Population futures in the Australian desert, 2001–2016

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Abbreviations and acronyms

ABS	Australian Bureau of Statistics
AGPS	Australian Government Publishing Service
ANU	The Australian National University
ARIA	Accessibility/Remoteness Index of Australia
ASFR	age-specific fertility rate
ASGC	Australian Standard Geographical Classification
CAEPR	Centre for Aboriginal Economic Policy Research
CAT	Centre for Appropriate Technology
CHINS	Community Housing and Infrastructure Surveys
CRC	Cooperative Research Centre
ERP	estimated resident population
GIS	Geographic Information System
LGA	Local Government Area
NARU	North Australia Research Unit
NPY	Ngaanyatjarra–Pitjantjatjara–Yakuntjatjara (Women's Council)
QCPR	Queensland Centre for Population Research
RC	Rural City
SD	Statistical Division
SLA	Statistical Local Area
SSD	Statistical Sub Division
TFR	total fertility rate

Summary

A proposal to establish a Desert Knowledge Cooperative Research Centre (CRC), focused on Alice Springs, has recently been submitted. Fundamental to any such proposal is an understanding of population dynamics in the desert region, because demographic information provides for assessment of the quantum of need in social and economic policy, and for assessment of the impact of that quantum in environmental policy. Ultimately, what is sought is a predictive capacity for planning and evaluation.

This paper arose out of partnership discussions between the Centre for Appropriate Technology (CAT) and Rio Tinto who commissioned the author to prepare Indigenous population projections for the desert region to 2016 and compare these with projections for the total population of the same region. The focus for this analysis is the Australian arid zone which lies approximately within the 250mm rainfall isohyet. It includes 45 per cent of the Australian land mass and a population, as at 1996, of 179,000, or 0.9 per cent of the Australian total.

Overall, the total population of the desert region is projected to increase by 10,402 between 2001 to 2016, from 179,028 to 189,430. This represents an increase of 5.8 per cent, or an average annual growth rate of 0.4 per cent, which is around half the rate projected for the Australian population as a whole over the same period (12.9%, or 0.8% per annum). Thus, while the desert region is one of relatively low population growth in national terms, it is significant to note that growth is positive. This is contrary to the experience of many parts of non-metropolitan Australia in recent years.

One trend matching that observed more generally across non-metropolitan areas is the markedly different growth implied for the Indigenous and non-Indigenous components of the desert population, with the former rising much more rapidly over time. In effect, and given an assumption of zero net migration, it is likely that virtually all of the increase in the desert population over the next 15 years will arise from natural increase among Indigenous peoples. As a consequence, the Indigenous share of the total desert population is projected to increase from 20.5 per cent in 2001 to 23.7 per cent in 2016.

In 2001, there were an estimated 7,003 Indigenous youth aged 15–24 years in the transition years between school and work. By 2016 this number is estimated to be greater by almost 1,400, or 20 per cent. By far the largest increase in Indigenous numbers, however, emerges in the years of prime working age. In 2001, there were 15,644 individuals aged between 25 and 64 years. By 2016, this group will have increased by more than 5,000, or 34 per cent. Thus, the ascendant issues for social planning in the desert region clearly derive from needs generated by expanding numbers in the prime working-age groups. For the Indigenous population, this is especially true of those in the older working-age group (45–64), due to the ageing of cohorts that were in the 20–39 years age-range in the mid 1990s.

Presently, the data and analytical tools for regional demographic analysis are both crude and blunt. The opportunity to refine and sharpen these is enhanced by the focus on a single ecological zone; this brings an internal consistency to the analysis of social systems, with prototype implications for regional analysis more generally.

Acknowledgments

This paper is based on research commissioned by Rio Tinto and the Centre for Appropriate Technology in support of a consortium submission for the establishment of a Desert People Centre and a Desert Knowledge CRC in Alice Springs. Particular thanks are due to Bruce Harvey, Janina Gawler, and Bruce Walker for their support. Andrew Howe of the ABS assisted with the provision of small area population estimates, while Trevor Imhoff smoothed the path towards the acquisition of CHINS data. Thanks are also due to Carl-Johan Rohlin of the Queensland Centre for Population Research (QCPR) at the University of Queensland for the preparation of maps. A version of this paper was presented at a public seminar held in March 2002 at the Centre for Appropriate Technology in Alice Springs and the comments of participants were helpful in redrafting. Useful feedback was also received from Professor Jon Altman of CAEPR, and the choice of demographic techniques has been greatly assisted by prior collaboration with Martin Bell of QCPR. As always, the final product is greatly enhanced by editorial input from Frances Morphy, and layout by Wendy Forster.

Introduction

A proposal to establish a Desert Knowledge Cooperative Research Centre (CRC) focused on Alice Springs has recently been submitted (for details, see http://www.desertknowledge.com.au/). Interest in such an initiative stems from a recognition that Australian desert regions display unique social, economic and environmental characteristics that raise particular challenges in terms of creating sustainable livelihoods. Four broad research themes have been identified. Fundamental to each of these is an understanding of population numbers, characteristics, distribution and change. This is because demographic information provides for assessment of the quantum of need in social and economic policy, and for assessment of the impact of that quantum in environmental policy. Ultimately, what is sought is a predictive capacity for planning and evaluation.

With these tasks in mind, I was commissioned to develop estimates and projections of Indigenous and total populations resident within an ecological zone defined as the Australian desert. This arrangement arose out of partnership discussions between the Centre for Appropriate Technology (CAT) and Rio Tinto. The aim was to generate background information and to explore the scope for demographic analysis within the desert region in order to support a submission by CAT and others in the consortium bid for establishment of the Desert Knowledge CRC. The specific terms of reference were:

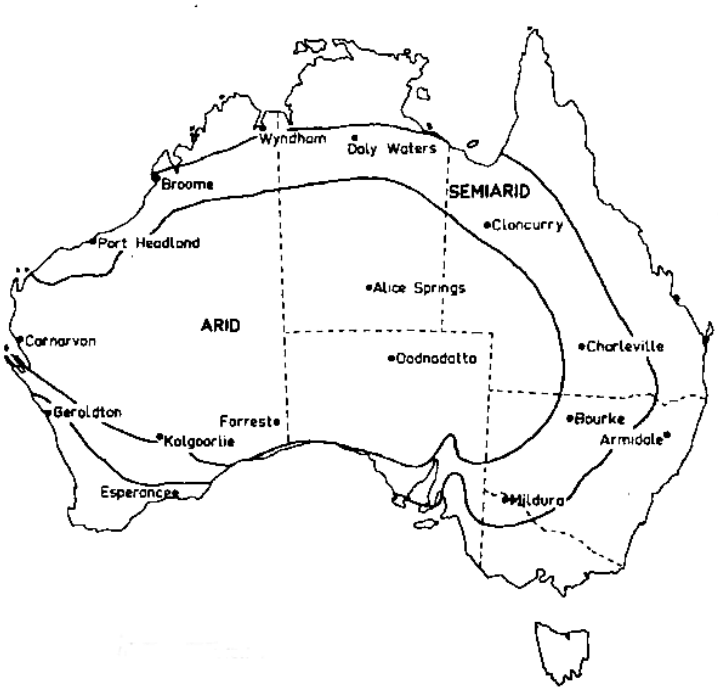
> To prepare Indigenous population projections for the desert region to 2016 and compare these with projections for the total population of the same region.

