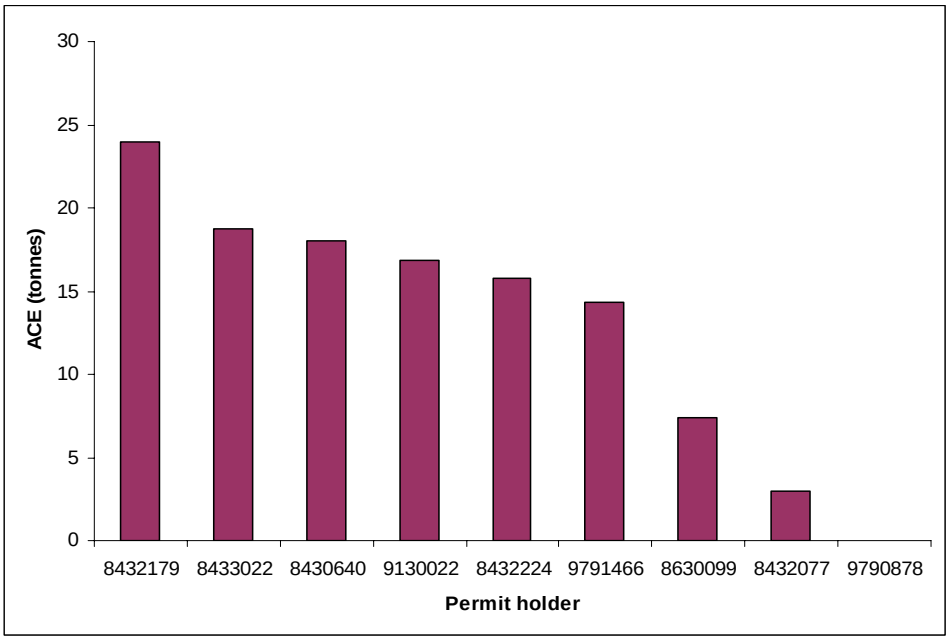
Table 10: Interim and annual deemed value charges

Deemed Value Type	Deemed Value Rate ($ per kg)
Annual	37
Interim	18.5

111 Most annual catch entitlements trade at between $2 and $4 per kg. This is well below the deemed value price of $18.50 per kg (interim), which means it is cheaper to buy annual catch entitlements to cover catches, than to pay the deemed value. This helps ensure commercial catches do not exceed the total allowable commercial catch.

112 There were nine owners of annual catch entitlements in the Coromandel scallop fishery as at 1 February 2006. Holdings range between 19 tonnes and 1 kg (**Figure 13**).

Figure 13: ACE holdings as at 1 February 2006 for Coromandel scallops based on the increased commercial catch level (118 tonnes meatweight) for 2005/06.



What are annual catch entitlements? ('ACE')

What are deemed values?

Annual catch entitlements (ACE) give the holder the right to take a certain weight of a fishstock during a fishing year. Quota shares generate an amount of ACE at the beginning of each fishing year. Each person who owns quota shares will be allocated an amount of ACE at the beginning of each fishing year. The total allowable commercial catch for that fishstock determines the amount of ACE that is allocated for a fishstock. There are 100 million quota shares for each quota stock, and ACE is allocated as a proportion of that.

For example: If the total allowable commercial catch for Coromandel scallops is 118, 000 kg, then the value of one quota share will be 0.00118 kg. This is calculated by dividing the total allowable commercial catch by 100,000,000. If a person owns 10,000 Coromandel scallop quota shares at the beginning of the fishing year, they will be allocated 11.8 kg of Coromandel scallops ACE.

Every month, the amount of ACE a fisher owns is compared to the amount of catch they have reported for the year to date.

When the amount of a fisher's reported catch is more than the amount of ACE they own, the fisher is issued with a deemed value invoice. Deemed value invoices must be paid within 20 days of the date on the invoice. If the fisher does not pay his/her deemed value invoice on time, and the amount of the deemed values owed is $1000 or more, their fishing permit will be suspended.

The Ministry of Fisheries sets both interim and annual deemed value rates for each quota management stock. The annual deemed value rate for a stock will always be higher than the interim deemed value rate.

Interim deemed values — If reported catch for the month is more than the fisher's ACE holdings as at the 15th day of the following month, then they will be charged an interim deemed value. Interim deemed values are charged each month for all quota stocks, for the first eleven months of the fishing year for that stock.

Annual deemed values — If reported catch for the fishing year is more than the fisher's ACE on the 15th day of the month following the end of the fishing year, they will be charged an annual deemed value. The annual deemed value is calculated by multiplying the total amount overfished for the year, by the annual deemed value rate for that stock. For some stocks, a differential annual deemed value will be used (so that the greater the overcatch, the higher the deemed value rate is). Any interim deemed values that have already been paid are deducted from this.

