The Present Status of the Garter Snake on Santa Catalina Island, California

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INTRODUCTION

The status of the garter snake on Santa Catalina Island has long been in doubt. Prior to 1974, only two specimens had ever been reported: one, in the California Academy of Sciences collection, from "Avalon" (Fitch 1940); the other, in the Los Angeles County Museum of Natural History, taken from "Middle Ranch" in 1941. During the ensuing 33 years, no new specimens were reported and the regrettable lack of documentation accompanying the recorded examples gave no additional clues. Even Fitch (1940), after thoroughly describing the single specimen available to him, stated:

> It seems improbable that an endemic population of garter snakes exists on Santa Catalina Island, and the specimen described above may be an abnormally marked individual brought there from the mainland through human agency.

So matters stood for many years, although herpetologists continued to list this species as part of the Santa Catalina Island fauna (Savage 1967, Stebbins 1966, 1972).

On the southern California mainland, the two-striped garter snake (*Thamnophis couchi hammondi*) is strictly confined to the vicinity of fairly permanent fresh water. While not really rare, populations are generally isolated from one another, occurring along canyon streams in the mountain foothills. Garter snakes were also formerly found in rivers, sloughs, and ponds in valleys and along the coast, but these habitats have been largely destroyed by urbanization. Throughout its range, the two-striped garter snake is thoroughly aquatic. It swims and dives well, and, although it may bask at the water's edge, it always takes refuge in the water when alarmed. As might be expected, its food consists of frogs, tadpoles, small fishes, salamanders, and earthworms.

In August 1974, I began a search of possible locations where populations might still occur and made inquiries of various persons familiar with the natural history of Santa Catalina Island. Natural permanent bodies of water are few on Santa Catalina. Although a number of manmade ponds and reservoirs have been constructed, I reasoned that if garter snakes were truly native to the island, they would have had to occupy one of the natural streams or ponds antedating the first arrival of Europeans. Pursuing the "Avalon" record, I was told that the nearest natural body of water was Echo Lake, a small isolated pond in a valley about 315 m above White's Landing (Fig. 1). Whatever Echo Lake once may have been, it has now been grazed barren of vegetation and trampled into a foul, muddy quagmire by goats, bison, and hogs—a totally unsuitable habitat for garter snakes.

A. Douglas Propst, then General Manager of the Wrigley holdings on Santa Catalina and now President of the Santa Catalina Island Conservancy, was extremely helpful in pointing out the canyons with springs and permanent water, all of which drain the west and southwest slopes of the island. These include Little Springs, Big Springs, Cottonwood, Middle, Fern, Bullrush, and Silver Canyons. Later, Mr. Propst visited several of these with me. While making further

[1]Deceased, 31 August 1979.

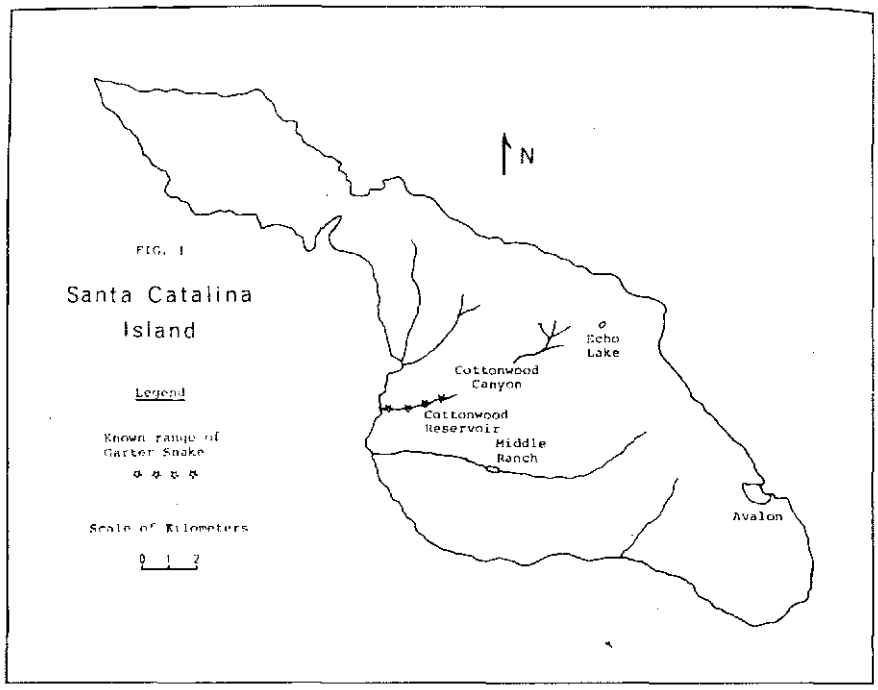

FIGURE 1. *Map of Santa Catalina Island showing range of garter snake (*Thamnophis couchi hammondi*).*

