Corella, 1997, 21(4): 112–118

POPULATION DEMOGRAPHICS OF THE RED-BROWED FINCH *Neochmia temporalis*, AT NEWCASTLE, NEW SOUTH WALES

MICHAEL K. TODD

Department of Biological Sciences, University of Newcastle, University Drive, Callaghan, New South Wales, 2308

Received: 14 February, 1996

At Blackbutt Reserve within the city of Newcastle, the size and structure of two Red-browed Finch populations were examined. There were between 100 and 300 birds in the two populations. Little movement between the two sites was observed despite the continuous nature of the bushland between them. Survival rates at both sites were high probably because of advantageous environmental conditions.

INTRODUCTION

The Red-browed Finch *Neochmia temporalis* has the third largest distribution among the Australian grassfinches and is regarded as a common granivore on the east coast. Despite being superficially a firetail, recent chromosomal and biochemical studies have shown it to be most closely related to the Plum-headed Finch *Neochmia modesta* (Christidis 1987). It weighs approximately 10 grams and is approximately 12 centimetres in length.

Very little has been published on the demographics of this species or the other Australian grassfinches. This is because most are not highly sedentary making long-term studies of populations difficult. Yom-Tov *et al.* (1992) estimated an average lifespan for the Red-browed Finch of approximately 11.4 months, a result that was affected by the low rate of recovery of banded individuals.

Zann and Runciman (1994) examined some of the population characteristics of the Zebra Finch *Taeniopygia guttata* in south-eastern Australia. They found that over 78 per cent of Zebra Finches captured were hatched in colonies other than the one they were studying. Sixty-six per cent of adult Zebra Finches were only captured once before they presumably left the colony. They concluded that adult mobility was largely responsible for these figures. Woinarski and Tidemann (1992) studied the survivorship of Gouldian Finches *Erythrura gouldiae*, Masked Finches *Poephila personata* and Long-tailed Finches *Poephila acuticauda* at two sites in the Northern Territory. Retrap rates for the two sites and the three species were low: Gouldian Finch — 12.9 per cent and 21.7 per cent, Masked Finch — 6.1 per cent and 31.9 per cent, Long-tailed Finch — 6 per cent and 36.6 per cent. They came to the same conclusion as Zann and Runciman (1994); that the low retrap rates were caused more by emigration than mortality.

Red-browed Finch populations were studied at the Blackbutt Reserve near Newcastle in order to discover the population sizes and age structure of populations in a semi-urbanized environment with constant food and water.

STUDY SITE AND METHODS

Red-browed Finches, *Neochmia temporalis*, were examined at two sites in Blackbutt Reserve at Newcastle, New South Wales on the east coast of Australia, approximately 150 kilometres north of Sydney. The sites were in the most northern and most southern gullies of the Blackbutt Reserve. They were named North Blackbutt (32°55.5′S, 151°42.5′E) and South Blackbutt (32°56.5′S, 151°42.5′E). The two sites were separated by approximately 2 kilometres of continuous bushland within the Blackbutt Reserve.

Both study areas supported sclerophyll forest, dry on the ridges and wet in the gullies along creeks. At both sites water and seed was always available within aviaries with large gauge mesh or as feed for domesticated geese. The aviaries were part of public exhibits within the reserve. Various aviaries were entered by the finches, with a wide variety of seeds being

