

DESERT KNOWLEDGE CRC

Population Dynamics and
Demographic Accounting in Arid
and Savanna Australia:
Methods, Issues and Outcomes

J. Taylor
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Report of a study for the
Desert Knowledge Cooperative Research Centre
and the
Tropical Savannas Cooperative Research Centre.

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Abbreviations/Acronyms

ABS	Australian Bureau of Statistics
ARIA	Accessibility Remote Index of Australia
ASFR	Age-specific Fertility Rate
ASGC	Australian Standard Geographical Classification
CD	Collection District
CRC	Cooperative Research Centre
DIS	Demographic Information System
DOHA	Department of Health and Ageing
DSS	Decision Support System
ER	Entity Relationship
ERP	Estimated Resident Population
FIFO	Fly In/Fly Out
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
PES	Post-enumeration survey
SLA	Statistical Local Area
TSCRC	Tropical Savannas Cooperative Research Centre
UR	Usual Residence

Executive Summary

Introduction

This report presents the findings of a scoping study of current and potential demographic research in geographic regions of interest covered by the Desert Knowledge and Tropical Savannas Cooperative Research Centres (CRCs). The key aims are to outline relevant aspects of data availability and quality, to consider issues related to Indigenous and non-Indigenous population mobility, to develop key demographic indicators for desert and tropical savanna regions, to explore the development of appropriate methods of demographic analysis for remote mobile populations, and to examine appropriate geographic classifications for data analysis. These objectives are augmented by the development of a prototype Demographic Information System (DIS) for desert and savanna Australia as an online facility for the accumulation, storage, manipulation and dissemination of key demographic data and derived indicators.

A blend of the Australian Standard Geographical Classification (ASGC) and the Interim Biogeographical Regionalisation for Australia (IBRA) is developed to allow demographic analysis in the ecological zones of arid semi-arid and savanna Australia. The total area of the desert (arid and semi-arid zones) is approximately 69 per cent of the Australian land mass. The savanna (which incorporates part of the semi-arid zone), amounts to 22 per cent of the Australia landmass. These regions have a population density of between 0.05 and 0.29 persons per km² (compared with 2.5 persons per km² for the country as a whole). They encompass all of the Northern Territory, large parts of Queensland, Western Australia and South Australia, the western half of New South Wales, and even a small portion of north-west Victoria. For many Statistical Local Areas in these zones accurate recording of demographic variables is rendered difficult by large geographic size, small and dispersed populations, frequent short-term population movement, and high population turnover. Errors of under-reporting in population data are especially problematic in remote, sparsely settled areas. These problems mean that denominators may not accurately measure change in social indicators.

Population distribution

More than half of the arid zone population is located in Western Australia and most of this population (84 per cent) is non-Indigenous. The other main concentration of arid zone population (and the largest Indigenous population) is in the Northern Territory focused mostly on Alice Springs and outlying Indigenous settlements based around small family groupings with an average size of only 20 persons.

In the savanna zone several Indigenous towns are emerging of more than 1,000 persons. This does not appear to be happening in the arid zone where community populations reach a population ceiling (typically between 250 and 500 people) at which point they either stabilise or fragment spatially and decline in size. Across northern Australia, there appears to be a significant structural break in terms of the range and number of services and functions located in towns between settlements of up to 2,000 population as opposed to those over this size and up to 8,000 persons. A pressing research need in the arid and savanna zones is to consider this relationship between settlement size and function, and compare the presence or absence of basic infrastructure and services in growing Indigenous towns with those in remote mainstream towns that are comparable in size.

Age and sex composition, and migration trends

There are marked differences in age distributions in the study region, with the Indigenous population being young with high fertility but having high mortality rates for all age groups. In contrast, the non-Indigenous population has lower fertility rates, with high net migration in the ages 10–14 to 20–24 years for all three biogeographic regions (indicating a loss to the rest of Australia, rather than intra-regional migration) compared to the immediately younger and older age groups.

Non-Indigenous populations in the three biogeographic regions are overwhelmingly male. In contrast, sex ratios for the Indigenous population are close to parity.

Non-Indigenous residents of the arid and savanna zones were much more likely than Indigenous people to have changed their zone of residence between 1996 and 2001. Only in the semi-arid zone did Indigenous people display a greater propensity to move from one zone to another.

The direction of net migration flows are broadly similar for Indigenous and non-Indigenous populations with a clear overall shift out of the arid and savanna zones to the rest of Australia. However, the rate of loss of non-Indigenous population from the arid zone to the rest of Australia is almost five times that of the Indigenous population, although the semi-arid rates are similar for the two populations. Higher non-Indigenous net loss is also recorded from the savanna and semi-arid area. The considerable difference in the intensity of net migration loss between the Indigenous and non-Indigenous populations (especially in the arid zone) underlines the key demographic reason why the Indigenous share of total population in these areas continues to rise.

Population change

Overall, the arid and semi-arid zone population counts fell between 1996 and 2001, while the savanna population count increased. Demographic reasons for these outcomes appear to vary in reliability, but increased Indigenous usual resident counts were recorded in all regions, and these were due to natural increase rather than net migration loss. We can reasonably conclude that the overall decline in population is due to a high rate of non-Indigenous net migration loss from the arid zone, except in the Northern Territory.

This continues the trend since 1981 of an increasing Indigenous share of the total population in the remote and very remote categories of the ASGC Remoteness Structure. This rose steadily from 12 per cent to almost 20 per cent in 1996. However, in the South Australian and the Northern Territory arid zones the Indigenous share of population has declined owing to a greater rate of increase in non-Indigenous population. The arid and savanna zones appear to serve as life-stage escalator regions enabling people from other parts of Australia to gain workplace experience and advance their career paths. The same outcome is evident across much of the savanna as well—in the Kimberley, the Top End of the Northern Territory, and Cape York Peninsula although in each of these areas Indigenous people still comprise a substantial and often majority share of the population.

The other broad region of increase in the Indigenous share of population is in the semi-arid zones of southern Queensland, central and western New South Wales, South Australia and the south west of Western Australia.

Population projections 2006–2021

Population projections may not be strongly predictive due to small populations, high levels of mobility, and incomplete data.

While the Indigenous population is projected to grow substantially in all zones, and especially in the semi-arid and savanna zones, the non-Indigenous population is projected to decline in the arid and semi-arid zones and to grow at a lower rate than the Indigenous population in the savanna. This will result in a rise in the Indigenous share of total population from an estimated 22.8 per cent in 2006 to 27.5 per cent in 2021 in the arid zone, from 14.5 per cent to 18.2 per cent in the semi-arid zone, and from 19.3 per cent to 20.8 per cent in the savanna. This would produce a significant restructuring of the age composition of the arid zone resident population from one that is predominantly youthful and non-Indigenous to one that is gradually ageing and increasingly Indigenous.

Demographic Information System (DIS)

A DIS is a computer system designed to store and retrieve demographic data in a systematic format. A DIS also needs to be an analytical tool and in this scoping exercise the foundations of an analytical DIS have been constructed for demonstration purposes. The system allows for interrogation of the biogeographic regions as well as providing selected data for individual SLAs through an interactive map interface.

There are numerous possibilities for enhancement of the DIS beyond the current scoping exercise. The report canvasses five possible developments: extensions to geography, added data sets, provision of socio-economic indicators, more sophisticated graphics and the inclusion of analytic capabilities. In combination, these developments would move the facility from being a DIS to become a Decision Support System (DSS) by using the data in conjunction with analytic capabilities and expert knowledge to explore alternative scenarios and hence provide a basis for decisions on a range of service provision and related policy issues. The work identified a number of research tasks for the future, including validation and improvement of demographic data, the need for the empirical identification of Indigenous mobility fields and the compilation of Indigenous social statistics that more closely reflect the realities of Indigenous social organisation. One of the most pressing issues in expanding the DIS is to achieve geographical consistency with output from the 2006 Census.

There are two key imperatives that pertain to the issue of improving demographic data—reducing census undercounts and increasing Indigenous registrations of vital events data. To overcome these issues new methodologies must be sought, not only to overcome deficiencies in the Indigenous data but also in the treatment of small area and subsequent small number analysis.

1. Introduction

This report presents the findings of a study aimed at scoping the current and potential content of wide-ranging demographic research in geographic regions of interest that are covered by the Desert Knowledge and Tropical Savannas Cooperative Research Centres (CRCs). In its conception, the key aims of the scoping exercise were to outline relevant aspects of data availability and quality, to consider issues related to Indigenous and non-Indigenous population mobility, to develop key demographic indicators for desert and tropical savanna regions, to explore the development of appropriate methods of demographic analysis for remote mobile populations, and to examine appropriate geographic classifications for data analysis. The findings in regard to each of these tasks are addressed in this report (sometimes separately, but often in combination). In addition, in an attempt to extend the practical outcomes of the study, these initial objectives are augmented by the development of a prototype Demographic Information System (DIS) for arid and savanna Australia as an online facility for the accumulation, storage, manipulation and dissemination of key demographic data and derived indicators. In conclusion, the report canvasses a range of key issues and components of a future CRC-focussed demographic research agenda.

The establishment of the Desert Knowledge and Tropical Savannas CRCs with their complementary interests in creating sustainable social, economic and environmental futures has generated a pressing need for demographic information regarding parts of the Australian continent that loom large in the popular consciousness and image, but fall short in terms of social scientific inquiry. While these regions may be defined biogeographically with reference to the Interim Biogeographic Regionalisation for Australia (IBRA), there is a sense, also, in which they display unique social, economic and cultural characteristics that require elucidation. Not least, here, is the significant presence of Indigenous populations, often resident on Indigenous lands, that co-exist with largely peripatetic non-Indigenous populations drawn to these regions primarily for the purposes of employment in one of the mainstays of the regional economy—mining, pastoralism, tourism and service delivery. This population mix is inherently demographically fragile.

For Indigenous populations, vulnerabilities abound. Despite being traditional (and contemporary) owners of much of arid and savanna Australia, Indigenous peoples exist mostly on the margins of the regional economy and their access to many services is curtailed by large distances and poor communications, while relatively low population densities constrain market demand. Above all, continuing high adult mortality remains a potent measure of basic insecurity. Simple estimation of Indigenous numbers and distribution is made problematic by virtue of chronic intra-regional mobility and data inconsistencies. As for non-Indigenous populations, turnover due to migration is also high but is invariably extra-regional, and a critical distinction exists between resident and temporary numbers with the latter constituting a significant share of the arid and savanna population present at any one time. From an economic base perspective, the vagaries of limited horizontal integration and single industry enterprise are reflected in high sex ratios, the emergence of Fly In/Fly Out (FIFO) regimes, and boom and bust economic cycles leading to variable population levels.

As a consequence of these inherent fragilities, a fundamental requirement underpinning much CRC deliberation in regard to sustainable futures is a firm appreciation of current numbers, characteristics, and distribution of these population groups, as well as the underlying mechanisms

that are likely to lead to 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. In public policy terms, ultimately, what is sought is a demographic support system for current and future planning and evaluation. To achieve this, separate analysis is required of Indigenous and non-Indigenous population dynamics given their quite different demographics. Demography aside, there are other reasons for this separate treatment since the Indigenous presence as landowners, institutional players, and cultural custodians far exceeds their proportional share of population, as does the weight of government and organisational policy effort in attempting to raise the level of Indigenous economic status.

The aim of this scoping study, then, is to outline key aspects of the demography of arid and savanna Australia while at the same time exploring the methodological and practical issues involved in the development of a DIS. Ultimately, this DIS would be an online facility for accessing data on the components of regional and sub-regional demographic change together with derived measures of interest to other CRC researchers, Indigenous communities, land councils, representative bodies, local governments, Australian, state and territory governments, and the private sector.

We begin (section 2) by examining issues in the design and definition of customised regions for use in socio-economic analysis. Having canvassed the problems and the suite of general solutions that appear in the scholarly literature, we apply appropriate techniques to delimit the boundaries of the desert and savanna, and define constituent zonal systems. Section 3 turns to the task of establishing valid and reliable demographic data for the regions and zones of interest. We examine, in sequence, the problems associated with small population size, inadequate coverage of data collections, the different forms of population count which are available, and the complexities added by high levels of population mobility, especially among Indigenous Australians. We give particular attention to the phenomenon of town camps and to the issues associated with establishing meaningful estimates of service populations. We also endeavour to construct aggregate demographic accounts for the regions of interest, with disappointing results. Section 4 utilises the data that are available to explore the demographic dimensions of the desert and savanna regions. We examine trends in population growth and distribution, drawing attention in particular to the very different spatial patterns of the Indigenous and non-Indigenous populations. The chapter then proceeds to examine differences in age structure, and in the levels of fertility, mortality and migration to and from each of the regions. Based on these analyses, we present projections of future population growth and contrast the outcomes between the Indigenous and non-Indigenous populations. Section 5 draws the core, substantive elements of the preceding sections together in the form of a prototype, web-based Demographic Information System. We outline the content and structure of the DIS and examine a number of options for its future enhancement as a primary tool for storage, dissemination and analysis of socio-economic data in desert and savanna regions. Section 6 then turns squarely to the substantive issues uncovered in the scoping study and elaborates key items of an agenda for future demographic research in arid and savanna regions.

2. Defining and delimiting customised regions

Since the early 1980s the Australian Bureau of Statistics (ABS) has used a standard geography—the Australian Standard Geographical Classification (ASGC)—across all of its data collections. Although the ASGC is aligned with major administrative boundaries such as States, Territories and Local Government Areas, an increasing need for data that do not match these legal boundaries has developed. Examples of such non-standard geographical classifications include ecological zones (Taylor & Biddle 2004; Brown 1984; Murrell 1984), Temporal Statistical Divisions (Blake et al. 2000) and Functional Region Zones (Brown & Rees 2006). Other examples of lack of fit to the ASGC include Australia Post postcodes, State and Commonwealth electoral boundaries, river catchments and official suburbs (ABS 2003b). In this paper we use ecological zones as the basis for our customised regions.

In adopting such a non-standard geography a number of issues and challenges are presented. In Goodchild and Lam's (1980, p. 298) words, these include trying to “derive comparable estimates for a different set of regions which in general do not respect the boundaries of the first”, otherwise known as the ‘polygon overlay problem’ or ‘spatial interpolation problem’. This challenge is most acute at the edges of customised regions where decisions need to be made regarding whether a source (administrative) zone merits inclusion in the target (ecological) zone. Methodological solutions to overcome this problem include:

- Proportional weighting (weighted concordance)
- Dasymetric estimation
- Best fit.

Both dasymetric estimation and proportional weighting use a ‘building block’ approach to construct the target geography, i.e., aggregating smaller geographic units to ‘build’ the larger geographic unit. Proportional weighting occurs in two forms, the simplest of which applies the proportion of the source zone in the target zone to the variable of interest. This procedure makes the assumption that the variable of interest is uniformly distributed across the source zone. A more accurate method is to disaggregate the source zone to the smallest possible geographical units on which the variable of interest is collected and then aggregate these ‘building blocks’ to the target geography.

In both instances information about the relationship of the source geography to the target geography is required so that weights based upon a function of that relationship can be derived. Dasymetric mapping takes this process further by using ancillary data (usually density levels of the variable of interest) to apply additional weights rather than relying purely on mathematical algorithms (Reibel & Bufalino 2005). Whilst both these methods are statistically more robust than a simple best fit procedure, discussed later, they have an inherent weakness when used with certain key demographic data (such as migration data or population estimates) as usual residence is only coded to Statistical Local Areas (SLAs), thus not permitting disaggregation below this level.

Best fit procedures wholly allocate source zones, to target zones based on either of the following two criteria:

- the majority of the source zone is located within the target zone
- the [population weighted] centroid is located within the target zone.

Best fit procedures are essential when considering forms of data such as migration. Both methods possess merits and weaknesses. Using the proportion of land area within the target zone to decide the allocation is most effective when there is no information available to apportion the data more accurately, but it does not take account of the way a population is distributed within the source zone. Population weighted centroids are sensitive to population distribution, but are influenced by zone shape, and in extreme circumstances a zone centroid can fall outside of the zone itself.

2.1 Delimiting the arid and savanna zones

In regard to ecological zones, areal interpolation is further complicated by shifting boundaries and overlapping zones. Ecological zones, although meaningful, are inherently fuzzy at the edges. For example, rainfall varies on an annual basis, thus zones categorised as arid on this basis in one year could be classified as semi-arid in another. This causes problems not only in where to draw the boundaries but also whether and how to hold them stationary over time. The fluidity of these boundaries is reflected in the fact that many ecological zones overlap or have areas of transition. Although this may reflect what happens on the ground it causes considerable problems in the delimiting process and subsequently deriving appropriate statistics. The only solution to these issues is to hold data to the smallest common zonal unit so that they can be aggregated as desired.

Accordingly, the IBRA has been developed as the primary classification system for Australian ecological zones (Hutchinson et al. 2005). This is an integrated classification of both biotic and abiotic variation. IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. Accordingly, an attempt was made to apply this classification in outlining the arid and savanna zones and the spatial distribution of these is shown in Figure 2.1 with constituent biogeographic sub-regions listed in Table 2.1. However, of these, only the savanna zone is unambiguously identified. While the arid zone is also coded, the distinction between this and the semi-arid zone is not, and so to delimit these two regions the climatic classifications of Köppen and Thornthwaite were also used (Heathcote 1983, p. 16). In Australia this describes the arid zone as lying approximately, though not entirely, within the 250mm isohyet as shown in Fig 2.2. Although based on just one indicator (rainfall) this produces a boundary for the arid zone that is very close to that outlined by the IBRA classification. As for the semi-arid zone, this lies approximately, though not exclusively, between the 250mm and 500mm isohyets (Figure 2.2). Delineation of the outer bounds of this zone is less obvious than in the case of the arid zone given its shared boundary with more closely settled agricultural lands and with the tropical savanna as presented by the IBRA. At the same time, the smaller area of SLAs along this frontier allows for greater discrimination in boundary selection.

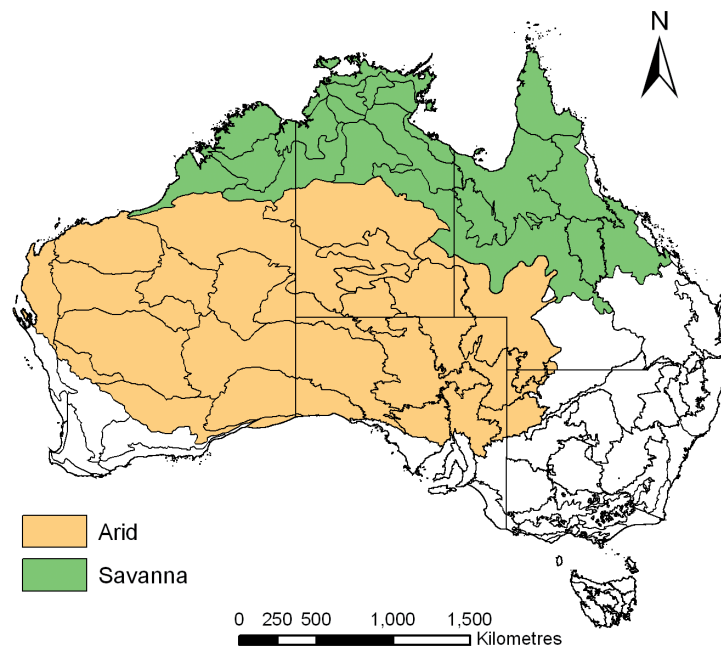


Figure 2.1: IBRA Arid and Savanna Biogeographic zones

Source: Environment Australia

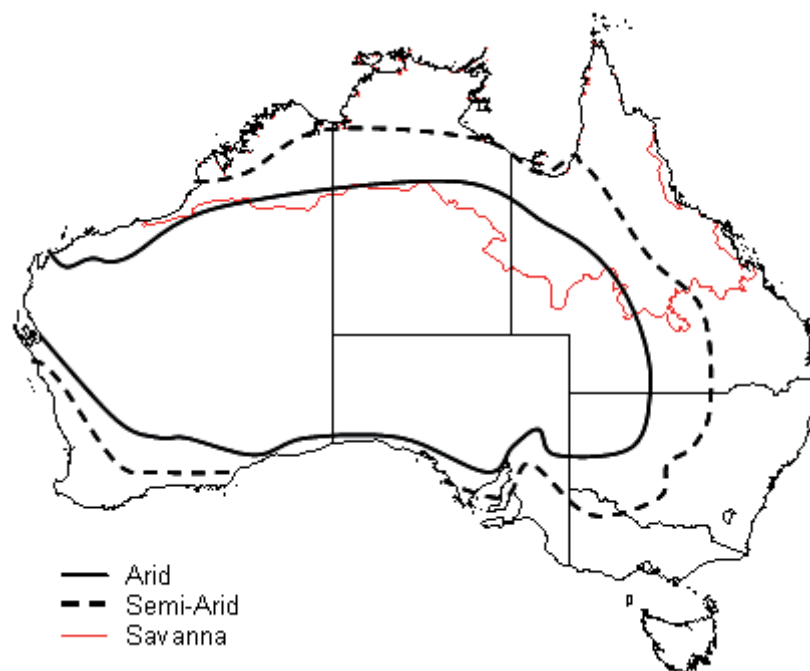


Figure 2.2: Select environmental boundaries of Arid, Semi-Arid and Savanna zones

Sources: Brown 1984; Murrel 1984.

It is clear from Figure 2.3 that inclusion of these semi-arid lands leads to a very broad conceptualisation of the desert region, extending as far north as the Victoria and Roper Rivers in the Northern Territory, across the Channel country and Murray Darling Basin to the western slopes of the Great Dividing Range in Queensland and New South Wales, as far south as the Riverland and Mallee in Victoria, and south west to the drier edges of the wheat belt in Western Australia. It is also clear that this produces an area of overlap between parts of the semi-arid zone and tropical savanna lands. This is significant at one level because it creates potential for competing or complementary interest between the two CRCs. In the immediate context, though, it creates considerable complications for demographic accounting.

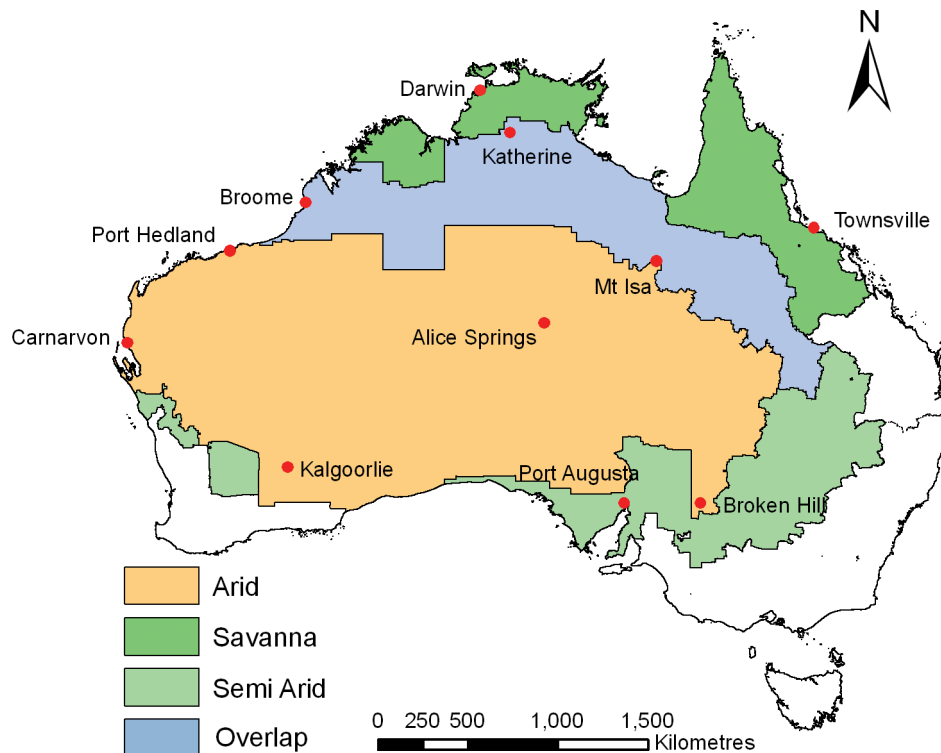


Figure 2.3: Geographic boundaries of Arid, Savanna and Overlap zones

(Note: this figure blends Figures 2.1 and 2.2 above)

As shown in Table 2.1, the arid and savanna zones contain a similar number of biogeographic regions (23 and 20 respectively), although reference to Figure 2.1 indicates that these tend to be larger in the arid zone in line with the greater potential for landscape variation in the wet tropics.

To create the customised geography based on the ecological zones (arid, semi-arid and savanna) used in this paper, population-weighted centroids of SLAs were utilised on a best fit basis. To overcome overlapping boundaries, any SLA that fell in the overlap of the semi-arid and savanna regions was classified as a fourth zone, nominally called 'overlap'. The final ASGC-based

geography for all four zones (arid, semi-arid, savanna and overlap) is shown in Fig 2.4. For practical assistance in working with this zonal geography, Appendix A lists all urban centres (populations of over 1000 people) and rural localities (populations of 200–999 people) within each of the four zones, while an SLA concordance to each zone is provided in Appendix B.

Table 2.1: IBRA biogeographic sub-regions in the Arid and Savanna zones

Arid	Savanna
Broken Hill Complex	Brigalow Belt North
Burt Plain	Cape York Peninsula
Channel Country	Central Arnhem
Finke	Central Kimberley
MacDonnell Ranges	Daly Basin
Simpson-Strzelecki Dunefields	Dampierland
Stony Plains	Desert Uplands
Flinders and Olary Ranges	Einasleigh Uplands
Gawler	Gulf Coastal
Hampton	Gulf Fall and Uplands
Carnarvon	Gulf Plains
Central Ranges	Mitchell Grass Downs
Coolgardie	Mount Isa Inlier
Gascoyne	Northern Kimberley
Gibson Desert	Ord–Victoria Plains
Great Sandy Desert	Pine Creek–Arnhem
Great Victoria Desert	Sturt Plateau
Little Sandy Desert	Top End Coast
Murchison	Victoria Bonaparte
Nullarbor	
Pilbara	
Tanami	
Yalgoo	

Source: Environment Australia

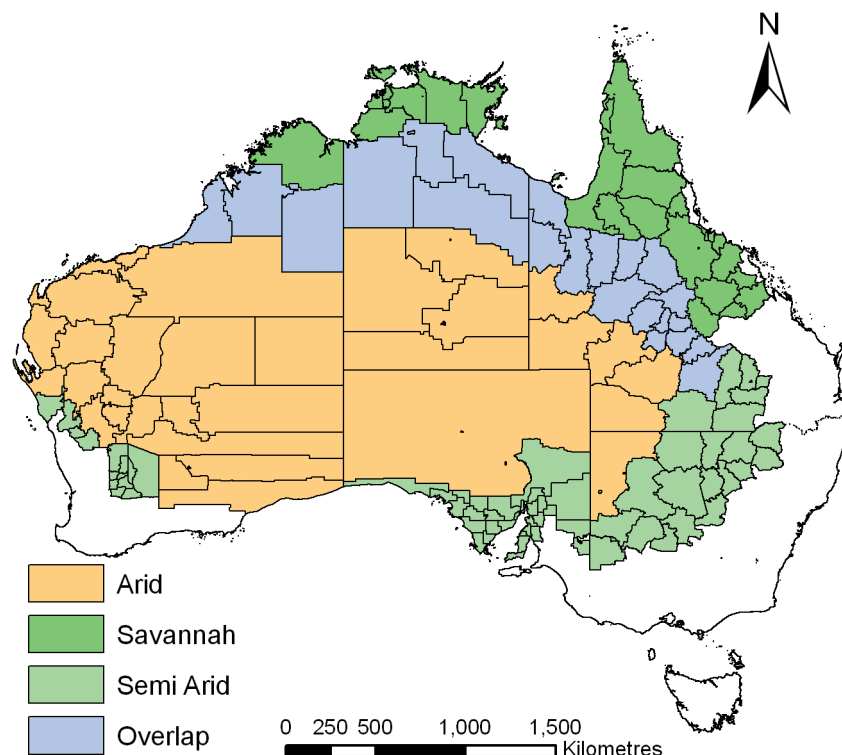


Figure 2.4: Zonal concordance to ASGC SLA boundaries, 2001

Source: ABS 2001c

2.2 Concordance

The delineation of the savanna used here varies from that adopted by the Tropical Savanna CRC (TSCRC). To achieve an aggregation of administrative areas that most closely matches the combined tropical savanna biogeographic regions, the CRC used the finest level geography possible—Census Collection Districts (CDs). This approach is acceptable if broad population counts are required, however it suffers from weaknesses in the context of the present scoping exercise since ABS data at this geographic level is limited to census enumeration counts and is often fraught with issues of confidentiality due to small numbers. In addition, some critical demographic data are simply not available at this level of disaggregation. For the development of a comprehensive DIS, it is necessary to progress beyond basic counts of the population to include analyses of fertility, mortality, and migration, as well as the use of population estimates and projections. Data for each of these purposes are not available at the CD level. As a consequence of this discrepancy in approach, slight differences arise between the areal extent of the tropical savanna region as identified by the TSCRC and as defined by the present study with an inevitable flow-on effect in terms of variable population numbers.

While configuration of the ASGC statistical units used here provides for a close approximation to major environmental boundaries, the delineation of biogeographical zones by statistical unit is experimental only and the units included could, and probably should, be fine-tuned at the edges on the basis of CRC research using more precise environmental and socio-economic parameters. Having said that, a key advantage of the ASGC is that it does provide ready-made scope for intra-zonal spatial analysis with as many as 91 SLAs located within the semi-arid zone and 45 in the arid zone (although five of these are in Alice Springs). The tropical savanna contains 106 SLAs, although 24 of these overlap with the semi-arid zone. Also, almost two thirds (68) of the tropical savanna SLAs are located in Darwin and Townsville. If these are grouped together (as they are for this scoping exercise), this leaves just 40 SLAs outside of these city areas. A look-up table for 1996 and 2001 SLAs to the four regions is provided in Appendix B.

To ensure maximum versatility, a DIS should hold data at the smallest geographical level for which demographic information are available (SLAs), thereby permitting in-depth analysis within each zone. However, boundary changes to administrative areas, which are more acute at small-area scales, compromise the ability to conduct time series analysis at this level, thus creating a need for procedures to ensure temporal geographical consistency. This presents a particular problem, for example, in the semi-arid parts of South Australia where considerable SLA boundary shifts occurred between the 1996 and 2001 ASGC. The options for achieving temporal geographical consistency can be listed as: ignore all boundary changes; freeze history; update to contemporary zones and; geo-reference household data (Blake et al. 2000). A further option is to construct designer zones from smaller building blocks, however, the smallest building blocks possible are already being used in this study.

The problem of ensuring temporal consistency raises further interesting questions regarding the most appropriate geography for analysis. While each of the biogeographic zones considered here comprise sparsely settled populations clustered in specific areas, these might more accurately be conceptualised as point data rather than areal units. In this way, urban centres and remote Indigenous communities could then be integrated into the DIS. Furthermore, point data facilitate geographical consistency—similar to using area centroids. Not all populations lie within discrete settlements, however, and not all demographic data are available for point locations.

While there are no simple solutions to these issues, the ABS is moving in a significant direction to resolve this matter. The planned output strategy for the 2006 Census is to code data to mesh blocks—a much smaller spatial unit than even Collection Districts (CDs). Approximately 200,000 mesh blocks will be used in 2006 output compared to 37,209 CDs used in 2001 (ABS 2003a). Mesh blocks will contain a minimum of 20 dwellings (except where a block is deliberately designed to have zero population) thereby offering highly flexible output. Coding census data to such a fine spatial scale will not only permit closer, if not perfect, aggregations to all political and administrative boundaries, but will also more closely reflect user-defined, customised geographies—a significant step forward in the field of zone design.

3. Demographic data issues

For many SLAs in the arid and savanna zones accurate recording of demographic variables is rendered difficult by large geographic size, small and dispersed populations, frequent short-term population movement, and high population turnover. For the Indigenous population some incompatibility between ABS enumeration procedures and Indigenous cultural forms are also problematic (Martin et al. 2002; Warchivker et al. 2000; Martin & Taylor 1996). In addition, Kinfu and Taylor (2005) have noted possible under-reporting of births data in some arid areas that may be due to misreporting of usual place of residence. As a consequence, it is fair to say that there continue to be concerns about the accuracy of demographic information pertaining to all populations in these regions, but especially to Indigenous populations. In the meantime, analysis must inevitably proceed with data that are available, though judicious analysis is required to establish reliable parameters of change.

3.1 Small numbers

The regional cities of Darwin and Townsville account for fully 52 per cent of the total population of the savanna zone population. Elsewhere, Broken Hill, Kalgoorlie, Port Hedland and Alice Springs account for the same proportion of the arid zone population. Away from these main centres, populations are dispersed over numerous much smaller settlements and, as a consequence, low overall population densities represent an almost defining feature of the arid and savanna biogeographic zones. While this has consequences in social, economic and ecological terms, it also has practical consequences in terms of scoping the construction of a DIS. The basic issue is that SLAs form the building block for data on the components of population change (births, deaths and migration) and yet population numbers in many of the SLAs that fall within the arid and savanna zones are too small to sustain robust analysis.

If we take mortality as an example, as a rule of thumb an SLA population of around 10,000 is required to sustain sufficient male and female deaths at different ages in a given year for robust mortality analysis, although this threshold could be reduced for the Indigenous population given higher mortality. For fertility measures the threshold would be somewhat lower due to the greater number of events, though the relevant population here, of course, is women of child-bearing age.

The fact is, relatively few SLAs in any of the biogeographic zones have sufficient population size to independently provide for meaningful demographic measures, as shown in Figures 3.1–3.3. This constraint is exacerbated by the conceptual, analytical and policy imperatives to separate Indigenous and non-Indigenous populations as this further reduces the number of SLAs of sufficient population size. Thus, if we exclude grouped SLAs in Darwin and Townsville, no single SLA in any of the zones has an Indigenous population of over 10,000 persons. In fact, almost all have populations of less than 5,000, and the vast majority are substantially below that level. While there are more SLAs with sufficient non-Indigenous numbers, once again this is very much the exception, with the majority below 5,000 population.