inquiries at Middle Ranch, I was told that children of ranch personnel had occasionally seen "water snakes" at Cottonwood Reservoir in Cottonwood Canyon. Everyone seemed quite familiar with the four common species of snake on the island—the ringneck, gopher snake, kingsnake, and rattlesnake—so there could be little question of mistaken identity. In southern California, garter snakes are often called "water snakes," and the fact that these particular snakes had always been seen in the water in Cottonwood Reservoir made this a very promising bit of information.

On the morning of August 4, 1974, my wife, Dr. Patricia Brown, and I captured the third known specimen of garter snake from Santa Catalina. This was a large female found lying in shallow water in the stream about 200 m below the dam at Cottonwood Reservoir.

MORPHOLOGY

To date, I have seen a total of 19 garter snakes in Cottonwood Canyon. Twelve of these, including nine adults and three juveniles (five males and seven females), were caught for meristic measurements. Except for the female specimen caught on August 4, 1974, all of these snakes have been examined in the field and released promptly where captured.

As the quotation from Fitch (1940) has already implied, the garter snakes on Santa Catalina Island look very different from mainland two-striped garters. Actually, the name "two-striped," which has been applied to the subspecies *hammondi*, is totally inappropriate for island specimens, which lack any markings whatever. Instead, they are a uniform olive-brown

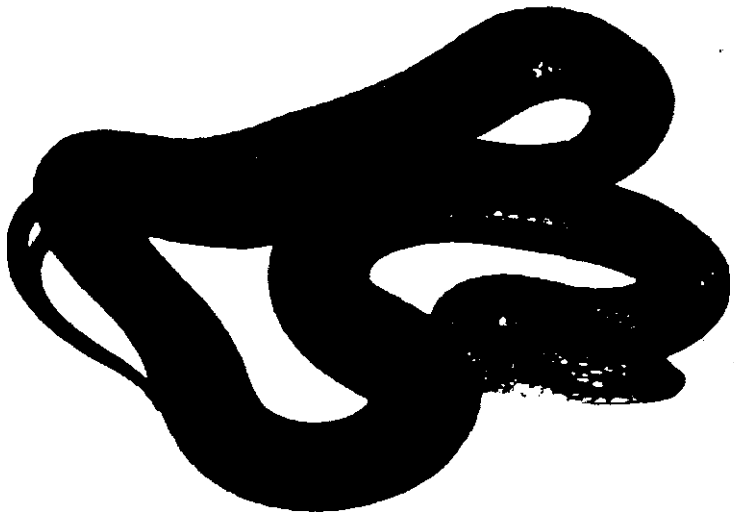

FIGURE 2. Thamnophis couchi hammondi—*adult female from Cottonwood Canyon, Santa Catalina Island (dorsal view).*

FIGURE 3. Thamnophis couchi hammondi —*adult female from Cottonwood Canyon, Santa Catalina Island (ventral view).*

on top (Fig. 2); their undersides are also olive-brown, but slightly clouded with orange. Only their chins, lip scales, and throats are pale olive-buff (Fig. 3). By contrast, most mainland specimens are blackish-brown on top with a well-defined yellow stripe along each side. Their lips, chins, and undersides are usually buff-yellow. Occasionally, a dark mainland snake can be found which approaches the coloration of the island specimens, but this is atypical. Aside from coloration, island and mainland forms seem basically alike. Meristics of the Santa Catalina examples fall within the range of *hammondi* as a whole.

Interestingly, there is another species of garter snake, the "Lower California garter snake" (*Thamnophis digueti*), found in a few bodies of fresh water in south-central Baja California that drain into the Gulf of California. This snake is virtually identical in coloration to the garter snakes on Santa Catalina and was originally assigned to *T. couchi hammondi*. The two forms differ only slightly in certain head proportions and average scale counts. It is hoped that biochemical studies will help clarify the relationships between the Lower California garter snake, that on Santa Catalina Island, and the two-striped form on the California mainland.