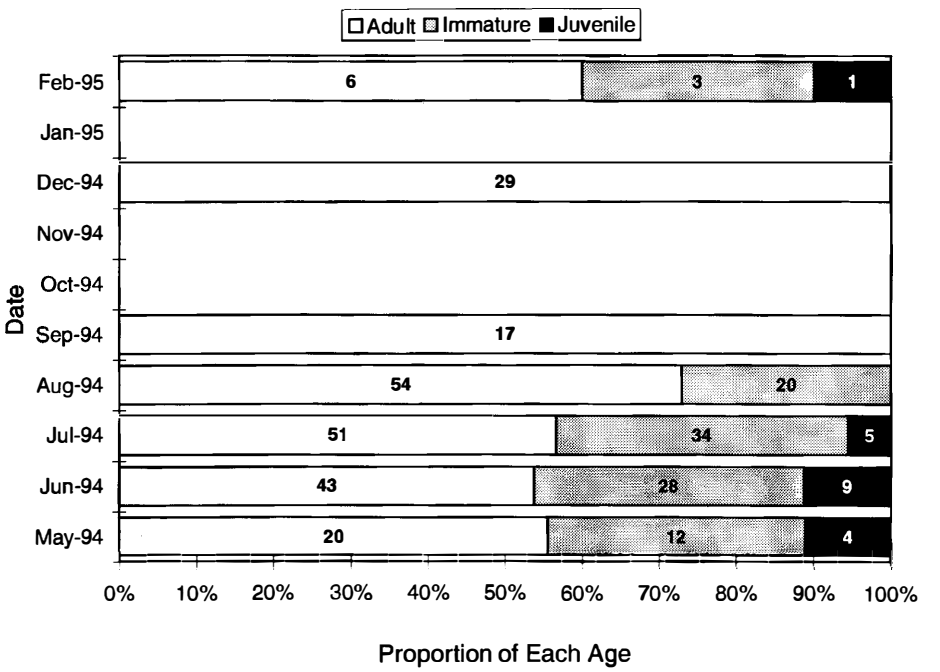

Figure 1. *Age structure of the captured sample of the North Blackbutt population of the Red-browed Finch over the study period.*

TABLE 1

Total captures of Red-browed Finches *Neochmia temporalis* at the North Blackbutt site.

Date	New Captures	% New Captures	Recaptures	% Recaptures	Total
25/05/94	36	100.0%	0	0.0%	36
11/06/94	25	92.6%	2	7.4%	27
18/06/94	34	61.8%	21	38.1%	55
3/07/94	12	36.4%	21	63.6%	33
10/07/94	6	20.7%	23	79.3%	29
20/07/94	2	10.5%	17	89.5%	19
30/07/94	0	0.0%	2	100.0%	2
7/08/94	9	12.0%	66	88.0%	75
7/09/94	1	5.6%	17	94.4%	18
10/12/94	1	3.6%	27	96.4%	28
22/12/94	0	0.0%	1	100.0%	1
19/02/95	5	50.0%	5	50.0%	10
Total	131		202		333

TABLE 2

Total captures of Red-browed Finches *Neochmia temporalis* at the South Blackbutt site.

Date	New Captures	% New Captures	Recaptures	% Recaptures	Total
1/05/94	32	100.0%	0	0.0%	32
7/05/94	28	80.0%	7	20.0%	35
5/06/94	63	77.8%	18	22.2%	81
25/06/94	21	38.2%	34	61.8%	55
17/07/94	11	18.3%	49	81.7%	60
20/08/94	22	25.0%	66	75.0%	88
25/11/94	4	20.0%	16	80.0%	20
9/01/95	17	68.0%	8	32.0%	25
21/01/95	15	39.5%	23	60.5%	38
9/04/95	4	25.0%	12	75.0%	16
Total	217		233		450

available within the aviaries. The Blackbutt sites were also partially isolated from larger areas of bushland by urban development and are probably on the way to becoming a geographical island of natural vegetation.

Sampling periods occurred in each season beginning in Autumn 1994 and concluding in Autumn 1995. Finches were mostly caught with mist nets placed near feeding areas and were subsequently banded with a metal identification band (supplied by the Australian Bird and Bat Banding Scheme) and a colour band specific to the site. Between one and three mist nets each 40 feet long were erected for periods of approximately 3–4 hours at appropriate positions for finch capture. Usually a period of about six weeks separated each capture session at each site. Occasionally drop-traps were use for finch capture.

