Notornis, 2001, Vol. 48: 131-136
0029-4470

Decline of brown teal (*Anas chlorotis)* in Northland, New Zealand, 1988 - 99

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Abstract Numbers of brown teal (*Anas chlorotis*) present at summer flock sites in Northland, New Zealand declined 65% during 1988-99 and the species' principal range contracted to three enclaves located along 20 km of the eastern coast. Most populations underwent a period of gradual decline followed by an abrupt crash, symptomatic of prolonged recruitment failure. Drought-induced habitat and landscape change is proposed as an important agent of decline in two formerly large populations at Clendon Cove and Tutaematai. Extirpation in Northland appears imminent.

Parrish, R; Williams, M. 2001. Decline of brown teal (*Anas chlorotis*) in Northland, New Zealand, 1988-99. *Notornis 48(3)*: 131-136.

Keywords brown teal; *Anas chlorotis*; population; status; Northland; New Zealand

INTRODUCTION

Few of New Zealand's extant endemic birds have experienced such a spectacular and widespread decline since European settlement as have brown teal *Anas chlorotis* (taxonomy follows Marchant & Higgins 1990). Historically, teal were widespread throughout swamps, lakes, and streams of New Zealand from Stewart Island to Northland, and on Chatham Island (Buller 1888; Atkinson & Millener 1991; Worthy & Holdaway 1994), and were still so even in the 1880s (Hayes & Williams 1982). However, by 1999 they were restricted to 3 enclaves –southern Fiordland, eastern Northland, and Great Barrier Island - and 6 small near-shore islands - Moturoa and Urupukapuka (Bay of Islands), Tiritiri Matangi and Little Barrier (Hauraki Gulf), Rakitu (off Great Barrier), and Kapiti (Williams & Dumbell 1996).

Steady declines continue at both mainland enclaves. Hayes & Williams (1982) reported teal as "....now restricted to a small part of Fiordland National Park - near the coast at the heads of Dusky, Breaksea and Doubtful sounds, and further inland on the mountain tarns in the Kepler and Murchison mountains. Within this area, sightings are becoming increasingly infrequent and are usually of single birds or family groups." Subsequent (post-1985) sightings have been rare; in the Seaforth catchment (Gair Loch and Loch Maree) at the head of Dusky Sound, at Lake Hakapoua and Waitutu River, and of occasional single birds or isolated pairs elsewhere (I. Southey, M.Willans pers. com.). Seven teal captured at 3 widely-spaced locations in Fiordland in 1996-99 all had mitochondrial 12S rRNA sequences which indicated past hybridisation with mallard *Anas platyrhynchos* or grey duck *A. superciliosa* (Gemmell & Flint 2000). Extirpation in Fiordland appears imminent.

A protracted decline in Northland was chronicled by Hayes & Williams (1982) in recording the demise of populations at Waipu and Hokianga Harbour in the 1960s and 1970s and the teal's retrenchment to the Kaeo-Kerikeri and Russell-Whangaruru areas of the eastern coastline. By 1988, however, teal were no longer regularly encountered within the Kaeo-Takao Bay area and the once conspicuous summer aggregation of teal on the Kaeo River had vanished entirely (RP pers. obs.).

On Great Barrier Island, (the acknowledged stronghold of the species: Hayes & Williams 1982; Dumbell 1986,1987; Williams & Dumbell 1996) an overall reduction in numbers and range during the period 1987-99 has occurred, especially of populations in the central and southern regions of the island (unpubl. data, Department of Conservation, Auckland).

It was against this background of obvious and continuing decline of brown teal throughout its range

Received 1 May 2000; accepted 2 July 2000

that monitoring of all significant populations remaining in Northland commenced in 1988. The aim was to establish the numerical trends in teal populations. In this paper, we report the results of monitoring conducted between 1988 and 1999.

METHODS

In summer, brown teal aggregate as conspicuous flocks at traditional sites (McKenzie 1971; Dumbell 1986). McKenzie (1971) reported flocks present between November and May, and on Great Barrier Island, peak numbers were recorded between December and March (Dumbell 1987). Therefore, Northland's teal were monitored by counting birds during summer at 16 sites (Appendix 1), all on the eastern coast from Bay of Islands south to Matapouri, which were known (in 1988) to be the only flock sites still regularly attended by teal.

