process program evaluation of a school-based parent-involvement program, Spanish-speaking parents are less likely to attend sessions than English-speaking parents, despite the fact that sessions are available in Spanish. An evaluator decides to find out why this is the case by setting up focus groups with Spanish-speaking parents. Results indicate that although Spanish-speaking parents want to be involved in their children's schooling, they view their lack of English proficiency as a barrier to effective involvement. Program staff can use this information to modify recruitment strategies, ensuring communication to Spanish-speaking parents that their involvement encompasses more than schoolwork assistance.

From Research to Practice

It might appear that evaluation research would have a significant impact on whether a program continues. However, this is not always the case, particularly when a program is immensely popular and taps into the public's perception of what should work. The Drug Abuse Resistance Education (D.A.R.E.) program provides a good example of a program that receives continued funding despite a plethora of evaluation research indicating that it has no long-term effects for preventing and reducing adolescent drug use. The D.A.R.E. case illustrates that program evaluation research can only be effective when program stakeholders, those with a vested interest in the program's success, actually utilize the results either to modify the existing program or to design a more effective one.

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See also Focus Groups; Latent Functions; Manifest Functions

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EXTINCTION

Extinction—the permanent disappearance of a species from the earth—can be thought of as the ultimate social problem. When our neighbors disappear from the planet forever, our potential social interactions are forever diminished. Extinction is not a new phenomenon. What is new, however, is the current *rate* of extinction, which is dramatically higher than any in the geologic record, and the fact that for the first time ever, a single species—our own—is the *cause* of this high rate of extinction. This is why extinction represents a serious social and environmental problem.

Extinction in Context

Just as every person will die someday, so too will every species eventually go extinct. In fact, almost all species that have ever existed on earth have already gone extinct. Paleontologist David Raup has estimated that 99.9 percent of all species in Earth's history have gone extinct (or, conversely, that today's living world represents only 0.1 percent of the variety of species that have existed at one time or another). Studies of marine fossils—the most continuous and reliable record of life on earth—indicate that the average "life expectancy" for a species is approximately 1 to 10 million years.

Simple microscopic life (formed of prokaryotic cells—those without cell nuclei, like today's bacteria) began appearing some 3.8 billion years ago. More complex unicellular life—formed of eukaryotic cells, those with cell nuclei and organelles—began to appear approximately 2 billion years ago. More recognizable, larger multicellular forms of life—fishes, plants, and the like—began proliferating about 542 million years ago (at the start of the Paleozoic era). Throughout the history of the Earth, species have arisen and faded like the blossoming and wilting of generations of flowers. Even though extinction is inevitable, species have different fates. Some morph into new, better-adapted species, becoming the ancestors of vital living lines. Others find themselves in evolutionary dead ends, the last of their kind. The

interaction of living species with the ever-changing environments on Earth, through the process of natural selection, creates ever-better-adapted organisms, usually resulting in greater diversity of life.

While extinction is almost as old as life, it has not always occurred at a uniform rate. Geologists and paleontologists have been able to decipher a "background extinction rate" throughout the geologic past—an average rate of species loss, which turns out to be approximately 2 to 3 extinctions per year globally. In general, though, new species have been generating much more rapidly than old ones have been going extinct. Creation, then, has generally been outpacing loss. (Accordingly, biological diversity on this planet is higher than ever before.) But there have been five "moments" in the geologic past when huge numbers of species became extinct at roughly the same time ("same time" in this case referring to a period of a few million years). Scientists refer to these as "mass extinctions." From most ancient to most recent, these mass extinctions occurred in the geologic ages known as Ordovician (440 mya [million years ago]), Devonian (365 mya), Permian (245 mya), Triassic (210 mya), and—best known—the end of the Cretaceous (65 mya). Two of these have drawn special attention from biologists.

The episode at the end of the Cretaceous (usually referred to as the "K-T" mass extinction, because it straddled the boundary between the Cretaceous—which geologists symbolize with a "K"—and the Tertiary periods) is familiar to the general public because this was the end of dinosaurs (many earlier forms of which had already gone extinct). The abruptness of this massive change in life forms had long been recognized, because of fossil evidence, but had long puzzled scientists. Evidence suggests that this mass extinction was precipitated when a meteorite approximately 6 miles (10 kilometers) wide struck the planet, in what is now the Gulf of Mexico, causing enormous climatic and habitat shifts. The meteorite's impact created thick dust clouds, which initiated a dramatic reduction in levels of photosynthesis. Other consequences of the meteorite impact included immense tidal waves, large-scale fires, and atmospheric changes leading to "acid rain."

