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Populating Polygons —
Social and Demographic Applications of Spatial Analysis and Information in Rural and Regional Australia

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INTRODUCTION

According to William Playfair (1801), the pioneer of graphical methods for presenting statistical data, a good visual display will provide as much information “in five minutes as would require whole days to imprint on the memory, in a lasting manner, by a table of figures”[1]. Two centuries later, and the general impression one obtains from a random scan of professional journal publications, conference papers and seminar presentations by demographers and other social scientists (with the notable exception of geographers), is that visualisation techniques are still either unheard of by many, or regarded as synonymous with pie and bar charts. A recent survey on visualisation practice in the social sciences by Ell and Southall (1998) highlighted

- geography as the main user of such techniques (followed by sociology, political sciences, economics and archaeology),
- a predominant use of non-GIS tools outside geography, most notably SPSS and Microsoft Excel, and that
- such tools are predominantly used for data storage and quantitative analysis rather than for their visualisation or graphics capabilities,

leading Ell and Southall to conclude that “visualisation was not generally used in the social sciences outside geography, except for simple graphs”.

Considering our disciplinary focus on people and populations (*demos*), and the emphasis on recording/description, we could be doing better. Given the explicit relevance of spatial and geographic configurations for many of our analytical endeavours, be they related to physical (environment , resources) or cultural space, location, or socioeconomic place, one cannot wonder why geographic and spatial applications have not had a more prominent impact on our discipline, either from an analytical or visualisation perspective. While it would go beyond the scope of this paper to speculate upon some of the reasons[2], we seem, as a social sciences discipline, still primarily leaning towards data and analytical methods and writing for fellow demographers, rather than focusing explicitly on the policy relevance of our work, and on making this relevance more visible to a largely non-demographic, non-technical

[1] Quoted in Vaupel et al. (2000).
[2] An obvious reason refers to a widespread lack of GIS-friendly data, as will be discussed more fully at a later stage.

audience in the form of providing user-relevant (and –friendly) information[3]. It is in this context of paying greater attention to translating data into information (Haberkorn, 1997), that geographic and spatial information science and systems could make a major difference to our discipline. Although colleagues working in the UN and World Bank, at North Carolina and IASSA — to just mention a few coming immediately to mind — have for many years applied spatial analysis and geographic information systems (GIS) as effective visualisation and analytical tools, demography as a discipline is yet to explore their full potential.

This paper seeks to explore how spatial information and geographic information systems can benefit demography, by making its disciplinary relevance to many facets of major public policy concerns both more transparent and accessible. It illustrates the visualisation and analytical power of GIS with reference to two recent research endeavours that focused on the integration of sociodemographic data with other information layers; it also informs on current work on making basic social and population data and analysis accessible to a wider audience in order to truly *mainstream* demography into the public domain.

WHAT DO WE MEAN BY SPATIAL ANALYSIS AND INFORMATION, GIS AND SIS — AND HOW CAN THEY BENEFIT DEMOGRAPHY?

Geographic Information Systems (GIS) and Spatial Information Systems (SIS) refer to specific tools, or toolsets, of spatial analysis, which itself is grounded in geographic information science (McGregor, 2000)— referred to variously as GISc or GIScience. Though GIS and SIS are very much related in their analytical/conceptual focus on *space*, GIS' emphasis on geography, on physical or social location and areas, for example, can be light years apart from the *space* occupied by some spatial analyst, with spatial information referring to positions, sizes, shapes, orientations, relations (Mark, 1999:3)[4].

GIS is basically a computer-assisted information management system that contains geographically referenced data. These can range from simple administrative data bases, with a reference to a region (eg. census collection district, postcode, town), to a street address, or something with an exact latitude/longitude location. Apart

[3] Burch (2001:1) in a recent paper on the structure of demographic knowledge, bemoans demography's continued preoccupation with empirical data and analytical techniques to the neglect of systematic development of theory.
[4] Mark (1999) uses the term *geospatial* to denote spatial information (eg. sizes and shapes) for phenomena at geographic scales.

from *points* (street address, lat-long specification) and *polygons* (space, such as an administrative area, like a postcode), *lines*, such a rivers and roads, make up GIS' third type of spatial object. A key function of GIS is the ability to link descriptions of locations (spatial data) with characteristics of particular features or phenomena (attribute data) found there. The former could, for example, refer to all rural communities with populations of between 200 and 1,000 residents and which are located in remote Australia[5], and which have a labour force with more than 25% involvement in agriculture related activities — with the latter information referring to attribute data.

Thematic maps or atlases produced with desktop mapping tools represent the *'lower'* end of GIS applications and spatial data. The more complex *'high end'* of geographic and spatial analysis and visualisation capabilities is illustrated by fully interactive electronic atlases (Kraak and Ormeling, 1996), in maps delineating demographic surfaces containing thousands of datapoints (Vaupel et al., 2000), and in techniques like 'neural spatial interaction modelling' and 'travelling wave solutions' — products, tools, techniques often requiring expensive equipment, and extensive analytical knowledge and experience, out of reach (and often usefulness) for most non-technical users. In between lie a broad spectrum of applications with varying degrees of interactive and modelling facilities and technical complexity.

Working at the policy-science interface of demographic and social research, the objective of communicating science and research results and highlighting their relevance and implications to policy-makers (with the aim that key messages are understood, deemed valid, and hopefully making their way through a vast and complex bureaucratic maze to ultimately underpin policy and program development), is as important, if not even more so than the substantive/thematic focus of our research endeavours and coming up with tangible results. Establishing sociodemographic correlates of natural resource management, for example, such as the age of farmers and farm managers, as well as establishing differential ageing patterns and processes across different agricultural industries (and hence geographic areas) and land zones is one thing, and a relatively simple one. However, establishing the potential impact of population ageing on farm business structures (intergenerational transfers; family versus corporate farms), on the overall rural demography, on the future viability of small country towns, and communicating these messages in a clear and simple message to an audience with a committed aversion to complex, controversial or simply bad news, is an altogether different challenge. ***It is in this context that GIS has its most powerful use and impact, and it is this very functionality of GIS that is the***

[5] These are identifiable through their scores on the Accessibility/Remoteness Index of Australia (*ARIA*).

focus of this presentation. Spatial applications in this context, not only benefit demographers and other population scientists in providing powerful analytical and visualisation techniques, but through the enhanced ability to make demography more relevant to non-demographers, they also provide demography with a legitimacy extending beyond academia.

Examples of social analysis and population applications

With most of the original development of geographic information systems and spatial analysis led by applications in land management and record keeping in government (Mark ,1999), and for environmental applications and use by specialist (Gerland and Vu, 1998), geographic information systems are becoming increasingly popular in other disciplines across the social sciences. Applications embrace both visualisation and analysis, and extend to a growing and widespread use by non-specialists with little or no specific training in either a specific scientific background or computers and geography (Gerland and Vu, *ibid*). This development is proceeding at a fast pace, facilitated both by the advent and popularity of web-based mapping tools, and a growing demand for spatially or geographically referenced information.

The attraction of geographic information systems and spatial analysis to data analysts and specialised researchers on one hand, as well as users and information managers in both public (policy analysts, program planners) and private sector (marketing strategists, communication specialists), is aptly summarised in Mark's (1999:6) report to the US National Science Foundation. Reviewing the current state of research into GIS and GIScience[6], and calling for a significant increase in funding related research activities, the report underlines GIS' versatility and capacity to

- support both exploratory and confirmatory analysis,
- provide tools for inductive and deductive approaches, and
- support both scientific research and the implementation of public policy.

Regarding social sciences applications, a report compiled by Dorling and colleagues and introduced by Dorling (1998) at a conference at the University of Leeds on advanced visualisation and virtual reality in the social sciences, makes reference to an astonishing 2,500 articles covering the use of various visualisation techniques, with

[6] Mark (1999) differentiates between research in basic Geographic Information Science (GIScience), and research <u>using</u> geographic information systems (GIS).

geography not surprisingly dominating the field and making the most extensive use of maps and GIS[7].