Birds were counted in 1988 and then every year from 1990 to 1999. Counts were made in January to March each year to coincide with expected peak numbers. However, because numbers at flock sites could vary seasonally, two counts were made in each year from 1992 to 1998 (Appendix 2).

Most flock sites were in the upper tidal reaches of small streams. Previous observations indicated that, irrespective of time of day, some birds would be feeding away from the flock site at low tide. However, at high tide, and especially during the middle of the day, birds appeared to gather at the flock site to sleep or rest for several hours. Similar behaviour was reported by Dumbell (1987). Therefore, counts were timed to coincide with a midday high tide.

Various observers participated in the counts during the study. All were instructed to conduct their counts in a way that caused least disturbance to the flocks. In many instances the most appropriate technique was simply to disturb the birds slightly so that they all went onto the water where they could be counted readily as they swam past a viewing point.

In practice, 2 people counted the teal at each flock site. One person hid in stream-side vegetation while retaining a clear view of the stream. The other would venture upstream, disturb the birds, and then drive them slowly downstream and past the observer. If the birds were so disturbed that some or all flew a short distance and an effective total count was not achieved, another attempt would be made to drive them past the observer, but this time upstream. The higher of the 2 counts was recorded.

RESULTS

Numbers counted

The maximum numbers of teal counted at each flock site in each year are listed in Table 1. As the study period progressed, it became apparent that teal had ceased to gather at some sites, generally because they no longer frequented the area or catchment (MW pers. obs), and these sites were either dropped from the monitoring programme or monitored irregularly.

When counts were made in both January and February (1994, 95, 98), January counts were the higher of the 2. For example, January counts at the 5 most populous sites in 1994 and 1995 were, collectively, 52% and 19% higher than February counts. Similarly, counts in February were higher than those made in March, e.g., 4% and 16% higher in 1992 and 1993 respectively..

Counts were not duplicated in 1999, nor were all sites visited, but the 4 remaining significant sites were all visited and the birds counted.

DISCUSSION

At face value, the data in Table 1 indicate a significant decline of brown teal, both in numbers and range. Significant concentrations of teal have become restricted to the 20 km of coastline of Northland's eastern coast, from Teal Bay to Whananaki. Whereas the total absence of birds from many traditional flock sites over successive years is unequivocal, numbers at the major sites varied considerably between years and between duplicate counts in any year, emphasising the need for careful interpretation of overall trends.

Interpretation of counts

Which birds were counted?

Flocks are reported to contain both adults (birds of breeding age) and fledged young of the year (Marchant & Higgins 1990; Dumbell & Williams 1996). During January - March, the 2 age classes were difficult to distinguish, the fresh dark brown plumage of juveniles being similar to that of adults (particularly females) after their annual body moult (MW, pers. obs.). At this time, only some of the adult males retained sufficient of their nuptial colouring to be recognisable. As a result, no attempts were made to determine proportions of adults and juveniles in the flocks.

Not all teal present in a catchment aggregate at the flock site in summer. For example, in early February (1994) 25-30% of known adults in the Clendon Cove and Tutaematai populations were still at their breeding sites but no juveniles other than unfledged young, remained there (MW unpubl. data). Similarly, birds were present in one-third of known breeding territories along streams and in swamps within the Okiwi basin, Great Barrier Island during daytime in February 1995 (MW unpubl. data). Significantly, breeding sites in the Tutaematai and Clendon Cove areas of Northland and on Great Barrier Island at which birds were present in February were those adjacent to damp or flooded pastoral areas in which teal regularly foraged at night. Teal from many of the breeding sites at Clendon Cove and Tutaematai whose adjacent feeding areas were dry during summer were observed regularly at the flock sites.

Table 1 Numbers of brown teal (*Anas chlorotis*) counted at summer flock sites in January-March, 1988-99. (*, no count made). See Appendix 1 for details of flock site locations and Appendix 2 for dates of counts. Sites are listed in geographic order from north-to-south.

