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GEOGRAPHIC DIFFERENTIATION AND DISTRIBUTION OF THE PERUVIAN SCREECH-OWL

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ABSTRACT.—Analysis of vocalizations of the dwarf form of screech-owl from northwestern coastal Perú establishes conspecificity with the Peruvian Screech-Owl (*Otus roboratus*) of the mid-Marañon Valley, a species previously considered to be monotypic. The small coastal form (*O. r. pacificus*) differs significantly from the nominate form in a series of characters of both size and color; some features do not overlap. Both subspecies of *O. roboratus* are polymorphic in color, with gray-brown and red phases represented. Alliance of *O. r. roboratus* with *O. choliba* and *O. r. pacificus* with *O. guatemalae,* as proposed by Hekstra, is not supported by either vocal features or plumage pattern. *Received 7 April 1989, accepted 24 Aug. 1989.*

The arid woodlands of northwestern coastal Perú have long been known to harbor a tiny screech-owl (*Otus*) of dubious systematic affinities. First collected over one hundred years ago, this owl was known in the mid-decades of this century to the late Maria Koepcke, pioneer naturalist in Perú, and has been recorded on a fairly regular basis in recent years by most field groups that have visited the region.

We first became intrigued by the identity of this little owl as a possibly undescribed taxon in 1967, when two specimens were netted in Piura by the late Carl B. Koford and his field party (R. B. Hamilton, R. B. Huey, and F. C. McCullom) from the Museum of Vertebrate Zoology, during a general survey of vertebrates in northwestern Perú. Although the basic color pattern suggested affinity with the Peruvian Screech-Owl (*O. roboratus* Bangs and Noble 1918), the unusually small size indicated that the owl represented an undescribed species. During three visits to Perú

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(August–September 1970, February 1972, and October–November 1974) we were fortunate to obtain additional specimens and tape recordings of the principal vocalizations both of the small owl, in Tumbes and Piura, and of the large *O. roboratus* in the Marañon drainage of Cajamarca and Amazonas.

This report presents the results of morphological, vocal, and ecological analyses which support the view that the small owl from northwestern Perú is a coastal differentiate of *O. roboratus*.

O. roboratus is known in the literature by several different vernacular names: "Roborate Screech Owl" (Hekstra 1973), "West Peruvian Screech-Owl" (Meyer de Schauensee 1966, Parker et al. 1982), "Urcututu occidental" (Koepcke 1964), and "Peruvian Screech Owl" (Marshall and King 1988). We prefer the latter usage (but with a hyphenated group name) because it is brief and appears in a world list of the names of birds of prey that can serve as a formal standard of vernacular nomenclature.

MATERIALS AND METHODS

Study specimens.—The Peruvian Screech-Owl is known at present from approximately 50 specimens. All major collections of the species are in the United States (American Museum of Natural History, New York; Louisiana State University Museum of Zoology, Baton Rouge; Museum of Vertebrate Zoology, University of California, Berkeley). In addition, five institutions (Chicago Natural History Museum; Museum of Comparative Zoology, Harvard University; Museo Historia Natural Javier Prado, Lima; British Museum [Natural History], Tring; and Alexander Koenig Museum, Bonn) have two specimens each. I have examined all of the aforementioned specimens except the type of *O. roboratus* (MCZ, Harvard) and the four skins in Tring and Bonn. Elevations in the following account are those on the specimen tags; as a result some are not in the metric system. Joe T. Marshall kindly provided color slides of the two specimens at Tring. John S. Weske graciously sent measurements of the two specimens at Bonn.

Measurements.—Size of three appendages of study skins was measured in millimeters with a dial caliper as follows: (1) wing (chord) length, from the bend of the wing to the tip of the longest primary; (2) tail length, from the basal point between the insertions of the central pair (1–1) of rectrices to the tip of the longest rectrix; and (3) bill length, from the anterior edge of the nostril to the tip of the upper mandible. We did not measure either the tarsus or the toes because of the difficulty of measuring feathered surfaces. Body mass in grams, was measured with a Pesola balance from each fresh specimen within a few hours after collection. For analysis, values of body mass were used both in raw form and after transformation to cube roots.

