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Original citation:

Saslis-Lagoudakis, C. Haris and Clarke, Andrew C (2013) Ethnobiology : the missing link in ecology and evolution. Trends in Ecology & Evolution, Vol.28 (No.2). pp. 67-68.

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Publisher's statement:

<http://dx.doi.org/10.1016/j.tree.2012.10.017>

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1 Ethnobiology: the missing link in ecology and evolution

2

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10 Evolutionary biologists and ecologists increasingly appreciate the value of local
11 knowledge of human communities for research on the past, present and future of biodiversity
12 [1-3]. However, there are often significant problems accessing and interpreting this
13 knowledge [3]. Here we argue that closer interaction with ethnobiologists, who study the
14 relationship between humans and the natural world, will enable local knowledge to be better
15 applied in ecological and evolutionary biological research. This will provide more
16 comprehensive answers to the scientific questions being asked, and will result in improved
17 engagement with both academic and non-academic communities.

18 Local knowledge encompasses historical and present beliefs, traditions, practices, and
19 views developed by local human communities [4]. Much of this knowledge is about the
20 natural environment, including agricultural and farming practices, the ways biodiversity is
21 used for food, drink, medicine, fuel, housing and clothing, the ecology of species and
22 communities, and local biodiversity and climatic patterns. We argue that collaboration
23 between ecologists/evolutionary biologists and ethnobiologists is the most effective and
24 meaningful way to incorporate local knowledge into biodiversity-related research. This
25 interdisciplinary interaction can provide mutual benefits for ethnobiologists and biodiversity
26 researchers.

27 Ethnobiologists, who often come from a social sciences background, are trained experts in
28 gathering, filtering, and managing local knowledge, and in fostering engagement with local
29 communities. All of these activities can be major obstacles for biologists wanting to access
30 local knowledge and integrate it into their research for the first time [3]. Through
31 collaboration, biologists can ensure issues such as prior informed consent, respectful use of
32 local community members' time and resources, data ownership, and the sharing of results and
33 benefits with local communities are managed properly, and in accordance with agreements
34 like the Convention on Biological Diversity. For a number of reasons, it is important for

35 evolutionary biologists and ecologists to engage directly with local communities, but
36 ethnobiologists can assist this process by helping communicate local concerns and needs,
37 thereby enabling collaborative projects to be planned that benefit all parties. Additional
38 benefits of collaboration may come from joint field work. Study destinations are likely to be
39 similar for researchers from all these disciplines because regions with high biodiversity often
40 coincide with regions of high cultural diversity [5]. Planning projects and conducting
41 fieldwork collaboratively can maximise the outcomes from those efforts.

42 Synergies between ethnobiology, evolutionary biology and ecology are starting to appear
43 more frequently in the literature and have resulted in remarkable outcomes. For example,
44 ethnobotanical observations, coupled with DNA sequencing, have helped elucidate ecological
45 preferences of poorly known species, such as the South American tapir (*Tapirus terrestris*
46 Linnaeus, 1758) [6]. A combination of studies has shown how evolutionary biology and
47 ethnobiology can collaborate to ensure food security. For instance, a study of genetic
48 diversity revealed that the common bean (*Phaseolus vulgaris* L.) is of Mesoamerican origin
49 and delineated local genetic groups in South America [7]. Ethnobiologists can use that
50 knowledge to highlight cultural factors influencing the distribution of different local varieties,
51 and this interdisciplinary knowledge can inform the efficient conservation of crop genetic
52 resources, as has been done in cassava/manioc (*Manihot esculenta* Crantz) [8]. Similar
53 approaches can help unearth past local knowledge. For example, ancient DNA amplification
54 techniques helped identify the contents of a medical preparation found in a 1st century
55 sunken Roman shipwreck [9], providing historical ethnobiologists insights into ancient
56 practices. As these interdisciplinary approaches demonstrate the benefits of interdisciplinary
57 projects, we encourage the three scientific communities to consider other directions for
58 combined research efforts. These could include using local knowledge of biodiversity
59 patterns to prevent loss of natural biotas, and synthesising modern and novel sequencing

60 technologies with ethnobiological knowledge to better understand crop and livestock
61 domestication, as well as to identify species used and traded in traditional medicine [10].
62 Further, this interdisciplinary collaboration can include research from other disciplines, such
63 as archaeology [11], as well as inform scientists from unrelated fields, such as those
64 conducting research on natural products and drug development [12].

65 Interdisciplinarity is increasingly recognised as being important. This is reflected in
66 funding agencies' programmes worldwide, including the National Science Foundation's
67 CREATIV scheme (US), the FP7 Marie Curie Actions (EU), the Leverhulme Trust (UK) and
68 the Australian Research Council. All these agencies call for proposals demonstrating
69 interdisciplinarity, with some supporting high-risk proposals. Research efforts spanning
70 ethnobiology, ecology, and evolutionary biology would successfully meet this criterion.

71 Ultimately, the proposed interaction can support the race against time to understand,
72 conserve, and responsibly utilise both the natural world and local knowledge. We urge
73 evolutionary biologists, ecologists and ethnobiologists to forge stronger and mutually
74 beneficial links.

75 **Acknowledgments**

76 For helpful comments on various aspects of this letter, we thank Olwen Grace, Laura Kelly,
77 Brian Mautz, Lynsey McInnes, Kristina Ramstad and Alice Storey.

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