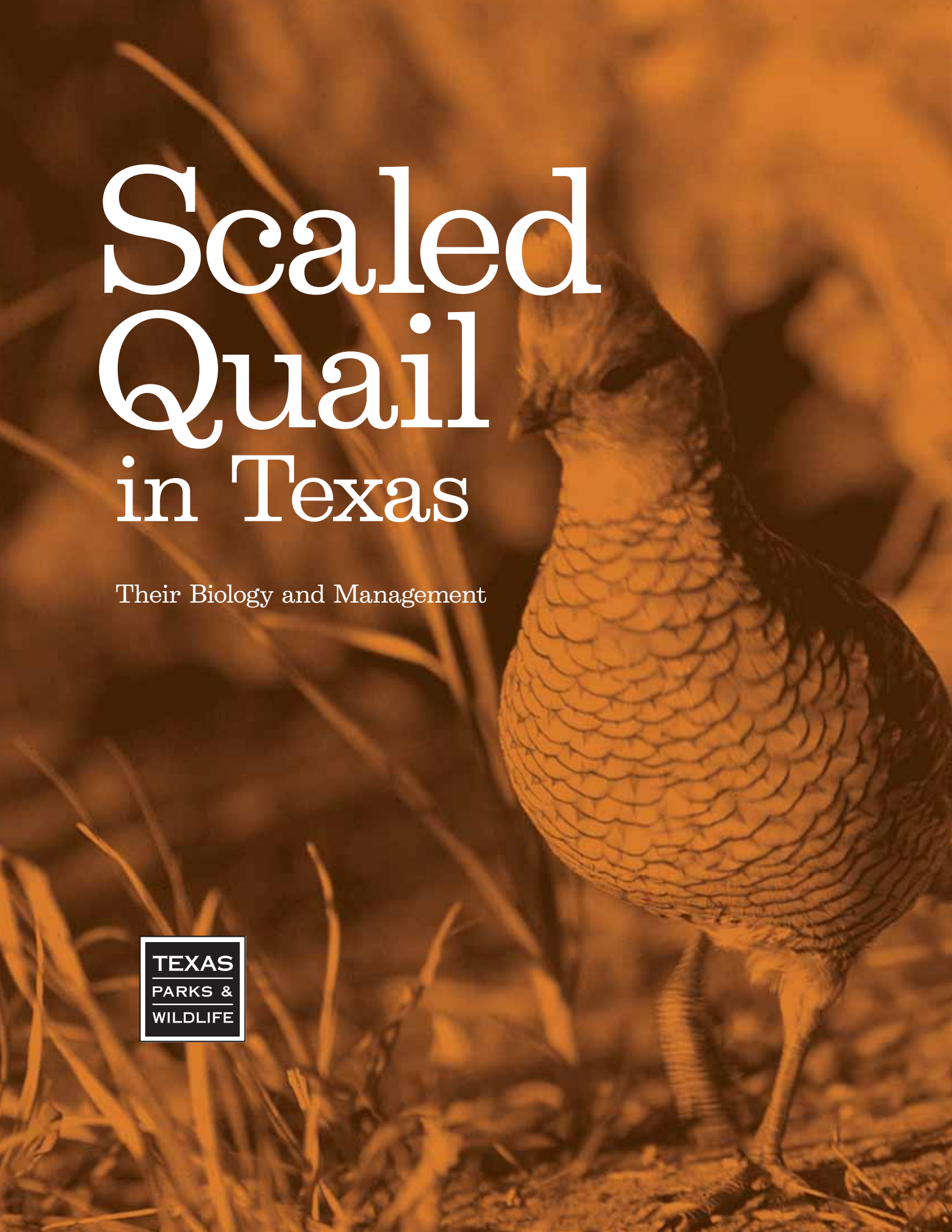

Scaled Quail in Texas

Their Biology and Management

TEXAS PARKS & WILDLIFE

Scaled Quail in Texas

Their Biology and Management

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INTRODUCTION

Four species of quail occur in Texas: northern bobwhite, scaled, Montezuma and Gambel's quail. However, when a Texan says that he is going "bird hunting" it is understood that he is going quail hunting – as in bobwhite hunting! Scaled quail are the next most common quail, but they usually do not get the same respect as the more "gentlemanly" bobwhite. Cussed at by hunters, dog trainers and perhaps even by bird dogs, the scaled quail is an upland game bird of the highest degree.

Although scaled quail are distributed widely throughout the southwestern United States, they have attracted relatively little attention in terms of scientific research compared to the more popular bobwhite. Scaled quail "management" is often limited to scattering a handful of grain around the ranch headquarters. Few direct management efforts are practiced routinely to benefit scaled quail. The ability to (a) recognize the essential needs of scaled quail, (b) appreciate the bird's limitations and (c) understand how weather and land management (e.g., livestock grazing) affect habitat are important skills for aspiring quail managers.

The purpose of this publication is to help land managers, sportsmen and others interested in scaled quail by describing its life history and habitat requirements. Management alternatives for enhancing scaled quail habitat in Texas are also addressed.

DISTRIBUTION

Scaled quail are commonly known as either "*blue*" quail, referring to the blue-gray body color ; "*cottontop*", referring to its white crest; or "*scalies*", referring to the scale-like appearance of the breast feathers, and chestnut-bellied quail, referring to the dark brown belly feathers commonly found on the South Texas subspecies. There are three subspecies of scaled quail. *Callipepla squamata squamata* occurs in Central Mexico; *C. s. castanogastris*, occurs in Central and South Texas and northeastern Mexico; and *C. s. pallida*, occurs in West Texas, New Mexico, western Oklahoma, southeastern Colorado, southeastern Arizona and northern Mexico.

Scaled quail inhabit the western one-third of Texas, generally west of the 100th meridian which corresponds roughly to U.S. Highway 83 (Fig. 1). Within scaled quail range in Texas, rainfall varies from 8 inches per year in the west up to about 25 inches per year in the east. The eastern edge of scaled quail range may extend eastward during periods of drought (e.g., 1950s). The range of scaled quail overlaps that of northern bobwhite east of the Pecos River. In far West Texas, scaled quail range also overlaps that of Gambel's and Montezuma quail. Scaled quail inhabit arid and semi-arid lowlands of sparse low-growing shrubs in level or rugged terrain. They are found throughout West Texas, except in the higher elevations (above 6,500 feet) and throughout the Panhandle where the highest densities occur along drainages, canyons and rough breaks.

