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NATURAL HYBRIDIZATION OF THE BISEXUAL TEIID LIZARD *CNEMIDOPHORUS INORNATUS* AND THE UNISEXUAL *CNEMIDOPHORUS PERPLEXUS* IN SOUTHERN NEW MEXICO.

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At a site two miles west and one mile south of Mesilla, Dona Ana County, New Mexico, two bisexual species of teiid lizards (*Cnemidophorus inornatus* and *C. tigris*) and two unisexual and presumed parthenogenetic species (*C. exsanguis* and *C. perplexus*) are sympatric. We have examined over 100 specimens of each species from this area. Of these, two males (UCM 29542 and 30001, see Fig. 1) cannot be allocated to any of the four species. These specimens share certain diagnostic characters of both *C. inornatus* and *C. perplexus* and appear to have had a hybrid origin.

From the paucity of published reports, it is evident that hybridization between reptilian species is either a rare event or has generally passed unnoticed.

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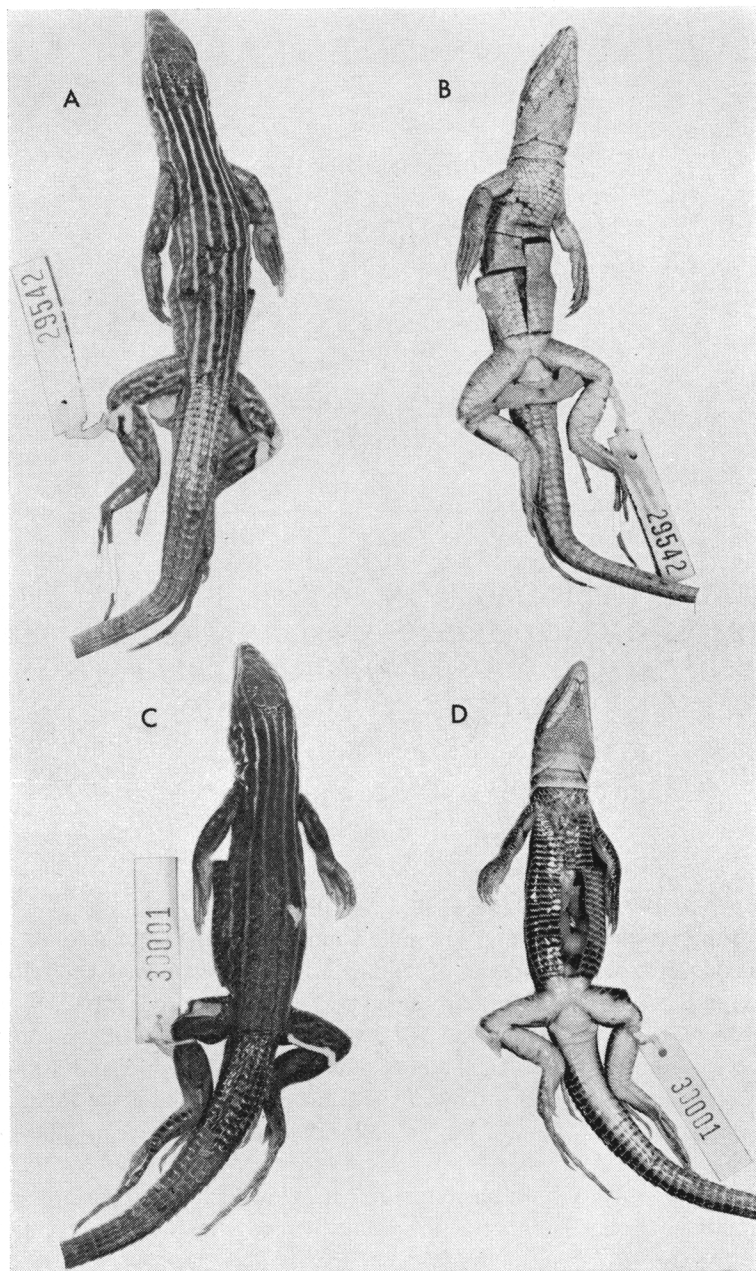


FIGURE 1. Dorsal and ventral views of *Cnemidophorus inornatus* x *C. perplexus* hybrid males collected from two miles west, one mile south of Mesilla, Dona Ana County, New Mexico. A. and B. - UMC 29542, body length 60 mm.; C. and D. - UCM 30001, body length 60 mm. UCM 30001 unnaturally darkened by formalin.