The Permian extinction crisis represented the closest brush that life on earth ever had with total annihilation. The history of extinction is usually examined through study of marine animal fossils. Marine environments have been present throughout Earth's history, and many marine animals fossilize well. When looking so far in the past, biologists tend to focus on organisms at the level of the family—two steps more general than species in the hierarchy of biological taxonomy—because they can have greater confidence in their conclusions about this more general grouping. During the other four mass extinction crises, roughly 12 percent of marine animal families went extinct, but during the Permian, well over half the families disappeared. Extrapolations suggest that this represents somewhere between 77 percent and 96 percent of *species* lost. It took almost 100 million years for species diversity to regain previous levels. But of course these were new species. One of the starkest realities of extinction is that it is truly forever—once a species and its complex genetic coding is lost, it will never be seen again.

Extinction Today

What is of concern today is that humans have initiated the sixth great extinction crisis in the history of the planet. While this point is occasionally argued in popular media, there is remarkable scientific consensus that this rate of extinction is much higher than anything seen in the fossil record. Humans' impact has been much greater than that of a meteorite smashing into the earth. It is difficult to be exact, of course, when predicting the future. And predicting extinction is especially challenging because the vast majority of species have yet to be described. Approximately 1.7 million species have been described and named by scientists, but no one thinks that is even close to the true measure of biological diversity. Well-reasoned estimates range from approximately 5 to over 100 million species on earth today. Why such confusion? Because Western science emerged from Europe and North America, the temperate zones have been studied much more carefully than other parts of the world. Certain habitats have only recently begun to be explored—the canopies of tropical rain forests, for example, and deep-sea thermal vents. As it turns out, these new biological frontiers are, in many cases, immensely more diverse than anything in Europe or North America. Also, certain groups of organisms—vertebrate animals, especially—are relatively well-known, whereas many other groups are just now being discovered.

In some cases, we are losing species before we even know they exist. One poignant example: In 1978 two botanists visited a ridge in Ecuador and found

almost 90 species of plants that were known from nowhere else. Within 8 years the ridge had been cleared for agriculture, and most of those species were gone forever. If not for that one visit, we would be ignorant of this loss.

In spite of these predictive challenges, many scientists have attempted to predict the short- and long-term future of extinction. Harvard biologist E. O. Wilson provided one of the most painstakingly calculated examples, estimating our current rate of extinction to be 2,700 times higher than the average "background rate" in the geologic record. Other estimates have asserted a current extinction rate "only" hundreds of times higher than the background rate. Actually, all these estimates are remarkably similar: All declare that the current extinction trend is at least an order of magnitude higher than ever before, and all estimates are based on conservative assumptions on numbers of species and optimistic assumptions on crucial changes in human behavior patterns. Thus the reality could be worse.

Not only is the future hard to predict in relation to extinction, but the recent past can elude certainty as well. For one thing, it is difficult to know exactly when a species *has* gone extinct. For another, as stated above, we cannot know true rates of past extinctions when we are only aware of the existence of a fraction of the world's species. Nevertheless, biologists do their best to maintain records of species loss. The International Union for the Conservation of Nature Red List—an authoritative database of loss and endangerment—documents a minimum of 844 extinctions since 1500. Alarmingly, the rate of loss increased dramatically in the most recent century.

