

## FINAL REPORT

POGO VISITING PROFESSORS  
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### January 8 – July 1, 2011 Namibia and South Africa

We arrived in Namibia on Jan. 8<sup>th</sup> and remained in residence through July 1, with a trip to South Africa in April. Our base was the National Marine Information and Research Centre (NatMIRC) in Swakopmund, Namibia. Our hosts were Bronwen Currie (Levin) and Anja Kreiner (Checkley). Our interactions were primarily with NatMIRC scientists and staff, University of Namibia students and staff, and University of Cape Town students and staff. We also interacted with various stakeholders involved in aquaculture, fisheries and industrial development.

Below we summarize our major activities.

#### I. Skeleton Coast Research Trip

During January 14-20, 2011, Checkley and Levin, participated in a research expedition to the Skeleton Coast, a unique and remote coastal environment of northern Namibia, now a national park accessible now only by research permit and accessible only by four-wheel-drive vehicles. Levin initiated a study of ocean-arid land energy exchange, and the role of the Kunene River; samples were collected for stable isotope analyses.

#### II. NatMIRC Lecture Series

We established a Friday afternoon lecture series at NatMIRC (typically 15-20 staff participants). Presentations included:

- January 11: *Levin Lab Research Overview* (to Aquaculture program) (Levin)
- January 21: *Long-Term Change in Anchovy and Sardine Populations* (Checkley)
- January 28: *Oxygen Minimum Zones: Causes, Changes and Consequences For Benthic Communities* (Levin)
- February 4: *Comparison of California, Humboldt, and Benguela Current Ecosystems* (Checkley)
- February 11: *Gobies and Their Predators in the Hypoxic Waters of the Benguela* (Salvanes, U. Bergen)

- March 4: *Short-Term Oxygen and pH Dynamics in Upwelling Areas*  
(Levin)
- May 20: *Long-Term Variability in the Habitat of the Namibian Sardine*  
(Checkley)
- June 17: *Stable Isotopes in Marine Ecology with examples from the Skeleton Coast* (Levin)
- June 30: *Climate and Sardine Fisheries in the Benguela Current Region.*  
(Checkley)
- June 30: *Larvae on the Loose: Connectivity and its consequences*  
(Levin)

### **III. Student Mentoring**

Levin worked directly with two UNAM summer interns at NatMIRC (Arnold DeKlerk and Blessing Kamwi) in the lab, at sea, in field (almost daily interaction during February and March). Checkley worked with Blessing Kamwi in May.

### **IV. Scientist Mentoring and Collaboration**

We both met frequently with our hosts (B. Currie, A. Kreiner) and periodically with other NatMIRC staff on specific issues. Examples follow.

B. Currie- advice on benthic survey/sampling design, sampling methods, isotope analyses, species identifications (approx 60 contact hours, excluding field work)

A. Kreiner – advice on CUFES operation and sample and data analysis; preliminary analysis of NatMIRC CUFES data \*; discussion of Northern Benguela ecosystems and fisheries

L. Hugo – Advice on biodiversity monitoring of rocky shore habitat, field trial

F. Hamukwaya – Advice on mussel recruit sampling

A. van der Plas – discussions of oxygen dynamics on upwelling shelves.

C. Bartholomae – design of NatMIRC's new research vessel \*; discussion of long-term variability of physical properties of Northern Benguela

B. Tjizoo – discussions of anchovy and sardine spawning habitat in Northern Benguela, including reanalysis of data and revision of manuscript

N. Moroff – discussion of Northern Benguela ecosystems and fisheries, stable isotope methods

S. Volges – Aquarium tour and discussion of aquarium education & outreach opportunities

Chibo Chikwililwa. Career planning/teaching discussions relative to the SPACES program

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J. P. Roux. Stable isotope studies of ocean-land exchange, sardine dynamics

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\* The final report by Dave on NatMIRC's CUFES and associated underway sampling, both on the RV *Welwitchia* and the new (final planning, construction to begin soon in Finland) fisheries research vessel, can be obtained from A. Kreiner or C. Bartholomae, or at:

[ftp://ftp.iod.ucsd.edu/checkley/reports/CUFES\\_at\\_NatMIRC\\_24jun11.pdf](ftp://ftp.iod.ucsd.edu/checkley/reports/CUFES_at_NatMIRC_24jun11.pdf) .

## V. Work at Sea

We both participated in a one-day cruise on the *RV Welwitchia* to the Namibian mud belt in February (benthic sampling). Dave also spent one day at sea at collecting Gobies with Salvanes and her technical assistant (U. Bergen). Lisa spent 4 days at sea with B. Currie on the *RV Welwitchia* in May sampling outer shelf sediments and fauna (to 280 m) to look at OMZ food webs and inner shelf water and sediment (30-40 m) to look for trophic influence of the Swakop River runoff and debris (both via stable isotopes).

