



ON BOBWHITES FOR OKIES

A BOOK SUMMARY OF FRED GUTHERY'S BOOK

WORKSHEET PREPARED BY ARBUCKLE MOUNTAIN AREA CHAPTER OF QUAIL UNLIMITED

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This Summary is intended to boil down the key points in Dr. Guthery's book and to focus the facts as they more directly relate to Southern Oklahoma. For the full context of the discussion, refer to the book page number before the Key Point.

All references to "Quail" in this summary are intended to mean "Bobwhite Quail", which are the only species common to the Arbuckle Mountain Area

Many of the key points are documented by facts and scientific research, but as with any wildlife environment, nature creates variations, and exceptions can occur. Use this tool as a quick management resource, remembering that nothing replaces field experience.

"Wildlife management has been defined as a science and an art. Fred Guthery has done more to advance the science of bobwhite quail management than any other biologist. On Bobwhites represents Fred's summary of his and other researchers' data on all things quail. This synopsis of the book puts key facts or a topical search at your fingertips!" Grant Huggins, Certified Wildlife Biologist, Resource Stewards LLC

"I've read Dr. Guthery's book "On Bobwhites" several times, and as my understanding broadens, I find subtle new jewels every time re-read a passage."
Chris Cowlbeck



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Topic	Pg	Key Facts, Considerations and Suggestions
Cover	7	Quail must freeze, run or fly to escape - take away any function, yields no quail
Flight	8	Average quail flight distance is 47 yards (range 4 to 148 yards, longer 350-450 + yards possible)
Flight	8	Average quail flight height is 2.4 yards with upper height 13 yards
Flight	8	Average quail flight time is 4-6 seconds, high range 13 seconds
Flight	8	Average quail flight speed 20 mph to 27 mph, takeoff bursts to 40 mph
Flight	9	Quail flight paths are generally short, low and mostly straight
Flight	9	Quail are rare in areas NOT offering 360 degrees of escape routes
Flight	10	Dense brush or forest with closely spaced trees are a problem for quail flight
Flight	10	Escape cover should be within 75 yards of food cover
Biology	11	Normal body temp of quail is 108.7° F
Biology	11	Death of quail is 116.7° F
Flight	11	Quail avoid long flight in summer and hang out in cooler habitats
Cover	11	Quail hang out in cooler cover in summer to reduce overheating
Soils	17	Quail do better in loams and sandy soils
Soils	17	Sands favor bunch grasses verses sod grasses - bunch grass better for quail
Soils	18	Red sand soils do offer the best diversity, yielding higher native food supplies
Loafing	20	Tall shaded loafing coverts can be 7° F cooler than ambient air
Loafing	20	Quail use tall coverts on hot days stay cool
Loafing	21	Quail use shorter coverts on cool days
Loafing	21	Quail rarely loaf where there is no cover at all
Loafing	21	Quail use short shaded cover on cool days, low light conditions or heavy overcast days
Loafing	21	Coveys seek out relatively thick brush
Loafing	21	Quail prefer relatively small amounts of heavier brush
Loafing	21	Canopy cover of heavier brush might be twice as high as available nearby
Loafing	21	Land managers must preserve small strips or blocks of mature brush
Loafing	21	Hot day coverts are a more important management concern
Loafing	22	Singleton trees can be used to nurse other brushy species around the base
Loafing	22	Cool day coverts can be cut brush and towed to deficient areas
Loafing	22	Hot day coverts can be tall wood teepees or stacked cinder blocks with lumber panels and limbs loosely covered
Loafing	23	Hot day coverts should be elevated , cool day coverts not as critical
Loafing	23	Clusters of coverts (1 hot and 4-6 cool) are better than singletons
Thermal	23	Quail die if exposed to 104° F consistent air temperature (ie 24 hours)
Thermal	23	Quail die if body temperature rises 8° F above normal
Thermal	23	Quail can die if they leave cover on very hot day , possibly within minutes
Thermal	23	Quail live perilously close to death from overheating
Thermal	23	Understanding quail thermal needs explains why they prefer certain brushy cover
Thermal	23	When considering quail thermal needs , think of the heat gain in a sealed parked car in shade and in full sun
Thermal	24	Quail chicks can die in 122 seconds in full sun
Thermal	24	Quail chicks are very vulnerable due to small body size
Thermal	24	Quail hens have died on nests in very hot droughty days
Thermal	24	Quail hen production is lower on hot summer days verses mild days
Thermal	24	Lower humidity (less water in air) allows more sun rays to hit the ground
Thermal	24	Brood rearing and nesting generally ends in late July or August
Thermal	25	Quail flights are shorter in summer , long flights can be lethal
Thermal	25	Plant cover keeps soil temp lower by shading the ground
Thermal	25	Bare soil temperatures can reach 130° F to 160° F in full sun
Thermal	26	Temperature Fact - 32° F quail needs about 550 milo seeds per day
Thermal	26	Temperature Fact - 68° F quail needs about 350 milo seeds per day
Thermal	26	Temperature Fact - 76° F to 78° F quail embryos develop in an egg held at this temperature
Thermal	26	Temperature Fact - 80° F to 85° F quail begin to dissipate heat
Thermal	26	Temperature Fact - 86° F quail needs about 250 milo seeds per day
Thermal	26	Temperature Fact - 99° F to 100° F quail egg incubation begins
Thermal	26	Temperature Fact - 102.2° F quail body's can't keep pace to dissipate heat and body temperature rises



