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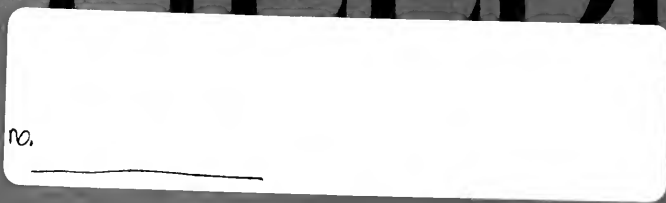
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no.

## Zoology

NEW SERIES, NO. 98

### Systematic Review of the Taiwanese Macaque, *Macaca cyclopis* Swinhoe, 1863

Jack Fooden

Hai-Yin Wu

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MURRA, J. 1946. The historic tribes of Ecuador, pp. 785-821. In Steward, J. H., ed., *Handbook of South American Indians*. Vol. 2, *The Andean Civilizations*. Bulletin 143, Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.  
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# FIELDIANA

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## Zoology

NEW SERIES, NO. 98

### **Systematic Review of the Taiwanese Macaque, *Macaca cyclops* Swinhoe, 1863**

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**Accepted February 16, 2001  
Published November 30, 2001  
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PUBLISHED BY FIELD MUSEUM OF NATURAL HISTORY

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ISSN 0015-0754  
PRINTED IN THE UNITED STATES OF AMERICA

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# Systematic Review of the Taiwanese Macaque, *Macaca cyclopis* Swinhoe, 1863

Jack Fooden and Hai-Yin Wu

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## Abstract

The Taiwanese macaque, *Macaca cyclopis* Swinhoe, 1863 ("1862"), is systematically reviewed, based on examination of 237 museum specimens, survey of relevant literature, and observation of natural populations. This review includes analyses of pelage characters, external measurements and proportions, cranial characters, molecular biology and genetics, and parasites. Information also is presented concerning natural history, reproduction, fossils, and taxonomic history. A hypothetical interpretation of the evolutionary history of this species is proposed. In an appendix, an annotated gazetteer lists 429 localities at which *M. cyclopis* has been collected or observed.

## Introduction

*Macaca cyclopis* is endemic to Taiwan and is the only species of nonhuman primate native to this subtropical island, which is situated 140 km off the coast of mainland China. The existence of monkeys on Taiwan became known to Western science as a result of a visit there in 1715 by the Jesuit missionary Père J.-A.-M. de Moyria de Mailla (Du Halde, 1735, pp. xxxiv, 162; Campbell, 1903, pp. 504, 506). The first scientific specimens of *M. cyclopis* were collected ca. 1862 by R. Swinhoe (1863, p. 350), author of the technical name of the species, who was then the British vice-consul assigned to the island. Relatively few museum specimens have subsequently been collected from natural populations (Appendix 1), and, probably as a consequence, relatively few systematic studies of this species have been published (see Synonymy, below).

The present review of *M. cyclopis* is based on the study of 237 museum specimens (62 of which were collected at known localities), survey of relevant literature, and observation of natural populations. Specimens examined are preserved in institutions listed below, which hereafter are cited by means of the indicated abbreviations; the number of *M. cyclopis* specimens in each institution is indicated by a parenthetical notation.

|        |   |
|--------|---|
| AMNH   | American Museum of Natural History, New York (3)                                |
| ANSP   | Academy of Natural Sciences, Philadelphia (1)                                   |
| BM(NH) | British Museum (Natural History), London (3)                                    |
| JMC    | Japan Monkey Centre, Inuyama, Japan (45)  |
| KUPRI  | Kyoto University Primate Research Institute, Inuyama, Japan (53)                |
| MCZ    | Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (1) |
| NMNS   | National Museum of Natural Science, Taichung, Taiwan (16)                       |
| NTUZ   | National Taiwan University, Department of Zoology, Taipei (7)                   |
| SMTD   | Staatliches Museum für Tierkunde, Dresden (1)                                   |
| TESRI  | Taiwan Endemic Species Research Institute, Chichi, Taiwan (14)                  |
| TM     | Taiwan Museum, Taipei (12)  |
| UMMZ   | Museum of Zoology, University of Michigan, Ann Arbor (2)                        |
| USNM   | National Museum of Natural History, Washington, D.C. (41)                       |
| YIO    | Yamashina Institute for Ornithology, Abiko, Japan (2)                           |

ZMB Zoologisches Museum des Humboldt-  
Universität, Berlin (25)  
— Private collections (11)

## Geographic Distribution, Island-wide Population Estimate

Locality records of *M. cyclopis* are widely distributed in the mountainous eastern two-thirds of Taiwan Island (Fig. 1); questionnaire and field surveys indicate that this species currently inhabits 111 of 270 townships (41.1%) in Taiwan (Hai-Yin Wu, Ling-Ling Lee, and Shih-Wei Chang, 2001, unpublished report). Prior to intensive human settlement and agricultural exploitation of the western lowlands, macaques probably also were fairly common there, judging from Père de Mail-la's observations in western Taiwan in 1715 (Du Halde, 1735, pp. xxxiv, 162). Local disappearance of macaques in western Taiwan was noted in 1862 by Swinhoe (1863, p. 351). The natural geographic distribution of *M. cyclopis* apparently does not extend to any of the small islands that surround Taiwan Island (Fig. 1).

Introduced feral populations of *M. cyclopis* have become well established at four localities in Japan: (1) Oshima, a small island south of Tokyo, *M. cyclopis* population introduced sometime between 1942 and 1953; (2) Nojima, a small island south of Nagoya, population introduced in 1958; (3) Wakayama Prefecture, south of Osaka, population introduced ca. 1960; and (4) Shimokita Hanto (= Peninsula), at the northern tip of Honshu (near the northern limit of distribution of *M. fuscata*), population introduced in 1971. For further details concerning these feral populations, see Appendix 2: Gazetteer.

Based on an ongoing survey conducted since 1996 by Ling-Ling Lee, Shih-Wei Chang, G. Agoramorthy, and Hai-Yin Wu, the total extant population of *M. cyclopis* in Taiwan has been estimated to be ca. 250,000  $\pm$  100,000 individuals in ca. 10,000  $\pm$  5,000 groups.

## Pelage

### General Characterization (Fig. 2)

The dorsal surface of the thoracic region in postinfantile *M. cyclopis* is yellowish brown (ol-

ivaceous) to golden brown; more caudally, on the lumbosacral region, the color gradually brightens to a richer golden brown. In individual hairs on the dorsal thoracic region, the basal two-thirds is grayish brown and the distal one-third is conspicuously marked by 1–3 bands of pale golden (cf. Inagaki, 1996, p. 91). On the lumbosacral region, the base of individual hairs is paler than in hairs on the dorsal thoracic region, and the distal bands are more erythristic. The crown generally is somewhat paler than the dorsal thoracic region, but it is not as brightly colored as the lumbosacral region. The skin of the thinly haired face is pinkish to reddish. Surrounding the face, on the forehead and cheeks, is an indistinct fringe of somewhat elongated blackish hairs. The lateral facial crest, which is pale grayish brown, is restricted to the posterior mandibular region (infrazygomatic crest; Fooden, 1995, p. 19). The proximodorsal surface of the limbs is approximately the same color as the adjacent dorsal surface of the trunk; more distally, the dorsal surface of the limbs gradually becomes somewhat more grayish. The proximal one-third of the dorsal surface of the tail is approximately the same color as the lumbosacral region; the distal two-thirds of the dorsal surface of the tail is dark grayish brown to clearly defined blackish. The ventral surface of the trunk, limbs, and tail is pale grayish. For a discussion of sexual skin coloration, see Reproduction below.

Dorsal pelage color in *M. cyclopis* is generally similar to that in many specimens of *M. fascicularis* (Fooden, 1995, p. 3), but the color contrast between the dorsal thoracic region and the lumbosacral region is greater in *M. cyclopis*. Dorsal pelage color in *M. cyclopis* is generally darker than that in *M. mulatta* (Fooden, 2000, p. 7), and the color contrast between the dorsal thoracic region and the lumbosacral region is less in *M. cyclopis*.

Hair stream patterns on the trunk and extremities of *M. cyclopis* have been studied in detail by Yasugawa (1960, p. 330).

## Age and Sex Variation

Neonatal pelage is dark gray to blackish (Horikawa, 1932, p. 69; Kuroda, 1940, p. 269; Hsu, 1990, p. 66). In older infants (USNM 294177, M1 not erupted, age ca. 9 months), pelage color is approximately the same as that in adults, but hairs are shorter and finer than in adults. Pelage color is generally similar in females and males, but the



dark dorsal surface of the distal two-thirds of the tail is more blackish in fully adult males than in fully adult females (H.-Y. Wu, pers. obs.).

### Seasonal and Geographic Variation

Although evidence of molting was not detected in *M. cyclopis* skins examined, Namiye (1914, p. 214) has reported that winter pelage is darker than summer pelage. Based on observation at several localities in Taiwan, Jui-Hua Chu (NTUZ; pers. comm., 16 Apr. 2000) confirms that annual molting occurs in *M. cyclopis* during the period May–August.

The available sample of wild-collected skins is insufficient to determine whether or not pelage color varies geographically in *M. cyclopis*.

### Albinism

Two or three albino captives of *M. cyclopis* reportedly originated in Hualien Hsien during the period 1978–1980 (Poirier & Davidson, 1979, pp. 141, 142; Anonymous, 1981, p. 47), and an albino juvenile was captured by local residents at Wushihkeng, Taichung Hsien, in the early 1990s (photograph in possession of H.-Y. Wu). Aberrantly pale specimens of *M. cyclopis* previously had been reported elsewhere in Taiwan by Kuroda (1940, p. 269) and Jones (1973, p. 370).

### External Measurements and Proportions

External measurements are available for only ten wild-collected specimens of *M. cyclopis* (Table 1); of these, two are adults—one female and one male—and eight are immatures. To supplement these meager data, measurements of captive specimens and specimens of unknown history also are presented; however, these measurements probably are not directly comparable with those of wild-collected specimens. The following inferences are based on the limited available data.

Head and body length is 440 mm in one wild-collected adult female and 650 mm in one wild-collected adult male (Table 1). The female/male length ratio is 0.68 in the two wild-collected adults, 0.86 in 25 captive adults, and 0.97 in six adults of unknown history. Although Bergner and

Jachowski (1968, p. 11) asserted that body size is greater in northern *M. cyclopis* than in southern *M. cyclopis*, no external measurement data are available to test this statement (cf. Cranial Characters below). A brief summary of crown–rump length measurements in 116 wild-collected but unlocalized specimens has been reported by Satoh et al. (1956, p. 42; cf. Setoguti & Sakuma, 1959, p. 158; Lin, 1976, p. 75).

Relative tail length (T/HB) apparently is similar in adult females and males, varying from approximately 0.65 to 0.95 (Fig. 3). In pooled samples (Table 1), mean relative tail length is  $0.82 \pm 0.058$  (SD) in 24 adult females and  $0.85 \pm 0.089$  in 8 adult males. This ratio apparently remains relatively constant from late fetal life to adulthood.