Very recently, Dr. Glenn Stewart of California State Polytechnic University, who has been studying the distribution and adaptive significance of color morphs in California garter snakes, informed me of a population of brown, patternless garter snakes at the mouth of the Santa Ynez River, about 8 km north of Lompoc in Santa Barbara County. This locality lies approximately 238 km northwest of the mouth of Cottonwood Canyon on Santa Catalina Island. Although I have not personally examined any of these garter snakes, they are said to resemble those of Santa Catalina much more than do snakes from populations in coastal Orange, Los Angeles, and Ventura Counties.

PAST DISPERSAL AND COLONIZATION OF SANTA CATALINA ISLAND

Santa Catalina, a large, topographically diverse island with a mild Mediterranean climate, lies only 32 km from the California mainland. The coastal mainland supports a rich and varied herpetofauna of nine amphibians and 25 reptiles. By contrast, only three amphibians and eight reptiles are native to Santa Catalina, although this well exceeds the number on any of the other Channel Islands (Savage 1967).

Geological and botanical evidence indicates that Santa Catalina has been separated from the mainland as well as from the other Channel Islands since the early Pleistocene (Savage 1967, Thorne 1967). This, plus the peculiar composition of the island's herpetofauna (derived from the mainland fauna, with some notable omissions), indicates chance colonization via over-water dispersal rather than by overland migration across land bridges (Savage 1967). For example, California toads (*Bufo boreas halophilus*), Great Basin fence lizards (*Sceloporus occidentalis biseriatus*), and California striped racers (*Masticophis l. lateralis*) are all very common along the adjacent mainland coast, but are absent from Santa Catalina. Conversely, western skinks (*Eumeces s. skiltonianus*), San Diego ringneck snakes (*Diadophis punctatus similis*), and two-striped garter snakes (*Thamnophis couchi hammondi*) are all rather uncommon on the mainland, but are, nonetheless, present on Santa Catalina. It is likely that, during the Pluvial period some 10,000 years ago, rainfall in southern California was much heavier and stream discharge along the coast much greater. Debris, frequently washed out to sea, could thus have provided dispersal opportunities through rafting—especially for amphibians and reptiles living along watercourses. Rafting was probably responsible for the peculiar herpetofaunal composition of Santa Catalina Island. Based on this assumption, it is likely that the herpetofauna of Santa Catalina consists of comparatively recent arrivals which have differentiated little or not at all from mainland forms.

The Lompoc garter snake population mentioned previously is of special interest since it represents the nearest mainland population with coloration like the garter snakes on Santa Catalina. At first, the likelihood of over-water transport from the Santa Ynez River around Point Arguello to the west side of Santa Catalina seems rather remote. However, studies of ocean currents along the southern California coast (Sverdrup *et al.* 1942, Wyllie 1966) show that the southward-flowing California Current sweeps quite close to shore in the general vicinity of Lompoc. South of San Nicolas Island, some of this water is caught up in a counterclockwise eddy which turns east and then northward, flowing past the shores of San Clemente and Santa Catalina Islands. If one estimates a distance of about 450 km along this

FIGURE 4. *Cottonwood Reservoir.*

"J"-shaped route and a speed of as little as 1 km/hr, such a journey would take a little over three weeks. Surface current velocities of twice this rate do occur, however (Schwartzlose 1963), and could, accordingly, reduce the time in transit.

Reptiles are notoriously able to survive long periods without food or water. They have thus been able to raft to rather remote oceanic islands, such as the Galapagos. Should a gravid garter snake have been carried out to sea on a raft of debris from the Santa Ynez River during a flood, it might well have ended up on the beach at Cottonwood Canyon, none the worse for a three- or four-week ocean journey. This unusual and distinctly colored form of garter snake could then have established a population of nearly identical individuals which has persisted in the absence of any selection against that color. The subsequent degradation of stream habitats by feral animals may well have extinguished garter snake populations elsewhere on Santa Catalina within the past two hundred years. By contrast, San Clemente Island, which completely lacks both suitable habitat and the treefrogs (*Hyla regilla*) which constitute such an important food item for garter snakes, was probably never successfully colonized by them.

