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## Distribution of the Coast Horned Lizard, *Phrynosoma coronatum*, in Southern California

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*Abstract.*—In order to access the endangered species status of any organism it is essential to know its past and present distribution. The Coast Lizard, *Phrynosoma coronatum*, was presumed to be threatened by habitat destruction due to human activities. I used historical literature and museum records to access past, and lizard survey teams to access current range and population numbers of *P. coronatum* in the five counties of Southern California between 1989–1991. The species occurs from sea level to 8,000' (2348m) in a wide variety of habitats. Fieldwork and questionnaires increased by a third the number of locations (from 672 to 1148) where horned lizards are known to occur. There are (post 1985) records of the species throughout its range and from all habitats. The lizard occurred in about 75% of its original range, and of that, more than 50% is in public lands where the lizard is protected or could be protected by effective management and enforcement.

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The Coast Horned Lizard, *Phrynosoma coronatum* (CHL), occurs from the Sacramento Valley, southward to the tip of Baja California. There has been concern (Jennings, 1987; Fisher and Case, 2000; Fisher, et al., 2002; Lemm, 2006; McGurty, 1980) that increasing human populations and consequent habitat destruction may have caused a rapid decline in the populations of horned lizards in San Diego, Orange, Riverside, Los Angeles, and San Bernardino Counties. If a species is thought to be endangered, it is important to know the exact distribution of the species. This is fairly easy for larger animals, but is more difficult with cryptic species or species with long periods of inactivity such as, *Phrynosoma coronatum* (Brattstrom, 2001; Hager and Brattstrom, 1997).

The Coast Horned Lizard (CHL) is found in California coastal and inland regions from sea level to 8000 feet (2348m), hence from grasslands and Coastal Sage Scrub (CSS) vegetation to pine forest (Jennings, 1988). It is the only species of horned lizard within its range. It meets the Desert Horned Lizard, *P. platyrhinos* at the high desert edge north of the San Gabriel Mountains from Palmdale to Adelanto. The ranges of the two species apparently do not overlap as the CHL is restricted here to the Juniper-Desert Chaparral habitat and the Desert Horned Lizard is found mostly in creosote bush scrub vegetation. A similar close proximity may occur in the Little San Bernardino Mountains and in northwestern Joshua Tree National Monument. The CHL is separated in range and habitat from the other two California Horned Lizards, *P. mcallii* of the low desert and *P. douglassii* of the Modoc-Klamath plateau area (Sherbrook, 2003; Stebbins, 1985).

### Materials and Methods

A 2.5 (1989–91) year study on the Coast Horned Lizard, *Phrynosoma coronatum* (=CHL), was conducted in Orange, Riverside, San Diego, and San Bernardino Counties, California, hence within the range of what was formerly known as *P. c. blainvillii* (Brattstrom, 1997). Distributional data were collected from museum records, field

surveys, questionnaires, and additional specific studies were done on three military bases: Miramar Naval Air Station, Fallbrook Naval Weapons Depot, and Camp Pendleton, San Diego County, California.

#### *Past Distribution: Museum, Literature and Database Search*

The distributional localities from museum records, the literature, and the California Department of Fish and Game (CDFG) California Natural Diversity Database (NDDDB) were compiled. All major United States and local museum records were examined. A list of these institutions, and all locality records, can be found in Brattstrom (1993) and CDFG and US Navy Data Base Computer Files. The localities have been incorporated in a Geographic Information System (GIS). Records collected by Brian McGurty (to 1980) and Mark Jennings (to 1982) have been verified by either examination of specimens, checking the location or checked for presence of CHL by field teams. Corrections have been sent to museum curators. Dot locations were placed on Delorme maps for Southern California. Each map is based on four 7 1/2", USGS quad maps. Copies of the maps are in Brattstrom, (1993). A copy of which is in the San Diego Natural History Museum and maps are also available from the author.

#### *GIS Analysis*

GIS maps of vegetation, soils, past fires, and current land use were prepared using OSUMAP software. GIS maps, including the horned lizard locality map, were used to estimate percent of horned lizard localities remaining or associated with land use, fire, land ownership, vegetation, and history. Locality data for lizards on the military bases was put directly into the U.S. Navy Environmental Data GIS system by Tierra Data Inc. where other ecological data was stored.

