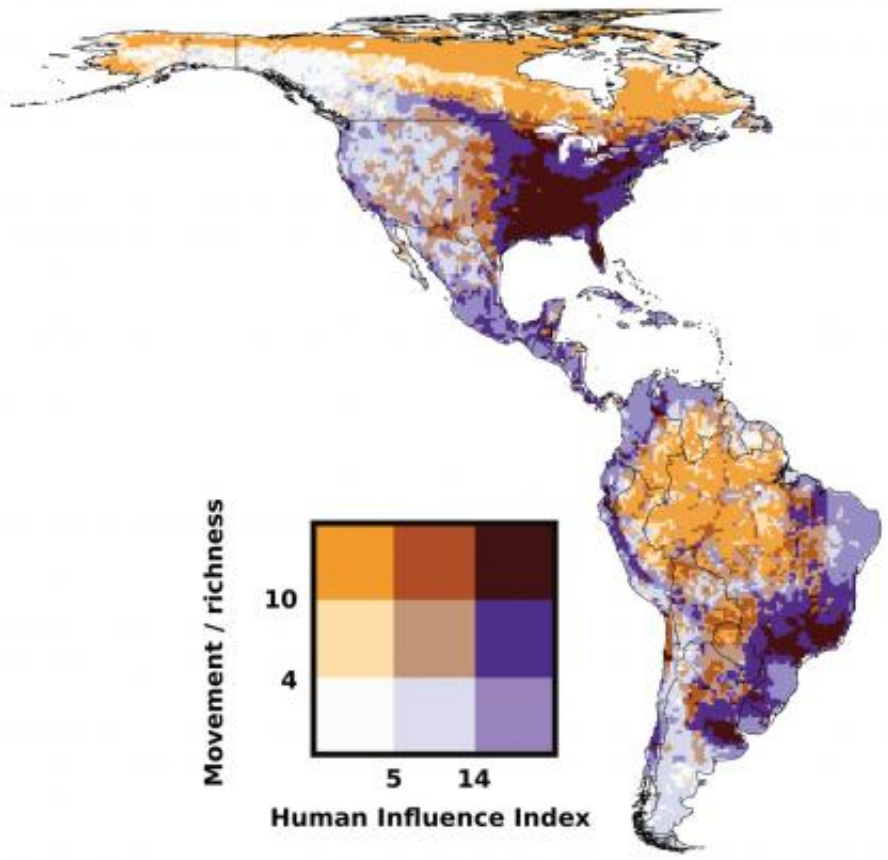
Enlisting evolutionary biology against modern threats

October 6 2014, by Sandra Hines



The percentage of mammal species unable to outrun climate change range from zero to low, shown in blue, to a high of nearly 40 percent, in light orange (UW's Josh Lawler, published 2012) . Applying what's known of evolutionary biology could guide efforts to help. Credit: U of Washington

To many, the term evolutionary biology encompasses the realm of fossils, dinosaurs and changes over eons.

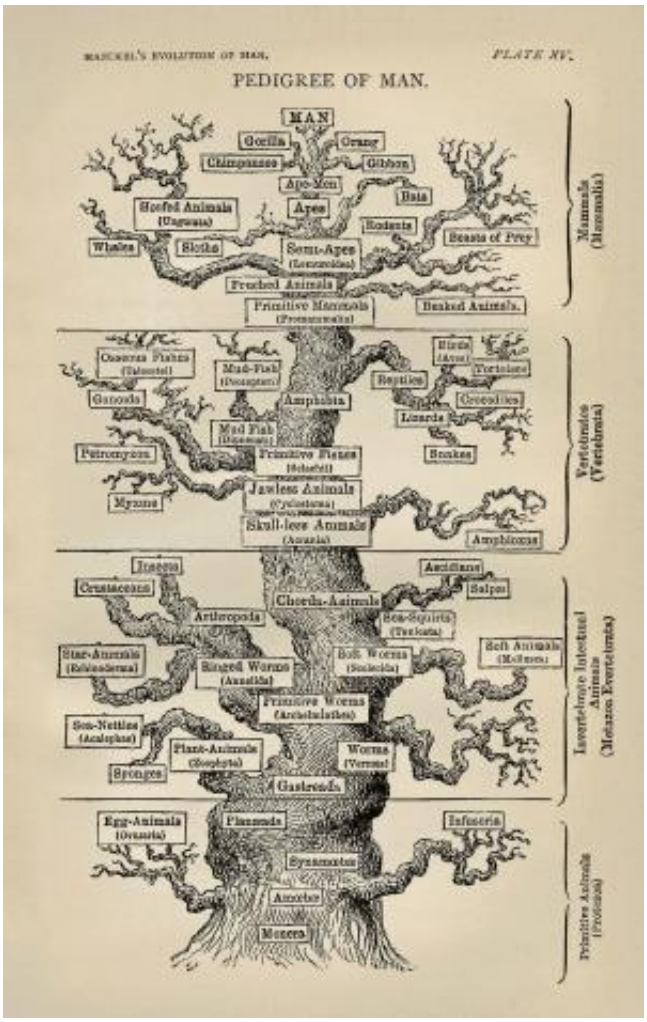
But evolutionary biology has tremendous potential to help solve many of today's pressing problems, according to nine international scientists, including Carl Bergstrom, a University of Washington professor of biology. The scientists point to everything from food security to emerging diseases in their article, "Applying evolutionary biology to address global challenges," published online Sept. 11 by *Science*.

