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Future technology for managing problems with vertebrate pests and over-abundant wildlife — an introduction

1. Managing problems with wildlife and vertebrate pests

The ever-changing dynamics among animal populations and human interests provide a continuing challenge to biologists to devise the materials, methods, and techniques by which these problems can be managed. The list of species to be managed and of kinds of environments, worldwide, where problems occur keeps growing. Yet, more and more constraints have been placed on managers, industries, landowners, and government agencies, forcing development of more sophisticated approaches than those used in the past. Why is it important to address these problems caused by burgeoning human populations and over-abundance of problem animals? The reasons can be categorized in several ways: economic, social and quality of life, conserving desirable wildlife, human and animal health, public safety, and, yes, political.

1.1. Economic issues

The economic losses caused by wildlife continue to be an over-riding concern for farmers, ranchers, forest managers, homeowners, and corporations, and for growing numbers of state, county, city, and town governments in the United States and elsewhere. Collectively, such losses range to billions of dollars and often occur unpredictably. Many additional dollars are expended by all of these entities, either directly or through taxation, to attempt loss reduction through the use of over-the-counter products; pest control, nuisance wildlife control, or wildlife damage control firms; or through government wildlife damage management programs, which nearly every country or state and many local governments have in some form. In addition, most national and state governments make substantial annual expenditures on enactment and enforcement of laws and regulations that dictate how, when, and by whom wildlife may be harvested and specify the permits and procedures required in the variety of situations where problems occur.

1.2. Social and quality of life issues

Urban commensal rodents and birds, such as starlings and pigeons, growing to large populations in cities and towns have long been the principal wildlife species reducing quality of life or offending the aesthetic values of large numbers of people. In recent years, suburban activity of deer, beaver, bears, geese, raccoons, coyotes, mountain lions, and a variety of other species have brought wildlife issues to the forefront in the suburbs and metropolitan open-space or recreation areas in the United States. Nuisance, horticultural damage, health risks, fecal contamination, spilling and spreading of garbage, damage to hydraulic structures, and safety threats, real or imagined, are among the most common concerns voiced to wildlife managers.

1.3. Conserving desirable wildlife

As desirable wildlife populations, particularly game species and endangered or threatened species, are forced into smaller and smaller fragments of remaining habitat, they become increasingly vulnerable to predation and competition in much the same way as farm crops or livestock are highly vulnerable to wildlife damage if not protected. The concept of “protecting” protected species from predation, harassment, habitat destruction, or competition has been difficult for many conservationists and some biologists to accept. Nonetheless, such protection is essential for closely managed species in vulnerable habitats. Management has become problematic in recent years because of restrictions on traditional methods of holding wildlife populations in check, particularly licensed public hunting and trapping. Feral animals, particularly cats and introduced ungulates, have been a particular problem on islands holding populations of endangered or threatened species, presenting a management problem of high-cost and growing concern. New efforts are underway to begin to address

the problems with invasive or alien species that threaten not only the fragile ecosystems of concern to conservationists, but production agriculture as well. Although most of the attention in these new efforts has been devoted to insects and weeds, introduced vertebrates, historically, have produced some of the most devastating and widespread examples of animal extinctions, disease epidemics, and other impacts on human societies. Many of the common and ubiquitous vertebrate pests of today were yesterday's introduced or invasive species.

1.4. Human and animal health

An increasing variety of diseases are linked to wildlife species as primary hosts or reservoirs. Disease transmission to humans and domestic animals may occur directly by bites, by contamination of food or habitat with feces or urine, or by various arthropod vectors. Growing human populations encroaching on traditional wildlife habitats, the concentration of domestic animals into more confined, high volume production facilities, and growing wildlife populations associated with the loss of traditional management methods, all play a role in what has become a growing problem, worldwide. The prevalence of older, well-known diseases, such as the encephalitides, plague, rabies, histoplasmosis, salmonellosis, and leptospirosis, along with more recently recognized wildlife-borne diseases, such as Lyme disease, *Sin Nombre* virus, the ehrlichioses, and West Nile virus is a growing concern.

1.5. Public safety

Animal bites and attacks and wildlife collisions with vehicles or aircraft are the most common public safety concerns. As development of human settlements pushes into traditional wildlife habitat and back-country recreation replaces timber harvest as a primary use of remote land, the human-wildlife interface is increasing more rapidly than at any time in the past. Animal bites and attacks, for many years a problem associated with domestic dogs and high rat populations in cities, are also becoming a phenomenon of wildlife in the suburbs and rural areas that is likely to continue to increase in importance. As high-speed highways have replaced country roads, the sudden appearance of a deer in the headlights has more frequently become a calamity rather an opportunity to stop and watch a formerly rare animal. A recent review estimated that more than 1 million deer-vehicle collisions now occur annually in the United States, and many more species of animals are involved as well. Parks, landfills, and wildlife refuges more and more frequently fill the areas adjacent to airports, and

new airports are being built in traditional wildlife habitats, further and further away from cities, creating the opportunity for disasters that are happening with greater frequency. Bird-aircraft collisions alone have been estimated to cost the United States civil aviation industry over \$300 million in direct damage and associated costs and result in over 500,000 hours of aircraft down time, annually. Fatalities are increasingly common. A variety of other wildlife species are involved in ground collisions that occur during landings and take-offs.

1.6. Political issues

Control of wildlife damage, or more often impediments to addressing the problems of wildlife damage, are increasingly recognized as issues in the political arena. The past two centuries have seen the fostering and management of wildlife pass from the hands of private land owners to governments, through an endless series of laws, regulations, and international treaties. The growth of wildlife management as a discipline in the 20th century brought governmental focus to three areas: managing the populations of game species by regulated harvest; protecting or recovering rare, desirable species; and controlling damage by injurious species. Wildlife managers have achieved spectacular successes in the first two areas. Control of wildlife damage, always controversial, under-funded, and often conducted on government-owned lands, has been a more reactive effort, carried out locally and sporadically in response to specific problems.

Meanwhile, expanding human populations have changed most of the Earth's landscapes. In the United States, for example, we have logged the forests; plowed the prairies; fenced the ranges; and connected the still expanding cities, towns, and suburbs with air, rail, and highway networks. Many wildlife species adapted to these landscape changes with great success; others have not, becoming extinct, endangered, or threatened. These changes are rapidly bringing wildlife into greater and greater human contact and generating conflicts among a populace with a host of conflicting goals related to wildlife and wildlife damage issues. Many of these conflicts are left to political and legal processes to resolve, resulting in legislative or legal guidance on managing the growing problems with over-abundant wildlife.

2. Old problems, new problems, new technology — a symposium session

Economic losses and environmental deterioration caused by wildlife species, and the variety of hazards to public health and safety associated with abundant

wildlife populations closely associated with human settlements, will present changing and diversifying problems in the 21st century. This special issue of *International Biodeterioration & Biodegradation* derives from a symposium session organized in conjunction with the 11th Triennial International Symposium of The Biodeterioration Society in Arlington, Virginia. Entitled, "Future Technology for Managing Problems with Vertebrate Pests and Over-abundant Wildlife", the session brought together participants from several countries to discuss these problems. This first series of papers includes studies on wildlife species involved in conflicts with humans and on the evolving technologies for managing the problems that result. Additional submitted papers address the theme of how such problems may be managed in the future and the types of research underway to make effective problem resolution possible.

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