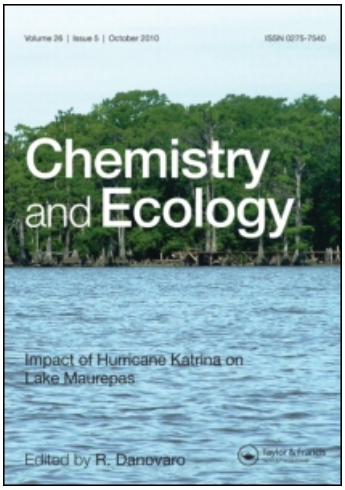

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Variations in Densities of Invertebrate Benthos of the Clyde Estuary Tidal Flats

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VARIATIONS IN DENSITIES OF INVERTEBRATE BENTHOS OF THE CLYDE ESTUARY TIDAL FLATS

The Clyde Estuary is recognised as an important area for overwintering flocks of ducks and waders (Smyth et al., 1974. Here we draw attention to some of the spatial and temporal variations in the invertebrate populations on which these birds feed. Smyth et al.(1977) discuss possible relationships between the bird populations and their invertebrate prey. A 12-month survey, 1976-77, provides the main information on numbers of feeding birds (Halliday, 1978), complemented by sampling over the estuarine flats for invertebrate prey species and for chemical environmental factors: salinity, organic carbon, organic nitrogen, dissolved oxygen, as well as sediment grades. Although there is no constant monitoring shceme for the estuarine flats, a series of surveys provide data over the period 1973-1981.

Coordinates on the 0.2 x 0.2 km sampling grid of the 1976/77 bird survey have been used to examine spatial variations by means of trend surface analysis using a third-degree polynomial model (Curtis, 1978). The distribution patterns indicated faunal groupings: Corophium volutator Pallas, Nereis diversicolor (O.F. Muller), Manayunkia aestuarina (Bourne) and Tubifex costatus Claperede were distinct from Hydrobia ulvae (Pennant), Macoma balthica L. and Peloscolex benedeni (Udekem) with Pygospio elegans Clap. intermediate. It was usually possible to use spatial coordinates to predict well the species' densities and community parameters (species richness and diversity, as well as environmental factors). H. ulvae showed markedly patchy distribution. C. volutator, N. diversicolor and H. ulvae varied mainly along the estuary, whereas the other species varied more with height up the shore. While average salinity in 1974 and interstitial salinity in 1976 showed gradation along the estuary, surface salinity in 1976 varied more across the shore, as did the levels of organic carbon and nitrogen

Spatial patterns from the trend surface analysis showed good agreement between surveys for most species.

However, for H. ulvae, values of Spearman rank correlation coefficient comparing the 1973 sample with four quarterly samples through the 1974 survey and the two samples from 1976/77 are:- -0.31, -0.26, 0.06, 0.20, 0.52 and 0.59. These indicate a marked change in distribution between 1973 and 1974 followed by a slow return to the original pattern. This change coincides with high levels of organic carbon in 1974/75 samples, following the Glasgow sewage workers' strike in late 1974.

In spite of their relative constancy in distribution pattern, the other two main macrofaunal species, C. volutator and N. diversicolor, showed marked temporal fluctuations in terms of their average densities:

		Corophium volutator	Nereis diversicolor
1973 Jul-Sept	(a)	3.9	1.1 (10^3 per m^2)
1974 Oct-Dec	(b)	5.2	3.2
1975 Jan-Mar	(b)	4.0	3.7
Apr-Jun	(b)	2.5	2.7
Jul-Sept	(b)	2.3	3.4
Oct-Dec	(b)	9.1	4.0
1976 May-Nov	(c)	4.3	2.0
/77 Dec-May	(c)	2.5	1.4
1978 Mar-May	(d)	3.9	2.4
Jun-Aug	(d)	11.5	3.1
Sept-Oct	(d)	14.8	4.4
1979 Mar	(e)	4.3	3.2
1980 Mar	(f)	0.05	0.9
Aug-Sept	(g)	2.9	3.9
Oct	(h)	5.3	2.7
1981 Jan	(h)	1.8	2.8

(Data sources a - h indicated in references below.)

The apparent near-extinction of C. volutator in March 1980 is of particular interest and may be one aspect of an ecological syndrome over which concern has been expressed by various parties (Perkins, 1981). Just as these invertebrate populations fluctuate, so the numbers of their bird predators rise and fall, as noted for example by Furness & Galbraith (1980), causing anxiety to ornithologists and conservationists; direct observations by D.B.A. Thompson, C.A. Galbraith and P.S. Thompson have provided data on the consumption of these prey species by some of the Clyde birds. Further analysis of the data presently available, together with continuing data acquisition will

improve our understanding of the causative agents, including chemical environmental factors, affecting the changes in invertebrate numbers, so that the Clyde estuarine ecosystem may be effectively managed.

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