



Creating the Nation's first BioPark

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Letter From the Desk of David Challinor
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When we refer to domestic plants and animals, most of us have in mind sheep, pigs, wheat, corn, etc. These organisms evolved naturally, occupying their environmental niches until humans learned to control their reproduction, making them more useful to human needs than they had been in their wild state. Today's corn, for example, bears little resemblance to its central American ancestor, just as today's sheep and cattle differ markedly from their wild progenitors. As humans have spread across the globe, even to the most remote oceanic islands, they have brought their domestic plants and animals with them.

Among the first domestic animals imported into North America from Europe were honeybees. Although there are about 170 bee genera and perhaps ten times that number of species north of Panama, none produced honey like the European bee (*Apis mellifera*) in quantities large enough to be worth harvesting.

Honey has long satisfied a crucial component in human diet. The craving for sweets in humans has been and still is as great as the craving for salt, so it is little wonder that high priority was given to importing bees to the new world. Today this human taste demand is satisfied by an enormous and profitable "junk food" industry; Americans consume over 500 cans of sugar-flavored soft drinks a year.

Our craving for sweet-tasting food may have an evolutionary basis. Unripe fruit, for example, often has a bitter taste and can in some cases cause illness when eaten. Thus sweetness of fruit has long been associated with safe consumption. Fruit is also a rich source of calories.

For the sweet-toothed, the commercial opening of the new world to Europe in the 17th century came at a critical time. It was not until the late 1600's that sugar, as used today to flavor food, became available as a commercial product. Cane was grown around the Mediterranean and on Crete and Cypress. The industry, despite the strong demand, rapidly dwindled as the forests which had furnished the fuel for the refineries all but disappeared due to overcutting. The principal Caribbean islands and subtropical South America soon replaced Europe as the world's major cane sugar-producing source, a status the area still retains.



Despite the current replacement of honey by cane sugar as the principal commercial sweetener, the role of domesticated bees still remains crucially important, with honey production now only a secondary byproduct of bee activity. The principal role of bees today is to pollinate important commercial food crops. For various reasons, but most importantly the loss of habitat, the heavily populated parts of the world are confronting a pollination crisis. Of the staple food crop plants, animals (birds, insects and even bats) pollinate about 75%, with the balance using wind or water to distribute pollen.

The pollination crisis arises from the assaults on animal pollinators from pesticides, diseases, parasites and particularly human encroachment on their habitats. We are ignoring our dependence on the relationship between plants and their pollinators, and we do so at our peril. Of the approximately 100 major food crops grown throughout the world, about 30 different animal genera are needed to fertilize them. Only about 15 of these 100 are pollinated by domestic honeybees, with the balance generally pollinated by other birds, insects and wind. Honeybees, however, are in decline with commercial colonies in the U.S. dropping from about 6 million in 1948-49 to only about 2-1/2 million in 1995. Most of this loss has been in the last five years and is attributed in part to the rapid spread of a parasitic mite.

Despite attempts to control honeybee breeding, there have been few successes. Brazilian apiarists attempted to produce more productive honeybees by importing an aggressive strain from Africa. Some of them escaped with serious consequences for domestic bee keepers. The so-called killer bees swarmed north in a relatively few years, reaching the southern border of the U.S. The newcomers not only failed to hybridize with the docile bees, but were so aggressive that they replaced feral colonies of the common European type. A Smithsonian scientist, David Roubik, has been following the spread of Africanized bees from Brazil. He learned from a 17-year study in French Guiana that the invaders are now the dominant pollinators there, replacing local pollinators and thus causing a 40% drop in the seed set of tropical legumes in that country.

Although the threat of a pollination crisis is real, there are actions that scientists and farmers can take. Other insect pollinators can be exploited. For example, alfalfa is an important legume used both as livestock forage and as a soil nitrogen replenisher. Honeybees can pollinate alfalfa flowers, but they are not as efficient as the smaller, solitary, ground-nesting alkali bee or the Alfalfa leaf-cutter bee, which came from the Old World. Farmers prepare ground-nesting beds around their alfalfa fields for the alkali bee. Soil texture and moisture have to be exactly right for the bee to excavate its

nesting hole, but when done properly, nesting densities can reach up to 3,000 per square meter. The leaf-cutter bee is now replacing the alkali bee because its females nest in existing cavities such as beetle holes in dead wood. Farmers can therefore expand the number of leaf-cutter bees by preparing artificial nesting cavities in grooved, wooden boards. These are scattered around the fields on moveable trailers, which are brought inside during the winter. This allows for a large production of young in the spring and thereby ensures adequate pollination of the alfalfa crop.

Specialty crop growers must be alert to discover and then exploit the best pollinator for their crop. For example, a couple of hundred miles east of Tucson, a farm has a ten-acre greenhouse growing tomatoes hydroponically (without soil). The blossoming plants produce much pollen but no nectar. Bees, however, need both. The grower has therefore developed his own sugar-water formula to feed the bees a synthetic nectar from plastic bags. He uses bumblebees instead of honeybees because the high pitch buzz produced by the wings of the former shakes the tomato pollen from the flowers' anthers onto the bee, which then visits other flowers to exchange the pollen with a new blossom. Honeybee buzzing is not strong enough to shake the pollen loose.

What is being done in Arizona may indicate a trend in food crop production, particularly for high priced luxury foods. Elaborate, closed greenhouse systems can be highly productive as in the case of hydroponically grown tomatoes or lagoon-raised shrimp and pen-raised salmon. There must be a cost to such elaborate crop-raising, but it may take years to become evident.

Meanwhile, the instant gratification of our evolutionarily developed craving for sweets and salt, and for fat as well, has consequences for us all. Many of us cannot moderate our intake of these dietary components and thus suffer the consequences. Perhaps we may evolve to be like the yellow jacket, able to guzzle jam and coke to our hearts' content without surcease, and still retain our trim figures, for I have yet to see an overweight yellow jacket.

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