Analysis of coloration.—Variation in color of the plumage of the crown and lower dorsum was analyzed quantitatively with a Bausch and Lomb Spectronic 505 recording spectrophotometer equipped with a visible reflectance attachment. Flatness of the 100% line was maintained within limits of 1.0% peak-to-peak, and flatness of the 0% line, within 0.5%. To permit analysis of limited areas of plumage, the sample port was narrowed to a diameter of 22 mm. The background of the contracted hole was painted with Krylon Spray Paint, Number 1602, Ultra Flat Black Enamel, produced by Borden, Inc. From trichromatic coefficients (x, y, z) obtained from curves of percentage diffuse spectral reflectance between

400 to 700 mμ by the 10 selected ordinate method of Hardy (1936:49–51), dominant wavelength (λ_d), brightness (Y), and excitation purity (P_e) were computed according to table 6 of Judd (1933:371) and using the ratios described in Johnson and Brush (1972:247). Routine comparison of series of specimens under uniform lighting which approximates natural north sky daylight was accomplished under a Macbeth Super Color Matching Skylight (Model BX 848A).

Vocalizations.—Trills and barks of owls were preserved for analysis on magnetic tape by use of a Uher Report-L portable tape recorder and a Sennheiser MKH 804 directional microphone. In the laboratory, the vocalizations were displayed visually as audiospectrograms using a Kay Elemetrics Model 6061A 85-8000 CPS Spectrum Analyzer with the wide band setting.

CHARACTER VARIATION

Populations of the Peruvian Screech-Owl can be divided conveniently into those occurring in the Rio Chinchipe-mid-Marañon drainage, between the western and Central Andes, and those inhabiting the arid coastal plains and foothills of northwestern Perú, west of the western Andes (Fig. 1). For the sake of simplicity in the following discussion of character variation, we use the names "Marañon" and "NW coast" or "coastal," respectively, to identify these disjunct populations.

Size.—In wing length, tail length, bill length, and body mass, Marañon specimens average significantly larger than those from the northwestern coast (Table 1). Both sexes illustrate this pattern. In fact, in all characters except bill length, no overlap occurs between values from specimens representing the two groups of populations.

Sexual dimorphism in size.—Using the Dimorphism Index (D. I.) devised by Storer (1966:424), we determined the degree of dimorphism in Marañon birds to be 1.36 in wing length and 3.93 in cube root of body mass. Comparable figures for coastal birds are 0.36 and 0.45, respectively. These D. I. values are low, in keeping with the insectivorous habits (see beyond) of this species. Furthermore, as in three species of North American *Otus,* degree of sexual dimorphism increases with absolute body mass (Earhart and Johnson 1970:255).

Color and pattern.—Birds from populations on either side of the western Andes exist in two color morphs or phases, "gray-brown" and "red" or "rufous." Within either morph, Marañon birds differ subtly from northwestern coastal birds in brightness, dominant wavelength, and purity of both the crown and the lower dorsum (Table 2). Differences in the color variables of the lower dorsum are more pronounced than are those of the crown.

Although both groups of populations clearly show the dark brown or blackish cap and pronounced nuchal collar that characterize the Peruvian Screech-Owl, dorsal or ventral pattern differences between specimens rep-

FIG. 1. Localities of occurrence of *Otus roboratus* in northwestern Perú, based on specimens examined in this study. Note that the dots for *O. r. pacificus* all fall west of the western Andes and that all of the squares for *O. r. roboratus* fall in the drainage of the Rio Marañon and Rio Chinchipe, east of the western Andes. The species has been reported beyond the southern boundary of the map (Koepcke 1964:68), but we have not studied specimens from this extra-limital region in order to verify their identity as *O. roboratus*.

resenting either group are very subtle (Fig. 2). As in the desert subspecies of the Western Screech-Owl (*O. kennicottii*) (Miller and Miller 1951:162–163, Marshall 1967), Peruvian Screech-Owls show great individual variability in: (1) the width and intensity of the dark shaft streaks, (2) the density of the horizontal vermiculations or vague "bars" found lateral to the shaft streaks, and (3) the background color, both dorsally and ventrally. In general, shaft streaks are wider and more contrasting in Marañon birds, especially on the upper breast and around the margins of the facial disk (Fig. 2, right). Differences in the lateral vermiculations on the body feathers are extremely subtle. Although there is much overlap, on the average it appears that Marañon specimens are slightly paler than northwestern coastal birds because of reduced lateral vermiculation. Overall