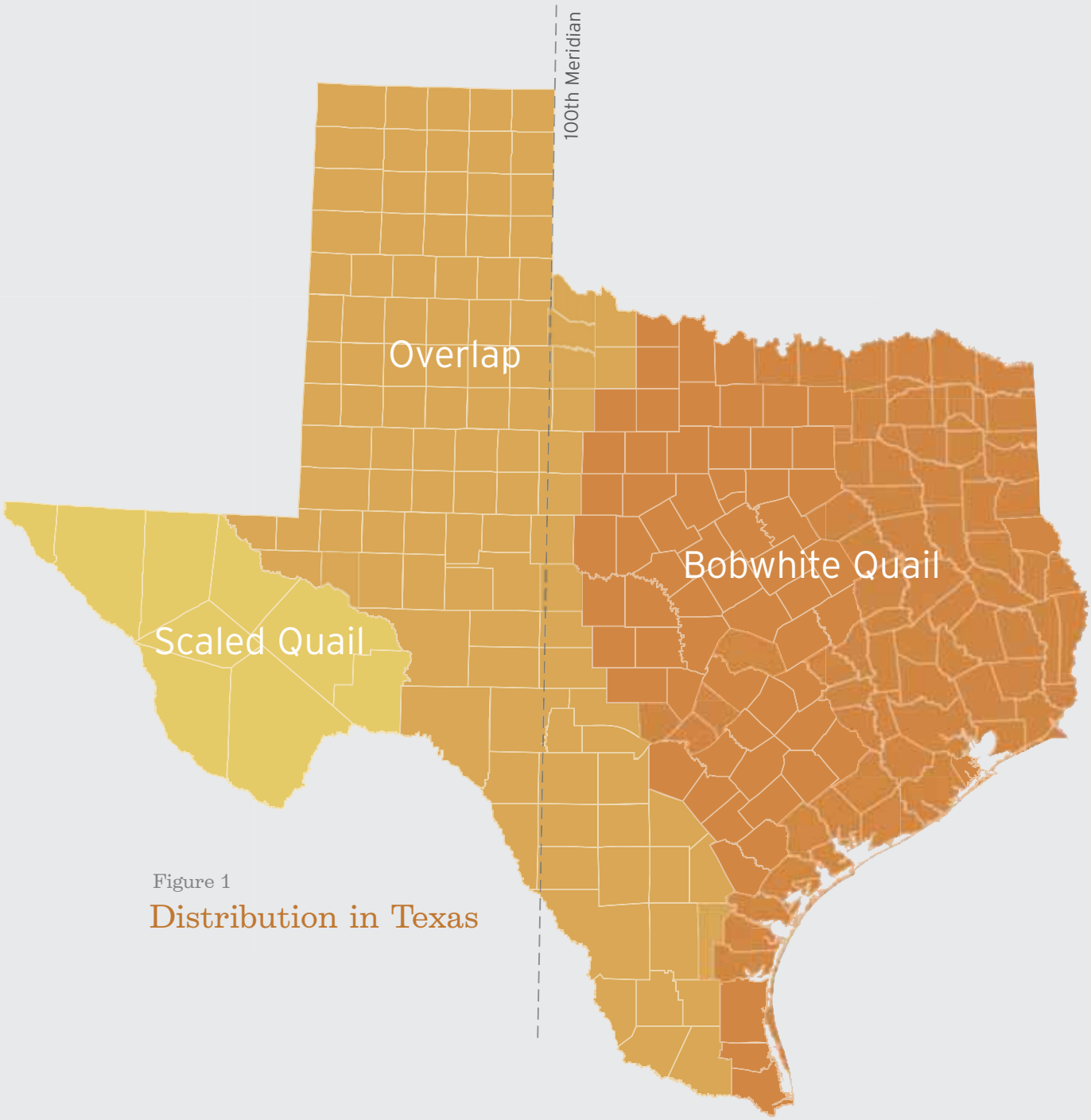

Figure 1

Distribution in Texas

LIFE HISTORY

Physical characteristics

Scaled quail are generally bluish gray-brown in color with a white crest and a fish scale-like ("squamate") feather pattern on their breasts. Males and females are similar in appearance, however they can be identified fairly easily "in hand." Males have a cream-colored throat, whereas the females have a more dirty brown-colored throat that has several faint brown lines running up and down the throat (Fig. 2). The "topknot" (i.e., crest) is only slightly longer (about 1 to 2 mm) in the male.

Scaled quail stand erect at about seven inches and have short, rounded wings. They are slightly larger than bobwhites. Adult scaled quail average just over six ounces (about 190 grams), with males being slightly heavier than females.

Birds of the year (i.e., subadults) can be distinguished from adults by the white-tipped primary covert feathers (Fig. 3). Date of hatch for subadult birds less than 10 weeks old can be estimated by examining the replacement pattern of the primary wing feathers. Quail have 10 primary wing feathers; the outermost feather is counted as No. 10. The age of the bird in weeks can be estimated by counting backwards (to the inside of the wing) from the No. 10 primary inward to the most recently replaced primary, then adding three to that number. For example if primary No. 7 is being replaced the bird is about 10 weeks old (6 + 3) (Fig. 4). For aging subadult birds under 12 weeks of age in the field, refer to A Guide for Aging Scaled Quail (see references).

Population status and trends

Scaled quail populations declined over most of their range in Texas over the last 30 years, and especially so during the 1990s (Fig. 5). The most severe declines occurred in the Rolling Plains and Edwards Plateau ecoregions. However, quail abundance rebounded nicely (over much of West Texas at least) since 2004.

Scaled quail populations normally fluctuate with precipitation patterns. An eight-year study conducted in southeastern New Mexico illustrates this relationship (Fig. 6). Scaled quail typically do not "boom" as high in good years as bobwhites do. Conversely, they typically do not "bust" as badly as bobwhites during dry years.

Reproduction

The number of subadult birds (also referred to as "juveniles", "hatch year birds", or "birds of the year") in the fall of the year is an index to reproduction in a quail population. Reproductive success can be evaluated by comparing the number of subadult birds bagged relative to adult birds during the hunting season. A higher percentage of subadults in the hunter's bag (e.g., 70 percent or more) suggests a successful breeding season

Figure 2

Fig. 2 The throat of the cock is a buff-color while the hen's has faint brown streaks that run down it. The cock's crest is slightly longer than the hen's.

Figure 3

Fig. 3 The primary coverts (in circle) are white-tipped in subadult birds (left) but have no white-tips in adult birds (right).

Figure 4

Fig. 4 Quail less than 12 weeks of age can be aged by examining the wing feathers. A quail has 10 "primaries" (the longer feathers of the wing), and they are numbered from the outside inward (i.e., the outermost is No. 10). This bird is replacing primary feather No. 6. By adding "3" to the primary feather that is being replaced, you can estimate the bird's age in weeks. This scaled quail is about nine weeks old.

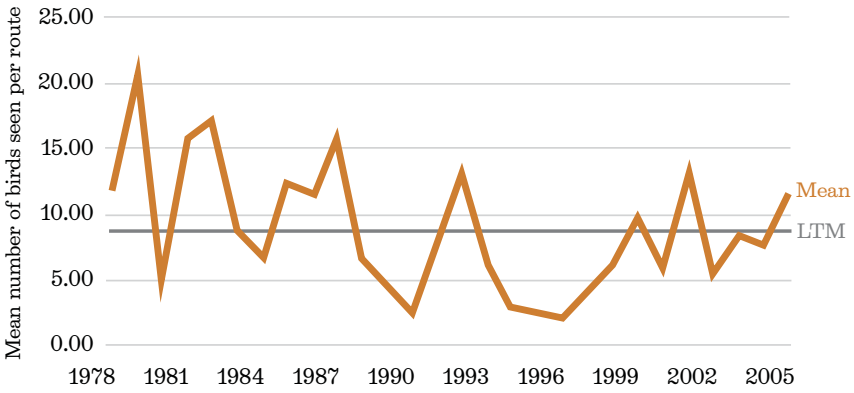

Figure 5

Texas statewide scaled quail trends 1978–2005.