Because the type of hybridization considered here must occur even less frequently, we have presented our evidence for the suspected hybridization in considerable detail. The recognition of the possibility of interspecific hybridization between bisexual and unisexual species of *Cnemidophorus*, based upon unusual specimens, is not new. Zweifel (1959) presented preliminary evidence for this phenomenon in *C. costatus barrancorum* x *C. exsanguis*, as did Axtell (1963) for *C. scalaris* x *C. exsanguis*, and Zweifel (1965) for *C. inornatus* x *C. tessellatus*.

To check our hypothesis, each of the two males is compared with individual samples of *C. inornatus* and *C. perplexus* taken from, or close to, the suspected hybridization area. The *inornatus* sample has been used in a previous study (Taylor, 1965). We have used those taxonomic characters which have proved to be most valuable in determining species relationships within this genus.

SIZE

C. inornatus attains a body length of at least 72 mm. (Taylor, 1965), and several specimens of *C. perplexus* in the University of Colorado Museum collection have a body length of 80 mm. Maslin, Beidleman, and Lowe (1958) and Duellman and Zweifel (1962) have discussed the unique body length (86 mm.) of the type specimen of *C. perplexus*, a size that has not been duplicated in several sizable series of this species that have subsequently been accumulated.

Both UCM 29542 and 30001 are 60 mm. in body length. The largest specimens of *inornatus* and *perplexus* that we have examined from the Mesilla site are: *inornatus*—66 mm.; *perplexus*—76 mm. Little can be ascertained from this character except that both specimens are of adult size.

COLOR PATTERN

The principal color pattern differences of these species are: *C. inornatus*—vertebral stripe straight (when present) and no light spots in the dark fields between the stripes; *C. perplexus*—vertebral stripe always present and undulant or serrate for at least part of its length with light spots present in the dorsolateral and lateral dark fields.

Both hybrid males have intermediate color patterns. UCM 29542 has a complete vertebral stripe, slightly serrate at midbody, but not as well developed as in *perplexus*. In UCM 30001, the vertebral stripe is also weakly serrate at midbody, but becomes disrupted and indistinct posteriorly. Both specimens have small light spots, but, in contrast to *perplexus*, the spots are fewer in number and are confined to the lateral dark fields only.

HEAD SCUTELLATION

Lowe and Zweifel (1952) first recognized that an extensive anterior extension of circumorbital scales between the supraoculars and median head plates was

diagnostic of *C. neomexicanus* (= *C. perplexus*) with respect to *C. inornatus* and several other species of *Cnemidophorus* in New Mexico. Subsequent testing of this character has demonstrated its objectivity for the majority of specimens. The usual condition in *perplexus* is a development of the circumorbital scales to the suture separating the second and first supraoculars. The type of *perplexus*, however, has a short series of circumorbitals which emarginates only three-fourths of the third supraocular (Maslin, Beidleman, and Lowe, 1958), and Duellman and Zweifel (1962) reported another specimen that has a shorter circumorbital extension. Three of 66 *perplexus* specimens in the University of Colorado Museum collection and one specimen in our *perplexus* sample have the circumorbital series terminating short of the anterior suture of the third supraocular, thus resembling the condition in the type. In contrast, the most common manifestation of this series of scales in *inornatus* is a bordering of the fourth supraocular only. There is occasionally a greater extension, and one specimen in our *inornatus* sample has these scales developed to the middle of the third supraocular.

UCM 29542 has the circumorbital series extending to the suture separating the second and first supraoculars and UCM 30001 to the middle of the second supraocular. Both specimens are definitely *perplexus*-like in this character.

POSTANTEBRACHIAL SCALES

The difference between *inornatus* and *perplexus* is tenuous when based upon the relative sizes of these scales. Most specimens of *C. inornatus* exhibit very slightly enlarged postantebrachials, whereas these scales are granular in *perplexus*. Granular postantebrachials also occur in some *inornatus* specimens (Taylor, 1965). Although this character did not provide a sharp distinction between our samples of *inornatus* and *perplexus*, the two males appear to have the slightly enlarged postantebrachials of *inornatus*.

