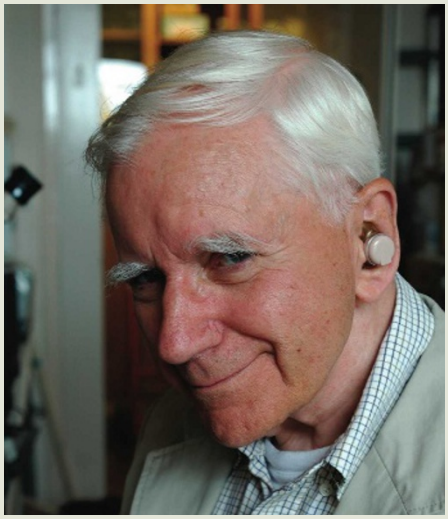
OBITUARY

Alan J. Southward (1928–2007)

Marine biologist: a pioneer of marine ecosystem time series.



G. BRAASCH

Alan Southward's many contributions set him among the most influential figures of twentieth-century marine science. Much of his career was spent at Plymouth, in Devon, an ideal location for studying how environmental changes affect marine ecosystems: the western English Channel and its approaches form a boundary between oceanic and coastal waters, as well as between two biogeographical provinces.

In the 1890s, plankton surveys were started in this region by the Marine Biological Association of the United Kingdom (MBA). Several time series were established, including those of zooplankton by Frederick Russell in the 1930s. Southward started baseline surveys of intertidal organisms around the British and Irish coasts in the 1950s, and later took over the Plymouth zooplankton time series. Using old records, he demonstrated how the distribution of organisms changed with changing sea temperatures. This was long before the advent of concern about global warming; his work laid the foundations for subsequent studies of climatic effects on marine ecosystems.

Southward was born in Liverpool, the son of a Cunard engineering fitter. He contracted meningitis at 15, with the result that he lost his hearing and sense of balance, and had to learn to balance by eye. An interest in shore organisms led him to study zoology at the University of Liverpool, graduating in 1948. Doctoral studies followed, on the ecology of intertidal animals, at Port Erin Marine Laboratory on the Isle of Man. It was there that he met, and later married, his lifetime scientific partner, Eve Judges.

In 1953, the year the MBA acquired the side-trawler *Sarsia* for offshore studies, Southward moved to Plymouth as a postdoctoral fellow. He was on the MBA staff from 1956 until his retirement in 1988, and continued working there until his death on 27 October 2007. He initially followed in the steps of Charles Darwin, the most famous student of barnacles, in showing how studies on barnacle distribution could allow inferences to be made about biogeographical barriers. His early intertidal surveys were used to quantify the damage caused by the detergent used to disperse the *Torrey Canyon* oil spill in 1967; more notably, he showed how long it took for the ecosystem to recover.

From the early 1950s onwards, Southward showed how minor changes in environmental conditions, especially temperature, correlated with changing geographical ranges of intertidal and planktonic organisms. He worked with Russell, and others, describing the events leading to the 1930s collapse of the herring fishery and the replacement of herring by pilchards. Their seminal paper, published in 1971, linked changes in water mass and water chemistry to changes in plankton species and abundance. Subsequent studies on cyclical and long-term changes in the marine ecosystem led to an understanding of the causes of these changes, and to predictions of the consequences of rising sea temperatures.

The Southwards first used *Sarsia* for deep-sea studies in 1956, dredging the continental slope for barnacles, which involved long hours of noisy winch work. The scientists' cabins were directly under the winch, making sleep difficult — except for Southward, whose deafness proved a boon (likewise his immunity to seasickness, although he was, once, reported to have felt uncomfortable in a force 12).

Looking through dredge sievings, the Southwards noticed hair-like organisms that had probably been ignored previously because they resembled the fibres of the dredge nets. They became fascinated by these small, mouthless, gutless tubeworms, known as pogonophores, and investigated whether they could obtain nutrition from dissolved organic compounds in the sediment. Following the 1977 discovery of hydrothermal vents and giant pogonophores (vestimentifera) on the Galapagos Rift, Colleen Cavanaugh showed that sulphur-oxidizing bacteria living symbiotically within the vestimentiferans supplied them with their nutrition by chemosynthesis. It soon emerged that the small pogonophores of the continental slope also contained such bacteria.

Several cruises to the slope were spent looking for the bacterial energy source because, unlike the vents, hydrogen sulphide and methane were almost absent there. Finally, Southward negotiated funding to study a shallow pogonophore habitat near Bergen, Norway. Two bivalve species were found, also with chemosynthetic bacteria, living alongside the pogonophores. Eventually, it was deduced that all these organisms 'mined' sedimentary iron sulphides to obtain energy for bacterial carbon dioxide fixation. In this way, chemosynthetic ecosystems were shown to be widespread in reducing sediments, from the intertidal regions to the deep sea.

Southward continued studying pogonophores throughout his life, a final paper being completed just before his death. Research came full circle with the conclusion that many pogonophores are 'mixotrophic', depending on both endosymbiotic bacteria and dissolved organic matter.

In retirement, Southward turned to the study of hydrothermal-vent ecosystems. This was aided by an invitation to become an adjunct professor at the University of Victoria, Canada, to study vents in the Pacific. He was an early user of stable-isotope data to follow nutritional pathways in such ecosystems in the Atlantic, Mediterranean and the Pacific.

Southward was an excellent writer and stimulating speaker. For 20 years he was a meticulous editor of *Advances in Marine Biology*, with an uncanny eye even for the missing comma in a reference list. He encouraged scientists from the Soviet Union to publish reviews in English to gain a wider audience. This led to a heavy editing workload, not least in coping with the authors' 'Russish', but Southward justifiably obtained great satisfaction from seeing their work in print. Following the break-up of the Soviet Union, there was little funding for Russian marine biologists, and Southward worked hard to find Western sources of money to keep them in post.

Alan Southward was an innovative, multi-disciplinary scientist, one measure of his encyclopaedic knowledge being the impression he left on postgraduates at Victoria by his ability to advise them on any research project. He published prolifically, with 11 papers stemming from his doctoral studies alone; overall, he published 200 papers, along with two books (*Life on the Seashore* and *British Barnacles*). He could be impatient, especially with administrators who took a short-term view, but devoted much time to encouraging young scientists. Southward was one of the greatest marine biologists of his generation, and leaves an internationally regarded legacy of dedication and achievement.

Paul R. Dando
Paul R. Dando, of the Marine Biological Association of the United Kingdom, is at the School of Ocean Sciences, Bangor University, Menai Bridge LL59 5AB, UK.
e-mail: oss109@bangor.ac.uk