AgriLIFE EXTENSION
Texas A&M System

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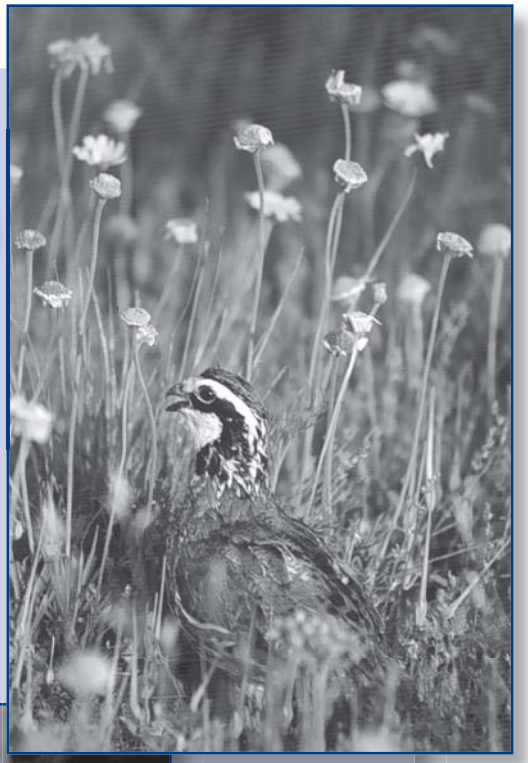
Counting Quail



**Dale Rollins, Jason Brooks,
Neal Wilkins and Dean Ransom, Jr.***

*Professor and Extension Wildlife Specialist;
Graduate Research Assistant, Texas Agricultural Experiment Station;
Associate Professor and Extension Wildlife Specialist;
and Assistant Professor, Texas Agricultural Experiment Station;
The Texas A&M University System.

Bobwhite and scaled quail populations have declined over much of their range in Texas during the last 30 years (Fig. 1). Those areas that still support good quail populations (generally northwest and south Texas) command top prices for quail leases and real estate value. Landowners and hunters are no longer taking the future of quail for granted. Habitat management techniques such as prescribed burning and brush "sculpting" are often used to try to increase quail abundance. But do such practices work? Do quail populations increase in response to our management efforts? Landowners and managers need a way of estimating quail populations on their properties and monitoring population fluctuations over time. Such estimates would allow managers to gauge the effectiveness of their management efforts.

Quail populations in Texas are often irruptive; that is, they have distinct "boom and bust" trends (Fig. 2). The causes of such irruptions are not fully understood, but we know they are driven by precipitation. The goal of quail management should be to maximize quail abundance in good years and minimize the decline in bad years. Tracking the magnitude of fluctuations can aid in making management decisions.

Managers have several options for assessing quail population trends. None of the techniques described are completely accurate, but when done consistently for several years the results can indicate the trend of a local quail population and how it responds to management. The survey methods vary in their degree of difficulty (Fig. 3). Some are very simple, while others are used only by trained personnel conducting research.