TABLE 1
SUMMARY STATISTICS FOR FOUR SIZE CHARACTERS OF *OTUS ROBORATUS*

Character	Region	Males N	Males $\bar{x}$	Males SD	Females N	Females $\bar{x}$	Females SD
Wing length (mm)	Marañon	16	167.6	5.51	8	169.9	4.12
	NW coast	13	140.8	3.48	11	141.7	5.22
Signif. of diff.:[a]	$t_{27} = 15.910$***		$t_{17} = 13.128$***				
Tail length (mm)	Marañon	16	92.3	3.66	8	91.6	1.94
	NW coast	12	76.8	2.63	8	78.6	4.18
Signif. of diff.:	$t_{26} = 13.024$***		$t_{14} = 7.95$***				
Bill length(mm)	Marañon	15	11.9	0.63	8	12.1	0.87
	NW coast	12	10.5	0.51	5	10.2	0.93
Signif. of diff.:	$t_{25} = 6.395$***		$t_{11} = 3.671$**				
Body mass (gm)	Marañon	7	143.9	11.08	3	161.7	2.52
	NW coast	10	86.9	9.41	7	87.7	10.97
Signif. of diff.:	$t_{15} = 11.086$***		$t_{8} = 16.835$***				

[a] One asterisk: $P < 0.05$; two asterisks: $P < 0.01$; three asterisks: $P < 0.001$.

background color is again extremely variable. Nonetheless, differences seem to pertain, with Marañon specimens averaging browner and coastal birds averaging grayer, but with much overlap.

Several specimen tags were annotated with data on the colors of soft parts. A single example from the Marañon Valley had golden-yellow irides with "pinkish-olive" eyelids. The bill of this specimen was grayish-olive with a yellowish tip. The feet were grayish-olive. Nine specimens from northwestern coastal Perú had data on eye color. Six, including one juvenile, had yellow irides, one was noted as having a "golden-yellow" iris, one had a yellow iris with a greenish cast, and one juvenile had a "pale yellow-olive" iris. Bills of the coastal birds were described variously as greenish, dark gray (2), greenish-gray with a yellow-green tip, dark bluish-gray, and "dusty pea green with dusty yellow tip." The feet of coastal specimens were noted as being dark-gray, gray, grayish-flesh, dark greenish-gray, or brownish. The meager information at hand does not indicate any difference in soft part colors between birds representing Marañon versus coastal populations.

Voice.—The primary song of both northwestern coastal and Marañon populations consists of a trill which is approximately 1.5 to 2 seconds in length. This trill is composed of low-pitched repetitive notes that begin softly, peak in loudness, then softly fade (Fig. 3A, B, D, E). The small samples available reveal no differences between birds representing pop-

TABLE 2

SUMMARY STATISTICS FOR SIX COLOR CHARACTERS OF MORPHS OF *OTUS ROBORATUS*

Character	Region	Gray-brown phase N	Gray-brown phase $\bar{x}$	Gray-brown phase SD	Red phase N	Red phase $\bar{x}$	Red phase SD
Brightness of crown (%)	Marañon	21	4.38	0.73	3	4.27	0.86
	NW coast	11	4.88	0.67	1	6.18	—
Signif. of diff.:[a] $t_{30} = 1.936$ ($P < 0.10$)							
Dominant wavelength of crown (mμ)	Marañon	21	584.4	1.04	3	585.4	1.39
	NW coast	11	582.9	1.70	1	586.4	—
Signif. of diff.: $t_{30} = 2.698$* ($P < 0.02$)							
Purity of crown (%)	Marañon	21	20.43	2.79	3	24.75	3.34
	NW coast	11	23.44	4.67	1	35.69	—
Signif. of diff.: $t_{30} = 1.962$ ($P < 0.10$)							
Brightness of lower dorsum	Marañon	21	6.69	0.89	3	7.16	0.89
	NW coast	11	7.49	0.93	1	6.91	—
Signif. of diff.: $t_{30} = 2.344$*							
Dominant wavelength, lower dorsum	Marañon	21	584.1	0.58	3	586.6	0.65
	NW coast	11	582.6	0.87	1	586.6	—
Signif. of diff.: $t_{30} = 4.969$***							
Purity, lower dorsum	Marañon	21	29.51	3.59	3	37.80	0.96
	NW coast	11	24.27	3.73	1	37.31	—
Signif. of diff.: $t_{30} = 3.832$***							

[a] See Table 1.

ulations on either side of the western Andes. Aggressive barks (Fig. 3C, F) are also similar between coastal and Marañon birds, although samples again are very small. Our recordings and audiospectrograms of *O. roboratus* show clearly that the vocalizations of the Peruvian Screech-Owl are broadly similar to those of other species in the New World group of *Otus* defined by Van der Weyden (1975).

