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Author: Howes, Paul Griswold 1892-
Publisher Info: Duell, Sloan and Pearce ; New York
Publication Date: [1954]
Edition: [1st ed.].
ISBN/ISSN:
Article Title: Not given
Article Author: Not given
Volume/Issue:
Article Date:
Pages: 222-239
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APPENDIX 2 *A Résumé of the Animals and Their Food Relationships*

FOR THE VISITOR OR STUDENT WHO IS PARTICULARLY INTERESTED IN the food habits of desert animals, the following brief annotated list has been included to illustrate some of these relationships.

Wherever possible, the technical names have been included, and the list is arranged in such a manner that the further one reads into it the more primitive will be the form of life listed. Thus it begins with mammals and ends with protozoa. All of the technical names of individual animals have been placed in italics (the genus being abbreviated after the first use), and these are followed in most cases by the name of the original describer in roman type. It is conventional in connection with these to place the author's name in parentheses if he named the species under a different generic name than that under which it is now listed. Technical names of families and orders are also given in roman.

The three simple diagrams accompanying this section of the book should prove of interest also. Look first at Figure 28. It shows four outstanding and conspicuous types of cacti which are found in this territory, and some of the animal life linked to, or in some manner influenced by, these plants. It also brings out the facts in regard to the animals which affect the cacti.

In Figure 29, we see the forms which were attracted to what at first seemed to us to be an insignificant species of grass, one which grew in countless little flat tufts or whorls almost everywhere that we made observations, either in the immediate neighborhood of our headquarters or far out in the cacti.

This grass, *Schismus barbatus,* will be seen dotting the ground areas in many of the illustrations in this book, and doubtless it also grew over wide areas which we did not have time to examine. This plant illustrated very nicely how almost everything in the thirsty

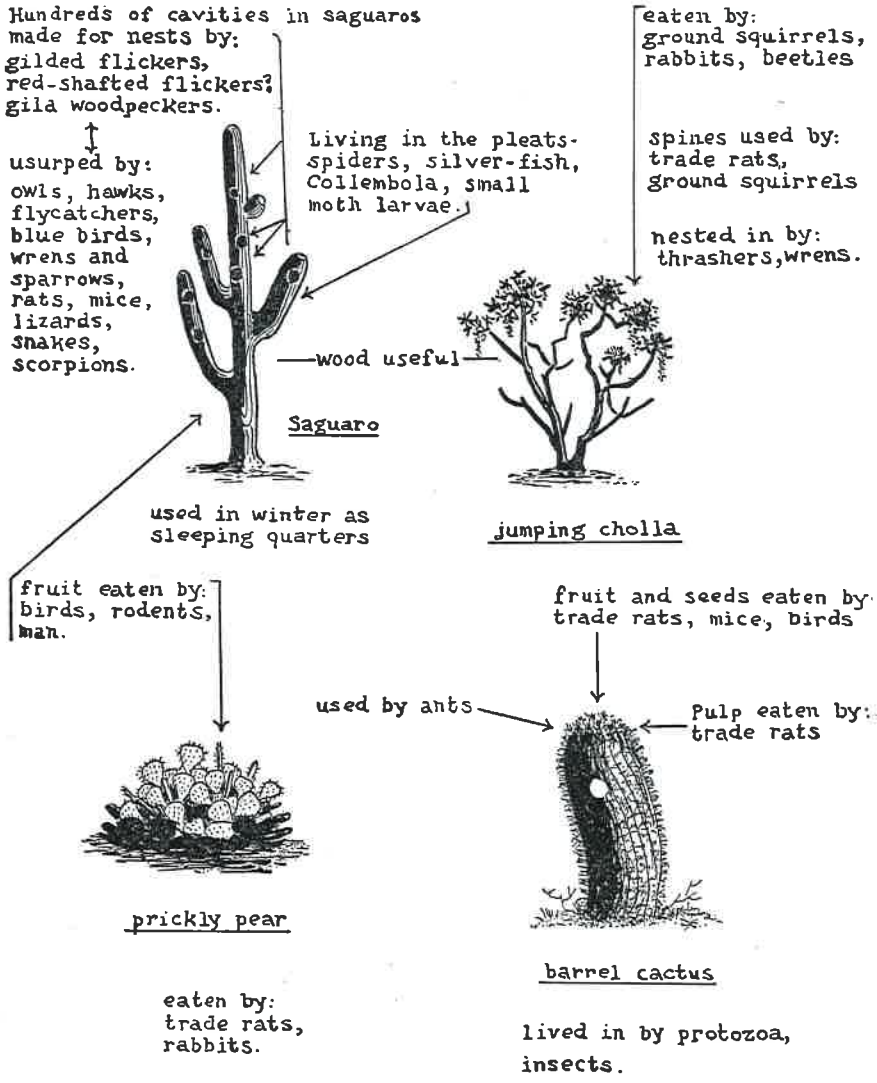

FIG. 28. Diagram showing four outstanding kinds of cacti and some of the animals linked to or influenced by these plants

desert which could be made use of was taken fully into account by other desert dwellers, and how many organisms may be linked together in one way or another. That such widely separated creatures as ants, squirrels, birds, rabbits, and horses sought this plant over and over again was one proof of the balance which had been set up at such great pains by nature, and proof that she is endeavoring always to improve these balances if only she may be let alone by man.