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Thermal	26	Temperature Fact - 104° F quail experiencing long periods will die of hyperthermia
Thermal	26	Temperature Fact - 108° F quail normal core body temperature
Thermal	26	Temperature Fact - 116° F to 117° F body temperature resulting in death for most vertebrates, including quail
Cooling	27	Quail open their mouths when under heat strain , also page 30
Cooling	27	Quail throats vibrate, like a rubber band, called gular flutter , and is used like panting dogs, for cooling
Skinny hen	30	Quail can recover rapidly from low body fat levels with sufficient food
Skinny hen	30	At best, a quail population can double , year to year
Skinny hen	31	During high prevailing ground temperature and drought delay and limit nesting , clutches are abandoned, hens die in nests, eggs incubate early and unevenly
Skinny hen	33	For every 1° F increase in late summer maximum temperature, laying season declines by 1 week
Skinny hen	33	Rainfall may not correlate well with good production in semiarid environments
Fat	34	Fat provides high octane energy that keeps quail body heaters going in extreme cold
Fat	35	Females require lots of energy during egg laying
Fat	35	Extra fat goes into yolk and keeps chicks going up to 3 days after birth
Fat	35	Yolk provides a rich nutrient store
Fat	35	High fat levels can be fostered by high availability of food
Fat	35	Food high in carbohydrate will elevate fat - millet, sorghum, croton, fruits and berries
Fat	35	Foods high in fat are sunflowers and western ragweed
Fat	36	Fat increases by reducing energy loss
Fat	36	Reduce energy loss by maintaining proper habitat structure and evenly distributing cover
Fat	36	Fat levels in quail are an adaptation to their climate , not habitat
Fat	36	Energy costs for quail movement (walking, running, flying) are trivial compared to cost of regulating body heat
Fat	36	Quail starve to death in 3 days if they fast in freezing weather
Food Choice	36	Food preferred 94% of the time was milo , followed by sorghum (54 seeds tested)
Food Choice	36	Food preferred next after milo & sorghum was wheat and switch grass
Food Choice	36	Preference for cracked corn was 15th and whole corn 33rd (54 seeds tested)
Food Choice	37	Preference for Partridge Pea was 24th and Kobe Lespedeza was 25th (54 seeds tested)
Food Choice	37	Preference for Bermuda was near last (54 seeds tested)
Food Choice	37	Crickets have a higher metabolic energy than milo
Food Choice	37	Quail eat less desirable foods because preferred foods were not available
Food Choice	37	Grit for quail crops is not essential
Food Choice	38	Quail need 23-28% crude protein for optimal growth
Food Choice	39	Forbs or grasses do not provide sufficient crude protein to meet growth requirements of quail
Food Choice	38	Quail can increase food consumption to offset energy deficient diets
Food Choice	39	Once a certain level of dietary quality is reached, better quality diet would have no effect
Food Choice	39	Quail seemed to have evolved as survival first, reproduction second
Food Choice	39	Diverse seed base (several species) and high insect diversity ensure adequate nutrients
Water	40	Water is the most vital nutrient for quail
Water	40	Quail get water from 1) free water in food 2) digesting food with water as byproduct and 3) surface water
Water	40	Quail can a do thrive on water in food and digesting food alone
Water	40	Quail do not need surface water to survive (ponds, creek, etc.)
Water	41	Quail may visit standing water in droughty periods
Water	42	Water facilities (manmade) may reduce quail stress in dry periods
Water	42	Water is never higher than third on a management list behind 1) proper habitat structure and 2) food supply management (if needed)
Water	43	15 bird quail covey will eat about 11 tablespoons of lettuce per day (the equivalent of 1 head) - not very much
Water	43	Laying hens require 40-60% more water - about 1.5 head of lettuce and still not very much
Water	44	Successful egg production and hatching in droughts may not yield more birds - chicks perish without insects in the first weeks (insects not around without water)
Water	44	5 year study in rainy and droughty years showed quail visited waterers , but no difference in abundance when compared to the nearby control site
Water	44	Current state of knowledge suggests supplemental water is a luxury
Fire Ants	45	There is much controversy about the effects of fire ants



