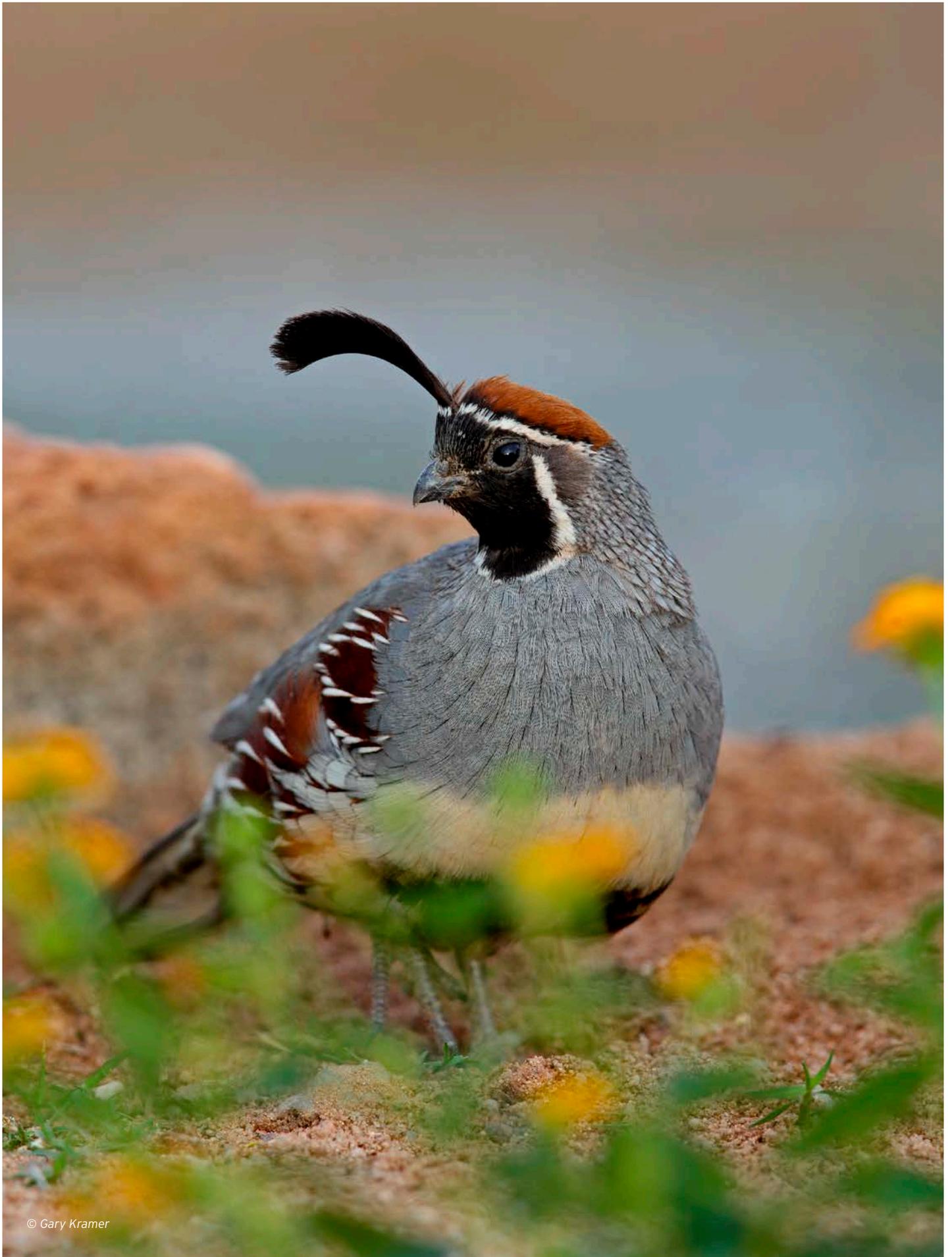


# Gambel's Quail in Texas

BIOLOGY AND MANAGEMENT





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### BIOLOGY AND MANAGEMENT

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## INTRODUCTION

**Gambel's quail (*Callipepla gambelii*) are a common quail species in the southwestern United States and the northwestern states of Mexico. In Texas, Gambel's quail occur exclusively in the Trans-Pecos, and are listed as a game bird by Texas Parks and Wildlife Department.**