SUBSPECIES

From the aforementioned data on character variation, we conclude that the populations of the Rio Chinchipe drainage and the mid-Marañon Valley and the populations of the lowlands and foothills of northwestern coastal Perú represent different subspecies:

Otus roboratus roboratus

Otus roboratus Bangs and Noble, 1918:448–449.

Type specimens.—Holotype: Adult male, No. 80073, Museum of Com-

parative Zoology, collected September 25, 1916, by G. K. Noble (not examined). Paratype: Adult male, No. 80072, Museum of Comparative Zoology, collected September 14 (17?), 1916, at Perico, Perú by G. K. Noble (examined).

Type locality.—Bellavista, Perú.

Measurements of type.—Wing, 168 mm; tail, 82; tarsus, 39; culmen from cere, 14 (from Bangs and Noble 1918:449).

Geographic range.—Drainages of the Rio Chinchipe and Rio Marañon in the Departments of Amazonas and Cajamarca, northern Perú. Southern limits of range poorly understood (see remarks below).

Characters.—Resembles *O. r. pacificus* of northwestern Perú but averages approximately 28–30 mm longer in wing length, 14–16 mm longer in tail length, 1.5–2.0 mm longer in bill length, and 56–73 gm heavier in body mass. In coloration, *O. r. roboratus* averages browner and has wider and more contrasting shaft streaks on the upper breast and facial disk than does *O. r. pacificus.*

Specimens examined.—24. PERÚ: Depto. Cajamarca.—Perico, Rio Chinchipe, 1 ([MCZ=] Museum of Comparative Zoology, Harvard), 11 ([AMNH=] American Museum of Natural History); below San Jose de Lourdes, 1 ([LSUMZ=] Louisiana State Univ. Museum of Zoology, Baton Rouge); Jaen, 2400 ft., Lower Marañon Valley, 2 (AMNH); 9 km S Jaen, 1 (LSUMZ); 5 mi. SSE Jaen, 3000 ft., 1 ([MVZ=] Museum of Vertebrate Zoology). Depto. Amazonas.—8 km WSW Bagua, 1500 ft., 4 (MVZ); Hda. Caimito, 10 km SE Bagua Grande, 1 (MVZ); 10 km WSW Bagua Chica, 1700 ft., 2 (MVZ).

Remarks.—A specimen (LSUMZ 97573) taken April 29, 1980, on the slopes west of San Damian at 64 road kilometers east of Huarmey, 2100 m, in the Department of Ancash, Perú, seems to represent *O. roboratus* in view of its blackish crown set off by a pale nuchal collar and the general patterning of the plumage otherwise. In size (wing length, 159 mm; tail length, 84.5 mm) it is too large to be *O. r. pacificus.* Instead, the form *O. r. roboratus* is suggested. However, the specimen is grayer dorsally and has wider and bolder ventral shaft streaks than any specimen of the latter form examined. These differences, considered together with the remoteness and elevational displacement of this locality from the known range of *O. r. roboratus,* also indicate that the specimen from Ancash could represent an undescribed subspecies.

Otus roboratus pacificus

Otus guatemalae pacificus Hekstra 1982:58.

Otus guatemalae rufus Hekstra 1982:58–59.

Type specimen.—Holotype: Adult female, No. 1902.3.13.1564 (pub-

FIG. 2. Photographs of male specimens of *Otus* in dorsal (left) and ventral (right) aspect. From left to right: *O. guatemalae guatemalae* (MVZ 142430, Guatemala); *O. roboratus roboratus* (MVZ 160801, Dept. Amazonas, Perú); *O. roboratus pacificus* (MVZ

lished incorrectly as 023.13.1564 by Hekstra [1982:58]), British Museum (Natural History), Tring, collected August 27, 1899, by P. O. Simons (not examined).

Type locality.—Morropon, 140 m, Piura, NW Perú.

Measurements of type.—Wing, 150 mm (from Hekstra 1982:58). Joe T. Marshall, Jr. (pers. comm.) has also measured the type specimen: wing chord, 143; tail, 79. Hekstra presumably measured the flattened wing, hence the discrepancy with Marshall's value for wing chord.