That so many animals were related to the end products of this and other vegetation, in the form of waste matter after digestion, was also a most interesting fact. While the horses are of course a fairly recent development, the use of their droppings by many animals may point to a time when other native species filled their place. Whatever may have been the case, the grass *S. barbatus* now plays an important and very interesting part in the economy of the cactus forest. This plant made up a large share of the "waste" material to which I refer.

In Figure 30 we have a condensed and greatly simplified picture of what the following complete and somewhat more detailed lists bring out. These diagrams and lists, it should be remembered, make no attempt to cover all of the food items consumed by any one group or species. They tell in the simplest terms just what we found out in the somewhat limited area of our observations. Almost any creature in the list will be found to relish a number of items, varying of course, according to where it may be observed, but we have in the lists a fairly accurate record of what was being eaten in the chosen spots in the cactus forest.

MAMMALS

Arizona White-Tailed Deer. *Odocoïleus cousesi* (Coues and Yarrow). Feeds upon grasses, leaves, buds, and other vegetation.

Sonoran Peccary. *Pecari angulatus sonoriensis* (Mearns). Eats roots, fruits, insects, reptiles, birds, eggs, almost anything.

Arizona Cottontail. *Sylvilagus auduboni arizonae* (Allen). Grasses, prickly pear, maybe other cacti, leaves, buds, dry horse dung, grain.

Arizona Jack Rabbit or Blacktail. *Lepus californicus eremicus* (Allen). Grasses, leaves, buds, dry horse dung.

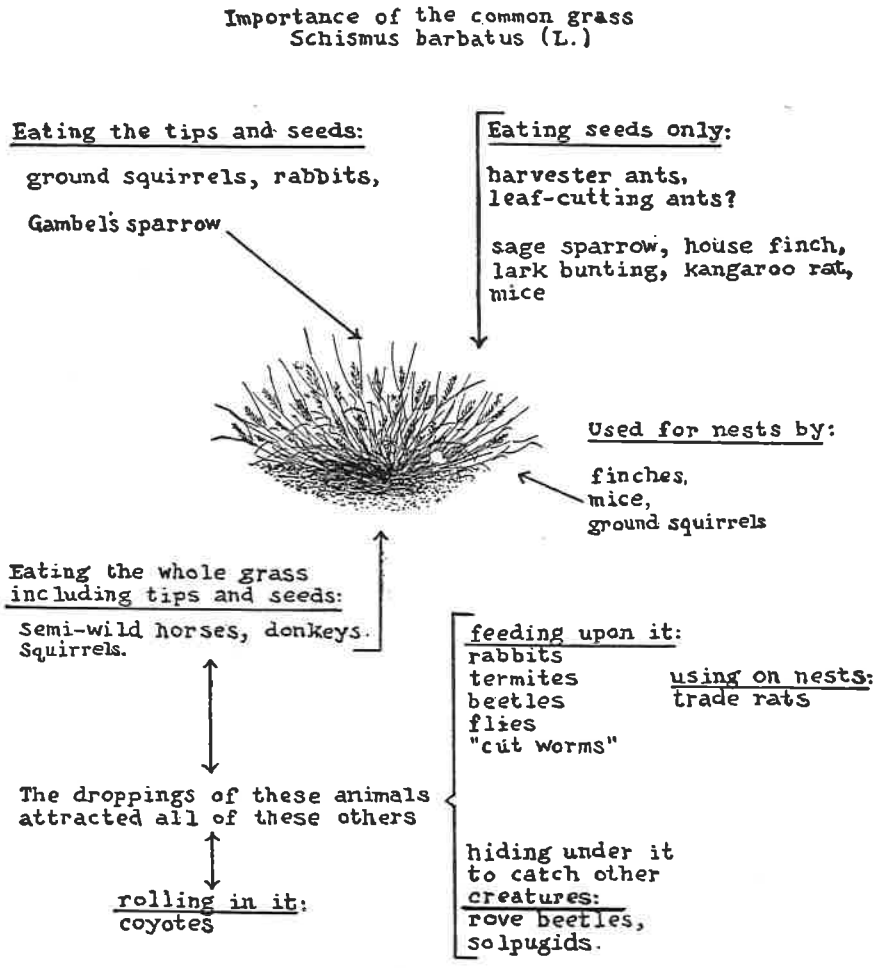

Fig. 29. Diagram illustrating the ecological importance which may be attached to a single, insignificant appearing desert plant

ANTELOPE JACK RABBIT. *L. alleni alleni Mearns.* Grasses, leaves, buds, some cacti, in one case dry horse dung.

WHITE-THROATED WOOD RAT. *Neotoma albigula albigula* Hartley. Cacti, especially prickly pear, also barrel cacti, cactus seeds, palo verde beans, rolled oats, grain, in one case bird meat.

