Issues and Perspectives

Dandelions and Climate Change: Lessons from Your Front Lawn

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At long last the immense threat of climate change is becoming more widely recognized and accepted as a reality at all levels of society. Resulting from this recognition comes the desire to act—to take the steps necessary so that severe droughts, intensified storms, sea level rise, and other catastrophes predicted to result from climate change might be limited in their scope.

Achieving this goal, to minimize the effects of climate change, has some inherent challenges or obstacles, with which we as humans have great difficulty coping. All result from the inherent nature of the beast before us.

Perhaps the greatest of these obstacles is that greenhouse gases are just that—gases. We cannot see them nor do we smell them, at least under the circumstances at hand. That means we are dealing with an invisible foe. *Homo sapiens* are much more adept at facing visible challenges. Filthy rivers, smog-laden air, trash-ridden dumps inspire outrage. Invisible gases? Not so. Most of us simply cannot comprehend of what 10 billion tons a year of invisible stuff entering the atmosphere really means.

An equally important obstacle is the lag time between cause and effect. We humans respond well to immediate threats. Fire-fighting, either literally or figuratively, is one of our strongest aptitudes. Addressing threats that only show themselves much later in time—the health effects of tobacco or cancer come to mind—are much more of a challenge.

But the point of this discussion is neither of these obstacles. Rather, it is a third—the difficulty we face in changing long-standing behaviors and what those new behaviors might entail. Such a behavioral shift, one virtually embedded in our culture for over a century, is fundamental if we are to adapt effectively to the new realities facing us. Particularly, the shift pertains to how might we most effectively conserve the precious animals and plants many of us cherish and how might we sustain our favorite forests, grasslands, and coastal environs, which we have come to take for granted.

To many this question has a ready solution: Setting aside protected areas and other types of reserves has been successful in the past, so we just need to ramp up this approach in a strategic way and all will be well. Well, will it?

Such a strategy is dependent upon projections, rent with caveats and speculation, about where habitats will migrate over time. Migrating habitats is a new concept to us. And these computer projections—what if we guess wrong?

Perhaps Mother Nature can shed some light on the subject. After all, animals have been adapting to changing environments since evolution began over 4 billion y ago. What might we learn from them?

Perhaps most importantly we learn that, in general, organisms evolve different strategies to cope with stable vs. variable environments. In a stable environment, meaning one relatively unchanging over time such as a rainforest, a number of organisms evolve a set of common characteristics. These include being long-lived, having few offspring, and nurturing those offspring for some time before they become independent. This evolutionary strategy suggests that such organisms—the gorilla *Gorilla gorilla* being a good example—take advantage of "knowing" their environment and passing learned skills on to their young.

This capacity is particularly advantageous in stable environments because such environs tend to have a high diversity of species among which competition is presumed to be intense. Under such circumstances the nurturing of offspring is clearly advantageous. Ecologists refer to this adaptive strategy as K-selection (Mac Arthur and Wilson 1967; Odum 1971; Futuyma 1979). In their lexicon K stands for carrying capacity, and stable environments tend to support species that are believed close to their carrying capacity. In simple terms, this means the species are maximizing the number of individuals their particular environment can support. Or, in other words, individuals have spread to every corner of the habitat leaving no room for others; thus, the individuals best able to cope with the unique

elements of that environment have the best chance to survive. Resultantly, animals with good genes coupled with knowledge from their parents have an advantage over animals with good genes alone.

The opposite adaptive strategy includes organisms that are short-lived, have numerous offspring, and provide no significant parental care to their young. Their offspring are ''good to go'' shortly after birth. The rabbit *Sylvilagus floridanus* is a fine example of such an organism, one that generally occupies unstable or transitional environments such as fields undergoing succession. The rabbit hedges its bets by spreading offspring widely in the hopes that a few will find adequate circumstances in which to survive. Ecologists refer to this adaptive strategy as r-selection, r representing reproductive rate, the driving force behind this life-style (Mac Arthur and Wilson 1967; Odum 1971; Futuyma 1979).

So what does this have to do with climate change or the need for a human behavior shift? Well, what is significant here is that if we apply the above ecological concepts to how humanity has approached conservation since the birth of the movement it becomes apparent that we have relied heavily on a K-selection strategy. Specifically, the conservation movement has largely focused its resources, both human and financial, on a few select sites through setting aside of protected areas and, in many cases, managing them intensively as the central element to achieve conservation. As an example, within the U.S. Fish and Wildlife Service, an agency with approximately a 2.5 billion dollar budget and nearly 9,000 staff, almost half a billion dollars and one-third of the staff are dedicated to land purchase, maintenance, and management of the National Wildlife Refuge System (U.S. Fish and Wildlife Service 2009). The U.S. National Park Service, with approximately a 3 billion dollar budget and over 20,000 staff, directs two-thirds of its funding and even a greater proportion of its staff toward park purchase, maintenance, and management (National Park Service 2009).