The following meristic characters provided sample means for *inornatus* and *perplexus* which were compared with individual values obtained for each of the two hybrid males. The results were tested for significant differences by use of a simplified t-formula (Simpson, Roe, and Lewontin, 1960) and a two-sided t-test. The alliance of the males with either *inornatus*, *perplexus*, or both is indicated by probabilities exceeding .05.

FEMORAL PORES

Both males have identical femoral pore counts although UCM 29542 is 21/19, and UCM 30001 is 20/20 for the two femora. The strong relationship of both specimens to *C. perplexus* can be seen from the data presented in Table 1.

TABLE 1. Analysis of number of femoral pores in samples of *C. inornatus*, *C. perplexus*, and *C. inornatus* x *C. perplexus* hybrids. N = sample size; M = mean; SD = standard deviation; SE = standard error; t = Student's t-value; P = probability.

Sample	N	Range of Variation and Frequencies											M	SD	SE				
		30	31	32	33	34	35	36	37	38	39	40				41	42		
<i>C. inornatus</i>	8	1		1	1	2	2	1									33.6	1.8	0.6
UCM 29542	1											1							
UCM 30001	1											1							
<i>C. perplexus</i>	21								4	5	5	5	1	1			38.8	1.4	0.3
Entities Compared								t					P						
UCM 29542 and <i>C. inornatus</i>								3.355					.02-.01						
UCM 30001 and <i>C. inornatus</i>								3.355					.02-.01						
UCM 29542 and <i>C. perplexus</i>								.835					.5-.4						
UCM 30001 and <i>C. perplexus</i>								.835					.5-.4						

DORSAL GRANULES

Both specimens show a distinct *inornatus* influence in two characters involving the number of dorsal granules contained within particular body dimensions (see Tables 2 and 3).

SPACING OF PARAVERTEBRAL STRIPES

UCM 29542 has an intermediate number of granules and is not significantly different from either species in this character. UCM 30001 is clearly allied with *C. inornatus* (see Table 4).

The morphological similarities of the two hybrids with the presumed parent species can now be summarized. Both specimens have color patterns intermediate to those found in *C. inornatus* and *C. perplexus*. We have examined 289 specimens of *inornatus*, and none of these had spots. Out of 196 *perplexus* specimens, only a few, of the same general size as the hybrids, had such weakly developed vertebral stripe serrations and so few spots. Even more convincing evidence is based on both specimens being either strongly patroclinal or strongly matroclinal in five of six other diagnostic characters, having mosaics of the parental characters rather than intermediate conditions. Thus, both specimens most closely resemble our *inornatus* sample in aspects of postantibrachial scales

TABLE 2. Analysis of number of dorsal granules around midbody in samples of *C. inornatus*, *C. perplexus*, and *C. inornatus* x *C. perplexus* hybrids. See Table 1 for an explanation of column designations.

Range of Variation	Frequencies				N	M	SD	SE
	<i>inornatus</i>	29542	30001	<i>perplexus</i>				
58	1							
59	1			<i>C. inornatus</i>	9	63.1	3.8	1.3
60	1			UCM 29542	1	63.0		
61	1		1	UCM 30001	1	61.0		
62				<i>C. perplexus</i>	24	74.7	1.7	0.3
63	1	1						
64								
65	1			Entities Compared		t	P	
66	1							
67	1			29542 and <i>inornatus</i>		.025	>.9	
68				30001 and <i>inornatus</i>		.523	.7-.6	
69	1			29542 and <i>perplexus</i>		6.745	<.001	
70			1	30001 and <i>perplexus</i>		7.897	<.001	
71			1					
72			2					
73			1					
74			4					
75			7					
76			4					
77			3					
78			1					

and dorsal granule counts. There is a close identity with the *perplexus* sample in arrangement of the circumorbital scales and in number of femoral pores. It appears that these characters have been inherited as blocks from each parent.