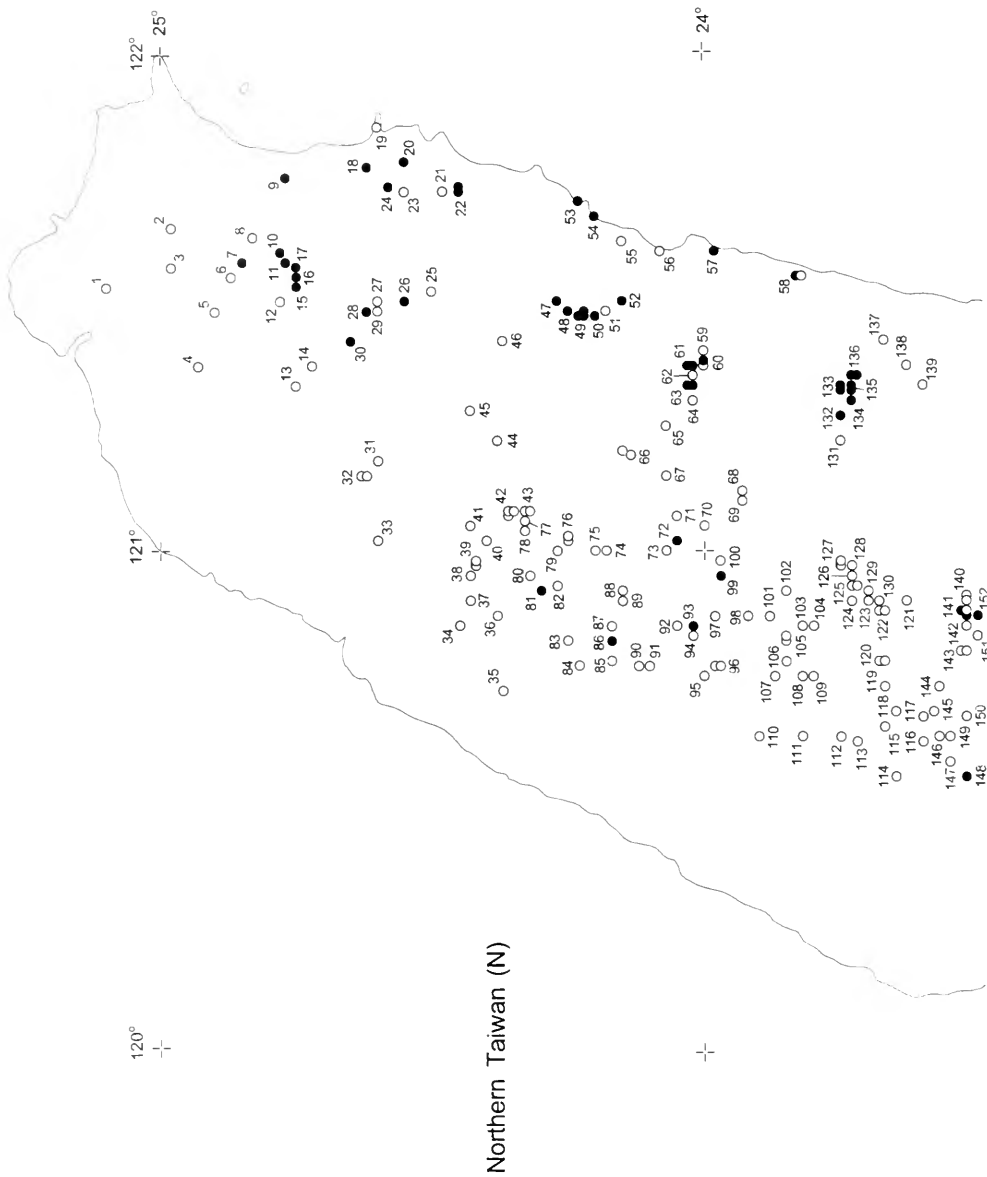
The hind foot apparently grows more slowly than the head and body from infancy to adulthood (Table 1). The same probably also is true of the ear, but data are ambiguous on this point.

Body weight (Table 1) is 8.12 kg in one wild-collected adult male (cf. Setoguti & Sakuma, 1959, p. 158) and varies from 6.30 kg to 18.50 kg in nine captive adult males (cf. Lin, 1976, p. 75; Poirier & Davidson, 1979, p. 139; Makita et al., 1984, p. 386; Smith & Jungers, 1997, p. 544). The female/male weight ratio is 0.66 in 36 captive adults. Mean birth weight is 402 g in 89 captives born in colonies in Taipei and 430 g in 22 captives born in a colony in Southboro, Massachusetts (Table 2).

### Cranial Characters (Figs. 4, 5)

In wild-collected specimens examined of *M. cyclopis*, the greatest length of the skull in adult males (125.2 mm,  $n = 15$ ) averages approximately 13% greater than in adult females (110.4 mm,  $n = 12$ ) (Table 3). Skull length in both sexes of *M. cyclopis* tends to exceed that in *M. fascicularis* and *M. mulatta* (cf. Fooden, 1995, p. 38; 2000, p. 38). Available measurements of wild-collected specimens of *M. cyclopis* are inadequate to indicate whether or not skull length varies geographically in this species (Table 4). In captive specimens of *M. cyclopis*, greatest length of the skull tends to exceed that in wild-collected specimens (Table 3;  $P < 0.02$ ; cf. Komatsu, 1944, p. 18; Mouri, 1995, p. 189; Koppe et al., 1999, p. 78).

The rostrum is moderately projecting in *M. cyclopis*, more similar to that in *M. fascicularis* than to that in *M. mulatta* (cf. Murie, 1873, p. 779;



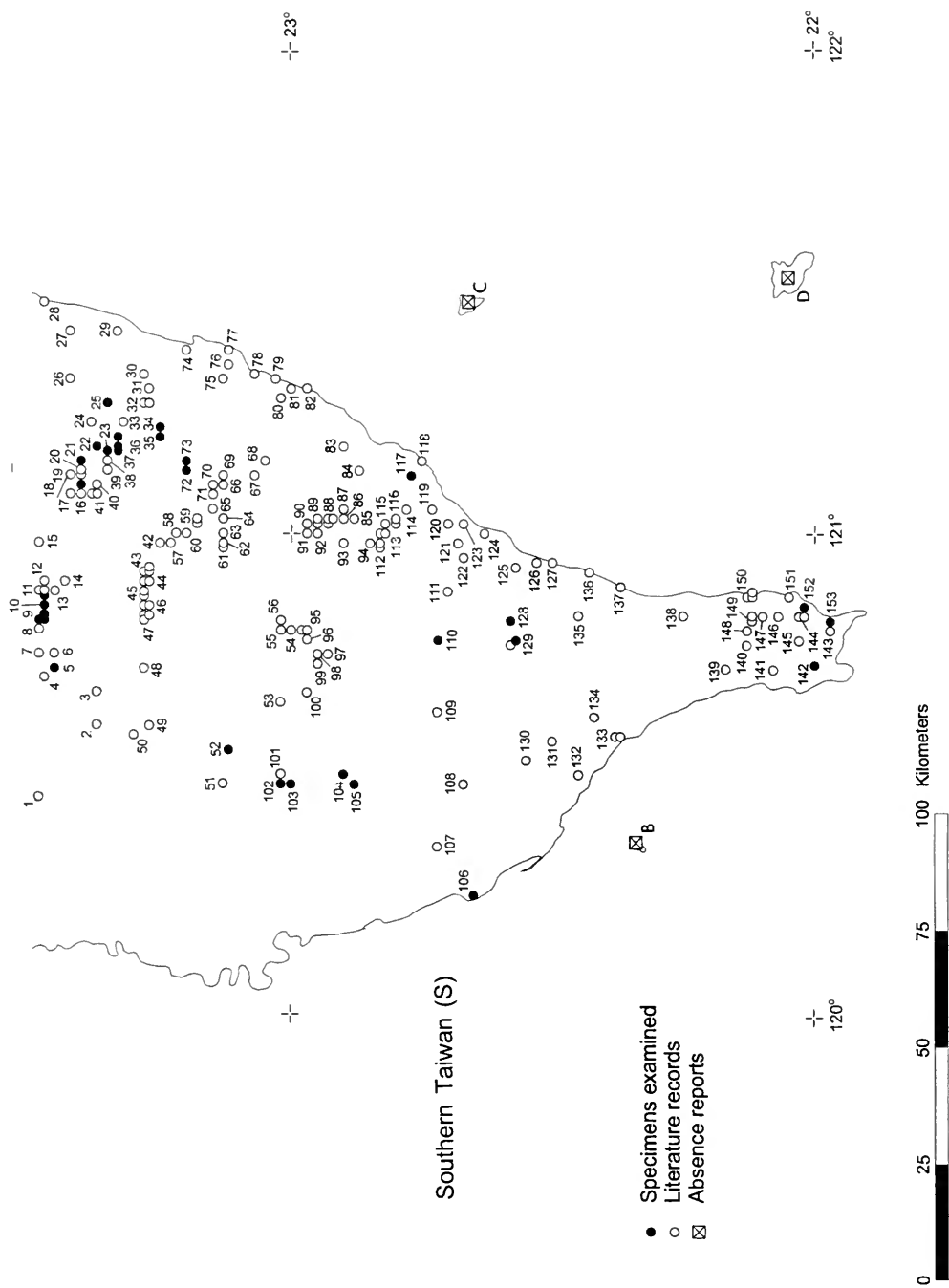


FIG. 1. Locality records of *Macaca cyclopis*; for documentation, see Gazetteer (Appendix 2). Specimens examined include living monkeys observed in the field by H.-Y. Wu and/or J. Fooden. Included in this figure are previously unpublished records from recent surveys conducted by TESRI, S.-W. Chang, L.-L. Lee, and H.-Y. Wu; excluded are unnamed localities mapped by Bergner and Jachowski (1968, p. 25) and Lee and Lin (1991, p. 34; 1994, p. 19).

## Key to Locality Numbers

### Northern Taiwan (N)

1. Hsi Lin.
2. Shihting Hsiang vicinity.
3. Mucha.
4. Sanhsia.
5. Shihtoushan.
6. Wulai: Wulai area.
7. Hsiao.
8. Tunghou.
9. Ilan (=Giran) region.
10. Ayu Shan.
11. Fushan Forest Station: Fushan Forest Station: Botanic Garden.
12. Fushan (=Rimogan).
13. Northern Cross-Island Highway, Fuhsing Hsiang, 550 m.
14. Fuhsing Hsiang
15. Ha-pen, Wulai Hsiang, 530 m.
16. Ha-pen, Wulai Hsiang, 535–570 m.
17. Ha-pen, Wulai Hsiang, 650 m.
18. Anpingkenghsi Mining Trail, Suao-Nanao Hsiang, 175 m.
19. Suao vicinity.
20. Wulaokenghsi Mining Trail.
21. Suhua road.
22. Lupishan Logging Trail, Nanao Hsiang, 245 m; 595–798 m.
23. Anpingkenghsi Mining Trail, Suao-Nanao Hsiang, 690 m; 1000 m.
24. Anpingkenghsi Mining Trail, Suao-Nanao Hsiang, 685 m; 810–930 m.
25. Taipingshan.
26. Jentse: Taipingshan, northwestern foothill area.
27. Northern Cross-Island Highway, Tatung Hsiang, 1258 m.
28. Northern Cross-Island Highway, Tatung Hsiang, 460 m.
29. Northern Cross-Island Highway, Tatung Hsiang, 720 m.
30. Northern Cross-Island Highway, Fuhsing Hsiang, 1050 m.
31. Loshan Logging Trail, Wufeng-Chienschih Hsiang, 1270 m.
32. Loshan Logging Trail, Wufeng-Chienschih Hsiang, 1050 m; 1210 m.
33. Tunghotsun.
34. Fayun Ssu.
35. Huoyenshan.
36. Hsiaoponko.
37. Tawan: Dikanhsi-Hsuehchenhsi; Pipitaishan.
38. Tahsueh Shan Logging Trail, Taian Hsiang, 1750 m.
39. Ssumahsien Logging Road: Tahsueh Shan, Hoping Hsiang, 1940–2100 m; Tahsueh Shan Logging Trail, Taian Hsiang, 1995 m.
40. Tahsueh Shan Logging Trail, Taian Hsiang, 2540 m.
41. Taanhsi.
42. Tahsueh Shan Logging Road 230, Hoping Hsiang, 2545 m; 2565 m; Tahsueh Shan Logging Road 230, Taian Hsiang, 2515 m.
43. Tahsueh Shan area, Taian Hsiang, 940–2775 m; Tahsueh Shan Hiking Trail, Taian Hsiang, 2385–2765 m.
44. Hsueh Shan.
45. Wuling (Taoshan Pupu).
46. Nanhu Tashan.
47. Chutsun, Hsiulin Hsiang.
48. Chutsun, Hsiulin Hsiang, 1100 m.
49. Chiumei Bridge: Lienhuachih, Hsiulin Hsiang, 800–1100 m; 1100–1200 m; Meiyuan: Taroko National Park.
50. Hsipao.
51. Tienhsiang.
52. Yen Hai Logging Trail.
53. Ta Ching Shui.
54. Chingshui Cliff: Hsiao Ching Shui.
55. Taroko National Park Headquarters.
56. Chingmei.
57. Hualien, mountains near: Hualien vicinity.
58. Mu-Kua-Chau: Shuilien Bridge No. 14.
59. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 650 m.
60. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 750–1200 m; Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 900–1200 m.
61. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1200–1310 m; Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1300 m (24°02'N, 121°22'E).
62. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1300 m (24°01'N, 121°21'E).
63. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1300–1340 m; Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1345 m.
64. Nengkao-Tungmen Powerline Right-of-way, Hsiulin Hsiang, 1840–2085 m.
65. Peitunyenshan, Jenai Hsiang, 1900 m.
66. Juiyen, Jenai Hsiang; Juiyenhsi, Jenai Hsiang, 2190–2205 m.
67. Peitunyenshan, Jenai Hsiang; Peitunyenshan, Jenai Hsiang, 1700–1800 m.
68. Chientai Logging Trail, Jenai Hsiang, 1250–1300 m.
69. Wanta Logging Trail.
70. Nanshanhsi, Jenai Hsiang; Nanshanhsi, Jenai Hsiang, 1300–1580 m.
71. Tungfeng.
72. Hui-Sun Experimental Forest.
73. Chunghsing Tahsueh.
74. Pahsienshan Forest Recreation Area.
75. Kukuan.
76. Shangnankeng: Tahsueh Shan Logging Road 220, Hoping Hsiang, 1925–1980 m; 2020 m; Tahsueh Shan Logging Road 221, Hoping Hsiang, 2030 m; Tahsueh Shan Logging Road 222, Hoping Hsiang, 2040 m; Wuling Farm.
77. Tahsueh Shan Logging Road 230, Taian Hsiang, 2250–2525 m.
78. Tahsueh Shan Logging Trail 230; Taian Hsiang, 2515 m.
79. Anmashan.
80. Hsuehshankeng, Hoping Hsiang, 750–880 m; Hsuehshankeng Logging Road, Hoping Hsiang, 1200 m.