Concerning population applications, early emphasis was on visualisation and an extensive use of thematic atlases and graphics, starting with hand-drawn population pyramids and Lexis diagrams and progressing to a more widespread use of computer graphics with growing access to cheaper and more powerful PCs. This was followed by the development of specialised demographic software packages in the 1980s with limited graphic facilities: *PEOPLE*[8] , for example, provided a powerful tool to introducing economic planners to population projections (and thus 'empowering' them to more reality-based planning); and *RAPID* was developed by the Futures Group International/ USAID/Research Triangle Institute to sensitise planners and policy-makers to the socioeconomic impacts of population growth[9].

While such programs had good interactive (modelling) capacities, and allowed for some basic visualisation — from simple graphics to moving (not quite animated) age-pyramids, for example — it was the gradual growth in GIS applications that put `demography on the map', in terms of providing it with a powerful platform to create and build, disseminate its findings, and offer solutions (or at least collaborative analytical approaches) to problem solving in matters and disciplines usually not associated with demography. Comprehensive reviews of population applications by Deichman (1996) from the US National Centre for Geographic Information and Analysis (NCGIA) at the University of California in Santa Barbara, Gerland (1996) and Gerland and Vu (1998) from the United Nations Statistical Division, for example, cover a broad range of GIS applications, that range from *ad hoc* developments addressing a specific (locational) purpose to longer term, comprehensive models and strategies. Reference is made to

- global initiatives, such as NCGIA's Global Demography project and the US Census Bureau's Global Population database,

[7] Given that number, it is hardly surprising to learn that the authors "found much overlap and repeated work because researchers were not aware of work that had already been done or which was currently being undertaken (Dorling, 1998:2).

[8] Richard Leete first developed *PEOPLE*, a user-friendly package for national and sub-national population projections in 1988, to assist economic planners in Malaysia to better understand the interplay between population dynamics and economic development. A simple, yet powerful visualisation and modelling tool, this package, and a later tool dealing specifically with labour force, household and education projections (*WORKERS*), has been extensively used in training large numbers of national economic and sectoral development planners and policy-makers throughout most Pacific island developing countries, in appreciating basic population-development-resource interactions (Haberkorn, 1994).

[9] Other popular and specialised demographic programs developed by this consortium with good modelling and basic visualisation capability are DemProj (population projections), FamPlan (projection family planning requirements) and AIM (HIV/Aids Projections and examining the social and economic impact of AIDS).

- regional level applications, such as USAID's *Africa Data Sampler* CD-rom producing a standardised set of GIS data layers for all African countries, and many
- national applications, using United Nations funded *PopMap* software, which was developed in 1989 (with the first DOS version released in 1991), in a developing country (Vietnam), with the rationale to "give developing countries an easy to use tool for producing geographical databases for country, district and community applications" (Gerland and Vu, *ibid*:12).

Having already referred to some of the general benefits of GIS systems highlighted by Mark (1999), the growing popularity of population-referenced and fully interactive/ analytical geographic information systems is readily explained in their

- combination of database and spreadsheet technology with graphics and mapping facilities,
- coverage of the full spectrum of data and information management options from data storage and organisation, to displaying patterns and trends, and options for analysis and interpretation,
- facility to integrate different data layers, and their
- immediate appeal to, and relative ease of use by non-technical users.

SOCIAL AND DEMOGRAPHIC APPLICATIONS OF SPATIAL ANALYSIS AND INFORMATION IN RURAL AND REGIONAL AUSTRALIA

Like developments elsewhere, the early emphasis on GIS and other spatial applications in Australia have been associated with studies of the physical environment and resource management, but far less so in the social sciences. Hugo (2001), in a recent paper discussing social and community planning issues with spatial information, makes reference to a paper by Garner (1990) which highlights the relative lack of attention paid to GIS applications with social, economic and planning implications — an assessment which, according to Hugo, "remains essentially accurate [to date]". Given the large amount of geo- and biophysical research undertaken in Australia, and in light of the still somewhat dominant perception that physical or biological problems require physical or biological solutions, this is not surprising. Considering, however, Hugo and his team's work in Adelaide since the establishment of their National Key

Centre for Social applications of GIS in 1995 — his comments reflect far too much modesty[10].

Regarding population and other social applications, thematic atlas-type publications have been around for some time, and the most well-known and widely used products in this area is without doubt the metropolitan social atlas series produced by the Australian Bureau of Statistics since 1971. The emphasis on metropolitan — in the Australian context treated synonymously with capital cities — reflects partly Australia's population geography, with 63 per cent of Australia's population living in 8 capital cities, and a total of 86 per cent living in urban areas of at least 1,000 residents. The lack of similar attention paid to rural and regional statistics is also, at least partly, attributable to many government agencies' display of 'pragmatic expedience', reflecting a policy of user-pay and cost recovery, with rural statistics traditionally not regarded as having sufficient marketing appeal.

This situation has changed somewhat with the publication of *a Social Atlas of Rural and Regional Australia* (Haberkorn et. al, 1999*),* a collaborative effort between the Australian Bureau of Rural Sciences[11] (which desperately needed, but could not get access to rural and regional statistics and information in an easy-to-digest and user-relevant format) and the National Key Centre for Social Applications of GIS (which had the technology).

This atlas had two important impacts . Firstly, reflecting our main objective and in line with the subtitle of the publication, it managed to put rural and regional people on the map, and into the public mindset. It presented a complex picture of rural and regional Australia and challenged many popular misconceptions and myths; it documented `well-known' (by those in the know) rural/urban/regional disparities in a way that could easily be ignored in complex statistical tables; it highlighted other, and very unexpected similarities with urban Australia; it caught most of us by surprise in highlighting areas where regional Australia is faring better than urban Australia; it pinpointed areas of concern most Australians would have identified as clearly an urban issue (welfare dependency, for example); and it highlighted major inter- and intra-regional variations that are incompatible with policy thinking along simplistic rural/urban, or regional/metropolitan dichotomies.

[10] His recent paper referred to above (Hugo, 2001) provides a good summary on current work undertaken by GISCA, with explicit policy and planning applications at community, state and national level.
[11] One of two, semi-independent research bureaus located in the Australian Department of Agriculture, Fisheries and Forestry.

The second impact was its unexpectedly high public appeal, and a subsequent growing demand for spatially referenced rural and regional statistics and information, from other Commonwealth and state agencies, as well as from rural and regional bodies, and many private sector customers. It's publication was timed to coincide with the country's first regional summit in October 1999, chaired by Australia's Deputy Prime Minister and bringing together some 300 plus delegates representing all three tiers of government, the private sector, research organisations, community leaders and representatives from different community groups. The fact that all delegates were provided with a copy of the atlas as part of their official conference briefing kit, undoubtedly helped to popularise this document and the usefulness of spatially referenced data and information[12].

The main message here is not product promotion, but highlighting a key strength of geographically referenced data and information — the power of visualising social, demographic, socioeconomic features, trends and relationships on one hand, and through this process generating new ideas, new research and analysis and policy and program development[13]. Let me illustrate this, as well as the analytical potential of spatial information systems, with some recent population and social applications in rural and regional Australia.

From visualisation to modelling to policy and program development — *Access to Services in non-metropolitan Australia*

As a direct spin-off from both the social atlas and the publicity generated during the Rural Summit, a Commonwealth agency with responsibility for regional services requested us to undertake a study to document current access to a wide range of public and private sector services across regional Australia. The political and policy climate was dominated by significant (regional) voter backlashes, regional service delivery being rationalised or streamlined, banks and other private sector service providers scaling down or closing rural and regional operations — in other words, an interesting choice of timing for such an endeavour. As with the social atlas, we again teamed up with GISCA, Australia's foremost specialised social applications GIS centre,

[12] Demand for social data and information pertaining to rural and regional Australia was further boosted by the sudden rise to prominence around the same time, of a very one-eyed and conservative politician, disseminating highly selective and at times not quite informed information about rural and regional Australia.