	Year										
Site	1988	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Clendon Cove	55	66	80	54	48	19	6	0	0	10	*
Gordons Dam	32	0	*	0	0	*	0	*	0	0	*
Bentzens Pond	16	8	17	14	15	2	1	*	*	*	*
Parekura Bay	87	80	57	43	16	6	0	0	6	2	2
Wairoa Stream	3	31	30	25	15	4	2	2	0	0	2
Ngaiotonga Stream	12	19	0	2	4	2	0	0	0	*	*
Tutaematai Stream	*c.*100	63	103	146	141	113	60	8	7	18	0
Punaruku Stream	6	8	23	14	2	2	4	6	8	4	*
Teal Bay	32	24	28	28	7	30	51	64	95	87	78
Ngahau Bay	10	3	12	13	8	2	8	14	5	31	3
Mimiwhangata	43	25	11	20	21	14	36	24	63	97	39
Otamure Bay	15	0	7	0	2	*	0	0	*	17	2
Whananaki River	82	78	c.70	44	51	39	20	14	43	29	0
Whananaki South	2	0	*	*	2	0	0	*	0	0	0
Hailes Road	19	0	0	0	0	0	0	*	0	0	*
Matapouri Bay	3	2	2	0	*	*	0	*	*	*	*
Total	517	407	440	403	332	233	188	132	227	295	126

Within-year count differences

In 1992-98 considerable differences were found between counts made 2-4 weeks apart at all flock sites. Most differences appeared related to the timing of counts with numbers declining after January. Seasonal peak numbers of teal at 22 flock sites on Great Barrier Island 1984-86 were sustained from December to April (Dumbell 1987) whereas at both Clendon Cove and Tutaematai peak numbers were recorded in early January during counts made between December 1993 and March 1994 (MW unpubl. data). However, at Mimiwhangata and Teal Bay flock sites, peak numbers in fortnightly counts were sustained throughout January to May in each year 1996-98 (J.Fraser pers. com).

We conclude that, because of the within and between year differences in counts, total numbers of birds at flock sites in any year are merely a guide to the size of local populations, not an absolute indication. Whereas most, if not all, fledglings attend the flock sites, the severity of summer drought probably influenced the proportion of the adult population present. Without estimates of the adult:juvenile ratio of birds at the flock site, and complementary surveys of the breeding areas, we could not apply correction factors to flock counts to more closely evaluate the size of the local breeding population. However, when the data in Table 1 are viewed as a time series, we consider they provide a realistic indication of the trend of Northland's brown teal populations.

Population trend

Given that the flock sites counted were the only ones that teal were known to frequent in 1988, and that, subsequently, no new sites were located, the downward trend provides convincing evidence for a significant overall decline. The line of best fit defining the trend in total numbers each year over the 11- year period (Fig.1) indicates a 65% decline, or a mean annual decline of about 10%.

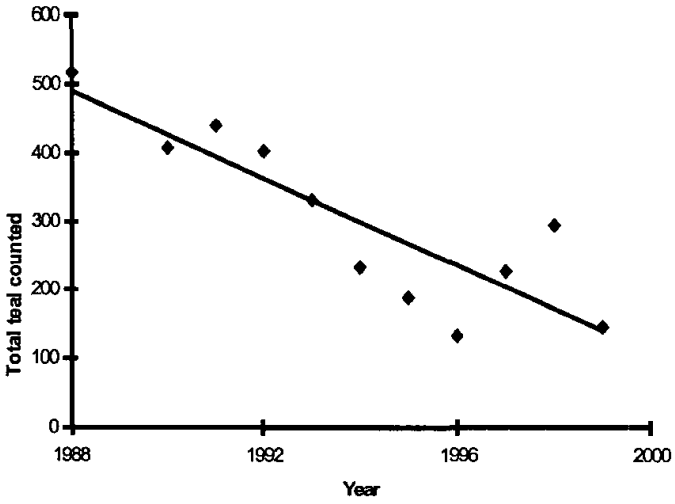

Fig. 1 Total number of brown teal (*Anas chlorotis*) recorded annually at monitored flock sites in Northland 1988–1999 (data from Table 1). The line of best fit is y = 492.8-32.6x (r = -0.868, P <0.001).

Population trends in individual flock sites

Trends in numbers and the timing of significant changes in numbers attending individual flock sites varied and that variation is illuminating in terms of the overall decline we identified.

CLENDON COVE, GORDONS DAM These 2 sites, less

than 1 km apart, served the population breeding over adjacent pastoral land. The wall of Gordons Dam collapsed in mid-1989 and it was not repaired for 2 years. Teal that previously joined the summer flock there were presumed to have joined those at Clendon Cove, which would account for the increased numbers there in 1990 and 1991. However, the abrupt decline in 1994 followed a breeding season in which 31 pairs are known to have bred in adjacent swamps and streams, collectively fledging at least 57 young (Williams in press). In the subsequent breeding season, only 5 pairs were present in the same area.

