Reports

Taxonomic and Environmental Stability in the Paleozoic

Abstract. *Available paleontological data show no relationship between environmental stress (proximity to the ancient shoreline) and duration of marine benthic macroinvertebrate genera in the Paleozoic. This is contrary to inferences from fossil community lineages, but in accord with genetic and physiological data on living taxa.*

On the basis of a composite phylogeny of Paleozoic benthic communities (*1*), it has been inferred that taxa inhabiting variable, nearshore environments persist longer than those in physically stable offshore areas (*2*). This conclusion has attracted considerable attention because the opposite relationship is usually predicted by neontologists; that is, the diverse communities characteristic of stable environments should have maximum taxonomic stability (*3*). A frequently discussed explanation is that unstable environments favor the maintenance of genetic diversity and thereby enhance the potential for long-term survival of taxa when the environment finally changes (*1, 2, 4*).

Information on living organisms is contradictory. Some workers (*5*) report high genetic variation in unstable settings, but others (*6*) find it in stable environments. The issue is further complicated by reports of individual physiological tolerances which exceed the range of environmental parameters. Desert pupfish inhabiting thermally constant springs tolerate a wide range of temperatures, while deepwater polychaetes are remarkably euryhaline and metabolically less sensitive to temperature changes than related intertidal worms. The bivalve *Chama* is euryhaline although its habitat is not subject to salinity fluctuations, and some subtidal gastropods are just as euryhaline as intertidal species (*7*). My own preliminary data indicate a similar situation in the salinity tolerances of articulate brachiopods. Thus, low genetic variation in stable environments would not imply a lower probability of taxonomic persistence since individuals are able to tolerate substantial physical changes.

The conflicting neontological evidence prompted a reexamination of the fossil record. I consider here the chronostratigraphic duration of genera of Paleozoic benthic (and nektobenthonic) marine macroinvertebrates as a function of position with respect to the ancient shoreline. In general, water depth may be regarded as increasing away from the shoreline. The onshore to offshore distribution is taken from available paleoecological studies (*8*). The durations of genera were obtained from (*9*). Generic durations are plotted as a function of distance offshore in Figs. 1 and 2. In general, there is no relationship between position with respect to the shoreline (environmental stress) and generic duration, although two exceptionally long-lived genera frequently occurred in nearshore environments: *Lingula* is renowned for its unusual persistence, while the taxonomic continuity of the second genus, *Palaeoneilo*, is dubious. I question that these two taxa are sufficient basis for the generalization that nearshore taxa are longer-lived than offshore ones.

This analysis is an alternative to the community evolution approach of Bretsky (*1*). Since the latter method suggests a relationship which I do not find, it is necessary to evaluate the reliability of the two approaches. I consider the durations of individual taxa directly instead of inferring them from the durations of generalized communities. Furthermore, the reliability of community phylogenies is compromised by the likelihood that the rock units of the various study areas utilized in the compilation were deposited under different conditions. The results may therefore chronicle environmental "noise" rather than community evolution (*10*). Although the information used here is subject to obvious inaccuracies, so is that available for syntheses of community evolution. In many cases, my data have been drawn from the same paleoecological studies employed in Bretsky's (*1*) original community evolution scheme. I conclude that the results reported here are at least as reliable as those obtained from community evolution.

In short, the paleontological evidence, like recent genetic and physiological in-

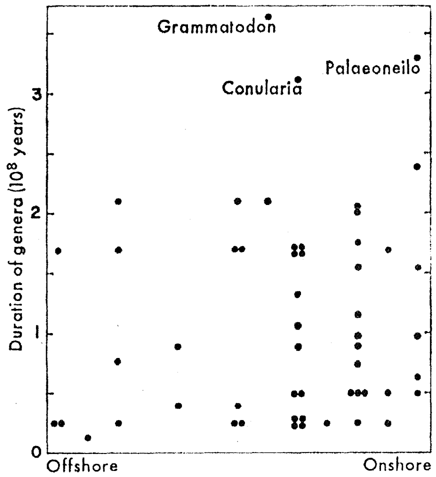

Fig. 1 (left). Duration of genera from the Upper Devonian Genesee Group of New York. The offshore-onshore axis is about 190 km long. Water depths are estimated to range from 0 (onshore) to 100 to 200 m (offshore) (*11*).

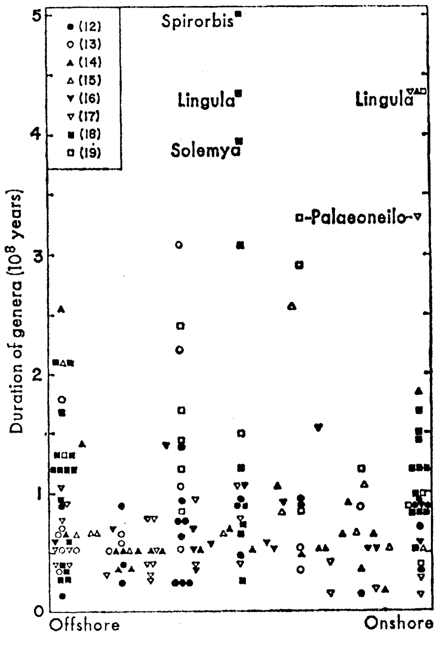

Fig. 2 (right). Duration of Paleozoic genera included in other paleoecological studies. The offshore-onshore axis is generalized since the distance and depth range considered by different workers varies. References (*12–19*) are given in parentheses in the inset.