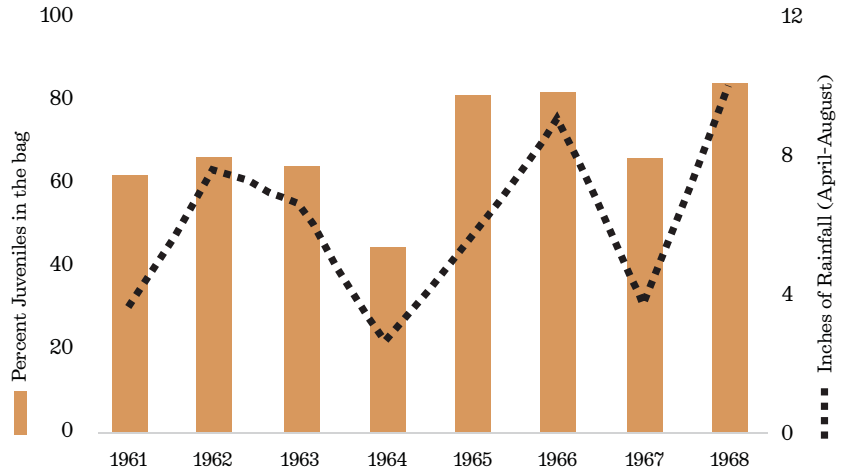

Figure 6

Production as influenced by precipitation.

Production (measured here as percent subadults in the hunter's bag) is strongly influenced by precipitation. These data are from an eight-year study in southeastern New Mexico (Campbell et al. 1973).

Table 1

Observed age ratios of scaled quail by method, state and author.

Author	State	Young:adult	Comments
Wallmo (1956)	Texas	1.6:1	hunter bag
Gallizioli & Swank (1958)	Arizona	1.5:1	hunter bag
Schemnitz (1961)	Oklahoma	2.9:1	hunter bag
Hoffman (1965)	Colorado	2.9:1	hunter bag
Snyder (1967)	Colorado	1.7–2.5:1	hunter bag
Banks (1970)	New Mexico	2.3:1	collected
Borden (1973)	New Mexico	3.8:1	collected summer
Campbell et al. (1973)	New Mexico	2.8:1	collected & trapped
Davis (1979)	Texas	1.3–10.4:1	trapped & hunter bag
Lerich (2002)			
Pleasant (2003)	Texas	0.4:1 – 2.3:1	trapped
Buntyn (2004)	Texas	0.3:1 0.1:1 4.4:1 5.3:1	trapped in Mar '99 shot in Jan '99 trapped in Mar '00 shot in Jan 00
Rollins et al. (2006)	New Mexico	2.9:1	Nov '01 - Mar '02

Figure 7

Radio telemetry, as shown here with this radio-collared hen, allows researchers to document many facets of the scaled quail's life.

and good chick survival, while a low incidence of subadults (e.g., less than 30 percent) suggests poor reproductive success. Age ratios of scaled quail from various regions are presented in Table 1.

"Good" versus "poor" reproduction was evident in scaled quail populations on a Pecos County ranch during 1998-99 and 1999-2000 hunting seasons. A sample of 143 birds bagged in January 1999 (following a dry summer in 1998) revealed only 17 subadults (12%). A year later (January 2000; following a wet summer in 1999) a sample of 100 birds bagged revealed almost the complete opposite (84% subadults, 16% adults). Age ratios in northern bobwhite (and likely scaled quail) may be biased towards subadult quail, as subadults are somewhat more vulnerable to hunting and predation than adults.

Nesting ecology

Nesting begins as early as April and continues through early October, usually peaking in June. The timing of pairing, nesting and egg-laying is dependent primarily on precipitation and (presumably) its effect on plant growth. Spring and summer droughts seem to hinder reproduction, although the exact physiological mechanism is not understood. In one study, a dry winter and spring in 2000 postponed breeding activity by over a month relative to a wetter spring in 1999.

Some researchers speculate that green vegetation needed to prepare quail hens for breeding is unavailable during such times. Following times of good winter and spring precipitation, conditions are usually good for nesting and egg-laying. Noted quail researcher from South Texas, Val Lehman, said that during the spring of the year one can predict how quail will fare prior to the reproductive season by looking at the color (cast) of vegetation at ground level. If it's green, indications are that quail will have a good start going into the reproductive season; if it's brown, the reproductive season will likely get off to a slow start.

Relatively little is known about reproductive habits of scaled quail. They are thought to be monogamous, but recent studies using radio telemetry indicate that bobwhites (formerly thought to be monogamous) have a more "flexible" mating system where hens occasionally mate with more than one cock. Fewer studies have been conducted with radio-tagged scaled quail (Fig. 7) but "double brooding" by scaled quail hens, i.e., laying two separate clutches of eggs with different cocks, has been documented .

Recent research using radio telemetry has increased our knowledge of scaled

Figure 8a

Figure 8b

Figure 9

quail reproductive ecology. Early (non-radio telemetry) studies often detected nests only after depredation or disturbance and may have underestimated nest success rates. Radio telemetry allows for the discovery and monitoring of an increased number of nests and more accurate reporting of nest success.

Nest sites in West Texas may include bunchgrasses (e.g., tobosagrass, bush muhly, threeawns), sacahuista, yucca, Russian thistle, and cacti. In Irion County, eight of 12 nests were located in association with prickly pear (Fig. 8a). Nests in Brewster County were located in grass and shrubs. In Pecos County, 85 percent of the nests were situated in tobosa (Fig. 8b). Soaptree yucca was a common nesting substrate in Bailey county and accounted for 34 percent of nests.

Clutch size averages about 13 eggs, but may range from nine to 18 eggs. Earlier nests (e.g., May) typically have more eggs than later nests (e.g., August). Eggs are white to cream-colored, usually with light brown flecks (Fig. 9). The incubation period is approximately 23 days. Hatch rates are often low, perhaps 25 percent; but hatch rate was "high" in a Pecos County study, where 55 of 72 nests (71%) were successful (Table 2). Mammalian predators are the most common cause of nest failure. The list of potential nest predators is a long one, but raccoons, foxes and skunks are three of the more common culprits (Table 3). Other causes of nest failure may include trampling by livestock, farm machinery, and flooding, but these factors pale compared to nest losses from predators.

Typically, the nesting season for scaled quail continues through mid-August depending on weather conditions. Re-nesting attempts following a destroyed or abandoned nest are made if the hens are in good condition and so long as there is adequate time to locate another suitable nest site, lay a clutch of eggs, incubate and hatch them, and raise chicks before inclement weather sets in. We have observed scaled quail chicks hatched as late as mid-October. If range conditions are extremely dry during the nesting season, they may postpone "pairing up" or stop nesting altogether, only to wait for an improvement in vegetative conditions.

Figs. 8 Common nesting sites for scaled quail include prickly pear (8a) and tobosa grass (8b).

Fig. 9 Scaled quail nests typically contain 12 to 15 eggs; the eggs usually have gold-colored flecking.

Table 2

Hatch rates for scaled quail nests at various locations.

State	Hatch rate (%)	Sample size	Reference
Texas	<25%		Wallmo (1957)
Texas	76%	72 nests	Buntyn (2004)
Texas	44%	105 nests	Pleasant (2003)
New Mexico	39%	62 nests	Sparks (unpublished)

Table 3

Potential predators of scaled quail at various stages in their life cycle.