ECOLOGY

Despite careful searching in the other stream canyons on Santa Catalina, I have been unable to find garter snakes in any but Cottonwood, nor have ranch personnel noted any elsewhere over the years. Cottonwood is unique in several respects. The permanently "live" portion of its stream flows for roughly 1.6 km from just below Rancho Escondido to a small cove south of Little Harbor. About 0.8 km upstream from where it is crossed by the Little Harbor-Middle Ranch road, there is a concrete dam some 8 m high across a narrow part of the canyon. Cottonwood Reservoir lies behind this dam (Fig. 4). This reservoir is a rather deep, narrow

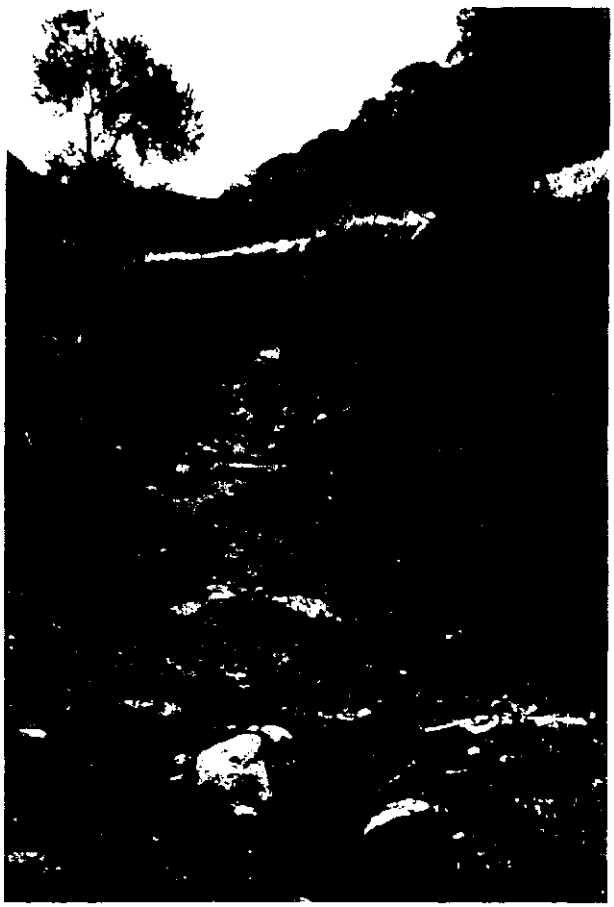

FIGURE 5. *Stream in Cottonwood Canyon.*

pond about 0.4 ha in extent. The upper end becomes quite shallow where it is fed by the stream. The Cottonwood stream continues "live" for another 0.5 km or so up to a place where ground water wells out below a ledge of metamorphic rock.

Unlike the other canyon streams, Cottonwood is fairly wide and has a rather gentle gradient (Fig. 5). Low falls and riffles are interspersed with long, flat stretches where the water may flow through several channels before joining again. The trees consist of small stands of cottonwoods (*Populus*), willows (*Salix*), and elderberries (*Sambucus*). Scattered clumps of bullrush (*Juncus*) and dense mats of salt grass (*Distichlis*) occur in the flat, open stretches. Various shrubs and herbs, including coyote bush (*Baccharis*), wild grape (*Vitis*), mugwort (*Artemisia douglasiana*), and virgin's bower (*Clematis*), grow along the stream bank. Unlike the other canyons, Cottonwood is quite open and free of the dense thickets of poison oak (*Toxicodendron*), coyote bush, willow, and bullrush which choke considerable stretches of other stream canyons. Behind the dam, Cottonwood Reservoir is lined by a stand of cattails (*Typha*). On the southwest side is a large clump of willows, but elsewhere the embankment is covered by a dense mat of salt grass with scattered clumps of California sagebrush (*Artemisia californica*).

FIGURE 6. *Garter snake habitat at Cottonwood Reservoir.*

This 1.6 km of stream, with Cottonwood Reservoir, constitutes the total known range of the garter snake on Santa Catalina Island (Fig. 1). Although individuals occasionally may be found along the stream, the nucleus of the population is at Cottonwood Reservoir. Garter snakes bask on the mats of salt grass along the embankment and quickly slide into the water at the slightest alarm. Once among the cattails in deeper water, they are almost impossible to see and are quite safe from most predators (Fig. 6).

