# COMMENT

## Comment on Drover's Proposed Seasonality Method

HENRY C. KOERPER

In the Winter 1974 issue of *The Journal of California Anthropology*, Christopher Drover described his preliminary work on a method which uses growth rings from two species of archaeologically recovered *Chione* for deriving seasonality data, or the season(s) when food resources were exploited. Drover's method draws heavily on Barker's (1970) and Berry's (1972) studies of growth periodicity in *Chione* clams. The method is based on the idea that in both *C. undatella* and *C. fluctifraga*, the pelecypods' mantles generally contract and cease the secretion of calcium carbonate during the colder winter periods. When a shell's growth is relatively inactive, a semi-opaque concentric annual groove will be externally visible. A winter death should be marked by such an incipient groove ("major groove," "disturbance groove," or "annual groove") at the ventral margin of a shell. Death at other seasons, it is argued, can be estimated from the shell's growth since the last winter groove was formed.

In *C. undatella*, growth after an inactive period is marked by easily observed concentric ridges which are usually added over a fortnightly (tidal) period. The average number of rings added in each year of life is a function of the length of growing season. The most important environmental factor cited for determining the length of a growing season is water temperature.

Drover's method has been used to generate seasonality data for prehistoric sites in coastal Orange County (e.g., Drover 1974; Howard and Carter 1975; Drover 1977; Howard 1977; Van Horn, McCawley, and Murray 1978), where such data are often seen as an invaluable aid to generating inferences about such related concerns as the time of year when a site was occupied, the nature of the scheduling of regional hunting and gathering pursuits within a yearly round of procurement activities, site function, and functional relationships between sites.

Review of Barker's (1970) and Berry's (1972) studies coupled with information derived subsequent to their 1970 and 1972 publications raises serious questions about the utility of the proposed seasonal dating method. Drover noted (1974:227) from Barker (1970) that the 16.9, 8.8, 4.5, and 2.0 fortnightly growth ridge averages added in successive years of *C. undatella* growth (Barker's Cholla Bay, Mexico sample) demonstrate increasing periods of growth inactivity. Drover seems not to have explored the full implications of Barker's data. Given the fact of fortnightly periodicity, it can be deduced that inactive periods for the Cholla Bay clams after the first year of life cover a much longer period than a

Henry C. Koerper, Dept. of Anthropology, Cypress College, Cypress, CA 90630.

mere winter. If on the average only 8.8 rings are added in the Cholla Bay second year specimens, then the inactive period(s) must occupy intermittently or continuously the majority of the second year of life. Berry writes that growth periods in four- and five-year-old shell specimens are limited to two and a half to three months in each of those years (1972:8); in fact, the growth periods ought to be even shorter if the period of ring addition remains strictly fortnightly. It would seem that no clear distinction can be made between a fall, winter, or spring procurement given such periods of inactivity in at least Cholla Bay shells which are more than one year of age. The phenomenon of high frequencies of supposedly winter harvested shells which have been reported for some Orange County sites, such as Ca-Ora-119-A (see Drover 1974), may likely be attributable to observers incorrectly designating shells as having been winter procured when their inactive periods include, say, large parts of both the fall and spring seasons. It should be concluded, then, that estimations of season of shellfish procurement from growth since the last so-called "winter" disturbance band are highly questionable.

Not all disturbance bands, or grooves, may be attributable to periodicity relatable to the obvious environmental growth factor, water temperature. Disturbance grooves might also be caused by a shell being upended during a storm. Growth activity stops until the shell is righted (Berry 1972; Berry and Barker 1975:12). Drs. Berry and Barker in their laboratory experiments turned over living shells and notched them to see what their growth responses might be; after a period of time, small disturbance rings would be discernable at the point of notching, suggesting that notching and/or flipping them over had something to do with an animal stopping shell growth and thus forming a disturbance groove. It may be possible to tell a seasonal from a storm related band by visual inspection, but Dr. Berry with his considerable expertise admits to not having been able to do so (William Berry, personal communication 1980). It might conceivably be possible to make the storm *vs.* inactive growth period band distinction by thin-sectioning shells, for a storm band is likely to contain sand embedded grains (Berry 1972:8, 11). Reproduction also causes a shell to stop growing, and an observer could confuse the resulting disturbance groove with a major inactive period groove (William Berry, personal communication 1980). Long periods of exposure could conceivably produce a disturbance ring (see Farrow 1971, 1972) which could also be confused with the deep grooves of an inactive "season."