#### *Questionnaires*

The present distribution and current status of the lizards were also determined by a survey questionnaire. The survey was sent to local professional and amateur herpetologists and herpetological clubs. A list of these people is provided in Brattstrom (1993). In addition, the San Diego Herpetological Society and Southwestern Herpetological Society reprinted the questionnaire in their respective newsletters. A total of 115 surveys were sent out and 50 surveys (or 43%) were returned. Of those returned, 33 or 29% had information on horned lizards.

## Results

#### *Distribution Past and Present*

The range of *Phrynosoma coronatum* in California and Baja California is shown in Jennings (1988) and that for the former *P. c. blainvillii* in Southern California (Figure 1). The range of the species is described by Jennings (1988) as: West of the Sierra Nevada crest from Kennett (now under Shasta Reservoir), Shasta County, California, south throughout all of Southern California (west of the Mojave Desert) and the Baja California peninsula at elevations from near sea level to over 1,830 m. A disjunct population occurs at Grasshopper Flat, near Medicine Lake, Siskiyou County, California. Attempted introductions into Yosemite Valley, San Clemente Island, Hawaii, Colombia, and Guatemala have failed (Jennings, 1988). Horned lizards were first collected in Southern California in 1880 in San Bernardino County, in 1884 in Los Angeles County (a collection record of 1863 cannot be confirmed), 1893 and 1907 for

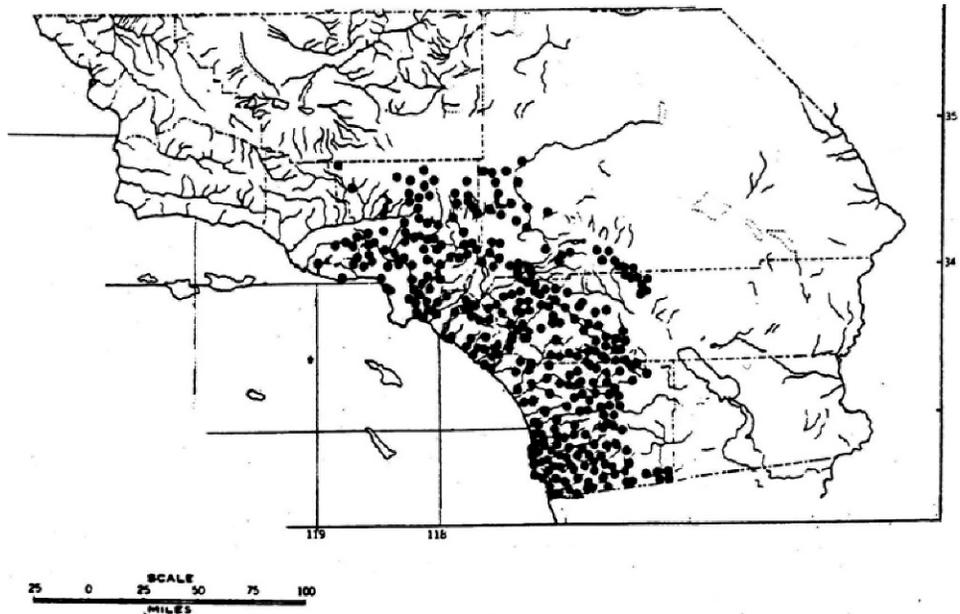


Fig. 1. Map of Southern California showing all known localities for *Phrynosoma coronatum*.