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Fire Ants	45	Studies show fire ants will eat eggs and hatching chicks
Fire Ants	45	Quail hens will eat fire ants attacking eggs but can be overwhelmed by the ants
Fire Ants	47	Fire ants may eat may local insects
Fire Ants	47	Fire ants compete for seeds
Fire Ants	48	Studies have show quail densities can be higher in fire ant infested areas compared to treated areas
Fire Ants	48	One fire ant study with 5 treated sites & 5 control sites had average quail density twice as high in treated areas
Fire Ants	49	Some South American fly specie can control fire ants , but not established in USA, and offers future hope
Seeds	53	Daily quail demand to balance energy on a cold day may need 18,639 lespedeza seeds or 666 milo seeds for a 10 hour period
Seeds	53	Quail can slowly starve eating small seeds with poor nutritional value
Seeds	54	Quail could conceivably reduce predation by eating bigger seeds as they spend less time feeding
Seeds	55	Insects are the best quail food available
Seeds	56	Generally, seeds rich in oils are rich in usable calories
Chick Food	56	Chicks have a 3 day supply of energy from the yolk sac
Chick Food	56	Quail managers should ensure that chicks eat well
Chick Food	56	Quail chicks should get 28% crude protein in the first 3 weeks
Chick Food	56	Adult quail need 12% crude protein, hens need 23% when laying
Chick Food	57	Insect bodies are about 50% crude protein
Chick Food	57	Insects are rich in other substances for growth and feather development
Chick Food	57	Management foods for chicks are grasshoppers, beetles and leafhoppers
Chick Food	57	To increase insect abundance, increase forbs and forb diversity
Chick Food	57	Succulent weeds result from rainfall , which is not controllable
Chick Food	57	Managers can create conditions which give weeds opportunity to grow
Chick Food	57	Grazing and disking reduce grass abundance and reduce grass litter
Chick Food	58	Chicks eat about 25% of diet of seeds
Chick Food	58	Top seeds for chicks include millets
Chick Food	58	Chick feeding grounds must be close to loafing cover
Chick Food	58	Good chick feeding strips should be disked between old and new brush
Chick Food	58	Chicks need bare ground near loafing cover
More Food	60	Quail need about 12 pounds of feed per year in average winters
More Food	60	50 quail on 100 acres would require 600 pounds of feed per year or about 6 pounds per acre
More Food	60	Milo yields about 2000 #/acre and browntop millet 750-1500 #/acre
More Food	60	Consider planting smaller plots to provide food needs - milo minimum of 120 sf , or strips 20' long and 6' wide
More Food	61	Food plots are only necessary if natural food scarcity is the limiting factor
More Food	61	Irony of food plots - when needed in drought years, they won't grow
More Food	61	Prime habitat hallmark - each quail can use each and every inch of countryside
Supp Feeding	64	Supplemental feeding can not counteract deficiency in cover quality
Supp Feeding	64	Supplemental feeding may increase predation as it concentrates quail in a small area
Supp Feeding	65	Supplemental feeding changes locations of coveys but has neutral effects on population
Supp Feeding	65	Alfa toxins are colorless, odorless, tasteless compounds provided by molds that contaminate feed stuff
Supp Feeding	65	Alfa toxins are potent carcinogens
Supp Feeding	65	Quail chicks are very susceptible to Alfa toxins
Supp Feeding	66	Adult quail are more resistant to Alfa toxins
Supp Feeding	66	Quail are more resistant to Alfa toxins than chickens
Supp Feeding	67	Irregular feeding patterns (broadcast spreading) might help quail find alternative natural foods
Supp Feeding	67	Studies show that at least 70% of supplemental feed goes to other wildlife
Supp Feeding	68	A fallow garden of 1 acre may have 450# of weed seed by October and 13# by winter's end
Supp Feeding	68	Kansas prairie may have 3.2 million quality seeds per acre and 700,000 by lat January
Presc Burn	69	Quail will hide in burrows made by small mammals during burns
Presc Burn	69	Imagine large dunce cones upside down on quail head - if hawk comes into cone area, quail are nervous
Presc Burn	69	Quail like overhead cones of zero volume and rarely let the cone volume grow to 20% of open field airspace
Presc Burn	69	Burns temporarily reduce overhead cover and expose to predation
Presc Burn	70	Patchy or small burns mixed with unburned plots would be better