Mesommammals	Scientific Name
Feral cats	*Felis catus*
Feral hogs	*Sus scrofa*
Coyote	*Canis latrans*
Badger	*Taxidea taxus*
Bobcat	*Lynx rufus*
Striped Skunk	*Mephitis mephitis*
Raccoon	*Procyon lotor*
Gray Fox	*Urocyon cinereoargenteus*
Red Fox	*Vulpes vulpes*
Ground Squirrel	*Spermophilus mexicanus*
Kit Fox	*Vulpes velox*
Armadillos	*Dasypus novemcinctus*
Opposum	*Didelphis virginiana*
Cotton Rat	*Sigmodon hispidus*

Raptors	Scientific Name
Northern Harrier	*Circus cyaneus*
Cooper's Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
Great Horned Owl	*Bubo virginianus*
Prairie Falcon	*Falco mexicanus*
Raven	*Corvus spp.*

Snakes	Scientific Name
Diamondback Rattlesnake	*Crotalus atrox*
Bullsnake	*Pituophis melanoleucus sayi*
Western Coachwhip	*Masticophis flagellum testaceus*

Figure 10

Scaled quail hybrids

Scaled quail do occasionally hybridize with bobwhites and Gambel's quail in Texas—the resultant cross is referred to as a "blob" (bobwhite X scaled quail) or "scramble" (scaled quail X Gambel's), respectively. Blobs are rare, but if you've hunted much where bobwhites and scaled quail are sympatric, chances are you know of someone who has shot one, or at least have heard of one. On a ranch in Zapata County about one in 1,000 bobwhites shot one year was a blob. Subsequent trapping and banding on the ranch indicated a hybridization rate as high as 70 per 1,000 bobwhites.

Apparently both crossings (i.e., bobwhite cock and blue hen, and vice versa) can occur, but the former pairing is more common. Blobs are true hybrids, i.e., infertile. Typically the blob looks like a dirty-faced bobwhite with a crest (Fig 10). However, the crest is not white-tipped as is the scaled quail's crest.

Movements

Like other quail, scaled quail have limited mobility. The home range of scaled quail (i.e., the area where a quail would spend about 80 percent of its time varies from 30 to 300 acres in size, depending on the availability of food and cover and time of year. Winter home ranges are typically larger than summer ranges. In the Trans-Pecos region of Texas, home ranges average about 320 to 640 acres in size.

While scaled quail are not migratory, they can and do make periodic long-distance movements (more than a mile). Long distance movements are most likely during spring dispersal (March and April). Several radio-tagged scaled quail in Pecos County moved over five miles, often to return later to their original home range. One leg-banded scaled quail in New Mexico moved 54 miles. Additional studies with leg-banded and radio-tagged quail may confirm other incidents of "unusual" movements.

Survival

Relatively little is known about the annual survival of scaled quail. Further, most of what is known about quail population dynamics was derived before the era of radio telemetry. Studies with leg-banded quail in southeastern New Mexico (a hunted population) estimated annual survival rates at 17 percent. The advent of radio "collars" for quail has altered many of our previous thoughts about bobwhites in the last 15 years, and we suspect the same with future scaled quail research. Such telemetry studies will most likely yield new information about scaled quail behavior, movements and reproductive ecology as well. Survival rates of (mostly) female scaled quail from March - August was quite high during a study in Pecos County during 1999-2000, and averaged 74 percent. Comparatively, summer survival rates have ranged from 39 percent (1999) and 75 percent (2000) in Bailey County , 70 percent in Irion County (Feb – July) and 57 percent in Brewster County (Mar - Sep). Additional

Figure 11

Evidence from a predation site of a mammal usually consists of just a pile of feathers; evidence from a raptor kill usually leaves a picked breastbone and both wings.

studies are needed for better understanding of scaled quail survival throughout other seasons of the year.

There are many causes which contribute to quail mortality (e.g., predation, weather). Most natural mortality in quail populations is caused by predators. Predators of quail, and their eggs, come in all shapes and sizes. Raccoons, foxes, coyotes, bobcats, feral cats, skunks, hawks and owls are common predators across the range of scaled quail (Fig. 11). Within raptors, accipiters (Cooper's hawks) and harriers (commonly referred to as "marsh hawks") are the most accomplished avian predators of scaled quail.

Recent studies involving radio-tagged scaled quail in Brewster, Irion and Pecos counties found predators accounted for 77 - 90% of mortalities from February - September. Of these, mammals accounted for 71 to 89% of the mortalities, while raptors (i.e., birds of prey) accounted for 14 to 28%. Other reported mortality factors include rattlesnakes, drowning and hailstorms.

Hunting as a factor

Recreational hunting is an activity unlikely to bring about significant reductions in a species inhabiting rough country like that found in West Texas or the rough breaks of the Panhandle. Scaled quail harvests ranged from a low of 82,000 birds in 1995 to a high of 714,000 birds in 1982 (Table 4). For many years, bobwhite researchers thought that hunting resulted in mostly "compensatory mortality", i.e., hunting mortalities substituted for some form of natural mortality that would occur anyway (e.g., predation). However, more recent studies with bobwhites suggest that hunting may be a more "additive" form of mortality, i.e., hunting increases the overall mortality rate.

The months of January and February are considered the bottleneck period in a quail's year. During this time, natural mortality rates are often high due to a reduction of cover, inclement weather and lower food supplies. All of these predispose quail to a higher degree of predation. Quail hunting at this time tends to become additive rather than compensatory. In essence, this means that more birds will be killed by hunters that would have survived into the breeding season in the absence of hunting. If fall populations are low, then a reduction or complete absence of hunting pressure, especially during the latter half of the hunting season (after January 1), may be beneficial.

Scaled quail have been observed to be "somewhat more intelligent" than bobwhites on the same range and are apparently less susceptible to predators than bobwhites. Data from a study in Irion County confirmed that radio-tagged scaled quail survived at higher rates from March - August than did bobwhites (Fig. 12).

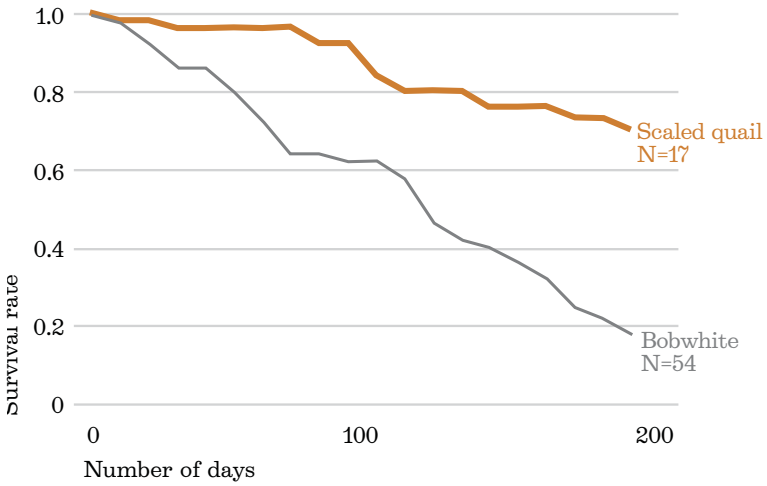

Figure 12

Scaled quail survival.

Survival of scaled quail during the breeding season is greater than that of bobwhites at the same site. These data are from Irion County.

Table 4

Statewide scaled quail harvest trends.