Drover's method for determining seasonality using *C. undatella* suffers significantly from our lack of understanding about the growth habits of local clams. If the local clams live, as we might reasonably expect, but a short time, the generally high number of ridges on archaeologically recovered specimens from Newport Bay area sites might indicate that they have longer growing seasons than the Cholla Bay specimens. If so, particularly in the younger chiones, some seasonality information might be extractable. Generally, however, more northerly dwelling chiones ought to have longer inactive growth periods than the Cholla Bay shellfish whose warmer water temperature would be more conducive to growth. It should be noted, however, that for some species of shellfish, environmental factors other than temperature influence growth (see Swan 1952; Pratt 1953; Pratt and Campbell 1956; Rhoads and Panella 1970; Farrow 1971, 1972; Berry 1972). These include such things as substrate grain size, position within tidal range, daily and seasonal illumination, low food supply, high water turbidity as a result of runoff after high rainfall, and storm related bottom scour. Berry and Barker (1977:661) write that "perhaps modes of life play a role in shell growth among certain mobile bivalves because

they can move away from conditions under which shell growth may be limited." Dr. Berry (personal communication 1980) now believes that many shells in their natural habitat may behave more in response to local environmental than to larger seasonal patterns.

A first step in possibly putting Drover's method on firmer footing would be thin-sectioning and analysis of a number of shells from local archaeological sites. With care, inactive winter period grooves and possibly spring growth increments could be identified and grooves indicative of either storm-related shell growth-stoppage or spawning might be recognizable. The sectioned shells might then be compared with shells of living animals from local environments for which environmental factors would be recorded. While also suggested as a species sensitive to seasonal growth (Drover 1974), *C. fluctifraga* is in some ways like *C. undatella* (see Berry 1972:9), and thus its use in seasonality studies may be questioned in many of the same ways as the use of *C. undatella* is questioned.

## CONCLUSIONS

The proposed seasonal dating method herein described can not now be shown to accomplish its intended purpose. If it is to be useful, the method must first be based on more data than we presently have for the growth patterns of local *C. undatella* and *C. fluctifraga*. Subsistence-settlement models which have been tested and subsequently supported by such indicators must be reexamined and possibly modified or abandoned.

## ACKNOWLEDGEMENTS

I thank Dr. William B. N. Berry of the Paleontology Department, University of California, Berkeley, for a detailed explanation of his and Dr. Barker's field and laboratory research on *C. undatella*.

## REFERENCES

Barker, Richard M.
1970 Constituency and Origins of Cyclic Growth Layers in Pelecypod Shells. Berkeley: University of California Space Sciences Laboratory Series 11, Issue 43.

Berry, William B. N.
1972 Constituency and Origins of Cyclic Growth Layers in Pelecypod Shells: Final Report on NASA Grant NGR 05-113-167. Berkeley: University of California Space Sciences Laboratory Series 13, Issue 36.

1977 Shell Growth in Bivalves: Its Relation to Growth Environmental Factors. International Journal of Chronobiology 4: 657-661.

Berry, William B. N., and Richard M. Barker
1975 Growth Increments in Fossil and Modern Bivalves. In: Growth Rhythms and the History of the Earth's Rotation, G. D. Rosenberg and S. K. Runcorn, eds., pp. 9-25. New York: John Wiley and Sons, Inc.

Drover, Christopher E.
1974 Seasonal Exploitation of Chione Clams on the Southern California Coast. The Journal of California Anthropology 1: 224-232.

1977 Shell Seasonality and Human Settlement at Ca-Ora-64. Manuscript on file at Archaeological Research, Inc., Costa Mesa, California.

Farrow, G. E.
1971 Periodicity Structures in the Bivalve Shell: Experiments to Establish Growth Controls in *Cerastoderma edule* from the Thames Estuary. Paleontology 14: 571-588.

1972 Periodicity Structures in the Bivalve Shell: Analysis of Stunting in *Cerastoderma edule* from the Burry Inlet (South Wales). Paleontology 15:61-72.

Howard, Jerry
1977 Seasonality and Settlement Patterns in the Orange County Coastal Foothills. Pacific Coast Archaeological Society Quarterly 11(2):11-21.

Howard, Jerry, and Christina Carter
1975 Excavations of the Spyglass Hill Sites, Ca-Ora-202 and Ca-Ora-203, in Orange County, California. Manuscript on file at Archaeological Research, Inc., Costa Mesa, California.

Pratt, D. M.
1953 Abundance and Growth of *Venus mercenaria* and *Callocardia morrhuana* in Relation to the Character of Bottom Sediments. Journal of Marine Research 12:60-74.

Pratt, D. M., and D. A. Campbell
1956 Environmental Factors Affecting Growth in *Venus mercenaria*. Limnology and Oceanography 1:2-17.

Rhoads, D. C., and G. Panella
1970 The Use of Molluscan Shell Growth Patterns in Ecology and Paleoecology. Lethia 3:143-161.

Swan, E. F.
1952 The Growth of the Clam *Mya arenaria* as Affected by the Substratum. Ecology 33: 530-534.

Van Horn, David M., William D. McCawley, and John R. Murray
1978 Excavations at The Glassell Site, Ora-168, in Newport Beach. Final Report on file at The County of Orange Environmental Management Agency, Environmental Services Division, Santa Ana, California.