CHAPTER 2:
NATURE AND DYNAMICS OF EMPLOYMENT IN THE BIODIVERSITY CONSERVATION SECTOR

INTRODUCTION

The purpose of this chapter is to analyse the dynamics of employment and employment trends in the biodiversity conservation sector for 2000 to 2007. It provides a trend analysis of the demographic profile (population group, gender and age), a qualification profile of the target workforce for the HCDS, including professionals, associate professionals and managers in the biodiversity conservation sector. This analysis was based on official data generated by Statistics SA (StatsSA) in the Labour Force Survey (LFS). The LFS represents the largest and most representative source of labour statistics, despite a number of limitations. It is one of the key data sources for the development of monetary and fiscal policy in the country, and is used by all government departments for planning purposes. In the final section of the chapter results from fieldwork done on employment/skills profile and vacancies are presented. This was based on fieldwork research done with a sample of biodiversity conservation organisations. The participating organisations submitted occupational gap analyses, an exercise requiring them to compare their current employment/skills profile (2008/09) and anticipated employment/skills profile (2013/14) based on their biodiversity conservation mandate. Eight out of 16 organisations submitted this information. Given the relatively small number of submissions, the results cannot be regarded as conclusive of trends in the sector, but are indicative of trends in the participating organisations. Owing to some of the limitations of the LFS data, triangulation with other sources was important. The employment and skills data from the fieldwork results were used as one source of triangulation; an additional source of triangulation on trends in public sector employment and vacancies was the Vulindlela public sector database, kindly supplied to us by the DEAT ESSP research team.

Background to achieving a diverse workforce

A key objective of the proposed HCDS is to address transformation in order to develop a workforce (professionals and managers) that is representative of the South African population. While the policy frameworks (NBF and the NBSAP) underpinning the proposed HCD strategy only refer to representation of the whole South African population, the Employment Equity Act No 55 of 1998 specifically

refers to the inclusion of designated groups, who are defined as follows: blacks (Africans, coloureds and Indians), women and people with disabilities. Thus, in this analysis, trends in the degree of representation of designated groups (in employment) were made in line with the definitions and numerical targets set as per the Employment Equity Act No 55 of 1998 (EEA). Chapter 3 on Affirmative Action in the Employment Equity Act provides background on the purpose and specific objectives promoted by the section in order to redress the profile of the South African workforce. Primarily the section seeks to "… implement affirmative action measures to ensure that suitably qualified people from designated groups are equitably represented in all occupational categories and levels in the workforce of the designated employer".

In order to establish the extent to which there is diversity of the workforce, section 19(2) proposes a specific measure to provide baseline information. This includes conducting "… an analysis of the workforce profile to identify the degree of under-representation of designated groups". This analysis should include the profile of the workforce in each occupational category and level in order to determine the degree of under-representation[1] of people from designated groups in various occupational categories and levels.

In general, South African research suggests that very little progress has been made over the last 15 years in achieving a more equitable and diverse workforce especially at senior and top management level. To this effect, despite its detractors, the results from the Commission for Employment Equity (CEE) annual report continue to provide the most comprehensive nationwide data publicly available on progress towards numerical equity, a proxy for transformation. These trends are derived from statutory employment equity reports submitted by companies defined as eligible (and legally obliged) within the scope of the EEA. An analysis of employment trends (large companies) for 2003 to 2007 in senior and top management confirmed the relative dominance of whites (despite some declines) and males against small improvements in the share of Africans at this level. Over this period, senior management continued to be dominated by whites despite a decline from 72.7% to 65.2% over the period; the share of Africans in senior management grew from 27.3% to 32.4% over the period (CEE, 2008:43). Further, top management continued to be dominated by

whites, despite a decline from 76.3% to 68.2%; African representation in top management grew slightly from 23.8% to 28.8 % (CEE, 2008:42). At the professional and middle management level, the results suggest a similar lack of progress, but of a slightly different dimension. Thus, unlike senior management, white and African representation started off from a relatively even base. However, for 2003 to 2007 the white share of employment increased from 49.2% to 56.9%; the African share of employment declined from 50.0% to 41.3%, based on self-reported employment shifts by eligible employers. Booysen (2007:50) describes this trend as "disturbing", given that professional and middle management occupations were often the "feeder" occupations in the transition into senior and top management positions. Thus, with regards to the biodiversity sector, in the design of career paths, succession planning, development and retention, this transition between the professional and managerial occupations will be a key area for constant monitoring of progress towards a more diversified, skilled workforce.

Historically, the benchmark used to track progress towards achieving greater representation of designated groups in the workforce is proportional representation in the economically active population (EAP) as shown in Table 2.1, based on results from the Labour Force Survey (LFS), September 2005. It has become evident that while the EAP as a benchmark was easily achieved in lower-level occupations, given the historical over-representation of blacks and females, this was not necessarily the case in mid- to high-level occupations. The EAP proportions (disaggregated by population group and gender) are a national benchmark (where appropriate) against which to assess specific patterns in the employment of designated groups.

Table 2.1: Profile of the economically active population by population group and gender (%) (LFS Sept 2005)

	Male	Female	Total
African	39.8	34.3	74.1
Coloured	5.6	4.7	10.3
Indian	1.9	1.2	3.1
White	7	5.6	12.6
Total	**54.3**	**45.7**	**100**

In this analysis, the employment trends by population group will be compared to the target EAP in order to assess numerical progress towards equity in the sector. Owing to the small (statistically insignificant) number of Indians and coloureds in the LFS, they are included in the overall black category. The EAP target for Africans is used for comparisons.

SCOPE, NATURE AND LIMITATIONS OF DATA

In this analysis, employment levels are used as a proxy for labour demand. A fuller analysis of labour demand is not possible in the absence of other economic data relevant to the sector. The key data source for identifying employment trends is the Labour Force Survey (LFS) from StatsSA, and consolidated by Quantec. All calculations are those of the authors.

The approach was to analyse employment trends for the period 2000 to 2007 to provide a seven-year estimate of employment trends. While a longer period may have been advisable, the dissonances between the LFS (2000) and its predecessor, the October Household Survey have been captured elsewhere (Wilson, Woolard & Leel, 2004). Also, given the small size of the sector under analysis, these limitations may greatly increase measurement difficulties.

The LFS series are conducted biannually in March and September and are based on samples of the national population. High annual fluctuations are often observed in the number counts. The fluctuations in data are particularly evident when national employment totals are disaggregated to another category, such as race or gender. This is often a product of small sample sizes and the process of weighting raw data obtained through a sample to approximate national parameters (Wilson et al, 2004). In the case of the biodiversity sector, these fluctuations may be exaggerated due to the relatively small size of the sector, poor capturing of data in the LFS, and the lack

of reliable and comparable data from credible sources in the sector. In reality the biodiversity conservation sector is made up of about 40 organisations largely concentrated in the public sector. Given the small size it may be possible to develop a system where employment statistics are gathered to use for triangulation purposes.

Creating a biodiversity conservation sector variable

The biodiversity conservation sector does not exist as a clearly defined sector in the official statistics. It is a "cross-cutter" in that it overlaps with other subsectors in the broader environmental sector. Thus, there is no one industrial category to identify the sector; instead it is a combination of subsectors. Therefore, the study started off with a joint scoping exercise of the biodiversity sector to establish a broadly acceptable definition in terms of institutional types, their services, as well as the applicable legislative and policy frameworks applicable. The nature, size, key stakeholders (public, private and nongovernmental organisations [NGOs]), definition and profile of key occupations and professions associated with it were subsequently determined. In line with the intended focus of the HCD strategy this analysis also focused on professionals, associate professionals and managers at NQF levels 5 and higher.

In order to develop employment trends, the research team had to create a proxy variable for the biodiversity sector. This was done in two steps. Firstly, we drew up a list of all the relevant Standard Industrial Classification (SIC) codes at the 3-digit level, i.e. the most detailed description of a sector. In discussions with the EXCO and stakeholders who are familiar with the type of organisations in the sector, a final set of SIC codes were agreed on. These broad sectors are summarised in Table 2.2., and represent the closest estimate of the boundaries of the sector, given the limitations of the available data.

Secondly, because we only wanted to include those employees who are relevant to the HCD strategy, we selected a set of occupations that are most relevant to the biodiversity sector. This selection was based on discussions with stakeholders and the reference group, and supporting documentation. Given that there are no clear definitions of a biodiversity occupation, there may be some overlaps with other occupations, for instance in other environmental occupations. However, given that

there are hardly any sources of comparable data (in the absence of a census of the sector) these estimates are the closest approximation available. Where possible, comparisons were made with other sources of data, such as Vulindlela (the government database), but this source also has very limited powers in terms of its comparability. For instance, the Vulindlela data (on public sector only) does not have more detailed or specific descriptions of occupations compared to the LFS. For instance: LFS (botanist, zoologist, bacteriologist & related); Vulindlela (botanist, zoologist & related).

The following represents a description of the sector used in this analysis (Table 2.2):

Table 2.2: The biodiversity conservation sector profile, using 3-digit SIC code

Agriculture, Hunting, Forestry & Fishing
113: Growing of other horticultural specialities and nursery products
141: Forestry and related services
151: Ocean and coastal fishing
152: Rivers and dams (ie. inland fishing)
171: Animal boarding activities without health care
176: Landscaping gardening and maintenance
181: Game propagation
183: Game breeding
871: Research and experimental development on natural sciences
911: Central government activities
913: Local authority activities
914: Provincial administration
963: Botanical & Zoological Gardens & Nature Reserve Activities
Higher Education
Mining

These subsectors were broadly aligned to the suggested scope of the future HCD strategy, that is, those institutions and organisations (including NGOs) whose core business is biodiversity conservation and whose policies and decisions impact directly or indirectly on biodiversity conservation, as well as education, training and development institutions that support the development of capacity and competence for the sector (Raven, 2009:2).

Detailed analysis was conducted on formal qualifications derived from the question “highest education completed”, and included:

- General Education & Training (GET) – up to Grade 9 (Standard 7)
- Further Education & Training (FET) certificate or diploma (Grade 10–12)
- National Diploma (NDipl) – equivalent to NQF 5
- Degree (undergraduate degree)
- Postgraduate (PG) qualifications (including PG certificates and diplomas, honours, master's degrees and doctorates)

The LFS does not provide postgraduate qualifications in a disaggregated manner, so this report provides separate analyses for each of the postgraduate qualifications for, for example, employment by honours degree. However, disaggregated analysis of PG qualifications was possible for the supply of data in Chapter 4.

This process of developing a *proxy sector* variable, and the limitations were shared with the DEAT ESSP team. It is hoped that, in future, in order to support the HCDS in the biodiversity sector, as well as the cognate sectors, DEAT in conjunction with Stats SA and the newly established Planning Commission in the Presidency will lobby for efforts to generate improved statistics on these sectors.

Selection of relevant occupational categories

A key part of the sector scoping was to decide on the classification of occupational categories to be used for analysis. On the one hand, a number of limitations had to be considered. Firstly, the LFS uses the SOC/SASCO definitions, which are highly aggregate. Further, in the skills development arena there is now a move towards the Occupational Framework (OFO), which has not yet been implemented in the official statistics. However, with regard to the main occupations under investigation, that is professionals, associate professionals and managers, these different frameworks did not pose a key problem for measurement, as they remained fairly standard, irrespective of the chosen occupational framework. The starting point for inclusion of the employed into the biodiversity sector related to the relative importance of particular clusters of occupations with regard to the implementation of the biodiversity mandate, using the relevant Standard Occupational Code (SOC) categories. Thus, occupations were clustered as either "core" or "generic", as set out in Table 2.3. In line with preliminary discussions in the sector (Raven, 2008:2), those

occupations whose functional roles were related to the core business of biodiversity conservation were identified as “core”. For example, among the core professionals were zoologists, botanists and the like; core managers were those involved in R&D and so on with applicable qualifications. On the other hand, those employed in biodiversity, but in support functions important to the efficient functioning of the institutions and in support of the core occupations, were classified as “generic”. Curators were placed under generic as opposed to core professionals, because there were no biodiversity professionals captured under this code in the LFS. Curators are most probably captured under biodiversity managerial codes in the LFS data.

A key limitation of the LFS is that it does not disaggregate study fields so as to distinguish an employee with a PG degree in Life Sciences from one who has a PG degree in Civil Engineering. Thus, the Science, Engineering and Technology study fields are grouped together in the LFS and cannot be disaggregated. This creates major difficulties in comparing demand and supply analyses. Limited comparisons can be made given our knowledge of the types of qualification generally required. For instance, associate professionals generally require an NDipl, instead of a PG degree.

Table 2.3: Professional, associate professional and managerial occupations in the biodiversity sector by 4-digit SOC

CORE PROFESSIONALS & ASSOCIATE PROFESSIONALS
Core Professionals
2112: Climatologist
2114: Geochemist, Palaeontologist, Hydrologist & related
2210: Scientist
2211: Botanist, Zoologist, Bacteriologist & related
2212: Biological sciences
2213: Soil Scientist, Horticulturist, Floriculturist, Agronomists & related
2223: Veterinarian
2310: Lecturers: Life Sciences & Nature Conservation
Core Associate Professionals
3211: Life science technicians
3212: Horticulture, Floriculture, Soil Science, Agronomy & forestry technicians
3213: Farming and forestry advisers/consultants
3227: Assistant, veterinary
GENERIC PROFESSIONALS & ASSOCIATE PROFESSIONALS
Generic Professionals
2122: Statistician
213: Computing professionals
2411: Accountants and related accounting occupations
2412: Personnel and careers professionals
2419: Business professionals
2431: Archivists and curators
2432: Documentalist
2441: Economists
2442: Anthropologist
Generic Associate Professionals
312: Computer associate professionals
3152: Safety, health and quality inspectors
3411: Advisor, financial
3416: Agent, procurement
3431: Administrative occupations
3433: Bookkeeper
3439: Administrative associate professionals not elsewhere classified
MANAGERS
Core Mangers (all with Biodiversity related fields of study)
1210: Directors; 1221: Managers; 1229: Head of Departments; 1237: R&D managers; 1311: General Managers
Generic Managers
Managers in Finance, HR, marketing, distribution, trade, storage, business services, and culture & recreation, etc.

Given the diverse nature of the biodiversity sector, a process of stakeholder consultation was used to develop a series of role clusters in order to define the key professional and managerial categories found in practice (Rosenberg, 2009). This information is attached as an Annexure at the end of the report.

Calculating employment estimates

The most common approach to facilitate comparability of employment trend analysis is to choose the estimates for either March or September (LFS) for a given year. In this analysis, however, a two-step approach was adopted in consultation with other researchers in order to generate the best estimate for employment levels for the sector. Firstly, the highest employment estimate was used as the baseline, which was either the March or September LFS results. Secondly, in order to reduce fluctuations and present smoother graphical trend lines, an employment average for the applicable period was calculated. These smoothed trends could have been over the entire seven-year period or over a four-year period, as the case may be.

This analysis excluded all “other” or “unknown” variables that constituted less than 5% of the total number of relevant cases. Owing to rounding off, some percentage totals did not constitute 100%. The compounded annual growth rate was used in order to calculate the average growth rate per annum. This calculation took into consideration the start and end year, as well as the number of elapsed years. The data were weighted to the population. However, owing to the small sample size, in certain categories the absolute numbers were very small when doing disaggregated analysis and should be treated with caution. Notes to that effect are included as appropriate.