## VI. Business – Academic Interactions

During the Skeleton Coast Trip we met the owners and operators of the Swakopmund Salt Company (J. and D. Klein) and H. Lobsher (recreational fishing guide/fisherman). We subsequently visited the Salt Ponds on our own, and developed and conducted a field project with UNAM students that examined salt stress effects on ecosystem-level processes in the artificial salt ponds (Levin & Checkley). Interactions with H. Lobsher included field testing of a new Goby collection net (with Salvanes) (Checkley). Checkley has had subsequent interactions with J. Klein about the culture of a brackish water prawn species collected from the Kunene River and other aspects of the Klein's extensive operations (salt and guano production and mariculture). Levin briefly discussed the commercial deep-water crab fishery with Aquataga.

We met with Jeremy Midgely (environmental consultant hired by Namibia Phosphate Inc.) to obtain information and discuss environmental impacts of planned deep-water phosphate mining. Offshore mining represents a new minerals industry with potential effects on fisheries.

We participated in a public workshop (May) and a private marine working group meeting (June) to address site selection and environmental issues associated with an industrial park proposed near Swakopmund by Gecko Holdings to serve

the 'Uranium Rush' demand for energy, water, industrial chemicals, and shipping. We contributed thoughts on various impacts, particularly marine, of the proposed development.

## **VII. Teaching and University Interactions**

### *A. Namibia - University of Namibia (UNAM)*

#### Teaching

We spent an intensive seven days with 37 UNAM Biology and Fisheries students during March 2011. We lectured at the Univ. of Namibia in Windhoek on March 7, 8 and 9 on general marine ecology (soft sediment ecology, rocky shore ecology, planktonic organisms), bioinvasions, ocean observing, and climate change and fisheries. On March 10 the students were transported to the Henties Bay marine facility on the coast and we led a field trip to sample four salt ponds at the Salt Company LTD (mile 4); these reflected a salinity gradient from 35 to 200 ppt. Measurements, collections, and observations included water and sediment properties, planktonic and benthic algae and invertebrates, as well as vertebrates, including birds. Students worked in pond groups, and in pairs to focus on specific taxa. The collections provided material for lab work over the next two days (Friday, Saturday) and assignments emphasized pond characterizations (species composition, abundance diversity) and ecosystem-level processes. Pond group presentations were made by the students and a cross-pond discussion was held on Sunday. Additional activities at Henties Bay included two lectures on climate change (covering deoxygenation, acidification, natural and anthropogenic fisheries variations) and a rocky shore field trip to illustrate concepts given in lecture in Windhoek. Movies (*Oceans, An Inconvenient Truth*) were shown on two evenings after dinner. Students were evaluated with worksheets (for Windhoek lectures), field trip observation forms, and a final quiz. The salt works was an opportune place for this due to the gradient in salinity stress and the existence of guano platforms, with abundant cormorants and other birds (e.g., flamingos), as well as oyster culture.

#### General thoughts and observations

The students were polite and attentive during lectures in Windhoek, but were hard to engage in discussion, and tended to copy worksheet answers. They came from a wide variety of backgrounds and their knowledge and skill levels varied greatly. They seemed to enjoy the field work; a number of them had never seen the ocean. The salt pond project was successful in requiring the students to learn about new groups of organisms and to think; i.e., they had to be creative and apply theoretical and basic concepts (about diversity, trophic structure, physical- biological interactions) to develop mechanistic explanations for observed patterns. Students ranged in aptitude and interest, with some clearly engaged, motivated, and capable.

## *B. South Africa - University of Cape Town (UCT)*

We spent one week at UCT, hosted by Professor Coleen Moloney. We taught, lectured, and interacted with students and staff in the Departments of Zoology and Oceanography.

### UCT Lecture Series

Topics in Benthic and Pelagic Ecology offered to Masters in Applied Marine Science, PhD students, postdocs and visitors (12-20 students and postdocs /lecture, more for open seminars):

- April 11: *Deep-Sea Biodiversity* (Levin)
- April 11: *Ocean Observing: Principles and Practice* (Checkley)
- April 12: *Climate Change and Deep-Water Benthos – Deoxygenation and Acidification* (Levin)
- April 12: *Fisheries and Climate* (Checkley):
- April 13: *Deep-sea Conservation Imperatives* (Levin)
- April 13: *Fisheries and Climate Change* (Checkley)
- April 14: *Population Connectivity – applications of trace elemental fingerprinting* (Levin)
- April 14: Open Seminar - Oceanography Department: *Particle dynamics in the epipelagic* (Checkley)
- April 15: Open Seminar - Oceanography Department: *Population connectivity of mussels and fishes assessed by trace elemental fingerprinting* (Levin)

### Levin discussions

Discussions of marine biodiversity and deep-water sampling and conservation with the following individuals:

- Colin Atwood (UCT) – marine and terrestrial biodiversity,
- Kerry Sink (Marine Program Manager, South African National Biodiversity Institute)
- Lara Atkinson ([South African Environmental Observation Network, Egagasini Offshore Node](#))
- Nina Steffani (Steffani Marine Environmental Consultants, marine benthos, phosphate mining EIA)
- Mark Gibbons (Univ. Western Cape)

Levin conducted additional discussions about larval dispersal with Coleen Maloney, George Branch, Mya Pfeff (UCT), Carl van der Lingen (Ministry of Fisheries), invasive species with Alison Mead (post doc, UCT), and oxygen dynamics with P. Monteiro (UCT).

