

**Final report of the BCLME  
(Benguela Current Large Marine Ecosystem)  
Project on Top Predators  
as Biological Indicators of Ecosystem Change  
in the BCLME**

**edited by S.P. Kirkman**



# Contents

## Executive summary

- Chapter 1 **Executive summary** ..... 1  
BCLME Top Predators Project Steering Committee

## Introductory chapters

- Chapter 2 **Introduction** ..... 15  
BCLME Top Predators Project Steering Committee
- Chapter 3 **Objectives for an ecosystem monitoring programme in the BCLME based on land-breeding top predators** ..... 17  
BCLME Top Predators Project Steering Committee

## Collation of time series

- Chapter 4 **Time series of data for Cape Fur Seals in the BCLME** ..... 21  
SP Kirkman
- Chapter 5 **Report on the availability and quality of seabird information in Namibia and South Africa** ..... 31  
J Kemper and RJM Crawford

## Cape Fur Seal

- Chapter 6 **Making sense of censuses and dealing with missing data: trends in pup counts of Cape Fur Seal *Arctocephalus pusillus pusillus* for the period 1972–2004** ..... 39  
SP Kirkman, WH Oosthuizen, MA Meÿer, PGH Kotze, J-P Roux, LG Underhill  
*African Journal of Marine Science* 29(2): 161–176 (2007)
- Chapter 7 **Ecological responses of Cape Fur Seals in South Africa to temporal shifts in pelagic prey availability** ..... 53  
SP Kirkman, WH Oosthuizen, MA Meÿer, PGH Kotze, M Boucher, LG Underhill

## African Penguin

- Chapter 8 **The African Penguin *Spheniscus demersus*: population estimates, trends, adult survival and age structure from molt and nest counts** ..... 69  
J Kemper, J-P Roux, PA Bartlett, YJ Chesselet, J-A Delpont, JAC James, R Jones, LG Underhill, N-N Uhongora, S Wepener
- Chapter 9 **Estimating African Penguin population size: a comparison of census techniques** ..... 77  
J Kemper
- Chapter 10 **Regionally coherent trends in colonies of African Penguins *Spheniscus demersus* in the Western Cape, South Africa, 1987–2005** ..... 81  
LG Underhill, RJM Crawford, AC Wolfaardt, PA Whittington, BM Dyer, TM Leshoro, M Ruthenburg, L Upfold, J Visagie  
*African Journal of Marine Science* 28: 697–704 (2006)
- Chapter 11 **Breeding patterns and factors influencing breeding success of African Penguins *Spheniscus demersus* in Namibia** ..... 89  
J Kemper, LG Underhill, J-P Roux, PA Bartlett, YJ Chesselet, JAC James, R Jones, N-N Uhongora, S Wepener

|            |  |     |
|------------|--|-----|
| Chapter 12 | <b>Artificial burrows for African penguins on Halifax Island, Namibia: do they improve breeding success?</b> .....                                   | 101 |
|            | J Kemper, LG Underhill, J-P Roux   |     |
| Chapter 13 | <b>The influence of food availability on breeding success of African Penguins <i>Spheniscus demersus</i> at Robben Island, South Africa</b> .....    | 107 |
|            | RJM Crawford, P Barham, LG Underhill, LJ Shannon, JC Coetzee, BM Dyer,<br>TM Leshoro, L Upfold<br><i>Biological Conservation</i> 132: 119–125 (2006) |     |
| Chapter 14 | <b>Effect of age and breeding status on molt phenology of adult African Penguins <i>Spheniscus demersus</i> in Namibia</b> .....                     | 115 |
|            | J Kemper, J-P Roux, LG Underhill   |     |
| Chapter 15 | <b>Energy budget of African Penguin <i>Spheniscus demersus</i> chicks</b> .....  | 125 |
|            | S Bouwhuis, GH Visser, LG Underhill  |     |

### **Great White Pelican**

|            |  |     |
|------------|--|-----|
| Chapter 16 | <b>Is predation on seabirds a new foraging behaviour for Great White Pelicans? History, foraging strategies and prey defensive responses</b> ..... | 131 |
|            | M de Ponte Machado   |     |