Where is the desert?

Fundamental to any regional demographic analysis is a clear demarcation of spatial boundaries. For the present exercise, this requires a definition of the desert region. However, no single definition exists and much depends on the criteria used. No doubt deliberations on this definition would form a key component of CRC-based research. In the meantime, conventional botanical and climatic definitions of arid or desert lands according to the classifications of Koppen and Thornthwaite have been selected (Heathcote 1983: 16). In Australia this describes a region that lies approximately, though not entirely, within the 250mm isohyet (Brown 1984: 254; Cogger 1984: 236; Murrell 1984: 338). The area covered is indicated in Fig. 1.

The point to note here is that this excludes the area defined as semi-arid lands which lie approximately, though not exclusively, between the 250mm and 500mm isohyets.[1] Inclusion of these semi-arid lands would lead to a much broader conceptualisation of the desert region, extending as far north as Wyndham in the Kimberley region and the Roper Valley in the Northern Territory, as far east as the slopes of the Great Dividing Range in Queensland and New South Wales, as far south as the Murray and Mallee in Victoria, and south west to the edge of the wheat belt in Western Australia.

Fig. 1. Location of arid and semi-arid zones

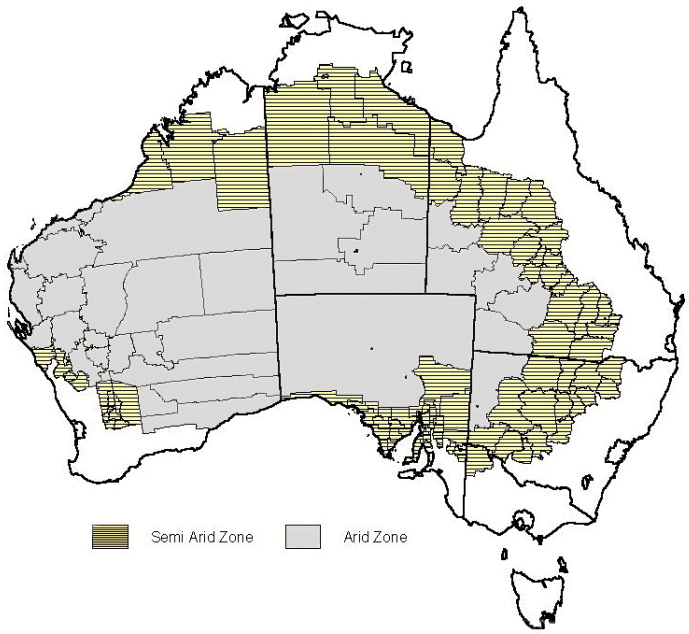


Source: Brown 1994: 254.

Since the outer bounds of this wider region begin to merge with more closely settled agricultural lands, zonal delineation is less obvious than in the case of the arid zone, in the absence of more detailed criteria and data for selection. Thus, the focus for demographic analysis is on the arid zone only, or the 'desert proper'. An extension of this analysis to the semi-arid zone would be an obvious initial task for the proposed CRC.

As far as demographic analysis of these regions is concerned, a key question is whether there are Australian Bureau of Statistics (ABS) statistical units that are spatially coincident. The answer is that there are ABS units that co-incide almost exactly, which is a gratifying comment on the sensitivity of ABS geography to Australian settlement patterns, and the links between these and environmental boundaries. In short, a prototype desert region can be described statistically (Fig. 2), and the units of the Australian Standard Geographical Classification (ASGC) selected to provide for this are listed in Tables 1 and 2. Of course, this delineation of zones of aridity by statistical unit is experimental only, and the units included could, and probably should, be varied at the edges on the basis of research using more precise environmental and socioeconomic parameters.

Fig. 2. ASGC spatial units in the arid and semi-arid zones



Source: ABS 2000c.

Table 1. ASGC spatial units in the arid zone

	ASGC unit
Northern Territory	Petermann SLA, Alice Springs LGA, Tanami SLA, Sandover Balance SLA, Tennant Creek Balance SLA, Tennant Creek SLA
Queensland	Boulia SLA, Bulloo SLA, Barcoo SLA, Diamantina SLA, Quilpie SLA
New South Wales	Unincorporated Far West SLA, Broken Hill SLA
South Australia	Unincorporated Far North SLA, Coober Pedy SLA, Roxby Downs SLA
Western Australia	Exmouth SLA, Carnarvon SLA, Upper Gascoyne SLA, Wiluna SLA, Meekathara SLA, Laverton SLA, Leonora SLA, Kalgoorlie-Boulder SLA, Coolgardie SLA, Ngaanyatjarraku SLA, Dundas SLA, Menzies SLA, Sandstone SLA, Mt Magnet SLA, Cue SLA, Yalgoo SLA, Murchison SLA, Shark Bay SLA, East Pilbara SLA, Port Hedland SLA, Roebourne SLA, Ashburton SLA

Table 2. ASGC spatial units in the semi-arid zone

	ASGC unit
Northern Territory	Lower Top End SSD, Tableland SLA
Queensland	Burke SLA, Mount Isa SLA, Cloncurry SLA, McKinlay SLA, Richmond SLA, Flinders SLA, Winton SLA, Longreach SLA, Aramac SLA, Ilfracombe SLA, Isisford SLA, Blackall SLA, Barcaldine SLA, Tambo SLA, Paroo SLA, Murweh SLA, Booringa SLA, Bungil SLA, Roma SLA, Bendemere SLA, Bungil SLA, Warroo SLA, Balonne SLA
New South Wales	North Central Plain SSD, Macquarie-Barwon SSD, Lachlan SLA, Upper Darling SSD, Central Darling SLA, Murray-Darling SSD, Carrathool SLA, Hay SLA
Victoria	Mildura (RC) – Pt. A SLA, Mildura (RC) – Pt. B SLA
South Australia	Unincorporated Riverland SLA, Yorke SSD, Eyre SD, Whyalla SSD, Pirie SSD, Flinders Ranges SSD, Wakefield SLA, Loxton-Waikerie East SLA
Western Australia	Campion SSD, Perenjori SLA, Mullewa SLA, Morawa SLA, Northampton SLA, Halls Creek SLA, Fitzroy SSD

In area, the arid zone covered by these ASGC spatial units amounts to 3.5 million km^2, or 45 per cent of the Australian land mass. If the units in the semi-arid zone were to be included as part of the definition of the desert region this would add a further 1.79 million km^2, bringing the total area to approximately 5.3 million km^2, or 69 per cent of the Australian land mass.