On Santa Catalina, such predators would include bullfrogs, kingsnakes, red-tailed hawks, ravens, loggerhead shrikes, sparrow hawks (kestrels), marsh hawks, great blue herons, green herons, black-crowned night herons, egrets, burrowing owls, island foxes, feral pigs, feral house cats, domestic dogs, and even ground squirrels. Bison, which frequently drink at the stream and browse streamside vegetation in Cottonwood Canyon, may occasionally kill or maim some snakes by stepping on them. The browsing and trampling of vegetation by bison may actually have a beneficial effect on the garter snake population by preventing dense plant growth from choking the stream. In other canyons, especially in steep, narrow ones less frequented by bison, such overgrowth has resulted in very poor garter snake habitat. By contrast, intense overgrazing by goats in steep, rugged Silver Canyon has removed virtually all of the herbaceous vegetation. The stream in Silver Canyon trickles down through a barren desert-like landscape of eroding rocky slopes with no vegetation except a few very old Catalina cherries (*Prunus*), some scattered tree tobacco (*Nicotiana*), and clumps of prickly pear (*Opuntia*). Here a *lack* of cover is the problem. Therefore, not only does the garter snake appear to have a very restricted range on Santa Catalina, but I estimate the total population in Cottonwood Canyon to be no more than 25 to 30 individuals. It is thus hovering on the brink of extinction.

A new threat to the garter snake population was the abrupt appearance of bullfrogs (*Rana*

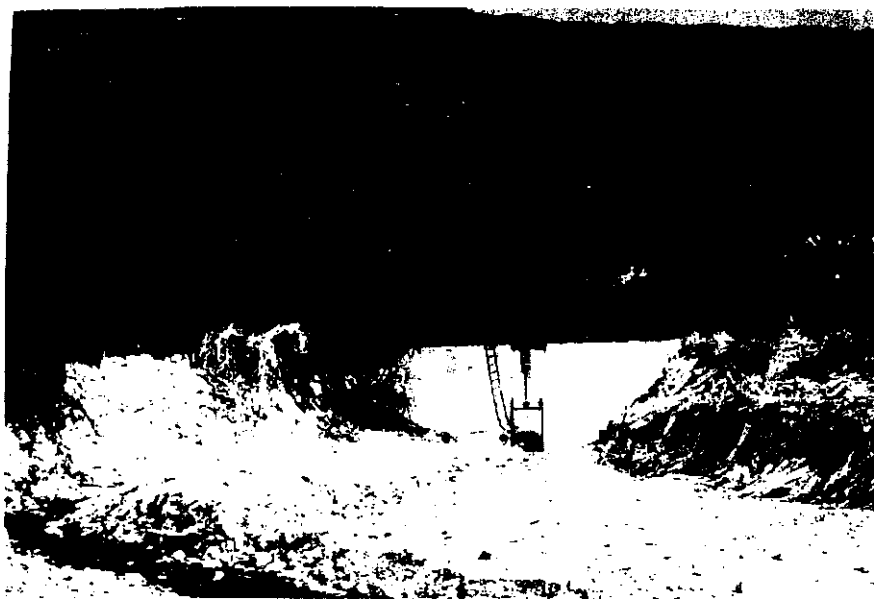

FIGURE 7. *Cottonwood Reservoir during winter drawdown; empty except for narrow stream along exposed bottom.*

catesbeiana) at Cottonwood Reservoir in August 1977. Both adults and tadpoles were seen, although neither had ever been noticed by me or by ranch personnel prior to that time. The nearest source of bullfrogs is Thompson's Reservoir at Middle Ranch. Bullfrogs were introduced into Thompson's Reservoir a number of years ago. However, the intervening terrain of several kilometers of steep, arid, scrub-covered ridges between Middle Canyon and Cottonwood would seem an effective barrier to dispersal.

While the tadpoles might occasionally be eaten by adult garter snakes, adult bullfrogs are voracious predators in their own right, seizing and swallowing any moving object they can engulf. A young garter snake would make an easy meal for an adult bullfrog. Given the low reproductive potential of the small garter snake population at Cottonwood, this new situation appears quite serious. Only the stream habitat will remain unsuitable for and therefore free of bullfrogs.

