5

Use of Dogs in Wildlife Research and Management

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INTRODUCTION

CONTEMPORARY TECHNIQUES FOR wildlife research and management tend to be relatively expensive and involve an ever expanding technology. In comparison, use of dogs to obtain wildlife data, a relatively old technique, may seem outdated, and a discussion on the use of dogs could appear elementary (Fig. 5.1). However, data collection in the wildlife profession must be field-based if modeling exercises are to represent reality. The use of dogs can provide valuable information that could not otherwise be collected in the face of shrinking budgets and limited personnel, or when more precise estimates are desired and use of dogs is known to surpass other methods. This is especially true given recent advances in techniques and technology, such as use of the Global Positioning Systems (GPS). Though dogs may be used infrequently in North America for wildlife work, European wildlife managers have a long history of using dogs, and their wildlife educational programs require a demonstrated ability to handle dogs (S. Tóth, University of Washington, personal communication). Currently, there is no comprehensive guide for using dogs to aid researchers. Thus, this chapter is intended to provide examples of how dogs can be employed to collect data, provide basic guidance on practices that work, and stimulate thought and discussion of other potential applications. This topic was covered in past editions (Zwickel 1971, 1980) of the *Wildlife Management Techniques Manual,* but was discontinued in later editions. Since the publication of these editions, many additional applications have been devised and are summarized here.

Dogs offer a unique set of skills that otherwise might not be available for collection of wildlife data. The scenting abilities of dogs have been well documented (Johnston 1999, Syrotuck 2000). For instance, dogs can detect scent up to 100 million times better than a human can (Syrotuck 2000) and can detect certain compounds up to 500 parts per trillion (Johnson 1999). Additionally, most dogs offer increased ground coverage with speeds that are up to 4 times faster than a human (Mecozzi and Guthery 2008). These factors illustrate the advantages of using various task-oriented dog breeds for some management and research activities. We have summarized the use of dogs in wildlife management into the following categories: (1) locating wildlife and assessing population status, (2) facilitating specimen and carcass collection, (3) detecting scat, (4) capturing and marking wildlife, (5) studying wildlife behavior, and (6) managing wildlife damage.

Fig. 5.1. "My dog, by the way, thinks I have much to learn about partridges" (Leopold 1970:67). Aldo Leopold with Flick (German shorthaired pointer) at the Riley Game Cooperative, Wisconsin. *Photo courtesy of the Aldo Leopold Foundation (www.aldoleopold.org).*

TYPES OF DOGS

Most experts agree that domestic dogs descended from wolves (*Canis lupus*) rather than other canids (Olsen 1985, Pennisi 2002, Wang and Tedford 2008). However, debate continues concerning timelines and specific selective factors for domestication, as well as the geographic location (Pennisi 2002). Interestingly, Coppinger and Coppinger (2002) describe a theory of natural selection for the evolution of the domestic dog (*Canis lupus familiaris*) that suggests dogs may be the only "self-domesticated" animal.

The American Kennel Club (AKC) currently registers 161 breeds of dog (www.akc.org); however, there are many more breeds throughout the world that are not recognized by AKC. Most individual breeds were developed for specific tasks. Breeds are generally grouped into the following broad categories: sporting, hound, working, terrier, toy, non-sporting, and herding. Hunting breeds (e.g., sporting and hound groups) are most commonly used for wildlife work because of their innate interest in game and other wildlife species, as this interest was the original selected trait. Herding breeds, including protection oriented breeds, also may aid wildlife work, including wildlife damage management. Often breeds in this group (e.g., border collie and German shepherd) exhibit high intelligence, cooperation, and trainability and have been used for tasks unrelated to their herding instincts.

There are too many breeds that could be used in wildlife work to list individually, and there are multiple volumes dedicated to **breed traits** (Fogle 2000, Coile 2005). The proper breed(s) should be chosen for specific tasks (Table 5.1), although, in a given breed or group, individual variation in traits (e.g., drive, intelligence, cooperation, trainability, range, and scenting ability) may be more important than the breed itself. Additionally, certain lines exist within breeds that exhibit specific traits and abilities. For example, English springer spaniels have "show" and "field" lines. The hunting line is commonly referred to as "field bred" English springer spaniels and may be of more value to wildlife work than the show type. Another example is the popularity of the Labrador retriever (labs) as a companion or family dog, and in many cases individuals have been bred irrespective of hunting abilities. Therefore, those interested in wildlife work should obtain labs from proven hunting parentage to ensure the proper traits are present to carry out the desired tasks. Potential for **crossbreeding** among breeds has been suggested in the past (Zwickel 1980); however, the yeoman effort of dedicated breeders to provide consistent heritable traits, combined with the availability of so many potential breeds, behooves the selection of a workable individual from **purebred** lines. This is not to imply that **mixed dogs** are not of use, but their traits will be much less predictable. Moreover, adoption of unwanted or rescue dogs (mixed or purebred) is easy and inexpensive, and may be a reasonable option. For instance, scat and reptile detection work has successfully used mixed breeds and rescue dogs where individuals exhibited specific desirable traits (discussed later). Thorough research into a breed, specific lines, and individual kennels should be undertaken before a dog is obtained for use in wildlife work.

GENERAL INFORMATION ON USE OF DOGS

In most cases, dogs will be used in wildlife work because of their **scenting abilities.** Scent, scenting conditions, and scenting ability of dogs are important when considering their use for field research. Bird scent is thought to be created by rafts of dead skin (continuously shed by birds) that bacteria metabolize, creating residues and secretions of vapor or "scent" (Gutzwiller 1990). However, lipids, fatty acids, and wax produced by the uropygial gland (used in preening) also may be another source of bird scent (Conover 2007). Regardless of scent origin, the ability of scent to be airborne and the impact of environmental conditions on airborne scent are key factors that influence scent-detection ability (Gutzwiller 1990, Conover 2007).

Weather conditions, such as wind, temperature, humidity, and barometric pressure, also play important roles in scenting conditions (Gutzwiller 1990, Shivik 2002, Conover 2007) and should be taken into account when conducting searches with dogs. **Scenting conditions** should be similar

Table 5.1. Dog types and breeds with potential for various wildlife oriented tasks

	Task								
Dog breed or type[a]	Detection of birds	Capture of birds	Harassment of birds	Detection of carcasses	Detection of scat	Livestock protection	Harassment of mammals	Capture of mammals	Detection of reptiles
Pointers									
EP, GSP, GWP, BR	X	X			X			X[b]	X[b]
Setters									
ES, GS, RS	X	X							
Retrievers									
LR,[c] GR,[c] CBR	X		X	X	X				X
Spaniels									
ESS, ECS, FS	X		X	X	X				
Hounds									
BGL, RBH, BTH, WKR, BLTH				X			X	X	
Collies and shepherds									
GSD, BC, AS, AK, KBD		X	X	X	X	X	X	X	X
Other breeds									
GP, AD						X			

[a] This list is not comprehensive but is meant to give an overview and general guidance for the most common breeds. As noted in the text, individual traits vary widely even within breeds and lines and may be the most important factor when considering a dog for specific wildlife tasks. Accordingly, some individuals (mixed or purebred) may work for tasks we have not listed. AD = Akbash dogs; AK = Australian kelpie; AS = Australian shepherd; BC = border collie; BGL = beagle; BLTH = black and tan coonhound; BTH = blue tick coonhound; BR = Brittany; CBR = Chesapeake Bay retriever; ECS = English cocker spaniel; EP = English pointer; ES = English setter; ESS = English springer spaniel; FS = field spaniel; GP = great Pyrenees; GR = golden retriever; GS = Gordon setter; GSD = German shepherd dog; GSP = German shorthaired pointer; GWP = German wirehaired pointer; KBD = Karelian bear dog; LR = Labrador retriever; RBH = red bone coonhound; RS = red setter; WKR = Walker coonhound.