Geographic range.—Coastal lowlands and foothills of northwestern Perú in the Departments of Tumbes, Piura and Lambayeque. Known from a single locality in Ecuador (see below). Both the northern and the southern limits of distribution are uncertain.

163707, Dept. Tumbes, Perú); and *O. choliba crucigerus* (MVZ 120482, Dept. Huila, Colombia).

Characters.—Resembles *O. r. roboratus* of the mid-Marañon drainage east of the western Andes but much smaller in length of wing, length of tail, length of bill and body mass and averaging slightly grayer, especially dorsally.

Specimens examined. 23.—PERÚ. Depto. Tumbes.—Quebrada Faical, 400 m. E El Caucho, 24 km SE Pampa de Hospital, 1 (LSUMZ); Canoas (near Mancora), 1 ([MHNJP] Museo Historia Natural Javier Prado, Lima); Quebrada Bocapan, 50 ft., 6 km S and 4 km W Zorritos, 2 (MVZ); Huasimo, 1 ([FMNH=] Field Museum of Natural History). Depto. Piura.—Parinas, 100 ft., 7 km N and 15 km E Talara, 6 (MVZ); Palambla, "3900–6500 ft.," 1 (AMNH); Amotape Mts., Sullana, 1 (FMNH); Barranco, 11 km N & 28 km E Cabo Blanco, 1 (MVZ); ca 3