[13] It should be noted here that the Australian Bureau of Statistics has recently set up a designated rural statistics unit, as well as 're-activated' official thinking on geo-coding, and reviewing its overall geographic classification system. .

which developed both the technology as well as produced all the maps for this particular study (Haberkorn and Bamford, 2000).

Our objective was straightforward — to pinpoint the number of people residing inside a particular service catchment area, and thus identify gaps in regional coverage. Our methodology was not very complicated either; it involved identifying the exact point location of a specific service provider, such as a general practitioner (GP), defining a service catchment in simple geographic terms, in our case defined as an 80km road access, applying the required buffer, and then populate this map with population census data. While the results confirmed what we all knew — that service access, as defined in this exercise, was universal in the most populated areas along the south east coast of Australia and the south western corner of the country —, this study, however, also highlighted some other interesting and quite surprising results:

- Population coverage across the country concerning most services was in the high ninety per cent; and focusing on regional Australia only (that is, the 6,5 million people living outside Australia's capital cities), service coverage was only marginally lower.
- Another surprise was the small number of communities located outside particular service catchment areas. In the case of GP coverage, for example, we found that only 18 out of 742 Australian towns with populations greater than 1,000 were located outside a designated GP catchment area; and even among very small communities, of between 200-999 residents, community coverage was a high 93 per cent. A similar pattern prevailed across all other general services (eg. hospitals, pharmacies, government schools, banks, post offices, social security offices).

An obvious explanation for these high service access rates was our choice of an 80km buffer zone, a distance chosen purely for illustrative and comparative (across sectors) purposes, as it was seen by our client to reflect an average one hour driving distance. Narrowing this buffer to 40 or 20km, yields an obvious increase in the number of people (and communities) outside a particular service catchment area; what appeared, however, far less obvious and again came across as a real surprise to us, was that still 96 per cent of Australia's total population, and 88 per cent of its rural and regional population lived no more than 20km from the nearest GP.

Given the ability to modify any parameter (eg. distance, service, population-type, population-numbers, communities) and to add additional ones (eg. population growth), the choice of designated buffer zones is ultimately irrelevant, as the real value of this exercise was in developing a geographic information system that would allow us to

visualise current patterns and relationships, and **model** different planning scenarios. Slides 1 and 2 illustrate these capabilities, demonstrating different access to aged care service scenarios for elderly Australians under 80km and 20km access zones. While the 80km scenario highlights considerable access limitations in, for example, south-west, central and northern Queensland, the 20km scenario suggests no such regional differences in locational disadvantage — with access limited right throughout the state, except for the populated south-east and some costal locations. Simply going by current lack of coverage, priority areas present themselves.

Considering, however, that most policy and service delivery are about meeting current and future needs, introducing a new population dimension into our model, such as the annual growth rate of the 65+ population, helps in gauging the extent to which today's priorities are likely to match tomorrow's demands. Slide 3 points to quite marked regional variations in ageing throughout Queensland, with the four most western local government areas in the south-west (Boulia, Diamantina, Barcoo, Bulloo) all showing declining 65+ populations in the near future; some areas in central-eastern Queensland, in contrast (eg. Jericho, Belyando, Broadsound, Emerald) can expect a doubling in their 65+ population over the next 16 years. Considering that both regions experience similar problems with current access to aged care services, anticipated population growth would suggest more pressing demands to improve access to aged care services in central-eastern Queensland than in south-west Queensland.

Following a presentation of our report findings to members of the Australian parliament, we are currently negotiating a second phase study, with a greater emphasis on scenario modelling (ie. providing our client with different access options), a broader range of services covered, as well as considering service quality and equity issues (eg. range of services provided) to provide more realistic baseline and benchmark data for designing (and later, for monitoring) better and more equitable service provision in rural and regional Australia. This example, once again underlines one of the principal comparative advantages of GIS/SIS applications — the power to stimulate new ideas, new research, new policy and program development.

Integrating social and biophysical data and information layers

Another important population/GIS application lies in the relative ease of linking spatial data with population and other socioeconomic data layers to better understand natural resource management matters, such as land use and land use change, and its impact on vegetation cover over time. This is an area of growing importance internationally (eg. *Agenda 21*), as reflected in recent research activities[14] and it occupying a specific regular session (S67) at this conference.

To provide a clear understanding of the status of and changes in Australia's land, vegetation and water resources and implications for their sustainable use, the Australian Government in 1997 set up a multi-year and multi-million dollars National Land and Water Resources Audit initiative to facilitate improved natural resource management decision making. One of its many programs focused on the creation of a web-based Social Resources atlas, designed with the intention to allow access to a variety of databases, and allow users to integrate different datasets and interrogate biophysical, sociodemographic and behavioural data concurrently. Our specific mandate was to focus on Australia's rangelands, and provide access on a specific GIS platform to a set of demographic, socioeconomic and behavioural data and indicators, which a comprehensive literature review had identified as having a major impact on sustainable natural resource management practices (Fenton and MacGregor, 1999). A straightforward task, one might be inclined to think, which, however, turned into a quite arduous and frustrating exercise. The reason? A lack of adequately geo-referenced data on one side, and inadequate data collection systems on the other[15].

Our problem started with the National Land and Water Resource Audit's insistence on the use of biophysical regions[16] as a geographic platform. Despite the lack of properly geo-referenced population and agricultural census data — a problem shared with many researchers worldwide — , concording available census information to the requested bio-regions proceeded with relative ease and a liberal reliance on

[14] See, for example, IASSA's Population-Development-Environment project over the past decade. See also Liverman et al., (1998), *People and Pixels: Linking remote sensing and social sciences*.

[15] The lack of geo-referencing continues to hinder data integration and represents a problem not just specific to Australia. Suffice to say that it seems quite paradoxical, to paraphrase Gerland (1996:2), that that while information on most population-related activities is usually collected at the point level (such as individual, household), it is mostly aggregated to existing spatial entities (such as different administrative units), to allow tabulations according to different data attributes, "with the spatial dimension of the information forgotten most of the time … [with] geography only used to collect data".

[16] The regions used are known as *IBRA* regions, Version 5.1 (Interim Biographical Regions of Australia). There are a total of 85 IBRA regions, with 53 covering the rangelands.

ceteris paribus assumptions[17], as illustrated in Slide 4, illustrating the current extent of mobility involving young Australians.

We hit a brick wall, however, when it came to applying behavioural and household economic dimensions, such as for example, different resource management practices and farm income sources. Having to rely on data obtained from the Australian Bureau of Agricultural and Resource Economics' annual farm surveys, which are built on sampling frames not readily conducive to flexible geographical reconfigurations, we could only cover one out of five bioregions (Slide 5). This limited our contribution considerably to help integrate sociodemographic and behavioural data with biophysical data.

Returning to SIS and GIS' power of visualisation, of contributing new ideas and spurring on new, alternative developments, this explicitly visible 'failure to deliver', delivered a powerful message of a different kind, and did so more effectively, without words, with people able to make their own observations, draw their own conclusions[18]: by publishing a series of near empty maps, we were able to highlight the current state of data collection in Australia pertaining to rural and regional statistics in general, and to important natural resource management matters in particular. At a time when environmental and natural resource management issues have well and truly made the transition from being the exclusive domain of the green movement to not only being embraced by mainstream political parties, but in Australia being increasingly recognised as absolutely critical to our future wellbeing, it seems utterly incongruent that we know more, or can access more information about the extent of land holdings under Celery and the age structure of Australia's Mandarin trees, than we do about farm-based salinity, water management, pest and weed control practices, conservation strategies and overall property management. The reason? A combination of a continued and almost exclusive reliance on geo- and biophysical sciences and economics (often involving expensive and sophisticated technology), and a breadcrumbs approach to the social and human dimension, as reflected in current data collection and information management philosophies and practices. I shall return to these observations again at the conclusion of this paper.

