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Emoia cyanura and *E. impar* (Lacertilia, Scincidae) Are Partially Syntopic in American Samoa

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Morphological similarity among species is often correlated with ecological and physiological traits (Pianka, 1973; Cody, 1974; Losos, 1990). Consequently, two similar species in sympatry may compete for limited resources. For lizards, habitat, food, or time of activity are niche axes along which species may avoid competition (Schoener, 1974). Bruna et al. (1996) recently provided quantitative evidence for habitat partitioning among the lizards, *Emoia cyanura* and *E. impar*, by comparing their relative abundances in different habitat types on Rarotonga, Cook Islands, where the two cryptic species coexist. Following information provided by Gill (1993) that both species were collected in the same microhabitat in Western Samoa, Bruna et al. (1996) found both species in all habitat types; however, beach and disturbed habitats had a significantly higher relative abundance of *E. cyanura* than *E. impar*. In less disturbed habitats, represented by secondary, coast forest, and interior forest types, relative abundances of *E. impar*, although not significantly different, were higher than for *E. cyanura*. Their data confirmed a number of previous observations that the two species are not only distinct morphologically (Ineich, 1987a; Ineich and Zug, 1991) and biochemically (Guillaume et al., 1994; Bruna et al., 1995) but also differ ecologically (Ineich, 1987b; Zug, 1991).

In this paper, we report additional observations on the ecology of these two species. Island distributions, macrohabitat and microhabitat preferences, and activity patterns of the herpetofauna of the American Samoan Islands were conducted in the late 1970s (Schwaner, 1979; Amerson et al., 1982a, 1982b). However, the presence of two separate species of skink was not yet recognized, and Schwaner's (1979) ecological observations refer to *E. cyanura* sensu lato (i.e., including both *E. cyanura* and *E. impar* as currently recognized). Those observations can, however, now be assigned to the appropriate species by a reexamination of voucher specimens. We compared these data for evidence of sympatry among islands and syntopy within macrohabitats on seven islands in American Samoa.

MATERIALS AND METHODS

Collected specimens from seven islands in American Samoa (Schwaner, 1979; Amerson et al., 1982a, 1982b; Table 1) were reidentified as the brown-tailed copper-striped skink and the blue-tailed copper-striped skink (Zug, 1991), *E. cyanura* and *E. impar*, respectively, based on morphological characters that distinguish the two species (Ineich and Zug, 1991). We tested for differences in tail color in life using a chi-squared analysis. We then reassigned these individuals to 10 macrohabitat types designated as littoral strand and shrub, littoral forest, mangrove forest, coastal forest, lowland rain forest, ridge forest, montane scrub, plantation and village land, and secondary forest in Amerson et al. (1982a); this reference included habitat illustrations and lists of characteristic dominant species for each vegetation type (e.g., table 30, pp. 102–107). We compared the numbers of individuals of each species in the same habitats across islands using contingency tables (Zar, 1974).

RESULTS AND DISCUSSION

The sample of 522 skinks contained 329 *E. cynaura* (63%) and 193 *E. impar* (37%). Both species occurred on all seven American Samoan islands from which scincid specimens were taken (Table 1). Tail colors in life for *E. cyanura* (96 green, 27 brown, and one blue) differed significantly ($\chi^2 = 168.6$, $P < 0.001$) from those for *E. impar* (5 green, 4 brown, and 74 blue), supporting the notion by Ineich (1987b:40) and Ineich and Zug (1991) that tail coloration was a good criterion to recognize both species in the field.

Table 1 distinguishes those islands that do not support particular habitats and those for which a habitat was present but in which one or both species were not observed. The only surveyed habitat in American Samoa in which both species were not found together was mangrove forest (occupied only by *E. impar*) on Tutuila; both taxa were syntopic in all of the remaining habitats. However, when habitats across islands were grouped as "open" and "closed," *E. cyanura* was most often collected in disturbed areas or those with open canopies, whereas *E. impar* predominated in forests with more or less closed canopies (2×2 contingency table for data pooled across islands, $P < 0.001$; Table 1). This was particularly true for littoral, mangrove, and

TABLE 1. DISTRIBUTIONS OF *Emoia cyanura* AND *E. impar* BY ISLAND AND MACROHABITAT TYPE IN AMERICAN SAMOA. Ec = *E. cyanura*; Ei = *E. impar*. Open canopy habitats include STRD = Littoral Strand, SHRB = Littoral Shrub, VGPL = Village and Plantation Land, SECD = Secondary Forest. Closed canopy habitats are MANG = Mangrove Forest, LITT = Littoral Forest, COST = Coastal Forest, LRNF = Lowland Rain Forest, RIDG = Ridge Forest, and MONT = Montane Forest. A dash (−) indicates the absence of a habitat; a plus (+) indicates that the habitat is present but both lizard species were not observable there. Islands: (A) 'Aunu'u, (B) Nu'utele, (C) Ofu, (D) Olosega, (E) Swains, (F) Ta'u, (G) Tutuila.

