

An Ambivalent Amphibian

David Lahti, reply by Bret Weinstein

/ *Letters*

In response to: “On Being a Fish” by Bret Weinstein (Vol. 2, No. 3).

To the editors:

You are a fish, as Bret Weinstein notes in his excellent piece on how to talk about organisms. One of evolutionary biology’s most wonderful contributions to the human experience is that we now have a consistent and empirical basis for naming and grouping organisms: relationship. The early taxonomist Carolus Linnaeus had nothing better than similarity to go on, which in comparison is about as scientific as deciding how to organize your kitchen pantry. Similarity can be squishy; who knows whether our imposed categories really exist out there in the world, or are they just based on our own assumptions or perceptions, when reality has other categories, or even none at all? We run into this problem in any pursuit of naming and grouping things in ignorance of their causes. We don’t know the causes of most mental disorders and conditions, for instance, and so we name them for their symptoms instead. If we knew the causes, we would have an empirical basis on which to construct a real psychiatric taxonomy. Likewise, now that we know what process actually causes new living things—evolution—we have a solid basis for naming and grouping organisms.

By the way, Linnaeus did a fantastic job with the tools available to him; many of his categories have been vindicated by studies of evolutionary relationship. His success, though phenomenal, is not surprising when we consider that similarity does often reflect relatedness. Moreover, Linnaeus was perceptive enough to recognize the nested pattern to organismal similarity, even though he did not know how it got there.

Anyway, in modern evolutionary biology we assign official names only to clades, or monophyletic groups—groups of organisms together with all their ancestors back to a most recent common ancestor of all of them and only them. Since mammals are nested within a broader clade that we tend to nickname “fish,” we are indeed fish in that sense. Since we descend from fish we are fish. Why do we nickname the Gnathostome clade “fish,” though, instead of being content with “jawed vertebrates”?¹ Well, the reason is that if we saw an early member of that clade, including the common ancestor, whether alive or in fossil form, we would immediately recognize it as a fish, in the ordinary language sense of the slimy thing swimming around. We very often choose our informal nicknames for clades like this.

But this puts us in a pickle. Ordinary language names for animals are pre-evolutionary, typological, named for structure or function, much like “chair” or “window.” In using the word “fish” at all, many evolutionary

biologists are proposing a revision, not only of scientific terminology (official Latin names), but also of ordinary language, to bring it too into line with how we know organisms came about. They not only want Gnathostomata to be a monophyletic group, they use the word fish to refer to that monophyletic group. That is a much more ambitious revisionism, as it means substantially changing the reference that word has for nearly all people. Unfortunately, very few people know about this enterprise, and so if you go around saying a whale is a fish you will often violate the main rule of communication, which is clarity.

This problem is a specific example of a general case where a usage or meaning or pronunciation, however valid, will be perceived as invalid by a majority of audiences. Bryan Garner came up with the name “skunked term” for situations like this, in his *Dictionary of Modern American Usage* (1998). If you say “writing is not my forte” and pronounce it correctly, with the e silent, a majority of people will think you have mispronounced the term. You cannot win; the term is skunked.

Moreover, the teacher who says “a whale is not a fish” is not wrong, for the teacher is using a different definition of fish, one that long predates the cladistic revision, and one that will be understood, despite its failure to take evolution properly into account, by all students. It is not the fault of the teacher that some evolutionary biologists have recently decided to apply a venerable term to a referent different than that for which it has always been used.

The question facing us is whether we have a scientific mandate to abolish the old sloppy meaning of “fish,” much as we have relegated terms like “phlogiston” and “life-force” to the dustbin of historical curiosities as having no referent in the real world. By this plan, the term “fish” would still remain, but it would refer to the entire clade of critters that pre-evolutionary humans referred to as fish, amphibians, reptiles, birds, and mammals. I propose a less radical solution: that we restrict the cladistic rule of monophyly to our official biological designations, and allow ordinary language names to continue referring to any assortment of things we wish.