Population Sizes

Population sizes for each of the sampling periods were calculated using the Jolly Seber[1] and Fisher-Ford Methods[2]. The advantage of both methods is that they take into account the unrestricted immigration and emigration between the sampling periods (Krebs 1989; Blower *et al.* 1981). The commonly used Jolly-Seber Method (Burton 1996; Dettman 1995) requires high sampling intensity; that is, each sampling period should be close together (Begon 1979). When data are extensive but somewhat scanty (i.e. separated by considerable time periods) then the Fisher-Ford Method is sometimes regarded as being the most appropriate method (Bishop and Sheppard 1973; Begon 1979). However, it assumes a constant survival rate over the time of study, something that is difficult to justify over a considerable period of time. The single survival rate is produced by grouping data together, combining samples and cancelling out sampling errors that are unavoidable when sampling is carried out over an extended period. As it can be difficult to decide on which method to use in these situations, both methods were used and compared with each other as recommended by Begon (1979).

Age

Red-browed Finches were aged by their plumage and the colour of their iris and placed in the categories adult, immature and juvenile according to Rogers *et al.* (1986).

Survival Rates

As the recapture rates were high (approximately 80 per cent of birds captured had been previously marked, over most of the study period), it was considered that an accurate estimate of survival rates could be obtained by calculating the percentage of birds of a certain age class that were later recaptured and classified into an older age class, thus demonstrating their survival. As the captures were only carried out over less than a year an estimate of annual survival was not possible.

RESULTS

A large number of recaptures was achieved at both sites. At North Blackbutt there were 333 captures of 131 banded individuals (Table 1) while at South Blackbutt there were 450 captures of 217 banded individuals (Table 2). At both sites greater than 50 percent of birds trapped were recaptures after only four capture sessions.

There were four recorded movements of birds from one of the sites to another; all of these were from North Blackbutt to South Blackbutt (Table 3).

Mark-release-recapture techniques can produce large standard errors which need to be taken into account when examining population estimates. It must be borne in mind that all the population sizes are estimates based on the samples and carry

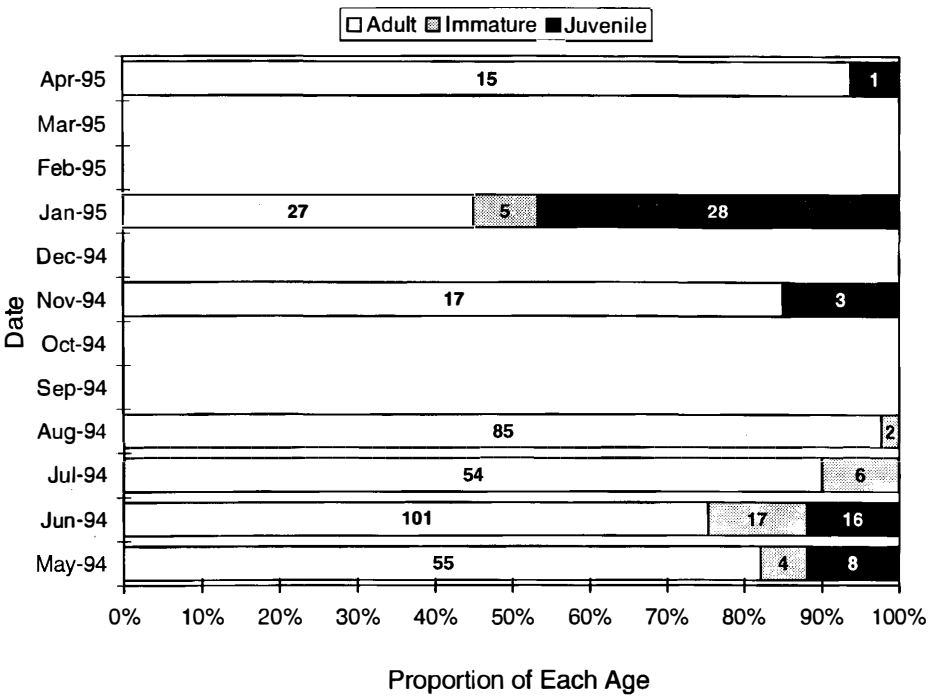

Figure 2. *Age structure of the captured sample of the South Blackbutt population of the Red-browed Finch over the study period.*

TABLE 3

Capture or observation details of all Red-browed Finches that moved from one study site to another during the study period.