MAIN FINDINGS

Figure 2.1 and Table 2.4 provide an overview of the average annual number of employees available across all levels of occupations in the sector for the period 2000 to 2007, by subsector. The result differentiates between those who were in core biodiversity-related occupations (see biodiversity-related workers, managers, professionals and associate professionals) and others who were also employed in the sector, but not necessarily in biodiversity-related occupations (see craft workers, clerks, service & sales workers and other managers, professionals and associate professionals). It shows that those in biodiversity-related employment only constituted 6.3% over the overall workforce in the relevant sectors. The largest contributing sector was Game, Agriculture, Forestry & Fishing [GAFF] with 55.1% of all biodiversity-related employment across the eight sectors, followed by Local

Government (LGov) and Central Government (CGov). However, the dominance of GAFF was largely due to its large number of skilled workers in biodiversity-related occupations (at less than NQF 5). At managerial & professional level, the picture is reversed, showing that the R&D subsector provided the single largest share (19.3%) of those with biodiversity-related employment, followed closely by CGov and Higher Education (HE). While CGov and LGov had sizeable professional and managerial biodiversity-related employment, Provincial Administration (Pgov) did particularly poorly. This may partly be explained by the possibility that some nature reserves (that are governed at a provincial level) may have been captured under the Libraries, Museums, Botanical Gardens & Nature Reserves (LMB&N)[1] sector. However, on average the LMB&N sector reported the availability of managers and professionals with biodiversity qualifications at about 50% compared to other subsectors. A similar scenario applied to the mining sector. This does not imply that these last three sectors have particularly poor employment levels at a high skill level, as there may be a range of factors that determine these levels of employment.

The data suggest that the broader sector of which biodiversity forms a part is largely dominated by a workforce not employed in biodiversity-related occupations; further, at about NQF level 4 and above, those in biodiversity-related occupations constituted less than 10% of the total available workforce. There are no directly comparable estimates available elsewhere, since the scope of coverage tends to differ. Thus, employment in the Conservation & Guiding sector (as per the THETA definition) in core occupations (senior officials, managers, professionals, rangers, associate professionals and technicians) are estimated at 12 000 (Prodigy-Grant Thornton, 2007). Given the scope of coverage under the THETA, these figures exclude core employees in government (covered under the LGSETA, PSETA), higher education, mining or GAFF. Therefore, if only the R&D, HE and LMB&N subsectors are

[1] Libraries are included in this sector for this analysis only.

considered, the core biodiversity employment estimates compared well at an average of 11 698 per annum. However, these comparisons are for illustrative purposes only, as there is general agreement that employment estimates in the tourism industry (within which conservation and biodiversity is often imbedded) are highly questionable (Lowitt, 2006).

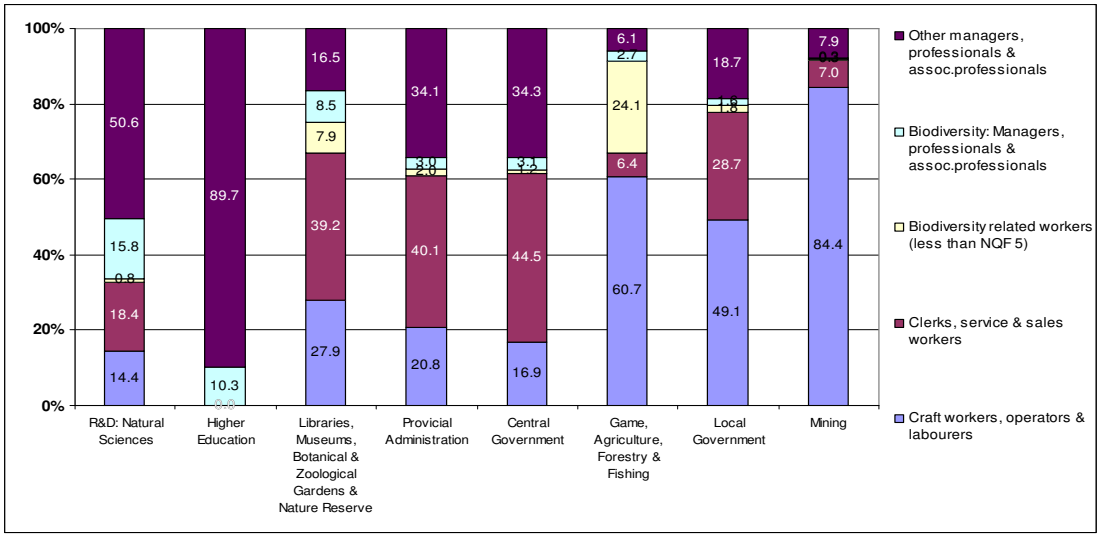


Figure 2.1: Average annual percentage of employees in the biodiversity subsectors (2000–2007)

Source: LFS 2000 – 2007, Quantec (2008)

Table 2.4: Average annual number of employees in the biodiversity subsectors (2000–2007)

Occupations		R&D: Natural Sciences	Higher Education	Libraries, Museums, Botanical & Zoological Gardens & Nature Reserve	Provincial Admin.	Central Gov.	Game, Agriculture, Forestry & Fishing	Local Gov.	Mining	Total
Other: managers, professionals & associate professionals	n	16266	37618	4478	9430	53225	9345	38526	40616	209503
Biodiversity: Core Managers	n	1659		520		1427	1447	1939	667	7658
	%	21.7	0.0	6.8	0.0	18.6	18.9	25.3	8.7	100
Biodiversity: Core professionals	n	2208	4317	960	833	1608	1606	1190	0	12722
	%	17.4	33.9	7.5	6.5	12.6	12.6	9.4	0.0	100
Biodiversity: Core associate professionals	n	1222		811		1808	993	214	998	6048
	%	20.2	0.0	13.4	0.0	29.9	16.4	3.5	16.5	100
Biodiversity: Total: Managers, professionals & associate professionals	**n**	**5090**	**4317**	**2291**	**833**	**4843**	**4046**	**3343**	**1665**	**26427**
	%	**19.3**	**16.3**	**8.7**	**3.2**	**18.3**	**15.3**	**12.6**	**6.3**	**100**
Biodiversity related work (less than NQF 5)	n	266	0	2139	549	1812	36638	3758	1801	46964
	%	0.6	0.0	4.6	1.2	3.9	78.0	8.0	3.8	100
Biodiversity related: Total	**n**	**5356**	**4317**	**4430**	**1382**	**6655**	**40685**	**7101**	**3466**	**73392**
	%	**7.3**	**5.9**	**6.0**	**1.9**	**9.1**	**55.4**	**9.7**	**4.7**	**100**
Clerks, service & sales workers	n	5908	0	10619	11105	69146	9702	58944	36399	201823
Craft workers, operators & labourers	n	4648	0	7549	5747	26223	92291	100943	436146	673546
Total	n	32178	41935	27076	27662	155249	152023	205514	516626	1158264

Source: LFS 2000–2007, Quantec (2008)

According to interviews and data obtained from parastatals, provincial government, local government and NGOs, generic managers, professionals and associate professionals (refer to Table 2.3 for detail) in the biodiversity sector form around three-quarters of the biodiversity workforce and core biodiversity managers, professionals and associate professionals about 20%. The remainder of the analysis will focus on those employed in core biodiversity occupations at managerial, professional and associate professional levels. Also, for this analysis, libraries are excluded, as many do not specialise in natural sciences related to biodiversity.

Employment and growth in core occupations in the biodiversity sector

In this section, the absolute size and average annual growth in the core managerial, professional and associate professional (MP&AP) workforce of the various subsectors are presented. These are actual numbers and not average estimates.

Figure 2.2 shows that over the 2000 to 2007 period there were huge fluctuations in the core managerial, professional and associate professional (MP&AP) workforce. The entire sector was declining at a –1.9% average annual growth rate over this period. The raw LFS data showed particularly strong declines in core biodiversity occupations in mining and government and to a lesser extent in higher education over the 2000 to 2007 period. Conversely, growth in core biodiversity employment

occurred especially in the BZ&N and to a lesser extent in R&D and GAFF subsectors over this period.

However, there may also be survey measurement errors in terms of data capturing. LFS for instance did not provide much provincial government data, as core biodiversity managers, professionals and associate professionals in provincial government were most probably captured under BZ&N and not under provincial government in the LFS dataset. Therefore, we made a comparison with the biodiversity *public* sector data in Vulindlela (the public sector database which includes environmental employment data from DEAT, all provinces and agriculture), although this data is over a slightly different time period. The biodiversity component in the broader Vulindlela environmental component was selected according to permanent (excluding temporary employment) occupational descriptions. It must be noted that it was not always possible to distinguish environmental-related occupations from biodiversity-related occupations, as the occupational descriptions were sometimes vague.

Contrary to LFS biodiversity government data, the core *biodiversity public* sector component grew at a low average annual rate of 1.1% over the 2003/4 to 2008/9 period, according to Vulindlela data (Table 2.6). This difference may be as a result of the two periods of the two datasets not being the same and therefore only indicative. As has been indicated, *provincial* data in LFS were also probably captured under the BZ&N component which has experienced growth. The numbers in the public sector in the two datasets do not differ much, except for 2003 and 2007 (Table 2.6). This is an important finding as it shows that the LFS public sector trends are reliable for the period indicated. The Vulindlela public sector database indicates that the total *environmental* public sector, contrary to the *biodiversity* component, has declined by a –1.8% average annual growth over this period.

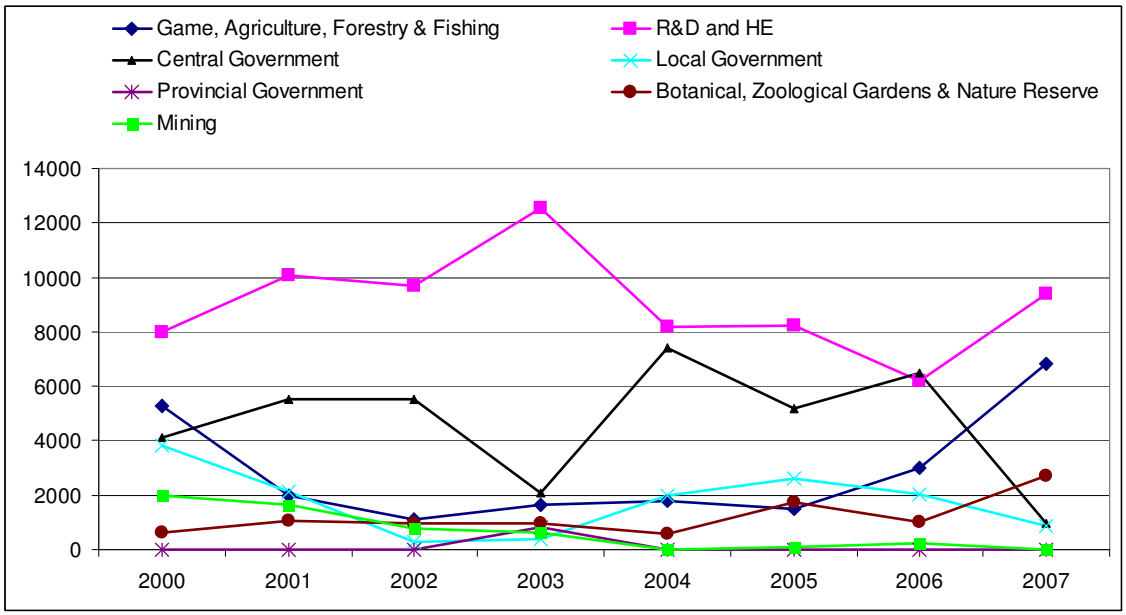


Figure 2.2: Employment trends in core occupations in the biodiversity subsectors (actual numbers) (2000–2007)

Source: LFS 2000_2007; Quantec (2008)

Table 2.5: Employment in the core occupations in the biodiversity subsectors (actual numbers) (2000–2007)

Sub-sectors	2000	2001	2002	2003	2004	2005	2006	2007	Average annual growth
Game, Agriculture, Forestry & Fishing	5289	2008	1124	1660	1768	1495	3014	6844	3.7
R&D and HE	8015	10063	9711	12530	8182	8234	6223	9416	2.3
Central Government	4130	5506	5506	2101	7398	5187	6512	976	-18.6
Local Government	3833	2116	297	412	1971	2612	2037	853	-19.3
Provincial Government	0	0	0	833	0	0	0	0	0
Government: Total	7964	7622	5802	3345	9369	7799	8549	1830	-18.9
Botanical, Zoological Gardens & Nature Reserve	638	1055	991	949	570	1739	1021	2727	23.0
Mining	1979	1625	759	632	0	89	229	18	-49.0
Total: Core MP&AP employment	23885	22374	18387	19114	19889	19356	19035	20834	-1.9

Source: LFS 2000-2007; Quantec (2008)

Table 2.6: Employment trends (actual numbers) in core occupations in the public sector

Public sector	Years								
	2000	2001	2002	2003	2004	2005	2006	2007	
Core public biodiversity (LFS)	7964	7622	5802	3345	9369	7799	8549	1830	
Core public biodiversity (Vulindlela)				8150	8452	7052	8237	8393	8601
Total public sector (Vulindlela)				54254	53502	45880	51621	49598	49523

Source: LFS (2000–2007); Vulindlela (2003/4–2008/9)

Figure 2.3 shows that the growth in the core biodiversity component in the public sector was mainly as a result of growth in the core *associate professional* category (10.3% average annual growth) and a negative average annual growth of –3.1% in the combined core managerial and professional component over the five-year period in the public sector. It must be noted that it is very difficult to distinguish between core professional and core managerial functions in the biodiversity sector, especially in the Vulindlela database. The r-squared linear regression method was applied to show the strength or consistency of upward/downward employment trends for the selected categories. A value close to one indicates a high linear reliability. The r-value can serve as an indicator of whether the direction of change can be predicted in the future with greater or lesser confidence. The core associate professional category had the strongest r-squared (R^2) value closest to one, while the managerial and professional categories did not have a strong r-square. The core associate professional category in the *public sector* is likely to grow faster in future.

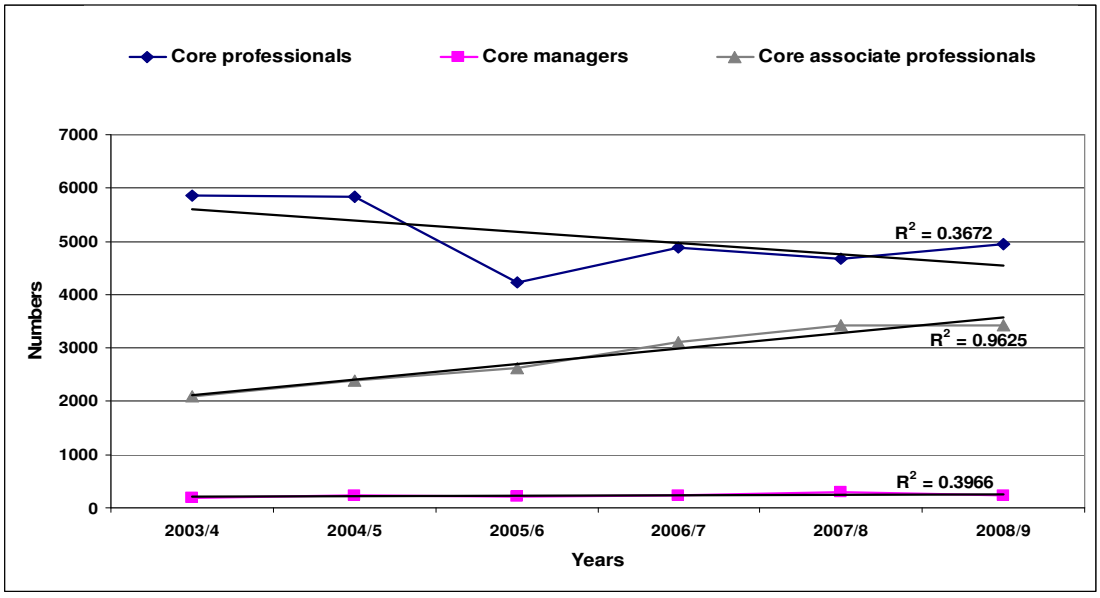
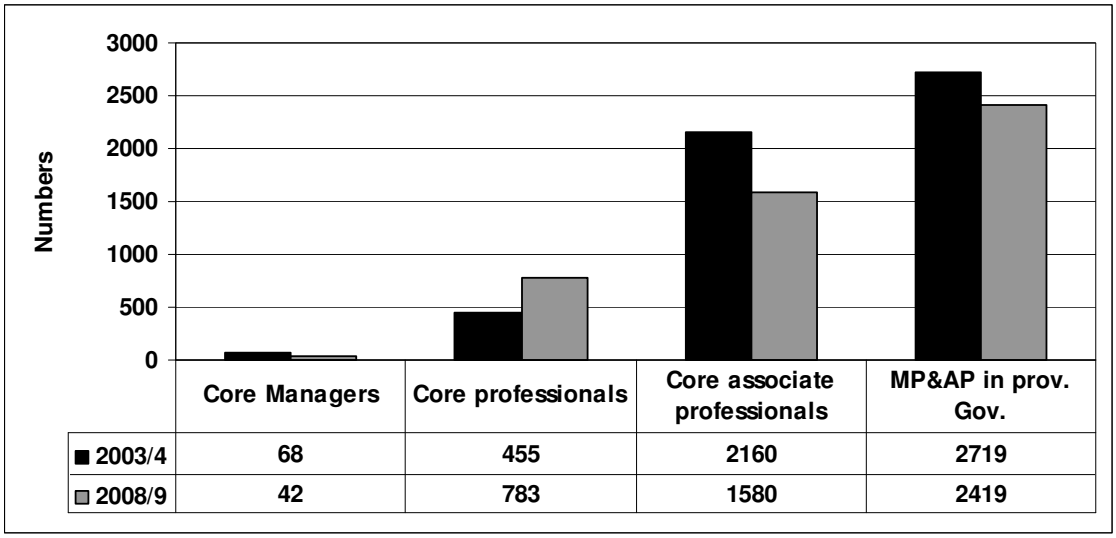


Figure 2.3: Employment trends in core occupations in public sector biodiversity (actual numbers) (2003/04 - 2008/09)

Source: Vulindlela (2003/4-2008/9)

However, in the *provincial* core biodiversity component of the public sector, the picture is different (Figure 2.4). Vulindlela public sector data indicates a negative average annual growth of –2.3% in the biodiversity *provincial* category over the 2003/4 to 2008/9 period. Both the number of core *managers* and core *associate* professionals declined; conversely the number of core *professionals* increased by as much as 11.5% in provincial departments over this period.