There is little chance that bullfrogs could have gone unnoticed at Cottonwood until the present time. They are large, and even their tadpoles are easily seen by day. Also, the bellowing calls of the adults at night are unmistakable. They must have been intentionally introduced not many weeks prior to their discovery. Control or elimination of bullfrogs will be quite difficult without seriously disrupting the already tenuous situation at Cottonwood.

HUMAN IMPACT

With the advent of new management policy, a major goal must be to minimize adverse human impact in Cottonwood Canyon. The construction of the dam and formation of Cottonwood Reservoir some 30 years ago greatly helped the garter snakes by creating new habitat for them, despite a great deal of temporary disturbance during construction. Each winter the dam

FIGURE 8. *Stream bed in Cottonwood Canyon during dry perio , August 1976.*

spillway is opened to prevent rain runoff from piling up silt behind the dam. This empties the lake for several weeks of each year, leaving only a narrow stream flowing along the exposed lake bottom (Fig. 7).

By 1976, a severe, prolonged water shortage on Santa Catalina Island prompted the drilling of a well 0.5 km up the canyon from Cottonwood Reservoir in a flat, elevated field about 100 m from the stream itself. Under the supervision of Mr. Propst, all possible steps were taken to minimize the impact of construction on the ecology of Cottonwood Canyon. An existing pipeline was reactivated to carry away a projected maximum flow of 60 gallons per minute. This was estimated to be well below the normal recharge rate into the stream from natural springs. Nevertheless, by August 1976, Cottonwood Reservoir was low and much of the stream was dry. Here and there a sluggish trickle ran over surface bedrock, but most of the stream bed consisted of long stretches of dry gravel (Fig. 8). Only a few stagnant pools held any surface

water. At this time, only one garter snake was seen in the stream bed itself. Another was found by ranch personnel on the lawn at Rancho Escondido, which lies on a steep, dry, scrub-covered ridge about 0.5 km from Cottonwood Reservoir. If this snake reached Rancho Escondido under its own power, it represents a considerable journey for a semiaquatic snake over very steep, arid terrain. The winter of 1976-77 brought little relief, but with careful monitoring of pumping, water levels in the stream and reservoir rose somewhat.

Fortunately, the drought ended with heavy rains during the winter of 1977-78. The dam spillway at Cottonwood Reservoir is still open because of accumulated flood debris, but there is again normal stream flow and pumping at the well has been discontinued. Despite these seemingly drastic changes, the garter snakes survive; established management procedures at the reservoir can be continued when necessary, therefore, without doing much harm. Any future well pumping should continue to be carefully monitored. A permanent reduction of stream water would have decidedly adverse effects; only close observation can determine what the maximum pumping rate should be.

The two-striped garter snake must be declared a *rare and endangered species on Santa Catalina Island*. The "live" stream portion of Cottonwood Canyon, including Cottonwood Reservoir, must be made off-limits to recreational activities such as hiking, picnicking, or camping. While such activities *per se* would not be harmful, they would attract too many people into the canyon. Informed ranch personnel would not molest snakes, but dogs, small children, snake collectors, vandals, and well-meaning but misguided adults who believe in killing every snake they see would soon extinguish the garter snakes on Santa Catalina. The best policy is to direct all visitors to less sensitive areas offering similar recreational advantages.

Finally, long-term population studies must provide information and recommendations for preserving these interesting reptiles for the future.

SUMMARY

For 33 years, only two specimens of the garter snake (*Thamnophis couchi hammondi*) were recorded for Santa Catalina Island and the status of this species remained unknown. In August 1974, a small population was discovered in the stream and reservoir in Cottonwood Canyon. The species apparently occurs nowhere else on the island.

Unlike most two-striped mainland specimens, garter snakes on Santa Catalina lack any pattern, being a uniform olive-brown with pale buff lips and chins. In this respect they most closely resemble a different species from central Baja California and a conspecific population near Lompoc on the California mainland.

The ecology of Cottonwood and other stream canyons on Santa Catalina is discussed, as are human impacts on garter snakes, and recommendations for conservation measures.

Finally, rafting is proposed as a mechanism by which garter snakes from the Lompoc region might have founded the population on Santa Catalina Island.

ACKNOWLEDGMENTS

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