Band Number	Date	Location
017-43193	25/5/94	North Blackbutt
017-43193	18/6/94	North Blackbutt
017-43193	7/8/94	North Blackbutt
017-43193	9/1/95	South Blackbutt
016-98125	18/6/94	North Blackbutt
016-98125	10/7/94	North Blackbutt
016-98125	25/11/94	South Blackbutt
016-98187	7/8/94	North Blackbutt
016-98187	7/9/94	North Blackbutt
016-98187	25/11/94	South Blackbutt
Observation of bird from North Blackbutt (red colour band)	22/10/94	South Blackbutt

TABLE 4

Estimated sizes of Red-browed Finch populations at the South Blackbutt study site using the Jolly-Seber Method and the Fisher-Ford Method. The non-symmetrical upper and lower 95% confidence values are for the Jolly-Seber Method and were taken from Krebs (1989).

North Blackbutt	Jolly-Seber Estimate	Jolly-Seber Lower 95% confidence value	Jolly-Seber Upper 95% confidence value	Fisher-Ford Estimate
5-June-94	194.5	89.3	331.7	269
25-June-94	373.8	172.6	630.2	109
17-July-94	183.9	118.4	194.4	99
20-Aug-94	156.2	102.3	162.2	118
25-Nov-94	185.8	122.7	220.1	182
9-Jan-95	434.1	108.8	1 604.2	357
21-Jan-95	311.0	113.4	671.3	240
9-Apr-95	143.5	61.8	303.7	109
Average	247.9	111.2	514.7	178.3

TABLE 5

Estimated sizes of Red-browed Finch populations at the North Blackbutt study site using the Jolly-Seber Method and the Fisher-Ford Method. The non-symmetrical upper and lower 95% confidence values are for the Jolly-Seber Method and were taken from Krebs (1989).

North Blackbutt	Jolly-Seber Estimate	Jolly-Seber Lower 95% confidence value	Jolly-Seber Upper 95% confidence value	Fisher-Ford Estimate
18/6/94	345.3	109.6	937.0	155
3/7/94	139.6	89.4	163.5	202
10/7/94	193.0	98.5	251.8	122
20/7/94	113.6	72.8	118.1	127
7/8/94	86.9	56.3	84.9	104
7/9/94	100.1	78.1	111.8	119
10/12/94	95.4	42.7	166.1	58
19/2/95	68.0	27.3	222.9	168
Average	142.7	71.8	257	131.9

[1]Data were compiled into a Method B table for Jolly-Seber analysis. The estimate of the number of birds in the population (N_t) using the Jolly-Seber Method is

$$N_t = \frac{M_t}{\alpha_t}$$

where M_t = the estimated size of the marked population just before sample size t.

$$M_t = \frac{(s_t + 1)\, Z_t + m_t}{R_t + 1}$$

and α_t = the proportion of animals marked.

$$\alpha_t = \frac{m_t + 1}{n_t + 1}$$

m_t = the number of marked animals caught in sample t, n_t = the total number of animals caught in sample t, s_t = the total number of animals released after sample t and R_t = the number of s_t individuals released at sample t and caught again in some later sample.

Z_t = the number of individuals marked before sample t, not caught in sample t, but caught in some sample after sample t.

[2]The estimate of the number of birds in the population (N_t) using the Fisher-Ford Method is

$$N_t = \frac{n_t \alpha_i N_{(i-t)}}{r_{ti}}$$

where n_t = total number of birds in sample at time t, α_i = total number of marked birds released at time i, $N_{(i-t)}$ = survival rate over the time period i-t and r_{ti} = the number of recaptures at time t of animals marked at time i (Southwood 1978).

a certain amount of possible error attached to them. However, it is highly likely that the two populations were between 100 and 300 birds throughout the study. The mean population size at South Blackbutt was estimated to be 247 by the Jolly-Seber Method and 178 by the Fisher-Ford Method. Similarly, the mean population size at North Blackbutt was estimated by the Jolly-Seber Method to be 142 and 131 by the Fisher-Ford Method. At North Blackbutt the population size was probably between 100 and 200 birds during most of the study period but may have approached 300 birds on 18 June 1994 (Table 4). At South Blackbutt, the population size appeared to have fluctuated from between 100 and 300 birds (Table 5).