	Core Managers	Core professionals	Core associate professionals	MP&AP in prov. Gov.
2003/4	68	455	2160	2719
2008/9	42	783	1580	2419

Figure 2.4: Employment trends in core occupations in the provincial government biodiversity subsector (actual numbers) (2003/4 and 2008/9)

Source: Vulindlela (2003/4 and 2008/9)

Another possibility to consider (outside of survey measurement error) is churning within the biodiversity sector as a whole. For instance, if one were to read together the period 2003 to 2004 for the government and R&D and HE subsectors, there is a suggestion of movements in and out of these subsectors (Figure 2.2). Thus, a massive decline in R&D and HE was accompanied by a tripling of the core MP&AP workforce in government. The complete reverse applied between 2006 and 2007 for these subsectors, which resulted in losses in government and gains in employment in R&D and HE. Also, there is anecdotal evidence of high rates of exit from government, some of which may end up in the GAFF sector, which experienced a more than doubling in employment over the 2006 to 2007 period. The fieldwork indicated that movement within government occurs because staff do not lose their benefits when moving from one department to another. Employment conditions could be a cause of movement between organisations, as revealed in interviews. Employment in the BZ&N sector in the core occupations showed tremendous growth (23% average annual growth), albeit from a low base.

Interviews in eight core biodiversity organisations (zoological and nature reserve organisations; parastatals; local government; and provincial government) and data

obtained from these organisations revealed that these organisations intend to increase their core biodiversity staff complement (core managers, professionals and associate professionals) by around 2%, while the support staff component (the generic component plus administrative staff, computer related occupations and other occupations) will slightly decrease by 2% over the next five years. Future increases will mainly be among designated groups, especially among black women, although one organisation has indicated that currently there were too few white core biodiversity staff members and that they were hard to come by.

For a comparative analysis of the various datasets on detailed occupations, refer to the second last section in this chapter on “Comparative results from occupational gap analysis”.

In conclusion, while the period under investigation was accompanied by positive economic growth in the country, the economy entered into a recessionary phase in the late 2008 and early 2009 period. This is likely to result in stagnation and cutbacks in state expenditures and thus employment opportunities, as well as pressure for financial sustainability in the biodiversity sector.

Employment profiles in core occupations and biodiversity functionality

The following results focus on the employment profiles of the core MP&AP workforce within the subsectors. It also comments on the extent to which these patterns may reflect how functional responsibilities with regard to their respective biodiversity mandates are operationalised in the subsectors. Note that at this level of disaggregation the numbers are very small.

Figure 2.5 shows that managers dominated in the LGov workforce (58%) and managers were also strongly represented (40%) in mining. These proportions may be somewhat out of sync with the sector’s key functions. Thus these two subsectors required the management of natural resources, as well as policy implementation, enforcement and conservation. In local government, given its closeness to communities (public advocacy and engagement), which is often affected by biodiversity legislation and the interplay between development needs and conservation, a top-heavy managerial workforce may not necessarily provide

sufficient on-the-ground support for innovative solutions. It has a sizable professional workforce (35%).

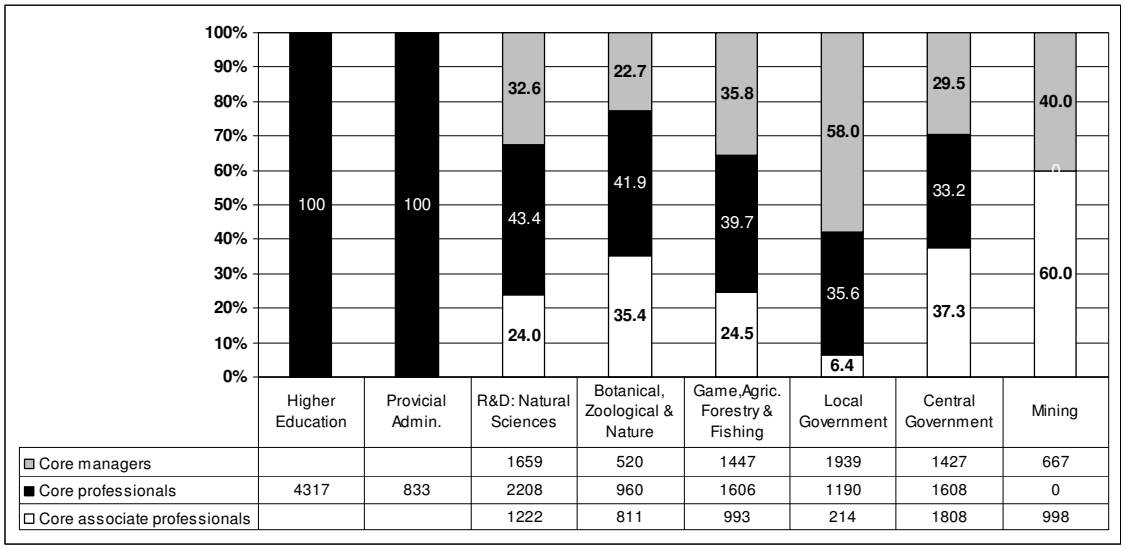
Mining had a more junior biodiversity workforce with associate professionals making up nearly two-thirds and no professionals (numbers were too small for inclusion). In this case, one might argue that professionals may serve as important interpreters (on a scientific basis) of the implications of biodiversity legislative and policy regulations for the sector, as well as researching innovative solutions to prevent and mitigate biodiversity degradation and losses. With a relatively large but junior set of scientists, this opportunity may be lost. CGov also had a slightly bigger junior biodiversity workforce than professional workforce and just over a quarter were core managers. One could also argue that CGov needs to have a larger biodiversity managerial workforce given the level of degradation of natural resources and climate change in the country.

In the HE sector, the core workforce was on a professional level only, in line with its functions of teaching and research. However, questions abound with regard to the rationale for a predominantly professional workforce at PGov (mostly provincial departments), albeit with very small, annual average numbers when compared to other subsectors. However, in the LFS dataset, the biodiversity workforce in provincial departments may be predominantly captured with botanical, zoological and nature reserve activities. According to the Vulindlela database (public sector database), for example, there are around 34 core biodiversity-related managers (as opposed to none in the LFS dataset), 1 557 core professionals (833 in LFS dataset) and 1 580 core associate professionals (none in the LFS dataset) in provincial government.

The remainder of the sectors all had professionals as the dominant employment group. In R&D and Botanical, Zoological Gardens and Nature Reserves (BZ&N), a professional workforce of just over 40% may be in line with their functional responsibilities. However, if associate professionals are regarded as a stepping stone (or as feeder occupations) to entry into professional occupations, then the proportion of associate professionals in the BZ&N subsector (35%) was more optimal compared to that in R&D subsector (24%). Also, in South Africa, those at professional level tend to be older (given their levels of experience) and act as

mentors and supervisors to those entering the profession, and facilitate the process of attaining higher levels (postgraduate in this case) of qualifications. The GAFF sector had a similar distribution in core occupations as the R&D sector.

In conclusion, it may be useful to explore and develop a baseline model of the "ideal" mix of core occupations. This model would have to be in line with the functional responsibilities of the various subsectors in achieving effective and efficient governance in the biodiversity conservation sector, as per Strategic Objective 2 of the NBSAP 2005. This will create further depth in the afore-going comparison attempted here, which only reflected the status quo. Also, the process of defining future capacity needs may become even clearer.



	Higher Education	Provicial Admin.	R&D: Natural Sciences	Botanical, Zoological & Nature	Game,Agric. Forestry & Fishing	Local Government	Central Government	Mining
Core managers			1659	520	1447	1939	1427	667
Core professionals	4317	833	2208	960	1606	1190	1608	0
Core associate professionals			1222	811	993	214	1808	998

Figure 2.5: Average annual number and percentage employed in core occupations in the biodiversity subsectors (2000–2007)

Source: LFS 2000–2007; Quantec (2008)

Figure 2.6 shows that nearly half of core occupations in the sector were in the public sector, while the private sector constitute at least one-third. NGOs also constituted nearly one quarter of the workforce, making them an important category in terms of defining capacity needs in the sector. A third of the managers and over a quarter of associate professionals work in the NGO sector; however, in all three categories, employment is predominantly in the public sector, although more than half of professionals are inclined to work in the public sector compared to one-third in the private sector and 14% in NGOs. Among associate professionals most (44%) were

in the public sector, 27% in NGOs and 28.6% in the private sector. In comparison, three-quarters of the engineering workforce works in the private sector as opposed to the public sector.

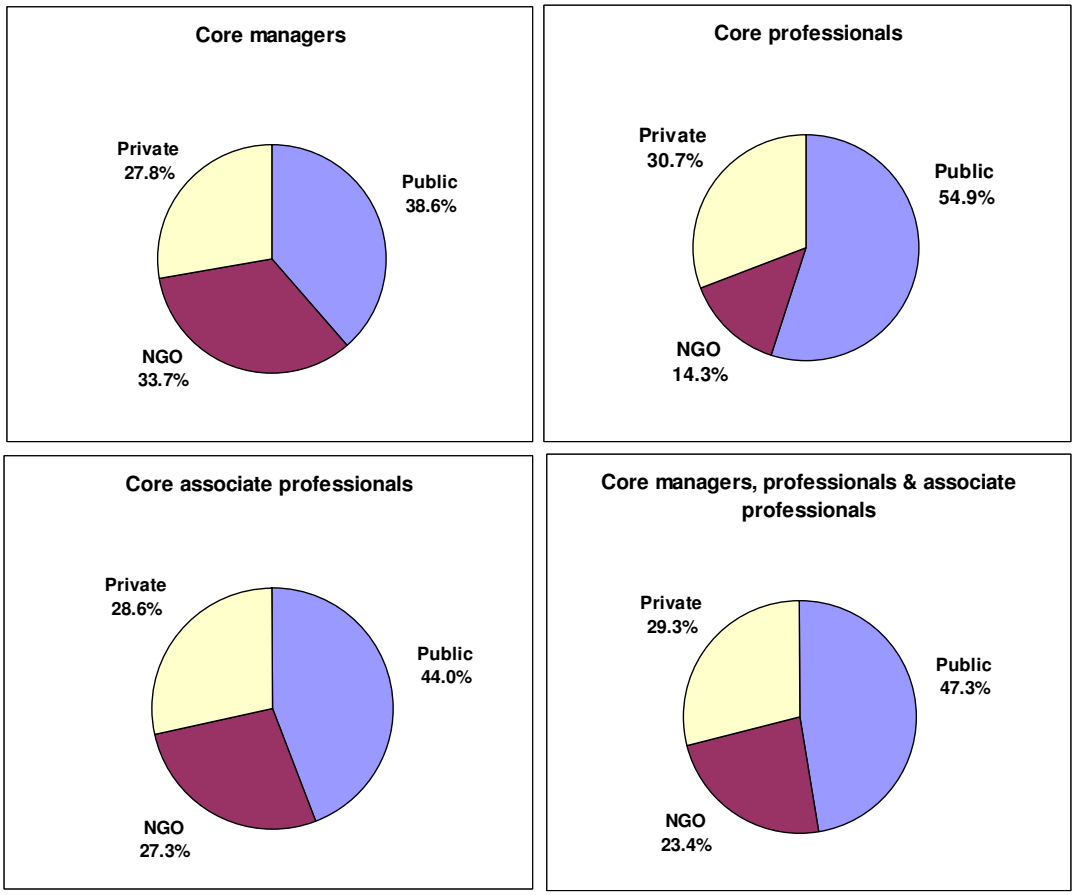


Figure 2.6: Employment profile in core occupations by public, private and NGO sectors (2000–2007)

Source: LFS 2000–2007, Quantec (2008)

In terms of the provincial distribution of employment as shown in Figure 2.7, one-quarter of all employment in the biodiversity sector was in Gauteng, followed by the coastal provinces, Western Cape (21%) and KZN (18%). This pattern appears to reflect more closely the provincial bias of economic development and skills availability in the country, as opposed to the allocation of natural resources and thus biodiversity responsibilities.

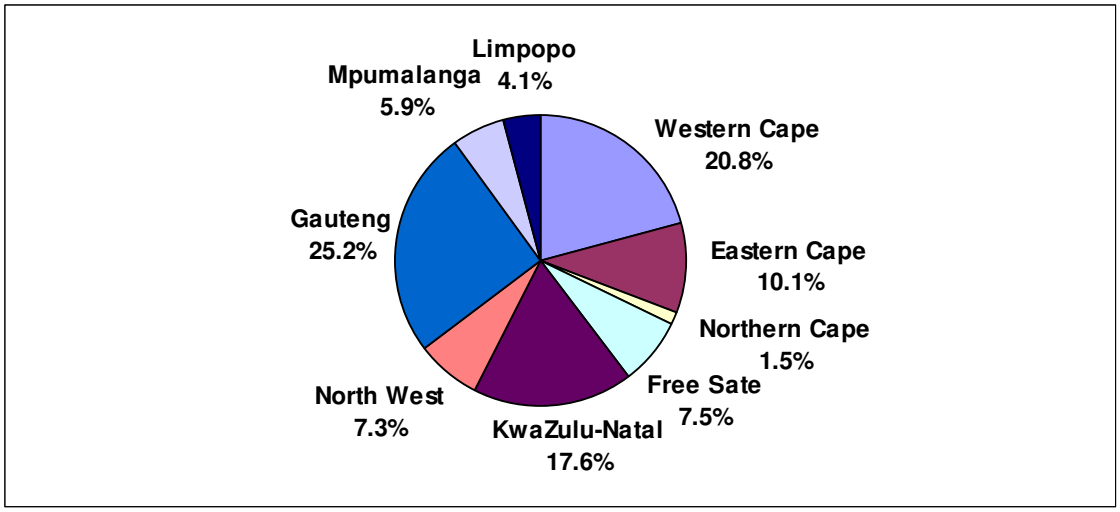


Figure 2.7: Employment profile in core occupations by province (2000–2007)

Source: LFS 2000 – 2007, Quantec (2008)

Changes in the demographic profile

This section analyses changes in the demographic profile of the core workforce in the various subsectors by population group[2] and gender. It also comments on progress towards achieving a more diverse core workforce that is more representative of the SA population in terms of the provisions of the EEA, as well as internal obligations adopted in the subsectors. It should be noted that this is a very disaggregated analysis, and thus the numbers (in certain categories) are very small – under 300 – and should be treated with caution. However, it should be noted that comparisons with public sector data (the largest employer in the sector) compared very well, confirming the general reliability of the LFS results for the core workforce.