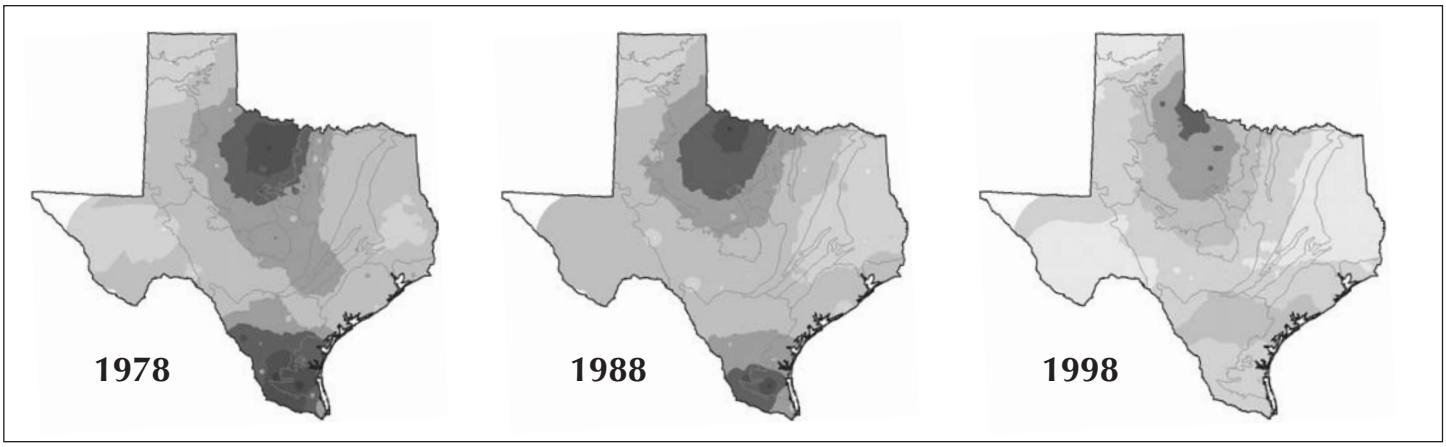


Figure 1. Bobwhite populations have declined over most of their range in Texas over the last 25 years. The darker areas indicate a greater abundance of bobwhites (adapted from Peterson et al. 2002).

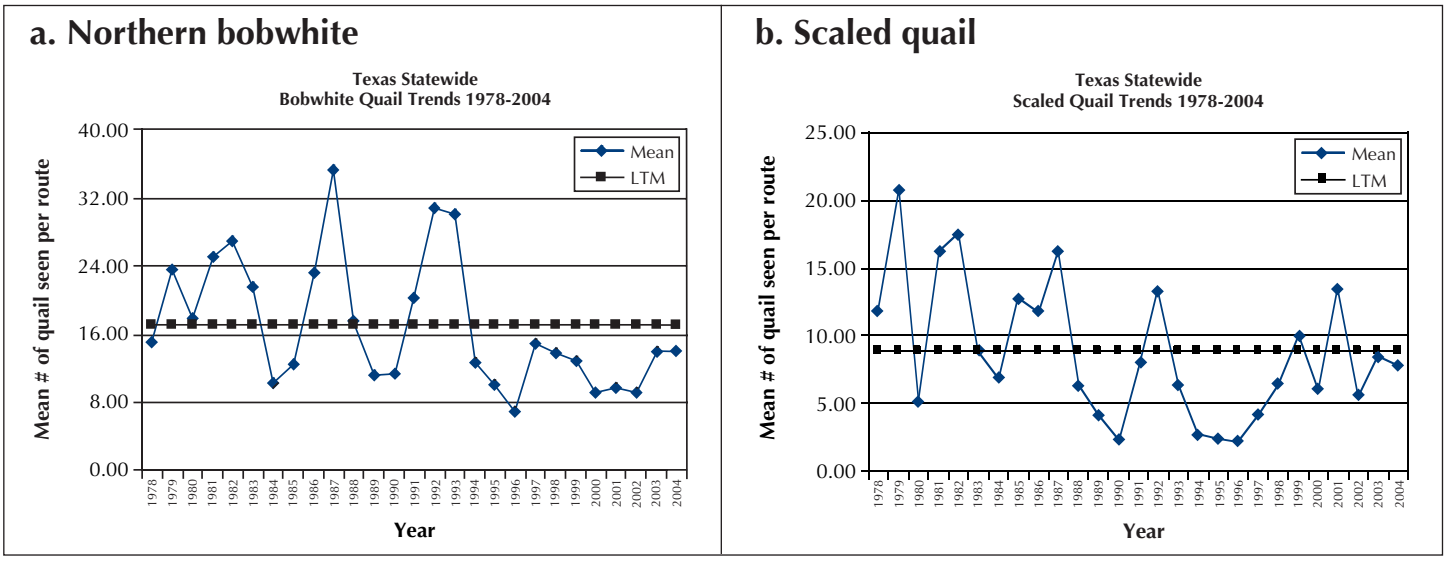


Figure 2. Statewide population trends for (a) bobwhite and (b) scaled ("blue") quail from 1978 to 2004 illustrate the "boom and bust" nature of quail populations in Texas. These data are from the Texas Parks and Wildlife Department's annual roadside surveys. The dashed line is the long-term mean (LTM).