81. Wushihkeng, ca. 1200 m; Wushihkeng vicinity.
  82. Wushihkeng, Hoping Hsiang; Wushihkeng, Hoping Hsiang, 600–1250 m; Wushihkeng, Hoping Hsiang, 635–1305 m.
  83. Shentao No. 8.
  84. Chingjen Ku.
  85. Takeng, 460–510 m.
  86. Maanliao.
  87. Tienleng.
  88. Paimao Shan Logging Road, Hoping Hsiang, 1140 m.
  89. Paimao Shan Logging Road, Hoping Hsiang, 850–1040 m.
  90. Pingting, Taiping Hsiang, 270 m.
  91. Toupienkeng.
  92. Hsiangtao No. 136, Kuohsing Hsiang, 600 m.
  93. Kuohsing Hsiang.
  94. Kangou.
  95. Chiuchiu Feng.
  96. Shihshotzu, Tsaotun Chen, 300–400 m; Shuangtung.
  97. Peishankeng.
  98. Lienhuachih.
  99. Puli (=Posia; Polisia); Puli vicinity.
  100. Linshoudien.
  101. Luliu-Chepinglun.
  102. Jihyueh Tan (=Sun-Moon Lake, Tsuisia Lake) vicinity.
  103. Erpingshan.
  104. Hsiangtao No. 131.
  105. Chichi Tashan, Chichi Chen; Chichi Tashan, Chichi Chen, 700–1250 m.
  106. Tienchung Park.
  107. Chungliao Hsiang.
  108. Chinshuikou.
  109. Fuchouli; Luku Shan.
  110. Pakua Shan.
  111. Ershui Monkey Protection Area, Ershui Hsiang, 170–210 m; Puchung.
  112. Pingting, Linnei Hsiang, 150 m.
  113. Hupen.
  114. Kukeng.
  115. Kankenghsi.
  116. Changhu, Kukeng Hsiang, 310–350 m.
  117. Tsaoling Road.
  118. Juilung Pupu.
  119. Taichi Hsiaku (Gorge).
  120. Hsitou, Luku Hsiang, 1270–1360 m; Hsitou (=Chi Tou), 1000 m; Hsitou (=Hsiton), Fenghuangshan, Luku Hsiang.
  121. Chunta Logging Trail, Hsini Hsiang (23°36–40'N, 120°52–56'E); Chunta Logging Trail, Hsini Hsiang, 1355–2515 m.
  122. Chunta Logging Trail, Hsini Hsiang, 810 m; Jenlun Logging Trail, Hsini Hsiang, 1300–1400 m.
  123. Chunta Logging Trail, Hsini Hsiang, 1580 m.
  124. Jenlun Logging Trail, Hsini Hsiang, 1400 m.
  125. Chunta Logging Trail, Hsini Hsiang (23°44'N, 120°56'E); Chunta Logging Trail, Hsini Hsiang, 2705 m; Chunta Logging Trail, Hsini Hsiang, 2790–2855 m; Jenlun Logging Trail, Hsini Hsiang, 1750 m.
  126. Chunta Logging Trail, Hsini Hsiang, 2495 m.
  127. Chunta Logging Trail, Hsini Hsiang, 2450–2455 m; Chunta Logging Trail, Hsini Hsiang, 2470 m.
  128. Chunta Logging Trail, Hsini Hsiang, 2485 m.
  129. Chunta Logging Trail, Hsini Hsiang, 1910–1920 m.
  130. Chunta Logging Trail, Hsini Hsiang, 1425 m.
  131. Chitsaihu, Hsini Hsiang, 2600–2730 m.
  132. Wanjung Logging Trail, Wanjung Hsiang, 1700 m.
  133. Wanjung Logging Trail, Wanjung Hsiang, 820 m; Wanjung Logging Trail, Wanjung Hsiang, 960 m.
  134. Wanjung Logging Trail, Wanjung Hsiang, 1410–1600 m.
  135. Wanjung Logging Trail, Wanjung Hsiang, 820 m; Wanjung Logging Trail, Wanjung Hsiang, 1085–1165 m.
  136. Wanjung Logging Trail, Wanjung Hsiang, 565 m; Wanjung Logging Trail, Wanjung Hsiang, 800 m.
  137. Kuangfu vicinity.
  138. Tahoshan.
  139. Fuyuan Forest Recreation Area.
  140. Shalih sien Hsi, Hsini Hsiang, 1350–2100 m; Shalih sien Hsi Logging Road, Hsini Hsiang; Shalih sien Hsi Logging Road, Hsini Hsiang, 1405–1600 m; Shalih sien Hsi Logging Road, Hsini Hsiang, 1485–1800 m.
  141. New Central Cross-Island Highway; New Central Cross-Island Highway, Hsini Hsiang, 2000 m (23°32'N, 120°53'E); Shenmu Logging Road, Hsini Hsiang, 1260–2500 m; Shenmu Tsun.
  142. Chushuihsi.
  143. Alishan zone, Alishan Hsiang, 2260 m; Alishan zone, Alishan Hsiang, 2310 m.
  144. Fengshan.
  145. Shihpi, Kukeng Hsiang, 1010–1065 m.
  146. Juifeng Bridge; Tashiaku.
  147. Taiping, Meishan Hsiang, 920 m.
  148. Chuchi.
  149. Juili, Meishan Hsiang.
  150. Juili, Meishan Hsiang, 700 m.
  151. Niupi.
  152. New Central Cross-Island Highway, Hsini Hsiang, 2300 m (23°30'N, 120°52'E).
- Absence Report  
A. Penghu Chuntao: Penghu Tao.
- Southern Taiwan (S)*
1. Chia-I.
  2. Kungtientsun.
  3. Danayee.
  4. New Central Cross-Island Highway, Alishan Hsiang, 1395 m.
  5. Tapang.
  6. Tefuyeh.
  7. New Central Cross-Island Highway, Alishan Hsiang, 1655 m.
  8. New Central Cross-Island Highway, Alishan Hsiang, 1860–2700 m.
  9. New Central Cross-Island Highway, Hsini Hsiang, 2300 m (23°28'N, 120°49'E); New Central Cross-Island Highway, Hsini Hsiang, 2300 m (23°28'N, 120°50'E); New Central Cross-Island Highway, Hsini Hsiang, 2300 m; (23°29'N, 120°49'E); Tzuchung; Yushan National Park; Yushan (=Yuishan), 2200 m.
  10. New Central Cross-Island Highway, Hsini Hsiang, 2300 m (23°28'N, 120°51'E).

(continued on the following page)

11. Lulin Shan Preserve, Alishan Hsiang, 2300–2420 m; Lulin Shan Preserve, Alishan Hsiang, 2700 m; New Central Cross-Island Highway, Hsini Hsiang, 2300 m (23°28'N, 120°52'E); Tatachia.
12. Paiyun Hiking Trail.
13. Nantzuhsien Hsi Logging Road, Alishan Hsiang, 1700–2120 m.
14. Nanshi Logging Road.
15. Patungkuan.
16. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1300 m (23°24'N, 121°05'E).
17. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1420–1570 m.
18. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1455–1735 m.
19. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1200 m.
20. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1300 m (23°24'N, 121°07'E); Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1300–2205 m.
21. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1478 m.
22. A-Sun-Lai-Ga.
23. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1630 m.
24. Yulishan.
25. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 800 m.
26. Taiping, Chohsi Hsiang.
27. Haianshanmo.
28. Takangkou.
29. Chunfu.
30. Antungwenchuan.
31. Tungli.
32. Chingshui Hsi Power Station; Choching.
33. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 250–420 m.
34. Changliang Logging Trail, Chohsi Hsiang, 980 m.
35. Changliang Logging Trail, Chohsi Hsiang, 825 m.
36. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 710 m.
37. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 950–1030 m; Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1200 m.
38. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1620 m.
39. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1690 m.
40. Tafen slope.
41. Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1220–1320 m; Lakulakuhsi Hiking Trail, Chohsi Hsiang, 1490–1520 m.
42. Southern Cross-Island Highway, Haituan Hsiang, 2065–2090 m.
43. Southern Cross-Island Highway, Taoyuan Hsiang, 2185 m; Southern Cross-Island Highway, Taoyuan Hsiang, 2310–2455 m; Southern Cross-Island Highway, Taoyuan Hsiang, 2585 m.
44. Southern Cross-Island Highway, Taoyuan Hsiang, 2015–2110 m; Southern Cross-Island Highway, Taoyuan Hsiang, 2250–2415 m.
45. Southern Cross-Island Highway, Taoyuan Hsiang, 1635–1750 m; Southern Cross-Island Highway, Taoyuan Hsiang, 1825–1975 m.
46. Southern Cross-Island Highway, Taoyuan Hsiang, 975–1050 m; Southern Cross-Island Highway, Taoyuan Hsiang, 1445–1565 m.
47. Meishan; Southern Cross-Island Highway, Taoyuan Hsiang, 995–1235 m; Southern Cross-Island Highway, Taoyuan Hsiang, 1250–1445 m.
48. Minsheng.
49. Tsengwen Shuiku.
50. Tapu Hsiang.
51. Kueitan.
52. Nanhua Hsiang.
53. Liukuei Hsiang.
54. Chuyunshan Logging Trail, 2300–2320 m.
55. Chuyunshan Logging Trail, 2260–2275 m.
56. Chuyunshan Logging Trail, 2220 m.
57. Southern Cross-Island Highway, Haituan Hsiang, 1855 m.
58. Southern Cross-Island Highway, Haituan Hsiang, 1665 m.
59. Southern Cross-Island Highway, Haituan Hsiang, 930–943 m; Southern Cross-Island Highway, Haituan Hsiang, 1040–1125 m.
60. Southern Cross-Island Highway, Haituan Hsiang, 1170 m.
61. Wulu Logging Trail, Haituan Hsiang, 2240 m.
62. Wulu Logging Trail, Haituan Hsiang, 2060–2215 m.
63. Wulu Logging Trail, Haituan Hsiang, 1925–2005 m.
64. Luliaoshan.
65. Wulu Logging Trail, Haituan Hsiang, 860 m.
66. Southern Cross-Island Highway, Haituan Hsiang.
67. Hungshih Logging Trail.
68. Kuanshan Chen vicinity; Kuanshan (=Kuang Shan Working Circle).
69. Southern Cross-Island Highway, Haituan Hsiang, 390 m.
70. Southern Cross-Island Highway, Haituan Hsiang, 435 m.
71. Southern Cross-Island Highway, Haituan Hsiang, 515 m.
72. Changliang Logging Trail, Chohsi Hsiang, 1920 m.
73. Changliang Logging Trail, Chohsi Hsiang, 1965 m.
74. Chungan, Iwan, Chengkung Chen; Chungan, Poaili, Chengkung Chen.
75. Hsinkingshan.
76. Sanminli.
77. Sanhsienli.
78. Hoping.
79. Hsini, Tousienchiao.
80. Peiyuan.
81. Tayuan, Haianshanmo; Tayuan (=Tai Yuan).
82. Tungho township.
83. Tulanshan.
84. Shanli, Peinan Hsiang.
85. Yenping Logging Trail, Yenping Hsiang, 1150 m.
86. Yenping Logging Trail, Yenping Hsiang; Yenping Logging Trail, Yenping Hsiang, 1215–1360 m.
87. Tungshing.
88. Yenping Logging Trail, Yenping Hsiang, 1330–1525 m; Yenping Logging Trail, Yenping Hsiang, 1555–1650 m; Yenping Logging Trail, Yenping Hsiang, 1600 m.
89. Yenping Logging Trail, Yenping Hsiang, 1705–1730 m; Yenping Logging Trail, Yenping Hsiang, 1740 m.
90. Yenping Logging Trail, Yenping Hsiang, 1665–1835 m.
91. Yenping Logging Trail, Yenping Hsiang, 1820–2060 m.