COUES'S GRASSHOPPER MOUSE. *Onychomys torridus torridus* (Coues). Insects, scorpions, centipedes, other mice, raw bird and animal meat.

LARGE KANGAROO RAT. *Dipodomys spectabilis spectabilis* Merriam. Seeds, cactus pulp, grasses, grain.

MERRIAM'S KANGAROO RAT. *D. merriami merriami* Mearns. Seeds, cactus pulp, green and dry grass, rolled oats and grain mixtures, sunflower and melon seeds, gourd seeds, lettuce, green beans, cookies. The civilized items on the lists of course refer to items taken by these mammals in captivity.

BAILEY'S POCKET MOUSE. *Perognathus baileyi baileyi* Merriam. Seeds of the desert mallow, grass seeds, grains and rolled oats, cookies.

HARRIS'S GROUND SQUIRREL. *Ammospermophilus harrisii harrisii* (Audubon and Bachman). Seeds, cactus pulp, grasses, leaves. They were easily trapped with rolled oats, grain, bread and cake, bones and raw meat. They also carted off orange halves and table scraps. Really omnivorous when a variety of foods are present.

ARIZONA ROUND-TAILED GROUND SQUIRREL. *Citellus tereticaudus arizonae* Grinell. Seed pods of the creosote bush, possibly its leaves, grasses and seeds, especially the grass *S. barbatus,* any kind of grain, raw meat.

BAILEY BOBCAT. *Lynx baileyi* Merriam. Rodents, birds.

MEARNS'S COYOTE. *Canis mearnsi* Merriam. Pocket mice, grasshopper mice, kangaroo rats, wood rats, ground squirrels, rabbits, seeds, fruits, coarse leaves, long grass, fresh meat, carcasses, cattle afterbirths, birds.

ARIZONA GRAY FOX. *Urocyon cinereoargenteus scotti* (Mearns). Insects, cactus fruit, rodents, birds, grass, seeds.

TEXAS BADGER. *Taxidea taxus berlandieri* (Baird). Wood rats, kangaroo rats, mice, ground squirrels, birds, eggs, perhaps some insects.

ARIZONA HOG-NOSED SKUNK. *Conepatus mesoleucus venaticus*

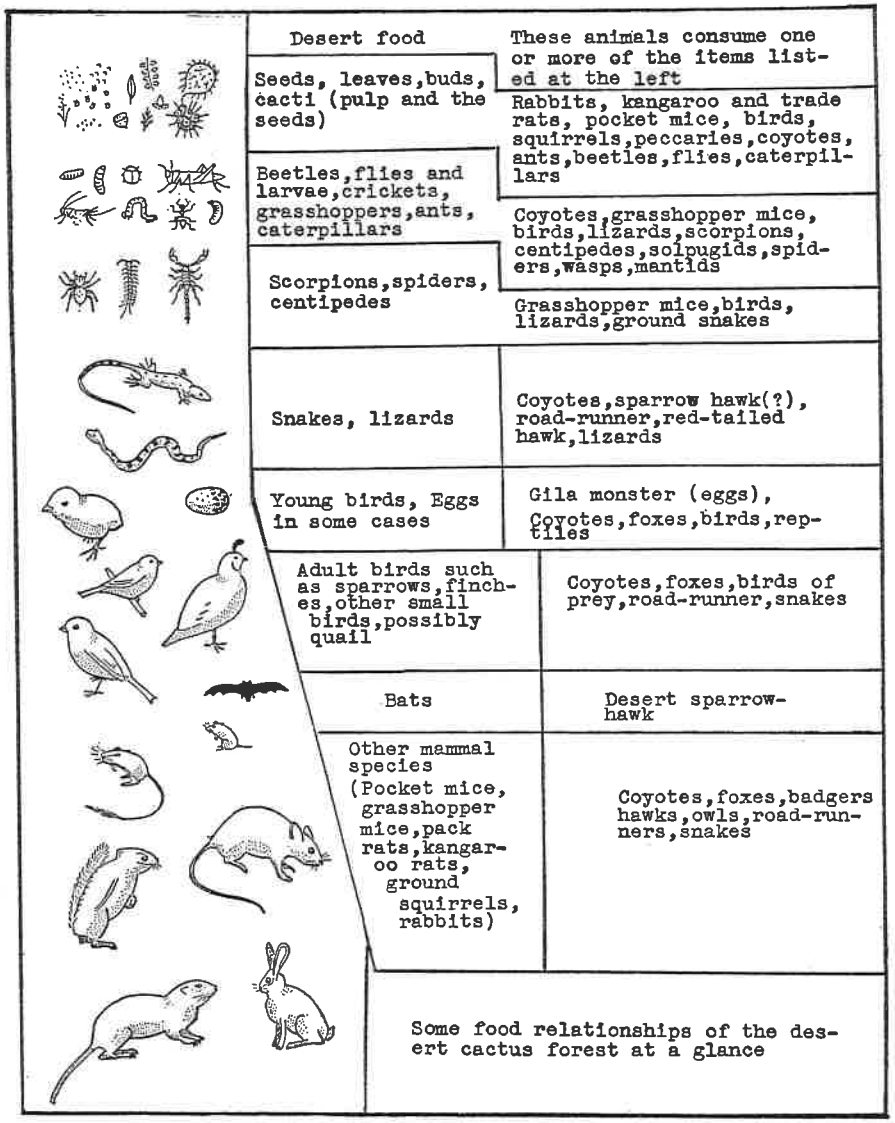

FIG. 30. Diagram showing, in a very simplified form, food relationships of some plants and animals of the desert cactus forest environment

Goldman. Many kinds of insects, rodents, birds, eggs, cactus fruit and other vegetable matter.