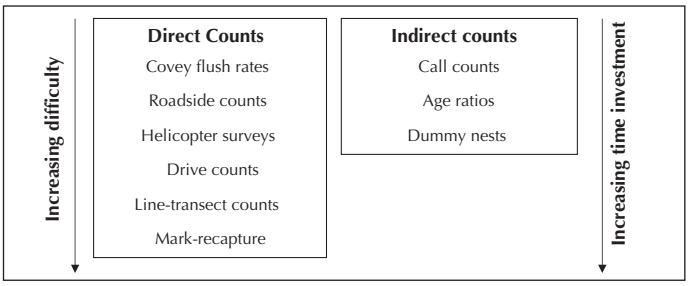


Figure 3. Counting techniques require different amounts of time and skill.

The techniques (with a few exceptions) are applicable to bobwhite and scaled ("blue") quail throughout Texas.

Before discussing actual survey techniques, some terms should be defined.

- **Population** – a collection of individuals that occupies a defined area at a specific time.
- **Abundance** – the number of individuals in the population.
- **Density** – the number of individuals per unit of area. Quail densities are often described as birds per 100 acres. A good management goal is one bird per acre.
- **Index** – the measure of some aspect of a population that is assumed to fluctuate with actual population size. A call count is an index. It is assumed that as population size increases, the number of birds calling will increase. Indices should be used with caution because their relationship with actual population size is unknown.
- **Trend** – a pattern of change in abundance or density over time or over several properties, pastures or even ecological regions.
- **Direct count** – counts based on direct observation of quail.
- **Indirect count** – counts based on observations of quail behavior such as whistles. Indirect counts are basically indices.

Direct Counts

Roadside counts

This is the method used by the Texas Parks and Wildlife Department (TPWD) to index quail populations at an ecoregion-level. Roadside counts are usually conducted in August or September. A designated transect (20 miles long for TPWD counts, various distances for ranch counts; the Texas Quail Index uses a 10-mile route) is driven at no more than 20 miles per hour. The counts should be conducted in the 2 hours after sunrise or before sunset. Different starting and ending points should be used each time the transect is driven. If the transect lies mostly east to west, conduct counts (morning or evening) so that the sun will be mostly at your back. Count and record all quail observed. Conduct at least three counts.

Helicopter surveys

Aerial surveys (conducted from a helicopter or airplane) are commonly used to count deer and pronghorn antelope in Texas, and have been used recently to survey quail. Generally, a quail survey is conducted in conjunction with a deer survey. Helicopter surveys are a form of line-transect survey.

Helicopters fly approximately 75 to 150 feet above the vegetation at a speed of 30 to 40 miles per hour. Adjacent transects should be at least ¼ mile apart and can be up to 1 mile apart on larger properties. Although counting quail from helicopters is experimental, preliminary findings suggest that the results are similar to those from line-transect counts.

Covey flush rates

Hunting success is positively correlated to the population densities of bobwhites. When using hunting success to estimate population trends over the years, hunting methods should be standardized, including factors such as the presence or absence of dogs, the daily start and finish times, and whether or not hunting takes place on baited roads. Habitat conditions should remain relatively constant and the sample period should be short. In Texas, quail season lasts 4 months, but comparisons should be made only early in the season and from the same time period each year (e.g., during the month of November). The entire management unit should be hunted to generate an accurate estimate. Hunting only the best areas (i.e., "honeyholes") will bias estimates of abundance.

The important variable to be recorded is the number of coveys flushed per hour, not the number of birds harvested. This number can then be compared with the size of the area covered to generate an estimate of coveys per unit of area. Estimates obtained from flush rates are likely conservative, as several studies have found that bird dogs typically detect only about two-thirds of the quail on a property on any given day.

Drive counts

Drive counts are conducted by several observers walking abreast (sometimes with the aid of dogs) and counting all quail that flush. Observers must be careful not to count the same birds twice. This method assumes the unlikely premise that all coveys are flushed and counted. The more observers there are the less space there will be between them and the more accurate the count will be. At least 15 to 25 percent of the property should be sampled. These counts generally underestimate populations and may be considered to give an estimate of the minimum population.

