

It's 7:30 in the morning on a ten-mile stretch of familiar road. You're running a bit late, so you nudge the gas pedal to a "safe" ten miles an hour over the posted speed limit. Zipping along, you catch a glimpse here and there of an animal—a squirrel, a lizard, a quail, perhaps a toad—crumpled on the blacktop or on the gravel shoulder. Some of the bodies—flattened to a smear of blood, bone, and fur—are beyond identifying.

A careful driver, you are hyper-vigilant for things dashing onto the roadway, but one morning you hit the brakes too late as a dove on the wing caroms off your front bumper and sails over the windshield. In your rear-view mirror you see it land and bounce along the pavement in a hail of feathers. Or perhaps you have seen a raven or coyote pulling at the entrails of a deer lying by

Our highways have become killing fields for wildlife

the side of the road. The sight is troubling, and you hope a road crew removes the carcass before you return.

You rue the sacrifice of wildlife to traffic. But what's to be done? Cities sprawl, roads are laid, animals die. It's a price paid for progress. Yet, you wonder, how many animals are killed each year on that ten-mile stretch of road? If you knew the answer, it might shock you.

BY TOM DOLLAR

AD RAGE



A study in Tucson's Saguaro National Park (opposite), revealed that cars kill at least 22,000 animals per year. The victims range from wild pigs, or javelinas (page 48), to Gila monsters (top), to Colorado River toads (above, remains held by Don Swann; right, identified by Adrian Schafer).



PETER NOBLELS (LEFT, FAR LEFT, AND PAGE 48); JACK DYRINGA (RIGHT)

Natasha Kline, a National Park Service (NPS) wildlife biologist, posed these very questions to herself as she witnessed the wildlife carnage on the roads running through and around Saguaro National Park near Tucson, Arizona. So she decided to investigate.

In a study spanning more than four

years, NPS employees and volunteers, under Kline's direction, patrolled the park, tallying roadkills. Methodically, they logged date, time (usually early morning), location, and, when possible, identity of each animal killed. They also recorded whether the corpse was fresh and plump or bloodless and desiccat-

ed—to help determine approximate time of death. Other park employees and volunteers not directly involved in the census carried log forms as they went about their daily business and randomly recorded road mortalities. As the daily tallies came in, park biologist Don Swann entered the information into a computer database for later analysis.

At first, the census-takers simply drove along the roads, getting out of their vehicles when they spotted a dead animal. But Kline had a lurking suspicion that simply eyeballing through the windshield of a moving vehicle, no matter how slowly one drives, is prone to error. She decided to double-check the survey by "ground-truthing," in which two spotters walked along the sides of a road while a third person drove it.

"The results shocked us," says Kline. "We had taken pride in being able to spot even the most cryptic smudges, but we knew we had to be missing some bodies while driving. We were astounded to find that the drivers recorded only one in six of the actual snake carcasses, none of more than a hundred lizards, and only a fraction of all the toads."

The real shocker came when Swann began to sift through the database. Swann and Kline had theorized that hundreds, if not thousands, of animals die annually beneath the wheels of automobiles on the 45 miles of road adjacent to and in the park's two divisions—one in the Rincon Mountains, east of Tucson, the other in the Tucson Mountains, west of the city. They were dumbfounded when data analyses resulted in upward of 22,000 vertebrates a year. The estimated carnage totaled 6,000 amphibians, 7,000 lizards, 1,350 snakes, 1,400 birds, and 6,000 mammals. That does not include all the invertebrates—butterflies, bees, moths, and others—smeared against windshields and grills.

What's more, Kline is certain that the figures err on the low side. "There's observer error. We miss a lot because predators and scavengers remove the carcasses," she says. "Some larger animals, although injured, drag themselves off the road, so we miss them, too. And though we can't be sure of the number, we know that people pick things up." The real total, she believes, is higher than 22,000, perhaps twice as high.