[b] GSP and GWP were originally bred to both point and retrieve feathered game, as well as track and find furred game, though many North American breeding programs have focused more on the bird finding abilities of these and other continental breeds. Therefore, individuals of the continental breeds may vary in their drive for mammals based on past breeding objectives.

[c] Because of the popularity of retriever breeds as companion and family dogs (e.g., Labrador retrievers are the most popular dog in the United States), many lines in these breeds have been bred irrespective of hunting ability. Therefore, individuals used for wildlife work should come from parentage focused on and used for their hunting traits.

between treatment and control groups when collecting data with dogs for experimental practices (Gutzwiller 1990). This requirement necessitates the use of standardized weather parameters as much as possible.

Shivik (2002) tested the ability of dogs to scent humans with scent-adsorptive clothing and found wind variability was negatively correlated with dogs' ability to locate subjects quickly. Gutzwiller (1990) suggested that moderate winds actually enhance scenting conditions, whereas weak or extremely strong winds degrade them. From the authors' personal experience, steady winds between 8 and 40 kph provide optimum scenting conditions, at least for pointing dogs.

In an interesting study, Steen et al. (1996) tested olfaction properties of pointing dogs while they were searching for game. They found that even while exhaling during hunting activities, the dog can maintain a continuous inward air flow for up to 40 seconds or at least 30 respiratory cycles. This ability is due to the **Bernoulli effect,** which results from lower pressure in the mouth cavity than in the nose during inhaling and causes an inward flow of air through the nose (Raphael et al. 2007). This phenomenon only occurs while the dog is running with its head held high and does not occur while it is resting or searching for ground scent (Steen et al. 1996). This phenomenon explains why dogs, and possibly other mammals, can be running and breathing hard (panting) yet continuously scent game.

All dogs are not created equal, and individual dogs differ in their ability to locate subjects (Jenkins et al. 1963, Gutzwiller 1990, Shivik 2002). The differentiating factors between individual dogs can be related to range or ground coverage, scenting ability, and/or age and experience. Thus, during wildlife data collection, individual dogs should be used consistently, and the number of dogs used in a study minimized to reduce bias, much like we minimize human observers (Gutzwiller 1990). Additionally, **individual dog performance** can be variable, even during a given day (Gutzwiller 1990). Therefore, environmental factors that may influence a dog's performance should be taken into account if possible. Physiological factors, such as parasite loads, poor diets, and fatigue, or other negative influences affect a dog's ability to find subjects optimally (Gutzwiller 1990). Furthermore, sociological factors also may influence a dog's performance. Some dogs are more competitive than others and may have ineffective sessions if paired with another dog they feel competitive toward (Gutzwiller 1990). Gutzwiller (1990) provided these standard procedures for **reducing bias** while using dogs in wildlife studies:

1. Use the same dog throughout a study, or balance the use of each of 2 or more dogs in time and space, to avoid observer bias.
2. Ensure dogs are physically fit (before and during searches) and well trained.
3. Search for birds under as similar temperature, wind, precipitation, and barometric conditions as possible, because these factors can affect bird activity, scent, and dog performance.
4. Restrict search to a certain period of the day, because daily cycles in temperature, humidity, and other variables influence scent production and detection. Bird activity and habitat use also vary with time of day.
5. Balance search efforts by using equal numbers of dogs and researchers per unit time and area.

Technology (e.g., **GPS units**) has become essential in wildlife research and management in recent years. The use of GPS has not escaped the realm of working dogs. There are several products currently available for tracking dogs using GPS technology (e.g., RoamEO™, White Bear Technologies, St. Paul, MN; Garmin™ Astro, Garmin International, Olathe, KS). The **Garmin Astro** is specifically designed for hunting dogs. Some researchers have simply attached small GPS units to the dog's collar for tracking purposes (Guthery and Mecozzi 2008), though based on their experience, they encouraged the use of GPS units specifically designed for dogs (G. Mecozzi, Oklahoma State University, personal communication). These units track the handler's path, along with the dogs' path (some units allow multiple dog tracking simultaneously), as well as providing other information about the dog (e.g., speed; distance from handler; direction; distance traveled; and activity, such as pointing or running). This technology may provide increased information concerning biases associated with using dogs and address some of the violated assumption concerns (100% detectability and coverage) of methods, such as the belt transect method (discussed later; Jenkins et al. 1963). Using GPS units designed for dogs can enhance the ability of researchers to collect data for probability detection methodology (e.g., distance sampling; see below; Buckland et al. 1993).

Other considerations when using dogs in wildlife work include **safety** of the subject species and the dog. This aspect of the work must be acknowledged and steps taken to minimize risk. It is especially important in modern research, where Animal Care and Use Committees and wildlife agencies are charged with the task of ensuring minimal harm to wildlife during management and research activities. When using dogs, the predatory instincts of these animals (especially hunting breeds) must not be underestimated. The desire to search out game, or hunt, is merely the first step in a predation event. Appropriate training and cooperation from the dog can keep the pseudo-predation event controlled; however, the intent of the dog remains predatory in nature. In our personal experience, individual dogs vary in their **prey drive** (the desire to chase and/or dispatch game), thus a handler must pay particular attention to each individual's natural drive. A muzzle may be useful for preventing undesired harm, though we could not find an example of its use. Additionally, special care should be given to keep the dog's physical and nutritional condition and its demeanor in order. Dogs can be injured by heat stroke, rattlesnake bites, and porcupine quills (Flake et al. 2010). Again, these concerns should be acknowledged in animal use protocols. Handlers should always maintain an ample water supply and a first aid kit specialized for field dogs.

LOCATING WILDLIFE

Dogs have been widely used for **sampling wildlife populations.** Often this includes counting animals, determining distribution, and/or gathering demographic (e.g., age and sex) information (Table 5.2). These data are then used to project **indices** for a population, such as density or productivity. In many instances dogs can enhance the detection of wildlife or mortalities beyond the ability of an observer alone (Novoa et al. 1996, Homan et al. 2001, Arnett 2006, Dahlgren et al. 2010).

Pointing dogs have been used to estimate densities or indices of the abundance of grouse in several different studies (Jenkins et al. 1963, Thirgood et al. 2000, Amar et al. 2004, Broseth et al. 2005, Dahlgren et al. 2006; Table 5.2). The original method for **estimating grouse density** was developed on red grouse (*Lagopus lagopus scoticus*) in Europe and consisted of using belt transects (Jenkins et al. 1963, Thirgood et al. 2000). In general, the method entails searching an area by working a pointing dog along parallel transects, often spaced approximately 150 m apart. The dog is cast (directed) to either side of the transect line (approx. 75 m), and all birds in the area are assumed to be detected and flushed. However, this assumption is uncertain, because other research indicates that pointing dogs only detected 50% of available radiomarked birds (Stribling and Sisson 1998). Essentially this method is a total (census) strip count that has been validated for consistency, but not accuracy (S. Thirgood, Macaulay Institute and Aberdeen University, UK, personal communication). Additionally, this method does not readily yield error rates for comparison purposes. Interestingly, Broseth and Pedersen (2000) reported detection of willow ptarmigan (*Lagopus lagopus;* known as red grouse in Europe) past 80 m (from the transect line) to be difficult when using dogs, that supports a similar belt transect width reported by Jenkins et al. (1963) and Thirgood et al. (2000).