[17] For a comprehensive discussion on methodology, see Haberkorn et al., 2001. Some sociodemographic indicators (median age, dependency ratio), which required access to unit records to meaningfully recompute, could not be concorded to IBRA regions.

[18] It is a well-known principle and method in fields as diverse as pedagogy and marketing, that audiences both pick up, learn and retain messages/material more effectively and for longer periods if they discover the meaning and/or message themselves, rather than having their nose rubbed in.

Rethinking data and information management — moving from product provision to educating, empowering and `creating' new users

One of the most striking advantages of, particularly GIS applications, is their inherent attraction and immediate relevance to data users, who are usually not *au fait* or very comfortable with statistical information. This includes people having to regularly digest large quantities of information (such as planners and policy-makers) and who have neither time nor energy (or sometimes lack relevant skills and experience) to sift through and make sense out of lengthy or complex numerical databases and tabulations. GIS applications also help only occasional or *potential* data users with understanding why population matters, how certain aspects of population dynamics (eg. growth, youth migration, ageing) impacts on the viability of rural communities, how particular demographic features (such as age) relates to other behavioural dimensions in specific geographic areas or agricultural industries, how to identify priority or problem areas for the provision of particular government services etc. They also assist in advocacy and social action, and thus make social and population data both more immediately relevant and tangibly useful to a much wider audience.

A flurry of recent publications and reports, both in traditional media (publications and conference papers) as well as, quite fittingly, web-based, highlight GIS' power for 'creative exploration' (Schmitt and Brassell, 2000), grassroots and community group applications (Craig, 2000; Brooks, 2000), and local area social and community planning (Hugo, 2001)[19]. In Australia, considerable work both in terms of research using GIS/SIS as well as research into GIS is being undertaken by the National Key Centre for Social Applications of GIS, under the leadership of Professor Graeme Hugo, and Hugo's (2001) recent paper provides a good and comprehensive overview on spatial analysis, spatial information and social and community planning issues.

Working in a policy-oriented environment, where research is primarily outcome and output focused, and where research objectives and directions are closely linked to public policy and specific industry concerns, the main thrust of our work is in 'mainstreaming' social, demographic and socioeconomic perspectives into an environment largely dominated by economic and biophysical concerns: the profitability of rural industry, sustainable natural resources management and salinity feature most prominently in this context, and economic and biophysical research and solutions are seen synonymous with providing the right decision support. Spatial and geographic

[19] Interesting snapshot information on current thinking across a broad spectrum of GIS/community action/advocacy issues, as well as work-in-progress in these matters, can be found at www.geo.wvu.edu/i19.

information systems are critical in this context in both directing attention to the importance of social, demographic and socioeconomic issues and processes, as well as in making data and information more accessible to a wider and concerned audience.

Following on from our recent analysis of *Access to Regional Services*, we are currently developing a follow-up study that would provide key public sector agencies with access to more interactive geographic information systems containing basic population parameters (eg. size, structure, composition, recent growth and medium term projections, age-specific net-migration), to provide policy analysts and program planners with an effective tool to

- pinpoint gaps in current service provision and program delivery,
- identify priority areas,
- assist in scenario-building and policy-modelling,
- track implementation of new programs, and
- facilitate impact monitoring.

Another activity we are currently pursuing has a strong multi-sectoral and community use orientation. Its principal aims are to make local area data more accessible to local users — local governments, the private sector, community groups, basically everyone with access to a PC, a CD-rom or modem — and to provide a platform and tool for `creative data exploration' (Schmitt and Brassell, 2000). Following the *Social Atlas of Rural and Regional Australia's* impact in putting some, and keeping other rural and regional issues in the public domain and on the policy agenda, and in generating a large demand for customised social and demographic information ranging from local area (eg. several adjacent local government councils) to catchment applications (eg. Lachlan river catchment, Lake Eyre Basin), as well as for access to specific data themselves, we decided to develop an interactive electronic application that would allow users limited data access, to satisfy their own information requirements, to pursue local area/neighbourhood analyses, and explore their immediate sociodemographic environment and wider catchment areas: users will be able to zoom in on a particular polygon, and extract data for specific features relating to surrounding areas (Slide 6). We have managed to secure approval in principle from the Australian Bureau of Statistics for our prototype, and plan to release the 2001 version of the *Social Atlas of Rural and Regional Australia* on such a more interactive and limited GIS platform. While full customisation will have to wait until census data become eventually geocoded — expected in the 2006 census— and until data access becomes more liberalised, our *Neighbourhood Analysis* CD-rom (and website application) will nevertheless represent an important step forward in reconceptualising data and information management, in educating and empowering current data users, and stimulating others to more actively look for and utilise social and population data and information.

SOME FINAL OBSERVATIONS

The widespread use of GIS for 'creative exploration' and grassroots and community group applications in the US as referred to earlier, and the fact that many GIS development initiatives are taking place there, cannot be dissociated from data *access* and *availability* issues. Given the US Census Bureau's enlightened approach to data management, facilitating and actively encouraging widespread and free access to its census data through the operation of state centres across the country, researchers can query databases to their hearts delight, and centre staff can field requests from schools, community groups and citizen enquiries. Compared to Australia, this represents quite a paradox according to Hugo (2001:39), in that the US, the "citadel of private enterprise, makes its census data available free, while Australia, with its egalitarian heritage, adopts a direct cost recovery principle".[20]

The issue of data access is primarily a matter of policy, and solutions could be readily identified in that domain. Problems with data *availability,* however, have more far-reaching implications. This is critical in areas such as environmental and natural resource management, as previously alluded to, where social sciences could make quite important contributions, considering that many problems, such as salinity and land degradation, have quite specific social and behavioural causes. Our analytical endeavours, however, are not helped by a lack of (relevant) data, because they are either not collected, or not collected at a scale required to undertake meaningful analyses. While it would extend beyond the scope of this paper to speculate on all possible reasons —with misperceptions about data availability, funding fatigue to underwrite new collections, or circular arguments about who is responsible for setting thematic priorities — it could be argued that the prime emphasis of publicly funded data collection systems, such as population and agricultural censuses and surveys, should focus on collecting information with as high a public goods value as possible. Current reality is, however, that we know more about land holdings under specific crops — with this information largely relevant to a particular industry — than we do

[20] This situation highlights a marked contrast in the way data dissemination and information management is approached in different countries: ranging from the notion of data, collected from the public and by a public agency as representing a public good that should be widely accessible, to the perception of such data as a commodity, that is not only sold and bought, but only accessible to those who can and are prepared to pay for it.

about farm-based salinity, or property management practices. Another paradox, one might argue, as basic information about natural resource management issues ought to have a higher public goods value, and certainly would have a much wider appeal and relevance.

GIS and SIS applications not only rely on good and comprehensive data as I have attempted to show throughout this presentation, but they also have to be backed up by science, by good science (Mark, 1999; Hugo, 2001), with Dorling (1998) suggesting there is "too much visualisation and not enough social sciences". With the powerful images provided by well designed maps, social researchers and analysts have to exercise great care in ensuring that the message they mean to provide, is conceptually sound and methodologically justifiable. This is of particular relevance when we populate large polygons, such as the bio-regions described earlier, and do so with relatively small numbers, as this can, without appropriate caveats, create false impressions of regional homogeneity when we know there are substantive intra-regional variations[21], or highlight major inter-regional contrasts when we know these could well be more reflective of insufficient sample sizes. Once out and visible in the public domain, information represented in images, such as in a map, are hard to alter, as I experienced several months ago: after demonstrating the usefulness of GIS-based policy modelling to members of the Australian parliament, press releases the next day appeared along the lines that `regional Australians never had such good access to services as today'.