### Checkley discussions

Checkley held discussions with a variety of scientists at UCT, U of the Western Cape, the Ministry of Fisheries to discuss climate, oceanography, fisheries, and students, including Coleen Maloney, Olivier Maury, Frank Shillington, Mark Gibbons, Carl van der Lingen, and Rob Crawford.

### General thoughts

The University of Cape Town (UCT) faculty conducts high-quality science with state-of-the-art tools. They remain at the forefront of oceanographic research and teaching in many areas. However, there is little deep-water expertise in the country despite the fact that mining and fishing activities are posing increasing threats to shelf and slope ecosystems of South Africa. Levin met with the few scientists (young) attempting conservation-oriented work in deep water, and it was clear that they would benefit from and are eager for greater exposure to international deep-water research, concepts, scientists etc.

Student training in oceanography occurs at a high level at UCT (and is probably the best on the continent). Admissions are selective and only a minority of the students in the graduate programs are black. Most of the black students are not from South Africa. Students were attentive and asked questions, but were not tested for understanding of the material presented. Capacity-building funds may be less essential at UCT than at all-black universities (e.g., U. Western Cape). Mark Gibbons may be a good contact for future POGO efforts in this realm.

### **VIII. Other Outreach Activities**

(a) Photo contributions to NACOMA group publishing a book on Coastal Ecology of Namibia (Levin and Checkley)

(b) Public Presentation at the Swakopmund Museum (Feb. 22, 7 PM)

*"Mysteries of the Deep: Ecology of Extreme Environments"* (Levin)

(c) Participation in NansClim, Stellenbosch, S Africa, 14-16 March (Checkley)

Dave was an invited participant at the interim project meeting of NansClim, a Norwegian-sponsored program of research using the RV Nansen on fisheries and climate in the Benguela. Participating countries are Angola, Namibia, and South Africa. Dave presented a talk entitled 'A View from Without' comparing fisheries and research in the California and Benguela Current regions, and participated in the program assessment and planning. He met with staff at S Africa's Ministry of Agriculture and Fisheries on 17 March.

(d) World Ocean Day, June 8 (Checkley)

Led panel discussion at local theater of *End of the Line* movie on overfishing.

Swakopmund Museum Talk: “*Our Deep Ocean Basket: Legacy or Loss*”.

(e) Secondary School Presentations (Checkley)

10 June (two presentations): Pro Ed Academy (private)

16 June: Westside High School (government)

(f) Met with V. Ittekkot, E. Omoregie and B. Currie to discuss the SPACES program and challenges for visiting scientists working in Namibia. (Levin)

(g) Presented Anton Bruun Memorial Lecture (*Understanding Margin Biodiversity: A New Imperative*) to the 26<sup>th</sup> IOC Assembly, Paris. (Levin)  
Discussed biodiversity on and intensifying threats to margins of less developed nations and suggested course of action. Also met with Ed Urban in Paris to discuss Namibia experiences.

## IX. Research Activities

### Levin

Developed new research on several themes:

- (1) Land-ocean energy exchange on the Skeleton Coast (with B. Currie)  
Stable-isotope-based study to examine use of coastal marine food sources by land animals along the arid coastline of N. Namibia.
- (2) Swakop –River Detritus Influence on the central Namibia Coast (with B. Currie)  
Stable-isotope based study to examine incorporation of organic matter into coastal foods webs from Swakop River flooding in April - June
- (3) Namibia cross –margin study of oxygen/OMZ influence on macrobenthic biodiversity and trophic roles (with B. Currie, NatMIRC, A. Salvanes – U. Bergen).  
Design and initiation of a sediment sampling program on the outer shelf and upper slope. Work with systematics, community structure and stable-isotope –based food web analyses.

### Checkley

Research on the effects of climate on sardine in the Northern Benguela and, less so, the Southern Benguela. This work strongly influenced by discussions with and information from colleagues at NatMIRC, including Beau Tjizoo, Anja Kreiner, Chris Bartholomae, Nadine Moroff, and Anja van der Plas; UCT, including Frank Shillington, Chris Reason, and Mathieu Rouault; U Western Cape, Mark Gibbons; S African Ministry of Agriculture and Fisheries, including Carl van der Lingen and Larry Hutchings; and NansClim, including Kay Emeis.

## **X. ACKNOWLEDGEMENTS**

We sincerely appreciate the support and encouragement POGO. The financial awards associated with our Visiting Professorships enabled us to contribute and learn in all of the activities described above. We found our experience in Namibia enabled by POGO to be extraordinarily enriching. We hope others have similar opportunities to contribute and learn.

We are indebted to our hosts, Bronwen Currie and Anja Kreiner, at NatMIRC for their efforts on our behalf. Their hospitality greatly enriched our stay in Namibia.

We thank the many individuals named above with whom we met and interacted.