Use of dogs for **distance sampling** procedures has been suggested to estimate density of birds (Buckland et al. 1993; Table 5.2). Rosenstock et al. (2002) encouraged use of more

Table 5.2. Dogs in wildlife research and management: summary of live animal, nest, and carcass detection[a]

Wildlife species	Dog breed or type[b]	Method	Reference
Study objective: abundance, density, and indices			
Red grouse (*Lagopus lagopus scoticus*)	Pointing dogs (pointers and setters)	Belt transect	Jenkins et al. 1963, Redpath and Thirgood 1999, Thirgood et al. 2000, Park et al. 2001, Thirgood et al. 2002, Amar et al. 2004
Greater sage-grouse (*Centrocercus urophasianus*)	Pointing dogs (German shorthaired pointers)	Belt transect	Dahlgren et al. 2006
Red grouse	Pointing dogs	Line transect distance sampling	Warren and Baines 2007
Ruffed grouse (*Bonasa umbellus*)	Pointing dogs	Belt transect	Berner and Gysel 1969
Sooty grouse (*Dendragapus fuliginosus*)	Pointing dogs	Belt transect	Zwickel 1972
Willow ptarmigan (*Lagopus lagopus*)	Pointing dogs	Line transect distance sampling	Pedersen et al. 2004, Broseth et al. 2005
Northern bobwhite (*Colinus virginianus*)	Pointing dogs	Effective strip width sampling	Guthery and Mecozzi 2008
Desert tortoise (*Gopherus agassizii*)	Herding dogs, Labrador retrievers, and mixed breeds	Systematically searched plots	Cablk and Heaton 2006, Nussear et al. 2008
Ringed seal (*Phoca hispida*)	N/A	Searched likely habitat	Lydersen and Gjertz 1986, Furgal et al. 1996
Study objective: productivity			
Red grouse	Pointing dogs	Belt transects	Redpath 1991, Redpath and Thirgood 1999
Willow ptarmigan	Pointing dogs	Searched entire study area and marked broods	Parker 1985, Schieck and Hannon 1989
Capercaillie (*Tetrao urogallus*)	Pointing dogs	Line transects	Novoa et al. 1996, Storaas et al. 1999
Black grouse (*Tetrao tetrix*)	Pointing dogs	Line transects	Storaas et al. 1999
Greater sage-grouse	Pointing dogs	Line transects and marked broods	Klott and Lindzey 1990, Dahlgren 2009
Columbian sharptailed grouse (*Tympanuchus phasianellus columbianus*)	N/A	Line transects	Klott and Lindzey 1990
Little spotted kiwi (*Apteryx owenii*)	N/A	Searched likely habitat	Colbourne 1992
Study objective: nest searches			
Greater prairie-chicken (*Tympanuchus cupido*)	N/A	Searched likely habitat	Bowen et al. 1976
Willow ptarmigan	Pointing dogs	Searched likely habitat	Schieck and Hannon 1989, Hannon et al. 1993
Capercaillie	Pointing dogs	Line transects	Storaas et al. 1999
Black grouse	Pointing dogs	Line transects	Storaas et al. 1999
Korean pheasant (*Phasianus colchicus karpowi*)	N/A	Searched likely habitat	Wollard et al. 1977
Northern pintail (*Anas acuta*)	N/A	Systematically searched likely habitat	Flint and Grand 1996
Greater golden-plover (*Pluvialis apricaria*)	Pointing dogs	Systematically searched likely habitat	Byrkjedal 1987
Eurasian dotterel (*Charadrius morinellus*)	Pointing dogs	Systematically searched likely habitat	Byrkjedal 1987
Little spotted kiwi	N/A	Searched likely habitat	Colbourne 1992
Yellow rail (*Coturnicops noveboracens*)	German shorthaired pointer	Searched likely habitat	Robert and Laporte 1997
Study objective: capture			
Willow ptarmigan adults and chicks	Pointing dogs	Hand-held nets, by hand, or noose poles	Erikstad and Andersen 1983, Hannon et al. 1990, Broseth and Pedersen 2000
Black grouse broods	Pointing dogs	Large nets dragged over brood or flushed into nets	Caizergues and Ellison 2000, Baines and Richardson 2007
Spruce grouse (*Falcipennis canadensis*)	Pointing dogs	Noose pole	Herzog and Boag 1978
Blue grouse (*Dendragopus* spp.)	Pointing dogs	Noose pole	Zwickel and Bendell 1967, Zwickel 1972
Greater sage-grouse	Pointing dogs (German shorthaired pointers)	By hand and hand-held nets	Connelly et al. 2000, 2003*b*

continued

Table 5.2. continued

Wildlife species	Dog breed or type[b]	Method	Reference
Aleutian Canada goose (*Branta canadensis leucopareia*)	Border collies	Herded into nets	Shute 1990
Mountain lion (*Puma concolor*)	Hounds	Treed and immobilized	Hornocker 1970
Black bear (*Ursus americanus*)	Hounds	Treed and immobilized	Akenson et al. 2001
Study objective: carcass searches			
Bat and bird fatalities at wind facilities	Labrador retrievers	Systematically searched plots beneath turbines	Arnett 2006

[a] For scat-detection wildlife damage, see the text and MacKay et al. (2008).

[b] N/A = not applicable.

detectability-based density estimates (i.e., distance sampling) in land-bird counting techniques, including the use of dogs while sampling. This method consists of using random or systematic transect lines placed in a specified area and casting the dog as the observer and/or handler walks the transect line (Fig. 5.2). The distance from grouse locations (or dog on point) to the centerline is recorded, as well as number of grouse per flock or cluster. Along with density, program DISTANCE (http://www.ruwpa.st-and.ac.uk/distance/) also calculates probability of detection, an effective strip width (ESW), and error rates. If reliable estimates of density can be obtained, those estimates can be used in a Geographic Information System (GIS) application of Kriging (a group of geostatistical techniques to interpolate the value of a random field) that allows extrapolation of data to obtain a spatial distribution of densities (Warren 2006, Warren and Baines 2007). Distance sampling and subsequent Kriging methods have been applied to red grouse, but further evaluation for additional species is needed. This method likely has application for any gallinaceous (and possibly other species) bird that pointing or flushing breeds commonly detect. However, because pointing dogs generally cover more area than flushing dogs and hold point, likely resulting in more accurate counts and distance measurements, we suggest there is an advantage to using pointing dogs over flushing dogs for distance sampling.

