New discoveries of tetrapod bearing fossil forests at Joggins Nova Scotia: implications for tetrapod entombment and ecological persistence

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The classic Carboniferous section at Joggins is most famous for the discovery of standing fossil lycopsid trees that bear a terrestrial fauna within their once hollowed out stumps. The first discovery of this diverse entombed fauna was made by Sir John William Dawson and Sir Charles Lyell in 1852. Dawson's extensive explorations of a single fossil forest at Coal Mine Point continued throughout the latter half of the nineteenth century. Eighteen productive trees were documented which yielded 12 species of tetrapods and 6 species of terrestrial arthropods. Among the disarticulated skeletal remains was the world's oldest known reptile (oldest amniote) named *Hylonomous lyelli.* Only two other tetrapod-bearing trees have been discovered between Dawson's death in 1899 until recent work (1994-present). Walter Bell noted two tetrapod-bearing stumps during the early twentieth century, however, the stratigraphic horizons and the specimens' whereabouts remain unknown.

The development of a search strategy informed by Dawson's writings, and study of his specimens in London and Montreal, has resulted in the discovery of eight additional tetrapod-bearing trees from six new stratigraphic horizons other than Dawson's Coal Mine Point fossil forest since 1994. Most of the fossiliferous trees discovered in recent years conform to the general model described by Dawson, with tetrapods occurring near the basal mineral charcoal infill which records evidence of wildfires. Three of these productive trees derive from a sequence of upright lycopsids underlying the Forty Brine coal seam. The Forty Brine tetrapod-bearing trees demonstrate persistence of ecological conditions in successive lycopsid forests, wherein entire forest stands were charred by repeated wildfire disturbance, and in at least one case, resulting in the formation of an unequivocal basal fire scar. These, in addition to the other five tetrapod-bearing forests, confirm that Dawson and Lyell's forest was not unique or unusual but that similar paleoecological conditions recurred. It is also unlikely that these conditions were exclusive to Joggins, and as yet undiscovered tetrapod-bearing forests doubtless occurred in wetlands of the tropical biome where seasonality promoted disturbance and wildfire.

Experimental computed tomography (CT) scanning shows promise in revealing the distribution of bone material within the tree fills, most of which is concentrated in the basal 15 cm in association with charred plant material. Tetrapod bones from the trees are presently being analyzed by electron microprobe to determine whether their CaO/P_2O_5 ratios record details of their thermal history and consequently about the chronology of their entombment as it relates to wildfire events and tree burial. The ability to study the taphonomy of the tree hollow fauna also permits evaluation of various scenarios of their entombment, in particular the long held pitfall theory and the newer perception of a hollow tree guild (denning). Our recent discoveries not only provide a clearer understanding of the role of wildfires in the development of the ecological niche inhabited by the earliest amniotes, but also unveil a rich new source of tetrapod skeletal material from this pivotal moment in vertebrate evolution.

Atlantic Geology, 2010, Volume 46, Number 1