The proportion of immature and juvenile birds captured was at its highest from May to July in 1994. The breeding season may have begun slightly later at North Blackbutt than at South Blackbutt. There was a statistically significant relationship between the proportions of age classes in the captures and the month of capture at North Blackbutt ($\chi_{12,\ 0.99}$, $p = 8.03 \times 10^{-43}$) (Fig. 1) and South Blackbutt ($\chi_{16,\ 0.99}$, $p = 2.64 \times 10^{-90}$) (Fig. 2).

The percentage of Red-browed Finches surviving to the next age class increased with age (Table 6). Over 80 percent of Red-browed Finches that were captured as adults were captured on more than one occasion. Well over half of the Red-browed Finches that were captured as immature birds were captured again as adults.

DISCUSSION

Both of the populations at Blackbutt Reserve were probably between 100 and 300 birds for most of the study period. The Jolly-Seber population estimates were usually in excess of those of the Fisher-Ford method. Bishop and Sheppard (1973) found that when both methods were applied to data where the survival rate was constant but data were scanty, that the Jolly-Seber method consistently over-estimated population size as compared to both the true values and those obtained by using the Fisher-Ford method. Begon (1979) suggests that when these two methods have been applied to the same data and the Jolly-Seber estimates are consistently greater than those from the Fisher-Ford method that greater reliance should be placed on the Fisher-Ford estimates.

Regardless, the results from the two models basically agreed with each other lending support to the size of the populations estimated. These populations were essentially not mixing, despite the continuous forest between them. At South Blackbutt there was an increase in population during summer 1994–1995, accompanied by a change in the age structure of the population. The surge of juveniles into the population from the 1994–1995 breeding season was probably responsible for this population increase. At North Blackbutt, the more modest population increases may have been the result of a more constant breeding rate over the time of study (Todd 1995). Supporting this was the timing of nesting activity which took place over a longer time period than at South Blackbutt (Todd 1995). This would have provided a relatively steady stream of unbanded young birds into the population over the time of study.

The Red-browed Finches studied at Blackbutt Reserve appeared to have an excellent survival rate. Although adult mortality rates were not calculated due to the short time of study, the results showed that over 80 percent of adults were captured more than once demonstrating survival from one capture session to another. The constant availability of food and water is a possible cause for this. The sedentary nature of the finches in this study and the high retrap rates experienced have not been repeated in other studies of Australian grassfinches, making comparison of survival difficult.

Woinarski and Tidemann's (1992) study of Gouldian Finches *Erythrura gouldiae*, Masked Finches *Poephila personata* and Long-tailed Finches *Poephila acuticauda* in northern Australia, found a very high mortality rate when compared to the Red-browed Finches in this study. It is possible that the harsher environment in northern Australia compared to the temperate east coast of Australia could be the cause. Similarly high mortality rates were estimated by Zann and Runciman (1994) in their study on the Zebra Finch *Taeniopygia guttata*, in northern Victoria. As for the Red-browed Finches at Blackbutt artificial supplies of food and water were available for these birds. Retrap rates of Zebra Finches in Victoria of 53 per cent, 59 per cent and 61 per cent (Zann and Runciman 1994) and in central Australia of 18 percent and 32 percent (Zann *et*

al. 1985) are well below those of more than 80 per cent at Blackbutt Reserve. If it is assumed that the low rate of recapture of the more mobile northern Australian grassfinches was due to high mortality then it can be concluded that the Red-browed Finch populations that were studied at the Blackbutt Reserve had a lower mortality rate than other grassfinch species. However, the great mobility of grassfinches could have caused the low retrap rate in the Woinarski and Tidemann (1992) study and the Zann and Runciman (1994) study and be responsible for the apparently high mortality rate. In both of these studies the authors concluded that the low retrap rates were caused more by emigration than mortality. In populations where emigration is significant or where home ranges are large, the level of mortality can become clouded by marked individuals leaving the population.