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Fat	70	Broomweed has 25% fat and provides good cover
Presc Burn	70	Preserve some travel lanes and loafing coverts during prescribed burns
Presc Burn	70	In drought prone areas, fire may be useful when applied infrequently , although not absolutely necessary
Cattle	71	Cattle need shade and gain weight more rapidly with shady areas
Presc Burn	71	Fire can fail as a management practice for quail
CRP Fields	73	Plant warm season bunch grasses in CRP buffers
CRP Fields	73	Plant large seed grasses in CRP buffers
CRP Fields	74	Maximize allowable soil disturbance programs as food strips
CRP Fields	74	Plant energy rich seeds in CRP fields like sunflower, cowpea and sorghum (milo)
CRP Fields	74	Use manmade loafing coverts in CRP fields
CRP Fields	74	Use sumac and wild plum for cover strips in CRP fields if legally allowed
Economics	75	Grazing provides most cost effective management tool to increase quail in a given area
Economics	76	Mechanical brush control (disking and roller chopping) can cause quail to boom, but not as cost effective as grazing
Economics	77	Food plots may not make economic sense - consider native plant species over domestic varieties
Harvest	78	Harvest mortality might be additive to a greater degree in low populations than in high ones
Harvest	79	Survival of younger quail at hunt season is lower than that of older birds - younger birds die at a faster rate
Harvest	79	Postponing hunting when hatches are late may not improve winter mortality
Management	81	Management of quail does make a difference
Management	81	Warm season rains set the stage for high chick survival and renesting if early clutches fail
Management	81	Warm season rains fatten adult birds within 2 months and effects can last up to 6 months
Management	81	Winter rains contribute to lowered body condition as birds may be unable to eat enough to maintain fat levels
Management	81	Warm season gully washers can flood nest and drown chicks
Management	82	Too much rain leads to rapid plant succession and dense grass stands , thus lowering quail numbers
Management	83	Disking, half cutting, shelter building has shown quail density increases of up to 6 times in drought years
Management	83	Disking, half cutting, shelter building has shown quail density increases of up to 2 times in wet years
Management	83	Range grasses with poor soil and vegetation characteristics have a low water storage capacity - plant stress occurs
Management	83	Water must enter the soil before it can be stored for later plant use
Management	83	Rangeland renovation for compact soils or hardpan includes plows, chisels, disks and aerators
Management	84	1984 drought in south Texas proved managed land had 2-5 times more quail density
Management	84	Rebound of quail after drought on managed lands was 2 years and 3 years on unmanaged lands
Management	84	Rainfall may explain 40-80% of quail population variation leaving 20-60% for management
Management	84	Quail management practices can lessen the effect of drought
Management	84	Caveat - if habitat for quail is operationally perfect, no management practice can influence increased abundance
Management	85	Beware of confounding - when effects of one practice are entwined with the effects of other practices
Management	86	To determine the benefits of one practice , it must be applied while other practices are controlled
Management	86	Harvest logs of previously leg banded quail can be measure quail responses to experimental control
Management	86	Breeding response can be found by studying age ratios of birds in harvest
Management	86	Adult quail lack white tips on primary covert wing feathers
Management	86	Immature quail have white tips on primary covert wing feathers
Management	87	Population density can be calculated by tracking hours spent hunting and number of coveys flushed
Edge	91	Managers need only provide adequate amounts of edge for a decent quail population
Edge	91	Edge must be meaningful for application of the principle - interstate with Bermuda edge won't work
Edge	91	Edge valuable to quail occur where habitats that provide refuge from harsh temperatures and predators meet and which provide nesting cover, loafing cover and food
Edge	91	Management has not yet been able to increase populations by increasing habitat quality on fully usable areas
Edge	91	Management may create more usable space for quail to live in and increase populations
Cover Areas	93	Canopy cover of herbaceous foods (grasses and forbs) should shade 25-75% of the ground at mid day
Cover Areas	93	At quail level (below 8") 30-60% of soil surface should be bare or lightly covered with plant litter
Cover Areas	93	Ideal solution for food plots would be to leave the crops unharvested or stubble standing until spring
Cover Areas	93	Low woody cover with dense canopies should be dispersed throughout the habitat