This approach, comparable to the above-mentioned gorilla nurturing its few young, is anything but r-selection. There is nothing rabbit-like, behavior-wise, in a land acquisition strategy. And that is how it should be. Or rather, should have been. The strategy has served us well because one of the conditions upon which our protected areas system is based since its inception is that any natural area we own can be managed to produce the particular habitats we desire. That is to say, by use of management techniques we can dictate what will or will not be present on the land—habitats will be as stable as we want them to be. We are in control. Habitat stability is entirely within our hands, while climate is benign and predictable. As a consequence, just as a K-selected species invests in nurturing only a few offspring, we invest in nurturing relatively few parcels of land.

Now that premise, a central tenet of the protected areas system, is no longer valid. The vagaries of climate change are such that despite our best efforts, what a particular parcel of natural landscape will look like but a few decades from now is anyone's guess. Instability and uncertainty are the new driving forces when it comes to land management. Such forces create habitats most suitable to r-selection strategies.

How does the conservation community adopt an r-selection strategy? Rather simply on paper, but not easily in practice. An r-selection conservation strategy would involve hedging our bets with regard to protected areas. It would mean investing much less heavily in particular land parcels while dramatically increasing the spreading of our human and financial resources much more widely across the broad environmental landscape. This would involve maximizing overall wise land use—keeping areas green, and avoiding irreversible land use changes—while shifting away from expensive, site-specific actions.

Such an approach is difficult in practice because: 1) it is counter to how we have conducted business for generations; 2) it requires us to address conservation on landscapes more intensively occupied and utilized by people; and consequently 3) it involves much greater engagement with the nonconservation community. Point one creates difficulty because it requires shifting from the status quo, something individuals and especially institutions do not like to do. Points two and three imply a shift not only in conservation strategy, but in the fundamental manner in which conservation professionals ply their trade. It is a shift away from management of habitats and species and movement toward the social aspects of conservation including a focus on influencing the attitudes and behaviors of individuals and communities. This shift is one with which resource managers are relatively unfamiliar and, consequently, often uncomfortable. It is also one for which we are inadequately trained. These are the behavioral challenges, major shifts in the way we do conservation business, alluded to earlier.

Shifting to an r-selection strategy of hedging our bets is further complicated by the human propensity for sole ownership rather than the sharing of land. Our national anathema to land-use planning is an additional complication of this approach.

Nevertheless, if how animals adapt to changing environments is any lesson, we have some adapting to do. A good starting point for such change might be creation of an entirely new approach to the training of future resource managers, one focused on the skills necessary for working with people more than studying critters.

As to the dandelions *Taraxacum officinale* on your lawn, yes, they too teach us a lesson. In 1971 a scientist by the name of Solbrig (1971) studied dandelions in a highly disturbed and frequently mowed area equivalent to a front lawn. We shall refer to these as ''lawn'' dandelions. He then compared these to other dandelions growing on an undisturbed adjacent meadow. What one would hypothesize is that the lawn dandelions, due to disturbance and frequent cutting, would be relatively scarce and nowhere near the carrying capacity of that habitat. Essentially, the regular modification of the site by mowing would make it a variable environment, one that we have seen is favorable to r-selected species.

Meanwhile, in the adjacent meadow where plants were permitted to grow undisturbed, the expectation is that dandelions would be much denser and closer to the carrying capacity of that habitat. Relative to a lawn, an uncut meadow is stable, a circumstance more favorable to K-selected species.

But the interesting finding was this—the lawn dandelions, apparently due to the lack of competition resulting from their unstable environment, produced significantly more seeds than their brethren in the more stable habitat of the uncut meadow—they displayed a more r-selection strategy!

The uncut meadow dandelions, due to their more stable environment, did not produce nearly as many seeds. Physiologically they focused their energy away from seed production, not as valuable a function in an already crowded environment, to other more survival-friendly needs. Clearly the environmental

stability around the dandelions favored plants with a decidedly more K-selected strategy for survival!

The dandelions apparently had responded to dramatic differences in their environmental conditions—differences in habitat variability. Each population had evolved alternate approaches to survival. Within a single-species r- and K-selection strategies were on display.

Apparently dandelions have adapted differing strategies for differing circumstances. It behooves us to look out our windows at these beautiful yellow blossoms and contemplate this extraordinary plant's capacity to cope in a changing world—and then to consider whether we, too, are capable of such adaptability in the face of environmental change at a pace heretofore unknown.

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