Reliable annual population estimates, harvest estimates, recruitment information, and distribution are essential for effective management of this bird. Unfortunately, little is known about Gambel's quail in Texas because the majority of information regarding this bird stems from research conducted in Arizona and New Mexico. This publication is intended to aide managers and hunters by providing information on the life history and habitat requirements for Gambel's quail in Texas. Additionally, information provided herein should identify factors which ought to be considered when implementing management regimes for this species.



*Figure 1: Typical Gambel's quail habitat in the Trans-Pecos*



Figure 2

## DISTRIBUTION IN TEXAS

Seven subspecies of Gambel's quail have been described in North America. Of these, five are known to breed in the United States. *Callipepla gambelii gambelii* occurs in southern Utah and Nevada, south to Baja California and in northwest Mexico. The subspecies *C. g. sana* is found in western Colorado, and *C. g. ignoscens* occurs in southern New Mexico and far west Texas. The Gulf of California and the island of Tiburon are home to *C. g. pembertonii*, and the subspecies *C. g. fulvipectus* occurs in north-central and southwest Sonora, northwest Mexico, southeast Arizona and southwest New Mexico.

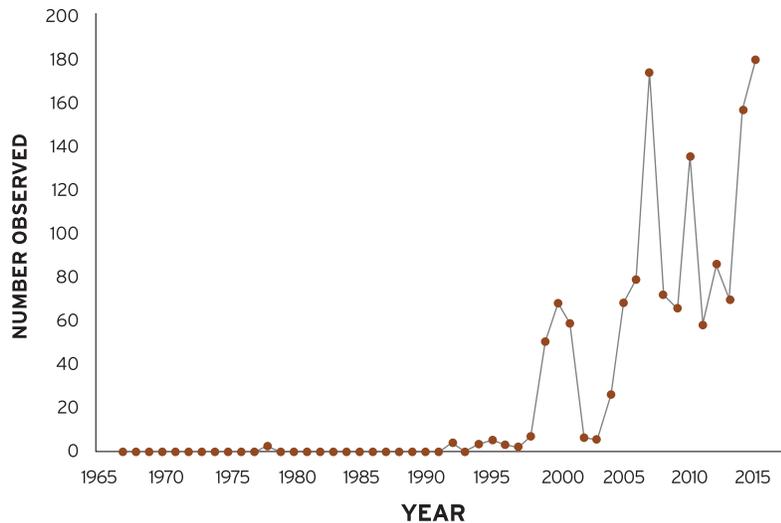
Therefore, of the five subspecies of Gambel's quail occurring in the United States, only *C. g. ignoscens* is known to occur in Texas. The current known distribution of this subspecies is limited to the Trans-Pecos region of the state, specifically, the upper Rio Grande Valley from El Paso to southwestern Brewster County (Figure 2). Within the distribution area, Gambel's quail can be found at elevations ranging from 600 to 3,900 feet. Typical habitats include riparian areas associated with floodplains or intermittent streams along the Rio Grande and its tributaries.