Source: based on http://www.fishserve.co.nz/information/ace/#deemedvalues

Quota holdings

113 There are 10 quota holders in this fishery. Holdings range from 35% of the total allowable commercial catch, to 4% (**Figure 14**). Some quota owners fish their entitlements themselves, while others sell their catch entitlements to other fishers (**see Figure 15**).

Figure 14: Quota holdings as at 1 February 2006 for Coromandel scallops.

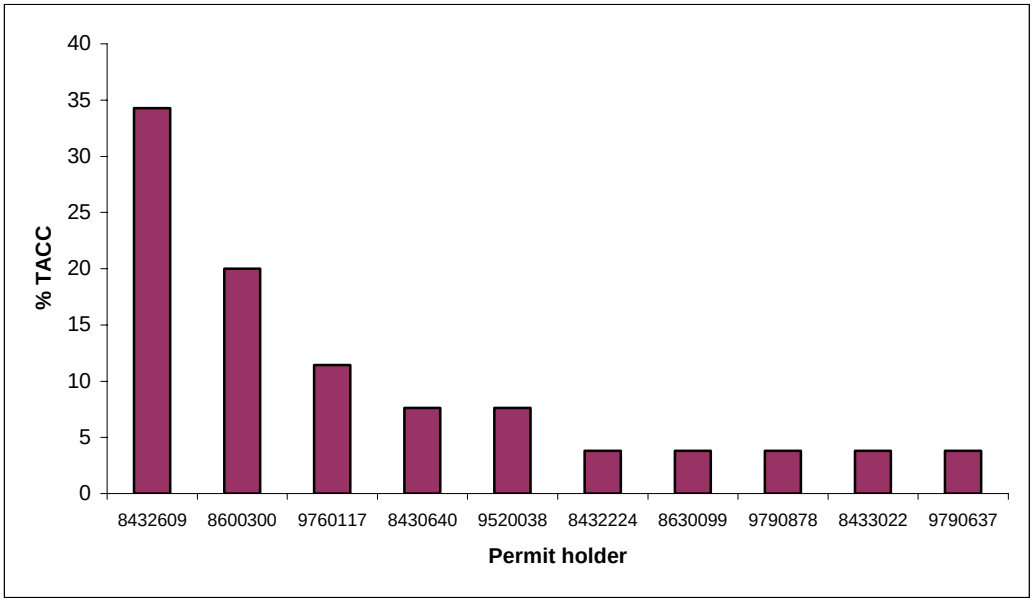
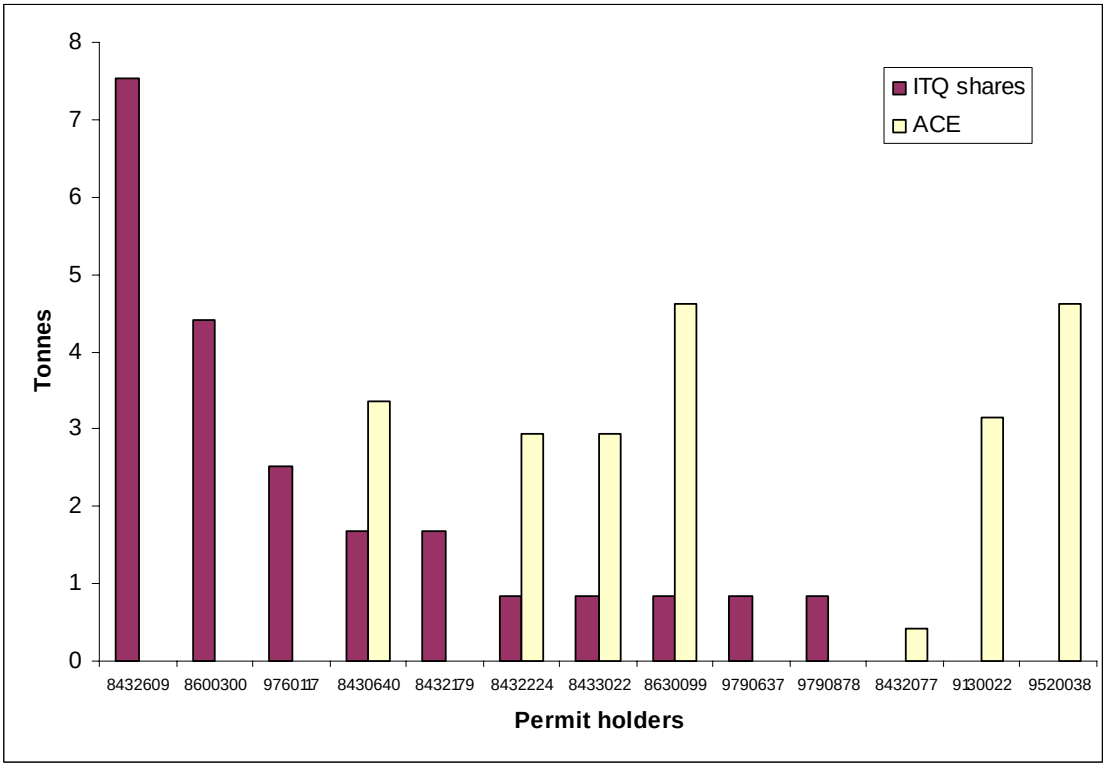


Figure 15: Comparison of quota and ACE holdings in SCACS (based on baseline ACE of 22 tonnes; as at 1 February 2006).