ARIZONA SKUNK. *Mephitis estor* Merriam. Insects and larvae, mice, rats, snakes, perhaps lizards, fresh or rotting meat, probably cactus fruit.

BAT. Species undetermined, but possibly the MEXICAN FREE-TAILED BAT, *Tadarida mexicana* (Saussure). High-flying insects of some kind.

BIRDS

GAMBEL'S SPARROW. *Zonotrichia leucophrys gambeli* (Nuttall). Food in winter consisted to a great extent of spikelets and seeds of the grass *S. barbatus*. This seemed to be the regular and preferred item in the cactus forest, where this grass grew so abundantly. Also ate the mixed grains at the feeding shelves. Many quartz grains in the stomachs, but no animal matter in those examined.

BREWER'S SPARROW. *Spizella breweri* Cassin. Small seeds.

SAGE SPARROW. *Amphispiza nevadensis* (Ridgeway). Seeds of the grass just mentioned, some insects and quartz grains in the only two stomachs examined. Also took grains at the food shelves, especially canary seed.

DESERT SPARROW. *A. bilineata* (Cassin). Small seeds and lots of grain at the food shelves.

GREEN-TAILED TOWHEE. *Oberholseria chlorura* (Audubon). Seeds, insects.

GREEN-BACKED GOLDFINCH. *Spinus psaltria hesperophilus* Oberholser. Small seeds.

LAWRENCE'S GOLDFINCH. *S. lawrencei* Cassin. Same food as the green-backed.

HOUSE FINCH. *Carpodacus mexicanus frontalis* (Say). Seeds of the grass *S. barbatus*, many kinds of unidentified wild seeds, fruit and grains from the food shelves.

LARK BUNTING. *Calamospiza melanocorys* Stejneger. Stomachs were packed with the tiny white seeds of the grass *S. barbatus*. There were a few other kinds of small seeds also. The grinding material was very fine quartz almost like powder.

ARIZONA CARDINAL. *Richmondena cardinalis superba* Ridgeway. Insects, mistletoe berries, grain, seeds of wild plants.

ARIZONA HOODED ORIOLE. *Icterus cucullatus nelsoni* Ridgeway. Insects, orange halves supplied on our food shelves.

SONORAN RED-WINGED BLACKBIRD. *Agelaius phoeniceus sonoriensis* Ridgeway. Seeds and grain, many kinds of insects.

YELLOW-HEADED BLACKBIRD. *Xanthocephalus xanthocephalus* (Bonaparte). Grasshoppers and many other insect remains were in the stomachs. Also a few seeds.

WESTERN MEADOW LARK. *Sturnella neglecta* (Audubon). Grasshoppers, crickets, other insects, caterpillars.

ENGLISH SPARROW. *Passer domesticus domesticus* (Linnaeus). Seeds, grain, insects, refuse and scraps.

AUDUBON'S WARBLER. *Dendroica auduboni* (Townsend). Minute beetles and other tiny insects found. In our experience these birds kept to the rocky ridges above the desert proper; they were thus recorded as they flew down from the sky like migrants on several occasions and then followed along the ridgetops in April.

WHITE-RUMPED SHRIKE. *Lanius ludovicianus excubitorides* Linnaeus. Grasshoppers and other insects.

PHAINOPEPLA. *Phainopepla nitens lepida* Van Tyne. These birds, especially the males, were seen to make aerial insect catches, but a regular and favorite food consisted of the sticky mistletoe berries. The birds could always be found close to the big clumps of this parasitic plant.

PLUMBEOUS GNATCATCHER. *Polioptila melanura* Baird. They fed frequently around the flowers of the creosote bushes. Stomachs examined contained small beetle fragments and small green, somewhat hairy caterpillars, although I could locate none of the latter on these bushes myself.

WESTERN BLUEBIRD. *Sialia mexicana occidentalis* (Townsend). Only one pair was seen and not really positively identified. Eating mistletoe berries.

CHESTNUT-BACKED BLUEBIRD. *S. mexicana bairdi* Ridgeway. Stomachs examined were filled with fragments of the black harvester ants described in the chapter on arthropods. They frequently ate beetles also, and quantities of mistletoe berries.

WESTERN ROBIN. *Turdus migratorius propinquus* Ridgeway. In the cactus forest we found them feeding upon the plentiful mistletoe berries. They also ate many insects.

Sage Thrasher. *Oreoscoptes montanus* (Townsend). When feeding at our trays, these birds never touched the grains, but they ate quantities of suet, orange pulp, and cake. Away from human influences they were seen running over the ground like robins, and here they were obtaining grasshoppers, crickets, occasional large ticks, and harvester and other ants.

