

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY

ARMSTRONG, F. A. J. & LAFOND, E. C., 1966. Chemical nutrient concentrations and their relationship to internal waves and turbidity off southern California. *Limnol. Oceanogr.*, Vol. 11, pp. 538-47.

Concentrations of silicate and nitrate, temperature and percentage transmission of white light were simultaneously recorded from a position in 18 m of water off Mission Beach, California. During a 3-day period in May, vertical distributions of these properties were recorded on four occasions. They showed differences between surface and bottom of 4-6° C, 10-15 % T, and 17 µg-at. Si/l. or 14 µg-at. NO₃-N/l., with all the variables changing correspondingly with depth. Two continuous records of about 18 h showed correlated fluctuations in temperature, turbidity and nutrients, with ranges of about 3° C, 30 % T, and of 14 µg-at. Si/l. or 7 µg-at. NO₃-N/l., respectively. These corresponded to internal waves up to 5 m high with periods around 10 min.

F.A.J.A.

BRYAN, G. W., PRESTON, A. & TEMPLETON, W. L., 1966. Accumulation of radionuclides by aquatic organisms of economic importance in the United Kingdom. In *Disposal of Radioactive Wastes into the Seas, Oceans and Surface Waters*. Int. atom. Energy Ag., Vienna, pp. 623-37.

A survey has been made of some of the more recent work which has been done in the United Kingdom on the extent to which radionuclides can be accumulated by edible plants, molluscs, crustaceans and fish in the sea and fresh water. Results from laboratory experiments on rates of uptake and factors affecting them have been combined with results from field work at Windscale, from fallout studies and from stable isotope analyses.

G.W.B.

EDMUNDS, M., 1966. Protective mechanisms in the Eolidacea (Mollusca Nudibranchia). *J. Linn. Soc. (Zool.)*, Vol. 46, pp. 27-71.

The protective system of eolid nudibranchs consists of crypsis, defensive behaviour patterns, autotomy of cerata, exudation of glandular secretions, ejection of nematocysts, and the structure of the epidermis. The existence of warning coloration has not been established. Different protective mechanisms are adapted to perform different functions. Thus epidermal vesicles probably protect the animal from explosions of nematocysts whilst feeding, and many mucous glands perform a cleansing function. Other protective mechanisms are directed against predators and can be regarded as defensive mechanisms. In species of *Eubranchus* and *Catriona* concentrated batteries of mucous and proteinaceous glands at the cerata tip are probably of considerable defensive importance. In other eolids, glands are not well developed and nematocysts are likely to be the most effective deterrent to potential predators. In *Palisa papillata* just one type of nematocyst is stored in the cerata, and this explodes readily when ejected; but in *Learchis poica* several types of nematocyst are stored and few explode when ejected. These differences may perhaps be correlated with different species of predators to which the eolids have become adapted, but this has not been investigated.

M.E.

GAGE, J., 1966. Seasonal cycles of *Notodelphys* and *Ascidicola*, copepod associates with *Ascidiella* (Ascidacea). *J. Zool.*, Vol. 150, pp. 223–33.

The population cycles of the ascidicolous copepods *Notodelphys allmani* and *Ascidicola rosea* in Southampton Water were studied mainly by taking monthly samples (in 1962 and 1963) of their sea-squirt 'host', *Ascidiella aspersa*. With *N. allmani*, young stages and the short-lived males appear in the summer when the total population greatly expands in number and nearly all of the *Ascidiella*—their numbers inflated by a fresh settlement—become 'infected'. The *Notodelphys* population declines by wintertime when it is maintained by a few overwintering females. The *A. rosea* are found as adult females throughout the year and remain for the whole life-span of the ascidian. But the young stages and the males appear only in summertime in the freshly settled *Ascidiella*, and 'infection' is almost restricted to the smallest sea-squirts. Some observations of the behaviour of the copepods and the free-living larvae in the laboratory were made also.

J.G.

HUGHES, G. M., 1966. The dimensions of fish gills in relation to their function. *J. exp. Biol.*, Vol. 45, pp. 177–95.