Line-transect counts

Line-transect counts (sometimes referred to as distance sampling) are a labor-intensive method of estimating quail abundance, but they may yield the most accurate results. Accordingly, distance sampling is usually restricted to research projects. An observer walks along a straight line (or transect) and counts the number of birds flushed. The right-angle (perpendicular) distance from the transect line to the point where the quail flush is measured (Fig. 4). A laser range finder or measuring tape can be used to measure this distance. The measure must be taken from the point where the bird(s) were initially sighted. These distances allow the observer to determine the likelihood of a covey flush as the distance from the transect increases. A computer program, DISTANCE, can be used to make these calculations and produce a population estimate.

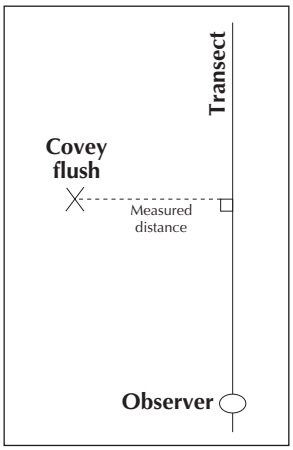


Figure 4. During line-transect counts, flush distances should be measured perpendicularly from the flush site to the transect, not from the observer to the flush site.

Assumptions that must be met when you conduct line-transect surveys are that

- all coveys on the line are observed,
- coveys are fixed in their initial position,
- measurements are exact,
- observations are independent events, and
- the probability of detecting a covey is independent of covey size.

Here are some guidelines for making line-transect counts.

- Establish four transects, each 1 mile long, per square mile or section (640 acres) of habitat.
- Conduct counts during the first 3 hours of daylight.
- Record only the birds flushed by the observer(s). Do not count those flushed by other people, vehicles or animals (e.g., cattle).
- Sample each line equally and repeat the counts three to five times.
- An estimate of average covey size can be obtained from the birds counted on the transect as well as from the number of coveys flushed along roads or during incidental field activities.

  With the average covey size you can use the number of coveys per acre to estimate the number of birds per acre.

Mark-recapture

The most accurate method of estimating population is mark-recapture, which involves trapping and marking quail (generally with leg bands), and then recapturing birds at a later date. Birds can be recaptured in another trapping session or by hunting. This method is costly, labor intensive, and requires special permits from the Texas Parks and Wildlife Department; therefore, it is used exclusively in research settings. The method assumes a "closed population," with no immigration or emigration, or births or deaths between captures. Program MARK is a computer software package that has several options for analyzing mark-recapture data.

Call counts

Call counts are simply counts of whistling quail (Fig. 5). There are two types of call counts for bobwhites—spring (mating) and fall (covey) call counts. Scaled quail do not have a fall covey call, so only spring call counts apply to them. To conduct these calls, permanent listening posts should be established at certain intervals (1-mile intervals are suggested). Calls may be heard up to 600 yards away, so all stations should be at least ½ mile from each other. Data sheets with concentric circles are a helpful aid for recording the locations of calling cocks or coveys (Fig. 6). Counts should not be conducted when it is raining or when the wind is blowing more than 10 miles per hour. Listening posts should be positioned at least a mile away from highways, if possible, to lessen problems with traffic noise.

Figure 5. Call counts are conducted in early morning. Record only the male "bob-white" whistles in the spring and the covey calls ("koi-lee") in the fall.

Spring call counts

Spring call counts are conducted in spring and early summer. During this time, bobwhite cocks give the familiar "poor-bob-white" whistle to attract a mate. The mating call of the scaled quail is the "whock" call (see *http://teamquail.tamu.edu/TexasQuailIndex.htm* for recordings of quail whistles). Quail make other calls, such as the assembly call, but only the mating call is recorded for spring call counts. Cocks calling at this time are generally thought to represent the bachelor males (those not paired) in the population, although this assumption has not been tested. Peak calling is typically observed in May and early June in Texas, so surveys should be conducted during this time period.