Palmer's Thrasher. *Toxostoma curvirostre palmeri* (Coues). Hard seeds, including those of the barrel cactus. Also green pulpy material and a great deal of the grain at the feeding shelves. One stomach contained gourd seeds. The young in one nest were fed cooked cream of wheat also taken from a food shelf, and fledged nestlings were fed grains selected from our offerings. Large masses of roost droppings were found to consist chiefly of seeds and vegetable matter. In the cases of the two thrasher species it is interesting that the coarse-seed eaters (Palmer's) had instinctively picked up unusually large bits of mineral grinding material, whereas the stomachs of the soft-food eaters (Sage) contained very much finer masses of these little millstones.

Western Mockingbird. *Mimus polyglottos leucopterus* (Vigors). Mistletoe berries, suet, insects, olives.

Rock Wren. *Salpinctes obsoletus obsoletus* (Say). Small black beetles, termites, other insects.

Cactus Wren. *Heleodytes brunneicapillus couesi* (Sharpe). At least four species of beetles, including the cactus weevil illustrated in the chapter on arthropods. Also other insects and most of the foods which we placed on the shelves. It was an interesting fact that none of the cactus forest birds cared for bananas, which were put out for them on several occasions. These wrens ate apricot filling from a stale pie, suet, and cake crumbs.

Verdin. *Auriparus flaviceps ornatus* (Lawrence). Stomachs contained very small hairy caterpillars, aphids, and insects too finely ground to identify.

White-Necked Raven. *Corvus cryptoleucus* Couch. Appeared to be chiefly carrion feeders at the dead horses, cows, and other animals killed on the roads. One was seen catching grasshoppers also.

Raven. *C. corax*. Similar food habits to those recorded for *C. cryptoleucus*.

Barn Swallow. *Hirundo erythrogaster* Boddaert. Birds seen high

over the cactus forests catching flying insects were doubtless this species.

Vermilion Flycatcher. *Pyrocephalus rubinus mexicanus* Sclater. Small insects, including grasshoppers, flies, beetles, many being watched for from a twig and then caught upon the ground.

Traill's Flycatcher. *Empidonax traillii traillii* (Audubon). Flies, small wasps, beetles, in one case small caterpillars.

Say's Phoebe. *Sayornis saya saya* (Bonaparte). Dipterous and other flying insects.

Ash-Throated Flycatcher. *Myiarchus cinerascens cinerascens* (Lawrence). Flies, small weevils with oddly and thickly spotted elytra.

Mexican Crested Flycatcher. *M. tyrannulus*. Beetles, flies, grasshoppers, noctuid moths.

Cactus Woodpecker. *Dryobates scalaris cactophilus* (Oberholser). Beetles, beetle larvae, ants.

Ant-Eating Woodpecker. *Balanosphyra formicivora formicivora* Swainson. Beetles, ants; acorns in its normal habitat.

Gila Woodpecker. *Centurus uropygialis uropygialis*. These birds were often seen picking at objects in the pleats of the giant cacti and in the entrance holes of old cavities over which small spiders stretched their webs. In these pleats we found spiders and spider-egg cases, silver fish and springtails, the last only after rains. The Gilas also ate ants, flies and beetles, and larvae which they dug out of dead limbs of trees, and rarely the cholla cacti. At the food shelves they ate jelly from a jelly roll, a little suet, and ravenously of orange pulp. They attack oranges upon growing trees also, for which they are sometimes killed at ranches.

Mearns's Gilded Flicker. *Colaptes chrysoides mearnsi*. Ants, and in one case hundreds of seeds, including cactus seeds from a barrel cactus, some pulp, and large fat seeds which seemed to be those of the desert gourd. This stomach was packed full of vegetable matter.

Red-Shafted Flicker. *C. cafer collaris* Vigors. Chiefly the black harvester ants in the specimen examined.

Arizona Blue-Throated Hummingbird. *Lampornis clemenciae bessophilus* (Oberholser). Nectar and minute insects. Seen in 1948 hovering about the creosote blossoms.

COSTA'S HUMMINGBIRD. *Calypte costae*. Frequently seen feeding at the ocotillo blossoms, which attracted many small insects also. Others fed at the pentstemons near the mountains.

WHITE-THROATED SWIFT. *Aeronautes melanoleucus* (Baird), or *A. saxatalis saxatalis* (Woodhouse). Winged insects, including flies, beetles, bees.

WESTERN BURROWING OWL. *Speotyto cunicularia hypugaea* (Bonaparte). Mice, lizards, grasshoppers, crickets, beetles, scorpions, centipedes. The cactus forest supports all of these foods in considerable quantities, but only one bird of this species was seen, on the rather level land near our first headquarters near Florence in 1948.

WHITNEY'S ELF OWL. *Micropallas whitneyi whitneyi* (Cooper). Beetles, centipedes, other insects.