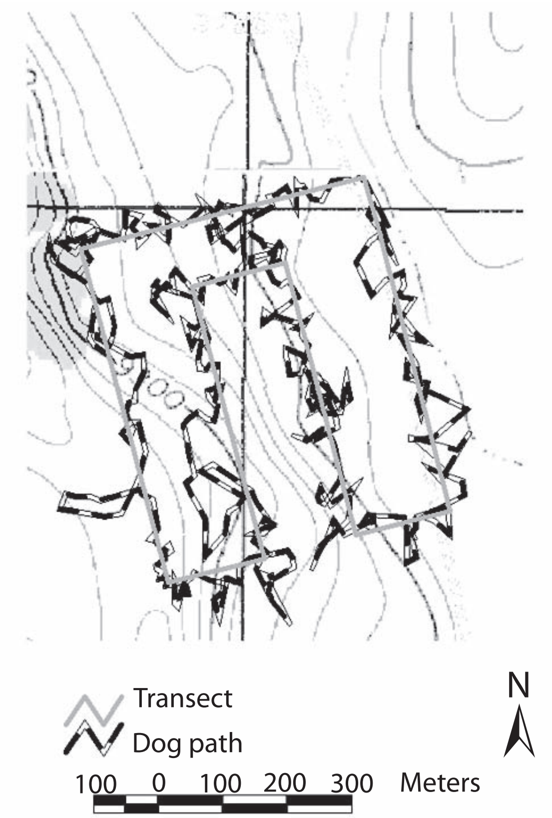

Fig. 5.2. Example of a transect in a 40.5-ha plot to monitor greater sage-grouse using pointing dogs on Parker Mountain, Utah, 2009. Data were collected using Garmin™ Astro GPS units. Transect line spacing was designed to reduce redundancy in the dog's path and to allow for distance sampling procedures. A problem with this design is that grouse detected at the corners do not have a perpendicular distance to transect line.

Guthery and Mecozzi (2008) developed a **modification of distance sampling** to obtain northern bobwhite (*Colinus virginianus*) densities using pointing dogs. This method uses a dog's path, recorded by GPS units attached to the dog, as the theoretical centerline for distance sampling. The distance from where a dog establishes a point to the bird(s) is the perpendicular distance, which program DISTANCE uses to estimate an ESW for the transect. The dog's path is then buffered by the ESW on each side to create an area (polygon). Redundancy in a single or multiple dogs' path(s) is then eliminated. Then the number of birds located within the polygon's area yields a density estimate. This method has only been used on northern bobwhites and has not been evaluated for other species. There are some biases with this methodology that should be considered. First, this method does not account for wind direction and assumes equal detectability on either side of the dog despite wind direction. Second, the assumption that all birds are detected in a path, and thus redundancy is wasted effort may not be valid. And third, measuring detection distance based on an established point may be a poor assumption, as the distance between the bird and an established point can vary considerably among individual dogs. In the authors' experience, many pointing dogs move well past the location of initial scent detection to approach the bird more closely.

Upland **game bird productivity** has been commonly assessed using dogs to locate hens and their broods (Table 5.2). This method is preferred, as observers without dogs often underestimate brood size (Novoa et al. 1996, Schroeder 1997, Dahlgren et al. 2010). Similarly, Dahlgren et al. (2010) reported that greater sage-grouse (*Centrocercus urophasianus*) chicks were detected more frequently using dogs compared to an observer walking alone. Individual chicks are located by the dog once the general location of the brood is found. Chicks have a tendency to hold tight and let observers pass by without flushing. Once a brood hen is located, a dog can be kept in close proximity to her location and can quickly (10 min) find the vast majority of chicks (Dahlgren et al. 2010).

Habitat use and **breeding characteristics** of various upland game bird species also have been studied with the aid of dogs. Baxter and Wolfe (1968) used dogs to evaluate pheasant (*Phasianus colchicus*) brood cover use in Nebraska. Hines (1986) used dogs to monitor flock characteristics, movement patterns, and home range of sooty grouse (*Dendragapus fuliginosus*) in British Columbia, Canada. Novoa et al. (1996) determined that pointing dog surveys provided better estimates of capercaillie (*Tetrao urogallus*) production than did routes carried out by observers alone. Dogs also have been used to determine breeding status. Hannon and Eason (1995) used dogs to assess the pairing status of male willow ptarmigan by searching their territories for females. Thus, for general distribution and abundance, dogs can greatly increase searcher efficiency and area covered.

Nest searches for gallinaceous and other ground nesting birds have been conducted using the aid of dogs (Table 5.2). Flint and Grand (1996) used dogs to search for northern pintail (*Anas acuta*) nests in Alaska. Byrkjedal (1987) used pointing dogs to locate nests of shorebirds (greater golden-plover [*Pluvialis apricaria*] and Eurasian dotterel [*Charadrius morinellus*]) in Norway. Specific species' reaction to nest disturbance should be considered when using dogs for nest searches. For instance, some species, such as northern pintail (Flint and Grand 1996) and spruce grouse (*Falcipennis canadensis;* Keppie and Herzog 1978), will return to a nest following disturbance by a dog, whereas others, like greater sage-grouse, may be prone to abandonment if flushed from a nest, especially during laying and early incubation (Patterson 1952). Most sage-grouse researchers avoid flushing the hen from the nest because of concerns about observer-induced nest abandonment (Fischer et al. 1993, Sveum et al. 1998, Wik 2002, Chi 2004, Holloran and Anderson 2005, Kaiser 2006, Baxter et al. 2008). Indeed, those who have flushed sage-grouse hens from their nests reported comparatively lower nest success rates (Herman-Brunson 2007, Moynahan et al. 2007). For species whose nest ecology is poorly understood, nest success rates should be carefully monitored for disturbed and undisturbed nests to determine whether the use of dogs is acceptable for that species.

Monitoring wildlife **management actions** is an important strategy for assessing practices and applying adaptive management. Dogs can be used to facilitate monitoring activities. Martin (1970) used dogs to assess greater sage-grouse use of chemically controlled sagebrush (*Artemisia* spp.) areas in Montana. Similarly, Dahlgren et al. (2006) used pointing dogs to monitor greater sage-grouse use of chemically and mechanically treated mountain big sagebrush (*A. tridentata* var. *vaseyana*) in late brood-rearing areas in Utah (Fig. 5.3). Newborn and Foster (2002) used dogs to count red grouse on plots where medicated and nonmedicated grit was applied to evaluate parasite control. Larsen et al. (1994) used dogs to monitor pheasant use of food plots in South Dakota.

Dogs have been used for detecting **species of conservation concern,** especially where other techniques are inefficient at detecting species in low abundance and/or patchy habitats. They have been used to locate a number of endangered species in New Zealand for >100 years (Browne et al. 2006), including the blue duck (*Hymenolaimus malacorhynchos*), kiwi (*Apteryx* spp.), and kakapo (*Strigops habroptila*). Detection dogs are an essential part of little spotted kiwi (*A. owenii*) conservation and data collection in New Zealand because of the difficulty locating nests and young (Colbourne 1992). A German shorthaired pointer successfully found the nests of yellow rail (*Coturnicops noveboracens;* classified as a vulnerable species) which are notoriously difficult to locate, in southern Quebec, Canada (Robert and Laporte 1997). Black rail (*Laterallus jamaicensis*), another difficult bird to locate, have been found using a German shorthaired pointer (R. Elmore, unpublished data). Cablk and Heaton (2006) tested

