The tip of the iceberg: Spatio-temporal patterns of marine resource confiscations in the Table Mountain National Park

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DECLARATION

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ABSTRACT

The aim of this study was to determine the scale of marine poaching in the Table Mountain National Park by analysing the amounts of South African abalone, West Coast rock lobster, and shellfish, finfish and bait species confiscated from fishers operating in the park's marine protected area between 2000 and 2009. The research objectives were fourfold, namely to strengthen conceptual frameworks on illegal harvesting in protected areas; identify the quantities of the various species seized by park officials over the decadal period; cartographically plot the areas in which confiscations took place; and distinguish the different resource users and stakeholders operating in the park and examine the roles they play in resource exploitation. Data was collected from offence logbooks maintained by SANParks rangers and managers, and from records kept by Marine and Coastal Management and the South African Police Services. GIS outputs indicated seizure events over the spatial area of the park. Further data relating to the levels of poaching was sourced from illegal fishers operating in the park who discussed their operations candidly.

The research findings indicate that poaching of both abalone and rock lobsters has increased significantly over time. Other marine species show lesser amounts of resources poached over the ten-year period. Spatial outcomes suggest that confiscations of abalone occur predominantly on the east coast of the park, while higher seizure events occur on the west coast for lobsters. Shellfish, finfish and bait species were confiscated in equal amounts from illegal fishers on both the east and west coasts. Future research recommended includes garnering further confiscations data from the police services and undertaking contemporary baseline assessments to discover the effects poaching has had on the resource base since the previous stock assessment in 2001. The challenge laid out for the custodians of the Table Mountain National Park marine protected area is to provide and protect cultural and environmental resources, without compromising biodiversity management, community associations and conservation strategies.

Keywords and phrases: Abalone, bait, confiscation, *Haliotus midae*, *Jasus lalandii*, linefish, marine protected area, park management, poaching, resource conservation, resource overexploitation, shellfish, Table Mountain National Park, urban park, urban protected areas, West Coast rock lobster.

OPSOMMING

Die doel van hierdie studie was om die skaal van marienebronstroping in die Tafelberg Nasionale Park te bepaal deur middel van die ontleding van die hoeveelhede Suid-Afrikaanse perlemoen, Weskus-kreef en skulpvis, vinvis en aasspesies wat vanaf oortreders (2000 tot 2009), gekonfiskeer is. Die doel van die navorsing was viervoudig naamlik, die versterking van die navorser se konseptuele-basis rondom die stroping van hulpbronne in beskermde gebiede; die bepaling van die hoeveelhede en tipe spesies wat deur parkbeamptes in beslag geneem is; die plekke waar konfiskasies plaasgevind het; en om die verskillende hulpbron gebruikers en belanghebbendes te onderskei en hulle rolle in die mariene-hulpbron benutting te ondersoek. Primêre konfiskasie-data is verkry vanaf SANparke se logboeke wat deur beamptes instandgehou is en sekondêre data is verskaf deur Mariene en Kusbestuur en die Suid-Afrikaanse Polisiediens. Beslagleggingsgebeure is dmv GIS tegnologie op kaarte vasgelê. Verdere inligting oor die vlakke van stroping is bekom deur openhartige gesprekvoering met vissers wat onwettig in die park bedrywig is.

Die navorsing het bevind dat die stropery van perlemoen en kreef met die verloop van tyd aansienlik toegeneem het. Ander mariene spesies het kleiner hoeveelhede stropery van die hulpbron oor die studietydperk aangetoon. Ruimtelike voorstellings toon dat perlemoen-stropery hoofsaaklik aan die ooskus van die park voorkom, terwyl groter beslagleggings/konfiskerings van kreef aan die weskus van die park plaasgevind het. Skulpvis, vinvis en aasspesies is gekonfiskeer by vissers wat onwettig bedrywig is in ewe groot hoeveelhede op beide die ooskus en die weskus. Toekomstige navorsing moet meer inligting oor beslagleggings van die polisie bekom en die kontemporêre basislynassesserings moet meer gereeld onderneem word om veral die effek van stropery op die hulpbron bloot te lê. Die laaste basislyn-assessering het in 2001 plaasgevind. Die uitdaging voor die bewaarders van die park se marienebeskermde gebiede is om kulturele en omgewingshulpbronne toeganklik vir alle gebruikers te maak maar dit ter selfder tyd ook te beskerm, sonder om biodiversiteit, gemeenskapassosiasies en bewaring strategieë te kompromitteer.

Trefwoorde en frases: Aas, *Haliotus midae*, hulpbronbewaring, hulpbronoorbenutting, *Jasus lalandii*, konfiskering, perlemoen, lynvis, mariene beskermde gebied, parkbestuur, skulpvis, stedelike beskermde gebiede, stedelike park, stropery, Tafelberg Nasionale Park, Weskus-kreef.

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ABBREVIATIONS AND ACRONYMS

Biodiversity – biological diversity

CFR – Cape Floral Region

CITES – Convention on International Trade in Endangered Species

DEAT – Department of Environmental Affairs and Tourism

GIS – geographic information system

IUU – illegal, unregulated and unreported

MARINES – Management Action for Resources of Inshore and Nearshore Environments

MCM – Marine and Coastal Management

MDG - Millennium Development Goal

MPA – marine protected area

SANParks – South African National Parks

SAPS – South African Police Services

TAC – total allowable catch

TMNP – Table Mountain National Park

TURF – territorial user rights in fishery

UCT – University of Cape Town

WCRL – West Coast rock lobster

CHAPTER 1: SETTING THE SCENE

"There was time not too long ago when conservation was seen to be mainly the purview of the ecological sciences. Now the reality is widely appreciated that conservation is primarily about managing ourselves, people, and the societies we create. To fail to appreciate this symbiosis is to fail to grasp the essence of what will determine future sustainability on the planet (Bennett, 2010: 3.)"

At a global scale, the problems of respecting and safeguarding the environment have been receiving increasing attention due to the growing consciousness that the time remaining to find effective solutions to correct management strategies of environmental goods is rapidly decreasing (Abakerli, 2001; Alessa, Bennett & Kliskey, 2003; Gios, et al., 2006). The degradation of ecosystems has triggered a number of responses both at the national and local level too (Centre for Resource Analysis, 2006). Important tasks of contemporary environmental practices are to monitor natural resources, to assess the impacts and effects of human activities and interventions, and to observe the state of the environment over an extended period of time (Roberts, Stallman & Bieri, 2002; Walz, 2008). These observations will contribute to strengthening environmental policy and management capacity, devising new resource management strategies and to meeting our commitments to the Millennium Development Goals (MDGs) that, among others, establish a linkage between poverty reduction and environmental sustainability.

Chapter 1 sets the scene for the research process that was followed. The real-world and research problem, aim and objectives are discussed in this chapter. The study area, the Table Mountain National Park (TMNP) is also demarcated. The research design gives a visual overview of the research framework that was followed, while the thesis structure explains the layout of chapters of the report.

1.1 Introduction

Subsequent to the 1972 United Nations Conference on the Human Environment, it became broadly accepted that protected areas act as a key mechanism to combat the loss of biological diversity (biodiversity) and degradation of global ecosystems (Guerreiro et al., 2010). Worldwide, protected areas occur in a variety of physical and socio-economic settings. However, protected areas located in urban areas with high densities of human populations dependent on local resources, raise particular challenges (DeFries, Karanth & Pareeth, 2010). This is in part due to mass immigration of individuals from rural areas to urban centres. Many of these people remain committed to a subsistence lifestyle, utilising local environmental resources for food, medicine, energy or bartering material, making the availability of free natural resources extremely important to their livelihoods (Vanderpost, 2006). Conversely, a minority of individuals see fit to harvest resources illegally out of greed. Man's avarice for natural resources has been responsible for the extinction or extirpation of a number of species. Indiscriminate poaching for high-value resources coupled with the expansion of human populations have been identified as two of the principal causes for the decline of some species in South Africa (Santiapillai, 2009).

Conservation of the unique biodiversity of South Africa is further complicated by the increasing human populations and elevated poverty levels in most areas, the high densities of humans living in or adjacent to some protected areas, the increase in uncontrolled and unregulated trade in wildlife products that feeds urban and international markets, and the process of globalisation (Cordeiro et al., 2007). Expanding urban areas often impose on neighbouring protected areas,

creating a trend toward ever-increasing proximity between these two environments (McDonald, Kareiva & Forman, 2008). A key question concerns what this increased propinquity to urban centres might mean for the ecological integrity of protected areas (Grimm et al., 2008). Substantial debate has occurred centring on the appropriate methods for conservationists to maintain the biological integrity of protected areas threatened by human activities (Redford & Sanderson; 2000; Peres & Zimmerman, 2001). However, quantitative assessments of the effects of urban growth on protected areas are limited (Mcdonald et al., 2009).

Against this background, there have been a few comprehensive studies undertaken, which have addressed the efficiency of law-enforcement monitoring in reducing biodiversity loss and illegal resource harvesting (Jachmann 2008a; 2008b; Mubalama, 2010). In this context, ecologists, conservation biologists and cartographers have become increasingly concerned at the accelerated loss of global natural resources, and thus regard protected areas as a core component of conservation strategies and the cornerstone for biodiversity protection (Myers et al., 2000; Bruner et al., 2001; Struhsaker, Struhsaker & Siex, 2005; Mubalama, 2010).

To fulfil its constitutional obligations to safeguard biodiversity, as well as commitments under regional and international environmental agreements, South Africa gives due importance to the expansion of the conservation estate – regarding both protected-area coverage and outside formally protected regions (Crane, 2006). The TMNP is one of these formally protected areas, and makes a significant contribution to the development and maintenance of a national system of protected areas in South Africa for managing and conserving biodiversity. Nationally, it contributes to the preservation of both the terrestrial and marine biomes found within the park, as well as to the optimum use and ecologically sustainable development of the country's natural resources (Faasen & Watts, 2007). The responsibility for delivering these services and strategies is entrusted to South African National Parks (SANParks), who are also mandated with providing recreational services to people. Thus, national parks in South Africa are not only for conservation, but also for the millions of people in the country.

But even environmentally sensitive regions, such as the TMNP, have experienced rapid processes of transformation, as the scenarios of tension among environmentalists, developers and resident communities have unfolded (Abakerli, 2001). Anthropogenic pressures are changing the landscape, as well as the ecosystem services we derive from the park, at unprecedented rates (Millennium Ecosystem Assessment, 2005), and these changes are expected to continue well into the future (Sala et al., 2000; Ewers & Rodrigues, 2008). Many of the direct causes of the decline in resource populations are well documented and vary spatially and temporally, with one of the key issues being poaching (Damania & Hatch, 2005).

Protected areas are particularly vulnerable to poaching (Galster, Schaedla & Redford, 2010), and SANParks is no stranger to these illicit activities. However, whereas incidents of illegal poaching and resource use were largely isolated, opportunistic, and primarily of a customary nature in the past, high demands for improved access to park resources, driven by an increasingly complex set of socio-political factors under the new political dispensation in post-apartheid South Africa, have recently shaped resource use, and policy development and implementation (Scheepers, Swemmer & Vermeulen, 2011). Conflicts between conservation and satisfying livelihood needs heighten the imperative to conservatively determine human activities detrimental to protected areas, with those living near parks often feeling that their own development or subsistence opportunities are

threatened (DeFries, Karanth & Pareeth, 2010). Recognition of the relationships between people and natural resources within these areas needs to be enhanced (Zube, 1986).

Over the past decade, levels of poaching in the TMNP are said to have dramatically increased, especially within the marine protected areas (MPAs) that fall within the park's boundaries (Buchman 2009, pers com; Nortier 2009, pers com). Non-compliance continues to be a universal problem for MPAs (Wood, 2004). Fisheries compliance issues are thought to arise as a result of many contributing and compounding factors, including the economic gains of breaking the rules against the risk of detection, the severity of sanctions, and the design of efficient management systems (Smith & Anderson, 2004). There are also other equally important social reasons that contribute to non-compliance. These include the legitimacy of regulations, stakeholder consultation and involvement in MPA planning, and the degree of individual moral development in the various fisheries (Hauck, 2008; Read et al., 2011).

Illegal, unreported and unregulated (IUU) fishing has been recognised as a chief contributing factor to the worldwide collapse of both finfish and shellfish stocks (Pitcher et al., 2002; Raemaekers & Britz, 2009). There have been relatively few studies undertaken at both the national and international level which attempt to quantify and describe IUU in fisheries over time or space, as illegal fishing activities are particularly difficult and dangerous to research (Ainsworth & Pitcher, 2005; Sumaila, Alder & Keith, 2006). Even less information is present confirming the scale of the illegal South African abalone (*Haliotis midae*) and West Coast rock lobster (*Jasus lalandii*) (WCRL) catch, and very few efforts have been made to estimate the extent of the operations involved with illegal fishing of these two resources (Gordon & Cook, 2004; Raemaekers & Britz, 2009). In addition to these species, marine poaching in TMNP also targets a variety of fin- and shellfish.

1.2 Problem statement

Cities are seen as drivers for national economies, offering wealth creation, social development enhancement and employment provision. However, these centres can also be the breeding grounds for poverty, exclusion and environmental degradation (UN-Habitat, 2008). Many of these urban poor rely heavily on the natural resource base, found in neighbouring protected areas and national parks, and the integrity of many protected areas is at risk because of the socio-economic conditions of local communities surrounding them (Niemela, 1999; Ferreira, 2011). For over four decades, the Conservation Foundation has advocated that national parks should reach beyond their borders both in regional planning and in educational programmes advocating park goals (Dilsaver, 1972). However, in 2011 the high density of the human populations in cities, and the consequent need for recreational and tourism areas, as well as the illegal harvesting or poaching of natural resources, have made nature conservation in these areas very complex and difficult to manage (Pierce et al., 2002; Ferreira, 2011).

Poaching in many of these protected areas is on the increase. Underlying causes for ongoing illicit activities include lack of capacity in conservation organisations and poor coordination between government and civil society bodies responsible for the management of natural resources. Furthermore, a lack of awareness of the importance of biodiversity, and a short-term focus on meeting the socio-economic needs of a large, previously disadvantaged populace exacerbates this complex issue (Gelderblom et al., 2003; Lochner et al., 2003; Younge and Fowkes, 2003).

Any attempts at conserving biodiversity have to accept the harsh reality of rapidly increasing numbers of people living below the poverty line for whom basic-needs satisfaction is the greatest challenge (Rishi, Moghe & Upadhyay, 2007). It is crucial that people living in or near parks perceive the vital connection between their own well-being and that of the protected areas, including TMNP.

Table Mountain National Park officials have noted a significant increase in the nature and magnitude of marine poaching over the past decade. However, no empirical studies have been undertaken to expose the historical and geographic anomalies of marine resource confiscations in the park. Thus, appropriate, contemporary management strategies and conservation guidelines cannot be devised based on definitive knowledge and informed decisions.

1.3 Research aim and objectives

The overarching aim is to uncover the 'tip of the iceberg' of marine poaching between 2000 and 2009 in the Table Mountain National Park. To realise this, four objectives were designed to further explore the issues, namely:

1. To strengthen the researcher's theoretical and conceptual base regarding the illegal harvesting of marine resources in protected areas (theories, concepts, case studies) by reviewing the latest academic literature.

2. Identify the quantities of various marine resource species confiscated historically within the TMNP, by using official records from government agencies.

3. To geographically plot marine resource confiscations over the area of the park to comprehend the spatial dynamics of poaching and law enforcement.

4. Distinguish the different resource users and stakeholders acting independently or through partnerships, and examine their roles in resource exploitation in the TMNP.

The outcomes of these objectives aim to create a better understanding of the nature and scale of marine poaching in the TMNP, which may be used to influence policies and adapt management strategies to better deal with IUU fishing and broader conservation goals.

1.4 Table Mountain National Park: The study area

Located at the south-western tip of Africa, the TMNP is a rugged area of some 221 km^2 surrounded by the City of Cape Town, South Africa. The TMNP exists almost entirely within a metropolitan area and functions as an open access system as most of the park is unfenced. In addition there are over 1000 km^2 of inshore ocean within the boundaries of the park's MPA (Forsyth & Van Wilgen, 2007). The park is not a single contiguous area, the mountainous areas which make up most of the park being separated by developed urban areas on intervening terrain (Figure 1.1). The park was proclaimed in 1998, prior to which it was managed by 14 separate public bodies (Forsyth & Van Wilgen, 2007). Conservation management in the area before proclamation was uncoordinated and fragmented (Van Wilgen, 1996; Forsyth & Van Wilgen, 2007). Currently governed by SANParks, daily operations are managed by seven dedicated resource management sections dotted throughout the three sections of the park (South African National Parks, 2011).

Source: South African National Parks (2011)

Figure 1.1: Management areas of the Table Mountain National Park

TMNP is the only large urban national park governed by SANParks and it is the most visited of all of South Africa's national parks (Forsyth & Van Wilgen, 2007). By 2010 the TMNP sought to become the world's premier urban national park, in part because of its biological bounty and physical beauty (Ferreira, 2011). The physical beauty for which Cape Town is internationally acclaimed is offset against the high levels of poverty in which 20% of its residents are living (Ferreira, 2011). The challenges of the downturn in the local and global economies have also impacted on Cape Town's poor, resulting in increasing urban crime. The TMNP is also experiencing these threats (Ferreira, 2011). TMNP has obtained World Heritage Site status in line with its global importance as a hotspot of biodiversity for higher plants and invertebrates. The region is also listed as a centre of plant diversity (Davis, Heywood & Hamilton, 1994), an endemic bird area (Stattersfield et al., 1998) and a Global 200 ecoregion (Olson & Dinerstein, 2002). It is also a centre of diversity and endemism for mammals (Kerley et al., 2003), other vertebrates (Skelton et al., 1995), and many invertebrate groups (Cowling et al., 2003). The surrounding coastal areas also add significant biodiversity to the region (Turpie, Heydenrych & Lamberth, 2003), and make up the Table Mountain Marine Protected Area, in which six restricted 'no-take' zones are located – Karbonkelberg Restricted Zone; Cape of Good Hope Restricted Zone; Paulsberg Restricted Zone; Castle Rock Restricted Zone; Boulder's Restricted Zone; and St James Restricted Zone. The TMNP also protects the core of the Cape Floral Region (CFR), a natural World Heritage Site and an island of biodiversity within the City of Cape Town (Standish & Boting, 2006). The CFR is one of the world's top 25 biodiversity hotspots, with 70% of the region's 9000 terrestrial and marine species being endemic (Goldblatt & Manning, 2000; Turpie, Heydenrych & Lamberth, 2003; Crane, 2006).

Bordering the biodiversity-rich TMNP are neighbours living in widely diverse socio-economic situations. On the western and eastern flanks of the park, very affluent households reside, whereas further east of the park, poverty and alienation of people prevail in the poorer communities (Davis, 2005; Ferreira, 2011). The park plays four major roles: protected area with a unique biodiversity; popular recreational area for local and international visitors; exceptional heritage site; and an economic platform for job creation, transformation, economic growth and social upliftment (Ferreira, 2011). Although the responsible management of the park faces a number of issues, the most serious of all is how to realise tangible benefits like job creation and economic growth, whilst maintaining and conserving the biological and social heritage (Child, 2009; Ferreira, 2011).

1.5 Research design and thesis structure

Figure 1.2 shows the research framework. The introductory chapter lays the foundation for the study and describes the study site and aims and objectives of the study. Chapter 2 reviews the past and contemporary literature on issues relating to national parks and marine protected areas, perceptions and justifications by communities involved in poaching, and facets concerning access rights and conservation management. Chapter 3 discusses the methodology followed in the study. Chapters 4 to 6 of the thesis contain the research findings and discussions. Chapter 4 is on abalone confiscations in TMNP over the study period. Chapter 5 looks at the trends in WCRL confiscations, while Chapter 6 discusses confiscations of shellfish and finfish in the park. These three chapters offer 'a tip of the iceberg' scenario of illicit activity in the park over the study period, reflected by confiscation data offered by SANParks, Marine and Coastal Management (MCM) and the South African Police Services (SAPS). Finally, chapter 7 concludes this study, drawing together the findings, and suggesting practical recommendations for future marine resource management studies.

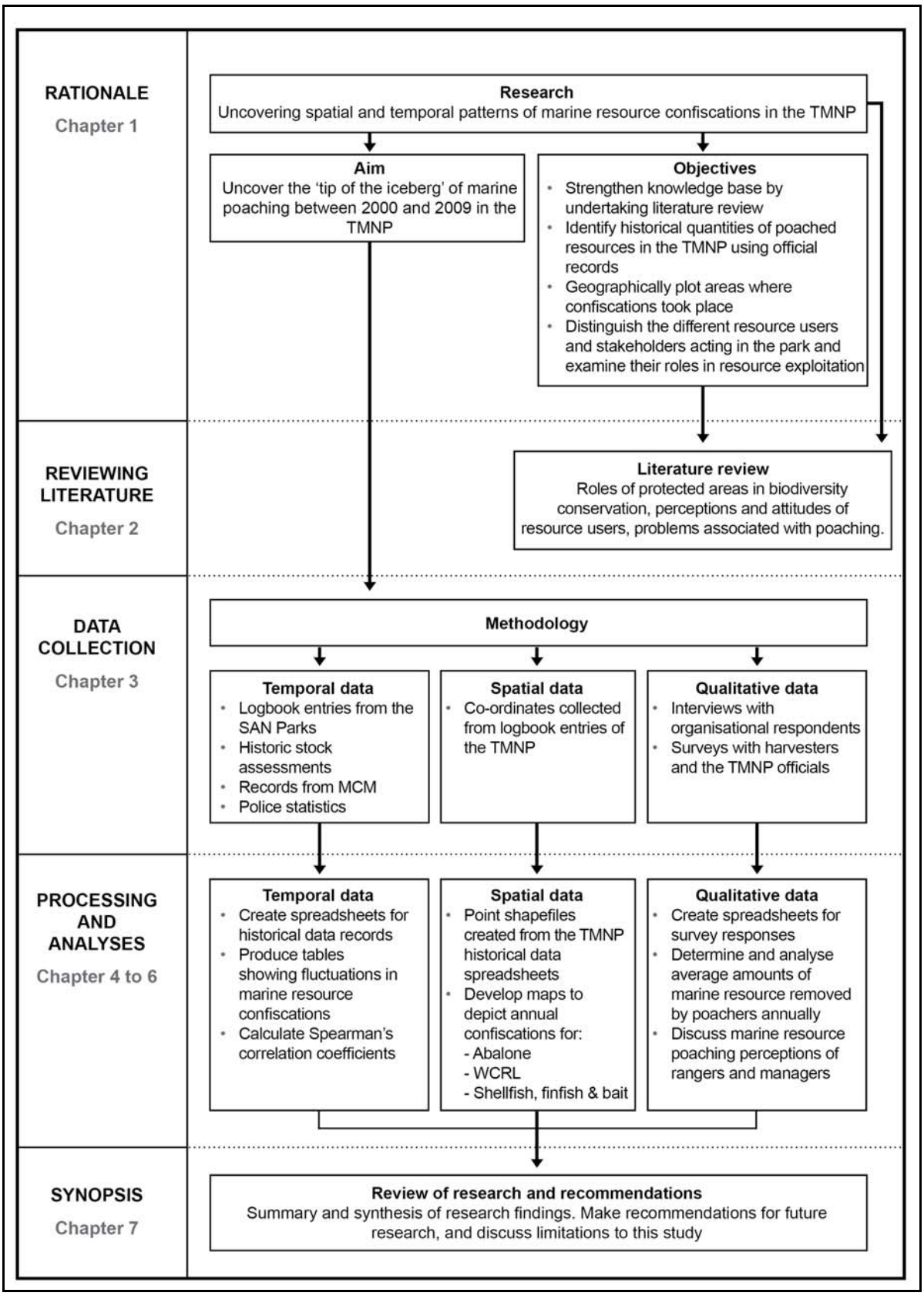

Figure 1.2: Research framework for investigating marine poaching in TMNP

The research framework graphically represents the stages undertaken in the study. By creating a step-wise structure one can ensure logical progression in the stages of research. Chapter 2 reviews the literature on conservation management and resource use in protected areas, by focussing on key issues surrounding user rights, protected area paradigms and the socio-economic and environmental values of marine resources.

CHAPTER 2: POACHING IN PROTECTED AREAS – CONFLICTS WITHIN CONSERVATION

The overview of literature in this chapter is discussed in the broader context of how the illegal harvesting of marine resources may impact on protected areas in coupled human-natural systems. The roles of protected areas are established, with particular focus on the function of MPAs in biodiversity conservation and preservation. Issues relating to the conflicts with current conservation strategies are examined. The perceptions, attitudes and behaviours of resource users are considered, and compared against a backdrop of historical access-rights issues. The problem of poaching is reviewed, to consider the theory behind why these illicit activities occur, and the socio-economic justifications for undertaking these activities. The concluding remarks reiterate the issues faced when urban populations, and particularly poor communities, apply pressure to neighbouring protected areas.

2.1 Introduction

Since the dawn of mankind, humans have used plant and animal species to supply their needs, be it for shelter, clothing, food, medicine, prestige or power (Haule, Johnsen & Maganga, 2002; Yom-Tov, 2003; McAllister, McNeill & Gordon, 2009). The use and extraction of natural resources have had historical and contemporary importance in economies and cultures for millions of indigenous people around the world (Endress, Gorchov & Berry, 2006). For millennia these commodities have been exploited with little or no consideration for the future. With the worldwide increase in human population and consumption levels, increasing pressure has been placed upon species, either through direct exploitation or indirectly through habitat loss (Wroe et al., 2004; Burney & Flannery, 2005; McAllister, McNeill & Gordon, 2009). Human activities levy a biological cost on species and habitats, as resources are accessed, harvested and used at rates which are often incompatible with inherent ecosystem processes and structures (Alessa, Bennett & Kliskey, 2003; Bulte & Horan, 2003), and there is thus a pressing need to conserve and preserve these resources in natural systems. Important tasks of contemporary environmental practices are to monitor natural resources, to assess the impacts and effects of human activities and interventions on these species, and to observe the state of the environment over space and time (Walz, 2008). These are the ideals on which the protected area paradigm is founded.

2.2 Protected-area paradigm

Protected areas have been designated as a principal strategy for environmental conservation, and have in the past served to keep the idea of biodiversity protection alive, contributing significantly to the survival of individual species and entire habitats that might have otherwise been destroyed (Abakerli, 2001; Michener et al., 2001; Liu, Dietz & Carpenter, 2007). In the early 20th century this led to the establishment of reserve areas and national parks the world over, in which habitats and the wildlife contained within them were protected (Ramutsindela, 2004). Internationally, protected areas are considered to be of paramount importance for both environmental conservation and sustainable development, with over 100 000 protected areas created worldwide to uphold this school of thought (Chape et al., 2003; Nawaz, Swenson & Zakaria, 2008). Protected areas such as national parks are part of the broader social, cultural and socio-economic framework, incorporating biophysical systems, which are inextricably intertwined (Hjortsø, Stræde & Helles, 2006).

But protected areas are not solely situated in terrestrial environments. Coastal resource management programmes are extensively implemented on a global scale to meet both conservation and fisheries management objectives. MPAs are generally defined as areas in the marine

environment where fishing and other activities are governed and regulated. Such regulations include either allowing limited fishing with the use of size- and species-selective fishing gears, or completely banning the collection of any organisms in these no-take areas (Maliao, Pomeroy & Turingan, 2009; Gaines et al., 2010). In recent years considerable emphasis has been placed on the establishment of MPAs in a broad range of jurisdictions. Spatial closures can have multiple goals, including habitat protection and non-economic values such as genetic diversity, but one primary objective is the protection of exploited fish stocks (Boersma & Parrish, 1999). MPAs reflect the extension of scientific concerns for the overall health and conservation of marine ecosystems, including their component populations and habitats, the processes that occur within them and the functions they offer (Ojeda-Martínez et al., 2009). Marine reserves can also provide imperative baseline data for population dynamics research (Sethi & Hilborn, 2008), especially when identifying the impacts of poaching in both protected and non-protected areas.

MPAs thus play a key role in the conservation of biodiversity and the sustainable utilisation of marine resources. This is strongly emphasised by the international attention they have received in the past decade. There has been a dramatic increase in the number of international commitments aimed at implementing MPA networks (Wood et al., 2008), many of which include the stipulation to include highly protected (no-take) areas as an essential component of these networks (Gaines et al., 2010). The 2002 World Summit on Sustainable Development called for a representative global network of MPAs by 2012, while the Convention on Biological Diversity advocates that member states effectively conserve at least 10% of each ecological region, including marine environments (Qiu et al., 2009**)**. Furthermore, the Fifth World Parks Congress recommended the designation of extensive MPA networks that protect a minimum of 20% of each marine habitat by 2012 (Qiu et al., 2009**)**. Networks proffer a hypothetical assurance of achieving conservation objectives that single small protected areas cannot accomplish, such as protection of a greater variety of habitat types and facilitating connectivity among sites to sustain endangered, overexploited or threatened populations (Gaines et al., 2010). However, marine reserves have traditionally been implemented as fairly small areas in coastal waters which are seldom effectively connected at a global scale. Isolated small reserves cannot perform the function of protecting threatened fishery species or ecosystems. This said, marine reserves can be established to accomplish conservation goals and/or fisheries management objectives, while also providing scientists with a better understanding of the community composition, dynamics, and functioning of intact marine systems (Gaines et al., 2010).

There has been little work in the MPA literature conducted on identifying the ecological and socio-economic linkages between MPAs, or in linking governance regimes in these areas to broader coastal zone management (Cicin-Sain & Belfiore, 2005). Intrinsically linked to the concept of assessing reserves and reserve networks is the aim to adaptively manage these protected areas. Although management plans may include a clause to evaluate whether reserves are meeting their intended social, economic or environmental goals and if not, to adjust the design accordingly, resource managers often fall short of a clear framework for determining what data and analyses are needed to make these challenging decisions (Gaines et al., 2010). Therefore the management of MPAs needs to look toward a governance approach that is both integrated and recognises the interdependences of the different elements, and the need to know and manage the impacts of each activity affecting the MPA (Ojeda-Martínez et al., 2009). When fishery managers appreciate the complex ecological and socio-economic environments in which fish and fisheries exist, they will be capable of anticipating the effects that fishery management will have on the ecosystem, as well

as the effects that ecosystem change will incur on fisheries especially within developing nations (Zhang et al,. 2009**)**.

The transposition of this marine paradigm in developing countries has neglected many socio-economic dynamics and resource management practices which have been fundamental to nature conservation in the areas (West & Brechin, 1991; Abakerli, 2001). While protected areas remain an essential approach for conservation, they can prove complex and complicated when implementing in many settings, especially in the developing world (Rao & Geisler, 1990). The borders and boundaries of protected areas are not always easily enforceable due to inadequate government resources, weak management capacities, budgetary constraints, remoteness of sites, and ineffective legal systems (Salafsky & Wollenberg, 2000). Many protected areas have been proposed on lands or in waters that are legally or customarily owned and managed by local people, making it impractical, illegal or impossible to proclaim these lands off-limits to human use (Salafsky & Wollenberg, 2000), although historically, the creation of protected areas has often resulted in the alienation and exclusion of indigenous populations from their land and resources (Oviedo, 2005; Crane, 2006). Whilst this protectionist approach has conserved many species from extinction, it has also led to severe and sometimes violent conflict between people and wildlife, particularly where they directly interact, such as on the boundaries of the protected areas (Woodroffe, Thirgood & Rabinowitz, 2005; McAllister, McNeill & Gordon, 2009).

2.3 Conservation and conflicts

A protected area such as a national park exists within a coupled human-natural system (Michener et al., 2001; Liu, Dietz & Carpenter, 2007), characterised by strong interactions between ecological and human components. It is broadly recognised that protected areas affect the livelihoods of local people, and thus, in determining the impact of protected areas, much emphasis has been placed on people living in or adjacent to these parks (Lynagh & Urich, 2002; Stræde & Treue, 2006; Abensperg-Traun, 2009; Armenteras, Rodríguez & Retana, 2009). Studies have shown that the development of protected areas can have a number of negative impacts and implications on local communities and populations, including displacement, restricted access, changes in tenure, conflicts with wildlife and cultural decline (Scherl et al., 2004; West, Igoe, & Brockington, 2006; Coad et al., 2008; Bennett, 2010). These interactions are especially relevant to protected area management because parks provide natural amenities attractive to humans that may spur the intensification of resource use in surrounding unprotected areas (Jones et al., 2009). Additionally, there has been an enduring debate about whether parks and protected areas intensify local levels of poverty (Adams et al., 2004; Roe & Elliot, 2004; Roe, 2008a; Bennett, 2010).

In recent years a connection between poverty and biological diversity loss has become more and more obvious (Abensperg-Traun, 2009). The challenge laid out is to provide cultural and environmental resources, without compromising biodiversity management and conservation strategies (Kessler, 1994; Simpson, 2001; Alessa, Bennett & Kliskey, 2003; Ramutsindela, 2004). A complete evaluation of the benefits arising from variations in the level of supply of natural resources should include all the benefits that these resources provide (Gios et al., 2006). Several studies have attempted to calculate the social, economic and ecological value of protected areas and the costs and benefits incurred by people living in the vicinity of such areas (Shyamsundar & Kramer, 1997; Godoy et al., 2000; Stræde & Treue, 2006). However, few studies have attempted the uncover issues of illegal resource harvesting in these areas.

2.4 Exploitation of natural resources

Wildlife exploitation and habitat conversion strategies differ significantly across societies, so that the worldwide distribution of natural resources varies considerably, as do the monetary systems attached to these resources found in the environment (Bulte & Horan, 2003). Economic development in South Africa has often been based on exploitation of natural resources, with a great deal of pressure being placed on marine systems (Hitzhusen, 1993). In South Africa, the use of natural resources by rural and peri-urban communities is rarely a choice but an economic imperative (Roe, 2008b). Given the economic circumstances in affected communities, a distinction between whether use of resources is primarily for subsistence or for commercial purposes is largely inseparable (Abensperg-Traun, 2009). In South Africa where an overwhelming majority of the population depend directly upon access to natural resources, equitable rights and sustainable management of these can make the difference between poverty and well-being, or insecurity and peace (Bonheur & Lane, 2002).

Excessive harvesting pressure placed on marine resources by various communities, provides a threat to the long-term survival of many species that are collected (Smulders, van Soest & Withagen, 2004). Historically, there are numerous examples of species that have been heavily influenced by subsistence and commercial demand (Strandby & Olsen, 2008). It is well documented that a vast number of species, usually wild harvested, are traded locally, nationally and internationally (Schippmann, Leaman & Cunningham, 2006). Although natural resource use by households living in or around natural areas is extensive, the extent of use, the quantities used and the value derived vary over space and time, and according to various household characteristics, including wealth (Shackleton & Shackleton, 2006). Luckert et al. (2000) highlight the relationship between household wealth and the use and trade in natural resources as a major research gap in understanding and supporting livelihoods in southern Africa, especially within poor urban households and communities.

A limited number of studies provide evidence of the importance of natural capital for urban populations (Falconer, 1990; Padoch, 1992; Ndoye, Ruiz Pérez & Eyebe, 1997). With rural-focused research and village case studies abounding, the importance of key natural resources at the level of poor households and communities, as well as regional economies, becomes increasingly apparent (Stoian, 2005). While it is acknowledged that increasing urbanisation results in escalating markets for natural-resource commodities (Wiggins & Holt, 2000), it remains unclear how this may convert into livelihood options for the urban and peri-urban poor. Neglect of the urban dimension of resource use may lead to an underestimation of the products' actual importance in the livelihood strategies of urban and peri-urban households.