In thinking this issue over, we should recognize up front that cladistics does not determine the groupings of organisms we are to favor with names, but merely restricts them to monophyly. Thus the cladistic revision would not help us to decide the question of whether we should cease to consider a bird as such if we discovered a splinter group of that lineage that had evolved without feathers. We would have two equally cladistically respectable options in that case. One would be to “lump”—i.e. to consider that group birds. The other would be to “split”—i.e., to decide that this landmark was significant enough that we want to call it and its descendents something else entirely, and then revise the taxonomy of the rest of the (previously all avian) tree accordingly. There are empirical matters that might help us decide which option to take, but nature does not dictate them; the groups are adopted by convention.

Notice that a definition of “bird” as “all the descendents of the most recent common ancestor of all birds” is self-referential and thus in a real sense leaves open what a bird is. We decide the content of that label however we wish, within the strict rule of monophyly. Our current ignorance is another factor to consider. For instance, we do not yet know if we are amphibians or not, cladistically speaking. We do not know if the most recent common ancestor of modern frogs, toads, salamanders, and caecilians is our own ancestor as well, or whether we descend from a separate group. Specifically, if it turns out that the ancestors of the animals we

call amphibians today branched off from the ancestral vertebrate land-invaders later than our own lineage did, then they are amphibians but we are not. But if they branched off earlier and then we in turn branched off from them, then we cannot call them amphibians without also including ourselves.

Are we doing kids a disservice by allowing them to refer to amphibians in the classic sense? I am being tongue-in-cheek, of course. My point is that the cladistic restriction on definitions cannot always be implemented in practice, and so we will at least have those exceptions whether we like them or not. Our cladistic definitions will have a persisting element of uncertainty about them that is good for science, but bad for ordinary language.

The amphibian example highlights not only the current incompleteness of our knowledge, but also a practical problem that would remain even if we knew everything about the evolutionary history of life. If every speaking human were restricted to using cladistic terms to refer to groups of organisms, we would be prohibited from referring directly to groups that exclude a lineage, because by excluding a lineage we have destroyed the group's monophyly. But evolutionary history is replete with examples of a group splitting off from a lineage and becoming something very different from its ancestral group. That splinter group we are allowed to name; it is monophyletic. But the group from which it derived? We can no longer call it anything unless we include that deviant splinter group.

So with the rise of cellular organelles we can talk about eukaryotes but we can no longer talk about prokaryotes. With the rise of multicellularity we cannot talk about the protists that gave rise to them. With the rise of deuterostomes we cannot talk about protostomes. With Bilateria we cannot talk about Radiata. With vertebrates we cannot talk about invertebrates, and so on. In these cases, derived groups destroy the monophyly of the ancestral group.

Fair enough for good phylogenetic groupings, but what if we actually do want to refer to certain groups that are not monophyletic, for whatever reason? If we do indeed descend from early amphibians, how can we easily and directly refer to all the critters we now call amphibians?

Cladistic naming necessarily suffers from such referential limitations and a bunch of others too. It does not let us know how to refer to common ancestors of a group beyond the most recent. It forces us to rename an entire group when one tiny outlying population speciates. It cannot handle evolutionary realities like hybridization, two species becoming one, or horizontal transmission of genetic material. Our own mitochondria invaded our ancestors from a different clade, but cladistics cannot handle this situation. Cladistic naming necessitates that some animal X lived way back when, which itself was an amphibian even though neither of its parents were amphibians.

These problems can fly in the face of evolutionary gradualism and continuity. They remind us that whereas evolution really happened and is not a human construct, cladistic rules for naming enjoy no such status; they are inspired by evolutionary history but are human conventions. They simplify and categorize, whereas evolution flouts us with complexity and continuity.

In short, we do not escape arbitrariness with the cladistic revision, nor do we recover a fully evolutionary

perspective, despite these two goals being the exclusive reason for the existence of cladistics. The most thorough, if practically impossible, perspective on the evolution of life would include no mention of clades at all. Nature does not create categories of species as evolution proceeds. We just like to pick out certain branches of the evolutionary tree and name them, as a sort of mnemonic device.

And you can start at any one species and get to any other species, no matter how distantly related, just by going from offspring to parent(s) some number of times, and then down another lineage from parent to offspring some number of times, and except for rather trivial senses you will never make a jump from one species to another in all of this procedure. That is the irony of systematics: it is biological in form and method, but its goal of categorization is foreign to a thorough evolutionary perspective on the history of life. That science is necessitated by human language and our desire to put things into named boxes, not by the tree of life itself which admits of no such categorization, but only the processes and patterns of continuous evolution.