Riverside and Orange Counties respectively (Jennings, 1988). Table 1 presents a summary of the numbers of localities in Southern California where *P. coronatum* has been found. This table includes historical, museum, and literature records found during this study. The table does not include 1147 records of localities for Baja California, Mexico, nor about an equal number of localities known from Central and Northern California. This study almost doubled the knowledge of the number of localities known for this horned lizard from 672 records to 1148. Most of these additional records were post-1985 records. These Southern California records are plotted in Figure 1. The post 1985 records indicate that records of viable or, at least, reproducing populations (many were records of young) occur through the range of the horned lizard and include recent records in habitat islands surrounded by houses and industry. All locality records for Southern California have been sent to the CDFG NDDDB, though not yet (as of 2013) entered into their database (Brattstrom, 1993). Locality records have been entered into the databases of: the Bureau of Land Management (BLM), several counties, agencies, environmental companies, and the U.S. Navy and Marine Corps databases. Localities from the three military bases are only listed by the name of the base. Detailed locations of lizards on each base are found in US Navy Data Bases. Detailed location maps (Dot maps on Delorme, 4 USGS 7 1/2" quads/ page) are presented in Brattstrom, (1993), a copy of which is in the herpetological collection of the San Diego Natural History Museum, lists and maps are also available from the author. After this paper is published, all databases, locality, and museum records will be placed in the herpetology section of the Los Angeles County Museum of Natural History. The species occurs from sea level to 8,000 feet (2348m) at Tahquitz Meadow in the San Jacinto Mountains, Riverside County, though 55% of all locations are below 2,000 feet (610m), 81% below 4,000 feet (1220m), and 99% are below 7,000 feet (2135m) in elevation.

Table 1. Total known localities for *Phrynosoma coronatum* for each of the Southern California Counties\*.

County:	Riverside	San Diego	Orange	San Bernardino	Los Angeles	Total
Historical						
Locations:**	168	177	6	113	208	672
Recent and						
Additional						
Locations:***	105	137	46	66	122	476
Totals:	273	314	52	179	330	1148

\* Does not include known localities north of Los Angeles County, or 1147 localities in Baja California, Mexico.

\*\* From museum records and the literature. These are pre-1985 records.

\*\*\* From questionnaires, CDFG NDDDB, correspondence, field work, and field surveys. Most of these are post-1985 records.

Post-1985 records, study plot data, and field observations made during this study have found the horned lizard throughout its known range in Southern California. Thus, while the lizard does not occur within central urban areas, there are recent records of reproducing populations (based on presence of young) within and around cities. For example, while the species is absent from central portions of the City of San Diego, it does occur in pockets within that city (e.g., Point Loma), and in environs north, east, and south of the city (Torrey Pines State Park, NAS Miramar, Border Field State Park, north, south and east of El Cajon, south of Lemon Grove, and Otay Mesa; see maps in Brattstrom, 1993).

Horned lizard distribution seems to imply that the horned lizard is extirpated from much of its former range (fide: McGurty, 1980). The San Diego example just mentioned suggests that this in part is due to a matter of scale. An example from the broad Los Angeles-Orange County Basin illustrates the problem. The Los Angeles-Orange County Basin was greatly altered through grazing and agriculture for the first three centuries of European history in the state; long before the first historical records (1884) of horned lizards in the area. Historical records in this basin (Figure 1) are from Malibu to the Manhattan Beach coastal strip, and along the Arroyo Seco, Los Angeles, Santa Ana, and San Gabriel Rivers. The species was historically absent from other locations in the basin, except for in sandy river and stream areas draining into these rivers or in isolated hills. There are no known historical or recent records, from the Palos Verdes area. Four students did projects in the Palos Verdes Peninsula in 1950 and 1954 as part of a herpetology course that I taught at UCLA. No horned lizards were found on the peninsula in any of the studies. The horned lizard did occur in the Central Los Angeles Basin in the Late Pleistocene time in the La Brea Tar Pits, but even that record was along a stream (Brattstrom, 1953). This means that, either the horned lizard never occurred in the Los Angeles-Orange County Basin, except along sandy coastal areas and along major rivers; or, if it did occur in the basin, it was eliminated by human activities prior to the first historical records. The horned lizard's apparent absence from much of the basin today therefore, cannot be ascribed to the recent impact of urbanization. Reproducing populations still occur today in undeveloped areas along the San Gabriel River and in the northern part of the drainage of the Los Angeles River. Much of the urbanization in Orange County over the past 50 years (described by Brattstrom, 1988), while spectacular,

has eliminated, probably, less than 10% of the historical range of the species in the county. This is due to the fact that historically at least, the horned lizard did not occur in most of Orange County that is now urbanized. The species still occurs in more than 60% of the Orange County, or 90% of its known historical range in the county.

#### *Details of Distribution*

The following describes the distribution of *P. coronatum* for the southern five counties in more detail, and points out some of the more interesting aspects of its distribution.