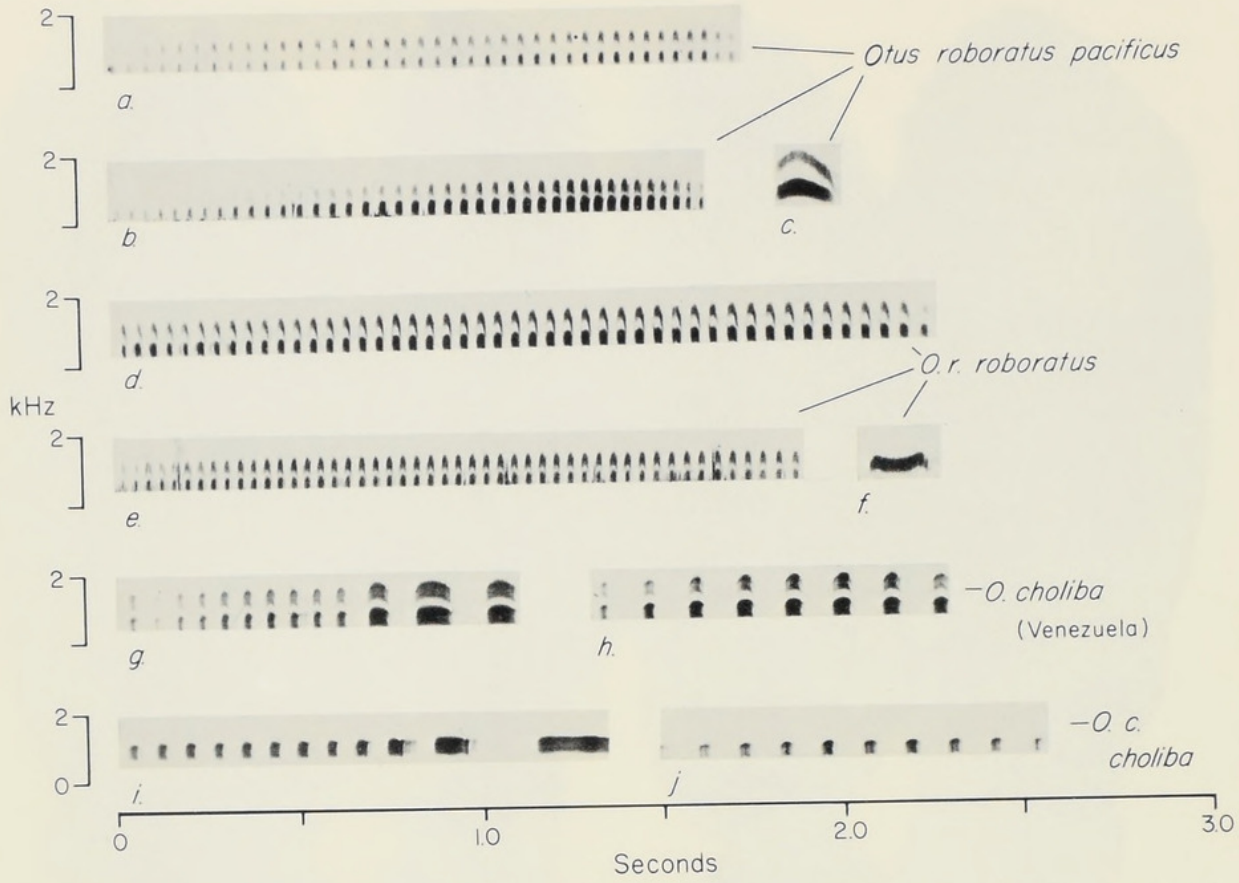

FIG. 3. Audiospectrograms of tape recordings of the common vocalizations of *Otus roboratus* and *Otus choliba*. (a) Advertising song of *O. r. pacificus* (MVZ tape 16, cut 7, cue 11), recorded by the authors at Parinas, 100 feet elevation, 7 km N and 15 km E. Talara, Depto. Piura, Perú, on October 29, 1974. (b) Advertising song of *O. r. pacificus* (MVZ tape 16, cut 8, cue 1), recorded by the authors at Quebrada Bocapan, 50 feet elevation, 6 km S and 4 km W of Zorritos, Depto. Tumbes, Perú, on October 30, 1974. (c) Bark of same male as recorded in b (cue 23). (d) Advertising song of *O. r. roboratus* (MVZ tape 15, cut 3, cue 2) recorded by the authors at 5 miles SSE Jaen, 3000 feet elevation, Depto. Cajamarca, Perú, on August 22, 1970. (e) Advertising song of *O. r. roboratus* (MVZ tape 15, cut 6, cue 26) recorded by the authors at 10 km WSW Bagua Chica, 1700 feet elevation, Depto. Amazonas, Perú, on August 31, 1970. (f) Bark of same individual recorded in e (cue 14). (g) Advertising song with terminal barks of *Otus choliba,* recorded by Paul Schwartz in Venezuela. Subspecies, exact locality, and date unknown. (h) Advertising song lacking terminal barks in *Otus choliba.* Same individual as in g. (i) Advertising song of *Otus choliba choliba* (MVZ tape 94, cut 2, cue 1), with terminal barks. Recorded by Victoria Dziadosz at El Tirol, 230 meters elevation, 19.5 km by road NNE Encarnacion, Depto. Itapua, Paraguay, on September 15, 1978. (j) Advertising song of *Otus choliba choliba* (MVZ tape 94, cut 1) in which the terminal emphatic notes (barks) are lacking. Same recordist, locality, and date as in i.

km by road N Chignia, ca 1000 ft., 1 (LSUMZ); Barbecoas, 500–600 m. cerca de Angolo, Hda. Mallares (cerca Sullana), 1 (MHNJP). Depto. Lambayeque.—Rio Tocto, ca 600 ft., ca 14 km N and 10 km E Olmos, 1 (LSUMZ); Las Pampas, 90 m, km 885, Old Pan-American Highway, 11

km N Olmos, 4 (LSUMZ); 11 road km N Naupe, 275 m, 1 (LSUMZ); 0.5 mi. N Rafan (between Mocupe and Lagunas), 3 m, 1 (LSUMZ).

Additional specimens known.—3. PERÚ. Depto. Piura.—Near Angolo, Hacienda Mallares, near Sullana, 700 m, N Perú coastal district, 1 ([AKMB=] Alexander Koenig Museum, Bonn), fide J. S. Weske, in litt., January 23, 1979. Depto. La Libertad.—Below Hacienda Llaguen (7°40′, 78°40′) fide J. S. Weske, in litt. January 23, 1979, 1 (AKMB). ECUADOR. Balzar Mtns. "Coll. Illingworth, Mar. 1880," 1 (BMNH, Tring No. 88.7.20.64).

Remarks.—Hekstra (1982:58–59) named *Otus guatemalae rufus,* here considered a synonym of *O. r. pacificus,* and chose the specimen from the Balzar Mtns., Ecuador listed immediately above as the type. He incorrectly designated the type as being in the United States National Museum instead of the British Museum (Natural History). Furthermore, in his list of additional specimens examined he mentioned a skin from the Field Museum of Natural History ("ChiNHM 222288" from "NW Peru at Tumbes"). This specimen, actually labelled number 222285 is from Huasimo, Tumbes, as listed above, and represents the red phase of *O. r. pacificus.*

A specimen from Vinces, Ecuador, mentioned by Bangs and Noble (1918:449) and Chapman (1926:246) as possibly belonging to *O. roboratus,* was also included by Hekstra (1982:58) under the name *O. g. rufus.* We have not examined this specimen and therefore cannot comment on its specific identity.

