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Research Interests

My research focuses on the biology, ecology and paleoecology of benthic foraminifera and their potential application in solving environmental and paleoenvironmental problems. Recent projects include work on salt marsh foraminifera of the southeastern U.S. coast and on foraminiferal life cycles, reproduction, dispersal, and allogromiid biodiversity (basal foraminiferal clades).

Salt marshes are very extensive on the Georgia coast and are accessible through the University ' s marine institute on Sapelo Island. Foraminifera are diverse and abundant in these settings, and their distributional patterns elsewhere have proven useful in studies on the Holocene rise in sea level. Salt marsh foraminifera of the Georgia coast likewise have distributional patterns that parallel elevation and, therefore, should be applicable to sea level studies. However, an assessment of those taphonomic and biological processes that control the accumulation and preservation of foraminiferal tests in subsurface sediment is essential to interpreting this stratigraphic record of sea level change. Results have demonstrated that the composition of subfossil assemblages is strongly influenced by both foraminifera living in shallow to deep infaunal microhabitats and the selective preservation of both agglutinated and calcareous tests. (See for example Goldstein et al., 1995; Goldstein and Watkins, 1998, 1999.)

Complete life cycles are known for only a handful of the thousands of extant species of foraminifera. Yet, an understanding of reproduction and life cycles can provide insight into adaptive strategies and phylogenetic relationships. Subjects for our work on foraminiferal life cycles have included: *Saccammina alba*, *Cribrothalammina alba*, *Ammonia tepida*, *Triloculina oblonga*, and a new allogromiid from coastal Georgia. Most, though not all, species of Foraminifera produce many thousands of tiny biflagellated gametes that are released directly into the surrounding seawater, and even the fine details of this process are broadly shared across most of the extant orders. (See for example Goldstein, 1997; Goldstein and Moodley, 1993; Goldstein and Barker, 1990.)

Benthic Foraminifera have long been recognized for their ability to quickly colonize new settings and respond to changing environments. Foraminifera accomplish this through dispersal, largely as tiny juveniles or propagules which form a seed bank or propagule bank in sediments. Many Foraminifera can be grown from just a small volume of fine-grained sediment, and different

foraminiferal assemblages can be grown from the same sediment under different environmental conditions. (See for example Alve and Goldstein, 2002, 2003.)

Allogromiids comprise the basal clades within the Foraminifera. Although these foraminifers with their non-mineralized tests or shells are not well-represented in the fossil record, they are more diverse and abundant in modern marine benthic environments than is generally recognized. Current research focuses on assessing the biodiversity and environmental occurrences of these foraminiferans in selected low- to mid-latitude settings. (See for example Goldstein and Richardson, 2002)

Selected Publications:

Edited Volumes:

Cedhagen, T., Goldstein, S.T., and Gooday, A.J., (Editors), 2002, Theme Issue: Biology and Biodiversity of Allogromiid Foraminifera: Journal of Foraminiferal Research, v. 32, no. 4, p. 331-458.

Martin, R.E., Patterson, R.T., Goldstein, S.T., and Kumar, A. (Editors), 1999, Special Issue: Taphonomy as a Tool in Paleoenvironmental Reconstruction and Environmental Assessment: Palaeogeography, Palaeoclimatology, Palaeoecology, 149(1-4):vii-434.

Goldstein, S.T. and Bernhard, J.M. (Editors), 1997, Theme Issue: Biology of Foraminiferida: Applications in Paleoceanography, Paleobiology, and Environmental Sciences: Journal of Foraminiferal Research, 27(4).

Book Chapter: Goldstein, S.T., 1999. Foraminifera: A Biological Overview, p. 37-56, in B.K. Sen Gupta (Ed.) Modern Foraminifera; Kluwer, Dordrecht, The Netherlands.

Journal Articles:

Habura, A., Goldstein, S.T., Parfrey, L., and Bowser, S.S., 2006. Phylogeny and ultrastructure of Miliammina fusca: Evidence for secondary loss of calcification in a miliolid foraminifer: Journal of Eukaryotic Microbiology, 53(3):204-210.

Alve, E. and Goldstein, S.T. 2003. Propagule transport as a key method of dispersal in benthic Foraminifera (Protista): Limnology and Oceanography, 48:2163-2170.

Goldstein, S.T., and Richardson, E.A. 2002. Comparison of test and cell body ultrastructure in three modern allogromiid foraminifera: Application of high pressure freezing and freeze substitution: Journal of Foraminiferal Research, 32:375-383.

Alve, E. and Goldstein, S.T. 2002. Resting stage in benthic foraminiferal propagules: a key feature for dispersal? Evidence from two shallow water species: Journal of Micropaleontology, 21:95-96.

Goldstein, S.T., and Watkins, G.T. 1999. Taphonomy of salt-marsh foraminifera: An example from coastal Georgia: Palaeogeography, Palaeoclimatology, Palaeoecology, 149(1-4):103-114.

Walker, S.E., and Goldstein, S.T. 1999. Experimental field taphonomy: Taphonomic tiering of molluscs and foraminifera above and below the sediment-water interface: Palaeogeography, Palaeoclimatology, Palaeoecology, 149(1-4):227-244.

Goldstein, S.T. and Watkins, G.T. 1998. Elevation and the distribution of salt-marsh foraminifera, St. Catherines Island, Georgia: A taphonomic approach:

Palaois, 12(6):570-580.

Goldstein, S.T. 1997. Gametogenesis and the antiquity of reproductive pattern in the Foraminiferida: Journal of Foraminiferal Research, 27:319-328.

Goldstein, S.T., Watkins, G.T., and Kuhn, R.M. 1995. Microhabitats of salt marsh foraminifera: St. Catherines Island, Georgia: Marine Micropaleontology, 26(1-4):7-30.

Goldstein, S.T. and Corliss, B.H. 1994. Deposit feeding in selected deepsea and shallowwater benthic foraminifera: Deep Sea Research, 41:229-241.

Goldstein, S.T. and Moodley, L. 1993. Gametogenesis and the life cycle of the foraminifer *Ammonia beccarii* (Linné) forma tepida (Cushman): Journal of Foraminiferal Research, 23:213-220.

Goldstein, S.T. and Harben, E.B. 1993. Taphofacies implications of infaunal foraminiferal assemblages in a Georgia salt marsh, Sapelo Island: Micropaleontology, 39:53-62.

Goldstein, S.T. and Barker, W.W., 1990, Gametogenesis in the monothalamous agglutinated foraminifer *Cribrothalammina alba*: Journal of Protozoology, 37:20-27.

Goldstein, S. T., 1988b, Foraminifera of relict salt marsh deposits, St. Catherines Island, Georgia: taphonomic implications: PALAIOS, 3:327-334.

Goldstein, S. T., 1988a, On the life cycle of *Saccammina alba* Hedley: Journal of Foraminiferal Research, 18:311-325.

Goldstein, S. T. and Barker, W. W., 1988, Test ultrastructure and taphonomy of the monothalamous agglutinated foraminifer *Cribrothalammina* n. gen. *alba* (HeronAllen and Earland): Journal of Foraminiferal Research, 18:130-136.

Goldstein, S. T. and Frey, R. W., 1986, Salt marsh foraminifera, Sapelo Island, Georgia: Senckenbergiana Maritima, 18:97-121.