# POPULATION ECOLOGY

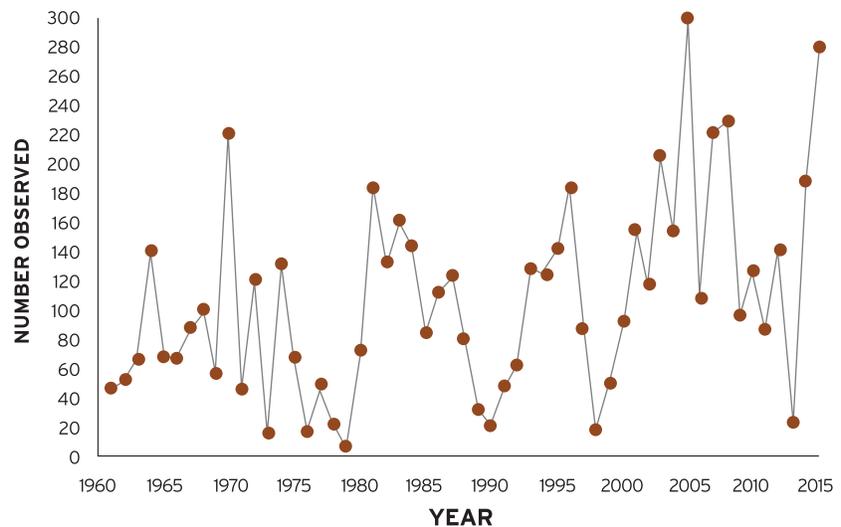
The composition of a population provides valuable information about population trends, survival rates, life expectancies, recruitment, and the population's future. Data regarding the structure of Gambel's quail populations are severely limited outside that of annual state game reports. Few studies have been conducted on the Gambel's quail in Texas; therefore, the majority of information available on population dynamics is obtained from studies conducted in either Arizona or New Mexico. The scarcity of studies performed in Texas is likely attributable to low population

densities and a restricted range. Historically, Arizona and New Mexico have used hunter success analyses to monitor Gambel's quail populations. In Texas, Gambel's quail are not currently monitored using scientific methods. Instead, current population trends in the Trans-Pecos are reliant on informal data collections such as Breeding Bird Surveys (BBS) and Christmas Bird Counts (CBC). According to BBS and CBC studies, the population of Gambel's quail in Texas is relatively stable or slightly increasing (*Figure 3; 4*).

*Figure 3:  
Population trend of Gambel's quail in Texas from 1967-2015 as reported by the Breeding Bird Survey (BBS).*



*Figure 4:  
Population trend of Gambel's quail in Texas from 1960-2015 as reported by the Christmas Bird Count (CBC).*



## PRODUCTIVITY, SURVIVAL AND RECRUITMENT



Figure 5: Nest site of a Gambel's quail revealed after partially parting the skirt of a sotol.

Quail population dynamics are a reflection of productivity, survival, recruitment, and by extension, a product of habitat availability and quality. Furthermore, we can attribute quail habitat characteristics to patterns and timing of precipitation. The timing and amount of precipitation during fall and winter have been shown to be positively correlated with Gambel's quail populations. This correlation is likely attributed to the positive relationship between precipitation and available forage. In years where there is an increase in available forage, clutch size is also likely to increase. Clutch size can range from less than 5 eggs in a dry year to 20 eggs

in years that have abundant precipitation. Typically, an average clutch will contain between 10 and 14 eggs. As a result of precipitation causing variability in clutch size, Gambel's quail populations are subject to the same "boom-bust" phenomenon as other quail. Additionally, ambient temperature can influence Gambel's quail populations. Recruitment of Gambel's quail has been shown to be hampered by excessively high temperatures during nesting and brooding seasons.

Annual survival rates for Gambel's quail can range from 8 to 40 percent. A study conducted in the Chihuahuan Desert of Texas indicated annual survival rates can differ greatly across years with survival one year reaching 42 percent, while the following year only had a 23 percent survival rate. Juvenile deaths account for the majority of mortality in the covey, and can reach 40 percent per year. Many factors can affect quail mortality; however predation is likely a leading cause of mortality in Gambel's quail. Potential predators of Gambel's quail include Cooper's hawks (*Accipiter cooperii*), Harris hawks (*Parabuteo unicinctus*), northern harriers (*Circus cyaneus*), prairie falcons (*Falco mexicanus*), Swainson's hawks (*Buteo swainsoni*), great-horned owls (*Bubo virginianus*), skunks (*Mephitis spp.*), raccoons (*Procyon lotor*), ringtails (*Bassariscus astutus*), foxes (*Vulpes spp.*), badgers (*Taxidea taxus*), bobcats (*Lynx rufus*), and coyotes (*Canis latrans*). The majority of Gambel's quail mortality occurs during the fall and winter. This time period coincides with seasonal increases in *Accipiter spp.*, (e.g., Cooper's hawk) which have been noted to predate heavily on Gambel's quail. Currently, there is limited data on survival rates for Gambel's quail in the Trans-Pecos. The lack of survival rate information for Gambel's quail in the Trans-Pecos is likely attributed to an absence of hunter harvest data, and the scarcity of available survey data on this species.

