

AVMA Animal Welfare Forum: The Welfare of Cats



Courtesy of Gerald Rende

November 3, 1995, Chicago, Illinois

The following papers were submitted by the speakers at the 1995 AVMA Animal Welfare Forum, held at the Bismarck Hotel in Chicago, Ill. The opinions presented in these papers are those of the authors.

The Forum concluded with the presentation of the 1995 AVMA Animal Welfare Award to Dr. Carol A. Ecker of South Bend, Ind.

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The AVMA Animal Welfare Forum is an annual event planned by the Animal Welfare Committee, under the direction of the Executive Board. For additional information about the Forum or the Animal Welfare Award, please contact the AVMA Division of Scientific Activities.

Opening Remarks

Dr. Mary Beth Leininger
President-Elect

On behalf of the more than 56,000 members of our national veterinary organization, I welcome you to this, the Sixth AVMA Animal Welfare Forum.

For thousands of years, there have been close links between human beings and the animals with which we share our planet. For most of that time, and certainly during all of recorded history, veterinarians and their predecessors have safeguarded the health and spoken for the well-being of those creatures. Sponsoring these forums is just one more way we fulfill our centuries-old commitment.

Today we will focus on understanding those fascinating felines that have usurped the title "man's best friend" from our canine companions, for in fact, there are millions more cats than dogs in American families. In her book, *The Tribe of Tiger: Cats and Their Culture*, Elizabeth Marshall Thomas describes some of the special characteristics that draw us to cats. For myself, who has been accepted as a peer (not as an owner, and certainly not a master) by several generations of cats, the presentations of our speakers are of particular interest.

The domestic cat: Perspective on the nature and diversity of cats

Joan Miller

Sometimes it seems as if the world is divided into two distinct groups—those who classify themselves as "cat people" and those who definitely do not like cats. Often these latter individuals have never actually been exposed to a cat in their own home. They see cats at a distance, think of them as a nuisance, or enter their world as a stranger. Because cats are cautious creatures, there is not always an immediate welcome. Cats are protective of their territory, generally preferring familiar routine, and they are sometimes aloof or fearful of newcomers. With time and patience, however, cats adapt to change, new people, and other animals. Cats have an innate desire for companionship that, with sensitivity, can be brought forth. Many individuals devoted to cats did not initially seek one, but instead had their awareness awakened only through a chance encounter. A cat arrived at the doorstep, managed somehow to enter their home and heart, and eventually changed their thinking and life. The Massachusetts Society for the Prevention of Cruelty to Animals survey in 1991 revealed that only 24% of cat owners acquired their cat by deliberately making an active effort.^a

From the Cat Fanciers' Association Inc, 6257 Gordon Valley Rd, Suisun, CA 94585.

We are all aware of individuals who do not yet know cats or care to associate with them. Such people have the opinion that cats are "free spirits, independent, mysterious." Those who love cats and truly appreciate the essence of feline character also will say cats are "free spirits, independent, mysterious." Clearly, our perceptions, expectations, and esoteric responses play major roles in defining the nature of the cat. We can expect the acceptance of cats to change dramatically in the coming years. Children growing up in the increasing number of American cat-owning households are becoming attuned to these animals. In the future, their own choice of a family pet will very likely be a cat.

How can we encourage more respect for cats? An important way is for "cat people" to set an example, by placing value on all cats, whether they are feral, random-bred, or pedigreed.

Ambivalence Toward Cats

Individuals may have a strong general position in favor of cats; however, even among "cat people," attitudes are inconsistent. Mixed messages or ambivalence about cats and their character is not a new phenomenon. Cats have always elicited powerful feelings and emotions

in human beings. Ancient superstitions and legends in which cats became allegorical symbols have created unconscious associations now ingrained in our collective memories. These intangible seeds form the basis of many sentiments about cats in our society today.

The physical and behavioral traits of cats have been admired throughout their history. These characteristics, however, which are responsible for cats' superb ability to survive, can be the very same qualities that contribute to the ambivalence and cause various perceived problems in human relationships with cats.

The Aura of Power

Cats project an all-knowing aura and a sense that they have magic, mysterious powers. This idea probably started when their amazing eyes were first noticed by the early Egyptians. The Egyptian word for cat is *mau*, which means "to see." Cats seem to see deep into our souls, and their superior attitude can make some human beings uncomfortable in their presence. The luminous quality of the cats' eyes is like the brilliance of the sun, and the Egyptians' worship of the powerful sun god, Ra, became merged with the cat.

The cats' pupils narrow to a fine slit in daylight and open to a large black circle at night, like the waxing and waning of the moon. Their retina enables cats to see in light at least 6 times dimmer than the darkest conditions in which human beings can see. Death was considered by the Egyptians to be the ultimate darkness, and the cats' ability to see and hunt at night was proof of feline power over the source of this culture's greatest fear.

We still envy the cats' apparent superiority, reflected in their free and independent spirit. These animals, which can be difficult to train or control, will readily adapt themselves to an environment that pleases them. It is not easy for some in our modern world to understand or appreciate a judgmental, decision-making animal that is not submissive to human will.

Predatory Desire

Of all the beautiful feline physical attributes we admire, we remain most in awe of the cat's grace, agility, and quick reactions. The cat is often called the "perfect killing machine." Cats are genetically programmed for specific predatory work, and the feline personality has remained strongly connected to this function. The Egyptians envied their cats' hunting ability, as did the Romans and many other cultures that followed.

Today we offer substitutes for protected house cats to satisfy this fundamental instinct, but many cat owners find it difficult to confine cats that maintain strong predatory desires, and there is an undeniable fascination with the sweet house cat's ability to instantly turn into an efficient predator. Unfortunately, this predatory behavior has led to the assumption that household pet cats can still exist on their own if abandoned. We are ambivalent in that we desire to have all cats kept safely indoors, but at the same time, we cannot help but acknowledge and appreciate the rodent-control potential of sterilized and maintained feral cat colonies, a concept only recently

being considered or even discussed by animal control agencies and feral cat networks.

Fertility and Libido

The female cat is strongly symbolic of fertility and was associated with the Egyptian goddess, Bastet, more than 3,000 years ago. Easy reproduction is another wonderful physical asset of cats and an optimal evolutionary quality essential to the survival of any animal species, but this characteristic now presents one of the greatest animal problems we address today, that of random and indiscriminate matings of cats.

Male cats are renowned for high sexual libido and territorial aggression. The "tomcat" image remains a strong symbol of human male prowess today. It also underlies the reluctance of some individuals to neuter cats, despite the rational acknowledged need.

Diversity: "The Domestic Cat" Does Not Exist

Another important factor in understanding the nature of cats is the recognition that great diversity exists within their species. No one uniform entity can be defined as "the domestic cat." Some cats are totally adapted to household living and are truly part of people's lives, but others successfully live a feral existence, similar to that of wildlife. In fact, the process of domestication in cats is by no means complete, and may not even be possible. Stephen Budiansky, author of *The Covenant of the Wild*, describes the concept of animal domestication as a "coevolved relationship" in which the animal species loses its defensive and self-sufficient behavior, in exchange for the gain of food, protection, or shelter offered by human beings.¹ Domestication involves a willingness on the part of the animal to adapt. The first animals to become domesticated (eg, dogs, cattle, sheep, horses) were social, easy to tame, ready scavengers, and accepting of dominance hierarchies. The dogs' domestication began at least 12,000 years ago, whereas taming cats was attempted much later, around 3,500 years ago, in Egypt.

Commensalism

Wolves are gregarious and social hunters during daylight. They feed on a wide variety of foods, and have a large home range. By comparison, wild cats are far more difficult to tame. Such cats are solitary nocturnal hunters, obligatory carnivores, and territorial animals possessing none of the characteristics thought by biologists to be needed for potential domestication. Juliet Clutton-Brock, a senior scientist in the Department of Zoology at the British Museum of Natural History, suggests an alternative theory, the concept of commensalism, relative to the evolutionary status of the cat. This theory involves an association between individuals of two species, in which one benefits from the other on a temporary or a permanent basis.²

Animals are commensal when they take our food, but continue to live as untamed wild creatures. A classic example of a commensal animal is the house mouse, which has been in close contact with human beings for

10,000 years and is not tame. Although the vast majority of cats has evolved to a fully domesticated status, others continue to hunt and roam freely, accepting food and only limited protection from human beings when it suits them. Within a single species, there can be commensal and domesticated varieties. Several birds, including the pigeon, have wild and fully tame representatives. Clutton-Brock states, "Feral cats can exist wild as commensals, yet under domestication cats can be so highly bred that they cannot survive without human protection."²

Understanding the relationship between human beings and cats will require us to acknowledge the existing species diversity and realize that this situation may continue for some time or even forever. Most veterinarians and cat owners know only varieties of fully domesticated house cats, but many animal agencies and cat rescue groups continue to deal on a daily basis with feral/unowned cats and their offspring. It is time to start appreciating all of the different segments of the cat population and to find ways to improve their well-being.

Cat Lifestyles

Between the truly feral cat existence and that of the pampered household pet, there is a continuum of lifestyles. I believe we can identify four main categories to-day (Fig 1).

Feral, independent "wildlife"—Some feral cats are independent of human contact and live like a variety of "wildlife." Their ancestry is feral, and their behavior unchanged. Most have an evolved disease immunity and are self-sufficient hunters, completely avoiding human beings, though some may be commensal. They are generally ignored by people and only seen from a distance in the countryside. Though their life span is relatively short, the quality of life is variable. They contribute to some degree to unwanted reproduction through their association with free-roaming farm cats.

Feral, interdependent free-roaming/unowned—Feral and/or free-roaming cats can have an interdependent relationship with human beings. The ancestry of these cats may be feral or pet reverted to wild. Their limited dependence on human beings is motivated by availability of food source, and they will gravitate to a home-base, colony-type interaction. Some of these cats display an innate desire for more than food. They seek shelter and comfort, and sometimes even affection and companionship. It is time to find ways to offer these to them.

Domesticated, interdependent free-roaming/loosely owned—These cats originate from the abandoned pet population, though some may be semi-tame feral cats. Their dependence on human beings is variable, as they are welcome or tolerated in restaurant alleys, ship ports, stadiums, and other places for rodent control, but they are not "owned."

Included in the two interdependent groups are managed, trap/test/vaccinate/alter/release (TTVAR), maintained cat colonies; strays that live in many circum-

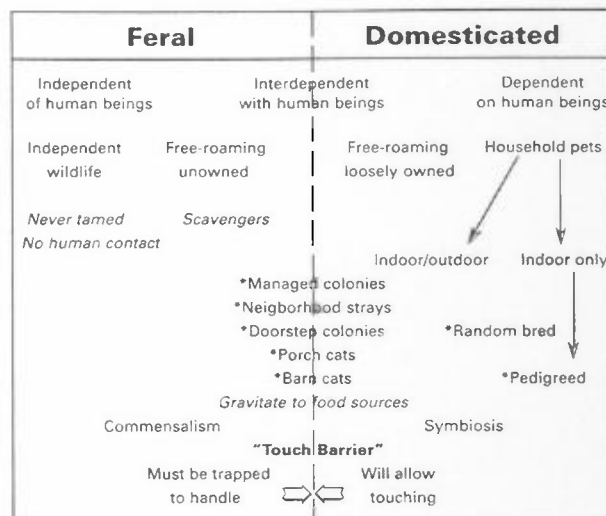


Figure 1—Categories of lifestyle in cats. Notice the "touch barrier" that separates feral from domesticated cats.

stances; "doorstep colonies" (several cats that are fed in backyards or near office buildings); "porch cats" that may be fed with raccoons and other wild animals in outlying residential areas; and barn cats maintained on farms. There has been little interest or effort among animal organizations to address, or even to determine the extent of, the problems related to the welfare of these cats. The Santa Clara County, Calif, survey conducted by Karen Johnson of the National Pet Alliance, with advice from Roger Nassar, and partially funded by The Cat Fanciers' Association, is the first of a series that attempts to determine how many unowned cats exist in the United States. Over 40% of the Santa Clara County cat population is stray/feral.³ The Humane Society of the United States' 1992 national survey revealed that 25% of dog and cat owners reported feeding stray cats, with 40% of owners feeding such cats nearly every day.⁴

"Touch barrier"—There is a definite overlap in the various free-roaming categories, and some cats who have become accustomed to human beings will revert to a more feral position, if necessary for survival. Taming and placement of these cats is difficult, but possible, and their kittens can become household pets if socialized early enough. The primary demarcation that determines our relationship with these interdependent cats is a line that I call "the touch barrier." Cats that must be trapped to be handled will only be tamed with a great deal of time and patience. When a cat or kitten will accept handling voluntarily, there is a chance that it can move from a feral/free-roaming existence to that of a loosely owned or owned cat. Success in helping these cats will involve offering an attractive, safe environment and skill in taming.

Domesticated, household pets—Completely dependent, domesticated, owned cats, whether random-bred or pedigreed, are part of a household. I prefer the term, "pets," because they are considered special and are cherished by owners. They have status because their needs

are evaluated by their family when vacations are planned or other decisions are made. Their health is protected, and they are well-fed and groomed and receive loving attention each day. Some are allowed partial access to the outdoors because they will not tolerate an indoor-only lifestyle or because their owners feel the cats are bored indoors. Rarely will owners of pedigreed cats allow their pets outside of home confinement, nor will these cats care to go out. Through many years of selective breeding, most of the pedigreed cats' predatory instincts have diminished enough to enable them to be content inside, with human companionship and play substitutes.

Human Intervention and the Environment

The needs of cats within the various lifestyle categories and the problems associated with them differ. No one goal can solve all problems or better the lives of all cats. For example, to simply declare that we must "dispel the myth that cats are free spirits" and insist that all cats be permanently kept inside homes is not realistic, and will not bring a positive response from caring people among the general public. Rather than rigidly imposing our will or attempting to change cats through domination, we may be more successful by helping people learn to modify the environment so that cats will be happier and safer, within their present existence, whatever that may be.

In the free-roaming categories, reproductive intervention must be the first objective. With help from animal agencies and veterinarians, cat caregivers can trap and sterilize feral cats so they will lead more protected lives in a maintained colony. Programs to sterilize free-roaming, loosely owned cats have been successful when incentives are offered to make it easier and less costly to care for cats who may not have owners. For example, mobile clinics for sterilization and vaccination of such cats are being tried in low-income, restaurant areas in Tokyo. Organized community outreach, with information and guidance for handling and sterilizing feral cats and unowned stray cats, can be achieved through cooperation among animal agencies, veterinarians, and cat groups.

The ideal is for cats to be indoors only, but that is not always easy. Domesticated pets with a hunting instinct will feel less stress inside when owners better understand ways to provide a stimulating environment. Voluntary identification of cats allowed outside is an important step toward protecting these cats from loss, whereas coercive measures may increase abandonment of cats in the loosely owned category. People tend to want to avoid fees and fines when the issue of ownership has not even been decided.