Fooden, 1995, p. 38; 2000, p. 38). From infancy to adulthood, the rostral–postrostral ratio more than doubles in *M. cyclopis* males (Table 3); during the same period, relative zygomatic breadth increases by less than 10%. Development of a sagittal crest apparently is relatively rare in wild-collected *M. cyclopis* adult males (3 of 15 specimens examined), as in *M. mulatta*.

Mean ages (in days) of emergence of deciduous teeth in 15 *M. cyclopis* captives studied by Yang et al. (1968, p. 543) are as follows:  $i_1$ , 5.4;  $i^1$ , 11.2;  $i_2$ , 19.4;  $i^2$ , 30.4;  $c_1$ , 54.6;  $c^1$ , 53.6;  $m_1$ , 63.3;  $m^1$ , 63.4;  $m_2$ , 125.2 ( $n = 14$ );  $m^2$ , 139.2. These ages are less than corresponding emergence ages reported for captive *M. fascicularis* and *M. mulatta* (Fooden, 1995, p. 38; 2000, p. 39). Morphological

details of permanent teeth in captive *M. cyclopis* have been studied by Saheki et al. (1962, p. 101; cf. Table 26 below).

## Molecular Biology and Genetics

### Mitochondrial DNA

Mitochondrial DNA has been investigated in six studies of three *M. cyclopis* captives without locality information (Table 5). These studies agree that, among living *fascicularis*-group species, mtDNA in *M. cyclopis* is most similar to that in *M. mulatta* and *M. fuscata*. In fact, in one of these

←

92. Yenping Logging Trail, Yenping Hsiang, 2085 m.
  93. Yenping Hsiang.
  94. Lichia Logging Trail, Peinan-Yenping Hsiang, 1420 m.
  95. Chyunshan Logging Trail, 1360 m; Chyunshan Logging Trail, 1400 m.
  96. Chyunshan Logging Trail, 1135–1300 m.
  97. Chyunshan Logging Trail, 1350 m.
  98. Chyunshan Logging Trail, 930–960 m.
  99. Chyunshan Logging Trail, 1290 m.
  100. Shanping.
  101. Wushan, Nanhua Hsiang, 500 m (23°01'N, 120°30'E).
  102. Wushan, Nanhua Hsiang, 500 m (23°01'N, 120°29'E).
  103. Wushan, Nanhua Hsiang, 500 m (23°00'N, 120°29'E).
  104. Chishan vicinity, Chishan-Meinon, 200 m (22°54'N, 120°30'E).
  105. Chishan vicinity, Chishan-Meinon, 200 m (22°53'N, 120°29'E).
  106. Kaohsiung (=Takao) vicinity; Shou Shan.
  107. Kuanyinshan.
  108. Pingtung vicinity.
  109. Santimen.
  110. Wutao Shan.
  111. Hsiao Kueihu.
  112. Lichia Logging Trail, Peinan-Yenping Hsiang, 1400–1475 m; Lichia Logging Trail, Peinan-Yenping Hsiang, 1435–1565 m.
  113. Lichia Logging Trail, Peinan-Yenping Hsiang, 1110–1130 m; Lichia Logging Trail, Peinan-Yenping Hsiang, 1175–1370 m.
  114. Lichia, Peinan Hsiang.
  115. Lichia Logging Trail, Peinan-Yenping Hsiang, 1055–1100 m.
  116. Lichia Logging Trail, Peinan-Yenping Hsiang, 930–950 m; Lichia Logging Trail, Peinan-Yenping Hsiang, 970–1045 m.
  117. Peinan.
  118. Taitung vicinity.
  119. Chienho.
  120. Chihpen Wenchuan.
  121. Chihpen Hsi, right bank.
  122. Chihpen Hsi, left bank.
  123. Huayuan.
  124. Chihpen Logging Trail.
  125. Chinlunshan.
  126. Chinlun, Taimali Hsiang.
  127. Toliang.
  128. Tawu Mountain Nature Preserve, Taimali Hsi, 300–400 m.
  129. Taimali Hsi; Tawu Mountain Nature Preserve.
  130. Chaochou.
  131. Wanglung.
  132. Linpien Hsiang.
  133. Fangliao vicinity; Shuitiliao.
  134. Fangshan Hsi.
  135. Taku.
  136. Tachu.
  137. Tawu Hsi.
  138. Shouchia.
  139. Lilungshan.
  140. Mutan.
  141. Lungkeaou.
  142. Hengchun (=Koshun; Koshiun).
  143. Kenting Kungyuan.
  144. Lanjen Hsi; Liteshan.
  145. Laofoshan.
  146. Pailuz; Sabkun Hsi.
  147. Payao.
  148. Chushe Hsi; Kaoshihfoshan; Shihmenshe.
  149. Forest Section No. 15; Forest Section No. 27; Kaoshih, Mutan Hsiang; Tataan.
  150. Chiupeng; Kangtzu; Nanjenlu-Kangtzu.
  151. Chufengshan.
  152. Chulaoshu Shan; Manchoutsun.
  153. Hengchun Nature Preserve; Kenting, 225 m; Shenting.
- Absence reports
- B. Liuchiu Yu.
  - C. Lu Tao.
  - D. Lan Yu.



FIG. 2. External characters in *Macaca cyclopis*: adult male photographed at Yushan National Park by Tsung-Su Ding.

studies (Melnick et al., 1993, pp. 286, 289), the interspecific mtDNA difference between *M. cyclopis* and Burmese–South Chinese *M. mulatta* was found to be less than the intraspecific mtDNA difference between Burmese–South Chinese *M. mulatta* and Pakistani–Indian *M. mulatta*. Estimates of the age of divergence between *M. cyclopis* and *M. mulatta* vary in these studies from 0.25 Ma to 1.8 Ma (Table 5).

The 464-bp sequence of the mtDNA D-loop of a captive specimen of *M. cyclopis* (without locality information) has been published by Kawamoto et al. (1999, p. 57). Based on a comparison of this sequence with that of a wild-collected specimen of *M. fuscata* and that of an apparent *cyclopis* × *fuscata* hybrid, Kawamoto et al. determined that the mother of the hybrid was *M. cyclopis*. In this study, the genetic distance between the *M. cyclopis* sample and the putative hybrid sample was less than 10% of the genetic distance between the

*M. fuscata* sample and the hybrid and *M. cyclopis* samples.

In an unpublished series of studies of the 550-bp sequence of the mtDNA D-loop in natural populations of *M. cyclopis*, Jui-Hua Chu (NTUZ; pers. comm., 1997–2000; cf. Wu et al., 2001b, p. 414) has investigated local and regional mtDNA variation within this species. The three most important findings of this research are:

1. At Yushan National Park, central Taiwan, haplotypes are identical in all samples from seven groups studied.

2. At Shou Shan, southwestern Taiwan, four haplotypes were identified in samples taken from females in 13 groups. Ten of these groups have the same haplotype; each of the remaining three groups has a different haplotype. Three haplotypes at this locality—including the haplotype common to ten of the groups—are more similar to each other (sequence divergence = 0.8%) than



TABLE 1. External measurements and proportions in *Macaca cyclopis*.<sup>1</sup>

| Age/sex class <sup>2</sup>                        | Head and body length (mm)        | Relative tail length (T/HB × 100)            | Relative hind foot length (HF/HB × 100) | Relative ear length (E/HB × 100) | Weight (kg)                           |
|---|----------------------------------|--|---|----------------------------------|---------------------------------------|
| <b>Wild-collected specimens<sup>3,4</sup></b>     |                                  |  |   |                                  |                                       |
| Infant  | 289                              | 73.4   | 34.3                                    | 11.1                             | —                                     |
| Juveniles   | 374.7 ± 30.01<br>335–405<br>(6)  | 87.2 ± 7.84<br>78.3–95.8<br>(5) <sup>5</sup> | 34.9 ± 2.54<br>30.2–37.3<br>(6)         | 8.9 ± 1.37<br>7.5–11.3<br>(6)    | 3.60 ± 1.545<br>1.89–5.25<br>(4)      |
| Subadult male                                     | 490                              | 79.6   | —                                       | 6.3                              | —                                     |
| Adult female                                      | 440                              | 88.6   | —                                       | 6.8                              | —                                     |
| Adult male  | 650                              | 69.2   | 25.4                                    | 7.4                              | 8.12                                  |
| <b>Captive specimens<sup>6</sup></b>              |                                  |  |   |                                  |                                       |
| Infants   | —                                | —  | —                                       | —                                | 1.15 <sup>7</sup><br>0.60–1.70<br>(2) |
| Juveniles   | 434.9 ± 69.02<br>338–550<br>(11) | 83.3 ± 7.63<br>72.2–93.9<br>(11)             | 31.9<br>(1)                             | 7.4 ± 1.28<br>5.9–8.2<br>(3)     | 4.47 ± 1.699<br>1.60–7.00<br>(14)     |
| Subadult females                                  | 446.7 ± 15.27<br>430–460<br>(3)  | 85.4 ± 4.54<br>80.2–88.9<br>(3)              | —                                       | —                                | 4.40 ± 0.400<br>4.00–4.80<br>(3)      |
| Subadult males                                    | 522.5<br>485–560<br>(2)          | 88.8<br>86.6–91.1<br>(2)                     | —                                       | —                                | 7.10 ± 1.268<br>5.60–8.70<br>(4)      |
| Adult females                                     | 466.9 ± 29.56<br>420–530<br>(18) | 82.2 ± 4.10<br>75.0–94.3<br>(18)             | —                                       | 4.7<br>(1)                       | 6.69 ± 1.497<br>2.50–9.50<br>(27)     |
| Adult males                                       | 544.3 ± 67.85<br>475–680<br>(7)  | 90.0 ± 4.38<br>84.9–94.7<br>(6)              | 21.2<br>(1)                             | 6.6<br>(1)                       | 10.21 ± 3.679<br>6.30–18.50<br>(9)    |
| <b>Specimens of unknown history<sup>3,8</sup></b> |                                  |  |   |                                  |                                       |
| Fetus   | 151                              | 82.1   | —                                       | —                                | —                                     |
| Juvenile  | 391                              | 88.7   | 37.3                                    | 8.1                              | —                                     |
| Subadult males                                    | 574.5<br>529–620<br>(2)          | 74.2<br>66.1–82.2<br>(2)                     | 30.6                                    | 7.4                              | —                                     |
| Adult females                                     | 501.4 ± 63.36<br>446–600<br>(5)  | 79.0 ± 10.54<br>65.0–91.0<br>(5)             | 31.9 ± 4.14<br>25.8–35.0<br>(4)         | 8.0 ± 1.66<br>5.5–10.0<br>(5)    | —                                     |
| Adult male  | 519                              | 77.3   | 29.5                                    | 8.1                              | —                                     |

<sup>1</sup> Mean ± SD (where  $n > 2$ ), extremes, and sample size (italicized figures in parentheses); cf. Horikawa (1932, p. 69).