Although cities and other urban centres drive national economies through wealth creation, enhancing social development and providing employment, they can also be the breeding grounds for poverty, exclusion and degradation of the environment (Ferreira, 2011). A variety of natural spaces abound in urban areas around the world, ranging from single-habitat patches to urban national parks (Niemela, 1999). Important aspects of the maintenance of these nodes of biodiversity in urban environments are the setting aside of green areas as vital components for ecosystem form and function (Faber, Costanza, & Wilson, 2002); the development of leisure and tourism spaces that can directly and indirectly support the costs of conservation (Byrne & Wolch, 2009); the fostering of sustainable urban livelihoods (Domene, Sauri, & Pares, 2005); and the health and well-being of urban residents (Bedimo-Rung, Mowen, & Cohen, 2005; Ferreira, 2011).

However, we poorly understand the incentives of such households for continued participation in the sustainable harvesting and processing of marine species, the contribution of resource-based income to livelihood security, and the potential to found occupational careers on product extraction, processing, and trade (Stoian, 2005). It has therefore been suggested to extensively study the characteristics of urban and peri-urban livelihoods dependent on marine resources and their responses to change (Wiggins & Holt, 2000; Stoian, 2005).

2.5 Marine resources: feast or famine?

The marine resources of South Africa are considered to be common property, and due to the open-access nature of many of these resources, they should be managed and developed for the benefit of the country as a whole (Clark, 2001). Accordingly, over the years the state has promulgated various statutes to ensure that these resources are used appropriately (Hauck, 2009). The principle goal of the regulations has been to make sure that marine resources are used on a sustainable long-term basis so as to maximise social and economic benefits for all of the country's citizens (Clark, 2001).

Current regulations include controls on the amount of fishing effort that may be expended, such as total allowable catch (TAC) and effort quotas, daily bag limits, restricted access and gear restrictions, while others are designed to maintain reproductive output (e.g. closed seasons, minimum size limits). Since their introduction, many of these regulations have been sadly ineffective due to a host of problems, the greatest of which is IUU fishing (Clark, 2001; Raemaekers et al., 2011).

The illegal exploitation of a number of high-value marine resources has been a serious problem in the Western Cape. Much has been done to improve fisheries compliance, but the scale of the poaching challenge remains daunting (Glavovic & Boonzaier, 2007) as the relationship between socio-economic variables and perspectives on marine resource management has been given relatively little attention in designing management and conservation strategies (Christie et al., 2003; Pomeroy et al., 2005; Broad & Sanchirico, 2008). McCay (1984) considered marine poaching to be a cultural practice, developed in response to enclosure and protection of coastal resources. These illegal harvesting activities are often grounded on historical disputes over property rights in marine fisheries (Faasen & Watts, 2007), and this has been the case in TMNP. There is thus a compelling need to complement law enforcement with voluntary compliance in fishing communities to achieve more equitable access to coastal resources (Glavovic & Boonzaier, 2007).

Issues surrounding fisheries management struggle to find a state of equilibrium between protecting resource sustainability, ensuring equitable access to resources and promoting economic efficiency and stability (Hauck & Kroese, 2006). At present, with the increasing rates and scale of development in natural areas and intensifying human impact on nature, the problem of preserving the marine environment is acquiring ever greater prominence. This is relevant to all the problems relating to protection, restoration and rational use of marine natural resources (Souvorov, 1999). A number of international agreements and statutes have been developed to ensure the sustainable use, management and conservation of global marine resources. Some incorporate the need to protect and prioritise fisheries for local livelihoods and food security, especially within small-scale fishing communities (Cullinan, Daniels & Sowman, 2005; Sowman & Cardoso, 2010).

Small-scale fisheries play a vital role in providing food and employment, and in the development of local economies (Hotta, 2004; Food and Agriculture Organization, 2005; Béné & Heck, 2005a; 2005b) where they play a prominent role in Cape Town's formal and informal markets (Peterson 2010, pers com; Peterson, 2011). The contribution of fisheries to food security at both household and national levels through direct and indirect contributions has been examined by the Food and Agriculture Organization (2005). Global estimates advise that over 90% of the 38 million fishers and fish-farmers are small-scale, collectively harvesting half of the world's fish for human consumption, and that 135 million people are directly or indirectly employed in small-scale fisheries and aquaculture (Food and Agriculture Organization, 2005). Scholars have been grappling with the definition of the terms 'subsistence', 'traditional', 'artisanal' and 'small-scale' fisheries which are often used interchangeably (Demuynck, 1994). In this study, the term small-scale fisheries as defined by Sowman & Cardoso (2010) will be used, that is a range of labour-intensive harvesting used to exploit fishery resources on a full-time, part-time or seasonal basis predominantly for subsistence, local and domestic markets, although export markets are increasingly becoming important for a number of valued resources, targeted by the three key fisher user groups – commercial, recreational and subsistence.

Records show that subsistence fishers have harvested the marine resources off the South African coastline for at least the past 100 000 years (Kyle et al., 1997) although the spatial and temporal intensity and distribution of these activities have varied markedly over time. In many areas, subsistence harvesting has mostly ceased, and has been replaced by other forms of fishing. The importance of commercial and recreational fishing activities has increased over the last century and now accounts for the greatest proportion of the catch of marine resources countrywide (Clark, 2001). Commercial fishers are those people who fish strictly for profit through the sale of their catch and operate as individuals or in groups or as companies, and range from those who are reliant on the resources for a basic livelihood to large-scale industrial operations, while recreational fishers fish for leisure or sport. By law, these fishers are forbidden from selling their catch, while subsistence fishers are allowed to sell a portion of their catch to afford other essentials, but may not engage in the sale of fish on a substantial scale (Clark, 2001).

There is no contesting the fact that the socio-economic structures related to small-scale subsistence and commercial fisheries in South Africa has been considerably influenced by the discriminatory regimes of the past (Hauck & Sowman, 2003; Hauck, 2009). Preceding 1998, small-scale fishers were basically considered informal and were perceived by the authorities as poachers, managed mainly through law enforcement (Sowman 2006; Harris et al., 2007). Despite being illegal, small-scale fisheries continued to operate, at times under the pretext of recreational fishing. However, quantities of catch, and the harvesting methods of small-scale fishers, often do not conform to the conditions specified by the recreational permits, should these fishers afford permit fees anyhow (Harris et al., 2002). A greater understanding of the values, knowledge and perceptions of small-scale fishers is therefore required to adapt management strategies to IUU fishing (Harris et al., 2002; Alessa, Bennett & Kliskey, 2003; Hauck, 2009).

2.6 Environmental perceptions and socio-economic variables

Recent research surrounding natural resource management focuses on the importance of understanding and incorporating local perceptions of conservation initiatives (Walpole & Goodwin, 2001; Broad & Sanchirico, 2008; Ferreira, 2011). Perceptions of environmental resources determine not only how a resource is used, but also its potential value to communities.

These culturally-defined principles are often critical in understanding local approaches to environmental management (Cinner & Pollnac, 2004). Although individual actors' perspectives and the socio-economic variables at household and community levels are not a complete set of factors to account for in conservation-policy design, they are essential components of such designs (Broad & Sanchirico, 2008). It is thus crucial that key stakeholders be aware of one another's needs, attitudes, beliefs and feelings (Ferreira, 2011). In addition to these perceptions, one needs to comprehend the variables within communities, to ascertain who is affected under these socio-economic rubrics in environmental resource decision making. Studies examining ecological impacts across human disturbance gradients are therefore fundamental in understanding the effect of human populations on natural ecosystems (Setsaas et al., 2007), and how these communities prioritise their needs to use and conserve resources.

Maslow (1954) hypothesised that there are seven hierarchical levels of needs – at the bottom is physiological requirements, then safety and security, belonging and a sense of social affiliation, self-esteem, cognitive, aesthetic, and finally self-actualisation. Maslow inferred that higher-order issues such as self-actualisation could not be achieved unless basic needs such as hunger and safety have been addressed. Although Maslow did not consider environmental conservation in his hierarchical classification, it would likely be in the third tier, as it can fulfil a sense of belonging in the natural world, or alternatively at the top of the hierarchy because it can fulfil aesthetic needs, a sense of purpose, and/or self-actualisation (Duroy, 2008).

Basic requirements start as the absolute minimum for survival needs, which evolve to a stage of subsistence needs for productive efficiency, and progress on to ever higher levels of human development (Duroy, 2008). A person who cannot meet basic demands of physiology, such as food, shelter or safety, cannot be expected to pursue goals of environmental conservation (Cinner & Pollnac, 2004). Thus, according to Maslow's hierarchy of needs, poorer communities are less likely to exhibit positive environmental attitudes, as they lack the necessary resources to meet basic needs (Duroy, 2008).

While the hierarchy-of-needs theory has largely become the conventional wisdom in the social sciences, it has been challenged. Studies have shown that community concern for the environment among residents of developing nations is stronger than that of residents in industrialised countries (Brechin & Kempton, 1994; Dunlap & Mertig, 1995; Martinez-Alier, 1995). While large-scale environmental conservation practices are likely to be strongly correlated with a nation's income level, environmental awareness and an individual's involvement in environmental conservation might exist quite independently of the level of social and economic development, local community involvement or governance (Duroy, 2008).

Nazarea et al. (1998) and Pollnac (2000) present findings that socio-economic variables such as education, age, employment, place of residence, and gender are related to varying perspectives on the environment and its resources. These different perceptions may help account for differences in behaviour related to resource use and management (Cinner & Pollnac, 2004). Setsaas et al. (2007) suggest that this behaviour, coupled with density and demography can be used as indicators of human exploitation. The interrelated nature of population density and environmental dynamics is open to discussion, but the relationship cannot be viewed as linear and mechanistic. At least two other factors determine the intensity of the stresses that a society exerts on its environment, namely the technical conditions for natural resources exploitation and the quantity of production that is not destined to meet the direct or indirect basic needs of the population, but is a response to

opportunities and constraints external to its social and physical reproductive needs (Raynaut, 2001). There are ongoing debates about the anthropological dimensions of environmental issues (Little, 1999; Raynaut, 2001) with a major focus of discussions placed on equitable and usufruct access rights.

2.7 Access rights to resources

The mechanics through which poorly defined resource-access rights may encourage an inefficient exploitation of natural resources have been extensively investigated, especially in the case of free-access exploitation (Hotte, 2001; Bennett, 2010). Extreme inequality of access rights coupled with additional factors such as growing population pressures, severe poverty, insufficient or non-existent rights of tenure, cultural and ethnic divisions, and a badly weakened civil society, aggravate overexploitation of resources placing marine ecosystems, as well as the communities who depend on them, at risk (Bonheur & Lane, 2002). In such cases we may have a tragedy of the commons scenario (Hardin, 1968), whereby people exploit the resource as quickly as they can before someone else does (Conradie & Knoesen, 2010). In this case, people pursue their own self-interests in a world of finite resources, for either their livelihood or for greed.

Contemporary South African conservation faces significant challenges, as the country suffers from highly skewed income and resource distributions (Holmes-Watts & Watts, 2008). The introduction of democracy has focused government funding on economic development and socio-economic priorities. This has led to diversion of funding away from sectors such as conservation, with consequent negative impacts on biodiversity. This only exacerbates the rates at which people exploit the marine environment, speeding up the demise of these systems. It has become increasingly obvious that for conservation to receive significant government and popular support in the future, it will need to make a significantly positive contribution to some of the development issues facing urban poor and marginalised communities, living in or around protected areas (Younge & Fowkes, 2003).

However, for decades, centralised, top-down conservation strategies have through supposed mismanagement of institutional capacity, reduced access to resources and livelihood security, eliciting conflicts that make conservation inefficient, inequitable and unsustainable (Wessels et al., 2003; Zhang & Wang, 2003; Chen, Yang & Xie, 2005). The non-acknowledgement of the livelihood strategies of local communities in the early environmental movement and in policies for development and conservation of environmentally-sensitive regions, has promoted conflicts over the control and use of natural resources (Abakerli, 2001; Holmes-Watts & Watts, 2008). These restrictions on access to natural resources deprive poor people of livelihoods. In fact, the creation of protected areas has changed the way how conservation officials perceive poor communities dependent on natural resources, referring to these as poachers (Faasen & Watts, 2007).

2.8 Problems of poaching

Neglected for decades by those in the social-science communities, the illegal taking of wildlife resources, or poaching, has come to the attention of natural-resource scholars in recent years (McMullan & Perrier, 2002). Poaching is broadly defined here as the illegal taking of natural resources, and is considered a major threat to biodiversity globally (Eliason, 2004). Most of the literature concerned with poaching comes from the perspectives of natural and environmental sciences, and it focuses largely on how to prohibit the practice, rather than on understanding its complexities (Hampshire et al., 2004). However, studies have begun to explore the social context and meanings of poaching, by stating that it is embedded in subcultural webs of meaning that

involve tradition, individual and social identities, ethnic heritage, and other socio-cultural factors (Muth & Bowe, 1998). Despite claims by some scholars that poaching is not a serious problem (Beattie, Giles & Cowles, 1977), others suggest that poaching is more rampant and widespread than is generally perceived (Muth, 1998; Eliason, 2004), although the scales of these issues are poorly understood, due to confiscation data often being non-representative of the scale of poaching activity.

The impacts of natural resource poaching vary significantly in scale and scope depending on the nature, extent and intensity of illegal activity and the degree of resilience of the ecological and socio-economic systems affected (Gavin, Solomon & Blank, 2010). These illegal activities and actions involve ownership rights violations, such as taking of resources from protected areas or private land without permission; unlawful land invasion and occupation; and contravention of resource-use regulations, including use that is in excess of established limits, out of season, and conducted with prohibited extraction methods, without required permits, or in prohibited areas (Gavin, Solomon & Blank, 2010). Illegal resource use also includes extraction of prohibited resources, such as protected species. Further biological impacts range from reductions in genetic diversity and species richness, to changes in community structures and ecosystem services (Pauly et al. 2002; Pitcher et al. 2002; Okello et al. 2008). Economically, illegal resource use can provide substitute livelihood strategies to marginalised people and premium profits to poachers (Webb 2007; Tacconi 2008). Legitimate resource users who stay within the boundaries of the law can endure significant revenue losses as a result of illegal use of resources (Gutierrez-Velez & MacDicken 2008), which further aggravate differences and inequality in resource access (Gavin, Solomon & Blank, 2010).

A common justification for poaching resources is that they are for food, medicine and other necessities for household consumption or for the local markets (Muth & Bowe, 1998; Eliason, 2004; Haule, Johnsen & Maganga, 2002). But the illegal taking of these resources occurs for a variety of other reasons, not just for subsistence means. Muth & Bowe (1998) developed a typology of 10 motivations for poaching, whereby some individuals poach for profit; others are prompted by obtaining a trophy; disagreeing with current regulations; enjoying thrills; or recreational satisfactions; providing for household consumption; gamesmanship; protection of property; rebellion; or exercising a traditional right of use. Previous poaching research has found support for differential association theory (Green, 1990; Curcione, 1992; Forsyth & Marckese, 1993) in that many community members appear to be brought into the activity by their family and close friends. Other studies have examined rationalisations as means of accounting for and justifying participation in these illegal activities (Sykes & Matza, 1957; Forsyth & Marckese, 1993; Eliason, 2004).

When asked to discuss the nature and scale of their poaching offences, some respondents will be candid and forthright about their reasons for violating wildlife laws whereas others will attempt to diminish personal responsibility for their misdemeanours by creating motives for such behaviour to make them appear socially acceptable (Eliason, 2004). It is common for people to be less willing to openly discuss matters of an illegal nature (Kühl et al., 2009), thus rationalisations are important factors that influence individual behaviour. These are not simply excuses or justifications given after participation in misbehaviour (Sykes & Matza, 1957), rather they are also used prior to engaging in illegal behaviour to justify the acts and alleviate the cognitive dissonance associated with law and management violations (Eliason, 2004).

Variation also exists in poachers' perceptions, both by those involved directly in enforcing or breaking laws, and by wider civil society (Hampshire et al., 2004). The public view of poaching is typically as a folk crime causing little real harm and it is often romanticised (Forsyth, Gramling & Wooddell, 1998; Muth 1998). This view can switch rapidly if the species involved are endangered or endeared. Poachers often manage to distinguish between acceptable and unacceptable forms of poaching. In contrast to the tacit acceptance of minor transgressions by subsistence or small-scale resource users, people are less tolerant of what they regard as real poaching (Hampshire et al., 2004). As subsistence livelihoods fall away to more urbanised lifestyles, both traditional poaching and survival poaching will decline (Forsyth, Gramling & Wooddell, 1998; Eliason, 2004). A misdirected focus on subsistence poaching further limits the possibilities of future efforts focused on benefit-sharing models between illegal resource users and the conservation of wildlife (Algotsson, 2006). An alternative starting point is that wildlife offenders are not seen as homogeneous entities, rather as socially-diverse units (Braithwaite, 2000). With people viewed as social actors, a very different set of questions arises from those which normally focus on people-centred approaches to natural resource management projects and programmes (Algotsson, 2006).

2.9 Conclusions from the literature review

We need to ask which social actors harvest and use what natural resources at different times, and how different people gain access to such resources, and whether their actions are legal or not (Algotsson, 2006). Unfortunately, little research has been done to identify wildlife offences and presently there is poor understanding of the socio-economic drivers of resource overexploitation, especially in urban protected areas (Twine, Siphugu & Moshe, 2003). Poorer households in urban centres often rely heavily on products, services, or land from nearby natural areas to meet their livelihood needs. Their use represents one demand on the biological resources of these areas, while their conservation objectives coupled with those of the state and conservation organisations constitute another (Salafsky & Wollenberg, 2000). The resulting conflict, and/or compatibility between the demands created by livelihood activities and conservation objectives have been the central point of discussions and debates over the last two decades. Despite the prolific dialogue on the linkage between livelihoods and conservation, there has been little attempt to systematically define the nature of this linkage or to measure the impacts caused by either legal of illegal exploitation (Salafsky & Wollenberg, 2000).

Exploitation by humans can have severe conservation implications for wildlife populations (Setsaas et al., 2007), and it accounts for almost a quarter of wildlife extinctions for which the causes can be identified (Wato, Wahungu & Okello 2006). When poaching occurs and population integrity within or surrounding protected areas begins to break down, the choice of policy may change as the effects of poaching enter the decision for open-area management (Sethi & Hilborn, 2008). It is only through this policy shift that we can counter the effects of the tragedy of the commons[1]. The integrity of many such protected areas is at risk because of these policy shifts as well as the socio-economic conditions of local communities living around parks of reserves (Niemela, 1999). Any attempts at conserving biodiversity have to recognise the reality of rapidly increasing populations living below the poverty line for whom basic-need satisfaction is the greatest challenge (Rishi, Moghe, & Upadhyay, 2007). It is therefore critical that communities or

[1] Tragedy of the commons is a dilemma arising from a situation where multiple individuals deplete a shared limited resource, even when it is not in the best long-term interest for this to happen.

individuals living in or near protected areas perceive the synergistic and evolving relationship between their own well-being and that of the environment (Ferreira, 2011).

Socio-economic and environmental systems co-evolve to form a holistic model for human and environmental interaction. This interface is complex and asks for the establishment of a discourse to incorporate multiple perspectives into environmental policy and practice (Konchak & Pascual, 2006). Focusing on the future, national park management in urban settings should ideally serve the dual objective of catering to nature protection as well as social development, and be an evolving and adapting planning and implementation process that understands the complexity of relationships between natural resource management and the local interests and perspectives of communities surrounding national parks who exploit these resources (Grimble & Laidlaw, 2002; Stræde & Treue, 2006).

Resource management, as opposed to resource exploitation, is more desirable both for the protection of the environment and for the sustainable development of resources (Kusuma-Atmadja, 1991). The management of marine resources is complicated by multiple scales of interest (local, regional, national and international) and differing perspectives at each scale (McAllister, McNeill & Gordon, 2009). Ideally, the impact of wildlife exploitation should be monitored closely by making regular estimates of stock sizes and exploitation rates (Robinson & Redford, 1991). However, in practice this level of monitoring is possible in very limited situations because it requires resource stocks and rates of harvesting to be easily quantifiable, and even in the best case it requires considerable resources, time and effort to measure them (Wato, Wahungu & Okello, 2006).

This chapter satisfies objective one, which aimed to contextualise protected areas in an urban context, while focusing on the issues of resource poaching. A number of factors were addressed including the justifications and perceptions of poaching in communities living adjacent to protected areas, the roles that natural resources play in the live of poor urban or peri-urban households, and the need to conserve the environmental heritage while integrating social and economic needs. The following chapter examines the methodology applied to the study, and discusses the various data sources and methods used for analyses.

CHAPTER 3: METHODOLOGY AND METHODS

The methodology chapter describes the ways in which this study was conducted. First, a literature review was undertaken to obtain relevant theoretical sources on natural resource harvesting in urban park environments and marine protected areas. Second, data was sourced from government agencies and academic institutions. Third, qualitative sampling was conducted in poaching communities and with park officials. Data gathering for this investigation was undertaken from February 2009 to December 2010. Last, statistical and geographic information systems (GIS) analyses were performed on data collected from SANParks.

3.1 Literature review

A comprehensive literature review was conducted on resource use and poaching in urban protected areas in an international and South African context. Only limited literature was found describing resource exploitation in urban parks in South Africa, with most concentrating on poaching in protected areas surrounded by rural communities. The literature focuses on historical and contemporary paradigms concerning natural resource management, issues regarding the use and trade in socially- and economically-valuable poached species, and suggested interventions that can be imposed to curb illicit harvesting within marine protected areas. The literature also offered a number of methodology considerations for this study.

The development of methodologies to advise management in data-limited situations is a priority, yet many conventional methods are data-intensive and difficult to use in less developed countries (Garcia & Rosenberg, 2010). From reviewing the literature, eight different methods used to study illegal resource use were identified: law-enforcement records; direct observation; indirect observation; direct questioning; self-reporting; randomised response technique; modelling; and forensics (Gavin, Solomon & Blank, 2010). This study considered law-enforcement records and direct questioning to be most viable options for data gathering. Many researchers recommend a combination of traditional quantitative, qualitative and participatory methods when researching livelihoods and natural resource-related issues (Elliot et al, 2001; Simpson, 2007; Cruz Trinidad, Geronimo & Aliño, 2009; Bennett, 2010). The following section discusses the collection of quantitative data for the study.

3.2 Quantitative data

To attempt to uncover the magnitude of poaching in the TMNP over the study period, a variety of data sources were reviewed. Data maintained by resource management agencies offers records detailing the expropriation of illegal goods, identifying targeted resources and estimating quantities of illegal take, which investigators can use to examine trends in illegal activities if consistent records exist (Davis et al., 2004; Hilborn et al., 2006; Gavin, Solomon & Blank, 2010). Data was sourced from records maintained by SANParks, where officials in the TMNP keep records of arrests, warnings and seizures of illegally harvested resources. Further secondary data was collected from other government agencies and from academic institutions, and is useful for initial insight and for triangulating results of livelihoods or natural resource-related research (Simpson, 2007; Cruz Trinidad, Geronimo & Aliño, 2009; Bennett, 2010).

3.2.1 Table Mountain National Park

Data on confiscations of illegally harvested natural resources from the TMNP was obtained from incident report logbooks maintained by each park section. After each confiscation, SANParks rangers based in the individual sections record the details of the offence, namely date, time, name of offender, address of offender, area of confiscation, resource confiscated, applicable legislation, SANParks offence number, SAPS offence number, arresting officer, and additional notes. Logbook entries also cover natural resources found abandoned along roadsides, near the shore, or in the ocean. Gavin, Solomon & Blank (2010) suggest that the use of law-enforcement records does not place excess labour demands on conservation agencies and does not require specialised technology or skills to collect or analyse. In most cases, enforcement personnel already maintain illegal activity records. Conservation bodies can add value to databases by expanding the types of information recorded and through more accurate and consistent data collection.

However, the data reported in the TMNP logbooks was most likely incomplete due to a number of reasons, including rangers not reporting an offence in the registers, logbooks having been misplaced or destroyed, and pages missing or illegibility of records (Buchmann 2009, pers com; Mossop 2009, pers com; Nortier 2009, pers com; Ruthenberg 2009, pers com). All logbook entries were in hard copy, and had to be coded and digitised for statistical analyses. Information in eight logbooks was digitised between March 2009 and January 2010, resulting in a record of 1083 incidents of illegal natural resource activity in the TMNP that occurred between January 2000 and the end of 2009.

For this study, only records pertaining to confiscations of marine resources were collated into a central database. Records were sorted by date to ensure that no duplicates were present, as many enforcement operations were undertaken by more than one section, each recording the arrests and confiscations in their respective section's logbook. Once the duplicated entries had been removed, 988 entries of illegal marine resource harvesting remained. Other marine-related records were collected by MCM.

3.2.2 Marine and Coastal Management

The MCM branch of the Department of Agriculture, Forestry and Fisheries (previously a branch of the Department of Environmental Affairs) is tasked with the conservation of marine species in South African waters. This agency also keeps records of population dynamics and resource harvesting. Their records were an invaluable source of comparative data on confiscations of two economically-important species – the South African abalone (*Haliotis midae*) and West Coast rock lobster (*Jasus lalandii*). Records from MCM used for this study span the decade January 2000 to the end of December 2009.

Data on annual landings and recommendations for TAC recommendations of WCRL for the 1999/2000 to 2008/2009 seasons was collated into spreadsheets for comparisons and calculation of weight conversion ratios. Data on landings and TAC covered commercial, recreational and subsistence fisheries. Biological records pertaining to the cohort compositions of WCRL for Areas 8 and 10 of MCM were also collected. Area 8 comprises Hout Bay to Cape Hangklip, while Area 10 covers Hout Bay and surrounds. Surveys in Area 8 were conducted during March through May annually, whereas Area 10 was mainly surveyed monthly throughout the year. Variables recorded include numbers of male and female WCRL caught and measured per year; average carapace length for males and females; average carapace length for undersized and sized lobster; and the average length for lobster tails.

Records of confiscations for illegally harvested abalone from the beginning of 2000 to the end of 2009 are also maintained by MCM. For the purpose of this study, provincial and national records of abalone confiscations kept by MCM were compared against the data from SANParks records. Historical data on marine species' was also collected by the University of Cape Town, and will be discussed in the next section.

3.2.3 University of Cape Town

A stock assessment of exploited invertebrate subtidal reef species was undertaken in 2001 by the university's Centre for Marine Studies as part of a study funded by the Table Mountain Fund. This report documented the abundance of targeted marine resources along the coast of the TMNP, and offers a retrospective glimpse into the conditions pertaining a decade ago. Since then, no baseline studies have been undertaken. Clearly, additional assessments need to be conducted to expose spatial and temporal trends in stock abundance. Researchers such as Maliao, Webb & Jensen (2004), Francini-Filho & de Moura (2008) and Gavin, Solomon & Blank (2010) concur, stating that monitoring marine populations of target species can assist in estimating illegal take. Further, baseline surveys and ongoing monitoring and evaluation efforts may be particularly important when determining the impact of compliance and enforcement interventions (Bennett, 2010). Further resource harvesting compliance and enforcement is offered by the South African Police Services (SAPS) whose records will be discussed in the section to follow.

3.2.4 South African Police Services

Records of resource confiscations for police precincts surrounding the TMNP were requested for verifying the species, amounts, and weights of resources confiscated from illegal harvesting within the park. Figures for abalone and WCRL confiscations were released for the period June 2008 to June 2009. No other records were made available. Secondary data sourced from the SAPS was used as a data set to compare against data from the TMNP records. The SANParks data was also used for spatial analyses to determine resource seizures over the geographic areas of the park.

3.3 Geographic information systems (GIS)

An objective of this research was to identify areas in the park where marine resource confiscations took place over time. The use of GIS technology is a fundamental and powerful tool in a planning process which considers a very large and exhaustive range of thematic layers (Senes & Toccolini, 1998). The GIS approach is invaluable as it is objective, repeatable and provides a spatial context for knowledge elicitation and simplifies data management, analysis and construction of spatially-explicit habitat maps (Yamada et al., 2003).

Conservation managers require detailed information about the spatial distribution and abundance of species to help understand their ecology and to apply management measures. These visual representations can be used to determine habitat preservation priorities, understand the implications of different management practices, or identify potential risks to the species, (Yamada et al., 2003). If each violation record notes a specific location, investigators can analyse the spatial distribution of illegal activity in a protected area (Holmern, Muya & Roskaft, 2007; Gavin, Solomon & Blank, 2010). The GIS outcomes from this study will offer georeferenced data to illustrate the areas in the TMNP where confiscations of illegally harvested marine resources took place between 2000 and 2009.

GIS analyses were undertaken using ArcMap 9.3. Point shapefiles were created from spreadsheets containing the data records noted in the TMNP offence registers. GPS coordinates in degrees, minutes and seconds were identified for the following variables:

(i) Areas where confiscation took place;

(ii) Suburb in which offenders reside; and

(iii) Locations of park's sectional head offices.

The coordinates were obtained from the GIS unit of the TMNP, the City of Cape Town Environmental Resource Management Department, and from GoogleEarth. These coordinates were converted to decimal degrees for spatial analyses. WGS84 was used as the specified geographic coordinate system. A predefined boundary image of the TMNP was used with a 20-m digital elevation model having the coast as its extent around Cape Town. Major and minor road layers were also inserted to allow for spatial trend discussions in the three resource chapters. Major roads included expressways, freeways and primary arterials, while minor roads encompassed secondary arterials, private roads and restricted access roads. Roads may have played a key role in explaining trends over the area of the park and why individuals chose to travel these paths. The next section discusses the methods used in obtaining qualitative data in the form of responses from individuals in government agencies, conservation bodies and enforcement units, as well as from park officials and resource harvesters.

3.4 Qualitative data

Further insight into the potential scale of illegal harvesting of marine resources in the TMNP was collected through qualitative sampling, and to fill the possible gaps in the quantitative records. Qualitative techniques are particularly valuable in exploratory research when little is known about a topic and they have been successfully used in research on human dimensions (De Ruiter & Donnelly, 2002; Eliason, 2004). Yonariza & Webb (2007) propose that direct questioning can provide information on the proportion of a population violating regulations, the socio-demographic profile of potential transgressors, and the incentives that are present which promote illegal activities. Direct questioning can also gather spatial data on locations where illegal activities occur, and identify resources used illegally, and estimate the quantities harvested (Mann, 1995). Finally, direct questioning can track short- and long-term trends in illegal activities (Gavin, Solomon & Blank, 2010).

Direct questioning through a harvesting survey was conducted on both poachers and park officials to gather perceptions of what is poached annually from inside the TMNP. Such perceptions and attitudes can be determined directly by asking respondents to report their individual beliefs or evaluations, or indirectly by analysing the content of the responses believed to reflect their attitudes and perceptions (Bohner & Wanke, 2002; Winter, Esler & Kidd, 2005). To date, no research has been undertaken using qualitative data on marine poaching in the TMNP. Current monitoring and management strategies are based on historical instances of poaching activity, with no verification of the true extent of the problem. The data from surveys and interviews will be used to:

(i) Analyse the roles of the different resource users in the park; and

(ii) Identify the various marine resources removed from the park and the locations of illegal harvesting, to complement the historical quantitative data.

The knowledge-based systems methodology for acquisition of local socio-economic, ecological and institutional knowledge as suggested by Walker et al. (1997) and Sinclair & Walker (1999) was adapted for interviewing resource harvesters. This involved knowledge collection from a small sample of deliberately-chosen individuals deemed by other harvesting community members to be knowledgeable, and who would be willing to cooperate in this study. A total of 39 harvesters were interviewed, spanning three marine resource harvesting communities – commercial abalone poachers, WCRL fishers and Rastafarians (Table 3.1). The interviews conducted with harvesters were based on a questionnaire (Appendix B) of 30 semi-structured and unstructured questions previously tested and adjusted through pilot interviews with marine harvesting community members.

Table 3.1: Respondents in illegal fishing groups surveyed on marine resource harvesting in the TMNP

Illegal harvesting group	Number of individuals interviewed	Number of individuals interviewed as percentage of total
Abalone fishers	11	28.2
Rastafarians	6	15.4
West coast rock lobster fishers	22	56.4
TOTAL	**39**	**100.0**

Twenty-two WCRL harvesters were interviewed (excluding Rastafarians). Questionnaires were distributed at the slipway in Kommetjie, residences of known WCRL harvesters in Oceanview, and at Hout Bay Harbour. In total, 87 WCRL fishers were approached to take part in this study. Unfortunately, many declined participation as they feared being prosecuted by either the SAPS or other agencies. Six Rastafarians out of 23 approached agreed to be interviewed. It has been claimed that marine harvesting plays an important role in many Rastafarian subsistence lifestyles (Buchmann 2009, pers com). From the 19 abalone poachers contacted, 11 agreed to be interviewed telephonically. The contact details of the poachers were obtained from SANParks and members of various SAPS units. The questions posed to resource harvesters were arranged in four categories:

(i) *Social aspects* with questions about age, sex, race, address (neighbourhood), resource harvesting background, and numbers of other community members known to be active harvesters;

(ii) *Economic factors* focusing on occupation, harvesting income (subsistence and commercial values), and location and method of sales;

(iii) *Ecological variables* which considered species of resources targeted, and part of resource most commonly harvested or used, amounts removed, location and method of harvesting, and temporal, seasonal and climatic parameters; and

(iv) *Cultural and institutional issues* relating to perceptions of sustainability and management interventions, methods of fishing and extraction, the use of nursery stocks and whether harvesters know the illegal nature of harvesting activities.

Gavin, Solomon & Blank (2010) advocate four central questions for research on illegal resource use: What species and extraction techniques are used?; Where does illegal resource use occur?; Who extracts resources illegally?; and Why does illegal resource use occur? These authors

recommend that researchers gather data on identities of violators and the resources targeted, techniques used to procure resources illegally, locations of illegal activities and incentives driving illegal resource use. In addition, answers to the target questions must account for the magnitude of illegal resource-use problems, which include the quantities of resources poached, prevalence at different spatial and temporal scales, the numbers of people involved and the frequency of illegal activity (Gavin, Solomon & Blank, 2010). All of these considerations were measured in this study.

Due to the illicit nature of poaching, it is extremely difficult to ascertain the real number of illegal harvesters removing marine resources from the TMNP annually. Thus, it is not possible to verify whether the sample interviewed was representative of the poaching population. A similar study undertaken by Peterson (2010, pers com) acquired the responses of 37 illicit harvesters in the same communities approached for this study. Many harvesters fear prosecution or arrest when discussing their illegal operations, or they are unknown to law-enforcement officials or other poachers. Because poaching is a criminal offence in the TMNP, and a sensitive issue for many individual harvesters, a low response rate in this qualitative survey of wildlife-law violators was expected. Illegal marine resource harvesting is mostly covert and there exist significant incentives for informants to withhold information (Gavin, Solomon & Blank, 2010). However, the researcher found that many of the respondents were quite open about their activities. Probable reasons for their acquiescent responses ranged from ignorance of the illegality of their activities and disregard for the law, to hopes of one day obtaining a legitimate permit or the right for resource harvesting.

To complement the perceptions of poachers, 17 TMNP officials were interviewed in an effort to comprehend the perceptions of those in park management. Officials from each section except the Kloof Nek branch agreed to participate in this study. Interviews with the rangers and managers of the TMNP used similar questions as posed to the harvesters relating to species targeted, areas of poaching and use of products (Appendix C). More attention focused on enforcement operations and caveats in current monitoring and management. Attitudes toward enforcement activities and possible recommendations were discussed, as well as the respondents' viewpoints on the extent of the illegal activities and the potential impact on the marine resources. All data was subsequently categorised according to the topics and cross-validated.