WESTERN HORNED OWL. *Bubo virginianus pallescens* Stone. Cottontails, kangaroo rats, trade rats or wood rats. These big owls sat on the tops of the saguaros just at dusk watching for small animals to appear. None of the cactus forest birds paid any attention to them as far as we could see, so the owls evidently do not molest other species of birds.

SAGUARO SCREECH OWL. *Otus asio gilmani* Swarth. Undoubtedly was in the neighborhood of our studies, but we did not happen to see any for certain. Their known diet includes kangaroo rats, mice, insects, scorpions, centipedes, and small birds.

ROAD RUNNER. *Geococcyx californianus* (Lesson). Grasshoppers, beetles, bugs, flies, ants, bees, wasps, caterpillars, spiders, scorpions, solpugids, centipedes, maggots, fruits, seeds, lizards, small snakes, mice, rats, young birds, swifts, sparrows (the last two very rarely); also eats garbage, fresh meat, and carrion.

WESTERN WHITE-WINGED DOVE. *Melopelia asiatica mearnsi*. Mostly seeds.

MEXICAN GROUND DOVE. *Columbigallina passerina palescens*. Mostly seeds.

WESTERN MOURNING DOVE. *Zenaidura macroura marginella* (Linnaeus). Finely ground-up vegetation, grains, but no wild identifiable seeds in the few stomachs examined. Much quartz and other mineral matter present.

MOUNTAIN PLOVER. *Eupoda montana* (Townsend). A flock of these birds was observed in 1948 on an abandoned airfield near Florence, Arizona. Possibly the objects they were picking up were small grasshoppers.

GAMBEL'S QUAIL. *Lophortyx gambeli gambeli* (Gambel). They ate green seed pods of the plantago illustrated in Chapter II. Also the orange-colored buds of the desert mallow, and in April they were frequently seen eating the buds of the palo verde trees. One stomach was filled with the black harvester ants described in the chapter on arthropods. There was hardly any grinding material in the stomachs examined, a surprising fact which may indicate a principally vegetable diet devoid of hard seeds, at least part of the time.

EASTERN SPARROW HAWK. *Falco sparverius sparverius* Linnaeus. Grasshoppers, other insects, house finches and other small birds, small rodents, bats.

MARSH HAWK. *Circus hudsonius* (Linnaeus). Small rodents such as ground squirrels.

WESTERN RED-TAILED HAWK. *Buteo borealis calurus* (Cassin). Ground squirrels, trade rats, rabbits, reptiles (lizards).

FUERTES'S RED-TAILED HAWK. *B. jamaicensis fuertesi* Sutton and Van Tyne. Ground squirrels, trade rats, rabbits. One killed on the highway contained squirrel remains and parts of a ground uta lizard.

BLACK VULTURE. *Coragyps atratus atratus* (Bechstein). Carrion feeders.

TURKEY VULTURE. *Cathartes aura* (Linnaeus). Carrion feeders.

REPTILES

ARIZONA BEADED LIZARD, or GILA MONSTER. *Heloderma suspectum* Cope. They eat eggs readily in captivity. In the wild they probably obtain bird and lizard eggs and doubtless eat other things also.

BLACK-CHESTED RACE RUNNER. *Cnemidophorus tigris gracilis*. Insects and, definitely, smaller lizards such as the striped ground uta.

REGAL HORNED LIZARD. *Phrynosoma solare* Gray. Various species of ants, small moths.

STRIPED GROUND UTA. *Uta stansburiana stejnegeri* Schmidt. This species fed chiefly upon ants. Stomachs contained remains of the leaf-cutting ants, the black harvesters, and the predatory and vegetarian ant, *Solenopsis maniosa* Wheeler. (See chapter on arthro-

pods.) The utas also ate small beetles and a small amount of vegetation, including mallow buds and small leaves.

Desert Spiny Lizard. *Sceloporus magister magister* Hallowell. Rather large beetles, wings of some chewed-up larger species still, wings of hymenopterous insects, and heads and legs of ants were found in the stomach examinations. In captivity one of these lizards ate certain insects but refused soft, hairless caterpillars.

Gridiron-Tailed Lizard. *Callisaurus draconoides ventralis* (Hallowell). Ants, small spiders, termites, bits of vegetation which appeared to be from the buds of the desert mallow.

Northern Chuckwalla. *Sauromalus obesus* (Baird). Leaves, buds, flowers, fruits. Apparently a strict vegetarian among the numerous carnivorous species of the cactus forest.

Western Collared Lizard. *Crotaphytus collaris baileyi* Stejneger. Feeds upon insects and other smaller lizards.

Variegated Ground Gecko. *Coleonyx variegatus variegatus* Baird. Feeds upon termites by preference, and small ants. A number of these little lizards were kept for considerable periods in captivity. They ate a few small ants without showing much enthusiasm, but when soft termites were introduced into their vivarium, they ate ravenously and an astonishing number of them. Under stones on the hills where most of the geckos were found, there were some termites and also small hairless caterpillars resembling typical cutworms, and a few round black beetles.

Rattlesnakes, *Crotalus*, including the Sidewinder, *C. cerastes cerastes* Hallowell, which is of doubtful occurrence in the cactus forest, and the Mohave Rattlesnake, *C. scutulatus scutulatus* Kennicott, which is probably the commonest. Both feed upon rodents, lizards, and probably birds in some instances.