# LIFE HISTORY

## Physical Characteristics

The Gambel's quail is a sexually dimorphic game bird of the Trans-Pecos region of Texas (Figure 6). Males exhibit distinctive physical features with multiple plumage ornaments, such as a black, tear-drop shaped head plume, light and dark belly patches, and a rusty head patch. The upper bodies of both sexes are blue gray. Unlike the scaled quail (*Callipepla squamata*), Gambel's quail lack the scale-like pattern on their chests; instead, plumage from the chest is a uniform cream color.

Their sides are chestnut-colored and the upper wing surfaces are olive gray with distinctive cream margins on the bottom of the secondary feathers. Females have a much smaller black plume on their heads and plumage is less ornate than that of males. Additionally, females lack the rusty cap and black faces displayed on males, and instead exhibit a face that is dull grey in color. Mature birds average about 11 inches in length and typically weigh about 5.6 to 7.1 ounces.

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Figure 6: Male (right) and female (left) Gambel's quail. Note differences in plumage of the head and face.

## Reproduction and Nesting Ecology

Gambel's quail are claimed to be strongly monogamous, although a recent study reported a flexible breeding strategy in which Gambel's quail exhibited monogamous and polygamous relationships. Pair formation in Gambel's quail typically follows the break-up of winter coveys. Males reach sexual maturity about two weeks earlier than females, and leave the covey first to begin courtship behavior. Males typically start seeking females during March, but it has been shown that in good years, males may start courting as early as February.

Courtship is often initiated when males enter into breeding condition. Breeding condition is characterized by reproductive organ development which is stimulated by vitamin A. Gambel's quail obtain vitamin A from green vegetation produced by winter moisture and store excess vitamin A in their livers. Onset of breeding condition occurs around March for males and approximately one month later for females with peak reproductive cycles occurring in May. Upon reaching reproductive condition males begin emitting single-note "cow" calls. Pair formation has been reported to be a subtle process which occurs over an indeterminate period of time. Males initiate breeding behavior by chasing and nudging females, and engaging in a ritual behavior referred to as "tidbitting," which can be described as the male making downward head movements which simulate offerings of food to the female. Additionally, males will stand in front of the female and posture by fully extending their legs, fluffing the feathers on their flanks, and fanning their tails in a sloping fashion while holding their heads close to the ground.

Once pairing occurs, females select nest sites, construct nests, and incubate eggs. Nesting typically begins in April and lasts until June or July. Females generally construct a bowl-shaped nest, and line it with small twigs, grass, leaves, and feathers. Eggs are dull white, smooth and often covered with small brown spots (*Figure 7*). Females develop the stereotypical brood patch during incubation in order to facilitate heat transfer to the clutch. Males seem to have no role in incubating the clutch as indicated by the absence of a brood patch. However, males are involved in the nesting process in that they remain close to the nest site and defend it from potential predators.

Clutch sizes average between 10 and 14 eggs; although clutches upward of 20 eggs have been reported in Arizona. Clutches exceeding 15 eggs are usually considered to be the result of multiple females laying eggs in a single nest. These nests are referred to as "dump nests" and are not uncommon. During dry years clutch sizes are often reduced, and may contain as few as five eggs. Occasionally, Gambel's quail may lay a second clutch in years with average or above average precipitation. During years when double clutching occur, chicks may be observed as late as September.