HABITAT AND ECOLOGY

Populations of the Peruvian Screech-Owl inhabit the Arid Tropical Zone (Chapman 1926) where vegetation ranges from open dry scrub comprised of various shrubs, cacti, and scattered short trees to dry deciduous forest composed of various kinds of small to moderately sized trees and columnar cactus (*Cereus*). Species of *Capparis, Acacia, Prosopis,* and *Bombax* are typically represented. Parker et al. (1982:23–24) illustrate these habitats. Most specimens with labels annotated as to habitat were taken in mesquite woodland (=algarrobal) and acacia scrub in washes or on arid hillsides. One individual was found roosting "in center of shrub in desert scrub on slope of foothills." Others were discovered roosting in cavities in mesquite.

The food habits of this species were unknown prior to this study (Hekstra 1973). Specimen tag data on stomach contents show that both subspecies are largely insectivorous, perhaps entirely so. Five stomachs of *O. r. roboratus* contained several different kinds of caterpillars, two large orthopterans, orthopterans, orthopterans and caterpillars, and one grass-

hopper. Fourteen stomachs of *O. r. pacificus* held insect parts (3), insect and grasshopper parts, a cricket and two beetle larvae, six beetle larvae and beetle elytra, 15 caterpillars, 21 2.5 cm (1-inch) long moth caterpillars, seven beetle larvae, beetle larvae, beetles and cricket, beetles and caterpillars. One stomach was full of beetle parts, and one was empty.

INTERSPECIFIC RELATIONSHIPS

The foregoing data on territorial song and plumage pattern establish conspecificity of the northwest coastal populations (*O. r. pacificus*) with those of the Rio Chinchipe drainage and Marañon Valley (*O. r. roboratus*). This conclusion disagrees with the classification of Hekstra (1982), who lacking vocal information, included *pacificus* as a subspecies of *O. guatemalae* and categorized nominate *O. roboratus* as a race of *O. choliba*. Although the songs of *O. guatemalae* and *O. roboratus* are superficially similar (compare Fig. 3 of the present paper with fig. 11 in Marshall [1967: 51] and fig. 2d in Van der Weyden [1975:70]), those of *O. guatemalae* are approximately four times longer (9+ sec) than those of *O. roboratus* (2+ sec). Furthermore, the plumage patterns of *O. guatemalae* and *O. roboratus* are entirely different (Fig. 2).

Alliance of *O. r. roboratus* with *O. choliba* is supported neither by plumage pattern (Fig. 2) nor by voice. The latter species often accents its trill with terminal barks (Fig. 2G–I) which are lacking in either form of *O. roboratus*.

DISCUSSION

Decisions on taxonomic status.—The situation described here, that of disjunct allopatry of taxa which are 100% distinctive in one or more characters, is seen commonly in Neotropical birds. Lacking the test of sympatry of such strong differentiates, we must base taxonomic decisions on indirect criteria. We assume that reproductive isolation in these largely nocturnal birds is achieved mainly by behavioral means, with the advertising song of the male playing an especially significant role. Great similarity or identity of the songs of birds representing both major groups of populations suggest that reproductive isolation probably could not be effected by voice alone in these owls. We are left with body size as the major difference between the two groups of populations. Could body size influence mate choice if sympatry were to occur? Although the answer to this question is unknown, geographic differentiation in the Western Screech-Owl provides some relevant information. In this species, subspecies closely comparable in size to *O. r. roboratus* and *O. r. pacificus* are represented (Miller and Miller 1951). In contrast to the situation in the Peruvian

Screech-Owl, in *O. kennicotti* the large form (*O. k. quercinus*) of the San Diegan district and northern Baja California and the small form (*O. k. xantusi*) of southern Baja are divided by a form intermediate in size (*O. k. cardonensis*) with which both presumably intergrade in northcentral Baja. Thus, the two most divergent forms do not contact directly and, therefore, the examples are not strictly comparable. Nonetheless. the example of *O. kennicottii* at least illustrates subspecific size divergence comparable to that seen in *O. roboratus*. On this basis we speculate that *O. r. roboratus* and *O. r. pacificus* probably would be reproductively compatible, despite their striking size difference and lack of intergradation, and therefore regard them as subspecies. This conclusion would not deny their phylogenetic species status, however, under the criteria of Cracraft (1983).