Veterinarians can play a major role by helping cats in all categories, rather than by limiting their services to only the owned household-pet category. Teams of cat-caring people, including shelter personnel, veterinarians, pedigreed cat breeders, pet store personnel, and groomers, can offer guidance for behavioral modification, teach the skills necessary to tame semi-feral cats, and cooperate with each other to increase successful permanent placement of cats in homes.

Any encouragement toward a dependent, domesticated status in cats will be slow. It will also be with the acceptance that cats are motivated by pleasure for themselves, rather than by a desire to please. We all know that cats are not small dogs.

Human Intervention and Selection

One way in which cats have successfully evolved toward home adaptability throughout their history is the result of human preferences leading to selective breeding. Roy Robinson and Niel Todd of the Carnivore Genetics Center traced the ancient gene origins and migration of cats throughout the world on the basis of many factors, including the coat color preferences of human beings. For centuries, cats were carried aboard ships to control rodents; therefore, huge expanses of water were not a barrier to migration of cats. Until 1975, the British Royal Navy still provided for the maintenance of cats onboard ships. In the Orient, cats were thought to be able to foresee storms at sea, and the *Mi-ke* (calico) cats were symbolic of good luck and would assure a safe voyage. In this way, the orange genetic allele, which originated in India and Asia, moved westward.

It is logical to assume that those cats selected for long journeys probably had pleasing social temperaments and thus were good companions, as well as hunters. In every port, these good-natured cats and their kittens jumped ship to form the basis of the domestic cat gene pools throughout the world.

Selective breeding of cats has developed for many reasons. The natural concentration of genes through geographic isolation of certain cats resulted in the development of several breeds; examples are the Manx on the Isle of Man and the Turkish Angora on the high Armenian plateau. For centuries, cats were kept in monasteries for protection of manuscripts from rodents. The monks had preferences in cat type, color, and coat, leading to the establishment of breeds such as the Korat and Chartreux.

Since the late 1800s, preservation of the pedigreed breeds has been aimed toward maintaining historic physical appearance and keeping personality traits associated with the various breeds. For example, today's American Shorthairs are bred to have the same appearance and amicable temperament of the cats brought from Europe to America by early settlers, before other cats with differing genetic traits arrived.

Persians were especially valued by the aristocracy in Europe and England almost 200 years ago because of their glorious coats and placid, sweet personalities. Queen Victoria, who kept blue Persians, added to their popularity in England. Persians today are extremely pleasing to people who like to lavish attention on a cat with a quiet, accepting nature.

Other breeds are appealing because of some individuals' preference for an active, playful feline or wild-cat appearance. The Abyssinian satisfies both traits and this natural breed has remained essentially unchanged for at least 150 years.

The Ocicat breed was purposely established from

pedigreed cats in the 1960s to closely resemble a wild cat, but one with an affectionate, stable temperament. Today's Ocicats are an almost exact match to the *Felis sylvestris ornata* ("Indian desert cat"), one of the wild cat subspecies believed to be an ancestor of the domestic cat.

For many people, predictability of temperament and appearance are important factors in their selection of a pet cat. For others, the spontaneous unpredictability they find in random-bred cats is interesting and desirable. Permanent bonding of a human being to a cat is more likely when the cat meets the person's particular needs and expectations.

The coevolving relationship between cats and human beings is ongoing. Any attempt to raise the status of cats starts with establishing an attitude of appreciation for all cats. As "cat people," we can take the lead by placing value on every category of cat—feral/

unowned, random-bred, and pedigreed—and by encouraging new approaches to improve the well-being of all cats.

**Massachusetts Public Opinion Study on Spaying and Neutering Pets. Conducted by the Dorr Research Corp, Boston, for the Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA), October 1991.*

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Feline behavior and welfare

Gary Landsberg, BSc, DVM

Cats that are housed exclusively indoors generally live long and healthy lives, free from the diseases, parasites, and potential injuries that are serious risks to outdoor cats. The welfare issue that must therefore be addressed is the effect of indoor living on the cats' behavior.

When a cat is motivated (or aroused) to perform such species-typical behaviors as play, investigation, feeding, hunting, drinking, scratching, and eliminating, the cat's environment must provide sufficient outlets to satisfy these needs (achieve de-arousal). Cats that are free to roam outdoors can exhibit these behaviors with little or no direct consequences for the owners. However, normal behaviors such as marking territory, predation, climbing, scratching, chewing, exploration and investigation, nocturnal activity, vocalization, and mating are often considered to be undesirable or intolerable when performed indoors (depending on the context in which they are performed). On the other hand, grave risks are associated with cats roaming freely outdoors, especially in densely populated urban environments. Outdoor cats may be exposed to potentially fatal diseases such as FeLV, feline immunodeficiency virus infection and panleukopenia. They may be involved in agonistic encounters with other cats and must learn to avoid predators, technology (eg, cars, trucks, trains), and even some human beings. Some humane societies in large urban centers such as Toronto, Canada have assessed these risks, and now allow only those who agree to house their cats indoors to adopt cats.

Although indoor housing is obviously desirable for

the cat's physical health and longevity, can a cat be housed indoors without any detrimental effects on its behavior? Certainly, some cats seem to have a strong desire to go outdoors, and frustrating these attempts could be difficult on the client and the cat. However, even with severe space constraints, most cats that are neutered and provided with all of the "amenities" of outdoor living in their indoor environment can live their entire life indoors, free of behavioral problems. This ability to survive and thrive indoors in bustling urban environments, along with their cleanliness, ease of housetraining, small size, social nature, and ability to tolerate being alone, has helped to make cats the most popular pet in the Western world.

The Social Nature of Cats: Selection and Socialization

Over the past few years, our knowledge of feline social structure has evolved from the widespread belief that cats are generally an asocial and solitary species. Evaluation of feline social organization reveals wide diversity in sociability and social structure. Genetic differences and early social interactions between cats, particularly during the sensitive period from 3 to 7 weeks of age, account for how social a cat becomes. Social relationships between cats and human beings also have great diversity. Although most cats develop strong social ties to people, some cats are more independent, with little desire for human contact.

Socialization is the process in which an animal develops a social relationship or bond with members of its own or another species. Cats that develop social relationships during the sensitive period are often capable

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of maintaining these relationships for life. Therefore, to reduce fearful or aggressive behavior toward people and other species, kittens should receive as much exposure and contact as possible, prior to 7 weeks of age. These relationships also should be maintained into adulthood. How sociable a cat becomes does not depend solely on socialization, but also on the cat's inherited personality type. About 15% of kittens may be resistant to socialization.¹ The strong influence of genetics on an adult cat's behavior should be considered in the pet selection process.

Breed and parentage—The best way to predict the behavioral and physical attributes of an adult cat is to obtain a purebred from known parentage. The potential pet owner should review the physical and behavioral characteristics of the breeds being considered, including the predilection for behavioral problems such as wool sucking² or excessive vocalization.³ Petting and handling the parent or parents also may provide some insight as to the potential of the offspring.

Sex and age—Because the most receptive age for socialization is between 3 and 7 weeks, kittens should be obtained by 7 weeks of age or have had sufficient human contact prior to that age. Kittens over 7 weeks of age and adult cats should be assessed prior to selection for sociability (see Temperament testing).

Castration reduces urine odor and expression of sexually dimorphic behavioral traits such as roaming, fighting, and urine marking (by about 90%).³ Spaying eliminates estrous cycles and associated marking. Even after neutering, however, approximately 10% of neutered males, but only 5% of spayed females, spray urine.

Temperament testing—The value and effectiveness of testing young kittens is debatable, because many behavioral and health problems do not emerge until the pet matures. For cats, three personality types have been identified: sociable, timid and unfriendly, or active and aggressive.⁴ Cats should be evaluated in an attempt to determine which of these behavioral types they fit, and should be placed in appropriate households.

Preventing Behavioral Problems: Setting up the Environment for Success

Cat-proofing the home—Owners must be prepared for the kitten's ability to jump, climb, and explore, as well as to chew on just about anything from thread to electric cords. Although crate training can work well for cats, kitten-proofed rooms are usually sufficient, as long as there is nothing that the kitten might damage and nothing dangerous to chew on, swallow, scratch, or climb onto. The room should contain appropriate toys, a scratching post or feline activity area, a comfortable sleeping (bedding) area, and litter box. Child locks and barricades also may be successful in keeping cats away from particular areas of the home.

Problem areas also can be protected with booby traps. Booby traps are intended to teach the cat that an area is aversive or out-of-bounds, in much the same way that a

cat might learn to avoid chewing on certain plants (eg, cactus) or avoiding certain locations (eg, swimming pools, train tracks) in their environment. Commonly used booby traps include motion detectors, aversive odors or tastes, or uncomfortable stimuli (eg, double-sided tape).

Litter box training—Litter box training is simple, as long as the cat is provided with an appropriate litter that is easily accessible and is cleaned regularly. Cats that eliminate in plant containers may prefer the texture or odor of soil. A simple solution is to keep the cat away from the plants. Placing a layer of decorative rocks over the soil may help. Other options are to add some soil to the litter to make it more desirable or to booby-trap the plants to keep the cat away. Cats that eliminate in one or two inappropriate locations may desist if food is placed in the area. All areas of inappropriate elimination should be thoroughly cleaned with a commercial odor inactivator, then made inaccessible or less desirable with booby traps (when the owners are unable to supervise). The litter box should be made as desirable as possible (consider location, type of litter, type of litter box), and any deterring factors must be corrected (eg, deodorized litter, strong disinfectants, insufficient cleaning). Sandy, clumping litter may be easier to keep clean and is often preferred by cats over conventional clay litter. If the cat persists in eliminating in a particular location, a second litter box can be placed at that location, and gradually relocated to a more appropriate area.

Preventing Behavioral Problems: The Role of Environmental Enrichment

Environmental enrichment should be accomplished not only through modifications and attention to the cat's physical environment, but also by providing appropriate forms of social interaction with people and other pets. Of course, indoor living does not preclude the occasional trip outdoors on a harness and leash for some fresh air and exercise. Because of marked individual differences between cats, owners must tailor their home environment to meet the specific needs of their own cat.

Play, exploration, and nocturnal activity—Understimulation, an excess of unused energy, and lack of appropriate opportunities for play can lead to play aggression, destructiveness, or excessive nocturnal activity. Obesity is also more common in cats that are inactive and housed exclusively indoors. Play and exercise sessions provide the cat with attention from the owner and an outlet for exploration, chase, and play. Cats seem to be most stimulated by moving objects that can be stalked, swatted, or pounced on. Some successful interactive toys might include wiggling ropes, wands with fur or feathers, and toys that are thrown or rolled for the cat to chase. Mirrors or laser pointers that produce moving spots of light are attractive to many cats. Obedience training, using food or play as rewards, can provide additional stimulation and activity.

For self-play, the cat can be provided with toys that roll, such as ping-pong balls or walnuts; toys that dangle; battery-operated or spring-mounted toys; scratching

posts; and toys within containers that can be chased and manipulated. Many cats enjoy exploring novel areas so that providing empty boxes, paper bags, or a feline activity center can be useful. Activity centers also provide a location for climbing and scratching. Some cats prefer perching at high levels, presumably because they make excellent vantage points. Shelves and bookcases often can be adapted to suit the cat's and the owner's needs. Catnip-treated toys and toys with food inside can help to stimulate play and exploration. Visual stimuli in the form of cat videotapes, television, or even a cat-proofed aquarium may be of interest to some cats. Cats with a strong desire for social play might benefit from the addition of a second kitten to act as a playmate, provided that both cats have been adequately socialized to other cats.

Some problems arise as a result of the cats' nocturnal nature. Typical complaints are cats that nibble or even attack the owner's ears or toes in bed, that walk across sleeping owners, or that have explosive, uncontrollable play sessions across the furniture and/or owners, during the night or early morning. By scheduling play periods and feeding the cat throughout the evening, the cat may sleep through the night. Some problems can be prevented merely by closing the bedroom door or confining the cat to a separate room at night. If the cat continues to cause problems, punishment techniques (eg, water sprayer, ultrasonic devices, compressed air) may be necessary to deter overexuberant and nighttime play.

Destructive behavior—Most destructive behavior in cats can be corrected by providing the cat with appropriate outlets for play, investigation, or chewing, and by preventing or deterring access to problem areas and problem items (eg, with booby traps or aversive tastes). Cats that climb drapes, jump onto counters, or chew on household objects (eg, string or electric cords) are usually exhibiting playful and exploratory behaviors. Cats that chew on plants may benefit from a higher-fiber diet (perhaps with some added raw vegetables) or a safe kitty herb garden to chew.

Feeding sessions can be made more natural if the cat is provided with a mechanism for searching for food. By providing small meals in various locations or requiring some form of manipulation to obtain food (eg, cat-scratch feeders or toys or entertainment centers with food inside), feeding can become a much more active and productive part of the cat's day.

Some cats, many of which are oriental breeds, have an overly strong desire to suck and chew material (particularly wool). Providing alternative oral stimulation in the form of dog chew toys or bulky, dry, or chewy foods might satisfy these desires of some cats. Booby traps and taste deterrents also may be helpful.

Excessive vocalization—Feline vocalization sometimes may be loud enough to generate complaints of excessive noise, but generally the persistent or nocturnal nature of the vocalization concerns the owner. Be-

cause cats are nocturnal by nature, a somewhat common problem is the cat that wakes or disturbs its owners at night. Cats also may howl and cry as a threat, as sexual behavior, or in an attempt to solicit resources, such as social contact, food, or attention. Some breeds such as the Siamese may have an increased genetic predisposition toward vocalization.³

Vocalization must never be rewarded (eg, by allowing the cat outdoors, or providing food, attention, or play on demand) if the owner feels this is a problem. Vocalization can be interrupted with a water gun, compressed air, a loud verbal "no," or alarm device, and the cat should be ignored until it is calm and quiet. Spaying and castration will abolish most vocalization associated with sexual behavior.

Scratching—Scratching is a normal behavior that conditions the claws, serves as a visual and scent marker, and is a means of stretching. However, when scratching is directed at furniture or members of the family, it is generally unacceptable. Inappropriate scratching can be prevented by keeping the cat away from problem areas, trimming the claws regularly, and providing a proper scratching post. Cats can be encouraged to use a scratching post by placing it near their sleeping area and by covering it with a material that is appealing to the cat. Toys or catnip also can be placed in this area. Should the cat continue to scratch in an inappropriate area, the post could be moved to that area and/or the scratched furniture can be covered with a less appealing material (eg, plastic or a loosely draped piece of material). Alternately, remote punishment (eg, water gun) and environmental punishment (eg, booby traps such as sticky tape, or a motion detector) can be used to deter further scratching of an area. Some owners may want to consider plastic coverings that can be glued over the claws monthly.