BENTZENS POND, PAREKURA BAY, WAIROA STREAM These 3 adjacent sites at the southern end of Bay of Islands are at the mouths of small valleys. Teal at each were considered to be residents of the respective valleys. Bentzens Pond is an impoundment where a small stream draining a catchment of about 20 ha enters its estuary. The immediate area probably supported no more than 5 breeding pairs and the sizes of the flock recorded in 1988-93 was consistent with that number. However, numbers in 1994 were significantly and abruptly lower and, within 2 years, teal were no longer recorded there. The 2 other flock sites were at the tidal margins of large streams draining valleys of similar size to that at Clendon Cove. Cattle were grazed over most of both of these valleys and the riparian margins were gradually stripped of scrub and trees. Parekura Bay and Wairoa Stream had identical histories of abrupt decline following the 1992 breeding season and few teal were present after 1994.

Ngaiotonga, Tutaematai, and Punaruku Streams All 3 streams drain small valleys with similar landscapes and land use at the head or on the western flanks of Whangaruru Harbour. Cattle were grazed on rough pasture on the valley floors, with the hills clothed by regenerating scrub and forest. Riparian strips supported varying amounts of tall manuka *Leptospermum scoparium*. Historically, teal were regularly seen at the mouth of Punaruku Stream where 52 were counted in 1978 (MW pers.obs.). However, from the beginning of this study, very few teal were recorded there, except for an inexplicable jump to 23 in 1991.

Nothing is known of the Ngaiotonga flock site before it was discovered in 1988. Its initial low numbers declined to zero, but the Tutaematai flock site consistently supported more than 100 birds during 1988-94. Tutaematai is at the confluence of 2 streams where at least 22 pairs bred in 1993 (Williams in press). Teal banded while breeding in small coastal wetlands between Tutaematai and Punaruku were at the flock site in January-March 1994 indicating that birds from beyond the immediate catchments also used the site. In mid-February 1994, teal suddenly shifted downstream from the flock site and into the estuarine reaches of Tutaematai Stream, their numbers were fewer (maximum 65) than recorded in January (115), and they were very easily disturbed. The missing birds could not be located elsewhere in the Whangaruru Harbour environs. In the following breeding season, only 15 pairs were found at the nearby breeding sites and 2 years later only 2 pairs and 4 individuals could be located at breeding time. Just as at Clendon Cove, the abrupt drop in numbers recorded at the flock site was accompanied an equally abrupt reduction in the number of breeding pairs in the near vicinity.

TEAL BAY, NGAHAU BAY, MIMIWHANGATA These 3 neighbouring sites, while differing in character (Appendix 1), showed similar population changes, including being the only sites in Northland where teal numbers increased during this study. Flocks at Mimiwhangata occupied several farm dams. In 1995, 6 dams including 1 of almost 3 ha, were built there, followed by 2 years (1996-98) of intensive trapping of mammalian predators throughout a 450 ha pastoral landscape. The subsequent increase in the number of breeding pairs of teal in the immediate area was complemented by an increase in the numbers of teal observed on dams in summer (J Fraser pers. com.). However, at Teal Bay, numbers increased without local predator control or the creation of wetlands. Teal numbers at the single flock site 1997-99 were more than 300% greater than counts during 1988-92. Even allowing for a significant proportion of local birds not attending the flock site at the time of counts in the initial years of this study, we conclude there has been a real, significant, but inexplicable increase in the Teal Bay population. The increase occurred also at Whananaki River (see below), which implies that the increase observed at Mimiwhangata was merely coincidental with, and not solely the result of, predator control there. Teal at the Ngahau Bay flock site suffer considerable human disturbance during summer and numbers fluctuate (J Fraser pers. com.). Although most birds there were probably residents of wetlands in the immediate catchment, the other two flock sites are within about 2 km and some teal banded while breeding on Mimiwhangata have been observed at the Ngahau Bay flock site (J. Fraser pers. com.).