According to ABS estimates, in 2001 the total usual resident population of the ASGC spatial units within the arid zone was 179,000, or 0.9 per cent of the Australian total (ABS 2002). In the semi-arid zone it was 394,000, or 2.0 per cent of the Australian total (ABS 2002). Overall, then, combining the two zones, the maximum population resident in the region of interest to a Desert Knowledge CRC is estimated to be 573,000, or almost 3.0 per cent of the Australian total.

In terms of overall population density, these figures convert to 0.05 persons per km^2 in the arid zone, and 0.22 persons per km^2 in the semi-arid zone. It should be noted that these calculations are based only on the usually resident population. At any given time, the desert region also caters for large numbers of temporary sojourners, mostly tourists, but also specialist groups such as fly-in/fly-out workers. Estimation of these numbers forms an important component of any comprehensive demography of the region, and is increasingly recognised as a crucial component of regional population analysis (Bell & Ward 1998a, 1998b, 2000).

Population trends in remote Australia

Reference to 'remote' Australia is long-standing in regional analysis. Essentially, the term draws attention to a distinction in social and economic geography between closely settled areas and sparsely settled areas, with economic development and service provision severely impeded in the latter by force of relative locational disadvantage, low accessibility, and a specialisation of economic activity (Faulkner & French 1983; Holmes 1988; Hugo 1986; Logan et al. 1975: 64).

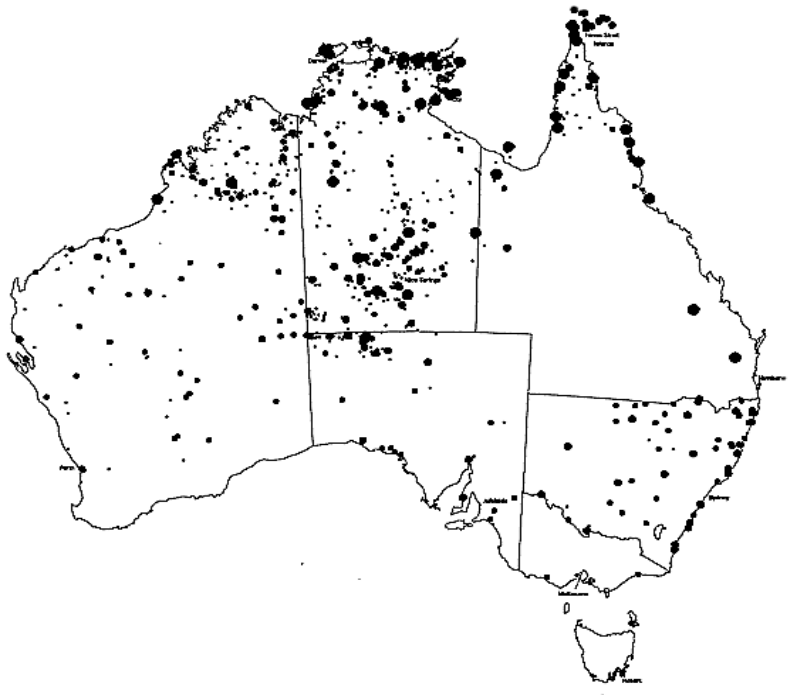
Not surprisingly, the arid zone defined here falls entirely within the remote and very remote categories of the Remoteness Structure within the ASGC (ABS 2000a). The ASGC is constructed on the basis of scores from the Accessibility/Remoteness Index of Australia (ARIA) which, in turn, are derived from measures of road distance from any point to the nearest town (service centre) in each of five population size classes.[2] In this calculation, the population size of service centres is used as a proxy measure of the range of services available, and road distance is used as a proxy for the degree of remoteness from those services (ABS 2001a, 2001b). Thus, the Remoteness Structure provides a summary measure of the degree to which the population of a given locality is restricted in its physical access to the widest range of goods and services and opportunities for social interaction (ABS 2001b: 19). Within the structure, remote and very remote areas are those where such physical access is minimised.

It is worth noting the parallels with the historic distinction drawn between 'colonial' and 'settled' Australia in recognition of the much higher proportions of Indigenous people in remote areas, and the somewhat different manner of their incorporation into wider social and economic structures (Rowley 1971). Indeed, away from the larger mining towns and service centres of the outback, it is possible to talk of Indigenous 'domains' in the sense that Indigenous people and their institutions predominate.

In recent years, moreover, there has been a substantial transfer of land back to Aboriginal ownership and stakeholder interest across the desert region, with the prospect of more to come via land purchase and native title claims (Pollack 2001). This land transfer is an important element of the post-productivist transition in Australia's rangelands (Holmes 2002), and newly recognised land values often lie outside the market economy, being more culturally-based. These values are manifest in the emergence of a distinct settlement structure on Aboriginal lands involving the formation of numerous, dispersed, small, and discrete Indigenous communities across the arid and semi-arid zones, especially in the Northern Territory, Western Australia and the far north of South Australia (Cane & Stanley 1985) (and see Fig. 3). This provides for quite different residential settings for Indigenous and non-Indigenous populations in the desert region. Thus, in 1996, only 26 per cent of desert Indigenous people were resident in the four major urban centres of the arid zone—Alice Springs, Port Hedland, Kalgoorlie and Broken Hill. By contrast, these towns accounted for as much as 55 per cent of the non-Indigenous desert residents.

In ABS parlance, discrete communities are defined as geographic locations that are bounded by physical or cadastral boundaries, and inhabited or intended to be inhabited predominantly by Indigenous people (more than 50 per cent), with housing and infrastructure that is either owned or managed on a community basis (ABS 2000c: 66). Such communities represent Indigenous living areas formerly constituted as government and mission settlements, or reserves. They also include special purpose lease areas within towns, as well as excision communities on pastoral stations. Most, if not all, of these communities were established for the purpose of administering Aboriginal welfare policies, or simply as camping areas removed from white society. As such, they required no modern economic base, nor have they subsequently acquired one, at least not in a manner that is presently sustainable beyond the provisions of the welfare state. The opportunity to describe the distribution of such places in detail is now available from the 1999 and 2001 ABS Community Housing and Infrastructure Needs Surveys (CHINS) (ABS 2000b) which identify the size (by estimated service population) of discrete Indigenous communities across the desert region, although analysis of this data for the ASGC-defined desert region would require initial file matching.