*Los Angeles County.*—The species occurs from the Ventura County line south and east throughout the County. As just described, there are no records for the Los Angeles Basin, except along the coastal strip below Santa Monica (to Manhattan Beach) and along the major rivers and tributaries that pass through the Basin. The species is absent from the high cold regions of Los Padres and Angeles National Forests, but this absence may be due as much to fire history and rugged terrain (which may restrict horned lizards and/or collectors) as it could be too cold, since the species does occur just east of Gorman. There are no records along the Ridge Route, (i.e. along and especially just east of I-5). The species extends out into the desert, in pinyon-juniper and/or desert chaparral areas (occasionally associated with Joshua Trees). Records for Elizabeth Lake, Palmdale, Little Rock, Phelan, Adelanto, and Hesperia occurred in areas of coastal scrub and chaparral, not creosote vegetation. The habitat for the records north of Palmdale and north of Lancaster is now urban and agricultural, but coastal vegetation did extend in fingers on low ridges out past Palmdale in the 1950's (personal observations). The record for Adelanto was accurately located in L. M. Klauber's field notes. Subsequently, the site was located and visited during this study. The record is just within (by 300 meters) desert chaparral vegetation. Even though much of this vegetation was burned and re-burned in a series of recent fires, stumps and stump sprouts of *Quercus dumosa*, *Ceanothus*, and *Juniperus* were verified in the field. The record for Oro Grande north of Victorville is either an invalid record for the species, or more likely, another example of a San Bernardino Mountain species (such as the pond turtle, *Clemmys marmorata* and the western toad, *Bufo boreas*) that had been carried accidentally to the Victorville area (where water and lush riparian vegetation occur) by one of many floods of the Mojave River. The record could even have reflected a former finger-like projection of the species along the river. The Coast Horned Lizard occurs throughout the Santa Monica and San Gabriel Mountains.

*San Bernardino County.*—The horned lizard occurs associated with the sandy areas of the flood plains of major rivers and in the foothills and the mountains of the Los Angeles Basin through San Bernardino, Redlands, Beaumont, and Banning, to the desert edge within coastal chaparral or coastal sage scrub vegetation, just south of Cabazon. The species appears to be absent from the northeast San Bernardino Mountains (Big Bear Lake, Baldwin Lake) and from the higher elevations in the south part of these mountains.

The species occurs in the central and eastern San Bernardino Mountains and eastward in pinyon-juniper, desert chaparral, and occasionally Joshua Trees (*Yucca brevifolia*), through the Morongo Valley and the Little San Bernardino Mountains within Joshua Tree National Monument. It does not occur in Creosote Scrub Desert or in classical Joshua Tree Woodlands or at lower elevations. It does not occur east of Yucca Valley, and the records for the Yucca Valley region are all from higher slopes.

*Orange County.*—There are only a few historical records for Orange County. Most of those were from along the reaches and flood plain of the Santa Ana River. Old records

from Garden Grove and Anaheim may have been collected from anywhere in the cities, but more than likely, they were collected from one of the open areas along any one of many stream channels draining the nearby Chino and Puente Hills. A few old historical records in coastal Orange County have now been enhanced with recent (post-1985) records along the coast, the Laguna Hills, and the San Joaquin Hills. Most of the other records come from the foothill area of the county and locations in the Cleveland National Forest. Many recent records come from northeast and southeast of San Juan Capistrano as part of biological surveys for possible future development and a proposed Transportation Corridor.

*Riverside County.*—Horned lizard records are found throughout western Riverside County. They are absent from the Temecula area, but are common near Lake Elsinore. This may be because of more than a century of overgrazing by sheep and cattle in the Temecula area. CHL records are common for the Perris Basin and the San Jacinto River drainage system. Records also occur in the San Jacinto Mountain region with the highest elevation record, 8,000 feet (2348m), coming from this mountain range. Other species of reptiles, *Crotalus viridis*, also have their highest elevation records in the San Jacinto Mountains. Many of the locality records for the horned lizard in Riverside County occur in National Forest, Wildlife Reserves, or other public and private conservation areas.

*San Diego County.*—Except within city centers the lizard occurs almost everywhere in San Diego County except in the low desert and high rugged mountains. It is found in the Palomar Foothills, Lake Henshaw area, and the Cuyamaca and Laguna Mountain high plateau (See Fisher, et al., 2002). Many of the locality records are on public lands.