OTAMURE BAY, WHANANAKI RIVER, WHANANAKI SOUTH, HAILES RD: The latter 2 sites appear to have been used occasionally as satellite sites of the wider Whananaki River population; birds were not present during the last six years of the study. Attendance at the main Whananaki River flock site declined progressively over the first 8 years of study but increased substantially in 1997. The increase coincided with similar major increases at the Mimiwhangata and Teal Bay sites immediately to the north. Otamure Bay resembles Ngahau Bay in having a small hinterland. The highest pre-study count here was 35 in 1986 but few birds were there during the study period.

Possible climatic influences

Our study coincided with significant climatic events. During 1988-90, New Zealand experienced a La Niña phase of the El Niño-Southern Oscillation climate

phenomenon that was more intense than any other during the previous 20 years. It was followed by one of the most protracted El Niño phases recorded in the 20th century, a brief La Niña in 1996-97 and an El Niño which, in 1998, was the second most intense of, at least, the 30 years to 1997 (NIWA 2000). In Northland, El Niño causes cold springs and summer-autumn droughts, which result in low water tables whereas La Niña often brings abundant summer rains, occasional tropical cyclones, and warmer than normal temperatures throughout the year (Brenstrum 1999).

One consequence of El Niño droughts in Northland pastoral landscapes is to concentrate the activity of cattle during summer and autumn in wet and swampy ground and in water courses. The potential impact of this on brown teal was demonstrated at Clendon Cove, where wet areas with luxuriant growth used by teal as breeding sites in spring of 1993, were, by May 1994, almost totally denuded by cattle grazing and trampling. Two years later, those sites remained as rough pasture (MW, pers. obs.). It is possible to view the "crashes" of the Clendon Cove and Tutaematai populations as being outcomes of prolonged drought and associated habitat changes, whereas the increases recorded in 1997 and 1998 at Teal Bay, Mimiwhangata and Whananaki were in response to the wetter La Niña event and the recovery of wetlands.

CONCLUSIONS

The contraction in range of brown teal in Northland during 1988-99 appears to be the last phase in the extirpation of this species in Northland and on the North Island. Notwithstanding the increase in numbers observed at Teal Bay, Mimiwhangata and Whananaki River flock sites (1996-98), the overall population decline observed during this study was entirely consistent with that over the past 50 years. During this time, brown teal have disappeared from Stewart Island, become very rare in Fiordland, disappeared from Coromandel and remnant sites in Waikato, and many of Northland's former significant populations such as those at Waipu, Hokianga, Kaeo and Takou Bay have vanished (McKenzie 1971; Hayes & Williams 1982; Williams & Dumbell 1996).

At a local level, the pattern has been of gradual decline followed by an abrupt crash. This was particularly well illustrated at Clendon Cove, Parekura Bay and Tutaematai, but there are historical precedents within Northland - at Waipu, Parua Bay (near Whangarei) and Kaeo (McKenzie 1971). Bell (1959) reported on an extensive survey of the lower Waipu River catchment in July 1958 and noted that numbers observed then were similar to those recorded during periodic surveys in the preceding 6 years. A follow-up survey at Waipu in 1963 (McKenzie 1971) recorded almost 40% fewer teal. Counts during 1964 and 1965 chronicled the subsequent abrupt crash. Within 10 years, teal had gone from being present "over the whole of the lower Waipu River system" (Bell 1959) to "small population persists" (Edgar 1972), before vanishing completely, as judged by there being no further reference to their presence within the Ornithological Society of New Zealand recording scheme or on files of the former Wildlife Service.

Despite evidence that not all adult brown teal were attending flock sites at the time of the annual counts, the sudden decline in numbers of birds at Clendon Cove (1994) and Tutaematai (1995,96) was reflected in dramatic reductions in the numbers of pairs in the breeding areas later in the year. Fewer birds at the flock site indeed indicated a reduction in the size of the local population.

While the causes of these dramatic declines remain unknown, it is possible to speculate on process. Reductions in numbers of teal at flock sites probably result from a combination of poor post-fledging survival of young and a significant post-breeding mortality of adults. Juvenile teal, other than unfledged young, were not detected in breeding areas when birds were counted at Clendon Cove and Tutaematai in 1994, so presumably juveniles still alive at that time were at the flock site. A significant drop in numbers at the flock site would indicate poor breeding or juvenile survival or both. Where a sharp reduction in numbers of adults at breeding sites was detected following a decline in numbers at a flock site in summer, it could indicate that juvenile survival to recruitment had been poor or non-existent and that there was also significant adult mortality. Reasons for poor juvenile survival between the end of breeding (October) and the flock counts (February), and causes of adult mortality both immediately after breeding and again between the flocking period and the commencement of breeding (June) need to be established.