Fig. 3. Distribution of discrete Indigenous communities



Note: The largest dots indicate 500 persons or more; the smallest dots indicate fewer than 50 persons
Source: ABS 2000b.

In the latter decades of the twentieth century, demographic trends in remote Australia have been volatile, with significant consequences for research activities

focused on the desert region. From 1981, the Indigenous share of the remote area population rose steadily from 12 per cent to almost 20 per cent in 1996 as a consequence of differential population dynamics (Taylor 2000). This has occurred because the Indigenous population is much younger in age profile, and has experienced a much higher rate of natural increase than the population in general. It is also because many Indigenous people in remote areas reside close to their ancestral homes, and their attachment to such places is reflected in a relative lack of net out-migration (Gray 1989; Taylor 1992; Taylor & Bell 1996, 1999). This contrasts with the historically more recent and ephemeral non-Indigenous settlement of the outback with, in recent decades, generalised out-migration leading to population decline in many non-metropolitan districts (ABS 2002; Bell 1992b, 1995; McKenzie 1994). Since 1981, the Indigenous population in remote areas of Australia has grown by 23 per cent. By contrast, since 1986, non-Indigenous population growth has been negative (Taylor 2000).

These demographic trends are significant given that one of the apparent transformations of the Indigenous population in the second half of the twentieth century was a shift in the balance of continental geographic distribution away from remote and rural areas in favour of urban and metropolitan centres, and consequently towards the south and east of the country. Over the longer term, this process may be viewed as an effect of the European settlement of Australia—the original dispersed distribution of Indigenous peoples broke down as individuals and families moved, or were moved, into government and mission settlements, reserves, towns and cities. Over the shorter term, it is not clear whether demographic or sociological processes are more responsible for this redistribution, nor indeed just how much redistribution has actually occurred. The indication from census analysis since the mid 1970s is that increased identification in census counts, and not net in-migration, has been the greater contributor to regional population shifts in favour of the more urbanised south and east of the country (Gray 1989; Taylor 2000).

Indeed, the only study to date that has attempted to measure the extent to which Indigenous people have relocated from sparsely settled to more closely settled areas found no evidence of a net shift (Taylor 1992). This is not to say that Indigenous people within the arid zone are immobile; quite the contrary. What it does indicate, though, is that such mobility as does occur (and this is considerable) takes place predominantly within the desert region (Warchivker, Tjapangati & Wakerman 1999; Young & Doohan 1989). To this extent, the desert may be viewed as a vast arena for Aboriginal social interaction.

Against this broad background, the present study aims to establish population trends within the desert region, and to consider their consequence for future demographic profiles. The first part of the paper provides a background rationale for the development of regional population estimates based on best-practice regional and local area planning. This is followed by a presentation of the results of population projections for the Indigenous and total populations of the desert region. The final section considers the implications, options, and requirements for CRC-based population research.

Population projections and regional planning

An essential component of community capacity building and regional planning is an ability to benchmark, plan for, and monitor change in social and economic conditions among targeted populations (Taylor 2001b). To date, such benchmarking and assessment of the quantum of need in remote desert communities has been facilitated by population data from the five-yearly Census of Population and Housing, as well as to a lesser extent from a variety of administrative data and sporadic surveys.

From a planning perspective, the interval between census enumerations means that population data, especially small area data, can rapidly become dated. There are also concerns about the accuracy of base year populations in terms of enumeration coverage. Data from administrative sources, on the other hand, are often ad hoc and lacking in standard definitions and methods of acquisition, thus raising questions about their reliability for planning purposes. This lack of timeliness and quality in the data is exacerbated by the fact that community populations tend to experience high rates of natural increase and high rates of population turnover. In short, remote community populations are very dynamic, and existing sources of demographic information are often poorly suited to servicing their detailed planning needs.

Inadequacies of this kind in the data present a challenge for regional planners. The translation of the content and intent of regional plans into a required quantum of program commitments over a given period requires a proactive methodology which seeks to anticipate and plan for expected requirements. The basis for such a methodology is population projections, and these have only just begun to emerge for Indigenous populations at the regional level (Taylor 2001a; Taylor & Bell 2002a). For the general population, however, approaches to settlement planning have long been more prospective.

For example, State and Local government planning authorities routinely develop future population scenarios and often seek budgetary allocations on the basis of anticipated needs. A key element in this process is the production of small area population projections or forecasts (Howe 1999). While the ABS provides official projections of State, Territory, Local Government Area (LGA) and Statistical Local Area (SLA) populations (ABS 2000c), individual States and Territories also produce regional and local area projections, down to LGA level or below (Bell 1992a). These are made using a wide range of demographic models and techniques (Bell 1997), but share a common goal of endeavouring to provide realistic assessments of the likely future size, composition and distribution of population.

Thus, for the SLAs contained within the desert region, detailed estimates and projections by five-year age-group and sex to from 1999 to 2016 already exist for the total population (ABS 2000c), and these are utilised here. ABS estimates of Indigenous populations in the same SLAs are also available (at least for 1996), but projections are not. The main purpose of the present exercise, then, is to

produce Indigenous population projections for these SLAs and, by so doing, to provide the first estimates and projections of the Indigenous and total populations for an ecological zone referred to as the Australian desert.

Projecting the Indigenous population of the desert

There are no formally accepted rules or procedures for demographic projection. Rather, there exists a large body of professional literature which is concerned with the computation of future populations and which collectively contains a set of guidelines that are generally accepted as representing good projection practice. Among these is the principle, supported by empirical evidence, that the accuracy of projections diminishes with the length of the projection period (Bell 1992a; Smith & Sincich 1991). It is also well established that projections for large populations are more reliable than projections for small populations (Keyfitz 1981).

Partly for such reasons, official projections of Indigenous populations in Australia have only ever been publicly available for large geographic areas (States and Territories), and never at sub-regional levels (ABS 1998b). Also, they have only ever been officially prepared for relatively short time periods (10 years) compared to the 50- and even 100-year periods often applied to the general population (ABS 2000c). While these observations do not preclude the development of Indigenous population projections at the regional level, and for longer time periods, they nonetheless attest to the innovative nature of the present attempt to do so.