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Cover Areas	93	The height of cover should be 10-20 inches - lower increases chance of predation, higher impedes flight takeoff
Cover Areas	93	More than 10% of an area should be nesting cover like 12-18" tall bunch grasses
Cover Areas	93	No cover type should be farther than 100 yards away and well distributed for quail walking
Cover Areas	94	Cover may be distributed in circular mottes , small scattered bushes , long narrow strips of mature brush all with or without scattered brush between
Cover Areas	96	Flexibility of cover distribution gives managers many acceptable situations
Rain Variable	96	The ability to measure the impact of management on wild quail has always been reduced due to the inability to compensate for the impact of precipitation
Space time	99	Quail spend their lives in small areas
Space time	99	Buildup of herbaceous and woody plants in high rainfall areas reduces usable space - quail can't use or walk
Space time	99	Burning can create more usable space
Space time	99	In areas lacking woody cover, artificial loafing shelters can be built
Space time	100	To maximize quail abundance, one must maximize the length of time quail can actually use the space
Space time	100	Usable space must also be considered with length of time of use, or space time
Space time	100	Top quail goal would be to allow quail to use every square inch of land 365 days a year
Space time	100	Any management practice must be relative (or needed) in order for that practice to add value
Space time	100	A non-relative practice would be building a brush pile in a thicket - relative would be building a brush pile in a prairie
Space time	102	Example of lost space-time would be the recovery time after disking - no cover while regrowth
Counting	103	Normal 20 mile route on secondary roads stopping every mile to record the number of males in 3 minute time
Counting	104	Texas uses number of quail seen per mile on secondary roads
Counting	104	A different count method can be done before dawn
Counting	105	When counting coveys with dogs , about 50% of quail can be missed in large areas
Counting	106	Direct sunlight kills bacteria necessary for scent production , regardless of temperature
Counting	106	Ask for assistance on quail counts from a wildlife biologist
Pen Birds	109	Few pen released quail (1-20%) make it to hunters bags in the 1940's stocking efforts
Pen Birds	109	Research showed wild trapped quail and pen raised quail were similar in genetic fitness
Pen Birds	109	Early environment may be more influential than genetic programmed instincts in shaping pen raised quail performance in the wild
Pen Birds	110	Managers should not assume crossing wild quail with pen reared quail will dramatically improve field performance
Pen Birds	110	Priority should be given to develop rearing procedures that minimize contact with humans
Pen Birds	110	Priority should be given to develop rearing procedures that promote natural behavior patterns before release
Pen Birds	110	Pen raised quail may perform poorly due to couch potato effect - lack of exercise
Pen Birds	110	Wild quail may be viewed more like lean athletes verses couch potatoes
Pen Birds	111	1990's study shows annual survival for pen raised quail is 1-2% verses 20-30% for wild quail
Pen Birds	111	Pen raised quail usage for supplemental harvest is justified where wild quail numbers are low or hunt use is high
Geography	115	Winter Texas quail weigh about 160 grams compared to 200 grams for Wisconsin quail
Geography	115	Larger size of northern quail is an adaptation to harsher winters
Geography	115	Northern quail carry 2-3 times more fat than southern quail, thus helping survival through fasting periods
Geography	116	North Texas quail average 80% mortality in hunted populations (20% survival)
Geography	116	North Texas juvenile to adult quail ratio is 3.9 to 1
Age	118	1000 quail chicks dwindle to 100 in a year or so
Age	119	Quail in captivity can live nine years
Age	119	Wild quail rarely live to old age
Age	119	Of 10,000 year-old quail, only 3 make it to 5 years old
Age	119	Predators suppress quail numbers when they take healthy quail that are unlikely to die of other causes
Die-Offs	121	Snowfall/ice that blankets the ground for 3-4 days can cause widespread quail die-offs
Die-Offs	122	Organic disease probably only rarely is a root cause of wild quail die-offs
Die-Offs	123	Simple starvation may be a potentially important factor in quail die-offs
Die-Offs	123	The average Texas quail will survive less than 2 days at freezing temperatures with nothing to eat
Die-Offs	123	Quail living largely on greens or running energy deficits may be prime candidates for die-offs
Production	124	Biological evidence indicates wild quail cannot raise a brood the same year they hatch