*Figure 7: Successfully hatched Gambel's quail nest*



Figure 8: Riparian habitat characteristic of areas inhabited by Gambel's quail.

## HABITAT

### Habitat Utilization

Although Gambel's quail typically restrict their distribution to riparian areas, there are certain plants that they have close associations with. Plants that Gambel's quail normally associate with in the Chihuahuan Desert include: honey mesquite (*Prosopis glandulosa torreyana*) white-thorn acacia (*Acacia constricta*), allthorn (*Koeberlinia spinosa*), littleleaf sumac (*Rhus microphylla*), catclaw acacia (*Acacia greggii*), and various yuccas (*Yucca* spp.). In the Trans-Pecos region, Gambel's quail show a preference for riparian vegetation. Drainages, washes, and riparian areas are essential components of Gambel's quail habitat. Typically, Gambel's quail spend greater than 85 percent of their time within 100 yards of a riparian

area. Gambel's quail are often found near dense stands of fourwing saltbush (*Atriplex canescens*), wolfberry (*Lycium barbarum*), mesquite, salt cedar (*Tamarix* spp.), or other woody riparian vegetation. Gambel's quail may also be found in shrub-invaded, semiarid grasslands adjacent to drainages.

Exotic grasses such as buffelgrass (*Pennisetum ciliare*) and Lehmann lovegrass (*Eragrostis lehmanniana*) have invaded much of the Gambel's quail habitat. However, Gambel's quail do not seem to be as susceptible as other quail species to the deleterious effects of exotic grasses. The decreased impact of exotic grasses is likely attributable to Gambel's quail reliance on shrub availability rather than herbaceous vegetation (Figure 8).

## Nesting Cover

Unlike other quail species, Gambel's quail do not require perennial bunchgrasses for successful reproduction. Instead, Gambel's quail typically construct their nest on the ground at the base of a shrub (Figure 9) or in a well concealed cavity. Most nests are built in a small depression, 1.5 inches deep and 5 to 7 inches across, and lined with small twigs and dry vegetation from last year's growth. Good nesting cover can be characterized by the presence of fourwing saltbush, honey mesquite, catclaw acacia, whitethorn acacia, desert willow (*Chilopsis linearis*), and littleleaf sumac. Other important plants may include tarbush (*Flourensia cernua*) and a variety of legumes (*Acacia* spp.). This preference for a woody canopy cover represents an evolutionary adaptation to reduce predation from aerial predators and to reduce exposure to high temperatures.

## Brooding

Gambel's quail chicks communicate with clutch mates and adults by emitting "peeps" through the eggshell. These "peeps" might also be involved with synchronous hatching, which occurs after an incubation period of 21-23 days. Hatching can commence as early as March, and can continue into July for some clutches. Typically, the peak hatching period occurs between late-April and mid-May. Brood size typically consists of 10-12 chicks. The newly hatched chicks are precocial and may be led away from the nest site by the female. Sex ratios for recently hatched Gambel's quail chicks is generally 50:50, however sex ratios begin to favor males as the summer progresses into fall and winter.

Gambel's quail broods are attended by both parents; however, a brood can be raised by a single parent if one parent perishes.

Gambel's quail chicks are incapable of complete thermoregulation for the first three weeks of their life. As a result, both parents exhibit brooding behavior during this period with an adult squatting on the ground and allowing the chicks to nestle among the feathers on their back and along their flanks. Soon after chicks are able to thermoregulate, they begin roosting with adults, typically in small shrubs. Chick mortality during the first three months is high, with mortality rates approaching 50 percent or more. Chicks are dependent, to some degree, on the adult until they are approximately three months of age. During this period of dependency, adults will spend the day leading the chicks to favored foraging areas, water sources, loafing areas, dusting sites, and roost sites. The female parent will engage in tidbitting behavior with one day old chicks. This tidbitting behavior seems to stimulate chicks to rush toward the hen and attempt to consume a food item. As such, chicks learn to identify suitable food and begin to forage on their own.