Arizona Coral Snake. *Micruroides euryxanthus* Kennicott. Feeds upon other snakes. *We* did not actually find this snake present.

Ground Snake. *Sonora semiannulata isozona*. The only specimen examined had eaten spiders.

Arizona Bull Snake. *Pituophis catenifer affinis*. Small rodents, young birds.

Black Whip Snake and Red Racer. These two are now considered as color phases of the same reptile, namely, *Masticophis flagellum piceus* Cope. Eats small rodents such as pocket mice, kangaroo rats, also insects and sometimes young birds.

AMPHIBIANS

Red-Spotted Toad. *Bufo punctatus* Baird and Girard. Ants, moths, beetles, other insects.

Giant Toad. *B. alvarius* Girard. Any kinds of insects which it can capture. This is a huge toad.

ARTHROPODS

Class Arachnida

Spiders, Scorpions, Mites

Spiders. Families Drassidae, Lycosidae, Attidae, Diguestidae, and others. The drassids made silken sacs under bark or refuse. The lycosids or wolf spiders made deep, silk-lined burrows. The diguestids suspended aerial tubes, some over four inches in length, decorated with seeds, dead portions of insects, little stones, and refuse. The attids or jumping spiders lived on the cacti or on other plants and stalked their game, jumping upon it suddenly. All of these spiders live on the juices of insects.

Solpugids. *Eremobates*. These strange animals eat insects. They have been reported as feeding rarely upon small lizards. Apparently they live chiefly upon the juices of their victims.

Mites. Order Acari. Tiny ones attached to long pedicels were found on scolopendromorphid centipedes. They may have been sucking centipede juice. A very fast-moving red mite was found living on the twigs of creosote bushes, where its endless rushing about probably indicated a search for some special host or escape from some predator. Many beetles carry mites about with them and so do some spiders. Mites were found upon white-throated wood rats, and a large tick was found feeding upon the eyelid of a kangaroo rat.

Class Insecta

Insects

Honeybee. *Apis mellifera*. These pollen and nectar gatherers were very numerous, especially around the blooming creosote bushes, the mallows, and the palo verdes.

Cuckoo Bee. *Nomada* (*Holonomada*) (new species?). Nectar and pollen feeders.

Flower Bees. A number of unidentified little bees were found feeding and gathering pollen at the various desert blossoms.

Huntress Wasp. An unidentified species measuring one half inch in length preyed upon spiders for feeding its larvae. The adult was a nectar feeder.

Velvet Ants (wasps with wingless females). Family Mutillidae. Nectar feeders.

Leaf-Cutting Ant. *Acromyrmex versicolor* Pergande. Cuts pieces of leaves, stems, buds, and blossoms. Transports them underground and grows a special fungus upon them on which the colony feeds. Desert mallows and crane's-bill were favorite species taken for the fungus beds.

Black Harvester Ant. *Veromessor pergandei* Mayr. Around the nest entrances were rings of dry vegetable matter — fragments of the grass *S. barbatus,* seed pods of the creosote bush, bits of stems and empty seed capsules and curled-up leaves. There were also thousands of empty netlike seed cases of the desert mallow. The main food is undoubtedly the seeds removed from the pods or capsules or grass spikelets, and the quantities of material around the nests represented the discarded refuse from the harvesting operations underground.

Harvester Ant. *Pogonomyrmex barbatus rufescens* Wheeler. Also seed eaters, making deposits of vegetable refuse like the last species.

Predatory and Vegetarian Ant. *Solenopsis maniosa* Wheeler. Very small ants which appeared to be feeding upon an exudation around the tops of the barrel cacti after the fruits had been knocked off.

Ichneumon Wasp. A species which closely resembled the common *Ophion macrurum* of the East appeared in numbers March 1, so there must have been some insect due upon which it was parasitic, probably some large moth caterpillar.

Cactus Weevil. Technical name undetermined. Larvae feed within the branches of the jumping chollas, causing ulcers.

Palo Verde Weevil. *Mylabris ulkei* (Horn). Larvae feed within the beans while they are in the pods.

Pinicate Beetle. *Eleodes.* Vegetarian feeders. They came into the live traps baited with rolled oats.

Fig Beetle. *Cotinus nitida.* Larvae feed upon the roots of plants.

Barrel Cactus Beetle. *Moneilema.* These huge larvae of a long-horned beetle or cerambycid measured up to one and three quarters inches. They were very destructive to small barrel cacti, eating out all of the tissue. One larva can completely destroy a small cactus.

Water Beetle. Family Hydrophilidae. Larvae are aquatic and predaceous. The adult beetle is fitted for swimming, diving, and flying, and is also doubtless predaceous on other aquatic creatures.

Rove Beetles. Family Staphylinidae. Numbers of these were found hiding under horse dung waiting to capture flies and other insects. Others found in decaying cacti were probably eating this substance. Many shining, minute black beetles also fed on this substance.