The possibility does exist that these two specimens are not hybrids at all, but represent male *perplexus*, which are exhibiting a strong sexual dimorphism. We are inclined to doubt this for two reasons: (1) male *perplexus* have not been discovered, or at least reported; (2) the males of predominantly female species that we have examined (*C. exsanguis*, *C. tessellatus*, and *C. velox*) closely resemble the respective females in both color pattern and scutellation characters. The only other reported case of natural hybridization between bisexual and

TABLE 3. Analysis of number of dorsal granules, occiput to rump, in samples of *C. inornatus*, *C. perplexus*, and *C. inornatus* x *C. perplexus* hybrids. See Table 1 for an explanation of column designations.

Range of Variation	Frequencies			N	M	SD	SE
	<i>inornatus</i>	29542	30001 <i>perplexus</i>				
148-150	1			<i>C. inornatus</i> 9	163.8	7.6	2.5
151-153				UCM 29542 1	166.0		
154-156				UCM 30001 1	178.0		
157-159	2			<i>C. perplexus</i> 23	185.4	2.3	0.5
160-162							
163-165	1						
166-168	4	1		Entities Compared		t	P
169-171							
172-174				29542 and <i>inornatus</i>	.274	.8-.7	
175-177	1			30001 and <i>inornatus</i>	1.773	.2-.1	
178-180			1	29542 and <i>perplexus</i>	8.249	<.001	
181-183			4	30001 and <i>perplexus</i>	3.146	.01-.001	
184-186			13				
187-189			4				
190-192			2				

TABLE 4. Analysis of number of granules separating paravertebral stripes at midbody in samples of *C. inornatus*, *C. perplexus*, and *C. inornatus* x *C. perplexus* hybrids. See Table 1 for an explanation of column designations.

Sample	N	Range of Variation and Frequencies								M	SD	SE
		7	8	9	10	11	12	13	14			
<i>C. inornatus</i>	9	1	2		4	1		1		9.7	1.8	0.6
UCM 29542	1					1				11.0		
UCM 30001	1		1							8.0		
<i>C. perplexus</i>	24					6	9	5	4	12.3	1.0	0.2
Entities Compared					t				P			
UCM 29542 and <i>C. inornatus</i>					.685				.6-.5			
UCM 30001 and <i>C. inornatus</i>					.895				.4-.3			
UCM 29542 and <i>C. perplexus</i>					1.274				.3-.2			
UCM 30001 and <i>C. perplexus</i>					4.214				<.001			

Table 5. Coefficients of variation in samples of *C. inornatus* and *C. perplexus* from Dona Ana County, New Mexico. FP = number of femoral pores; GAB = number of dorsal granules around midbody; OR = number of dorsal granules, occiput to rump; PV = number of dorsal granules between paravertebral stripes, at midbody.

Sample	FP	GAB	OR	PV
<i>C. perplexus</i>	3.6	2.3	1.2	8.1
<i>C. inornatus</i>	5.4	6.0	4.6	18.6

parthenogenetic forms of lizards involves subspecies of *Lacerta saxicola* (Darvinsky and Kulikova, 1964). Both parental forms were diploids, $2N = 38$, and fertilization of a diploid egg (originating via automixis) by a haploid sperm resulted in hybrids which were all sterile, triploid females. The situation under consideration here is similar to the above, in that both *C. perplexus* and *C. inornatus* are diploids, $2N = 46$ (Pennock, 1965, and unpublished data). They differ in that our specimens have no cytogenetic documentation, both are males, and their evolutionary role in the population is unknown.

In gross anatomy, the hemipenes, testes, epididymides, and vasa deferentia appear to be normal and well developed in UCM 29542 (collected 1 July 1965). These structures are considerably smaller in UCM 30001, which might be expected in a hybrid, but the later date of collection (2 August 1965) could explain the atrophied condition.

Because of the close similarities in size, number of femoral pores, number of dorsal granules around midbody, color pattern, and the rarity of hybridization, it is probable that the two males resulted from a single mating.

The presence of interspecific hybridization in the genus *Cnemidophorus* introduces the possibility of introgressive hybridization, despite its low probability. The variability of our *perplexus* sample is quite low when contrasted to the sample of bisexual *inornatus* (see Table 5), thus following the general pattern found in earlier comparisons of unisexual and bisexual species by Taylor (1965) and Zweifel (1965). If introgressive hybridization should occur in a parthenogenetic species, a method would be provided for increasing its variability, an event of potential evolutionary significance.

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