An account is given of the dimensions of the gills of 14 species of British fish, mostly marine, and the gills of two specimens of the Antarctic haemoglobinless fish, *Chaenocephalus*. These measurements, together with those of earlier workers, are considered against a theoretical analysis of the functioning of fish gills. From the dimensions of the gill sieve, calculations are made using a modified Poiseuille equation for the expected flow when the normal differential pressures operate across the sieve. The values obtained exceed those measured and support the view that most of the water flows between the secondary lamellae.

Different ways in which given gill areas can be constituted are considered in relation to their effect on the resistance to flow and the conditions for gaseous exchange. It is concluded that the large gill area of active fish results from an increase in the total number of pores in the gill sieve, due to the large number of secondary lamellae per millimetre and the large number of filaments. This arrangement reduces the diffusion distances and hence the physiological dead space at high ventilation volumes. It also requires less space in the head for the gill sieve. In less active fish, the relatively greater filament length, inter-lamellar distances and height of the secondary lamellae require a larger amount of space and leads to a less streamlined head. *Chaenocephalus* appears to represent an extreme in this respect. Its gills offer very low resistance to flow and are presumably adapted to functioning most efficiently at low rates of water flow and will require less work to be done by the respiratory muscles.

G.M.H.

KUZNETSOV, A. P., CORNER, E. D. S. & HOLME, N. A., 1966. Material on the ecology and amino acid composition of protein in the commercial bivalve mollusc *Pecten maximus* in the Plymouth region. *Trudy Inst. Okeanol.*, T. 81, pp. 179–87.

A natural population of *Pecten maximus* from the shallow-water grounds of the western part of the English Channel has been studied as a potential source of commercially available protein. In this area, the concentration of phytoplankton is sufficient to supply the animals with their food requirements throughout the year and it has been estimated that about 10 million specimens could be fished annually without jeopardizing future stocks. Protein has been separated from the animals by standard

methods and its amino acid composition has been analysed by ion-exchange chromatography. In terms of the relative amounts of amino acids, the protein from *Pecten* is very similar to that from marine zooplankton, as represented by *Calanus helgolandicus*, and contains all the amino acids considered to be essential for mammals. Thus, because of its abundance and the amino acid composition of its protein, this population of *Pecten* could be of considerable use as a source of foodstuff for human needs.

E.D.S.C.

PALING, J. E., 1966. The functional morphology of the genitalia of the spermatophore-producing monogenean parasite *Diplectanum aequans* (Wagener) Diesing, with a note on the copulation of the parasite. *Parasitology*, Vol. 56, pp. 367-83.

The genitalia of *Diplectanum aequans* (Wagener) Diesing are described and a functional interpretation is postulated. Spermatophores are produced from a pair of diffuse glands lying laterally amidst the vitellaria. The secretion from these glands is stored in an anterior reservoir, across the centre of which is a viscous disc which delineates two internal chambers. Each spermatophore has an elongated stalk and an ovoid head and is considered to be moulded in a muscular bulb and in the penis, prior to extrusion through the penis. The penis is composed of two concentric tubes and it has a slight hook at its distal end. The vagina has a glandular base and muscular lip. Its internal cast corresponds to the shape of the penis tip. Copulation in *D. aequans* is described. The occurrence and biological significance of spermatophore production in animals are discussed.

J.E.P.

PALING, J. E., 1966. The attachment of the monogenean *Diplectanum aequans* (Wagener) Diesing to the gills of *Morone labrax* L. *Parasitology*, Vol. 56, pp. 493-503.

The main adhesive apparatus of *Diplectanum aequans* is described and a functional interpretation is offered. Two sets of organs are involved in adult animals: 4 hamuli (median hooks) and the 3 associated accessory bars, and 2 squamodiscs. The two pairs of hamuli are 'gaffed' into the gill tissue of the host by the following mechanism: muscular contraction produces a posterior movement of the anterior ends of the hamuli which are so pivoted that the points of the hamuli are caused to extend out from the haptor.