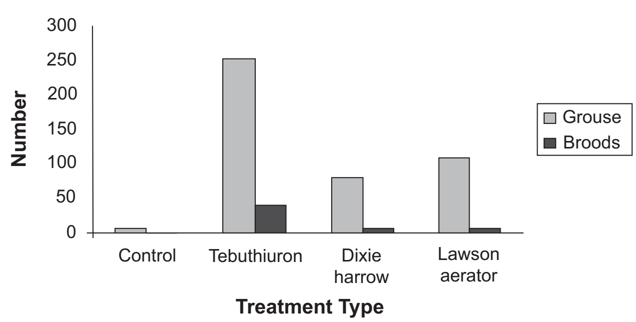

Fig. 5.3. Example of greater sage-grouse use data collected with pointing dogs in 40.5-ha experimental plots on Parker Mountain, Utah, 2003–2004 (see Dahlgren et al. 2006). These data show a preference for tebuthiuron (Spike®; an herbicide) treated plots for both grouse in general and broods specifically. Using dogs allowed the classification of sage-grouse by age and sex, which benefited this project specifically designed to improve late brood-rearing habitat.

the efficacy and reliability of dogs to locate the United States federally listed desert tortoise (*Gopherus agassizii*) above and below ground in the Mojave Desert of the southwestern United States in various climate conditions. They reported that dogs found 90% of the known population and located smaller tortoises than human observers were able to detect. They also suggested using dogs to conduct distance sampling and mark–recapture techniques for this species. Dogs have been used to locate ringed seal (*Phoca hispida*) subnivean structures in the arctic for studies on characteristics of seal predation and territory size (Lydersen and Gjertz 1986, Furgal et al. 1996).

Dogs can be used to locate unknown **grouse leks** (D. Dahlgren and R. Elmore, unpublished data; Fig. 5.4). Although leks are generally easy to locate during the first few hours of the day when the birds are actively displaying, the window of time the birds display is fairly narrow. However, males typically use cover near the lek most of the day. Using pointing dogs that can cover large areas quickly is an ideal method of locating these males. Once a large number of male grouse are flushed, the researcher can mark the location and come back during display periods to do a visual count and determine the precise location of the lek. This method extends survey time in areas with unknown lek locations.

Fig. 5.4. German shorthaired pointers pointing greater sage-grouse while researchers search for unknown lek (display) sites in the spring in northwestern Utah. Using dogs for this purpose can extend the survey time beyond the grouse display period by locating males using habitat near lek sites. Once males are located, researchers can come back during display periods and determine the exact location of the lek.

SPECIMEN AND CARCASS COLLECTION

The use of dogs to detect **carcasses** has many wildlife management and research applications involving human–wildlife interactions. Examples include detecting mortality from collisions with manmade structures, poisons, or disease events. The use of dogs around wind farms is proving to be particularly beneficial to determine impacts on avian and bat species. Additionally, dogs can be allies in the search for bird carcasses due to mortality from pesticide use, especially in dense cover (Homan et al. 2001). Finley (1965) used dogs to help locate birds that were affected by use of an insecticide in a Montana forest. Homan et al. (2001) reported that dogs found 92% of house sparrow (*Passer domesticus*) carcasses compared to 45% by human searchers, and dogs provided a greater searching efficiency per unit time. Because scavenging rates may be high in many areas, the ability of dogs to locate carcasses quickly can be beneficial (Homan et al. 2001). Accordingly, dogs have been successfully used to search for lesser prairie chicken (*Tympanuchus pallidicinctus*) fence strike mortalities in Oklahoma (R. Elmore, unpublished data). Dogs also may be used to search for birds dying from natural causes (Jenkins et al. 1963). Dogs have been used to collect ducks with botulism and were able to be trained to select live specimens (Zwickel 1980).

Arnett (2006) used Labrador retrievers to assess the ability of dog–handler teams to recover dead **bats** (and birds) during fatality searches typically performed at **wind energy** facilities to determine fatality rates for birds and bats (Fig. 5.5). Dogs found 71% of bats used during searcher-efficiency trials at one site and 81% of those at a second site, compared to 42% and 14% for human searchers. Dogs and humans both found a high proportion of trial bats within 10 m of the turbine, usually on open ground (88% and 75%, respectively). During a 6-day fatality search trial at 5 turbines at a wind facility, the dog–handler teams found 45 bat carcasses, of which only 42% (n = 19) were found during the same period by humans. In both trials humans found fewer carcasses as vegetation height and density increased, whereas dog–handler teams search efficiency remained high. Arnett (2006) suggested that broad-scale use of dogs to monitor fatalities at wind facilities may be difficult to implement, especially at large facilities, where several trained dogs and handlers would be required. However, dogs could easily be employed to (1) survey smaller facilities (generally those with 20 turbines), particularly when low-visibility habitats prevail; (2) confirm specific questions regarding individual or small numbers of turbines for any facility (e.g., confirm whether bats are killed at nonoperational turbines or meteorological towers); or (3) obtain more precise and accurate estimates of fatality when testing and comparing different approaches to reduce bat fatalities at wind turbines.

Beyond finding carcasses, there are opportunities to use dogs to locate and capture animals. Small dogs have been used to bring fox pups from dens (Zwickel 1980). Small dogs also have been commonly used by the U.S. Department of Agriculture's Wildlife Services to lure coyotes (*Canis latrans*) into gun range for control (M. Conover, Utah State University, personal communication). Further, Johnson (1970) re-

Fig. 5.5. Researcher Ed Arnett, Bat Conservation International, searches for dead bats and birds beneath wind turbines with his Labrador retriever at a facility in south-central Pennsylvania.

ported that raccoons (*Procyon lotor*) captured using dogs provided the most unbiased and representative diet samples, compared to trap-caught animals. Often when nuisance wildlife requires extermination, wildlife agencies will employ dogs (usually hounds) to track individual animals (M. Conover, personal communication). Mecozzi and Guthery (2008) describe characteristics and behaviors of walk-hunters and dogs pursuing northern bobwhite in Oklahoma and Missouri. Shupe et al. (1990) used pointing dogs to facilitate harvest of northern bobwhite in a study on the vulnerability of sex and age of this species. Hardin et al. (2005) used hunters and pointing dogs to spatially analyze northern bobwhite hunting using models that predict daily harvest. By using such models, better understanding and management of quail hunting can be achieved. The use of dogs to harvest wildlife in indigenous Neotropical villages in Nicaragua was a significant predictor of species composition in harvest, and the advantage of using dogs was their ineffectiveness at pursuing species that were vulnerable to overharvest, such as tree dwelling species (e.g., primates), that are much more difficult to detect with dogs (Koster 2008).

SCAT DETECTION

An emerging field in wildlife work is the use of **scat detection** dogs for research and management (Fig. 5.6). An extensive overview of scat detection dogs is found in MacKay et al. (2008) and Hurt and Smith (2009). Based on these 2 main sources and several other recent works, we provide a detailed summary of dogs used for scat detection.

Early uses of scat dogs involved finding scats of such species as black-footed ferrets (*Mustela nigripes;* Dean 1979, Winter 1981); wolves, coyotes, black bears (*Ursus americanus;* P. Paquet, University of Calgary, unpublished data); and lynx (*Lynx Canadensis;* U. Breitenmoser and C. Breitenmoser-Wursten, International Union for Conservation of Nature Species Survival Commission, Cat Specialist Group, unpublished data) to help biologists obtain presence, diet, and other information on populations. In the 1990s, the new benefit of gleaning **DNA information** from scat—such as individual presence and movement, sex ratios, relatedness, habitat selection, and home ranges (Kohn and Wayne 1997)—led to a more formalized and systematic approach to using scat detection dogs (MacKay et al. 2008). In Washington, wildlife researchers and a professional narcotic-detection dog trainer joined forces and applied training techniques similar to narcotic, cadaver, and search-and-rescue disciplines to scat-detection dog methodology (MacKay et al. 2008; Hurt and Smith 2009). Their formally trained dogs were then used to search for scats of bear and other carnivores in the Okanogan National Forest (S. Wasser, B. Davenport, and M. Parker, Okanogan National Forest, Washington, unpublished data). Subsequently, this research team used scat detection dogs to locate brown (*U. arctos*) and black bear scat over a 5,200-km^2 area in Alberta, Canada, and reported that dogs reduced bias in collection methods (Wasser et al.

