

Letter from the Desk of David Challinor
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As scientists worldwide become increasingly concerned by the precipitous population decline in such highly visible species as pandas and Asiatic rhinos, they unanimously stress the need to maintain biological diversity. This term—now shortened to biodiversity—has become a popular rallying cry for global efforts to protect existing areas known to or expected to have exceptionally broad species variation. It is only in the last 20 or 30 years that biologists have been able to make even an educated guess as to the number of insect species living in tropical forest canopies; the more that is done to try to determine variety in all kinds of small invertebrates, the greater the realization of how many unknown species there are. This month's letter will discuss how biodiversity is measured, the importance of maintaining biodiversity in as many places as possible, and some of the trade-offs that may be necessary to achieve varying biodiversity goals.

All are familiar with the old saw "variety is the spice of life." There is, however, a lot more to variety than just spice. Without variety in people's tastes, politics, culture, language, *et al*, life for most of us would be intolerable. We humans so dominate the terrestrial world that our perceived needs for food, shelter and even the "right to happiness" have led to massive landscape alteration in order to meet our wants—all at the expense of species diversity. Examples abound and are often so obvious that we do not even recognize how impoverished some species have become.

Consider, for instance, the landscape of cities and their surrounding satellite towns and suburbs. Downtown ubiquitous paving defeats all but a score of hardy "weeds" that can grow between the cracks. Some animals adapt readily to city life: rats, mice, feral cats and dogs are the principal mammals; cockroaches, houseflies, silverfish and head lice are the hardy invertebrates. Suburban development encroaches on farmland, which itself represents a highly modified, relatively species-poor environment. Other living organisms that adapt to densely populated human habitats are generally categorized as vermin, or at best as pests, such as the Canada geese that foul our lawns and golf courses or the raccoons that rummage in our garbage. Even the city-nesting peregrines are unwelcome by urban racing pigeon owners. The latter fly much higher than park or street pigeons and are, therefore, a more attractive falcon target.

Wide species variation is not only more aesthetically and intellectually pleasing to those humans who can afford to enjoy nature for its own sake, but it also helps ensure relatively stable and predictable conditions. For example, wolves reintroduced to Yellowstone Park a score of years ago became directly responsible for improving the trout fishing. After a century without wolves, generations of elk had exploited streamside willow, aspen and cottonwood browse. So efficient were elk that stream banks were kept

mostly clear of riparian trees. With the arrival of wolves, elk became increasingly vulnerable to predation along streams and moved back to graze on open meadows where wolf packs were more visible. Freed from browsing, the water-demanding trees soon grew to shade the streams, thus cooling the water, stabilizing the banks and improving conditions for trout. Not only did fishers benefit, but also spectacular piscivores such as eagles, osprey and even grizzlies.

Despite the fact that more than 99% of all species that have ever lived on earth are now extinct, there is still a strong argument to prevent or at least significantly slow extinctions. Most species became extinct before humans could record or were even aware of which creatures had disappeared. Today, by studying subfossils, scientists have a pretty good record of the large mammals and birds that vanished in the past 50,000 years. Scientists now monitor and record declining populations and have learned that once a species has gone, it's gone for good. Despite such efforts as those of the Heck brothers in Germany in the 1930's to recreate the tarpan, the forest-dwelling horse depicted on the cave walls of southern France and Spain, they were only able to produce a horse that looked like one, not an actual tarpan.

The loss of a species has a profound emotional effect on many humans. Scientists worry about the small creatures that disappear and are unknown to them, including such obscure invertebrates as the Hayes Spring scud, now officially endangered. This tiny creature lives in the seepage from a cliff-sided seasonal spring within the National Zoo. How many people will know, much less care, if this tiny creature in an obscure corner of the Zoo becomes extinct? Practically, too many other small invertebrates exist for us to save them all.

The large visible birds and mammals have our attention as we continue trying to save threatened species such as the Hawaiian and Mediterranean monk seals from extinction, but they may be doomed as were their Caribbean congeners.

Probably the best way to protect and, therefore, ensure future species biodiversity is to set aside large habitats that include as wide an array as possible of plants and animals. To this end, conservation biologists have identified locations throughout the world deemed to be especially abundant in species. The designated sites are known as "hot spots" and considerable local and international effort is spent to ensure their permanence. Most hot spots are in the tropics where the greatest concentration of species per unit area exists in both terrestrial and aquatic sites. For those interested, there is a website that lists hot spot locations: biodiversityhotspots.org.

Because so many hot spots are in developing countries, I believe that prosperous nations such as the US have a strong moral obligation to provide both money and scientific support to local efforts to achieve permanent protection. A model for such an

effort is the Charles Darwin Foundation (CDF), whose focus is on the Galapagos. Although not currently rated as a hot spot, its biological importance rests on the islands' isolation and their consequent high degree of endemism (organisms that have evolved locally). For almost 35 years, I have been directly involved with the CDF, the international organization that built the research station at Academy Bay on Santa Cruz Island. Thanks to the CDF's efforts, guides are trained to escort tourists, endangered land tortoises are bred at the station for subsequent release, and feral goats and pigs have been eradicated or are being significantly reduced on the islands. Both plants and animals have recovered, making the Galapagos an even more attractive tourist site. Today tourism, along with oil and bananas, are the government's major hard currency sources. The CDF's American partner foundation in Falls Church, VA sends three or four million dollars annually to help operate the station and to support activities of the national park service there. The effort to preserve this biological gem intact is continually threatened by the strain of increasing numbers and needs of tourists and by illegal fishing in the rich adjacent waters.

Human pressure on the Galapagos and other hot spots cannot be stopped but mitigated only through tradeoffs. In the Galapagos, for example, the one hundred dollar a head landing fee helps finance remote natural reserves east of the Andes. More island tourists are accommodated by tightly controlling ship itineraries to ensure that scarce landing beaches are visited by only one liner at a time. Such tradeoffs between human demands and site handling capacity will require ever more imaginative accommodations.

It is sometimes necessary to create a semi-artificial habitat for vulnerable species. Research, such as that conducted by Russ Greenberg at the National Zoo, has led to increased support for shade-grown coffee in southern Mexico and Central America. Coffee plantations below canopy trees are attractive habitats for wintering North American passerines (perching birds). There are even side benefits to shade-grown coffee; many consider these beans to be tastier than sun-grown beans. Furthermore, shade-grown plantations require less fertilizer and provide better erosion control. Keeping wintering rice fields flooded provides an excellent habitat for migrant waterfowl. Other large-scale, land-hungry tropical crops are being assessed for environmentally beneficial husbandry.

Human pressure on hot spots will certainly continue through the next few centuries before the globe's human population stabilizes. The challenge is to keep thinking ahead to plan on reasonable ways to curb our insatiable appetite. Is opening the wildlife refuge on the north slope of the Brooks Range to oil drilling really worth the optimistic oil yield of only six months of oil at our current consumption rate? Despite being "at war," no one has been asked to change his/her lifestyle. We as a nation seem unable to plan ahead for farther than the next election. The petroleum age is likely to end this century, but relatively little official thought has been given to the consequences of

his cataclysm. Our current governmental attitude towards the environment scarcely serves as a model for what environmentally concerned Americans and Europeans are asking third world countries to do to protect their hot spots. In fact, those countries seem to be setting a standard that the US should emulate. Much work has been and is being done to find answers to preserve and maintain biodiversity. My plea is to put them into action.

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