Scoreboard for Reports: In the past few weeks the editors have received an average of 68 Reports per week and have accepted 12 (17 percent). We plan to accept about 12 reports per week for the next several weeks. In the selection of papers to be published we must deal with several factors: the number of good papers submitted, the number of accepted papers that have not yet been published, the balance of subjects, and length of individual papers.

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formation, does not justify the assumption of a direct relationship between environmental variability and taxonomic stability. Because such a relationship is predicted by current explanations of the relative duration of fossil communities, there is reason to question the apparent stability of fossil communities or the proposed mechanism for their persistence.

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20. I thank E. Dickson for her editorial acumen, P. Igginas for secretarial assistance, R. Strathmann for reading the manuscript, and J. S. Levinton for provocative discussion.

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Fossil Spores, Pollen, and Fishes from Connecticut Indicate Early Jurassic Age for Part of the Newark Group

Abstract. *Palynologically productive localities have been found in the United States throughout the Newark Group basins, most of which had previously been assumed to be barren. Rich palynoflorules dominated by coniferous pollen of* Circulina-Classopollis *type, and well-preserved fossil fishes, including possible new semionotids, have been found in the Hartford basin. Palynological data indicate that the Newark Group has considerable time-stratigraphic range: Upper Triassic for the Cumnock Formation (North Carolina), the Vinita Beds (Virginia), and the upper New Oxford Formation (Pennsylvania), Rhaeto-Liassic for the Brunswick Formation (New Jersey), Portland Formation (Connecticut and Massachusetts), and the Shuttle Meadow Formation (Connecticut).*

The Newark Group of eastern North America occurs in basins generally regarded as fault-bounded (*1*), outcrops of which extend from North Carolina to Nova Scotia. Although there is considerable literature on the general geology and paleontology of these basins, little information is available on the palynology of this group of rocks. One study (*2*) indicated a general absence of palynomorphs in samples from the Newark Group of Virginia, New Jersey, Connecticut, Massachusetts, and Nova Scotia. The samples were, however, taken mostly from red sandstones and shales, which are notoriously unpromising for spore preservation. The same study reported presence of palynomorphs in the Cumnock Formation of the Newark Group in North Carolina, and another palynological study has been published on material from the Pekin Formation (*3*) of that state. From the more northern "Newark" basins, however, no previous report of palynomorphs has been published (*4*). One of us (*5*) has located a number of palynologically productive localities in the Hartford basin of Connecticut and Massachusetts, and in the Richmond and Culpepper basins of Virginia. We have also obtained productive samples from the Newark basin of New Jersey, the Gettysburg basin of Pennsylvania, and the Cumnock Formation of North Carolina (*6*).

Palynomorph and fish localities in Connecticut and Massachusetts. Four of the seven productive localities found in the Hartford basin are from the Shuttle Meadow Formation, and three others are from the younger Portland Formation. The most intensively studied locality is at North Guilford, Connecticut—locality 1. Here the Shuttle Meadow Formation is exposed on the east slope of Totoket Mountain in the Durham quadrangle (*7*). The rock at the palynologically most productive horizon is a greenish-gray, soft, poorly bedded, silty shale. However, palynoflorules were also recovered from limonitic mudstone, black microlaminated micritic limestone (lake bed), and a gray underclay at this locality. (See Fig. 1 for diagram of the section.) Locality 2 is the well-known Durham fossil fish site on the west slope of Totoket Mountain and probably represents the same black shale and limestone that outcrop at locality 1. Locality 3 is in a gray, silty shale at the north tip of Totoket Mountain and is stratigraphically lower than the section at localities 1 and 2.

Locality 4 is a section of the Shuttle Meadow Formation roughly equivalent stratigraphically to that from locality 1 (Fig. 1) but occurs more toward the center of the basin. Gray, silty clays and a compact greenish-gray shale, both palyniferous, are exposed along Highland Brook, just below the transition from red mudstones and shales in the upper part of the section to gray siltstones and mottled gray-brown sandstones in the lower part.

Locality 5 is in the lower half of the Portland Formation, the uppermost formation of the basin. This locality is at least 750 m stratigraphically above localities 1 to 4. It is located in the Middletown quadrangle near the top of a ravine, overlooking Chestnut Brook and Connecticut Route 9. Palynologically productive samples were taken from a 20-cm lens of greenish-gray, silty shale, which is part of a micaceous, arkosic sandstone sequence with numerous dinosaur footprints. Locality 6 is also from the Portland Formation, in the southernmost part of the Middletown quadrangle along Laurel Brook. Black, organic shales with numerous fossil fishes yielded moderately corroded palynomorphs.

Locality 7 is from Holyoke, Massachusetts, at a recent excavation for commercial development along highway U.S. 5, about 1.6 km south of the