Year	Hunters	Kill/ Hunter	Total Kill	Days/ Hunter	Kill/ Day
1986-1987	68,902	4.66	320,928	2.65	1.76
1987-1988	91,505	6.99	639,832	3.38	2.07
1988-1989	65,223	4.09	267,079	2.65	1.55
1989-1990	47,368	3.07	145,646	2.97	1.03
1990-1991	45,334	2.98	134,891	2.46	1.21
1991-1992	50,431	3.35	169,175	2.51	1.34
1992-1993	71,682	4.99	357,343	2.93	1.70
1993-1994	65,247	3.96	258,493	2.64	1.50
1994-1995	46,696	3.61	168,402	2.44	1.48
1995-1996	32,509	2.53	82,398	2.34	1.08
1996-1997	23,021	2.53	58,227	2.14	1.18
1997-1998	43,327	4.36	188,825	2.65	1.64
1998-1999	38,542	3.95	152,391	2.69	1.47
1999-2000	41,011	4.25	174,230	2.57	1.66
2000-2001	26,073	4.02	104,879	3.06	1.32
2001-2002	33,659	5.89	198,351	2.98	1.98
2002-2003	27,249	4.01	109,350	2.21	1.82
2003-2004	39,640	5.04	199,736	2.88	1.75
Average	47,634	4.13	207,232	2.67	1.53

Figure 13

Fig. 13 Discolored livers are suggestive of a bacterial infection. This scaled quail was collected in Crockett County in December, 1988.

Figure 14

Fig. 14 The encysted worms in this quail's breast muscle are a parasitic roundworm called *Physaloptera*. The worms mature when the quail is eaten by a bobcat or coyote. The worms are not thought to be harmful to the quail, and pose no health concern to humans, provided the quail is cooked before consumption of course.

Nest depredation

Perhaps the greatest impact of predators on quail is via nest (egg) destruction. Studies on scaled quail in the Panhandle of Oklahoma reported a hatch rate of only 14 percent, and a study in Cottle County, in the southeastern Texas Panhandle, reported that only one of 12 nests hatched. Conversely, survival of actual and simulated (i.e., "dummy" nests) was uncharacteristically "high" in a recent study in Pecos County, averaging 77 and 81%, respectively. Abundance of mammalian predators (i.e., track counts) was "low" at this study site.

Disease and parasites

The importance of disease is usually dismissed as a concern in quail management. However, essentially nothing is known about the role that diseases play in population ecology of wild quail (as opposed to pen-raised quail). Scaled quail experienced dramatic, inexplicable declines during 1989-2002 over most of their range in West Texas. Anecdotal information suggests that some disease may have been involved in the decline. Quail with abnormal livers and symptoms of diarrhea were discovered in Crockett and Andrews counties in 1988 and 1989 (Fig. 13), but unfortunately these birds were not submitted for disease testing. Sick quail don't last long in the wild before they are eaten by a predator, therefore, diseased quail are rarely submitted for post-mortem examination.

Coccidiosis is often blamed by locals, but it does not appear to be a major disease problem of wild quail populations in the United States. Pox virus has been reported in scaled quail, however there appears to be no real concern to the population. Other possible diseases associated with wild scaled quail may include avian cholera, ulcerative enteritis, histomoniasis, aspergillosis and quail bronchitis. Hunters should report any quail they find that are emaciated, show symptoms of diarrhea or have abnormal looking livers ("spotted" as compared to a uniform "liver" color).

Parasites like eyeworms (*Oxyspirura petrovi*), cecal worms (*Aulonocephalus lindquisti* and *Subulura brumpti*), and tapeworms (*Rhabdometra odiosa* and *Raillietina sp.*) have been found in scaled quail but do not appear to be a big concern to the quail manager. Sometimes encysted worms about the size of a kernel of wheat appear in the breast muscle (Fig. 14). They are intermediate stages of *Physaloptera* roundworms. These worms develop in carnivores like coyotes when the coyote eats an infected quail. They do not pose a health threat to the quail they infect, nor to people eating infected quail (providing they are cooked of course!).

Table 5

Key foods consumed by quail.

Shrubs/Cacti	Scientific Name
Allthorn	*Koeberlinia spinosa*
Catclaw mimosa	*Mimosa biuncifera*
Desert olive	*Forestiera angustifolia*
Desert willow	*Chilopsis linearis*
Ephedra	*Ephedra antisyphilitica*
Hackberry	*Celtis reticulata*
Gregg Catclaw	*Acacia greggii*
Javelina bush	*Microrhamnus ericoides*
Lotebush	*Ziziphus obtusifolia*
Mesquite	*Prosopois glandulosa*
Prickly pear	*Opuntia spp.*
Tarbush	*Flourensia cernua*
Tasajillo	*Opuntia leptocaulis*
Wolfberry	*Lycium berlandieri*

Grasses	Scientific Name
Johnsongrass	*Sorghum halepense*
Plains bristlegrass	*Setaria macrostachya*
Panicgrass	*Panicum spp.*
Paspalum	*Paspalum spp.*

Crops	Scientific Name
Milo	*Sorghum sp.*
Wheat	*Triticum aestivum*

Insects	Scientific Name (Order)
Ants	*Hymenoptera*
Beetles	*Coleoptera*
Caterpillars	*Lepidoptera*
Desert termites	*Isoptera*
Grasshoppers	*Orthoptera*
Leafhoppers	*Homoptera*

Forbs	Scientific Name
Basketflower	*Centaurea americana*
Bladder pod	*Lesquerella spp.*
Buffalobur	*Solanum rostratum*
Caltrop	*Kallstroemia parviflora*
Common broomweed	*Xanthocephalum dracunculoides*
Cowpen daisy	*Verbesina encelioides*
Doveweed	*Croton spp.*
Erect dayflower	*Commelina erecta*
False mesquite	*Calliandra eriophylla*
Filaree	*Erodium spp.*
Flax	*Linum spp.*
Heath carlowright	*Carlowrightia pubens*
Kochia	*Kochia scoparium*
Noseburn	*Tragia stylaris*
Pigweed	*Amaranthus spp.*
Pricklepoppy	*Argemone sp.*
Purselane	*Portulaca spp.*
Rushpea	*Hoffmanseggia spp.*
Sandlily	*Mentzelia sp.*
Scarlet muskflower	*Nyctagina capitata*
Spurges	*Euphorbia spp.*
Thistles	*Cirsium spp.* and *Salsola iberica*
Snakeweed	*Guiterrezia sarothrae*
Sunflower	*Helianthus spp.*
Western ragweed	*Ambrosia cumanensis*
Woolly bundleflower	*Desmanthus cooleyi*

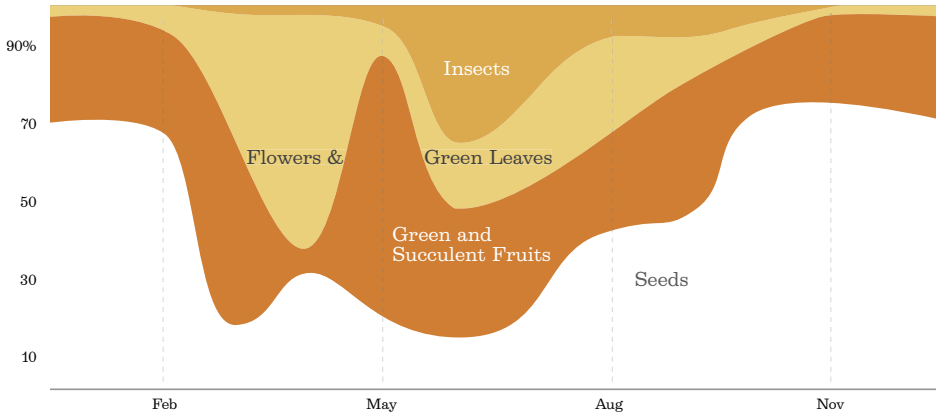

Figure 15

Scaled quail annual diet.