For argument's sake, let's work with the lower figure. Divide 22,000 by 45 miles of road and that means that 488 animals are killed annually for every mile. If you adjust the figure for crippled animals that disappear into the brush and animals removed by predators, scavengers, and people, you may infer, conservatively, that the yearly slaughter for every mile of park roadway is more than 500 animals. When you bear in mind that these roadkills occur in a national park—a haven for wildlife in which posted speed limits are lower than limits outside the park, in which motorists are more likely to drive cautiously, and in which selected roads are closed after dark—the scale of the massacre is all the more appalling.

Hit hardest are the longer-lived desert creatures—Gila monster, bobcat, desert tortoise, mountain lion. These species reach reproductive maturity slowly and may not breed successfully each year. The killing of one or two adults annually in a dwindling population of desert tortoises, for example, could be catastrophic. Whitetail deer and desert bighorn sheep have already been extirpated in the park's Tucson Mountain unit. The impact may not be so great on quail, cottontail, ground squirrel, red-spotted toad, javelina, and others that reproduce in greater numbers, although there is no way to be sure without further studies.

Also, "When animals are injured or killed by automobiles," explains Kline, "a whole roadside ecology develops."

Raptors are drawn to roadside power poles from which they stoop to capture crippled animals. Injured quail or cottontails are easy prey for coyotes and bobcats. Roadkilled snakes, toads, lizards, birds, and squirrels are carried off or consumed by carrion feeders such as turkey vultures, ravens, road-runners, skunks, and humans. Even birds not usually linked with scavenging, such as cactus wrens and curve-billed thrashers, partake of the bonanza. One observer reported seeing an antelope ground squirrel nibbling on the corpse of another squirrel. "Protein is protein," Kline says.

But there's a downside to this road-kill smorgasbord: By becoming roadside denizens, predators and scavengers

put themselves in harm's way, thus adding to the grim aggregate.

The harmful effects of roads begin long before the killing starts. A road cut is the first tentacle of urban sprawl, and its impact on wild communities is immediate. Besides killing plants and animals directly and degrading or eliminating habitat, road construction is noisy, stressing animals and altering their activity and reproductive patterns. A road often creates a barrier, especially where it bisects natural corridors such as arroyos, fragmenting habitat and thwarting movement. Animals are not only denied habitat resources but they become genetically isolated and threatened with local extinction.

During rainstorms in the Southwest, roads become streambeds, collecting water, directing its flow, and dispersing it. Paved roads, in particular, greatly alter a region's hydrological scheme, affecting hydrodynamics and sediment flows over many miles. Gushing rapidly from road and parking surfaces to flood arroyos and scour streambeds,



PETER NOBELS; LON LAUBER/OXFORD SCIENTIFIC FILMS (FAR RIGHT); TOM NEZO (TOP); JACK DYKINGA (LEFT)



The beauty of the park's signature species, the saguaro cactus (opposite), belies the fact that park roads are killing fields. Water that collects (left, park biologist Natasha Kline and assistant Kristen Beaupre) may attract thirsty wildlife, such as the javelina (above). Curve-billed thrashers (top) and other birds learn to prey on roadkills.



It's easy to see why Picture Rocks Road (opposite) has become a commuter link to the city of Tucson. A Harris's ground squirrel (right) trying to cross this road faces one car every 17 seconds—not much room for error. Odds are it will become food for turkey vultures (above) and other scavengers.

water that once recharged aquifers now squirts away uselessly. The consequent drawdown of the water table, plus overdraft pumping of groundwater, has dried up rivers and cienegas (marshes), destroying vast mesquite bosques and cottonwood gallery forests, both critical habitats for Neotropical birds.

The Saguaro National Park researchers discovered that, in a kind of biological bait-and-switch, breeding amphibians lured to ephemeral ponds formed in roadside depressions were squashed beneath the tires of speeding autos before they had a chance to reproduce. After one overnight thunderstorm, a morning survey revealed more than 300 corpses of Sonoran Desert toads near a pond beside the aptly named Speedway Boulevard, which runs along the northern boundary of the Rincon Mountain unit. Comparative measurements show that Sonoran Desert toads within the park are larger than those immediately outside, leading biologists to implicate roads adjacent to the park as death traps for these long-lived amphibians.