The cohort component method of projection represents accepted best practice in the field; it is the method used routinely by national statistical agencies worldwide, by international organisations such as the United Nations Organisation, and by all State government forecasting agencies in Australia. It is based on the recognition that age structure is an important element of the dynamics of population change, having pronounced effects on the projection of future births because of shifts in the number of women of child-bearing age, and because of sex differentials in mortality and net migration. Obviously, then, a prerequisite for the development of regional projections based on this method is the availability of data on the components of population change by age and sex. In particular, the following are required for the geographic area of interest:

- an estimated resident population (ERP) by sex and five-year age-group for the base year;
- age-specific fertility rates (ASFRs) for the female population of child-bearing age;
- the sex ratio at birth;
- age- and sex-specific mortality rates for the whole population; and
- age- and sex-specific net migration rates for the whole population.

Data providing for all of these measures are available for the Indigenous population in 1996 at SLA or State/Territory level. Thus, any problems that arise concerning the feasibility of constructing Indigenous regional population

projections, or in regard to the reliability of projection results, rest ultimately in the accuracy of these data. Indeed, much of the analytical effort expended in constructing population projections is directed towards data verification and building credible assumptions about plausible future demographic rates.

All of the SLAs within the desert region are located within parts of the continent where the accurate recording of demographic variables is rendered difficult by large statistical boundaries, small and dispersed populations, frequent short-term population movement, relatively low levels of literacy and numeracy, and some incompatibility between ABS enumeration procedures and Indigenous cultural forms. As a consequence, it is fair to say that there continue to be concerns about the accuracy of demographic information pertaining to the Indigenous population (Martin & Taylor 1996; Taylor 1993). Clearly, one of the more important research tasks for a Desert Knowledge CRC would be to validate and seek improvement to information systems for desert demography.

Projection assumptions

Selection of the appropriate fertility, mortality (survival) and net migration rates to apply to each cohort of the base population is a key step in the application of cohort component projections. Problems of data quality and reliability are intrinsic to all demographic analysis and projection activity, but are especially acute in the case of the Indigenous population. While data quality issues must be constantly borne in mind, population forecasting is ultimately the art of the possible. Analysis must inevitably proceed with the data that are available, though careful analysis of these data is required in setting projection parameters.

Vital rates

Conventional practice in small area population forecasting suggests that State/Territory-level deaths data are most suited for projection purposes, whereas for births, data based on the local area (SLA) may be applied. In calculating ASFRs for the present projection, the approach taken was to group the births recorded in individual SLAs to create aggregate rates for the whole desert region. This produced a 1996 Indigenous Total Fertility Rate (TFR) for the desert region of 2.6 (Table 3).

Survival rates are drawn from State/Territory level data, and some decision is required as to which jurisdictional figures best apply to the desert region. A similar decision was needed in preparing population projections for the area serviced by the Ngaanyatjarra–Pitjantjatjara–Yankunytjatjara (NPY) Women's Council which straddles borders of the Northern Territory, Western Australia and South Australia (Taylor 2001a). For this area, rates based on ABS 1995–97 Indigenous abridged life tables for the Northern Territory (ABS 1998a) were found to be most applicable, as might be expected for such a remote population: data for South Australia and Western Australia reflect more urbanised populations. Given that social, cultural, and economic conditions for Indigenous people

throughout the desert region are arguably similar to those prevailing in the NPY region, the same logic is applied here, and age-specific survival ratios are drawn from these same Indigenous life tables for the Northern Territory. Furthermore, these are held constant for the projection period, in line with evidence that life expectancy for Indigenous people in recent times (1986–91 and 1991–96) improved only slightly in the Northern Territory and showed signs of decline in South Australia, Western Australia, Queensland and New South Wales (Gray 1997: 12).

Net migration

Migration is the most troublesome of the components of population change because it can substantially impact on local population growth, yet it is difficult to acquire reliable data. Nonetheless, in using a cohort component methodology it is necessary to derive a set of net migration rates (balance of in-movements and out-movements) by age and sex. If reliable data prove elusive then it is advisable to set net migration to zero. In this event, any projection would reflect population change due to natural causes only.

While data on inter-SLA population movement are available from the census, these are incomplete due to under-enumeration and age selectivity. Concerns have also been raised about the gap between empirically observed high mobility and low census-derived rates in remote areas (Taylor & Bell 1996). The alternative option of calculating indirect estimates of migration for each SLA using vital rates is not taken up here for reasons of poor data quality. In the absence of this input, net migration is set to zero in the projection (Table 3), and the only population growth assumed is that due to natural increase. This is not to suggest that migration into and out of the desert region does not occur; it is simply assumed for the purposes of projection that such movement as does occur is in balance. Ideally, improvement in local area demographic statistics, including migration, would be a focus of ongoing research in a Desert Knowledge CRC.

Table 3. Summary of Indigenous projection assumptions

Component	Assumption
Fertility	SLA births aggregated to desert region. 1996 TFR 2.6
Mortality	Northern Territory survival ratios 1995-97 held constant
Net migration	Zero at all ages

The actual projection is conducted separately for males and females in five-year blocs to 2016 using 1996 population estimates as the base year. Projected births for the 1996–2001 period are added to the existing 1996 population and each cohort is then subjected to respective survival rates to arrive at an estimate of the population in each age-group in 2001. This process is continued through to 2016. The results in terms of the size and age structure of the Indigenous and total populations at each five-year interval are summarised in the next section.

Projection results

Population totals at the end of each five-year period are shown in Table 4 together with the percentage change in population between 2001 and 2016. Fig. 4 displays the same data graphically, and adds a third 'non-Indigenous' population figure as the residual of the other two.

Overall, the total population of the desert region is projected to increase by 10,402 between 2001 to 2016, from 179,028 to 189,430. This represents an increase of 5.8 per cent, or an average annual growth rate of 0.4 per cent, which is around half the rate projected for the Australian population as a whole over the same period (12.9%, or 0.8% per annum). Thus, while the desert region is one of relatively low population growth in national terms, it is significant to note is that growth is positive. This is contrary to the experience of many parts of non-metropolitan Australia in recent years (ABS 2002; Bell 1992b, 1995; McKenzie 1994).

One trend that does appear to match that observed more generally across non-metropolitan areas is the markedly different growth implied for the Indigenous and non-Indigenous components of the desert population, with the former rising much more rapidly over time. In effect, and given the assumption of zero net migration in the projection, it is likely that virtually all of the increase in the desert population over the next 15 years will arise from natural increase among Indigenous peoples. As a consequence, the Indigenous share of the total desert population is projected to increase from 20.5 per cent in 2001 to 23.7 per cent in 2016.

The note of caution here reflects the fact that the category of 'non-Indigenous' population change is calculated by subtracting Indigenous estimates from those for the total population. Given that the assumptions underlying the development of estimates for the Indigenous and total populations are inevitably quite different, the creation of a residual (non-Indigenous) population in this way is statistically problematic. Any estimation and projection of a 'non-Indigenous' population would need to be guided by its own unique underlying assumptions, and the development of these is beyond the scope of the present exercise. Indeed, the social construction of such a population raises questions as to whether it is statistically possible at all.