<sup>2</sup> Dental specifications: infants, deciduous teeth only; juveniles, some permanent teeth erupted; subadults, M3 in females or C in males incompletely erupted; adults, all permanent teeth completely erupted.

<sup>3</sup> Sample size = 1 unless otherwise indicated.

<sup>4</sup> Infant: USNM 394177, Maanliao. Juveniles: AMNH 184955, Hualien, mountains near; NMNS T1726, Ta Ching Shui, YIO 733<sup>5</sup> and 734, Hengchun; Shui-Wei Chang (pers. comm., 27 Apr. 1999), measurements of two specimens, Luku Shan. Subadult male: USNM 296795, Kaohsiung vicinity. Adult female: USNM 296794, Kaohsiung vicinity. Adult male: Dien (1958, p. 346). Wulai.

<sup>5</sup> Excludes questionable relative tail length = 114.0% (456 mm/400 mm) in YIO 733, Hengchun.

<sup>6</sup> Infants: KUPRI 3658, 6082. Juveniles: KUPRI 2795, 2796, 3652, 3653, 3660; NMNS 000546; USNM 296796; Hill (1974, p. 589) (PM. 16); Hai-Yin Wu, measurements of eight zoo animals. Subadult females: Hai-Yin Wu, measurements of three zoo animals. Subadult males: KUPRI 3654, 3655; Hai-Yin Wu, measurements of two zoo animals. Adult females: KUPRI 1745, 2913, 3056, 3224, 3651, 3656, 3657, 3659, 3852, 4238, 5228, 5843; USNM 296797; Hai-Yin Wu, measurements of 17 zoo animals. Adult males: KUPRI 2514, 4233, 6431; NTUZ Aoki 3484; Hai-Yin Wu, measurements of six zoo animals.

<sup>7</sup> Mean birth weight is 0.408 kg in 109 laboratory-born captives (see Table 2).

<sup>8</sup> Fetus: TM MA-0378. Juvenile: TESRI acc. no. T 0177. Subadult males: NMNS T 3911; NTUZ uncatalogued. Adult females: NMNS 000547, T 1883, T 3909; NTUZ Aoki 94; TESRI acc. no. T 0115. Adult male: NMNS T 1725.

TABLE 2. Mean birth weight (g) reported in laboratory-born *Macaca cyclopis*.

| Sex     | Taiwanese laboratories <sup>1</sup> |                            |                               |                          | U.S. laboratory                |                          |
|---------|-------------------------------------|----------------------------|-------------------------------|--------------------------|--------------------------------|--------------------------|
|         | Yang et al.<br>(1968, p. 538)       |                            | Peng et al.<br>(1973, p. 209) |                          | Price et al.<br>(1972, p. 304) |                          |
|         | N                                   | Mean weight                | N                             | Mean weight <sup>2</sup> | N                              | Mean weight <sup>2</sup> |
| Females | 22                                  | 408                        | 30                            | 398 ± 67                 | ?                              | —                        |
| Males   | 13                                  | 393                        | 22                            | 407 ± 55                 | ?                              | —                        |
| TOTALS  | 35                                  | 402 (300–530) <sup>3</sup> | 52 <sup>4</sup>               | 402 ± 61                 | 22                             | 430 ± 45                 |

<sup>1</sup> Both studies were conducted at the College of Medicine, National Taiwan University, and the U.S. Naval Medical Research Unit No. 2.

<sup>2</sup> SD also indicated.

<sup>3</sup> Extremes.

<sup>4</sup> Inadvertently recorded as “54” in cited reference.

to the fourth haplotype (sequence divergence = 3.0%).

3. Based on paired comparison of sequence divergence, samples from localities in various parts of Taiwan were divisible into four regional groups: southern Taiwan (Kaohsiung and Pingtung counties), central Taiwan (Chia-I and Nantou counties), eastern Taiwan (Hualien county), and northeastern Taiwan (Ilan county). The within-group sequence divergence is <4.0%, and the between-group sequence divergence is 4.5–9.0%.

### Nuclear DNA

The hinge region of the immunoglobulin C<sub>α</sub> gene was studied by PCR amplification and electrophoresis of three *M. cyclopis* samples (Sumiyama et al., 1998, p. 33). In these samples, the size and sequence of the PCR products were found to be individually variable. Similar polymorphism also was detected in six other species of macaques, in baboons, and in colobines. This polymorphism is hypothesized to be the result of

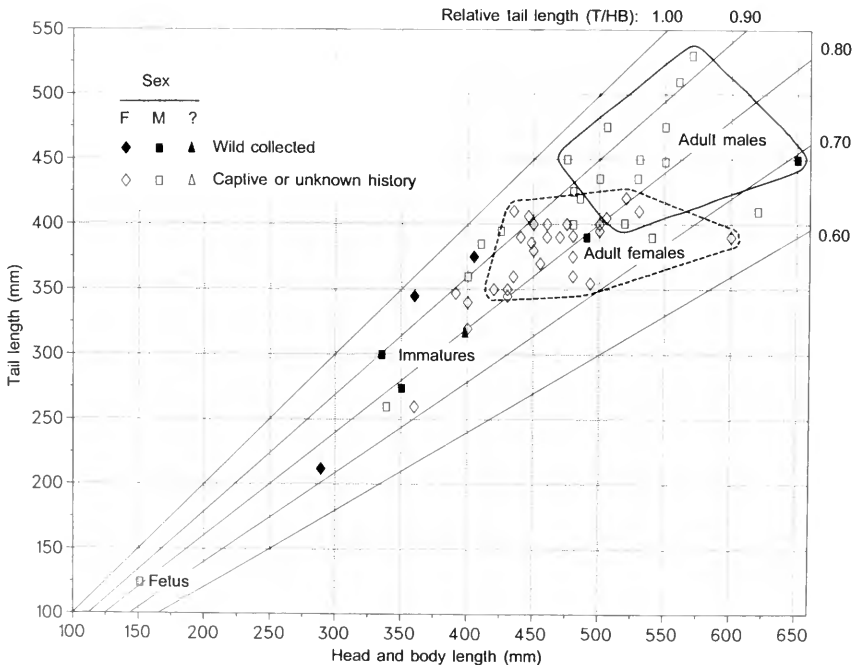


FIG. 3. Tail length vs. head and body length in *Macaca cyclopis*.

TABLE 3. Cranial measurements<sup>1</sup> and proportions in *Macaca cyclopis*.<sup>2</sup>

| Age/sex class <sup>3</sup>          | Greatest length<br>(mm) | Relative zygomatic<br>breadth<br>(ZB/GL × 100) | Postrostral length<br>(mm) | Rostral-postrostral<br>ratio<br>(R/PR × 100) |
|-------------------------------------|-------------------------|--|----------------------------|--|
| <b>Wild-collected specimens</b>     |                         |  |                            |  |
| Infants                             | 81.0 ± 1.46             | 63.5 ± 2.07                                    | 69.9 ± 1.47                | 25.6 ± 4.68                                  |
|                                     | 79.8–83.5<br>(5)        | 60.8–65.5<br>(5)                               | 69.0–71.6<br>(3)           | 20.8–30.1<br>(3)                             |
| Juveniles                           | 100.9 ± 7.00            | 67.0 ± 2.32                                    | 77.5 ± 3.67                | 36.8 ± 1.61                                  |
|                                     | 92.4–113.4<br>(10)      | 63.7–71.2<br>(10)                              | 74.1–83.7<br>(5)           | 35.6–39.3<br>(5)                             |
| Subadult female <sup>4</sup>        | 104.2                   | 66.3   | —                          | —  |
| Subadult males                      | 120.1 ± 4.59            | 70.0 ± 1.93                                    | 86.0 ± 2.58                | 50.6 ± 2.92                                  |
|                                     | 114.0–125.9<br>(8)      | 66.6–72.2<br>(8)                               | 82.9–90.3<br>(7)           | 45.6–55.1<br>(7)                             |
| Adult females <sup>5</sup>          | 110.4 ± 2.40            | 67.6 ± 1.75                                    | 81.4 ± 2.02                | 48.2 ± 3.04                                  |
|                                     | 107.7–114.5<br>(12)     | 64.7–70.4<br>(12)                              | 78.7–83.4<br>(4)           | 44.7 ± 51.1<br>(4)                           |
| Adult males <sup>5</sup>            | 125.2 ± 5.20            | 69.2 ± 2.58                                    | 88.5 ± 4.85                | 55.2 ± 2.10                                  |
|                                     | 114.6–133.4<br>(15)     | 64.4–73.6<br>(14)                              | 77.8–93.1<br>(8)           | 52.6–58.2<br>(8)                             |
| <b>Captive specimens</b>            |                         |  |                            |  |
| Adult females                       | 113.6 ± 6.16            | 68.4 ± 2.56                                    | 83.6 ± 3.58                | 47.8 ± 3.65                                  |
|                                     | 100.0–127.3<br>(44)     | 64.0–77.0<br>(44)                              | 75.6 ± 95.1<br>(44)        | 41.1–56.4<br>(44)                            |
| Adult males                         | 131.0 ± 7.47            | 70.8 ± 2.89                                    | 91.2 ± 3.90                | 54.3 ± 3.13                                  |
|                                     | 113.0–142.6<br>(23)     | 65.4–76.1<br>(23)                              | 82.9–98.2<br>(22)          | 49.0–60.6<br>(22)                            |
| <b>Specimens of unknown history</b> |                         |  |                            |  |
| Adult females                       | 116.2 ± 6.22            | 67.9 ± 0.65                                    | 84.2 ± 2.68                | 50.7 ± 4.01                                  |
|                                     | 107.9–122.9<br>(4)      | 67.1–68.4<br>(4)                               | 80.3–86.5<br>(4)           | 46.8–56.3<br>(4)                             |
| Adult males                         | 122.6 ± 6.02            | 69.8 ± 2.36                                    | 87.6 ± 2.60                | 52.8 ± 5.36                                  |
|                                     | 113.7–129.3<br>(6)      | 67.1–73.0<br>(6)                               | 84.4–90.3<br>(6)           | 45.6–60.3<br>(6)                             |

<sup>1</sup> For definition of measurements, see Fooden (1969, p. 40); cf. Horikawa (1932, p. 69).

