trations as new, small, light industrial sources are considered. The concentration increases slightly up to 40 new sources, after which a marked increase is observed.

A total of 70 new, small, light industrial sources may be added before the national mean annual carrying capacity of 80 $\mu g\ m^{-3}$ is marginally exceeded. Figure 2 shows a steady increase in the mean annual concentration when light industrial polluters are systematically introduced. An average increase in peak ambient SO_2 concentration of about 2 $\mu g\ m^{-3}$ occurs with the addition of every five new sources.

Similar computations were performed for the addition of medium industrial sources. It was found that 15 additional sources with mean emission rates of 15 and 20 $g\ s^{-1}$ could be added before national guideline values were exceeded (Fig. 3). With an increase in mean emission rate to 30 $g\ s^{-1}$, only five new sources could be added before carrying capacity was exceeded.

Conclusion

The impact of two development scenarios — a petrochemical cluster and a light industrial complex — on air quality in the SDIB has been investigated through the use of the ISC3 dispersion model. Control runs predicted the SO_2 concentrations for the current mix of industries. The predicted 1-h maximum exceeds the South African national guideline values over a fairly large area within the SDIB. Using WHO and SDSDMS guidelines, there were exceedances for all averaging periods. As a consequence, we argue that the carrying capacity of the SDIB is already surpassed by the existing mix of industries.

The proposed petrochemical cluster is predicted to lead to a slight improvement in air quality for all averaging periods as a result of the planned 50% reduction in SO_2 emission at one of the refineries.

An investigation of the number of new industrial sources that could be established in the SDIB reveals that 55 new, small, light industrial sources (5 $g\ s^{-1}$) and five medium light industrial sources (30 $g\ s^{-1}$) may be introduced before the national 24-h (260 $\mu g\ m^{-3}$) and annual (80 $\mu g\ m^{-3}$) carrying capacities are exceeded. It should be remembered, however, that 1-h national guidelines and all WHO and SDSDMS guidelines are currently exceeded. In conclusion, we recommend that, in the absence of emission reduction, further establishment of industries in this area would be unwise.

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It is, or should be, irrelevant that natural fluctuations of the surface temperature involve changes from year to year that exceed the amounts predicted by the computer models, for the natural fluctuations are both upwards and downwards. A consistently increasing trend of temperature, even as little as one-fifth of a degree each decade, would be a very different matter. It is relevant that the melting of the ice at the end of the last Ice Age took more than 1000 years, during which the average temperature of the Earth's surface increased by roughly 6 degrees; that is the equivalent of 0.06 degrees each decade, or less than a third of the lowest rate of temperature increase now predicted by the climate models.

John Maddox (*What Remains to be Discovered*)

Biodiversity of seaweeds and echinoderms in the western Indian Ocean

J.J. Bolton[a*], E. Coppejans[b], R.J. Anderson[c], O. De Clerck[b], Y. Samyn[d], F. Leliaert[b] and A.S. Thandar[e]

A three-year project has increased by more than 30% the number of seaweed and echinoderm species recorded off KwaZulu-Natal, and included some new to science. It demonstrates that we do not need to go to abyssal depths to make a significant and novel contribution to our knowledge of marine biodiversity.

A final workshop for this inter-institutional collaborative project,[†] funded by the Flemish government and the National Research Foundation, was held at the University of Ghent, Belgium, on 31 August 2001. The project has been under way since 1999, enabling biologists from the universities of Cape Town and Durban-Westville, and Marine and Coastal Management, to collaborate with their colleagues working in Belgium on seaweeds (University of Ghent, UG) and echinoderms (Free University of Brussels, VUB) of the tropical Indian Ocean.

Joint work has involved detailed collecting in KwaZulu-Natal (KZN), and concentrated on the poorly investigated subtidal zone. The extent of this collecting is substantial. First, the echinoderm biologists accomplished approximately 42 hours of subtidal observations per diver and obtained some 725 specimens; second,

[†]Biodiversity studies on seaweeds and echinoderms in the transition between temperate southern Africa and the tropical western Indian Ocean.

[a]Botany Department, University of Cape Town, Private Bag, Rondebosch, 7701 South Africa.
[b]University of Ghent, Department of Biology, Laboratory of Botany, K.L. Ledeganckstraat 35, 9000 Ghent, Belgium.
[c]Seaweed Unit, Marine & Coastal Management, Private Bag X2, Roggebaai, 8012 South Africa.
[d]Unit of Ecology & Systematics, Free University of Brussels, Pleinlaan 2, 1050 Brussels, Belgium.
[e]Zoology Department, University of Durban-Westville, Private Bag X50041, Durban, 4000 South Africa.
*Author for correspondence.
E-mail: bolton@botzoo.uct.ac.za

Leliaert's presentation of a biogeographical seaweed analysis used information from as many as 3 447 annotated specimens.

The introduction to the workshop (Coppejans) emphasized the importance of KZN as an overlap between temperate and tropical regions of the western Indian Ocean. The summary that followed of previous knowledge of marine biogeographical patterns in the region (Bolton) highlighted confusion in the literature as to whether the KZN marine biota is best described as subtropical, as a mixture of temperate and tropical, as tropical, or as various combinations of the three. At a number of different parts of the coast, biogeographical boundaries have been drawn.

