12-2001

Age and Climatic Correlates of Carolina Bays and Inland Dunes of the South Atlantic Coastal Plain: New Data

Mark J. Brooks
University of South Carolina - Columbia, brooksmj@comporium.net

Barbara E. Taylor

Publication Info

Published in *Legacy*, Volume 6, Issue 2, 2001, pages 6-7.
http://www.cas.sc.edu/sciaa/

Age and Climatic Correlates of Carolina Bays and Inland Dunes of the South Atlantic Coastal Plain: New Data

By Mark J. Brooks and Barbara E. Taylor

Mark J. Brooks (USC, SCIAA-SRARP), Barbara E. Taylor (University of Georgia, Savannah River Ecology Laboratory [SREL]), and Andrew H. Ivester (State University of West Georgia, Department of Geosciences) obtained 11 Optically Stimulated Luminescence (OSL) dates on quartz sand from inland eolian dunes and Carolina bay sand rims in South Carolina. The OSL technique dates the time that the sand, which is ubiquitous to the Coastal Plain, was last exposed to sunlight. A major advantage of OSL dating is that accurate dates can be obtained going back to ~120 ka B.P., whereas radiocarbon dates older than ~30 ka B.P. may be unreliable. The samples were processed by the Thermally and Optically Stimulated Luminescence Research Laboratory, Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, Canada.

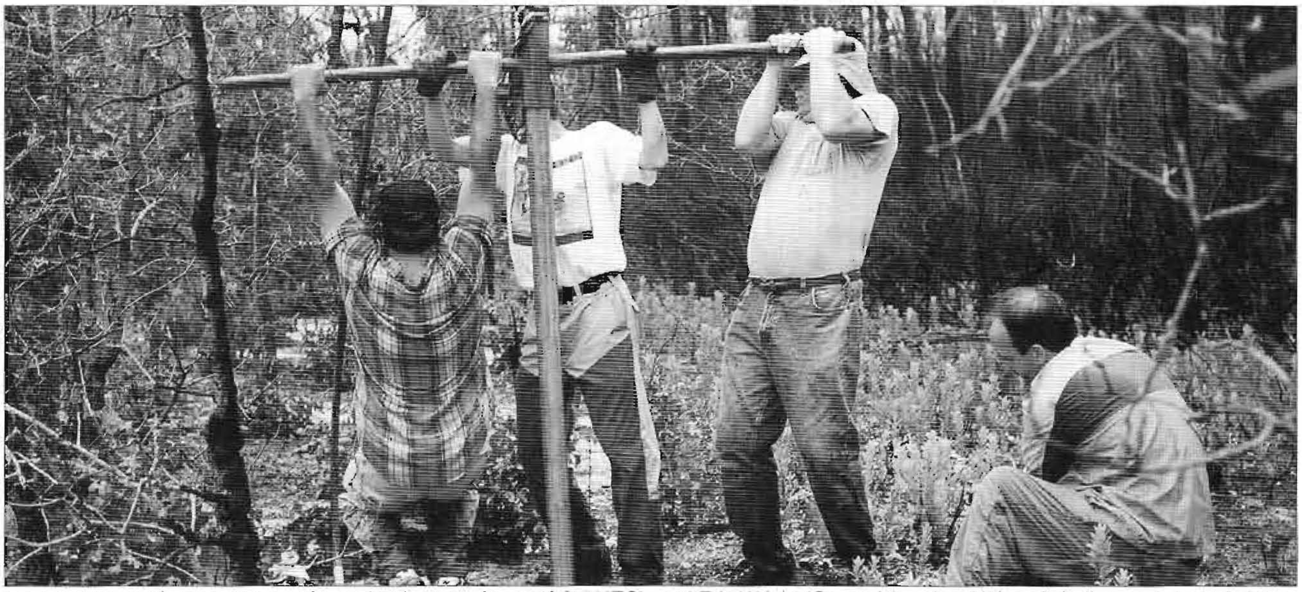
Carolina bays, which were particularly attractive to prehistoric humans, were formed and oriented NW-SE by the action of southwesterly winds on ponded water. During low-water stands, the exposed eastern shoreface was the sediment source for eolian deposition that formed the characteristic sand rim on the east side of bays.

Inland dunes occur on the northeast side of southeasterly flowing rivers and were also formed by southwesterly winds; sand was swept from braided channel deposits exposed during low-water phases at a time(s) when floodplains of the Coastal Plain were much more sparsely vegetated than at present.

The formation of both bay rims and inland dunes by southwesterly winds deriving sediments from immediately adjacent sources exposed during low water (dry climate?), coupled with the observation that in some areas bays and dunes intrude into one another, have lead researchers to suspect that formation of bays and dunes was penecontemporaneous and that their formation required specific climatic regimes.