For those owners who cannot train destructive cats to use a scratching post, declawing is another alternative. The primary reasons for declawing are property damage or the risk of injury to people or other pets.⁵ Sometimes, the welfare of a family member may be best protected by declawing the family cat (eg, for human beings with compromised immune status because of human immunodeficiency virus infection or immunosuppressive therapy). When an owner requests declawing, whether declawing is in the best interests of the cat and the family must be decided. Declawing allows the family to keep the cat and enjoy the rewards of pet ownership. Declawing also results in fewer cats needing to be rehomed or destroyed and more cats being placed in homes.

In studies performed to date,⁵⁻⁸ whether declawing causes an increase in behavioral problems has been examined. In each study, declawing was shown not to alter the cats' behavior. In fact, cats continued to scratch furniture after declawing, but did not cause substantial damage. In a study of more than 850 cats,⁹ declawed cats were no more likely to bite than were clawed cats. Results of declawing successfully met or surpassed the owner's expectations for all cats, and more than 70% of cat owners indicated that the cat-owner relation-

ship improved following declawing.² In a study of veterinarians in Ontario, it was estimated that more than 50% of owners of declawed cats would not have owned or kept their cats had those cats not been declawed.⁶

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Advances in feline health research: Impact of recent developments in vaccinology on feline welfare

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In view of the very large number of cats which are kept in a state of domestication in this country, it is really extraordinary that the special study of their diseases should have been so profoundly neglected as has hitherto been the case. It is only within very recent years that adequate attention has been paid even to the dog, except by a few pioneers among veterinary surgeons; still less anxiety and interest have been exhibited in the diseases of that other companion of the household—the cat.¹

This observation, stated by Dr. Hamilton Kirk in 1925 in his text, *The Diseases of the Cat*, applies to our day as well. The popular adage, "cats are not small dogs," serves to remind us that cats are a species unto themselves, unique in their diseases and responses. Within the past two decades, cats have begun to receive the attention they deserve, and those of us with "anxiety and interest" have much for which to be thankful. Veterinary textbooks devoted exclusively to the cat abound, and veterinary literature brims with results of feline research efforts. Still, our understanding of cats lags far behind that of dogs, and incomparably far behind that of human beings. Although most feline infectious disease research is presently focused on pathogens that model those of human beings, feline-only infective agents also are receiving attention, at least to the extent that funding allows.

Historical records reveal that as long as cats and human beings have coexisted, so have cats and infective agents. Included in records dating back to 1414, a severe form of dysentery raged in Germany, reportedly affecting cats. In 1796, a "distemper" outbreak of extraordinary proportions spread from Philadelphia throughout

the Northeast; during the summer and autumn of that year, almost 10,000 cats died in Philadelphia and New York City alone. During the same year, a similar pestilence affected large numbers of cats in England; during a single 14-day period, more than 5,000 cats died in three London parishes.² Spectacular events such as these speckle historical accounts, and although the battle between cats and their pathogens has probably raged for millennia, a stalemate is likely to continue for some time to come, without a clear winner emerging. Unlike the Filoviridae and other emerging infective agents of human beings, there appear to be no pathogens possessing the capability to eliminate the feline presence from the face of the earth—at least none of which veterinarians are yet aware.

Though the survival of the species seems sure, a plethora of infective organisms continues to imperil individual cats from at least three fronts: first, directly via the agent itself; second, indirectly, from the zoonotic potential of the agent; and third, paradoxically, from our attempts to protect cats from infection.

Direct Impact of Infection

In our day of remarkable advancements in the understanding of infectious diseases, outbreaks continue at a disheartening rate. Despite the widespread use of effective vaccines, epizootics of panleukopenia still occur in shelters, farms, and to a lesser extent, catteries, serving to remind us of the awesome potential for devastation that the causative organism possesses. Feline herpesvirus (FHV-1) infections and feline calicivirus (FCV) infections are enzootic in many shelters and catteries, with sporadic epizootics resulting in high morbidity. Even though routine use of FHV-1 and FCV vaccines has re-

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duced the severity of disease caused by these agents, the carrier state continues; vaccination has apparently had little impact on the numbers of cats shedding virus.³ Feline infectious peritonitis (FIP) and *Microsporium canis* infections remain singularly difficult to control in catteries, at least in part because the agents and the host immune response remain poorly understood. Although serving as models for human disease, FeLV and feline immunodeficiency virus (FIV) receive attention that is unprecedented among feline pathogens. Still, the immune response to these agents is not completely understood,⁴ and the true efficacy of commercially available FeLV vaccines is not known.⁵ The anguish resulting from unsuccessful attempts to treat cats infected with any of these pathogens is another tragic reminder of the inadequacy of our understanding.

Impact of Infection: Zoonoses

Infective agents of cats also capable of infecting and causing disease in people are rightfully receiving much attention. Cat owners particularly at risk for acquiring zoonotic infections are those with compromised immune systems. Several million people in the United States are immunosuppressed, as a result of underlying noninfectious diseases, immunosuppressive therapy, or immunosuppressive infectious diseases.⁶ Thirty to 40% of these individuals also own pets,⁷ and although the psychological benefits of pet ownership among this group is at least as great as that for other individuals, the risk of zoonotic infection must not be ignored. Unfortunately, many well-meaning but often misinformed health care providers make overly cautious recommendations, counseling immunosuppressed patients to not obtain pets or to relinquish those they already own. In fact, more than 60% of pet owners infected with the human immunodeficiency virus have been told that they should not own pets of any kind; ownership of cats is perceived to pose a particularly great risk.⁸

Although many of the organisms with zoonotic potential are directly detrimental to cats, arguably of greater risk to cats is an exaggeration or misunderstanding of the part they play in transmission of zoonoses. Even now, many years after the establishment of easy and effective methods for preventing transmission of infective *Toxoplasma gondii* oocysts to human beings, pregnant women are often told that they must "get rid of the cat." Clearly, the historical precedent is to falsely accuse cats or over-emphasize their role in the transmission of infectious disease. With an ever-increasing population of immunocompromised people and the discovery of even more organisms with zoonotic potential, investigation of the true role that cats play in transmission must be aggressively pursued if we are to avoid a modern-day, feline equivalent of the "witch hunt." Excellent discussions of risk-management strategies for immunocompromised people already exist.^{6,8} For the zoonotic potential of cat ownership to be fairly and accurately assessed, cooperation and communication between the veterinary community and those who provide human health care must continue and increase.

Impact of Infection: Problems from Attempts to Prevent Infection

In 1796, Dr. Edward Jenner discovered that after he injected material collected from a cowpox pustule on the wrist of an infected milkmaid into the skin of another person, immunity to smallpox was induced. Since that time, vaccination has relieved much human and animal suffering, and in the opinion of many, vaccination has been one of mankind's most significant scientific achievements. Louis Pasteur's prediction that "it is within the power of mankind to eradicate infection from the face of the earth"⁹ is, from our vantage point, clearly seen to be an overstatement; aside from smallpox eradication in 1977, vaccination has failed to completely relieve human beings or other animals from infection. Still, no one would argue that countless lives have been spared and much suffering has been prevented by the widespread use of vaccines.

Feline vaccines have a far shorter history, but no less dramatic impact on health, than those of human vaccines. Prior to the development of effective panleukopenia virus (PV) vaccines in the 1930s, more than 50% of cats passing through adoption shelters developed panleukopenia, with very high mortality. The early tissue-origin vaccine was quite crude by modern standards, but saved countless feline lives. Thirty years later, techniques were developed that allowed production of cell-culture-origin inactivated and modified-live panleukopenia virus vaccines that remain the basis for vaccines used today. A pneumonitis vaccine was developed in the 1950s and in the 1970s, vaccines were developed to protect cats against disease caused by FHV-1 and FCV. The first FeLV vaccine was licensed in 1985, and an FIP vaccine followed in 1991. More recently, an inactivated *M. canis* vaccine has become available. Rabies virus (RV) vaccines play an extremely important role, not only in protecting cats from infection, but in helping to prevent spread into the human population. Some feline vaccines are considerably more efficacious than others (PV and RV vaccines being the most), but all have, to some extent, improved the health of vaccinated cats and remain a valuable armament in the battle against infectious disease.

Unfortunately, neither human nor feline vaccines are devoid of adverse effects. In people, most poliomyelitis cases are now vaccine induced, albeit at a rate of less than 1 case/1,000,000 vaccinates. In cats, anaphylactic reactions to vaccination continue, though they are infrequent. Though an uncommon consequence (estimates of 1 to 4 cases/10,000 vaccinates), the recent recognition of sarcoma development at vaccine sites (usually from inactivated vaccines, especially FeLV and RV) is alarming and disturbing.

Sadly, cats are doubly threatened by any problem stemming from vaccination. First, the reaction itself, though rare, may be life-threatening. Second, and perhaps of even greater importance, is that owners seeking to protect their cat from an adverse reaction may omit vaccination altogether, thereby placing not only the cat, but in the case of rabies, themselves at risk of infection,

too. Few would argue that widespread poliomyelitis vaccination of the human population should be discontinued because of untoward vaccine reactions; likewise, this would be true for rabies vaccination in cats.

According to Pasteur, "The microbe is nothing; the terrain everything."¹⁰ Even today, we recognize that not only the agent, but also the environment and the individual's immune response to the organism, constitute the interrelated triad of factors influencing infective disease. New research methods in which monoclonal antibody and recombinant DNA technology are used are helping to form a more complete understanding of the complex interaction between host, agent, and environment. The remainder of this article will be concerned specifically with viral vaccine strategies based on some of these techniques.

Vaccines and Adjuvants

Traditionally, vaccines have been of two types: modified-live virus (MLV) or attenuated vaccines, and killed or inactivated vaccines. Each possesses considerable advantages and disadvantages. The viruses contained in most modern MLV vaccines are attenuated by repeated passage in tissue culture or in eggs, sometimes coupled with *in vitro* growth at nonphysiologic temperatures to produce temperature-sensitive mutants. Jenner's original smallpox vaccine was based on the use of a variant virus from another species that was naturally attenuated in human beings.

Modified-live vaccine viruses that invade host cells produce endogenous antigens; subsequent binding by major histocompatibility complex (MHC) class-I molecules causes the antigen to be recognized by cytotoxic T lymphocytes, thus stimulating a strong cell-mediated immune response. The MLV vaccines also are better able to overcome maternal antibody interference and are less likely to cause a hypersensitivity reaction, and stimulate a more rapidly developing and longer-lasting immune response, compared with that of inactivated vaccines.¹¹ Depending on the organism, MLV vaccines designed for local administration (eg, conjunctival, intranasal, oral) can be advantageous by stimulating local immunity at the site of initial infection. They also are easier and less expensive to manufacture than inactivated vaccines, and are able to invoke suitable immunity without the addition of an adjuvant.¹²

However, not all pathogens can be attenuated by traditional means. Of particular importance are the retroviruses, FeLV and FIV, both capable of inserting harmful viral genetic material into the host cell genome. Residual virulence of an MLV vaccine strain may be a problem, too, especially for cats that are immunosuppressed by other infections, medication, or stress. Cat breeders sometimes report that modified-live FCV/FHV-1 vaccines cause considerable upper respiratory tract disease after vaccination in an unacceptably high number of cats. This disease may result from variation within the cat population or from a genetic predisposition within certain lines of purebred cats. To be effective, live attenuated vaccines must remain viable and therefore, must not

contain preservatives. As a result, storage requirements are stringent, and contamination with other organisms is a concern.

Inactivated vaccines are effective alternatives in many situations, but are not devoid of disadvantages. In addition to the relative deficiencies reported earlier, most inactivated vaccines must be administered more than once to stimulate a protective immune response, are generally less able to stimulate strong cell-mediated immunity (CMI), are not suitable for local administration, and are less effective in overcoming maternal antibody interference. Storage requirements are less stringent, but because the agent does not replicate within the host, inactivated vaccines require a large antigenic mass and often must contain adjuvants to be adequately immunogenic.

Chronic granulomatous inflammatory lesions at the site of inactivated vaccine administration have been suggested to, in a few cats, progress to neoplasia.¹³ Recent research has revealed that nearly 100% of cats vaccinated with FeLV or RV vaccines develop local granulomatous reactions,¹⁴ yet few reactions progress to tumors. This being the case, additional factors obviously influence sarcoma development. Some researchers propose that genetic predisposition may play a role¹⁵; others are investigating the role of growth factors on wound healing and neoplastic transformation.¹⁶

Despite their shortcomings, most feline vaccines are extremely safe and acceptably efficacious, and have improved the lives of untold numbers of cats. As such, they will continue to play a central role in preventing infectious disease of cats. Critical to the development of safer and more effective vaccines is a more thorough understanding of the feline immune system and how it responds to vaccination and pathogen invasion. Equally important is an understanding of the pathogen itself, particularly of how it induces disease and stimulates immunity. Through recombinant DNA technology, the viral genome can be manipulated by deletion and/or insertion of genes, thus identifying which parts of the genome are responsible for virulence and which parts code for proteins that stimulate immunity. Armed with such knowledge, vaccines can be developed that improve on the strengths of MLV and inactivated vaccines, while minimizing the weaknesses. Many new vaccine strategies are being developed; discussion of several of these follow.