These examples highlight a problem specific to spatio-visual representation — when systems allow the creation of representations that are, or appear to be accurate, but in the end could well be misleading (Curry, 2000). Most professionals are guided by, and abide by some form of `professional ethics'; yet with the growing popularity of GIS/SIS, particularly among non-technical users in government and in business applications[22], there is a real danger when images overtake facts. While less emphasis on visualisation and more on science as suggested earlier would go some way to ensure conceptual relevance and some form of quality control, it is ultimately ethical and *critical practice* (Goss, 2000) which determines whether spatial visualisation and analysis has something real and meaningful to offer, or goes down the path described by Openshaw (2000), who suggests that "in excess of 90% of all GIS applications, maybe even 99.9%, are of no significance to people or society".

[21] Which could emerge at lower levels of geography, such as statistical local areas — of which there are 428 in the rangelands, as compared to just 53 IBRA regions — and the even smaller census collection districts.

[22] Business applications of GIS are reported to be the fastest growing segment of the industry (Goss, 2000).

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Slide 1

Access to Aged Care Facilities (80km)

- # A locality is defined as having an aged care facility when it has at least one nursing home, or hostel bed. This does not include aged care facilities provided by hospitals or multi-purpose health centres.
- # Among persons aged 65 years and over, 99.2 per cent live within 80 kilometres of an aged care facility. The highest proportions were 100 per cent in ACT, 99.9 per cent in Victoria, 99.8 per cent in New South Wales and 99.7 per cent in Tasmania.
- # In Tasmania there were no centres with population greater than 200 located more than 80 kilometres from the nearest aged care facility, with few centres lying beyond 80 kilometres from the nearest aged care facility in Victoria, New South Wales and South Australia.
- # In Queensland, there were 45 centres lying beyond 80 kilometres from the nearest aged care facility, compared with 41 in both Western Australia and the Northern Territory.
- # Throughout Australia, 0.8 per cent of the aged population experienced restricted accessibility to aged care facilities. In the states, the highest proportions were in Western Australia (3.0 per cent) and the Northern Territory (21.4 per cent).

Accessibility/ Remoteness Index of Australia (ARIA)

Relative remoteness and accessibility, as measured by the Accessibility/ Remoteness Index of Australia (ARIA), is depicted on this map by isolines (lines of equal ARIA values). ARIA interprets remoteness as access to a range of services, some of which are available in smaller and some only in larger centres. The remoteness of a location is measured in terms of distance travelled by road to reach a service centre. The accessibility index uses a continuous floating point variable with values between 0 and 12 where 0 indicates high accessibility and 12 high remoteness.

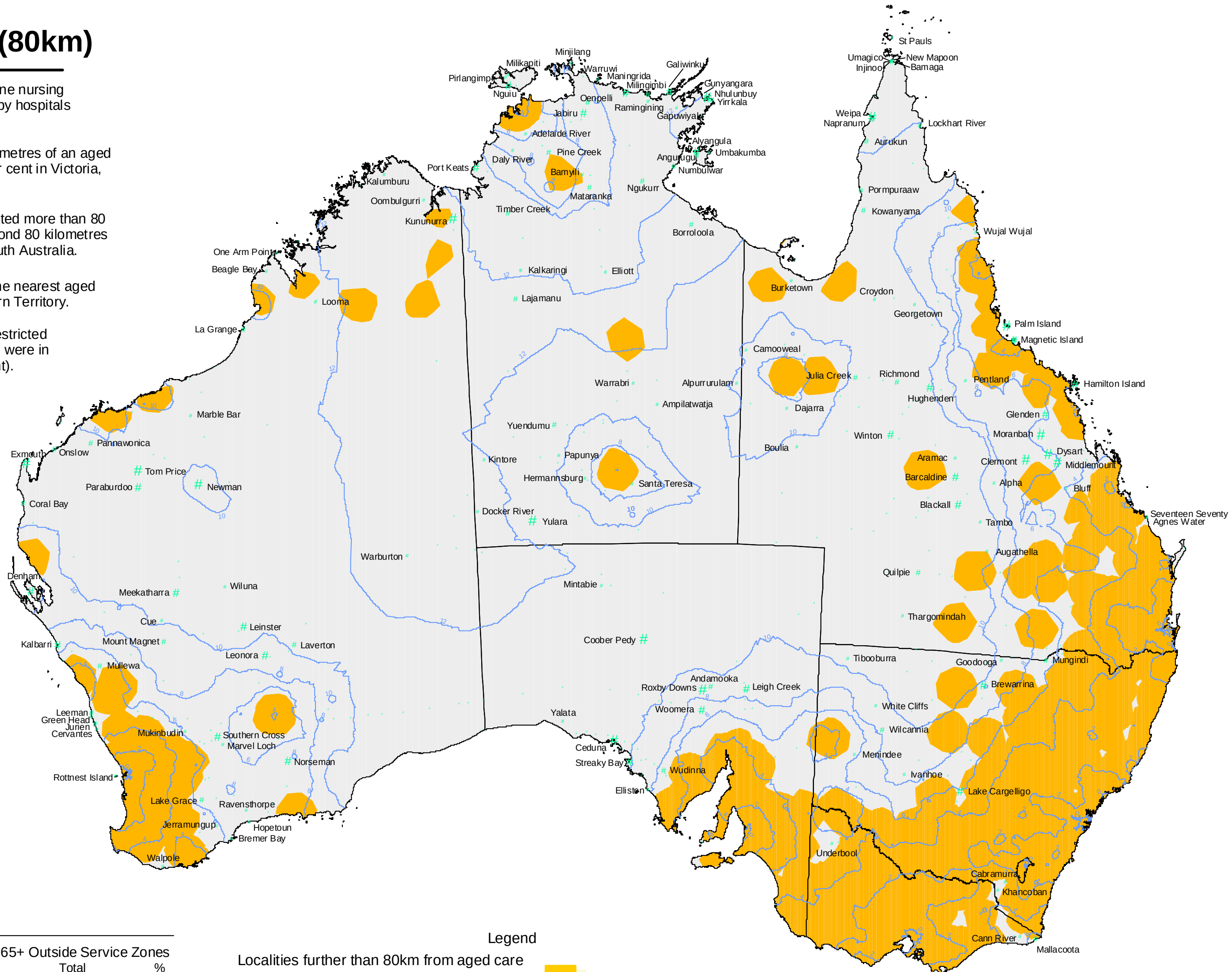
For more information on ARIA, refer to the Department of Health and Aged Care Occasional Paper Series No. 6 or the Departments web site at www.health.gov.au

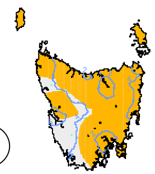
Localities with > 200 Persons Outside 80km

State	Population 200 - 500	501 - 1000	1001 - 2000	> 2000
ACT	0	0	0	0
NSW	7	1	2	0
VIC	2	1	0	0
SA	3	2	3	3
QLD	20	12	7	6
WA	19	10	8	4
TAS	0	0	0	0
NT	21	12	6	2
Total	72	38	26	15

Population Characteristics

State	Persons Aged 65+ Inside Service Zones			Persons Aged 65+ Outside Service Zones		
	Number	Total	%	Number	Total	%
ACT	21,052	21,052	100.0	0	21,052	0.0
NSW	761,644	762,902	99.8	1,258	762,902	0.2
VIC	524,908	525,413	99.9	505	525,413	0.1
SA	195,638	197,265	99.2	1,627	197,265	0.8
QLD	392,748	398,515	98.6	5,767	398,515	1.4
WA	174,420	179,753	97.0	5,325	179,753	3.0
TAS	56,465	56,640	99.7	175	56,640	0.3
NT	7,290	9,277	78.6	1,987	9,277	21.4
Total	2,134,173	2,150,817	99.2	16,644	2,150,817	0.8





Legend

Localities further than 80km from aged care

- < 200 persons
- 200 - 500 persons
- 501 - 1000 persons
- 1001 - 2000 persons
- > 2000 persons

Area within 80km of aged care

Area outside 80km from aged care

ARIA Isolines

200 0 200 400 600 800 1000 kilometres

Data Sources:
Population data: ABS Census 1996.
Locality data: AUSLIG TOPO250K database.
ARIA contours: GISCA.
Aged Care facility location data: Dept of Health and Aged Care, September 1999.