The species extends toward the desert, though in desert chaparral, in broad open valleys, such as south of Warner's Springs and towards Scissors Crossing. Elsewhere, as at the eastern edge of the Laguna Mountains and east of Jacumba, the species stops its easternmost distribution atop the abrupt high plateau. The descent to the desert in these places, as it is on the east side of the San Jacinto and Santa Rosa Mountains in Riverside County, is notably abrupt (a 3,000+-foot drop in about 5 miles (915m in 8km), and the slopes are covered with large granite boulders or consist of steep decomposed granite talus. This topography may restrict the horned lizard and/or collectors as no records of the lizard occur in this area.

*Interesting or Erroneous Records.*—In placing localities on maps, the difficulty of where to actually place a dot becomes a problem. Where does one place a locality record for "San Diego" collected in 1890? In the city center? Balboa Park? By practice, such records are placed in the center of the city. Some old records for San Diego and Riverside County have had their name changed, because, what was once an outlying village is now within the city. Fortunately, old maps provide the solutions to many of these problems. It was, however, impossible to find "El Nido" until informed by Mark Jennings (pers. comm.) that the location is now located under lower Otay Lake. It was originally an important stage stop on the road from San Diego to Dulzura. It was flooded out at the turn of the century by the original dam on Otay River when waters reached the dam on January 27, 1916, during the major floods of that year. Many of John Van Denburgh's (a former herpetologist at the California Academy of Sciences) collecting localities were obscure, and detective work by Jennings and Brattstrom have found some of these localities. While again searching through the California Academy of Sciences files, Jennings found a box labeled "maps showing routes traveled by John Van Denburgh in California". Unfortunately, they do not indicate the location of two San Diego localities that have plagued horned lizard map plotters for years: Clogston's Valley and Gulion.

Based on other Van Denburgh records, the locations are probably in southern San Diego County along, or south of, what is now Interstate 8.

A specimen from LACM is recorded as coming from 30 miles east of 29 Palms. I have checked the specimen, and it is a *P. coronatum* and not the expected *P. platyrhinos*. Either the locality is wrong or the specimen is mislabeled, because *P. coronatum* does not occur within 60 miles of this site. A specimen from LACM labeled “Baker, Los Angeles County” has to be totally in error. The latitude and longitude data indicate that the location is for “Baker, San Bernardino County”. That town is along I-15 in the Mojave Desert, more than 100 miles from the nearest other *P. coronatum* location. It is a town where travelers stop, and the specimen may have been a pet accidentally dropped. In any event, the locality is in error and is eliminated from all lists. Since the species was common in the pet trade (Jennings, 1987), such records are to be expected. There is even a 1934 record for the species for the State of Montana (Missoula, MT; Harbaugh, 1935), which is clearly a record based on the accidental dispersal of a pet!

Another peculiar record is that for “6 mi. N. Bush, San Bernardino County” (SDSMH-LMK 39903). This specimen presumably collected by L. M. Klauber in 1949, has been verified by me as being a *P. coronatum*. It is, however, far outside its range. It is east of 29 Palms and in Creosote Bush Scrub. Klauber’s diaries are in the library of the Natural History Museum in San Diego. He kept excellent records and wrote in his diary almost every day of his life. On this trip in 1949, he recorded collecting a *P. platyrhinos* 10 miles east of 29 Palms, a Patch-nosed Snake 17 miles east, and both Whiptails and Desert Iguanas 19 miles east of 29 Palms. From this last locality on the road, ascends a hill and it is here that the *P. coronatum* was supposed to have been collected. Yet he recorded for June 4, 1949, at 6 mi. N Bush, “1 Whiptail shot on road, and rocky desert with scattered brush”. Later, at 8 mi. north of Bush, at the base of the Sheep Hole Mountains, he recorded taking 2 *Xantusia vigilis* under *Yucca*. The next record in the diary is for Amboy Crater where he caught a *P. platyrhinos* 19 mi. S. of the town of Amboy. He pickled the specimen in Ludlow. His records indicate no locations for *P. coronatum* in this area. On the same trip, he did catch a *P. coronatum* at 10 mi. S. Adelanto (#40003). All other specimens from the trip are numbered and preserved in the order that he collected them, except the *P. coronatum*, erroneously given the locality of 6 mi. N. Bush presumably by some cataloger. This locality is therefore considered to be an error.