<sup>2</sup> Mean ± SD (where  $n > 2$ ), extremes, and sample size (italicized figures in parentheses).

<sup>3</sup> Dental specifications: infants, deciduous teeth only; juveniles, some permanent teeth erupted; subadults, M3 in females or C in males incompletely erupted; adults, all permanent teeth completely erupted.

<sup>4</sup> Sample size = 1.

<sup>5</sup> Cf. Table 4.

positive selection for maintenance of the activity of the immunoglobulin IgA antibody.

Polymorphic microsatellite loci in captive and provisioned natural populations of *M. cyclopis* were studied by Chu et al. (1999, p. 575). These loci were found to be useful in paternity determination. In addition, at one highly polymorphic locus, one group of alleles in *M. cyclopis* was found to be notably larger (269–285 bp) than alleles at the same locus in *M. fascicularis* (<206 bp) and *M. mulatta* (<250 bp).

Tosi et al. (2000, p. 138), who sequenced two Y-chromosome genes (TSPY and SRY) in a *M. cyclopis* captive without locality information and compared these sequences with those in samples

of various populations of 17 other macaque species, found that *M. cyclopis* sequences were most similar to those in other *fascicularis*-group species. Within the *fascicularis* group, *M. cyclopis* clustered most closely with *M. mulatta* (south-eastern China, Burma, India) and Vietnamese *M. fascicularis* (unresolved polychotomy); next most closely with *M. fuscata*; and least closely with non-Vietnamese *M. fascicularis* (Thailand, Java, Borneo, Philippines). The somewhat incongruous Y-chromosomal sequence similarity of *M. cyclopis* to Vietnamese *M. fascicularis* was attributed by Tosi et al. to possible hybridization between Vietnamese *M. fascicularis* and *M. mulatta*.



FIG. 4. Skull of adult female *Macaca cyclopis*—USNM 296794, Kaohsiung vicinity, Kaohsiung Hsien. (Photographs by John Weinstein, The Field Museum.)

### Blood Proteins

Variation of blood-protein allele frequencies is relatively low in available samples of *M. cyclopis* (Table 6). Of 21 loci that are polymorphic in *Macaca*, 11 are monomorphic in *M. cyclopis* and eight have major alleles with frequencies of at least 0.90. At one of the remaining loci (TBPA), the major allele has a frequency of 0.75; at the other (Pa), the major allele has a frequency of 0.50. Within the *fascicularis* group, blood proteins in *M. cyclopis* are more similar to those in *M.*

*mulatta* than to those in *M. fascicularis*, and least similar to those in *M. fuscata* (Fooden & Lanyon, 1989, p. 224); based on the amount of blood-protein difference between *M. cyclopis* and *M. mulatta*, Nozawa et al. (1977, p. 26) have estimated that these two species began to diverge ca. 70 Ka.

Blood-protein analysis—particularly of the ADA, Dia, and Tf loci—indicates the occurrence of hybridization in Japan between a recently introduced population of *M. cyclopis* and a native population of *M. fuscata* (Kawamoto et al., 1999, p. 55).

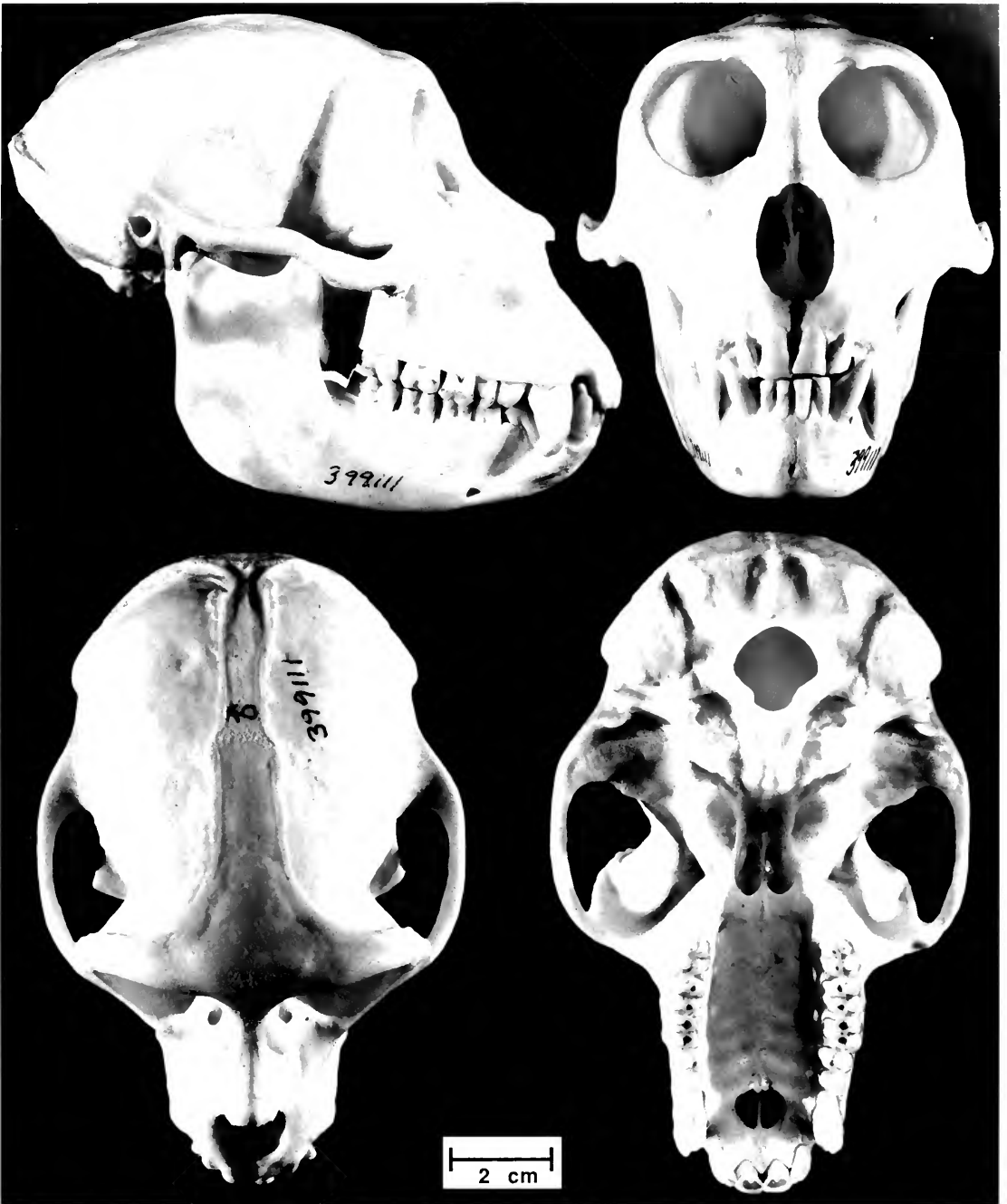


FIG. 5. Skull of adult male *Macaca cyclopis*—USNM 399111, Hsiao, Wulai District, Taipei Hsien. (Photographs by John Weinstein, The Field Museum.)

### Karyology

The karyotypes of one *M. cyclopis* female and one *M. cyclopis* male have been published by

Chen et al. (1981, p. 73); precise geographic origins of the specimens are not specified. These *M. cyclopis* karyotypes appear similar to those in other species of *Macaca* (cf. Makino, 1952, p. 290:

TABLE 4. Local variation in greatest length of skull in wild-collected *Macaca cyclopis* (cf. Table 3).

| Locality <sup>1</sup>          | Latitude (N) | Longitude (E) | Mean ± SD    | Extremes    | N  |
|--------------------------------|--------------|---------------|--------------|-------------|----|
| <b>Adult females</b>           |              |               |              |             |    |
| Chingshui Cliff                | 24°12'       | 121°40'       | 110.9        |             | 1  |
| Hui-Sun Experimental Forest    | 24°03'       | 121°01'       | 108.0        |             | 1  |
| A-Sun-Lai-Ga                   | 23°22'       | 121°11'       | 114.5        |             | 1  |
| Kaohsiung vicinity             | 22°39'       | 120°15'       | 107.8        |             | 1  |
| Tawu Mountain Nature Preserve  | 22°35'       | 120°49'       | 108.1        |             | 1  |
| Manchoutsun                    | 22°01'       | 120°51'       | 110.9 ± 5.12 | 107.7–113.9 | 7  |
| ALL                            |              |               | 110.4 ± 2.40 | 107.7–114.5 | 12 |
| <b>Adult males<sup>2</sup></b> |              |               |              |             |    |
| Wulai <sup>3</sup>             | 24°52'       | 121°33'       | 121.0        |             | 1  |
| Ayu Shan                       | 24°47'       | 121°36'       | 125.7        |             | 1  |
| Puli                           | 23°58'       | 120°57'       | 129.6        |             | 1  |
| Mu-Kua-Chau                    | 23°50'       | 121°33'       | 128.0        | 126.5–129.5 | 2  |
| Manchoutsun                    | 22°01'       | 120°51'       | 124.6 ± 5.52 | 114.6–131.6 | 7  |
| Kenting                        | 21°58'       | 120°49'       | 127.8        | 122.2–133.4 | 2  |
| ? (UMMZ 85349)                 | —            | —             | 117.5        |             | 1  |
| ALL                            |              |               | 125.2 ± 5.20 | 114.6–133.4 | 15 |

<sup>1</sup> In this and subsequent tables, localities are listed in north–south order, where sufficient information is available.

<sup>2</sup> Excludes USNM 399111 (Coll. No. 392), adult male, trapped 6 Jun. 1963 at Hsiao (24°51'N, 121°35'E), greatest length of skull 131.1 mm. This monkey was maintained as a laboratory captive for approximately 1 year, until 22 May 1964 (Bergner & Jachowski, 1968, pp. 22, 30); its cranial measurements have been included in the calculation of statistics for captive adult males presented in Table 3.

<sup>3</sup> Measurement from Dien (1958, p. 346).

TABLE 5. Sister groups and divergence ages of *Macaca cyclopis* as determined in five studies of mtDNA in *fascicularis*-group species; in these studies, *M. cyclopis* data were derived from a total of three captive specimens.

| References   | Analytical method             | Origin of <i>M. mulatta</i> samples studied | Sister groups <sup>1</sup> of <i>M. cyclopis</i> |                             | Divergence ages (Ma) |
|--|-------------------------------|---|--|-----------------------------|----------------------|
|  |                               |   | Tree construction method                         |                             |                      |
|  |                               |   | Neighbor-joining                                 | Other <sup>2</sup>          |                      |
| <b>Studies in which <i>M. cyclopis</i> data were derived from one captive specimen<sup>3</sup></b> |                               |   |  |                             |                      |
| Hayasaka et al. (1988, p. 278)   | Restriction sites, 17 enzymes | India                                       | MUL (India) + FUS                                | MUL (India) + FUS           | 0.9–1.8              |
| Melnick et al. (1993, p. 289) <sup>4</sup>   | Restriction sites, 15 enzymes | Pakistan, India, Burma, S China             | MUL (Burma & S China) + FUS                      | MUL (Burma & S China) + FUS | —                    |
| Zhang and Shi (1993a, p. 13) <sup>4</sup>  | Restriction sites, 16 enzymes | India, <sup>5</sup> S China                 | MUL (India) + FUS                                | MUL (S China)               | 1.8 <sup>6</sup>     |
| Hayasaka et al. (1996, p. 1050)  | Sequencing, 896-bp region     | India, unknown                              | MUL (India) + FUS                                | MUL (India) <sup>7</sup>    | 0.63–0.70            |
| <b>Study in which <i>M. cyclopis</i> data were derived from two captive specimens</b>              |                               |   |  |                             |                      |
| Morales and Melnick (1998, p. 15)  | Restriction sites, 22 enzymes | N India, S China                            | MUL (S China)                                    | MUL (N India)               | 0.25                 |

<sup>1</sup> Abbreviations: FUS, *M. fuscata*; MUL, *M. mulatta*.