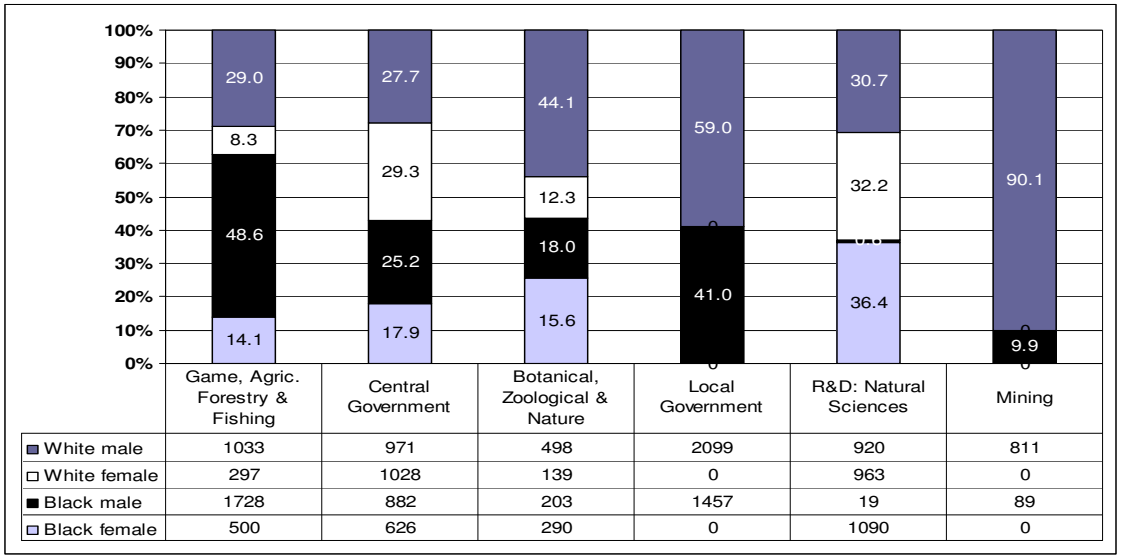
[2] Black included Africans, Indians and coloureds. The numbers for the last two groups were too small to be included separately.

Figure 2.8 focuses on the core managerial workforce. It shows that, with the exception of the GAFF subsector, all other subsectors were dominated by whites for the period. Thus, whites constituted almost a two-thirds of the managerial employment in the subsectors combined, whereas in Mining 90% of managers were white. However, in the broader public sector, other studies show greater representation of blacks at the managerial level. These results suggest that the core biodiversity managerial component (which excludes the generic biodiversity managerial component) in the government subsector may be an exception.

More positively, with the exception of LGov and mining, where white male core biodiversity managers dominate, there are significant numbers of female core biodiversity managers, especially in the R&D (68.6%) and CGov (47.2%) sectors. Among the women, black women managers dominate in the R&D (36.4%), BZ&N (15.6%), and GAFF (14.1%) sectors. Black males appear to have made major inroads in the core biodiversity managerial component, except in the R&D sector. Among black core managers, black males were nearly twice the proportion of black female core managers. Black females outnumbered black males by far in the R&D subsector. The profile represented here appears to echo the slow progress in terms of a more representative managerial workforce generally experienced in other sectors of the economy.

Figure 2.9 attempts to explain how periodic shifts may have occurred in comparing the demographic profile for the periods 2000 to 2003 with 2004 to 2007 in the managerial category. It shows that in the first period, males were in the vast majority (79.7%). It was also a predominantly white category, as whites constituted nearly three-quarters (74.5%) of core managers. There were two key changes in the second period. Firstly, the overall white share declined to 59%, largely as a result of a white male share that was close to half its original size. Secondly, the major beneficiaries of the change were black women whose share more than doubled and white women whose share nearly doubled. Black male managers had a negligible increase in their employment share, although it is still larger than either the share of white or black women. So, the core managerial category remained a predominantly male category (59.2%), but with significant gains made by women.

No core managers were recorded in the provincial biodiversity subsector in the LFS dataset, but there were some recorded in the provincial Vulindlela data (Figure 2.4).



	Game, Agric. Forestry & Fishing	Central Government	Botanical, Zoological & Nature	Local Government	R&D: Natural Sciences	Mining
White male	1033	971	498	2099	920	811
White female	297	1028	139	0	963	0
Black male	1728	882	203	1457	19	89
Black female	500	626	290	0	1090	0

Figure 2.8: Profile of the core managerial workforce in the biodiversity subsectors by population group and gender (2000–2007)

Source: LFS 2000-2007, Quantec (2008)

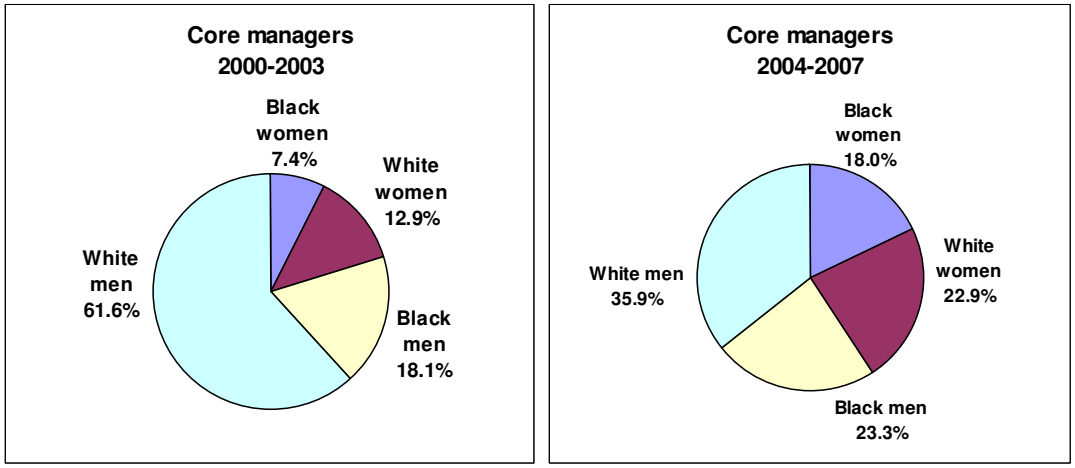


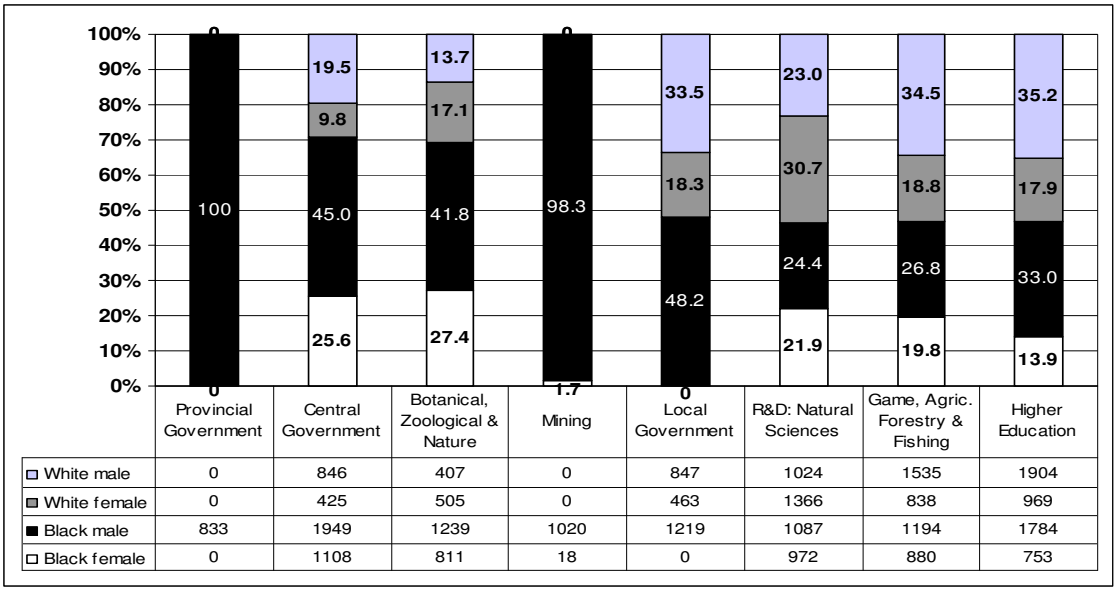
Figure 2.9: Comparison of the core managerial workforce by population group and gender (2000–2003; 2004–2007) (%)

Source: LFS 2000-2007, Quantec (2008)

The next section presents a similar analysis based on changes in the demographic profile of the core professionals and associate professionals (P&APs).

Figure 2.10 presents a demographic profile of the core P&APs that is more nuanced when compared to that for managers. Black P&APs dominated in four subsectors (PGov, CGov, BZ&N and Mining), while white P&APs dominated in the remaining four subsectors (LGov, R&D, GAFF and HE). In the CGov and BZ&N subsectors white P&APs constituted about one-third of employment, while in the PGov there were no white P&APs. Thus, while white P&APs were still over-represented when compared to their share of the economically active population (12.6%), the larger number of black professionals mirrors the pattern in other sectors of the economy. In startling contrast to core managers, Figure 2.10 also shows that white P&AP males were represented at much lower numbers than in the core managerial category. In HE, GAFF and LGov white male P&APs had around a third of the employment share in each of these subsectors, very small employment shares in the CGov, BZ&N and R&D subsectors and none in PGov and mining. However, this does not imply an absolute reduction in the white male employment share in the biodiversity sector. It may just mean that more white males are progressing into managerial roles as was suggested in Figure 2.9, shown previously.

With regard to the position of white female P&APs, they comprised almost a third of employment in R&D, similar to that among managers shown previously. They also had sizable employment shares in GAFF (18.8%), LGov (18.3%), HE (17.9%) and BZ&N (17.1%). Improvements in the black share appeared to be concentrated among black males. They dominate P&AP employment in PGov (100%), Mining (98.3%), LGov (48%), CGov (45%), and BZ&N (42%). They also commanded the second-largest employment share compared to white males in HE and GAFF. In contrast to their representation in core managerial roles, black women P&APs were mostly employed in BZ&N (27%), CGov (26%) and R&D (22%). When one compares the position of black women core managers and core P&APs to the rest in these categories, the results suggest that they have the best chance of progress in the R&D subsector, and the worst chance in LGov.



	Provincial Government	Central Government	Botanical, Zoological & Nature	Mining	Local Government	R&D: Natural Sciences	Game, Agric. Forestry & Fishing	Higher Education
White male	0	846	407	0	847	1024	1535	1904
White female	0	425	505	0	463	1366	838	969
Black male	833	1949	1239	1020	1219	1087	1194	1784
Black female	0	1108	811	18	0	972	880	753

Figure 2.10: Profile of core professionals and associate professionals (P&AP) in the biodiversity subsectors by population group and gender (2000–2007)

Source: LFS 2000-2007, Quantec (2008)

Figure 2.11 attempts to explain how periodic shifts may have occurred. Among core professionals the results suggest while there was a slight decline in the male share of employment; over the two periods the sector remained predominantly male. The key shifts among core professionals were in the decline of white males, which appeared to have accrued to black females (a tripling in numbers from a very low base) and to a lesser extent black males. Thus, by the second period, the black share among core professionals improved to 47.9% from about 29.7%.

Conversely, by the second period the share of black core associate professionals had decreased and the white share had increased, although black associate professionals still constituted the majority in this category. The white share among the associate component increased from 16 to 40%, while the black share decreased from 84 to 61%. There has been a dramatic shift towards females, who constituted 42% of the associate professional category by the second period. Black females almost doubled and the number of white females improved from none in the first period to 13% in the second period. However, males still form more than half of the associate professional category. The dominant black share is explained by the

fact that this type of employment represents entry-level scientists (often with a NDipl, undergraduate or honours degree). Therefore, if these occupations are regarded as feeders into the core professions, the results suggest that black males have a greater chance of breaching that ceiling compared to black females. However, black females appear to be catching up as the dramatic increases in this category over the two periods suggest, and represent a group where there is enormous potential for capacity development.

Overall in the biodiversity sector transformation progress has been made in core MP&AP employment, as shown in Figure 2.12. Over the 2000 to 2003 period one-third of core MP&APs were black, while over the second period half of MP&APs were black. The proportion of women increased from almost a quarter in the first period to over a third in the second period. The proportion of white males decreased from 47% to a third, the share of white women stayed constant, the proportion of black men increased from a quarter to a third, while the proportion of black women improved significantly from 7% to almost a fifth.

However, according to more recent data obtained from interviews in the biodiversity sector (data from eight core institutions in the biodiversity sector), transformation progress has even improved since 2007, as shown in Figure 2.13. The main inroads were made by black men (59%), but black women have also increased their share to almost a third.

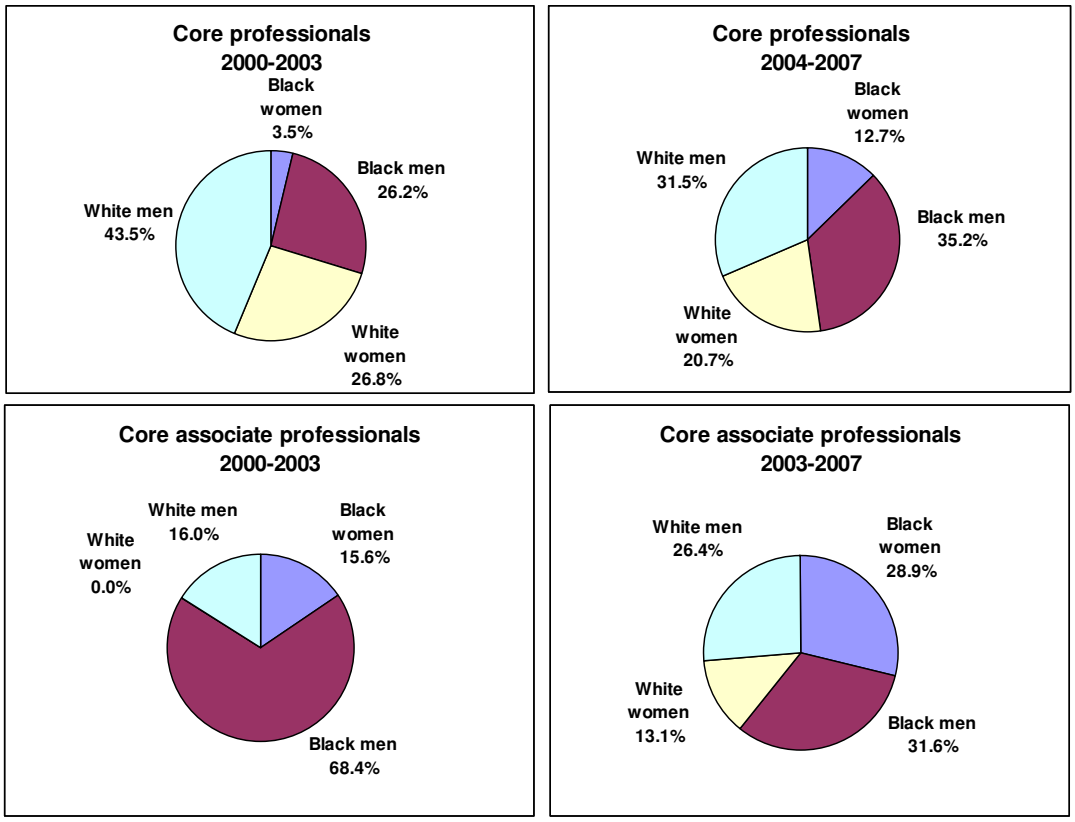


Figure 2.11: Comparisons of core professionals and associate professionals by population group and gender (2000–2003; 2004–2007)

Source: LFS 2000–2007, Quantec (2008)