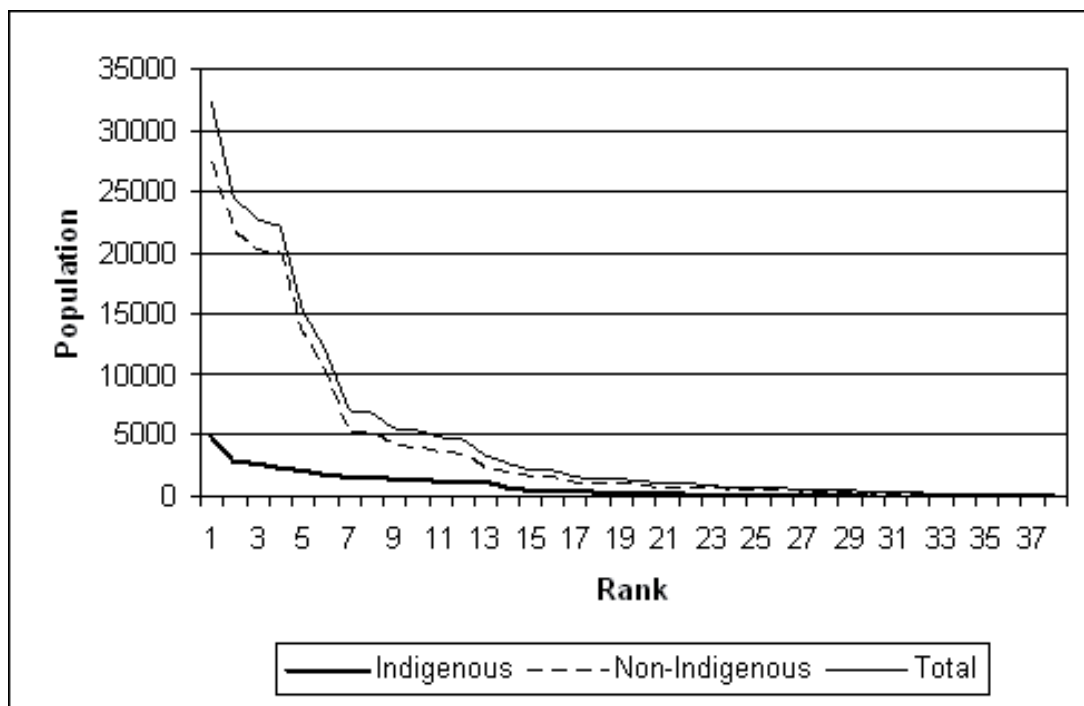


Figure 3.1: Arid zone SLAs by Indigenous, non-Indigenous and total population rank size, 2001

Source: ABS customised tables

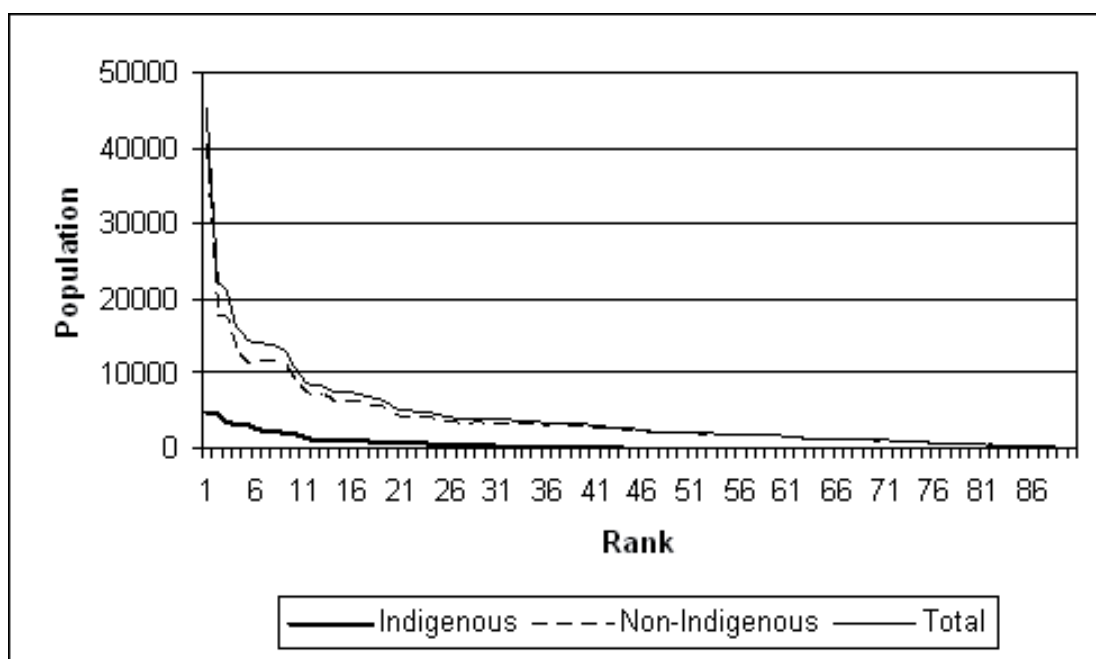


Figure 3.2: Semi-Arid zone SLAs by Indigenous, non-Indigenous and total population rank size, 2001

Source: ABS customised tables

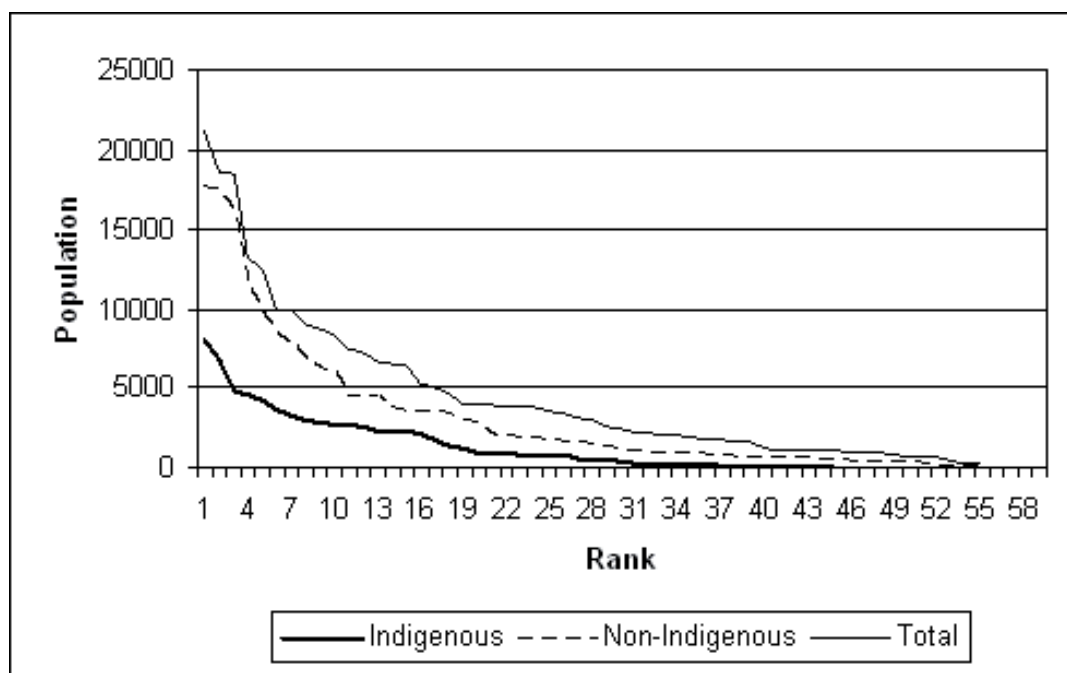


Figure 3.3: Savanna zone by SLAs by Indigenous, non-Indigenous and total population size, 2001

Excluding Darwin and Townsville SLAs

Source: ABS customised tables

For the most part, then, demographic analysis at the sub-biogeographic zonal level requires amalgamation of SLAs in order to reach threshold population sizes. The question of what particular amalgamations might be appropriate is not addressed as part of the present scoping exercise since the focus here is on population dynamics at the zonal level. It does, however, represent an important issue for policy and is one of many issues requiring further work.

Two other issues related to small population size also detract from the quality of demographic information (at least at sub-zonal scales). The first concerns population estimates. The ABS constructs two sets of population estimates for SLAs. In recognition of the fact that it fails to count some people, the ABS develops post-censal estimates of ‘true’ resident populations by augmenting SLA-level usual residence counts according to an estimate of those missed (net undercount), as well as other demographic adjustments. This produces an Estimated Resident Population (ERP), which in effect becomes the official population of each SLA in Australia for the purposes of electoral representation and financial distributions. The second set are annual intercensal adjustments to the Census-based estimates, which are based on a regression model that takes account of a range of symptomatic indicators of population change, with the sum across SLAs subsequently constrained to independently estimated State and Territory totals.

The simple fact is, larger SLA populations tend to be more accurately estimated than small SLA populations when the measure of accuracy is the percentage difference between preliminary estimates (based on previous census year levels) and final estimates based on current census year levels (Howe 1999). In 1996, the average absolute error (either underestimated or overestimated) for SLAs with a population of less than 500 persons was as much as 23 per cent, while 37 per cent of these SLAs had errors greater than 20 per cent (Howe 1999). As indicated in Figures 3.1–3.3, this includes a sizeable number of arid and savanna SLAs. An additional factor that impacts on the accuracy of estimates is population growth. Once again, moderately changing populations can be estimated with greater accuracy than rapidly changing populations. According to analysis for the 1991–1996 period, the lowest errors in estimation were for SLAs that experienced intercensal population changes of less than 10 per cent (Howe 1999). As we shall see in due course, many SLAs in the arid and savanna zones experienced population change in excess of this amount between 1996 and 2001, and no doubt will continue to do so.

The second issue concerns the potentially volatile and large size of percentage changes from a small population base. As just as one example of this, between 1996 and 2001 the non-Indigenous population of the East Arnhem SLA in the savanna zone of the Northern Territory increased by as much as 161 per cent, although this represented an absolute increase of just 407 persons, from 252 to 659. Care must therefore be taken when interpreting large proportional shifts in sub-zonal numbers.

3.2 Data coverage

All population data are subject to errors of under-reporting but such issues are especially problematic in remote, sparsely settled areas. Not only is under-enumeration more likely, but its impact is more pronounced because of the small number problem discussed above. Particular concerns have been raised in regard to Indigenous population estimates and it is important to note that these have been observed to differ from other (unofficial) population estimates generated by alternate means (Taylor & Bell 2002a). Also for noting are methodological tendencies within the special procedures adopted by the ABS in remote communities and urban town camps in northern Australia that seem likely to produce an undercount of Indigenous people (Taylor 2005; Sanders 2002; Martin & Taylor 1996). This calls for extension or refinement of the standard ERP methodology to adequately compensate for these shortcomings, and the capacity to achieve this has been questioned especially given the lack of a post-enumeration survey to check coverage in remote areas (Taylor & Bell 2002a), although this is to be remedied following the 2006 Census.

Surprisingly, only one study exists that can claim to directly test the validity of a census count for a remote Indigenous community. This involved an ethnographically-based enumeration of Wik Aboriginal people in the community of Aurukun in the savanna of Far North Queensland that was exactly concurrent with the 1986 ABS Census count (Martin & Taylor 1996). The latter was conducted as a conventional count of persons found present in dwellings. The former involved the use of genealogical methods to first develop a comprehensive list of all Wik people whose families were Aurukun residents. This produced a master list of the *de jure* population of the Aurukun region—in effect, a list which answered the question, who could conceivably be found in Aurukun at census time? This was then used as check-list against which a count of those present could be assessed.

Results from these two approaches found that the official census fell short of the ethnographically-based count by 17 per cent with most of this gap accounted for by people under 30 years of age. One conclusion of this study was that the enumeration strategy adopted by the ABS for use in remote Indigenous communities was structured in such a way as to increase the likelihood of omitting young people—the more mobile and more socially marginal. The basic problem was, and still is, an attempt to assign individuals to particular dwellings and households as mainstream constructs in situations where extended households and high inter-household and inter-community mobility are the norm.

Overall, the benchmarking of Indigenous community ERPs in the savanna region of Queensland against previous population counts and estimates, and against usual residence data from administrative sources, points to the possibility that ERPs are too low in many instances, and that their age profiles might be somewhat biased towards older ages (Taylor & Bell 2002a). The essential background to these claims includes the lack of an official estimate of undercount for these communities, a series of methodological questions surrounding the quality of usual residence counts, and the lack of publicly available local intelligence to support often erratic census-based population trends. While there is no denying that *de facto* head counts in communities will vary, even on a daily basis, far less intercensal variation than that observed would reasonably be expected in respect of usual residence estimates, especially in communities where the majority of residents have long-term cultural attachment and association.

Administrative data sources that include population numbers (such as school enrolments, clinic data, and Centrelink data) also suffer a range of limitations, and as such they should in no way be taken to represent a direct replacement for ERPs. Indeed, there are fundamental differences in the conceptual foundation of population figures based on census counts as opposed to administrative data that ultimately prejudice their comparability. It might be argued, for example, that population numbers derived from administrative data sets are more closely akin to a service population, rather than a resident count, even though they lack the visitor contingent that forms an essential component of the service population concept.

At the same time, it is difficult to ignore the variation in population levels that can be derived from these different methods of estimation. In modelling annual intercensal ERPs, the ABS routinely uses administrative data as proxy indicators of population impacts (Howe 1999). Because there can be variation between SLAs in the relationship between symptomatic indicators and population

outcomes, the ABS also acknowledges a need to spatially stratify these applications. With these precedents and practices in mind, it may be prudent to consider the use of administrative data sources as a partial input to the final determination of Indigenous population estimates.

Having said that, one objective of the scoping study was to explore the options for utilising a unique administrative database to better quantify population mobility between communities in the arid zone of central Australia. This data source was the *Population List Database* that has been collected by the Northern Territory Department of Health and Community Services since 1998 as part of the Aboriginal Communities Health Information Project. Populations from the following communities: Alcoota, Areyonga, Bonya, Docker River, Haasts Bluff, Harts Range, Ntaria, Kings Canyon, Alpurrurulam, Nyirripi, Titjikala, Mt Allen, Mt Liebig, Laramba, Papunya, Santa Teresa, Wallace Rockhole, Yuendumu, Willowra, Aputula and Ti Tree; are recorded on the database via health centre records which include name, date of birth, sex and community of residence. This information is updated at each community every six months with individuals added or deleted as determined by their current usual residence.

The proposition was to process these lists in such a way as to enable a comparison of confidentialised individuals at different points in time in order to gain some insight into patterns and levels of intra-regional mobility. Unfortunately, this exercise failed to proceed owing to the labour intensive requirement of having to approach community councils at each of the locations listed above as laid down by the Central Australian Ethics Committee. The essential message here, is that even if administrative data sets exist, and even if methods can be devised to ensure confidentiality in their use, procedural requirements may influence capacity to gain access and such contingencies need to be anticipated, planned for, and resourced.

Inability to track the substantial movements of population that occur between and within Indigenous communities over time thus remains an issue. This is especially problematic given the five year gap between census counts in the context of high levels of short-term population mobility. Ideally, what is sought is a more regular source of population data that are validated for each community, and that provide a measure of the impact of mobility in the estimation of service populations, much along the lines of estimation work done by Warchivker et al. (2000) in central Australia.

These uncertainties for demographic measures due to enumeration problems and high mobility are highlighted in the context of benchmarking Indigenous social policy outcomes. As Cunningham (1998) notes, governments at all levels are increasingly interested in outcomes and have turned to performance indicators to evaluate the success or otherwise of policy. Given that many such indicators are rate or ratio measures, questions arise regarding the capacity to make such assessments when the denominators used to measure change in social indicators can vary so much between census counts and where these may differ in unknown ways from numerator data drawn from other sources such as administrative collections. For example, rates that use administrative data for the numerator and census-based population estimates as the denominator, may be revised downwards because of an expanded denominator, as occurred, for example, with estimates of Indigenous fertility and mortality in the Northern Territory following the 1996 Census (ABS 1997a, p. 55; 1997b, p. 47). As Cunningham (1998) points out, uncertainty regarding the population in both numerators and denominators and the extent to which these move together over time presents particular difficulties for the assessment of trends.

3.3 Temporary mobility and population counts

The Australian census is the most comprehensive source of information on the size and composition of the population at a single point in time, census night. The census also provides the basis for three related, but quite distinct measures of the population: Census Count, place of usual residence (UR) and Estimated Resident Population (ERP) (Bell & Ward 1998a). Table 3.1 details the key differences between the three measures of population together with their availability. It is evident that, although related, the measures will result in different population numbers. The Australian census is conducted on a *de facto* basis, thus people are enumerated where they happen to be on census night, irrespective of their place of usual residence. Thus the Census Count comprises those residents at home as well as visitors to the area, both from overseas and from other parts of Australia. The UR measure accounts for the *de facto* nature of the census by statistically returning all visitors (also known as temporary movers) to their place of usual residence, as indicated on the census form, with overseas visitors excluded. Thus, visitors to the area are excluded, and residents temporarily absent elsewhere on Census night are added back in. Finally the ERP, a synthetically derived estimate of the population, adds an allowance for under-enumeration and for Australian residents temporarily overseas to the UR measure. It is the ERP that represents the official estimate of the Australian population.

At a national level, the numerical differences between the Census Count, UR and ERP are relatively small. The 2001 Census Count (18,972,350) was just 1.1 per cent above the figure for Usual Residents (18,769,249), representing the number of overseas visitors in Australia on census night. The 2001 ERP (19,386,700) was 2.2 per cent above the Census Count and 3.3 per cent above the Usual Residents figure, revealing the extent of under-enumeration and Australians temporarily overseas. However, it is at the small area level where the differences between these three population measures are more pronounced. For example, comparison of the Census Count and Usual Resident population for SLAs in 2001 reveals that 55 per cent (743) of SLAs in Australia registered up to 5 per cent difference in these two population measures. A further 27 per cent (363) recorded a difference between 5 per cent and 10 per cent, and in a small number of cases, 1.9 per cent (26 SLAs), the difference in the two population measures was in excess of 50 per cent. There are some SLAs where the enumerated population is actually smaller than the usual resident population indicating a net absence of usual residents. Interestingly, these are all located at the outer edges of the semi-arid zone especially in the south west of Western Australia, on the Eyre and Yorke Peninsulas of South Australia, and in central New South Wales and central Queensland as illustrated in Figure 3.4. For the most part though, the overwhelming message from Figure 3.4 is that across the bulk of the arid and savanna zones the enumerated population is substantially higher (more than 30 per cent higher in most SLAs) than the usual resident population. Thus, it is evident that temporary movers, i.e., those enumerated in dwellings not considered as their place of usual residence, substantially augment demands on existing infrastructure and services.

Table 3.1: Difference between Census, Usual Residence and Estimated Resident Population counts

Attribute	Census Count	Usual Residence	Estimated Resident Population
Basis of Calculation			
People counted at home	Included	Included	Included
Domestic visitors	Included at place of enumeration	Returned to place of usual residence	Returned to place of usual residence
Overseas visitors	Included at place of enumeration	Excluded	Excluded

Residents temporarily overseas	Excluded	Excluded	Included at place of usual residence
Under-enumeration	No adjustment	No adjustment	Adjustment made
Availability			
Reference date	Census date	Census date	30-Jun
Updates	Five yearly	Five yearly	Annual
Geographic level	CD	SLA	SLA
Data available	All census data	No family, household or dwelling data	Age and sex only
Timing	First	Second	Last

Source: Bell and Ward (1998)

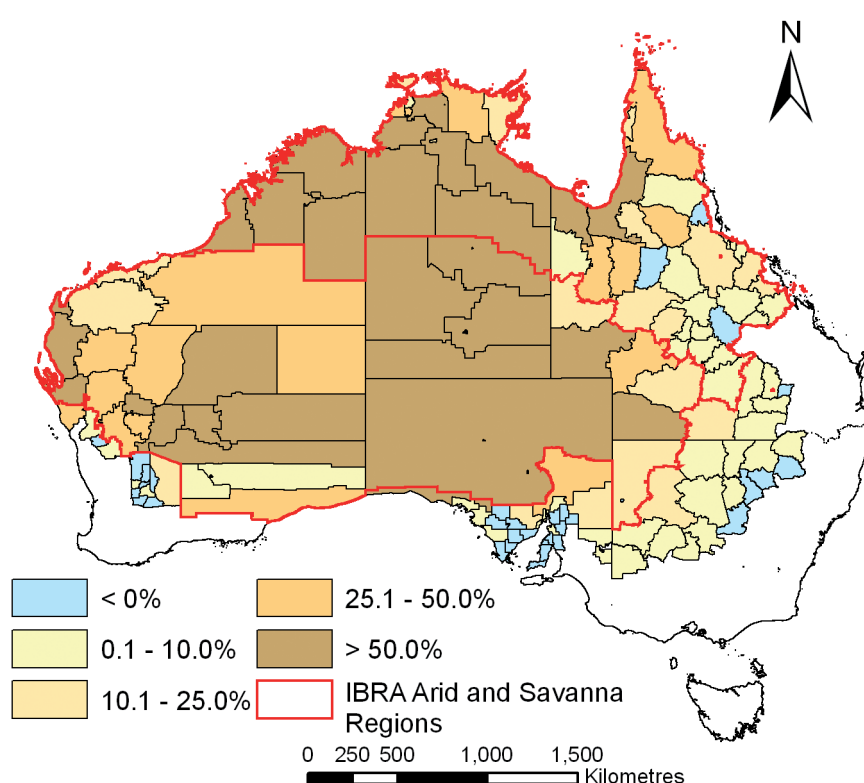


Figure 3.4: Percentage difference between Non-Indigenous enumerated population and Non-Indigenous usual resident population by SLA, 2001

Source: ABS customised tables

The Australian Census is a rich data source on temporary movers: 46 multi-part questions are asked, moves are geocoded to one of more than 1,360 SLAs, and people residing in non-private dwellings are included. Offsetting these advantages, some deficiencies must be acknowledged. Perhaps most serious is that the picture provided by the Census is not necessarily representative of other times of the year. Many forms of temporary movement are highly seasonal (Koenig & Bischoff 2003). For example, vacation trips among families with children are low at Census time because it is deliberately scheduled to avoid coincidence with school holidays (ABS 2005a). Since

the Census is taken on a weekday, it is also more likely to capture business travel and to exclude weekend trips. Thus, care is needed in generalising from the apparent magnitude, composition and spatial distribution of temporary movements revealed by the Census.

The criteria employed to define usual residence also create difficulties. The Australian Census defines usual residence as that address at which the respondent lives for six months or more during the Census year. However, it is difficult to assess how seasonal workers, who spend little time in any one place, interpret the question. Dual-home owners, children in dual families and long-distance commuters create similar problems (Behr & Gober 1982). In the same way, the notion of a single ‘usual’ residence is scarcely meaningful to many Indigenous Australians for whom ‘home’ involves multi-locale relationships (Taylor & Bell 2004). One readily identifiable group of circular migrants whose temporary moves are specifically excluded from the Census are boarders at schools and colleges, who are instructed to regard their school or college, rather than their home address, as their usual residence. The 2001 Census also explicitly recognised that some people have no usual address, however for people who gave this response usual address was recorded for output as “Not Stated” and so the exact number of persons who do not have a usual address cannot be determined. A further issue is under-enumeration. The overall undercount at the 2001 Census was just 1.8 per cent but the figure for people counted away from home was 12.2 per cent (ABS 2003a).

Additions to the resident populations of the arid and savanna zones caused by the temporary movement of people into and out of these regions is significant as it more than offsets any population loss due to out-migration. While it adds to pressure on selected local services, at the same time it generates extra demand and therefore enhances economies of scale. To this extent, temporary migrants form an important element of the regional economy. By their very nature, though, temporary movers are elusive in the context of formal statistical collection, and this is particularly the case among Indigenous populations in remote regions who are frequently mobile over the short-term (Taylor & Bell 2004). While this may lead to undercounting of the population at census time (Martin & Taylor 1996), it can also produce wide discrepancies between client-based population lists (for example in the form of clinic registers), and official head counts (Taylor & Bell 2002a).

3.3.1 Non-Indigenous temporary mobility

Research into temporary mobility—territorial movement that does not involve a lasting change of usual residence (Zelinsky 1971)—has to date been largely characterised by a series of fragmented analyses (Bell & Brown 2006, 2005). However these disparate analyses provide a range of insights into different types of temporary mobility such as seasonal migration among the elderly (Mings 1997; McHugh & Mings 1996; Pollard 1996; McHugh & Mings 1991; Longino & Marshall 1990), seasonal workers (Perloff et al. 1998; Laut 1969), long distance commuters (Green et al. 1999; Houghton 1993), second-home owners (Hall & Muller 2004; Roseman 1985) and convention delegates (Zelinsky 1994). Furthermore, tourism possesses its own extensive, specialised literature on particular forms of travel for pleasure (Hall & Page 2002).

In Australia, spatial patterns of temporary mobility are almost in complete contrast to patterns of permanent migration. Enduring facets of permanent migration include a net loss of migrants from inland Australia to coastal and metropolitan areas and a movement out of metropolitan areas to neighbouring high amenity coastal districts. However these spatial patterns are not evident for temporary mobility (Figure 3.4). While the remote interior lost permanent migrants, it registered

gains from temporary movement. Permanent outflows from the interior reflect the long-standing deficit between job opportunities and population growth, exacerbated since the early 1980s by successive rural crises, the accelerated decline of older industrial and mining towns, and the withdrawal of public and private services from country areas in the pursuit of greater economic efficiency (Bell 1995). Temporary mobility gains reflect a range of motives and types of movement including tourism, stopover travel, and seasonal work in industries such as shearing and fruit-picking (Hanson & Bell forthcoming). One significant component is based on mineral exploration and extraction. In the 1960s and 1970s the minerals boom led to the establishment of numerous small, company-built mining towns in remote Australia (Sharma 1983). Since the 1980s, however, existing towns have progressively closed and new mining activities have been serviced through long-distance commuting based on fly in/fly out (FIFO) arrangements (Storey 2001; Houghton 1993).

As with any form of temporary mobility, gathering data on tourist numbers is notoriously difficult (Carson et al. 2002), with information obtained either from two major survey sources (the National Visitor Survey and the International Visitor Survey administered by the Tourism Research Australia). State based tourism commissions also conduct their own surveys (such as the Northern Territory Travel Monitor). In addition, information can be gathered from accommodation sites such as hotels, motels, hostels, caravan parks and campgrounds. However, not all travellers are captured by these methods and one group in particular that involves large numbers in the arid and savanna zones who remain mostly undetected are off-road 4-wheel drive tourists. Some idea of the scale of tourism numbers in 2001 is provided by the Lake Eyre Basin Heritage Tourism Report (Lake Eyre Basin Coordinating Group 2004) which estimates a total of 614,000 visitors to the Northern Territory Centre, 714,000 to the Flinders Ranges and South Australian outback, and 293,000 to the Queensland outback.

3.3.2 Indigenous temporary mobility

One characteristic of the Indigenous population in the arid and savanna zones which is widely acknowledged as having implications for the delivery of health, housing, employment, education and training services is a propensity for frequent mobility over the short-term (Taylor & Bell 2004; Taylor 1998). This is because of the impact that population shifts may have on the level and composition of service demand and usage in different localities. At the same time, very little is known in a comprehensive way about the scale, direction and pattern of such mobility, or about the characteristics of those involved.

A good example of this lack of information is provided by the 1992 report of the House of Representatives Standing Committee on Aboriginal Affairs into the needs of urban dwelling Indigenous people (Commonwealth of Australia 1992). This report devoted a whole chapter to the needs of what it called 'itinerant' people, mostly in the towns of arid and savanna Australia, but it provided very few data on itinerancy, save for a comment on the higher than average proportion of Indigenous people in hostels and refuges and a table showing the number of beds provided by Aboriginal Hostels Limited. The fact is that policy makers who contemplate the effects of temporary mobility on the spatial pattern of demand for services do so in an information vacuum.

The basic policy issue at stake here is how to most effectively plan for a population that is frequently mobile over the short-term. How is the need for services best defined and provided for when individuals often shift their place of residence, even within the same locality? Which population should be employed as the base when considering such issues as overcrowding in

dwellings, the demand for schools or use of medical facilities? To begin to answer such questions, there is a fundamental need for information indicating the volume, pattern and duration of short-term population movements.

One way of presenting a snapshot of the numbers involved in short-term migration, and the pattern of relocation that this creates, is by cross-tabulating census data on place of enumeration by place of usual residence. In 1991, this revealed that 7 per cent of the Indigenous population was enumerated away from their usual place of residence, somewhat higher than the 4.9 per cent recorded for the population as a whole (Bell & Brown 2006; Taylor 1998). Examination of the spatial pattern of this displacement, using the original 60 ATSI Regional boundaries, revealed that almost half of all moves (43 per cent) were relatively long-distance (to another region) with most of these being transfers between non-metropolitan and major city regions. Very little short-term Indigenous population transfer was recorded between major cities.

Of greater significance was the net effect of these movements in terms of temporarily adding to, or subtracting from, regional populations. Overall, net rates of inter-regional movement were low with gains or losses rarely exceeding 2 per cent of any region's usual resident population, although no doubt the demographic impacts of temporary movement are much greater at the sub-regional level, in particular, localities. At the same time, a fairly regular pattern of regional net gain and loss is evident. It is noticeable, for example, that all major city regions experience net gains, while the majority of broad non-metropolitan regions (80 per cent) record net losses—a pattern of short-term movement opposite to that observed for the total population (Bell & Ward 2000). The indication is that at any one time a proportion of the Indigenous population of major cities and regional centres around the country is comprised of individuals from surrounding areas who are only short-term residents.

In 1991, the degree to which this was so varied considerably from just over 2 per cent in Sydney to over 11 per cent in Darwin. In each case this net shift of short-term movers reflects the spatial concentration of higher-order services in relation to the distribution of much of the Indigenous population. Thus, for many Indigenous people, access to banks, hospitals, government offices, employment opportunities, public housing, sporting events, education and training institutions involves considerable travel and time away from home.

The effect of this mobility to service centres is to create a pool or catchment of population around each service town. Some sense of the size of these population catchments, and their spatial extent, is provided by data from the Indigenous Community Housing and Infrastructure Needs Survey (CHINS) conducted by the Australian Bureau of Statistics (ABS). This survey records the nearest town that members of each community in remote Australia travel to in order to access higher order services such as banking and major shopping. In the 1999 survey a total of 96 service centres across remote Australia were identified as servicing 1,100 smaller communities with a collective population of 80,000 (Taylor 2002). Figure 3.5 provides an indication of the spatial pattern of their catchment areas.

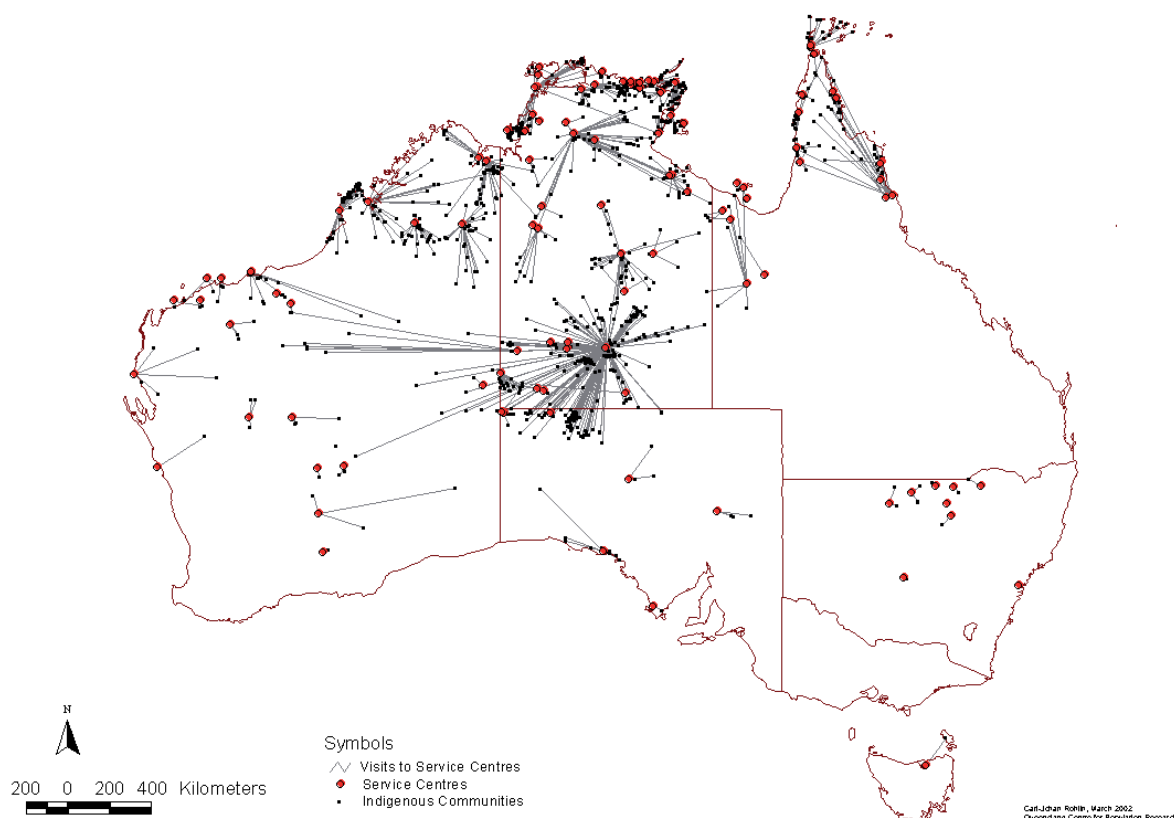


Figure 3.5: Journey to services from discrete Indigenous communities in Arid and Savanna Australia

Source: Taylor 2002

The map highlights the major role played by Alice Springs in servicing vast areas of the arid zone. In all, Alice Springs (population 24,000) services some 260 small Indigenous communities encompassing a combined estimated population of 15,000. Moving north into the savanna, Katherine and Darwin emerge as other major regional centres of attraction, while Cairns stands out in north Queensland. In Western Australia, a string of smaller catchment areas are evident in the savanna parts of the Kimberley and around the arid zone coastal towns of the Pilbara, and interior towns such as Kalgoorlie, Wiluna and Laverton. In each case, the primary direction of circular movement for service access is illustrated and it is significant that not all populations access their nearest service centre. This is partly a function of variable transportation links, but in some instances it reflects patterns of cultural affiliation, as among desert peoples in the centre of Western Australia who prefer to travel long distances eastwards to towns in the Northern Territory. Also of note are the vast distances traversed within many of the catchment areas involving round trips of 1,000 km or more.

Movement of individuals to access services can also generate ancillary flows. For example, in many parts of remote Australia health care strategies are predicated on the air evacuation of Indigenous patients to urban centres for hospital and other health services. Research among the Yolngu from the savanna of northeast Arnhem Land suggests that this transfer of medical patients represents only a fraction of total health-related mobility as it also generates much larger, related movements, primarily of kinfolk anxious to fulfil cultural obligations to “keep company” with their sick relatives for the duration of treatment (Coulehan 1995). Such transience is enhanced by the

fact that the threshold for hospital admissions is often lowered in an attempt to improve morbidity and mortality rates among remote populations, as well as to compensate for the lower effective health service delivery in Aboriginal communities.

This spatial dichotomy between the concentration of services and dispersion of population over vast distances raises a number of questions regarding access and equity (Warchivker et al. 2000; Taylor 1998). For example, if the residence pattern of many Indigenous people is multi-locale, where are services optimally located? Should services be replicated to cater for frequent movement between places? If urban areas are net recipients of temporary sojourners, should urban services be augmented to compensate for additional loads, or should attempts be made to decentralise service delivery to overcome the need for movement? Although the provision of hostel accommodation in towns provides one example of augmented services, what of the pressure on housing in town camps and suburban areas that frequently host visitors? Ultimately, in which location are services legitimately claimed?

3.3.3 Town camps

Many of the issues that arise as a consequence of short-term population movement find their expression in Indigenous living areas within desert and savanna regional towns. The long-standing plight of many Indigenous peoples resident in these locations has begun to attract considerable attention from the federal and Northern Territory governments at the same time as the difficulties of population measurement have also been highlighted by one other Desert Knowledge CRC project: the Tangentyere Population and Mobility Study (Foster et al. 2005). Accordingly, some focus is given here to related population matters, as policy issues concerning town camps are clearly emerging as uniquely arid and savanna zone concerns that encapsulate many of the consequences of (mostly unmeasured) Indigenous temporary mobility.

