Teaching and learning about shore ecology is best done where it's all happening, advises **Dumile Tshingana**. He explains how a pilot educational outreach coastal monitoring programme in the Eastern Cape brings learners and teachers into direct, active contact with environmental science.

Out of the classroom, into the field

Associated with the SAEON Elwandle (Coastal–Inshore) Node, or observation platform, is the pilot Schoolyard Long-Term Ecological Research (LTER) coastal monitoring programme. This outreach environmental science initiative gives students and educators the chance to experience at first hand – and make a real contribution to – the scientific processes used for monitoring and looking after South Africa's coastal ecosystems.

The shores and estuaries of the Eastern Cape are among the country's most productive ecosystems. Despite their ecological significance and conservation status, however, they are being increasingly affected by people – directly by harvesting and trampling, and indirectly through pollution and litter. In addition, climate change along this coastline could generate changes in plant and animal life.

Monitoring the habitats within the coastal environment is therefore critical for evaluating their state of health. Our pilot outreach programme aims to start regional monitoring initiatives that can expand into other areas – as sites are identified, learners actively engaged, and terrain marked out for permanent long-term investigation. Curious learners will see the reality of what is happening in the coastal environment outside their schoolyards – and find out how to explore and address these realities for the rest of their lives.

Photographs: Courtesy of SAEON

Top right: SAEON researchers take notes as they measure and monitor plants at a designated site.
Right: Monitoring a coastal area.

Maths and environmental science

Mathematics is a pervasive and essential instrument of environmental science. Conservationists rely on maths to help to interpret and explain what their observations of environmental conditions mean. They need, for example, to count the different animals in a nature reserve so as to prevent overstocking that would cause starvation and death, turning the reserve into a desert.

But animals differ in size and in what they prefer to eat. They are also hard to count because they can hide, run, or swim away, and counting them from a helicopter or boat costs a lot of money. Imagine trying to count many different kinds of fish that can swim underwater anywhere they like*!

So scientists use mathematics to estimate numbers and work out what there is per separate area; and also to calculate whether there will be enough food for the animals, how many may be hunted or fished, and even how many there will be next year. The data are often integrated in graphs and maps, to allow visual comparisons of places, species, conditions, and times. Mathematical formulae are used to establish future conditions, so that the right decisions can be taken early enough. And mathematical models are constructed from massive amounts of data, which often represent complex ecological interrelationships, and must therefore be analysed through computer programs and statistical methods. – *Johan C. Pauw, Managing Director: SAEON*

* For ways in which scientists approach this problem, read "Still counting" in Quest, vol. 3, no. 1 (2006), pp. 24–27.

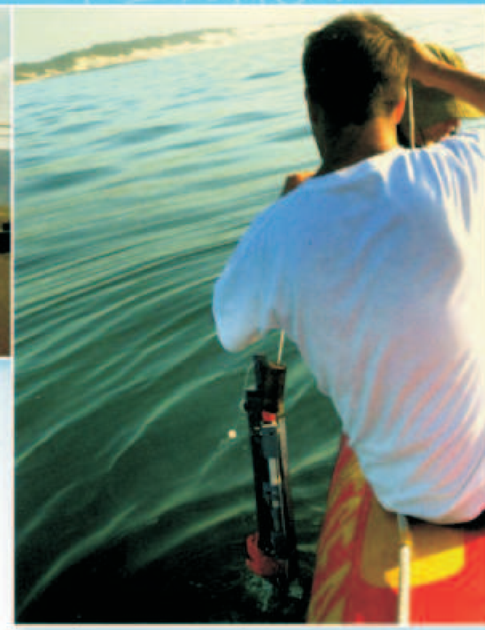
SAEON

The South African Environmental Observation Network (SAEON) was created to deliver long-term reliable data for scientific research and for informed management and policy-making. Its six nodes cover various ecosystems (Savanna; Arid Lands; Fynbos; Marine–Offshore; Coastal–Inshore; and Grasslands/Forests/Wetlands), with a connecting internet data-management system.

Earth observation monitors the planet's surface from space by satellites, from the air by cameras, and from the ground by direct measurements. To determine real trends and changes – given the variability and complexity of natural systems – SAEON keeps environmental data over many decades. South Africa co-chairs the Group on Earth Observation, which is developing a Global Earth Observation System of Systems into which SAEON data will be fed.