<sup>2</sup> Maximum parsimony: Hayasaka et al. (1996). PAUP: Melnick et al. (1993); Morales and Melnick (1998). Unweighted pair group: Hayasaka et al. (1988); Zhang and Shi (1993a).

<sup>3</sup> The same *M. cyclopis* captive provided mtDNA data for all four studies.

<sup>4</sup> The source of *M. cyclopis* data used in this study is Hayasaka et al. (1988, p. 273).

<sup>5</sup> The source of the Indian *M. mulatta* data used in this study is Hayasaka et al. (1988, p. 273).

<sup>6</sup> See Zhang and Shi (1993b, p. 602).

<sup>7</sup> This is the sister group of *M. cyclopis* in a tree constructed from data for 896 sites; in a tree constructed from data for 664 sites, the sister group of *M. cyclopis* is MUL (India) + FUS.

TABLE 6. Allele frequencies (%) at blood-protein loci in samples of *Macaca cyclopis*.<sup>1</sup>

| Locus            | N   | Major allele: frequency | Minor alleles: frequencies       |
|------------------|-----|-------------------------|----------------------------------|
| Acp              | 121 | A: 100                  |                                  |
| ADA              | 67  | 2: 100                  |                                  |
| Alb              | 167 | A: >99                  | B: <1                            |
| CA-I             | 139 | A: 99                   | D2: 1                            |
| CA-IC            | 92  | X+: 100                 |                                  |
| CellEs           | 46  | 1: 100                  |                                  |
| ChEs             | 50  | 1: 100                  |                                  |
| Dia              | 47  | C: 93                   | A: 4; D: 3                       |
| Gc               | 99  | S1: 100                 |                                  |
| HbA <sup>2</sup> | 151 | 1: 100                  |                                  |
| HbB <sup>2</sup> | 102 | 1: 100                  |                                  |
| IDH              | 44  | 2: 92                   | 1: 8                             |
| LDHB             | 50  | 1: 100                  |                                  |
| Pa               | 99  | D: 50                   | F1: 28; F2: 22                   |
| PGD              | 137 | A: >99                  | S: <1                            |
| PGM-I            | 39  | 1: 100                  |                                  |
| PGM-II           | 39  | 1: 100                  |                                  |
| PHI              | 64  | 1: 92                   | 4: 8                             |
| PI               | 139 | C: 90                   | B: 7; D: 2; F: 1                 |
| TBPA             | 305 | F: 75                   | S: 25                            |
| Tf               | 267 | C: 91                   | D: <1; E: 4; F: <1; F': 4; G: <1 |

<sup>1</sup> For references and key to locus abbreviations, see Fooden and Lanyon (1989, p. 214) and Chao (1990, pp. 52, 60, 66, 68, 73).

<sup>2</sup> Cf. Chao (1990, p. 60), who similarly reports that a sample of *M. cyclopis* (n = 99) was monomorphic for hemoglobin (Hb, allele S).

Ardito, 1979, p. 251; Cao et al., 1981, p. 120). The diploid chromosome number in *M. cyclopis* is 42.

## Parasites

### Protistans

FLAGELLATES—Fifty-three of 594 blood samples (8.9%) collected from natural populations of *M. cyclopis* in seven counties in eastern and central Taiwan were positive for a trypanosome similar to *Trypanosoma conorhini* (Table 7). Among counties, the incidence of positive samples varied from 5.4% to 40.0%. The incidence of positive samples in Taipei, Ilan, and Hualien counties—adjacent counties in northeastern Taiwan—tends to exceed that in the remaining four counties; however, sample sizes are small for Taipei, Ilan, and Hualien counties.

Three of 38 unlocalized fecal samples (7.9%) of *M. cyclopis* were positive for *Trichomonas hominis* (Kuntz et al., 1968, p. 123).

AMEBAS—Endoparasitic amebas that have been detected in fecal samples of *M. cyclopis* include

at least four species of *Entamoeba* and one species each of *Endolimax* and *Iodamoeba* (Table 8). The incidence of *Entamoeba* species in these unlocalized samples varies from 11.8% to 41.2%, and the incidence of *Endolimax nana* is 16.2%, and the incidence of *Iodamoeba buetschlii* is 14.2%.

MALARIA—*Macaca cyclopis* is naturally infected by *Plasmodium inui* and *P. cynomolgi*, which are the two most widely distributed malarial par-

TABLE 7. Incidence of trypanosome infections (*Trypanosoma cf. conorhini*) detected in samples of natural populations of *Macaca cyclopis*.<sup>1</sup>

| County    | N   | Infected |      |
|-----------|-----|----------|------|
|           |     | No.      | %    |
| Taipei    | 18  | 4        | 22.2 |
| Ilan      | 7   | 1        | 14.3 |
| Hualien   | 15  | 6        | 40.0 |
| Nantou    | 13  | 1        | 7.7  |
| Kaohsiung | 75  | 5        | 6.7  |
| Taitung   | 135 | 18       | 13.3 |
| Pingtung  | 331 | 18       | 5.4  |
| TOTALS    | 594 | 53       | 8.9  |

<sup>1</sup> References: Cross et al. (1970, p. 15; 1983, p. 536). Cf. Kuntz et al. (1968, p. 126), who report *Trypanosoma* sp. in two unlocalized *M. cyclopis* individuals.

TABLE 8. Incidence of ameba species detected in unlocalized fecal samples of *Macaca cyclopis* (N = 136).<sup>1</sup>

| Species                           | Incidence |      |
|-----------------------------------|-----------|------|
|                                   | No.       | %    |
| <i>Entamoeba coli</i>             | 56        | 41.2 |
| <i>E. hartmanni</i>               | 16        | 11.8 |
| <i>E. histolytica</i>             | 43        | 31.6 |
| <i>E. polecki</i>                 | 41        | 30.1 |
| <i>Entamoeba</i> sp. <sup>2</sup> | 34        | 25.0 |
| <i>Endolimax nana</i>             | 22        | 16.2 |
| <i>Iodamoeba buetschlii</i>       | 19        | 14.0 |

<sup>1</sup> Reference: Kuntz et al. (1968, pp. 123, 124).

<sup>2</sup> Includes one or more unidentified species.

asites of macaques; these two parasites also naturally infect *M. fascicularis*, *M. mulatta*, and several other macaque species (Hsieh, 1960, p. 483; Garnham, 1966, pp. 207, 286, 340; Coatney et al., 1971, pp. 90, 255, 318; Collins, 1988, pp. 1477, 1484, 1485; cf. Fooden, 1994, p. 576). *Macaca cyclopis* probably also is naturally infected by *P. knowlesi*, which is otherwise restricted to *M. fascicularis* and *M. nemestrina* in Southeast Asia, but evidence for the *M. cyclopis*-*P. knowlesi* association is not conclusive (see references above). The length of the asexual erythrocytic cycle is 72 hr (quartan) in *P. inui*, 48 hr (tertian) in *P. cynomolgi*, and 24 hr (quotidian) in *P. knowlesi*.

The incidence of natural malarial infections in *M. cyclopis* apparently is greater than 25% (Table 9); in one survey in which the sex of monkeys was reported, the incidence of infections in males was approximately one-half of that in females. As expected, the incidence of malarial infections in *M. cyclopis* tends to be greater in wet areas of Taiwan than in drier areas (Bergner & Jachowski, 1968, p. 27). The natural vector of malaria in *M.*

*cyclopis* probably is *Anopheles takasagoensis*, which is the only Taiwanese member of the Leucosphyrus Group (Peyton & Harrison, 1980, pp. 336, 343); this group of mosquitoes apparently is essential in the transmission of simian malaria in Asia (Coatney et al., 1971, p. 24).

CILIATE—*Balantidium coli* was detected in 45 of 136 unlocalized fecal samples (33.1%) of *M. cyclopis* that were studied by Kuntz et al. (1968, pp. 123, 124), and a similar or identical parasitic ciliate was also frequently detected in *M. cyclopis* fecal samples collected at Yushan National Park, central Taiwan (Wu & H.-Y. Lin, 1996, p. 24). At Yushan National Park, the incidence of this parasite in *M. cyclopis* samples was highest in summer and autumn.

### Trematodes

Two species of flukes have been reported as natural parasites of *M. cyclopis* (Table 10). One of these, an unidentified species of Lecithodendriidae, has been detected in *M. cyclopis* only once. The more common fluke parasite of *M. cyclopis* is *Ogmoctyle indica* (Family Notocotylidae); in *M. cyclopis* samples examined, the incidence of this fluke varies from 0% to 66.7%. The geographic pattern of this variation is not readily interpretable; Yu-Li, where the reported incidence of *O. indica* is 66.7% (n = 3), is less than 50 km east of Yushan National Park, where the reported incidence is 0% (n = 134).

The human liver fluke, *Clonorchis sinensis*, has been detected in one *M. cyclopis* individual by Kuntz et al. (1968, p. 128). However, these authors suspect that the infection may have been ac-

TABLE 9. Incidence of natural malarial infections detected in surveys of *Macaca cyclopis* populations.

| Survey date | Survey area         | N    | Infected        |                   | References <sup>1</sup> |
|-------------|---------------------|------|-----------------|-------------------|-------------------------|
|             |                     |      | No.             | %                 |                         |
| ca. 1940    | Taitung, Hualien    | 28   | 11              | 39.3              | 1                       |
| 1949        | "southern Taiwan"   | 35   | 18 <sup>2</sup> | 51.4              | 2                       |
| 1962-1964   | "throughout Taiwan" | 277  | 71 <sup>3</sup> | 25.6 <sup>4</sup> | 3                       |
| ca. 1965    | Taitung             | ?    | ?               | 71.9              | 4                       |
| TOTAL       |                     | >340 | >100            | >29.4             |                         |

<sup>1</sup> Key to references: 1. Hsieh (1960, p. 479). 2. Hsieh (1960, p. 482). 3. Bergner and Jachowski (1968, p. 27). 4. Peyton and Harrison (1980, p. 342).

<sup>2</sup> Possibly includes two *Hepatozoon* infections.

<sup>3</sup> Possibly includes *Hepatozoon* infections.

<sup>4</sup> 13.7% in 102 males, 27.2% in 136 females (sex undetermined in 39 host individuals).



TABLE 10. Incidence of trematode parasite infections detected in *Macaca cyclopis* samples.<sup>1</sup>

| Locality   | N   | Incidence |      | References <sup>2</sup> |
|--|-----|-----------|------|-------------------------|
|  |     | No.       | %    |                         |
| Notocotylidae: <i>Ogmocotyle indica</i> <sup>3</sup> |     |           |      |                         |
| Unknown  | 98  | 28        | 28.6 | 1                       |
| Unknown  | 18  | 2         | 11.1 | 2                       |
| Yu-Li, Taitung Hsien                                 | 3   | 2         | 66.7 | 3                       |
| Yushan National park                                 | 134 | 0         | 0    | 3                       |
| Shou Shan  | 131 | 0         | 0    | 3                       |
| Lecithodendriidae: Gen. sp. ?                        |     |           |      |                         |
| Unknown  | 18  | 1         | 5.6  | 2                       |

<sup>1</sup> Excludes one infection with *Clonorchis sinensis* reported by Kuntz et al. (Ref. 1), who suspect that this infection was acquired in captivity.

<sup>2</sup> Key to references: 1. Kuntz et al. (1968, pp. 124, 128). 2. Yoshimura et al. (1968, p. 292; 1969, p. 460). 3. Hai-Yin Wu, Huey-Yu Lin, and Yao-Sung Lin (unpublished data).

<sup>3</sup> The species reported by Yoshimura et al. (Ref. 2) is *O. ailuri*, which may be a synonym of *O. indica* (see Ref. 1).

identally acquired while the monkey was being held in captivity.