## Loafing Cover

Gambel's quail will utilize areas of tall grasses; however they require shrubby/woody cover for loafing. Shrub and woody cover provides both avian and thermal protection throughout the day, and is particularly utilized during midday loafing periods. Important shrub species used for loafing include catclaw acacia, littleleaf sumac, and mesquite.

## Roosting Cover

Unlike other southwestern quail species, which roost on the ground, Gambel's quail roost in dense shrubs or small trees (Figure 10). Depending on the roost site selected, individuals may spend the night perched several inches to a few feet above ground. Roost sites vary by season, but typically include netleaf hackberry (*Celtis laevigata* var. *reticulata*), littleleaf sumac, mesquite, and various acacias (*Acacia* spp.).

## Food

Gambel's quail are primarily herbivorous and eat a variety of foods depending on seasonal availability. A study in Arizona indicated that more than 90 percent of the Gambel's quail diet consisted of plants. Another study which analyzed 405 crops collected throughout the Trans-Pecos over a 24 month period showed twenty food items accounted for 91 percent of the total volume of all items consumed. Major food items identified in the Trans-Pecos study are listed in Table 1. The most important of these are seeds from annual forbs and soft mast of woody perennials, which generally make up 60 percent of the Gambel's quail annual diet.

Consumption of forb seeds are most important in the winter months, whereas the consumption of vegetation (e.g., leaves, buds, flower parts, sprouts) becomes increasingly important in the spring and summer months. In Arizona, mesquite has been shown to be an important food item for Gambel's quail, as they rely heavily on its seeds, leaves, and flowers throughout the year. Foods typically consumed in higher quantities when available include Russian thistle (*Salsola kali*), Berlandier's wolfberry

(*Lycium berlandieri*), desert willow (*Chilopsis linearis*), tansy mustard (*Descurainia pinnata*), and cowpen daisy (*Verbesina encelioides*). Annual mustards (i.e., pinnate tansymustard (*Descurainia pinnata*), peppergrass (*Lepidium* spp.), and bladderpods (*Lesquerella purpurea*) can play an important role in Gambel's quail diet in early spring and through summer. Foods important throughout the summer and fall are typically mast species (e.g., Berlandier's wolfberry, littleleaf sumac, and Warnock condalia (*Condalia warnockii*)). Broom snakeweed (*Gutierrezia* spp.) and kochia (*Kochia americana*) can also be considered a principal food source when they are available.

During the spring and summer, invertebrates can account for up to 13 percent of Gambel's quail diets. During this time period, invertebrates provide much needed protein to adults and chicks alike. Protein derived from consuming invertebrates is essential for chick growth and development. Additionally, invertebrates provide more energy per unit volume than herbaceous matter.

## Gambel's Quail Hybrid

Gambel's quail may occasionally hybridize with scaled quail where their ranges overlap in Texas. The resulting hybrid is referred to as a "scramble" (scaled x Gambel's). Scrambles have been documented in both New Mexico and Arizona. An early report of a scramble in New Mexico (Grant County) dates back to 1916. These hybrids generally have a distinctly scaled pattern on the breast, back, and upper flanks. The color of head plumes are dark reddish-brown and the rufous crown, chestnut sides, and black of the belly, throat, and forehead are greatly reduced by encroachment of the adjacent light-colored areas.