### **Cape Gannet**

|            |  |     |
|------------|--|-----|
| Chapter 17 | <b>Trends in numbers of Cape Gannets (<i>Morus capensis</i>), 1956/1957–2005/2006, with a consideration of the influence of food and other factors</b> ..... | 145 |
|            | RJM Crawford, BL Dundee, BM Dyer, NTW Klages, MA Meÿer, L Upfold<br><i>ICES Journal of Marine Science</i> 63: 169–177 (2007)                                 |     |
| Chapter 18 | <b>Breeding in a dynamic system: intra- and inter-seasonal variability in foraging behaviour and chick growth of Cape Gannets</b> .....                      | 155 |
|            | RHE Mullers, RA Navarro RA, LG Underhill LG, GH Visser   |     |

### **Cormorants**

|            |   |     |
|------------|---|-----|
| Chapter 19 | <b>Trends in numbers of Cape Cormorants (<i>Phalacrocorax capensis</i>) over a 50-year period, 1956/57–2006/07</b> .....      | 165 |
|            | RJM Crawford, BM Dyer, J Kemper, RE Simmons, L Upfold, F vaz Velho  |     |
| Chapter 20 | <b>Trends in numbers of three cormorants <i>Phalacrocorax</i> spp. breeding in South Africa's Western Cape Province</b> ..... | 173 |
|            | RJM Crawford  |     |

### **Kelp Gull**

|            |   |     |
|------------|---|-----|
| Chapter 21 | <b>The influence of culling, predation and food on Kelp Gulls <i>Larus dominicanus</i> off western South Africa</b> .....       | 181 |
|            | RJM Crawford, LG Underhill, R Altwegg, BM Dyer, L Upfold  |     |
| Chapter 22 | <b>Geographic variation in reproduction and survival of Kelp Gulls <i>Larus dominicanus vetula</i> in southern Africa</b> ..... | 189 |
|            | R Altwegg, RJM Crawford, LG Underhill, AP Martin, PA Whittington  |     |
| Chapter 23 | <b>Prefledging energetics of Kelp Gull (<i>Larus dominicanus vetula</i>) chicks in a warm environment</b> .....                 | 195 |
|            | GH Visser, T Bakker, KM Tjørve, LG Underhill  |     |

|  |  |     |
|--|--|-----|
| Chapter 24   | <b>Primary moult of the Kelp Gull <i>Larus dominicanus vetula</i> in the Western Cape, South Africa</b> .....  | 201 |
|  | VL Ward, HD Oschadleus, LG Underhill   |     |
| <b>Other seabirds</b>  |  |     |
| Chapter 25   | <b>Population estimates and trends of seabird species breeding in Namibia</b> .....  | 207 |
|  | J Kemper   |     |
| Chapter 26   | <b>Trends in numbers of Leach's Storm Petrel, Hartlaub's Gull and Swift and Roseate Terns breeding in South Africa</b> .....   | 211 |
|  | RJM Crawford, PA Whittington, BM Dyer, L Upfold  |     |
| <b>Colonial waterbirds</b>   |  |     |
| Chapter 27   | <b>The development of the heronry on Robben Island, Western Cape, South Africa, 1980–2005</b> .....  | 217 |
|  | LG Underhill, RJM Crawford, DM Harebottle, KMC Tjørve  |     |
| <b>Turtles</b>   |  |     |
| Chapter 28   | <b>Brief report on the status of turtles in Angola</b> .....   | 225 |
|  | M Morais   |     |
| <b>Influence of environment and fish stocks on trends in top predators</b> |  |     |
| Chapter 29   | <b>Food, fishing and seabirds in the Benguela upwelling system</b> .....   | 229 |
|  | RJM Crawford   |     |
| Chapter 30   | <b>Influences of the abundance and distribution of prey on African Penguins <i>Spheniscus demersus</i> off western South Africa</b> .....                                    | 235 |
|  | RJM Crawford, LG Underhill, JC Coetzee, T Fairweather, LJ Shannon, AC Wolfaardt  |     |
| Chapter 31   | <b>Implications for seabirds of an unfavourable, long-term change in the distribution of prey: a South African experience</b> .....  | 243 |
|  | RJM Crawford, T Fairweather, LG Underhill, AC Wolfaardt  |     |
| Chapter 32   | <b>An altered carrying capacity of the Benguela upwelling system for African Penguins (<i>Spheniscus demersus</i>)</b> .....   | 251 |
|  | RJM Crawford, LG Underhill, L Upfold, BM Dyer<br><i>ICES Journal of Marine Science</i> 64: 570–576 (2007)  |     |
| Chapter 33   | <b>The efficacy of hand-rearing penguin chicks: evidence from African Penguins (<i>Spheniscus demersus</i>) orphaned in the <i>Treasure</i> oil spill in 2000</b> .....      | 259 |
|  | PJ Barham, LG Underhill, RJM Crawford, R Altwegg, TM Leshoro, DA Bolton, BM Dyer, L Upfold   |     |
| Chapter 34   | <b>Impact of predation by Cape Fur Seals <i>Arctocephalus pusillus pusillus</i> on Cape Gannets <i>Morus capensis</i> at Malgas Island, Western Cape, South Africa</b> ..... | 265 |
|  | AB Makhado, RJM Crawford, LG Underhill<br><i>African Journal of Marine Science</i> 28: 681–687 (2006)  |     |
| Chapter 35   | <b>Management of avian cholera <i>Pasteurella multocida</i> outbreaks on Dyer Island, South Africa, 2002–2005</b> .....  | 273 |
|  | LJ Waller, LG Underhill<br><i>African Journal of Marine Science</i> 29: 105–111 (2007)   |     |