Call counts should begin about sunrise and continue for 1 to 1½ hours after sunrise. Drive to a particular listening post, then turn off the engine of your vehicle and walk about 25 yards away in order to get away from the noises of the engine cooling down. Note the time (a stopwatch is recommended), and then count (a) the number of different cocks heard, and (b) the total number of calls heard. Marking the location of various cocks calling on the data sheet (Fig. 6) will help you determine if a bird you hear calling has been identified previously. Experience shows that spring call counts are fairly accurate until the number of calling cocks is greater than eight birds per listening post. Each station should be monitored for at least 3 minutes, preferably 5 (monitor for the same length of time at each listening station). Then proceed directly to the next station and repeat the procedure until all stations have been completed. The surveys should be conducted at least three times. These counts provide an index of breeding "capital."

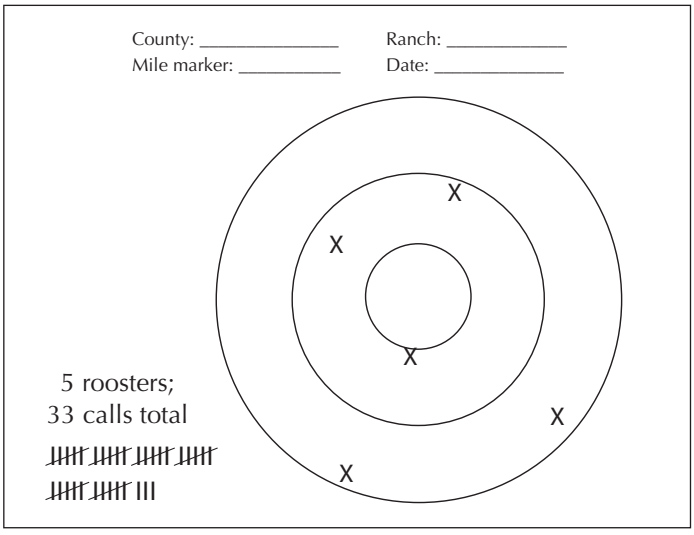


Figure 6. Data sheets with concentric circles aid in recording the locations of different coveys/cocks during whistle surveys. Your listening post should be at the center of the circle. Each ring represents a distance of 200 yards. An "x" is placed at the approximate location of the bird. Tick marks (lower left) record the total number of calls heard.

Fall covey counts

Covey calls of bobwhites are often called "wake-up calls." Covey calls, given as "koi-lee," are typically heard during the fall and winter (October to March) in the early morning, about 30 minutes before official sunrise. Calling sessions are generally brief, lasting from 30 seconds to several minutes. Go to a listening post at least 45 minutes before official sunrise and listen for a total of 20 minutes after you hear the first covey call, as sometimes calling commences a second time. There is usually a chorus effect as one covey begins to call and surrounding coveys join in. For fall counts, only one station can be sampled each day. Use the same permanent listening posts as for the spring call counts, but realize that you can record call counts at only one listening post per morning. You might enlist several observers to increase the number of listening points sampled on a given day. Use the same type of data sheet as for spring call counts to help locate individual calling coveys. This survey also should be conducted at least three times.

Age ratios

The increase in the annual quail population from reproduction is an indicator of management success and the influence of other environmental factors. Keeping stringent harvest records can give you an indication of population change over the years. The ratio of adult to juvenile quail in the hunter's bag is a measure of productivity and survival since the breeding season. More productive breeding seasons (in other words, cooler, wetter summers) yield a higher percentage of juveniles in the bag (Fig. 7). In Texas, adult:juvenile ratios for bobwhites have ranged from 1:0.6 (poor reproduction) to 1:11.8 (outstanding reproduction). In the Rolling Plains, adult:juvenile ratios average about 1:3.8, while in South Texas, the average is about 1:2.8. For scaled quail, adult:juvenile ratios have ranged from 1:0.2 (poor reproduction) to 1:7.0 (good reproduction).