Map Prepared by GISCA
University of Adelaide
1 March 2000

Slide 2

Access to Aged Care Facilities (20km)

- # A locality is defined as having an aged care facility when it has at least one nursing home, or hostel bed. This does not include aged care facilities provided by hospitals or multi-purpose health centres.
- # Among persons aged 65 years and over, 95.2 per cent live within 20 kilometres of an aged care facility. The highest proportions were 100 per cent in ACT, 96.9 per cent in Victoria and 95.8 per cent in New South Wales. The lowest proportion was 74.5 per cent in the Northern Territory.
- # The number of populated centres with more than 200 persons located more than 20 kilometres from the nearest aged care facility was low in the ACT (nil), Tasmania (27), the Northern Territory (43) and South Australia (48). The highest numbers of such centres were in New South Wales (110) and Queensland (115).
- # Throughout Australia, there were 103,864 (4.8 per cent) persons aged 65 years or older who lived more than 20 kilometres from the nearest aged care facility. In the states, the highest numbers were 16,188 (3.1 per cent) in Victoria, 26,372 (6.6 per cent) in Queensland and 31,716 (4.2 per cent) in New South Wales.

Accessibility/ Remoteness Index of Australia (ARIA)

Relative remoteness and accessibility, as measured by the Accessibility/ Remoteness Index of Australia (ARIA), is depicted on this map by isolines (lines of equal ARIA values). ARIA interprets remoteness as access to a range of services, some of which are available in smaller and some only in larger centres. The remoteness of a location is measured in terms of distance travelled by road to reach a service centre. The accessibility index uses a continuous floating point variable with values between 0 and 12 where 0 indicates high accessibility and 12 high remoteness.

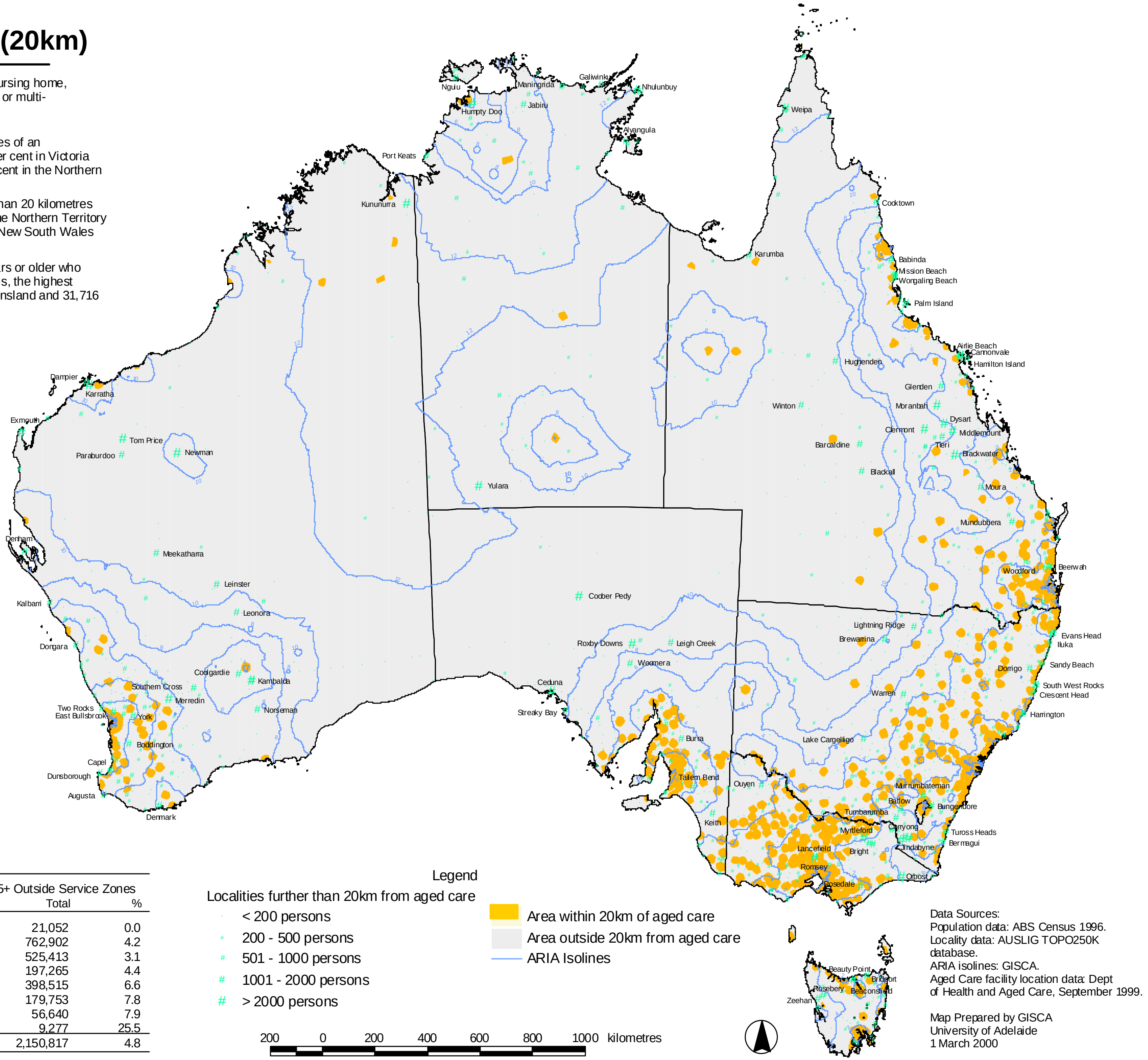
For more information on ARIA, refer to the Department of Health and Aged Care Occasional Paper Series No. 6 or the Departments web site at www.health.gov.au

Localities with > 200 Persons Outside 20km

State	Population 200 - 500	501 - 1000	1001 - 2000	> 2000
ACT	0	0	0	0
NSW	67	23	16	4
VIC	38	8	6	3
SA	28	11	6	3
QLD	55	35	16	9
WA	40	23	20	7
TAS	16	6	5	0
NT	21	13	6	3
Total	265	119	75	29