	Emoia cyanura							*Emoia impar*						
	Island							Island						
	A	B	C	D	E	F	G	A	B	C	D	E	F	G
Open														
STRD	+	+	1	+	1	+	+	+	+	+	+	+	+	+
SHRB	+	+	3	7	5	+	3	+	+	+	1	+	+	+
VGPL	33	−	58	+	31	17	86	4	−	19	+	30	1	+
SECD	3	+	+	+	+	47	+	+	5	+	+	−	6	1
	n = 295							n = 67						
Closed														
MANG	−	−	−	−	−	−	−	−	−	−	−	−	−	5
LITT	1	−	4	3	4	−	3	+	+	9	8	1	55	16
COST	+	2	+	+	−	+	+	1	25	+	+	−	+	+
LRNF	−	−	+	+	−	+	14	−	−	+	+	−	+	1
RIDG	−	−	3	−	−	−	−	−	−	4	−	−	−	−
MONT	−	−	−	−	−	+	+	−	−	−	−	−	−	1
	n = 34							n = 126						

coastal forests where *E. impar* was captured far more frequently than *E. cyanura*. One possible exception to this pattern was the almost equal numbers of both species in village and plantation land on Swains Island. Field notes (TDS) indicated that daily samples from various localities around the island contained almost equal numbers of both species. This coral atoll has a limited number of habitats and only a small area of littoral forest. It also contains only two other skinks, *Lipinia noctua*, restricted to tree trunks, and *Emoia adspersa*, a potential predator; the remaining islands supported up to four other scincid species, *Cryptoblepharis boutoni*, a potential competitor restricted to littoral strand, and three large potential predators, *Emoia nigra*, *E. samoense*, and *E. lawesii* (Schwaner, 1979).

Ineich (1987b:44) reported that *E. impar* favored forested habitats with closed canopies on Moorea Island, French Polynesia. Based on observations along two transects on two Fijian islands, Zug (1991:73) referred to *E. impar* as a forest skink, inhabiting principally moderate- to closed-canopied forest, occasionally at the forest edge, and in human-disturbed habitats, whereas *E. cyanura* occupied open habitats. Our results found the same significantly higher relative abundance of *E. cyanura* than *E. impar* in open habitats (Table 1) as did Bruna et al. (1996) in beach and disturbed habitats; closed habitats in American Samoa are probably similar to the secondary forest, coast forest, and interior forest sampled by these authors on Rarotonga, and our studies confirm their results that *E. impar* was more abundant than *E. cyanura* in these forest types.

MATERIALS EXAMINED

Island names follow Motteler (1986). 'Aunu'u: *Emoia cyanura* KU 185132–46, USNM 21449–51, 215453–67, 215469–70, 215473, 215475; *E. impar* USNM 215452, 215468, 215471–72, 215474. Nu'utele Islet: *E. cyanura* USNM 215602, 215613, *E. impar* KU 185147–52, USNM 215600–01, 215603–12, 215614–24. Ofu: *E. cyanura* KU 185153–57, 185159–60, 185162–67, 185169–70, 185172–76, 185183–84, 185187–91, USNM 215544–55, 215558, 215562–79, 215589–92, 215595, 215597–99, 215626–27, 215629; *E. impar* KU 185158, 185161, 185168, 185171, 185177–82, 185185–86, 185192, USNM 215556–57, 215559–61, 215580–88, 215593–94, 215596, 215625, 215628. Olosega: *E. cyanura* USNM 215630–35, 215637, 215644–45, 215647; *E. impar* USNM 215636, 215638–43, 215646, 215648. Swains: *E. cyanura* USNM 215476, 215479–80, 215482–84, 215487, 215492–95, 215501, 215504, 215509–12, 215514–15, 215517, 215520, 215523–24, 215527–34, 215536,

215538–41, 215543; *E. impar* USNM 215477–78, 215481, 215485–86, 215488–91, 215496–500, 215502–03, 215505–08, 215513, 215516, 215518–19, 215521–22, 215525–26, 215535, 215537, 215542. Ta'u: *E. cyanura* KU 185193, 185195–204, 185206, 185208, 185220, 185237, 185240, 185247, 185251–66, 185268, 185270–74, 185276–87, 185289–91, USNM 215649–51, 215653–63; *E. impar* KU 185194, 185205, 185207, 185209–19, 185221–36, 185238–39, 185241–46, 185248–50, 185267, 185269, 185288, 185292–98, USNM 215652, 215664–73. Tutuila: *E. cyanura* USNM 215315–18, 215320–31, 215333–53, 215356–82, 215384, 215386–402, 215418, 215425–47; *E. impar* USNM 215319, 215385, 215403–17, 215419–24, 215448.