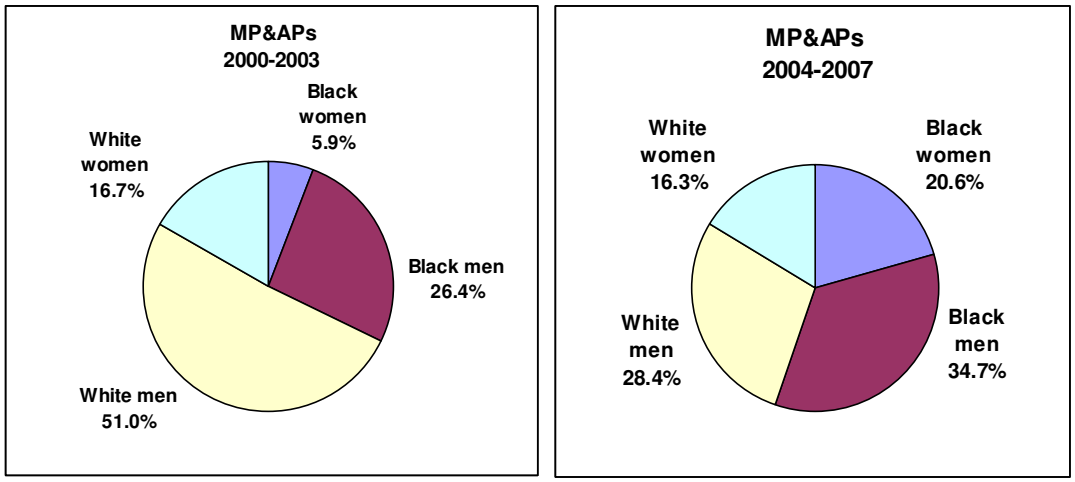


Figure 2.12: Comparison of core managers, professionals and associate professionals (MP&AP) by population group and gender (2000–2003; 2004–2007)

Source: LFS 2000–2007, Quantec (2008)

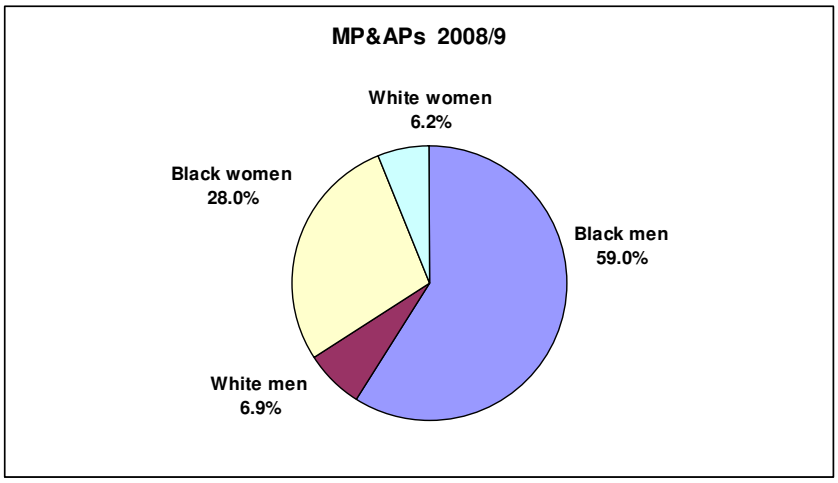


Figure 2.13: Comparison of core managers, professionals and associate professionals (MP&AP) by population group and gender (2008/9)

Source: Data from core biodiversity institutions obtained by the authors (2008/9)

Figure 2.14 shows that over this period, the majority (about 53%) of the core workforce in the biodiversity sector was in their most economically productive years – 30 to 49 years. It also had a sizable (27%) entry-level workforce (15–29 years), dominated by professionals. The mature group in the workforce (50 years and

above) represented the smallest share (21%) of the biodiversity sector. This profile suggests that the perception that this is an ageing population may be an outdated notion. The distribution of the population echoes that of the ordinary economically active population with a bulge in the centre (labour participation rates tend to peak in the thirties), followed by those younger and older. The age distribution is important for calculating replacement demand, an area to be addressed by the HCDS.

Some concerns may arise in terms of sharing the load of mentoring, especially among core professionals. If one assumes that those in the mid range 30 to 49 years will be central to all activity in the sector, they may face obstacles in supervising and mentoring the large numbers of entry-level professionals. Furthermore, the number of professionals aged 50 to 64 years is patently too small to render this service of acclimatising young scientists in the sector. Another interesting phenomenon is the dominance of managers across all age ranges. On average, there appears to be as many older managers as younger ones. Also, among the key age group, 30 to 49 years, managerial responsibility reduces even further their capacity to supervise and mentor. Finally, there appears to be some stagnation in attracting more younger associate professionals. However, their relative dominance in the 30 to 49 category may represent a major challenge to the sector. On the one hand, they may possess considerable experience (but lower level qualifications) in the sector, and thus have few opportunities for advancement and may need supervision and mentoring to advance in the sector. The dynamics around the qualification profile is explored in the next section.

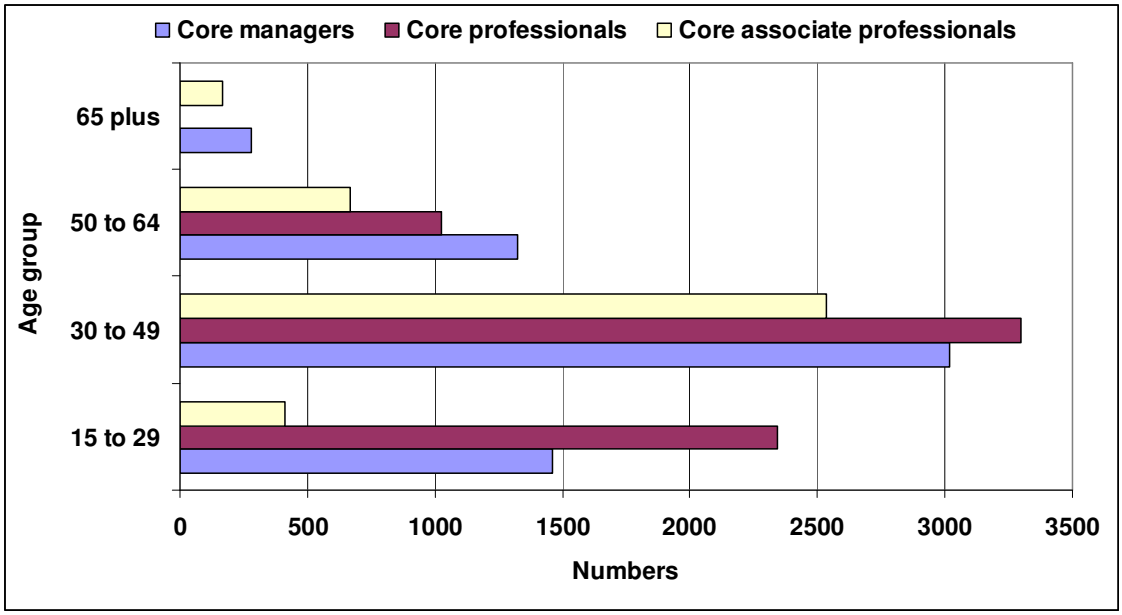


Figure 2.14: Profile of core workforce by age group (2000–2007)

Source: LFS 2000–2007, Quantec (2008)

Changes in the qualifications profile in core occupations

The final set of findings analyses the distribution of qualifications among those employed in core occupations. The key qualifications include GET (up to Grade 9), FET (Grades 10–12), NDipl (NQF 5), first degree (NQF 6) and Postgraduate (NQF 7 and higher). The LFS does not allow for disaggregated postgraduate qualifications. The fieldwork suggested that the entry-level qualification is at postgraduate level, honours or preferably a master's degree. Also, it was suggested that they rarely employed people with just a first degree.

It is therefore surprising that, according to Figure 2.15, nearly 12% of those employed in core occupations had a qualification lower than a NQF 5. Most (57%) had either a NDipl or a first degree. Almost a third had a postgraduate degree. It is not clear to what extent these ratios are a fair reflection of what is needed in the sector. There is a concern that the share of those with degrees is virtually equivalent to those with postgraduate degrees. Interviews revealed that there were very few suitable honours candidates available to appoint in the "feeder" positions and they need to be handpicked and trained to become core professionals. Perhaps an

analysis of changes in qualification profiles within the specific occupations will shed more light on this.

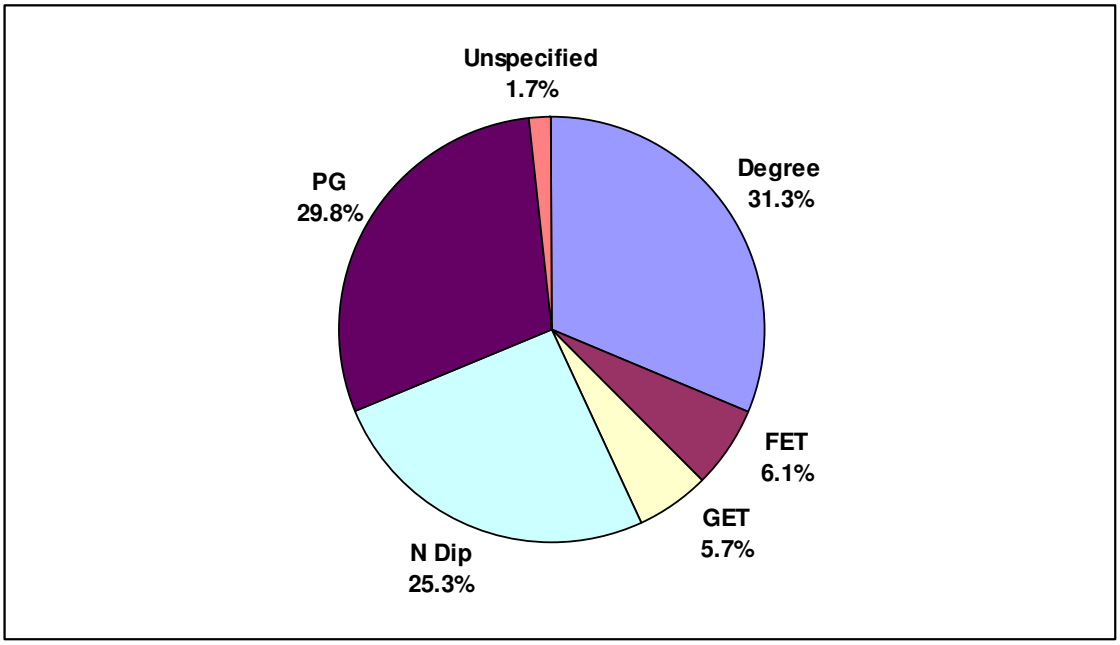


Figure 2.15: Qualification profile in the core occupations (%) (2000–2007)

Source: LFS 2000-2007, Quantec (2008)

Among core managers, the results suggest that from the first into the second period, the qualification profile remained fairly static. Thus, despite a 13.5% decline among those with an NDipl, this did not translate into substantial increases in the employment of those with degrees or postgraduate degrees. Those with a postgraduate qualification did, however, improve slightly. In the second period, the result suggested even the employment of those with less than Matric qualifications, albeit at very low levels (Figure 2.16).

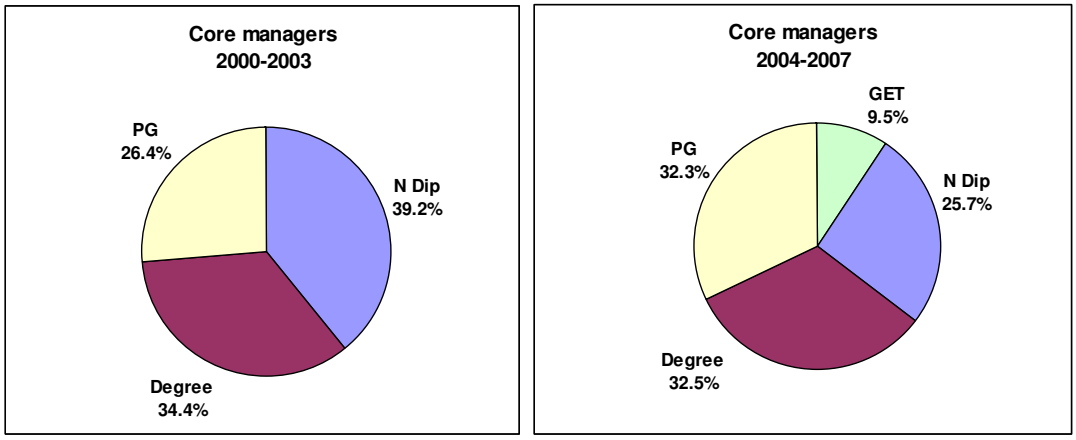


Figure 2.16: Changes in the qualification profile of core managers (2000–2003; 2004–2007)

Source: LFS 2000–2007, Quantec (2008)

Among those employed as core professionals, it was very evident that a worrying decline in the qualifications became evident over the two periods: whereas, in the first period, postgraduates constituted 40% of all core professionals, in the second period this declined by 6%. A similar decline was evident for those with degrees. The relatively small share of those with an NDip doubled in the second period. Therefore, increasingly, professionals with qualifications of NQF 4 and lower are being employed in the sector. The employment of professionals with lower level qualifications implies that these individuals may be required to operate at levels of responsibility that they are not necessarily qualified for. This applies equally to those with qualifications at NQF 4 and lower. It shows that, in the second period, a third was in this situation. The result of this disjuncture in qualifications and responsibility is echoed in other research indicating that the levels of enforcement competence are often low. The high levels of expenditure on consultants in DEAT (see chapter 1) may further illustrate this phenomenon.

With regard to those at associate professional level, the results suggest that the proportion of those with a degree declined by about 10%. There was a small proportion that had a postgraduate qualification and this share remained constant from the first to the second period. As expected, the dominant entry qualification was a NDip in both periods, with some decline. However, and worryingly so, the

proportion of those with a qualification at NQF 4 more than doubled. The share of those with less than NQF 4 and an unspecified qualification constituted about 23% of the associate professional workforce.

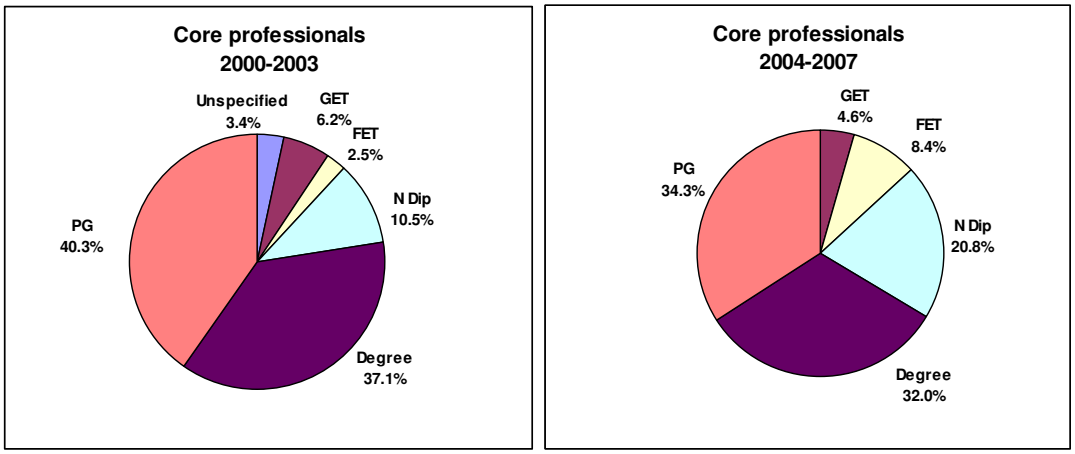


Figure 2.17: Changes in the qualification profile of core professionals (2000–2003; 2004–2007)

Source: LFS 2000–2007, Quantec (2008)

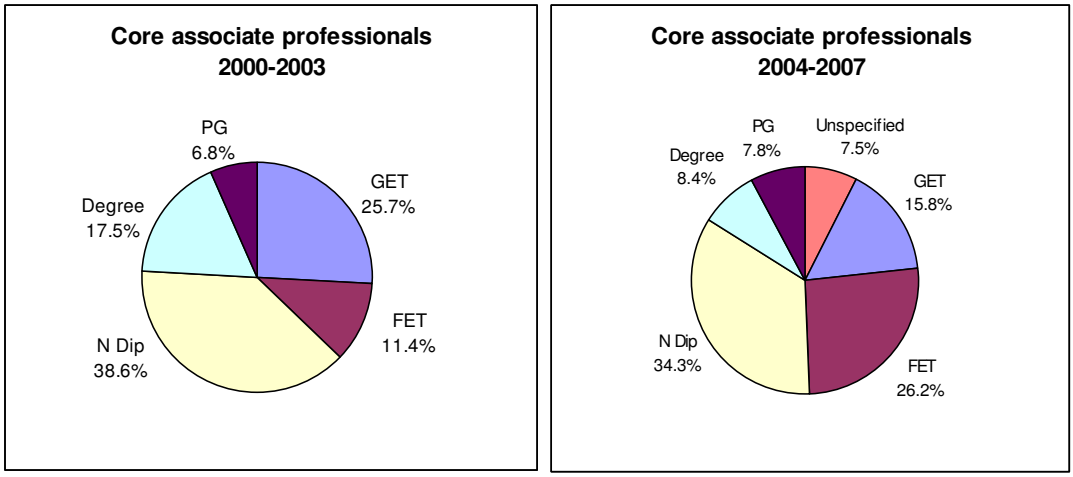


Figure 2.18: Changes in the qualification profile of core associate professionals (2000–2003; 2004–2007)

Source: LFS 2000-2007; Quantec (2008)

The implication is that, given the oversupply of those with Matric as well as NDipl, the sector has been dropping its entry qualifications. Among core professionals, instead of a greater absorption of those with first degrees, those with an NDipl and

matriculants filled the gap. Given that employers (in the fieldwork) indicated that they intend increasing their associate professional workforce, it may be because they are now lowering their entry qualifications and have no choice. This implies that the original intention of the HCDS to focus only on those with an NQF level 5 and higher may have be reconsidered, since there appear to be substantial proportions in the system with lower qualifications. For instance, skills upgrading to NQF 5 will affect up to 42% of the associate professional workforce. This includes people with an incomplete secondary education. Managers upgrading to NQF 5 will affect about 10%.