Fleas. Order Siphonaptera. Found on ground squirrels, trade rats, and grasshopper mice. None were ever seen on the clean little kangaroo rats.

Flies. Order Diptera. There were many of the common bluebottle and blowflies upon carrion. Also a very few houseflies, *Musca domestica.* There were very large fly larvae of three kinds feeding in rotten saguaro cacti, and *Cuterebra,* a parasite which attacks the scrota of ground squirrels. A species of bot was parasitic upon the wood rats.

Red-Eyed Pomace Fly. *Drosophila melanogaster.* Came about when a bottle of wine was opened. Maybe they were depositing eggs upon the bananas in our cottage. They are known to breed in vinegar and old beer also. The point is that this universal creature was present in the cactus forest environment as soon as suitable food appeared.

Bee Fly. Family Bombyliidae. One species fed at flowers with its very long tongue, but its larvae were probably parasitic.

Robber Fly. Family Asilidae. They fed ravenously upon other insects, swooping upon them like little hawks.

Moths. Heterocera, order Lepidoptera. A number of small species, most of which were geometrids or noctuids, were not identified as to species. There were large broods around our headquarters in 1950. Also a few hawk moths. All are nectar feeders.

Butterflies. Rhopalocera, order Lepidoptera. All of those found in the cactus forest are nectar feeders. Their names are given following:

Checkered Skipper. *Hesperia communis* Grote.
Small Checkered Skipper. *H. scriptura* Boisduval.
Clitus Dusky-Wing. *Thanaos clitus* Edwards.
White Butterfly. Possibly a species of *Pieris* or a Western White.
Mexican Orange. *Eurema (Eurema) mexicana* Boisduval.
Nicippi Orange. *E. (Abaeis) nicippe* Cramer.
Dogface. *Colias (Zerene) cesonia* Stoll.
Ariadne Sulfur. *C. (Colias) eurytheme* f. *ariadne* Edwards.
Pima Orange-Tip. *Anthocharis (Anthocharis) pima* Edwards.
Baird's Swallowtail. *Papilio bairdii* Edwards (?).
Pipe Vine Swallowtail. *P. philenor* Linnaeus.
Little Blue. *Lycaenopsis argiolus cinerea* Edwards.
Great Purple Hairstreak. *Atlides halesus estesi* Clench.
Snout Butterfly. *Libytheana bachmannii larvata* Strecker.
Painted Lady. *Vanessa cardui* Linnaeus.
Queen. *Danaus gilippus berenice* Cramer.
Monarch. *D. melanippe menippe* Huebner.

Ant Lions. Family Myrmeleontidae. Conical pits were common in the sand, where the larvae of these insects were catching ants for food.

Assassin Bugs. Family Reduviidae. These bugs kill and then suck the juices of other insects.

Water Scorpions. Family Nepidae. Aquatic insects feeding upon other insects.

Water Boatmen. Family Corixidae. Aquatic vegetarian feeders.

Tree Hoppers. Family Membracidae. They live on the sap of grasses and leaves.

Termite. *Gnathamitermes perplexus* (Banks). Found often under partly dried horse droppings. Also under stones, lumber piles, and in dead cacti.

Mantids. Family Mantidae. One species fed upon other small insects.

Earwigs. Order Dermaptera. Fed upon small insects.

Short-Horned Grasshoppers. Family Acrididae. *Schistocera vaga* and *Trimerotropis p. pallidipennis*. Both species feed chiefly upon vegetation and occasionally upon animal matter.

Crickets. Family Gryllidae. Two or three species appeared to be omnivorous.

Cave Cricket. Family Stenopelmatidae. The so-called sand crickets and camel crickets. The one found in the cactus forest was omnivorous, eating both the rolled oats and the meat offerings in our traps.

Dragonflies. Order Odonata. Only two kinds were seen in the desert and these were catching aerial insects.

Springtails. Suborder Collembola. Minute creatures which leap into the air when disturbed. Among the most primitive of insects. I believe they are chiefly vegetarian feeders.

Silver Fish. Family Lepismatidae. The most primitive insects. They were found occasionally in the cottages and tent, under papers, but more commonly in the fallen and rotting cacti, under the shells or bark. They are vegetable feeders.

Class Chilopoda

Centipede. Order Scolopendromorpha. A species with twenty-one pairs of legs and reaching quite a good size was common under boards, refuse, and rocks where some little moisture might remain after rain. There was a small blackish fly which lived in the same places and I saw a centipede snatch and devour one of these insects. This centipede also fed on a variety of other insects and one was seen dining upon a cricket.

Class Nematoda

Threadworms. These are legion in the world, especially in the tropics. Several kinds were found as intestinal parasites on certain birds and mammals, as mentioned in other parts of this book.

PROTOZOA

Three single-celled microscopic forms, varying greatly in size, were found thriving in countless thousands in the orange-colored water which had somehow accumulated inside a hollowed-out barrel cactus. The hole was probably made by trade rats, and the water must have been rain. The largest of the three kinds observed was a giant when compared to the smallest, and its body was shaped like a laboratory beaker. Probably each organism was preying upon its smaller contemporaries in this vast culture.