Compliance

114 MFish provides compliance services in the Coromandel scallop fishery for the recreational, customary, commercial, and blackmarket-poaching sectors.

115 MFish compliance staff:

- ❖ Educate fishers on their obligations under fisheries legislation;

- ❖ Deter fishers from offending;
- ❖ Monitor compliance with fisheries legislation;
- ❖ Detect, investigate, and prosecute offending;
- ❖ Develop and maintain systems to support these services

116 It is not possible to give meaningful levels of compliance in the fishery, because this information is heavily dependent on where MFish compliance focuses its efforts.

Educating fishers

117 During patrols both on and off the water, fishery officers take the opportunity to educate fishers on the fishing rules. For example, in late 2005, the Fisheries (Amateur Fishing) Regulations were amended to allow divers to take scallops for safety people on board their vessel. When on patrol, fishery officers will spend time explaining these recent amendments and answering fishers' questions. Fishery officers also hand out brochures and other information (e.g. measuring devices) to help fishers comply with the legislation. Fishery officers also discuss requirements for commercial fishers during any vessel and processing plant inspections.

Deterring fishers from offending

118 Fishery officers on patrol will sometimes ensure they can easily be identified to help deter fishers from offending.

Monitor compliance with fisheries legislation

119 Fishery officers collect information on compliance by fishers in all the sectors. In recent years, information has been collected and collated centrally by fishery officers carrying out land and sea-based patrols of recreational fishers.

Detect, investigate, and prosecute offending

120 Depending upon the severity of the offence, MFish can warn a fisher, issue an infringement notice, or proceed with an investigation that may result in a prosecution (and in the most serious cases, forfeit fishing gear and other related property used at the time of the offence). Each case is decided on the particular circumstances, including the severity of the offending.

121 In the commercial fishery, compliance activities focus on auditing and examining fishing and products returns and records as well as conducting patrols on the water. In the recreational fishery, fishery officers conduct patrols on the water and at the boat ramps. The most common offences in the recreational scallop fishery are taking excess or undersized scallops.

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Annex One: Regulations

122 Commercial regulations include:

- Various areas are closed to commercial scallop harvesting (Regulation 22 of the Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986);
- A commercial size limit of 90 mm (Regulation 22B of the Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986);
- Controls on when harvesting can occur – only during daylight hours (starting 1 hour before sunrise and ending 1 hour after sunset); only Sunday to Thursday inclusive; and only between July 15 and 21 December (Regulations 22(2), (3), and (4) of the Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986);
- Controls on dredge design and size – commercial fishers must not use (a) more than 1 dredge with a bar or bit that is more than 2.5 m long; or (b) more than 2 dredges, either of which has a bar or bit that is more than 1.4 m long (Regulation 78 of the Fisheries (Commercial Fishing) Regulations 2001);

123 Amateur regulations include:

- A daily bag limit of 20 scallops (Regulation 19(1) of the Fisheries (Amateur Fishing) Regulations 1986);
- A size limit of 100 mm (Regulation 19(4) of the Fisheries (Amateur Fishing) Regulations 1986);
- A season that runs from 14 July to 15 February (Regulation 24 of the Fisheries (Amateur Fishing) Regulations 1986). Note that as of 2007, the new amateur season will run from 1 September to 31 March.
- A Maori Committee, marae committee, or kaitiaki can authorise fishing for scallops for a hui, tangi, or other approved purposes outside of the standard amateur regulations (e.g. more than the bag limit) (Regulation 27 of the Fisheries (Amateur Fishing) Regulations 1986);
- A diver operating from a boat can take an additional bag limit of scallops (or dredge oysters) on behalf of 1 or 2 people who are on the boat and are acting in a safety capacity; this regulation does not apply to other shellfish (except dredge oysters) or shore-based diving for scallops. (Regulation 19A of the Fisheries (Amateur Fishing) Regulations 1986);
- Scallops can be opened and eaten on a boat, but any scallops that are landed must be in a measurable state (Regulation 20 of the Fisheries (Amateur Fishing) Regulations 1986). The daily bag limit still applies in either instance.
- Regulation 29(4) of the Fisheries (Amateur Fishing) Regulations 1986 provides the following defence for taking scallops out of season: “In the case of any person charged with taking or being in possession of scallops during a closed season, if that person satisfies the Court that the scallops were washed ashore.”