In 1982, town camps were officially defined as comprising:

... any group of Aboriginals living at identified camp sites near or within towns or cities which form part of the socio-cultural structure of towns and cities, but which have a lifestyle that does not conform to that of the majority of non-Aboriginal residents and are not provided with essential services and housing on a basis comparable to the rest of the population.

(Commonwealth of Australia 1982)

While the term ‘town camps’ has persisted, many such localities are in effect now residential suburbs, although the levels of infrastructure available, the management regimes, and legal tenure of such sites invariably remain at variance with the rest of the urban centre.

As suggested, for the most part town camps are very much a unique feature of arid and savanna Australia, especially in the Northern Territory and Western Australia. Following the displacement of Indigenous people from station work after the granting of the pastoral award in the 1960s, many regional centres such as Darwin, Katherine, Kununurra, Halls Creek, Fitzroy Crossing, Tennant Creek and Alice Springs experienced an influx of people forced into makeshift residential arrangements that were located physically within the boundaries of town or shire councils (or at least on their fringes) but sat administratively outside of their declared areas of responsibility

(Sanders 1984). Over subsequent years, while the legal and infrastructural status of town camps has become more regularised, they have invariably been viewed by town councils and Indigenous migrants themselves as a convenient solution to meeting short-term accommodation needs building on the strong family connections that particular town camps maintain with countrymen from outlying settlements. However, as population numbers have generally risen, and as the necessity for short-term movement into regional towns has also grown as people become more enmeshed in a cash economy, questions are emerging about the adequate measurement of population demand on town camp infrastructure and services in a context of high population turnover. Such concerns emerged, for example, from the Desert Knowledge CRC–sponsored Tangentyere Population and Mobility Study (Foster et al. 2005).

Considerable variety exists in terms of the social and physical structure of town camps ranging from the ephemeral and hastily constructed dry season camp of one family or tribal group (often renewed annually at the same site) through to permanently occupied camps with identifiable core populations—some consisting of one or two related groups and others with a mixture of several groups/tribes/families often with a large transient component. These permanent camps vary considerably in terms of quality of housing and infrastructure from rudimentary shacks with no amenities at all to housing and urban services comparable to those available in any standard suburb.

Apart from the blurring caused by this diversity in Indigenous housing supply, simple distinctions between the population of town camps and the rest of the urban area are further complicated by intra-urban population movement. Unfortunately, census migration data are not sufficiently fine-grained in the small town context to provide any indication of intra-urban mobility while survey work aimed at determining the extent to which such movement does or does not take place has been limited. Consequently, discussion of the precise mechanisms of Indigenous settlement in these urban settings is conducted largely in a void. From a policy perspective, in terms of estimating and planning for appropriate levels of Indigenous housing in town camps or elsewhere in the urban area, there is little appreciation of how individual and household transfers between town and country and between different components of the urban housing supply system impact on each other.

In defining a niche for town camps, the tendency to date has been to view the options for Indigenous urban settlement in simple oppositional terms between residence in a town camp, residence in a suburban house, or residence in a rural community. In this view, the process of settlement is determined by lifestyle criteria (traditional/non-traditional) and structured by two generalised and opposing modes of living—either you are a town camper, a suburbanite, or a community resident. The reality is more complex, as it is often difficult to draw social, economic, and cultural distinctions between these categories.

While the majority of Indigenous people in north Australia who live in suburban houses occupy rented housing commission dwellings, there are some, albeit relatively few, who obtain accommodation through their employer, either public or private, or who are privately renting or purchasing a property. On the other hand, in some urban centres, Aboriginal organisations own conventional houses in suburban areas and rent these out to Aboriginal clients in circumstances

not unlike that of certain town camps. Apart from these options, accommodation in town is also available at Aboriginal Hostels Limited which, in theory, is intended for short term occupancy only but, in practice, often provides a base for longer term residency of up to a year or more.

The only studies that have attempted to quantify population flows in and out of these components of remote urban housing markets are Taylor's (1990a) analysis of intra-urban Indigenous mobility in Katherine in the Northern Territory, and the more recent Tangentyere Population and Mobility Study conducted in the 19 town camps of Alice Springs in 2005 by the Tangentyere Council Research Unit (Foster et al. 2005). Both of these reveal considerable movement between town camps, hostels, and suburban dwellings, as well as directly between town camps and surrounding rural communities. This latter mobility typifies the spatial interaction between towns in the arid and savanna zones and their surrounding regions and is stimulated by the location of kinfolk resident in both town and country as well as by the limited access to higher order goods and services experienced by people living in remoter rural areas. For those migrants who seek to remain in town, residential choices are often dictated by expediency and this can involve movement between town camps, hostels, and accommodation shared with friends or relatives in more conventional suburban housing. Outside of this there are others who occupy dry season camps in and around the town area.

From both of these studies, it is apparent that circular flows of population into the urban residential scene and out again to surrounding communities render estimation of the Indigenous town camp populations, and indeed of the Indigenous population of entire urban areas, difficult. Not surprisingly, the only study to actually observe the official enumeration of Indigenous people in town camps (in Alice Springs at the 2001 Census) found that the count proved extremely difficult and did not capture all people present, particularly visitors (Sanders 1984). The pressing issue, then, is how to adequately establish town camp service population levels?

The 1996 ABS *Review of Demography Statistics* identified considerable support in the policy and research community for the estimation of what it referred to as 'service populations' (ABS 1996, p. 12). This concept arises out of the fact that estimates of usual resident population often fail to account for the use of local services and infrastructure by non-residents. In general, government agencies expressed an interest in service population estimates to assist in policy and planning activities as well as in calculating the costs associated with service provision. At the same time, much work remains to be done to standardise the definition of service populations and to establish methodologies for measurement. For Indigenous populations, such work as does exist suggests that three population totals may be derived for a given locality:

- a base population, defined as the sum of people (residents and visitors) counted by the conventional means of recording the numbers resident at each dwelling at the time of a survey
- a potential population, defined as the sum of the largest number of persons ever to have been accommodated in each dwelling in the course of the year
- a service population, defined as the average population likely to be present at any given time. This is assumed to lie somewhere between the base and potential populations and is estimated from data on visitor numbers and duration of stay.

Variation in these population estimates can be quite substantial. An example is provided by data from a survey of the Bagot Community in Darwin (Taylor 1998). At the time of the survey this was a community of some 300 individuals occupying 40 dwellings on crown lease land. Because of a steady flow of visitors, the service population was estimated to be 41 per cent higher than the base population while the potential population was as much as 75 per cent higher. The considerable effect that this can have on estimates of overcrowding was shown by an almost doubling of housing occupancy rates from 7.5 persons per dwelling to around 13 persons. Similar calculations for the entire town of Katherine revealed a service population 30 per cent higher than the base with average occupancy ranging from six to nine persons per dwelling (Taylor 1990b). In 2005, the Tangentyere Population and Mobility Study estimated a potential service population for the 19 town camps in Alice Springs of between 2,560 and 3,300 (using core residents plus visitor flows over a one year period). This compared to a town camp census count in 2001 of just 973 (Foster et al. 2005). Similar large gaps between enumerated and usually resident populations have also been reported for outlying Aboriginal communities in Central Australia (Warchivker et al. 2000). Because of such discrepancies, Young (1990) advocated some time ago for a regional approach to the estimation of Indigenous service delivery needs in central Australia. Indeed, it can be argued that this needs to be extended across the entire arid and savanna regions.

While there is no doubt some imprecision here, it is clear that much more needs to be done to adequately establish the true levels of service delivery and infrastructure needs in town camps. The indication is that census counts alone fail to capture this and that the short-term nature of much movement in and out of town camps leads to a substantial under-estimation of demographic impacts. At the very least, in planning for service provision, recognition needs to be given to the role that central places fulfil on behalf of adjacent hinterlands. Also apparent is a need to include temporary residents in estimations of household size. Although visitation to households may be an infrequent occurrence in the general Australian population, this is not the case for Indigenous households (Henry & Smith 2002; Taylor 1998; Martin & Taylor 1996). In the meantime, place of enumeration data are best used as a guide to estimating service demand in urban areas, particularly in northern Australia, in the knowledge that these should include a component of temporary residents. Research is also needed to better identify this temporary component in the population, what their special needs are, and where and how these are best met. Many so-called transients in town are, in fact, relatively long-stayers, and while such people may ultimately return to a rural community, the issue of their service requirements whilst away from home is pertinent. Apart from the obvious question of accommodation needs there may also be implications for health and education services, while relatively long absences from home also raise questions about employment and training prospects.

In many rural areas, particularly those in the Northern Territory and parts of Western Australia, South Australia and Queensland, net temporary population loss is prevalent. To compensate for this it is essential that usual place of residence data are employed as the basis for estimating community service requirements as many of the issues raised in regard to urban areas apply equally in rural contexts, for example, in terms of the interactions between outstations and associated host townships. What this study identifies is that an enormous research and information gap prevails in regard to the volume, nature and impact of short-term Indigenous population movements in arid and savanna Australia.

3.4 Accuracy of population accounts

An essential task in the demographic analysis of any region is the assembly of comprehensive population accounts. Such accounts are needed to establish the relative contributions to growth of the various components of population change; they also form the foundation for reliable analysis of key demographic rates (e.g., of fertility and mortality), and for the preparation of reliable assumptions for population projections.

Using the demographic balancing equation, four data items are required when accounting for regional population change:

- usual residence counts at the beginning and end of a period (1996 and 2001 here)
- the number of births over the period in question
- the number of deaths over the same period
- the number of movers in and out over the same period.

We regard usual resident counts as the most appropriate population for demographic accounting because it is conceptually closest to the way the other data items—births, deaths and migration—are collected. Each of the above items were obtained from the ABS for Indigenous and non-Indigenous populations for the period 1996–2001 in respect of the three major biogeographic zones as well as for the area of overlap between the semi-arid and savanna zones. Usual residence counts were from the 1996 and 2001 Censuses, births and deaths data are from registrar general collections as collated by the ABS, and movers in and out were from the standard census question on place of usual residence five years ago. By bringing these data together for each zone in an accounting framework, the aim is to explore the size and direction of population change and the contribution to this of natural increase versus net migration.

The first point to note is that a number of issues combine to compromise demographic accounting. First, usual residence counts do not capture the whole population and involve a different undercount rate at each census point. Second, persons with births and/or deaths registered in one of the zones may not necessarily be part of the zone population. Equally, not all births and deaths are registered and a degree of time lag invariably exists between vital events and year of registration. A third limitation is that census data do not capture all forms of migration into and out of each zone. While movements to and from other parts of Australia are captured, only inwards movements from overseas are encompassed in the Census. The migration data contain no information on people who left the country during the reference period. Thus, a critical component of the demographic accounts is missing. While it may be thought that the extent of overseas emigration from inland Australia may not be large, the fact that this is unknown inevitably compromises the demographic accounting task, and leaves an error of closure. The deficiencies are further exacerbated by the fact that Census migration data are subject to non-response and also exclude the movements of children born during the reference period.

One technique commonly used to address the above deficiencies is to calculate net migration as a residual, once the other components of population change have been taken out. This overcomes the deficiencies in the migration data themselves (lack of data on emigration, non-response to Census questions, lack of data on migration of the birth cohort). However, the residual estimate also inherits any errors in the vital statistics data or in the original population counts. All of these reasons mean that the estimation of net migration as a residual from natural increase is imprecise, and while census migration data are to be preferred, these often produce a quite different scale and, sometimes, direction of net migration than that derived from the balancing equation using vital registration data.

Further complications arise when accounting separately for Indigenous and non-Indigenous population change since it is not clear where to allocate people who do not indicate their Indigenous status. In the arid zone, for example, this amounts to 12,099 persons (or 7.2 per cent of the 2001 usual residence count), in the semi-arid zone 17,101 persons (or 4.4 per cent of the usual residence count), and in the savanna 25,622 persons (or 5.5 per cent of the usual residence count).

With these caveats in mind, the accounting results are shown in Tables 3.2–3.5. Overall, the arid zone population count fell by almost 4,000 between 1996 and 2001, the count in the semi-arid zone fell by 638, while the savanna population count increased by almost 27,000. Demographic reasons for these outcomes appear to vary in reliability. For example, if we use natural increase based on registration data, then estimated net migration loss in the arid zone appears reasonably close to that obtained from census data and we can reasonably conclude that a high rate of net migration loss from the arid zone of somewhere between 89–102 persons per thousand is responsible for the decline in population. In the semi-arid zone, a reduction in usual residence count is also due to net migration loss, but the Census data show a much higher level of loss than is apparent from the residual estimate. If the Census migration data are correct, this implies a significant (and seemingly improbable) gain from international migration. The gap in the net migration rate of between 44 and 69 persons per thousand is much wider than for the arid zone. In the savanna, the increase in the usual resident count can be attributed entirely to gains from natural increase with the residual estimate showing just a small net migration loss (at 3 persons per thousand). However, the Census data indicate a much higher rate of net outwards migration (at 32 per thousand), again implying a net gain in the order of 12,000 from overseas.

Table 3.2: Components of population change by biogeographic zone: Total population, 1996–2001

	1996 UR count	2001 UR count	Pop change	Births	Deaths	Natural increase	Estimated net migration	Census net migration
Arid	172,652	168,769	-3,883	15,614	4,397	11,217	-15,100	-17,286
Semi-Arid	392,330	391,692	-638	31,486	15,083	16,403	-17,041	-27,044
Savanna	442,230	469,067	26,837	40,418	12,246	28,172	-1,335	-14,816

Note: Total population includes Indigenous status not stated

Note: semi-arid and savanna zones include overlap

Source: ABS customised tables

For the Indigenous population, increased usual resident counts were recorded in all zones (Table 3.3). In the arid zone, this resulted entirely from natural increase due to relatively low net migration loss of between 14 and 20 per thousand. In the semi-arid zone, however, it is not clear whether natural increase alone accounted for population increase since the balancing equation suggests slight net migration gain, while census migration data point to relatively high net migration loss of around 52 per thousand. A similar situation occurs in the savanna.

From a comparison of Tables 3.3 and 3.4, it is clear that the overall declines in arid and semi-arid populations are due to non-Indigenous losses and that these are overwhelmingly due to sizeable net out migration of around 132 per thousand in the arid zone and around 70 per thousand in the semi-arid zone. While the savanna also experiences net migration loss of non-Indigenous population, this is much lower at around 30 per thousand resulting in overall growth in population through natural increase.

Table 3.3: Components of population change by biogeographic zone: Indigenous population, 1996–2001

	1996 UR count	2001 UR count	Pop change	Births	Deaths	Natural increase	Estimated net migration	Census net migration
Arid	31,043	33,165	2,122	4,053	1,479	2,574	-452	-654
Semi-Arid	43,738	48,447	4,709	6,191	1,726	4,465	244	-2,399
Savanna	72,268	81,422	9,154	10,831	2,878	7,953	1,201	-1,514

Note: Indigenous population excludes Indigenous status not stated

Note: Semi-arid and savanna zones include overlap

Source: ABS customised tables

Table 3.4: Components of population change by biogeographic zone: Non-Indigenous population, 1996–2001

	1996 UR count	2001 UR count	Pop change	Births	Deaths	Natural increase	Estimated net migration	Census net migration
Arid	131,225	123,505	-7,720	11,443	2,887	8,556	-16,276	-16,425
Semi-Arid	335,202	326,144	-9,058	25,057	13,157	11,900	-20,958	-24,503
Savanna	351,153	362,023	10,870	29,240	9,301	19,939	-9,069	-13,241

Note: Non-Indigenous population excludes Indigenous status not stated

Note: Semi-arid and savanna zones include overlap

Source: ABS customised tables

Of course, appreciation of the actual change in population size is complicated again by the use of population estimates (ERPs) that adjust for census undercount. Thus, the decline in the arid zone population apparent in the usual resident data is modified when considering the ERPs, while in the semi-arid zone the apparent population loss is converted into clear population gain (Table 3.5). Likewise, the population increase in the savanna is raised even further. Similar adjustments occur to the Indigenous and non-Indigenous population (Tables 3.6 and 3.7).

Table 3.5: Usual residence count and ERP change by biogeographic zone: Total population, 1996–2001

	1996 UR count	2001 UR count	UR change	1996 ERP	2001 ERP	ERP change
Arid	172,652	168,769	-3,883	178,313	176,506	-1,807
Semi-Arid	392,330	391,692	-638	399,547	406,990	7,443
Savanna	442,230	469,067	26,837	457,063	493,616	36,553

Note: Semi-arid and savanna zones include overlap

Note: Usual residence counts exclude Indigenous status not stated

Source: ABS customised tables

Table 3.6: Usual residence count and ERP change by biogeographic zone: Indigenous population, 1996–2001

	1996 UR count	2001 UR count	UR change	1996 ERP	2001 ERP	ERP change
Arid	31,043	33,165	2,122	34,520	37,597	3,077
Semi-Arid	43,738	48,447	4,709	47,805	54,880	7,075
Savanna	72,268	81,422	9,154	80,170	92,139	11,969

Note: Semi-arid and savanna zones include overlap

Note: Usual residence counts exclude Indigenous status not stated

Source: ABS customised tables

Table 3.7: Usual residence count and ERP change by biogeographic zone: Non-Indigenous population, 1996–2001

	1996 UR count	2001 UR count	UR change	1996 ERP	2001 ERP	ERP change
Arid	131,225	123,505	-7,720	143,793	138,909	-4,884
Semi-Arid	335,202	326,144	-9,058	351,742	352,110	368
Savanna	351,153	362,023	10,870	376,893	401,477	24,584

Note: Semi-arid and savanna zones include overlap

Note: Usual residence counts exclude Indigenous status not stated

Source: ABS customised tables

Construction and interpretation of demographic accounts poses a challenge in any spatial setting but the extent of the discrepancies in the semi-arid and savanna regions between census count losses and ERP gains is so large as to cast serious doubt over the quality of one or more of the sources of data employed here. The fact that substantial discrepancies are apparent for both the Indigenous and non-Indigenous populations simply underlines the serious nature of the problem. In our view, this points to deficiencies in basic data that represent a serious impediment to understanding the dynamics of demographic trends and processes in desert and savanna regions, and calls for sustained attention if planning for the future social wellbeing and economic prosperity of either region is to be achieved.

4. Demographic characteristics of biogeographic zones

This section outlines, in some detail, the size, composition, distribution and change in respective Indigenous and non-Indigenous populations of the different biogeographic zones as a background to the development of population projections and ultimately as essential input into the DIS.

4.1 Population size

In area, the arid zone as defined here amounts to 3.5 million km², or 45 per cent of the Australian land mass. The semi-arid zone adds a further 1.79 million km² (23 per cent of the Australian land mass), bringing the total area of the desert to approximately 5.3 million km², or 69 per cent of the Australian land mass. The savanna (which incorporates part of the semi-arid zone), amounts to 1.67 million km² or 22 per cent of the Australia landmass. Using the 2001 total ERPs in Table 3.5, the arid zone population of 176,506 produces an overall population density of 0.05 persons per km², the semi-arid population of 406,990 converts to 0.23 persons per km², and the 491,947 in the savanna produces 0.29 persons per km². Of course, these calculations, especially that for the savanna, include a number of major population concentrations, and if Darwin and Townsville alone were removed from the latter then the overall population density for the savanna would be reduced to 0.14 persons per km². For context, in 2001, population density for the continent as a whole stood at 2.5 persons per km².

It should be noted that these density calculations are based only on those estimated as usually resident. At any given time, the desert region also caters for large numbers of temporary sojourners, mostly tourists, but also specialist groups such as FIFO workers. Estimation of these numbers forms an important component of any comprehensive demography of the region, and is increasingly recognised as a crucial element of regional population analysis, raising crucial issues regarding the selection of appropriate population measures for planning, service delivery, and demographic analysis (Bell & Ward 2000, 1998a, 1998b).

Thus, in 2001, the population counted as present in the desert was much greater than those counted as usual residents, and this was far more so in the arid zone and among the non-Indigenous population as a comparison of Tables 4.1 and 4.2 reveals. The allied point here is that Indigenous census counts in the desert show almost no variation between place of enumeration and place of usual residence. This probably reflects a mix of conceptual problems regarding what constitutes a 'usual place of residence' amongst highly mobile people, plus a real lack of Indigenous intercensal residential change.

The basic enumeration problem here is how to assign individuals to particular dwellings and households as mainstream constructs in situations where extended households and high inter-household and inter-community mobility are the norm. As Morphy (2002, p. 44) has observed, there appears to be some conflation between place of enumeration and place of usual residence in remote area census counting which is not surprising given the high mobility (especially among teenagers and children) that is observed between households that can extend to areas outside of the immediate community, essentially to any locality where kin reside (Peterson 2004; Young & Doohan 1989). Alongside the need for frequent absences to access higher order services this renders the whole notion of a single place of usual residence problematic.

Table 4.1: Non-Indigenous census counts by biogeographic zone, 2001

	Place of enumeration count (1)	Place of usual residence count (2)	Difference (1-2)	Ratio (1/2)
Arid	145,146	123,538	21,608	1.17
Semi-Arid*	351,571	334,642	16,929	1.05
Savanna*	404,005	369,507	34,498	1.09

Note: Includes overlap

Note: Excludes Indigenous status not stated

Source: ABS customised tables

Table 4.2: Indigenous census counts by biogeographic zone, 2001

	Place of enumeration count (1)	Place of usual residence count (2)	Difference (1-2)	Ratio (1/2)
Arid	33,555	33,148	407	1.01
Semi-Arid*	51,086	51,343	-257	0.99
Savanna*	84,300	84,138	162	1.00

Note: Includes overlap

Note: Excludes Indigenous status not stated

Source: ABS customised tables

4.2 Population distribution

The three biogeographic zones are large; they encompass all of the Northern Territory, large parts of Queensland, Western Australia and South Australia, the western half of New South Wales, and even a small portion of north-west Victoria. This creates a cross-jurisdictional context for considering CRC-wide social, economic and environmental issues, and it also means that the degree to which arid and savanna concerns are of interest varies substantially between jurisdictions given the varying degree to which these zones form a part of each State and Territory. The distribution across these jurisdictions of Indigenous and non-Indigenous populations are shown for each biogeographic zone in Tables 4.3–4.5.

Table 4.3: Arid zone Indigenous and non-Indigenous ERPs by State and Territory jurisdiction, 2001

	Indigenous (n)	Non-Indigenous (n)	Total (n)	Indigenous (%)	Non-Indigenous (%)	Total (%)
NSW	1,278	20,674	21,952	5.8	94.2	100.0
Qld	491	2,441	2,932	16.7	83.3	100.0
SA	3,395	10,088	13,483	25.1	74.9	100.0
WA	14,909	79,352	94,261	15.8	84.2	100.0
NT	17,530	26,348	43,878	40.0	60.0	100.0

More than half of the arid zone population is located in Western Australia alone (Table 4.3) and most of this population (84 per cent) is non-Indigenous with a large part of the reason being the wide spread of mining settlement across arid Western Australia including places such as Kalgoorlie, Coolgardie, Port Hedland, Karratha, Newman, and Tom Price. The other main concentration of arid zone population (and the largest Indigenous population) is in the Northern Territory, focused mostly on Alice Springs and outlying Indigenous settlements. Elsewhere, most of the remaining arid zone population is located in New South Wales in and around Broken Hill, followed by South Australia from the Flinders Ranges northwards. Once again, Indigenous peoples here (located largely in the Anangu–Pitjantjatjara lands) are outnumbered regionally by non-

Indigenous residents largely due to mining settlement at places like Olympic Dam, Roxby Downs and Coober Pedy. Queensland has by far the lowest arid zone population located mostly on large pastoral properties.

The striking feature of semi-arid populations (Table 4.4) is the rise in both Indigenous and non-Indigenous populations in New South Wales, Queensland and South Australia (including the Mildura area of Victoria). South Australia particularly stands out as having a substantial semi-arid population (particularly non-Indigenous) focused largely on the agricultural areas of the Eyre and Yorke Peninsulas. In contrast, the Indigenous and non-Indigenous populations of semi-arid Western Australia and Northern Territory are lower than their respective arid zones. However, the proportion of the Western Australia semi-arid zone that is Indigenous is more than twice that of the arid zone.

Table 4.4: Semi-Arid zone Indigenous and non-Indigenous ERPs by State and Territory jurisdiction, 2001

	Indigenous (n)	Non-Indigenous (n)	Total (n)	Indigenous (%)	Non-Indigenous (%)	Total (%)
NSW	14,439	74,207	88,646	16.3	83.7	100.0
Qld	1,187	48,429	49,616	2.4	97.6	100.0
SA	9,568	57,982	67,550	14.2	85.8	100.0
WA	6,686	133,440	140,116	4.8	95.2	100.0
NT	13,866	28,781	42,647	32.5	67.5	100.0

Source: ABS 2001c; Environment Australia 2000

Obviously, the savanna population is restricted to the northern three jurisdictions, with Queensland accounting for the bulk of this followed by the Northern Territory (Table 4.5). The savanna in Western Australia refers essentially to the Kimberley where almost half of the population is Indigenous. In the Northern Territory, the Indigenous share is relatively low (26 per cent) because of the 100,000 non-Indigenous residents of the greater Darwin area. Away from Darwin, Indigenous people predominate across the Northern Territory savanna. The same applies to Queensland in regard to the influence of Townsville.

Table 4.5: Savanna zone Indigenous and non-Indigenous ERPs by State and Territory jurisdiction, 2001

	Indigenous (n)	Non-Indigenous (n)	Total (n)	Indigenous (%)	Non-Indigenous (%)	Total (%)
Qld	37,413	268,019	305,432	12.2	87.8	100.0
WA	15,425	17,200	32,625	47.3	52.7	100.0
NT	39,335	114,555	153,890	25.6	74.4	100.0

Source: ABS 2001c; Environment Australia 2000

4.2.1 Indigenous share

Spatially, then, both the size and distribution of Indigenous and non-Indigenous resident populations varies substantially across the three zones. However, the degree to which this is so is distorted to some extent by the concentration of non-Indigenous population in a handful of large regional and mining settlements as well as in agricultural parts of the semi-arid zone. A more detailed examination of population distribution at the SLA level reveals that the Indigenous presence is more widespread than first appears. This is shown in Figure 4.1.

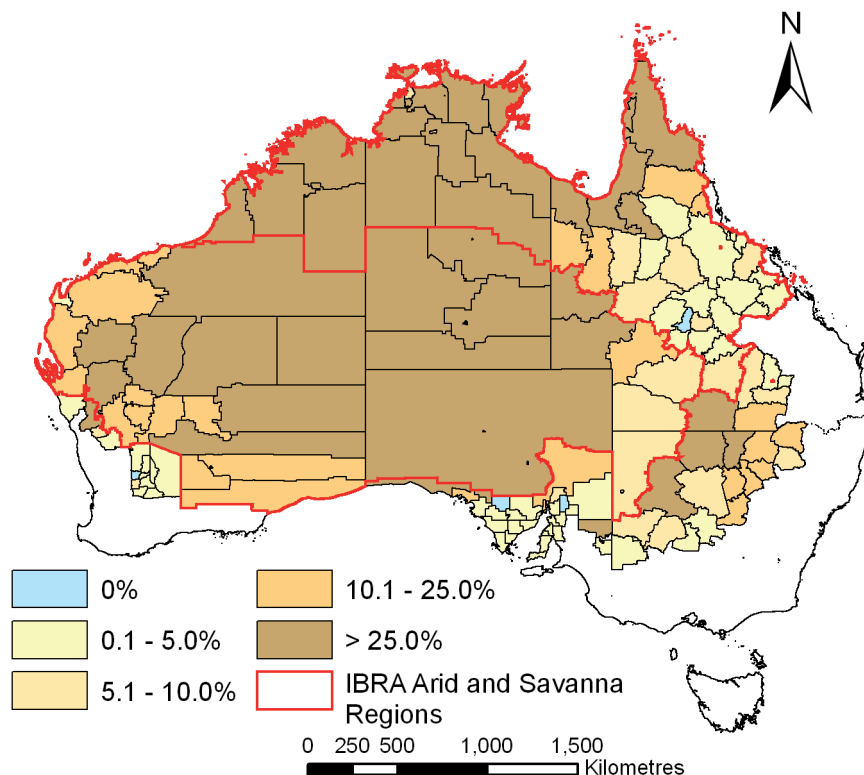


Figure 4.1: Indigenous percent of total SLA population, 2001

Source: ABS 2001c; Environment Australia 2000

Thus, across much of the savanna/semi-arid zones of central/western Queensland, on the Eyre and Yorke Peninsulas of South Australia, and in the semi-arid zone of Western Australia, the Indigenous share of population is uniformly low at less than 10 per cent. The main exception to this low Indigenous representation in the semi-arid zone occurs in central and northern New South Wales with the Indigenous population accounting for over 25 per cent of the total along many parts of the Darling river system, and over 50 per cent in the Brewarrina region (Taylor & Biddle 2004). Elsewhere, as we move inland and northwards into the arid and savanna zones, Indigenous population shares are almost uniformly above 25 per cent and above 50 per cent in most of the Northern Territory, the Gulf country in Queensland, and the Kimberley and select parts of the arid zone in Western Australia.

4.3 Settlement pattern

Not surprisingly, given prevailing low population densities, the arid and savanna zones coincide very closely to the remote and very remote categories of the ASGC remoteness structure as shown in Figure 4.2. These categories are constructed on the basis of scores from the Accessibility/Remoteness Index of Australia (ARIA) that, in turn, derive from measures of road distance from any point to the nearest town (service centre) in each of five population size classes. 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). Thus, the ASGC 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 2001a). Within the structure, remote and very remote areas are those where such physical access is minimised.

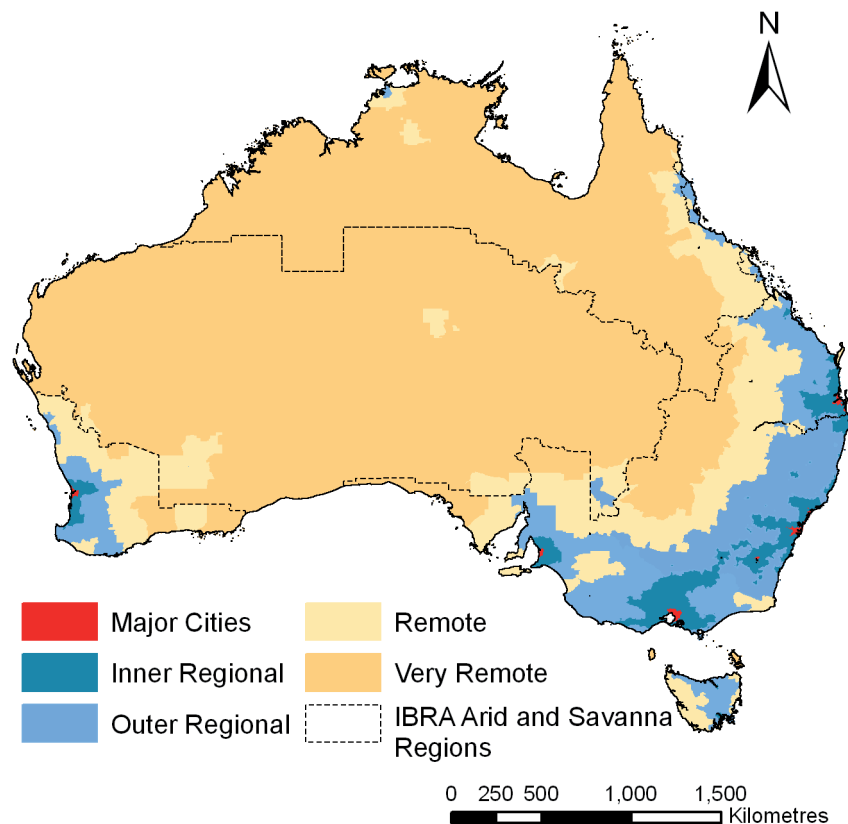


Figure 4.2: ASGC Accessibility and Remoteness Index of Australia (ARIA) regions

Source: ABS 2001c; Environment Australia 2000

It is also worth noting parallels here between the contemporary ASGC structure and the historic distinction drawn by Rowley (1971a) 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. Indeed, away from the larger mining towns and service centres of the outback, it was, and still is, possible to talk of Indigenous ‘domains’ in the sense that Indigenous people and their institutions predominate.

This sense of an Indigenous domain in desert Australia has been strengthened since the 1970s by 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). Such land transfer forms an important element of the post-productivist transition in Australia’s rangelands (Holmes 2002), with newly recognised land values often based outside the market economy, being more culturally-focused.

One manifestation of such values has been 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 savanna zones, and mostly in the Northern Territory, Western

Australia and the far north of South Australia (Cane & Stanley 1985). This provides for quite different residential settings for Indigenous and non-Indigenous populations in these regions. Thus, in 2001, only 28 per cent of the resident Indigenous population of the arid zone was located 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 57 per cent of non-Indigenous desert residents. Likewise, 57 per cent of non-Indigenous residents of the savanna were located in Darwin and Townsville alone compared to just 19 per cent of Indigenous residents.

For some decades now, demographic trends across remote Australia have been volatile. Since 1981, the Indigenous share of the total population within an area approximating the remote and very remote categories of the ASGC Remoteness Structure rose steadily from 12 per cent to almost 20 per cent in 1996 (Taylor 2003b). This occurred as a consequence of differential population dynamics. Thus, the Indigenous population is much younger in age profile and has experienced a much higher rate of natural increase than the population in general. Equally, many Indigenous people remain closely associated with their traditional lands and overall Indigenous net migration loss from remote areas has been relatively low (Taylor 2006; Taylor & Bell 1999, 1996). This contrasts with the historically more recent and ephemeral non-Indigenous settlement of the outback with the experience of recent decades being one of an ageing population and generalised substantial out-migration leading to population decline in many non-metropolitan districts (ABS 2006; Bell 1995; McKenzie 1994; Bell 1992a).

Accordingly, since 1981, the Indigenous population in remote parts of Australia has grown by 23 per cent. By contrast, since 1986, overall non-Indigenous population growth in these areas has been negative (Taylor 2003b). As a consequence, away from the larger mining towns and service centres of remote Australia, Indigenous peoples are increasingly the majority and there is every reason to expect that this will continue to be the outcome. For example, projections to 2016 of the Indigenous population in select regions across much of remote Australia have indicated a rapidly growing Indigenous population in Cape York Peninsula, West Arnhem Land and the Gulf country of the Northern Territory, and more moderate, but nonetheless, sustained growth in the East Kimberley region and across the arid zone (Taylor 2004a, 2003a; Taylor & Bell 2002b, 2001).

Against this, population growth scenarios implied for the non-Indigenous component of the population in these same regions are in many instances negative, and, at best (in the Kimberley and the arid zone), barely positive (Taylor 2004a, 2003b). Thus, across the arid zone, the Indigenous population has been projected to rise from 37,000 in 2001 to 45,000 in 2016 representing an increase in the regional share of total population from 20 per cent to 24 per cent (Taylor 2003a). In the combined regions across the wet tropics from Cape York to the Kimberley, equivalent projections indicate a rise in Indigenous population from 25,600 to 32,400 representing an increase in population share from 38 per cent to 42 per cent (Taylor & Bell 2001). Even in the more economically dynamic remote regions of the outback, such as the Pilbara, the Indigenous share of regional population is projected to continue rising from 16 per cent in 2001 to 18 per cent by 2016 (Taylor & Scambray 2005).