All this having been said, as far as scientific terminology goes, cladistic regulations are sensible and cover the majority of cases. I am not aware of a better option. Adhering to monophyly is certainly more biologically respectable than a pre-evolutionary naming of things by some scale of “similarity.” While we endure the simplifications and restrictions that cladistics imposes, however, we should always endeavor to do better than cladistics in our evolutionary understanding, even if our nomenclature falls short—indeed, so we can recognize when it does fall short and why. Outside of formal taxonomic designations, I suggest that we should be free to use terms to refer to any group of organisms we want, as long as we are clear. In other words, cladistics should be in charge only over the formal naming of living things, not over our mere reference to them.

Surely, terms referring to groups of living things will be more useful and meaningful the more evolutionary the basis for those terms’ existence. So for instance, frogs and toads and salamanders and caecilians are more closely related to each other than they are to any other extant organisms, and they share important features of life history and physiology by common descent. If, on this basis, we want to apply the informal name amphibian to them, so be it. Let the systematists figure out, in due course, the particulars of our relationship to them, and produce formal monophyletic taxonomic names accordingly, such as Lissamphibia. If, in addition to formal Latin names, evolutionary biologists want to hazard the adoption of longstanding vernacular terms as nicknames of certain clades, we can do so, but we ought to be explicit that we are instituting revisionist definitions and also remain patient with the majority of the human population who might have reason to continue recognizing the older meanings of those words.

I hope we can retain evolutionary respectability in our informal terms even if we reject the monophyly restriction, such that there is a certain fluidity between ordinary language and scientific terminology whenever possible. One way to ensure this is to understand our informal names as a relation among cladistic names.

For instance, suppose we accept the revisionist cladistic definition for the ancient term “fish,” as a nickname for Gnathostomata. Both it and its subset Tetrapoda are both clades—this is not currently in dispute. Note that we can use phrases that are a relation between these terms, such as “fish except for tetrapods,” and this will

be clearly interpretable as a precisely defined evolutionary group, despite not being monophyletic. And if we want to refer to that group, as in teaching or in field guides or when talking about functions or habitats, we can do that. And in doing so, synonymy is acceptable; we can use a term to replace a phrase. It so happens that a term already exists that refers to gnathostomes minus tetrapods—fish!

Surely it is a bit confusing that we are using the term “fish” in two different ways here, but that is not the fault of the ancient term and its definition; it is the fault of the cladists who decided to revision the old definition for another grouping, however well-intentioned. Thus some of us refer to Gnathostomata not as the “fish,” but as the “jawed vertebrates,” avoiding this confusion. Having a jaw does not make the clade, of course, but the Latin term Gnathostomata means “jawed mouth.”

Reference to traits makes our terms robust and relevant, even if they are potentially misleading or even half-truths. The important thing is simply to know what we are doing. In any event, when we evolutionary biologists refer to a group that is unsuitable for official naming because it is not monophyletic, we should be aware as much as possible of what the cladistic way of referring to that group would be (such as “Bacteria plus Archaea” for prokaryotes or “Hominoidea except Hominini” for nonhuman apes). There is no group we are prohibited from talking about. Referring to a group that is not monophyletic is not anathema, and does not necessarily reveal a lack of knowledge; we should simply recognize that it is not a group that can be formally biologically named.

So much for the professionals and the evolutionarily savvy; but in an educational context we well may want to keep things far simpler at first. We often tell youngsters, and others with little knowledge of a particular topic, generalities that are not entirely true, or provide definitions that are not formally correct, being content to enrich their knowledge later. A circle is first presented to pupils in tautological terms—in terms of roundness—whereas only later do we talk about all points on a circumference being equidistant from the center. So too in biology we might choose to say that eukaryotic cells have nuclei—and in fact that is what eukaryotic means—even though mammalian blood cells do not have nuclei. Or we might tell kids that birds have feathers even though feathers were around long before birds, and avian embryos do not have feathers despite being birds. Despite the problems in oversimplifying definitions or overlooking exceptions, we can still find heuristic advantages in such a strategy. When a zoo docent tells kids that apes do not have tails but monkeys do, we should consider perhaps that the kids might thereby learn something valuable, if incomplete.