Fig. 5.6. After alerting her handler to bear scat (upper center of photo) by sitting next to the sample, the scat detection dog now ignores the scat. She chews on her reward toy while her handler prepares to label and collect the sample.

2004). In their study, scat found by dogs helped identify individual bears and sex ratio as well as habitat use patterns, and it provided indices of physiological stress and reproductive activity.

Many dogs have been trained with a similar professional approach to locate scats of **target species** and ignore others both on land and in water (MacKay et al. 2008; Hurt and Smith 2009). In California, Smith et al. (2003*a*) compared detection and accuracy rates of 4 dogs trained to find scats of San Joaquin kit fox (*Vulpes macrotis mutica*) and demonstrated that dogs could provide large, accurate sample sizes of fox scat for DNA population analyses. They also showed that 1 dog with the lowest detection rate for kit fox scat still equaled the detection rate of 2 experienced humans. Smith et al. (2005) found that scat-detection dog surveys were successful in San Joaquin kit fox population areas that varied in both relative fox density and vegetation type. In addition, other studies using dogs to locate San Joaquin kit fox scat provided current information on status, sex ratio, relatedness, movement patterns, scent marking, and size of home range (Ralls and Smith 2004; Smith et al. 2006*a, b*).

Long et al. (2007*a, b*) used scat detection dogs in Vermont to simultaneously locate scat of black bear, fisher (*Martes pennanti*) and bobcat (*L. rufus*). Dogs proved effective for collecting detection–nondetection data on these three species (Long et al. 2007*a*) and compared to remote cameras and hair snares yielded the highest raw detection rate and probability of detection for each species plus the greatest number of unique detections (Long et al. 2007*b*). Beckmann (2006) used dogs over multiple years to simultaneously locate scat of black bear, grizzly bear (*U. a. horribilis*), wolf, and mountain lion (*Puma concolor*) in Idaho and Montana. DNA from scat combined with location data identified areas that can support these four species at low densities over time (Beckmann 2006). In New Mexico, a dog trained to find bobcat scats produced approximately 10 times the number of bobcat detections than did remote cameras, hair-snares, and scent stations, suggesting the appropriateness of this method for population monitoring of bobcats (Harrison 2006). Scat detection dogs also have worked well from boats. Rolland et al. (2006) used dogs to locate scats of North Atlantic right whales (*Eubalaena glacialis*) and found rates of scat collection with dogs were >4 times higher than with opportunistic methods. Thus, the use of dogs ensured the required number of samples needed to conduct endocrine, disease, genetic, and biotoxin studies was obtained.

Scat detection dogs also have been used in international research. In Brazil, data from dog-collected scat is helping develop species distribution and landscape models for maned wolf (*Chrysocyon brachyurus*), jaguar (*Panthera onca*), mountain lion, giant anteater (*Myrmecophaga tridactyla*), and giant armadillo (*Priodontes maximus;* C. Vynne, University of Washington, personal communication). Moreover, DeMatteo et al. (2009) reported that a dog could successfully locate scats of the bush dog (*Speothos venaticus*) in dense forest vegetation in Argentina, thereby offering an opportunity to obtain data needed for developing conservation strategies.

In controlled laboratory settings, scat detection dogs have been used for their scent discrimination abilities to match species or individuals from scat samples. This use of dogs can potentially help avoid costly **genetic analysis** and provide reliable information for mark–recapture methods (Smith et al. 2003*a,* Kerley and Salkina 2007, Wasser et al. 2009). On the species level, dogs showed promise in being able to differentiate scats of grizzly and black bear (A. Hurt, unpublished data); bobcat and sympatric carnivores, such as fox and coyote (Harrison 2006); and San Joaquin kit fox from red fox (*V. vulpes;* Smith et al. 2003*a*). However, accuracy rates for dogs at this task can be affected by individual dog aptitude and performance, presence of target scats in matching test, and a number of other variables (A. Hurt, unpublished data; Smith et al. 2003*a;* Harrison 2006). On the individual level, Kerley and Salkina (2007) showed that dogs were 87% accurate at matching individual Amur tigers (*P. tigris altaica*) with their scats. Most recently, Wasser et al. (2009) reported that 3 dogs correctly matched 25 out of 28 scat samples from individual maned wolves, thus demonstrating the potential for dogs to assist researchers even more in obtaining valuable information from scat.

Detection dogs also have been trained to detect guano to locate roosting structures used by bats. Field experiments were first conducted to identify factors that influence the probability of guano detection by scent detection dogs in pinyon–juniper (*Pinus* spp. and *Juniperus* spp., respectively) woodlands in New Mexico (A. Chung-MacCoubrey, U.S. Forest Service Rocky Mountain Research Station, unpublished data). Detection probabilities were higher for larger quantities of scat, and detection probabilities decreased as height of scat increased from ground level to 2 m. There was no effect of dog–handler pair or scat dispersal on detection probabilities, but there were significant interactions among temperature, scat distance from path, and cumulative work time: the probability of detection decreased with increasing values of these variables. Lower detection probabilities also were associated with fatigue (cumulative time worked) and time since scat placement. Researchers in Arizona and New Mexico (A. Chung-MacCoubrey, National Park Service, C. Chambers and L. Mering, Northern Arizona University, and C. Vojta, U.S. Forest Service, unpublished data) then tested the efficiency of dog–handler pairs in locating known roosts of bats in ponderosa pine (*Pinus ponderosa*) snags. Dogs in these trials were trained using a blend of guano from 5 species of bats, and the influence of weather, characteristics of roost trees, roost height, number of bats, and dog–handler pair on the success of identifying roosts was evaluated. The researchers found that dogs located 71% of known roosts and were most successful when roosts had higher numbers of bats and were closer to the ground; there was no difference among dog–handler pairs. Building on previous tests, these researchers also compared the success of dogs finding bags with varying quantities of guano (0 g, 5 g, or 20 g) placed at different heights (2 m or 6 m) throughout 1-ha plots and found that dogs were more likely to find large amounts of guano closer to ground than smaller amounts placed higher. The researchers suggested that detection dogs are likely to be most effective in woodlands (e.g., pinyon–juniper), where bats roost close to ground, or in locating ground (e.g., hidden cave) roosts. In summary, scat detection dogs have and continue to be used for a wide range of species in diverse habitats for multiple research purposes.

CAPTURING AND MARKING WILDLIFE

Capturing and marking of wildlife is often an essential field activity for many research projects. Dogs can provide invaluable service to this end (Table 5.2). Some researchers have suggested using pointing dogs to **capture** grouse chicks approximately ≤4 weeks of age; chicks 2 weeks of age can be picked up by hand in front of the dog, but older chicks should be captured in front of the dog using a long-handled net or noose poles (Hannon et al. 1990; Connelly et al. 2000, 2003*b*). Border collies were used to capture and relocate the endangered Aleutian Canada goose (*Branta canadensis leucopareia*) to predator-free islands in Alaska (Shute 1990). Dogs in this study were not only more efficient at capturing geese by herding them into nets, but they also spared injury to geese and researchers that had occurred prior to using dogs. However, dogs may increase mortality during capturing activities (Zwickel 1980), and individual dogs vary in their ability to aid in the safe capture of wildlife. This variability is largely related to prey drive and the level of control that handlers have over their dogs.