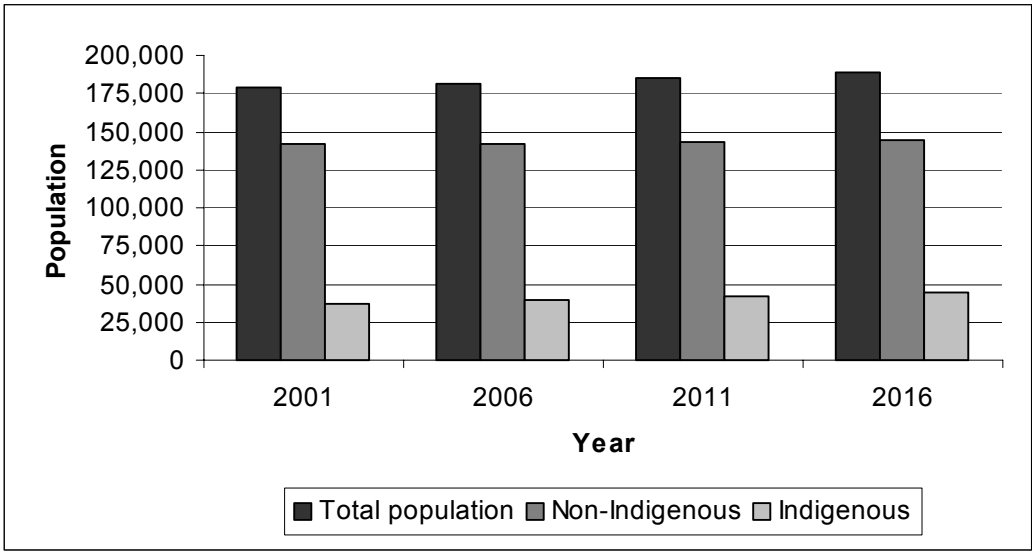
CRC research could nevertheless usefully explore mechanisms for monitoring differential components of population change among Indigenous and non-Indigenous residents of the desert region. These subgroups display quite different socioeconomic and cultural dispositions. Employment, mostly in pastoralism, mining and the services sector, remains a key reason for non-Indigenous residence in outback regions, and net migration trends in such areas have been shown to be highly sensitive to changes in prevailing economic conditions (Bell & Maher 1995; Taylor 1989). By contrast, Indigenous residents are less responsive in this way to market stimuli, partly as a consequence of their marginal

attachment to the labour market (Taylor & Roach 1998), but also because of their cultural attachment to country (Taylor 1999; Young & Doohan 1989).

Table 4. Projected total and Indigenous populations in the Australian desert, 2001–2016

	2001	2006	2011	2016	Numeric change 2001–2016	% change 2001–2016
Total population	179,028	181,514	185,436	189,430	10,402	5.8
Indigenous	36,671	39,322	42,116	44,905	8,228	22.4

Fig. 4. Projected total, Indigenous and implied non-Indigenous populations in the Australian desert, 2001–2016



Change in demographic composition

Detailed results of the projections for the total and Indigenous populations of the desert are shown in Appendix 1 in Tables A1 and A2, by sex and five-year age-group for each five-year period between 2001 and 2016. As a summary device, it is interesting to consider these changes in demographic composition in terms of age groups that typically form the target of social policy initiatives, at least as far the five-year classification allows. These are shown in Tables 5–8 for the total and Indigenous populations. They include the infant and pre-school years (0–4 years), the years of compulsory schooling (5–14 years), the years of school-to-work transition (15–24 years), the years of family formation and employment (25–44 years), the years of family dissolution (45–64 years), and an aged category of

those over 65 years (which arguably in an Indigenous context could be set at a much earlier cut-off point).

The effects of population momentum and overall ageing are clearly visible in these tables. Population momentum refers to the movement of larger, or smaller, cohorts up the age structure, replacing their smaller (or larger) predecessors. The sheer weight of such momentum inherent in the original populations of young adult and middle-aged people is manifest in the growth of older working-age numbers by 2016. In 2001, 24 per cent of the total desert population was over the age of 45 years; by 2016, this figure will have risen to 29 per cent. The reduction in percentage share occurs among children, with the proportion of those aged less than 15 years set to decline from 25 per cent in 2001 to 22 per cent in 2016.

Table 5. Absolute and per cent change in the size of social policy target groups: total population of the desert, 2001–2016

Age-group (years)	2001	2016	Absolute change	% change
0–4	15,192	14,256	-936	-6.2
5–14	29,162	26,544	-2,618	-9.0
15–24	25,890	26,621	731	2.8
25–44	65,614	66,605	991	1.5
45–64	33,364	41,730	8,366	25.1
65+	9,806	13,674	3,868	39.4
Total	179,028	189,430	10,402	5.8

Much of the underlying dynamic here is to be found among the Indigenous population (Table 6). In 2001, there were 7,003 Indigenous youth aged 15–24 years in the transition years between school and work. By 2016 this number is estimated to be greater by almost 1,400, or 20 per cent. By far the largest increase in Indigenous numbers, however, emerges in the years of prime working age. In 2001, there were 15,644 individuals aged between 25 and 64 years. By 2016, this group will have increased by more than 5,000, or 34 per cent. Thus, the ascendant issues for social planning in the desert region clearly derive from needs generated by expanding numbers in the prime working-age groups. For the Indigenous population, this is especially true of those in the older working-age group (45–64), due to the ageing of cohorts that were in the 20–39 years age-range in the mid 1990s.

Increase in the Indigenous school-age population appears far more subdued, although given the negative growth projected for the total population aged under 15 years it seems likely that the educational needs of Indigenous children will loom larger, proportionally, over time. As for the elderly (over 65 years), the effects of much higher Indigenous adult mortality appear evident, with substantially lower growth than for the total population.