COMPARATIVE RESULTS: OCCUPATIONAL GAP ANALYSIS

As part of the fieldwork, participating organisations were asked to complete an occupational gap analysis. The purpose of the gap analysis was to produce a comparison of size (actual numbers) and nature (population group and gender) of current skills availability and future (next five years) skills needs in the core and support occupations. Some organisations completed both the current and future sections of the gap analysis, while some only completed the current situation and not the future situation. In total, information from eight organisations was available to enable an analysis of the current and future situation with regard to skills needs. Additional data from the WSP and annual reports were used to supplement gaps in the occupational gap analysis. As indicated earlier on in this chapter, the findings are indicative only of the trends in the participating organisations, and not of the sector as a whole. However, it does represent some potential for triangulation, to confirm some of the employment trends suggested in the LFS. Where appropriate, comparisons were also drawn from the Vulindlela data which report on national and provincial departments linked to the DEAT.

Eight biodiversity organisations (a provincial government department; three parks boards; one research organisation; one local government; one NGO and one national organisation) provided data on current and future employment either through a gap analysis, WSP or annual report.

Projected trends in employment to 2013/14

Fundamental to the HCDS is the ability to plan for the future. While only 50% of the participating organisations sent information, it was a very useful exercise and bears repetition, given problems in the utility of WSPs.

The results (see Figure 2.19) showed that in 2008/09, core biodiversity employment formed a fifth of total employment while the remainder involved support positions in the participating organisations. This finding is in line with the LFS results that 20% of biodiversity employment was in the core occupations. The support component (around 80%) consisted of a 16.6% computer-related component, 6.8% administrative, 6.5% generic staff (refer to Table 2.3 for a definition of generic staff), and the majority was made up of other staff such as sales personnel, engineering, trade workers, operators, drivers, labourers, and so on. Among the support occupations, computer professionals and associate professionals constituted about 17% as the second largest component. The participating organisations anticipated that, in 2013/14, the proportion of core biodiversity managers, professionals and associate professionals would increase slightly from 19.9% to around 22.2%. None of the other occupations were predicted to increase at all.

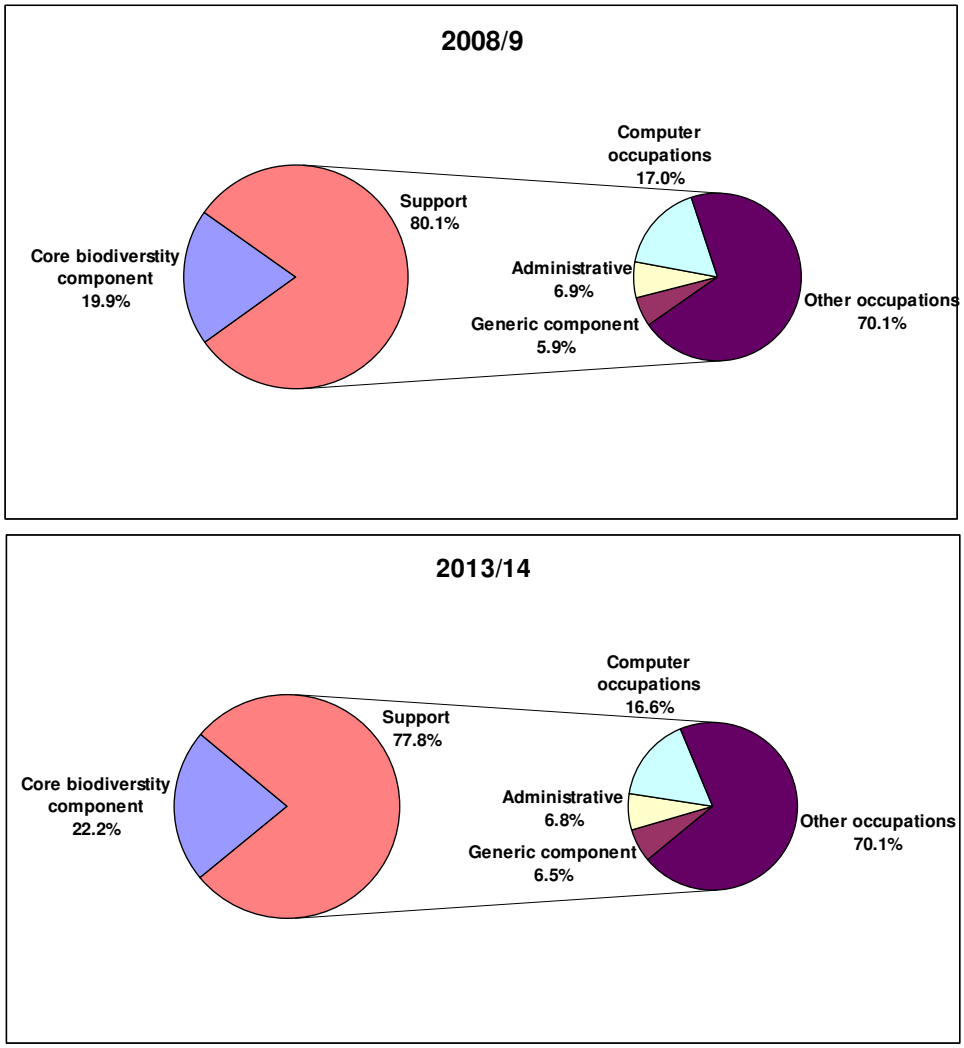


Figure 2.19: Comparison of the proportion of core and support occupations in participating organisations in the biodiversity sector (2008/09 and 2013/14)

Source: Fieldwork data (2009)

Thus, biodiversity employment is expected to grow at an average of 1.2% annually over the next 4 to 5 years. This future projection is indicative of a 5.6% vacancy rate in the *biodiversity sector* across all occupation levels (public, private, NGO sectors). Conversely, according to the Vulindlela database (which includes DEAT, provincial departmental and agricultural data), there was a 22.2% vacancy rate in the *biodiversity public* sector and a 36.9% vacancy rate in the *environmental public* sector across all occupation levels.

The low employment growth anticipated in the fieldwork organisations implies very little room for recruitment. However, the LFS data also showed that in the period prior to 2007 employment was growing at a negative rate, –1.9%. This happened during a period of economic growth, implying that in the current conditions there is not much chance of an upsurge in employment. Also, the qualifications profile suggests that core professionals are increasingly employed in positions that require qualifications higher than they possess. This has implications for the level of productivity and the standard of work performed. Later, in the supply chapter, it will be shown that there have been improvements in the number of black postgraduates, as well as graduates. Yet the biggest bottleneck exists for black women to move from masters into a doctoral programme. The second bottleneck for blacks in general is to move from honours into masters.

These results also suggest that when postgraduates do join the sector, they do so in a managerial position.

The implications are that the HCDS may have to start off with a large-scale upgrading programme from within the sector. The target group include core professionals and managers, where the greatest potential exists in terms of their qualifications. Firstly, a thorough skills audit needs to be done in order to establish the distribution of postgraduate qualifications. Unfortunately, the LFS does not disaggregate postgraduate degrees. The DEAT skills audit (the detailed report was not available) may provide a useful starting point, that is, if a qualifications profile was collected. The skills audit will provide a more detailed profile of qualifications, as well as the numbers involved. Secondly, those with honours degrees present the best chance for upgrading in terms of the attainment of a master's degree. The second level of upgrading has to happen among professionals with a first degree.

The third target group is core professionals with an NDipl. The development of a learnership at the NQF 6 level, which will allow for an occupationally-based qualification and a theoretical component geared towards the specific needs of the sector, needs to be considered.

Finally, while professional registration is not compulsory in the sector, an investigation in terms of the possible role that registration may play in standardising entry requirements within the sector may be considered. Other sectors, such as the ECSA (the Engineering Council of SA), have very specific requirements in terms of the minimum theoretical and work experience needed for competence and registration at specific levels. There appears to be some credibility issues attached to the professional association in the natural scientific profession. However, there is an umbrella body, Scientific, Engineering and Technological Societies and Allied Professions Group of SA (SETAG) under the NSTF that coordinates about 40 professional associations in order to ensure the setting of standards across the professions. An engagement of these structures may be required. Registration may also become an incentive for young graduates to ensure that they meet the requirements for registration, and standardise the requirements for mentoring and improved quality assurance of workplace learning.

Occupational ratios

Ideally, the ratio required within the core occupations, and between the core occupations and "other" occupations, should be related to the challenges of effectively addressing biodiversity-related and environmental losses experienced in the past 15 years and into the future.

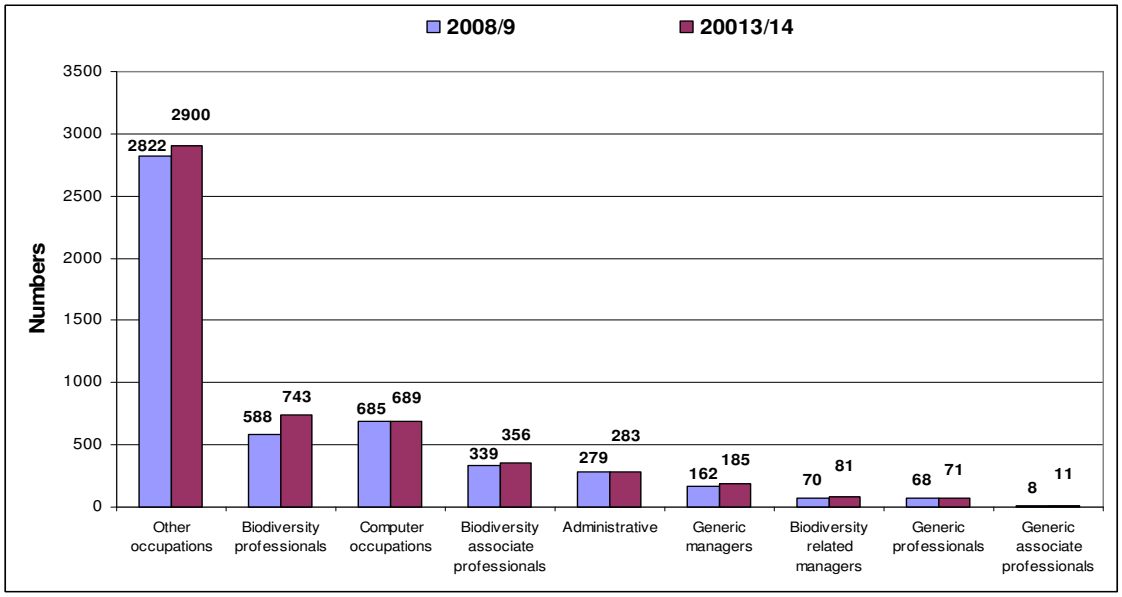


Figure 2.20: Distribution of occupations in participating organisations (2008/09–2013/14)

Source: Fieldwork data (eight biodiversity organisations)

Figure 2.20 shows that the participating organisations intended to increase the core component (core managers, professionals and associate professionals) at an average rate of 1.2% per annum, while the average annual growth among the support component (generic managers, professionals and associate professionals; administrative staff and other occupations) was minimal at 0.6% per annum over a five-year period.

The occupational gap analysis suggests that the strongest average annual growth over the next five years may be expected in generic associate professional occupations (6.6%) but from a very low base; followed by core biodiversity-related professional occupations (4.8%); then core biodiversity-related managers (3.0%); generic managerial occupations (2.7%); core associate professionals (1.0%); generic

professionals (0.9%); administrative occupations (0.3%); and computer occupations (0.1%).

The anticipated growth in core professions (4.8%) is just below the 5.8% average annual growth in overall biodiversity related *graduations* over the 2000 to 2007 period. Thus, for these organisations, there is a theoretical pool of graduates, but the competition is severe as this pool is very marketable.

Interestingly, computer-related occupations constituted the second largest noncore occupation, despite minimal anticipated growth. This may reflect the growing importance of information technology (IT) in biodiversity scientific work. Given the demand for Geographic Information Systems (GIS) but with a natural science background as well (for instance in conservation assessment), this group may present an opportunity for the development of a multiskilled pool of professionals.

The proportion of biodiversity core professionals to core associate professionals in the eight biodiversity organisations was very similar to that in the LFS results, as well as the Vulindlela data (Figure 2.21). Core professionals formed almost two-thirds and core associate professionals another third of the core biodiversity component in all three datasets. The sector needs to determine the extent to which this is an appropriate ratio in order to sustain development of more science professionals from the feeder occupations and associate professionals. Thus, the extent to which this ratio enables professional mentoring, in order to grow more experienced staff while maintaining ongoing scientific work by experienced professionals, is questionable. The *public* sector seems to have less professional capacity than the other sectors for mentoring the less experienced. In future the core associate component will most probably increase (Figure 2.3), especially in the public sector, placing more stress on the system.

An important consideration for the sector is to determine the ideal ratio of the core managerial component vis-à-vis the core professional and associate professional workforce in order to deal effectively with biodiversity challenges at all levels. Figure 2.21 compares the LFS, fieldwork and Vulindlela data in terms of the ratio of core managers: core professionals: core associate professionals.