*Figure 9: Typical Gambel's quail nest at the base of a shrub.*



*Figure 10: Gambel's quail roost site in a littleleaf sumac.*



Table 1

## Key Foods Consumed by Gambel's Quail in the Trans-Pecos, Texas

<b>Forbs</b>	<b>Scientific name</b>
Russian thistles	<i>Salsola iberica</i>
tansy-mustard	<i>Descurainia pinnata</i>
stickleaf mentzelia	<i>Mentzelia multiflora</i>
pepperweed	<i>Lepidium spp.</i>
cowpen daisy	<i>Verbesina encelioides</i>
desert spike	<i>Oligomeris linifolia</i>
<b>Shrubs/Cacti</b>	<b>Scientific Name</b>
Berlandier's wolfberry	<i>Lycium berlandieri</i>
littleleaf sumac	<i>Rhus microphylla</i>
netleaf hackberry	<i>Celtis laevigata var. reticulata</i>
Warnock condalia	<i>Condalia warnockii</i>
desert willow	<i>Chilopsis linearis</i>
honey mesquite	<i>Prosopis glandulosa var. torreyana</i>
whitethorn acacia	<i>Acacia constricta</i>
catclaw acacia	<i>Acacia greggii</i>
pricklypear	<i>Opuntia spp.</i>
<b>Grasses</b>	<b>Scientific Name</b>
plains bristlegrass	<i>Setaria leucopila</i>
Johnson grass	<i>Sorghum halepense</i>

### Home Range

Home ranges of Gambel's quail vary depending on habitat. In upland areas with riparian habitat, home ranges vary from 25 to 393 acres. In areas where the only suitable habitat was along a river or stream, Gambel's quail home ranges are generally smaller and range from 9 to 137 acres. In riparian areas that possess native riparian habitat and large quantities of salt cedar, Gambel's quail selected native riparian zones 66% of the time and salt cedar riparian zones 31 percent of the time.

# MANAGEMENT CONSIDERATIONS

## Grazing Management

Overgrazing by livestock can cause a reduction of ground cover and loss of suitable nesting cover for quail. Landowners should use a conservative stocking rate for livestock if quail management is a priority. The implementation of grazing systems that allow plants to recover from defoliation is ideal. Grazing systems that determine stocking rates based on seasonal forage availability help prevent overgrazing since desert rangelands do not recover as quickly as areas that receive greater amounts of precipitation. Planned grazing is essential for quail as it improves vegetative conditions that provide optimal nest cover and plant diversity. However, before deciding on any program of livestock grazing, one should consult with a natural resource professional.

## Water Development and Management

Practices that minimize precipitation runoff will limit erosion and increase plant growth creating small quail “oases.” If livestock watering facilities are available, these are often adequate water sources for quail including Gambel’s. Additionally, these facilities should be located near woody cover to reduce predation. Although Gambel’s quail are not reliant on standing water for survival; they will utilize available water during times of drought. When making water available for quail or other wildlife species, it is recommended to equip the guzzler or livestock water trough with access and escape ramps to prevent accidental drowning. Also, if water sources are placed specifically for quail, escape cover should be provided close to the water source.

## Cultivation Practices

Shallow winter disking on approximately 1-3 percent of suitable quail habitat can stimulate forb production if done before the last freeze. To increase habitat for Gambel’s quail, areas selected for disking should be located in deeper soils adjacent to washes and drainages. Disking in these areas should be conducted at a depth of 4-6 inches while following the contours of the landscape. Additionally, disking should be restricted to areas where the slope does not exceed 3 percent, and preferably in areas with slopes  $\leq 1$  percent. Late winter disking can promote growth of seed-producing forbs and annual grasses, both of which can be valuable to Gambel’s quail, as well as scaled quail, doves, or other seed-eating species. Cultivation of these forb patches can also provide an abundance of insects that can serve as forage for a variety of birds.

## Prescribed Burning

Fine fuels are often limited in Gambel’s quail habitat, but where fine fuels are available; fire is a vital tool for habitat enhancement. The use of prescribed fire stimulates germination of annual and perennial forbs, including legumes. Legumes are an essential part of Gambel’s quail diets and are also important to a variety of other bird species. The Texas Parks and Wildlife Department encourages a multi-year rotation with regard to a fire regime so that approximately 10 percent of the property is burned each year. Gambel’s quail may respond favorably to a mosaic of burns of various intensities. Additionally, fire tends to favor desirable bunchgrasses and can suppress undesirable species.