Table 6. Absolute and per cent change in the size of social policy target groups: Indigenous population of the desert, 2001–2016

Age-group (years)	2001	2016	Absolute change	% change
0–4	4,156	4,985	829	19.9
5–14	8,787	9,161	374	4.2
15–24	7,003	8,390	1,387	19.8
25–44	11,337	13,807	2,470	21.8
45–64	4,307	7,201	2,894	67.2
65+	1,082	1,362	280	25.9
Total	36,671	44,905	8,234	22.4

Table 7. Percentage distribution of the total population of the desert by social policy target groups, 2001 and 2016

Age-group (years)	2001	2016
0–4	8.5	7.5
5–14	16.3	14.5
15–24	14.5	14.0
25–44	36.6	35.1
45–64	18.6	22.0
65+	5.5	7.2
Total	100.0	100.0

Table 8. Percentage distribution of the Indigenous population of the desert by social policy target groups, 2001 and 2016

Age-group (years)	2001	2016
0–4	11.3	11.1
5–14	24.0	20.4
15–24	19.1	18.7
25–44	30.9	30.7
45–64	11.7	16.0
65+	2.9	3.0
Total	100.0	100.0

Although the projections point to slower growth in school-age and young adult populations, it is difficult to be certain about the changing profiles of these age groups as they are highly susceptible to possible shifts in fertility rates. School participation outside the region and migration for jobs and training are also unpredictable variables among these typically mobile cohorts. Much greater

certainty, however, surrounds the size and age composition of the adult population aged over 25 years. On the whole, these individuals are already resident within the region and, compared to their non-Indigenous counterparts, are invariably located close to home country and less likely to migrate.

Fig. 5. Age pyramids for the Indigenous population of the desert, 2001 and 2016

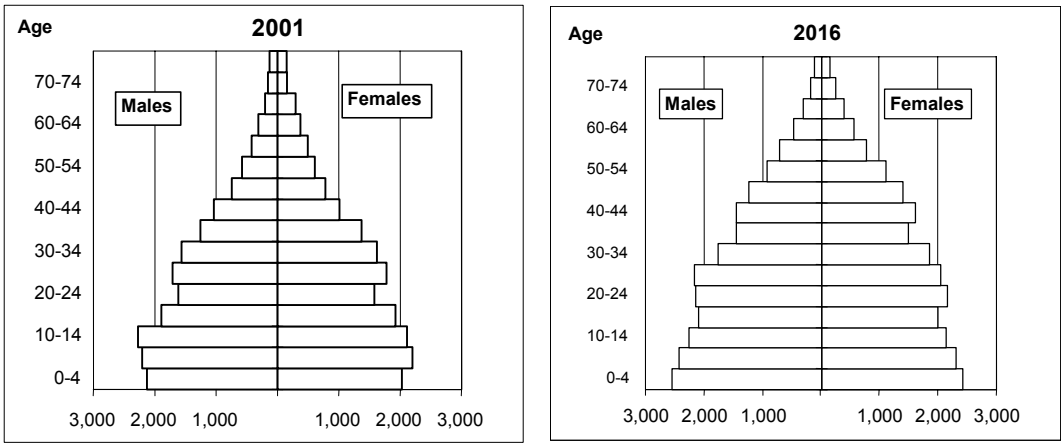
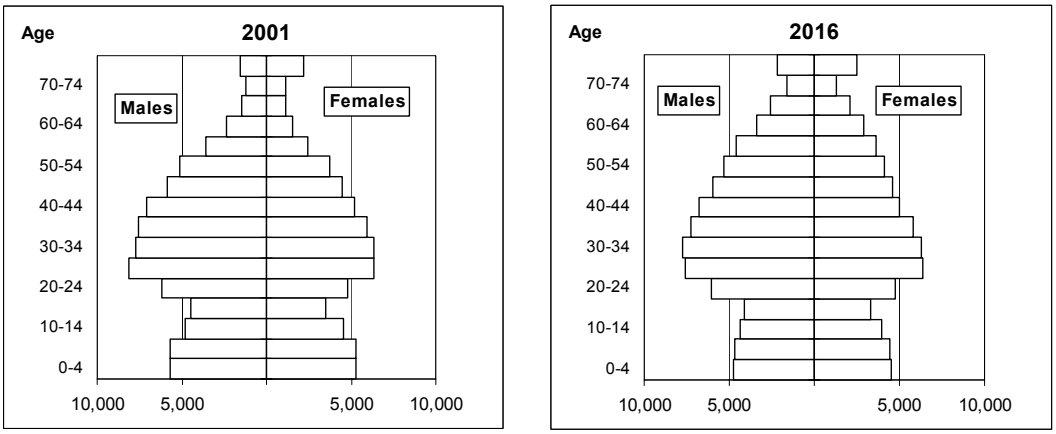


Fig. 6. Implied age pyramids for the non-Indigenous population of the desert, 2001 and 2016



Comparison of the Indigenous age structure with that implied for the 'non-Indigenous' population is shown graphically in Figs 5 and 6. These graphs clearly highlight the consequences of differential migration into the desert region. For example, the 'non-Indigenous' population has a much higher estimated sex ratio (123 males per 100 females in 2001), compared to the almost evenly balanced sex ratio for the Indigenous population (98 males per 100 females). Also, the shape of

the 'non-Indigenous' age distribution is typical of a migrant population with relatively few children and old people, and a concentration of numbers (especially males) in the younger working-age groups. This contrasts sharply with the Indigenous age pyramid, which displays the characteristics of a population which is expanding by natural increase in situ.

Implications for CRC research

The basic aim of this paper was to demonstrate that both the data and the tools are available to commence demographic analysis in an ecological region described as the Australian desert. Beyond this, two broad strands of research emerge for a Desert Knowledge CRC. First, a strand that focuses on improving demographic data quality, analytical methods and outputs. Second, a strand that considers the implications of demographic trends for public policy.

There are several refinements that, if developed, would provide for greater certainty in the assumptions underlying population estimates and projections. One obvious such refinement is possible after each five-yearly census count. The forecasts presented here are based on 1996 population counts, but by February 2003 new regional Indigenous population estimates are expected to be available from the 2001 Census. These can be used to assess the validity of the current projections for 2001, while new projections may also be developed using the latest population estimates as the base. In making use of 2001 census counts, however, consideration should be given to the role that demographic information from administrative data sets might play in fine-tuning population estimates, as demonstrated in the development of Indigenous population projections for Cape York Peninsula (Taylor & Bell 2002a, 2002b).

There is scope also for altering the spatial boundaries employed to adjust the region of interest; for example, to include the semi-arid lands, or to consider desert areas within different jurisdictions such as States and Territories or Aboriginal Land Council areas. At the widest scale, some spatial fine-tuning will no doubt be required to more closely match ASGC units to environmental boundaries and to other criteria that might be applied in defining the desert region. Within the desert region, particular catchments (such as Land Council areas) are readily defined as long as they fit the ASGC. If, on the other hand, some idea of future numbers in specific localities at sub-SLA level were desired, then options exist for applying ratio allocation techniques based on the current regional projections in much the same way as in a previous analysis of desert community populations (Taylor 2001a).