The opportunity to describe the emergent Indigenous settlement structure associated with this population growth is now available from the ABS Community Housing and Infrastructure Surveys (CHINS) which identifies the size (by estimated service population) of discrete Indigenous communities. 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. 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. They are located in all States and Territories but are found overwhelmingly in the arid and savanna lands of Queensland, Western Australia, South Australia and the Northern Territory with major concentrations in central Australia, the Kimberley, the Top End of the Northern Territory and Cape York Peninsula, as indicated in Figure 4.3.

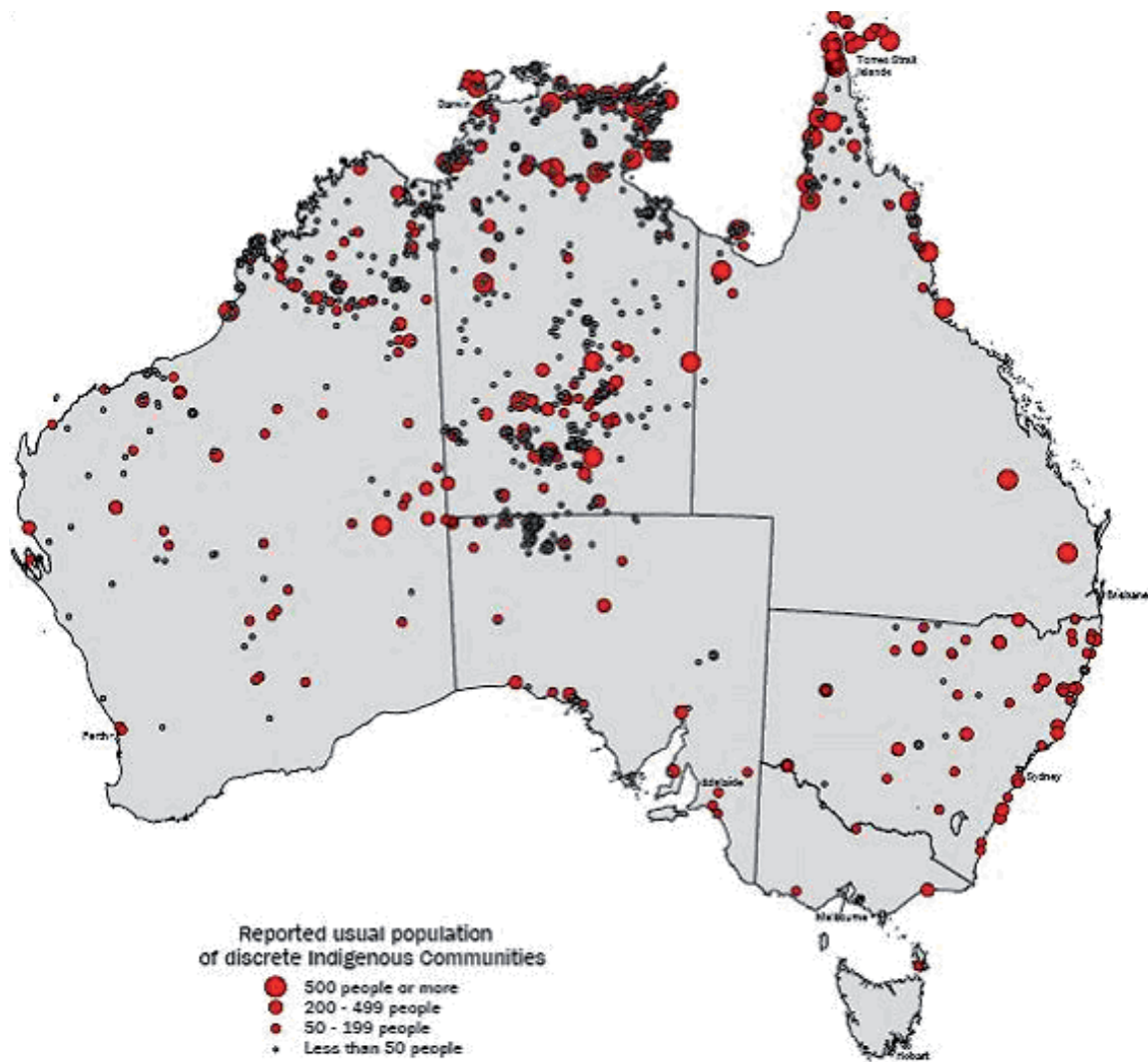


Figure 4.3: Distribution of discrete Indigenous communities, 2001

Source: ABS 2002a

As the product of administrative arrangements, or of Indigenous flight from such, these settlements required no modern economic base, nor have they subsequently acquired one, at least not in a manner beyond the combined provisions of a sizeable state sector, a limited private sector, and variable (though largely unquantified) customary economic activities. The term ‘hybrid economy’ has been coined to describe this structural arrangement (Altman et al. 2006; Altman 2005).

Across the continent as a whole, a total of 1,216 such communities were identified in 2001 with a total reported (service) population of 108,085. However, if we focus on the arid and savanna zones alone we can combine data on the number of settlements of less than 200 persons from the CHINS with the ABS ASGC listing of Urban Centres/Rural Localities (which indicates the number of settlements of 200 persons and over) to develop an almost complete continuum of settlement size distribution for each zone. In the arid zone (excluding semi-arid), a total of 365 localities of less than 200 persons were identified. In the savanna zone the number was 533. These figures reveal for the first time important Indigenous components at the base of the Australian settlement hierarchy.

One long-standing technique for describing the distribution of settlement sizes in integrated urban systems is the rank-size rule (Zipf 1949; Stewart 1947). This states simply that the second ranking settlement in a settlement system will have one-half of the population of the largest (first-ranked) settlement, the third ranking settlement will have one-third of the first ranked, and so on down the hierarchy. Thus, a graphical plot of the rank-size distribution approximates to a lognormal statistical distribution and the degree to which a distribution conforms to the rule is visually expressed by the extent and manner of deviation from a straight line plot. While generally applied to city-sized settlements, the same technique can be used here to help identify the overall structure of the settlement hierarchy in the arid and savanna zones remembering that these are not independent of wider settlement systems outside of these areas.

Figure 4.4 shows the rank-size distribution of settlements in the arid zone against the idealised lognormal distribution. The system is dominated by a series of regional towns of roughly equivalent size (10–30,000 persons) at the top of the hierarchy. These include places such as Broken Hill, Kalgoorlie, Port Hedland and Alice Springs. Below this is a tier of some 17 smaller towns of between 1–3,500 persons. From this level down there are progressively fewer smaller settlements than predicted against the rank size distribution, with 144 localities of between 30 and 1,000 persons, and 270 very small places of less than 30 persons.

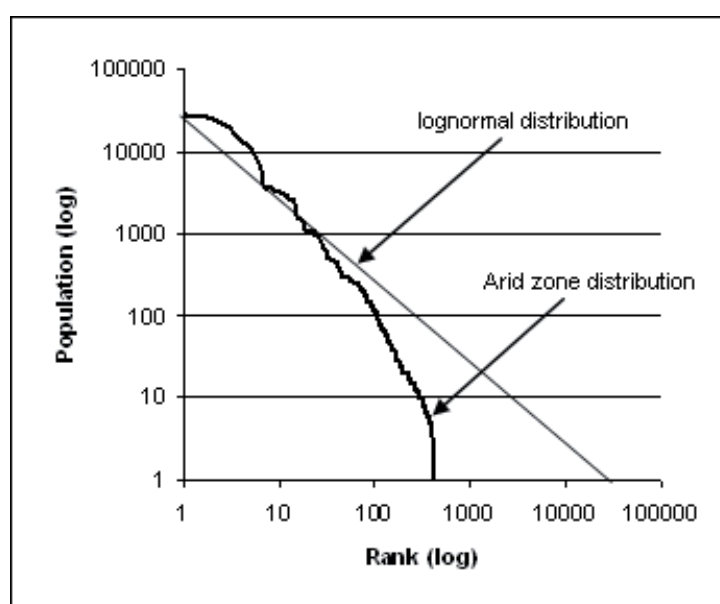


Figure 4.4: Rank size distribution of Arid zone settlements, 2001

Source: ABS customised tables

A similar tiered pattern is evident in the savanna zone (Figure 4.5), although here the top of the hierarchy is occupied by just two large settlements of around 100,000 persons (Darwin and Townsville). The next tier, occupied by Mt Isa and then Broome, with populations of 20,570 and 15,906 respectively, is more or less in line with the predicted rank size. This is followed by a long string of 21 settlements of between 1,000 and 10,000 persons, and then a further 94 settlements between 100 and 1,000 population size all running parallel to the predicted distribution. Below this, at the base of the hierarchy, there is a proliferation of 513 very small localities with less than 100 persons. However, this constitutes far less localities with very few people than would be expected according to the rank size rule.

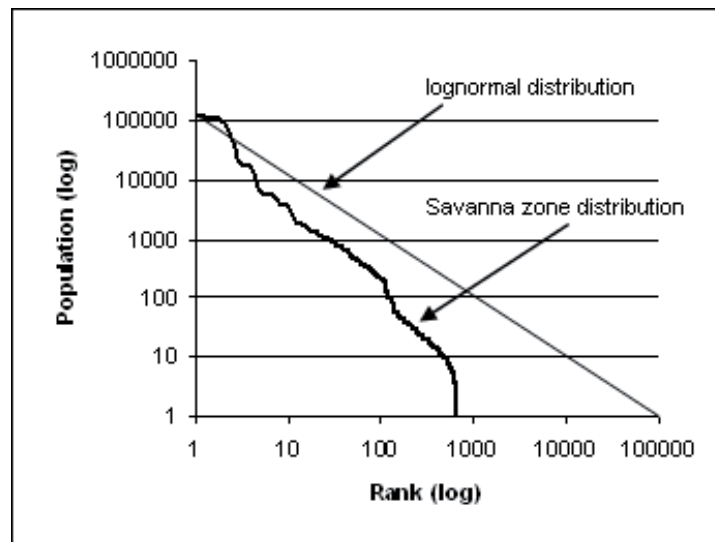


Figure 4.5: Rank size distribution of Savanna zone settlements, 2001

Source: ABS customised tables

What both of these distributions identify is a four-tiered settlement hierarchy in both the arid and savanna zones with each tier stepped by a factor of ten (in terms of population size) from the next. The other common feature is the relative lack of population clusters at the bottom of the hierarchy below 200 population size. This no doubt reflects the unique characteristics of outstation settlement focused on small family/clan groupings with an average size of only 20 persons.

4.3.1 The growth of Indigenous towns

A particular feature of the settlement hierarchy in remote areas, especially in the savanna zone, that deserves special mention as being counter to the general trend is the emergence of several Indigenous towns of more than 1,000 persons that appear to be growing rapidly in size. According to Rowley (1971b, pp. 362–4), the many mission and government settlements across Australia were instrumental in frustrating urbanisation. In his view, they functioned as ‘holding institutions’ serving to prevent the inevitable migration of Aboriginal people to towns and cities (Rowley 1971a, p. 84). With the benefit of more than 30 years, this proposition is only partially upheld. While migration from the bush to towns and cities has undoubtedly occurred, the equally telling observation is that many remote settlements have continued to grow in size and complexity with several achieving the status of ‘urban centre’ within the ASGC. Among those with a population that now exceeds 1,000 persons, or are very close to it, are the following in the Northern Territory:

Wadeye, Maningrida, Nguiu, Galiwinku, Milingimbi, Ngukurr (as well as Larapinta town camp in Alice Springs); and in Queensland: Aurukun, Palm Island, Yarrabah, Doomadgee, Mornington Island, Woorabinda, and Cherbourg. The current trajectory for these towns is for continued growth, in contrast to the fortunes of many other more mainstream country towns.

One interesting observation is that these large Indigenous towns tend to be located in the savanna zone while equivalent institutional settlements in the arid zone do not appear to have achieved similar size or growth rates. Indeed, in the Centre, the pattern of settlement growth observed generally over the past 20 years is one whereby community populations tend to reach a population ceiling (typically between 250 and 500 people) at which point they either stabilise or fragment spatially and decline in size (Taylor 2001). In this region, population growth beyond this has been generally accommodated by the formation of new settlements, initially as satellite outstations, some of which have developed as separate entities. The reasons underlying this expansion of outstation residence across central Australia have been well canvassed (Young & Doohan 1989; Blanchard 1987; Cane & Stanley 1985). These include the capacity to live in smaller, more politically manageable social units away from the social pathologies of overcrowded centralised settlements. There are, it seems, limits to growth for desert communities that may be linked to issues of sociability and community cohesiveness (Fletcher 1990).

Thus, across the arid zone of central Australia the development of outstations appears to have acted as a brake on the continued growth of many Indigenous towns, at least as indicated by their periodic population counts. What these counts do not reveal, however, and what it would be important to know, is the extent to which individuals who occupy outstations nonetheless still spend lengthy periods of time in the main settlement and retain rights of residence there. Nor do they reveal the extent to which the main settlements continue to provide services for their satellites. It appears often to be the case that outstations provide only a short-term alternative residence, especially if their infrastructure and resourcing are rudimentary (Young & Doohan 1989; Cane & Stanley 1985).

Thus, contrary to the outback experience of the past two decades which has seen many country towns (especially in semi-arid areas) facing decline, an emergent public policy issue in the remote Indigenous domain, especially in the savanna zone, is how to accommodate (often literally) urban growth. A prime example of this (and likely to be representative of the situation in all the other towns listed above), is provided by the town of Wadeye in the savanna zone of the Northern Territory. Initiated as a Catholic mission in 1939, this town and its hinterland, have grown steadily ever since to reach of population of around 2,200 by 2005. On current trends, it is estimated to reach 3,800 by 2023 (Taylor 2004b). By that time and at this level, it would constitute the Northern Territory's fourth largest town behind Darwin, Alice Springs and Katherine.

Presently, the population at Wadeye suffers an acute housing shortage with an average housing occupancy rate of 17 persons per functional dwelling. Unless a major upgrading occurs, the population growth trajectory means that Wadeye will be increasingly anomalous in the Australian settlement hierarchy for being a vibrant and growing small-sized country town yet missing significant elements of basic infrastructure and services normally associated with such places due to its legacy of mission, and then Aboriginal community-funding regimes (Taylor & Stanley 2005).

Across northern Australia, there appears to be a significant structural break in terms of the range and number of services and functions located in towns between settlements of up to 2,000 population as opposed to those over this size and up to 8,000 persons (Hugo et al. 2001). A pressing research need in the arid and savanna zones is to consider this relationship between settlement size and function and by comparing the presence or absence of basic infrastructure and services in growing Indigenous towns compared to remote mainstream towns that are comparable in size.

4.4 Population change

As already noted, the relatively narrow economic base of desert and savanna regions, with heavy reliance on primary production and government spending, produces an inherent instability in population levels (Taylor 1989), although the demographic consequences of this vary both temporally and spatially. While pastoral and agricultural areas have shared in the general drain of population from the inland towards coastal Australia, mineral provinces and associated towns have experienced mixed fortunes, while the growth of tourism-related industries has provided a stimulus to growth in some areas. Somewhat related to these changes have been variable expanding or contracting government and other services. The overall net demographic effect is a patchwork, and considerable difference is evident between the Indigenous and non-Indigenous components of the arid and savanna populations.

Between 1996 and 2001, Indigenous population growth was widespread across much of the arid and savanna zones with a number of SLAs experiencing population increase in excess of 20 per cent (Figure 4.6). The main areas of Indigenous population decline were located in the savanna component of central Queensland as well as in localised parts of the semi-arid zone in South Australia and the south-west of Western Australia.

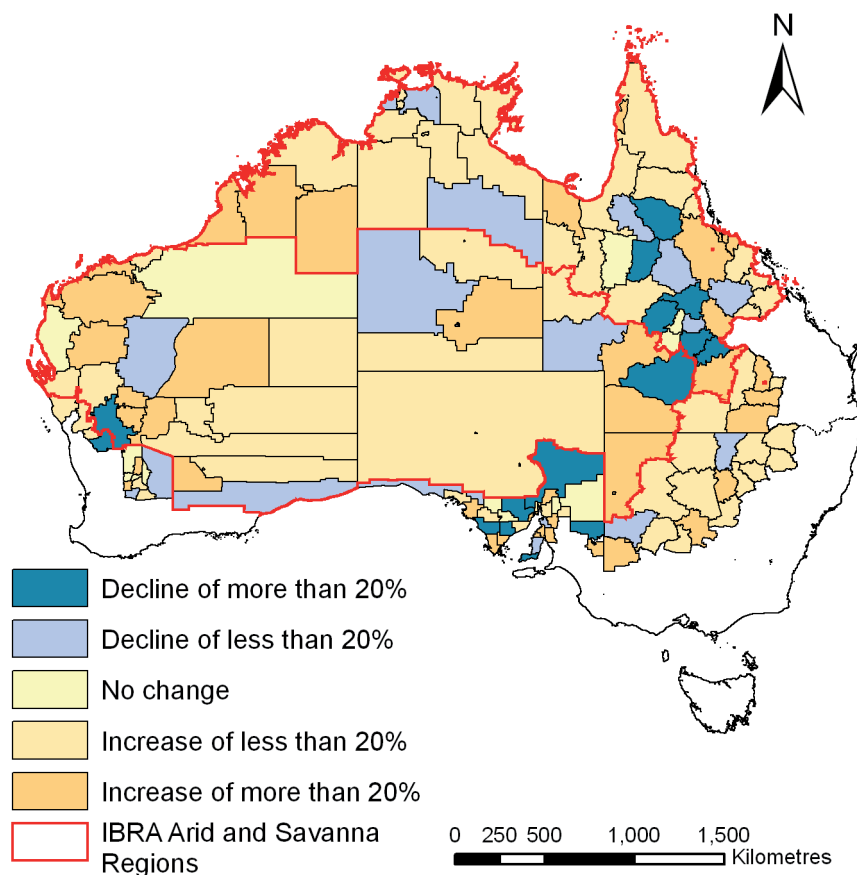


Figure 4.6: Indigenous population change 1996–2001

Source: ABS customised tables

By contrast, non-Indigenous population decline was experienced across most of the arid and semi-arid zone in Western Australia as well as almost uniformly across the Queensland savanna and the semi-arid zone in New South Wales, South Australia and Western Australia (Figure 4.7). Most gains in non-Indigenous population occurred in the arid parts of South Australia and the Northern Territory, as well as across the Kimberley savanna, and in the Gulf country and Arnhem Land. Aside from the Kimberley, one common denominator in these regions of relatively high non-Indigenous growth is their low initial population base.

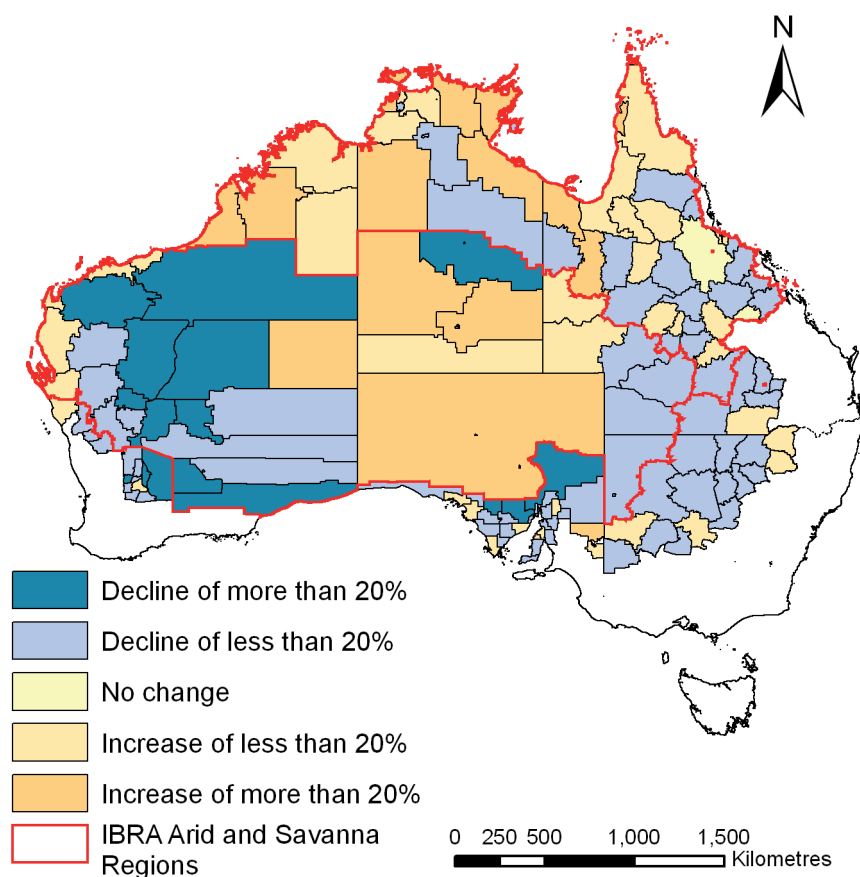


Figure 4.7: Non-Indigenous population change 1996–2001

Source: ABS customised tables

As a consequence of these spatial variations in Indigenous and non-Indigenous population change, substantial variation exists in the degree to which the Indigenous share of total population has increased or fallen (Figure 4.8). Almost the entire arid zone of Western Australia has seen an increase in the Indigenous share of total population and in those few SLAs where the Indigenous share dipped (Carnarvon, Yalgoo and Ngaanyatjarraku), the percentage shift was miniscule. However, the situation in the Western Australian arid zone stands in contrast to that of the South Australian and the Northern Territory arid zones where the Indigenous share of population has declined slightly owing to a greater rate of increase in non-Indigenous population. The same outcome is evident across much of the savanna as well—in the Kimberley, the Top End of the Northern Territory, and Cape York Peninsula. However, reference to Figure 4.1 shows that in all of these areas, Indigenous people still comprise a substantial and often majority share of the population. The other broad region of increase in the Indigenous share of population is in the semi-arid zones of southern Queensland, central and western New South Wales, South Australia and the south west of Western Australia.

Given the varying degree to which the arid and savanna zones fall within particular jurisdictions, it is instructive to consider Indigenous and non-Indigenous population changes by State and Territory. As shown in Table 4.6, all of the growth in Indigenous arid zone population occurred in New South Wales, Western Australia and the Northern Territory, while South Australia and

the Northern Territory were the only jurisdictions to record growth in non-Indigenous arid zone population. The greatest loss in non-Indigenous population from the arid zone (-5,534) occurred in Western Australia resulting in a 6.5 per cent decline compared to a growth in the arid zone Indigenous population in that state of 13 per cent.

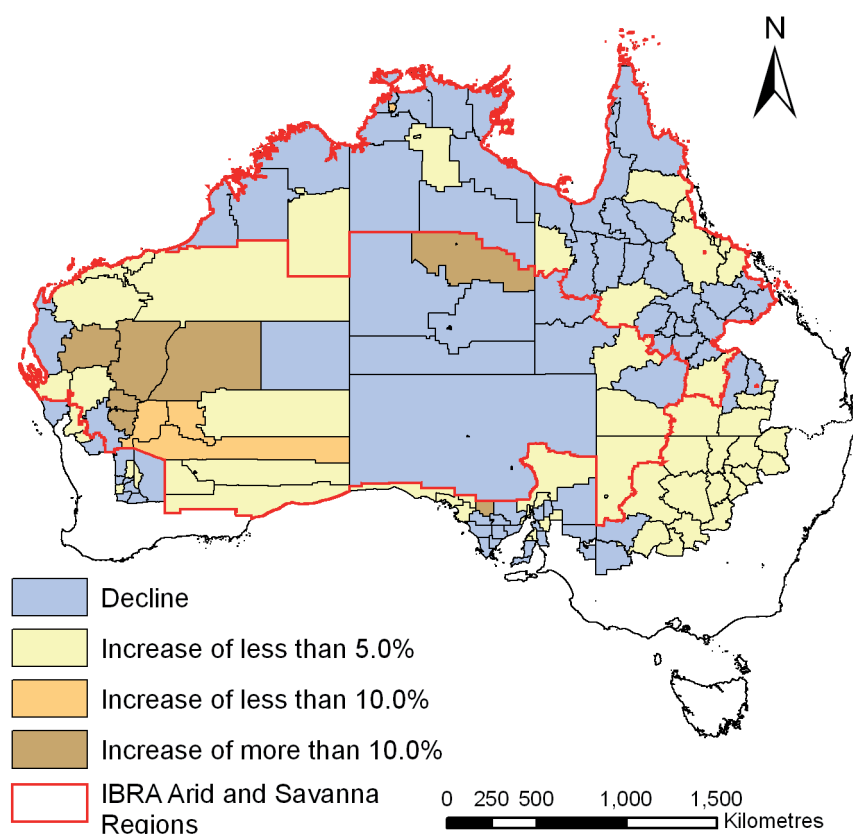


Figure 4.8: Change in Indigenous share of total population 1996–2001

Source: ABS customised tables

Table 4.6: Indigenous and non-Indigenous population change: Arid Zone by State and Territory 1996–2001

	Number			Per cent		
	Indigenous	Non-Indigenous	Total	Indigenous	Non-Indigenous	Total
NSW	417	-1,336	-919	48.4	-6.1	-4.0
Qld	-12	-185	-197	-2.4	-7.0	-6.3
SA	-17	979	962	-0.5	10.7	7.7
WA	1,720	-5,534	-3,770	13.0	-6.5	-3.8
NT	969	1,192	2,117	5.9	4.7	5.1
Total	3,077	-4,884	-1,807	8.9	-3.4	-1.0

Source: ABS customised tables

In the semi-arid zone, Indigenous population growth was positive in all jurisdictions with relatively high growth in Western Australia (the very high growth rate in Victoria reflects a small population base), followed by Queensland and South Australia. By contrast, non-Indigenous population mostly declined with Western Australia being the main exception, although as Figure 4.7 shows non-Indigenous population decline was still widespread across much of the Western Australian semi-arid zone.

Population change in the savanna zone was uniformly positive with Indigenous and non-Indigenous growth rates closely matching in Western Australia and the Northern Territory and much higher Indigenous growth recorded in the Queensland savanna. Non-Indigenous growth in the Northern Territory savanna mostly reflects the continued expansion of the Darwin city region.

Table 4.7: Indigenous and non-Indigenous population change: Semi-Arid Zone by State and Territory 1996–2001

	Number			Per cent		
	Indigenous	Non-Indigenous	Total	Indigenous	Non-Indigenous	Total
NSW	1,048	-1,163	-115	7.8	-1.5	-0.1
Vic	330	3,475	3,805	38.5	7.7	8.3
Qld	1,236	-841	395	14.8	-1.4	0.6
SA	967	-3,520	-2,553	16.9	-2.6	-1.8
WA	2,767	2,642	5,409	25.0	10.1	14.5
NT	727	-54	673	8.6	-0.6	3.8
Total	7,075	539	7,614	14.8	-0.2	1.9

Source: ABS customised tables

Table 4.8: Indigenous and non-Indigenous population change: Savanna Zone by State and Territory 1996–2001

	Number			Per cent		
	Indigenous	Non-Indigenous	Total	Indigenous	Non-Indigenous	Total
Qld	4,887	7,105	11,992	15.0	2.7	4.1
WA	3,018	3,935	6,953	24.3	29.7	27.1
NT	4,064	13,544	17,608	11.5	12.9	12.6
Total	11,969	24,584	36,553	14.9	6.5	8.0

Source: ABS customised tables

As noted earlier, annual intercensal population estimates by SLA are also produced by the ABS, and while these can be used to track population change from 2001 to the present, they suffer from two drawbacks in the context of the current scoping exercise. First, they do not include a breakdown by Indigenous status. Second, they are not available for the entire geographic area of interest here, at least not for the post-2003 period. This last observation requires some explanation. Basically, the ASGC structure was extended in 2003 to cater for a new spatial category carved out of pre-existing SLAs. These were classified as Community Government Council (CGC) areas in the Northern Territory, and as Aboriginal Communities (ACs) and Islander Communities (ICs) in Queensland (ABS 2003b). The purpose was to provide periodic population estimates for numerous new local government entities focused on particular remote Indigenous settlements. However, due to data quality issues caused mostly by small population size, these estimates are made available only for census years. Given that collectively these new spatial units comprise a large component of pre-existing SLA populations this omission leaves sizeable gaps in the intercensal estimates in many parts of the arid and savanna zones, and, in particular, in the following Statistical Sub-Divisions: Finnis, Alligator, Daly, East Arnhem, Lower Top End, Barkly, Central NT (all in the Northern Territory), and Northern Balance, Far North Balance, and North West (all in Queensland). For the most part, though, the semi-arid zone is unaffected by this change and intercensal estimates for SLAs in this zone show a continuation of widespread total population decline, especially in Western Australia (ABS 2006).

4.5 Age and sex composition

Aside from the total population, it is the age and sex composition of the population that will have major implications for the development and implementation of policy initiatives. It is evident that the age and sex composition of the three biogeographic regions display similarities for the Indigenous population and the non-Indigenous population, however there are marked differences between the two populations (Figures 4.9–4.11). Initially considering the Indigenous population, there are three main features worthy of note in each of the biogeographic regions. Firstly, the pyramid has a relatively wide base which is indicative of high fertility, though it is interesting to note that fertility appears to be declining in each of the zones: the 0–4 years age groups are smaller than the older 5–9 years age groups, though this difference may also be due to an error in estimating the 5–9 years age group. Secondly, there is rapid tapering of the pyramids as cohorts age, indicative of high mortality rates for all age groups, but especially the youngest age groups. This appears particularly marked for the male population aged 15–19 and 20–24 years—the group which falls within the ‘accident hump’, indicating death resulting from accidents and violence. Thirdly, the regular decline in population with age is indicative, though not proof, of a net migration balance, something that is not evident in the pyramids for the non-Indigenous population.

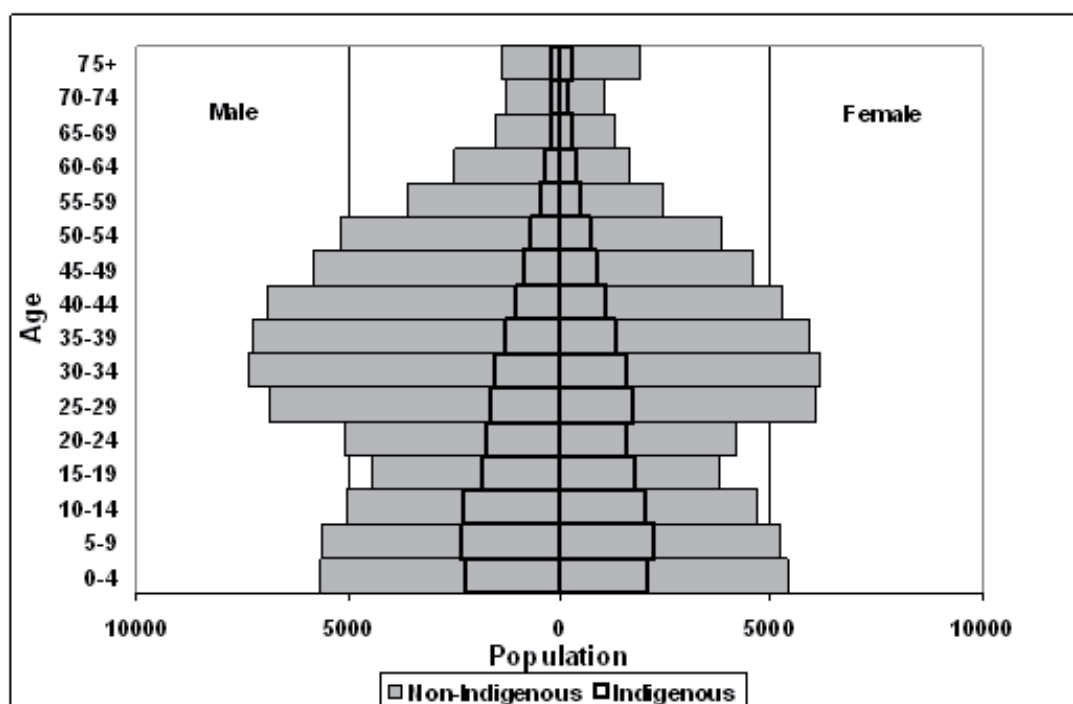


Figure 4.9: Indigenous and Non-Indigenous age distribution, Arid zone 2001
Source: ABS customised tables

In contrast to the Indigenous population, the pyramids for the non-Indigenous population display a relatively narrow base indicative of lower fertility rates, however the level of undercutting in the national figures is not evident in these pyramids. Indeed, this is confirmed in subsequent analysis of total fertility (Section 4.6.2 and Table 4.9 in particular), which reveals lower fertility for the non-Indigenous population compared to the Indigenous population, however total fertility rates for both populations in all zones are considerably higher than the national figure in 2001 of 1.73 births per woman.

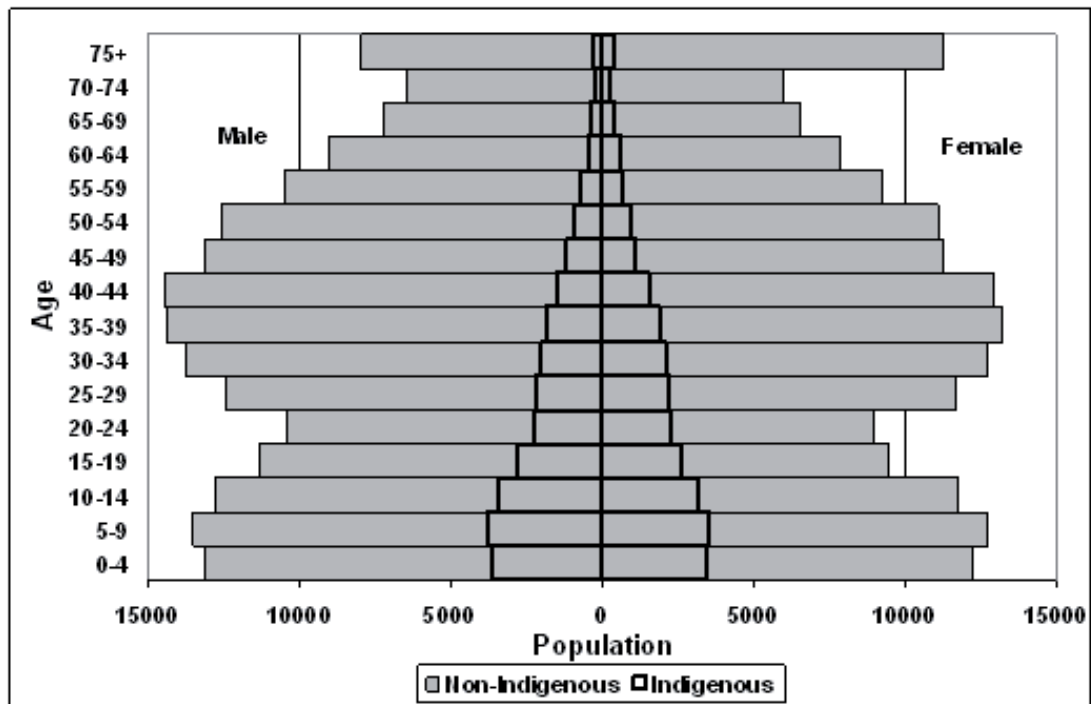


Figure 4.10: Indigenous and Non-Indigenous age distribution, Semi-Arid zone 2001
Source: ABS customised tables

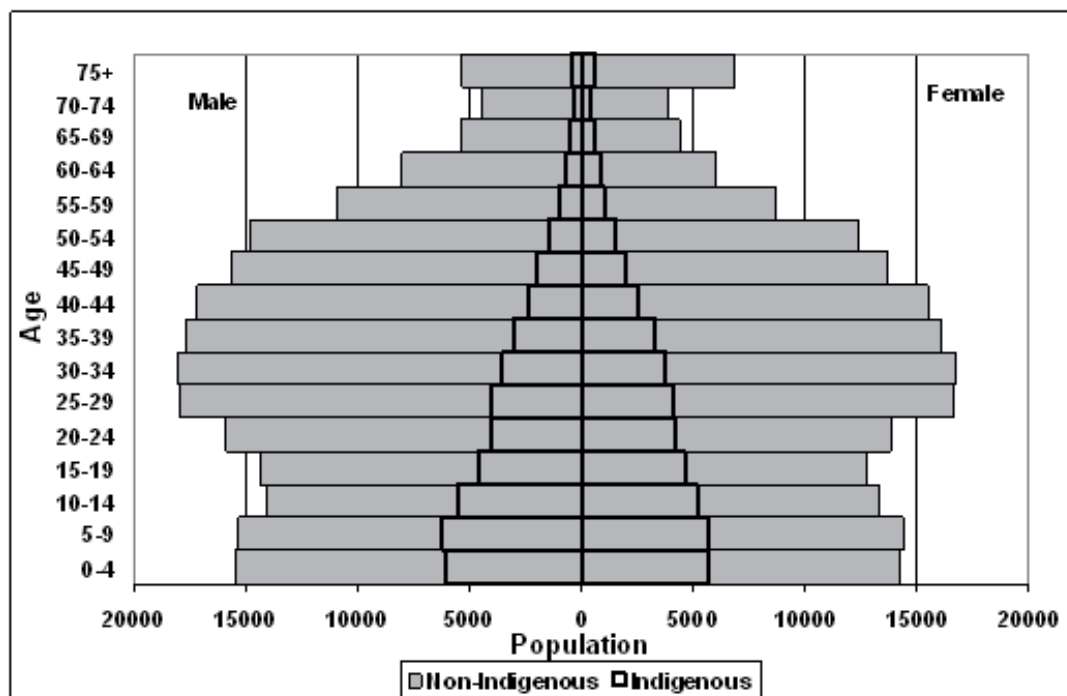


Figure 4.11: Indigenous and Non-Indigenous age distribution, Savanna zone 2001
Source: ABS customised tables

There is a clear reduction in the numbers of non-Indigenous males and females aged 10–14 to 20–24 years for all three biogeographic regions compared to the immediately younger and older age groups. For example, there are a total of 26,257 persons aged 5–9 years in the Semi-Arid zone region in 2001, which decreases to 19,404 aged 20–24 years before increasing to 24,085 persons aged 25–29. This is distinctly different to the even tapering evident for the Indigenous population.