Roads are ideal conduits for invasive alien plants. In the Sonoran Desert, the seeds of such exotics as buffelgrass,



TOM VEZO (LEFT AND ABOVE); PETER NOEBELS (RIGHT)

fountaingrass, Russian thistle, tamarisk, tree tobacco, and filaree hitchhike on vehicle tires and hikers' pant legs, to be deposited along road- and trailsides. Eventually, the seeds of these aggressive aliens wash or blow off roadways into dry washes and uplands. There, they proliferate and either oust the native species or provide fuel for brushfires.

Roads spur increased human activity, some of it directly deleterious, such as illegal hunting and fishing, wildlife hazing, plant collecting, off-road vehicle use, and dumping. Power poles and telephone lines bring pigeons, starlings, and other non-natives that prefer line perches. Exotic species associated with agriculture, logging, and mining invade opportunistically. Great-tailed grackles, for example, followed farmers into Ari-

zona in the 1930s. Once established, the birds infiltrated city parks and even dry washes where they thrive so long as there is plenty of water nearby.

The catalogue of damaging effects from roads on wildlife communities seems endless. Blacktopped roads are heat islands, which draw reptiles, amphibians, and small birds to their warm surfaces. Likewise, songbirds are attracted to dirt roads for dust baths. Blowing dust from unpaved roads settles on plants and blocks photosynthesis and interferes with water evaporation from the soil. In addition, roads collect organic pollutants, salt, ozone, and heavy metals, particularly lead. Vehicles often hit mammals that are attracted to roadside "salt licks."

We talk of mitigation, of measures to reduce the slaughter of animals on our roadways and ease our consciences. What, if anything, I ask Natasha Kline, can be done in Saguaro National Park?

"There are things we can do inside the



park," she says. "We can lower speed limits, close roads, put in speed bumps." She sighs. "Outside the park is another matter. Roads that were designed in the 1930s for sightseers, like Picture Rocks Road, have become major commuter routes into the city. To try to lower speed limits there, low enough to protect wildlife, would be hotly opposed, I'm afraid."

Picture Rocks Road runs across the northern boundary of the Tucson Mountain unit and is one of the busiest park roads. A 24-hour traffic survey revealed that a car passes any given point on the road every 17 seconds.

"Mitigation," Kline continues, "seems to be species and site specific, so in most cases it must be tailor-made."

Improved grading of existing roads would eliminate hazards to amphibians seeking ephemeral ponds. More important, man-made wildlife corridors at established animal crossings can save lives. Kline mentions tunnels in the Netherlands that allow badgers to

move under dangerous roads, and in Canada, overpasses and underpasses have been built for deer or grizzly bears [see "Walk This Way," page 18]. Animals need to be able to move, but that's not always enough. "Toads, for example, like to see sky," Kline says, "so a grate over a tunnel may be important."

The ultimate solution is to stop building roads, especially needless ones. Improved planning is required when we absolutely must lay down new ones. Roads are designed solely to serve industry, such as logging, or to transport people and commodities. The impact of new roads on wildlife should be a top priority, something people have hardly considered in the past. Harvard landscape ecologist Richard Forman has developed the "road-effect zone (REZ)," which extends beyond the road surface and encompasses the total ecological area affected by a roadway. By including the REZ concept in mapping and planning for building new and

upgrading existing roads, engineers can reduce the environmental impacts of our highways and byways.

It is not difficult to rally public indignation toward crimes against wildlife, such as poaching, or practices such as fur trapping. Yet, much greater damage is done with the automobile. The Humane Society of the United States estimates that every day in America one million animals die on our roads, a figure that probably errs on the conservative side. Meanwhile, to accommodate demand for speedy access to recreational sites and tourist attractions—each family ensconced in its own air-conditioned box on wheels—we keep building new roads, wider roads, faster roads—roads that are killing fields.

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Tom Dollar wrote about the Sonoran Desert National Park and Preserve in the June 2000 issue. For more on the roadkill problem, check out www.fhwa.dot.gov/environment/wildlifecrossings/

