Global ocean monitoring strategy

SIR — We applaud Duarte *et al.*[1] for emphasizing the need to maintain broad-area coastal and ocean monitoring studies. But they do not discuss the need for scientific and pragmatic incentives to encourage countries to monitor marine ecosystems.

A new paradigm in ocean use was initiated in 1982 when the United Nations Law of the Sea Convention established exclusive economic zones up to 200 nautical miles from the baselines of territorial seas, granting coastal states the sovereign rights to explore, manage, and conserve the natural resources from an ecosystem perspective[2]. Within and extending seawards beyond the boundaries of the zones are large marine ecosystems being subjected to increased stress from growing exploitation of fish and other renewable resources, coastal-zone damage, river-basin runoff, the dumping of urban waste and the fallout from aerosol contaminants. Global climate change has become a factor in the sustainability of biomass production in large marine ecosystems[3]. The rather large-scale fluctuations in marine biomass yields of large marine ecosystems over the past several decades, when considered in the light of growing concern over coastal pollution and habitat loss, are serving to accelerate movement towards the development and implementation of a coastal global ocean observing system[4] to provide biological, physical and chemical data for the development of indices to monitor changing states of large marine ecosystems[5]. The indices should improve communication between scientists and resource managers, should help to implement mitigation strategies where appropriate, and should reinforce the need for the long-term (multidecade) ecosystem-wide monitoring programmes that, according to Duarte *et al.*[1], are being terminated in Europe.

Monitoring and research are activities with different purposes and aims. Yet there is no clear-cut boundary between them, and monitoring the marine environment and living resources provides data that are used as an important component of research on perturbations and driving forces in large marine ecosystems. Insight into the mechanisms behind the large-scale fluctuations in biomass yields of these ecosystems is a prerequisite for an improved management strategy based on ecological knowledge and the principle of sustainable use[6].

The 49 large marine ecosystems that have been identified are located around the margins of the ocean basins and extend over coastlines of several countries[7]. They are in regions of the oceans most affected by overexploitation, pollution and habitat degradation, and collectively represent target areas for mitigation effort. The Global Environment Facility of the World Bank, in collaboration with National Oceanic and Atmospheric Administration, Intergovernmental Oceanographic Commission, United Nations Environment Programme, Food and Agriculture Organization of the United Nations, Natural Environment Research Council, the Sir Alister Hardy Foundation for Ocean Science and the national marine resource agencies of several countries (for example, Belgium, Cameroon, China, Denmark, Estonia, Germany, Ivory Coast, Japan, Kenya, Korea, The Netherlands, Nigeria, Norway, The Philippines, Poland and Thailand) are reviewing proposals to support assessment, mitigation and coastal monitoring activities of marine ecosystems as proposed by Duarte and his colleagues.

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Storing plutonium

SIR — Your leading article "Why not plutonium?" (*Nature* **358**, 356; 1992) contains two conflicting messages: that plutonium should be burnt in fast-breeder reactors and that plutonium should be stored in 'secure repositories'.

A third option, plutonium disposal, should also have been mentioned. No commercial need for plutonium as a fuel for nuclear reactors exists anywhere in the world today, nor is it likely to for some decades. It is cheaper and safer to produce nuclear electricity by burning enriched uranium. As plutonium is not an 'economic resource' in any conventional sense, it should therefore be treated as radioactive waste.

The argument for storing separated plutonium (currently about 300 tonnes in weapons and civil stocks worldwide) against future use is also weak. Current world nuclear capacity (about 340 GWe) can be sustained with known economic uranium resources for about a century. When and if the world's nuclear power capacity grows so large that fast reactors are required, the plutonium needed for reactor start-up could be derived from spent fuel from light-water reactors. For instance, if a tripling of nuclear capacity occurs to about 1,000 GWe, and there is then a wholesale shift to fast reactors over, say, a 40-year period, 150 tonnes of fissile plutonium would be required annually to fuel these reactors, or 6,000 tonnes over 40 years. A conventional 'thermal' nuclear programme of 1,000 GWe would discharge about 120 tonnes of plutonium annually. On these scales, the fate of 300 tonnes of plutonium seems relatively trivial.

Storing hundreds of tonnes of plutonium for several decades is not, however, a trivial problem. Plutonium is a bomb material and will always remain a target for proliferators and terrorist threats. Its use, handling and transport should therefore be restricted to the bare minimum. Treating plutonium surpluses as waste, immobilizing them in glass (or some other suitable material), with a view to eventual disposal seems to us a prudent approach to a global security and environmental problem.

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Motive to sin

SIR — E. T. Rakitzis (*Nature* **359**, 9; 1992) misrepresents my position (**358**, 10; 1992). Contrary to his assertion, I do not believe (and did not say) that people commit fraud because the stakes are high. I said they commit it because it is rewarded (the rewards and stakes are remarkably low by the standards of the business world). Such people are certainly unsuited for any position of responsibility, in science or elsewhere. But they exist, and always will, and science should be run so that they do not have the motive to sin. This is not a rationalization of fraud; it is the suggestion that it is better not to test everyone's integrity too often. More important, the system that rewards fraud by the unscrupulous also rewards bad work by the honest.

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