

Letter to the Editor

PAE under the AEI thesis: a response

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Sir,

Recent proposals by us (Crother and Murray, 2011, 2013) discuss a foundational ontology as well as subsequent implications on operation in biogeographical endeavours, respectively. Areas of endemism (AoEs) are proposed to be philosophical individuals as opposed to artificial classes or natural kinds (Crother and Murray, 2011). Furthermore, we offer epistemological insight into an operational tool to diagnose such areas under our novel philosophical views (Crother and Murray, 2013). We proposed that parsimony analysis of endemism (PAE; Rosen, 1988; Morrone, 1994) might be a useful discovery operation for AoEs, although PAE required interpretational tinkering in light of our ideas (Crother and Murray, 2011).

Hovenkamp (1997) doubted AoEs existed and must have found Crother and Murray (2011) a challenge to his theory. Now, Hovenkamp (2013), in rebuttal fashion, offered comments on our operational reinterpretation of PAE under the AoE as individuals thesis (Crother and Murray, 2013). Hovenkamp's (2013) comments unfortunately introduced unnecessary semantic and operational confusion potentially based on algorithmic misunderstanding and misreading. We respond under four themes: (1) clarification on the definition of a "unique assemblage of taxa", (2) the value of monophyly in PAE, (3) the use of consensus trees in PAE, and (4) the nested hierarchical nature of AoEs.

1 It is apparent that some confusion exists for Hovenkamp regarding the "unique assemblage of taxa" (UAT) concept, despite frequent mention (Axelius, 1991; Linder, 2001). As stated in Crother and Murray (2011), a UAT is analogous to a unique combination of character states in the description of a taxon, as opposed to a unique character. Biogeographically, an area of endemism can be identified by an assemblage of taxa that exist in one area and no other area within a study scale or nested area unit within that study scale. As Hovenkamp (2013) explicitly states, a UAT is not reliant on a single taxon or "endemic taxon".

Rather, a combination of species in an area that exists in no other area identifies an AoE. In nested situations it is useful to entertain the example used in Hovenkamp's rebuttal. The area (N(OT)) is diagnosed by the unique assemblage (figure 3): taxa 5, 9, 10, 25, 26, 35, 36, 37 and 42. The inclusion of area R in (N(OT)) possesses a unique assemblage from (N(OT)) (taxon 17) or the more inclusive (S(R(N(OT)))) (taxa 28 and 42), and thus area (R(N(OT))) is an area of endemism as well. In figure 2, when ignoring homoplasies, area (N(OT)) does not have a UAT from area (R(N(OT))) (both areas share taxa 1, 2, 3, 4, 5, 6, 7, 8, and 9) and is not an AoE. Homoplasious taxa and non-homoplasious taxa alike are individually important because their inclusion or lack thereof is used to diagnose an AoE when considered in combination with all other area taxa, thus forming a "unique assemblage". Hence, taxon 35 is capable of being diagnostic for area (N(OT)). Hovenkamp also claims to catch an error in recognizing an AoE: "Strangely enough, (G) is not listed by C & M as an AoE." That is strange indeed, given that G is listed as an AoE in Crother and Murray (2013, p. 2, bottom of last paragraph).

2 Hovenkamp (2013) concludes that "PAE fails to identify correctly the uniqueness of a particular assembly of taxa". He states that (BE) shares the same assemblage as B, and this is true. Area B possesses five taxa unique to E and two that it shares. Hovenkamp claims that an instance of inconsistency is that (BE) has the same UAT as (BA), (BC), and (BF), and is therefore not unique. However, area (BE) has a UAT diagnosed by taxa 35 and 40. Areas A, C, and F do not possess taxa 35 or 40, area A does not possess 46, 2, 27, and 44, area C does not possess 46, 24, 27, and 44, and area F does not possess 46, 2, 24, and 27. Needless to say these areas do not share a UAT. This misinterpretation, however, introduces the importance of monophyly and spatial boundaries. As per the interpretation of Morrone (1994), as well as ours, one does not interpret polyphyletic groups of areas as AoEs (BC for example). Because, under the "areas of

endemism as individuals” (AEI) thesis, AoEs are hierarchically nested so monophyletic groups resulting from parsimony analysis are only considered. Furthermore, polyphyletic quadrat sets are not considered either, because AoEs are spatially bound. That is, if area G was a member of a larger group in a resulting cladogram, it could not be considered as a member of a nested AoE when superimposed on the quadrat map because it is spatially separated.

3 Hovenkamp (2013) additionally faulted Crother and Murray (2013) for only inspecting the strict consensus tree for AoEs and not utilizing each of the most parsimonious trees that resulted from their analysis or Morrone’s (1994) analysis. Perhaps Hovenkamp missed it, but our figure 2(b) used the exact same tree as Morrone (1994) to diagnose AoEs. Our figure 3 is congruent with figure 2(b) but includes the homoplastic taxa. Our modesty kept us conservative in seeking the information found shared among all the most parsimonious trees, visualized in a strict consensus tree.

4 Hovenkamp (2013) maintains that Crother and Murray (2011, 2013) “want” to identify more AoEs but vastly underestimate the number that their concept recovers (of course, as noted above, we did not underestimate the number of AoEs, instead Hovenkamp misinterpreted the trees). In response, we do not seek a method to diagnose large numbers of AoEs, but rather a method that is consistent with the thesis that AoEs are individuals and considers the hierarchically nested nature of AoEs. PAE does this with a cladistic hypothesis, conforming to the definition of UAT and maintaining cladistic monophyly second to spatial boundedness.

With the help of his own comments, Hovenkamp (2013) considers the hierarchical nesting of AoEs a “methodological artifact”. While the above sections correct his misunderstandings about PAE under AEI, it is theoretically interesting to consider his stance and its inconsistency with global biotic distributions and areas. Cape York Peninsula is largely considered an AoE (e.g. Cracraft, 1991; Laffan and Crisp, 2003; Slatyer et al., 2007). This section of tropical Australia is a

part of a larger continental Australia and Hovenkamp’s views beg the question: is Australia then not an AoE? Furthermore, if AoEs exist, under any concept, is Earth not an AoE? And is not Australia a subset of Earth? There is no question that AoEs are nested at hierarchical spatial scales and PAE (under AEI) is a potential method to identify and interpret this aspect of these units.

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