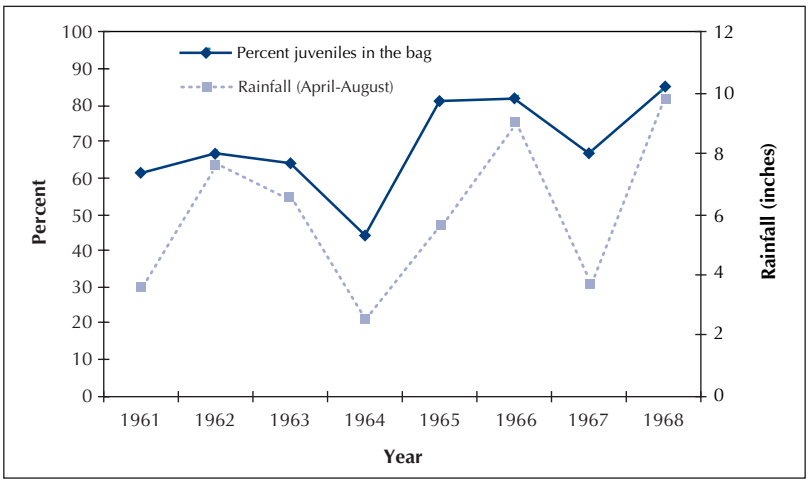


Figure 7. Rainfall during the breeding season is correlated with production and the subsequent percentage of juveniles in the hunter's bag. These data are for scaled quail from southeastern New Mexico (from Campbell et al. 1973).

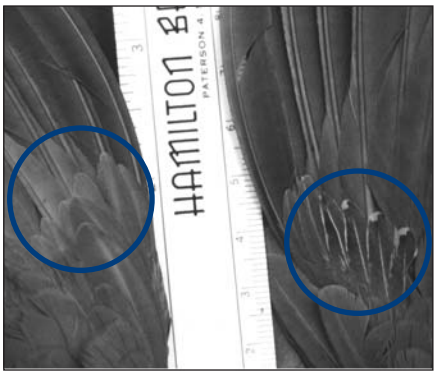


Figure 8. Quail can be aged by comparing the primary coverts (small feathers located on the top of the wing). Coverts on adults (birds at least 1 year old, left) have uniform coloration, while those on juveniles (birds less than 1 year old, right) have white- or buff-colored tips.

These data are easy to collect from harvested birds. Juveniles have buff-colored tips on their primary coverts, the small feathers on the upper side of the wing that cover the primary flight feathers (Fig. 8). Adult primary coverts are a uniform gray-brown color. These patterns apply to both bobwhite and scaled quail.

Dummy nests

"Dummy" nests are simulated quail nests (containing three chicken eggs in lieu of quail eggs) used to monitor nest survival. A group of simulated nests (e.g., 36 nests) are established and then monitored weekly for a given time period (28 days are recommended). Supplies needed for this technique include medium-sized chicken eggs, flagging tape, a permanent ink marker, latex gloves, metal washers (nickel- to quarter-sized), and data sheets for recording the locations of the nests (Fig. 9). A small cooler is helpful for transporting supplies. If available, a hand-held GPS unit can be used to record waypoints for each nest and help in locating nests during monitoring.

To begin, randomly select six of your listening posts. Once you arrive at a listening post, flip a coin to randomly select the side of the post (left or right) where you will establish your transect. At a right angle (90 degrees) to the road, count off 50 yards and flag the nearest tree. Identify this flag by writing on it with a permanent marker "T1 N1" (transect one, nest one). From the tree, count off ten steps

Figure 9. Supplies necessary for establishing dummy nests include (from left to right) pencil, data sheets, flagging tape, permanent marker, medium-sized chicken eggs, and metal washers. A hand-held GPS unit is optional. Latex gloves should be worn when handling eggs.

to the right. Select the nearest suitable bunchgrass (more than 12 inches in diameter) in which to situate the nest. Use the toe of your boot to hollow out a small "bowl" at the base of the grass clump. Place a small washer in the bowl and put three eggs in the bowl (handle the eggs with latex gloves to avoid contaminating them with human scent). The washer will identify the nest bowl in the event that all eggs are removed by a predator.