Virulence gene-deleted virus vaccines are MLV vaccines, so they should possess all the advantages of that vaccine type. In contrast to traditional empiric methods of attenuation, gene-deleted vaccine strains are specifically constructed by deleting regions of the genome that are not necessary for growth in cell culture but when deleted, result in a marked decrease in virulence. If large and multiple deletions are made, such a vaccine may be less likely to revert to virulence than would traditionally attenuated vaccines, yet still induce strong immunity. Unfortunately, not all viruses can be modified in this way; one prerequisite is that the virus grow in cell culture, and another is that it contain a large genome. However, some smaller viruses, notably the human immunodeficiency virus (and possibly FIV), might be attenuated by

deletion of small accessory genes. An experimental, gene-deleted, mutant FHV-1 vaccine has been produced, but is not commercially available.¹⁷

Nucleic acid vaccines (DNA-encoded vaccines or "naked" DNA vaccines) consist of a plasmid into which genes coding for viral antigens are inserted. After introduction into the host, transfection of the host's cells by these genes should result in endogenous production of the encoded viral peptide antigen. The peptide antigens then are expressed on the surface of the transfected cell, in conjunction with MHC class-I molecules, making them the target of cytotoxic T cells and triggering a strong cell-mediated immune response. Nucleic acid vaccines also stimulate a strong humoral immune response and can be administered parenterally and by the mucosal route.¹⁸ Nucleic acid vaccines are, in theory, simple and quick to manufacture and are easily purified. Of major safety concern is the potential development of antinucleic acid immunity or incorporation of foreign genetic material into the vaccinee's genome. Addressing these concerns may be possible by the use of messenger RNA, instead of DNA, as the encoding vaccine.¹⁹

Recombinant viral vector vaccines are designed by inserting one or more of a pathogenic organism's genes into the genome of an avirulent organism, called a vector. Genes from the pathogen that encode useful immunogenic proteins, rather than proteins that are harmful or irrelevant to the generation of immunity, are cloned into the vector genome. When expressed by the vector, these proteins stimulate immunity, without causing disease. Like other MLV vaccines, strong CMI, as well as humoral immunity, should be induced. Although numerous microbial organisms, including several bacteria, viruses, and yeasts, may be suitable for use as vectors, poxviruses possess characteristics that make them particularly attractive for use as vectors. For example, vaccinia virus (VV), a large double-stranded DNA virus, has a genome of nearly 200,000 base pairs containing at least 12 sites into which foreign genes can be inserted. It is highly immunogenic, easy and economical to grow in culture, and stable in freeze-dried form. It has a broad host range and can be administered via many routes, including SC, intranasal, and PO. The VV inoculation of people contributed considerably to the eradication of smallpox, so it has been given to millions with minimal adverse effects and without known adverse environmental impact.²⁰ Eukaryotic growth factors, cell surface markers, oncogenes, bacterial enzymes, protozoan structural proteins, and a multitude of viral gene products have been expressed by VV recombinants.²¹ Coexpressing genes for interleukins or other modulators of the immune response also may be possible in a vaccine vector construct, thus enhancing immunity.^{20,22} In veterinary medicine, VV has been used as the vector for a recombinant vaccine against rinderpest, Peste des petits ruminants, vesicular stomatitis,²⁰ and rabies.²³ Because of the large number of possible insertion sites, a single vaccine vector could express antigens from numerous different infective agents simultaneously, thus providing for pro-

tection against multiple agents. In cats, a recombinant vaccine against RV and PV in which raccoon poxvirus is used as a vector has been developed, but is not available commercially.²

Although advantageous in many ways, recombinant vaccines are not inherently safer than are traditionally attenuated vaccines. For example, a recombinant VV expressing the peplomer protein of FIP induced production of enhancing antibodies, similar to that with more traditionally attenuated strains.^{24,25}

Most recombinant viral vector vaccines are in an experimental phase and major safety issues still must be addressed before widespread use is expected. Potential adverse effects of recombinant viral vector vaccines include changes in cell, tissue, or host tropism and virulence; exchange of genetic information with other vaccine or wild-type strains; and spread in the environment and genetic instability.²⁶ Another concern is that an immune response directed to the vector itself may evoke a weaker immune response to the heterologous antigens when booster vaccinations are given, particularly if different vector-based vaccines are given sequentially.²⁷

Subunit vaccines contain only viral protein, rather than the whole, intact virus. Incapable of replicating in the host, they avoid some of the potential problems associated with recombinant viral vector vaccines. The first commercially available subunit vaccine was an FeLV vaccine.⁶ Produced in a more traditional sense, this subunit vaccine requires growth of infective organisms in cell culture, followed by production, harvesting, and purification of the desired immunogenic viral proteins.

Another approach to subunit vaccine production is to first identify the desired protein gene, then to clone the gene into a high-level protein expression system. This technique is not only cost effective, but permits production of subunit proteins from organisms that are difficult or impossible to grow in cell culture.¹⁹ Another commercially available FeLV vaccine is produced in such a way; a portion of the FeLV subgroup A envelope gene is cloned into a protein expression vector, in this case *Escherichia coli*, and the expressed protein is harvested and purified.

Subunit vaccines appear to be most useful if neutralizing antibody plays the major role in protective immunity.²⁸ Because they are incapable of replicating within the host, most inactivated vaccines, including subunit vaccines, lack the ability to interact with MHC class-I molecules and are thus unable to stimulate cytotoxic T cell responses, often important in viral immunity.²⁷

To enhance the cellular and humoral immunogenicity of inactivated vaccines, adjuvants are often included in the preparation. The manner in which adjuvants intensify the immune response is incompletely understood, but likely involves the following mechanisms: first, they maintain a depot of antigen at the injection site; second, they promote the accumulation of immunoreactive cells at the vaccine site and in draining lymph nodes; third, they modify the activities of cells devoted to generating, promoting, and maintaining an immune response; and fourth, they modify how the antigen is presented to the

immune system.²⁷ Mineral oil and aluminum salts are commonly used adjuvants in commercially available veterinary vaccines, but other preparations are being explored. Because they enhance CMI, adjuvants in which saponins, muramyl dipeptide, block copolymers, and cytokines such as interleukin-2 are used are receiving attention, as are biodegradable microspheres, liposomes, and immunostimulating complexes.²⁹ Much more research is needed on the nature of adjuvant action before the advantages of subunit vaccines can be fully realized.

Complex Interactions in Immunity

For meaningful advances in vaccine technology and infectious disease control, a better comprehension of the feline immune system is absolutely essential. Although humoral, cell-mediated, and mucosal immunity are each important in protecting against pathogens, for many infective agents, particularly those that replicate intracellularly, a strong cell-mediated immune response is more important than are the other parts of the immune system. Unfortunately, CMI is considerably more complex and less understood than is humoral immunity, and much research is needed to adequately characterize it in the cat.

In a recent review of the assessment of CMI, several questions were raised that require answering if the most effective vaccine for a particular pathogen is to be designed. What role does CMI play in providing protection? Which antigenic components evoke the strongest CMI? What vaccine strategy (eg, antigen delivery system or adjuvant preparation) stimulates the most protective CMI? What are the responses following vaccination or natural infection? How can they be quantified?²⁹

Of additional interest is the duration of immunity derived from vaccination.³⁰ If immunity to an infective agent correlates with a humoral immune response, duration of protection can conceivably be predicted on the basis of antibody titers. Recent findings suggest that antibody directed against PV and FCV persists for at least 3 years in cats vaccinated at 12 weeks of age or older.^d For pathogens in which immunity does not correlate well with antibody production, determining duration of immunity becomes much more complex because there are as yet no methods that easily allow determination of an adequate cell-mediated response in an individual cat.

Conclusions

Recombinant DNA technology will at least influence, and in many cases, revolutionize the study and control of infectious disease of human beings and cats. Recombinant vaccines promise to provide important advantages over traditionally formulated vaccines. Though remarkable progress has been made, recombinant vaccine development for feline diseases is still in its infancy, and important safety and efficacy questions need to be answered before these types of vaccines merit widespread use. Until then, traditional vaccines will continue to provide dependable protection and safety while undergoing incremental improvements.

^aHu L. Development of raccoon poxvirus vectored feline recombinant

vaccines. Doctoral dissertation, College of Veterinary Medicine, Cornell University, Ithaca, NY, 1995.

^bLeukocell, Pfizer Animal Health, Exton, Pa.

^cGenetiVac FeLV, Mallinckrodt Veterinary, Mundelein, Ill.

^dScott FW, Department of Microbiology and Immunology, College of Veterinary Medicine, Cornell University, Ithaca, NY: Personal communication, 1995.

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Population medicine and infectious diseases

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Domestic cats are susceptible to infection with a large number of agents, but somewhat small groups of infective agents account for most disease problems observed in cats in households, catteries, boarding facilities, animal shelters, and veterinary facilities. Some of these infective agents, contracted from domestic cats, may pose an inherent risk for immunocompromised people.¹

Inhalation and ingestion are the common means by which many of these agents may be transmitted from cats to human beings. Transmission also can be by cat bites or scratches, or by arthropod vectors. In addition, infective agents may be maintained in inanimate objects such as soil, water, or vegetation. In these situations, domestic cats may contaminate the environment with the agent; however, people and domestic cats acquire these types of infections simultaneously and independently. Primary disease that people contract by handling infected cats include rabies, toxoplasmosis, cat-scratch disease (CSD), dermatophytosis, bite/scratch infections, giardiasis, salmonellosis, and campylobacteriosis (Table 1).² Of these, CSD and bite/scratch infections are the most common.

Cat-scratch Disease

Cat-scratch disease is a self-limiting, presumed bacterial infection of human beings. In most people, the illness is mild and clinical signs may include resolving skin lesions, regional lymphadenopathy (usually in the axilla and neck), low-grade fever, malaise, and generalized myalgia.³ The infective agent that causes CSD is *Bartonella henselae*, formerly classified as *Rochalimaca henselae*, and originally known as the cat-scratch disease bacillus.⁴ In addition to being associated with many classic cases of CSD in immunocompetent people, *B henselae* can be recovered from human patients with bacillary angiomatosis, bacillary peliosis, relapsing fever with

bacteremia, endocarditis, retinitis and optic neuritis, and other disorders.

Bartonella henselae bacteremia seems to be common in domestic cats in the United States. Nationwide, 28% of apparently healthy cats are seropositive and bacteremia has been documented in 25 to 41% of healthy cats.⁵ Most domestic cats with *B henselae* bacteremia are not ill and lack distinctive clinical features.³ The largest gap in our knowledge of the epidemiologic features of CSD includes the role of the domestic cat, mode of transmission of the agent, role of insect vectors such as fleas and ticks, and other potential reservoir hosts for *B henselae*. *Bartonella henselae* has been cultured from fleas obtaining blood meals from naturally infected cats,⁵ but vector competence is unclear. Kittens younger than 1 year, kittens or cats infested with fleas, and feral cats or former strays are most likely to have *B henselae* bacteremia.

Most physicians diagnose CSD mainly on the basis of clinical criteria, a history of cat contact, or histologic examination of lymph node biopsy specimens.³ Most patients with CSD have mild illness and require minimal treatment such as analgesics, bed rest, and heat applied to painful regional lymph nodes. If suppuration is observed, lymph nodes are aspirated to reduce pain, but surgical incision and drainage or removal of the nodes is not usually indicated. Antimicrobial treatment has not necessarily shortened the duration of illness or prevented lymph node suppuration. Doxycycline, erythromycin, and rifampin are recommended for treatment,⁶ but clinical improvement has been reported following the use of penicillin, gentamicin, ceftriaxone, ciprofloxacin, and azithromycin. Treatment for 2 weeks in immunocompetent individuals and for 6 weeks in immunocompromised people is generally recommended. Relapses, associated with bacteremia, are observed in immunocompromised people, despite appropriate antimicrobial treatment. Effective antimicrobial treatment has not been established for eliminating *B henselae* bacteremia in domestic cats.

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Table 1—Diseases acquired by human beings from domestic cats²

Disease (agent)	Synonyms	Source of agent	Affected vertebrates	Medical problems in human beings
Rabies (rhabdovirus)	Hydrophobia	Animal bite, inhalation, ingestion	All mammals	Progressive neurologic disorders and death
Campylobacteriosis (<i>Campylobacter</i> spp)	NA	Fecal ingestion	All mammals and birds	Gastroenteritis, septicemia
Cat-scratch disease (<i>Bartonella henselae</i>)	Cat-scratch fever, CSD	Cat bite/scratch	Human beings, cats	Inflicted wound, fever, lymphadenopathy, malaise, headache
DF-2 infection (<i>Capnocytophaga canimorsus</i>)	NA	Animal bite	Human beings	Abscess at bite wound, septicemia, endocarditis, meningitis
Salmonellosis (<i>Salmonella</i> spp)	NA	Fecal ingestion	Human beings, most other mammals, birds, and reptiles	Gastroenteritis, septicemia
Miscellaneous bacterial infection (<i>Bacteroides</i> spp, <i>Fusobacterium</i> spp, <i>Nocardia</i> spp, <i>Actinomyces</i> spp, <i>Pasteurella</i> spp)	NA	Bite wound, contamination by oral fluids	Human beings, cats, many other vertebrates	Abscess at bite wound, bacteremia
Giardiasis (<i>Giardia</i> spp)	NA	Fecal ingestion (ingestion of cysts)	Human beings, many other mammals, many birds	Immunocompetent: self-limiting gastroenteritis; immunocompromised: severe gastroenteritis
Dermatophytosis (<i>Microsporum canis</i> , <i>Trichophyton mentagrophytes</i>)	Ringworm	Contaminated environment, direct contact with infected animal	Human beings, many other mammals	Immunocompetent: self-limiting, circular, erythematous skin lesions; immunocompromised: chronic, generalized, erythematous skin lesions
Toxoplasmosis (<i>Toxoplasma gondii</i>)	NA	Ingestion of tissue cysts and fecal oocysts	Human beings, cats, many other mammals	Immunocompetent: malaise, fever, lymphadenopathy, congenital defects or stillbirth; immunocompromised: same symptoms, as well as severe encephalitis, myositis, pneumonia, retinochoroiditis

NA = not applicable.

Cat Bite/Scratch Infections

A multitude of aerobic and anaerobic bacteria (eg, *Bacteroides* spp, *Fusobacterium* spp, *Nocardia* spp, *Actinomyces* spp, *Pasteurella* spp) colonize the mouths of healthy and clinically ill cats.² Many of these bacteria will cause signs of illness in people if the agents are inoculated through the skin or mucous membranes by cat bite or scratch wounds. In immunocompetent people, most of the bacteria associated with cat-inflicted wounds lead only to local infection. Immunocompromised people or people exposed to *Pasteurella* spp or *Capnocytophaga canimorsus*, however, may develop generalized illness.⁷ In such cases, local cellulitis is noticed initially, followed by evidence of deeper tissue infection. Bacteremia and the associated signs of fever, malaise, and weakness are common and death can occur; fatal disease is most commonly associated with concurrent immunosuppression. Polyarthrititis, osteomyelitis, meningitis, and endocarditis also may develop with persistent infections.

Diagnosis is confirmed by culturing the infecting organism. Treatment includes local wound management and systemic antimicrobial treatment. Penicillin derivatives are effective against most *Pasteurella* infections. Penicillin, cephalosporins, and others are effective against *C. canimorsus* in vitro. Immediate thorough washing of

all bite wounds and scratches is imperative.² Irrigation of the wound with isotonic fluids, delivered by intermittent high-pressure pulsations, is an effective way to dislodge bacteria and debris.

Prevention of Zoonotic Disease

To prevent transmission of infective agents from domestic cats to people, thorough washing of any cuts, bites, and scratches and not allowing a cat to lick an open wound is always advisable.³ Children should be taught not to annoy a cat into scratching or biting, and owners should discourage rough play. Flea control is recommended.

Litter boxes should be located away from human eating areas and should be cleaned by an immunocompetent, nonpregnant adult. A litter box should be shared by no more than two cats and located in an area that can be easily cleaned and disinfected (ie, a water-impermeable area where the surrounding floor and walls can be easily swept, washed, and disinfected). Ventilation around the litter box should be sufficient to remove all odors. The litter should be scooped free of feces daily and changed as often as possible, at least weekly for high-absorptive litter. The more often the litter is changed, the less likely fecal contamination of the environment

will result. Used litter should be placed into sturdy bags, sealed, and disposed of as soon as possible. The litter box should minimize litter loss by being high-sided, large, and made of material that is easy to clean and disinfect. Along with food and water bowls, the litter box should be thoroughly cleaned and disinfected as frequently as possible, but at least once a week.