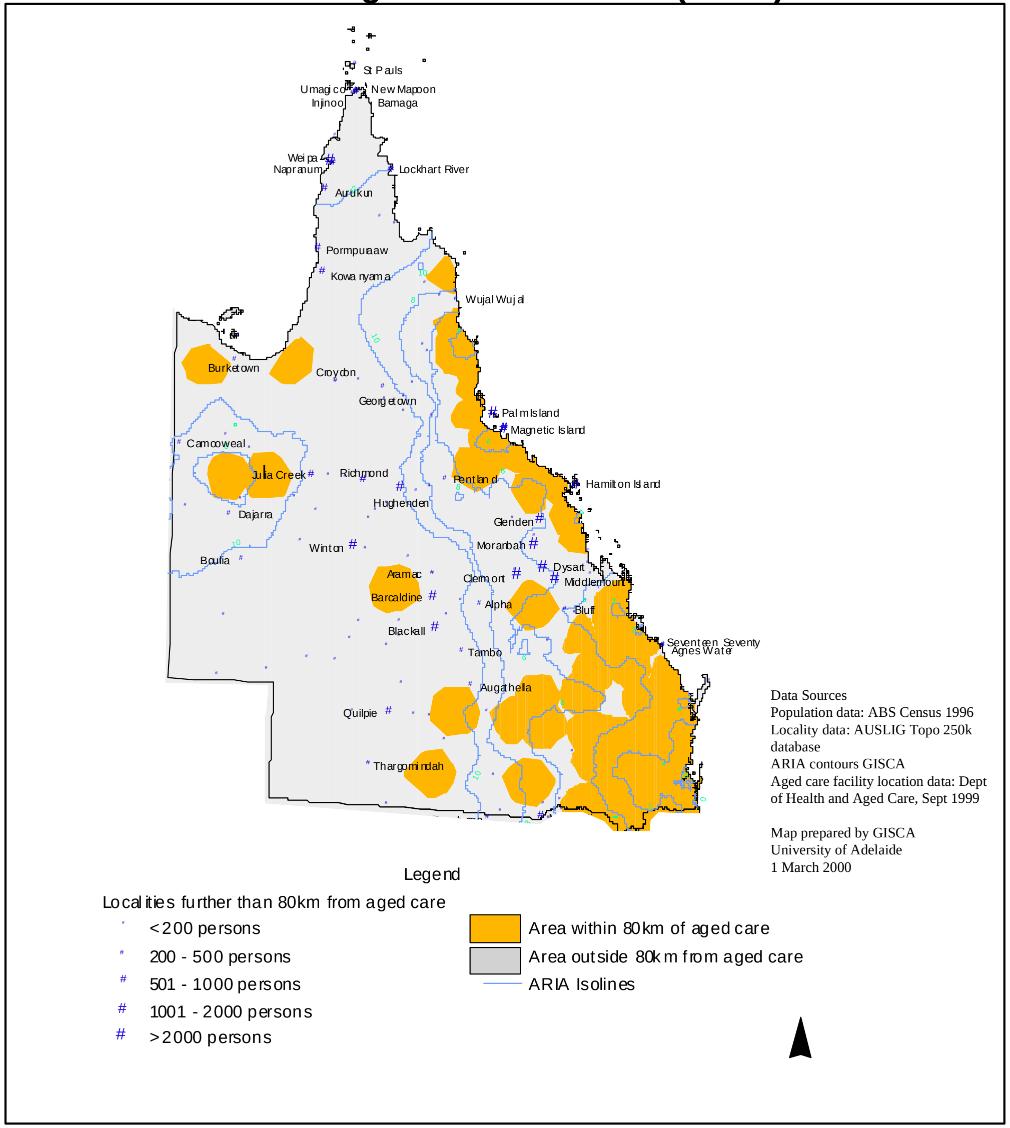
Population Characteristics

State	Persons Aged 65+ Inside Service Zones Number	Total	%	Persons Aged 65+ Outside Service Zones Number	Total	%
ACT	21,052	21,052	100.0	0	21,052	0.0
NSW	731,186	762,902	95.8	31,716	762,902	4.2
VIC	509,225	525,413	96.9	16,188	525,413	3.1
SA	188,541	197,265	95.6	8,724	197,265	4.4
QLD	372,143	398,515	93.4	26,372	398,515	6.6
WA	165,735	179,753	92.2	14,018	179,753	7.8
TAS	52,155	56,640	92.1	4,485	56,640	7.9
NT	6,916	9,277	74.5	2,361	9,277	25.5
Total	2,046,953	2,150,817	95.2	103,864	2,150,817	4.8