Eggs should be well concealed to simulate an actual quail nest (Fig. 10).Take a GPS waypoint at the nest now (if available). Count the number of steps from the nest back to your flagging, and record the distance and a description of the location of the nest (e.g., "14 steps southwest in silver bluestem at the base of small mesquite"). The more descriptive you are, the more likely you are to find the nest in subsequent weeks. Now, resume your heading along your transect and count another 50 yards. Flag the nearest tree (label it as "T1 N2" for transect one, nest two), but this time go 10 steps to the left of the transect. Create another simulated nest. If prickly pear is on the site, alternate between using grass clumps and prickly pear as nest sites (you might situate all odd-numbered nests in prickly pear). Repeat these procedures until there are six nests on the transect.

Figure 10. Dummy nests should be well concealed in order to properly simulate an actual quail's nest. The circle depicts the location of this dummy nest.

As you return to the listening post, count and record all suitable bunchgrass (basketball-sized) and prickly pear (size of a hoola hoop) nesting clumps encountered along the transect. Hold out your arms and count all clumps that are rooted within your arm span (approximately 2 yards for a person who stands 6 feet tall) (Fig. 11). Multiplying the number of nest clumps encountered by a factor of 8 provides an estimate of the number of suitable nest sites per acre.

Monitor simulated nests once a week for 4 weeks. Check the nests on the same day of the week if possible. Record whether each nest was "intact" or "destroyed." If any nests survive for 2 weeks, replace the old eggs with new eggs. Do not replace eggs in the nests that were destroyed. Carry the old eggs back to your vehicle for disposal some distance away; do not discard them near your nest transects. Doing so could attract nest predators and bias your simulated nest survival.

Figure 11. Nesting habitat is often the limiting factor for quail populations. Counting the number of bunchgrass clumps (size of a basketball) and prickly pear (size of a hoola hoop) rooted within the observer's arm span provides an estimate of nesting cover.

Designing a monitoring system

Surveying quail (perhaps with several of the methods described here) allows managers to gauge the effectiveness of their management practices. Consistency is important, both in the timing of surveys across the years and in the methods used. Here are some guidelines for designing a comprehensive population monitoring system.

- Use more than one survey method. This will help offset biases from one particular survey and allow you to compare results from different surveys.

  Divide your property into management units, especially if you have more than 3,000 acres. Using ecological or operational boundaries (pastures) is the best way to do this.

- Establish a permanent route using steel t-posts complete with permanent markers (Fig. 12). If the property is large enough (perhaps 2,000 acres or more), we recommend positioning listening posts at 1-mile intervals. Listening posts also can be used as photo points. Taking photos in these locations at the same time each year can demonstrate changes in habitat over time.

Figure 12. Permanent markers serve as references for photo points and listening posts for whistle counts.

- Keep detailed management records. This includes the records from individual counts, but also precipitation records, harvest records (e.g., flush rates, percent juveniles in the bag), livestock grazing records, habitat manipulations, and management changes. Summarizing records across years may reveal patterns that aid in making management decisions.

- Consistency is key. Conduct surveys consistently; do not be afraid to try new techniques, but maintain at least one baseline survey across the years.

Texas Quail Index

The Texas Quail Index (TQI) is a long-term demonstration that began in 2002. It uses several of the methods described here to correlate these indices with the number of birds encountered during the hunting season (Fig. 13). Scent stations and forb diversity are two other techniques used in the TQI. The TQI Web site, *http://teamquail.tamu.edu/TexasQuailIndex.htm*, contains preliminary results and also has protocols and data sheets for each of the techniques described above.

For more information on quail population surveys or the Texas Quail Index, contact your county Extension agent or local Texas Parks and Wildlife biologist, or visit one of the following Web sites:

TeamQuail — *http://teamquail.tamu.edu*

Texas Parks and Wildlife — *www.tpwd.state.tx.us*

Tall Timbers Research Station — *www.ttrs.org/research/gamebird.htm*

Resources

Campbell, H., D. K. Martin, P. E. Ferkovich, and B. K. Harris. 1973. Effects of hunting and some other environmental factors on scaled quail in New Mexico. Wildlife Monograph 34.

Peterson, M. J., X. B. Wu and P. Rho. 2002. Range-wide trends in land use and northern bobwhite abundance: an exploratory analysis. *Proceedings of the National Quail Symposium* 5:35–44.

Figure 13. The ultimate goal of quail managers is being able to forecast the number of coveys that will be encountered during hunting season.