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Literature Cited

Amerson, A. B., Jr., W. A. Whistler, and T. D. Schwaner. 1982a. Wildlife and wildlife habitat of American Samoa. I. Environment and ecology. US Dept. Interior, Fish and Wildlife Service, Washington, DC.

———, ———, and ———. 1982b. Wildlife and wildlife habitat of American Samoa. II. Accounts of flora and fauna. US Dept. Interior, Fish and Wildlife Service, Washington, DC.

Bruna, E. M., R. N. Fisher, and T. J. Case. 1995. Cryptic species of Pacific skinks (*Emoia*): further support from mitochondrial DNA sequences. Copeia 1995:981–983.

———, ———, and ———. 1996. New evidence of habitat segregation between two cryptic species of Pacific skinks. *Ibid.* 1996:998–1005.

Cody, M. L. 1974. Competition and the structure of bird communities. Princeton Univ. Press, Princeton, NJ.

Gill, B. J. 1993. The land reptiles of western Samoa. J. R. Soc. NZ 23:79–89.

Guillaume, C. P., I. Ineich, and S. Boissinot. 1994. Allozyme evidence for specific status of the two French Polynesian skink species in the genus *Emoia* (Reptilia: Lacertilia). Copeia 1994:1042–1047.

Ineich, I. 1987a. Description d'une nouvelle espece du genre *Emoia* (Sauria, Scincidae) en Polynesie francaise. Bull. Mus. Hist. Nat., Ser. 4. 9:491–494.

———. 1987b. Recherches sur le peuplement et l'evolution des Reptiles terrestres de Polynesie francaise. Unpubl. Ph.D. diss. Universite des Sciences et Techniques du Languedoc, Montpellier, France.

———, and G. Zug. 1991. Nomenclatural status of *Emoia cyanura* (Lacertilia, Scincidae) populations in the central Pacific. Copeia 1991:1132–1136.

Losos, J. B. 1990. Ecomorphology, performance capability, and scaling of West Indian *Anolis* lizards: an evolutionary analysis. Ecol. Monogr. 60:369–388.

Motteler, L. S. 1986. Pacific island names. A map and name guide to the new Pacific. Bishop Mus. Misc. Publ. 34:1–91.

Pianka, E. R. 1973. The structure of lizard communities. Ann. Rev. Ecol. Syst. 4:53–74.

Schoener, T. W. 1974. Resource partitioning in ecological communities. Science 185:27–39.

Schwaner, T. D. 1979. Biogeography, community ecology and reproductive biology of the herptofauna of the American Samoan Islands. Unpubl. Ph.D. diss. Univ. of Kansas, Lawrence.

Zar, J. H. 1974. Biostatistical analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Zug, G. R. 1991. The lizards of Fiji: natural history and systematics. Bishop Mus. Bull. Zool. 2:1–136.

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Literature Cited

Cryptic Species of Pacific Skinks (Emoia): Further Support from Mitochondrial DNA Sequences

Emilio M. Bruna; Robert N. Fisher; Ted J. Case

Copeia, Vol. 1995, No. 4. (Dec. 21, 1995), pp. 981-983.

Stable URL:

http://links.jstor.org/sici?sici=0045-8511%2819951221%293%3A1995%3A4%3C981%3ACSOPS%28%3E2.0.CO%3B2-A

New Evidence of Habitat Segregation between Two Cryptic Species of Pacific Skinks (Emoia cyanura and E. impar)

Emilio M. Bruna; Robert N. Fisher; Ted J. Case

Copeia, Vol. 1996, No. 4. (Dec. 27, 1996), pp. 998-1005.

Stable URL:

http://links.jstor.org/sici?sici=0045-8511%2819961227%293%3A1996%3A4%3C998%3ANEOHSB%3E2.0.CO%3B2-Y

Allozyme Evidence for Specific Status of the Two French Polynesian Skink Species in the Genus Emoia (Reptilia: Lacertilia)

Claude-P. Guillaume; Ivan Ineich; Stéphane Boissinot

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Stable URL:

http://links.jstor.org/sici?sici=0045-8511%2819941219%293%3A1994%3A4%3C1042%3AAEFSSO%3E2.0.CO%3B2-1