## RESEARCH NEEDS

Since Gambel's quail have such a limited distribution in the Trans-Pecos, hunter harvest data is not a reliable source to use for creating a population index. Instead, the development of population indices that are independent of harvest data should be established (e.g. call-count and brood-count surveys).

Additional research should focus on the following areas: (1) basic life history knowledge (e.g. cause-specific mortality, seasonal food habits, habitat use, and nesting chronology); (2) effects of predation on populations; and (3) how various management strategies (e.g. grazing, prescribed fire, supplemental feed, and water) affect populations.

## EXPERIMENTAL REINTRODUCTION INTO HISTORIC RANGE

In an effort to restore Gambel's quail to their former distribution along the Rio Grande, TPWD and El Carmen Land and Conservation Company initiated a reintroduction project during the winter of 2013-2014. A total of 211 Gambel's quail were captured using funnel traps and transported to the area of restored habitat on the release site. All birds were fitted with TPWD aluminum leg bands and color bands for identification. Supplemental water and bird feed blocks were also provided to minimize dispersal.



Although long-term success of this effort is unknown, initial reports suggest it has been successful. Researchers (B. McKinney, ECLCC, unpublished data) have reported large coveys of Gambel's quail, reports of successful nesting and brood rearing, and distribution along the Rio Grande from Black Gap WMA to Boquillas.

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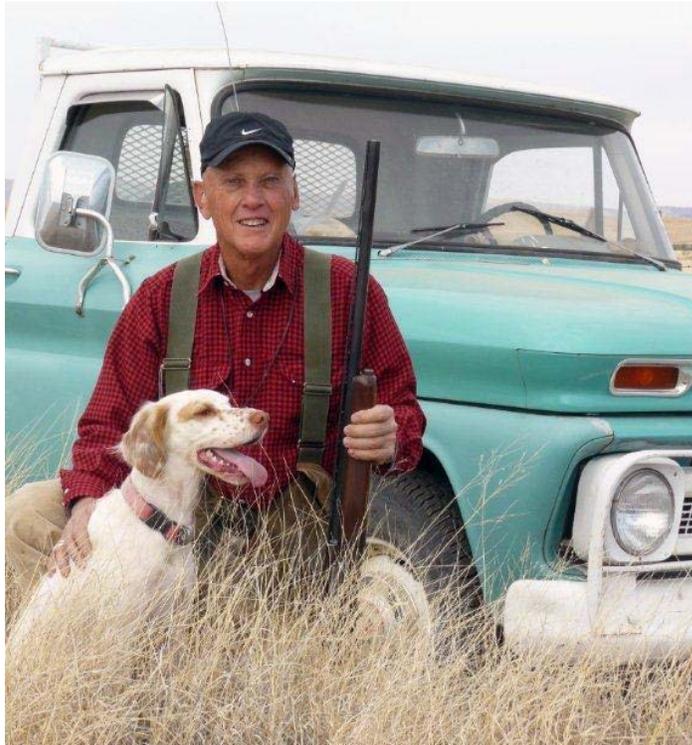
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# DEDICATION

We are honored to dedicate *Gambel's Quail in Texas: Biology and Management* to our friend, colleague, and mentor

## **Michael D. Hobson, 1948–2012**

Mike Hobson was a consummate professional who was passionate about applying natural resource management principles and practices in Texas. Mike graduated from Texas A&M University with a B.S. in Wildlife Management in 1970 and proudly served our great state as a Texas Parks and Wildlife Department employee from 1973 thru 2005. Mike mentored hundreds of aspiring and professional wildlife biologists during his tenure at Texas Parks and Wildlife Department. Mike was an avid hunter who especially enjoyed chasing west Texas quail. Mike helped champion and supervise the first research project on Gambel's quail in Texas.



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