As a network of organizations and people involved in environmental observation, SAEON integrates the work of different research organizations and people. It also promotes the development of young scientists by supporting science and mathematics educators, learners, and students through environmental monitoring and research projects. – *Johan C. Pauw*

For more about SAEON, visit **www.saeon.ac.za**. For an impression of issues covered by SAEON, consult the special suite of articles in the *South African Journal of Science*, vol. 103 (2007), pp. 289–342.



Above and right: Taking samples and measurements on land and at sea.

Schoolyard programme participants examine the rocky shores. Photograph: D. Tshingana

Why monitor rocky shores, sandy shores, and estuaries?

These ecosystems support some of South Africa's richest and most diverse coastal plant and animal life (biota), yet they are subject to constant change, mainly through people. At some sites, especially in the Eastern Cape, harvesting and trampling have dramatically reduced the abundance and diversity of the biota (mussel harvesting, for example). The accessibility of these ecosystems has encouraged more and more visitors of various kinds. But walking along the rocky shores and estuaries can disturb some species and lead to unpredictable changes.

By their nature, rocky shores, sandy shores, and estuaries are exposed to many of the pollutants produced by human (anthropogenic) activity. Contaminants released into the air fall on the sea surface, and they are carried onto the shore – as also are chemical contaminants, such as oil spills from ships. Waste materials dumped on land are washed into the sea, some remaining for years on the coast that they cross.

The animals and plants that inhabit coastal areas may be affected more seriously by anthropogenic activities than biota in the sea elsewhere. But the accessibility of these habitats can make them easier to monitor and observe, so they make fine outdoor marine classrooms.

Scientists predict that, with rising air and sea temperatures, the distribution of species along our coast is likely to change, and global warming will probably cause water levels to rise. The zonation pattern of the intertidal area, where species are sorted into bands according to tidal height, may be particularly sensitive to such adjustments, as a rise in sea level could shift the zones higher up on the shore, and also change the pattern itself as the shoreline configuration and associated wave-forces alter over time. Long-term, annual sea-level cycles could also influence zonation patterns.

For these reasons the SAEON Elwandle Node emphasizes the importance of observing and tracking marine organisms over time, and actively engages young people in this exercise.

Real participation

Through the Schoolyard programme, students actively participate – as part of the Rocky Intertidal Monitoring Project – in surveying key invertebrate and algal species at one of the established rocky-shore monitoring sites in the Bushman's River mouth. They examine marine life and tidal patterns; identify fish and other marine organisms in the rocky shores; test the estuary water's pH (acidity or alkalinity) and salinity; and analyse its turbidity (the sediment that it carries). Intertidal monitoring is conducted at low tide; and transects and quadrats[1] are used to survey and measure the abundance, distribution, and species-richness of the area.

The programme targets Grades 9, 10, and 11, and the three participating schools are Ikamvalesizwe Combined School and Nompucuko Combined School in Kenton, and Kuyasa Combined School in Port Alfred.

Participation in a hands-on outreach programme such as this one offers in-depth, experiential learning[2]. It is a practical way to start to understand the ecology of one of the world's most diverse ecosystems, with its rocky intertidal habitats, estuary, and sandy shores. Research-based monitoring helps students to develop problem-solving skills, use the tools and methods employed by field scientists, and learn to analyse data. Students also make their own active contributions to a data-set used to identify changes in the life of these ecosystems over long periods of time. This project incorporates natural science, life sciences, physical science, and mathematics, through curriculum-driven activities addressing national educational requirements.

In the classroom, before going into the field, students find out about the Schoolyard programme; learn the importance of monitoring; learn to identify the organisms that are surveyed in the field; and practise protocols of monitoring using graphs, field guides, quadrats, and learner-support materials such as posters and textbooks. Back at school after field expeditions, students work with the data they have collected, generate graphs that can be used to interpret results, and share their findings through presentations and poster demonstrations.

The Schoolyard monitoring programme provides long-term data. What's important is that it also introduces learners to the rich coastal biota, and builds up a group of informed, concerned citizens who will continue watching over and nurturing these fascinating ecosystems in the future. □

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1. A *transect* is a sample strip of land used to monitor plant distribution, and animal populations, for example. A *quadrat* is an area of vegetation, usually one square metre, selected at random for the study of plants in the surrounding area.
2. In the planning stages is another project to monitor coastal weather. Participating schools will conduct continuous weather observations. The project will largely depend on the availability of weather observation kits and data collection tools. Learners and educators will collect data over time until they see the weather trend (or overall picture of coastal weather fluctuations). These data will be translated into school syllabus work through graphical interpretation and charts.