f38 The effect of including fossils in cladograms

< crown group and stem group >

A monophyletic group has by definition an age of origin. Such a group can include living and extinct organisms. Characters deemed to relate a group of living organisms are mostly advanced (apomorphic) by contrast to the primitive (plesiomorphic) state of these characters in fossils. Implicit in this is the hypothesis that fossils can establish the polarity of a character. With this information, a living group that contains an apomorphy can be distinguished from a living group that contains the same character in its pleisomorphic state. For such, the minimum number of organisms which a cladogram can portray is three (***Figure f38.1***): a crown group of two that have a similar apomorphic character and one, called the *sister group*, that has a similar character in its plesiomorphic state. In their phylogenetic history, the age of differentiation of the crown group could be significantly more recent than the divergence of this group from its sister group. During that time interval, organisms could have evolved an intermediate state of the character that discriminates between the crown and the sister group. Should any be discovered, living or fossil, they can be inserted into a cladogram as stem representatives of the stem lineage that evolutionary theory allows. Fossils inserted into a cladogram can establish minimum ages for cladogenetic (branching) events and provide a calibration for molecular clocks. Fossils can help discriminate between trees bedeviled, as is common, by spurious similarities in character states that arise from convergence, parallelism, or reversals. Also, fossils can restore otherwise lost information as to character transformations, and which require nodes be added to a cladogram.

That fossils will *unambiguously* polarize character states is nonsense. Living fossils exist and have been a feature of all ages. For this reason, a phylogentic sequence cannot be reliably read directly from the stratigraphic record. For the disappointed, R. A. Fortey and R. P. S. Jefferies have suggested that stratigrahic occurrence can help "fine tune" a cladistic analysis based on morphology alone. Even so, they caution that paleogenomics should be attempted only when the stratigraphic record is demonstrably good and the sequence repeatable from place to place.[1] A success is for echinoderms.[2]

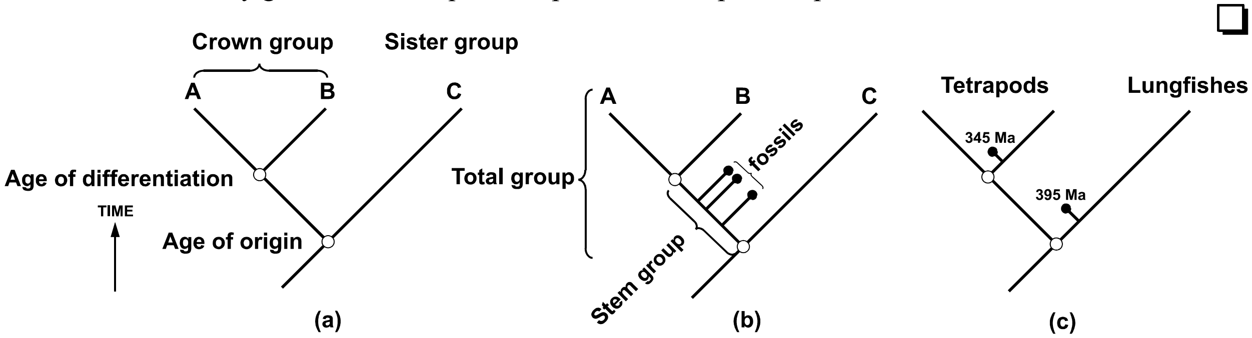

Figure f38.1 [3] A cladogram can portray the phylogeny of a monophyletic group which, at a minimum, has a total of three member groups. In the above examples, groups A and B that while differing themselves share a character that is judged to be apomorphic (advanced) in comparison to a character state in C that is judged to be plesiomorphic (primitive).

Hennig in 1966 [4] recognized that the group A and B (called the *crown group* by Jefferies in 1979)[5] could have differentiated at a significantly later time than the age of origin of the total monophyletic group. In this total group, the sister group C retains a compared character in its plesiomorphic form. Information which is obtained at a later time than the construction of (a) can be inserted as in (b) and (c). In (b), fossils have been inserted which have been identified as stem representatives of the spectrum of stem lineages that arose before the age of differentiation and after the age of origin of the total group. In (c), inserted fossils give information as to the minimum ages of differentiation and origin and so provide knowledge of the duration of the stem lineage.

Scholium f36.1 New World potatoes & sweetpotatoes and Old World yams

Potatoes, upland (above the tree-line) Mesoamerican in origin (and the world's highest crop plant), are smooth-skinned tubers (short, blocky, rounded ends) of the Solanaceae (Nightshade) family. Sweetpotatoes, lowland Mesoamerican in origin, are smooth-skinned tuberous roots (short, blocky, tapered ends) of the Convolvulaceae (Morningglory) family. Both are dicot plants. Potatoes develop 'eyes' that sprout and can be propagated from 'seed pieces' (chopped tuber pieces with eyes) rather than from the seeds of potato flowers. The bushy plant is poisonous in all its above-ground parts. Sweetpotatoes do not develop 'eyes' and can be propagated by transplanting sprouts that rise from the growing roots and by rooting vine cuttings. The above-ground liana (woody climbing tropical vine) is not poisonous. Potatoes and sweetpotatoes come in a great variety of flesh colors and skin colors.

Yams, Chinese or West African in origin, are scaly-skinned tubers (long, cylindrical some with "toes") of the Dioscoreaceae (Yam) family. Yams are monocot vine-plants. Yam tubers are white-, off-white-, or purple-inside-fleshed. Chopped pieces of the underground tubers sprout at their cut ends. Propagation is by transplants of these or of their aerial tubers and bulbils. The English word *yam* is derived from *nyami* a West African word for the same.

Confusingly, an orange-inside-fleshed sweetpotato (*Ipomoea batatas*) grown in the USA is called a "yam." Philip B. Mortenson, in *This is not a weasel: A close look at nature's most confusing terms*, 2004, writes: "Many yams have a bitter taste that only boiling can dispel, and some species can grow as long as eight feet and weigh more than a hundred pounds. And whereas yams are important foods in the tropics and in Asia, they are seldom sold in North America, and almost never appear on dinner tables especially the eight-foot-long variety." [12]