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Production	125	General rule is that 30-35% of nest initialed are expected to succeed
Production	125	It is thought that all hens in a population attempt to nest at least one clutch
Production	125	The average egg count in initial nests is 12 , with less in the 2nd and 3rd attempts
Production	125	Hens may attempt to nest up to 4 times
Production	125	Laying seasons range from between 90 days in north US to 150 days in drier southern climates
Production	125	Cold days early and hot days late can reduce the laying season length
Production	126	Chick loss is on the order of 44 out of 10,000 per day
Production	126	Managers may be able to increase the laying period by making quality nesting cover throughout the season
Production	126	Any practice such as over grazing that reduces nesting cover later in the season is likely to reduce production
Production	126	In east-south Texas, the laying season begins after March 1st , peaks late May/mid July and ends September
Production	127	About 85-90% of production will be completed by June 30
Production	127	Flooding rains are the most likely catastrophe during breeding season
Production	127	Drowning chicks is less likely in rolling types of country with good drainage
Production	127	Drowning chicks is more probable in low flat country where water ponds forcing chicks to swim or perish
Production	127	Chicks have their vitality lowered by wet and chilling
Production	128	Heavy rains can have a devastating effect on quail populations
Densities	130	Quail densities of 2-3 birds per acre are know to have existed in Texas and other states
Densities	130	Quail densities of nearly 5 birds per acre are know to occur on well managed ranches
Densities	131	A series of extremely mild winters might lead to a quail population expansion
Densities	131	Long distance migrations of quail have recently been documented in Oklahoma
Multi-Broods	134	Study has shown that 60% of young quail were weaned by early July
Multi-Broods	135	Gypsy hens have mated, laid eggs, left the male to incubate, then mated with another male - up to 3 times
Multi-Broods	135	Researchers have observed up to 26% male incubation and brood rearing
3rd Broods	136	Quail can and do raise up to 3 broods per season
3rd Broods	136	Renesting is a hedge against high nest loss and a 65-80% annual mortality
3rd Broods	137	Entire process of nesting , laying, incubation and hatching is 47-55 days (50 days on average)
3rd Broods	137	The opportunity for hens to produce multiple broods accrues only if they begin laying very early
3rd Broods	137	The average laying period may approach 150 days in south Texas (less in north Texas and Oklahoma)
3rd Broods	137	If the laying period is say 100 days due to weather, hens can't hatch 3 broods based simply on time
Density	140	Quail can seem quite common in late summer due to the groups being pairs, singles and broods
Density	141	Quail can seem to decrease in autumn as they form coveys instead of being in several small groups
Islands	142	Today's wild lands are like islands in a sea of civilizations
Islands	142	Large areas have the advantage of having large populations that help ensure survival of some individuals
Islands	142	Quail on island habitats can disappear with one ice storm, fire or flood, perhaps never to return
Islands	143	Island habitat eliminates the chance of replenishment through ingress from surrounded areas
Islands	143	Very small populations are susceptible to inbreeding and the expression of undesirable traits
Islands	143	Population ecologists recommend at least enough habitat for 500 individuals
Islands	143	Biologists hotly debate injecting new genetic material into bred populations
Islands	143	One habitat approach to fragmentation would be to create corridors or stepping stones between islands
Islands	144	Great blocks of habitat two miles apart might represent no quail habitat at all
Population	144	Weather catastrophes can devastate quail numbers and their only defense is their remarkable productivity
Population	145	Probability and minimum population size - read pages 145 and 146
Density	147	Density dependent survival describes the phenomenon whereby survival decreases and density increases
Density	147	Density dependent production describes lower density populations are more productive than higher densities
Density	147	Higher densities create social stresses , making quail more vulnerable to diseases, parasites, etc
Density	148	Higher densities allow predators to focus on quail
Density	148	As density declines , the average hen will produce more chicks - production will increase
Density	148	Higher densities yield fewer resources per individual quail (like food, water, cover)
Density	148	As density declines , survival increases in quail
Regulations	150	Hunt season length does not matter much to quail populations
Regulations	150	Most public quail hunting occurs on open and close weekends and on holidays
Regulations	150	Bag limits do not have much impact on quail populations