Although direct questioning was believed to be the most effective form of gathering information from poachers, this form of data collection suffers from several sources of bias. Unless informants trust the interviewer, there are possibilities that respondents may provide false or misleading answers, responses that they believe interviewers want to hear regardless of truthfulness (Catania et al., 1996; Gavin, Solomon & Blank, 2010). To avoid concern over whether respondents would respond honestly to the questionnaires, or attempt to appease the interviewer, all interviews were conducted under conditions of strict confidentiality and anonymity. Questionnaires were primarily used to guide the interview, and were not shown to respondents prior to the interview so avoiding respondents making anticipated answers (Alessa, Bennett & Kliskey, 2003; Yamada et al., 2003). Where possible, interviews were conducted in the informant's native language at home, and personal opinions on the conservation issues in question were not discussed. Explanatory sheets were given to informants who needed further clarification (Appendix A).

Snowball sampling, a method deemed particularly effective in small communities or where populations are difficult to locate, was also used (Hampshire et al., 2004). Consultations were held with a spectrum of stakeholders (Table 3.2), using semi-structured interviews in which the questions were evaluated continually and refined.

Table.3.2: Respondents in the interviews on marine resource harvesting in the TMNP

Organisation, institution or individual stakeholder	Number of individuals interviewed	Number of individuals interviewed as percentage of total	Number of interviews	Number of interviews as percentage of total
Abalone Rights Holders Association	2	2.6	2	1.6
CapeNature	1	1.3	1	0.8
City of Cape Town Municipality • *Environmental Resource Management Department*	2	2.6	2	1.6
Feike Natural Resources Management Advisors	1	1.3	2	1.6
Institute for Security Studies	3	4.0	5	4.0
Kommetjie Environmental Action Group	2	2.6	2	1.6
Department of Agriculture, Forestry and Fisheries, Marine and Coastal Management branch				
– Directorate Resources Research • *Fisheries Research*	3	4.0	10	7.9
– Chief Directorate Monitoring, Control and Surveillance • *Directorate Compliance/Control*	2	2.6	5	4.0
Noordhoek Environmental Action Group	1	1.3	1	0.8
Rhodes University • *Department of Ichthyology and Fisheries Science*	1	1.3	1	0.8
South African Heritage Resources Agency	1	1.3	1	0.8
South African Inshore Fishing Industry Association	2	2.6	2	1.6
South African National Parks (SANParks) – Scientific and Research Departments				
• *Conservation Unit – Kruger National Park*	1	1.3	1	0.8
• *Geographic Information Systems – Cape Town*	1	1.3	3	2.3
• *Marine Coordinator – Cape Town*	1	1.3	2	1.6
• *Social Science Research Unit – Cape Town*	3	4.0	6	4.8
• *Corporate Investigative Services – Pretoria*	2	2.6	4	3.2
– Table Mountain National Park				
• *Boulder's – Simon's Town*	2	2.6	3	2.3
• *Central Section – Silvermine*	1	1.3	3	2.3
• *Corporate Investigative Services – Newlands*	2	2.6	6	4.8
• *Head Office - Kirstenbosch*	1	1.3	1	0.8
• *Marine Section – Signal School*	12	16.0	12	9.5
• *Newlands Forest - Constantia*	1	1.3	1	0.8
• *Northern Section – Kloof Nek*	1	1.3	3	2.3
• *Southern Section – Klaasjagersberg*	3	4.0	5	4.0
South African Police Services – Precincts				
• *Cape Town*	2	2.6	2	1.6
• *Claremont*	1	1.3	1	0.8
• *Hout Bay*	1	1.3	2	1.6
• *Oceanview*	2	2.6	4	3.2
• *Rondebosch*	1	1.3	1	0.8
• *Simon's Town*	2	2.6	4	3.2
– Specialist Units				
• *Dog Unit*	2	2.6	2	1.6
• *Sea Border Line Control*	2	2.6	4	3.2
• *Strategic Management*	2	2.6	3	2.3
South African Revenue Services				
• *Customs*	2	2.6	2	1.6
• *Airfreight control*	1	1.3	1	0.8
Sustainable Livelihoods Consultants	1	1.3	3	2.3
Table Mountain Fund	1	1.3	1	0.8
TRAFFIC	1	1.3	3	2.3
University of Cape Town				
• *Department of Economics*	1	1.3	2	1.6
• *Environmental Evaluation Unit*	2	2.6	7	5.6
TOTAL	**76**	**100.0**	**126**	**99.9**

A total of 126 semi-structured, open-ended interviews were conducted with representatives of government and parastatal entities, conservation bodies and private companies as well as members of civil society. The 76 individuals interviewed from these bodies were believed to be reliable sources of accurate information and objective perceptions regarding poaching in the TMNP. A number of follow-up discussions were held with selected individuals and informants, if further information was required.

This study adopted an open-ended qualitative data-collection approach where respondents were allowed to speak for themselves, thus capturing respondents' views in their own words so increasing confidence that the interpretations of the information are consistent with the respondents' perspectives (Lauber, Decker & Knuth, 2008). The responses provided a glimpse of the social world of violators of resource-harvesting law and of the harvesters' points of view, as well as those of conservation officials who deal with the collectors (Eliason, 2004). Although the information garnered from surveys and interviews was not statistically analysed, primarily due to the small samples sizes, statistical analyses were conducted on data originating in the park's offence registers.

3.5 Statistical analyses

Statistical analyses were performed using Statistica 8. Quantitative data was expressed as means, percentages and frequencies. Spearman's non-parametric correlation coefficients were calculated to assess the relationships between variables. Spearman's correlation is more robust against outliers when compared to Pearson's product-moment method. The essence of these analyses was to determine if there were increases in confiscated resources over time. Time (year) was always one of the variables and the different resource measurements as the second variable. Calculated probability values served as grounds for rejection of the null hypotheses (no increases in confiscated resources over time).

3.6 Concluding remarks

The illegal nature of poaching poses distinctive methodological challenges and varies in scope and scale; therefore different types of illegal activity may require different methods of data collection (Gavin, Solomon & Blank, 2010). Few researchers have empirically compared estimates of illegal resource use collected through different methods, and none have conducted comprehensive research on marine resource harvesting in the TMNP. Mann (1995) concludes that direct questioning provides higher estimates of illegal take than those measured in enforcement records, which was reason for the inclusion of both techniques in this study. However, there is concern about the limitations of enforcement data which is biased by the restricted number of encounters that compliance and enforcement personnel have with poachers (Gavin, Solomon & Blank, 2010). This has implications for the study as only those events in which resource seizures occur are considered, thus limiting the true nature and scale of poaching in the TMNP to be revealed. Finally, enforcement records can be biased toward readily apparent violations, including illegal activities closer to enforcement headquarters and activities that poachers cannot conceal (Gavin, Solomon & Blank, 2010).

CHAPTER 4: THE PLIGHT OF A SEASNAIL – ABALONE CONFISCATIONS

This chapter examines the confiscations of the South African abalone (*Haliotis midae*) from the waters surrounding the TMNP over the study period. Fluctuations in amounts and weights of confiscated resources are compared across the ten-year period, and statistical analyses assess relationships between variables. Geographic anomalies are also plotted, to illustrate the success of resource seizures over the spatial scale of the park. Responses from surveys conducted among known abalone poachers provide primary data to ascertain the scale of abalone poaching in the TMNP. Management perceptions offered by park officials also contribute to the discussions offered in this chapter.

4.1 Introduction

Several international abalone fisheries have collapsed or are on the brink of collapse due to harvesting levels which are unsustainable and/or to increasing levels of IUU fishing for this high-valued resource (Raemaekers & Britz, 2009). TACs have been progressively decreased in almost every abalone fishery worldwide, with many countries with major abalone fisheries closing their fishery entirely (Karpov et al., 2000; Dowling, Hall & McGarvey, 2004; Rogers-Bennett, Allen & Davis, 2004; Heasman, 2006; Lessard & Campbell, 2007; Raemaekers & Britz, 2009). In South Africa, scientists have been warning of the potential collapse of the commercial abalone industry for a number of years due to a number of reasons, the primary one being illegal fishing of the resource (Tarr, 2000). The recreational fishery was closed indefinitely in 2003 following scientific recommendations that the current stocks could not cope with harvesting demands. Pressure from highly structured, illegal fishing practices preceded this date and surged since the 1990s and continues today in many parts of South Africa (Hauck & Sweijd, 1999; Tarr, 2000; Raemaekers & Britz, 2009), including in the TMNP. Moreover, the illegal exploitation of South African abalone is believed to be the most criminalised trade of African wildlife (TRAFFIC, 2007). Fortunately, considerable social, economic and natural scientific research has been conducted over the past two decades in attempts to understand the complexities of illegal fishing in the abalone fishery (Hector, 1995; Hauck, 1998; Tarr, 2000; Raemaekers & Britz, 2009; Raemaekers et al., 2011).

The rate of abalone poaching in South Africa, particularly in the Western Cape, appears to have reached epidemic proportions as it has evolved into an intensely organised international trade (Hauck & Kroese, 2006). Also, the South African abalone (*Haliotis midae*), known locally as 'perlemoen'[2], has been identified as one of the most difficult marine resources to manage (Branch & Clark 2006; Hauck, 2009; Liedeman 2009, pers com). This is a result of a combination of factors including the high value of the resource, environmental phenomena and the transformation of political processes which have attempted to redistribute amicable access rights (Hauck & Kroese, 2006). South African abalone are often found adjacent to areas with high levels of unemployment which makes the illegal industry and the product a viable and very lucrative income generator. When communities notice that their illegal activities derive benefit and the severity of punishment does not outweigh the benefits, poaching becomes attractive.

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[2] The word comes from the Dutch *Paarlemoer*, meaning mother-of-pearl.

The remainder of this chapter describes the species and the history of abalone harvesting in the Western Cape, and uncovers the historical numbers and weight of abalone appropriated during compliance and enforcement operations by analysing confiscations data maintained by officials of the TMNP during 2000 and 2009.

4.2 Species description

The South African abalone (*Haliotis midae*) (C. Linnaeus) is a marine snail from the class Gastropoda in phylum Mollusca (Middlebrook, 1999). About 70 abalone species have been described globally and all are placed in the family Haliotidae, in the genus *Haliotis* (Lindberg, 1992). South Africa has five endemic species of abalone but only one species (*H. midae*) is harvested commercially. *H. midae* inhabits shallow rocky reefs close to the shore. It is endemic to South Africa, found only from St Helena Bay on the west coast to the northern Transkei on the east coast (Figure 4.1).

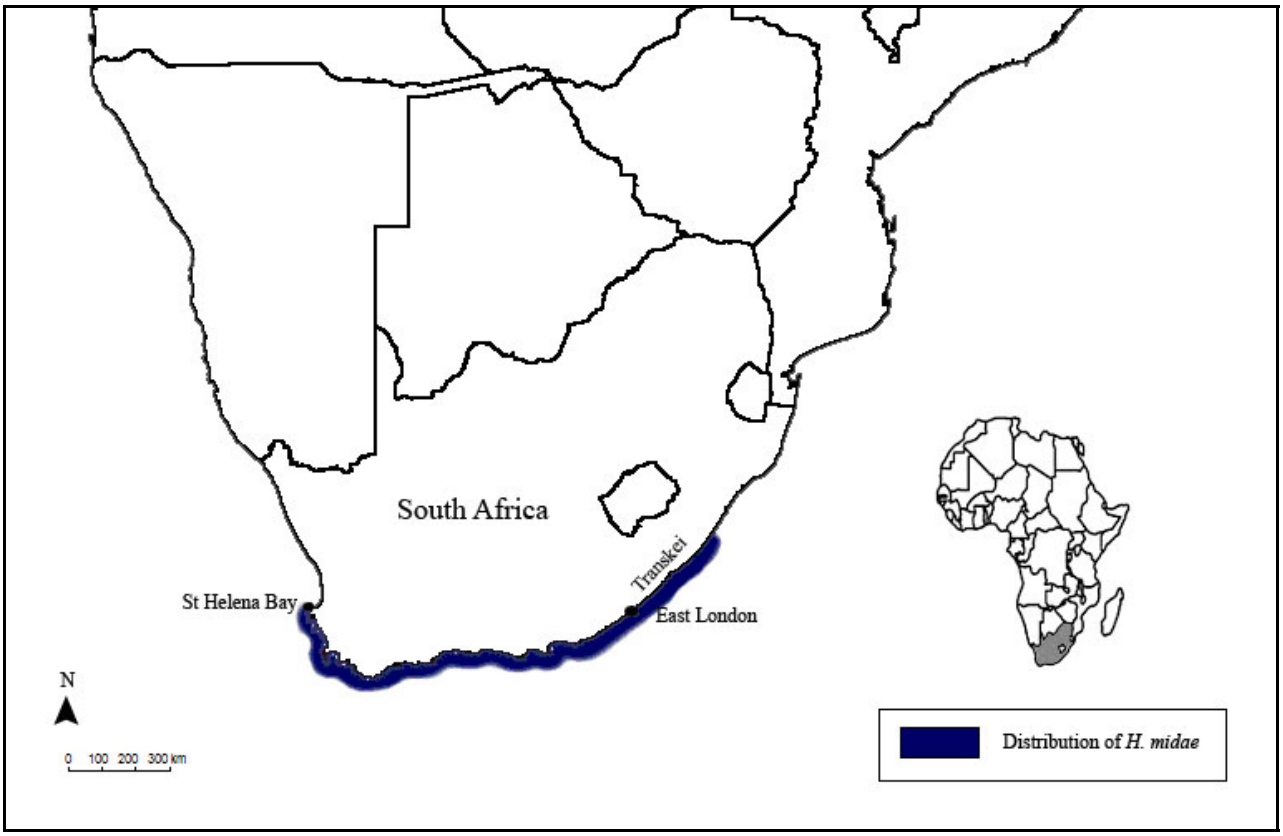

Figure 4.1: Distribution of *Haliotis midae* along the South African coast

H. midae reach a size of 230 mm shell width and are particularly long-lived, surviving for up to 30 years in the wild, although some species live for over 70 years (Smith, Stamm & Petrovic, 2003). *H. midae* grows incredibly slowly making them extremely vulnerable to overexploitation. They grow at a rate of less than 1 cm per year and take between eight to 10 years to reach sexual maturity (Steinberg, 2005).

The illegal harvesting of undersized abalone, coupled with the targeting of more easily accessible shallow-water populations, is significantly affecting a vital foundation of egg production (Tarr, 2000). Abalones are dioecious[3], spawning externally, often involving synchronised broadcast

[3] Dioecious means having the male and female organs in separate and distinct individuals.

spawning within the whole population (McShane, 1992). The larvae, known as veligers, undergo a period of free-swimming before settling on rocky reefs and growing into a miniature abalone (Middlebrook, 1999). The following section considers the history of abalone harvesting in the Western Cape.

4.3 History of harvesting of abalone

Harvesting of South African abalone dates to about 6000 years ago. A number of shell middens have been discovered in the coastal provinces of South Africa, indicating that abalone have been impacted on by nomadic fishers for thousands of years (Van Noten, 1974). It is however the contemporary issues arising in the last century that have had the most significant impact on abalone in the Western Cape.

South Africa's commercial and recreational abalone fishery in the Western Cape was once very stable (Tarr, 2000) after the commercial fishery started in 1949 (Steinberg, 2005). By the mid-1960s about 2800 tonnes of abalone were extracted annually. Signs that the South African abalone stock was being overexploited were detected by the late 1960s. In a bid to stem overexploitation and protect the resource, seasonal quotas were introduced in 1970 (Hauck, 2009). The first TAC was set at 700 tonnes and marginally and incrementally decreased over the next 25 years. By 1995 the annual quota was 615 tonnes (Tarr, 2003).

Acknowledging that the abalone fishery was under pressure, government introduced recreational permits in 1983 which led to more significant monitoring and control of this sector. Limitations were implemented, such as a personal daily allowance of five abalone and a minimum-size restriction of 114 mm shell breadth (Hauck, 2009). But the situation deteriorated considerably over time despite the numerous restrictions placed on harvesting. Since the mid-1990s traditional management processes which have attempted to sustain a rights-based fishery have been rendered increasingly ineffective due to widespread illegal fishing so that national stocks are now in a state of imminent collapse (Hauck, 2009).

Tarr (2000) and Steinberg (2005) have attributed the unprecedented rise of the illegal abalone trade in the 1990s to a number of factors, including the abolition of apartheid legislation in the early 1990s and the democratic transition in 1994; the poor exchange rate of the South African Rand against the U.S. dollar, which made the export price of abalone attractive; and weak border control which allowed the illegal product to be exported easily. In the mid-1990s the poaching frenzy evolved into the highly organised international trade that it is today with poaching expanding eastwards from the Western Cape along the south coast to the Eastern Cape, thus contributing to the large-scale decimation of the abalone stock (Steinberg, 2005; Raemaekers & Britz, 2009). Progressively, two types of illegal abalone fishing operations evolved: opportunistic, shore-based fishers with a small capital investment and weaker networks; and highly organised and experienced boat-based fishers with a high capital investment and efficient intelligence and marketing networks (Raemaekers & Britz, 2009). Finally, the existence of an organised Chinese crime network in South Africa encouraged the bartering of drugs and other illicit goods for abalone (Raemaekers & Britz, 2009). It is widely believed that Chinese Triads, as well as other national and international syndicates, are integrally involved in the illegal transnational abalone trade (Gastrow, 2001; Hauck & Kroese, 2006). The outcomes of this chapter and the results achieved from analyses of the TMNP seizure data cannot support contentions about the illicit abalone trade as this is outside of the scope of this study, but they will serve to enlighten resource managers to

the tip of the abalone-poaching problem that has occurred in the park over the decadal period of this study.

4.4 Analyses and interpretation of temporal abalone confiscations data

The results reported in this section refer to the data collected from TMNP offence registers for the period of this study. A quantitative data overview is presented, providing a background for abalone-related records. The numbers of abalone-related incidents over the ten-year period are reported, as well as seasonal patterns in confiscation events. The numbers and weights of abalone confiscated from fishers in TMNP between 2000 and 2009 are also presented. Statistical analyses indicate correlations in amounts and weights of abalone confiscated over time, while GIS graphics depict abalone-related offences over the spatial scale of the park over the decadal period.

4.4.1 Overview of quantitative data sources

The fishery data for this study was extracted from the TMNP's records of confiscated or abandoned abalone. Additional information was acquired from documents of the SAPS and MCM. The data used spans the period January 2000 to the end of December 2009. Records for years preceding these dates are inconclusive, sporadic and uninformative other than giving a date and the type of resource confiscated or abandoned. This substandard data has not been used. The records refer to de-shelled (shucked) and eviscerated or whole abalone (unshucked) in fresh or frozen state that were:

(i) Confiscated from recreational fishers;

(ii) Retrieved following abandonment by fleeing illegal fishers;

(iii) Found at sea by SANParks divers;

(iv) Washed ashore;

(v) Abandoned or concealed in coastal vegetation, rocks, kelp and drift wood; or

(vi) Confiscated during the arrest of suspected abalone poachers.

The results discussed below highlight fluctuations in abalone confiscations in the park between 2000 and 2009, recorded in recreational fishery catches prior to closure and in the commercial poaching operations said to be decimating local abalone populations.

4.4.2 Abalone-related incidents

No other research results are extant on illegal abalone harvesting in the TMNP, although investigations have attempted to quantify the impact of IUU abalone fishing in other areas of the Western Cape and South Africa by analysing the complex reasons for and drivers of the demise in the South African abalone fishery (Hauck & Sweijd, 1999; Hauck & Kroese, 2006; Raemaekers & Britz, 2009; Plagányi, Butterworth & Burgener, 2011). This section aims to contribute to a greater understanding of the illicit abalone fishery in the Western Cape, by looking at historical enforcement data in the TMNP.

Table 4.1 indicates the number of abalone-related incidents reported annually by the TMNP rangers and managers, and the percentage contribution of each yearly confiscation to the decade total. The highest number of confiscation events occurred in 2009 (n = 68), with the lowest number recorded in 2007 (n = 22). However, the percentage contributions of each year to the overall total

are more representative of the scale of abalone-related incidents over the study period. Proportions for only five years, namely 2000 (13.7%), 2001 (11.6%), 2005 (12.5%), 2008 (10.5%) and 2009 (15.5%) account for over 60% to the study period total of abalone confiscation events. There was a fairly even distribution of abalone confiscation incidents over the first half (47.4%) and latter five years (52.6%) of the study period. This result could infer that there has been a shift from recreational confiscations, to commercial poaching operation seizures, due to the closure of the recreational fishery in 2003. The total number of recorded abalone-related offences during this study period was 439, averaging 44 confiscation events annually.

Table 4.1: Abalone-related confiscation incidents in TMNP, 2000 to 2009

Year	Number of abalone confiscation incidents	Confiscations per year as percentage of decadal total
2000	60	13.7
2001	51	11.6
2002	27	6.2
2003	41	9.3
2004	29	6.6
2005	55	12.5
2006	40	9.1
2007	22	5.0
2008	46	10.5
2009	68	15.5
TOTAL	**439**	**100.0**

Even though there have been an increasing number of confiscation events since 2007, it is difficult to discern poaching patterns by merely looking at yearly figures. An improved analysis should come from looking at the temporal patterns of abalone confiscations in the TMNP, to note changes in the amount of resources seized monthly and over seasonal periods.

4.4.3 Monthly and seasonal patterns in abalone confiscations

To identify temporal patterns one must observe monthly abalone-related incidents (Table 4.2). Confiscation incidents over the ten-year period were highest for January (n = 66) and the lowest for October (n = 17). However, monthly statistics are less informative, and do not offer much value to resource management. Seasonal data is more valuable for compliance and enforcement operation design and implementation. To obtain seasonal patterns, one must combine the monthly totals that fall into the four seasons of the year (Table 4.3). Confiscation incidents are evenly spread throughout the seasons, with an average of 25% reported across these yearly quarters for the study period. The values for summer and autumn showed a combined percentage of 55.7%, indicating that a slightly greater number of incidents occurred during the months of November through April than over the cooler months (44.3%). This suggests that abalone poaching occurs throughout the year, although the conditions are more favourable in the warmer months. Calculations yielded a monthly average per season of 37.5 abalone-related offences.

To further support the occurrence distributions shown by the TMNP logbook entries, interviews were held with known abalone poachers, as well as officials from the TMNP. A sample of abalone poachers was surveyed to determine the perspectives of these illegal fishers. Of the 11 abalone poachers interviewed, only three (27%) govern their poaching activities by seasonal parameters, such as weather or sea conditions. This supports the supposition that poaching of this highly-treasured resource is not influenced by time of the year.

Table 4.2: Numbers and averages of abalone-related confiscations per month in the TMNP (decade 2000 - 2009)

Month	Number of confiscation events	Number of confiscations per month as percentage of decadal total	Average number of confiscation events per month
January	66	15.0	6.6
February	29	6.6	2.9
March	39	8.9	3.9
April	41	9.3	4.1
May	48	10.9	4.8
June	20	4.6	2.0
July	24	5.5	2.4
August	49	11.2	4.9
September	41	9.3	4.1
October	17	3.9	1.7
November	27	6.2	2.7
December	38	8.7	3.8
TOTAL	**439**	**100.1**	**43.9**

Table 4.3: Seasonal distribution of abalone-related confiscations in the TMNP (decade 2000 - 2009)

Season	Number of confiscation events	Number of confiscations per season as percentage of decadal total	Average number of confiscation events per month per season
Summer (Nov, Dec, Jan)	131	29.2	43.7
Autumn (Feb, Mar, Apr)	119	26.5	39.7
Winter (May, June, Jul)	92	20.5	30.7
Spring (Aug, Sept, Oct)	107	23.8	35.7
TOTAL	**439**	**100.0**	**37.5**

The park's rangers and management interviewed believe that abalone poaching takes place throughout the year, regardless of seasonal variations in daylight hours, temperature, wind or rough seas. They did however report that abalone poaching is conducted primarily at night, so as to avoid detection by enforcement operations. The agreement between the perceptions of poachers and officials about seasonal influences supports the findings in the logbooks, which indicates a fairly even distribution of resource impoundments throughout the seasonal periods. Seasonal trends are important considerations when designing management strategies and another expression of seasonality is the number of abalone and the weight of these resources confiscated from the waters surrounding the TMNP over time.

4.4.4 Number of abalone confiscated

This section looks at the amount of abalone seized annually and the nature of these confiscations. The objective is to determine whether there are discernible changes over time and to suggest reasons why these events occur. Records of abalone confiscations maintained in the TMNP logbooks indicate that abalone were seized from poachers as either shucked (without shell) or unshucked (in shell) (Table 4.4). The records for the first year of the study period show that over 90% of seized abalone had been removed from their shell. This proportion gradually decreased over the next five years. There was a considerable increase in the number of unshucked resource appropriated in the second half of the study period (n = 52 641) amounting to 78.6% of the decadal total.

Table 4.4: Numbers of shucked versus unshucked confiscated abalone, 2000 to 2009

Year	Number of shucked abalone confiscated	Percentage of shucked to annual total of confiscations	Number of unshucked abalone confiscated	Percentage of unshucked to annual total of confiscations	Annual total of all abalone confiscations
2000	3353	91.9	297	8.1	3650
2001	1291	61.0	826	39.0	2117
2002	850	36.0	1509	64.0	2359
2003	1142	33.0	2315	67.0	3457
2004	4292	31.3	9405	68.7	13 697
2005	1727	7.4	21 731	92.6	23 458
2006	2126	40.6	3116	59.4	5242
2007	728	13.8	4531	86.2	5259
2008	2686	28.8	6653	71.2	9339
2009	2695	14.0	16 610	86.0	19 305
TOTAL	**20 890**		**66 993**		**87 883**

The finding that unshucked abalone are confiscated in greater numbers was expected given the objective of abalone poachers is to obtain as many abalone as possible in a poaching operation. Contrarily, anecdotal responses by park officials suggest that many abalone poachers shuck their catch while diving to increase the number of abalone they can fit into a bag (Nortier 2009, pers com). The evidence in Table 4.4 appears to contradict such popular beliefs held by the park's staff.

Another objective of this chapter is to determine whether the number of abalone confiscated increased over the decadal period under review. Table 4.5 shows the number of abalone confiscated per year from fishers during the study period and the proportional contribution of each year to the decadal total. Small figures and percentages were noted for 2001 to 2003. Years 2004 and 2005 contributed 42.3% to the total abalone confiscations over the study period. An additional 32.6% was contributed by confiscations in 2008 and 2009. The first half of the decadal period yielded less than one third (28.8%) of the total amount of seized resources recorded in the park's logbooks. A substantial increase accounting for 71.2% of confiscations occurred in the latter five years under review, further supporting the conclusion that poaching operations outside of the recreational fishery are to blame for the greater share of abalone poaching in the TMNP. Spearman's rank nonparametric testing was done for the total amounts of abalone confiscated annually in the TMNP. A positive correlation of 0.70 ($p = 0.03$) suggests a high correlation between variables and a significant increase in the number of abalone removed in the park over time.

Although the numbers presented in Table 4.5 suggest that considerable amounts of abalone have been requisitioned from poachers operating in the TMNP waters, there are discrepancies between SANParks logbooks entries and records maintained by the SAPS. For example, the TMNP records for June 2008 to June 2009 total 7889 confiscated or abandoned abalone whereas the police had documented numbers of 10 150 abalone from TMNP waters being admitted into evidence over the same time. If this information is representative of the entire 10 years studied, then TMNP's records of commandeered abalone appear to be over 20% short of what is being reported by the SAPS.

Table 4.5: Numbers of all abalone confiscated in the TMNP, 2000 to 2009

Year	Number of abalone confiscated	Number of confiscations per year as percentage of decadal total
2000	3650	4.2
2001	2117	2.4
2002	2359	2.7
2003	3457	3.9
2004	13 697	15.6
2005	23 458	26.7
2006	5242	6.0
2007	5259	6.0
2008	9339	10.6
2009	19 305	22.0
TOTAL	**87 883**	**100.1**

To gain further clarity on the nature and scale of abalone requisitions, a comparison of MCM's confiscations data with that of SANParks allows one to calculate the percentage contribution of impounded abalone originating within TMNP (Table 4.6). Over the period (2000 to 2009) abalone from the waters surrounding the TMNP amounted to 1.2% of the total abalone confiscations recorded by MCM nationally, and 1.7% of resources seized in the Western Cape. Each year over the decadal period showed a TMNP percentage contribution of less than 5% for both the provincial and national totals. Clearly, numbers of expropriated abalone originating in the waters surrounding the TMNP are small compared to the Western Cape and national confiscations. Whether enforcement operations outside the park's boundaries result in more confiscations in those areas or whether the poachers are avoiding detection within the park is moot. Given that the WCRL confiscations reported by SANParks are 22.3% lower than official records held by the SAPS, one can assume that the overall contribution of abalone seized in the park will be greater than presented in this research.

Table 4.6: Numbers of abalone confiscated by MCM and SANParks, 2000 to 2009

Year	Number of abalone confiscated from the TMNP (SANParks)	Number of abalone confiscated in Western Cape (MCM)	TMNP confiscations as percentage of Western Cape confiscations	Number of abalone confiscated nationally (MCM)	TMNP confiscations as percentage of MCM national confiscations
2000	3650	296 282	1.2	335 478	1.1
2001	2117	398 085	0.5	443 440	0.5
2002	2359	844 728	0.3	956 894	0.3
2003	3457	633 743	0.5	731 604	0.5
2004	13 697	604 811	2.3	755 005	1.8
2005	23 458	495 174	4.7	688 420	3.4
2006	5242	1 002 261	0.5	1 163 804	0.5
2007	5259	802 684	0.7	907 899	0.6
2008	9339	469 778	2.0	561 061	1.7
2009	19 305	522 283	3.7	611 354	3.2
TOTAL	**87 883**	**5 077 768**		**7 154 959**	

Source: Marine and Coastal Management (2010)

Although it was imperative to determine the volume of abalone seized over the study period, a further component of the third objective was to find out whether there was an increase in the weight of abalone confiscated over the ten-year period. The following discussion looks at the weight of abalone resourced seized over time.

4.4.5 Weight of abalone confiscated

Apart from examining the numbers of abalone requisitioned from fishers operating in the TMNP over the last decade, the study aimed to determine the weight of the abalone removed. This objective hopes to establish whether there are considerable changes in the weight of resources seized over the duration of the study period. To translate the numbers of abalone into a weight measure, conversion ratios supplied by MCM and those used by Raemaekers & Britz (2009) were used to convert the numbers of abalone seized per year into a weight equivalent. These conversion ratios are based on average abalone size relative to weight. The data was generated by MCM's research teams for each year of the study period.

Perusal of the table of conversion ratios (Table 4.7) evidences declines in the conversion ratios in 2006 to 2009. MCM researchers noted a distinct decrease in the size of abalone found along the coast, and thus had to alter the weight:size conversion ratios accordingly. Table 4.7 also shows the calculated weight following the conversion of the numbers of abalone seized per annum by their respective yearly ratios. The weight of shucked abalone averaged 341 kg per annum, while the average annual weight of unshucked resources measured 3514 kg, a mass that is ten-fold higher. The weight difference is expected given the contribution of the shell to the weight of unshucked resources, but the margin of difference between the shucked and unshucked resources is larger than expected. Additionally, Spearman's correlation coefficient was highly positive ($r = 0.77$) and significant ($p = 0.01$) for the total weight of abalone removed annually from the park. This infers that there was a significant increase in the weight of resources commandeered from poachers over the decadal period.

Table 4.7: Numbers of confiscated shucked and unshucked abalone, conversion ratios and weight calculations, 2000 to 2009

Year	Shucked			Unshucked		
	Number of abalone seized	Conversion ratio: (kg)	Weight of abalone (kg)	Number of abalone seized	Conversion ratio: (kg)	Weight of abalone (kg)
2000	3353	0.12	402.4	297	0.36	106.9
2001	1291	0.17	219.5	826	0.52	429.5
2002	850	0.14	119.0	1509	0.41	618.7
2003	1142	0.16	182.7	2315	0.47	1088.1
2004	4292	0.18	772.6	9405	0.55	5172.8
2005	1727	0.20	345.4	21 731	0.59	12 821.3
2006	2126	0.18	382.7	3116	0.54	1682.6
2007	728	0.17	123.8	4531	0.52	2356.1
2008	2686	0.17	456.6	6653	0.51	3393.0
2009	2695	0.15	404.3	16 610	0.45	7474.5
TOTAL	**20 890**		**3409.0**	**66 993**		**35 143.5**

Table 4.8 contains the percentage contributions of shucked and unshucked abalone weights, compared to the annual combined weights of confiscated abalone resources. These figures are more representative of the scale of abalone confiscations over time, as they describe the poaching problem more accurately. The surprisingly high percentage (79%) of shucked abalone

confiscations in 2000 is an anomaly as in every other year in the decade studied the unshucked resources dominate impoundments. This anomaly could be explained by enforcement officials targeting the commercial fishers in 2000. The fishers in this sector tended to shuck their catch (Nortier 2009, pers com).

Table 4.8: Weight of shucked and unshucked abalone, 2000 to 2009

Year	Weight of shucked abalone	Percentage of shucked weight to annual total of all abalone	Weight of unshucked abalone	Percentage of unshucked weight to annual total of all abalone	Annual total of combined confiscated abalone weight	Weight of confiscations per year as percentage of decadal total
2000	402.4	79.0	106.9	21.0	509.3	1.3
2001	219.5	33.8	429.5	66.2	649.0	1.7
2002	119.0	16.1	618.7	83.9	737.7	1.9
2003	182.7	14.4	1088.1	85.6	1270.8	3.3
2004	772.6	13.0	5172.8	87.0	5945.4	15.4
2005	345.4	2.6	12 821.3	97.4	13 166.7	34.2
2006	382.7	18.5	1682.6	81.5	2065.3	5.4
2007	123.8	5.0	2356.1	95.0	2479.9	6.4
2008	456.6	11.9	3393.0	88.1	3849.6	10.0
2009	404.3	5.1	7474.5	94.9	7878.8	20.4
TOTAL	**3409.0**	**8.8**	**35 143.5**	**91.2**	**38 552.5**	**100.0**

From 2000 to 2004 the average annual contribution of shucked abalone amounted to 31.3%, and decreased to 8.6% in the second half of the study period. Unshucked resources averaged 68.7% during the first five years of the 10-year period and increased to 91.4% in the second half of the period. These changes suggest that abalone poachers became more inclined over the study period to take unshucked resources, as there is the probability of removing more unshucked resources in a diving period than if divers shucked abalone catch underwater. It is noteworthy that though the sizes of abalone are decreasing as per their respective conversion ratios, quite likely due to the sheer numbers of abalone removed, the total weight has been increasing. This implies that poachers are removing greater quantities of smaller abalone.

In addition to the logbook data maintained by the TMNP, survey data was collected from abalone poachers (n = 11) to measure their perceived catches in tonnage per annum. An annual total of 27 tonnes was estimated to be removed from the marine reserves surrounding the TMNP, averaging 2.5 tonnes per annum per respondent. Discussions with park officials concluded that rangers and managers believe that as much as 108 tonnes of abalone are poached annually from inside the TMNP yearly. This estimate by the park's officials far exceeds those indicated in the logbook entries, which suggests that the rangers and managers are experiencing a different situation in the field, compared to what is being reported in confiscation statistics. This may very well be the case, as the chances of getting caught are very small according to officials responsible for enforcement. Moola (2009 pers com) alleges that there is only a 10% confiscation rate of poached abalone , although others claim that law-enforcement agencies only seize about 5% of the illegal abalone catch (Raemaekers & Britz, 2009).

Many poachers apprehended are also repeat offenders (Nortier 2009, pers com), with many of them stemming from defunct commercial operations. It would therefore be worthwhile for

government to focus enforcement operations on garnering the support from these individuals so as to create policy that is more representative of the nature of the commercial abalone fishery. Further, there have been numerous political and enforcement operations taken place in the Western Cape over the decadal period of this study. Each of these events has played a pivotal part in encouraging or discouraging abalone poaching in the TMNP and these would most likely be reflected in the confiscations data recorded by SANParks.