Large mammalian predators also have been captured and marked by using dogs (hounds; Table 5.2). Akenson et al. (2001) used hounds to estimate black bear density in Oregon. Hornocker (1970) used hounds to capture and mark mountain lions in Idaho for a predation study. Shaw (1989) used his many years of experience to relate the nuances of capturing mountain lions with hounds that could be helpful to others capturing and marking large cats. In contrast Logan et al. (1999) believed that capturing mountain lions with foot-hold snares produced fewer deaths compared to traditional methods of capture—using dogs and immobilization. Germaine et al. (2000) used hounds to monitor presence–absence data for mountain lions in southwestern Arizona. While focusing on likely habitat, hounds were run off horseback, and hound behavior was noted when they detected fresh scent.

STUDIES OF WILDLIFE BEHAVIOR

Studies of **wildlife behavior** can be aided by the use of dogs. Zwickel (1980) reported this area of using dogs in wildlife research may have the most potential for growth. Storaas et al. (1999) used dogs to simulate mammalian predation on capercaillie and black grouse (*Tetrao tetrix*) nests and broods in fragmented habitats. They found that detection distances (behavior of the predator) and reaction-to-predator distances (behavior of the prey) differed between nests and broods when using dogs. Miller et al. (2001) used dogs (accompanied by a handler and alone) to measure disturbance behavior of songbirds (2 grassland species and 1 forest species) and mule deer (*Odocoileus hemionus*) along recreational trails and off trails. They found that wildlife had different responses to different treatment stimuli. Sweeney et al. (1971) used hounds to chase radiomarked white-tailed deer (*O. viginianus)* and monitor escape behavior. They found that individual deer selected different strategies, but most ended up using bodies of water in their tactics. Most deer returned to their home range within a day, and all deer remained in good physical condition. Artificial nest studies are often used in avian research, but they can be compromised by predator behavior of following human scent trails (Donalty and Henke 2001). Donalty and Henke (2001) used a dog when checking artificial nests to test whether the dog's scent could mask human scent and found no difference in treatments and controls.

WILDLIFE DAMAGE MANAGEMENT

Wildlife damage management is an important field due to an extensive wildlife–agricultural interface and expansion of the human–wildlife interface near urban areas. Dogs have been successfully used to target problem animals for capture, harass animals, and protect domestic animals. Because of the protected status of brown bears in North America, Gillin et al. (1997) suggested using animals specifically bred for chasing bear, Laika dogs, for nonlethal management when bear–human conflicts occur. Karelian bear dogs also have been used for this purpose (see www.beardogs.org; C. Hunt, Wind River Bear Institute, unpublished data.). Beckmann et al. (2004) evaluated the effectiveness of **nonlethal deterrents,** including hounds, to manage problem black bears in the Lake Tahoe Basin of the Sierra Nevada range. They found that over time, all nonlethal deterrents were ineffective at keeping nuisance bears from returning to their original home ranges. In contrast, dogs were used to successfully harass nuisance geese in urban settings (Conover and Chasko 1985). Castelli and Sleggs (2000) reported that border collies were successful at controlling nuisance Canada geese (*Branta canadensis*) in New Jersey. Once trained, these dogs can be confined to specific areas by use of electric fences and shock collars (i.e., invisible fences). This has considerable application for golf courses, which have high rates of wildlife conflicts, particularly with Canada geese (M. Conover, personal communication). Dogs also were used to reduce damage caused by white-tailed deer to a tree plantation in Missouri (Beringer et al. 1994). Caley and Ottley

(1995) tested the effectiveness of hunting dogs for removing feral pigs (*Sus scrofa*). They found that effectiveness of dogs decreased with increasing group size of the pigs, and dogs were biased toward catching male pigs. These researchers found that dogs were only effective for removing pigs following control with other methods.

Detection dogs have been used in Guam to locate brown tree snakes (*Boiga irregularis*) in outgoing cargo to prevent the spread of this invasive species (Engeman et al. 1998). However, the dogs only detected 61–64% of known planted brown tree snakes in an efficacy test (Engeman et al. 2002). The handlers' search pattern did not change between detected and undetected cases, but the dog's body language failed to indicate a snake for the latter. This study demonstrated a difference in detection based on indoor or outdoor searches. This discrepancy likely occurred because of variable scenting conditions outside, or possibly because of training issues, as the dogs experienced more distracting stimuli outside.

Livestock protection dogs have been used for thousands of years in Europe and Asia, but have seen less emphasis in the western hemisphere (Green and Woodruff 1980). Smith et al. (2000) reported a document written in 150 B.C. on Roman farm management that described the use of livestock protection dogs. European breeds are the most common, and Great Pyrenees is probably the most popular breed, though many others exist, including the Akbash dog, Anatolian shepherd, Komondor, and sarplaninac (Green and Woodruff 1980, Green et al. 1984). Green and Woodruff (1988) provided an overview of the use of different breeds and their characteristics for livestock protection. Coppinger et al. (1985) reported that mongrel dogs can make effective livestock protectors as well and, historically, have been used for this purpose by the Navajo tribes of the southwestern United States. One common ingredient for a successful protection dog is raising it among the animals that it is to protect. The majority (89%) of livestock producers using dogs feel they are cost effective, and most (80%) individual dogs from the breeds mentioned above become reliable protection dogs (Green et al. 1984). Andelt and Hopper (2000) showed that protection dogs reduced domestic sheep depredation in Colorado and that producers without dogs lost 2.1 and 5.9 times (depending on year) more lambs than did producers with dogs. Savings from protection dogs outweigh the cost in most cases, and some producers saved up to approximately US$14,000 per year with use of dogs (Green et al. 1984).

TRAINING AND HANDLING

Training dogs in general is an art form as much as a science. All dogs used in wildlife research should have basic obedience training (sit, come, stay, heel, etc.) prior to more specialized training for their target species. There are many different modern and traditional techniques for training hunting dogs (e.g., Wolters 1961, Tarrant 1977, Williams 2002). Training can take place at any age, though young dogs (≤2 years) seem most impressionable. Keeping things simple and fun (no pressure) for puppies is important. Each dog matures at different ages, and a good trainer recognizes when to increase the training pressure. The choice to train a dog yourself for specialized work is a personal one. Often a working relationship or bond develops during training that can reward the trainer with a morale boost and a partner with excellent skills, if done properly. If commitment (of time, space, expertise, and desire) is lacking, the training and its incomplete results can often be the most frustrating aspect of using a dog in wildlife work. Another option is to obtain a partially or fully trained dog, though upfront costs are generally higher than those for a puppy. If personal training is an issue, hiring a professional dog trainer is an alternative to get the dog to perform tasks according to specific project needs. However, after ensuring the professional trainer understands these specific needs, the researchers using the dogs need to work with the trainer, so the dog will respond to them as consistently as it does to the trainer.

This requirement presents an inherent problem for wildlife research work. Research projects often rely on graduate students, who may be working on the project for only 2–4 years. These temporary situations may conflict with committed dog ownership (unless the graduate students have their own dogs), because the life span for most working breeds generally ranges between 8 and 12 years. Therefore, it may be preferable for a principal investigator—rather than the university or agency—to have ownership of the animal. Trained dogs can then be used as needed by field personnel. In our experience, university and agency ownership adds considerably to the burden of using dogs in research, as institutional requirements become very restrictive.