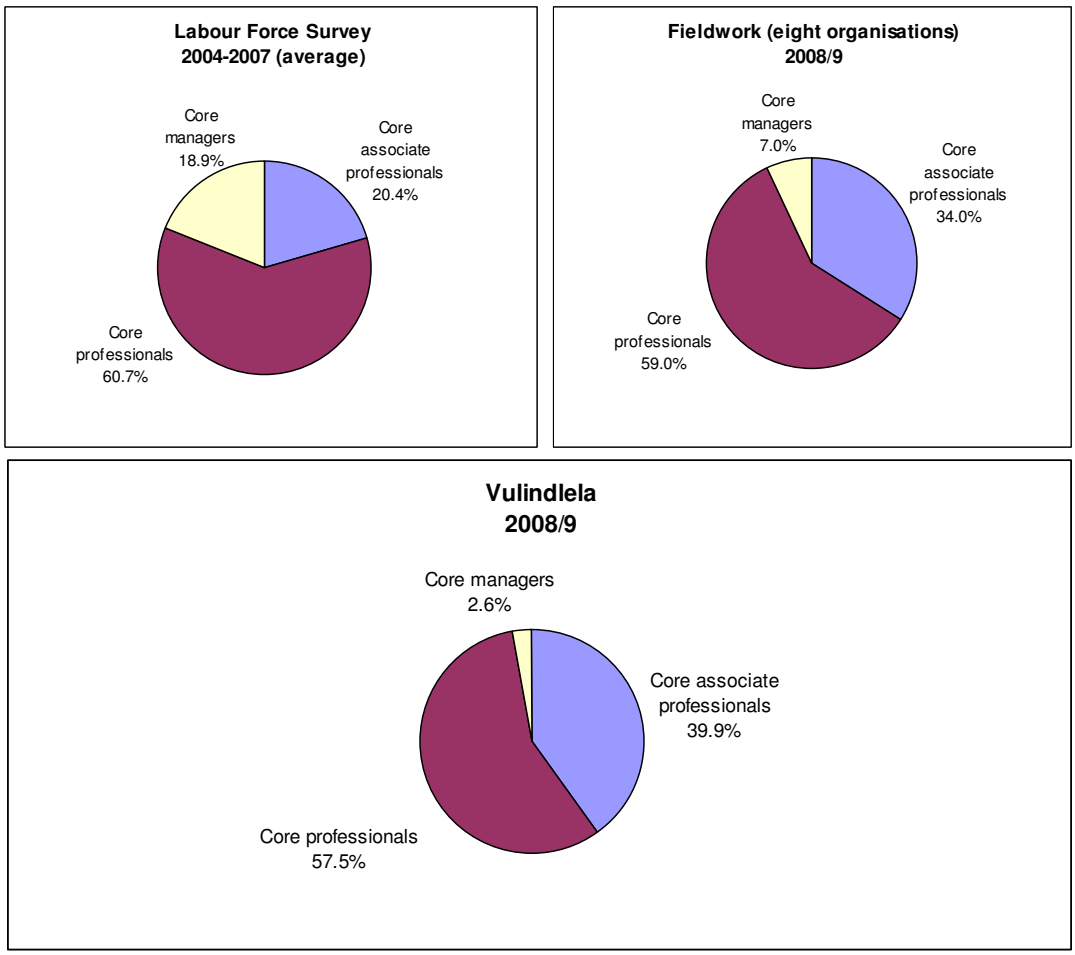


Figure 2.21: Comparison the ratio of core managers to core professionals and core associate professionals in the biodiversity sector (2004–2007)

Source: Fieldwork data (eight key biodiversity organisations); LFS (2000–2007); Vulindlela (2008/9)

This shows that there were similar proportions of core professionals across the three datasets. Despite the limited nature of the fieldwork data (based on the occupational gap information) the results confirm that at least for the professional section of the core biodiversity workforce in these organisations, the LFS may be regarded as a reliable source. However, the proportion of core biodiversity managers in the fieldwork data (7%) and Vulindlela data (2.6%) was much lower than in the LFS data (18.9%). Part of the explanation could be that professionals and managers are not always clearly defined or distinguished from each other in the fieldwork and Vulindlela data. Unlike the LFS data, there were very few government departments represented among the organisations that submitted data in the fieldwork and there was also no representation from the mining and agricultural sectors, all of whom had

large numbers of managers in the core workforce, as captured in the LFS (see Figure 2.4). The underestimation of the managerial component may have contributed to an over-estimation of the associate professional component in the fieldwork data. These differences are carried over into the comparisons on the progress towards equitable transformation in the next analysis.

On progress towards transformation, there were similar trends between the LFS data results and those found in the fieldwork data especially on the professional workforce, with larger differences in the managerial and associate professional workforce (Figure 2.22).

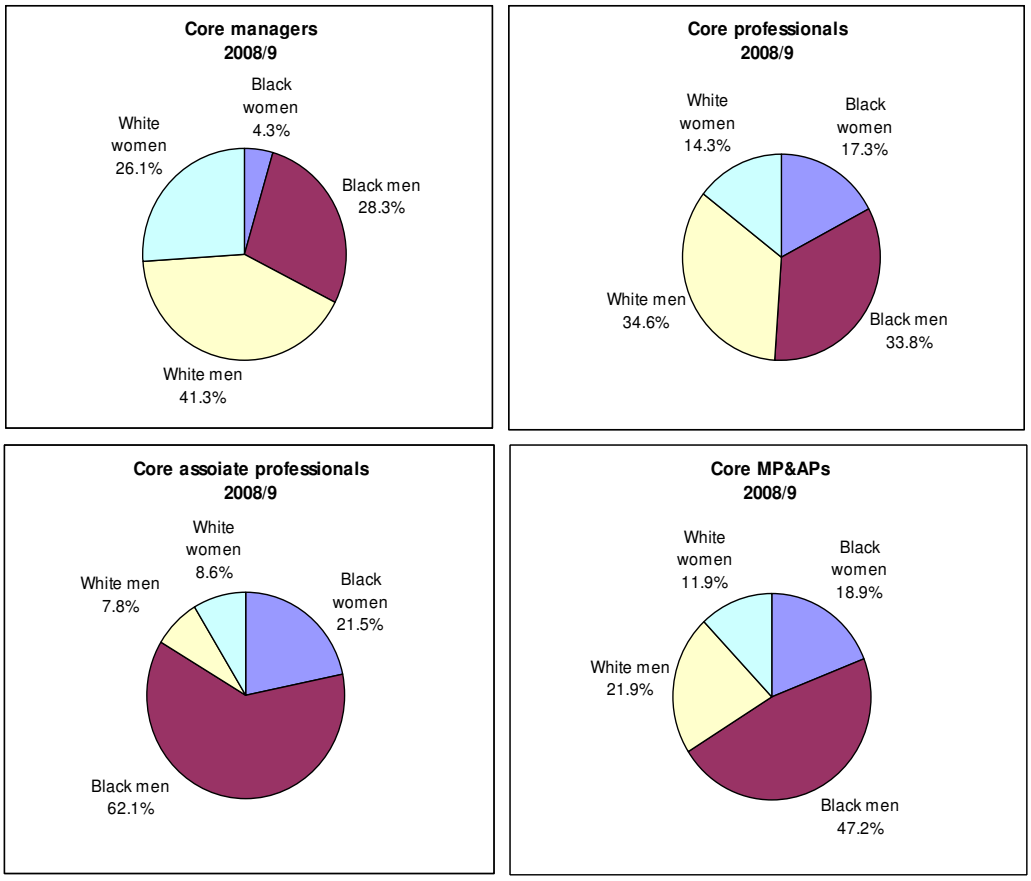


Figure 2.22: Distribution of core managers, professionals and associate professionals by race and gender (2008/09)

Source: Fieldwork data (eight key biodiversity organisations)

According to the LFS data, the proportion of white men in the core managerial component was 35.9% and in the fieldwork data around 41.3%. Fieldwork data indicated that the proportion of core black women managers was smaller and that of white women and black men slightly larger than in the LFS data.

Thus, while the differences are not large, one of the confounding factors in the fieldwork data related to the fact that it was often difficult to distinguish core managers from core professionals in the fieldwork data, as different organisations used different occupational descriptions. Thus, for comparative purposes, the standardisation of occupational descriptions is definitely an area to explore for the planning and implementation of the proposed HCDS.

The fieldwork data indicated that white men constituted about a third (34.6%) of the core professional component, just slightly larger than indicated in the LFS data (31.5%). Conversely, black women had a slightly greater slice (17.3%) among core professionals than indicated in the LFS data (12.7%).

With regard to the core associate professional workforce, larger differences occurred between the LFS and the fieldwork data, as suggested earlier. For instance, black men constituted up to 41.1% of the core associate professional component in the LFS, while according to the fieldwork data, their share was nearly two-thirds. White women formed considerably more (8.6%) of the core associate professional category according to the fieldwork data than according to the LFS data (0.4%). The LFS data indicated that black women formed almost half of the core associate professional category; while fieldwork data showed that they formed only a quarter of this category. However, in both datasets, white men formed less than 10% of the core associate professional category.

According to both datasets black men made up the major part of the total core component (core managers, professionals and associate professionals). This is in line with the supply data which indicated that, over the 2000 to 2007 period, much of the improvement in the black share of doctoral graduates especially accrued to black men. In both datasets white men formed about a quarter, black women just under a quarter and white women the smallest part.

Thus, on balance, the fieldwork data had some comparative value and showed future potential for triangulation, given increased submission of data and greater standardisation in occupational categories. As indicated previously, there were stronger similarities between the two datasets with regard to the professional occupations, and least similarities in terms of the associate professional occupations.

Finally, Figure 2.23 represents an occupational analysis of the anticipated growth in specific occupations between 2008/09 and 2013/14 based on the limited occupational gap analysis. As indicated previously, the results are indicative of trends in the participating organisations, rather than conclusive of trends in the sector. Another limitation was the lack of standardisation in occupational descriptions, but an attempt was made to group together the occupational information, using descriptive names most commonly used by the participating

organisations. There may be some overlaps across seemingly disparate categories, for instance nature conservation scientists, natural scientists and environmental scientists.

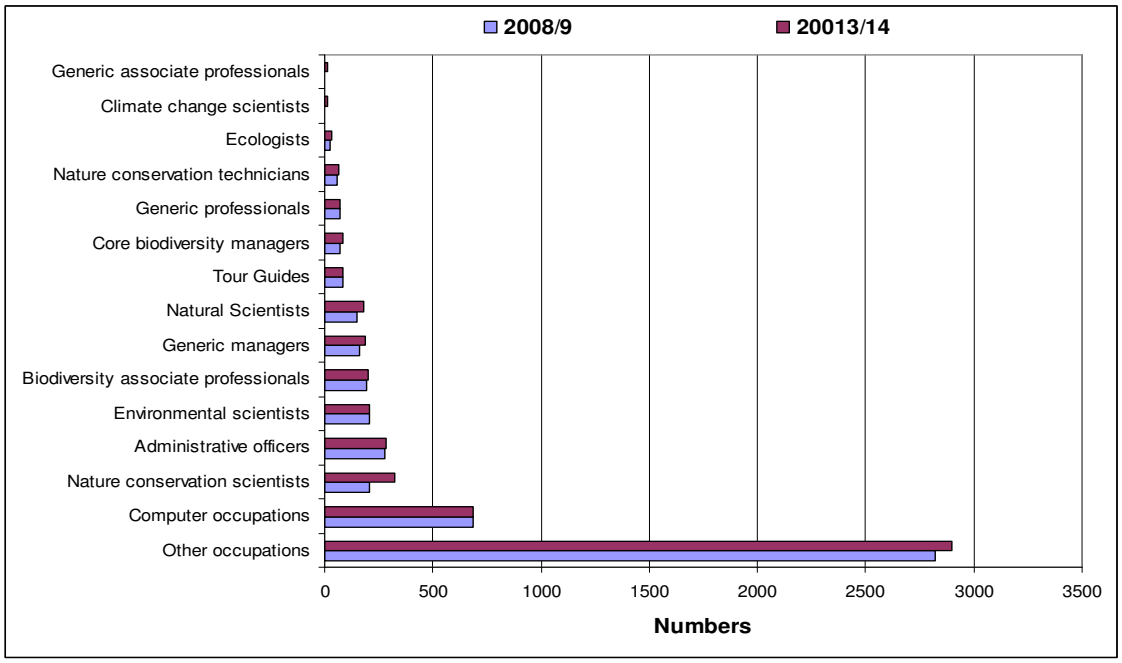


Figure 2.23: Anticipated occupational growth in key biodiversity organisations (2008/9–20013/14)

Source: Fieldwork data (eight key biodiversity organisations)

An important result was that the participating organisations anticipated that nature conservation-related scientists will increase by an average annual growth of 9.1% – the largest increase. Chapter 1 highlighted the fact that protected areas are anticipated to grow, requiring much greater capacity, including conservation scientists. However, this rate is nearly double the rate of increase of new graduates. Thus, bottlenecks will occur, which explains why the DEAT spent so much on employing consultants in supporting the protected areas (see Chapter 1).

The anticipated increase in natural scientists was 3.4%, while ecologists were expected to increase at an average annual rate of 4%, although from a very low base. Climate change scientists were expected to increase with an average annual growth of 4.1%, but also from a very low base. Very slow growth was anticipated in the biodiversity associate professionals, environmental scientists and other

occupations with 0.5% each. Interestingly, no growth was expected in computer occupations up to 2013/14.

According to the DEAT's Scarce Skills Audit (KNC & Associates 2006) there is a comprehensive policy and legal framework in place for biodiversity and conservation in South Africa, but there are actual implementation gaps as a result of funding, staff turnover and skills gaps especially in planning, project and financial management, computer skills and technical skills, such as biosystematics. Furthermore, conservation assessment is a data-driven process that requires specialist skills which includes GIS and IT skills. In 2007 only about 5% of graduates graduated with majors in both IT and Botany or IT and Geography or IT and Zoology, which is a big gap that needs to be addressed in South Africa. What is promising, however, is that, in 2007, about 79% of these graduations with an IT major combination were among blacks and 54% of these graduations were among women. Even more positive is that 47% of these graduations were among black women (refer to Chapter 4, Table 4.3).

Table 2.7: Employment trends in the public sector (2003/4–2008/9)

Permanent occupations	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	Average annual growth
Environmental health professionals	6	5	12	29	32	31	38.9
Computer occupations	36	51	63	86	103	101	22.9
Natural sciences related professionals	207	261	299	454	538	570	22.5
Agriculture related	733	870	1067	1256	1374	1469	14.9
Curators & related professionals	2	4	3	4	4	4	14.9
Administrative	1043	1282	1532	1679	1798	2023	14.2
Veterinarians	139	145	171	188	205	225	10.1
Botanists, zoologists & related prof.	66	72	99	132	103	88	5.9
Zoology & life science technicians	1110	1079	1040	975	1110	1365	4.2
Farming, forestry advisors & managers	192	221	200	239	284	223	3.0
Hydrologists & related professionals	177	190	188	186	193	205	3.0
Nature conserv. & related technicians	518	527	534	467	441	598	2.9
Veterinary assistants	55	70	67	59	59	61	2.1
Agric., ocean & other scientists	775	851	780	852	974	840	1.6
Horticulturists, agric. & forestry technicians	2261	2261	2338	2098	2233	2235	-0.2
Conservation labourers	617	611	480	366	403	379	-9.3
Other occupations	46317	45002	37007	42551	39744	39106	-3.3
TOTAL	**54254**	**53502**	**45880**	**51621**	**49598**	**49523**	**-1.8**

Source: Vulindlela (2003/4–2008/9)

The extent to which the projections by the participating organisations adequately reflect the particular skills needs required in a period of increased pressure on ecosystems in light of global warming and economic pressures in a developing economy such as South Africa is not clear, and this needs to be taken into consideration in the HCDS planning process.

IMPLICATIONS AND RECOMMENDATIONS

Biodiversity conservation is a cross-cutter sector and difficult to define in terms of the current SIC used by StatsSA. It is proposed that the sector lobby (in conjunction with DEAT in the sector) for the capture of industry data at the 4-digit level. Similarly, occupational data need to be captured at the 6--digit level in line with the new OFO that is being put into place. These changes will enable more effective analysis and demarcate and define various occupations and sectors with more accuracy. In addition, occupational analysis at postgraduate level which, given the drive towards a more knowledge-driven economy, is very important to the SET needs to be

captured (or presented in the data) at a disaggregated level to enable more detailed analysis similar to the HEMIS data.

The fields of study (as presented at tertiary institutions) should be disaggregated in the LFS dataset to draw clearer distinctions between various fields of study.

Within the sector, the public sector database, Vulindlela, needs to capture more detailed and specific occupational descriptions if specific skills needs are to be identified. In order to facilitate better sector skills planning, monitoring and evaluation, it will be important for the key definitions (such as occupations and occupational descriptions) to be standardised for better inter-sector comparisons.

There were a number of key findings in terms of the dynamics of employment over the last seven years (2000–2007) that have implications for effective governance and implementation of the new mandates flowing from the legislative and policy framework in the sector. The trends suggested by the LFS are reliable based on triangulation with the Vulindlela public sector data and employment data received from the fieldwork. The share of employment of the core workforce was the same in both datasets. Further, the employment trends (absolute numbers) in the public sector workforce were similar across both datasets. The distribution of core professionals and associate professionals was similar between LFS and the fieldwork data.