4.4.6 Antipoaching operations and actions

Over the 10-year period under review much has happened in the political systems that govern fisheries management in South Africa. Added to this is the transformation in the industry itself, and countless socio-economic and environmental factors that have impacted on the nature and extent of illegal harvesting of abalone. This section looks at the changes that occurred within social and political systems in the Western Cape, and suggests how these developments could have altered the poaching landscape in the TMNP, thus affecting the confiscations data reported in this study.

In the Western Cape, with the legal commercial fishery at stake, several large-scale law-enforcement operations were designed over the years to combat illegal abalone fishing (Hauck & Sweijd, 1999; Herbig & Joubert, 2002; Hauck & Kroese, 2006). However, implementation of these operations has been fragmented, uncoordinated, largely reactive and, above all, unsustained (Raemaekers & Britz, 2009). The following discussion of these operations is divided into four intervals, namely the 2000-1, 2002-4, 2005-6 and 2007-9 periods.

(i) *2000 to 2001: Operation Neptune*. Operation Neptune, a collaboration between the SAPS and MCM, was implemented in the 2000/2001 fishing season. The operation's objectives were twofold. First, the intention was to increase police presence, making the environment difficult for poachers to operate in, and second, to crack down on existing gangs and groups known to be involved in poaching by collecting evidence and ultimately arresting and jailing those involved (Steinberg, 2005). During Neptune's first year in operation, the number of abalone confiscated nationally increased threefold, and then increased substantially during the following two years (Steinberg, 2005). Yet, if the aim of Neptune was to deter poachers, these figures are not heartening at all. Indeed, they suggest that the total illicit catch continued to increase annually, despite significant confiscations. But was this the case, or were enforcement operations improving to the point where more poachers were getting caught, as opposed to more resources being illegally removed? The figures presented in Table 4.1 show a decline in the number of poaching incidents in the TMNP (60 to 51) in this period too, which could show that Operation Neptune swayed the minds of would-be poachers. The total number of abalone confiscated also declined from 2000 to 2001 (Table 4.4), but increased thereafter. Curbing the illegal harvesting of abalone in South Africa has been successfully attempted through means other than law enforcement and compliance. In 2001 the South African government took the bold step to include known poachers of abalone in its regulatory framework by allocating poachers and legal divers commercial harvesting rights which were valid for two years, in a bid to determine a long-term strategy to recover abalone stocks (Hauck, 2009).

(ii) *2002 to 2004: TURF and environmental courts*. Between 2002 and 2003 abalone divers were invited by the government regulator, MCM, to advise it on the design of a long-term strategy and policy for abalone management. The product was a policy premised on the territorial user rights in fisheries (TURF) format (Christy, 1996; Caddy, 1999; Castilla & Defeo, 2001; Hauck, 2009;

Plagányi, Butterworth & Burgener, 2011). The TURF policy, introduced in 2003, allowed the allocation of commercial abalone fishing rights for 10 years to abalone divers who were each allocated a proportion of the TAC that was determined for their geographically-defined TURF area (Hauck, 2009). Government hoped that these long-term access rights would provide incentives for sustainable use of the resource (Plagányi, Butterworth & Burgener, 2011). Unfortunately, this was too little too late, as the illegal fishing operations had already become firmly entrenched by that stage (Plagányi, Butterworth & Burgener, 2011).

However, faced with a mandate to set sustainable TACs, the ever-increasing illegal catches meant that when total extractions were taken into account in the assessment model, there was a decreasing amount of abalone available for allocation to other sectors (Plagányi, Butterworth & Burgener, 2011). The recreational fishery was the first to suffer the consequences, and was closed indefinitely in 2003. In addition to the closure of the recreational industry was the promulgation of the Protected Areas Act (No. 57 of 2003) which afforded the TMNP MPA further protection status. This could also be a reason for an increase in the number of confiscations and resources seized in 2003.

A further government action set out to target the rampant poaching problem, was the formation of the MARINES (Management Action for Resources of Inshore and Nearshore Environments), which were special groups of municipal marine conservationists that took on poaching at a more localised scale. The teams were tasked with cracking down on illegal commercial poaching operations (Liedeman 2009, pers com). The MARINES were seen to be complementary to the teams residing under Operation Neptune.

The final weapon in the anti-poaching arsenal was the formation of the first environmental court, set up in 2003 in Hermanus by DEAT and the Department of Justice and Constitutional Development. In its first year this court was very successful, with a 70% success rate for abalone poaching convictions (Moola 2009, pers com). Prior to the two departments setting up the environmental court, the success rate in prosecuting marine-related offences hovered near the 10% mark as these cases would have easily gone on for a period of two years before being finalised in normal courts.

The closure of the recreational fishery in 2003, coupled with the new legislation and enforcement units, did anything but curb poaching. The opposite happened, with a spate of confiscations coming from the park when compared to 2002. Over 80% of the TMNP records were for recreational fishers, in possession of single abalone, who claimed to be unaware of the closure of the fishery. Many recreational fishers and full-time poachers still managed to avoid detection because too few enforcement and compliance officials from MCM were deployed in the field (Liedeman 2009, pers com; Nortier 2009, pers com).

There was a decrease in the number of abalone offences recorded in the registers spanning 2003 to 2004, possibly due to the closure of the recreational fishery and/or the formation of the environmental courts in Hermanus. Contrarily, the number of abalone confiscated or found abandoned increased almost fourfold partly due to a major bust of a known abalone-poaching syndicate in 2004 (Oosthuizen 2009, pers com). Over this period it is said that there was an increase in the efficiency of poaching and surveillance technology used by poachers (Liedeman 2009, pers com; Nortier 2009, pers com). This meant that illegal abalone fishers spent less time at sea, got more abalone per trip, and were less likely to be apprehended by law enforcers.

Compounding this was the cessation of Operation Neptune in December 2004, which markedly reduced police presence.

(iii) *2005 to 2006: Marine protected areas*. In recognising their capacity and resource constraints, MCM began delegating compliance authority to other institutions (Hauck, 2009). This is the case of the TMNP MPA where SANParks was contracted to undertake fisheries compliance in the MPA in 2005 (Hauck, 2009). Since then, management arrangements have been effected by the promulgation of the Protected Areas Act which states that "marine and terrestrial protected areas with common boundaries must be managed as an integrated protected area by a single management authority" (Section 38(4)) (Hauck, 2009). The initial memorandum of understanding to enhance fisheries compliance in the TMNP MPA was an important development in intensifying visibility of officers along the Cape Peninsula. Thus, the TMNP management established a Marine Rangers Section in March 2005 which was operational under a two-year contract to MCM (Hauck, 2009). The Marine Unit is tasked with enforcing the Marine Living Resources Act, the National Environmental Management Act, and the National Parks Act. The unit also acts as a channel for engaging with the public while on patrol, and providing access to general marine information at the Signal School Offices (Standish & Boting, 2006). Their mandate was to ensure fisheries compliance in the MPA and to produce the required statistics achieved through arrests and confiscations (Hauck, 2009). The problem with this approach was that senior personnel believed it more important to keep the resources in the sea and make a presence felt along the coast than justify to MCM that their objectives in arrests and confiscations were being met (Hauck, 2009).

Moreover, during this time the TURF strategy floundered and poaching rapidly increased by 2005 as DEAT suddenly decided to end all funding for the environmental courts, which then closed (Hauck, 2009; Moola 2009, pers com). DEAT also put an immediate stop to the MARINES unit and suspended all investigations into Triad and other high-profile gang involvement in the illegal trade in abalone. By the end of 2005 and again at the end of 2006, it was understood that approximately one million units of abalone were illegally harvested in South Africa, compared with the estimated 400 000 to 500 000 units that were believed to have been poached during 2003 and 2004 (Hauck, 2009). A surge in abalone-related offences in the park occurred in 2005 and the largest number (23 458) of abalone confiscated in any one year over the study period was reported. Whether these events were due to the halting of government entities, or whether the efficacy of the new marine section in TMNP structures assisted with a number of high profile-busts, is debatable.

(iv) *2007 to 2009: Convention on International Trade in Endangered Species (CITES) and commercial abalone fisheries, off/on/off*. In May 2007 the South African government was granted Appendix III listing for *Haliotis midae*, which required all international trade consignments of South African abalone to be accompanied by CITES documentation. A CITES Appendix III is a list of species included at the request of a CITES member country that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation (Damania & Bulte, 2007). International trade in specimens of species listed in Appendix III is allowed only on presentation of the appropriate permits or certificates. CITES parties can unilaterally list a species in Appendix III at any time (Damania & Bulte, 2007). Burgener (2009b, pers com) believes that the CITES listing had the potential to reduce the illegal harvesting and trade of abalone in South Africa and it could potentially enhance the sustainability of the resource stocks.

Additionally in mid-2007, it was announced that government was considering closing the commercial abalone fishery should the resource not recover from unprecedented levels of poaching (Hauck, 2009). At the end of October 2007, a week before the fishing season was to commence, DEAT announced the suspension of the commercial abalone fishery indefinitely (Hauck, 2009). The abalone industry proceeded with court action the following week to obtain an urgent interdict to prevent the suspension (Moola 2009, pers com). Realising that a fatal legal error had been made by his department by not consulting with the abalone fishing industry, the minister announced on 31 October 2007 that the commercial abalone fishery would not be suspended and that 75 tonnes of abalone could be harvested until the end of January 2008 (Hauck, 2009).

Commercial catches were gradually phased down until the commercial fishery was suspended (Raemaekers & Britz, 2009). Industry representatives consistently argued against cutting their legal quota in synchrony with increases in illegal catches, perceiving such cuts as merely translating into increased numbers of abalone becoming available to the illegal sector (Plagányi, Butterworth & Burgener, 2011). The closure of the commercial abalone industry has compounded the issue of abalone poaching, as the ex-commercial abalone fishers have little alternative but to poach, given that they have little recourse to alternative fishing opportunities (Nortier 2009, pers com). Access to markets, the number of trained individuals, high-tech equipment and "the will to piss off government" are all fuel to the fire (Moola 2009, pers com). Some researchers even charged that closing the fishery was a failure in management and governance (Britz 2009, pers com).

Further, in June 2010 the South African government made the decision to delist *H. midae*, thus removing its protection status offered by the CITES convention a deed which scholars and conservationists have slated as effectively retrograding South Africa to the historic circumstances in which government had to tackle uncontrolled and highly organised illegal abalone harvesting and trade on its own. The decision to delist *H. midae* is perplexing given a wildlife product which is almost wholly exported to international markets in excessive volumes of illegal trade.

The study not only shows an increase in the number of offences occurring in 2007 to 2009 (Table 4.1), but also the volume of abalone being removed. The second highest number of seized and abandoned abalone was recorded in 2009 intimating that poaching was escalating. Newspaper reports during the ten-year period confirm that there has been a substantial increase in not only the number of poaching incidents and confiscations, but also in the number of resources seized by various law-enforcement authorities (Independent Online Limited, 2000; 2001a; 2001b; 2006a; 2006b; 2006c; 2006d; 2006e; 2006f; 2006g; 2006h; 2006i; 2007a; 2007b; 2007c; 2008; 2009a; 2009b; 2009c; 2009d; 2009e; Ajam, 2003; Christians, 2003; Damon, 2003; Gosling, 2003; 2004; 2008; 2009a; 2009b; Shlensky, 2006; Barnes, 2007; Hawker, 2007; Bailey, 2008; Dolley, 2009; Gosling & McKune, 2009; McKune, 2009; Yeld, 2009). Although the temporal data and reports suggest rampant poaching, an important consideration for resource managers and enforcement agencies is the spatial extent of abalone impoundments over time. From this perspective, one can note the success of compliance and enforcement operations geographically, which can further enhance future policies and practices.

4.5 GIS analyses and interpretation

This section considers the spatial component of abalone confiscations in the TMNP between 2000 and 2009. The data used in the temporal analyses was georeferenced in Arcview 9.3 to graphically plot abalone seizures over the area of the park to determine where enforcement successes have

taken place. An annual overview is presented here to indicate the areas where abalone was appropriated or found abandoned and the number of resources seized each year. Following this, each area is measured against the decadal total to determine the number of confiscations and resources seized at each point in the park over time. Finally, an annual assessment was undertaken to determine the year-on-year figures for confiscations across the spatial extent of the park. Only abalone confiscation incidents with area-specific details are discussed, thus not all of the abalone-related confiscations over the study period are plotted. Table 4.9 lists the numbers and percentages of incidents and abalone confiscations at particular locations in the park per year. Figures 4.2 and 4.3 illustrate the incidents recorded in Table 4.9.

Table 4.9: Areas where abalone seizures occurred and numbers and percentages of resources seized in the TMNP, 2000 to 2009

Year	Area where abalone confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of abalone confiscated	Number of abalone seized per area as percentage of annual total
2000	Black Rock	1	2.2	4	0.3
	Bluegums	5	10.9	31	2.2
	Bordjiesdrif	1	2.2	12	0.9
	Buffels Bay	2	4.3	14	1.0
	Cape Point	12	26.1	943	66.9
	Castle Rock	1	2.2	4	0.3
	Froggy Pond	1	2.2	4	0.3
	Glencairn	2	4.3	7	0.5
	Millers Point	2	4.3	119	8.4
	Partridge Point	2	4.3	12	0.9
	Simon's Town	5	10.9	111	7.9
	Smitswinkel Bay	10	21.7	136	9.6
	Soetwater	1	2.2	1	0.1
	White Sands	1	2.2	12	0.9
SUBTOTAL		**46**	**100.0**	**1410**	**100.2**
2001	Bordjiesdrif	1	3.6	5	0.9
	Boulder's Beach	4	14.3	30	5.2
	Buffels Bay	2	7.1	48	8.3
	Cape Point	11	39.3	113	19.6
	Castle Rock	2	7.1	60	10.4
	Glencairn	1	3.6	2	0.3
	Millers Point	4	14.3	207	35.9
	Smitswinkel Bay	2	7.1	101	17.5
	Venus Pools	1	3.6	11	1.9
SUBTOTAL		**28**	**100.0**	**577**	**100.0**
2002	Bordjiesdrif	3	14.3	387	18.3
	Buffels Bay	2	9.5	379	18.0
	Castle Rock	2	9.5	204	9.7
	Millers Point	3	14.3	222	10.5
	Partridge Point	1	4.8	63	3.0
	Scarborough	1	4.8	2	0.1
	Simon's Town	3	14.3	52	2.5
	Smitswinkel Bay	3	14.3	770	36.5
	St James	1	4.8	3	0.1
	Venus Pools	1	4.8	5	0.2
	White Sands	1	4.8	23	1.1
SUBTOTAL		**21**	**100.2**	**2110**	**100.0**

Continued overleaf

Table 4.9 continued

Year	Area where abalone confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of abalone confiscated	Number of abalone seized per area as percentage of annual total
2003	Black Rock	1	3.3	63	2.7
	Bluegums	2	6.7	432	18.4
	Bordjiesdrif	2	6.7	40	1.7
	Buffels Bay	2	6.7	152	6.5
	Cape Point	3	10.0	47	2
	Castle Rock	2	6.7	75	3.2
	Glencairn	2	6.7	174	7.4
	Hout Bay	1	3.3	8	0.3
	Kommetjie	1	3.3	1	0
	Millers Point	3	10.0	171	7.3
	Scarborough	1	3.3	3	0.1
	Silvermine I	2	6.7	328	14
	Simon's Town	6	20.0	376	16
	Smitswinkel Bay	2	6.7	480	20.4
SUBTOTAL		**30**	**100.1**	**2350**	**100.0**
2004	Bordjiesdrif	2	8.3	3173	30.3
	Cape Point	3	12.5	23	0.2
	Glencairn	2	8.3	57	0.5
	Koeël Bay	1	4.2	27	0.3
	Millers Point	5	20.8	630	6.0
	Partridge Point	1	4.2	170	1.6
	Redhill I	1	4.2	297	2.8
	Rooikrans	1	4.2	79	0.8
	Scarborough	1	4.2	132	1.3
	Simon's Town	5	20.8	5565	53.2
	Smitswinkel Bay	1	4.2	248	2.4
	St. James	1	4.2	64	0.6
SUBTOTAL		**24**	**100.1**	**10 465**	**100.0**
2005	Bluegums	1	2.1	237	1.1
	Bordjiesdrif	1	2.1	19	0.1
	Buffels Bay	3	6.2	202	0.9
	Cape Point	6	12.5	1409	6.3
	Castle Rock	2	4.2	229	1.0
	Glencairn	6	12.5	17 726	79.4
	Hout Bay	1	2.1	8	0.0
	Kalk Bay	1	2.1	84	0.4
	Kommetjie	1	2.1	1	0.0
	Meadows	2	4.2	110	0.5
	Millers Point	4	8.3	594	2.7
	Oceanview I	1	2.1	126	0.6
	Partridge Point	3	6.2	400	1.8
	Scarborough	1	2.1	1	0.0
	Simon's Town	11	22.9	1161	5.2
	Soetwater	2	4.2	2	0.0
	St. James	2	4.2	27	0.1
SUBTOTAL		**48**	**100.1**	**22 336**	**100.1**
2006	Black Rock	1	2.8	22	0.4
	Bordjiesdrif	2	5.5	269	5.4
	Cape Point	4	11.1	221	4.4
	Castle Rock	1	2.8	157	3.1
	Granger Bay	1	2.8	118	2.4

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Table 4.9 continued

Year	Area where abalone confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of abalone confiscated	Number of abalone seized per area as percentage of annual total
2006	Hout Bay	2	5.5	254	5.1
	Kalk Bay	2	5.5	340	6.8
	Kommetjie	1	2.8	16	0.3
	Millers Point	4	11.1	350	7.0
	Milnerton *	1	2.8	131	2.6
	Oceanview I	1	2.8	168	3.4
	Rooikrans	2	5.5	174	3.5
	Sandy Bay	2	5.5	16	0.3
	Simon's Town	3	8.3	53	1.1
	Smitswinkel Bay	5	13.9	339	6.8
	Soetwater	1	2.8	21	0.4
	St James	1	2.8	2313	46.2
	Sunny Cove	1	2.8	25	0.5
	Venus Pools	1	2.8	22	0.4
SUBTOTAL		**36**	**99.9**	**5009**	**100.1**
2007	Black Rock	1	5.9	75	1.8
	Bordjiesdrif	1	5.9	57	1.3
	Buffels Bay	1	5.9	1	0.0
	Cape Point	1	5.9	3400	79.7
	Castle Rock	1	5.9	129	3.0
	Glencairn	3	17.6	60	1.4
	Granger Bay	1	5.9	33	0.8
	Hout Bay	1	5.9	1	0.0
	Kalk Bay	1	5.9	5	0.1
	Millers Point	1	5.9	85	2.0
	Partridge Point	2	11.8	204	4.8
	Scarborough	1	5.9	131	3.1
	Sea Point	1	5.9	44	1.0
	Simon's Town	1	5.9	39	0.9
SUBTOTAL		**17**	**100.2**	**4264**	**99.9**
2008	Bordjiesdrif	2	4.7	537	7.3
	Buffels Bay	2	4.7	212	2.9
	Cape Point	7	16.3	2396	32.7
	Castle Rock	3	7.0	167	2.3
	Hout Bay	1	2.3	35	0.5
	Kalk Bay	2	4.7	53	0.7
	Koeël Bay	1	2.3	92	1.3
	Millers Point	6	14.0	1185	16.1
	Milnerton *	1	2.3	5	0.1
	Muizenberg	1	2.3	21	0.3
	Partridge Point	2	4.7	166	2.3
	Redhill I	1	2.3	1069	14.5
	Scarborough	1	2.3	11	0.2
	Simon's Town	5	11.6	451	6.2
	Smitswinkel Bay	6	14.0	909	12.4
	White Sands	2	4.7	24	0.3
SUBTOTAL		**43**	**100.2**	**7333**	**100.1**
2009	Black Rock	3	5.4	1302	8.4
	Bordjiesdrif	7	12.5	2206	14.2
	Buffels Bay	7	12.5	4601	29.7
	Cape Point	5	8.9	985	6.4

Continued overleaf

Table 4.9 continued

Year	Area where abalone confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of abalone confiscated	Number of abalone seized per area as percentage of annual total
2009	Castle Rock	2	3.6	38	0.2
	Glencairn	2	3.6	29	0.2
	Kalk Bay	2	3.6	171	1.1
	Kommetjie	2	3.6	9	0.1
	Melkbosstrand *	1	1.8	2102	13.6
	Muizenberg	2	3.6	2	0.0
	Redhill I	1	1.8	377	2.4
	Scarborough	3	5.4	42	0.3
	Simon's Town	10	17.8	489	3.2
	Smitswinkel Bay	6	10.7	2768	17.9
	Soetwater	1	1.8	7	0.0
	Venus Pool	2	3.6	359	2.3
SUBTOTAL		**56**	**100.2**	**15 487**	**100.0**
TOTAL		**349**	**100.1**	**71 341**	**100.0**

Notes: I = inland; * = area not neighbouring TMNP

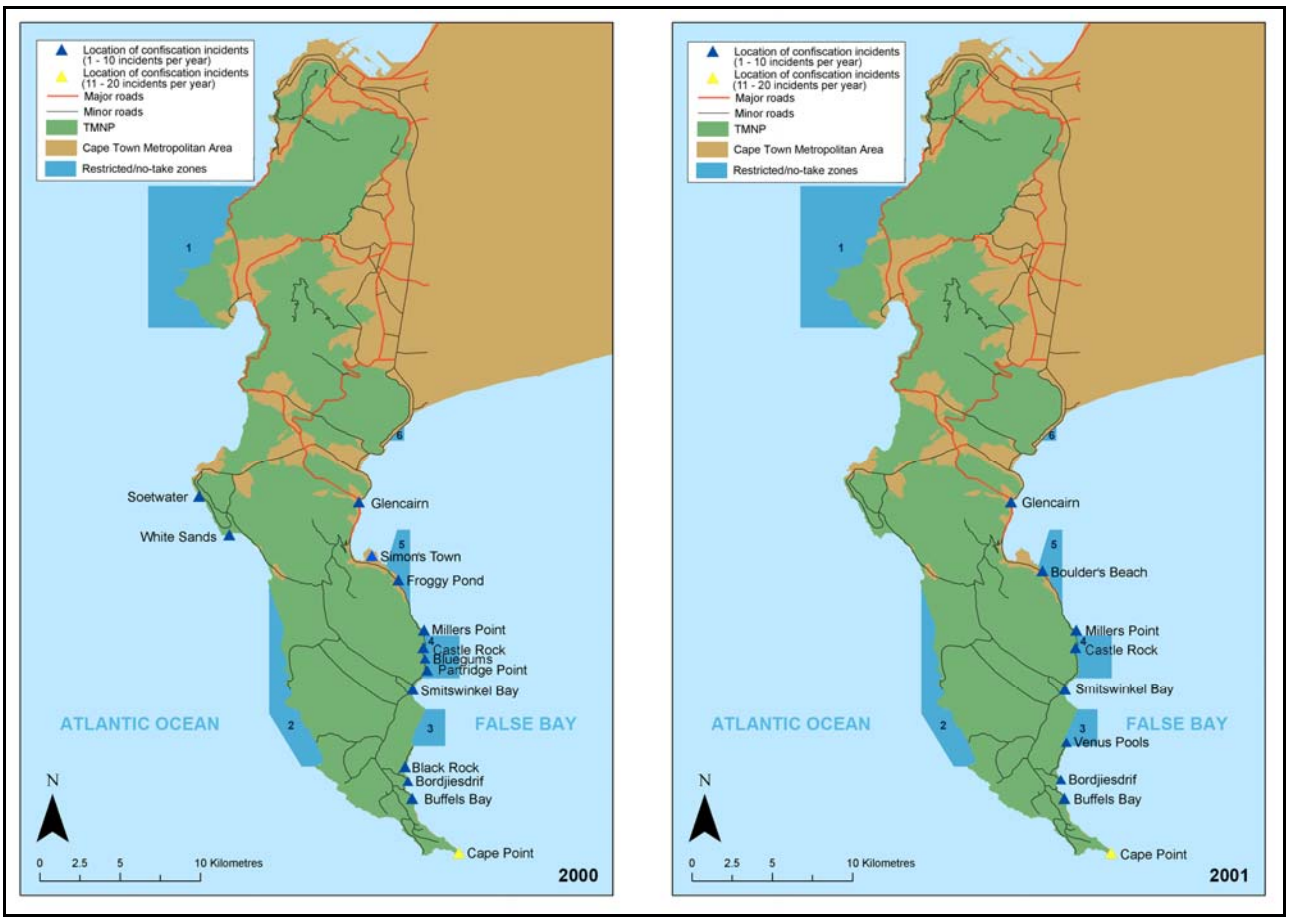


Figure 4.2: Abalone seizure incidents in the TMNP, 2000 and 2001

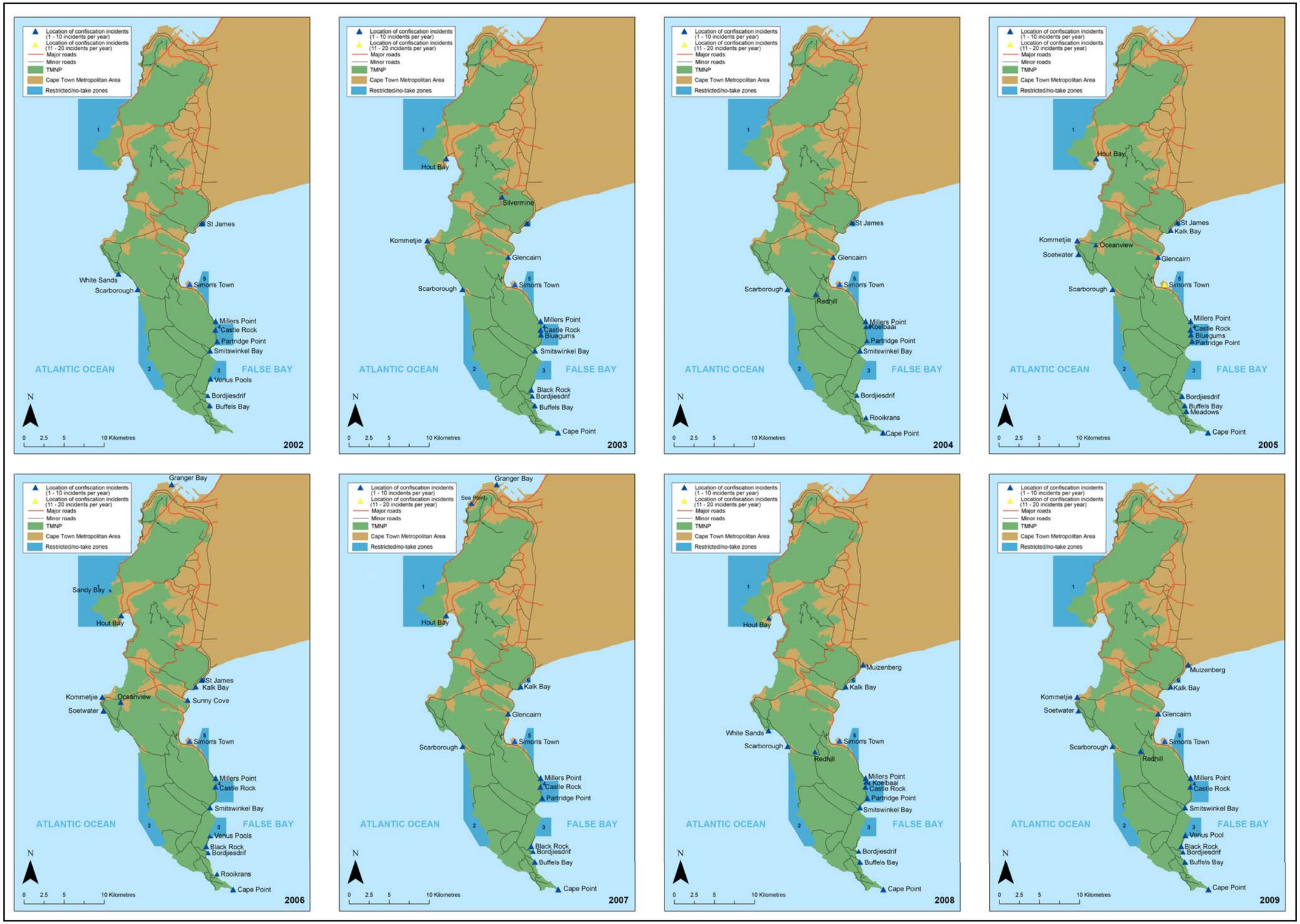


Figure 4.3: Abalone seizure incidents in the TMNP, 2002 to 2009

Some incidents occurred outside of the Peninsula but are reported. During the first half of the study period, there were 149 incidents occurring in 60 areas. The latter half of the year showed greater numbers with 200 incidents occurring in 82 locations. The average number of areas and numbers of incidents per year between 2000 and 2004 was 12 and 30 respectively, while for the latter half of the study period these values increased to 16 and 40 respectively. On average, 114 abalone were seized per incident between 2000 and 2004, although only 38% of the annual total recorded during this time equalled or exceeded this value. This average increased to 272 over the latter half of the ten-year period, with 30.5% of entries being equal to or larger than the average.

The annual totals of areas in which confiscations took place and the number of abalone seized are shown in Table 4.10. In 2001 all reported abalone-related incidents and confiscations occurred along the False Bay coastline. In 2002, 2003 and 2004 the percentage of abalone incidents on the False Bay coast of the TMNP totalled 90.5%, 83.3% and 95.8% respectively. The second half of the ten-year period showed marginally lower percentage values for both the number of incidents and the amount of abalone seized on the False Bay side of the park. The total abalone-related incidents occurring on the False Bay coast of the TMNP was 87.6%, while 93.0% of all abalone confiscated in the park occurred here.

Table 4.10: Annual number of confiscation incidents and abalone seized in the TMNP, 2000 to 2009

Year	Number of confiscation areas per year	Number of confiscation areas as percentage of annual total	Number of abalone confiscated	Number of abalone seized as percentage of annual total
2000	46	13.2	1410	2.0
2001	28	8.0	577	0.8
2002	21	6.0	2110	3.0
2003	30	8.6	2350	3.3
2004	24	6.9	10 465	14.7
2005	48	13.8	22 336	31.3
2006	36	10.3	5009	7.0
2007	17	4.9	4264	6.0
2008	43	12.3	7333	10.3
2009	56	16.0	15 487	21.7
TOTAL	**349**	**100.0**	**71 341**	**100.1**

The second half of the study period represented 57.3% of the total number of confiscation areas per year, indicating a relatively even spread across the former and latter halves of the ten-year period. However, there was less of an even distribution in the number of abalone commandeered during the last five years under review as 76.3% of resources were seized over this period (n = 54 429). A notable feature of the area-specific entries is that the average number of resources confiscated per incident over the first half of the study period amounted to 114 abalone, while this more than doubled to 272 abalone per incident in the latter half of the ten-year period.

Table 4.11 records the total number of incidents and the amount of abalone seized per area over the decadal period. As reported, 87.6% of all abalone-related incidents and 93.0% of all abalone confiscated by TMNP officials occurred on the False Bay side of the park. A total of 34 individual locations were recorded for georeferenced abalone seizures, averaging 10 incidents per area.

Table 4.11: Total number of abalone-related incidents and resources confiscated per area in the TMNP, for the decadal period

Area where abalone confiscation occurred		Total number of incidents per area	Number of incidents per area as percentage of total	Number of abalone confiscated per area	Number of abalone seized per area as percentage of total
Black Rock	E	7	2.0	1466	2.1
Bluegums	E/4	8	2.3	700	1.0
Bordjiesdrif	E	22	6.3	6705	9.4
Boulder's Beach	E/5	4	1.1	30	0.0
Buffels Bay	E	21	6.0	5609	7.9
Cape Point	E	52	14.9	9537	13.4
Castle Rock	E/4	16	4.6	1063	1.5
Froggy Pond	E/5	1	0.3	4	0.0
Glencairn	E	18	5.2	18 055	25.3
Granger Bay	*	2	0.6	151	0.2
Hout Bay	W	6	1.7	306	0.4
Kalk Bay	E/6	8	2.3	653	0.9
Koeël Bay	E/4	2	0.6	119	0.2
Kommetjie	W	5	1.4	27	0.0
Meadows	E	2	0.6	110	0.2
Melkbosstrand	*	1	0.3	2102	2.9
Millers Point	E	32	9.2	3563	5.0
Milnerton	*	2	0.6	136	0.2
Muizenberg	E	3	0.9	23	0.0
Oceanview	I	2	0.6	294	0.4
Partridge Point	E/4	11	3.2	1015	1.4
Redhill	I	3	0.9	1743	2.4
Rooikrans	E	3	0.9	253	0.4
Sandy Bay	W/1	2	0.6	16	0.0
Scarborough	W	9	2.5	322	0.5
Sea Point	W	1	0.3	44	0.1
Silvermine	I	2	0.6	328	0.5
Simon's Town	E	49	14.0	8297	11.6
Smitswinkel Bay	E	35	10.0	5751	8.1
Soetwater	W	5	1.4	31	0.0
St James	E/6	5	1.4	2407	3.4
Sunny Cove	E	1	0.3	25	0.0
Venus Pools	E/3	5	1.4	397	0.6
White Sands	W	4	1.1	59	0.1
TOTAL		**349**	**100.1**	**71 341**	**100.1**

Notes: E = east coast (False Bay) of TMNP; W = west coast of TMNP; 1 = Karbonkelberg Restricted Zone; 2 = Cape of Good Hope Restricted Zone; 3 = Paulsberg Restricted Zone; 4 = Castle Rock Restricted Zone; 5 = Boulder's Restricted Zone; 6 = St James Restricted Zone; I = inland; * = area not neighbouring TMNP

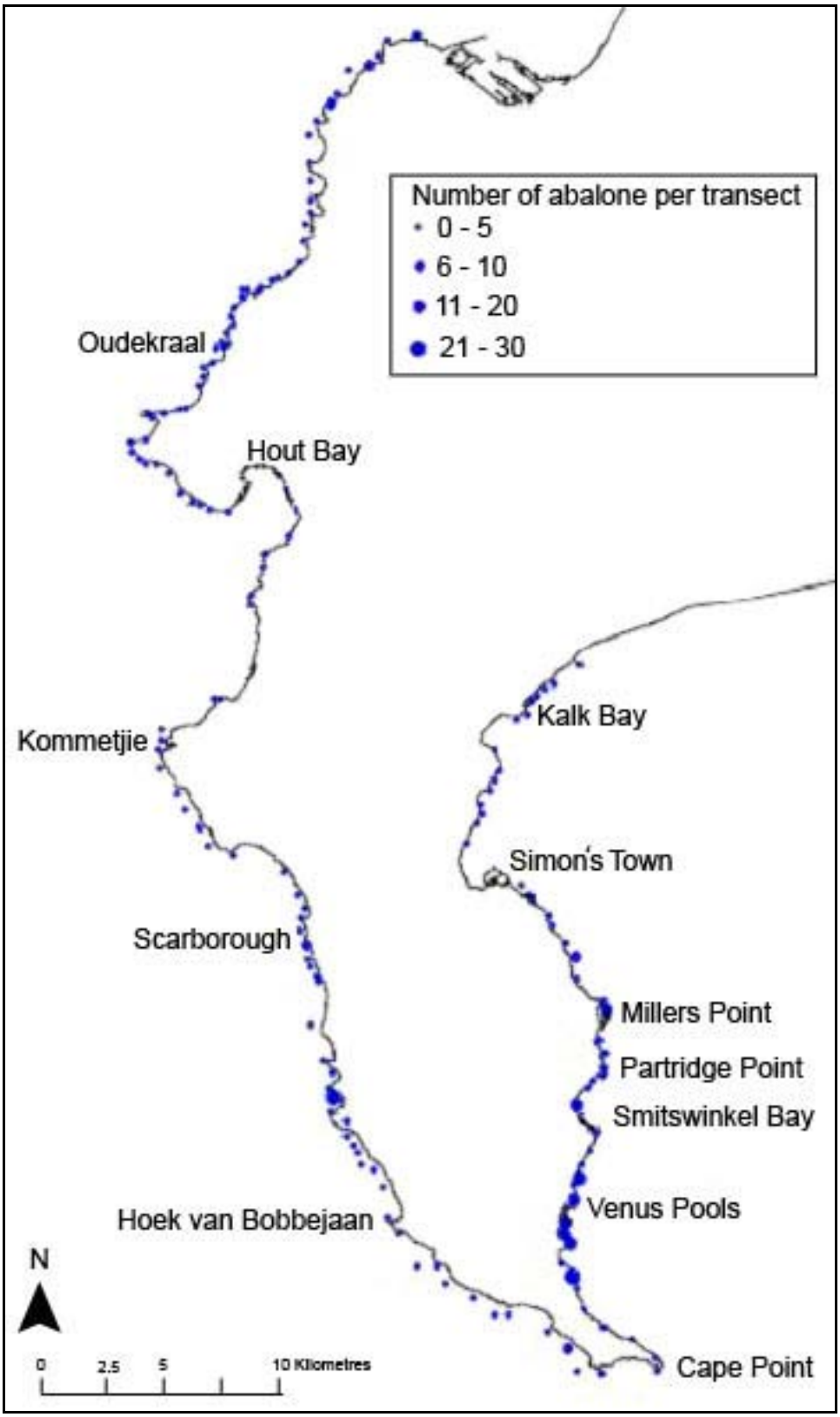
Cape Point recorded the highest number of incidents (n = 52) and contributed 13.4% of the total number of abalone seized for the ten-year period. Glencairn only provided 18% of the total number of abalone confiscation incidents, but recorded 25.3% of all resources expropriated in the park. The 18 incidents which occurred at Glencairn over the decadal period averaged 1003 abalone seized per seizure event. Melkbosstrand, outside of the park's boundaries, showed the highest average number of 2102 abalone seized per incident, although there was only one recorded abalone-related event in this area. Some 79.5% of all abalone confiscation incidents and 81.2% of abalone seized were recorded in SANParks logbooks with a location. Although these figures indicate that close on 80% of incidents and numbers of seized resources are being reported, it is the researcher's belief that there is still room for improvement, which would ensure a more accurate representation of where abalone-related incidents are occurring.