On the U. S. Department of Energy's Savannah River Site (SRS), adjacent to the Savannah River in the Upper Coastal Plain, two OSL dates from the rim of Flamingo Bay indicate that the bay formed initially at 108.7 ± 10.9 ka B.P. and was rejuvenated at 40.3 ± 4.0 ka B.P. A single date from Bay 40 indicates that it formed at 77.9 ± 7.6 ka B.P.

On Shaw Air Force Base's Poinsett Electronic Combat Range, about 10 km east of the confluence of the Wateree and Congaree Rivers in the Middle Coastal Plain, a large-scale eolian sand sheet emanating from the confluence area encroached into the western side of Big Bay at 74.3 ± 7.1 ka B.P. The bay was fully formed at the time of encroachment, and the 4.5 m of organically enriched, pedogenically modified bay fill buried beneath the sand sheet indicates that bay formation occurred



Mark Brooks (left), Daniel Ryan (Shaw AFB), Peter Stone (SC DHEC), and Eric Wright (Coastal Carolina University) vibra-coring at Big Bay. (*SREL photo by Barbara Taylor*)


Andrew Ivester (State University of West Georgia) taking an OSL sample at Big Bay. (*SREL photo by Barbara Taylor*)

well before that time, plausibly at the time of Flamingo Bay's initial formation. Dates on two parabolic dunes on the sand sheet were 29.6 ± 2.4 ka B.P. and 33.2 ± 2.8 ka B.P.

Five OSL dates were obtained from surficial dunes on Sandy Island, located on the Lower Coastal Plain between the Waccamaw and Great Pee Dee Rivers. The dates are: 29.9 ± 2.8 ka B.P., 31.4 ± 2.5 ka B.P., 35.8 ± 4.8 ka B.P., 36.7 ± 6.0 ka B.P., and 39.0 ± 4.5 ka B.P.

From these data, bays appear to be older than dunes. In reality, it may be that once bays are formed, their distinctive morphology is less likely to be obliterated through subsequent reworking of sediments than are the more surficial, easily eroded dunes. The sand sheet that encroached into Big Bay informs on these related issues of relative bay/dune age and sediment reworking. While the toe or leading edge of the sand sheet encroached into Big Bay around 74 ka B.P., the sand sheet as a large-scale geomorphic body must be much older 10 km to the west adjacent to its source. Thus, Big Bay and the sand sheet may well have originated at about the same time, well before 74 ka B.P. The two geomorphically distinct parabolic dunes on the surface of the sand sheet owe their distinctiveness to their relatively recent age, which probably represents the last major interval of eolian reworking.

Comparison of dune and bay dates with the Oxygen Isotope record provides a basis for tentative inferences regarding late Pleistocene climate in this area of the Southeast. The 108.7 ± 10.9 ka B.P. date from Flamingo Bay spans Oxygen Isotope Stages (OIS) 5d-5c during the early Wisconsinan, immediately following the Sangamon interglacial. Glacial ice at that time may have been only slightly greater than present. The 77.9 ± 7.6 ka B.P. date for Bay 40 falls during OIS 5a, an interval of less ice following an increase in ice during OIS 5b. The 40.3 ± 4.0 ka B.P. date for Flamingo Bay bridges a peak during OIS 3 that also corresponds to a brief interval of less ice. Thus, it appears that Carolina bay dates occur during periods of less ice that, presumably, correspond to somewhat warmer conditions and increases in moisture that would be necessary for ponding in bay formation. As for drier periods that would be necessary for eolian deposition of the sand rims, our dating resolution is inadequate to determine if the shifts between moist and dry conditions were at a seasonal or even longer time scale involving a change in climate.

The dunes all date between 40 and 30 ka B.P., during OIS 3. This was a time of general increase in ice that continued up to the last glacial maximum near 18 ka B.P. during OIS 2. Presumably, the climate in this unglaciated area was becoming colder and drier. The pollen record at White Pond, South Carolina, indicates cold, dry climate at the time of the glacial maximum. Further, dry conditions and sparse vegetation, at least in floodplain source areas, would seem to be a prerequisite for eolian deposition.

Of possible relevance to regional trends in late Pleistocene climate, Ivester and colleagues have reported that most of their OSL and radiocarbon dates bearing on dune activity in the Coastal Plain of Georgia range between 30 and 15 ka B.P. The earlier dates for dune activity in South Carolina suggest that cold, dry climate associated with the glacial advance may have occurred earlier in South Carolina than in Georgia. Well-dated pollen from numerous locales of appropriate age throughout the south Atlantic Coastal Plain could resolve this question.