## **Predators as indicators**

- Chapter 36 **Using a top predator to monitor a fish resource: juvenile Cape hake (*Merluccius capensis*) early growth parameters, birth date estimates and recruitment index: the 2005 cohort** ..... 281  
J-P Roux
- Chapter 37 **Can seal diet predict future catches of commercial prey?** ..... 289  
S Mecenero, J-O Krakstad, J-P Roux, LG Underhill
- Chapter 38 **Indexing the availability of anchovy and sardine to seabird predators in the southern Benguela ecosystem** ..... 297  
LG Underhill, RJM Crawford

## **Surveys of southern Angola**

- Chapter 39 **Report on top-predator survey of southern Angola including Ilha dos Tigres, 20–29 November 2005** ..... 303  
BM Dyer
- Chapter 40 **The first aerial survey of Cape Fur Seal numbers at Baia dos Tigres, southern Angola** ..... 307  
MA Mëyer
- Chapter 41 **Seabirds and marine mammals distributions and patterns of abundance** ..... 309  
J-P Roux, BL Dundee, J da Silva

## **The status of seals and seabirds in the BCLME**

- Chapter 42 **Revision of the conservation status of seabirds and seals breeding in the Benguela Ecosystem** ..... 325  
J Kemper, LG Underhill, RJM Crawford, SP Kirkman

## **Comparison of seabirds in the Benguela and the Humboldt LMEs**

- Chapter 43 **Comparison of assemblages and some life-history traits of seabirds in the Humboldt and Benguela systems** ..... 345  
RJM Crawford, E Goya, J-P Roux, CB Zavalaga  
*African Journal of Marine Science* 28: 553–560 (2006)

## **Capacity building**

- Chapter 44 **Collation of training inputs undertaken within the BCLME Top Predators Project** ..... 355  
LG Underhill
- Chapter 45 **Time Series Analysis Course, 24–26 May 2005, Lüderitz, Namibia** ..... 359  
J Kemper

## **Monitoring recommendations**

- Chapter 46 **Recommendations for a regional monitoring programme for Cape Fur Seals in the BCLME** ..... 367  
SP Kirkman
- Chapter 47 **Monitoring seabirds in the BCLME: monitoring objectives, priorities and recommendations**  
J Kemper ..... 373

## **Scientific output**

- Chapter 48 **Scientific output of LMR/EAF/03/02** ..... 379
- Annex 1 **Members of the Steering Committee of BCLME Project LMR/EAF/03/02** ..... 381