Such a dramatic decrease in the size of these age groups is indicative of net migration loss and given that all three regions display the same trend, the loss appears to be to the rest of Australia, i.e., areas outside of the study regions. The age and sex profile of migration in Australia closely resembles that of other developed countries with a key facet being peak migration occurring among young adults aged 20–25 years. The reasons for such an age and sex schedule have been well documented, with the main drivers being events occurring in the life course—education, leaving the parental home, employment and marriage being key factors for young adults (Castro & Rogers 1983a, 1983b; Rogers & Castro 1981). For males and females aged 25–34 years it appears that there are net gains which account for the filling of the pyramid in the ‘middle age’ groups. It is not possible to identify whether these are return migrants—the same individuals as those who left 5–10 years previously—however, research (Bell 1995) shows that those aged 25–29 and 30–34 display high rates of return migration, making this a possible explanation.

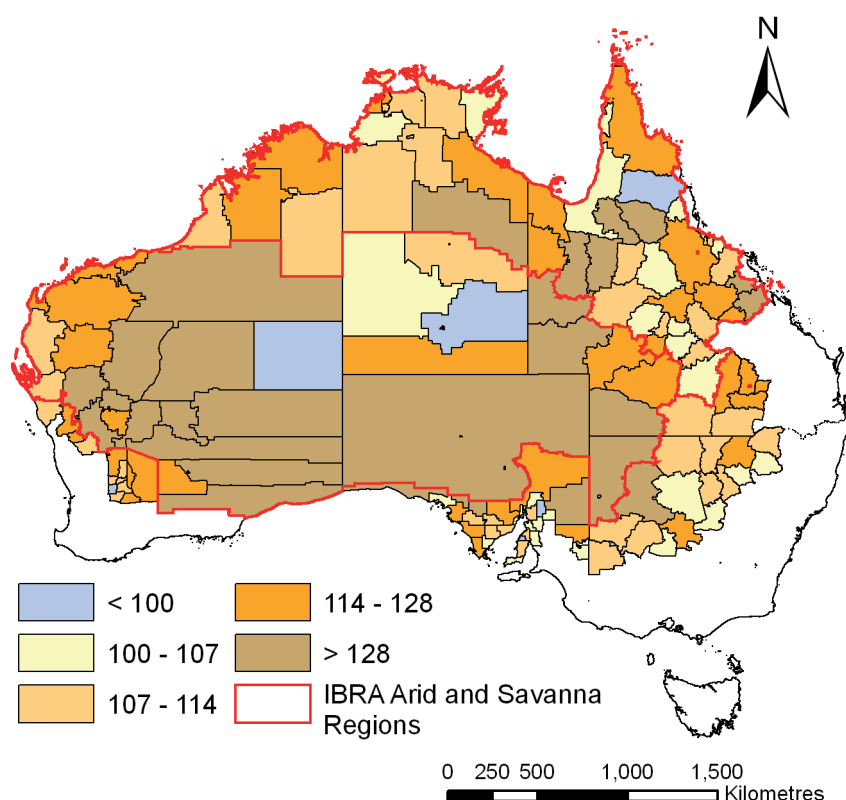


Figure 4.12: Total population sex ratios by SLA, 2001

Source: ABS customised tables

An interesting point to note in the composition of the population within the three biogeographic regions is that it is overwhelmingly male (Figure 4.12). There are only 23 (9.8 per cent) SLAs where females outnumber males, for the remaining SLAs there are more males than females and in some instances this difference is considerable. The highest sex ratios occur in the SLA of East Arm, a port facility in Darwin, where a staggering 95 per cent (416) of the total population of 439 is male. Sex ratios are also particularly high in the SLAs of Litchfield Pt A, Yalgoo and Wiluna where there are over twice as many males as females: 328, 235 and 213 respectively. Closer analysis of these figures by Indigenous status reveals that for each of the four regions the sex

ratios for the Indigenous population are close to parity, an equal number of males and females. Indigenous sex ratios for the arid, semi-arid and savanna zones are 100, 102 and 99 respectively, thus the greatest differences occur in the non-Indigenous population where the ratios are 119, 108 and 111 respectively. Undoubtedly a major influence on the differences between the two populations is the impact of mining operations within the regions. The group of SLAs in the Western Australian desert with particularly high sex ratios include Wiluna, Laverton, Leonora, Meekatharra and the Pilbara, all of which are locales for major mines. The lifestyle of other occupations, such as farming, is also an influence and serves to keep the non-Indigenous population in these areas overwhelmingly male.

4.6 Components of population change

The ABS and State and Territory governments routinely project jurisdictional populations using standard cohort-component methodologies. These require the calculation of estimates of mortality, fertility, and net migration and the establishment of a set of assumptions about how these are likely to change over a given projection period. In a study of population change in the arid zone, Taylor (2003a) developed projections of the Indigenous population based on the ABS experimental Indigenous life table for the Northern Territory, an estimate of Indigenous age-specific fertility based on births registration data for arid zone SLAs, and a census-derived assumption about net migration that set this to zero. No projections were calculated for the total arid zone population as these were already available at SLA level as constructed by the ABS on behalf of the Department of Health and Ageing.

4.6.1 Mortality

An attempt was made to construct a life table for the three zones using registered deaths data by Indigenous status for each of the three biogeographical regions. However, the available data were not sufficiently robust for this purpose. Even when averaged over several years, the basic problem was one of too few numbers, especially in younger age groups, with a correspondingly disproportionate effect on overall life expectancy outcomes. In the long term one option would be to explore the application of alternate life table methods designed to deal with the problem of too few deaths (Toson & Baker 2003) but such a task was beyond the current scoping exercise. In the meantime, in order to progress the analysis, ABS-derived Northern Territory experimental survival ratios for the period 1999–2001 were utilised (Australian Bureau of Statistics 2001b) on the assumption that these would reflect conditions generally across the regions involved.

4.6.2 Fertility

It is well known that the fertility of Indigenous women is considerably higher than that recorded for non-Indigenous women and that peak childbearing age occurs earlier. This differentiation is clearly evident in each of the four regions (Figure 4.13). The highest age specific fertility rates occur in the 20–24 age group for Indigenous women and is highest in the semi-arid region, whereas fertility rates peak for non-Indigenous women in the 25–29 year age group and are also highest in the semi-arid region.

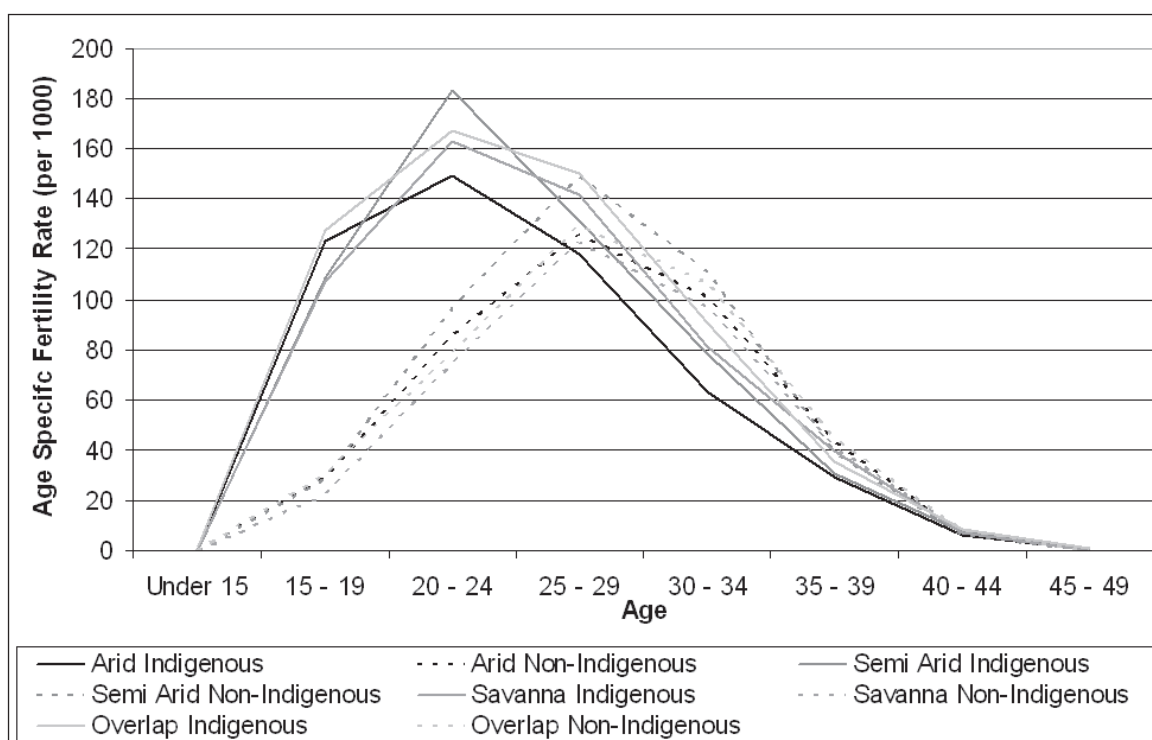


Figure 4.13: Indigenous and non-Indigenous age-specific fertility rates by biogeographic zone, 1996–2001

Source: ABS customised tables

The net result of these age specific fertility rates is to produce Total Fertility Rates (TFRs) that are considerably higher for Indigenous women in each of the four zones (Table 4.9). This is especially so in the Overlap and Savanna regions, with the smallest gap between Indigenous and non-Indigenous rates occurring in the arid zone.

Table 4.9: Indigenous and non-Indigenous Total Fertility Rates, 1996–2001

	Arid	Semi-Arid	Savanna	Overlap
Indigenous	2.45	2.71	2.71	2.91
Non-Indigenous	1.96	2.15	1.82	1.98

Source: ABS customised tables on registered births

It is important to note that the Indigenous TFRs reported in Table 4.9 are likely to be minimum outcomes as they represent Indigenous women's fertility only and do not include Indigenous births to non-Indigenous mothers. They are also based on registered births as opposed to births drawn from midwives' collection (such as those available in Western Australia) that have been shown to produce higher numbers of Indigenous births and higher TFRs than registered births (Taylor & Scambary 2005; Taylor 2004a).

4.6.3 Migration

From Table 4.10 it is evident that non-Indigenous residents of the arid and savanna zones were between 55 and 67 per cent more likely than Indigenous people to have changed their zone of residence between 1996 and 2001. Only in the semi-arid zone did Indigenous people display a greater propensity to move from one zone to another.

Table 4.10: Percent of Indigenous and non-Indigenous populations who changed their zone of residence between 1996 and 2001

	Indigenous (1)	Non-Indigenous (2)	Ratio (2/1)
Arid	35.6	55.0	1.55
Semi-Arid	48.7	38.5	0.79
Savanna	34.7	52.2	1.50
Overlap	33.3	55.5	1.67

Source: ABS Census 2001 customised tables

Figures 4.14, 4.15, and 4.16 show the age pattern of this movement in each of the biogeographic zones. In each case, non-Indigenous movement rates exceed Indigenous rates at all ages except to a limited extent at older ages. Furthermore, the gap in rates is often substantial, especially at the prime movement ages between 15 and 35 years. If there is any variation in this pattern at all it is found in the semi-arid zone where the gap between Indigenous and non-Indigenous rates is somewhat narrower.

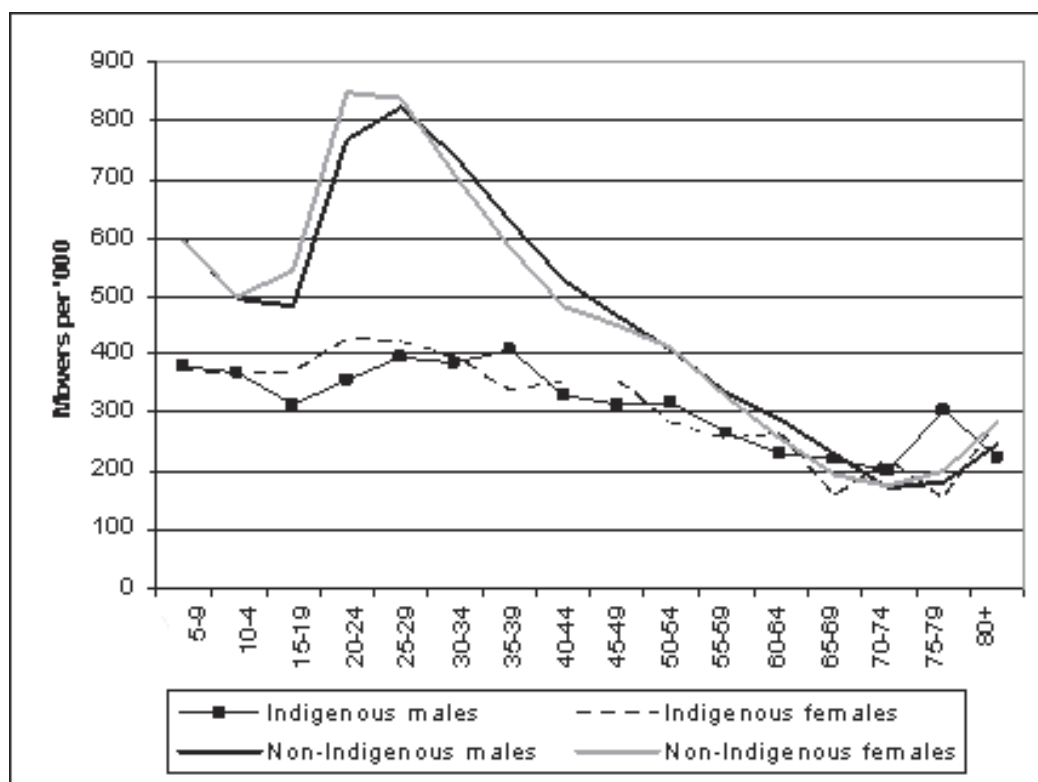


Figure 4.14: Indigenous and non-Indigenous propensities to move by age and sex: Arid Zone 1996–2001

Source: ABS Census 2001 customised tables

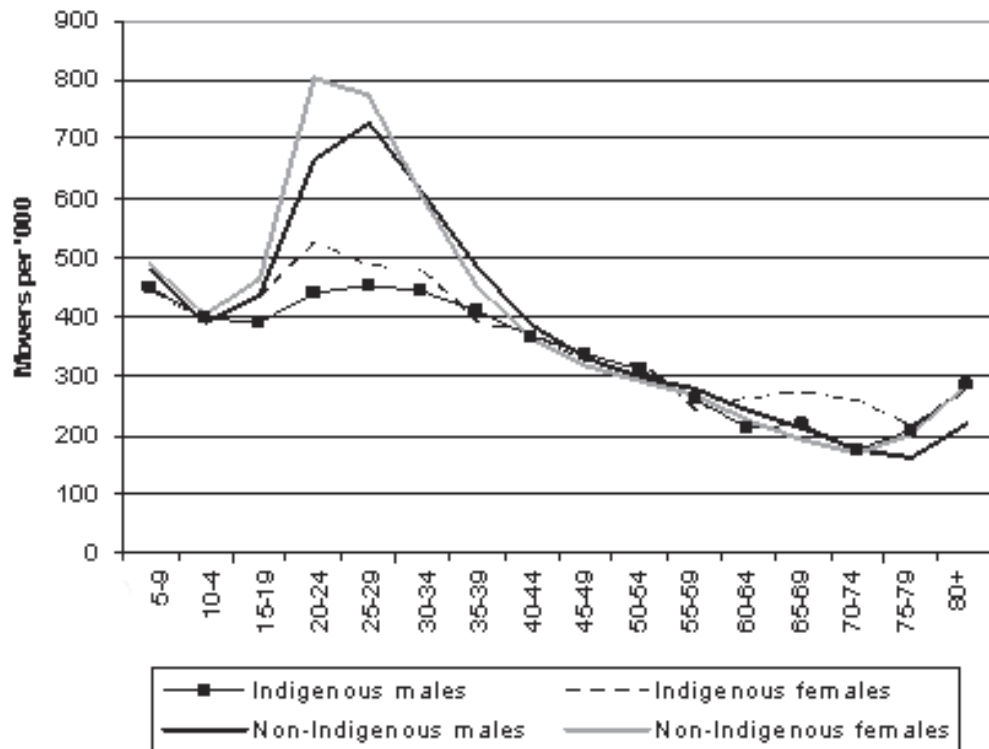


Figure 4.15: Indigenous and non-Indigenous propensities to move by age and sex: Semi-Arid Zone 1996-2001

Source: ABS Census 2001 customised tables

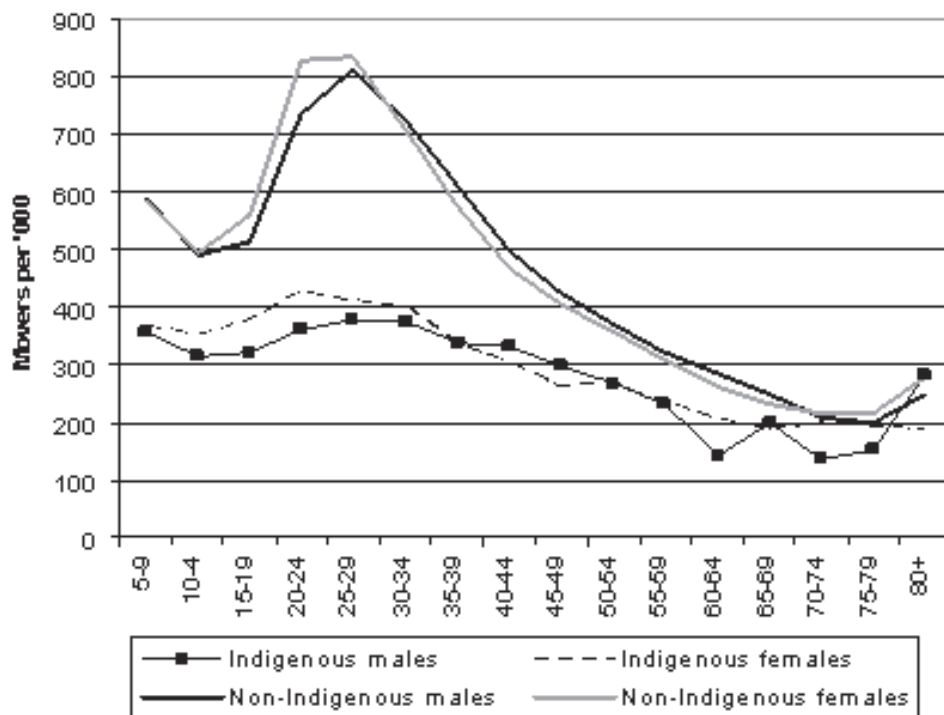


Figure 4.16: Indigenous and non-Indigenous propensities to move by age and sex: Savanna Zone 1996-2001

Source: ABS Census 2001 customised tables

For the non-Indigenous population, the peak in the age profile of migration that is clearly evident in the young adult age range has been firmly linked to the combined influence of life cycle events including departure from the parental home, the start of tertiary education and training, entry into the labour force and the establishment of independent living arrangements (Bell 1995, pp. 19–24). While broad agreement in this patterning of migration by age suggests that similar influences also bear on the Indigenous young adult population, the much flatter profile of Indigenous migration also indicates that such drivers are weaker. This no doubt reflects a combination of cultural and socio-economic factors.

For example, much lower labour force participation is observed for Indigenous people in the arid and savanna zones at ages when job search and job mobility are primary factors in population movement for the rest of the population (Taylor & Scambary 2005; Taylor 2004a, 2004b, 2003c). Also, the establishment of independent living arrangements is likely to be less of a stimulus for migration among young Indigenous adults in cultural settings that place emphasis on maintaining extended kinship ties. In any case, there is often a shortage of available housing to accommodate new household formation, and this, combined with high dependence on rental housing, presents an additional mobility constraint (Henry & Smith 2002).

This lack of census-recorded Indigenous population movement in arid and savanna Australia has been noted before (Taylor & Bell 1999, 1996) and so has the fact that this conflicts with evidence from ethnographic studies that reveals high levels of circular Indigenous population movement in the same regions (Peterson 2004; Young & Doohan 1989). At one level, this simply reflects methodological issues concerning the limited application of fixed-period measures of population movement in situations where circulation is the predominant form of mobility. At the same time, there is a very real sense in which Indigenous people in these regions are not migratory (in the sense of involving residential relocation) even though they are mobile. Unlike the majority of non-Indigenous residents of the arid and savanna zones who originate from elsewhere in Australia, most Indigenous people in these regions are located within kin-defined territories that essentially define their field of spatial interaction (Memmott et al. 2006; Young 1990; Young & Doohan 1989). Invariably, this includes a regional centre (such as Alice Springs, Darwin, Katherine, Port Augusta, Mt Isa, Cairns, Townsville, Kalgoorlie, Port Hedland, and Broome) as well as a network of Indigenous townships and outstations. For the most part, this pattern of interaction confines Indigenous mobility to within zones rather than between zones. The degree to which this also reflects an association between ecological zones and cultural zones is worthy of investigation.

The numbers of people involved in these inter-zonal shifts and the associated net and gross migration rates are shown in Tables 4.11 and 4.12 for the Indigenous and non-Indigenous populations respectively. Interpreting the matrix of these movements requires a little explanation. Basically, according to Table 4.11, between 1996 and 2001 a total of 10,896 Indigenous people left one of the four arid/savanna zones for the rest of Australia, while 7,381 left the rest of Australia to move into one of these four zones. Likewise, a total of 3,360 left the arid zone to some other category, while 2,706 moved into the arid zone from everywhere else.

The key observations from all of this are as follows: all of the arid and savanna biogeographic regions lost Indigenous population to the rest of Australia with the highest rate of loss occurring from the semi-arid zone and lowest from the savanna. To some extent, this may reflect simple contiguity as the savanna is geographically furthest removed from the rest of Australia, although

the degree to which this is the case remains unknown in the absence of an SLA-to-SLA matrix of population movements. Turnover (gross) rates follow this same pattern with the highest rates associated with the semi-arid zone.

Table 4.11: Migration rates of Indigenous population movement between biogeographic zones and the rest of Australia, 1996–2001

	In	Out	Net	Net rate	Gross	Gross rate
Arid	2,706	3,360	-654	-21.1	6,066	195.4
Semi-Arid	2,704	4,051	-1,347	-57.2	6,755	286.9
Savanna	4,379	4,841	-462	-9.3	9,220	184.7
Overlap	2,034	3,086	-1,052	-41.5	5,120	202.0
Rest of Australia	10,896	7,381	3,515	15.9	18,277	82.7

Note: Migration rates are per thousand of the 1996 population

Source: ABS 2001 Census customised tables

The volume of inter-zonal population flow was much higher for the non-Indigenous population (Table 4.12) with an aggregate net loss from all of the arid/savanna zones to the rest of Australia of 46,886 persons. Migration rates were also much higher than Indigenous rates, except in the semi-arid zone, although if this were added to the overlap zone to reflect conditions in the solely semi-arid zone, then non-Indigenous net migration losses from all zones to the rest of Australia can be seen to be substantially higher than Indigenous net migration losses.

Table 4.12: Migration rates of non-Indigenous population movement between zones and the rest of Australia, 1996–2001

	In	Out	Net	Net rate	Gross	Gross rate
Arid	30,970	47,395	-16,425	-96.8	78,365	461.8
Semi-Arid	35,278	52,498	-17,220	-55.7	87,776	284.0
Savanna	61,750	67,708	-5,958	-17.7	129,458	384.4
Overlap	17,139	24,422	-7,283	-86.3	41,561	492.3
Rest of Australia	171,087	124,201	46,886	3.2	295,288	19.9

Note: Migration rates are per thousand of the 1996 population

Source: ABS 2001 Census customised tables

As for the direction of net migration flows, Figures 4.17 and 4.18 show these to be broadly similar for Indigenous and non-Indigenous populations with a clear overall shift out of the arid and savanna zones to the rest of Australia. However, as noted above, significant differences are evident in the intensity of Indigenous and non-Indigenous flows. Thus, the rate of loss of non-Indigenous population from the arid zone to the rest of Australia is almost five times that of the Indigenous population, although the semi-arid rates are similar for the two populations. Higher non-Indigenous net loss is also recorded from the savanna and the overlap area. Compared with these losses to the rest of Australia, flows between the arid and savanna zones are relatively minor for both population groups. The considerable difference in the intensity of net migration loss between the Indigenous and non-Indigenous populations (especially in the arid zone) underlines the key demographic reason why the Indigenous share of total population in these areas continues to rise.

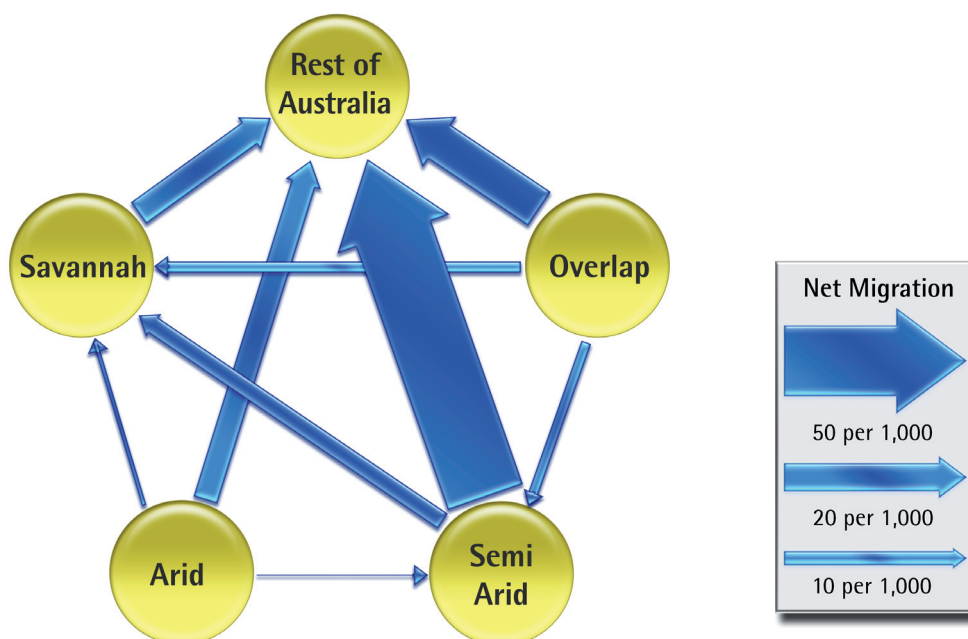


Figure 4.17: Rates and direction of Indigenous net migration losses by biogeographic zones and the rest of Australia, 1996–2001

Source: ABS 2001 Census customised tables

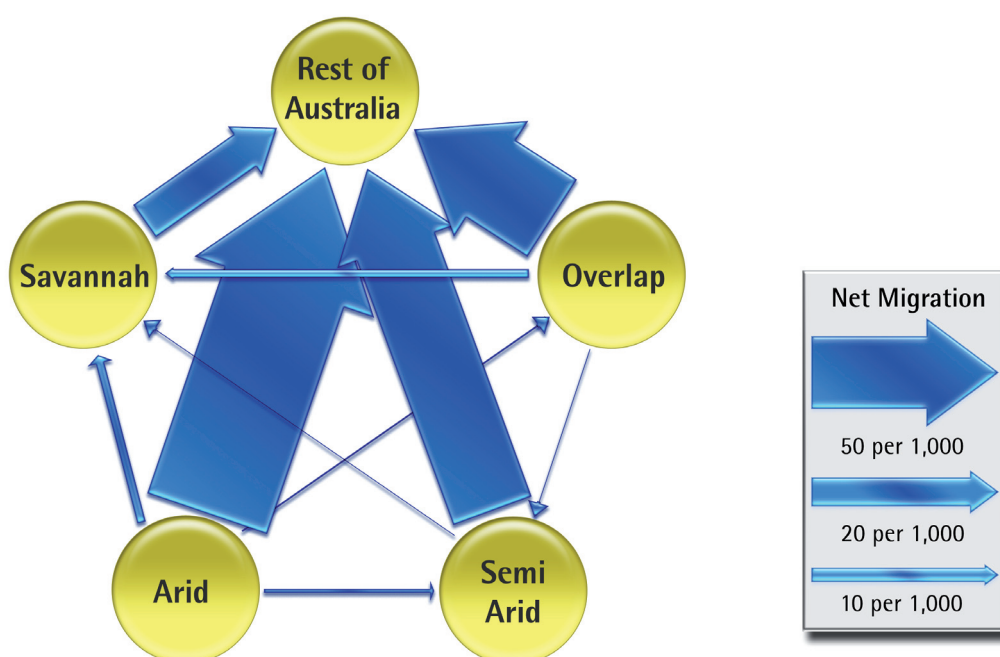


Figure 4.18: Rates and direction of non-Indigenous net migration losses by biogeographic zones and the rest of Australia, 1996–2001

Source: ABS 2001 Census customised tables

4.7 Population projections 2006–2021

4.7.1 Concepts and issues

Well-established methods and techniques exist for the production of population projections at national and regional levels, and even for relatively small areas within cities (Wilson & Rees 2005). There is also a large professional literature that contains the collective wisdom of projection practitioners with respect to the art of population forecasting, which together contains a comprehensive set of guidelines that are 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 horizon (Bell 1992b; Smith & Sincich 1991). It is also well established that projections for large populations are more reliable than those for small populations (Keyfitz 1981).

Partly for such reasons, official projections of Indigenous populations in Australia have only ever been produced for large geographic areas (States and Territories) and never systematically at the level of SLAs, although some case study examples do exist (Taylor 2004a, 2004b; Taylor & Bell 2002a, 2001). Also, they have only ever been prepared for much shorter time periods (10 years) compared to the 20-year and even 100-year projections often applied to the general population (ABS 2005b; 2001b). While such observations do not invalidate the present exercise, they provide an indication of the challenges and innovative nature of projecting small Indigenous populations.

Among the methods available for population projection, three groupings are most relevant to the present exercise: mathematical methods, cohort-component methods, and ratio allocation methods.

For mathematical projections a rate of population growth is either assumed or established empirically and simply extrapolated into the future. If this is done arithmetically then growth occurs by the same amount in each year of the projection period, resulting in a straight line projection when graphed. Alternatively, geometric or exponential growth assumes a compound rate of increase over time, resulting in an upward curve when graphed. While these methods are easy to apply, they produce only a projection of total population, with no indication of population composition, for example by age and sex. Nor do they account for the very important effects that changing age and sex structures can have on growth rates.

The most accurate population projections are those that account for the effects of changes in population age structure and the manner in which these changes interact with other demographic processes. Accordingly, the cohort-component method represents the most commonly used form of population projection. In its most elementary form, the cohort-component technique involves taking a population disaggregated by age and sex, and advancing it through time by ageing each cohort, while simultaneously applying assumptions with respect to the future trajectories of the three components of population change, mortality (survival), fertility, and migration. Rates for these components of change are applied to each cohort of a base population, resulting in a set of projections for a set time period. The process is iterative over the projection period.

The final method of projection—ratio allocation—involves the development of a formula for distributing the projected population of a region among its constituent parts. It is ideally suited to small area geographic entities, such as suburban areas, that are not easily projected by the other methods. It overcomes some of the problems of projecting numbers for localities where relatively

small variations in growth rates can have a substantial numeric effect. Also, the allocation of a share of regional growth to constituent zones sets a limit on the maximum possible growth of each zone, and benchmarks growth against the regional context.

State and Local government planning authorities routinely develop future population scenarios and often seek budgetary allocations on the basis of anticipated needs for human services and infrastructure (Commonwealth of Australia 1997). The 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, individual States and Territories also produce regional and local area projections, down to LGA level or below (Bell 1992b). 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, projections for the total population for each SLA in the country exist for the period 1999–2019 in the ABS series developed for the Commonwealth Department of Health and Ageing (DOHA) in 2000 using 1996 Census-derived estimates as the base. At the time of conducting the scoping study, this was the only official series available that provided SLA-level projections based on a consistent methodology across all SLAs within the arid and savanna zones. Of course, other projection series exist; all States now produce their own small area population projections utilising local information and in-depth knowledge of processes operating ‘on the ground’ (for example see Western Australian Planning Commission 2005). An exception is the Northern Territory Government which does not produce in-house projections for small areas.

In the context of this study, though, there are a number of deficiencies in these State-produced population projections. The most serious limitation of State-derived projections, aside from the fact that none are available for Northern Territory (although these are currently under development), is that individual States are consistently optimistic in projections of their population, as revealed by comparison against projections produced by a central agency such as ABS (Bell 1992b). The effect is that State projections generally sum to a figure considerably higher than that calculated for Australia as a whole by ABS. Thus there is no consistency in the population figures. Further complications arise from the application of different projection methodologies and assumptions. Since Indigenous population projections were not available from any official source at the SLA level, an important element of the scoping exercise was the development of a coherent set of Indigenous projections, at least at the level of the biogeographic regions which form the organising framework for this study. Given the cross-jurisdictional nature of the regions under consideration, this still requires a consistent methodological approach.