In a preliminary biogeographical analysis, Samyn revealed the echinoderm fauna of KZN as primarily Indo-Pacific (73%), although with a considerable number of southern African endemics (21%). The data suggest a region of change around St Lucia, although this particular part of the coastline is not well sampled, so strong conclusions cannot be drawn at this stage. Distribution data were compiled (Leliaert) on 440 species of seaweeds, which have been recorded from Tsitsikamma on the south coast to the extreme north of KZN. A detailed analysis was carried out only on the 270 intertidal species in this dataset, as the subtidal data are too discontinuous at present. The major change in the flora occurs between the Cape St Lucia and Sodwana regions, with a less marked region of change along the Transkei and southern KZN coasts. To stimulate discussion about possible explanations for these patterns, Anderson presented a survey of recent literature on inshore oceanography of KZN. The Agulhas Current has a powerful controlling effect on the KZN coastal biota. It runs close to the coast in northern KZN (Maputaland), but begins to move offshore around Cape St Lucia, where in the Natal Bight the continental shelf widens. Here, topographically induced upwelling lowers the water temperature, and the shallower shelf and increased river run-off also result in higher levels of turbidity inshore. These changes in physical factors may explain the biogeographical importance of the Cape St Lucia region. A detailed understanding of the causes of distribution patterns of the inshore biota is hampered, however, by the lack of relevant temperature data along the KZN coast.

The project has added significantly to our understanding of the variety of species to be found in the area. Before the project, the record of shallow-water (less than 50 m deep) echinoderm fauna of KZN comprised around 130 definitely valid species, although the majority of these were known only from single collections (Thandar). As with some other groups such as polychaetes, only a temperate and a tropical biogeographical region have been recognized, with a boundary along the Transkei coast. In the course of the project, 51 species have been added to the echinoderm faunal record of the region, an increase of almost 40% (Samyn). Most of the additions belong to the tropical Indo-West-Pacific component, although they include at least three species of sea cucumber and probably one species of brittlestar new to science.

Particularly worthy of note is that several genera belonging to different echinoderm classes are here reported for the first time for southern Africa. Some of the new findings in the family Holothuriidae (Holothuroidea: Aspidochirotida) are especially interesting. The genus *Labidodemas*, for instance, which till now had only four recorded species, was hitherto unknown from southern Africa; furthermore, during the course of this project, two known species and one species new to science have been reported, which allows a worldwide revision of the genus. Similar work is under way for the holothurian genera *Actinopyga* and *Holothuria* and for the genus *Ophiocoma* (Ophiuroidea: Ophiocomidae).

The recorded flora of red algae (Rhodophyta) for KZN has also been significantly increased, by over 30%, from 221 to 289 species (De Clerck). Among the 68 new records, the majority are again Indo-West-Pacific tropical species, with a few pan-tropical representatives. A small number of species have disjunct distributions in the Indian Ocean, and these tend to be deeper subtidal species, suggesting that the gaps in the record are due to insufficient collections. New records of species described from Australia are not uncommon, but very few species appear to be endemic to northern KZN/southern Mozambique. Based on these collections, details of a new genus of the red algal family Ceramiaceae will be submitted for publication (De Clerck). Taxonomic studies of certain red algal groups were presented, including *Plocamium* (Engledow, UG), as well as molecular systematic studies of the commercially important families Gelidiaceae (Tronchin, UCT) and Gracilariaceae (Iyer, UCT). A number of new species and new records will be published on the basis of these studies.

Twenty-three of the green algae species (Chlorophyta) found were new records for KZN (representing a 38% increase), including 17 new records for South Africa (Leliaert). The flora now includes 11 species of *Cladophora* (where previously there were only three), and 11 species of *Caulerpa*.

The Flanders Marine Data and Information Centre (introduced by Vanden Berghe from the Flanders Marine Institute) will contribute GIS and other expertise to a proposed extension of the current project. A clear understanding of biogeographical boundaries is needed to investigate potential effects of global climate change, and further studies are planned that will concentrate on the Cape St Lucia marine boundary. They will include documenting the inshore temperature regime at a number of sites, describing the subtidal marine vegetation in this overlap, as well as producing guides to the seaweeds and echinoderms of KZN.

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'[William Smith's creation of the first-ever modern geological map] required patience, stoicism, the hide of an elephant, the strength of a thousand and the stamina of an ox. It required a certain kind of vision, an uncanny ability to imagine a world possessed of an additional fourth dimension, a dimension that lurked beneath the purely visible surface phenomena of the length, breadth and height of the countryside, and that, because it had never been seen, all customary cartography ignored. To see such a hidden dimension, to imagine and extrapolate it from the little evidence that could be found, required almost a magician's mind — as geologists who are good at this sort of thing know only too well today.

And yet this was still a wholly unknown area of imaginative deduction — there were no teachers, no guidebooks. Just one man, doing it all by himself, imagining the unimaginable. Small wonder that the map of these new underground dimensions took fourteen long years to complete, years more than it was supposed to have done. It proved to be the financial ruin — at least in the short term — of the man who had the vision to see it made. But when it was done, it all proved to be so very good, so revolutionary, so filled with potential for profit and fame, that it was stolen, copied, pirated, and the man who had made it overlooked, ignored and forgotten for years.'

From *The Map that Changed the World* by Simon Winchester (Viking, London; 2001).