Qualitative assessments indicate that abalone poachers target areas on the basis of two key factors – resource abundance and accessibility. Other factors that sway decisions about where to poach are sea currents, wave action and sea conditions. Abalone poachers claimed that fishing on the False Bay side of the TMNP was the most lucrative and facilitated easier getaway in the event of enforcement pursuits. The primary areas of poaching are: Millers Point, Smitswinkel Bay, Black Rock, Castle Rock, Partridge Point, and the area in front of Bluegums. Each of the areas mentioned by poachers is reflected in the maps generated from the TMNP records. Park officials believe that the majority of abalone poaching takes place along the east coast of the park, in particular between Millers Point and Cape Point.

GIS analyses of annual abalone-related incidents are important tools for resource managers as the maps produced allow them to see the areas where confiscations occur, from which they could infer where illegal activities are occurring. A data set for specific poaching locations would have been a better option had SANParks kept such records. Nevertheless, when shown the initial GIS graphic output, most of the officials agreed that the maps would aid the identification of possible poaching areas (Nortier 2009, pers com). The mapped information affords management opportunities to note the areas where successful confiscations occurred, so enabling them to formulate and develop effective management plans. Further, management can use the georeferenced data to measure confiscations against potential areas where the abalone are more abundant, according to baseline population data.

A stock assessment of exploited invertebrate subtidal reef species of the then Cape Peninsula National Park was undertaken by the Centre for Marine Studies at the University of Cape Town (UCT) in 2001. When one compares the areas of abalone confiscations in the GIS outputs with the distribution and abundance of abalone from diver counts undertaken by the UCT, one notes that the majority of confiscations occurred on the east coast of the park in False Bay which the diver counts indicated to be the area with the highest densities of abalone. The UCT report showed that abalone were at least twice as abundant in the area around Venus Pools compared to other sections of the coast (Figure 4.4). This is most likely due to a combination of factors, including the difficulty in accessing this stretch of the coastline from the landward side, and the low frequency with which prevailing sea conditions permit diving in this area (Mayfield et al., 2001). Poachers want to spend the least amount of time in the water and therefore concentrate their operations in areas with the greatest abundance of abalone. According to Nortier (2009, pers com), the east coast

of the park with its numerous coves and bays is difficult for officials to monitor, and this strengthens poachers' decisions to fish these areas.



Source: Mayfield et al. (2001)

Figure 4.4: Distribution and abundance of *Haliotis midae* assessed from underwater transects, 2000

However, the UCT assessment was made a decade ago and since then large numbers of boat-based poaching operations have entered the park's waters intent on harvesting abalone. Unfortunately, no further assessment has been undertaken again to call attention to the existing stocks of abalone. In the absence of longer-term studies and multiple case studies from which to draw comparative lessons, there is a need for more rapid approaches that will allow approximations, drawing on static ecological data such as size- or age-class profiles across the abalone resources recorded in this study (Shackleton, Guthrie & Main, 2005; Avocèvou-Ayisso et al., 2009). These can act as suitable foundations for future studies, and allow resource managers to devise suitable strategies based on contemporary information to reach more accurate conclusions on the state of the resource base.

4.6 Abalone's uncertain future: concluding remarks

Worldwide, abalone stocks have been declining in the recent past due to the mass overexploitation of wild resources in many abalone-producing countries (Prince & Shepherd, 1992; Tarr, 2000; Godfrey, 2003; Hancock, 2004; Hauck, 2009). Concern that many of these species will be commercially extinct in a few years is unsurprising given the current pressures on the fisheries. The picture in South Africa mirrors that of other countries where the poaching of abalone is driving species to near extinction. Research over the past ten years has sought to understand the complexities of the South African abalone fishery and in particular to explore the scientific and socio-economic effects of IUU fishing (Hauck & Kroese, 2006). Biological and social studies done since the mid-1990s show that high levels of illegal fishing has resulted in a dramatic decrease in the TAC for the abalone fishery between 1996 and 2005, causing the eventual closure of both the recreational and commercial industries (Hauck & Kroese, 2006).

This study seeks to add to the literature on illegal abalone fishing as few national or international studies have attempted to quantify or describe IUU fishing in the abalone fishery, as illegal activities are notoriously difficult to research (Mann, 1995; Ainsworth & Pitcher, 2005; Sumaila, Alder & Keith, 2006). No studies have tried to quantify the levels of IUU fishing in the TMNP. Little information existed to confirm the size of the illegal abalone catch and few attempts have been made to estimate the nature and scale of the illegal abalone fishing operations (Gordon & Cook, 2004; Raemaekers & Britz, 2009). The outcomes of this chapter have satisfied objectives one through five, albeit partly, given that there are other resources which shall be discussed in later chapters. The objectives for this chapter endeavoured to add context and background to illegal abalone fishing in the TMNP, identify the various stakeholders involved in the informal abalone fishery, geographically plot resource seizures over the area of the park over time, and uncover the amount and weight of impounded abalone over the ten-year period. All of these objectives were met.

Although the contributions of confiscated abalone from the TMNP amount to only 1.7% of MCM's Western Cape abalone seizure total over the decadal period under review, the data coming from the park's logbooks suggests that poaching is on the increase. Statistical analyses confirm this conclusion, and park management is aware of the gauntlet that lies before them. However, it is further acknowledged that the numbers presented in this study are merely the tip of the iceberg regarding the nature and scale of abalone poaching in the TMNP. Plagányi, Butterworth & Burgener (2011) recognised that there were considerable uncertainties and difficulties associated

with estimation of the "missing component" (illegal component) of the abalone catch in the Western Cape when looking at official catch records maintained by state departments. It is speculated that only around 10% of all abalone poaching activities are intercepted, although some researchers believe that the upper limit of illicit activity detection is sitting at between 14% (Plagányi, Butterworth & Burgener, 2011) and 17% (Plagányi, 2007).

Even if one assumes that 20% of illicit activity is detected, potentially some 158 159 abalone could have been poached in the TMNP between 2000 and 2009, weighing 138 789 kg. At lower levels of detection, these figures are considerably higher, and are in all probability more realistic of what is occurring in the field. This leads officials and academics to believe that abalone poaching in the park is at crisis level (Nortier 2009, pers com; Burgener 2009b, pers com). However, further information and clarity is needed on numbers of abalone poachers currently operating in the TMNP waters to model more accurate predictions, which will build on the findings of this study. From this study's results, it can be concluded that the main threat to the coastal resources of abalone is overexploitation (Boonzaier et al., 1999; Griffiths, 2000; Turpie, Heydenrych & Lamberth, 2003). Increased concern over the sustainability of the abalone fishery and the conflict between stakeholders has spurred a suite of diverse responses from government and civil society (Hauck & Kroese, 2006). Political responses to the illegal fishing of abalone have, from the outset, mainly been to increase law enforcement (Hauck & Kroese, 2006). However, even with this law enforcement, the problem of abalone poaching is already out of control (Moola 2009, pers com).

The importance of law enforcement and deterrence in achieving greater compliance with regulations is not seen exclusively in a South African context as it has been recognised worldwide (Sutinen, Rieser & Gauvin, 1990; Sutinen, 1996; Kuperan & Sutinen, 1998; Raakjaer-Nielsen & Mathiesen, 2003; Hauck & Kroese, 2006). This instrumental approach understands non-compliance largely as a result of external influences, such as rewards and punishment, prompting individual fishers to act in their immediate self-interest. The penalties imposed on violators simply cannot compete with the financial rewards from the illegal activities (Turpie, Heydenrych & Lamberth, 2003). Based on this perspective, fishers will choose to comply based on economic gains, the likelihood of detection and the severity of sanctions (Hauck & Kroese, 2006). Thus, enforcement efforts attempt to increase the probability of detection and conviction (Sutinen, Rieser & Gauvin, 1990).

The overall assessment of law enforcement over the decadal period under review is that it has been inadequate and ineffective (Moola 2009, pers com; Burgener 2009a, pers com). The closure of the environmental court, the amalgamation of the MARINES into MCM, and the growth of the informal fishery has led to high levels of despondency and frustration among the formal fishery, coastal communities and law-enforcement authorities (Hauck, 2009). Although law-enforcement strategies have evolved over the years, particularly in relation to intelligence-based investigations, informal fishing continues on a regular basis along the TMNP coast (Hauck, 2009; Liedeman 2009, pers com; Moola 2009, pers com; Nortier 2009, pers com). Had abalone poaching been tracked and managed effectively in the early 2000s, resource management agencies might have gained some ground (Burgener 2009b, pers com). Nortier (2009, pers com) goes further in suggesting that the harvesting operations needed to be monitored and managed 20 years ago for there to be any hope of sustainability in the fishery. Despite a number of initiatives in this

direction, the illegal abalone trade has flourished and the fishery seems destined to collapse due to resource depletion. This has focused MCM's attention on the need to explore complementary compliance strategies that encourage a more integrated approach to addressing illegal harvesting (Hauck & Kroese, 2006).

The South African abalone fishery spotlights the difficulties and complexities associated with illegal fishing. This requires a combination of appropriate adaptive management systems, adequate policing and penalties, and extensive consultation and communication, all of which collectively come with their own price tag and problems (Plagányi, Butterworth & Burgener, 2011). Some officials and scholars believe the issues to be beyond resolution. Britz (2009, pers com) disagrees, averring that poaching is not an 'untouchable monolith'. Despite there being no ready formula for a solution, it comes down to having the rights holders and communities on board in adaptive-management strategies. To win the war against poaching, government will need to implement a cooperative approach to resource management. The worst thing to do is nothing (Britz 2009, pers com).

A similar sentiment is expressed in the West Coast rock lobster fisheries where poaching is becoming more and more prevalent. There is a long history of rock lobster exploitation in the Cape dating back to early man. Since this time, demand for the resource has changed considerably with increased fishing pressure impacting severely on lobster populations. The next chapter centres on WCRL poaching in the TMNP between 2000 and 2009.

CHAPTER 5: BETWEEN A ROCK AND A HARD PLACE – CONFISCATIONS OF WEST COAST ROCK LOBSTER

Chapter 5 focuses on confiscations of West Coast rock lobster (WCRL) in the TMNP over the decadal period of this study. The annual numbers and weights of seized resources are reported, while statistical analyses measure relationships between variables. Size preference data is also discussed, while GIS outputs show confiscation events over the park's spatial area. The perceptions of a sample of WCRL poachers and officials from the TMNP contribute to unpacking the issue of poaching of this resource in the park.

5.1 Introduction

The exploitation of WCRL is one of the oldest and most important aspects of the fishing industry in South Africa (Heydorn, 1969). The history of the informal WCRL fishery is well documented from the late 1800s to early 1990s (Van Sittert, 1993; 1994). Commercial exploitation began in 1875, but archaeological evidence suggests that there is considerable history of resource use dating to pre-colonial times (Melville-Smith & Van Sittert, 2005). While the European export market began to develop in the late 1800s, rock lobster was locally considered a food for the poor and an important source of protein for impoverished coastal communities (Melville-Smith & Van Sittert, 2005; Hauck, 2009). Further, rock lobster was used as bait for other fishing activities and was thus harvested prolifically. A high local demand for WCRL for both consumption and bait led to a thriving traditional fishery at the commercial level and on a small scale, and latterly to a more organised informal fishery (Van Sittert, 1994).

The WCRL fishery is an important small-scale fishery in South Africa and the WCRL is still considered a high-value resource (Cockcroft et al., 2002), which have obvious implications regarding economic development and livelihoods for coastal communities, and also important customary value owing to the historical use of the resource. This emphasises the complexity of managing a small-scale fishery in which economic incentives to harvest the resource are high, historical rights of access are legitimate and formal access rights are limited (Hauck, 2009). Concerning compliance, this is a fishery that has a growing informal trade, exacerbated by government's failed attempts to collaborate fairly with the different fisher groups. This chapter hopes to undercover the tip of the iceberg regarding illegally harvested WCRL in the TMNP by looking at the historical confiscations data maintained by SANParks. This study also aims to improve the understanding of the potential scale of the burgeoning informal rock-lobster fishery in the Western Cape.

5.2 Description of WCRL

West Coast rock lobster (*Jasus lalandii*) (H. Milne-Edwards), better known in some areas as kreef or crayfish, is found in the class Malacostraca in phylum Arthropoda. WCRL is one of four lobster species in South Africa, and one of two commercial species, with all species placed in the family Palinuridae. WCRL occur only in southern Africa, from Walvis Bay in Namibia to East London in the Eastern Cape (Figure 5.1), inhabiting coastal waters up to 50 metres deep, although usually found on rocky bottoms (Heydorn, 1969). The WCRL fishery targets the species *J. lalandii*, which is distributed close to shore (<200 m depth) and was historically distributed largely on the southern African west coast, from Namibia to the Cape of Good Hope.

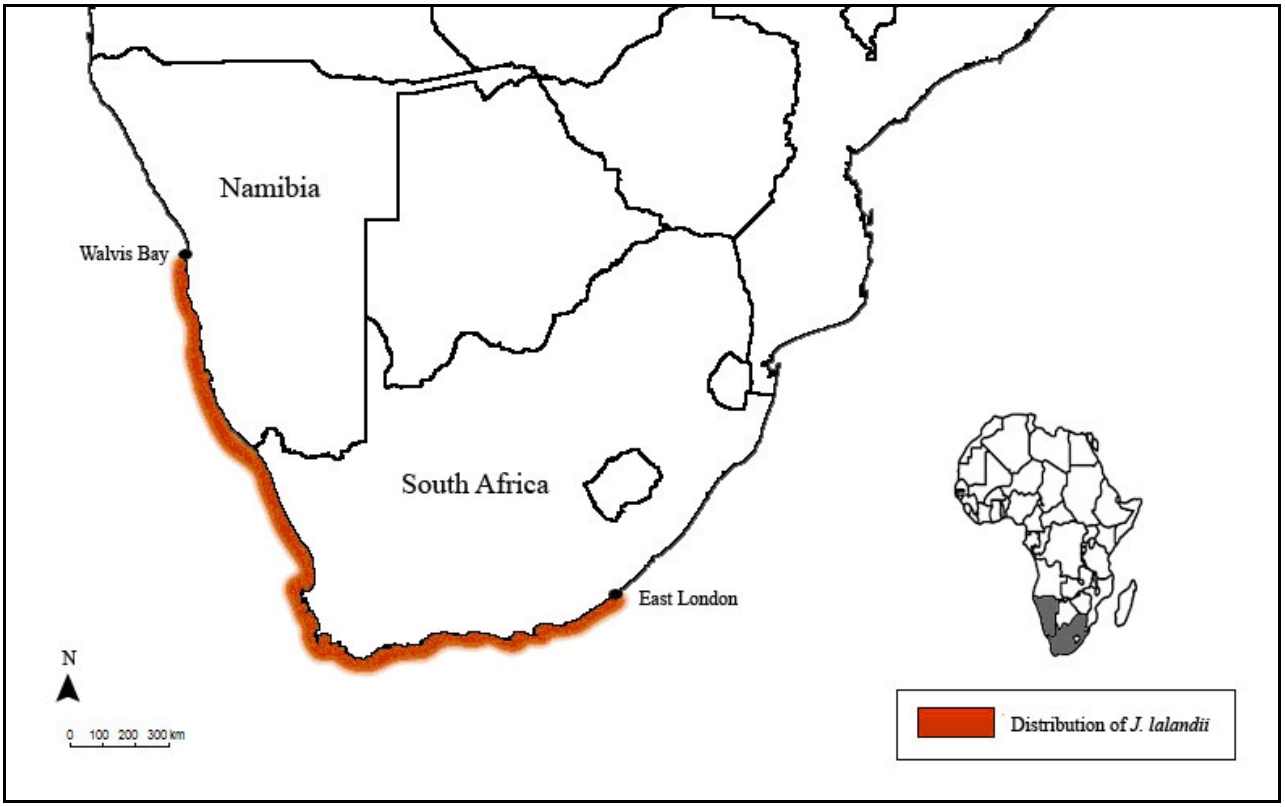


Figure 5.1: Distribution of *Jasus lalandii* along the South African and Namibian coasts

WCRL are extremely slow-growing and also take a long time to reach sexual maturity, and may grow to a total length of 46 cm, with a carapace length of 18 cm (Mayfield, Branch & Cockcroft, 2000). Minimum larval duration is 14 to 18 months and sexual maturity is reached only five years later. Females grow slower than males, taking approximately 20 years to reach a size of 89-mm carapace length, while males take 7 to 11 years to reach the same size (Clark, 2001).

Overall, the rock-lobster resource is considered to be severely depleted (less than 10% of historical levels) and recruitment is down to 35% of pristine levels (Clark, 2001). Unsustainable commercial catches in the 1960s were principally responsible for the current state of the fishery, but low oxygen and black- or red-tide events as well as a recent coast-wide reduction in lobster growth rates has taken a major toll in recent years (Clark, 2001). A size limit of 85-mm carapace length and a ban on catching ovigerous females[4] are some of the management measures put in place to limit the biological impact on the species through fishing activity.

There have been numerous other initiatives implemented by the South African government aimed at protecting and rebuilding the WCRL stocks. However, the history of rock-lobster harvesting has not been favourable to the success of conservation efforts, and the informal fishery is set to begin growing in scale, intensity and organisation following the imminent demise of abalone populations in the Western Cape.

[4] Females which brood their eggs.

5.3 History of harvesting of WCRL

WCRL have been targeted for centuries by subsistence fishers (Khoisan), although little is known of the importance of this resource in pre-colonial hunter-gatherer subsistence (Jerardino & Navarro, 2002). The earliest records of human exploitation of the species, established from remains found in Khoisan caves and middens, date from between 2000 (Jerardino, 2010), 8000 (Jerardino & Navarro, 2002) and 10 000 years before present (Cockcroft & Payne, 1999). Commercial exploitation commenced in the late 19th century and expanded during the early 20th century. The long tradition of WCRL harvesting on South Africa's coast has been well documented, as has the historical marginalisation of this sector (Van Sittert, 1993; 1994). Although various fisheries reforms in South Africa have attempted to broaden access rights to traditional fishers, these processes have largely resulted in the status quo, with the monopolisation of rights in the hands of big capital (Croeser, Van Sittert & Ponte, 2006; Van Sittert et al., 2006; Isaacs, Hara & Raakjær, 2007). Disenchanted with government for decades, impoverished fishers, with formal rights or not, have continued to turn to the sea for what they consider a legitimate livelihood (Hauck, 2009).

Organised groups of opportunists have been operating in the WCRL informal fishery from the 1970s as a means to supply an increasing local demand (Van Sittert, 1994). These were people with business interests, many of whom did not fish themselves, but provided transportation, storage and distribution of WCRL across South Africa. In addition, recreational fishers became increasingly sophisticated with the use of diving gear and ski-boats, supplying local middlemen and using the money to supplement other forms of income (Hauck, 2009). Formal networks began to develop between individuals, groups and middlemen to ensure a regular and sufficient supply to the black market (Van Sittert, 1994). Informal fishing therefore developed as a source of seasonal or full-time employment in Cape Town and along the west coast where networks became highly organised and were also involved in other illicit activities (Hauck, 2009). The fishers involved in these operations largely harvest outside of the formal fishery, although during the lobster season many fishers purchase a recreational permit to legitimise their presence at sea (Hauck, 2009). Recreational fishers have been required to obtain permits to harvest WCRL, and on average approximately 50 000 permits are sold annually (Hauck, 2009). These fishers are required to use hoop nets from the shore or small vessels and they are permitted to dive, but without the use of artificial breathing apparatus. Other regulations include a minimum carapace length (85 mm), fishing during certain times, and closed seasons. Despite the legislative interventions regarding minimum-size classes, the informal fishery continues today.

Most of these informal operations supply the domestic market with varying degrees of organisation dependent on their ability to provide reliable catches. Thus, despite the fishery being considered illegal by the state and big industry, it continues to operate with very little conflict at local level (Hauck, 2009). While the abalone fishery may be unique in its level of sophistication and be considered as the most organised illegal fishery in South Africa, there are signs in the WCRL fishery that a similar degeneration could occur (Hauck, 2009). Other less lucrative fisheries in South Africa may also become prey to informal syndicates. Although at a smaller scale in terms of economic value, market demand and level of organisation, these fisheries are impacted by the involvement of outside opportunists who establish a black-market trade for their economic gain.

The information collected from the TMNP logbooks contribute to the existing literature and premises on the informal rock-lobster fishery and the proliferating black-market trade in the resource.

5.4 Analyses and interpretation of WCRL confiscations data

This section looks at the WCRL-related data recorded in the TMNP offence registers between 2000 and 2009. A quantitative data overview is provided, offering an insight into the nature of rock-lobster confiscations in the park over time. The numbers of incidents that occurred over the study period are reported, as well as seasonal variations in confiscation events. Fluctuations in the numbers and weights of WCRL confiscated in the park over the ten-year period are presented. Additionally, size-preference data is provided. GIS analyses used WCRL-related georeferenced data to depict the spatial distribution of confiscation events in the park over the decadal period of this study.

5.4.1 Overview of quantitative data sources

The records of confiscations of rock lobster were sourced from the same registers used for abalone. The data extracted for 2000 to 2009 related to whole WCRL (sized and undersized) and WCRL tails confiscated from recreational fishers or found abandoned. The results presented below are based on data collected from the recreational and subsistence fisheries operating in the park.

5.4.2 Confiscation incidents

Table 5.1 indicates the number of WCRL-related incidents reported between 2000 and 2009 by the TMNP rangers, and the percentage contribution of each year to the decadal total. The latter half of the decadal period contributed 63% of WCRL-related confiscation events, indicating a noteworthy increase in rock lobster confiscations over that time. The recorded abalone-related offences averaged 43 confiscation events annually.

Table 5.1: Number of WCRL-related confiscation incidents in TMNP, 2000 and 2009

Year	Number of WCRL confiscation incidents	Number of confiscations per year as percentage of decadal total
2000	50	11.7
2001	38	8.9
2002	19	4.4
2003	34	8.0
2004	17	4.0
2005	63	14.8
2006	48	11.2
2007	66	15.5
2008	39	9.1
2009	53	12.4
TOTAL	**427**	**100.0**

Compliance issues and concerns related to the WCRL fishery were first acknowledged in research done on the abalone fishery in the 1990s (Hauck, 1997). Although there were cases of arrests and confiscations related to the lobster fishery, the focus of law enforcement was, and often still is, on the lucrative abalone fishery (Hauck, 1997; 2009). Over the years, as the abalone resource has become depleted, more and more informal fishers have turned to the lobster fishery as a source of

income and livelihood (Nortier 2009, pers com). With the grim socio-economics in many impoverished communities surrounding the park, it comes as no surprise that the numbers of WCRL confiscated in the park annually are increasing. Newspaper reports from the period under review support the data, suggesting that confiscations are on the increase (Gosling, 2002; Bamford 2003; Yeld, 2004; 2006; 2008; Yeld & Prince, 2006).

These increases are most noticeable between 2004 (n = 17) and 2005 (n = 63) when the number of confiscation incidents more than tripled. One of the reasons offered by park officials for the swelling in WCRL seizure events over this period was the devolution of responsibility from MCM to SANParks (Nortier 2009, pers com; Ruthenberg 2009, pers com). With greater enforcement capacity in the park, more emphasis was placed on compliance operations, which could have resulted in greater numbers of confiscation incidents. The dedicated marine resource section was also created in 2005 which may have improved compliance and enforcement operations, increasing the potential for lobster seizures. The numbers of rock lobster requisitions fluctuated over the remainder of the study period, dropping to a below average figure (n = 39) in 2008. A possible reason for the decline in incidents recorded in that year is possibly the issuing of interim relief permits for fishers who claimed a cultural right to the resource (Hauck, 2009). These permits legitimised the activities many fishers were undertaking regardless.

Politically and socially there has been little change over the WCRL fishing landscape during the ten-year period under review. The users have remained the same, unlike in the abalone fishery where new poachers are entering the game almost daily (Nortier 2009, pers com). The majority of poaching in the WCRL fishery is undertaken by subsistence fishers who wish only to feed their families (Buchmann 2009, pers com; Liedeman 2009, pers com). There are exceptions to this where some of these individuals opt to sell their excess catches, often exceeding bag limits or harvesting rock lobster outside allocated fishing seasons. This seasonal fishing behaviour is an important consideration for enforcement operations mandated by SANParks.

5.4.3 Monthly and seasonal patterns in WCRL confiscations

The number of confiscation events occurring in the TMNP per month over the decadal period under review can help to uncover any seasonal patterns. For WCRL, confiscation totals for the study period were highest in January (n = 110) and December (n = 97) (Table 5.2). The lowest recorded confiscations total arose in July and October (n = 5). There were on average 43 WCRL-related confiscations each month in the TMNP between 2000 and 2009. There is clear evidence that WCRL confiscations are more prevalent from November to April (n = 388) compared to just 9.1% of total seizures arising in the months May through October. Combined monthly totals created seasonal data (Table 5.3). Confiscation incidents are not evenly spread throughout the year as reported in abalone, but favour the summer and autumn months. The combined total for the summer months contributed over 58% of the total number of confiscation events that occurred. The combined total for summer and autumn data totalled 90.9%. The seasonal records for spring and winter held less than 10% of WCRL-related confiscation events. Seasonal calculations yielded a monthly average of 35.6 abalone-related offences.

Table 5.2: Numbers and averages of WCRL-related confiscations per month in the TMNP (decade 2000 - 2009)

Month	Number of confiscation events	Number of confiscations per month as percentage of decadal total	Average number of confiscation events per month
January	110	25.8	11.0
February	24	5.6	2.4
March	62	14.5	6.2
April	54	12.6	5.4
May	6	1.4	0.6
June	7	1.6	0.7
July	5	1.2	0.5
August	7	1.6	0.7
September	9	2.1	0.9
October	5	1.2	0.5
November	41	9.6	4.1
December	97	22.7	9.7
TOTAL	**427**	**99.9**	**42.7**

Table 5.3: Seasonal distribution of WCRL-related confiscations in the TMNP (decade 2000 - 2009)

Season	Number of confiscation events	Number of confiscations per season as percentage of decadal total contribution	Average number of confiscation events per month per season
Summer (Nov, Dec, Jan)	248	58.1	82.7
Autumn (Feb, Mar, Apr)	140	32.8	46.7
Winter (May, June, Jul)	18	4.2	6.0
Spring (Aug, Sept, Oct)	21	4.9	7.0
TOTAL	**427**	**100**	

A feature of the seasonal harvesting of WCRL is that 90.9% of confiscations occurred during the legal fishing season, which coincides with the summer and autumn months (November through April). The cooler winter and spring months yielded 9.1% of confiscations. Evidence given by fishers and park officials indicates that illegal WCRL harvesting is preferred during the summer months when the weather and sea conditions are more favourable for fishing. Another explanation for the summer-autumnal seasonal occurrence of confiscations is that enforcement and compliance operations are concentrated in the fishing season. Further, biological markers (such as increased sunlight, food availability, temperature) can cause the WCRL to migrate to shallower waters where they are easier to catch. Although feasible, the latter is the least likely reason for the seasonality pattern. When designing management strategies, it is important to take the seasonal variations in confiscations events into account. Further considerations should include the numbers and weights of lobsters seized from poachers over time.

5.4.4 Confiscated numbers and weight of WCRL

Limited research has been undertaken to quantify the amounts of WCRL resources removed by fishing communities along the Cape Peninsula. Research done in the early 1990s by Cockcroft & Mackenzie (1997) aimed to describe the recreational WCRL fishers at the time and quantify the

amounts these users were removing on a yearly basis, but as yet there is no research which measures the scale of confiscated WCRL resources within the TMNP.

Table 5.4 displays the number of sized, undersized and WCRL tails expropriated from fishers, and the weight of these seized resources. Size preference for WCRL is an important characteristic of this resource's exploitation. Records show that there are three size classes – sized, undersized and tails. Sized WCRL refers to individuals that conform to the legal length restrictions in fishing regulations (85-mm carapace length), and undersized lobsters have carapace lengths shorter than the legal limit. Often, WCRL fishers break the carapace off and only keep the tails to bypass size regulations as tail size is not representative of whether a lobster is legally sized and harvestable or not.

In the first half (2000 to 2004) of the study period, sized specimens totalled 54.7% of the number (n = 1954) of rock lobsters seized over these five years. WCRL tails exceed the number (n = 534) of impoundments of undersized specimens (n = 352) over the same period. Sized confiscations contributed 48.1% (n = 4959) of the total number of rock lobster seizures between 2005 and 2009 (n = 10 319), while undersized resources and WCRL tails contributed 29.2% (n = 3008) and 22.8% (n = 2352) respectively. Over the ten-year period, sized WCRL confiscations totalled 6027 and contributed 49.1% to the decadal total. The percentage contributions for seized undersized WCRL and tails amounted to 27.4% (n = 3360) and 23.5% (n = 2886) respectively. These values infer that WCRL fishers were inclined to poach sized lobster, which is intuitive given the potential food or income gains for the amount of fishing effort expended. An alarming concern is that the number of undersized rock lobsters confiscated increased almost ten-fold between the first (352) and second half (3008) of the study period. An explanation given by SANParks officials is that the fishers often do not have the required measuring tools or they conceal the undersized individuals with legally-sized ones (Nortier 2009, pers com). Almost always, the undersized WCRL are caught by opportunistic fishers and harvested for own consumption (Buchmann 2009, pers com). This tends to be the case with tails too, although it is illegal to sever the tail from the rest of the body, as it is carapace length that is measured to determine whether a lobster is legally sized (Liedeman 2009, pers com). Officials believe that there is a transition concerning the use of tails from subsistence fishing to harvesting WCRL in this bodiless manner to foil compliance officers to be able to sell the catch.

A study by Tewfik & Béné (2004), on South Caicos in the Caribbean, comprising a biological analysis of the landings of Caribbean spiny lobster (*Panulirus argus*), found that the proportion of immature (undersized) individuals was extremely high (42% for the fishing season). Thankfully, the overall percentage of undersized confiscations is not so high in the TMNP, although the increase in undersized resource seizures is reason for concern among park management. Further apprehension is warranted by the overall increase in the numbers of resources seized during the latter half of the ten-year period, regardless of size preference.

Table 5.4: Size preference of WCRL, number seized and weight of expropriated resources in the TMNP, 2000 to 2009

Year	Resource size preference	Number of WCRL seized	Number of resources confiscated per year as percentage of yearly total	Conversion ratio (kg)	Weight of WCRL (kg)	Weight of resources confiscated as percentage of yearly total
2000	Sized	243	69.6	0.30	73	78.5
	Undersized	96	27.5	0.20	19	20.4
	Tails	10	2.9	0.10	1	1.1
SUBTOTAL		**349**	**100.0**		**93**	**100.0**
2001	Sized	451	75.5	0.33	149	86.6
	Undersized	68	11.4	0.22	15	8.7
	Tails	78	13.1	0.11	9	5.2
SUBTOTAL		**597**	**100.0**		**173**	**100.2**
2002	Sized	32	54.2	0.32	10	62.5
	Undersized	27	45.8	0.22	6	37.5
	Tails	0	0.0	0.11	0	0.0
SUBTOTAL		**59**	**100.0**		**16**	**100.0**
2003	Sized	271	70.8	0.34	92	78.6
	Undersized	109	28.5	0.23	25	21.4
	Tails	3	0.8	0.12	0	0.0
SUBTOTAL		**383**	**100.0**		**117**	**100.0**
2004	Sized	71	12.5	0.33	23	27.7
	Undersized	52	9.2	0.23	12	14.5
	Tails	443	78.3	0.11	48	57.8
SUBTOTAL		**566**	**100.0**		**83**	**100.0**
2005	Sized	973	53.9	0.32	311	69.0
	Undersized	437	24.2	0.22	96	21.3
	Tails	396	21.9	0.11	44	9.8
SUBTOTAL		**1806**	**100.0**		**451**	**100.1**
2006	Sized	478	35.7	0.30	143	55.9
	Undersized	266	19.9	0.20	53	20.7
	Tails	596	44.5	0.10	60	23.4
SUBTOTAL		**1340**	**100.0**		**256**	**100.0**
2007	Sized	994	50.0	0.31	308	68.8
	Undersized	304	15.3	0.21	64	14.3
	Tails	690	34.7	0.11	76	17.0
SUBTOTAL		**1988**	**100.0**		**448**	**100.1**
2008	Sized	591	20.1	0.31	183	29.7
	Undersized	1799	61.2	0.21	378	61.4
	Tails	549	18.7	0.10	55	8.9
SUBTOTAL		**2939**	**100.0**		**616**	**100.0**
2009	Sized	1923	85.6	0.31	596	91.6
	Undersized	202	9.0	0.21	42	6.5
	Tails	121	5.4	0.11	13	2.0
SUBTOTAL		**2246**	**100.0**		**651**	**100.1**
TOTAL		**12 273**	**100.0**		**2904**	**100.1**

An average of 391 lobsters were seized per year in the first half of the period under review, but this increased substantially to 2064 WCRL per year during the latter five years. The total amount of WCRL seized in the TMNP was 12 273 for the ten-year period. Some 84.1% of WCRL confiscations occurred between 2005 and 2009, with the greatest number recorded in 2008 (n = 2939). The number of lobster resources confiscated in 2002 was the lowest on record (n = 59) and contributed only 0.5% to the decadal total of seized WCRL in the TMNP. There was a spike in numbers of confiscated rock lobster in 2005, which some officials have suggested resulted from the creation of the TMNP Marine Section with its new permit compliance structures implemented at slipways and entry points within and along the park's boundaries (Nortier 2009, pers com; Sieben 2010, pers com). Another significant increase in WCRL seizures was noted in 2008. Park management and MCM employees submitted that increased confiscations were occasioned by closure of the commercial abalone fishery causing many fishers to seek an alternative food source or income generator (Hauck, 2009; Nortier 2009, pers com; Liedeman 2009, pers com).