Although it would have been feasible to develop a customised set of population projections for this project, the lack of consistent, reliable and robust components of population change data, which are fundamental to the calculation of any projection, would have severely compromised their use in any subsequent analysis or discussion. In essence, population projections in this context need to wrangle three of the most difficult issues in the field: small populations; high levels of mobility; and unreliable data, and as such the calculation of any population projection is a perilous business.

4.7.2 Projections for the biogeographic regions

The approach adopted here, therefore, was to adapt existing projections for the regions as a whole prepared by ABS with a new set of projections for the Indigenous population generated by the authors, using a cohort-component model. As for projections of the non-Indigenous population, the simple approach adopted here was to derive these as a residual between the Indigenous projections and projections of the total population. As noted, total population projections covering the three biogeographic zones were available from the ABS DOHA series, and these were modified by the ABS to produce a new set of projections for the period 2002–2022 for the 234 SLAs contained within the arid and savanna zones. The technical details underlying these projections are set out in Appendix C.

Aside from the fact that these projections of total population are now dated, the main drawback to their use in the present context is methodological. 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 the manner utilised here is statistically problematic. Any estimation and projection of a ‘non-Indigenous’ population would ideally need to be guided by its own unique underlying assumptions, but 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. Nonetheless, an ability to consider the likely changing balance of Indigenous/non-Indigenous population shares is seen as an important element of the scoping exercise and while the residual method of estimation is therefore retained, any conclusions to be drawn are presented as a guide only.

The cohort-component method of projection is applied in line with standard ABS practice. A prerequisite for the development of regional projections based on this method is the availability of data for the geographic units specified on the components of population change by age and sex. Specifically, the following are required for the geographic areas of interest:

- 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
- age- and sex-specific net migration rates for the whole population.

Data for all of these measures are available for the Indigenous population 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.

As we have seen, for many SLAs in the arid and savanna zones, accurate recording of demographic variables is rendered difficult by large geographic areas, 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 (Martin et al.

2002; Warchivker et al. 2000; Martin & Taylor 1996). In addition, Kinfu and Taylor (2005) have noted possible under-reporting of births data in some arid areas that may be due to misreporting of usual place of residence. 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. In the meantime, analysis must inevitably proceed with the data that are available, though careful analysis of these is required in setting projection parameters.

4.7.3 Projection assumptions

Data on Indigenous births by age of mother are available at SLA level. In order to calculate age-specific fertility rates (ASFRs) for the present projection, the approach taken was to group all such records for SLAs in each of the biogeographic regions for the period 1996–2001 and then to average these to produce ASFRs for each zone. Accordingly, the TFRs shown in Table 4.9 are applied and held constant for the projection period.

Conventional practice in small area population forecasting suggests that State/Territory-level deaths data are most suited for projection purposes. However, because the arid and savanna zones straddle several State/Territory boundaries questions arise as to how to proceed; some decision is required as to which jurisdictional figures might best apply. Given that social, cultural, and economic conditions for Indigenous people throughout these zones are predominantly those of remote communities, Indigenous life tables for the Northern Territory were considered the most likely to be representative of prevailing survival chances as they represent a majority non-urban population. Furthermore, these are held constant for the projection period, in line with evidence that life expectancy for Indigenous people has shown little sign of improvement since the mid-1980s (Kinfu & Taylor 2002; Gray 1997).

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 high census non-response and age selectivity. Concerns have also been raised about the gap between empirically observed high Indigenous mobility and low census-derived rates in remote areas (Taylor & Bell 1996). Nonetheless, census data on Indigenous and non-Indigenous net migration in and out of each zone were obtained for the period 1996–2001 and the results are shown by five-year age group for Indigenous and non-Indigenous populations in each biogeographic zone in Figures 4.19–4.21.

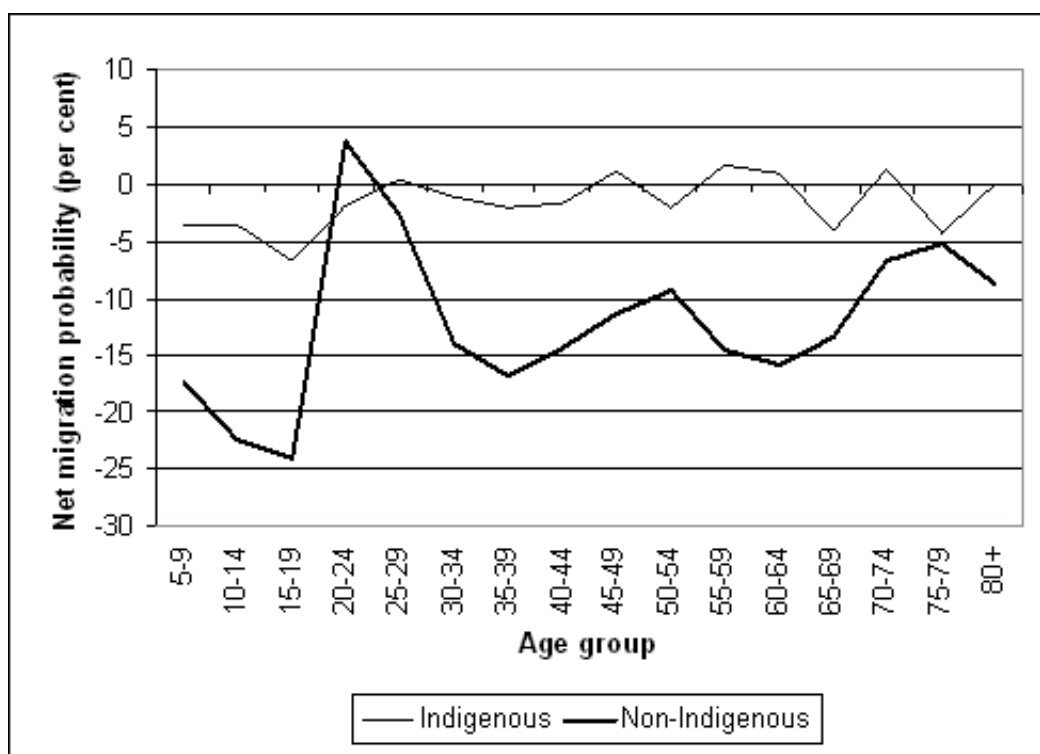


Figure 4.19: Indigenous and non-Indigenous net migration probabilities by age: Arid Zone, 1996–2001

Source: ABS 2001 Census customised tables

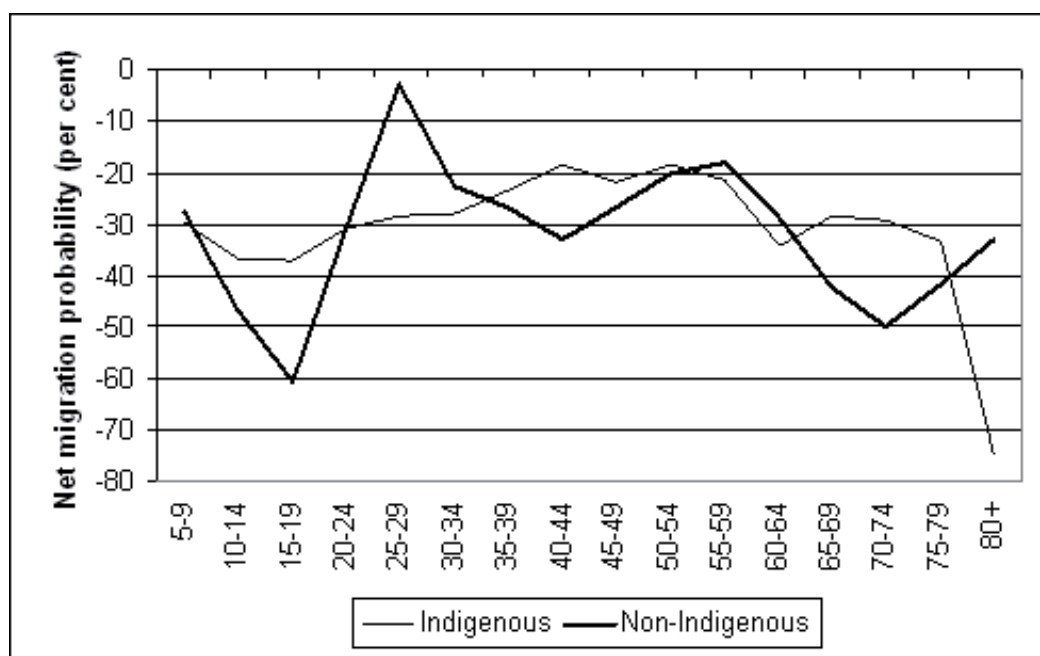


Figure 4.20: Indigenous and non-Indigenous net migration probabilities by age: Semi-Arid Zone, 1996–2001

Note: Semi-Arid Zone includes overlap

Source: ABS 2001 Census customised tables

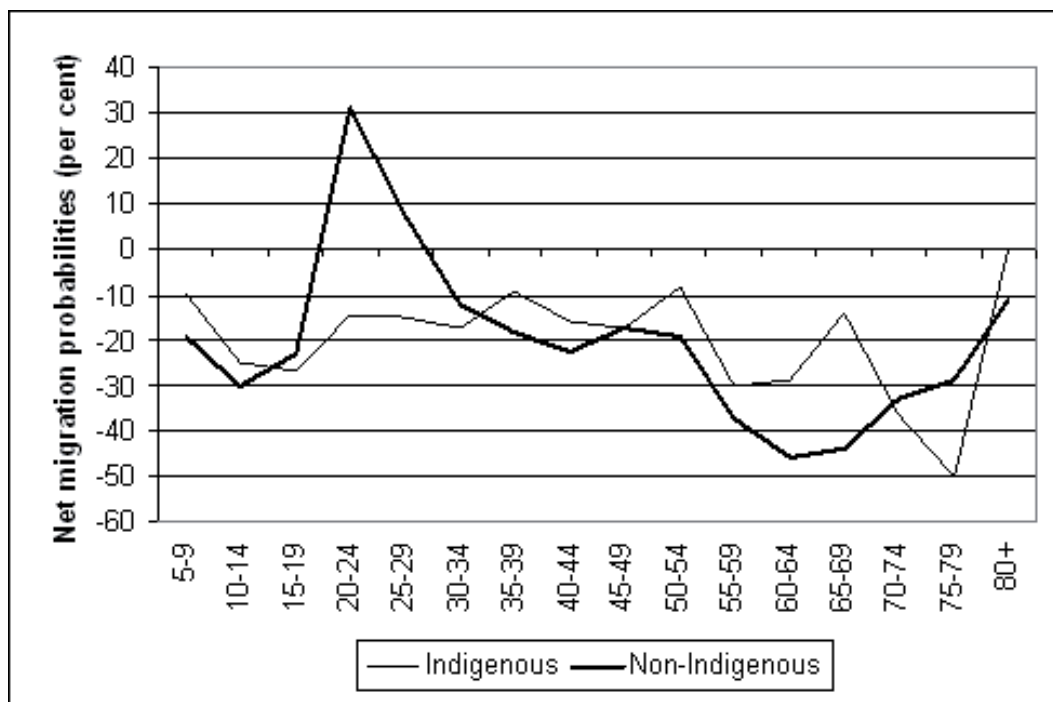


Figure 4.21: Indigenous and non-Indigenous net migration probabilities by age: Savanna Zone, 1996–2001

Note: Savanna Zone includes overlap

Source: ABS 2001 Census customised tables

It is evident that there is considerable volatility in the net migration probabilities obtained from the 2001 Census for the three biogeographic regions, despite using the 5-year interval in an effort to reduce noise in the data. This volatility is irrespective of whether Indigenous or non-Indigenous populations are considered. All regions show a net migration loss for all age groups with the exception of non-Indigenous persons aged 20–24 years, and 55–59 years in the arid region, and aged 20–29 in the savanna region. Ultimately these probabilities are the product of small numbers and of the inability of standard administrative data collections to adequately capture the nature of Indigenous mobility. Memmott et al. (2006) have demonstrated that Indigenous mobility occurs within defined cultural regions, which frequently do not correspond to the geographical boundaries used in administrative data collections. As such, not only is Indigenous migration under-reported in the quinquennial census, but it also does not fully capture the true nature of Indigenous population mobility.

Use of these migration data as input assumptions into our population projections would effectively cause the Indigenous population of all three regions to decrease as net migration losses could not be recouped through natural increase, a process counter to current research indications (Kinfu & Taylor 2005). Furthermore, future patterns of Indigenous migration are far from clear, thus it would not be advisable to keep these migration probabilities constant over time. In light of these limitations, and with the lack of any viable alternative, it was decided to set net migration to zero for all age groups in the following projection of Indigenous populations. However, it should be noted that the DOHA SLA projections from which our non-Indigenous projections are derived make different assumptions regarding migration (Appendix C), though this is for the total population rather than just the Indigenous component.

Table 4.13 summarises the projection assumptions. As indicated, the only Indigenous population growth assumed is that due to natural increase. This is not to suggest that migration of Indigenous people into and out of the various zones does not occur; it is simply assumed for the purposes of projection that such movement as does occur is in balance. Likewise, no allowance is made for any change in the identification of Indigenous people in population numbers, nor for births of Indigenous children to non-Indigenous mothers. These are all refinements that should be considered for further demographic analysis, along with the production of different projection series based on varying assumptions.

Table 4.13: Summary of Indigenous projection assumptions

Component	Assumption
Fertility	Age-specific Indigenous rates based on SLA registered births for each region averaged over 1996–2001, zonal TFRs as per Table 4.9
Mortality	Northern Territory experimental survival ratios 1999–2001 (ABS Cat. 3302.0; 2001) held constant
Net migration	Zero at all ages

Source: ABS 2002b

4.7.4 Projection results

Indigenous and implied non-Indigenous population projections for 2006 and 2021 are shown in Tables 4.14 and 4.15 respectively. The results for the two population groups are quite different. Whereas the Indigenous population is projected to grow substantially in all zones, but especially in the semi-arid and savanna zones, the non-Indigenous population is projected to decline in the arid and semi-arid zones and to grow at a lower rate than the Indigenous population in the savanna. Thus, while the non-Indigenous pattern of projected growth is in line with the experience of many parts of non-metropolitan Australia in recent years (ABS 2006; Tonts 2000; McKenzie 1994; Bell 1992b), Indigenous population growth continues to run counter to this. One consequence of these projected figures is a rise in the Indigenous share of total population from an estimated 22.8 per cent in 2006 to 27.5 per cent in 2021 in the arid zone, from 14.5 per cent to 18.2 per cent in the semi-arid zone, and from 19.3 per cent to 20.8 per cent in the savanna.

Table 4.14: Projected change in Indigenous population by biogeographic zone, 2006–2021

	2006	2021	Net change	% change
Arid	39,840	47,402	7,562	18.98
Semi-Arid*	59,290	74,571	15,281	25.77
Savanna*	100,120	125,831	25,711	25.68

Source: Author's own calculations

* Includes overlap

Table 4.15: Projected change in non-Indigenous population by biogeographic zone, 2006–2021

	2006	2021	Net change	% change
Arid	135,171	124,775	-10,396	-7.69
Semi-Arid*	349,268	334,579	-14,689	-4.21
Savanna*	417,696	479,349	61,653	14.76

Source: Author's own calculations

*Includes overlap

4.7.5 Projections of age composition

Detailed projections for the Indigenous and non-Indigenous populations of each zone were prepared by sex and five-year age group. As a summary device, however, it is useful to consider the changes in demographic composition in terms of age groups that typically form the target of social policy initiatives, at least as far as the five-year classification allows. These are shown as absolute and percentage changes for the Indigenous and non-Indigenous populations of each zone in Tables 4.16–4.21. 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 given the prevalence of premature mortality).

The effects of population momentum and overall ageing are clearly visible in all these tables. 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 age numbers by 2021. Taking the Indigenous population of the arid zone first (Table 4.16), growth is evident in all age groups but the highest percentage (and absolute) increase is expected among those aged 45–64 years. Growth among the school age and transition-to-work age groups is projected to be relatively low.

Projections of the non-Indigenous population in the arid zone (Table 4.17) produce an exaggerated version of this outcome as the only age groups projected to increase are those over 45 years with almost all of this increase expected among those aged 65 years and over. All age groups below 45 years undergo decline. If this were to eventuate it would produce a significant restructuring of the age composition of the arid zone resident population from one that is predominantly youthful and non-Indigenous to one that is increasingly aged and Indigenous. Similar changes in age and Indigenous composition are projected for the semi-arid zone (Tables 4.18 and 4.19). This outcome is a product of several different factors—above replacement fertility of the Indigenous population combined with below replacement fertility and net migration loss in the younger ages of the non-Indigenous population. Thus, this increasing, youthful Indigenous population accentuates the decline and ageing of the non-Indigenous population. A fuller discussion is provided below in reference to Figures 4.28–4.33.

Table 4.16: Absolute and per cent change in the size of social policy target groups: Indigenous population of the Arid zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	4,105	4,821	716	17.45
5–14	8,776	9,050	274	3.12
15–24	7,900	8,267	367	4.65
25–44	12,095	14,728	2,633	21.77
45–64	5,593	8,624	3,030	54.18
65+	1,370	1,912	541	39.51
Total	39,840	47,402	7,562	18.98

Source: Author's own calculations

Table 4.17: Absolute and per cent change in the size of social policy target groups: non-Indigenous population of the Arid zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	9,906	7,367	-2,539	-25.63
5–14	18,426	12,889	-5,537	-30.05
15–24	15,742	11,468	-4,274	-27.15
25–44	46,793	39,287	-7,506	-16.04
45–64	34,148	35,350	1,203	3.52
65+	10,157	18,414	8,258	81.30
Total	135,171	124,775	-10,396	-7.69

Source: Author's own calculations

Table 4.18: Absolute and per cent change in the size of social policy target groups: Indigenous population of the Semi-Arid zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	6,603	8,810	2,207	33.42
5–14	14,406	15,602	1,197	8.31
15–24	11,919	13,527	1,607	13.48
25–44	16,373	22,281	5,908	36.08
45–64	7,792	11,752	3,960	50.83
65+	2,197	2,600	403	18.32
Total	59,290	74,571	15,281	25.77

Note: Includes the overlap with semi-arid

Source: Author's own calculations

Table 4.19: Absolute and per cent change in the size of social policy target groups: non-Indigenous population of the Semi-Arid zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	21,933	16,511	-5,422	-24.72
5–14	47,776	33,753	-14,024	-29.35
15–24	38,922	30,744	-8,177	-21.01
25–44	97,048	82,311	-14,737	-15.19
45–64	93,430	96,603	3,173	3.40
65+	50,159	74,656	24,497	48.84
Total	349,268	334,579	-14,689	-4.21

Note: Includes the overlap with semi arid

Source: Author's own calculations

Table 4.20: Absolute and per cent change in the size of social policy target groups: Indigenous population of the Savanna zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	11,635	14,388	2,754	23.67
5–14	23,635	26,062	2,427	10.27
15–24	19,845	23,096	3,251	16.38
25–44	29,159	37,510	8,351	28.64
45–64	12,699	20,468	7,769	61.17
65+	3,147	4,308	1,160	36.87
Total	100,120	125,831	25,711	25.68

Note: Includes the overlap with savanna

Source: Author's own calculations

Table 4.21: Absolute and per cent change in the size of social policy target groups: non-Indigenous population of the Savanna zone, 2006–2021

Age-group (years)	2006	2021	Absolute change	% change
0–4	27,981	27,112	-870	-3.11
5–14	57,095	52,424	-4,671	-8.18
15–24	58,643	61,520	2,877	4.91
25–44	133,453	144,043	10,590	7.94
45–64	104,060	123,810	19,750	18.98
65+	36,464	70,439	33,976	93.18
Total	417,696	479,349	61,653	14.76

Note: Includes the overlap with savanna

Source: Author's own calculations

In contrast to the arid zones, all age groups are projected to increase in the savanna with the exception of non-Indigenous children under 14 years of age (Tables 4.20 and 4.21). Once again, though, the effects of ageing are clear with Indigenous growth highest in the 45–64 age group and among non-Indigenous population over 65 years.

The following population pyramids provide a full, graphical overview of the changes discussed above (Figures 4.22–4.27). The increase in the total Indigenous population is clear across all age groups, with the exception of the 10–14 and 15–19 age groups which either show very small increases (semi-arid and savanna) or a slight decline (arid). The ageing and decline of the non-Indigenous population provides a stark contrast. With the exception of the savanna region, population decline occurs in all age groups up to those aged 55–59 years, with the greatest losses occurring amongst young adults and those of middle age, most notably those aged 40–44.

The non-Indigenous population in the savanna region follows a slightly increasing trend. Whilst there is undoubtedly population ageing occurring between 2006 and 2021, with considerable increase in the 60+ age groups, these gains are partly offset by gains in younger age groups, notably those aged 20–39 years. Closer scrutiny of these projections reveals the majority of these gains occurring in the larger urban centres of Darwin and Townsville. Darwin Statistical Division shows a 17.5 per cent (2,950) and 24.9 per cent (9,244) increase in the 15–24 and 25–44 age groups respectively, whilst Townsville LGA displays increases of 16.8 per cent (2,912) and 21.3 per cent (6,258) respectively—both of which are considerably above the average for the region (Table 4.21).

The preceding analysis of the population projections with respect to key social policy groups revealed a significant restructuring of the age composition of the arid zone resident population from one that is predominantly youthful and non-Indigenous to one that is increasingly aged and Indigenous. This trend is now considered further with respect to absolute and per cent change occurring within individual age groups (Figures 4.28–4.33). The changes observed for the total population are drawn directly from the DOHA projections, whilst those for the Indigenous population are the result of applying our assumptions to 2001 ERPs and then selecting the 2006 outcome. The non-Indigenous population is merely the residual difference between these total and Indigenous population projections.

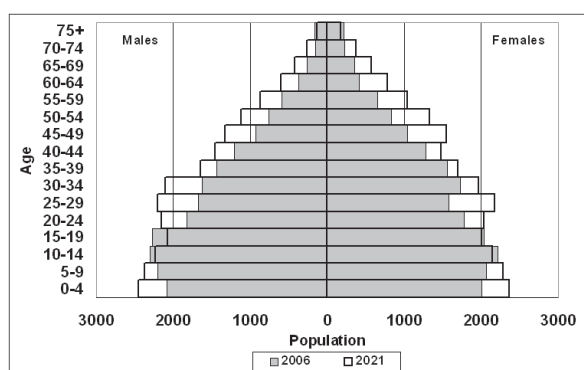


Figure 4.22: Age pyramids for the Indigenous population of the Arid zone, 2006 and 2021

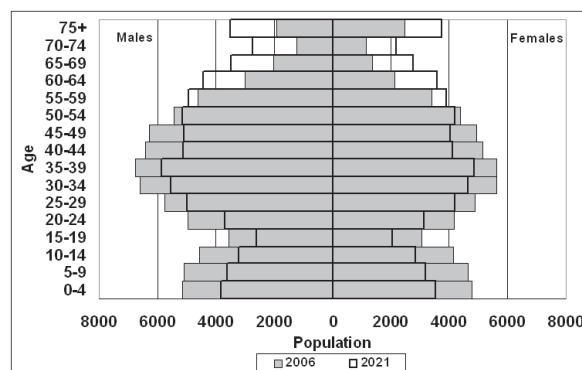


Figure 4.23: Age pyramids for the non-Indigenous population of the Arid zone, 2006 and 2021

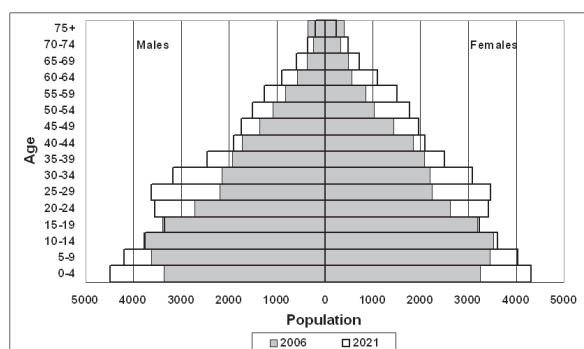


Figure 4.24: Age pyramids for the Indigenous population of the Semi-Arid zone, 2006 and 2021

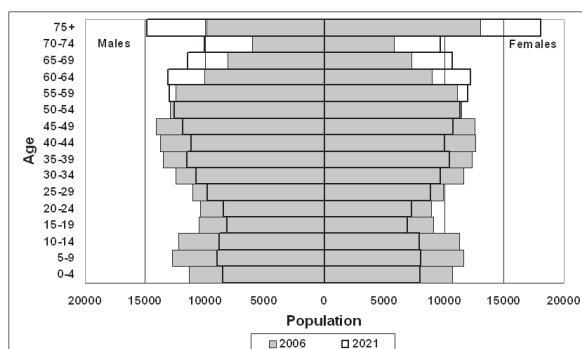


Figure 4.25: Age pyramids for the non-Indigenous population of the Semi-Arid zone, 2006 and 2021

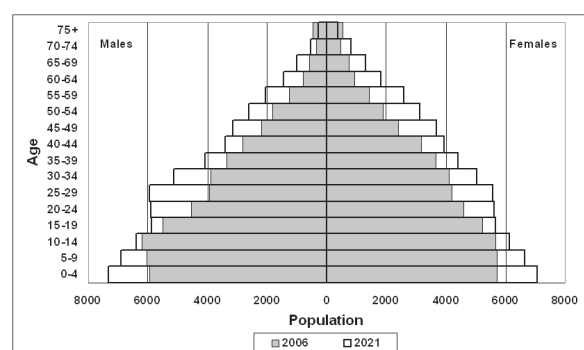


Figure 4.26: Age pyramids for the Indigenous population of the Savanna zone, 2006 and 2021

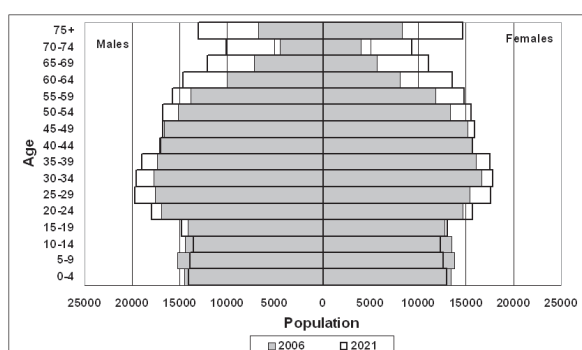


Figure 4.27: Age pyramids for the non-Indigenous population of the Savanna zone, 2006 and 2021

It is not surprising, therefore, that both per cent and absolute change in each age group for the non-Indigenous and total populations are closely aligned as the Indigenous population comprises a small proportion of the total and so do not greatly detract from the underlying projections of the total population. In contrast, the graphs showing per cent change by age for the Indigenous population appear to be at considerable odds. Although it is true that different assumptions have been used to generate the Indigenous projections and so differences are to be expected, the per cent change results should be viewed with caution. The size of the population in each age group is relatively small, especially compared to the non-Indigenous population, which will serve to exacerbate the proportionate change projected. This is confirmed when absolute change is considered. Thus, in this instance, measures of absolute change yield a clearer picture of change than the per cent change occurring in each age group.

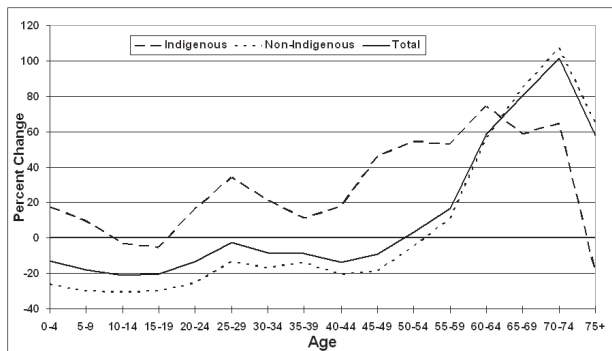


Figure 4.28: Indigenous, non-Indigenous and total per cent population change by age group, Arid zone 2006–2021

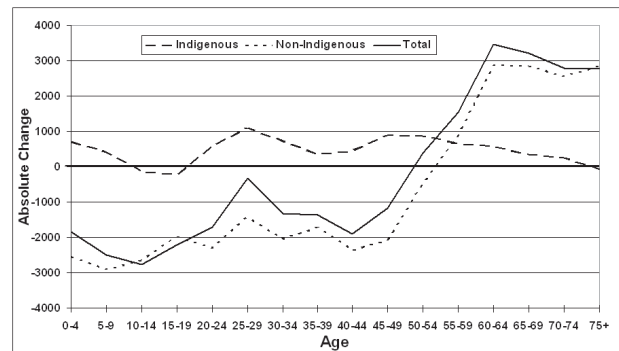


Figure 4.29: Indigenous, non-Indigenous and total absolute population change by age group, Arid zone 2006–2021

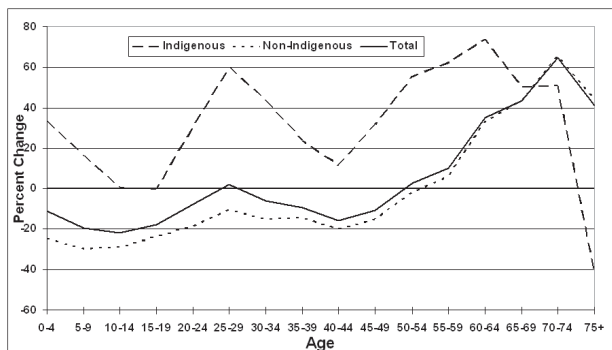


Figure 4.30: Indigenous, non-Indigenous and total per cent population change by age group, Semi-Arid zone 2006–2021

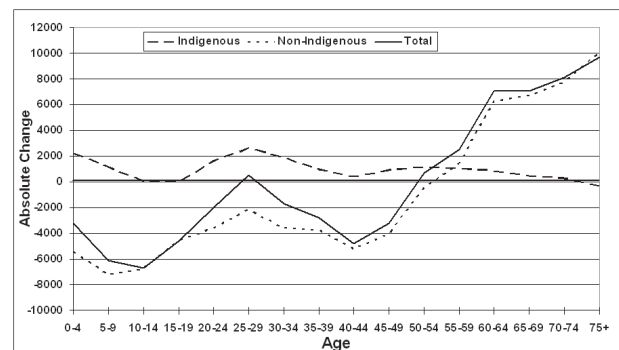


Figure 4.31: Indigenous, non-Indigenous and total absolute population change by age group, Semi-Arid zone 2006–2021

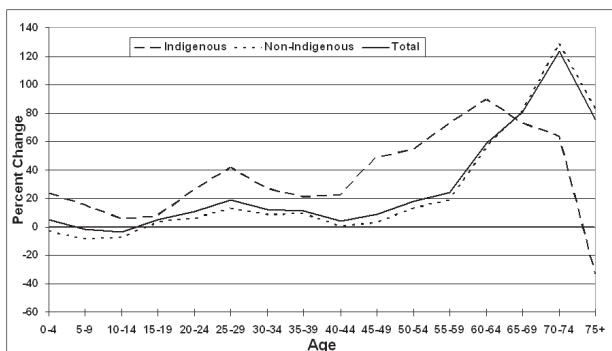


Figure 4.32: Indigenous, non-Indigenous and total per cent population change by age group, Savanna zone 2006–2021

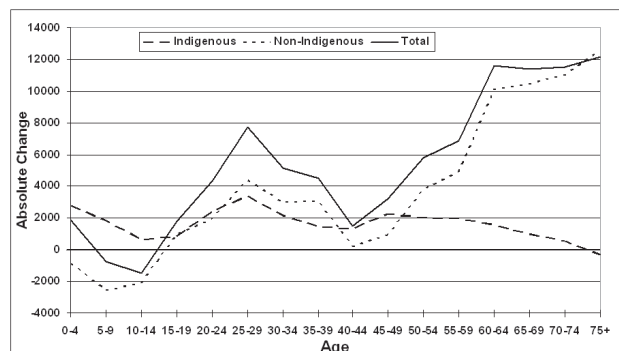


Figure 4.33: Indigenous, non-Indigenous and total absolute population change by age group, Savanna zone 2006–2021

Figures 4.34 and 4.35 present the geographic outcome of projected total population change by SLA, and a number of localised areas within the arid zone and savanna stand out as the focus of relatively large absolute and percentage increases in population. In the arid zone these include central Australia and the north of South Australia, as well as the Pilbara coastal regions. In the savanna zone they include the Kimberley of Western Australia, the Victoria River District, Gulf country and East Arnhem Land regions of the Northern Territory, and the Gulf country and Cape York Peninsula in Queensland. Areas of population decline include almost the entire arid zone in Western Australia along with the semi-arid areas of New South Wales, central Queensland, South Australia, and the south-west of Western Australia.

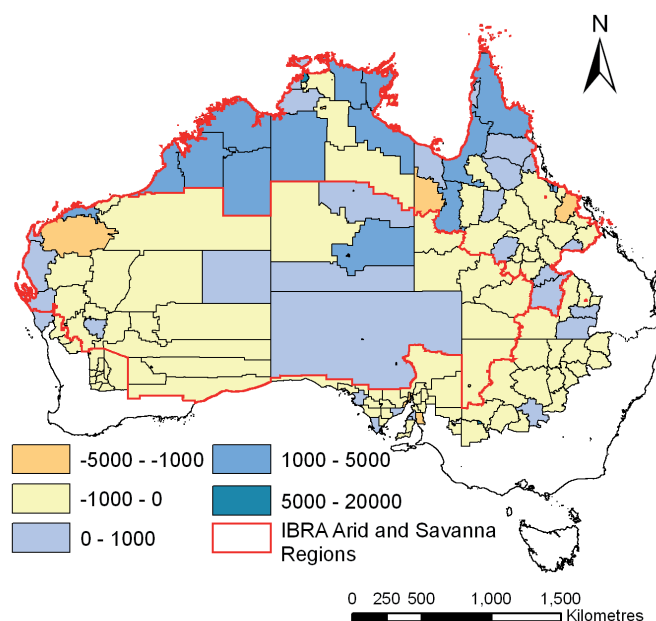


Figure 4.34: Absolute total population change by SLA, 2006–2021

Source: ABS customised tables

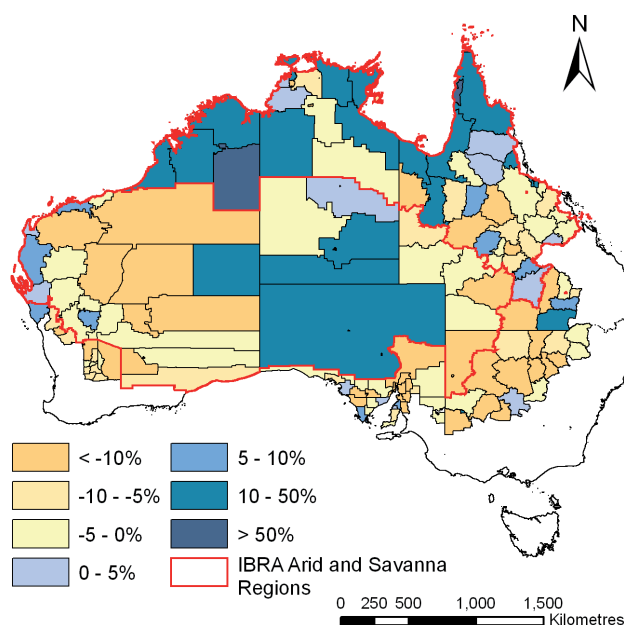


Figure 4.35: Percent total population change by SLA, 2006–2021

Source: ABS customised tables

5. Demographic Information System

We have foreshadowed the need for a DIS in this report, but the concept as yet remains to be defined. In its simplest form a DIS is a computer system designed to store and retrieve demographic data in a systematic format, however more complex formulations would allow real time manipulation, interrogation and display of the stored data in line with developments generally in the application of spatial data for regional and community planning (Hugo 2001). In essence, to be more than just a data repository, a DIS also needs to be an analytical tool. To meet both requirements there are a number of different formats which the database can take, for example large quantities of data can be stored and analysed in specialist packages such as Oracle, Microsoft Access and SPSS. However, an integral component of demographic data is its spatial context, thus the data need to be geo-referenced. To this end, storing the DIS within a GIS framework is imperative, not only to display the data in meaningful ways but also to permit quick data extraction for user-defined areas. By holding the data at the smallest possible geographical level together with information regarding membership to other geographies, it is a comparatively simple process to dissolve SLA boundaries to form larger user-defined zones and aggregate the statistics held in the DIS accordingly. Furthermore, a GIS also allows linkage (overlay) between demographic and socio-economic data stored within the DIS, and additional data, such as physical boundaries (rivers) and spatial networks (roads and railways), increasing potential avenues of investigation. Thus the storage capability of the attribute table within a GIS combined with its inherent spatial components and analytical power makes it an ideal tool for this task.