In this study, we have monitored an alarming decline in brown teal numbers in Northland and a further retrenchment of the species' distribution. These data, and that of historic counts of now extinct populations elsewhere in Northland, leave no room for optimism.. This former very abundant and nationally distributed species (Buller 1888; Atkinson & Millener 1991; Worthy & Holdaway 1994) is about to disappear from the mainland of New Zealand and maintains a tenuous existence on several tiny offshore islands and Great Barrier Island, sites which are not regarded as offering enduring sanctuary (Williams & Dumbell 1996).

ACKNOWLEDGEMENTS

We acknowledge the field contributions of many Department of Conservation staff who participated in the annual counts of teal flocks, and thank all landowners for allowing access to properties where the flock sites were located. We thank I. Southey, M. Willans,and J. Fraser for allowing us to quote their personal communications.

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Appendix 1 Location and characteristics of flock sites at which brown teal (*Anas chlorotis*) were counted during 1988-1999. Map reference is to NZMS 260 (1:50000) series.

Site name	Map reference	Site character	Site detail
Clendon Cove	Q05 211568	Streambank in tidal reaches	Grazed pastoral land: teal roost beneath mangroves on bank or on overhanging trees.
Gordon's Dam	Q05 215557	Stock dam	Grazed pastoral land: teal roost on grazed edges.
Bentzen's Pond	Q05 223598	Dam	Dam formed by road across tidal mudflats. Wooded environs, water margins heavily vegetated.
Parekura Bay	Q05 247589	Streambank in tidal reaches	Puhinui Stream draining narrow grazed valley. Teal roost on streambank and overhanging trees.
Wairoa Stream	Q05 260588	Streambank in tidal reaches	Grazed pastoral land: teal roost beneath overhanging trees. Site secluded.
Ngaiotonga Stream	Q05 289523	Streambank in tidal reaches	Rough pasture and saltmarsh environment.
Tutaematai Stream	Q05 289515	Streambank in tidal reaches	Grazed pastoral land: Teal roost on streambank or exposed roots & branches of streamside trees.
Punuruku Stream	Q05 305479	Streambank in tidal reaches	Rough pastoral land: Teal roost on streambank beneath trees.
Teal (Helena) Bay	Q06 347388	Streambank in tidal reaches	Owai Stream draining pastoral catchment. Teal roost on sand bar, grazed stream edge or in bank hole beneath overhanging trees.
Ngahau Bay	Q06 374388	Stream mouth	Mouth of Te Waiorakau Creek. Pastoral environs. Teal roost on grazed bank or on dead trees.
Mimiwhangata	Q06 402401	Stock dams	Large protected dam in pastoral landscape. Teal also use several smaller stock dams within 1-2 km radius.
Otamure Bay	Q06 432332	Stream mouth	Small stream draining pastoral valley. Teal roost beneath or on overhanging trees.
Whananaki River	Q06 408318	River bank in tidal reaches	River drains pastoral valley. Teal roost at several sites including exposed streambank, beneath or on overhanging trees.
Whananaki South	Q06 426300	Tidal reaches	Teal roost amongst mangroves
Hailes Road	Q06 404304	Tidal reaches	Roost beneath road bridge.
Matapouri Bay	Q06 463237	Streambank in tidal reaches	Te Wairoa Stream draining pastoral valley. Teal roost amongst rank grass or beneath overhanging trees.

Appendix 2 Dates of counts of brown teal (*Anas chlorotis*) at flock sites in 1988-1999 (year, initial count, second count; -, no count). 1988, 19-23 Feb, -; 1990, 19-23 Feb, -; 1991, 18-20 Feb, -; 1992, 24 & 25 Feb, 25 & 26 Mar; 1993, 23 Feb, 18 Mar; 1994, 26 Jan, 25 Feb; 1995, 23 & 24 Jan, 20 Feb; 1996, 13 Feb, 26 Feb; 1997, 11 Feb, 26 Feb; 1998, 15 Jan, 16 Feb; 1999, 15 Feb, -.