One device frequently deployed to canvass a range of possible projection outcomes is the calculation of several projection series based on varying assumptions. The current calculations involve the use of only one series. An obvious further development of these projections would be the generation of alternative scenarios based on possible combinations of falling/rising/stable fertility and mortality, and varying assumptions about net migration. While there

is some heuristic potential here, such exploration should be based on plausible indicators, and so the indicators themselves would also need to be researched and assessed.

An abiding feature of population projections is the stimulus they provide for debate on the future demographic outcomes of particular social and economic behaviours. It is possible to repackage the projection results in ways that best suit different audiences, including in interactive formats; for example by providing a capacity for planners, decision-makers, and community leaders to vary the underlying assumptions and thereby explore alternative planning scenarios.

For research on the policy implications of desert demography, the projected expansion of population in working-age groups is significant, especially in the Indigenous population. There are consequences here for policy research on the generation of sufficient employment opportunities and related skills development, as well as on the means to secure new housing and related infrastructure development to support increased family and household formation.

Many Indigenous people in the expansionary working-age cohorts have been dependent for much of their adult life on welfare, either via CDEP or more directly from Centrelink and its predecessors. As these cohorts age, their lack of meaningful work experience to date, and their attendant lack of skills become significant in the light of the basic aim of governments and regional Indigenous organisations to foster Indigenous participation in remunerative and sustainable economic activity. Capacity building among this sub-population is rendered problematic, and consideration needs to be given to expanding the notion conceptually beyond the mere provision of jobs and training into more social arenas such as facilitating community and cultural leadership roles. The effects of increased levels of morbidity and disability which will inevitably arise with an ageing population, are also issues of future concern.

Because of the focus in the present analysis on population projections, relatively little has been said about the importance of better understanding the desert settlement structure and related patterns of spatial interaction. Both have consequences for the delivery of services. On the one hand, there is some indication of limits to growth for desert communities that may be linked to issues of sociability and community cohesiveness, which tend to foster the fragmentation of settlements (Taylor 2001a). On the other hand, urban centres loom large in the lives of all desert residents—for non-Indigenous people because they mostly live there, and for Indigenous people because they frequently spend short periods of time accessing urban-based services (Young & Doohan 1989). This dichotomy between concentration of services and population dispersion over vast distances, and the level of mobility that it engenders, raises a number of questions about access to and equity in the provision of services (Taylor 1998, 2002). For example, if the residence pattern of many Indigenous people in the region is bi-local, or even multi-local, in which location are services legitimately claimed? Should services be replicated to cater for frequent movement between places? If urban areas are net recipients of temporary sojourners, to what extent should

urban services be augmented to compensate for additional loads? At the other end of the settlement hierarchy, what degree of dispersion can be sustained?

Population research is fundamental to the aims of a Desert Knowledge CRC. Presently, the data and analytical tools for regional demographic analysis are both crude and blunt. The opportunity to refine and sharpen these is enhanced by the focus on a single ecological zone: this brings an internal consistency to the analysis of social systems, with prototype implications for regional analysis more generally.

Notes

1. The zone boundaries indicated in Fig. 1 approximate to, but do not represent, the 250mm and 500mm isohyets.
2. Use of this classification is made possible by developments in spatial information systems which present enormous potential for monitoring the changing spatial distribution of service infrastructure, and for linking this to other relevant social and economic variables of public policy interest (see Hugo 2001).

Appendix 1. Population projection tables

Table A1. Indigenous population projection by five-year age-group: desert region, 2001–2016

Males

	2001	2006	2011	2016
0–4	2,129	2,278	2,445	2,553
5–9	2,206	2,120	2,268	2,435
10–14	2,274	2,199	2,113	2,261
15–19	1,891	2,255	2,180	2,095
20–24	1,612	1,858	2,215	2,142
25–29	1,705	1,574	1,814	2,163
30–34	1,562	1,645	1,519	1,751
35–39	1,256	1,481	1,560	1,440
40–44	1,040	1,166	1,374	1,448
45–49	744	940	1,054	1,242
50–54	579	652	824	924
55–59	419	503	567	716
60–64	312	344	413	466
65–69	203	233	257	309
70–74	155	137	157	173
75+	128	111	97	99
Total	18,214	19,495	20,859	22,219

Females

	2001	2006	2011	2016
0–4	2,027	2,169	2,328	2,431
5–9	2,199	2,016	2,157	2,316
10–14	2,108	2,191	2,009	2,149
15–19	1,921	2,094	2,176	1,995
20–24	1,579	1,904	2,075	2,157
25–29	1,775	1,562	1,884	2,054
30–34	1,620	1,742	1,533	1,849
35–39	1,372	1,572	1,690	1,487
40–44	1,007	1,311	1,502	1,616
45–49	781	935	1,218	1,395
50–54	609	715	856	1,115
55–59	492	554	650	779
60–64	372	427	480	564
65–69	294	300	344	387
70–74	153	211	216	248
75+	149	123	137	145
Total	18,457	19,827	21,257	22,686

Table A2. Total population projection by five-year age-group: desert region, 2001–2016

Males

	2001	2006	2011	2016
0–4	7,857	7,407	7,232	7,336
5–9	7,911	7,552	7,271	7,135
10–14	7,097	7,060	6,815	6,610
15–19	6,354	6,332	6,386	6,206
20–24	7,787	7,970	8,083	8,200
25–29	9,863	9,234	9,598	9,726
30–34	9,247	9,455	9,135	9,470
35–39	8,802	8,673	8,943	8,699
40–44	8,088	7,904	7,944	8,213
45–49	6,620	7,162	7,103	7,180
50–54	5,670	5,810	6,286	6,261
55–59	3,994	4,798	4,933	5,333
60–64	2,631	3,044	3,729	3,870
65–69	1,689	1,976	2,305	2,869
70–74	1,413	1,327	1,542	1,771
75+	1,663	1,942	2,080	2,309
Total	96,686	97,646	99,385	101,188

Females

	2001	2006	2011	2016
0–4	7,335	6,977	6,845	6,920
5–9	7,517	7,019	6,847	6,716
10–14	6,637	6,455	6,215	6,083
15–19	5,412	5,462	5,391	5,274
20–24	6,337	6,682	6,861	6,941
25–29	8,149	7,824	8,220	8,439
30–34	7,961	7,884	7,762	8,118
35–39	7,291	7,322	7,394	7,317
40–44	6,213	6,416	6,554	6,623
45–49	5,288	5,674	5,845	5,975
50–54	4,327	4,781	5,098	5,243
55–59	2,898	3,750	4,104	4,392
60–64	1,936	2,452	3,190	3,476
65–69	1,427	1,523	1,926	2,516
70–74	1,255	1,178	1,285	1,573
75+	2,359	2,469	2,514	2,636
Total	82,342	83,868	86,051	88,242

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