Composition of the diet throughout the year based on percentage of major classes of food. Data from 71 crops from two years. (Wallmo, 1957)

HABITAT REQUIREMENTS

Scaled quail presence and abundance depends primarily upon the quantity of habitat that can be used, i.e., the site's "habitability" for quail. The key to managing scaled quail is providing their basic habitat components of food, cover and water on a year-round basis. Scaled quail must have a year-round supply of food and adequate protection from the elements. This includes protection from predators and the environment while nesting, feeding, loafing and roosting. In order to be good habitat, food and cover should occur within close proximity to one another.

Food

Scaled quail eat a variety of foods (Fig. 15) depending upon seasonal availability and the quail's physiological needs. Four categories of food items include: (1) seeds, (2) succulent fruits, (3) green leafy material and (4) insects. Of all the plant species used by scaled quail for food, probably less than 10 species in any particular region make up the bulk of their diet. Major food items are listed in Table 5. The quail manager's ability to identify the major plant species and predict their responses to land management practices is important for managing quail habitat.

Seeds of forbs (broad-leaved "weeds") and woody plants are usually the most important items in scaled quail diets (Fig. 16) and typically comprise about 70% of the quail's annual diet. Most grasses contribute little food for scaled quail; exceptions are the paspalums and panic grasses which have hard, smooth seeds. Grasses like plains bristlegrass and johnsongrass are good sources of quail food where they are available. Seeds of cultivated grasses like sorghums and wheat are important quail foods.

Consumption of succulent fruits and green leafy material is highest during the spring and summer months. These food items are critical for providing water as well as essential vitamins and nutrients. The fruits (tunas) of tasajillo (and

Figure 16

Figure 17a

Figure 17b

sometimes stems) and prickly pear are often taken during November through February. Greens, e.g., filaree, are heavily used throughout the winter (Figs. 17).

Insects provide the "perfect" quail food. Although insects may be found in a quail's crop during any month of the year, they are especially important during the summer and fall. Insects provide protein, energy and water. Insects are especially important in the diets of chicks. Research conducted on bobwhite chicks indicates that they require a diet consisting of 28 percent crude protein during the first 10 weeks of life. Scaled quail chicks probably require a similar diet. Grasshoppers, beetles and other insects provide essential nutrients needed for growth and survival. The best way to ensure a good abundance of insects is to manage for a diversity of forbs.

Cover

Cover requirements must address various needs in the scaled quail's life: nesting, loafing, roosting, "thermoregulation" (i.e., the ability to stay warm or cool), brood-rearing and escaping from its predators (including hunters).

Although grasses are relatively unimportant in scaled quail diets, they are important from the aspect of screening and nesting cover. Although nest sites may be associated with some type of brushy cover (e.g., javelinabush, mesquite) or may even be nestled within a clump of prickly pear, grasses are a prime component of the nest itself. Prickly pear may provide critical nesting cover when suitable herbaceous nesting cover is lacking because of drought or overgrazing.

Quail spend considerable time scratching the ground in search of food (seeds and insects). Excessive amounts of herbaceous cover can impede a quail's mobility, especially for chicks, thus their ability to search for food. It is important that some bare ground be present in an area for scaled quail to survive. In most parts of scaled quail range sufficient bare ground is not a concern. An exception may be in improved pastures and Conservation Reserve Program fields where grass cover may be too dense.

Sites dominated by annual broomweed and western ragweed provide excellent feeding and brood-rearing cover. These forbs often grow under the same environmental conditions which foster good quail reproduction, i.e., wet winters and springs. In addition to the seeds they produce, their growth form, i.e., single-

Fig. 16 The crop contents of a scaled quail from Pecos County indicate that seeds of various forbs are the staples of the diet. Insects and greens round out the diet.

Figs. 17 Greens are a common component of the winter and spring diet and serve as a source of water year-round. The crop of this scaled quail (Fig 17a) in Pecos County was stoked with leaves of California filaree; note the fat deposition around the crop. Filaree (Texas filaree, Fig. 17b) is especially important.

Figure 18

Fig. 18 A landscape dominated by annual broomweed, like this site in Borden County, usually heralds a good season for quail hunting.

Figure 19

Fig. 19 Loafing coverts, sometimes referred to as "quail houses," are important habitat components for scaled quail. Several species of shrubs can fulfill the role.

stemmed with a branching canopy, provides ideal overhead cover and brood-rearing habitat (Fig. 18).

Suitable loafing coverts (i.e., "quail houses) are one of the most important aspects of scaled quail habitat. Loafing coverts are used for resting during midday. Loafing coverts provide overhead protection from hawks, yet are open at ground level to allow a quail adequate visibility to detect mammalian predators. Coverts may take the form of old farm machinery, tangled brush thickets, tall-growing cacti or even dense patches of coarse weeds. However, bushes about the size of a pickup truck are generally preferred (Fig. 19). Some of the major brush species used for loafing coverts include lotebush, catclaw mimosa, littleleaf sumac, skunkbush, algerita, wild plum, mesquite, cholla and taller forms of prickly pear.

Scaled quail roost on the ground and prefer open areas with little overhead cover where they can flush when disturbed without any interference from overhead branches or other obstacles. Roosting cover is seldom deficient in scaled quail range.

Food and cover relationships

The spatial relationships, i.e., interspersion, of food and cover cannot be overemphasized. This means that food and cover types required by scaled quail should be available within their daily travels (perhaps 40 acres). Ideally, the association of food and cover types should be in an irregular, i.e., "crazy quilt" pattern. Areas characterized by different plant communities, brush structure or relief (e.g., drainages) usually provide adequate interspersion.

Water

The availability of water has probably received more attention than any other phase of scaled quail management. Scaled quail evolved in a region where surface water was scarce, if not absent, over much of the range. Until European settlers came to the Southwest there were no stock tanks, water troughs, nor windmill overflow areas to provide surface water to quail. Although watering areas attract scaled quail, and may be the focal point of their daily movements, no evidence indicates that providing water

sources increases a population. Giving credit where it is due, the development of livestock water has made habitat more desirable for scaled quail and for other wildlife species in the arid Southwest.

Surface water is considered as a desirable, but not essential, habitat requirement. While surface water may be used when available, scaled quail are able to meet their water needs from other sources, such as dew, greens, fruits and insects. The water obtained from food items is referred to as metabolic water. Research with bobwhites in Texas indicates that pre-formed (e.g., dew) and metabolic water can supply most, if not all, of a quail's water needs. If these types of foods are not available, then quail may benefit from (if not require) surface water.

Research in the Trans-Pecos region indicated that some coveys will adjust their daily activity patterns to include visiting watering sites. Available surface water attracts quail and may help in production, but apparently, quail can survive without it.

MANAGEMENT CONSIDERATIONS

Search through any publication on bobwhite management and you can find an array of habitat management techniques designed to improve quail habitat. Are these practices applicable for scaled quail habitat? Perhaps, but what works for bobwhites doesn't necessarily mean it will work for scaled quail. Keep in mind that most scaled quail ranges receive less than 18 inches of rainfall per year. The relatively low amounts of rainfall decrease the success rates for habitat management practices (e.g., food plots) commonly prescribed for bobwhites. Consequently habitat management efforts for scaled quail are typically more "extensive" in scope (e.g., grazing management) than "intensive" (e.g., food plots).

Grazing management

Proper grazing management can do more for quail habitat than any other management practice discussed. Grazing can be harmful or helpful depending on how it is applied. Generally, ranges grazed by cattle under light to moderate stocking rates in a deferred - rotation grazing program are beneficial to scaled quail. By providing pastures adequate rest periods following livestock grazing, quail food species and nesting cover are enhanced. Grazing by sheep and goats may be more of a concern to the quail manager. These kinds of livestock prefer to eat many of the forbs that are reliable seed producers for scaled quail. Sheep and goats can be grazed successfully with scaled quail, but greater attention to stocking rates is required.