For the immunocompromised cat owner, special precautions beyond those listed earlier should not be necessary. Immunocompromised individuals should not adopt or have contact with stray kittens or cats; a flea-free, adult, indoor cat of known origin is a safer choice for a pet. Newly acquired cats should be vaccinated and receive routine anthelmintic treatment for roundworms and hookworms.¹ Serologic testing for FeLV, feline immunodeficiency virus, and *Toxoplasma gondii* is recommended. Although the feline viruses pose no chance of infecting people, cats infected with these immunosuppressive viruses are more likely to develop other infectious diseases. Illness in any cat should be an important reason to seek veterinary care.

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Cats and their people: A (nearly) perfect relationship

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In this report, I will address people's attitudes and beliefs about cats from a historical perspective, give some facts about present-day cat-keeping, and present some of the findings of recent research into our relationships with our feline friends. I would like to begin with a little bit about my personal history with animals. I have loved animals for as long as I can remember. As a very young child, for some reason that to this day I cannot explain, I wanted a pony. For my fourth birthday, my parents called a nearby stable and had them bring several ponies that my little friends and I rode around the court where we lived. When I was a little older, I entered a hula-hoop contest that was giving away a pony as first prize and was devastated when I didn't win. As far as family pets, we had dogs, and a parakeet that was with us for nine years. I remember having had a rabbit at one time, and a bullfrog that my brother brought home for me from summer camp. Like a lot of kids, I kept lightning bugs in jars and chased birds and butterflies in my back yard. I have always loved animal movies and remember crying while watching *Old Yeller* and *Big Red*.

But, as unbelievable as it may seem today, for 30 years of my life, I was never especially fond of cats. I never had one and never wanted one. I was just not a cat person. I

did not object to being around them, but did not want them to do annoying things like rubbing up against my legs. Once, a friend called me on the phone crying hysterically because her 17-year-old cat had died. I listened and tried to console her, but inside I was wondering what the big deal was—after all, it was only a cat.

Obviously, between then and now, something happened. About 15 years ago, a friend from Germany came over to visit me in Philadelphia, where I was living at the time. While she was staying with me, she wanted to adopt a little gray kitten from someone whose cat had had a litter. Who but the most hardened ailurophobe can resist a tiny, fuzzy, adorable kitten? I was like a fish waiting to take the bait. By the time Lucy was about to go to Germany with her owner, I was hooked. Just before they left, I went to a local shelter and adopted my very own first cat—Rascal. About two months later, I decided I wanted company for Rascal and again went to the shelter and found Ollie, who had been designated as the "Pet of the Week" by the *Philadelphia Daily News*. Suddenly, after being petless for about 18 years, I was owned by two rambunctious feline furballs. Little did I know that in many ways, my life would never be the same. Ten years later, on a freezing February night, I found Muffie on the steps of the American Diner and took her home. It must have been around that same time that I remember mak-

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ing a comment to someone that in the 10 years I had had my cats, there hadn't been a single day that they hadn't made me laugh. And I think it was at that precise moment that I realized the amazing impact these creatures have had on my life. Not long after that we all packed up and moved to California.

Looking back on my life BC (before cats), perhaps the only unusual thing about my feelings toward cats was that I was fairly indifferent toward them. Cats seem to generate stronger emotions in people than any other domestic animal does. In general, people love cats or hate them. No other animal has experienced the kind of turbulent relationship with people that has characterized the human-cat relationship. Throughout the ages, cats have been worshiped and revered as gods, and maligned and persecuted as the servants of witches and devils. They have been immortalized in music, art, and literature and relentlessly abused and victimized by sadistic villains. How can we explain the cat's roller-coaster ride through the annals of human society? A brief historical look at people's attitudes and beliefs about cats may provide some clues.

Although no one really knows when cats were first domesticated, the earliest associations between people and what we know as the domestic cat appear to have occurred in Egypt, somewhere around 2,000 BC.¹ In this agricultural society, cats were valued for their ability to protect the large stores of grain from rodents. But cats also were attributed a sacred place in the religious beliefs of the Egyptians. The temple of Bastet, the feline goddess of fertility, was the center of cat worship, and special care was given to the thousands of cats that lived there. Cats were a protected species everywhere in Egyptian society, and injuring or killing one, even by accident, was punishable by death. When a pet cat died, the entire family would go into mourning and shave their eyebrows as a sign of respect.²⁻⁵

Although it was illegal to export them, cats eventually made their way to Europe and for a while, continued to live in peaceful coexistence with the Europeans. But the eventual rise and spread of Christianity led to dramatic and unfortunate changes in attitudes and beliefs about cats. Because of their association with Bastet and other deities, cats, along with their human friends, were persecuted in a merciless effort to eradicate the vestiges of pre-Christian religions. Witchcraft, of course, is the best-known cult associated with cats during that time, and any old woman unlucky enough to be caught in the company of any animal, but especially a cat, was accused of practicing witchcraft and was imprisoned or executed.^{4,5}

This tyranny lasted for centuries. Even up to the beginning of the modern era, feast day celebrations included capturing and torturing cats in unspeakable ways to symbolize driving out the devil. As recently as the 19th century, cats have been viewed with great loathing.⁴

Perhaps the unique nature of the cat, however, was as much the cause of this oppression as was its association with heretical religions and witches. Its independence and defiance of control could certainly incur the

enmity of those seeking power and obedience. To this very day, it is these distinctive feline characteristics—amenable to sharing our homes, yet unwilling to be subjugated to the will of a master—that we love or hate.

Fortunately, many more people these days are fond of our feline friends. We all know that there has been a dramatic increase in recent years in the number of cats being kept as pets. The AVMA has reported that between 1987 and 1991, the number of pet cats in the United States increased from 54.6 million to 57 million.⁶ In 1994, according to the American Pet Product Manufacturing Association, that number increased to 59.4 million cats living in 28.3 million American households,⁷ an average of 2.1 cats/household. Of course, nearly 60 million cats eat quite a bit of cat food. The Pet Food Institute has reported that in 1994, cat owners spent nearly \$2 billion on canned cat food, more than \$1.5 billion on dry food, \$110 million on moist food, and \$77 million on cat treats, for more than \$3.6 billion on all forms of cat food and treats.⁸

In addition, there is kitty litter. How many of us have found ourselves standing dumbfounded, for what seems like an eternity, in front of shelf after shelf of endless varieties of catbox filler? It is no longer a simple question of which brand to buy or how much. This is a major decision-making process: should we buy clumping litter or the regular stuff? If we decide on clumping litter, should it be the flushable kind that is easier to deal with, but doesn't clump as hard, or the regular clumping litter that has to be emptied into a trash can and dumped? What about the sandy stuff that feels good or the "low-tracking" gravelly kind? For those of us that have two or more cats, should we get the kind made especially for multiple-cat households? Finally, do we want it in a bag, box, jug, or tub?

What better indicator is there of the present-day popularity of cats than cat shows? Since the first show was held in London in 1871, with about 160 entries, the cat fancy has caught on like wildfire.³ In 1994, the Cat Fanciers' Association had a registry of more than 71,000 cats among the 36 recognized breeds. The same year, that association sponsored 365 shows in North America alone, with over 90,000 entries and several thousands of cat lovers in attendance.⁴

According to the American Association of Feline Practitioners, of the more than 1,000 practices with which their members are affiliated, about 270, or a quarter, are feline-only practices.⁹ Cats are the only small-animal species to have veterinary practices devoted exclusively to their care. As another interesting veterinary tidbit, I recently learned that veterinarians in Japan believe that yoga is good for cats, and assist them with their positioning.³

There seems to be an infinite number of ways that cats have taken ownership of our lives. The shelves of any respectable bookstore carry books on every cat topic imaginable: cat care, cat behavior, cat history, cats and people, cat lore, and naturally, cat humor. There are greeting cards featuring cats for every occasion. The catalogs that we regularly find in our mailboxes are filled with

hundreds of items, for both cats and their people, more than anyone could ever dream.

Just what is this feline fanaticism about? What is it about these furry creatures that steals our hearts and dominates our lives in so many ways? In recent years, scientists from various disciplines have been exploring the nature of relationships between people and their pets. In these studies, topics such as comparing personality characteristics of pet owners and nonowners^{9,10}; differences among owners of various types of pets¹¹; the effects of pet ownership on human health and well-being;^{12,13} and the value of animal companions for special populations such as the elderly, people with disabilities, and people living in institutional settings have been investigated.¹⁴⁻¹⁶ Although most of these studies have focused on dogs, pets in general, or comparing interactions with different types of pets, more studies of human-cat interactions have been appearing in the literature.

In a recent study in Australia, cat owners and nonowners were compared on several psychologic dimensions.¹⁷ Although there were no differences between the two groups on some specific measures such as depression, anxiety, or life events, the study revealed that the general psychologic health of the cat owners as a group was significantly better than that of the nonowners.

Even more dramatic effects have been found in studies of special populations, especially the elderly. In one study,¹⁸ the effects of resident cats for a hospital-based geriatric population, where the cats were already being kept as ward mascots, were investigated. Although there were some concerns about hygiene and maintenance of the cats, the nursing staff reported that the cats helped to increase the general responsiveness of the patients to the ward environment; the patients enjoyed holding, petting, and taking care of the cats and were entertained by them; the cats gave the ward a more pleasant, home-like atmosphere and made the environment more soothing and tranquil; and the cats helped to keep patients in touch with reality.

Of course, animal companions also can be important for older people living in the community. In one study,¹⁹ 20 older people living alone were interviewed for a cat adoption program. Of the 17 who adopted a cat, 11 kept their pets for more than a year. At the end of a year, the long-term owners had higher scores on an objective measure of life satisfaction and were also less lonely, less anxious, and less depressed, on the basis of self-ratings of these measures. All of these differences were statistically significant. In addition, some of the cat owners appeared to have derived remarkable physiologic benefits. Four of them, including two diabetics, who had high blood pressure before acquiring their pets had a decrease in blood pressure that was maintained for at least two years. One woman was even able to stop taking her medication, and both of the diabetics had a decrease in blood glucose concentrations. Of the five hypertensive nonowners, two had increases, two stayed the same, and one had a decrease in blood pressure.

The investigators in this study were careful to point

out that the important factor for these cat owners was not simply that they now had an animal sharing their living space. Rather, it is the social bond—the quality of the relationship or attachment—that is the crucial element in any benefits to the pet owner. The companionship of a pet that is loved and cherished can help to increase a person's quality of life.

This issue of attachment brings up something that has become a pet peeve of mine. In some studies,^{20,21} dog owners have been reported to be more attached to their pets than are cat owners. But how are relationships between people and animals measured? Several instruments have been developed as a way of providing an objective measure of attachment to pets.^{20,22-26} Examples of the kinds of items typically included on these scales are regarding the pet as a family member, touching and playing with the pet, talking to and confiding in the pet, believing that pets understand our moods, spending time together, and sleeping with or near each other. But because human-dog interactions are often used as the standard for evaluating all human-companion animal relationships, attachment scales often include items such as time spent training the pet, the pet's attentiveness and obedience, walking or jogging together, and traveling together. So if the instruments for measuring attachment include these kinds of items, it is no wonder that dog owners would have higher scores.

To understand people's relationships with their pets, it is important to acknowledge that people have different kinds of interactions with different animals. To state what should be the obvious, a cat is not a dog. Although dog owners and cat owners may value their pets for different reasons and engage in different kinds of interactions with them, their attachment can be equally strong. For example, the attitudes of the public toward pet dogs and cats were explored in one study.²⁷ Dog owners and cat owners reported that having a pet helped them to feel less lonely. They also agreed that talking to or playing with their pet could help them get rid of anger. Both groups reported that they owned a dog or cat because of the love and affection they could give it and felt that their pets were important members of the family.

Another study revealed that dog owners were more likely than were cat owners to take their pets with them on errands and trips, and that cat owners were more likely to allow their pets on the furniture.²⁸ However, dog owners and cat owners were equally likely to view their pets as family members, talk to them, share food with them, and believe that the pets understand their owner's moods.

Finally, I would like to present the findings of a survey of human-cat relationships conducted at our center.²⁹ Driven by the question of attachment to cats versus to dogs, the purpose of this study was to find out what it is about cats that people love. To do this, we surveyed a sample of 100 cat lovers. Fifty-four were people who had attended a cat show in southern California and 46 were members of an electronic cat club through the Prodigy computer network. Of the 100 respondents, 92 preferred cats to all other pets. All together, the participants owned 267 cats, with the number of cats in any one household

ranging from 1 to 11. The time they had lived with cats ranged from 2 months to 60 years, and the time they had been living with the cat they were reporting about ranged from 2 months to 17 years.

The respondents listed up to five reasons for preferring their pet of choice. The most common reason for preferring cats was that they are easy to care for because they are clean, can be left alone for a couple of days, and do not need to be walked. The next most common reason was that cats are affectionate and loving and provide companionship. Third had to do with personality; many people made a general statement like "great personality," whereas others mentioned specific characteristics such as intelligence, independence, and friendliness. The fourth category was behavior and appearance. Some of the specific comments about their cats were, "their antics and behavior are fun to watch," and "they can entertain themselves." Several people reported feeling comforted by cats. One person explained that, "purring creatures who sit in your lap tend to reduce stress levels."

In addition to the reasons for preferring cats in general, the respondents explained what they liked about their present cats. Ninety-seven individuals described some form of interactive behavior such as, "sleeps with me," "sits in my lap," "greet me," and "stays nearby." Some of the unique behaviors mentioned were, "he taps with his paw for more food," "he leads me to his food bowl by holding onto his tail," and of course, "helps with paperwork." The respondents described a wide variety of activities to capture the uniqueness of their cat's personality, such as "plays in the sock drawer," "flushes the toilet," "runs wildly around chasing invisible things," and (my favorite) "runs and plays, chirps and sings."

Many people believed that their cat understands their emotional ups and downs. "He knows when I'm sick," "she makes a lot of effort to show how much she loves me," and "they miss me when I'm away" were some of their comments.

As much as we love them, we know that our little furry friends are not perfect and some of the problems we encounter with them can be frustrating and expensive. The respondents described several categories of behavior they did not like about their cats. Some mentioned annoying behaviors that are not serious problems, such as sitting on books or paperwork, jumping on furniture and counter tops, waking them up too early in the morning, and hogging the bed at night. One person complained that her cat sits on the cable box and changes the channels. Others described more serious problems such as destroying furniture, aggressiveness toward people and other pets, and misuse of the litter box.