The squamodiscs of adults are operated by extrinsic muscles which produce posterior movement in the anterior region of each squamodisc. This tends to push the parasite out from its position between adjacent secondary gill lamellae. The tendency to dislodgement is opposed by the two pairs of hamuli which 'gaff' into the base of the secondary lamellae. In addition, the more posterior spines on the squamodiscs become embedded in the gill tissue and so provide further resistance to the movement of the anterior region of the squamodisc. Thus the attachment of adults requires both sets of adhesive organs functioning in a complementary manner. Juveniles do not possess squamodiscs. They are considered to adhere to their hosts primarily with their hamuli.

J.E.P.

SACCHI, C. F., 1964. *Littorina obtusata* (L.) (Gastropoda, Prosobranchia): a problem of variability and its relation to ecology. *Symp. genet. Biol. ital.*, Vol. 13, pp. 1-21.

In Plymouth Sound, as well as in Brittany and Spanish Galicia, the three main colour-classes of *L. obtusata* show different microdistributions related to ecological factors. Class *olivacea* prevails in sheltered stations; class *reticulata* is far more abundant

in places strongly exposed to waves. Class *citrina* proved to be less disturbed by direct light than *olivacea* and *reticulata*, both in the field and in the laboratory.

'Dwarf' adults are more frequent than 'normal' individuals in stations more exposed to waves. They also proved to be markedly less able to endure environmental dryness, in experimental conditions, than the normal adults.

Sex-ratio is much the same in the three main colour-classes. It is slightly in favour of males among 'dwarfs' and in favour of females among 'normals'. This also confirms what was previously found elsewhere.

C.F.S.

SACCHI, C. F., 1966. Sur le dimorphisme du pénis chez *Littorina obtusata* (L.). *C. r. hebdomadaire. Séances Acad. Sci., Paris*, T. 262, pp. 2370-2.

The adult penis of 'normal' *Littorina obtusata* strongly differs in its morphology from the penis of 'dwarfs'. The glandular section is relatively more important in 'normal', while 'dwarfs' have a far longer distal section ('distale Zapfen' of Linke, 1934). The 'normal' penis is strongly reminiscent of the penis of the species-group *Littorina rudis* (= *saxatilis*), while the 'dwarf' penis is more like the completely developed penis of *L. littorea*. This difference suggests that a reproductive isolation may emphasize the main differences (in morphology, colour distribution, ecology, physiology, sex-ratio, etc.) found between 'normals' and 'dwarfs', so leading to the tendency of regarding them as two different species.

C.F.S.

SACCHI, C. F., 1966. Contribution à l'étude des rapports entre variabilité et écologie chez un Prosobranchier intertidal *Littorina obtusata* (L.). V. Recherches dans le Plymouth Sound (Angleterre S.-W.). *Cah. Biol. mar.*, T. 7, pp. 281-94.

The microdistribution of the three main morphs (*citrina*, *olivacea* and *reticulata*) is the same in Plymouth Sound as in Brittany and in Ria de Vigo. Morph *citrina* shows a higher 'photophily' both on the shore and in the laboratory; morph *olivacea* prevails in sheltered places, while morph *reticulata* is relatively more abundant in stations more exposed to waves.

The size of *L. obtusata* is larger in Plymouth than in the Brittany coasts of the Channel. The 'dwarf' adults are relatively more abundant in Plymouth Sound than they are in the Roscoff area, because of the more exposed characteristics of the Plymouth coasts. As in Roscoff, morph *olivacea* is far less frequent among 'dwarfs' than among 'normals'.

The sex ratio is slightly in favour of males among 'dwarfs', while females are slightly more abundant among 'normals'. This is also true for the Brittany and Galicia populations of *L. obtusata*. 'Dwarfs' show, in Plymouth also, a different morphology of penis.

As for resistance to desiccation, 'dwarfs' can tolerate shorter periods of emersion than 'normals'; this can be related to the preference of 'dwarfs' for stations more exposed to waves, i.e. less subjected to dehydration in their algal beds. Differences in lithology of the substratum do not seem to affect size or population density of *L. obtusata*.

C.F.S.