In this scoping exercise the foundations of an analytical DIS have been constructed. The system allows interrogation of the biogeographic regions as well as providing selected data for individual SLAs through an interactive map interface. Subsequent sections detail the database holdings stored in the prototype DIS, describe how the DIS operates, and outline the steps necessary to make a full DIS a viable proposition. The database schema and a full listing of files associated with the DIS are provided in Appendix E.

5.1 DIS data holdings

The data held within the DIS are derived from the materials assembled to undertake the research presented above, and thus contain biogeographic region and SLA data. As discussed in Appendix E, the database is static—it currently does not allow real-time manipulation or the calculation of derived measures. Thus the outputs from the analysis of population size and composition, fertility, migration and population projections form inputs into the DIS, rather than being derived measures. As such it is a comprehensive and versatile tool for presenting information on the regions of interest. Furthermore the fact that SLA-level data, the smallest appropriate geographical unit, are held, permits the DIS to be updated to a real-time analytic tool. This is discussed in greater detail in Section 5.3.

The complete data holdings for the biogeographic zones and their constituent SLAs are presented in Table 5.1. It is evident that there are more data available for the biogeographic zones than for the SLAs. This is a product of the larger size of the zones compared to the SLAs. The smaller population size of the SLAs frequently renders the data unusable or unavailable due to small number problems (as discussed in Section 3.1), or confidentiality restrictions (data randomisation, not fit for purpose or not publishable).

Table 5.1: Data items held in the prototype desert and savanna DIS

Attribute	Biogeographic zone	SLA
Population count	1996 & 2001 by Indigenous status	2001 by Indigenous status
Change 1996–2001	Absolute and per cent change by Indigenous status	
Total fertility rate	1996 & 2001 by Indigenous status	
Dependency ratios	1996 & 2001 by Indigenous status	2001 by Indigenous status
Sex ratios	1996 & 2001 by Indigenous status	2001 by Indigenous status
Migration	1996–2001 Net flows and net rates by Indigenous status	
Population pyramids	2006 & 2021 by Indigenous status	2006 & 2021 for total population
Population projections		
Counts	2006 & 2021 by Indigenous status	2006 & 2021 for total population
Change 2006–2021	Absolute and per cent change by Indigenous status	Absolute and per cent change for total population
Dependency ratios	2006 & 2021 by Indigenous status	2006 & 2021 for total population
Sex ratios	2006 & 2021 by Indigenous status	2006 & 2021 for total population

5.2 Using the DIS

A major advantage of the database schema is that it permits a simple and intuitive web-based information tool to be constructed. This section details key aspects of a DIS that was developed on the UQ server for the purposes of proofing. Using select visual downloads, it provides a comprehensive guide to the use of this prototype. The long term view would be to have such a system publicly available, hosted on a Desert Knowledge CRC server, though this is subject to meeting the data distribution requirements of the ABS (discussed in Section 5.3). It should be noted that Internet Explorer is the main supported web-browser, however the DIS also operates using Mozilla Firefox.

The Desert Knowledge CRC DIS page would welcome the user with 4 key tabs: *Home*, *About*, *ViewData* and *Affiliates* (Figure 5.1). These will be briefly discussed in turn:

- *Home*: the homepage for the DIS where basic information and contact details are presented.
- *About*: information regarding delimiting the biogeographic regions as well as providing SLA to biogeographic regions for 1996 and 2001 census geographies.
- *ViewData*: the portal to accessing the demographic data stored within the DIS.
- *Affiliates*: a list of partner organisations involved in the research project.

Home	About	View Data	Affiliates
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Figure 5.1: The 4 key tabs associated with the DIS

5.2.1 Home and Affiliates

The homepage provides information about the DIS—what it is, who has developed the system and who to contact for more information about the system (Figure 5.2). This information is fully customisable to Desert Knowledge CRC requirements and can easily be changed when hosted in its new environment. Similarly the Affiliates page presents information concerning the key partners in the research project, which can be updated as the DIS grows in complexity and functionality.



Figure 5.2: The DIS homepage

5.2.2 About

The *About* page provides a comprehensive explanation of the project rationale and geographic concepts used within the system, thus is a précised version of Section 2.1 of this report. Information on the criteria used to delimit the geographic regions is presented together with Figures 2.2–2.4 for full clarity. Look-up tables for 1996 and 2001 SLAs to their respective biogeographic regions are provided in a form that can be downloaded by users.

5.2.3 ViewData

This is the initial gateway to the data stored within the DIS. Users are greeted by a map of the biogeographic regions (Figure 5.3), as well as additional information on the geographical size of each region, delimiting criteria and a count of the constituent SLAs. The remaining steps to access the DIS data are described below.

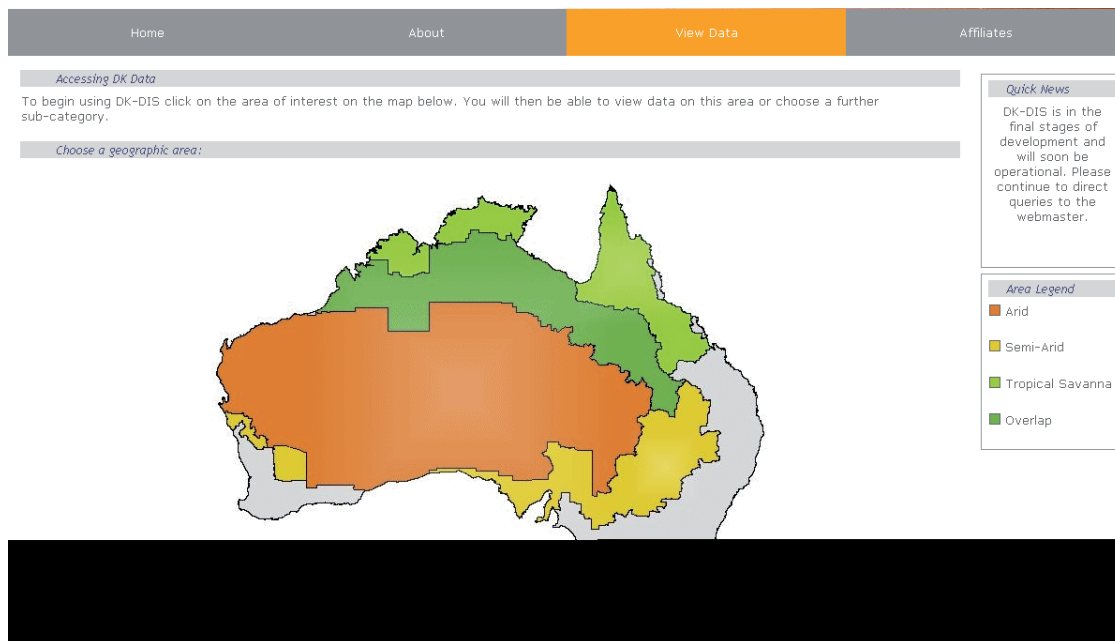


Figure 5.3: The ViewData page

1. Through the use of 'tool tips' this is a fully interactive graphical user interface (GUI). Thus, rather than selecting from extensive lists (there are a total of 234 SLAs within the four regions), users select their zone of choice directly. Users should note that when the mouse pointer hovers over a region, basic information is provided about that region on the top left of the map. To proceed through the gateway the user needs to click on their region of choice, for this example the arid zone is chosen.
2. Selecting the arid zone progresses the user through the gateway to a new area selection page. On this page a map of all SLAs within the biogeographic region is provided. In some instances a number of geographically small SLAs are located within the same area, so for ease of identification the SLAs have been magnified. Again the user will notice that basic information, SLA name and code, are displayed as the mouse pointer moves over the map (Figure 5.4). At this point the user has the option of selecting the whole region, by clicking on the region map in the top left corner, or selecting an individual SLA by clicking on that SLA.
3. Having selected a region or an individual SLA the user is then taken to the data page. It is on this page that all the data available (Table 5.1) are provided (Figure 5.5). Although these data can be copied directly to other software packages, due to ABS copyright the data have not been made available for download. At this point the user can either choose 'back' on their browser or click on 'Choose new area' to select a new area.

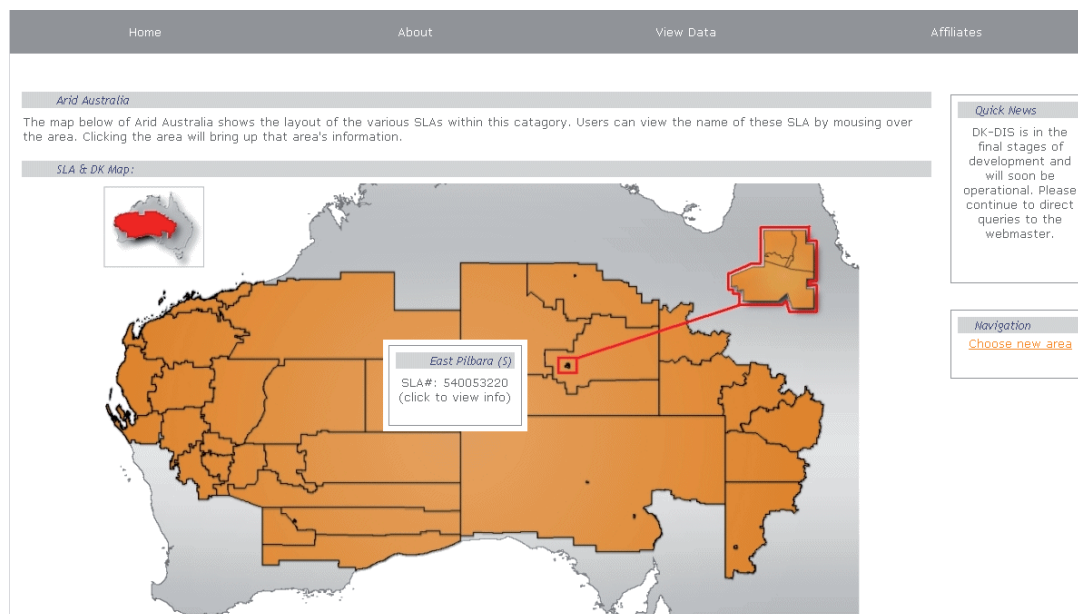
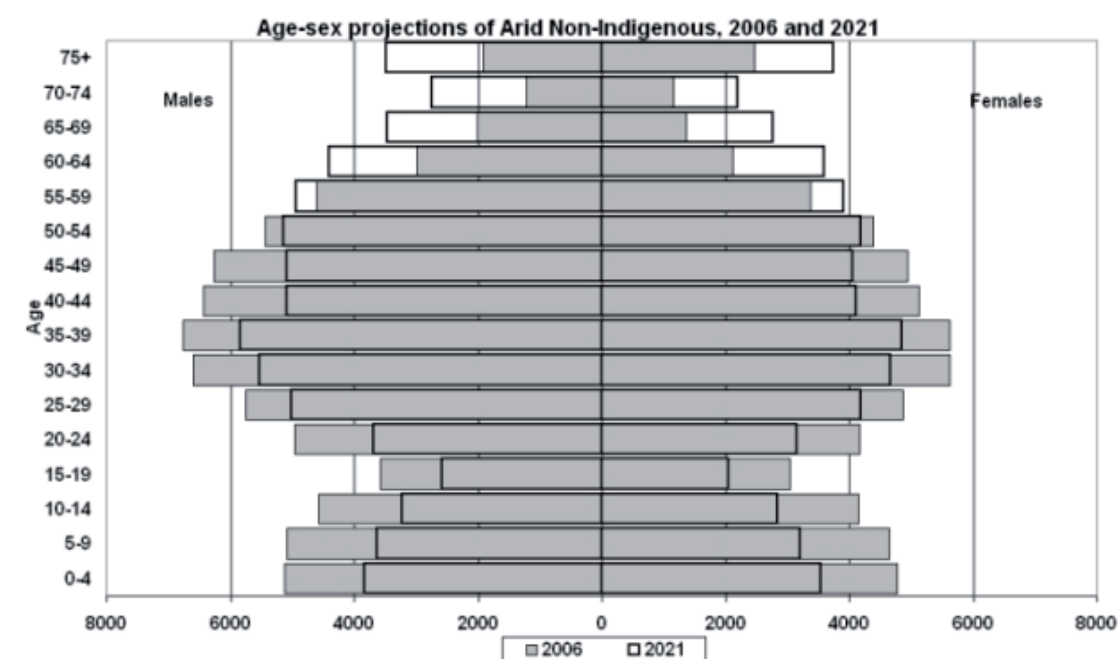


Figure 5.4: Accessing region and SLA based data



Population Projections				
	2006	2021	Projected Change	Percentage Change
Indigenous Persons	39840	47402	7562	18.98%
Non-Indigenous Persons	135171	124775	-10396	-7.69%
Total Persons	175011	172177	-2834	-1.62%

Figure 5.5: Selected data provided in the DIS

5.3 DIS viability

It is evident that the DIS is already a useful data storage and presentation tool. However, to be truly viable as an analytic and interrogative system, certain advances need to be made. These advances include acquisition of the necessary data distribution licensing from ABS and further development of the system with regard to its data holdings, updateability to more contemporary data and its analytic capability.

5.3.1 Data licensing

All of the data held within the DIS have either been directly purchased from the Australian Bureau of Statistics or have been derived from the purchased data. Accordingly the data are subject to ABS copyright. The full intricacies of ABS licensing and copyright are complex. However, if the DIS is to be made public there are some issues which need to be negotiated. Where individuals seek to produce or commercialise ABS data a licensing agreement with ABS is required and a fee needs to be paid. The fee is to cover the costs incurred by ABS in disseminating the data and varies according to the nature of the data and access rights. Figure 5.6 provides a guide to the license and fee required according to the nature and users of the data.

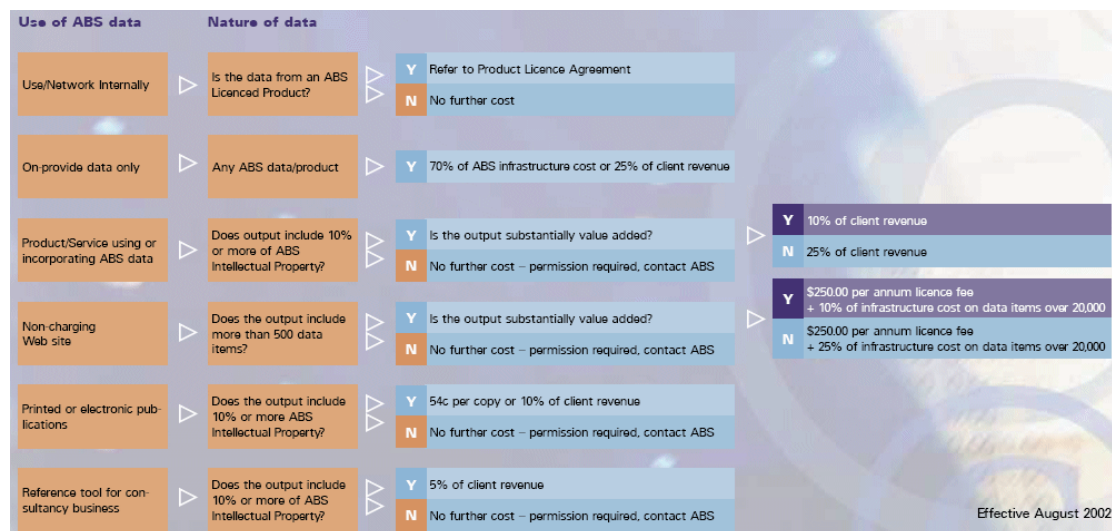


Figure 5.6: ABS Licensing Agreement

Source: ABS 2002c

The first question is whether the DIS will be commercialised—i.e., accessed for a fee. If this is the case then the question arises as to whether the output includes 10 per cent or more of ABS intellectual property. In this case the answer is yes and so 5 per cent of the revenue generated by the DIS will need to be paid to ABS. If the website is free, the fees incurred are not as large, but the issue of ‘substantial value adding’ needs to be resolved. If the DIS has substantially value added to the ABS product, an annual fee of \$250 needs to be paid. Given that there are less than 20,000 data items held within the DIS, 10 per cent of the infrastructure cost does not need to be paid. If there has been no substantial value adding, then no costs are incurred but permission must be given by the ABS to make the DIS public.

It is the responsibility of the Desert Knowledge CRC to decide how to use the DIS and to negotiate with ABS over the terms of the licensing agreement.

5.4 Further development of the DIS

There are numerous possibilities for enhancement of the DIS beyond the current scoping exercise. We canvass briefly here just five possible developments: extensions to geography, added data sets, provision of socio-economic indicators, more sophisticated graphics and the inclusion of analytic capabilities.

5.4.1 Geographic extensions

As indicated earlier, the geographic basis for the prototype DIS is the bio-geographic zones and their constituent SLAs. While these represent a functional zonal system, there are a number of other administrative and statistical geographies which might usefully be added to the system. Census collection districts and postcodes, for example, each have a number of unique, associated datasets that would materially extend and enhance the utility of the DIS. In a similar way, as suggested in section 2, many data are available for urban centres, rural localities and Indigenous Communities which could be added to the database. Another option is the facility to create user-defined geographies, based on selected collections of zones.

5.4.2 Additional data sets

The prototype system contains a minimum of key data items sufficient to demonstrate the versatility and potential of a DIS, but the scope for inclusion of additional data is almost unlimited. A starting point would be the inclusion of vital event data from ABS collections (e.g., births, deaths, marriages, etc) together with population characteristics and household and dwelling data from sequential Censuses. Much of this data, however, is readily available direct from ABS and the real benefit of a DIS capacity would best be realised by focusing on other datasets, especially those held by individual communities, or alternative administrative systems. Examples here include the CHINS data and materials from the midwives' collection.

5.4.3 Derived socio-economic indicators

While a DIS can readily make available raw data stored in database format for user-defined areas, another option is to create customised socio-economic indicators, such as labour force participation rates, dependency ratios, or health service utilisation rates. Coupled with user-defined geographies, these can be made computable at the time of inquiry, and linked to sophisticated graphical output, including bar and line charts to enable cross-regional and time series comparisons.

5.4.4 Enhanced graphics

The prototype system incorporates simple population pyramids to graphically display the current and projected future age structure of the population of a defined area, but considerable further enhancement is feasible. Options include the generation of customised bar and line charts, and animated population pyramids, all of which can be downloaded.

5.4.5 Decision support

The logical successor of a DIS is a DSS, a decision support system that enables users to employ the data stored in the database in conjunction with analytic capabilities and expert knowledge to explore alternative scenarios and hence provide a basis for decisions on a range of service provision and related policy issues. While a DSS can include a large range of analytical tools, the most obvious illustration in the context of this report would be through the inclusion of a demographic projection model that allowed users to explore alternative projection scenarios. One device frequently deployed to canvass a range of possible projection outcomes is the calculation

of several projection series based on varying assumptions. The present scoping exercise has made use of just one series. An obvious option for further development of these projections would be to generate alternative scenarios based on possible combinations of falling/rising/stable fertility and mortality rates and varying assumptions about net migration. While there is some heuristic potential here, it obviously makes sense to base such exploration on plausible indicators, and so the indicators themselves would also need to be assessed against their potential to influence change in demographic variables.

In using projections as a means of targeting policy, one possibility is to estimate the future size of the resident labour force in the arid and savanna zones by applying labour force participation rates to the projected working-age populations. If likely future trends in employment numbers could also be established, then the quantum of need for additional job creation (especially for the Indigenous working age population) could be calculated according to specified or agreed employment levels. This exercise would essentially represent a regionalised version of similar calculations of Indigenous employment demand made at the national level (Taylor & Hunter 1998). Similar exercises have been conducted in the savanna zone in the East Kimberley and in the arid zone in the Pilbara (Taylor 2005, 2004a).

Finally, 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 and decision-makers to vary the underlying assumptions and thereby explore alternate planning scenarios. An enhanced DIS provides a logical framework for the delivery of such a facility.

6. Towards a demographic research agenda for arid and savanna Australia

As a scoping study, the present analysis has unearthed and canvassed a wide range of statistical issues that begin to map out the content of an on-going demographic research agenda for the Desert Knowledge and Tropical Savanna CRCs and interested stakeholders. In addition, the means to establishing a potentially commercial online Demographic Information System has been outlined and a prototype developed. In this final section, we summarise these key findings under broad headings and suggest potential directions for further work.

6.1 Arid/savanna zone geographies

A recurring issue to arise from scoping the availability of demographic information is the relative lack of consideration of the social, cultural, economic, environmental and related policy research questions that such information might inform. Directly related to this lacuna is a need for clear specification of the varied geographies of the arid and savanna zones that require demographic (or any other) statistical information. While, for now, the construction of sub-zonal units of interest and their concordance with demographic information is dictated by the relative inflexibilities of the ASGC structure, new developments here in the use of mesh blocks post-2006 Census open up potentially innovative avenues for added precision and creativity in the construction of population geographies. Accordingly, a dialogue needs to commence between CRC partners and interested stakeholders as to what the requirements and possibilities are.

At the very least, in order to increase the robustness of demographic parameters, there needs to be some amalgamation of the SLA building blocks and decisions regarding the most appropriate configurations needed to address key research and policy issues.

One particular issue regarding arid/savanna zone geographies that does emerge is the need for further research on settlement hierarchies and the various functions that different localities/levels of settlement actually do and/or might be expected to perform given their relative size, location and composition. The foundation conceptual work here began more than 20 years ago with the efforts of Clark (1982), while Holmes (Holmes 2002, 1998, 1988a, 1988b, 1985a, 1985b; 1984) has built up a body of empirical evidence on remote settlement patterns and functions and the policy implications of post-productivist public and private investment. More recently, Hugo et al. (2001) have noted a significant structural break in terms of the range and number of services and functions located in towns between settlements of up to 2,000 population as opposed to those over this size and up to 8,000 persons. A pressing research need in the arid and savanna zones is to consider this relationship between settlement size and function by comparing the presence or absence of basic infrastructure and services in growing Indigenous towns compared to remote mainstream towns that are comparable in size.

6.2 Temporary mobility

Because of the temporary nature of much population movement into, out of, and within the arid and savanna zones, the full extent of population relocation and its implications for policy and measurement remains unknown. We can take just two very practical examples here to highlight the

need for greater insight into this phenomenon. Firstly, a key plank of government-funded health programs in remote Indigenous communities is the provision of housing and environmental health infrastructure to agreed minimum standards. The question arises: how may the impact of such provision on the health outcomes of individuals be assessed in situations (such as exist) of very partial achievement of agreed standards and of high intra-dwelling mobility when we have very little data on the short-term movement of populations? Secondly, temporary population numbers fluctuate, in some cases wildly, over the course of the year, displaying distinct seasonal patterns. It has been shown that in the arid zone visitors can comprise a majority of the total population and as such these visitors can place excessive demand on local infrastructure and services. Furthermore the timing and spatial patterning of these peak periods are constantly being modified by new forms of mobility, such as the flourishing industry in 4WD tourism (Carson et al. 2002). While pioneering work is already well underway (Bell & Brown 2005; Taylor & Bell 2005; Bell 2004), a fuller understanding of the nature of seasonal variations in temporary mobility across Australia is required together with more robust methodologies for calculating service population estimates so that adequate services and infrastructure can be provided to accommodate visitors during these peak periods (see Charles-Edwards et al. 2006).

In pondering these sorts of issues in regard to Indigenous mobility and service provision in the arid zone, Young (1990) argued for the empirical identification of Indigenous mobility fields and the compilation of Indigenous social statistics that more closely reflect the realities of Indigenous social organisation. On the whole, this challenge remains to be taken up, although an initial step has been taken in the recent work of Memmott et al. (2006) in mapping out mobility regions for select Indigenous populations in the savanna and semi-arid lands of north-west Queensland around Mt Isa. This type of exercise could most usefully be extended to other areas of strategic interest, and an imminent opportunity to initiate this will arise with the release of data (in 2007) from the 2006 ABS Community Housing and Infrastructure Needs Survey (CHINS) that records the pattern of journey to services from discrete Indigenous communities as per Figure 3.5.

6.3 Demographic data and methodologies

One of the more pressing research tasks for the arid and savanna regions revolves around the validation and improvement of demographic data.

6.3.1 Mortality and fertility

There are two key imperatives that pertain to the issue of improving demographic data: reducing census undercounts and increasing Indigenous registrations of vital events data. Through the Post Enumeration Survey (PES) the net undercount in the 2001 Census was estimated to be 1.8 per cent—an increase of 0.2 percentage points from the 1996 Census. However, the total undercount masks considerable variations between population groups and between different parts of the country. For example, undercount in ‘balance of state’ regions was 2.6 per cent compared to just 1.3 per cent for capital cities. No doubt this reflects the difficulty in accessing populations resident in the more remote parts of the country. This is supported by the fact that undercount for the Indigenous population was 6.1 per cent.

Analysis of intercensal changes in the Indigenous population reveal marked discrepancies. Between the 1991 and 1996 Censuses the Indigenous population increased by 33 per cent, whilst the increase between 1996 and 2001 was 16 per cent (57,000). For the 1991–96 period, less than half of the

increase was attributed to demographic processes, namely natural increase. A further 7 per cent was the result of changes in census editing and vetting of the Indigenous status leaving fully 50 per cent of the change in the two census counts unexplained. Change between 1996 and 2001 was more fully understood, with only 4 per cent of the 16 per cent change attributed to unexplained factors. It is evident that factors such as individuals changing their Indigenous status has a large impact on these figures. However, the lack of identification of Indigenous status when registering births and deaths is also an important factor, though births data are considered to be more reliable than mortality data. This is highlighted by the fact that Queensland did not collect Indigenous deaths data until 1995–96 and that there are considerable annual variations in state and territory data—death registrations in Queensland increased by 330 per cent between 1995–96 and 1996–97, whilst death registrations in New South Wales increased by 159 per cent between 1996–97 and 1997–98.

As already stressed in this report, it is obvious that considered as single issues these deficiencies in data will compromise their use and any interpretation or policy for which they form the base. However, considered in tandem these issues affect not only the numerator counts, for example births and deaths registrations, but also the denominator populations at risk leading to great scepticism of the data and any subsequent measures derived. To overcome these issues new methodologies must be sought, not only to overcome deficiencies in the Indigenous data but also in the treatment of small area and subsequent small number analysis.

One research avenue worthy of further exploration is the application to Indigenous data in arid and savanna regions of indirect techniques for demographic estimation as applied in developing countries in situations where data are deficient (United Nations 1983). Having said that, it is worth reflecting that the science of indirect demographic estimation evolved in Africa as part of the colonial project amongst British and French administrators who had to make decisions in environments of imperfect information. In the post-colonial era, many countries in the developing world have circumvented this need by establishing community-based longitudinal demographic systems to provide the first real information for many populations on dynamics of change, demographic trends and related indicators of socio-economic wellbeing as the basis for rational policy-making and evaluation (INDEPTH 2002). Based on the prior consent and participation of communities, these yield continuous data on entire populations of defined regions with longitudinal measurement a key characteristic. While much larger in population size than the arid and savanna populations identified here (and certainly much larger than their constituent parts), the basic INDEPTH methodology of whole-of-community engagement is of relevance and worthy of consideration. The central Australian Population List Database that has been collected as part of the Aboriginal Communities Health Information Project might be usefully explored as the beginnings of an arid zone prototype.

Some steps have been taken in producing more reliable measures of mortality, both within Australia and internationally in the context of Indigenous data and small number problems. The ABS, for example, has developed a new methodology for calculating experimental Life Tables for Use in Population Estimates and Projections of Aboriginal and Torres Strait Islander Australians (ABS 2004). Since 1998, ABS has used the Preston-Hill method (Preston & Hill 1980) to estimate the extent to which deaths registrations have been incomplete. Correction factors are then derived from the Preston-Hill method to adjust the intercensal counts of deaths such that the death registrations are consistent with the census date population estimates at the end of the period. The Preston-Hill method relies on demographic consistency, i.e., the two census counts that are used

as input data are demographically consistent. However, it has been shown that there is 4 per cent unexplained growth between the 1996 and 2001 Census counts of the Indigenous population. The Preston-Hill assumptions are violated by this unexplained growth and an alternative method is required.

The response from ABS has been to experiment with use of the Bhat (2002) method, which itself is a reformulation of the general growth balance method advanced by Brass (1975), developed to estimate census and registration completeness. Hill (1987) originally advanced the Brass methodology by developing the formula to make it applicable to non-stable populations, though maintained the assumption that they were closed to migration. Bhat's (2002) advance was to develop the methodology to apply to populations exposed to migration. It is this form of the growth balance method, one that is applicable to non-stable populations exposed to migration, that the ABS have adopted for their experimental life tables. Although the advance in methodology adopted by ABS represents an important step, reservations about the application of the Bhat method to Australian Indigenous data have been expressed (Brown 2005) and alternative approaches such as developing linked data sets, as used in Western Australia, should also be explored.

The British Office of National Statistics (ONS) has also sought to develop new methodologies for analysing mortality, in particular calculating life tables for small populations (Toson & Baker 2003)—a problem that was also encountered in this project. The ONS analysis had three components: (i) adoption of an appropriate methodology; (ii) establishing a minimum population for calculating lifetables and; (iii) dealing with the effect of zero deaths in some age groups. Results showed that both the test methodologies—Chiang (1984; 1977) and Shyrock and Siegel (1976)—produced similar results, though the Chiang methodology was finally adopted. For very small populations—under 5,000—life expectancy at birth tended to be overestimated, with the 95 per cent confidence intervals for populations of 4,000 approaching eight years and for populations of 1,000 exceeding 15 years. Thus, robust calculation of life expectancy at birth could not be calculated for populations smaller than 5,000.

This is therefore a major issue for demographic analysis in the arid and savanna zones given the large number of SLAs that have populations below this level, even without disaggregation by sex or Indigenous status. Finally, with regard to age groups with no deaths, it was found that the closest approximations to reference life expectancy and standard errors were achieved by avoiding imputation for age groups with zero deaths. However, for the final age band a value is essential, which, in the case of a zero count, should be set to a figure based on the national or regional age-specific rate. While methodological advances are clearly being made, many research challenges in search of innovative techniques remain.

6.3.2 Migration

The exodus from inland Australia has been well documented (Bell 1995, 1992a) though this scoping study provides the first empirical analysis focused on the arid and savanna zones. What this reveals is some complexity in the overall dynamics with a broad distinction between arid zone losses and savanna gains. Also evident is a differentiation between Indigenous and non-Indigenous populations in terms of the intensity, direction and composition of migration flows. While migration links are mostly between arid and savanna zones and the rest of Australia, the composition of population exchanges between these two zones remains to be established. Explanation for the low migration exchanges between these two regions is also unclear. The

answers may lie in the low level of horizontal integration between arid and savanna zone economies. Indeed, the migration data also beg the question as to whether social linkages from each are in fact stronger to other parts of Australia.

In light of these questions, there is considerable scope for further research on the composition of inter- and intra-regional migration flows, especially in regard to workforce composition. High rates of migration turnover, coupled with relatively young age profiles, suggests that for some younger migrants at least, arid and savanna zones serve as life-stage escalator regions enabling people from other parts of Australia to gain workplace experience and advance their career paths. Also required are more detailed analyses of the geography of migration flows based on SLA matrices in order to tease out the detailed patterns of inter-regional linkage and the particular role of places such as Darwin, Townsville and Alice Springs in influencing overall regional population dynamics. Memmott et al. (2006) have initiated research into Indigenous migration based on alternative geographical boundaries, adopting a mobility region approach. Their results show that Indigenous migration occurs within distinct mobility regions which frequently do not match administrative boundaries, indicating that standard administrative records of migration are either under-estimating migration intensity or not fully capturing the true nature of migration, or both. The shift to a meshblock geography for census data collection in 2006 should allow for the construction of user-defined geographies that more closely approximate these mobility regions.

6.3.3 Population projections

The calculation of more accurate population projections is fundamentally dependent upon the reliability and accuracy of the input data. Producing population projections for these biogeographic regions and the SLAs of which they are comprised is a perilous business that needs to address the three most difficult issues: (i) small populations; (ii) highly mobile populations and; (iii) unreliable data. To that end it is essential that consistent components of change data are generated.

At one level this suggests the need to focus on compiling data and constructing projection parameters at the largest possible scales, such as the zonal levels used in this scoping exercise. One option then, for sub-zonal projection, would be to apply ratio allocation techniques based on indicators suggestive of a continuation or clear shift in sub-zonal percentage population shares. The other need is for greater frequency of revision of projection series based on relevant data inputs as and when they become available.

Given the limited horizontal integration, single industry character, and heavy fiscal dependency of arid and savanna economies, boom and bust economic cycles are fairly characteristic leading to highly variable population levels. Under such circumstances, methodologies for constructing official population estimates and projections based on approaches that constrain regional dynamics to match those at the State level suffer from a lack of intelligence regarding local influences on population change to the point where local outcomes are often far removed from expectations. As a consequence, regional outcomes are often far removed from expectations.

Ideally, population projections for regions within the arid and savanna zones that often experience major regional economic shocks due to activities such as mining (for example in the Pilbara), would attempt to account for these using input-output techniques and simple demographic-economic impact forecasting methods (Phibbs 1989). However, these require whole-of-region data input, especially in regard to workforce demand and composition (for example in terms of FIFO

components). This task is a major enterprise by itself insofar as it requires building consortia of stakeholders and consolidating data inputs, although there are indications from major potential stakeholders in these regions that such developments would be advantageous (Harvey & Brereton 2005; Harvey 2002). As for the Indigenous population, however, relative detachment from the mainstream economy leaves it less susceptible to demographic-economic impacts and so a standard cohort-component methodology would remain more readily applicable, once attention has been given to raising the quality, and reliability, of the basic demographic inputs.