Conservation.—Within its range and in appropriate habitat, the Peruvian Screech-Owl can be encountered regularly by imitating their trilled vocalizations at night in order to elicit aggressive responses, especially of males. At localities where we have worked, our estimates of their numbers justify the expression "common," or locally, "very common." In view of the comparatively limited geographic distribution of both known forms of the species, however, conservation issues become important despite substantial local numbers. During our work in the early 1970s, the arid woodlands of northern Perú were being seriously impacted by two sources—browsing by goats and destruction by firewood gatherers and charcoal producers. A brief tour of the Olmos region of Lambayeque and the Rio Chinchipe-San Ignacio region of Cajamarca in July 1983 further verified the continued and increased habitat degradation from these sources. One favorable aspect of this owl's ecology is its ability to occupy very sparse woodland and scrub, at least for foraging and, probably to a lesser extent, for roosting, a habit shared by the Western Screech-Owl in the deserts of the southwestern United States (Miller and Miller 1951). However, our limited knowledge of the life history of the species suggests that nesting probably could not occur in such open habitat without trees of at least moderate stature which could provide nesting cavities. Therefore, any useful conservation strategy for the protection of the Peruvian Screech-Owl should at least include the safeguard of senescent trees. Provision of artifical nest boxes should be tried locally where old cavity-bearing trees have been removed. Although destruction of the mesquite woodlands by goat browsing and by firewood gathering will be difficult to control because of the pastoral economy typical of many areas of rural northwestern Perú, charcoal harvesting for barbeques ("asados") should be discouraged or prohibited wherever possible.

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LITERATURE CITED

Bangs, O. and G. K. Noble. 1918. List of birds collected on the Harvard Peruvian Expedition of 1916. Auk 35:442–463.

Chapman, F. M. 1926. The distribution of bird-life in Ecuador. Bull. Am. Mus. Nat. Hist. 55:1–784.

Cracraft, J. 1983. Species concepts and speciation analysis. Pp. 159–187 *in* Current ornithology, vol. 1 (R. F. Johnston, ed.). Plenum Press, New York, New York.

Earhart, C. M. and N. K. Johnson. 1970. Size dimorphism and food habits of North American owls. Condor 72:251–264.

Hardy, A. C. 1936. Handbook of colorimetry. Technology Press, Mass. Inst. Tech., Cambridge, Massachusetts.

Hekstra, G. P. 1973. Scops and screech owls. Pp. 94–115 *in* Owls of the world (J. A. Burton, ed.). E. P. Dutton & Co., Inc., New York, New York.

———. 1982. Description of twenty-four new subspecies of American *Otus*. Universiteit Van Amsterdam Bull. Zoologisch Museum 9:49–63.

Johnson, N. K. and A. H. Brush. 1972. Analysis of polymorphism in the sooty-capped bush tanager. Syst. Zool. 21:245–262.

Judd, D. B. 1933. The 1931 I. C. I. standard observer and coordinate system for colorimetry. J. Optical Soc. Amer. 23:359–374.

Koepcke, M. 1964. Las aves del Departamento de Lima. Grafica Morsom, Lima, Perú.

Marshall, J. T., Jr. 1967. Parallel variation in North and Middle American screech-owls. Monogr. West. Found. Vert. Zool. 1:72.

Marshall, J. T. and B. F. King. 1988. Subfamily Striginae Typical Owls Genus *Otus*. Pp. 331–336 *in* Hawks and owls of the world: a distributional and taxonomic list by D. Amadon and J. Bull. Proc. West. Found. Vert. Zool. 3:294–357.

Meyer de Schauensee, R. 1966. The species of birds of South America and their distribution. Livingston Publ. Co., Narberth, Pennsylvania.

Miller, A. H. and L. Miller. 1951. Geographic variation of the screech owls of the deserts of western North America. Condor 53:161–177.

Parker, T. A., III, S. A. Parker, and M. A. Plenge. 1982. An annotated checklist of Peruvian birds. Buteo Books, Vermillion, South Dakota.

Storer, R. W. 1966. Sexual dimorphism and food habits in three North American accipiters. Auk 83:423–436.

Van der Weyden, W. 1975. Scops and screech owls: vocal evidence for a basic subdivision in the genus *Otus* (Strigidae). Ardea 63:65–77.