### Discussion

The best way to preserve or protect a species is to protect its habitat. The habitat for an animal is a resource for food, water, shelter (from heat and cold as well as shelter from predators), and for lizards a habitat must provide heat, basking sites, egg-laying sites, the opposite sex, and enough space to carry out normal behavior (Brattstrom, 1994). Extinction rates are greater on small habitat “islands” (Soule, et al., 1988; Crooks, et al., 2001). A general rule of habitat conservation is that it is better to protect habitat in a few large islands rather than many small islands (Shafer, 1991). It is also true that islands are smaller for some species, such as the California Gnatcatcher which needs 20 acres (49ha)/pair (Atwood, 1992) than they are for horned Lizards where a single acre may contain 3–20 horned lizards (7–48 ha), or more; (Gerson, 2011; Jennings, 1987; Hager, 1992; McGurty, personal communications). It is further wise to try to protect as many species as possible in a given area (Multispecies Habitat Conservation) than face the management problems associated with protecting a single target species.

Predation on CHL by people for pets is now minimal and while CHLs are eaten by many predators (often with difficulty), their inactivity and crypsis (Sherbrooke, 2003, 2008; Brattstrom, 1996) makes predation a minimal threat. The exception occurs in the urban/wildlands interface where domestic cats, *Felis catus*, prey on horned lizards (Fisher and Case, 2000; Fisher, et al. 2002). While this study was done over 20 years ago, and in spite of housing developments, there has been no major or significant change in Southern California in the intervening years that affect distribution. The exception is the actual impact of introduced Argentine Ants, *Linepithema humile* (Bolger, 2002; Foster, et al. 2007; Holway, 1999; Menke et al. 2009; Pitt, et al. 2009 and Suarez, et al. 1998). CHLs still live in city island habitats (parks, rivers) and at the urban/wild land interface. It is here, especially associated with moist soil, that the impact of introduced Argentine Ants, *Linepithema humile*, may be severe (Fisher, et al. 2002; Suarez, et al. 2000). CHLs do not eat these ants and the ants reduce the populations of native ants, which CHLs do eat (Bolger, 2002; Holway, 1999; Suarez, et al., 1998). The sympatric Western Fence Lizard, *Sceloporus occidentalis* actually eats Argentine Ants (Foster, et al. 2007). Argentine Ants also probably eat CHLs. Argentine Ants will continue to be a problem for CHL, but CHL occur in many habitats and areas where Argentine Ants do not occur. The ants occur in moist soil areas where CHLs do not occur now or ever did occur (Menke, et al. 2009; Miltrovich, et al. 2010). Because soil moisture is critical to Argentine Ant survival, the urban/wild lands interface will be the most impacted area. Much of the rest of the range of the Horned Lizard will not be impacted.

It is recommended that land managers of forests, parks, and reserves should try to assure that horned lizard and harvest ant habitats are undisturbed.

#### Conclusions

1. The original range of the horned lizard was throughout Southern California but with no historical or recent records from the Los Angeles-Orange county basin and the Pomona, Ontario, San Bernardino area except along river flood plains and isolated hills. There are no historical or recent records of the area about Temecula.
2. The horned lizard occurs in the coastal and inland physiographic provinces and in the extension of the latter into the Little San Bernardino Mountains to Joshua Tree National Park.
3. The horned lizard localities occur in habitats including some urban habitats.
4. The horned lizard localities occur in areas with and without past fires, through survey data from this study how that more horned lizards were found in unburned areas (see Matsuda, et al., 2011; Rochester, et al. 2010).
5. The horned lizard localities show that the lizard never occurred in many areas that are now urban and suburban except along river flood plains (where it still occurs in patches). Pockets of horned lizards do occur in suburban areas as well, but are not discriminated in the GIS program. The locality data and GIS analysis show that about 25% of the total original range and habitat of the horned lizard is now occupied by development. The lizard occurs in 75% of its range, and 50% of these localities occur in National Monuments and Parks, National Forests, State Parks and other public lands and reserves. The remaining 50% of CHL range occurs on private lands. It is recommended that land managers of forests, parks, and reserves should try to assure that horned lizard and harvest ant habitats are undisturbed.

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