

(Howarth 1983; Dunlap 1995). Relative humidity is typically near 100 percent in caves that support troglobitic invertebrates (Elliott and Reddell 1989). During temperature extremes, the listed species may retreat into small interstitial spaces (human-inaccessible) connected to a cave, where the physical environment provides the required humidity and temperature levels (Howarth 1983). These species may spend the majority of their time in such retreats, only leaving them to forage in the larger cave passages (Howarth 1987).

Since sunlight is absent or present in extremely low levels in caves, most karst ecosystems depend on nutrients derived from the surface either directly (organic material brought in by animals, washed in, or deposited through root masses) or indirectly through feces, eggs, and carcasses of troglonemes (species that regularly inhabit caves for refuge, but return to the surface to feed) and troglonemes (species that may complete their life cycle in the cave, but may also be found on the surface) (Barr 1968; Poulson and White 1969; Howarth 1983; Culver 1986). Primary sources of nutrients include leaf litter, cave crickets, small mammals, and other vertebrates that defecate or die in the cave.

As described in our final rule to list the nine species (65 FR 81419), the continuing expansion of the human population in karst terrain constitutes the primary threat to the species through: (1) Destruction or deterioration of habitat by construction; (2) filling of caves and karst features and loss of permeable cover; (3) contamination from septic effluent, sewer leaks, runoff, pesticides, and other sources; (4) exotic species, especially nonnative fire ants (*Solenopsis invicta*); and (5) vandalism.

#### *Karst in Bexar County*

The northern portion of Bexar County is located on the Edwards Plateau, a broad, flat expanse of Cretaceous carbonate rock that ranges in elevation from 335.5 meters (m) (1,100 feet (ft)) to 579.5 m (1,900 ft) (Veni 1988; Soil Conservation Service 1962). This portion of the Plateau is dissected by numerous small streams and is drained by Cibolo Creek and Balcones Creek. To the southeast of the Plateau lies the Balcones Fault Zone, a 25-km-wide fault zone that extends from the northeast corner of the County to the western County line. The many streams and karst features of this zone recharge the Edwards Aquifer.

The principal, cave-containing rock units of the Edwards Plateau are the upper Glen Rose Formation, Edwards Limestone, Austin Chalk, and Pecan

Gap Chalk (Veni 1988). The Edwards Limestone accounts for one-third of the cavernous rock in Bexar County and contains 60 percent of the caves, making it the most cavernous unit in the County. The Austin Chalk outcrop is second to the Edwards in total number of caves. In Bexar County, the outcrop of the upper member of the Glen Rose Formation accounts for approximately one-third of the cavernous rock, but only 12.5 percent of Bexar County caves (Veni 1988). In Bexar County, the Pecan Gap Chalk, while generally not cavernous, has a greater than expected density of caves and passages (Veni 1988).

Veni (1994) delineated six karst areas within Bexar County. The regions were named after places within their boundaries. These karst fauna regions are bounded by geological or geographical features that may represent obstructions to the movement (on a geologic time scale) of troglonemes, which has resulted in the present-day distribution of endemic (restricted to a given region) karst invertebrates in the Bexar County area.

These areas have been delineated by Veni (1994) into five zones that reflect the likelihood of finding a karst feature that will provide habitat for the endangered Bexar County invertebrates based on geology, distribution of known caves, distribution of cave fauna, and primary factors that determine the presence, size, shape, and extent of caves with respect to cave development. These five zones are defined as:

*Zone 1:* Areas known to contain one or more of the nine endangered karst invertebrates;

*Zone 2:* Areas having a high probability of suitable habitat for the invertebrates;

*Zone 3:* Areas that probably do not contain the invertebrates;

*Zone 4:* Areas that require further research but are generally equivalent to zone 3, although they may include sections that could be classified as zone 2 or zone 5; and

*Zone 5:* Areas that do not contain the invertebrates.

Under contract with the Service, Veni (2002) re-evaluated and, where applicable, redrew the boundaries of each karst zone originally delineated in Veni (1994). Revisions were based on current geologic mapping, further studies of cave and karst development, and the most current information available on the distribution of listed and nonlisted cave-adapted species (Veni 2002).

#### *Endangered Karst Invertebrate Distribution*

As of December 2002, 475 caves were known to occur in Bexar County, some of which have been biologically surveyed for listed species (Veni 2002). At least 97 of the 475 caves were sealed or destroyed before they could be biologically surveyed (Veni 2002). Not all of the remaining caves in Bexar County have been adequately surveyed for invertebrates. It is likely that some of these caves will be found to contain one or more of the listed species. When the species were listed as endangered in December 2000, the Service knew of 57 occupied caves. When critical habitat was proposed in Bexar County in August 2002, we knew of 69 occupied caves. We now know of 74 caves containing one or more of the listed species in Bexar County (Table 1). The following species status descriptions are based on information available to us as of December 23, 2002.

##### *Braken Bat Cave Meshweaver*

The Braken Bat Cave meshweaver, *Cicurina venii* (Araneae: Dictynidae), was first collected on November 22, 1980, by G. Veni and described by Gertsch (1992). Braken Bat Cave remains the only location known to contain this species (Table 1).

##### *Cokendolpher Cave Harvestman*

The Cokendolpher cave harvestman, *Texella cokendolpheri* (Opiliona: Phalangodidae), was collected in 1982 and described by Ubick and Briggs (1992). This species, along with the Robber Baron Cave meshweaver, is only known from Robber Baron Cave (Table 1).

##### *Government Canyon Bat Cave Meshweaver*

The Government Canyon Bat Cave meshweaver, *Cicurina vespera* (Araneae: Dictynidae), was first collected on August 11, 1965, by J. Reddell and J. Fish (Reddell 1993), and described by Gertsch (1992). The species is currently known from Government Canyon Bat Cave in Government Canyon State Natural Area and an unnamed cave referred to as "5 miles northeast of Helotes." However, the specimen collected from the latter cave has been tentatively identified as a new species (Cokendolpher, in press).

##### *Government Canyon Bat Cave Spider*

The Government Canyon Bat Cave spider, *Neoleptoneta microps* (Araneae: Leptonetidae), was first collected on August 11, 1965, by J. Reddell and J. Fish (Reddell 1993). The species was originally described by Gertsch (1974).