The fact that the monkey clade contains the apes is a more complex lesson; depending on the age and experience of the kids, perhaps we can forgive the docent for postponing it. Perhaps a better docent might tantalize them with the fact that the Barbary macaque does not have a tail to speak of but is not an ape either. Tails do not make the monkey; evolutionary relationships do. Likewise, if a kid came up to me and asked me if we are amphibians, I would say “no.” If we had more time to talk, however, I might eventually admit to him that there is a sense of that term according to which I am not sure whether we are amphibians or not. That could be a wonderful teaching opportunity on several levels.

Appreciation of evolution is at the root of Weinstein’s article, as well as this letter. However we proceed, we will necessarily run into issues with rigid terms and discrete categories that imperfectly help us make sense of things. Far more important than where we come to rest with respect to informal terms, is our shared gripe that

an evolutionary understanding is still uncommon, despite evolution being the basis on which we name and organize life; indeed, it is central to any real knowledge of life's history and diversity. We can only hope that teachers and parents and docents will know what it is they are doing when they name and refer to groups of organisms. This is not a casual hope, as evolution is still very often either misunderstood, ignored, or actively combated.

An irony in this situation is that as we here discuss how to name organisms in a way that reflects their evolutionary history, there are still people who do not even accept that they have one.

David Lahti

Bret Weinstein *responds:*

My friend David Lahti is correct that my proposal would, in the early phases, create some trouble for those who wish to discuss the biota semi-scientifically. But I think he misses that this is an absolutely natural consequence of scientific progress in every field, and that people are well equipped to deal with the inconvenience, at least as far as communicating is concerned.

To the ancients, the stars were lights in the sky. We now know where they are, what they are, and why they shine. We also know why most are fixed in relation to each other, while others—not stars at all—move about oddly, but predictably. We further know that our own sun is an unremarkable star, awesome only in its proximity to us.

If one generalizes Lahti's concerns, one might imagine that understanding the true causes at work in astronomy would have created havoc as the speech of enlightened humans became incomprehensible to the uninitiated. Perhaps such did occur in places, but the main problem of the scientific revolution was famously not one of communication. For Europeans, at least, it was quite the opposite. It was a philosophical crisis; what was being said with scientific authority was perfectly comprehensible, and quite at odds with the inherited wisdom. The ancient myths were simply not built to endure our actual earthly position in an impossibly vast universe.

Our present predicament is all too similar. Our vernacular is not yet ready to deal with the wondrous absurdity of evolutionary history, and instead of fixing it, we preserve a pre-Darwinian understanding of the biota, foolishly denying children their right to feed dinosaurs in the park, if they so choose, and forcing others to confront a mass of Latin terminology, scientific jargon and logically confusing tree diagrams. To what end?

I would prefer to tell them the simple truth. With respect to a person's place in the cosmos, people should know that the universe contains at least 300 sextillion stars that shine as their immense gravity fuses light elements into heavier ones. And as for their position on the tree of life, we should be clear: if we can agree that sharks and guppies are both fish, then strange as it may sound, so too are you.

I did find myself gratified to discover that by the end of his letter, Lahti seems to have talked himself most of the way around to my position. My proposal includes no objection to discussing paraphyletic groups, so long

as one is clear about it. If one simply speaks of dinosaurs, birds are included. If one wishes not to include birds, speaking of “non-avian dinosaurs” is perfectly acceptable and precise. One can also speak of “non-human primates,” or “lizards of the world, excluding snakes.” If one wishes to speak of the extant fish without including the 50% of living gnathostome species that are members of the tetrapod clade, “non-tetrapod fish” leaves no ambiguity.

And, on those occasions when we continue to use archaic terms in their original, informal sense, the world will not come to an end. Being cladistically aware is no more a threat to going out for some fresh fish, than being astronomically aware has dampened our delight at glimpsing a shooting star.

David Lahti is assistant professor in the Department of Biology of Queens College, City University of New York.

Bret Weinstein is a theoretical evolutionary biologist at The Evergreen State College in Olympia, Washington.

1. I am assuming, with Weinstein, that we are stopping short of the “jawless fishes” or agnathids; otherwise the fish clade is synonymous with the vertebrates (and by the way, whether we include or exclude them is an arbitrary convention—either way we have a good fish clade).