6.4 Demographic Support System

The Demographic Information System built for this project has many potential avenues for extension including extensions to the geography, additions to data holdings, inclusion of socio-economic indicators, provision of more sophisticated graphics and the incorporation of analytic capabilities. One of the most pressing issues in expanding the DIS is to achieve geographical consistency with output from the 2006 Census. Indeed, the innovative developments in census geography post-2006 point to new opportunities for the development of more appropriate regional boundaries better suited to the needs of Desert Knowledge CRC researchers and stakeholders along with customised refinement of data and output specifications. Developments such as this would represent the first steps in converting the DIS into a Demographic Support System (DSS) that could be used to help develop policy, monitor outcomes and address emerging research questions. A sound, reliable, user-friendly accessible DIS, however, requires a significant investment of resources, not only for initial development, but for ongoing maintenance.

Appendix A: 2001 UCL to Biogeographic Zone LUT

Code	Name	Zone
114000	Broken Hill	Arid
307600	Boulia (L)	Arid
347800	Quilpie (L)	Arid
354400	Thargomindah (L)	Arid
400600	Amata (L)	Arid
400800	Andamooka Opal Fields (L)	Arid
405200	Coober Pedy	Arid
406900	Ernabella (L)	Arid
407400	Fregon (L)	Arid
409400	Indulkana (L)	Arid
415700	Mimili (L)	Arid
416200	Mintabie (L)	Arid
423700	Roxby Downs	Arid
429600	Woomera (L)	Arid
504000	Carnarvon	Arid
504800	Coolgardie	Arid
505150	Coral Bay	Arid
505600	Cue (L)	Arid
506200	Dampier	Arid
506600	Denham	Arid
509000	Exmouth	Arid
511900	Jigalong (L)	Arid
512400	Kalgoorlie-Boulder	Arid
512640	Kambalda West	Arid
512800	Karratha	Arid
515200	Laverton (L)	Arid
515800	Leinster	Arid
516000	Leonora	Arid
517200	Marble Bar (L)	Arid
517600	Meekatharra (L)	Arid
518100	Monkey Mia (L)	Arid
519000	Mount Magnet (L)	Arid
520800	Newman	Arid
521000	Norseman	Arid
521800	Onslow (L)	Arid
522000	Pannawonica (L)	Arid
522200	Paraburdoo	Arid
523500	Point Samson (L)	Arid
523600	Port Hedland	Arid
524800	Roebourne (L)	Arid
526400	Tom Price	Arid

Code	Name	Zone
527800	Warburton (L)	Arid
528400	Wickham	Arid
528800	Wiluna (L)	Arid
530100	Yandeyarra (L)	Arid
700200	Alice Springs	Arid
700290	Alpururulam (L)	Arid
700450	Amoonguna (L)	Arid
700500	Ampilatwatja (Aherrenge) (L)	Arid
702800	Hermannsburg (L)	Arid
703440	Kaltukatjara (Docke River) (L)	Arid
703800	Kintore (L)	Arid
705300	Nyrripi (L)	Arid
705600	Papunya (L)	Arid
706600	Santa Teresa (L)	Arid
706800	Tennant Creek	Arid
706880	Titjikala (L)	Arid
707200	Warrabri (L)	Arid
Code	Name	Zone
707700	Willowra (L)	Arid
708000	Yuendumu (L)	Arid
708200	Yulara	Arid
300320	Alice River	Savanna
300400	Alligator Creek (L)	Savanna
301000	Alpha (L)	Savanna
301050	Alva Beach (L)	Savanna
301600	Arcadia Bay (L)	Savanna
302200	Aurukun (L)	Savanna
302400	Ayr	Savanna
302700	Badu Island (L)	Savanna
302900	Balgai Beach (L)	Savanna
303000	Bamaga (L)	Savanna
306930	Bohle Plains	Savanna
307800	Bowen	Savanna
308200	Brandon (L)	Savanna
309850	Bushland Beach	Savanna
311600	Capella (L)	Savanna
312400	Charters Towers	Savanna
313400	Clermont	Savanna
314150	Coen (L)	Savanna
314200	Collinsville	Savanna
314400	Cooktown	Savanna

Code	Name	Zone
316100	Croydon (L)	Savanna
316340	Cungulla (L)	Savanna
316700	Darnley Island (L)	Savanna
317200	Deeragun	Savanna
317400	Dimbulah (L)	Savanna
318400	Dysart	Savanna
322200	Georgetown (L)	Savanna
322600	Giru (L)	Savanna
323200	Glenden (L)	Savanna
325300	Gununa (L)	Savanna
326120	Hammond Island (L)	Savanna
326800	Herberton (L)	Savanna
327600	Home Hill	Savanna
327800	Hope Vale (L)	Savanna
327850	Horn Island (L)	Savanna
327900	Horseshoe Bay (L)	Savanna
328950	Injinoo (L)	Savanna
330600	Kalamia Estate (L)	Savanna
331000	Karumba	Savanna
333200	Kowanyama (L)	Savanna
333600	Kuranda	Savanna
334400	Lockhart River (L)	Savanna
335100	Mabuiag Island (L)	Savanna
336800	Mareeba	Savanna
337300	Marpuna (L)	Savanna
337600	Merinda (L)	Savanna
337800	Middlemount	Savanna
340400	Moranbah	Savanna
341200	Mount Garnet (L)	Savanna
343100	Murray Island (L)	Savanna
343460	Napranum (L)	Savanna
343550	Nebo (L)	Savanna
343600	Nelly Bay	Savanna
343900	New Mapoon (L)	Savanna
344600	Normanton	Savanna
Code	Name	Zone
345000	Pallarenda (L)	Savanna
346000	Picnic Bay (L)	Savanna
347140	Porpuraaw (L)	Savanna
348400	Ravenshoe (L)	Savanna
348500	Ravenswood (L)	Savanna
350100	Saibai Island (L)	Savanna
350850	Saunders Beach (L)	Savanna
352205	Talbot Islands (L)	Savanna
355200	Thursday Island	Savanna

Code	Name	Zone
355400	Tieri	Savanna
356450	Toolakea (L)	Savanna
357200	Townsville-Thuringowa	Savanna
358100	Umagico (L)	Savanna
359300	Warraber Island (L)	Savanna
359800	Weipa	Savanna
362150	Yam Island (L)	Savanna
363100	Yorke Island (L)	Savanna
512440	Kalumburu (L)	Savanna
514200	Kununurra	Savanna
529800	Wyndham (L)	Savanna
700100	Adelaide River (L)	Savanna
700400	Alyangula (L)	Savanna
700600	Angurugu (L)	Savanna
701000	Batchelor (L)	Savanna
701160	Belyuen (L)	Savanna
701450	Cooinda (L)	Savanna
701800	Daly River (L)	Savanna
702000	Darwin	Savanna
702600	Galiwinku	Savanna
702640	Gapuwiyak (L)	Savanna
702690	Gulin Gulin-Weemol (L)	Savanna
702730	Gunyangara (L)	Savanna
702870	Howard Springs	Savanna
702920	Humpty Doo-McMinns Lagoon	Savanna
703200	Jabiru	Savanna
703980	Mandorah (L)	Savanna
704000	Maningrida	Savanna
704200	Milikapiti (L)	Savanna
704400	Milingimbi (L)	Savanna
704450	Minjilang (L)	Savanna
704600	Nguiu	Savanna
705000	Nhulunbuy	Savanna
705200	Numbulwar (L)	Savanna
705400	Oenpelli (L)	Savanna
705500	Palmerston	Savanna
705530	Palumpa (L)	Savanna
705650	Peppimenarti (L)	Savanna
705800	Pine Creek (L)	Savanna
705870	Pirlangimpi (L)	Savanna
706000	Port Keats	Savanna
706400	Ramingining (L)	Savanna
706950	Umbakumba (L)	Savanna
707020	Virginia-Bees Creek	Savanna
707600	Warruwi (L)	Savanna

Code	Name	Zone
707800	Yirrkala (L)	Savanna
103400	Balranald	Semi-Arid
110600	Boggabilla (L)	Semi-Arid
110800	Boggabri (L)	Semi-Arid
112400	Bourke	Semi-Arid
113400	Brewarrina	Semi-Arid
115400	Buronga (L)	Semi-Arid
Code	Name	Zone
119200	Cobar	Semi-Arid
120200	Collarenebri (L)	Semi-Arid
120600	Condobolin	Semi-Arid
121600	Coonamble	Semi-Arid
125800	Dareton (L)	Semi-Arid
129800	Euston (L)	Semi-Arid
133800	Gol Gol (L)	Semi-Arid
134200	Goodooga (L)	Semi-Arid
134400	Goolgowi (L)	Semi-Arid
136200	Gulargambone (L)	Semi-Arid
139000	Hay	Semi-Arid
139600	Hillston	Semi-Arid
141000	Ivanhoe (L)	Semi-Arid
145400	Lake Cargelligo	Semi-Arid
147800	Lightning Ridge	Semi-Arid
152000	Menindee (L)	Semi-Arid
154600	Moree	Semi-Arid
157000	Mungindi (Part) (L)	Semi-Arid
159200	Narrabri	Semi-Arid
161600	Nyngan	Semi-Arid
163400	Pallamallawa (L)	Semi-Arid
175200	Tottenham (L)	Semi-Arid
180000	Walgett	Semi-Arid
181600	Warren	Semi-Arid
182200	Wee Waa	Semi-Arid
182600	Wentworth	Semi-Arid
183200	White Cliffs (L)	Semi-Arid
183800	Wilcannia (L)	Semi-Arid
207520	Cabarita (L)	Semi-Arid
232600	Merbein	Semi-Arid
233800	Mildura	Semi-Arid
236400	Murrayville (L)	Semi-Arid
240600	Ouyen	Semi-Arid
244400	Red Cliffs	Semi-Arid
254600	Underbool (L)	Semi-Arid
316400	Cunnamulla	Semi-Arid
317600	Dirranbandi (L)	Semi-Arid

Code	Name	Zone
329000	Injune (L)	Semi-Arid
339600	Mitchell	Semi-Arid
350000	St George	Semi-Arid
352200	Surat (L)	Semi-Arid
358800	Wallumbilla (L)	Semi-Arid
363400	Yuleba (L)	Semi-Arid
401200	Ardrossan	Semi-Arid
401250	Arno Bay (L)	Semi-Arid
401600	Balaklava	Semi-Arid
402800	Blyth (L)	Semi-Arid
403000	Booleroo Centre (L)	Semi-Arid
404000	Bute (L)	Semi-Arid
404400	Ceduna	Semi-Arid
404800	Cleve (L)	Semi-Arid
405000	Coffin Bay (L)	Semi-Arid
405600	Cowell (L)	Semi-Arid
406000	Crystal Brook	Semi-Arid
406200	Cummins (L)	Semi-Arid
406600	Edithburgh (L)	Semi-Arid
406800	Elliston (L)	Semi-Arid
407100	Fisherman Bay (L)	Semi-Arid
407800	Gladstone (L)	Semi-Arid
409000	Hamley Bridge (L)	Semi-Arid
409200	Hawker (L)	Semi-Arid
Code	Name	Zone
409800	Iron Knob (L)	Semi-Arid
410000	Jamestown	Semi-Arid
410200	Kadina	Semi-Arid
411200	Kimba (L)	Semi-Arid
412000	Laura (L)	Semi-Arid
412200	Leigh Creek (L)	Semi-Arid
412800	Loxton	Semi-Arid
413800	Maitland (L)	Semi-Arid
415800	Minlaton (L)	Semi-Arid
416400	Moonta	Semi-Arid
416600	Moorook (L)	Semi-Arid
418600	Napperby (L)	Semi-Arid
419800	Orroroo (L)	Semi-Arid
420000	Owen (L)	Semi-Arid
420600	Peterborough	Semi-Arid
421000	Port Augusta	Semi-Arid
421200	Port Broughton (L)	Semi-Arid
421600	Port Germein (L)	Semi-Arid
421800	Port Lincoln	Semi-Arid
422200	Port Pirie	Semi-Arid

Code	Name	Zone
422400	Port Victoria (L)	Semi-Arid
422600	Port Vincent (L)	Semi-Arid
422800	Port Wakefield (L)	Semi-Arid
423000	Quorn	Semi-Arid
424200	Snowtown (L)	Semi-Arid
424400	Spalding (L)	Semi-Arid
424600	Stansbury (L)	Semi-Arid
425000	Streaky Bay	Semi-Arid
426600	Tumby Bay	Semi-Arid
427800	Walleroo	Semi-Arid
428000	Warooka (L)	Semi-Arid
428400	Whyalla	Semi-Arid
429000	Wilmington (L)	Semi-Arid
429200	Wirrabara (L)	Semi-Arid
429800	Wudinna (L)	Semi-Arid
429900	Yalata (L)	Semi-Arid
430200	Yorke town (L)	Semi-Arid
502600	Bruce Rock (L)	Semi-Arid
512200	Kalbarri	Semi-Arid
513200	Kellerberrin (L)	Semi-Arid
517450	Marvel Loch (L)	Semi-Arid
517800	Merredin	Semi-Arid
518400	Morawa (L)	Semi-Arid
519400	Mukinbudin (L)	Semi-Arid
519600	Mullewa (L)	Semi-Arid
Code	Name	Zone
520400	Narembreen (L)	Semi-Arid
521600	Northampton (L)	Semi-Arid
525400	Southern Cross (L)	Semi-Arid
301400	Aramac (L)	Overlap
302000	Augathella (L)	Overlap
303400	Barcaldine	Overlap
305400	Blackall	Overlap
309300	Burketown (L)	Overlap
311000	Camooweal (L)	Overlap
312200	Charleville	Overlap
314000	Cloncurry	Overlap
317800	Doomadgee	Overlap
328200	Hughenden	Overlap
330200	Julia Creek (L)	Overlap
334600	Longreach	Overlap
341400	Mount Isa	Overlap
348800	Richmond (L)	Overlap
349200	Roma	Overlap
352600	Tambo (L)	Overlap

Code	Name	Zone
360400	Winton	Overlap
500890	Balgo (L)	Overlap
500920	Bardi (One Arm Point) (L)	Overlap
500930	Bayulu (L)	Overlap
500950	Beagle Bay (L)	Overlap
502400	Broome	Overlap
507000	Derby	Overlap
509200	Fitzroy Crossing	Overlap
511000	Halls Creek	Overlap
514600	La Grange (L)	Overlap
516400	Looma (L)	Overlap
517900	Mindibungu (L)	Overlap
527900	Warmun (L)	Overlap
530700	Yungngora (L)	Overlap
700800	Bamyili (Barunga) (L)	Overlap
701200	Beswick (L)	Overlap
701400	Borrooloola (L)	Overlap
701700	Dagaragu-Kalkaringi (L)	Overlap
702100	Duck Creek (L)	Overlap
702400	Elliott (L)	Overlap
703600	Katherine	Overlap
703900	Lajamanu (L)	Overlap
704070	Mataranka (L)	Overlap
704800	Ngukurr (L)	Overlap
706860	Timber Creek (L)	Overlap

Source: ABS 2001c; Environment Australia 2000

Appendix B: SLA to Biogeographic Zone LUT, 1996 & 2001

Code	Name	Zone
11250	Broken_Hill_(C)	Arid
18809	Unincorp._Far_West	Arid
30450	Barcoo_(S)	Arid
30900	Boulia_(S)	Arid
31750	Bulloo_(S)	Arid
32750	Diamantina_(S)	Arid
36150	Quilpie_(S)	Arid
41330	Coober_Pedy_(DC)	Arid
46970	Roxby_Downs_(M)	Arid
49529	Unincorp. Flinders Ranges	Arid
49589	Unincorp._Far_North	Arid
50250	Ashburton_(S)	Arid
51540	Carnarvon_(S)	Arid
51960	Coolgardie_(S)	Arid
52380	Cue_(S)	Arid
53080	Dundas_(S)	Arid
53220	East_Pilbara_(S)	Arid
53360	Exmouth_(S)	Arid
54280	Kalgoorlie/Boulder_(C)	Arid
54970	Laverton_(S)	Arid
55040	Leonora_(S)	Arid
55250	Meekatharra_(S)	Arid
55390	Menzies_(S)	Arid
55810	Mount_Magnet_(S)	Arid
56160	Murchison_(S)	Arid
56620	Ngaanyatjarraku_(S)	Arid
57280	Port_Hedland_(T)	Arid
57560	Roebourne_(S)	Arid
57630	Sandstone_(S)	Arid
57770	Shark_Bay_(S)	Arid
58470	Upper_Gascoyne_(S)	Arid
59250	Wiluna_(S)	Arid
59590	Yalgoo_(S)	Arid
70201	Alice_Springs_(T)_-_Charles	Arid
70203	Alice_Springs_(T)_-_Heavitree	Arid
70205	Alice_Springs_(T)_-_Larapinta	Arid
70207	Alice_Springs_(T)_-_Ross	Arid
70208	Alice_Springs_(T)_-_Stuart	Arid
73009	Petermann	Arid
73209	Sandover_-_Bal	Arid
73609	Tanami	Arid

Code	Name	Zone
73800	Tennant_Creek_(T)	Arid
74009	Tennant_Creek_-_Bal	Arid
10300	Balranald (A)	Semi-Arid
10950	Bogan (A)	Semi-Arid
11150	Bourke (A)	Semi-Arid
11200	Brewarrina (A)	Semi-Arid
11600	Carrathool (A)	Semi-Arid
11700	Central Darling (A)	Semi-Arid
11750	Cobar (A)	Semi-Arid
12150	Coonamble (A)	Semi-Arid
13850	Hay (A)	Semi-Arid
14600	Lachlan (A)	Semi-Arid
15300	Moree Plains (A)	Semi-Arid
15750	Narrabri (A)	Semi-Arid
17900	Walgett (A)	Semi-Arid
17950	Warren (A)	Semi-Arid
18200	Wentworth (A)	Semi-Arid
Code	Name	Zone
24781	Mildura (RC) - Pt A	Semi-Arid
24782	Mildura (RC) - Pt B	Semi-Arid
30300	Balonne (S)	Semi-Arid
30650	Bendemere (S)	Semi-Arid
30850	Booringa (S)	Semi-Arid
31850	Bungil (S)	Semi-Arid
35800	Paroo (S)	Semi-Arid
36400	Roma_(T)	Semi-Arid
37200	Warroo (S)	Semi-Arid
40510	Blyth-Snowtown (DC)	Semi-Arid
40630	Browns Well (DC)	Semi-Arid
40840	Bute (DC)	Semi-Arid
40980	Carrieton (DC)	Semi-Arid
41010	Ceduna (DC)	Semi-Arid
41040	Central Yorke Peninsula (DC)	Semi-Arid
41190	Cleve (DC)	Semi-Arid
41480	Crystal Brook-Redhill (DC)	Semi-Arid
41750	Elliston (DC)	Semi-Arid
41960	Franklin Harbor (DC)	Semi-Arid
42520	Hawker (DC)	Semi-Arid
42740	Jamestown (DC)	Semi-Arid
42940	Kanyaka-Quorn (DC)	Semi-Arid
43220	Kimba (DC)	Semi-Arid

Code	Name	Zone
43570	Le Hunte (DC)	Semi-Arid
43710	Lower Eyre Peninsula (DC)	Semi-Arid
43780	Loxton (DC)	Semi-Arid
44270	Minlaton (DC)	Semi-Arid
44830	Mount Remarkable (DC)	Semi-Arid
45280	Northern Yorke Peninsula (DC)	Semi-Arid
45390	Orroroo (DC)	Semi-Arid
45740	Peterborough (M)	Semi-Arid
45810	Peterborough (DC)	Semi-Arid
45950	Pirie (DC)	Semi-Arid
46090	Port Augusta (C)	Semi-Arid
46160	Port Broughton (DC)	Semi-Arid
46300	Port Lincoln (C)	Semi-Arid
46440	Port Pirie (C)	Semi-Arid
46950	Rocky River (DC)	Semi-Arid
47280	Spalding (DC)	Semi-Arid
47490	Streaky Bay (DC)	Semi-Arid
47910	Tumby Bay (DC)	Semi-Arid
48190	Wakefield Plains (DC)	Semi-Arid
48330	Walleroo (M)	Semi-Arid
48400	Warooka (DC)	Semi-Arid
48540	Whyalla (C)	Semi-Arid
48820	Yorke town (DC)	Semi-Arid
49039	Unincorp. Riverland	Semi-Arid
49179	Unincorp. Lincoln	Semi-Arid
49249	Unincorp. West Coast	Semi-Arid
49389	Unincorp. Whyalla	Semi-Arid
49459	Unincorp. Pirie	Semi-Arid
51120	Bruce Rock (S)	Semi-Arid
54410	Kellerberrin (S)	Semi-Arid
55460	Merredin (S)	Semi-Arid
55670	Morawa (S)	Semi-Arid
55880	Mount Marshall (S)	Semi-Arid
55950	Mukinbudin (S)	Semi-Arid
56020	Mullewa (S)	Semi-Arid
Code	Name	Zone
56370	Narembreen (S)	Semi-Arid
56790	Northampton (S)	Semi-Arid
56860	Nungarin (S)	Semi-Arid
57000	Perenjori (S)	Semi-Arid
58400	Trayning (S)	Semi-Arid
59030	Westonia (S)	Semi-Arid
59660	Yilgarn (S)	Semi-Arid
30250	Aurukun_(S)	Savanna
30600	Belyando_(S)	Savanna

Code	Name	Zone
30950	Bowen_(S)	Savanna
31700	Broadsound_(S)	Savanna
31900	Burdekin_(S)	Savanna
32250	Carpentaria_(S)	Savanna
32300	Charters Towers (C)	Savanna
32501	Cook_(S)_(excl._Weipa)	Savanna
32504	Cook_(S)_(Weipa_only)	Savanna
32600	Croydon_(S)	Savanna
32700	Dalrymple_(S)	Savanna
33100	Etheridge_(S)	Savanna
33700	Herberton_(S)	Savanna
34100	Jericho_(S)	Savanna
34850	Mareeba_(S)	Savanna
35250	Mornington_(S)	Savanna
35700	Nebo_(S)	Savanna
35850	Peak_Downs_(S)	Savanna
36801	Kelso	Savanna
36804	Kirwan	Savanna
36807	Thuringowa_(C)_(Pt_A_Bal)	Savanna
36831	Thuringowa_(C)_(Pt_B)	Savanna
36950	Torres_(S)	Savanna
37001	Aitkenvale	Savanna
37003	City_(Townsville)	Savanna
37007	Cranbrook	Savanna
37012	Currajong	Savanna
37014	Douglas	Savanna
37015	Garbutt	Savanna
37018	Gulliver	Savanna
37023	Heatley	Savanna
37026	Hermit_Park	Savanna
37027	Hyde_Park-Mysterton	Savanna
37031	Magnetic_Island	Savanna
37033	Mt_Louisa-Mt_St_John-Bohle	Savanna
37034	Mundingburra	Savanna
37038	Murray	Savanna
37041	North_Ward-Castle_Hill	Savanna
37044	Oonoonba-Idalia-Cluden	Savanna
37047	Pallarenda-Shelley_Beach	Savanna
37051	Pimlico	Savanna
37054	Railway_Estate	Savanna
37058	Rosslea	Savanna
37062	Rowes_Bay-Belgian_Gardens	Savanna
37065	South_Townsville	Savanna
37068	Stuart-Roseneath	Savanna
37071	Vincent	Savanna

Code	Name	Zone
37074	West_End_(Townsville)	Savanna
37078	Wulguru	Savanna
37084	Townsville_(C)_-_Pt_B	Savanna
59520	Wyndham-East_Kimberley_(S)	Savanna
70609	Bathurst-Melville	Savanna
70700	Coomalie_(CGC)	Savanna
70759	Cox-Finniss	Savanna
Code	Name	Zone
70809	Daly	Savanna
71004	Alawa	Savanna
71008	Anula	Savanna
71014	Brinkin	Savanna
71018	City_-_Inner_(Darwin)	Savanna
71024	Coconut_Grove	Savanna
71028	Fannie_Bay	Savanna
71034	Jingili	Savanna
71038	Karama	Savanna
71044	Larrakeyah	Savanna
71048	Leanyer	Savanna
71052	Lee_Point-Leanyer_Swamp	Savanna
71054	Ludmilla	Savanna
71058	Malak	Savanna
71064	Marrara	Savanna
71068	Millner	Savanna
71074	Moil	Savanna
71078	Nakara	Savanna
71084	Narrows	Savanna
71088	Nightcliff	Savanna
71094	Parap	Savanna
71098	Rapid_Creek	Savanna
71104	Stuart_Park	Savanna
71108	The_Gardens	Savanna
71114	Tiwi	Savanna
71118	Wagaman	Savanna
71124	Wanguri	Savanna
71128	Winnellie	Savanna
71134	Wulagi	Savanna
71138	City_-_Remainder_(Darwin)	Savanna
71169	East_Arm	Savanna
71209	East_Arnhem_-_Bal	Savanna
71609	Groote_Eylandt	Savanna
72000	Jabiru_(T)	Savanna
72304	Litchfield_(S)_-_Pt_A	Savanna
72308	Litchfield_(S)_-_Pt_B	Savanna
72409	Nhulunbuy	Savanna

Code	Name	Zone
72804	Driver	Savanna
72808	Gray	Savanna
72814	Moulden	Savanna
72818	Woodroffe	Savanna
72824	Palmerston_(T)_Bal	Savanna
73309	South_Alligator	Savanna
74809	West_Arnhem	Savanna
30150	Aramac_(S)	Overlap
30400	Barcaldine_(S)	Overlap
30750	Blackall_(S)	Overlap
31950	Burke_(S)	Overlap
32450	Cloncurry_(S)	Overlap
33200	Flinders_(S)	Overlap
33850	Ilfracombe_(S)	Overlap
34050	Isisford_(S)	Overlap
34700	Longreach_(S)	Overlap
34800	McKinlay_(S)	Overlap
35300	Mount_Isa_(C)	Overlap
35600	Murweh_(S)	Overlap
36300	Richmond_(S)	Overlap
36650	Tambo_(S)	Overlap
37400	Winton_(S)	Overlap
50980	Broome_(S)	Overlap
52800	Derby-West_Kimberley_(S)	Overlap
Code	Name	Zone
53920	Halls_Creek_(S)	Overlap
71409	Elsey_-_Bal	Overlap
71809	Gulf	Overlap
72200	Katherine_(T)	Overlap
73409	Tableland	Overlap

Source: ABS 2001c; Environment Australia 2000

Appendix C: Technical note on DOHA population projections

The regions

The population projections for the selected 234 SLAs across States and Territories cover the period from 30 June 2002 (base) to 30 June 2022 with results given by five-year age group and sex.

Method

The cohort-component method was used for these projections. In this method, the base population is projected forward annually by calculating the effect of births, deaths and migration within each age-sex group according to the specified fertility, mortality and migration assumptions. Projected resident population by single year of age and sex is produced in four successive stages: national; state/territory; capital city/balance; and finally Statistical Local Area (SLA). Assumptions are made for each level and the resulting projected components and population are constrained to the geographic level above for each year.

Assumptions for capital city and balance of state/territory projections

These projections are from the medium scenario (Series B) in *Population Projections, Australia, 2002 to 2101* (ABS 2003c) published on 2 September 2003. They incorporate the following general assumptions:

- Fertility: Total fertility rate (at national level) declining to 1.6 babies per woman by 2011 and then remaining constant.
- Mortality: Life expectancy at birth (at national level) of 84.2 and 87.7 years for males and females respectively in 2050–51. Under this assumption, life expectancy at birth will increase by 0.30 years for males and 0.25 years for females per year until 2005–06, following which improvement will gradually decline until 2050–51.
- Overseas migration: Annual net overseas migration gain (at national level) of 100,000 by 2005–06.
- Interstate migration: ‘Medium’ net gains and losses from states and territories.

The latest available base populations are used for the projections. For example, for Australia and states and territories, preliminary 20 June 2002 Estimated Resident Population was used, while for Sydney/Balance of NSW it was final 30 June 2001 ERP.

Assumptions for SLA projections

The base population for SLAs was the preliminary estimated resident population in each area by single year of age and sex, at 30 June 2002. SLA fertility and mortality assumptions are derived by combining the medium scenario state/territory assumptions from *Population Projections Australia, 2002 to 2101* with historical patterns observed in each SLA. The assumed migration levels were based on historical trends of net migration in each SLA, the assumed levels of State/Territory overseas and interstate migration, and in some cases recent State/Territory government population

or dwelling/land release projections. The assumed SLA net migration levels, largely based on recent SLA trends, were constrained to the capital city and balance of State/Territory assumptions in Series B. The age-sex distributions for the assumed migration levels were based on overseas and inter-SLA migration rates used in the calculation of published ABS SLA age-sex population estimates, which were originally derived from 2001 Census of Population and Housing migration data. SLA-specific fertility and mortality assumptions were derived using historical SLA births, deaths and population data combined with assumed state-specific rates of future change.

Nature of projections

The nature of the projection method and inherent fluctuations in population dynamics mean that care should be taken when using and interpreting the projection results. The projections are not exact forecasts but simply illustrate future changes which would occur if the stated assumptions were to apply over the projection period. While the projections take account of land planning and other decisions by governments known at the time the projections were derived, the ABS does not always have access to the policies or decisions of Commonwealth, State and Local Governments and businesses that assist in accurately forecasting small area populations. The projections do not attempt to allow for non-demographic factors (e.g., major government policy decisions, economic factors, catastrophes, wars) which may affect future demographic behaviour. The unpredictability of migration trends, especially in the short term, can have a significant effect on projection results. Special care should be taken with small SLAs (populations under 1,000 people) and small age-sex cells (populations under 100 people). Accordingly, SLAs with a base population of less than 500 have generally been kept constant as the age-sex cells are too small for reliable projection.

All SLAs in these projections are based on the Australian Standard Geographic Classification boundaries as they existed at the 2001 Census (ABS 2001c). The actual boundaries for a given SLA, or for other geographic regions such as Local Government Areas (LGAs) derived from this SLA, may change over time making the projections no longer comparable with other data. The effect of intercensal discrepancy on the base year population should also be noted. Intercensal discrepancy is the difference between the post-censal estimated resident population (ERP) of a given area at a given date, and the ERP of that area at that date following processing of the next census. Although we might expect intercensal discrepancy to affect these projections, the direction and magnitude of this discrepancy will not be known until after the 2006 Census of Population and Housing.

Reference

The projections should be referred to as “... projections prepared by the ABS according to assumptions agreed to by John Taylor, ANU”.

Appendix D: Population projections

Population projections by Indigenous status 2006

	Arid		Semi-Arid*		Savanna*	
	Indigenous	non-Indigenous	Indigenous	non-Indigenous	Indigenous	non-Indigenous
0–4	4,105	9,906	6,603	21,933	11,635	27,981
5–9	4,262	9,724	7,087	24,313	11,737	29,089
10–14	4,514	8,702	7,319	23,463	11,898	28,006
15–19	4,300	6,621	6,581	19,580	10,713	26,963
20–24	3,600	9,121	5,339	19,341	9,132	31,680
25–29	3,257	10,617	4,426	20,876	8,125	32,942
30–34	3,356	12,236	4,356	24,027	8,018	34,397
35–39	3,001	12,383	4,017	25,768	7,021	33,531
40–44	2,481	11,557	3,574	26,377	5,994	32,584
45–49	1,964	11,225	2,826	26,602	4,595	31,772
50–54	1,583	9,818	2,115	24,286	3,716	28,543
55–59	1,251	7,991	1,704	23,540	2,679	25,631
60–64	795	5,114	1,147	19,002	1,709	18,114
65–69	618	3,386	867	15,388	1,328	12,810
70–74	381	2,381	565	11,911	823	8,522
75+	371	4,390	765	22,860	996	15,132
Total	39,840	135,171	59,290	349,268	100,120	417,696

* Includes overlap

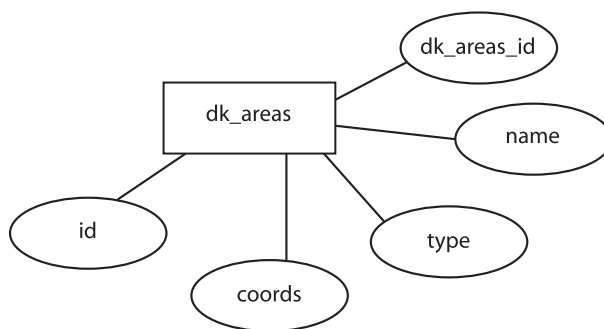
Population projections by Indigenous status 2021

	Arid		Semi-Arid*		Savanna*	
	Indigenous	non-Indigenous	Indigenous	non-Indigenous	Indigenous	non-Indigenous
0–4	4,821	7,367	8,810	16,511	14,388	27,112
5–9	4,670	6,825	8,232	17,054	13,543	26,531
10–14	4,380	6,064	7,370	16,699	12,519	25,893
15–19	4,079	4,635	6,562	15,003	11,562	27,896
20–24	4,188	6,833	6,965	15,741	11,535	33,623
25–29	4,370	9,198	7,083	18,721	11,513	37,324
30–34	4,080	10,197	6,246	20,422	10,170	37,396
35–39	3,347	10,683	4,963	22,016	8,498	36,558
40–44	2,931	9,209	3,989	21,152	7,330	32,764
45–49	2,866	9,149	3,717	22,525	6,848	32,727
50–54	2,453	9,339	3,283	23,830	5,739	32,327
55–59	1,916	8,864	2,760	24,988	4,638	30,542
60–64	1,388	7,999	1,992	25,260	3,243	28,214
65–69	982	6,243	1,303	22,057	2,300	23,244
70–74	629	4,935	852	19,710	1,348	19,523
75+	301	7,236	445	32,889	660	27,672
Total	47,402	124,775	74,571	334,579	125,831	479,349

* Includes overlap

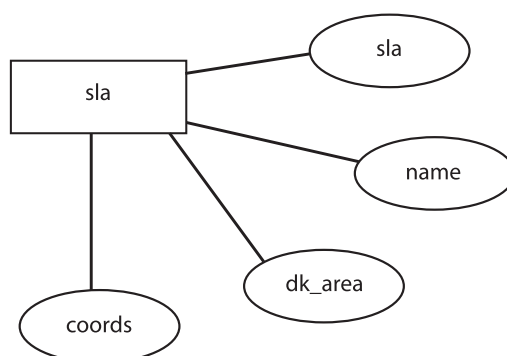
Appendix E: DIS data schema

As the database content is static, that is to say there is no real-time data manipulation such as calculating derived measures, the choice was made to allow some data redundancy within the database. This concession however makes updating and maintaining the database much easier. See the Entity Relationship (ER) diagrams below for details. Each diagram represents the structure of a table with the table name contained in the rectangle and each oval representing a column.



dkarea_id	0,1,2 or 3 representing the dk areas Arid, Semi-Arid, Overlap and Tropical Savanna
id	Automatically incremented number to uniquely identify each record within the table (1,2,3 etc) and operates as the primary key
name	Unique name to identify each geographic region on the map ("arid", "semi1", "semi2", "semi3", "overlap", "savanna1", "savanna2", "savanna3")
type	DK area categories Arid, Semi-Arid, Overlap and Tropical Savanna
coords	The x and y coordinates that outline the shape of each DK area on the image (format: x,y x,y x,y etc such that each point can be joined with a straight line to the next to map out the shape)

Similarly for the SLA data



sla	Statistical Local Area number, uniquely identifies each SLA's data
name	Unique name to given to each SLA
dk_area	DK area categories Arid, Semi-Arid, Overlap and Tropical Savanna that the SLA is part of
coords	The x and y coordinates that outline the shape of each SLA on the image (format: x,y x,y x,y etc such that each point can be joined with a straight line to the next to map out the shape)

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