There should have been fewer WCRL confiscated given that interim relief permits were issued during 2008 to fishers who claimed historical rights to the resource. This could explain why undersized rock lobster seizures (n = 1799) outnumbered confiscations of sized resources (n = 591) in 2008. Interestingly, 53.5% of all undersized impounded resources took place in 2008. Although there was a slight decline in the number of WCRL sequestered from 2008 to 2009, the number of lobsters impounded still exceeded the average for the last five years of the study. While the evidence suggests that the numbers of rock lobsters taken away from poachers has increased over the first and second halves of the decadal period, it is also imperative that the park's management is aware of fluctuations in the weight of resources being seized. This information has important repercussions for the future management of people and the park.

Weights for WCRL seized in the TMNP were calculated using conversion ratios supplied by MCM, based on annual biological stock assessments. Due to the nature of the size preference in the numbers of resources confiscated, the associated weights fluctuate over the decadal period. The weight value of confiscated resources seized in 2002 is naturally the lowest percentage contribution (0.6%) given that there were only 59 commandeered rock lobsters reported for this year. The latter half of the decadal period yielded 83.4% of the total weight of rock lobster removed from fishers. The average weight of WCRL seized per year in the first half of the study period amounted to 96 kg, while this figure increased almost fivefold to 484 kg during the latter five years. The combined weight of confiscated WCRL recorded by the TMNP officials over the ten-year period was 2904 kg. Notably, the total weight of seized resources in 2009 exceeded that measured in 2008 due to the size preference of the rock lobsters confiscated, and not due to the confiscation ratios, as there were virtually no changes in these values between the last two years of this study. There were marginal changes in the values of these confiscation ratios, averaging 0.32 for sized WCLR, 0.22 for undersized resources and 0.11 for lobster tails.

Spearman's coefficients showed high correlation between the combined numbers of rock lobster (r = 0.88) and the weight of these resources removed from poachers (r = 0.82), respectively, over time. A probability value of less than 0.01 was reported for both the variables tested, indicating a significant increase in both the numbers and weights of rock lobster commandeered from illegal activities in the TMNP over the study period. It was not surprising that the numbers and weight of

confiscated WCRL showed an upward trend in 2000 to 2009. Managers note more users applying for recreational fishing permits on a yearly basis (Buchmann 2009, pers com; Liedeman 2009, pers com; Nortier 2009, pers com) which brings the potential for some of the more unscrupulous fishers to try their luck and poach more than their allotted five-lobster quota. Although the size of the informal WCRL fishery is difficult to quantify, estimates suggest that between 400 and 500 tonnes of WCRL are being harvested annually (Branch, Hauck & Smith 2007).

Much of the research conducted on global lobster species focuses either on fishing effort (Béné & Tewfik, 2001) or on the biology of the species (Seiderer, Hahn & Lawrence, 1982; Butler & Hernkind, 1997; Medley & Ninnes, 1997), with little work focusing on fisher communities and their reliance on this resource for food, income and cultural practices. Given the dire global economic situation of late, poaching often becomes a necessity, rather than an act of greed (Nortier 2009, pers com). Park officials are aware that many people who rely on the natural-resource base for food, will impact on the resources more heavily during recessionary times when they stop buying food from grocery stores and local markets (Burgener 2009b, pers com). Given that the harrowing economic conditions are not easing, poaching of lobsters in the park is destined to increase.

Particularly significant now is that many of the issues raised by the informal abalone fishers a decade ago are now being brought to the fore by the informal lobster fishers (Hauck, 2009). In management circles, and in the formal WCRL fishery, scientists, government and industry officials have viewed the decline and ultimate closure of the abalone fishery as a harbinger of the lobster fishery's fate (Hauck, 2009). There is increasing concern that the informal lobster fishery is significantly growing in magnitude and becoming more established, and that the WCRL fishery is facing a similar lot to the abalone fishery. The earlier degeneration of the abalone fishery should prepare officials and decision makers to effectively handle current developments in the informal lobster fishery (Hauck, 2009).

Finding comparisons between the informal WCRL fisheries and the abalone fisheries do not bode well for the future of the rock lobster resource in the TMNP. Further comparisons between the data maintained by the TMNP officials and those by the police paint a different picture too. Police records for confiscated WCRL from June 2008 to June 2009 were compared with the park's records which totalled 562 versus 1120 WCRL admitted into SAPS evidence. Poached WCRL were clearly underreported in SANParks records to the tune of 50% compared to SAPS records. This difference indicates inaccurate record keeping on the part of park officials and suggests that the true number and weight and WCRL seized in the park are considerably greater than reported in this study. Further evidence from police records for the full decadal period is required before such contentions can be substantiated.

To further validate the data maintained by SANParks, qualitative assessment questionnaires were distributed to a number of known lobster poachers. WCRL fishers (n = 22) claimed to illegally remove 320 WCRL each on average per annum. The Rastafarians interviewed (n = 6) poached enough rock lobsters to fill 54 shopping bags. Given the many recreational fishers harvesting from the resource base, it is obvious why this fishery has one of the highest rates of poaching in the park. The number of WCRL reportedly being harvested illegally in one year by the 22 WCRL

fisher respondent's totals 7200 – three times the reported confiscations in the park's record books for 2009. This advances the belief that the data kept in the TMNP logbooks represents an underreporting or captures only a small portion of actual poaching events. The park officials interviewed believed that WCRL is the most targeted marine species in the TMNP, with some 25 000 specimens perceived to be removed on an annual basis by illegal fishers. The spatial extent of rock lobster poaching is another concern for the park's management, as there have been some high-profile poaching incidents on both the east and west coast of the park during the ten-year period under review. The next section discusses WCRL rock lobster confiscations over the geographical area of the park.

5.4.5 GIS analyses and interpretation

The spatial component of WCRL confiscations in the TMNP are reported and discussed in this section. The data used to create the relevant tables and graphics arose from logbooks maintained by the park for the period 2000 to 2009. Arcview 9.3 was implemented to graphically plot the locations inside and outside of the park where resources were seized from illegal fishers (Figures 5.2 and 5.3). Data for the ten-year period expresses the area in which the confiscation incident occurred, and the number of resources commandeered. Annual figures for both variables are also compared against the decadal total, and each area where incidents occurred is also analysed. Only those incidents that had location details attached to the logbook entries are discussed. Table 5.5 registers the areas in which WCRL confiscations took place over each of the 10 years under review. The numbers of rock lobster expropriated from fishers are also included. Incidents that occurred outside the park are also mentioned, but are not part of the GIS outputs (Figures 5.3 & 5.3).

Table 5.5: Areas where confiscation incidents of WCRL occurred and the numbers of resources seized per area in the TMNP, 2000 to 2009

Year	Area where WCRL confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of WCRL confiscated	Number of WCRL seized per area as percentage of annual total
2000	Buffels Bay	2	10.0	16	9.2
	Cape Point	11	55.0	48	27.8
	Glencairn	1	5.0	4	2.3
	Karbonkelberg	1	5.0	5	2.9
	Kommetjie	1	5.0	5	2.9
	Rooi Els *	1	5.0	30	17.3
	Smitswinkel Bay	2	10.0	57	33.0
	Soetwater	1	5.0	8	4.6
SUBTOTAL		**20**	**100.0**	**173**	**100.0**
2001	Buffels Bay	1	20.0	13	11.5
	Castle Rock	1	20.0	77	68.1
	Chapman's Peak	1	20.0	3	2.7
	Duikers Klip	1	20.0	17	15.0
	Sandy Bay	1	20.0	3	2.7
SUBTOTAL		**5**	**100.0**	**113**	**100.0**
2002	Bluegums	1	8.3	13	32.5
	Buffels Bay	1	8.3	4	10.0

Continued overleaf

Table 5.5 continued

Year	Area where WCRL confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of WCRL confiscated	Number of WCRL seized per area as percentage of annual total
2002	Castle Rock	1	8.3	1	2.5
	Hout Bay	1	8.3	2	5.0
	Kommetjie	1	8.3	3	7.5
	Noordhoek	1	8.3	2	5.0
	Oceanview I	4	33.3	9	22.5
	Scarborough	1	8.3	4	10.0
	Smitswinkel Bay	1	8.3	2	5.0
SUBTOTAL		**12**	**99.7**	**40**	**100.0**
2003	Buffels Bay	2	9.5	6	2.5
	Cape Point	4	19.0	11	4.7
	Hout Bay	2	9.5	14	5.9
	Kommetjie	3	14.3	6	2.5
	Noordhoek	1	4.8	1	0.4
	Platboom	2	9.5	110	46.6
	Rooikrans	2	9.5	4	1.7
	Simon's Town	1	4.8	3	1.3
	Smitswinkel Bay	1	4.8	74	31.4
	Soetwater	3	14.3	7	3.0
SUBTOTAL		**21**	**100.0**	**236**	**100.0**
2004	Cape Point	5	33.3	41	16.7
	Hout Bay	1	6.7	21	8.5
	Koeël Bay	1	6.7	17	6.9
	Kommetjie	4	26.7	102	41.5
	Oceanview I	1	6.7	29	11.8
	Simon's Town	2	13.3	24	9.8
	Soetwater	1	6.7	12	4.9
SUBTOTAL		**15**	**100.1**	**246**	**100.1**
2005	Buffels Bay	1	1.7	2	0.1
	Cape Point	6	10.3	59	3.6
	Hout Bay	12	20.7	287	17.4
	Kommetjie	19	32.8	365	22.2
	Millers Point	1	1.7	4	0.2
	Noordhoek	1	1.7	11	0.7
	Oceanview I	7	12.1	178	10.8
	Rooikrans	1	1.7	179	10.9
	Sandy Bay	1	1.7	20	1.2
	Scarborough	4	6.9	35	2.1
	Soetwater	5	8.6	507	30.8
SUBTOTAL		**58**	**99.9**	**1647**	**100.0**
2006	Fishhoek	1	2.4	10	0.8
	Hout Bay	10	24.4	552	42.6
	Kommetjie	9	22.0	38	2.9
	Millers Point	1	2.4	4	0.3
	Mitchells Plain I	1	2.4	2	0.2
	Noordhoek	1	2.4	3	0.2
	Oceanview I	6	14.6	377	29.1
	Sandy Bay	1	2.4	5	0.4
	Scarborough	1	2.4	120	9.3

Continued overleaf

Table 5.5 continued

Year	Area where WCRL confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of WCRL confiscated	Number of WCRL seized per area as percentage of annual total
2006	Simon's Town	1	2.4	59	4.6
	Smitswinkel Bay	1	2.4	2	0.2
	Soetwater	6	14.6	112	8.6
	White Sands	2	4.9	11	0.8
SUBTOTAL		**41**	**99.7**	**1295**	**100.0**
2007	Boyes Drive I	1	1.8	1	0.1
	Cape Point	10	17.9	15	0.8
	Granger Bay *	1	1.8	3	0.2
	Hout Bay	9	16.1	821	45.6
	Kalk Bay	1	1.8	267	14.8
	Klein Slangkop	1	1.8	2	0.1
	Kommetjie	19	33.9	496	27.6
	Noordhoek	2	3.6	7	0.4
	Oceanview I	7	12.5	120	6.7
	Platboom	1	1.8	4	0.2
	Soetwater	2	3.6	14	0.8
	White Sands	2	3.6	49	2.7
SUBTOTAL		**56**	**100.2**	**1799**	**100.0**
2008	Cape Point	3	10.7	7	0.3
	Hout Bay	5	17.9	217	8.2
	Kalk Bay	1	3.6	48	1.8
	Kommetjie	8	28.6	382	14.5
	Millers Point	1	3.6	28	1.1
	Milnerton *	1	3.6	24	0.9
	Noordhoek	2	7.1	6	0.2
	Oceanview I	5	17.9	205	7.8
	Simon's Town	1	3.6	1703	64.7
	Soetwater	1	3.6	13	0.5
SUBTOTAL		**28**	**100.2**	**2633**	**100.0**
2009	Cape Point	4	9.8	20	0.9
	Glencairn	2	4.9	1015	45.7
	Hout Bay	8	19.5	100	4.5
	Kommetjie	12	29.3	247	11.1
	Mitchells Plain *	1	2.4	661	29.8
	Noordhoek	2	4.9	5	0.2
	Oceanview I	8	19.5	100	4.5
	Platboom	3	7.3	61	2.7
	Simon's Town	1	2.4	10	0.5
SUBTOTAL		**41**	**100.0**	**2219**	**99.9**
TOTAL		**297**	**100.0**	**10 401**	**100.0**

Notes: I = inland; * = Area not neighbouring TMNP

The first half of the study period experienced a quarter (24.6%; n = 73) of all the georeferenced incidents over the decadal period. These incidents occurred in 39 different areas of which eight were involved on per year over five years. The latter half of the study period experienced the remaining three quarters (75.4%) of incidents in the ten-year period and showed a greater number of areas where WCRL were impounded (n = 55), averaging 11 locations per year. Some 92.2% (n

= 9593) of the WCRL resources confiscated were reported between 2005 and 2009. Kommetjie was reported as an area in which WCRL confiscations occurred in nine of the ten years, and contributed 64 incidents and 15.8% (n = 1644) of the total number of resources confiscated over the decadal period. An average of 1040 lobsters were seized each year over the decadal period, although this figure was never reached in the first five years, as the average number of WCRL confiscated totalled only 162 between 2000 and 2004. The average number of rock lobster seized was 1919 for years 2005 through 2009. This indicates a significant difference between the first and second halves of the study period suggesting that the numbers of rock lobsters confiscated are increasing dramatically. Some 297 WCRL-related incidents recorded in the TMNP logbooks were referenced with the locations where the confiscations took place (Figures 5.2 & 5.3). Figure 5.2 reflects georeferenced locations of confiscation incidents over 2000 and 2001, whereas Figure 5.3 shows the locations where WCRL seizures took place between 2002 and 2009.

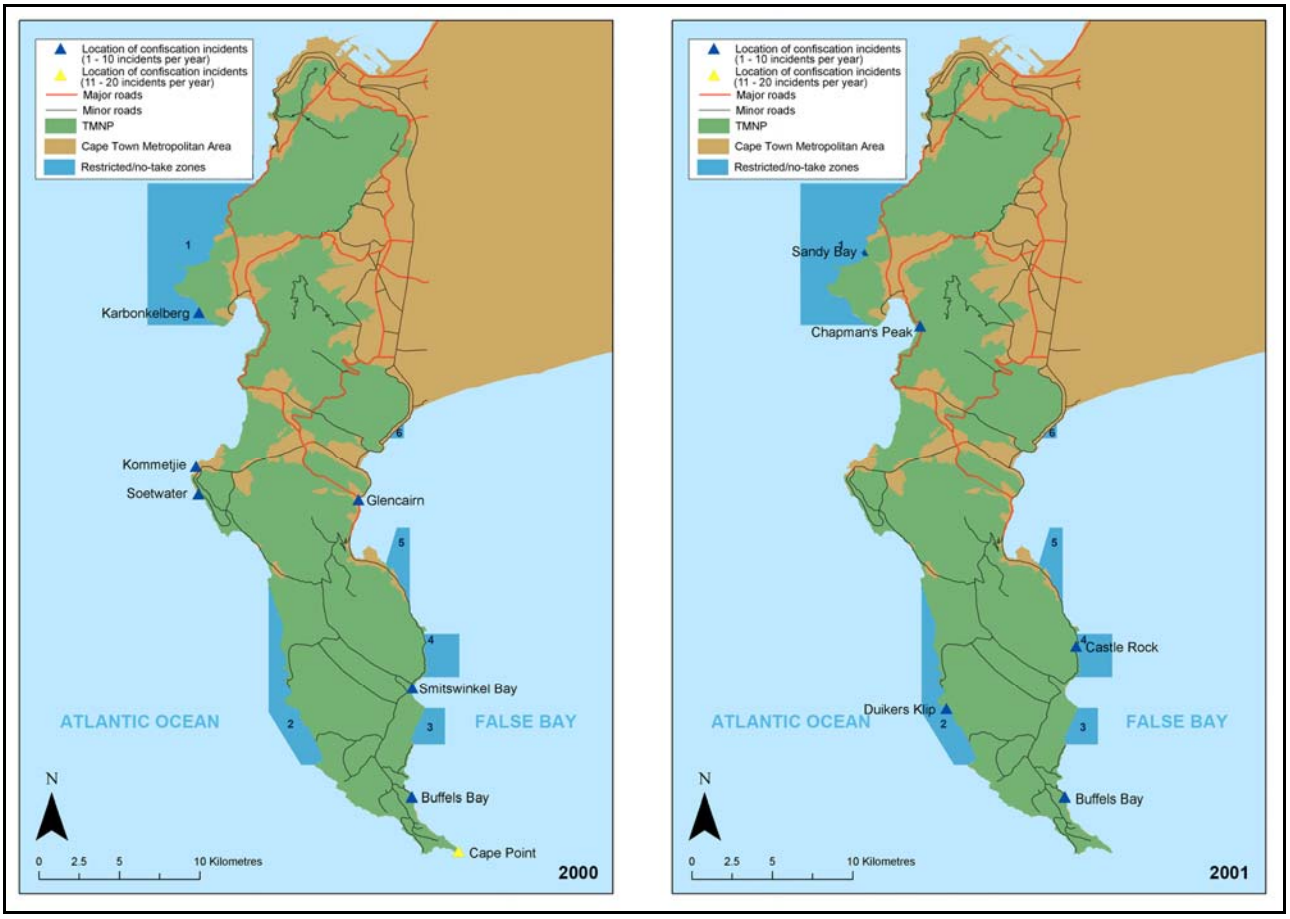


Figure 5.2: WCRL seizure incidents in the TMNP, 2000 and 2001

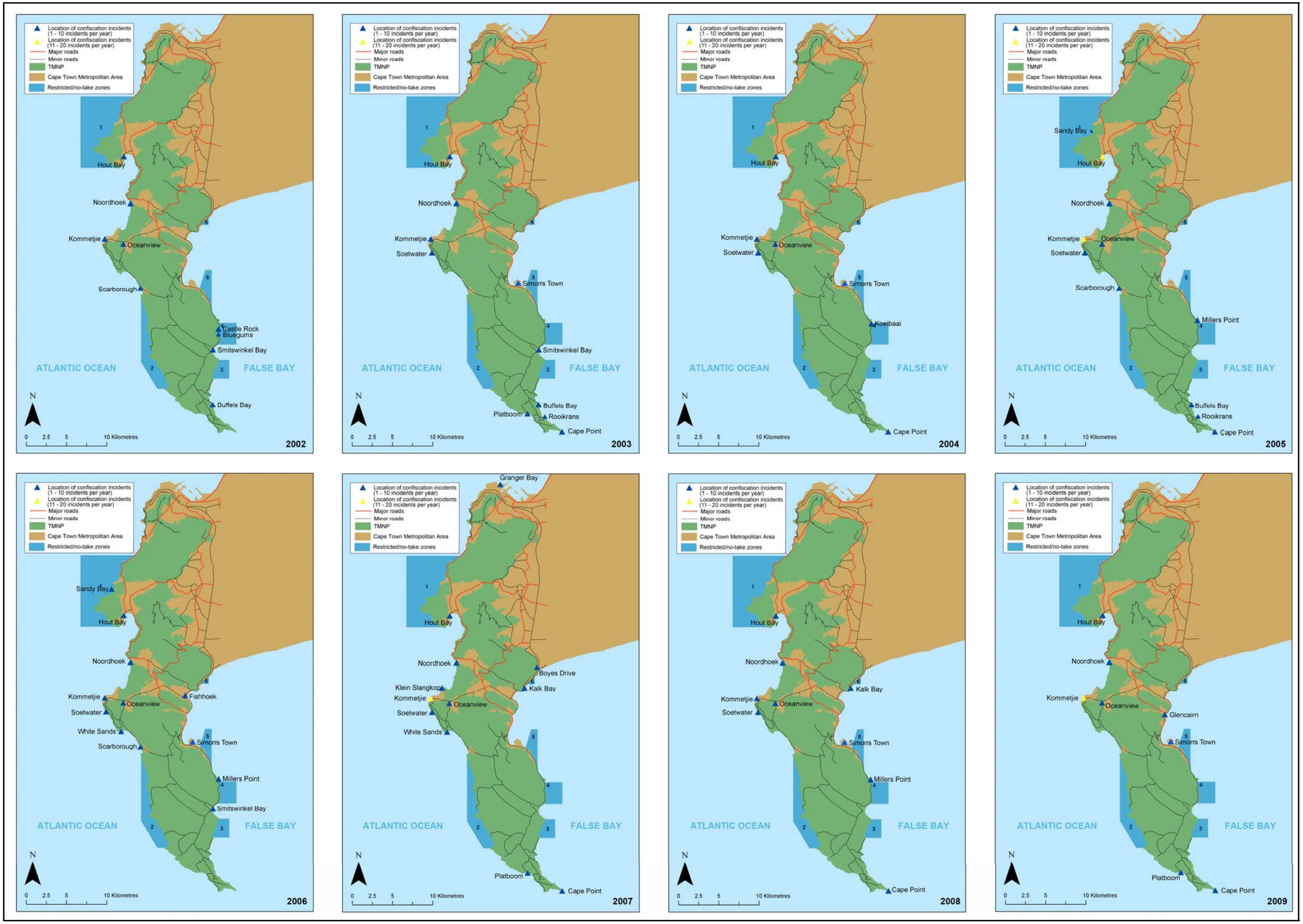


Figure 5.3: WCRL seizure incidents in the TMNP, 2002 to 2009

Only five of the 30 locations where WCRL confiscations took place (16.7%) were on major roads. This suggests that enforcement operations patrolling the minor roads were more successful at detecting poachers. Table 5.6 indicates the total number of WCRL-related incidents and the number of rock lobster confiscated per location.

Table 5.6: Total number of WCRL incidents and resources confiscated per area in the TMNP (decade 2000 - 2009)

Area where WCRL confiscation occurred		Total number of incidents per area	Number of incidents per area as percentage of total	Number of WCRL confiscated per area	Number of WCRL seized per area as percentage of total
Bluegums	E/4	1	0.3	13	0.1
Boyes Drive	I	1	0.3	1	0.0
Buffels Bay	E	7	2.4	41	0.4
Cape Point	E	43	14.5	201	1.9
Castle Rock	E/4	2	0.7	78	0.7
Chapmans Peak	W	1	0.3	3	0.0
Duikers Klip	E	1	0.3	17	0.2
Fishhoek	E	1	0.3	10	0.1
Glencairn	E	3	1.0	1019	9.8
Granger Bay	*	1	0.3	3	0.0
Hout Bay	W	48	16.2	2014	19.4
Kalk Bay	E/6	2	0.7	315	3.0
Karbonkelberg	W/1	1	0.3	5	0.0
Klein Slangkop	W	1	0.3	2	0.0
Koeël Bay	E/4	1	0.3	17	0.2
Kommetjie	W	76	25.6	1644	15.8
Millers Point	E	3	1.0	36	0.3
Milnerton	*	1	0.3	24	0.2
Mitchells Plain	*	2	0.7	663	6.4
Noordhoek	W	10	3.4	35	0.3
Oceanview	I	38	12.8	1018	9.8
Platboom	W	6	2.1	175	1.7
Rooi Els	*	1	0.3	30	0.3
Rooikrans	E	3	1.0	183	1.8
Sandy Bay	W/1	3	1.0	28	0.3
Scarborough	W	6	2.1	159	1.5
Simon's Town	E	6	2.1	1799	17.3
Smitswinkel Bay	E	5	1.7	135	1.3
Soetwater	W	19	6.4	673	6.5
White Sands	W	4	1.3	60	0.6
TOTAL		**297**	**100.0**	**10 401**	**99.9**

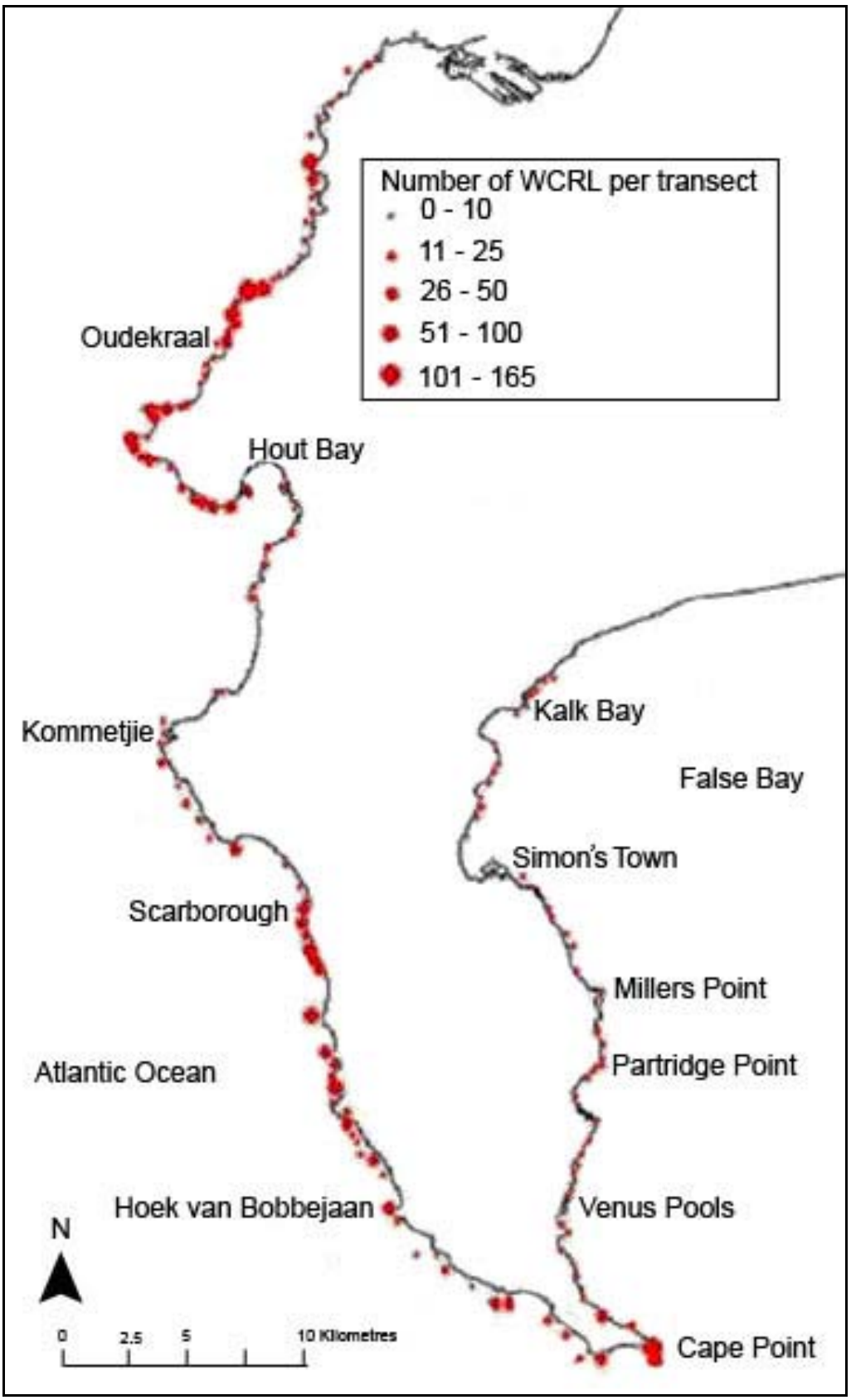
Notes: E = east coast (False Bay) of TMNP; W = west coast of TMNP; 1 = Karbonkelberg Restricted Zone; 2 = Cape of Good Hope Restricted Zone; 3 = Paulsberg Restricted Zone; 4 = Castle Rock Restricted Zone; 5 = Boulder's Restricted Zone; 6 = St James Restricted Zone; I = inland; * = area not neighbouring TMNP

It is noteworthy that unlike abalone confiscations, WCRL seizures occurred in 12 locations each on the east and west coasts of the park, but the east-coast areas reported 77 incidents of WCRL impoundments, while the west-coast areas had two-and-a-quarter (176) times more confiscations over the ten years. The number of resources confiscated on each side of the Cape Peninsula showed smaller differences, with only 46% (n = 4798) being seized on the west coast. Notably, 9.8% of all the confiscated rock lobster was commandeered inland in Oceanview. The average number of WCRL seized per area amounted to 347. This is no doubt as a result of increased compliance checks at Kommetjie, Noordhoek and Hout Bay, as well as enforcement operations in Oceanview and Soetwater.

Complementing the TMNP data, respondents in the WCRL fisher group stated that their primary areas of harvest were in and around Kommetjie and Oudekraal (in the Karbonkelberg sanctuary). Rastafarians ventured farther in search of fishing grounds, targeting the resource in areas between Scarborough and Cape Point. Park officials intimated that rock lobsters were fished more frequently around Hout Bay and Kommetjie, which coincides with responses from the WCRL fishers interviewed. The results from surveys completed by fishers and park management support the evidence in SANParks logbooks, namely that confiscations at Kommetjie contributed 25.6% of the total number of WCRL commandeered from illegal fishers, while Hout Bay contributed a further 16.2% to the decadal total. Another explanation for the high incidence rates occurring in Hout Bay and Kommetjie probably relates to resource abundance in these areas shown in Figure 5.4 where the greatest abundances of rock lobsters clearly occurred between Oudekraal and Hout Bay, and between Scarborough and Hoek van Bobbejaan in the Cape of Good Hope no-take zone.

According to Figure 5.4, the areas around Cape Point showed high numbers of rock lobsters per transect. Rock lobsters were scarce in False Bay because the water is typically several degrees warmer than the areas on the west coast (Mayfield et al., 2001). The findings of the stock assessment (Mayfield et al., 2001) support the TMNP data in that fishers tend to poach in areas having a greater abundance of lobster. The slipways at Hout Bay and Kommetjie act as gateways to accessing the areas where rock lobster are in abundance, and they are thus targeted by law enforcement officials who check for permit compliance to ensure that the recreational fishery is not being overexploited.

When comparing the annual maps with the baseline assessment's findings, note that the areas with high levels of confiscations on the maps are not necessarily where the poaching of rock lobsters occurs. Most WCRL fishers do not stray far from slipways where their boats are launched, as the nearby lobster populations are still able to support their fishing efforts. The future could see these recreational fishers moving farther south from Hout Bay and Kommetjie into marine protected areas in search of more fruitful fishing grounds (Nortier 2009, pers com; Liedeman 2009, pers com). Currently, as per the TMNP logbook entries, only 11 locations are in restricted no-take zones and they contributed just 4.5% (n = 473) to the total number of seized lobsters over the decade under review.



Source: Mayfield et al. (2001)

Figure 5.4: Distribution and abundance of *Jasus lalandii* assessed from underwater transects, 2000

To assess the success of the current reserve network at a basic level, the total number of each species found in areas where it receives protection was compared by Mayfield et al. (2001) to the total for each species in areas where exploitation is permitted. Of all the rock lobsters encountered in the entire survey, 73.5% were counted in areas in which they received protection. However, it was concluded that the rock-lobster resource was far below pristine levels. Spawner biomass lay at about 6% and the fishable biomass was just 4% of pre-exploitation levels. These figures are alarming given the current levels of resource exploitation.

5.5 Conclusions about WCRL

With the resource population estimated to be at 4% of pristine rates, rock lobsters need all the protection that they can be afforded through adequate and efficient enforcement and compliance efforts (Mayfield et al., 2001). During times of resource crisis, emphasis is increasingly placed on the role of law enforcement to sustain the formal fishery (Hauck, 2009), which has been the case historically, through enforcing new regulations and laws (Van Sittert, 1994). With increasing concerns over reductions in the TAC, and barefaced informal fishing, there is persistent pressure from resource managers, scientists and industry, for government to enhance law-enforcement capacity and effectiveness within the WCRL fishery (Hauck, 2009). Strategic meetings and workshops have been initiated by the WCRL commercial sector as a means to catalyse resource managers to implement plans for increased law enforcement along the coast (Branch, Hauck & Smith, 2007). However, frustration remains high as little progress has been achieved, with community member's often disregarding enforcement and compliance operations.

The results of this study highlight the blatant disregard for compliance in the WCRL fishery, which points to an uncertain future for the sustainability of this fishery. WCRL found along the Cape Peninsula's coasts, and particularly those in TMNP waters, are probably second only to abalone in their need for conservation (Mayfield & Branch 2000; Mayfield et al., 2001). Current estimates of national poaching suggest that 400 to 500 tonnes are fished illegally annually, though some believe this to be an underestimate (Mayfield *et al.*, 2001; Branch, Hauck & Smith, 2007). Findings of this study point to over two tonnes of rock lobster resources confiscated from illegal fishers over the period of a decade. This is only the tip of the iceberg, as the numbers of poachers going undetected far exceed those that are ever apprehended by officials (Nortier 2009, pers com). Responses from WCRL fishers interviewed in the study further suggest that the recorded figures kept by SANParks officials are marginal to what is being poached. A major benefit to enforcement operations is that it appears that the majority of poaching occurs in the summer and autumn months, allowing officials to focus efforts compliance checks during these seasons.

However, officials believe that without the proper adaptive-management structures and community support, baseline population data and illegal catch figures, the nature and scale of the informal WCRL fishery may well go the way of the illicit abalone trade (Nortier 2009, pers com; Liedeman 2009, pers com). This must be avoided at all costs, as the socio-economics and environmental systems that depend on the resource are too intertwined to cope with a collapse. Perhaps only time will tell what the outcome will be, but the enforcement agencies cannot simply sit back and wait for this to happen (Liedeman 2009, pers com). It is of vital importance to collect further biological and fisheries data across various spatial and temporal scales that aim to properly manage the

exploitive activity of fishing. We require an understanding of how the exploited population responds to fishing pressure and how fishermen respond to changing abundance on a useful scale (Tewfik & Béné, 2004), which will ultimately affect their access to the rock-lobster resource.

A concern that has emerged from this research is the issue of access to the resource through equitable user rights. All of the WCRL fishers interviewed feel alienated and disenfranchised by the current management structures involving fisheries in South Africa and that fishers are persecuted for undertaking what they believe to be historical practices. The WCRL industry has long provided opportunities for the local inhabitants of the province, although the informal users have grown in number, so much so that they are now a fully recognised entity in the small-scale fishing industry. These small-scale fishers contend that the informal trade will continue to grow in size and sophistication as a result of their exclusion from formal access rights (Hauck, 2009). With growing concerns over the sustainability of the resource, and annual cuts in the commercial TAC and formal fisheries since 2005, the sentiment is that a crisis is looming. Further, the collapse of the commercial abalone fishery has resulted in more fishers turning to the rock-lobster resource as a viable source of income (Hauck, 2009). Now at a critical turning point, an understanding of the dynamics in the formal and informal WCRL fisheries is necessary to avoid the fate that befell the abalone fishery. This chapter further satisfies objectives two and three, by determining the quantities of WCRL confiscated temporally and spatially in the TMNP. Chapter four's objective was attained by distinguishing the users of this resource and the stakeholders involved in its exploitation and management. The following chapter hopes to complete objectives two through four by looking at the remaining marine resources confiscated in the TMNP.