Some people complained that their cats were not sociable or affectionate, with statements such as "he won't sleep with me," "won't sit in my lap," and "the cat isn't friendly to other people." One person said the cat does not greet her with much enthusiasm, and two people complained that the cat does not come when called. Other kinds of problems mentioned were irritating natural behaviors such as depositing hairballs on the carpet, feed-

ing difficulties, and trouble with grooming and medicating the cat. What was remarkable about these situations, however, was that because of the strong emotional connection to the pet, these owners were willing to tolerate even serious problems with their cats and work at finding solutions.

Finally, we wanted to find out how feline friends would fare in comparison to human companions. The cat owners were asked to complete a scale designed to assess their relationships with their cats. The scale was also adapted to assess their relationship with their spouse or significant other. The study revealed that the cats provided their owners with companionship, something to care for, and a feeling of being needed to a significantly greater extent than the owners' human companions did. On the other hand, human companions were rated significantly higher in providing a feeling of safety and as a motivator for exercise.

The participants also explained what they get from people that they do not get from their cats, and what they get from their cats that they do not get from people. The most frequent responses concerning relationships with people were "conversation and verbal communication," followed by "affection and support" and "intellectual stimulation." Responses given most often regarding their relationships with their cats were "unconditional love and affection," "undivided loyalty and devotion," and "total acceptance."

What do people like about cats? It appears that people with feline friends believe that they have the perfect relationship when it comes to having a pet. They have an animal that is easy to care for and provides years of undemanding love, comfort, and entertainment. With their wonderful personalities, beautiful appearance, playfulness, and silly antics, cats help to fulfill the important emotional needs that all people have for companionship, nurturance, and feeling needed. Despite their reputation for being independent and aloof, our feline companions demonstrate their affection by greeting us when we come home, staying close by or sitting in our lap, sleeping with us, and seeking out our company in many ways. They can be a great source of comfort and constancy in the face of our daily ups and downs.

In closing, I would like to say how very happy I am to do my small part in helping to make life a little better for our feline friends. For all the joy and laughter they bring to our lives, they ask nothing in return except that we love and care for them for the amazing creatures and wonderful companions that they are.

^aBrim M, Cat Fanciers' Association, Manasquan, NJ: Personal communication, 1995.

^bThomson K, American Association of Feline Practitioners, Albuquerque, NM: Personal communication, 1995.

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Surgical neutering and nonsurgical alternatives

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Overpopulation of unwanted or stray cats and dogs continues to be a problem not only in North America, but in other countries of the world. It has been reported that more than 27 million dogs and cats are impounded annually in the United States alone.¹ Although the figures vary, an estimated 5.4 to 9.1 million dogs and 5.7 to 9.5 million cats were euthanatized in animal shelters in the United States in 1990.² It is important to recognize that although this problem is primarily one of unwanted or stray animals, some cats can be included in the classification of "pet overpopulation." The term "pet" connotes that a human being has assumed ownership and responsibility for the animal. However, that does not mean that the pet owner is a responsible individual, nor does it mean that he or she has not contributed to the overpopulation of unwanted or stray cats. A survey of 500 pet-owning households in Massachusetts revealed that 73 and 87% of all dogs and cats, respectively, had been neutered. Of interest was that 20% of these neutered animals had been allowed to reproduce before they were sterilized.² In addition, the numerous cats that are abandoned or euthanatized for such undesirable characteristics as behavioral problems may be a component of "pet overpopulation." Not only should pet owners assume responsibility for their pets, but the practicing veterinarian must assume responsibility to counsel clients on responsible pet ownership, including behavioral modification and the advantages and risks of neutering.

As parents, we want our children to experience the "miracle of birth" as it relates to the family pet. However, if 1 litter is allowed to be born, the effects on animal overpopulation can be overwhelming. If 2 cats produce 8 kittens/y, production of 174,760 cats in 7 years could potentially result.²

Prevention of Pregnancy

Any method of prevention of pregnancy in cats must be affordable, reliable, safe, and convenient.² Methods for neutering cats can be divided into the categories surgical and nonsurgical. Nonsurgical methods or alternatives to neutering in female cats include oral administration of megestrol acetate, parental administration of

steroid hormones, induction of pseudopregnancy, administration of gonadotropin-releasing hormone agonists and antagonists, zona pellucida vaccines, and tissue-specific cytotoxins. Nonsurgical methods of neutering in male cats include steroid-hormone suppression of reproductive function and injection of chemical sterilants into the testes.³

Surgical methods of neutering in female cats include ovariectomy (OHE), tubal ligation, ovariectomy, salpingectomy, or subtotal hysterectomy. Surgical methods of neutering male cats include castration (bilateral orchidectomy) and vasectomy.

Nonsurgical alternatives—By definition, "neuter" refers to desexing an animal or rendering it sterile.⁴ It is also defined as a spayed or castrated animal.⁵ To this end, the only nonsurgical methods of neutering would be the use of agents that permanently render the cat sterile. These agents would include chemical sterilants, cytotoxins, and vaccines.^{2,3} Other methods of nonsurgical prevention of pregnancy require continuous administration of medication/treatment that does not render the cat permanently incapable of reproduction and requires responsible pet ownership.

Chemical sterilization—Chemical sterilants for injection into the testis and/or epididymis of dogs have been developed. Except for neutralized zinc arginine, chemical sterilants have not been developed or evaluated in cats.³ Injection of chemical sterilants into the testes, ductus deferens, or epididymides results in permanent azoospermia, alteration in the physical composition of the testes, and alteration of testosterone production. If a chemical sterilant is injected into the testes, androgen production is reduced, thus ameliorating androgen-dependent disorders such as prostatic disease, behavioral problems (urine marking, mounting, aggression toward other males, and fighting), and gonadal disease. If these agents are injected into the ductus deferens or epididymides, azoospermia may result, but androgen-dependent disorders may still develop.^{2,3}

Chemical sterilants that have been evaluated in dogs include chlorhexidine gluconate, with or without dimethyl sulfoxide (DMSO); ethylcellulose in DMSO and formalin; chlorhexidine in ethylcellulose; zinc tannate; zinc arginine; and acrylic hydrogel N-50 and N-90 dissolved in DMSO. Aqueous solutions of chlorhexidine

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digluconate have been injected into cats, but results were inconsistent. The aforementioned chemical agents have not developed into promising methods of chemical sterilization because of inconsistent results and unsatisfactory tissue reactions.²

A chemical sterilant that holds promise for use in dogs and cats is zinc gluconate neutralized by arginine. Injection of this chemical into the testes of epididymides induces sterility, without interfering with development of male secondary sex characteristics. The mode of action is attributable to the zinc arginine causing atrophy of the seminiferous tubules, scar tissue formation, and atrophy of the rete testis and coils of the head and body of the epididymis, resulting in failure of production and maturation of spermatozoa. The increased concentration of zinc ion in the testis inhibits division and replication of germinal cells and causes fragmentation of the cell membrane and nucleus. Extensive research trials have been completed in dogs and cats.⁶ Presently, the FDA Center for Veterinary Medicine is reviewing the results of the research trials and evaluating proposed clinical trials in dogs.

Zona pellucida vaccines are being evaluated in cats. Perhaps if such a vaccine was given before puberty, it would render a cat's ovaries permanently nonfunctional. Tissue-specific cytotoxins may achieve permanent sterilization in cats and dogs, but these agents have not been fully developed.²

Surgical alternatives—Surgical sterilization of cats, whether pre- or postpubertal, is the most reliable and commonly used method of rendering cats incapable of reproducing. The anesthetic and surgical techniques for OHE and castration in prepubertal and mature cats have been well documented.⁷⁻¹⁰ The advantages of surgical sterilization include not only the obvious one of rendering the cat incapable of reproducing, but also include a decrease in the incidence of androgen- and estrogen-dependent medical disorders and of other reproductive diseases or conditions related to the reproduction organs.³

Ovariohysterectomy—Ovariohysterectomy or spay is an important contraceptive technique in cats because they are polyestrous induced ovulators, and thus may have fertile estrous cycles year-round.³ Complications of spaying in cats are similar to those described for dogs, but less well documented, and include anesthetic complications, wound dehiscence, incisional infections, adverse reaction to suture materials, hemorrhage, incomplete removal of ovaries and uterus (ovarian remnant syndrome), accidental ligation of a ureter, and granulomas of uterine or ovarian stumps.^{9,10} The benefits of OHE to the cat are decreased risk of mammary neoplasia, prevention of pyometra, and decrease in urine marking.^{3,11}

Bilateral orchidectomy—The advantages of bilateral orchidectomy in male cats include a decrease in reproductive behavior (age-dependent), aggressive behavior, roaming, and urine marking. Other beneficial aspects include a decrease in risk of testicular cancer, orchitis, and disease of secondary sex organs.¹¹ Postoperative com-

plications include anesthetic risks, avulsion of ureters, hemorrhage, scrotal bruising and swelling, and infection at the surgery site.^{9,10} A common misconception is that castrated male cats gain weight and become lethargic. Weight gain and lethargy are probably related to dietary habits and decrease in activity (eg, roaming behavior).¹¹ A potential disadvantage of castration is retention of the adhesions that are present between the penis and prepuce during pre- and postnatal development, but this has not been documented as an important cause of preputial inflammation or infection.¹²⁻¹⁵

A very common misconception is the theory that castration, especially at an early age, predisposes male cats to urethral obstruction. There is excellent scientific evidence that the incidence of urethral obstruction or lower urinary tract disorders is not related to castration in cats.¹²⁻¹⁷

Early-age Neutering

It stands to reason that if neutering cats is the most reliable method to avoid unwanted pregnancies and thus avoid contributing to the overpopulation of stray or unwanted cats, neutering the cat before it reaches sexual maturity would be more effective.^{2,18,19} This philosophy is especially important for animal shelters, because owner compliance with neutering programs is often less than 60%.¹⁵ Thus, it would be ideal to release for adoption only cats that were neutered, and thus maintain 100% compliance.

Puberty may occur between 4 and 21 months of age in female cats and between 8 to 10 months in males.¹³⁻¹⁵ Although neutering is one of the oldest surgical procedures described in domestic animals,²⁰ there is very little information in the literature that establishes the ideal age at which to neuter a cat. Most veterinarians were instructed during training that the optimal age to neuter cats was 5 to 8 months. A search of the literature reveals that early in this century, cats, dogs, and other domestic farm animals were neutered at 4 weeks to 6 months of age.¹³

Although there is now evidence that neutering cats and dogs at less than 4 months of age is a safe and effective procedure, veterinarians, pet owners, and shelter personnel still question such a practice.^{7,10,12,14-15} Many concerns over early-age or prepubertal neutering of cats included risks of neonatal anesthesia, stunted growth, obesity, perivulvar dermatitis, vaginitis, urinary incontinence, endocrine and dermatologic abnormalities, behavioral changes, immunocompetence, and urethral obstruction. Some of these conditions are related to neutering, but there is no evidence in the literature to substantiate claims that early-age neutering increases the risk of these conditions developing. On the contrary, recent studies involving early-age neutering in cats and dogs have revealed that such problems are not related to early-age neutering.^{11-13,15}

A study was conducted by Salmeri and coworkers at the University of Florida, relative to early-age neutering of dogs.¹² As a follow-up to this study, a similar investigation was performed in domestic cats. Thirty-one do-

mestic cats were studied to determine the effect of prepubertal gonadectomy on skeletal maturation and growth, body weight, body fat, secondary sex characteristics, and behavioral development. Thirty-one kittens from 7 litters were randomly allotted to 3 groups. The 11 kittens in group 1 were neutered at 7 weeks of age, and in group 2, at 7 months of age. The 9 cats in group 3 were kept sexually intact, and were neutered following completion of the study. Anesthetic and surgical techniques for neutering cats less than 4 months of age were very similar to those already described.^{7,10,21} Technical advantages of early-age neutering included decreased operative time, improved visibility of intra-abdominal structures, and rapid recovery from anesthesia.

The results early-age neutering of cats were similar to those in dogs.^{12,14,15} Closure of the distal radial physis was significantly delayed in neutered cats in groups 1 and 2 compared with that in sexually intact control cats in group 3. There was no significant difference in maturation of the distal radial physis between female and male cats of any age group. Although physeal closure was delayed in groups 1 and 2, there was no significant difference in mature length of the radius among any of the treatment groups. Male cats in all groups had significantly longer radii than their female counterparts did.

Body weights of cats in groups 1 and 2 did not differ significantly. However, group-2 cats were significantly heavier than the intact cats group 3. All male cats were heavier than their respective female counterparts. Fat measurements in group-1 and -2 cats were significantly greater than in group-3 cats. There were no differences in body fat between male and female cats.

Secondary sex characteristics of group-1 and -2 cats were underdeveloped. The penile spines in group-2 male cats were atrophied, and in group-1 cats were completely absent, compared with those of group-3 cats. The vulva in group-1 and -2 females appeared smaller than in group-3 females.

Four urinary tract variables were measured in each treatment group, to include maximal urethral pressure, maximal urethral closure pressure, functional urethral pressure length, and diameter of the urethra (male cats only). No significant differences were noticed among any of the treatment groups, relative to these variables.

There were very few behavioral differences between the 3 treatment groups for the variables measured, which included activity level, excitement, frequency of vocalization, affection, and intraspecies aggression. The sexually intact group of cats (group 3) displayed significantly greater intraspecies aggression and less affection toward a human observer than did neutered cats.

At the completion of the project, the intact cats in group 3 were neutered at 12 months of age. An identification microchip was implanted subcutaneously in each cat in all 3 treatment groups. The cats were placed with

private owners in 1992. Follow-up questionnaires and physical examinations were completed on all of the cats that were able to be located in 1993, 1994, and 1995. These long-term follow-up evaluations have identified no adverse effects previously thought to be related to prepubertal gonadectomy. It was concluded that neutering at 7 weeks and 7 months of age had similar effects on physical and behavioral development in domestic cats.

Prepubertal gonadectomy in cats is a safe and effective means of controlling the feline population in animal control and private veterinary practice environments. The advantages of early-age neutering far outweigh the risks. However, there is still a need to further document the long-term effects of early-age neutering.

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Feral cats in the United Kingdom

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Feral cats are domestic cats that have adopted or been born into a free-living lifestyle. In the past, they have been largely ignored or regarded as pests. But feral cats are intrinsically interesting and a source of pleasure to the many people who feed them and care about them. In this report, I will try to show how thinking on feral cats has changed in the United Kingdom over the last 20 years, how public pressure forced the animal protection societies to change their views and practices, and how the present methods used for control of feral cat populations were developed. I will then make some recommendations on the basis of this experience.

Studies of Feral Cats

One of the first groups of feral cats to be studied in London were the cats of Fitzroy Square, in the area known as Bloomsbury. These cats were already familiar to the readers of T. S. Eliot's *Old Possum's Book of Practical Cats*. Eliot called them "Jellicle Cats":

Jellicle Cats come out tonight;
Jellicle Cats come one come all;
The Jellicle Moon is shining bright—
Jellicles come to the Jellicle Ball.