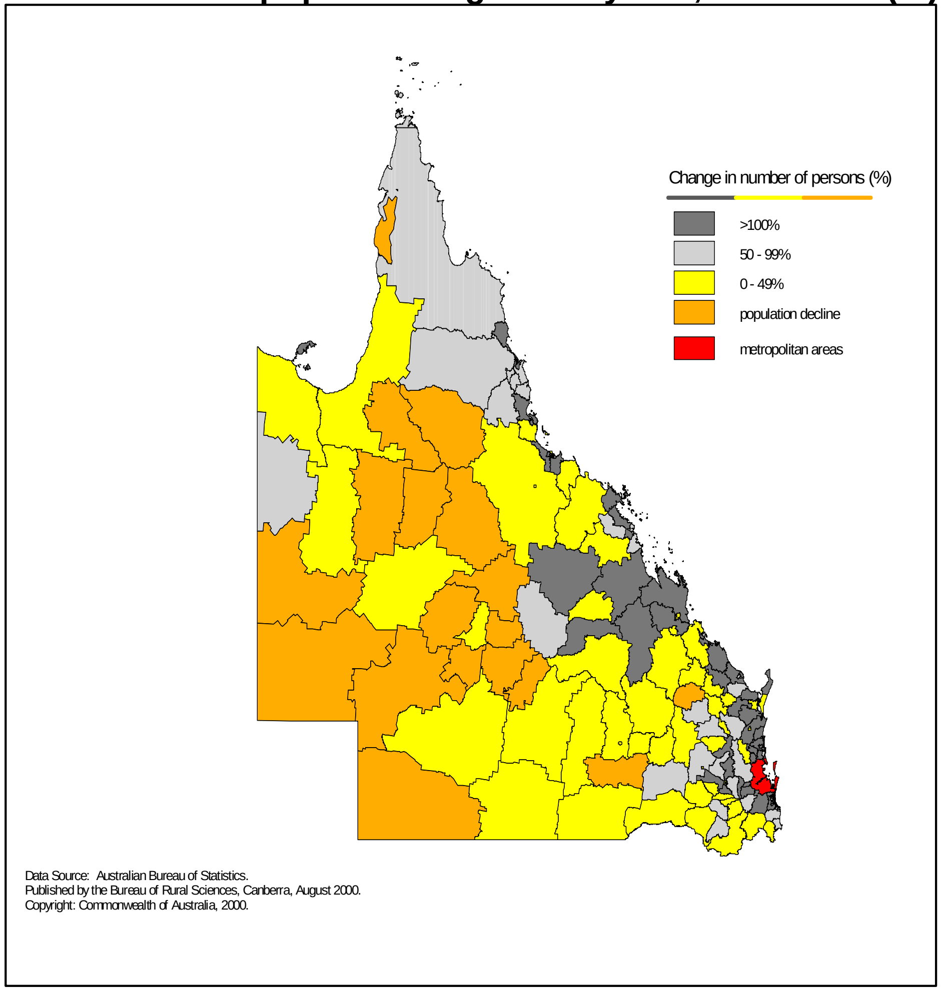


Slide 3 - Access to Aged Care Service (Population Growth) - Queensland

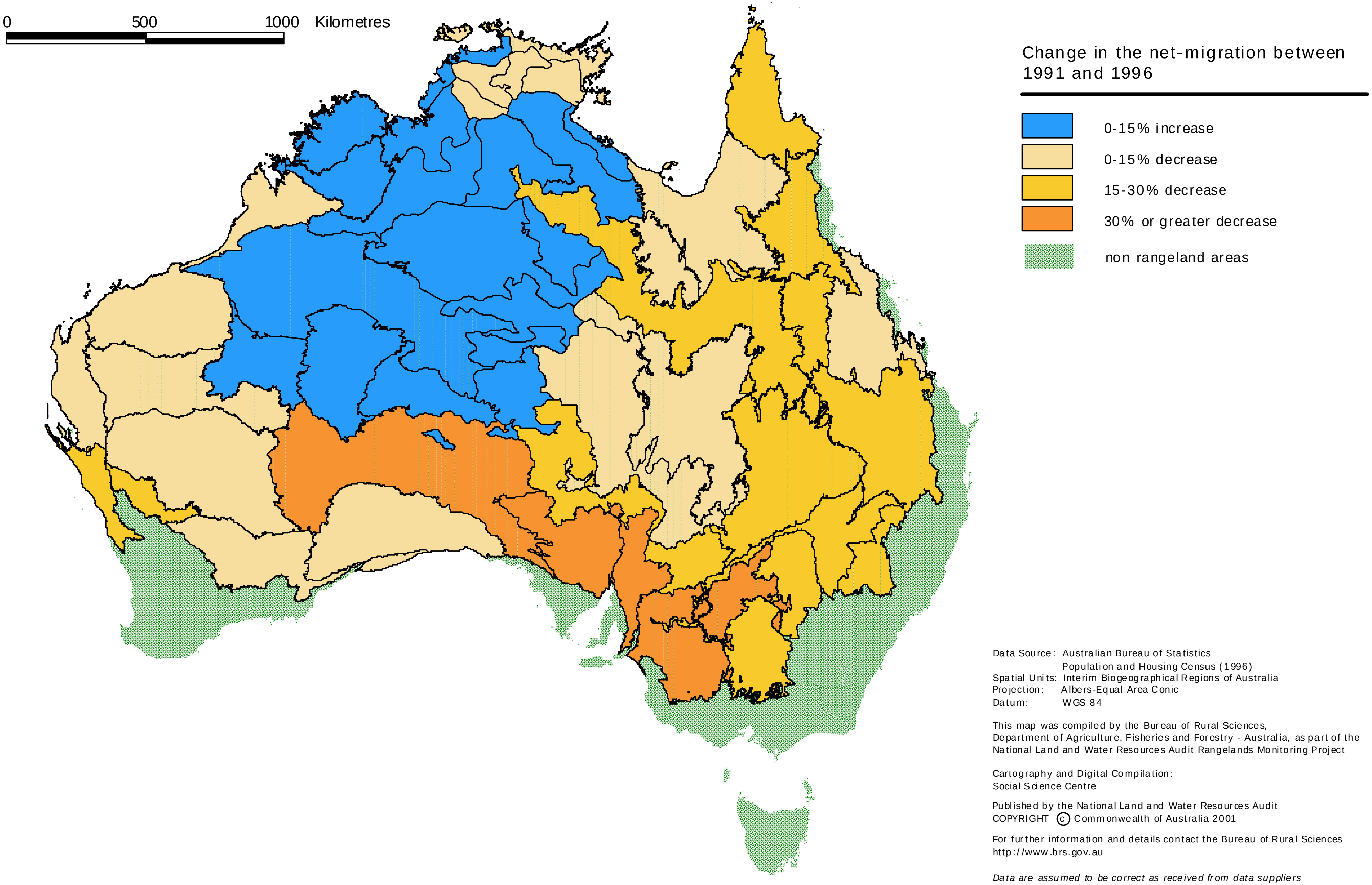
Access to Aged Care Facilities (80km)



Growth in the population aged 65+ years, 1999-2017 (%)



Slide 4 - Net migration of Young Australians (15-24 years olds), 1996



Data Source: Australian Bureau of Statistics
Population and Housing Census (1996)
Spatial Units: Interim Biogeographical Regions of Australia
Projection: Albers-Equal Area Conic
Datum: WGS 84

This map was compiled by the Bureau of Rural Sciences, Department of Agriculture, Fisheries and Forestry - Australia, as part of the National Land and Water Resources Audit Rangelands Monitoring Project

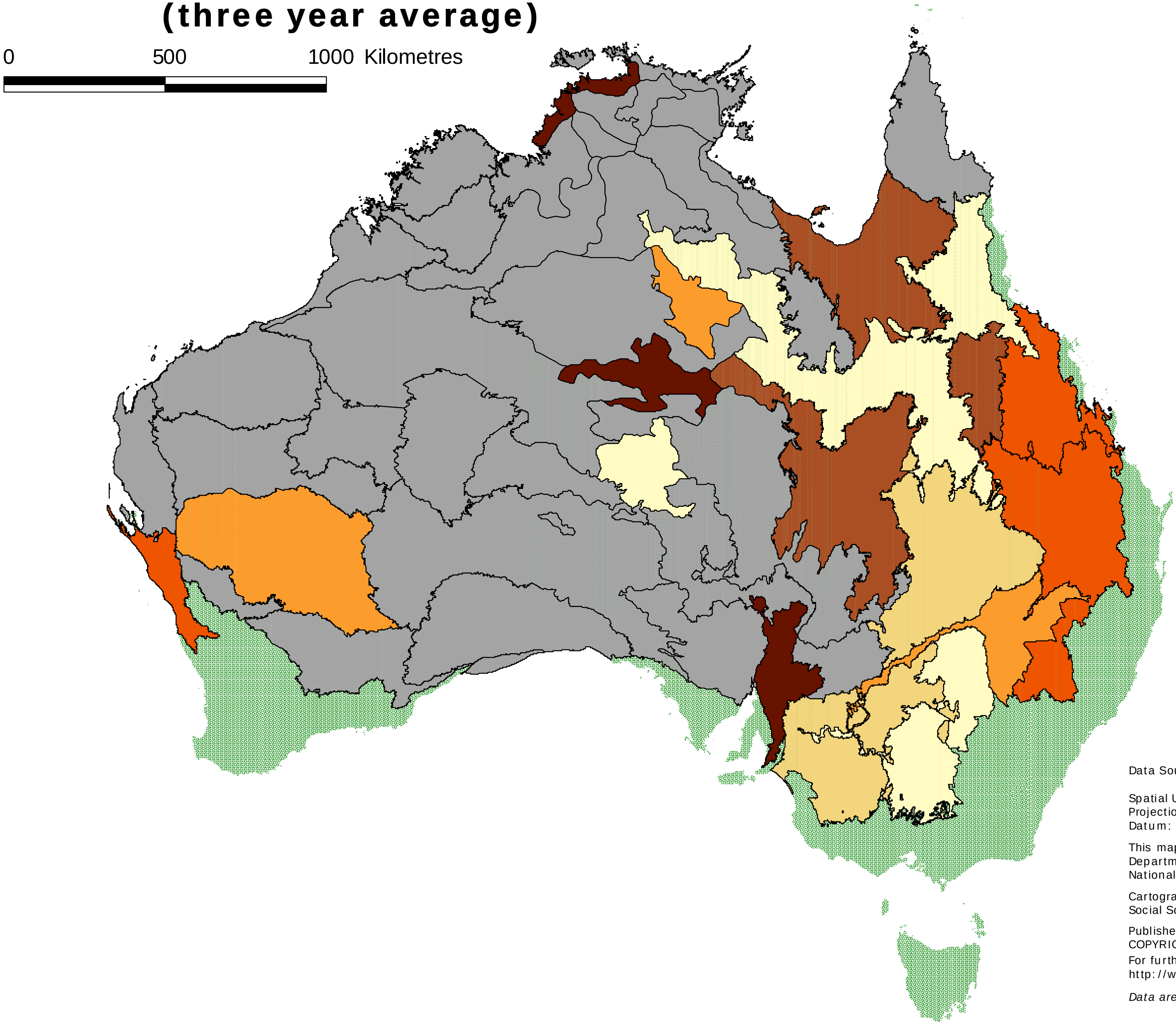
Cartography and Digital Compilation:
Social Science Centre

Published by the National Land and Water Resources Audit

For further information and details contact the Bureau of Rural Sciences
http://www.brs.gov.au

Data are assumed to be correct as received from data suppliers

Slide 5 - The total family income of farms sampled, 1996-1997 to 1998-1999 (three year average)



Total Annual Family Income (in $)

- more than $100,000
- $60,000 - $99,999
- $50,000 - $59,999
- $40,000 - $49,999
- $30,000 - $39,999
- less than $30,000
- no data available due to insufficient sample size
- non rangeland areas

Data Source: Australian Bureau Agricultural and Resource Economics (ABARE) Annual Farm Survey, 1996/1997 to 1998/1999
Spatial Units: Interim Biogeographical Regions of Australia
Projection: Albers-Equal Area Conic
Datum: WGS 84

This map was compiled by the Bureau of Rural Sciences, Department of Agriculture, Fisheries and Forestry - Australia, as part of the National Land and Water Resources Audit Rangelands Monitoring Project

Cartography and Digital Compilation:
Social Science Centre

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Slide 6 - Neighbourhood analysis CD-Rom prototype (in progress)