CHAPTER 6: A FISH OUT OF WATER – SHELLFISH, FINFISH AND BAIT CONFISCATIONS

Chapter 6 reports on the confiscations of finfish, bait and shellfish in the TMNP from 2000 to 2009. The total numbers of expropriated resources are reported and statistically analysed. Spatial patterns of confiscations in the park are graphically illustrated for the ten-year period using GIS. Subsistence fishers and rangers and managers of the TMNP offer additional insight into the illegal collection of marine resources in the park's boundaries.

6.1 Introduction

On a global scale shellfish have been exploited by humans for thousands of years (Underwood, 1993; Sharpe & Keough, 1998) and the potential ecological impacts of such use are well recognised (Keough, Quinn & King, 1993; Sharpe & Keough, 1998). The popularity of shellfish in both ancient communities and among today's coastal populations is mainly because they were, and still remain in many countries, an open-access resource, an excellent source of protein and they are high in essential minerals (Beaumais & Appéré, 2010). Traditional intertidal shellfish gathering has been a custom among coastal inhabitants in southern Africa for millennia and it is still practised by indigenous peoples in many coastal areas (Siegfried, 1988). The organisms collected are used for food, in traditional medicines, in cultural practices, and as income generators (Kyle et al., 1997).

The coastline of South Africa is still heavily impacted by subsistence harvesters who gather a variety of shellfish and finfish species (Dye, Lasiak & Gabula, 1997). Here and in other parts of the world, the consequences of such harvesting can be severe, affecting not only the target species but also other species that are impacted indirectly (Branch & Odendaal, 2003). In South Africa, harvesting of intertidal resources is concentrated in northern KwaZulu-Natal and the Eastern Cape (the former Transkei) (Hockey, Bosman & Siegfried, 1988; Lasiak, 1992; Kyle et al., 1997). The majority of contemporary research on shellfish harvesting in South Africa has thus looked at coastal communities residing in these areas, with little investigation undertaken in the Western Cape. Primarily, this is because the shores in this region have been subject to substantially less exploitation, owing to its low human population density until fairly recently (Robinson et al., 2008). Secondarily, it was perhaps never considered a livelihood strategy in coastal communities in the Western Cape, or conceivably, there were other socio-economic or environmental grounds for little assessment being made of the harvesting strategies of shellfish by Western Cape subsistence fishers. The aim of this chapter is to contribute to the existing literature on marine resource harvesting in the Western Cape, and in particular the TMNP, by considering confiscation records maintained by SANParks.

6.2 The history of shellfish and finfish collection in the Western Cape

Shellfish and finfish have been consumed by people for thousands of years (Beaumais & Appéré, 2010). Despite arguments about the exact dates and the intensity of coastal resource use in human prehistory, it now appears that intertidal species have been used by hominids as sources of food

dating to the Middle Pleistocene[5] (McBrearty & Brooks, 2000; Bird et al., 2002). Shellfish harvesting dating to 70 000 years ago has left evidence that more species have been collected along the Cape coast than are reported in this study. Analyses of shellmiddens along the west coast of South Africa show that coastal hunter-gatherers exploited at least two species of crustaceans among a dozen other invertebrate species. Species included subtidal barnacles (*Austromegabalanus cylindricus* and *A. cylindricus*), black mussels (*Choromytilus meridionalis*) and limpet species (*Patella barbara* and *P. argenvillei*) (Jerardino, 1995; Jerardino & Navarro, 2002). Evidence found in shell middens records black and white mussels, limpets, whelks, barnacles and WCRL (Halkett et al., 2003). Other archaeological digs in the Western Cape have uncovered seven limpet species harvested regularly by ancient hunter-gatherers (Jerardino & Navarro, 2002). These records indicate that shellfish played a major dietary role in the lives of the province's early inhabitants. Debates centred on ancient coastal diets and the relationships between marine resource exploitation and intertidal environments have been based largely on analyses of variability in shellmidden assemblages (De Boer, 2000; Bird et al., 2002).

Although historical evidence suggests that marine resources (shellfish, finfish and bait species) were harvested by coastal dwellers along the west coast of South Africa at least 50 000 years ago, colonial exclusion from the 17th century onward only allowed whites to enter the commercial and recreational sectors thus creating an informal sector of designated non-white poachers (Jerardino & Navarro, 2002). Recent research by Hauck (2009) suggests that small-scale fisheries such as shellfish and finfish collection still play important roles in meeting food needs in coastal communities, especially in poorer non-white communities, and are an integral part of their cultural tradition. The next section reports the species harvested in the TMNP over the decadal period of this study, and offers discussions of the various elements involved with shellfish, finfish and bait collection.

6.3 Analyses and interpretation of other marine resource confiscations

The results presented in this section are based on data collected from the offence registers maintained by the TMNP rangers for the period 2000 to 2009. The target species are presented, indicating the diversity of marine organisms that are illegally harvested in the park. Three resource groups are delineated, namely finfish, bait and shellfish species. The number of confiscation events and resources seized from subsistence fishers are reported and discussed for each of the groups, followed by the seasonality patterns noted over time.

6.3.1 Species targeted

In the records documented in the offence registers maintained by the TMNP officials there are 13 harvested shellfish species, 14 finfish species and four species of bait are identified (Table 6.1). This list is consistent with the findings of shellfish harvester surveys in which target species included brown and black mussels, limpet species, crabs, alikreukel and octopuses. Perceptions garnered from park officials of what shellfish species are collected include black mussels, limpets,

[5] The Middle Pleistocene epoch lasted from ca. 781 000 to 126 000 years ago.

Venus ear (*Haliotis spadicea*), alikreukel and oysters (*Crassostrea gigas*). Notably, oysters and Venus ear were not recorded in the offence registers.

Table 6.1: Shellfish, finfish and bait species harvested in the TMNP

	Scientific name	Common name
Shellfish	*Choromytilus meridionalis*	Black mussel
	Cymbula spp	Limpet species
	Helcion spp	Limpet species
	Octopus vulgaris	Common octopus
	Ocypode ryderi	Pink ghost crab
	Perna perna	Brown mussel
	Plagusia chabrus	Red rock crab
	Scutellastra spp	Limpet species
	Turbo sarmaticus	Alikreukel
Finfish	*Argyrosomus inodorus*	Silver kob
	Argyrosomus japonicus	Dusky kob
	Atractoscion aequidens	Geelbek
	Chrysoblephus laticeps	Red Roman
	Clinus superciliosus	Super klipvis
	Dichistius capensis	Galjoen
	Diplodus capensis	Cape white seabream
	Helicolenus dactylopterus	Jacopever
	Pachymetopon blochii	Hottentot
	Pomatomus saltatrix	Shad
	Poroderma africanum	Pyjama shark
	Sardinops sagax ocellatus	Pilchard
	Seriola lalandii	Yellowtail
	Thunnus albacores	Yellowfin tuna
Bait	*Eunice aphroditois*	Wonder-worm
	Galaxias spp	Whitebait species
	Pseudonereis variagata	Mussel worm
	Pyura spp	Red bait

Source: TMNP offence registers

A decadal analysis of subsistence and small-scale fisheries in South Africa by Sowman (2006) found that limpets, polychaete bait worms, mussels, oysters, winkles, rock lobsters, abalone, octopuses, redbait, bivalves, crabs, and various fish species were targeted by communities that access the intertidal shore zone. The most common bait organisms used in the TMNP are red bait, sardine, white mussel, harders, sand prawns, mud prawns, blood worm, wonder worm, mussel worm, coral worm, squid, octopus, crabs and black mussel (Clark, 2001). Many of the results reported in Clark's (2001) and Sowman's (2006) papers coincide with those of this study. The following subdivisions focus on the three resource types in turn.

(i) Shellfish. Intertidal shellfish are especially vulnerable to human predation because most are sessile, predictable, and require little specialised technology to exploit (Erlandson et al., 2008). The majority of the shellfish reported in this study are located within the tidal flats on rocky shorelines, which are easily exploited systems. The number of shellfish-related confiscation events and the amounts of resources seized annually are shown in Table 6.2. Low percentages were noted for both the number of events and resources confiscated from 2000 through 2006, excluding

records for 2001, which yielded the second highest percentage contribution of shellfish seizures, 18.7% (n = 297) over the decadal period. The first half of the study period contained only 40% of the total number of shellfish confiscations. An increase in resource expropriation was reported in 2007, 2008 and 2009, with over 48% of shellfish requisition occurring over these three years (n = 7700). Over the 10-year study period 15 831 shellfish were commandeered by the TMNP officials during 109 confiscation incidents.

Table 6.2: Shellfish-related incidents and numbers of resource confiscated in the TMNP, 2000 to 2009

Year	Number of confiscation incidents	Number of confiscations per year as percentage of decadal total	Number of shellfish confiscated	Number of shellfish confiscated per year as percentage of decadal total
2000	4	3.7	619	3.9
2001	15	13.8	2967	18.7
2002	1	0.9	12	0.1
2003	17	15.6	1302	8.2
2004	7	6.4	1229	7.8
2005	9	8.3	817	5.2
2006	9	8.3	1185	7.5
2007	12	11.0	2183	13.8
2008	17	15.6	2526	16.0
2009	18	16.5	2991	18.9
TOTAL	**109**	**100.1**	**15 831**	**100.1**

Informal shellfish harvesting is generally difficult to quantify because the harvesting is carried out by many, often illiterate, individuals along long stretches of inaccessible coastline (Kyle, Robertson & Birnie, 1997). Collectors return directly home with their catches and there are no landing- or checkpoints at which the catch can be assessed (Kyle, Robertson & Birnie, 1997). This applies to shellfish harvesting in the TMNP too, as patrolling of the rocky intertidal zone is often neglected by park officials who focus law enforcement and compliance efforts on abalone and WCRL fisheries, allowing harvesters an unabated opportunity to collect shellfish (Nortier 2009, pers com). Additionally, there are no dedicated points at which rangers can inspect the haul, making the assessment of the scale of illegal shellfish fishery in the park very difficult to quantify. As a result, little is known about the extent of harvesting and the effect such harvesting has on the stocks.

Totalling only 109 records in the park's offence registers, shellfish harvesting can either be seen as non-intrusive or as a non-priority area for management and law enforcement. The number of confiscation events (n = 1) and the amount of seized resources in 2002 (n = 12) was an unexpected anomaly, which contributed 0.1% to the total number of impounded shellfish between 2000 and 2009, given that the annual average was 1583 commandeered resources. It is highly improbable that so few shellfish-related harvesting activities took place over the ten-year period, suggesting either that enforcement officials were unfocused on compliance of the resource type in favour of other marine species or that they were unsuccessful in detecting illegal fishers.

This study's results show that the number of shellfish removed annually has been increasing rapidly since 2005. Park officials see this tendency in practice and they have submitted that

shellfish harvesters are collecting resources as a free source of protein in recessionary times (Nortier 2009, pers com). Sowman & Cardoso (2010) acknowledge that troubling socio-economic conditions elicit communities to harvest from these open-access resource bases. Other park officials suggest that the increase in confiscated resource figures is as a result of the improvements in law enforcement along the areas where shellfish harvesting takes place (Buchmann 2009, pers com). Whatever the case for this increase in confiscations over time, shellfish populations in the intertidal zones in other areas of South Africa are said to be more heavily impacted than those in the TMNP. This may be due to the extreme reliance on the resource base by local communities (Sowman, 2006), or the numbers of communities targeting the resource over time (Lasiak, 1992; Kyle et al., 1997; Kyle, Robertson & Birnie, 1997).

Fishers from two communities were called upon to corroborate with the findings of the study. Responses from Rastafarian fishers interviewed showed that collectors removed on average enough shellfish species to fill seven standard-sized shopping bags on an annual basis. The seven WCRL fishers that took part in marine-species harvesting (other than WCRL) estimate that they removed a collective yearly total of 1100 mussels, 200 limpets, 50 alikreukel and 20 octopuses. The numbers of resources claimed to be harvested annually complement those identified in offence registers, given the size of the population surveyed. These resources are consumed within the household, or sold or bartered locally with other community members. Park officials believed that an average of 9000 mussels, 3000 alikreukel and 2000 limpets were poached annually from in the TMNP. The figures offered by the TMNP rangers and managers may be more representative of the scale of the poaching problem, than what is being reflected in logbooks.

Shellfish resources are important sources of income and protein for traditional inhabitants of coastal zones. A review by Sowman (2006) of the Western Cape region reveals that 43% of subsistence households in this province were identified as food insecure, thus forcing the communities into marine resource collection. This is evident in many informal settlements and poorer residential areas surrounding the TMNP whose inhabitants not only collect shellfish, but bait and finfish resources too. The next section focuses on finfish harvesting in the park.

(ii) Finfish. Linefishing in all regions of South Africa, as well as fishing from non-motorised boats in the Western Cape were deemed suitable for subsistence, small-scale commercial and recreational sectors in Sowman's (2006) study. The records presented in this section refer to finfish species caught by recreational or subsistence fishers. During the decadal period of this study there were a total of 62 finfish-related confiscations, averaging only 6 incidents annually (Table 6.3). The second half of the study period yielded a total of 63% of seizure events, despite no reported cases during 2006. A total of 492 finfish were commandeered over the 10-year period, averaging just under 50 fish per year. The percentage contributions for 2009 (n = 220) and 2005 (n = 110) tallied 67.1%., while for each of the other years there was a contribution of less than 10% to the overall total of confiscated resources.

Table 6.3: Finfish-related incidents and numbers of resource confiscated in the TMNP, 2000 to 2009

Year	Number of confiscation incidents	Number of confiscations per year as percentage of decadal total	Number of linefish confiscated	Number of linefish confiscated per year as percentage of decadal total
2000	6	9.7	30	6.1
2001	1	1.6	3	0.6
2002	1	1.6	5	1.0
2003	11	17.7	31	6.3
2004	4	6.5	13	2.6
2005	14	22.6	110	22.4
2006	0	0.0	0	0.0
2007	7	11.3	39	7.9
2008	12	19.4	41	8.3
2009	6	9.7	220	44.7
TOTAL	**62**	**100.1**	**492**	**99.9**

In the past there have been sporadic attempts to quantify the rocky-shore harvest of finfish by indigenous peoples along the South African coast (Lasiak, 1992) and there are several reports examining the effects of such harvesting on rocky-shore communities (Siegfried, Hockey & Crowe, 1985; Hockey, Bosman & Siegfried, 1988). Estimates of the total harvest have generally been based on extrapolations from short-term surveys and the effect of the harvesting has been assessed by comparing either community or population size structures in impacted and unimpacted sites (Siegfried, Hockey & Crowe, 1985; Hockey, Bosman & Siegfried, 1988; Lasiak, 1991; Kyle et al., 1997; Kyle, Robertson & Birnie, 1997). These assessments have never been undertaken in the TMNP, and thus there is no indication of the levels of pressure placed on the resources by fishers. It is generally difficult to quantify finfish harvests, particularly small-scale subsistence fisheries that operate continuously through the year, use a variety of gear types, catch multiple species and have multiple landing sites (Craig, Green & Tuilagi, 2008). Additionally, historical catch or harvest data is rarely available. Data relating to such informal fishing activities is difficult to collect because compliance controls are almost impossible to implement (Kyle et al., 1997; Kyle, Robertson & Birnie, 1997). Subsistence fisheries are therefore often underestimated and their impact is almost unknown mainly because this activity is difficult to assess directly by monitoring fishing efforts and landing surveys (Labrosse, Ferraris & Letourneur, 2006). The objectives of this section are to improve the data on finfish harvesting in TMNP over the study period by looking at the offence registers maintained by the TMNP officials.

Given the collapsed state of many linefish species, fisheries scientists recommended severely reduced effort quotas (number of allowable catch per species) when rights were allocated (Griffiths, 2000; Attwood et al., 2000). As a result, the state has sharply reduced numbers of permits allocated to the traditional linefishers of the Western Cape, and has required that subsistence fishers who wish to undertake linefishing, purchase a recreational licence and comply with recreational permit restrictions (such as bag limits, closed seasons and no sale) (Cockcroft et al., 2002; Sowman, 2006). In the parts of the TMNP where linefishing is permitted, permits are required. This could be the justification for there being so few confiscation events over the decadal period of this study, with none of the years showing more than 14 records of finfish seizures. There

were some years with only one finfish-related incident (2001 and 2002), while in 2006 there we no reported events of commandeered illegally-caught finfish. Although there were few events, there were some surprising anomalies in the numbers of resources appropriated. The most alarming of these was seen in the final year of this study when 220 finfish were seized in just 6 confiscation events which represented nearly one quarter of linefish-related confiscations. There was a similar experience in 2005 when 110 fish were commandeered from recreational or subsistence fishers over 14 compliance incidents. In the remainder of the years under review it is unclear whether there was a greater level of compliance by resource harvesters, or if enforcement officials were less focused on linefish-related events, or if fishers who poached finfish resources went undetected.

The WCRL fishers and Rastafarian respondents who took part in the fisher surveys reported that they caught 130 linefish illegally on an annual basis. The records for 2005 in the TMNP offence registers are the only ones similar those declared by known poachers (n = 110). The number of documented resources seized in 2009 exceeds this value, which is expected given the size of the fisher population interviewed. For the remainder of the years under review, there is gross underreporting. It can be concluded that the total number of finfish taken away from poachers annually, as reported in the TMNP logbooks, is not representative of the scale of activities in the field. More compliance and enforcement emphasis therefore needs to be focused on the recreational and subsistence sectors of the linefish fishery in the park. The park officials interviewed did not consider linefish a priority enforcement concern in the TMNP (Nortier 2009, pers com). In fact, the 12 SANParks respondents who recorded linefish as resources caught illegally mentioned only three species – hottentot, snoek and galjoen. These species of linefish are often caught with bait organisms harvested in the intertidal zone.

(iii) Bait. Fishers make use of a wide variety of marine-bait organisms to catch other more desirable species. Marine-bait organisms harvested by fishers in the Cape Peninsula's waters include a large number of different species, some of which are used exclusively as bait, whereas for others only the excess or individuals too small to be consumed are used as bait (Clark, 2001). There were 975 bait organisms seized during only 12 confiscation events over the decadal period of this study, averaging less than 100 resources per annum (Table 6.4). There were no years that exceeded three confiscation incidents, while 2002, 2004, 2009 yielded no bait-related incidents whatsoever. The annual totals were also variable, with only three years recording resource seizures of more than 10, namely 2000 (n = 560), 2007 (n = 125) and 2008 (n = 256). The percentage contributions of these three years totalled 96.5% (n = 941).

Kyle, Robertson & Birnie (1997) name the most commonly targeted species in South Africa as mussels (*Perna perna*), oysters (*Striostrea margaritacea* and *Saccostrea cucullata*), the large tunicate (*Pyura stolonifera*), limpets (*Patella* spp.) and barnacles (*Tetraclita squamosa rufotincta*), all of which are associated with rocky shores. Their finding agrees with that of this study, suggesting that intertidal harvesters are selective in their collecting habits, targeting species that are suitable bait species for other target species and/or those that deliver the most protein value for the effort exerted during harvesting activities. The results also indicate that the intertidal environments throughout South Africa contain similar species composition.

Table 6.4: Bait-related incidents and numbers of resource confiscated in the TMNP, 2000 to 2009

Year	Number of confiscation incidents	Number of confiscations per year as percentage of decadal total	Number of bait confiscated	Number of bait confiscated per year as percentage of decadal total
2000	3	25.0	560	57.4
2001	1	8.3	10	1.0
2002	0	0.0	0	0.0
2003	1	8.3	10	1.0
2004	0	0.0	0	0.0
2005	1	8.3	10	1.0
2006	1	8.3	4	0.4
2007	2	16.7	125	12.8
2008	3	25.0	256	26.3
2009	0	0.0	0	0.0
TOTAL	**12**	**99.9**	**975**	**99.9**

Responses from the surveys done among illegal fishers yielded similar species descriptions. The value of these resources to fishers was also reported as significantly less than other more valuable resources, such as shellfish and WCRL. Collectively, individuals interviewed from the WCRL fishing community believed that they collected only 35 bait organisms per year. Fishers intimated that the time taken to collect bait species from the intertidal zone did not yield sufficient numbers of organisms to justify the effort required. These figures are an underestimation of what is recorded in TMNP logbooks. The Rastafarian respondents often resorted to collecting bait, as many could not afford purchasing conventional fishing bait such as pilchards or sardines. This group reported to collect four shopping-bags full of bait organisms per annum, which is more in line with numbers documented in the TMNP record books. Although the Rastafarians collect more bait organisms compared to the WCRL fishers, this activity is seen as a non-priority activity by both communities. This fishery is also given little priority by the TMNP officials, who consider the scale of bait-collecting activities to not warrant compliance and enforcement operations (Nortier 2009, pers com). None of the park's staff interviewed reported bait organisms as marine species poached in the TMNP, further implying that these resources are either not considered a poaching problem, or are not central to marine compliance policy and practice. The results of statistical analysis of data on the combined shellfish, finfish and bait species are reported next.

6.4 Non-parametric correlation coefficient of other marine resources

Spearman's correlation testing was done for the combined additional marine resources impounded by the TMNP officials over the decadal period, as the individual totals for confiscated resources in each group were too small to perform statistical analyses on. Spearman's test yielded a moderately high, positive correlation (0.43) suggesting that there was a reasonable increase in the number of other marine resources confiscated over time. There was no significance in the data for this resource group ($p = 0.21$). Even though it is imperative to discern the number of resources being impounded and the success of confiscation events, which attempt to estimate the scale of the subsistence shellfish, finfish and bait fisheries in the TMNP, it is even more essential to understand the seasonality of harvesting in the park, so as to serve to inform policy and compliance operations in the park.

6.5 Monthly and seasonal patterns in the confiscations of other marine resources

The identification of any seasonal trends in intertidal harvesting is complicated by cultural and social facets of coastal community life that have no bearing on shellfish, finfish or bait stocks or the environment, and also vary with the species collected (Kyle et al., 1997; Kyle, Robertson & Birnie, 1997). This section attempts to unearth potential patterns in seasonal marine resource harvesting in the TMNP over the ten-year study period.

Information about the monthly marine resource-related incidents is marshalled in Table 6.5. It is important to note if there are individual monthly anomalies in shellfish, finfish or bait harvesting, but one can obtain a more representative picture of monthly events by comparing each of the resource types with the total for all seizures in the combined group. Confiscation incidents over the ten-year period were highest for shellfish in March (n = 23), representing over one fifth of all shellfish-related confiscations. The lowest total was recorded for May (n = 2). There was an average of 10.9 shellfish-related confiscations each month over the study period. When looking at the patterns in linefish-related impoundments, there were no monthly totals that exceeded 10 confiscation events throughout the study period. The number of bait organisms commandeered per month was even less than the other two resource types, with decadal monthly totals never exceeding five and seven of the 12 months showing no confiscation events throughout the study period. When one looks at the combined totals for all three resource types, more meaningful results are obtained (Table 6.5), with an average of 18 events per month measured over the 10-year period. Although monthly totals are important considerations, seasonal data is more likely to represent fisher behaviour.

Discerning of any seasonal patterns can be accomplished by combining the totals of the three months constituting each season (Table 6.6). For shellfish-related events, spring and summer yielded the same percentage value of 25.7%, while autumn is the most prominent season for seizures (33.9%). The winter months contributed less than 15% to the total. Seasonal averages amounted to nine shellfish-related offences per three-month period. When exploring the seasonal incidences in illegally caught finfish apprehensions, it is evident that finfish impoundments occurred more in summer (37.1%) than any other season. The combined total of finfish-related confiscation events for summer and autumn (n = 40) accounted for 64.5% of the overall seasonal contributions. Three quarters of bait-related events occurred during summer with autumn and winter contributing the remainder. The all-type figures for summer (n = 60) and autumn (n = 56) over the study period indicate that 63.4% of confiscations occur in these two seasons. The justification why summer and autumn harvesting is more prevalent is that the seasonal weather and ocean conditions are more suited to harvesting marine resources on the rocky shore. In addition, compliance operations could prove more successful over these periods, given the increase in daylight hours that could result in greater levels of compliance checks (Nortier 2009, pers com). To corroborate these findings, subsistence fishers from the WCRL and Rastafarian communities surrounding the TMNP were interviewed. These individuals claimed to shape much of their harvesting activity around seasonal parameters, such as time of day and weather conditions. Although shellfish collection is believed to be opportunistic (Buchmann 2009, pers com), only two (7.1%) of the respondents were not governed by diurnal hours, while three (10.7%) of the 28 interviewees would collect marine resources regardless of the weather.

Table 6.5: Monthly numbers and averages of other marine resource-related confiscations per month in the TMNP (decade 2000 - 2009)

	Shellfish			Finfish			Bait			All types		
Month	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**	**Number of confiscation events**	**Percentage contribution**	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**	**Average number of confiscation events per month**	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**
January	14	12.8	1.4	8	12.9	2	16.7	0.2	0.8	24	13.1	2.4
February	6	5.5	0.6	2	3.2	2	16.7	0.2	0.2	10	5.5	1.0
March	23	21.1	2.3	6	9.7	0	0.0	0.0	0.6	29	15.9	2.9
April	8	7.3	0.8	9	14.5	0	0.0	0.0	0.9	17	9.3	1.7
May	2	1.8	0.2	5	8.1	0	0.0	0.0	0.5	7	3.8	0.7
June	4	3.7	0.4	2	3.2	1	8.3	0.1	0.2	7	3.8	0.7
July	10	9.2	1.0	3	4.8	0	0.0	0.0	0.3	13	7.1	1.3
August	6	5.5	0.6	2	3.2	0	0.0	0.0	0.2	8	4.4	0.8
September	10	9.2	1.0	6	9.7	0	0.0	0.0	0.6	16	8.7	1.6
October	12	11.0	1.2	4	6.5	0	0.0	0.0	0.4	16	8.7	1.6
November	10	9.2	1.0	6	9.7	2	16.7	0.2	0.6	18	9.8	1.8
December	4	3.7	0.4	9	14.5	5	41.7	0.5	0.9	18	9.8	1.8
TOTAL	**109**	**100.0**	**10.9**	**62**	**100.0**	**12**	**100.1**	**1.2**	**6.2**	**183**	**99.9**	**18.3**

Table 6.6: Seasonal distribution of confiscation numbers in the TMNP (decade 2000 – 2009)

	Shellfish			Finfish			Bait			All types		
Season	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**	**Number of confiscation events**	**Percentage contribution**	**Average number of confiscation events per month**
Summer (Nov, Dec, Jan)	28	25.7	9.3	9	75.0	3.0	23	37.1	7.7	60	32.8	6.0
Autumn (Feb, Mar, Apr)	37	33.9	12.3	2	16.7	0.7	17	27.4	5.7	56	30.6	5.6
Winter (May, June, Jul)	16	14.7	5.3	1	8.3	0.3	10	16.1	1.9	27	14.8	2.7
Spring (Aug, Sept, Oct)	28	25.7	9.3	0	0.0	0.0	12	19.4	4.0	40	21.9	4.0
TOTAL	**109**	**100.0**		**12**	**100.0**		**62**	**100.0**		**183**	**100.1**	

In the former Transkei, Kyle et al. (1997) and Kyle, Robertson & Birnie (1997) made different findings, with more shellfish-collecting effort occurring during winter than in summer, with the least harvesting activity in December. This behaviour too is conditioned by weather, as the Eastern Cape is a summer rainfall area, potentially making shellfish collection during these periods less desirable for subsistence communities. It could also be true that coastal communities living in the Eastern Cape are more dependent on marine resources during winter when compared to fishers living adjacent to the TMNP.

A further justification for finfish collection at certain times of the year could be the effect of fishing seasons. Table 6.7 denotes the fishing-season ratings for a number of linefish targeted in TMNP waters, and shows which months and seasons are the preferred times of the year to catch these species. From Table 6.6 it appears that finfish confiscations are most prevalent in summer (37.1%) and autumn (27.4%). Again, this could either be a product of greater compliance checks enforced by the TMNP officials or a greater number of recreational or subsistence fishers undertaking linefishing. Table 6.7 connotes that these two seasons are the best (excellent and/or good) time for linefishing for all the target species listed. There are a number of species that offer excellent fishing opportunities year-round, as seen in the beach and rock fish, and reef fish species. Additionally, Cape snoek have excellent ratings for winter and spring, and good ratings for the other two seasons. Five species/classes (50%) have fair and/or poor ratings during winter and spring which seems to support the findings based on the TMNP records of fisher effort, suggesting that confiscations are more prevalent when target species are more likely to be caught.

Table 6.7: Recommended fishing seasons for some linefish species targeted by illegal fishers

Fishing season ratings	Excellent	Good	Fair	Poor

	Autumn			Winter			Spring			Summer		
Fish	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Albacore tuna												
Beach & rock fish												
Big-eye tuna												
Cape salmon												
Cape snoek												
Kob												
Reef fish												
Sharks & rays												
Yellowfin tuna												
Yellowtail												

Source: Naysmith (2011)

Although seasonal patterns of confiscations are an important consideration for the park's officials, it is imperative that resource managers understand the spatial context of marine-related seizures over time. The next section considers area-specific data relating to confiscations of other marine species in the park. Annual confiscations data is plotted on the spatial area of the park according to where seizure events took place and not where the poaching occurred.

6.6 GIS analyses and interpretation

This section looks at the number of confiscation incidents of other marine resources and the number of resources seized in the TMNP between 2000 and 2009 as recorded with the location at which the impoundment took place. Further examinations consider the percentage contribution of each area's incidents to the decadal total to determine the number of confiscations and resources seized at each location in the park over time. Finally, a year on year comparison is shown to indicate patterns in confiscation incidents and the numbers of resources sequestered. Not all other marine resource-related confiscations had the details of where the confiscations took place, so that only those that could be georeferenced are included in the GIS analyses. The annual number of confiscation incidents and number of other marine resources requisitioned per location are shown in Table 6.8, with Figures 6.1 and 6.2 illustrating these records. Figure 6.1 indicates the location of confiscation incidents between 2000 and 2007, while Figure 6.2 showcases other marine resource seizures in 2008 and 2009.

Table 6.8: Areas where confiscation incidents of other marine resources occurred and the numbers of resources seized per area in the TMNP, 2000 to 2009

Year	Area where other marine resources confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of other marine resources confiscated	Number of other marine resources seized per area as percentage of annual total
2000	Cape Point	1	33.3	236	91.8
	Rooi Els *	1	33.3	1	0.4
	Smitswinkel Bay	1	33.3	20	7.8
SUBTOTAL		**3**	**99.9**	**257**	**100.0**
2001	Castle Rock	1	20.0	142	19.3
	Millers Point	1	20.0	53	7.2
	Partridge Point	2	40.0	440	59.9
	Scarborough	1	20.0	100	13.6
SUBTOTAL		**5**	**100.0**	**735**	**100.0**
2002	White Sands	1	100.0	16	100.0
SUBTOTAL		**1**	**100.0**	**16**	**100.0**
2003	Bluegums	2	10.0	8	0.6
	Cape Point	1	5.0	2	0.2
	Hout Bay	1	5.0	40	3.2
	Kommetjie	3	15.0	235	18.8
	Millers Point	1	5.0	24	1.9
	Noordhoek	5	25.0	919	73.3
	Redhill I	1	5.0	1	0.1
	Scarborough	1	5.0	2	0.2
	Simon's Town	4	20.0	12	1.0
	St James	1	5.0	10	0.8
SUBTOTAL		**20**	**100.0**	**1253**	**100.1**
2004	Boulder's Beach	1	14.3	7	0.7
	Cape Point	1	14.3	770	72.8
	Glencairn	2	28.6	69	6.5
	Kommetjie	1	14.3	35	3.3
	Scarborough	1	14.3	90	8.5
	Simon's Town	1	14.3	86	8.1
SUBTOTAL		**7**	**100.1**	**1057**	**99.9**
2005	Boulder's Beach	1	7.1	20	3.5
	Glencairn	2	14.3	306	54.3
	Hout Bay	1	7.1	15	2.7
	Kommetjie	2	14.3	116	20.6
	Meadows	1	7.1	2	0.4
	Millers Point	3	21.4	6	1.1
	Noordhoek	1	7.1	85	15.1
	Oceanview I	1	7.1	1	0.2
	Partridge Point	1	7.1	3	0.5
	Scarborough	1	7.1	10	1.8
SUBTOTAL		**14**	**99.7**	**564**	**100.2**
2006	Black Rock	1	12.5	551	46.4
	Hout Bay	1	12.5	45	3.8
	Klein Slangkop	1	12.5	63	5.3

Continued overleaf

Table 6.8 continued

Year	Area where other marine resources confiscation occurred	Number of incidents	Number of incidents per area as percentage of annual total	Number of other marine resources confiscated	Number of other marine resources seized per area as percentage of annual total
2006	Kommetjie	1	12.5	20	1.7
	Noordhoek	2	25.0	300	25.3
	Soetwater	2	25.0	208	17.5
SUBTOTAL		**8**	**100.0**	**1187**	**100.0**
2007	Boulder's Beach	1	5.6	13	0.6
	Cape Point	1	5.6	10	0.4
	Chapmans Peak	1	5.6	25	1.1
	Glencairn	1	5.6	4	0.2
	Kalk Bay	1	5.6	637	28.5
	Kommetjie	6	33.3	626	28.0
	Millers Point	1	5.6	2	0.1
	Noordhoek	2	11.1	311	13.9
	Sandy Bay	1	5.6	243	10.9
	Scarborough	2	11.1	218	9.7
	White Sands	1	5.6	150	6.7
SUBTOTAL		**18**	**100.3**	**2239**	**100.1**
2008	Boulder's Beach	1	4.5	2	0.2
	Cape Point	4	18.2	124	10.6
	Castle Rock	1	4.5	5	0.4
	Froggy Pond	1	4.5	1	0.1
	Hout Bay	1	4.5	75	6.4
	Kalk Bay	1	4.5	1	0.1
	Kommetjie	4	18.2	320	27.3
	Milnerton *	1	4.5	1	0.1
	Noordhoek	2	9.1	275	23.5
	Scarborough	3	13.6	169	14.4
	Silvermine I	1	4.5	133	11.4
	St James	1	4.5	63	5.4
	Venus Pools	1	4.5	2	0.2
SUBTOTAL		**22**	**99.6**	**1171**	**100.1**
2009	Black Rock	1	5.9	7	0.4
	Bordjiesdrif	3	17.6	170	8.5
	Glencairn	1	5.9	12	0.6
	Granger Bay *	1	5.9	29	1.5
	Hout Bay	2	11.8	12	0.6
	Kalk Bay	1	5.9	20	1.0
	Klein Slangkop	1	5.9	198	9.9
	Muizenberg	1	5.9	1	0.1
	Noordhoek	1	5.9	253	12.7
	Scarborough	1	5.9	36	1.8
	White Sands	4	23.5	1257	63.0
SUBTOTAL		**17**	**100.1**	**1995**	**100.1**
TOTAL		**115**	**100.0**	**10 474**	**100.1**