The target population of the proposed HCDS, core biodiversity managers, professionals and associate professionals, constitute about 20% of the entire biodiversity conservation sector. The sector is dominated by the public sector, including government departments, conservation agencies and research institutes, as well as a substantial proportion of NGOs. Employment in this sector (private, public plus NGOs combined) has been declining over the 2000 to 2007 period, growing at –1.9% per year on average. There were strong declines in core biodiversity occupations in the mining and government sector and to a lesser extent in higher education. Conversely, there was substantial growth in the botanical, zoological & nature reserves sector and to a lesser extent in R&D and game, agricultural, forestry & farming subsectors over this period.

Based on the Vulindlela public sector data, there was slight employment growth (1.1%) in the core biodiversity *public sector* component over the 2003/4 to 2008/9

period, but strong declines (by as much as 11.5%) in the *provincial* government component over this same period (note this trend occurred over a slightly different period, only in the public sector, and not significantly different from the LFS trends). The little growth in the public sector was mainly in the core *associate professional* category with a decline in the combined core managerial and professional category. The core associate professional category in the *public sector* will most probably grow in future.

However, eight participating organisations predict that they (private, public & NGO) anticipate more growth (1.2% per annum) in the core *professional* and *managerial* component, especially among conservation scientists (9.1%), ecologists (4%) , natural scientists (3.4%) and climate change scientists (4.1%), than in the core associate professionals.

The implication is that the low average annual growth in core employment is likely to continue and even worsen, given budget cuts as a result of the recession. The effect is likely to continue into the rest of the MTEF period, as economic growth is projected to drop to 1.2% for 2009, much lower than the 5% achieved for 2004 to 2009. Whatever employment expansion may occur (very unlikely) is not going to be sufficient to accommodate a substantial influx of new graduates, except where vacancies have already been funded. In occupations where growth was predicted, such as the public sector, these may be reconsidered.

The vacancy rates as reported in the public sector were generally higher than those in the private sector in the rest of the country. The reported vacancy rate in the public biodiversity sector was a 23.2% vacancy rate across all occupation levels, ranging from 51.5% in nature conservation technicians to 36.9% among natural science professionals. The vacancies generally take up to 6 months to fill. There have been improvements in the vacancy rates but the vacancy rate for nature conservation and oceanographic occupations remained high at 41%. This implies that the public sector has greater difficulty in finding suitable applicants, or greater barriers to entry such as high entry qualifications or poor working environments, including salaries and benefits. There is also a suggestion that employees move within the public sector organisations including the parastatals, the universities and conservation agencies. The reasons for high vacancy rates need to be established. It does explain why the

DEAT is anticipating consistently high expenditure on consultants in its MTEF budget, especially with regard to the protected areas. Other solutions have been secondments of scientists from the NGO sector to the DEAT to assist (reported in the fieldwork). The DEAT does have a scarce skills programme, which does not appear to have had a beneficial impact.

Therefore, given budget cuts in government, particular difficulty will be experienced especially in associate professional posts in nature conservation and oceanography, life science and natural science professionals, geologists & related and computer-related professions, with the highest vacancy rates.

There has been progress made towards transformation in the sector. This is summarised in table 2.8. It shows that the best progress was made among black men, across all of the core occupations, against the national EAP target. The target for professional black men is the closest, at 35%. There is still substantial progress to be made among managers, as black men are only at 23%.The share of black men among associate professionals dropped substantially, but is only 10% away from target. White men and women are still substantially over-represented, despite declines in the share of white men over time. White men dominate the managerial profession by a substantial margin. Black men have made substantial inroads, confirming the contention that the sector is male-dominated for the most part. White women are substantially over-represented in both the managerial and professional occupations. Unlike white men though, they have made substantial inroads into managerial employment by 10% over the period. Black women made substantial progress, but from an extremely low base. Therefore even where they tripled their representation, this was not sufficient among managers and core professions. Black women remained concentrated in the lowest group, associate professions, and are the closest in terms of the target of 34%.

The implications are that, while the sector has made progress, it will need to upscale the development of black women even more across all occupations. This is especially the case in the core professions, where representation of black women is extremely poor (12.7%). The sector may have made more progress with black men because it is a male-dominated sector and because black men started off a higher

base. A more overt emphasis on the development of black women may need to be adopted given that the sector is still far off target.

The domination of whites at the more senior level is likely to continue given the supply patterns, as well as their historical prominence in the sector and the age profile. The NGO sector may account for the growth in the share of white women managers, while their share appears to have fallen off in the professional occupations.

Table 2.8: Progress towards equity (2000–2007)

	Black				White			
	Men		Women		Men		Women	
Employment equity target(%)	40		34		7		5.6	
Biodiversity sector employment: (%)	2000	2007	2000	2007	2000	2007	2000	2007
Managers	18.1	23.3	7.4	18	61.6	35.9	12.9	22.9
Core professionals	26.2	35.2	3.5	12.7	43.5	31.5	26.8	20.7
Associate professionals	68.4	31.6	15.6	28.9	16	26.4	0	13.1

Source: LFS (2000–2007); LFS, 2005.

As mentoring is required in order for the less experienced core workforce to progress up the ladder, a more mature core workforce, especially at the professional level, is required to do the mentoring. However, the mature group (50–64 years) in the workforce represented the smallest share of the biodiversity sector. Mentoring is made even more difficult as the proportion of core professionals aged 30 to 49 years is just slightly more than core associate professionals in the same age group. This means that the mentoring strategy needs to be refined in order to secure expertise that is not wholly based within the sector, as that may put too much stress on the system. Examples elsewhere include secondments of experienced professionals to other organisations, as appears to be the case between the public sector and NGOs. Inside the sector itself, a special mentoring project may need to be set up, coordinated at a senior level, where those about to retire may be dedicated to conducting mentoring in research projects with younger professionals and associate professionals. Thus, a concerted strategy should be implemented for the retention of those about to retire, but on the condition that they do mentoring. There is a gender dimension to mentoring, however, given that the target group for mentoring is likely to be black women, and the mentoring pool is likely to consist of white males. In Chapter 1 reference was made to the openness of organisational cultures to those

perceived as outsiders, and the extent to which sociocultural differences may hamper the drive towards diversity. Mentoring programmes are notoriously difficult to implement, and will have to be carefully considered in terms of who qualifies as a mentor and their competency level, not so much as researchers but as mentors.

It seems as if core professionals with appropriate qualifications are hard to come by, especially in the public sector, as in the combined public, private and NGO sector there is a slightly higher representation of core professionals than in the pure public sector component (refer to Figure 2.21). Core professionals with appropriate qualifications may also move to managerial positions, as core managerial qualifications are improving slightly, while qualifications of core professionals are lowering (Figure 2.16 and 2.17).

When the age profile is read together with the qualifications profile, the results suggest that the sector may already have (or will have in future) major efficiency problems. On the one hand, there may not be as many people of pensionable age as is often asserted. The workforce distribution is quite in line with a normal economically active population with a large concentration of workers in the middle age range (30–49 years). The largest proportion of those who wanted to retire has probably already done so. It may just be that the top scientists are mostly in their 50s and male, as is the case all over the world. However, the small share of those in the 50 to 64 age group has implications for the potential mentoring capacity as indicated previously. The sector may need to conduct an audit to calculate the replacement demand, based on the age profile and other factors of attrition, including resignation, medical retirement, retrenchment and so forth. This will confirm whether it is an ageing population and assist in projecting replacement demand and the level of skill required.

The bulk of the workforce is aged between 30 and 49 years and the second largest proportion of professionals and managers is in the youngest age group, 15 to 29, implying young graduates. Yet, there are hardly any young associate professionals coming through the system. This implies major imbalances for efficiency in the sector. For the youngest group it may mean that they have been promoted into professional and managerial posts before they were ready. This conclusion appears reasonable, given the general decline in the overall level of qualifications in the

sector over the period. Thus, nearly 10% of managers only have a general education, while 34% of core professionals have an NQF 5 and lower (the FET proportion doubled over the period). It also implies that because the sector struggles to attract "the cream of the crop" (the postgraduates), or even employing those with a first degree in professional and managerial posts, it has had to employ whoever was available. This has serious implications for productivity and efficiency in the sector, especially given the legislative mandate that has become much more sophisticated and the operational requirements that are increasing. Yet, purely based on the age and qualification profile, at professional and managerial level competence may be declining. The literature in the sector does allude to a decline in enforcement competence, and the poor quality of graduates coming into the system (levels of literacy, numeracy and maturity). The concentration of professionals and associate professionals in their peak productive years (30–49 years) implies limited mentoring capacity, as they are likely to be responsible for both output and supervision.

This does imply that the sector has to consider an intensive "growing our own timber" programme to upgrade qualifications especially among professionals. One means is through the development of an NQF 6 level learnership to upgrade the theoretical and vocational skills of those currently having an NDipl. The establishment of the QCTO will facilitate the quality assurance of higher level learnerships to a larger extent than has been the case previously. Also it will allow for employed diplomates to earn while studying and the learnership allowance (paid by the SETA) will cross-subsidise some of the costs of not having an employee at the workplace for blocks of time. Further, the development of a learnership will require a CEP (Community of Experts) from within the sector to ensure the quality and competence levels required in the system. The learnerships may last from three months to more than a year.

A second level of skill upgrading lies with those who currently have an honours degree – up to 60% of the current postgraduate pool. This is the group that is easiest to develop as they are in the system and have picked up some workplace-related skills, in contrast to new graduates with no exposure. Once the supply data have been presented, clearer proposals in this regard will be considered.

Finally, career pathing in the sector has to be addressed, given the dominance of older staff in associate professional occupations who appear not to have advanced.

At the same time, the large proportion of managers in this age group (virtually equivalent to the professionals) suggest that managerial progression is the focus of the career path in the system. The lack of an effective career path is explored in the fieldwork. The question the HCDS should determine whether the current ratio of managers to core professionals is efficient, since the numbers are close to equal. In fact it may be that the sector is employing young graduates (or diplomates) in managerial professions as a recruitment tool or to fulfil equity targets or for other reasons.

Other areas to explore relates to the standardisation of minimum entry requirements to the professional and associate professions. The fact that those with GET and FET are increasingly being employed in professional and managerial positions implies that there has been a lowering of entry qualifications. The supply data suggest that there are more graduates coming through, yet the sector appears not to be attracting them (based on the declining share of postgraduates among core professionals). Where postgraduates are employed, it appears that they enter into managerial positions.

In the *combined* biodiversity sector (public, private and NGO) there seems to be a demand for core *professionals*, especially nature conservation-related scientists, natural scientists, ecologists and climate change scientists. Conversely, in the *public* biodiversity component there seems to be more of a demand for core *associate professionals,* especially nature conservation-related technicians and then also horticultural technicians. However, a number of various core *professionals* were also required in the *public* sector such as life science professionals; hydrologists; natural scientists; veterinarians; agricultural, oceanography and related professionals; zoological and related professionals and also forestry and farming managers.

The role of professional registration as an incentive for skills upgrading and progression, as well as a means to standardised competency levels throughout the system, needs to be investigated.

In conclusion, the results from the LFS analysis show that there was a decline in the common qualification profile of both the core associate professional and professional occupations. It suggests that while employment of those with lesser qualifications increased, this may present massive challenges in achieving the stated goal of

effective and efficient governance in the sector. Over time, there has been increased complexity in the functional responsibilities of scientists in these core occupations, given climate change, increased degradation of biodiversity and a complex legislative and policy framework. However, in practice the evidence suggests that the qualifications profile (and perhaps competence profile) has moved in the opposite direction.

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APPENDIX A: OCCUPATIONAL ROLE CLUSTERS IN THE BIODIVERSITY CONSERVATION SECTOR

A key limitation of the data was that the role clusters as described here are not used in the Labour Force Survey (LFS) data and this information is therefore purely for discussion purposes. The following broad areas of functionality and expertise were identified:

Scientists

Policymakers include senior scientists (trained in botany, zoology, ecology, environmental sciences, planning). They work in national government especially the DEAT, provincial DEAT and conservation agencies such as SANBI and SANParks; they head up provincial conservation agencies or conservation NGOs. They may also have social science expertise. The Department of Agriculture employs resource conservationists tasked with providing guidance to provincial departments on the protection of resources such as soil or wetlands (but in practice there is not a strong biodiversity focus here).

Area-wide planners are scientists (trained in botany, zoology, ecology, environmental sciences, planning, information technology e.g. GIS for mapping). They work in national and provincial DEAT, conservation agencies, large metros and consulting firms. They identify conservation priorities and develop conservation strategies, area-wide plans for others (e.g. conservation and stewardship managers and Working for Wetlands, Working for Water) to implement.

Researchers/scientists work in universities and research institutions (including SANBI); do research in ecology, botany, zoology, marine biology, environmental sciences, natural resource economics and conservation (e.g. conservation farming). They provide empirical data and case studies to policymakers and managers. They often also teach and/or manage departments. They may sit on policymaking bodies, advisory committees, and so on for government and NGOs.

Other applied scientists – apply university degrees in botany, zoology, forestry, taxonomy, biosystematics, environmental science and ecology-related fields to

identify conservation priorities, and advise on Environmental Impact Assessment applications). They often work as members of teams, for example as consultants, in municipalities and provincial government especially DEAT and conservation agencies, also DWAF, Agriculture, and NGOs such as WESSA. In DWAF they would work in teams with hydrologists to determine the conservation status of a river or other water body. In WESSA'S Wetlands Programme they advise landowners (farmers, forestry industry) on how to manage their wetlands. A large percentage is employed by private companies, developers, industry, and so on, or works on a freelance basis.

Curators work in herbariums and museums developing and managing collections of plants or animal species. They have a background in taxonomy, biosystematics and perhaps museum sciences.

Information technology support

Information management specialists and technicians – work in the biodiversity sector as

- Systems analysts communicate with biodiversity scientists, interpret their needs and communicate with the computer specialists below. They need some understanding of both computer science, and life or earth sciences.
- GIS specialists and technicians (often with a geography background, but not always) – prepare GIS maps which digitise and portray biodiversity and geographical data and make them available for research, conservation and development planning and management purposes.
- Software developers (programmers) – new software is needed to put wealth of available biodiversity data and herbarium contents, for example, into digital format for research and management purposes.
- Website developers – for biodiversity-related fields, topics, organisations
- Information management specialists (e.g. for organisations, setting up and managing databases)

- Monitoring specialists need a postgraduate qualification in mathematics or statistics, but also need to understand the biodiversity components that are being monitored (e.g. land degradation).

Managers in environmental affairs

- Environmental managers are responsible for managing biodiversity (e.g. mitigating habitat destruction, rehabilitation) along with other aspects of environment, for example water or air pollution. They are employed by municipalities big and small, as well as industries including mines and forestry, which have a major impact on biodiversity loss through habitat conversion, pollution and impact on freshwater systems. They may or may not have a background in conservation, ecology or bio-sciences, forestry.
- Natural resource managers are in charge of a protected area (national park, provincial or municipal nature reserve) where they manage the biodiversity/conservation priorities (e.g. doing periodic burns, putting out wild fires, culling game or introducing new species) as well as staff, finances, tourism facilities (sometimes) and overseas stakeholder relationships (e.g. with neighbouring communities, farmers). Traditionally they have a background in nature conservation (technikon diploma) or a university degree in zoology, botany, terrestrial ecology-related discipline, perhaps also veterinary sciences. A new area is marine protected areas; here managers would ideally have a background in marine biology or marine-related ecology.

Educators in sciences and environment

- “Public educators” are tasked (often alongside other jobs of a more managerial or technical nature) with engaging stakeholders in biodiversity conservation, such as communities bordering a protected area; farmers and other landowners (as extension workers or stewardship officers), interested and affected parties in developments. They may lead awareness campaigns of formal education or training programmes, for example in government–NGO partnerships. They work across the sector in national, provincial and local government and NGOs. Mixed qualifications; traditionally a nature conservation diploma or extension qualification from a technikon, or an MSc in

environment-related sciences. Social ecologists often have a background in almost any social field, including teaching, with no ecological background.

- Formal educators in GET, include teachers in mathematics, life sciences, geography, computer sciences/information technology. University and university of technology (formerly known as technikons) lecturers are tasked with educating new professionals (often doing research and managing departments, as well as “outreach” work.).