Why do species go extinct? While some species have been directly and intentionally exploited, the most common cause of extinction is destruction or fragmentation of habitat. Certain characteristics of species predispose them to be more vulnerable to extinction. Species with more general food and habitat preferences are able to adapt to environmental changes—including those induced by humans—more readily than specialists. Species with limited geographic ranges, such as islands, are at special risk. In fact, 75 percent of the animal species that have gone extinct in the past 4 centuries were island dwellers. Species that specialize in a particular habitat become vulnerable when people desire that habitat. Many species from the prairies of the North American Midwest, for example, almost all of which have been plowed under for large-scale agriculture, have either gone extinct or hang on in remaining shreds of prairie—in pioneer cemeteries and along remote roadsides. Passenger pigeons were once the most abundant bird in North America; individual flocks, numbering millions of individuals, were known to darken the sky at midday. Their extinction would have been unthinkable to early settlers. Yet the pigeons relied on extensive tracts of eastern deciduous forest; once these forests were cleared away for settlement and agriculture, they did not last long. Some species are victims of direct hunting and persecution; those that taste good or scare us are especially vulnerable. Some species, especially large predators such as bears and mountain lions, have problems because they require large areas to roam. Some species are vulnerable for several of these reasons. Wolves, for example, require large home ranges of relatively wild country, and they have been persecuted for centuries because people consider them fearsome beasts. Whatever the initial causes of endangerment, when a population becomes very small, it becomes especially susceptible to extinction. Chance occurrences can exert critical influence on a species' survival. Random sorting of gametes can unbalance a species' sex ratio, lowering its probability of ongoing successful reproduction. Small populations are more likely to inbreed (mating between closely related individuals), which can accentuate harmful genetic traits (as was seen in some European royal families). And unpredictable events, such as forest fires or hurricanes, can be catastrophic for a species with only a few individuals.

Extinction as a Social Problem

As terrible as wars, injustice, and poverty are, no form of human violence and indiscretion will have such long-lasting and irreversible consequences as the extinction of species from our planet. As Wilson has pointed out, this is the only human-caused problem that will take literally millions of years to compensate, and then only incompletely. The forms of life we lose will never come back, a folly for which Wilson believes our descendants will be least likely to forgive us. His calculations, described earlier in this entry, on extinction rates work out to a prediction of losing 10 to 25 percent of the species in the world in the next 50 to 100 years. This relatively conservative prediction is based on an assumption of stabilizing human population and reducing excessive consumption in developed

nations. Without achieving those laudable goals, the losses will be much greater, perhaps even worse than losing a quarter of the species in the world in the next two human generations.

Why does this matter? Foremost is the simple tragedy of so much loss. Forms of life that evolved over the course of millions of years, through the interactive forge of natural selection, have an intrinsic right to exist for their own sakes. More pragmatically, the loss of biodiversity creates both direct and indirect problems for humanity. Biodiversity has several types of instrumental (utilitarian) value for people. It directly provides *goods,* such as food, medicines, fuel, and fiber. It also provides ecosystem *services*—for example, climate regulation, pollination of crops, and fixation and cycling of crucial chemical elements. Without these services, life on earth as we know it would cease to exist. Moreover, wild species hold *information* of untold usefulness to humans—potential templates for genetic engineering and future medicines, for example. For this reason, environmental philosopher J. Baird Callicott has likened the mindless destruction of biodiversity to book burning. Finally, the world's biodiversity holds *psychospiritual* value for people: in the sheer aesthetic beauty of the world, as the source, in some cases, for religious awe, and as a sanctuary for mental and spiritual well-being. For all these reasons, a world of human-hastened extinction of species is a tragically diminished world. But because humans are the cause of this problem, we are also the source of solutions.

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See also Deforestation; Desertification; Environment, Pollution; Environmental Degradation; Global Warming; Nonrenewable Resources; Population Growth; Water Quality

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Extramarital Sex

Extramarital sex refers to any sexual activity, but usually intercourse, that takes place outside of a legally sanctioned marriage. Even though general use of the term is with respect to heterosexual partnerships, it can also apply to homosexual relations when one of the individuals is in a heterosexual marriage. Furthermore, extramarital sex is a broad concept that encompasses sex that takes place in a cohabiting relationship; teenage sex; any other form of premarital sex; and adulterous sexual relations between two people, at least one of whom is married.

The 20th century witnessed increases in all the forms of extramarital sex, which eventually helped normalize sexual activity outside of marriage. A vocal group of commentators and scholars decried these increases as a sign that the American family was in decline. The 1960s, in particular, witnessed a marked increase in the rates of cohabitation, nonmarital births, and divorce. College students in the 1960s and 1970s were prime movers with respect to cohabitation and premarital/teen sex. By the 1990s most of the trends had stabilized, indicating that despite concerns, marriage remained a lasting American institution into the 21st century.

According to demographers, overall trends in extramarital sex since World War II are primarily the result of the long-term process of women's growing employment outside the home and their better access to birth control. Social scientists also draw on shifts in social and cultural values—such as the decline in the power of religious norms to affect individual behavior and changing opinions on the permanency of marriage—to explain the increase in extramarital sex.

One of the most common forms of extramarital sex is cohabitation, the sexual union between an unmarried man and woman. Cohabiting partners share the