Notes: I = inland; * = Area not neighbouring TMNP

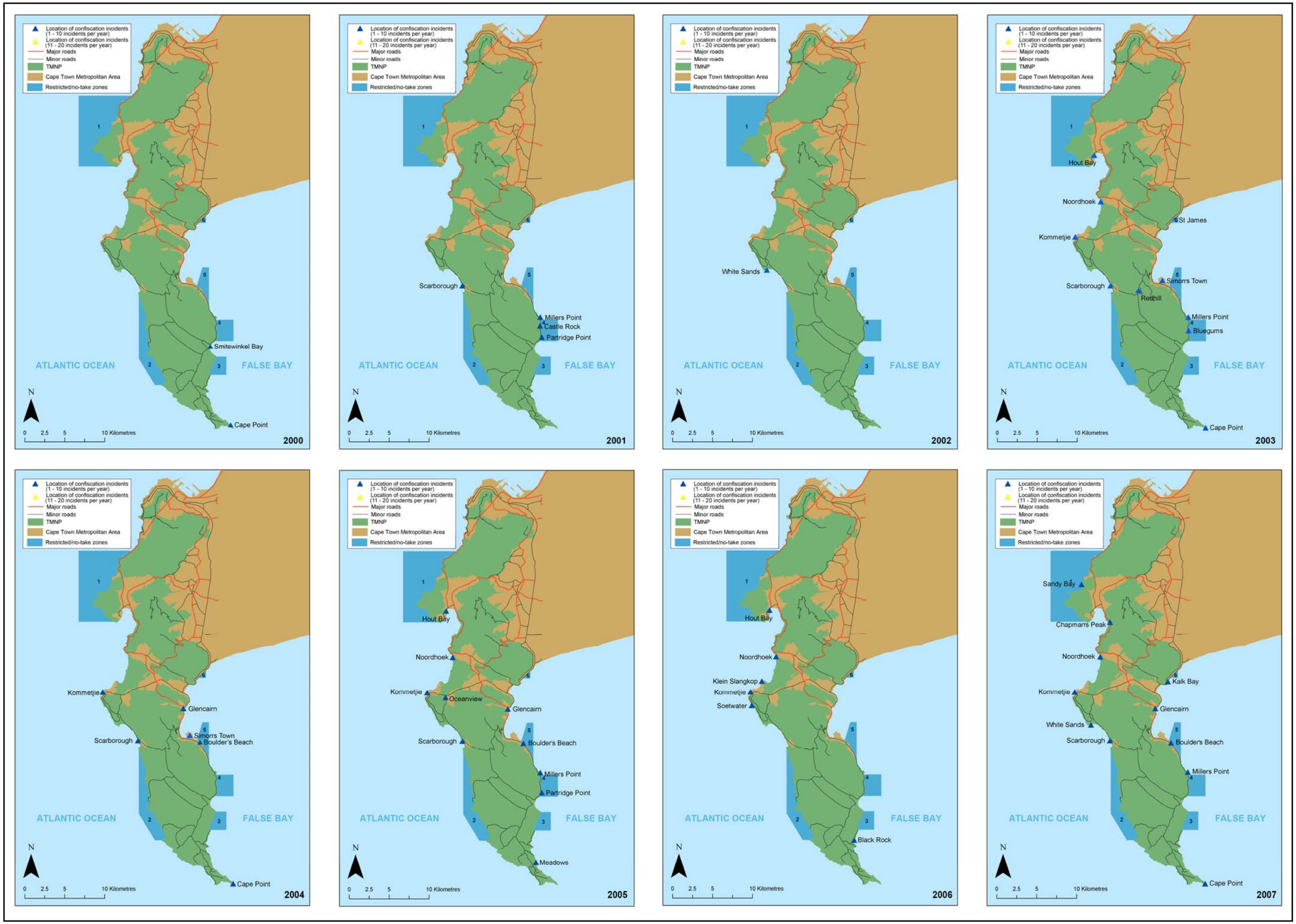


Figure 6.1: Seizure incidents of other marine resources in the TMNP, 2000 to 2007

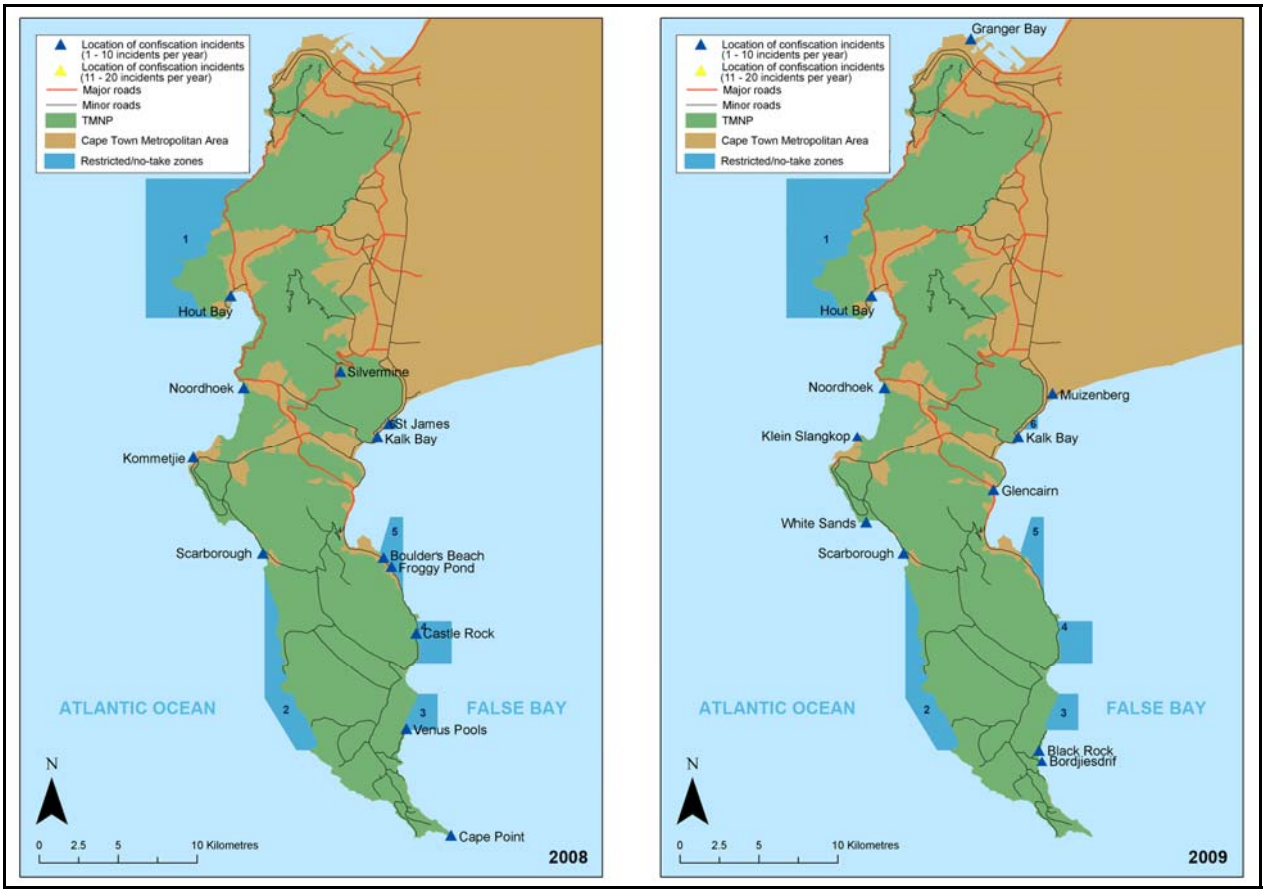


Figure 6.2: Seizure incidents of other marine resources in the TMNP, 2008 and 2009

The few areas listed for 2000 to 2002 (n = 8) contributed only 7.8% to the total number of area-specific incidents (n = 115) and only 9.6% (n = 1008) to the total number of resources confiscated. The greatest number of individual areas reported was noted in 2008 (n = 13), although a total of 22 incidents were recorded. The three incidents that took place outside the park's boundaries are listed in the table to give a full record of where confiscations took place, but they are represented in the maps.

Of the 32 locations recorded for incidents involving other marine resources more than half are on the east coast of the park (n = 17) (Table 6.9). A possible reason for more seizure events on the east coast is the abalone-enforcement operations occurring in areas along the False Bay side which could discover illegal fishers operating in these areas. The east coast is also easily accessed by both major and minor roads, allowing for more efficient compliance patrols. However, there was a fairly even distribution in the number of incidents which occurred on the east (n = 51) and west coasts (n = 61). The greatest number of incidents occurred in Kommetjie (n = 17), Noordhoek (n = 13) and Scarborough (n = 10), contributing 34.8% to the total number of incidents which occurred over the ten-year period, and 39.3% to the total number of other marine resourced commandeered.

Table 6.9: Total number of WCRL-related incidents and resources confiscated per area in the TMNP (decade 2000 - 2009)

Area where other marine resources confiscation occurred		Total number of incidents per area	Number of incidents per area as percentage of total	Number of other marine resources confiscated per area	Number of other marine resources seized per area as percentage of total
Black Rock	E	2	1.7	558	5.3
Bluegums	E/4	2	1.7	8	0.1
Bordjiesdrif	E	3	2.6	170	1.6
Boulder's Beach	E/5	4	3.5	42	0.4
Cape Point	E	8	7.0	1142	10.9
Castle Rock	E/4	2	1.7	147	1.4
Chapmans Peak	W	1	0.9	25	0.2
Froggy Pond	E/5	1	0.9	1	0.0
Glencairn	E	6	5.2	391	3.7
Granger Bay	*	1	0.9	29	0.3
Hout Bay	W	6	5.2	187	1.8
Kalk Bay	E/6	3	2.6	658	6.3
Klein Slangkop	W	2	1.7	261	2.5
Kommetjie	W	17	14.8	1352	12.9
Meadows	E	1	0.9	2	0.0
Millers Point	E	6	5.2	85	0.8
Milnerton	*	1	0.9	1	0.0
Muizenberg	E	1	0.9	1	0.0
Noordhoek	W	13	11.3	2143	20.5
Oceanview	I	1	0.9	1	0.0
Partridge Point	E/4	3	2.6	443	4.2
Redhill	I	1	0.9	1	0.0
Rooi Els	*	1	0.9	1	0.0
Sandy Bay	W/1	1	0.9	243	2.3
Scarborough	W	10	8.7	625	6.0
Silvermine	I	1	0.9	133	1.3
Simon's Town	E	5	4.3	98	0.9
Smitswinkel Bay	E	1	0.9	20	0.2
Soetwater	W	2	1.7	208	2.0
St James	E/6	2	1.7	73	0.7
Venus Pools	E/3	1	0.9	2	0.0
White Sands	W	6	5.2	1423	13.6
TOTAL		**115**	**100.1**	**10 474**	**99.9**

Notes: E = east coast (False Bay) of TMNP; W = west coast of TMNP; 1 = Karbonkelberg Restricted Zone; 2 = Cape of Good Hope Restricted Zone; 3 = Paulsberg Restricted Zone; 4 = Castle Rock Restricted Zone; 5 = Boulder's Restricted Zone; 6 = St James Restricted Zone; I = inland; * = area not neighbouring TMNP

These figures relate to areas where existing compliance check points are in place for the WCRL fishery, thus increasing the probability of confiscation events for other marine resources. There are also three areas recorded in the TMNP logbooks that are outside the park but where other marine resource confiscations took place. The average number of other marine resources taken away from illegal fishers per site was 327.

All of the interviewed subsistence and recreational fishers who target other marine species indicated that resource harvesting occurred in rocky intertidal zones which were convenient to access and did not require great distances to be travelled. Each respondent mentioned that Kommetjie and Scarborough were preferred harvesting sites, although two of the individuals said that harvesting occurred throughout the park. Park officials believed that the other marine resources at White Sands, Oudekraal, Kommetjie and Soetwater were impacted the hardest by illegal fishers.

It is encouraging to see that the park's management perceptions of the areas in which resource harvesting is taking place are the same as the locations which the harvesters claim to target. Oudekraal was the only location mentioned by the park's officials that falls within a no-take marine restricted zone. As part of the park's management objectives, it is important to determine how many incidents are occurring in no-take zones and the number of resources being removed from these areas. Fortunately only 16.5% (n = 19) of other marine resources incidents occurred in the six restricted areas of the TMNP MPA, and included 1617 resources confiscated. Although this is encouraging in that the majority of resource seizures are occurring outside these no-take areas, there is little evidence to suggest that poaching is not occurring inside these no-take zones. As mentioned in Chapters 4 and 5, harvest area-specific data would ensure a more precise spatial representation of other marine resource harvesting in the park over time.

The number of confiscation areas and the number of resources expropriated over the ten-year period are recorded in Table 6.10. There were fewer areas where incidents occurred during the first half of the study period (n = 36), compared to the total number of areas reported from 2005 to 2009, which contributed 68.7% (n = 79) to the decadal total (n = 115). The resources confiscated in the first half of the ten-year period represented 31.7% (n = 3318) of the ten-year total, and averaged 92 resources per incident per year. The latter half yielded an average of 91 resources per incident per year. Note that though the number of incidents occurring between 2005 and 2009 more than doubled compared to the first half of the study period, the number of resources confiscated per reported incident was almost identical.

Almost two thirds (62.8%) of other marine resource incidents are referenced with the area in which the confiscation took place. A similar percentage of 60.6% is noted for the number of confiscated other marine resources entered into SANParks logbooks with a location. There is thus considerable scope for more accurate record-keeping by officials about where the confiscation incidents of illegally obtained resources are.

Table 6.10: Number of georeferenced confiscation incidents and number of other marine resources confiscated in the TMNP (decade 2000 - 2009)

Year	Number of georeferenced confiscation incidents per year	Number of georeferenced confiscations as percentage of annual total	Number of other marine resources confiscated	Number of other marine resources seized as percentage of annual total
2000	3	2.6	257	2.5
2001	5	4.3	735	7.0
2002	1	0.9	16	0.2
2003	20	17.4	1253	12.0
2004	7	6.1	1057	10.1
2005	14	12.2	564	5.4
2006	8	7.0	1187	11.3
2007	18	15.7	2239	21.4
2008	22	19.1	1171	11.2
2009	17	14.8	1995	19.0
TOTAL	**115**	**100.1**	**10 474**	**100.1**

6.7 Other marine resources concluded

Informal shellfish gathering has been practised by coastal inhabitants for centuries and still features in the lives of coastal dwellers in various parts of the world. In South Africa, shellfish are particularly important in the diets of indigenous people inhabiting the coastal strips of northern KwaZulu-Natal and the Eastern Cape north of the Kei River. Consequently, most research on this topic has been undertaken in these areas. The volume of research into shellfish harvesting in the Western Cape, and in particular the TMNP, is very limited. Further, more information has been gathered on the ecological impacts of harvesting than on community dependence on the resources, with even less conducted on the size of the illegal catch. Ethnic, economical and cultural components, linked to geographical characteristics and types of traditional exploitation, are rarely considered (Labrosse, Ferraris & Letourneur, 2006).

The results in this study are aimed to improve the existing literature on intertidal resource exploitation. The outcomes of this section suggest one of three things: either shellfish, finfish and bait harvesting is not a primary resource for fisher communities; or enforcement officials are less focused on compliance checks for these resources; or that confiscations incidents are sporadic due to fishers evading detection. Often, the species discussed in this chapter are regarded as secondary, safety-net options in times of resource shortages, with harvesting occurring when the opportunity arises. It may well be that the available quantitative data on these other marine resources underreports the situation, as emphasis is placed on vigilance over WCRL and abalone harvesting, although the findings of the interviews support the offence registers' account that shellfish, finfish and bait species are not heavily targeted in the TMNP. To date, there has been no attempt to gather any fisheries data by directly measuring the quantities and kinds of organisms collected by local harvesters over an extended period (Kyle et al., 1997; Kyle, Robertson & Birnie, 1997). There is

thus room for further research in this field. This research aims to advance our understanding of intertidal resource harvesting by studying confiscations data for SANParks over time. The findings and evidence reported here have contributed to successfully attaining objectives two through four.

Although the confiscation rates reported for these shellfish, finfish and bait resources are low in comparison to those of abalone and WCRL, the consequences of the former group's harvesting can be severe, affecting not only the target species but also other species impacted indirectly (Branch & Odendaal, 2003). These other marine resources should be managed efficiently, using up-to-date baseline assessment data and by applying the same strict enforcement tactics used to protect premier marine resources like lobster and abalone. In the case of the resources discussed in this chapter, no baseline data exists, which is problematic for the conservation objectives and management strategies of the TMNP. This is especially disconcerting given that there has been growth in both the number of incidents and resources confiscated over the latter half of the decadal period of this study. The reasons for this have been discussed, but particular mention should be made of the poor economic situations in which many of the communities surrounding the park find themselves in, which may force them to impact on the resource base more heavily during recessionary times. A growing population in communities surrounding the TMNP with limited livelihood and work alternatives will continue to pose threats to the sustainability of the marine resources discussed in this chapter (Sowman & Cardoso, 2010), and will continue to do so unless the economic situation improves dramatically. It is only through working with these communities that the TMNP officials will be able to continue to conserve the shellfish, finfish and bait species found in the park's marine environment. Further conclusions will be discussed in the next chapter.

CHAPTER 7: CONCLUSION – ARE THERE PLENTY MORE FISH IN THE SEA?

Chapter 7 summarises and synthesises the key issues examined throughout this study. Concluding remarks emphasise the importance of future management strategies which aim to promote the conservation of marine resources. The limitations of the study are noted and suggestions are made for future research.

7.1 Summary and synthesis of the main findings of marine poaching in the TMNP: The tip of the iceberg

The conservation literature leaves little doubt that illegal marine resource use is a major problem. Another pressing issue is that sufficient data on illegal resource use does not exist and that collection of this information is complicated and difficult. It is probable that non-compliant harvesting of marine resources within these protected areas may have a significant effect on the success of marine reserves as fishery management tools. This study spotlighted the potential nature and scale of marine poaching in the TMNP by analysing confiscation data from the park's offence registers and comparing this against records of external agencies. Four objectives were derived from the overarching aim, namely to strengthen the theoretical and conceptual knowledge base regarding the nature of illegal harvesting of marine resources in protected areas; to identify the quantities of marine resource species confiscated in the TMNP over time; to geographically plot marine resource confiscations over the area of the park; and to distinguish the different resource users and stakeholders exploiting or managing marine resources in the TMNP. The next sections will highlight the findings from the three resource chapters.

7.1.1 Abalone confiscations

Abalone was the most impacted marine species in the TMNP over the decadal period reviewed. Nearly 88 000 abalone were seized during the ten-year period in 439 confiscation incidents. Unshucked resources made up an expected three quarters of the confiscations. There were fewer abalone confiscations in winter, although there were no distinct seasonal differences. A concerning trend is that the last five years saw just over 70% of the total number of abalone commandeered and in excess of three quarters of the total weight of the resources impounded, indicating that abalone poaching in the park was on the increase. This was further validated by non-parametric correlation analysis which yielded moderate to high positive correlations and a substantial relationship between numbers and weight of resources sequestered over the ten-year period.

However, the numbers reflecting poaching in the park are dwarfed by the MCM's national totals, with the abalone impounded in the TMNP contributing only 1.2% to MCM's decadal total for the total amount of abalone seized from poachers or found abandoned. Even compared with MCM's abalone seizure totals for the Western Cape, the TMNP resource requisitions contributed only 1.7%. This could indicate less poaching in the park versus other areas outside TMNP boundaries, or that fewer confiscations are occurring inside the park. It is feared that the latter opinion is more valid,

given that the 11 abalone poachers interviewed claimed to harvest 27 tonnes of the resource annually in the TMNP MPA. Moreover, given that enforcement officials reckon that only 10% of illegal abalone harvesters are ever apprehended, the figures reported in this study are heavily deflated. The incompleteness of abalone-related data maintained by park officials in their logbooks is further questioned when one compares their figures to those recorded by the SAPS in official documents. This study reveals that the TMNP officials underreported their seizure data by about 22% for abalone between June 2008 and June 2009. This may not be the case for all their data. Unfortunately, without a complete data set from the SAPS for the decade period reviewed, it is impossible to determine the true degree of underreporting.

From a spatial perspective, abalone-related confiscations are georeferenced in nearly 80% of the cases recorded in the SANParks logbooks. These records account for 81% of resources expropriated from poachers from 2000 to 2009. This georeferenced data showed that 88% of incidents occurred on the east coast of the park, accounting for 93% of the seized resources. These high numbers are no doubt due to resource abundance (as per historical baseline assessment), accessibility to fishing grounds on the False Bay side and improved getaway opportunities for poachers who are detected by park officials. Also, the numerous coves and bays on the east coast decrease the chances of detection by law enforcers.

7.1.2 Confiscations of West Coast rock lobster

Although fewer rock lobsters were seized from poachers compared to abalone, some 12 300 resources were confiscated over the ten-year period. Of these 49% were sized, 27% were undersized and 24% were tails broken off from the carapace, suggesting that poachers were selective in their preference for sized resources. The total weight of the lobster requisitions amounted to 2 900kg, with 83% being contributed in the last five years of the study. Both the numbers and weight of resources impounded in the latter five years greatly exceeded the totals yielded from 2000 to 2004. Statistically, high positive correlations were calculated for the combined numbers of rock lobster ($r = 0.88$) and the weight of these resources (0.82) removed from poachers respectively. The results were highly significant for both measures.

Although these numbers of poached resources are alarming, they are considerably smaller than those reported by the SAPS between June 2008 and June 2009. The police documented 50% more commandeered resources arising from poachers operating inside the park, which adds to the alarm as this underreporting suggests that WCRL poaching in the park is significantly worse than reported in this study. Further concern about underreporting is noted when considering the responses by the 22 WCRL poachers interviewed. They claimed to harvest 7200 lobsters a year. The six Rastafarians interviewed gather an additional 54 shopping-bags full of the resource, adding pressure to the population living in the TMNP MPA. The WCRL fishers and the Rastafarians preferred to fish in the warmer summer and autumn months, a preference supported by the SANParks offence data which showed that 91% of confiscations occurred during these two seasons. These seasonal confiscations tie in with the legal fishing season running from November to April. There are

additional enforcement and compliance checks during these months, ensuring surges in confiscations during these periods.

Spatial analysis uncovered an even distribution in the number of confiscation locations on the east and west coasts of the park. Some 30 areas where seizure events took place are documented in the park's logbooks. Despite their being an equal number of locations on each coast, the west coast was responsible for 59% of the resources seized. This is partly due to the number of enforcement operations held at the slipway in Kommetjie and compliance checks in a number of holiday resorts and communities along the park's west coast. The baseline assessment by UCT concluded that there is greater WCRL abundance on the west coast, corroborating the results of the spatial analysis that the Atlantic coast of TMNP had more confiscation incidents.

7.1.3 Confiscations of other marine resources

Of the three types constituting this resource, shellfish were the most impacted by poaching with some 15 830 resources being confiscated in 109 incidents. Finfish seizures totalled 62 incidents yielding nearly 500 resources and in the 12 events recorded for bait species some 490 resources taken away from illegal harvesters. Seasonal confiscation trends were different for each of the resource groups with most shellfish seized in autumn, while summer showed the highest incidence of bait appropriations, with both summer and autumn being most prevalent for linefish impoundments. Respondents interviewed from the informal WCRL fishery and Rastafarian communities preferred the warmer months for harvesting which supports the reports by the TMNP officials. About 63% of the 183 confiscation incidents recorded for this group of resources were georeferenced. Some 10 500 resources were confiscated at 32 locations. There were marginally more (53%) resources seized in locations on the False Bay side of the park. The interviewed poachers supported this finding, declaring that harvesting occurs along both coasts. The next section looks at the issue of non-compliance and discusses the reliability of data sources.

7.2 Data dependency

In fisheries, non-compliance is partly due to the common property nature of the resources and the expense of monitoring and enforcing regulations. This is the case in TMNP where access to marine resources is free and open – allowing Hardin's (1968) tragedy of the commons to unfold, and driven by groups of variously motivated individuals, many incrementally harvesting for economic survival. Many of the marine resources in the TMNP have been heavily overexploited, and scholars and park officials are worried that some populations may be headed for collapse. This study shows that a number of marine resources have been heavily impacted by fishers in the subsistence, recreational and commercial sectors over the decadal period under review.

Although this study utilised secondary data offered by SANParks, MCM and the SAPS and anecdotal responses from known poachers, more comprehensive data on illegal resource use is needed. With reliable measures of illegal activities, managers could monitor success of conservation efforts allowing them to design more efficient interventions. What's more, with appropriate methods illegal resource use may be detected before it has biological impacts, so providing early warnings of

threats to biodiversity. Luckily, information on IUU is increasing as societal concern grows and as international and national governance mechanisms strengthen, albeit that uncertainty about the estimates is substantial. What is known is that the impacts of this harvesting in the TMNP on the base populations can only be speculated about without proper baseline comparisons. The managers of the TMNP nevertheless have consensus that current rates of poaching cannot continue without significant negative effects on the species being targeted.

7.3 Poaching and poverty

Harvesting of marine resources by the urban populace is said to be unevenly spread, but nevertheless widespread throughout Cape Town, with larger impacts clustering closer to low-income residential areas (Peterson, 2011). The inequitable socio-economic conditions of the Cape Town metropolitan region and the encroachment of informal settlements on the park contribute directly to criminal activities in and around the park. Because of the hardship prevailing in some areas close to the park, people have taken to poaching as an income-generating activity while being oblivious to the need for wildlife to be conserved (Ferreira, 2011).

Poaching of marine resources in the TMNP is foundered on two key fundamentals – the social and economic value of these products. If academics cannot correctly understand the dependence of the social and economic drivers of communities surrounding TMNP on the functioning of the ocean ecosystem, or if officials cannot set priorities in marine natural resources production and follow these correctly, then the resulting destruction of the ocean ecosystem will be just a matter of time (Souvorov, 1999). This study has contributed to the understandings of the values of marine resources to communities surrounding the park and living further afield, by unpacking the scale of illegal marine resource harvesting over time to identify the relations between people and nature. If ecological and economic relations with the ocean are not formulated, or if equitable user rights and access issues are discounted from management principles, with communities surrounding the park continuing to harvest these resources illegally, causing further, possibly irreparable damage (Schumann & Macinko, 2007). Therefore it is important that poverty alleviation strategies are mainstreamed into co-management arrangements, although this has largely been absent from policy deliberations on equitable transformation of the fishing industry, especially when considering subsistence fisheries in communities surrounding TMNP. Even if the majority of fishers surrounding the park believe in the purpose and benefits of the TMNP MPA, problems with poaching will likely arise when legal fishing and TURF policies are lacking. This may eventually result in not only more damage to the harvestable stocks, but may also give way to territorial and social conflicts between users.

This has been the case with the abolition of the subsistence and commercial sectors for abalone and WCRL which has led to many fishers being excluded from the industry. In a province where livelihoods from the sea have been vitally important, both historically and culturally, this is proving extremely debilitating for many coastal communities, especially those surrounding the park. More often than not, this has resulted in poaching of resources as poorer communities are heavily dependent on the resources offered by the waters surrounding the TMNP. Given the economic

circumstances within these communities, both in the past and present, a distinction between the use of resources for primary subsistence or commercial purposes is largely inseparable. However, in spite of its importance, subsistence fishing in the TMNP is poorly documented from the point of view of fisheries assessment. The full impact of this sector is almost unknown, mainly because this activity is difficult to assess directly through monitoring of fishing effort or landing surveys. Added to this, is that confiscations records are often inaccurate or incomplete, which compounds the issue.

7.4 Success through synergy

Many urban communities living in coastal areas rely heavily on local natural resources for their livelihood, and this is true for a variety of stakeholders neighbouring TMNP. Knowing this, conservation efforts will always have to operate within the constraints set by the natural resource base, socio-economic and cultural conditions, as well as political structures. Economic and social benefits derived from coastal harvesting activities are essential for the well-being of the national economies and the livelihoods of coastal communities, whether these be through legal or illicit means. However, the existing body of marine reserve literature has largely ignored some realities of noncompliant resource-user behaviour, namely poaching within urban reserve boundaries.

Wherever communities, whether poor or affluent, abut on protected areas there are tensions between the demands for access and use versus the needs of resource conservation and management. As in the case of protected areas, local people often have continued to use resources in the core reserve even if prohibitions are posted or otherwise made public. Moreover, if a large number of people live adjacent to a national park with exceptional biodiversity and heritage value, there is no other option than to nurture a healthy co-existence for the sake of society and nature (Ferreira, 2011). The challenge facing this generation of conservationists and urban managers is not only to reconcile the priorities of biodiversity conservation with the needs and aspirations of local people, but also to link their economic and social development to conservation.

It is probable that the overall success of marine conservation initiatives in the TMNP will largely depend on the extent to which practices that synergise ecosystem service use and human development with biodiversity conservation can be developed and enhanced. It is thus believed that context-specific conservation targets that acknowledge and integrate developmental needs are required, and may well be essential for limiting biodiversity loss in the longer term, which will ultimately ensure the success of the marine protected area in the TMNP.

7.5 Limitations of this study and recommendations for future research

There were four major limitations to this study. The first was the reliability or underreporting in records maintained by SANParks. Many of these records were not entered correctly, were devoid of key information, illegible or duplicated. A review of the data-entry protocol should be mandatory for all current and future employees, so as to ensure accurate record collection. In addition to the existing information written in offence registers, officials need to collect data on the number of patrols taken per day; and the number of personnel, area covered and time spent on each patrol. This data will strengthen the objectives of the park’s resource management strategies, as more robust data

will allow managers to better understand the complexities of illegal activity detection when undertaking enforcement and compliance operations. Additionally, officials should obtain the information of where seized resources were poached, so as to better map the areas being most heavily targeted and adjust enforcement strategies accordingly.

The second limitation is the comparative data set requested from the SAPS for the decadal period under review. The applications for these records were declined because the SAPS allege that their collation would be too time-consuming. This was unfortunate given the evidence of underreporting apparent in the SANParks logbooks when compared to the year-long records on resource confiscations offered by the police. It is recommended that future research conducted on marine confiscations, requiring secondary data from the police, apply for these records through legislative channels, by citing the Promotion of Access to Information Act, 2000 (Act No. 2 of 2000).

Third, there is a lack of a contemporary baseline assessment. The measurement of ecological status is fairly straightforward, however the investigation of human influence on marine resources is complicated by the need to have long-term monitoring data on population trends. In the case of TMNP, only one marine-stock assessment has been undertaken some ten years ago. It is recommended that adequate baseline assessments of the abalone, WCRL and other marine resources be undertaken to help managers better understand the existing population sizes of targeted resources in the park and appreciate the implications of current and future poaching pressures. Without this information it is inconceivable to make informed decisions regarding the management of natural resources or to comment intelligently on the impacts of illegal harvesting on these species.

Fourth, more than 60% of poachers who were approached to take part in this study declined to comment and participate for fear of prosecution by law enforcement agencies. A low rate of response was anticipated, although the numbers of respondents achieved is comparable to a similar study conducted by Peterson (2011). Should future research wish to garner further responses from fishing communities, it is recommended to get to the support of community leaders as this may encourage other harvesters to share their insights and be more forthcoming with responses.

Last, future research into conservation, poverty and poaching needs to incorporate wider theoretical conceptualisations of both poverty and biodiversity. It is recommended that more in-depth ecological and socio-economic studies be conducted to answer further questions about the protection of target species, costs and benefits to local communities and enforcement success.

This study hopes to contribute to the literature on resource use in protected areas, and engender the appropriate responses from park officials to ensure conservation success of marine species and to limit IUU fishing in the TMNP. This was achieved through reviewing historical confiscations data from a variety of sources, and garnering responses from active poachers operating in the TMNP. It is only by reviewing the state of the resource base and including stakeholders in future management plans, that the park will be successful in resource conservation.

(43 017 words)

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APPENDICES

10.1 Appendix A: Explanatory sheet for TMNP marine resource harvesting questionnaire

Explanatory sheet for TMNP marine resource harvesting questionnaire

Subject name/number
Even though no names will be used in my report, I will require names in the event that I need to verify any of the details in the questionnaire.

Occupation
The role of the interviewee with TMNP e.g. field ranger. This will be to identify whether there is any significant difference within perceptions of the various levels of management.

Race
e.g. African. This is to ascertain whether cultural perceptions play a role in understanding what is believed to be the nature of the harvesting within the park.

Sex
e.g. female. This is purely a demographic statistic, although possible perception trends could be identified.

Age
e.g. 36. This figure is again a demographic statistic.

Location of interview
This data needs to highlight the section in which the interviewee is stationed.

What resources are harvested?
Species - this point is looking for all the species targeted by poachers/harvesters within the park e.g. abalone, rock lobster etc.
Part of resource – it is hoped to identify what part of the resource is harvested, as it is seldom the case where the whole resource is removed e.g. rock lobster tails, abalone meat, etc.

How much resource is harvested?
This point needs to be specific to each of the resources mentioned in the previous point. E.g. 2 tons of abalone annually.

How many harvesters are caught?
Numbers – this is to try and identify the perceptions of the interviewee into how successful operations are at catching poachers e.g. 25 per year
Demographics – this is a breakdown of what the interviewee believes the racial composition of poachers e.g. 70% white, 10% coloured. Alternatively, interviewees can specify that there are more white poachers in the abalone trade as opposed to 90% Africans in the shellfish harvesting communities etc.

Where does harvesting take place?
This is a representation of the "hotspots" of illegal harvesting. It is an interesting point to note where the interviewee believes the majority of poaching to occur e.g. millers point - abalone, etc.

Is harvesting governed by parameters?
This point is trying to determine whether interviewees believe if poaching is governed by seasonality, time of day or the weather
Season – e.g. rock lobster season, abalone all year round
Time of day - e.g. night time abalone, day time rock lobsters
Weather dependent – e.g. abalone poachers do not come in rain, etc.

Value of resource to harvester?
Cash value – what does interviewee believe the cash value of the resources mentioned above hold? e.g. R750/kg abalone, etc
Barter/exchange – are any of the resources exchanged for other goods e.g. abalone for drugs, WCRL for food, etc.

What doe\s subject use resource for?
Personal use – this points hopes to highlight the uses of the resources e.g. rock lobster for food etc
Commercial gain – this point is trying to ascertain whether the interviewee believes that a resource is harvesting primarily for personal or commercial reasons e.g. abalone to Chinese market, etc

Numbers of harvesters known to subject?
This point is not trying to identify whether any harvesters are known personally by the interviewee, but rather to try and ascertain how many poachers the interviewee believes to be actively removing resources from the park e.g. 200 abalone poachers, etc.

What management methods are in place?
This point hopes to identify what the interviewee believes to be in place to manage the resource harvesting problem e.g. sting operations, education projects etc.

Biggest problem with enforcement?
This point is hoping to see what the interviewee believes to be a short-coming in the enforcement. E.g. lack of man-power, insufficient training etc.

Is harvesting sustainable?
Finally, it is hoped to identify whether the interviewee believes that harvesting can be conducted on a sustainable basis, and reasoning for their answers. e.g. abalone poaching is not sustainable, as too much of the resource is removed for the population to continue to maintain healthy growth and reproduction.

10.2 Appendix B: Questionnaire for marine resource harvesters

HARVESTERS / SELLERS			
Subject name/ no.:		Date:	
Race:		Occupation:	
Age:		Sex:	
Address of harvester:			
Location of interview:			
How long has subject been harvesting?			
What does subject harvest?			
- species			
- part of resource			
How much resource is harvested?			
How is resource harvested?			
- hands			
- mechanical tools			
Where does harvesting take place?			
Is harvesting governed by parameters?			
- season			
- time of day			
- weather dependent			
Value of resource to harvester?			
- cash value			
- barter/exchange etc			

What does subject use resource for?	
- personal use	
- commercial gain	
Where does subject sell resource?	
Numbers of harvesters known by subject?	
Is harvesting sustainable?	
Would subject use nursery stock?	
How much would subject pay?	
Reasons for use/non-use	
Is demand for resources?	
What management stops harvesting?	
Does subject know harvesting is illegal?	

10.3 Appendix C: Questionnaire for TMNP officials

RANGERS / MANAGERS			
Subject name/ no.:		Date:	
Race:		Occupation:	
Age:		Sex:	
Location of interview:			
How long has subject been a ranger/mnger?			
What resources are harvested?			
- species			
- part of resource			
How much resource is harvested?			
How many harvesters are caught?			
- numbers			
- demographics			
Where does harvesting take place?			
Is harvesting governed by parameters?			
- season			
- time of day			
- weather dependent			
Value of resource to harvester?			
- cash value			
- barter/exchange etc			

What does subject use resource for?	
- personal use	
- commercial gain	
Numbers of harvesters known by subject?	
What management methods are in place?	
Biggest problem with enforcement?	
Is harvesting sustainable?	