Another option is to use **volunteers** from local hunting dog or conservation groups. Such organizations as the North American Versatile Hunting Dog Association or AKC breed clubs have chapters throughout North America and may provide volunteers with highly trained dogs. We caution that dogs and handlers vary greatly, and it may be difficult to ensure quality data collection. Specific protocol must be established and adhered to. However, for general presence–absence studies or animal capture, they can be extremely beneficial. Additionally, in some cases volunteers could be used to determine density or indices to density of animals, such as in an evaluation of habitat treatments (Dahlgren et al. 2006).

Use of modern **electronic collars** (e-collars; the authors have successfully used products from the following companies: Tri-tronics, Tucson, AZ; and Dogtra, Torrance, CA) can be helpful for training purposes (e.g., Dobbs et al. 1993). E-collars are a humane and effective method for dog training if used properly. If used improperly, e-collars are destructive to both the training process and the dog's personality and drive. The most common mistake people make when using e-collars is delivering correction from the e-collar prior to the dog's complete understanding of the command.

A dog must know it disobeyed a command before stimulation from the e-collar can be effective. This understanding from the dog comes from consistent repetitive training sessions prior to e-collar stimulation. Without this understanding, training with an e-collar is completely ineffective. Additionally, dogs vary in how they respond to e-collars. For some dogs, it may not be an effective tool.

Scat detection dogs are motivated by different factors than many dogs trained to find live animals; pointing dogs, for example, have instincts for bird detection that training will hone. In contrast, scat detection dogs are obsessively eager to receive a reward (usually toy-play or food) and are taught to seek a target of no inherent interest by learning that finding that target will result in getting the reward. This noninstinctual reward-based system relates to other differences between scat detection dogs and other wildlife dogs: breed is largely irrelevant and dogs may be taught to detect many targets at once. In all documented studies to date, scat detection dogs have varied by sex, age, and breed (pure and mixed; e.g., Australian cattle dog, Australian shepherd, Belgian malinois, border collie, German shepherd, golden retriever, Labrador retriever; Table 5.1). Of great interest to biologists is that scat detection dogs have the ability to be trained to multiple species, cover large search areas, and locate cryptic or hard-to-find scats of rare and common species. Furthermore, scat detection dogs have been successful in cross-training to detect live animals as well as invasive and rare plants (Cablk and Heaton 2006; Goodwin et al. 2006). In fact, with some live-animal detection, it may be favorable to work a dog with less prey drive and thus less inherent interest in the target (see Calbk and Heaton [2006] for detailed information on training and handling dogs for locating desert tortoise).

Without breed preferences or instinctual interests as a guide, selecting dogs with a specific set of traits is paramount for successfully training a dog for scat detection. Desirable traits, or "drives," in a scat detection dog are similar to those in one selected for narcotic or cadaver detection, but the ideal proportion of these qualities may differ from dogs better suited for other detection disciplines. The relevant drives and characteristics (and ideal drive strength) are pack drive (moderate), play drive (extremely high) or food drive (extremely high), hunt or search drive (extremely high), prey drive (low to moderately high), work ethic (extremely strong), and nerve strength to handle stress and new stimuli (moderate or greater). Scat detection dogs contend with rugged physical environments, like all other wildlife dogs, and so the most versatile and low maintenance dog will be heat tolerant, moderately sized, agile, and fit (Hurt and Smith 2009).

Training is similar to other detection disciplines and consists of: (1) imprinting the target odor so the dog understands that smelling the target results in receiving the reward, (2) training an "alert" (e.g., sit or bark) the dog is to perform upon locating the scent, (3) developing interactive search behavior with the handler, and (4) maintaining fidelity to the target scent. Because individual dogs vary considerably, the selection criteria are strict, and training is intense, not all candidates that begin training end up being used for official work; one dog out of 200–300 will be selected to begin training, and of those selected, 40% become field ready (Hurt and Smith 2009). For additional selection and training information for scat detection, see Smith et al. (2003*a*), Wasser et al. (2004), and Hurt and Smith (2009).

Arnett (2006) trained Labrador retrievers to locate dead bats by seeding a 10 m × 25 m belt transect with bat carcasses representing different species and in varying stages of decay. The dog was rewarded with a food treat if it performed the task of locating a trial bat, sitting or at least stopping movement when given a whistle command to do so, and leaving the carcass undisturbed. Arnett (2006) chose to begin formal testing based on his perception of the dogs' quickening response to the scent of trial bats, their response to commands, and their ability to consistently find all trial bats during their last few days of training.

SPECIAL CONSIDERATIONS

Reporting research results is a special consideration when using dogs for wildlife studies. Here the researcher must describe the specific attributes of the dogs used and steps taken to control bias and variance among dogs. It is not adequate to simply state that dogs were used in a certain manner to collect data. Specific information needs to be reported, such as breed, temperament (prey drive), range (average and maximum), and ground coverage (average velocity, redundancy in pattern) of the **individual dogs.** Although this requirement may seem a radical departure from traditional research involving humans, it is necessary when using dogs. For human researchers we often have established protocols to attempt to eliminate observer bias. Removing bias is more difficult to achieve with dogs, as they do not completely understand research intent. For example, a dog's range is unique to that animal, as is its velocity of travel. Although the handler can take steps to control for these variations, such as selection of individuals and monitoring range, there are limitations on what can be controlled, and any 2 dogs will behave differently. Therefore, studies using the same methodologies, but with different types of dogs could vary considerably in their results. This variability does not necessarily result in poor studies, but for a researcher attempting to replicate the work, it becomes problematic. However, if specific characteristics of the dog(s) are explicitly described, the reader can more accurately infer results and design future research that is comparable. This practice should be considered true disclosure, just as with any study where potential limitations are described.

We believe **future research needs** for using dogs in wildlife studies could be enhanced by considering the following information. First, the effects of scenting conditions are inherently difficult to deal with and have rarely been modeled. By quantitatively assessing these environmental factors, better data and a greater understanding of scenting conditions can be gathered. Second, with an increase in the use of probability detection techniques, it will be important to know how detection rates may vary by species and individual dogs. Third, we have described various techniques for using dogs to obtain density estimates. Efficacy studies on techniques using dogs have been rare in wildlife research, and there is a need for more work assessing the accuracy of these methods.

SUMMARY

Although dogs have been used in wildlife management and research for many years, there has not been a synthesis of this work, and their use has largely been conducted by trial and error on the part of individuals. We have synthesized the vast array of useful applications of dogs in the field of wildlife management and research. We hope this chapter will not only serve as a reference for field practitioners, but also will stimulate new applications of dogs in our field. Dogs have limitations, and there are special considerations in using them, just as for any technique or tool. Despite their limitations, they provide the wildlife professional with abilities that cannot be otherwise replicated.

The authors' experience and the available literature indicate that dogs are truly an underutilized tool. We hope that professionals find this information useful and consider methods using dogs to better manage wildlife resources. In many instances, the dogs can lend superior skills that lead to better data in the field of wildlife research and management. Advances in techniques from scat detection to GPS technology increase the value of dogs for wildlife work. Consistent and proper training cannot be overemphasized when considering dogs for use in data collection. "Man's best friend" may in fact be a biologist's best asset.