They are now familiar in most countries of the world, thanks to the popularity of Andrew Lloyd-Webber's musical, *Cats*. They are the small ones, black with white faces, white waistcoats, and white spats.

By the time Roger Tabor came to study these cats in the 1970s, Virginia Woolf and the other occupants of Fitzroy Square had gone and the houses had become offices. Some of the cats had stayed on and developed a free-living life-style, forming a colony of distinctively marked black-and-white cats, finding shelter in the garden of the square and in the surrounding buildings. Tabor found about a dozen of them; they were not seen during the day, but at 9 o'clock each evening they would begin to congregate at a particular point just inside the railings of the gardens and wait for their feeder to arrive. Her name was Mary, and she fed them every evening without fail for many years. When she arrived, these cats, which were shy and had no other human contacts, approached her with their tails upraised in greeting, and some even rubbed themselves against her legs.

Tabor studied the behavior and family lives, home ranges, food preferences, and coat colors of these cats.

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In 1983, he published the results in a book entitled, *The Wildlife of the Domestic Cat*.¹

A similar study of the cats living in the Royal Navy dockyards in Portsmouth was undertaken by Jane Dards in the 1970s.² These cats were the descendants of ship's cats that were carried aboard naval vessels, and had been an almost-closed colony since 1711. There were about 300 cats, distributed among nine major areas, in social groups based on a few females with their offspring. They rested in warm areas near steam pipes. They lived on food brought to them by dockyard workers or scavenged from waste bins, and on fish thrown to them by anglers. They also hunted birds and rodents. The rate of reproduction was high, but mortality was also high, mainly through death of kittens from panleukopenia and respiratory disease. The population had remained fairly stable over several years, despite efforts to reduce the numbers by shooting.

At about the same time, David MacDonald of Oxford University was studying home ranges in farm cats,³ and the Ministry of Agriculture was funding research on the relationships between feral cats and foxes, to assess the risk that feral cats could pose if rabies were introduced into Britain. All these people contributed to a symposium on the ecology and control of feral cats that was held by the Universities Federation for Animal Welfare (UFAW) in 1980.⁴

In the 1970s, the Animal Protection Societies also were taking an interest in feral cats. Animal lovers had previously complained that the Societies, and in particular the Royal Society for the Prevention of Cruelty to Animals (RSPCA), were unsympathetic in their response to requests for help with untamed cats and offered euthanasia as the only remedy.

The feral cat working party—The RSPCA established a feral cat working party to look into the problem and in 1977, funded Paul Rees to perform a survey of feral cat colonies in Great Britain. Rees identified 123,000 feral cats, but was not able to estimate whether this represented 10%, 1%, or even less of the total feral population. He was able to conclude that the highest densities of cats were found in association with the highest densities of human beings, and that the most likely place to find a colony consisting of more than 50 cats was a hospital for patients requiring long-term care.⁴ Of the cats identified, 90% were fed by local people. The rest seemed to depend on waste bins and hunting. At more than half the sites, the cats were regarded as a

nuisance, because of smell, noise, dead cats, fleas, and staff allergies. There were also infrequent complaints of people being bitten and scratched. This study also revealed that in areas where feral cats had been trapped, neutered, and returned to their site of capture, they survived well and seemed to show no changes in behavior.

The RSPCA received this report with little enthusiasm. They did not wish to use the time of their inspectors in trapping shy and elusive cats, then spend their own funds in having the cats neutered. Had it not been for the persistence of one of their Council members, the report may have disappeared without trace.

That person was Celia Hammond, and she was one of the great pioneers of feral cat neutering. She had started rescuing feral cats in the early 1970s, removing them from sites where they were in danger of being shot or poisoned. She took them home and put them in special pens in her garden. She soon realized, however, that this was not the answer to the problem. First, to control the population, feral cats must be neutered. Second, cats like to be in familiar surroundings, and often do not thrive if housed with many other cats. She therefore encouraged the owners of the sites to allow the cats to return after neutering, as long as the feeders were prepared to continue feeding the cats.

The Cat Action Trust—A new organization that could work independently of the mainstream animal protection societies was necessary to communicate these ideas. In 1977, the Cat Action Trust was founded by another great pioneer, Ruth Plant, with the slogan, "Control without killing." But first, Miss Plant discussed strategy with Celia Hammond and the chairman of the Cats Protection League. They wanted to investigate some methods that were being used in Denmark, and they needed a technical adviser. I was working for UFAW, a charity that aims to give technical advice on animal welfare, and they invited me to work with them.

The Danish methods—In 1976, I went to Denmark, where a group of cat lovers was controlling the feral cat population around the port of Ejsberg by slipping pills of progestational steroid into fish heads and distributing them among the cats once a week. The Danish Cat Protection Society also was capturing feral cats in special traps, which permitted the veterinarian to immobilize the cat by injection of ketamine, without risk of being bitten. These cats were then neutered and returned to their original site, in numbers previously agreed with the site owners, with their ears marked to identify them.

The idea of putting feral cats on "the pill" seemed rather attractive and appealed to the public imagination, but I soon found that it was not entirely satisfactory. Cat feeders responsible for giving the pills to each cat on the right day began to suffer nervous breakdowns, particularly if they were responsible for a colony of identical black cats. Cats that ate more than their share of the pills developed abnormalities of the uterus.⁵ Male cats eating the pills probably also developed changes, but these were not studied.

Trapping and neutering—Trapping and neutering was more satisfactory and probably cheaper in the long term, if one assumes that a feral cat will probably live for 8 years, on average. We developed combinations of traps and cages whereby the trapped cat could be transferred, without handling, to a cage fitted with a crush back or squeeze panel. We discovered that drug combinations such as ketamine/xylazine were ideal for anesthesia. Castrated males could be returned to their sites the same day, and females needed only one or two nights' convalescence before release. Many veterinarians could be persuaded to offer special rates if several cats were brought to them at once.

In Britain, veterinary students are taught that ovariohysterectomy in cats is most easily and safely performed through a flank incision. This is fortunate for feral cats, because it means that in the occasional event of postoperative wound breakdown, there is little risk of evisceration, compared with that for ventral midline incisions.

For a flank approach, the cat is placed on the table in lateral recumbency, with the hind limbs pulled caudal and secured by tapes. To find the best line of incision, the last rib, the transverse processes of the lumbar vertebrae, and the tuber coxae are located. The center of the incision should be perpendicularly ventral to the tuber coxae, and the line of the incision should bisect the angle between the last rib and the tips of the vertebral processes.

We consulted widely before deciding how to mark the cats to identify them as neutered. We selected ear-tipping (ie, the removal of 1 cm from the tip of the left ear) because it is visible from a distance and thus gives a clear signal that the cat is a member of a controlled colony. We did not consider it necessary to identify individual cats. This procedure is considered a mutilation by some veterinarians, but has been approved by the Royal College of Veterinary Surgeons, on the grounds that it reduces the likelihood of a cat being subjected to a second laparotomy because of ignorance of the earlier surgery.⁶

Practical application—The Pest Control Division of the National Health Service took a great interest in our work, and soon neutering schemes for feral cats had been introduced at many of the long-term mental hospitals near London. Cats were already kept in the wards, where their therapeutic effect had long been recognized. We discovered that many patients also had important relationships with the cats outside.

Previous attempts to trap these cats for euthanasia had often been thwarted by patients releasing the cats. We found that the patients took a great interest in the neutering schemes, however, and in some cases, wished to pay the veterinary fees out of their own pocket money.

The idea spread quickly, and staff in many hospitals cooperated to organize feeding and trapping teams. Our objective was to maintain populations at desirable levels, with the mortality of neutered cats being matched by the birth of kittens to cats not yet trapped, or by new

stray cats immigrating to the depleted colonies. In some cases, we were too successful. At Stoke Mandeville hospital, where patients stay a long time for rehabilitation after accidents causing paralysis, all the neutered outdoor cats have died and none have come to take their place.

Neutering schemes were started in all sorts of places—public parks, elderly care facilities, and housing estates, with small-scale programs in streets and private gardens. The Cat Action Trust trained people in the art of trapping and gave advice; they also set up a support group for feeders.

New Cat Action Trust groups were organized and are now widespread in Great Britain. They cannot afford to employ anyone to help in the organization or trapping, because all the money they raise is used to pay veterinary fees, so active members tend to get worn out quickly. Fortunately, the Cats Protection League, whose aims are to rescue stray cats and rehabilitate them when possible, and to encourage neutering, is a large and well-funded organization, willing to give practical and financial help in many cases.

Regents Park—The Cat Action Trust was so persuasive in its arguments that Roger Tabor agreed to have the Fitzroy Square cats neutered in the late 1970s. By 1990, they had all died, so now there are no jellies in Fitzroy Square.

There was a similarly colored group of cats in Regents Park, descended from a black-and-white cat that was thought to have strayed from Winfield House, the US Ambassador's residence in London. This cat and her kittens established themselves behind the Open Air Theatre and by 1982, there were seven of them.

The park keepers suspected these cats of killing some imported ducks on the lake, and asked the RSPCA to trap them. The RSPCA failed at this task because the feeder would not cooperate with them, so I offered to set up a neutering scheme for this group and for a second group that lived in a little wood by the leaf yard on the Outer Circle of the park. The park authorities agreed, on the understanding that any cat seen in the act of killing a duck would be caught and removed. Later, they discovered that there was a fox in the park, and that it was the culprit. The cats sometimes caught rabbits, but because rabbits did not officially exist in the park, this was kept quiet.

The feeder's name was Alice; she fed perhaps 20 cats in and around the park and she was perfectly willing to cooperate in the neutering scheme. We soon caught and neutered the dam of the kittens and found homes for the youngest kittens. Before catching the males, we decided to study the cats more closely, because animal lovers had been asking us questions we could not answer with any confidence.

Welfare questions—These questions were:

- 1) Is the health of the cats impaired as a result of trapping, transport, or surgery?
- 2) Will the neutered cats stay away from the feeding site and thus suffer neglect?

- 3) Will neutered cats returned to the site be attacked by the sexually intact cats still there?
- 4) Will the social hierarchy of the cats be disrupted?
- 5) If the populations decrease, will immigrant cats join the colony?

The UFAW hired a young biologist, Peter Neville, who spent many hours in all weather during one year observing the cats and logging their behavior before and after neutering.

The results of this study were not definitive, however, because the theater site was disrupted by building works during the study and the cats stayed away much of the time. The cats in the woods were not a cohesive family group and the social hierarchies were not clear. Nevertheless, we were able to show that the cats remained in good health, that they stayed together as groups, and that no new cats immigrated until the groups were reduced through the death of existing cats. One cat disappeared and was probably killed on the road, and another was severely injured and was euthanatized. Most of the others remained for several years before dying of old age.

The most important finding was that the cats showed more affectionate interactions after neutering, and the males spent more time near the feeding sites. The best part was that they showed more affection to the feeder, who thus derived even more pleasure from feeding them.⁷

Long-term success of neutering programs—In 1984, I did a follow-up study of 17 neutering programs that I had helped to start 5 years earlier.⁸ A total of 254 cats had been trapped and neutered; 53 of these had been homed or relocated, and 201 had been returned to site, with 141 still at the site. That is, 70% had survived on their original site for up to 5 years after neutering.

Another survey was published by UFAW in 1990.⁹ Several sites were visited to assess progress, and 80 people were interviewed to obtain their views on the cats. The conclusion was that neutering feral cats and returning them to the site of capture was widely accepted as an effective method of population control, more humane and cost-effective than any other currently available alternative.

Cost—Neutering cats is expensive, even if the trapping is done by volunteers; trapping by a pest control company for the purposes of killing the cats is also expensive and is rarely 100% successful. A site that is attractive to cats, with the necessary shelter and food sources, rarely remains empty of cats for long, and any unneutered female evading capture will breed remarkably quickly to fill the void. In places such as hospitals, where the colonies are officially tolerated, it would be logical for the costs incurred in the neutering scheme to come out of the pest control budget.

Experience in other countries—In the 1980s, the idea of neutering feral cat colonies spread around the world. In countries like France, this happened independently of developments in Britain. British animal protectionists supporting the Greek Animal Welfare Fund initiated neutering for stray cats in Athens, and the cats of

Venice and Rome became famous as a result of the publicity given to their neutering programs. The RSPCA, who had by now become convinced of the value of the method, so long as they did not have to do it themselves, sent traps and squeeze cages to the societies they support overseas.

At UFAW, we were often asked for advice, and Peter Neville and I helped to set up schemes in Kenya and in Tunisia, where the program was given the official approval of the Tunisian National Tourist Office. Neville described the method at the Boston meeting of the World Society for the Protection of Animals in 1984, and this led to contacts with feral cat people in the United States. Alley Cat Allies of Washington, DC, have links with UFAW and the Cat Action Trust, and have drawn freely on our experiences.

Recommendations

Experience over the last 20 years has convinced me that feral cats can thrive in the free-living state, usually enjoying more interesting lives than those of pets confined indoors, as long as certain criteria can be met: a site offering shelter from the weather and escape from dogs and people; the acquiescence of the owner of the site; a feeder prepared to visit daily; a support group to help or train the feeder in trapping; and enough supervision to ensure the welfare of the cats. These are not just desirable, but are necessary if the person returning the cat to the site is not to be guilty of abandonment, which in Britain is an offense under the Protection of Animals Acts. Details of how to set up controlled colonies of feral cats have been published by UFAW in the United Kingdom¹⁰ and as a series of information sheets by Alley Cat Allies in the United States.³

Relocation

There are some sites where it is not possible for the cats to stay, perhaps because of change in land use, because there is no one willing to feed and supervise the cats, or because the presence of the cats is a risk to wildlife. This is where conflicts can develop. Cat lovers will go to amazing lengths to prevent the death of cats, even when euthanasia is the obvious solution to the problem. Some cats can be tamed with expert care. Kittens usually respond to human kindness, particularly if they are caught before the age of 2 months. Cats can sometimes be relocated (eg, to a farm), but sometimes a cat sanctuary is the only alternative.

Caring for a cat in a sanctuary for the rest of its life can be expensive, particularly if precautions such as vaccination and blood testing for FeLV and feline immuno-

deficiency virus are performed. A cat action group needs to think carefully about whether this is a good use for their funds if money is scarce.

The Role of the Veterinarian

Veterinarians have an important role in giving support to feral cat neutering groups. They will be asked to give advice on diet and parasite control, and on the fitness of particular cats for surgery. They should be prepared to give sympathetic advice on euthanasia. Criteria for euthanasia, such as serious illness, injury, and old age, may need to be discussed. In some cases, they will need to ease the guilt felt by group members if death seems to be the only solution for a cat that has nowhere to go.