Livestock grazing is an alternative for setting back plant succession. By use of an attractant (feed) in key areas, hoof action from high stock densities can disturb the soil thus allowing low succession plants to germinate. Heavily grazed "sacrifice areas", i.e., sites around corrals or feeding areas, are often dominated by annual forbs like buffalobur, the seeds of which are a common food for scaled quail. While food production is typically

Figure 20

Quail houses should be available about a softball-throw apart.

highest on "poor" or "fair" condition rangelands, higher condition classes ("good" and "excellent") normally provide better scaled quail habitat.

As one moves westward, the concern for quail habitat is often too heavy grazing, not too light. Accordingly, a flexible stocking rate that incorporates seasonal deferments is one of the best tools for managing quail habitat. Overgrazed rangelands result in little nesting and screening cover and a reduction in quail foods. Although overgrazing produces bare ground (a necessary but rarely limiting requirement of quail), it takes away other more essential habitat needs.

Brush management

Brush management is practiced by ranchers to reduce the density of woody cover and promote grass growth for livestock. Clearing brush, in moderation, can be an effective way to improve habitat for scaled quail. When planning brush management, consideration should be given to the treatment method selected, clearing size and the spatial arrangements of these habitat components. The particular method of brush control used should allow you to preserve brush in acceptable patterns and amounts. Generally mechanical methods (e.g., grubbing) or "individual plant treatments" using selective herbicides are recommended over large-scale application of herbicides.

Brush cover requirements of scaled quail are relatively low, as much of their range has rather low levels of brush density compared to those on some bobwhite ranges. However, the presence of suitable loafing (e.g., lotebush) and screening cover (e.g., catclaw mimosa) often dictates the habitability of a site for quail. Maintaining five - 15 percent brush canopy in pastures should be suitable to meet scaled quail cover requirements. At such levels, the distance between loafing coverts should ideally be about a softball throw apart (Fig. 20).

If other wildlife species occupy the same habitat, their needs must also be considered. For example in West Texas, brush cover on areas managed for mule deer and scaled quail should be maintained at about 15 to 25 percent cover. Whereas, in South Texas, the chestnut-bellied subspecies generally uses sites where brush cover reaches 50 percent. Mosaic patterns of brush are most beneficial to edge species such as quail.

In areas devoid of loafing cover, artificial methods of developing coverts can be employed. One method is to plant woody cover species such as plum, skunkbush and fourwing saltbush. Plantings may require irrigation until

establishment and protection from cattle, rabbits and rodents. New techniques that incorporate weed barrier cloth and "watershed harvesting" strategies have been very successful at establishing woody plantings on the High Plains. Brush piles can be erected to provide loafing and protective cover (Fig. 21). However, regular maintenance may be required to maintain their effectiveness as quail cover.

"Half-cutting" is an option where "re-growth" mesquite trees are the dominant woody species. Half-cutting can be used to alter their growth form of such mesquites thus making it more attractive as a loafing site (Figs. 22). Select multi-stemmed trees with smooth bark for half-cutting. Using a limb saw, cut halfway through the lower limbs and bend them downward to develop a bush or shrubby type of growth form (see http://teamquail.tamu.edu for a video clip of this procedure). Half-cutting is best done during April and May when the limbs are most flexible.

Water development

Providing water at windmill sites and by construction of ponds and spreader dams may benefit scaled quail. Aside from the water per se, moist soil sites benefit scaled quail because they promote plant diversity, thus insect diversity. Such moist-soil sites produced about 25 times more grasses and forbs than adjacent uplands in a Pecos County study (Fig. 23). The same sites also produced about six times greater insect availability.

Water for quail should be available at ground level and close to screening cover. Modified "gallinaceous guzzlers" (Fig. 24) (approx. 8 ft. x 10 ft.) can be constructed at minimal cost. Overflow from windmill storage tanks can be directed to ground level dugouts or cement saucers. Tapping into an existing livestock water pipeline and utilizing drip irrigation emitters is an easy way to provide water for scaled quail. Keeping livestock watering troughs "brim" full will allow some overflow during windy days (Fig. 25). Placing a concrete ramp inside the trough, or including some type of floating substrate, allows quail a means of escaping should they fall in. During one research study in Brewster County, three radio-tagged quail drowned in the same water trough.

Figure 21

Brushpiles may be useful in some situations where other quail houses are lacking.

Food plots

Food is seldom the limiting factor for quail. Despite that knowledge, the planting of food plots is a common practice in bobwhite country. With low and often erratic precipitation patterns, food plot establishment in scaled quail range is questionable, unless they are irrigated. Scaled quail do benefit from crops like milo or wheat when fields are adjacent to suitable escape cover.

Figure 22a

Figure 22b

Figure 23

Figure 25

Figs. 22 "Half-cutting" multi-stemmed mesquite trees enhances their utility as quail houses. The tree on the right was half-cut five years earlier.

Fig. 23 Capturing runoff from thunderstorms with "spreader dams" can provide microhabitats important for quail. This site in Pecos County produced 25 times more vegetation and six times more insects than the adjacent uplands.

Fig. 24 Guzzlers such as this one are used frequently by scaled quail in arid habitats.

Fig. 25 Another option for providing drinking water is to keep one's stock tanks brim full—when the wind blows some water spills to the ground where it is more useful to quail. The moist sites also promote forbs, which in turn promote insects.

Along the eastern range of the scaled quail where rainfall is higher (perhaps 20 inches annually), food plots may be established utilizing commercial seed mixes or grain crops. Our experiences with food plots in West Texas suggest that (a) when you need them you can't grow them (i.e., during dry years), and (b) when you can grow them you probably didn't need them (i.e., during wet years).

Cultivation practices

In areas with cropland, leaving rows of grain unharvested along the field margins, turn rows and fencerows will benefit scaled quail. Not only will these strips provide food, but also travel corridors from a food supply to protective cover. In areas where center pivot irrigation is common, or where fields are in irregular shapes, there always seem to be odd corners that complicate farming practices. Leaving such corners in standing crops or allowing them to grow into weedy patches benefits quail.

Soil disturbance

Most plants important as food for scaled quail are products of soil disturbance. "Early successional" plants like crotons (doveweed), western ragweed, buffalobur, carelessweed, annual sunflower, spurges, and paspalum grasses commonly grow in disturbed areas. Insect production from weedy fields is usually higher than other sites, even food plots. Soil disturbance may be caused by livestock grazing, farming practices, brush control or even drought. Discing in winter is an effective method of stimulating forbs in the eastern range of the scaled quail. Best results can be achieved by discing in sandy type soils as tighter clays are not very conducive to forb production.

Discing should be done in January or February, well before the last frost date, to a depth of three to six inches. Discing should be in close association to woody cover such as shelterbelt edges, field borders, fencerows, pipeline right of ways, wooded draws and even along existing ranch and pasture roads.

Road systems featuring water turnout ditches ("spreader dams") collect runoff water from roads helping in the germination of forbs. Similarly, contour plowing with a single-shank chisel, or a two-bottom breaking plow can be used to harvest water and promote forb diversity.