The Red-browed Finch populations studied were relatively small (100–300 birds) compared to studies of other grassfinch colonies elsewhere in Australia; for example, 880 and 1 380 for the Gouldian Finch at two sites in the Northern Territory (Woinarski and Tidemann 1992). They also were significant in possessing a high survival rate. The reasons for these population characteristics may be the partial isolation of the Blackbutt Reserve within urban areas and the constant availability of food and water, reducing the need and opportunity for emigration.

ACKNOWLEDGMENTS

This research was carried out as part of a Bachelor of Science with Honours Degree at the University of Newcastle. It was funded by an Environmental Research Grant from the Lake Macquarie City Council. The Australian Bird and Bat Banding Scheme provided bands and permission was given for this study by the Australian Nature Conservation Agency and the University of Newcastle Ethics Committee. I would like to acknowledge the support of my supervisors, Associate Professor R. C. Jones and Dr K. Myers. Dr B. C. Conroy helped with the population size estimations and G. Holmes kindly provided advice on draft copies of this manuscript. The field work relied heavily on the mist netting expertise of D. Geering.

REFERENCES

Begon, M. (1979). 'Investigating Animal Abundance: Capture-Recapture for Biologists.' (Edward Arnold: London.)

Bishop, J. A. and Sheppard, P. M. (1973). An evaluation of two capture-recapture models using the technique of computer simulation. In 'The Mathematical Theory of the Dynamics of Biological Populations' Eds. (Bartlett, M. S. and Hiorns, R. W.) (Academic Press: London and New York.)

Blower, J. G., Cook, L. M. and Bishop, J. A. (1981). Estimating the Size of Animal Populations. (George Allen and Unwin. London.) Pp. 58–61.

Burton, T. C. (1996). Changes in the abundance of silvereyes in a central Victorian vineyard during the grape ripening period. *Corella.* **20(2):** 61–66.

Christidis, L. (1987). Phylogeny and systematics of estrildid finches and their relationships to other seed-eating passerines. *Emu* **87:** 119–123.

Dettman, E. B. (1995). Use of the Jolly-Seber model to detect variation in survival, population size and recruitment of Bridled Honeyeaters at Paluma, Queensland. *Corella* **19:** 61–67.

Krebs, C. J. (1989). 'Ecological Methodology'. (Harper and Row. New York.) Pp. 399–404.

Rogers, K., Rogers, A. and Rogers, D. (1986). 'Bander's aid: a guide to ageing and sexing bush birds'. (St Andrews, Victoria: Rogers, A.)

Southwood, T. R. E. (1978). 'Ecological Methods, with Particular Reference to Insect Populations'. (Chapman and Hall. London.) Pp. 102–103.

Todd, M. K. (1995). The ecology of the Red-browed Finch, *Neochmia temporalis* in an urbanized environment. (Honours Thesis, The University of Newcastle.)

Woinarski, J. C. Z. and Tidemann, S. C. (1992). Survivorship and some population parameters for the endangered Gouldian Finch, *Erythrura gouldiae* and two other finch species at two sites in tropical northern Australia. *Emu* **92:** 33–38.

Yom-Tov, Y., McCleery, R. and Purchase, D. (1992). The survival rate of Australian passerines. *Ibis* **134:** 374–379.

Zann, R. and Runciman, D. (1994). Survivorship, dispersal and sex ratios of Zebra Finches, *Taeniopygia guttata* in south-east Australia. *Ibia* **136:** 136–146.

Zann, R. A., Morton, S. R., Jones, K. R. and Burley, N. T. (1995). The timing of breeding by Zebra Finches in relation to rainfall in central Australia. *Emu* **95:** 208–222.