Veterinarians have another role in the feral cat story as well: that is, to encourage all owners of cats to have them neutered, even if it means charging lower fees and convincing people who would not normally consider it. Even if all the feral cats in the world were removed this year, there would still be feral cats next year, because people will have abandoned unwanted pets and some of these will be pregnant females.

³Alley Cat Allies. *Feral cats: a series of information leaflets*. Alley Cat Allies, PO Box 397, Mount Rainier, MD 20712.

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Animal shelter issues

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The purpose of this report is to examine the problems facing domestic cats, in the context of the role of animal shelters, and to propose some solutions. I would like to start by addressing the question for which everyone seems to want an answer: how many cats are killed in shelters? Although the euthanasia rate for cats is one of the measurements that can help determine the nature, size, and dynamics of a community's feline population, this rate does not begin to tell the total story of what is happening to cats. A shelter's euthanasia rate is no more and no less than a partial measurement of what happens to a portion of a community's feline population after their arrival in a particular shelter. This measurement certainly can help demonstrate to what degree a shelter is unable to find the owners of lost cats or new homes for homeless cats, but the euthanasia rate does not identify the nature of the welfare problems facing cats.

Shelters try to help cats who are in need, in trouble, or at risk: lost cats, found cats, sick and injured cats, abused and neglected cats, kittens without homes, unwanted cats, unvaccinated cats, reproducing cats, the neighbor's problem cats, and unowned cats. The feline welfare issues about which all of us should be concerned involve understanding why so many cats are in trouble in the first place, regardless of whether or not they end up in shelters. The focus of an active and productive community animal shelter is not simply to reduce their euthanasia rate. Important goals include addressing the source of the problem by identifying threats to the well-being of cats in the community, and implementing effective strategies to lessen their suffering.

Animal shelters are community resources. As such, every shelter is different and reflects a community's interests, needs, and demands for services. Some shelters, like humane societies, are part of a private organization whose activities are governed by concerned citizens and funded by charitable contributions. Some shelters, like animal control agencies, have a governmental mandate and are municipally operated and funded by fees and/or taxes. Other shelters are a combination of these two types. Cats experience different problems in different communities, and the inherently local nature of animal shelters means that the response to the needs of cats varies considerably among areas. Because very few states or municipalities have enacted laws requiring that citizens who

Table 1 —Sources of owned animals in Massachusetts^a

Source	Percentage of cats	Percentage of dogs
Family/friends	47	30
Stray	17	5
Born in household	3	3
Shelter	12	20
Pet store	8	7
Via advertisement	3	3
Breeder/kennel	3	30
Veterinarian	2	1
Other	5	1

keep cats behave responsibly, it is not at all uncommon for public-sector shelters (ie, animal control facilities) to provide little or nothing in the way of services for cats. This lack illustrates a core problem: there is no consensus about what responsible cat ownership entails or about what type of public policy intervention, if any, is appropriate to encourage whatever it is we mean by responsible cat ownership.

As if that were not enough of a challenge, some new and even more confusing issues are becoming apparent. We are not even sure what "cat ownership" means. Of course, we all know that cats are not simply dogs with retractable claws; cats are a very different kind of beast. We must be careful not to make the mistake of viewing "ownership" of cats as being identical to "ownership" of dogs. However, a definition of cat ownership is necessary for any kind of pet responsibility requirement involving cats, including, for example, mandatory rabies vaccination. It is important to recognize that besides approximately 58 million cats that people say they own, there are also large populations of unowned, sort-of-owned, fed, not fed, sort-of-fed, socialized, unsocialized, and sort-of-socialized cats living outside of our homes, without the benefit of a lap on which to curl up. And although some guess that the free-roaming cat population is at least as large as the "owned" population, no one has a reasonably accurate estimate. With these issues in mind, we can examine some information that will help us understand how and why cats are suffering.

A Case Study in Feline Welfare Issues in Massachusetts

The Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA) has conducted several studies of Massachusetts pet populations, employing an in-

^aFrom the Humane Services Division, Massachusetts Society for the Prevention of Cruelty to Animals, 350 S Huntington Ave, Boston, MA 02130.

Table 2—Circumstances of ended human/cat relationships in Massachusetts^a

Circumstance	Percentage of cats
Cat died/euthanatized	61
Cat disappeared	17
Owner moved—no pets allowed	7
Cat given away	6
Owner allergies	4
Troublesome/vicious cat	3
Owner without time/ means of caring for cat	3

dependent research agency and using a demographically spread, random-digit phone call methodology.^{a,b} Of the surveyed households, 29% included a cat, with a mean of 1.6 cats/cat-owning household. The owned-cat population is estimated to be 791,000, and each year, approximately 25% of these cats permanently leave their homes.

More often than not, cats apparently "find their people," instead of people making a deliberate effort to acquire a cat (Table 1).^a The good news is that large numbers of people open their doors to cats that they did not intend to acquire. Given that so many cats are acquired unintentionally, however, that cats receive a lower level of care, compared with that for dogs, is not surprising.

Compared with dogs, cats receive approximately half the amount of veterinary care.¹ Veterinary service expenditures and mean number of visits for cats were \$2.33 billion and 0.88, respectively, compared with \$4.56 billion and 1.88 for dogs, in the United States during 1991. A shocking 30% of cat-owning households report that they do not have a veterinarian. This is an important feline welfare issue, with consequences that directly affect animal shelters, which are often called on to respond when this lack of medical care causes suffering in cats, leads to unwanted kittens, or raises concerns in the neighborhood.

The percentage of owned cats that are sterilized is high (82%).^a Slightly more than 20% of spayed cats, however, had previously given birth to a mean of 2.43 litters, with 4.3 kittens/litter. The pool of sterilized cats has therefore added approximately 700,000 kittens to the population.

Owners whose cats were not sterilized ($n = 98$) were asked why this procedure had not been performed.^a Heading the list of reasons for not sterilizing cats was the belief that the cat was too young for the surgery (27% of owners' responses). The cost of the surgery was stated as the second-most important reason for not sterilizing cats (17% of owners' responses), but this reason was not listed in the top 10 answers provided by owners of unsterilized dogs. Because sterilization is a somewhat low-cost medical procedure, perhaps this difference is reflective of the perceived value of cats.

Death of the cat is the leading reason (61% of the cases) of ended human-cat relationships (Table 2).^b Of

Table 3—Lost cats returned to owners^c

State (Year)	All sheltered cats	Cats returned to owners	
		No.	Versus all sheltered cats
Massachusetts(1993)	21,191	242	1.14
Maine (1993)	11,485	299	3.3
Washington (1994)	31,540	1,505	4.77
Maryland (1992)	38,000	760	2.0
Iowa (1992)	32,237	967	3.0
Minnesota (1983)	26,396	256	1.0
Total	160,849	4,029	2.5

the cats that died, 18% were killed by cars. Other leading causes of death were cancer/tumors, FeLV infection, and renal failure. Other than death, the leading cause of ended relationships is "disappearance."

Approximately half of all cat owners reported that their cats live exclusively indoors.^b Most of the other owners reported that their cats spend more than 25% of their time outdoors, with 13% of owners having cats that are outdoors more than 75% of the time.

Data from 6 states illustrate a serious feline welfare problem (Table 3).^c Just about every shelter worker in the United States could attest to the rarity of finding a lost cat with some kind of identification that would lead to locating the owner. In addition, people who lose cats unfortunately do not seem to look for them. In many shelters, having a cat returned to owners is so unusual that it is cause for celebration.

In 1994 and 1995, the MSPCA conducted some research about unowned cats.^d Over a 3-year period, 7% of Massachusetts households (15% of pet-owning households) fed cats that were not their own. Individuals in 12% of rural households, 7% of suburban households, and 5% of urban households were feeders. These households fed a mean of 3.7 cats, which means that about 582,000 unowned cats were fed in the state during this period. An estimated 183,000 kittens, 46% of which died or disappeared, were born to these cats. Of the fed cats, 68% were described as being "tame," and about half of the feeders said that they felt as though these cats were their own. Despite those feelings, however, the feeders firmly believed that the presence of these unowned cats was not their fault or their responsibility; they were simply "helping out" some cats. Almost a quarter of the feeders reported that they had taken an unowned cat to a veterinarian, most frequently for vaccination. Many reported that these "unowned" cats spend time (usually during the winter or during other bad-weather periods) inside their homes.

In the summer of 1995, the MSPCA conducted a phone survey of individuals who advertised free kittens in local newspapers (Table 4).^e The survey revealed that most of the owners (72%) considered having the queen spayed before it became pregnant. Most of these births appear to be preventable, and many people continue to believe that some young cats of reproductive age are still "kittens" and are therefore too young to give birth.

The majority of cats admitted to MSPCA shelters are kittens in need of homes (42%) or unowned "found"

Table 4—Owners' reasons for not spaying queens that produced kittens advertised as "free to a good home"^a

Reason	Percentage of owners
Could not afford it	32
Thought cat was too young to get pregnant	16
Indoor cat that got out	14
Did not get around to it	8
Cat was still nursing kittens	6

Table 5—Reason for cats being admitted to shelters (1992–1994)^a

Reason	Percentage of cats
Owned kittens needing a home	24
Unowned kittens needing a home	18
Stray adult cats	17
Owner moving/landlord problems	10
Behavior problems	8
Owner requested euthanasia of cat	7
Owner not interested in owning cat anymore	7
Financial	6
Owner allergies	4

Approximately 70,000 live cats were admitted by the Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA) during this period.

cats (17%; Table 5).^c Between 1985 and 1994, there has been a substantial decrease in the number of puppies and adult dogs received at shelters operated by the MSPCA (a private humane organization that does not generally handle stray dogs; Table 6). Feline admissions, however, have been relatively constant over the past 10 years. Since the mid-1980s, about 10 small, cats-only humane organizations have been started in Massachusetts.

Conclusions

All of this information is cause for alarm, and I think we can agree that the welfare of cats is in jeopardy. We are just starting to determine the scope of the problems facing cats. Accurate and complete national numbers are not available yet, but because feline welfare issues are local matters, the best information often comes from local sources. We can learn much from any community or region that makes the effort to collect and examine complete information about the cats in their area. In Massachusetts, we have learned that 200,000 human-cat relationships end every year. Of these cats, 120,000 die, but 80,000 go somewhere else. We do not know how many unowned cats there are or what happens to them, and we have no idea of their birth rate, because there are so many unaccounted-for cats out there.

Shelters are one place where we can collect some data, but we must realize that shelters handle only a small portion of the cats in need. There are 16 open-admission animal shelters in Massachusetts, and in 1993, they admitted nearly 56,000 cats. About 41,000 of those cats were euthanatized.^c Approximately 60% of the cats admitted were "owned," and about half of the total were kittens. Because of the seasonal nature of cat reproduction, most of those kittens arrive between May and October. It is not unusual for MSPCA shelters alone to ad-

Table 6—Canine and feline admissions at MSPCA shelters (1985–1984)^c

Year	No. of admissions				
	Total	Dogs	Pups	Cats	Kittens
1985	44,274	12,260	5,824	11,651	14,539
1986	43,476	12,117	5,827	10,961	14,571
1987	39,808	10,860	3,825	12,275	12,848
1988	39,880	10,718	3,000	12,868	13,294
1989	36,504	9,467	2,196	12,394	12,447
1990	38,540	9,225	1,933	14,182	13,200
1991	32,323	8,251	1,508	12,058	10,506
1992	33,129	7,849	1,649	12,546	11,085
1993*	32,809	7,460	1,362	12,854	11,133
1994*	32,187	7,546	1,488	12,716	10,437

*Data from 7, instead of 8, shelters.

mit 2,500 kittens less than 6 months of age in a single summer month. In a good month, we will find homes for 500 kittens. Yes, we are overwhelmed by the volume. We can only guess what is happening to the other cats that shelters never see or hear about. The more we look, the more frightening the numbers get.

There are many opportunities for improvement, however. The solutions need to be flexibly applied, because we must address numerous kinds of feline populations. Different communities may pursue different solutions, based on the nature of their feline population, the interests and priorities of the community, and the resources available.

I propose a basic set of principles, beginning with a critically important tenet: it is in the best interest of cats, of people, and of the environment that cats be maintained and cared for in homes. Therefore, with regard to free-roaming unowned cats, we need to have as our goal reducing population growth, and ultimately, the population itself. There are clearly numerous kinds of responses to populations of unsocialized cats, and it is not my aim to endorse any particular one. Whatever the approach, it should be conducted responsibly and humanely, fitting the community's standards and needs. The ultimate goal, however, should never be forgotten.

With regard to "owned" cats, I propose that we establish some goals we should all be striving for:

Elevate the status of cats—Cats suffer from their second-class status. Too many people perceive cats as not worthy of attention, expense, or care.

Keep cats safe at home—Probably the most important protective measure a cat owner can take is to lessen the risk of disappearance, accidents, and disease transmission by keeping cats confined or safely supervised.

Vaccinate and provide regular medical care

Use some kind of effective identification—There are many effective identification systems. Microchip technology is creating new opportunities for permanent identification, but we should not ignore the simple collar and tag. Every year, literally hundreds

of thousands of lost cats never make it home again, because their owners failed to provide identification.

Sterilize cats early—Animal shelters are pleased that they can safely sterilize young animals before they are adopted. But by far the most exciting and important consequence of the growing acceptance of pre-pubescent sterilization of pets is that veterinarians can incorporate this procedure into their own practices.

These are not just "shelter issues." Because veterinarians interact with more cats and more "cat people" than any other profession does, veterinarians have the opportunity to play a lead role in addressing the welfare of cats.

Even if we agree on these principles, we may disagree on implementation. Should these matters be part of the law? Whose job should this be? How much should sterilization cost? What about the medical compromises involved in sterilizing unvaccinated cats? Who will pay the costs of these programs? Are unowned cats third-class animals? How viable are sterilize-and-release programs? There are plenty of other difficult questions to answer.

However, if we start by agreeing that the goals mentioned earlier should be the focal point of all our efforts, we can make progress. The harsh reality is that cats are

suffering in large numbers, and it is going to take a long time before this problem is solved.

In one final note of good news, the National Council on Pet Population Study and Policy, of which the AVMA is a charter member, began regional epidemiologic studies of failed human-animal relationships last year. In addition, the first complete national shelter census is nearly finished. Within the next year, results will be available, with the promise of further improving our understanding of companion animal problems and helping us all work toward new solutions.

¹*Massachusetts Public Opinion Study on Spaying and Neutering Pets.* Conducted by the Dorr Research Corp, Boston, for the Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA), October 1991.

²*A marketing research study of people/pet relationships that have ended.* Conducted by the Dorr Research Corp, Boston, for the MSPCA, February 1994.

³Data available from author.

⁴*A research study of the feeding of unowned cats in Massachusetts.* Conducted by the Dorr Research Corp, Boston, for the MSPCA, September-October 1995.

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