Prescribed burning

Prescribed burning has become popular as a range and wildlife management tool in Texas. A prescribed burn is conducted to meet a land management objective under specific climatic and environmental prescriptions for relative humidity, air temperature, wind speed and direction, fuel load, and fire lane width for the major vegetative type. Because of the semiarid nature of scaled quail range, prescribed burning is not often recommended solely for quail habitat management. Land managers should seek assistance from the Texas Cooperative Extension, Texas Parks and Wildlife Department or the Natural Resource Conservation Service if prescribed burning is selected as a habitat management tool.

Figure 26

Fig. 26 The "Currie quail feeder" is a rugged, inexpensive design if one chooses to feed quail.

Figure 27

Fig. 27 These range cubes for cattle have been laced with whole milo. The milo passes mostly intact through the cow's digestive tract and provides a "patty melt" quail feeder. Quail are used to scratching seeds out of dung pats.

Supplemental feeding

Supplemental feeding is a popular, but largely unproven practice in quail management. A recent study in southern New Mexico found that grain supplementation (e.g., milo) did increase survival of hens during the breeding season.

Supplemental feeding is an inefficient, hence expensive, practice. Recent studies showed that less than 10 percent of the visitations at quail feeders at four sites in West Texas were by quail. Feeding programs alone don't usually result in bountiful populations of quail because food is seldom the factor limiting population density. On a positive note however, it probably doesn't hurt to feed . The use of quail "blocks" and feeders is a common practice in quail country but they are typically employed more to attract birds for viewing or hunting rather than for the sake of increasing quail survival. Scaled quail are quick to find and frequent "sling feeders" used by deer hunters. To be most beneficial, feed should be available to all birds in a population (i.e., perhaps a spacing of one feeder per 80 acres) and in close proximity to cover. While feeders are often assumed to predispose quail to greater risk from predation, recent studies have not documented this concern.

A simple, rugged and inexpensive quail feeder can be constructed by drilling small holes (9/32 inch) near the bottom of a steel drum, filling it with milo, and elevating it to where the holes are about six inches off the ground. To view a video clip of how to build such a feeder, see http://teamquail.tamu.edu. Scaled quail readily use such feeders (Fig. 26), especially during the winter months when their energy requirements are highest. If cattle share the pasture where the feeder is located, secure the feeder with two T-posts to prevent cattle from turning it over. To get maximum effectiveness from a feeding program, feeders should be dispersed across the habitat.

Another option for feeding quail that may be useful on grazing ranges is to produce a range cube (i.e., cottonseed "cake") that contains 300 pounds of whole milo per ton of feed (Fig. 27).

Much of the milo in the range cube passes through the cow, and is deposited in the cow patties. Quail readily learn to pick the milo from these "patty melt" feeders.

There is a concern about the possibility of contamination in feeds with a naturally occurring toxin called "aflatoxin." Aflatoxins are more of a problem with corn than milo, but to be on the safe side, one should buy only feed that is certified to have less than 20 ppb of aflatoxin.

Predator control

Managers often ask if predator control is an effective technique for reducing quail losses? Predator control has been practiced for bobwhites in areas with varying results. Predator-prey relationships are complex issues. Often if one predator species is reduced (e.g., coyotes), another predator species increases (e.g., raccoons, gray foxes). If predator control is used, it should be targeted at reducing mammalian nest predators just before and during the breeding season. Studies near San Angelo and Weatherford suggested intensive predator control, on roughly 600 acres, for a defined time period (30 days just prior to nesting), did not increase northern bobwhite survival or simulated nest success.

Local predator abundance can be assessed by using "scent stations." Scent stations are constructed by covering a circular area (e.g., hula hoop) with flour or sifted soil, and then placing a scent attractant (e.g., fatty acid scent, bobcat urine) in the middle of the scent station (Figs. 28). Predators are attracted to the scent and leave their tracks in the substrate. Employing a series of scent stations at one-mile intervals will provide a species-specific index to abundance.

The best form of predator control may be a good "defense", i.e., an abundance of suitable nest sites across the landscape. Research has shown that simulated quail nest survival increases as potential nest sites (i.e., bunchgrasses) increase on the landscape up to some threshold level. Scaled quail typically nest in perennial bunchgrasses in association with shrubs. Presumably, as the number of suitable nest clumps per area increases, the more difficult it becomes for a predator to locate the quail's nest, so nest success increases. The availability of desirable nest sites can be enhanced through grazing management. Scaled quail in West Texas also use prickly pear as nesting habitat. Nesting in prickly pear affords a nesting quail some relief from nest depredation, especially in areas with low availability of perennial bunchgrasses.

While predators are well known causes of quail mortality, many times little thought is given to the more serious problems of brush clearing and overgrazing which can all but eliminate quail populations through habitat destruction. Address any gross deficiencies in habitat prior to implementing intensive practices like predator control.

For more information, see Predator Control as a Tool in Wildlife Management.

Figure 28a

Figure 28b

Figs. 28 Monitoring "scent stations" gives an index to local predator populations (28a). This scent station registered raccoon tracks (28b).

Quail life in the sympatric zone

Scaled quail are *sympatric* with bobwhites (i.e., their ranges overlap) over the western one-third of Texas. They share the same diet as bobwhites, but typically occupy more "open" habitats than bobwhites. They tend towards the more gravelly soils with pear flats/blackbrush ridges in South Texas. They will be found more often on the more heavily grazed and/or shallower sites in the Rolling Plains and Edwards Plateau.

Scaled quail tend to be better survivors than bobwhites in the same range. A scaled quail's crop will generally contain two to four times more food than a bobwhite taken at the same time of the day. Scaled quail are better "hustlers" than bobwhites and are considered to be "smarter" and wilder relative to hunting. Spring and summer survival of blue quail west of San Angelo was about thrice that of bobwhites during one study. Scaled quail typically do not "boom" quite as much in good years as do bobwhites, but neither do they "bust" as badly as bobwhites in dry years.

For most quail managers that have bobwhite and scaled quail, management will likely be targeted to the more hunter-friendly bobwhite. Manage your property for bobwhites (e.g., conservative stocking rates), and then appreciate the idea that you'll have more scaled quail in the droughty years.

Evaluating your management efforts

We encourage managers to try these (and other) management techniques as a means of bolstering (or sustaining) their local population of scaled quail. However, one should always have a means of evaluating their progress. Various techniques using whistle counts, roadside counts and helicopter counts can be used to estimate abundance of scaled quail at the ranch level. Simulated nests can be used to estimate hatch rates.

SUMMARY Scaled quail can be difficult to manage because of the extreme population fluctuations inherent with this species and the limitations imposed by a harsh environment. Accordingly, most management practices are "extensive" rather than "intensive" in nature. Land managers interested in maintaining the highest quail populations possible during drought years should consider quail habitat requirements when contemplating livestock stocking decisions and adjust hunting pressure accordingly.

Several habitat management options are available; however, the primary tools available to the land manager in scaled quail range are grazing management and brush management. Applying every quail management practice known to man in no way assures high numbers of quail. There are no guarantees; quail production is highly dependent on timely rainfall, a factor over which we have no control. However, by proper range management, we can maximize the effect of the rain that is received.

Whatever means of manipulating the habitat chosen, the principle of biodiversity, should be kept in mind. As a general rule, the more diverse the habitat in the form of plants and insects, the better it will be for quail.

This publication provides information needed to begin a scaled quail management program. Scaled quail management assistance is available free of charge to interested land managers through wildlife biologists of Texas Cooperative Extension, the Texas Parks and Wildlife Department and the USDA's Natural Resources Conservation Service.

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LIST OF FIGURES

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