Using evolutionary biology is one way to try to outwit evolution where it is happening too quickly – as when pests and diseases adapt rapidly and defeat our attempts to control them – and to perhaps find accommodations when evolution occurs too slowly – as when species can't adapt to habitat altered by climate change.

"Evolutionary biology is often thought of as figuring out things in the past," Bergstrom said. "Very often it's viewed as a retrospective science. What gets less attention from the general public is how evolutionary biology can help solve practical problems now."

That's one reason the time was right for this review, Bergstrom said.

"One important part of making that shift is for the public to recognize that evolution is not something that always happens slowly or is imperceptible in terms of our lifetime and irrelevant to our decision making," he said.



Evolutionary biology is not just about figuring out things in the past but can be used every day to try to outwit evolution that's happening too fast and find solutions when it occurs too slowly. Credit: Haeckel

For example, billions of people face the effects of pests, pathogens and cancers that adapt quickly to our attempts to control them. Applying what we know about evolutionary biology can help.

In the case of agricultural lands where cotton, corn and other crops have been engineered to produce toxins that kill insect pests that chew on them, there will always be mutations leading to insects able to resist the

toxins. Interspersing engineered crops with areas planted with crops that don't contain any of the toxins means there will be non-resistant insects to breed with the resistant individuals as they emerge. The offspring are likely to inherit the susceptibility, suppressing the evolution of the resistance.

Human diseases can produce resistant strains, even within an individual patient undergoing treatment, Bergstrom said. If you use the same drug over and over again, what eventually evolves is a drug-resistant strain. Thus evolutionary biology may lead doctors to use a combination of drugs because it's less likely that resistance can develop to multiple assaults all at the same time.

Anyone who follows the news knows about problems of bacteria rapidly evolving resistance to antibiotics. Annual estimated costs of combatting drug-resistant microbes in the U.S. alone is $35 billion.

It's a prime example of need for applied evolutionary biology to be discussed across disciplines, the co-authors said. They urge a coming together to think about critical public benefits, in this case to discuss the use of antibiotics in medicine for humans and in agriculture to promote growth of cattle, poultry and other animals.

"A particular worry is that the unaddressed need for management of evolution that spans multiple sectors will lead to the spread of new infectious diseases and anti-microbial resistance genes between natural, human health and agricultural systems," said Scott Carroll of the University of California Davis. Carroll and Peter Søgaard Jørgensen of the University of Copenhagen were lead authors of the paper.

On the flip side of evolution that's unwanted are instances in which animals and plants don't adapt quickly enough to changing conditions.

"Climate change is generating massive amounts of selection of all kinds on populations all around the globe," Bergstrom said. "The responses we see to climate change will depend on evolutionary processes, but we could perhaps use our understanding of those processes to think about ways to help species."

Evolutionary tools can improve prospects for sustainable development, the co-authors said. The health, food and environmental sectors urgently need to adopt tools that take a long-term perspective by considering species' evolutionary histories and the risk of unwanted effects from rapid evolutionary adaptation to human management, they urge.

More information: "Applying evolutionary biology to address global challenges." Scott P. Carroll, Peter Søgaard Jørgensen, Michael T. Kinnison, Carl T. Bergstrom, R. Ford Denison, Peter Gluckman, Thomas B. Smith, Sharon Y. Strauss, and Bruce E. Tabashnik *Science* 1245993Published online 11 September 2014 [DOI: 10.1126/science.1245993]

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