### Cestodes

Two species of tapeworms have been detected at relatively low frequencies (<5%) in fecal samples of *M. cyclopis* (Table 11).

### Nematodes

Eleven species of nematodes have been reported as parasites in natural populations of *M. cyclopis* (Table 12). Of these, the species most frequently detected in *M. cyclopis* are *Trichuris trichiura* (68.3% incidence), *Oesophagostomum bi-*

*furcun* (29.6%), *Strongyloides fuelleborni* (26.7%), and *Ternidens* sp. (11.5%); the reported incidence in *M. cyclopis* of each of the other seven parasitic nematode species is less than 10%.

The incidence of nematode parasitism varies geographically in *M. cyclopis*. Although 42% of 55 *M. cyclopis* individuals trapped in Taipei and Taoyuan counties—the two northernmost counties in Taiwan—were parasitized by *Macacacnema formosana*, none of 222 individuals trapped in ten other counties were positive for this parasite (Bergner & Jachowski, 1968, p. 24); the area of *Macacacnema* parasitism in Taipei and Taoyuan counties is in a region of especially heavy rainfall (Bergner & Jachowski, 1968, p. 15). Similarly, the incidence of nematode parasitism in *M. cyclopis* at Yushan National Park, central Taiwan, differs from that at Shou Shan, southwestern Taiwan (Table 12).

The incidence of nematode parasitism in *M. cyclopis* also varies seasonally and sexually. The reported incidence of parasitism by *Oesophagostomum*, *Strongyloides*, and *Trichuris* is greatest in summer and autumn (Lin et al., 1996, abstract no. 712; Wu & H.-Y. Lin, 1996, p. 24). Analyzed according to sex, the incidence of *Macacacnema* parasitism in Taipei and Taoyuan counties is 28.0% in 25 *M. cyclopis* males and 53.3% in 30 *M. cyclopis* females (Bergner & Jachowski, 1968, p. 28).

The same species of *Enterobius* that parasitizes *M. cyclopis* in Taiwan (*E. macaci*) also is known to parasitize *M. mulatta* in China (Hugot, 1999, p. 544).

TABLE 11. Incidence of cestode parasite infections detected in fecal samples of *Macaca cyclopis*.

| Locality                 | N   | Incidence |     | References <sup>1</sup> |
|--------------------------|-----|-----------|-----|-------------------------|
|                          |     | No.       | %   |                         |
| <i>Bertiella studeri</i> |     |           |     |                         |
| Unknown                  | 110 | 4         | 3.6 | 1                       |
| Yushan National Park     | 134 | 2         | 1.5 | 2                       |
| Shou Shan                | 131 | 3         | 2.2 | 2                       |
| TOTALS                   | 375 | 9         | 2.4 |                         |
| <i>Taenia hydatigena</i> |     |           |     |                         |
| Unknown                  | 57  | 2         | 3.5 | 3                       |

<sup>1</sup> Key to references: 1. Kuntz et al. (1968, p. 124); Jessee et al. (1970, p. 87). 2. Hai-Yin Wu, Huey-Yu Lin, and Yao-Sung Lin (unpublished data). 3. Kuntz and Meyers (1967, p. 84).

TABLE 12. Incidence of nematode parasite infections detected in samples of natural populations of *Macaca cyclopis*.<sup>1</sup>

| Parasite <sup>2</sup>              | Yushan National Park |      | Shou Shan |      | Locality unknown |                   | Total |      | References <sup>3</sup> |
|------------------------------------|----------------------|------|-----------|------|------------------|-------------------|-------|------|-------------------------|
|                                    | No.                  | %    | No.       | %    | No.              | %                 | No.   | %    |                         |
| Class Adenophorea                  |                      |      |           |      |                  |                   |       |      |                         |
| Order Stichosomida                 |                      |      |           |      |                  |                   |       |      |                         |
| <i>Capillaria</i> sp.              | 134                  | 2.2  | 131       | 2.2  | 12               | 0                 | 277   | 2.2  | 1, 2                    |
| <i>Trichuris trichiura</i>         | 134                  | 84.3 | 131       | 38.2 | 310              | 74.2              | 575   | 68.3 | 1, 2, 3, 4, 5           |
| Class Secernentea                  |                      |      |           |      |                  |                   |       |      |                         |
| Order Rhabditida                   |                      |      |           |      |                  |                   |       |      |                         |
| <i>Strongyloides fuelleborni</i>   | 134                  | 17.2 | 131       | 38.2 | 12               | 8.3               | 277   | 26.7 | 1, 2                    |
| Order Strongylida                  |                      |      |           |      |                  |                   |       |      |                         |
| <i>Oesophagostomum bifurcum</i>    | 134                  | 42.5 | 131       | 12.2 | 110              | 34.5              | 375   | 29.6 | 1, 2, 3, 4              |
| <i>Ternidens</i> sp.               | 134                  | 6.7  | 131       | 1.5  | 110              | 29.1              | 375   | 11.5 | 1, 2, 4                 |
| <i>Trichostrongylus</i> sp.        | 134                  | 6.0  | 131       | 4.6  | 110              | 24.5 <sup>4</sup> | 375   | 25.1 | 1, 2, 4                 |
| Order Ascaridida                   |                      |      |           |      |                  |                   |       |      |                         |
| <i>Ascaris</i> sp.                 | 134                  | 4.5  | 131       | 14.5 |                  |                   | 265   | 9.4  | 2, 6                    |
| <i>Enterobius macaci</i>           | 134                  | 2.2  | 131       | 0    | 98               | 21.0 <sup>5</sup> | 363   | 21.1 | 2, 4, 7                 |
| Order Spirurida                    |                      |      |           |      |                  |                   |       |      |                         |
| <i>Macacatenia formosana</i>       |                      |      |           |      | 277              | 8.3               | 277   | 8.3  | 3, 8                    |
| <i>Physaloptera tumefaciens</i>    | 134                  | 4.5  | 131       | 0    | 110              | 14.5              | 375   | 5.9  | 1, 2, 3, 4              |
| <i>Streptopharagus pigmentatus</i> | 134                  | 2.2  | 131       | 0    | 110              | 16.4              | 375   | 5.6  | 1, 2, 3, 4              |

<sup>1</sup> Excludes *Ogmocotyle indica*, a trematode cited as a nematode by Bergner (1967, p. 107; cf. Yoshimura et al., 1968, p.292; 1969, p.460).

<sup>2</sup> Classification follows Maggenti (1983, p. 29).

<sup>3</sup> Key to references: 1. Jessee et al. (1970, p.87). 2. Hai-Yin Wu, Huey-Yu Lin, and Yao-Sung Lin (unpublished data; cf. Lin et al., 1996, abstract no. 712; Wu & Lin, 1996, p. 24). 3. Bergner (1967, p. 107). 4. Kuntz et al. (1968, p. 124; cf. Myers & Kuntz, 1964, p. 864). 5. Pryor et al. (1970b, p. 1120). 6. Lin et al. (1996, abstract no. 712). 7. Hugot (1999, p. 544). 8. Bergner and Jachowski (1968, p. 28; cf. Hsieh, 1961, p. 99; Schad & Anderson, 1963, p. 797; Kim & Bergner, 1964, p. 81; Kuntz et al., 1968, p. 128).

<sup>4</sup> Cited as "Trichostrongylid."

<sup>5</sup> Cited as "Oxyurid."

## Leech

Kuntz et al. (1968, p. 129) accidentally discovered leeches, *Dinobdella ferox*, in the nasal cavities of at least three *M. cyclopis* skulls that were being prepared as museum specimens; no information is available concerning sample size. Subsequently, Pryor et al. (1970a, p. 1926) detected the same species of leech in the nasal cavities of 6 of 150 laboratory captives of *M. cyclopis* (4%) that had been acquired from animal brokers in various parts of Taiwan; in lots of 20–30 monkeys, the incidence of leeches reportedly varied from 0% to 6%.

Part of an unidentified leech was observed protruding from the nostril of a living adult male macaque at Kenting, extreme southern Taiwan (H.-Y. Wu, pers. obs.).

## Lice

Two species of *Pedicinus* have been detected on *M. cyclopis* specimens—*P. eurygaster* on 12–

15 specimens of *M. cyclopis* and *P. obtusus* on one specimen (Kuhn & Ludwig, 1967a, pp. 173, 252; 1967b, p. 266; Kuntz et al., 1968, p. 129).

## Viruses

**B VIRUS**—Seven of 43 *M. cyclopis* individuals (16.3%) were positive for anti-B virus antibodies (Table 13); locality data are not available for the monkeys tested. In other *fascicularis*-group species, the incidence of positive samples varied from 0% to 34.9%.

**REOVIRUS**—Of 15 *M. cyclopis* individuals tested, ten (66.7%) were positive for antibodies to at least one type of reovirus; the other five individuals were negative for antibodies to all three types of reovirus (Yang et al., 1976, p. 2).

**SIMIEN FOAMY VIRUS**—Of 120 *M. cyclopis* samples tested, 37.5% were positive for either simian foamy virus type 1 or simian foamy virus type 2 (Table 14); in these *M. cyclopis* samples,

TABLE 13. Incidence of anti-B virus antibodies detected in *fascicularis*-group macaques.<sup>1</sup>

| Species                                 | N   | Positive |      |
|---|-----|----------|------|
|   |     | No.      | %    |
| <i>Macaca fascicularis</i> <sup>2</sup> | 86  | 30       | 34.9 |
| <i>Macaca cyclopis</i> <sup>3</sup>     | 43  | 7        | 16.3 |
| <i>Macaca mulatta</i> <sup>4</sup>      | 6   | 0        | 0    |
| <i>Macaca fuscata</i> <sup>5</sup>      | 61  | 7        | 11.5 |
| TOTALS                                  | 196 | 44       | 22.4 |

<sup>1</sup> Reference: Endo et al. (1959, p. 229).

<sup>2</sup> Cited as *M. irus*; origin of specimens: Thailand, Malaysia, Indonesia, and Philippines.

<sup>3</sup> Origin of specimens: "Formose" (=Taiwan).

<sup>4</sup> Origin of specimens: Pakistan.

<sup>5</sup> Origin of specimens: Yakushima, southern Japan.

virus type 1 tended to be somewhat more frequent than virus type 2 ( $P < 0.025$ ). No strong geographic pattern is evident in the incidence of these virus types in Taiwanese counties.

SIMIEN VIRUS 40—Infections with simian virus 40 (SV<sub>40</sub>) were detected in 45 of 197 serum samples (22.8%) collected from natural populations of *M. cyclopis* (Table 15). SV<sub>40</sub> infections were much more common in samples from southern Taiwan (42/103 = 40.8%) than in those from northern and eastern Taiwan (1/89 = 1.1%).

## Natural History

### Habitats

The primary habitat of *M. cyclopis* is broadleaf evergreen forest (Bergner & Jachowski, 1968, p. 11; Poirier & Davidson, 1979, p. 132; Masui et al., 1986, p. 390; Tanaka, 1986, p. 100; Lee & Lin, 1994, p. 19). At upper elevations, as at Yushan (1730–2670 m), this species also inhabits mixed broadleaf–needleleaf forest (Lu et al., 1991, p. 91; Norikoshi, 1991, p. 138), and occasionally it may be found in needleleaf forest and bamboo forest (McCullough, 1974, p. 11; Poirier & Davidson, 1979, p. 131). Although *M. cyclopis* exploits all strata of the forest, from ground level to the crowns of the tallest trees, it is observed most frequently in lower forest strata (Kano, 1940, p. 63; Lu et al., 1991, p. 95).

Swinhoe (in Blyth, 1860, p. 87; 1863, p. 350) misleadingly indicated that rocky, relatively treeless areas were the preferred habitat of *M. cyclopis*. This misapprehension presumably was the re-

TABLE 14. Incidence of simian foamy virus, type 1 and type 2, detected in samples of natural populations of *Macaca cyclopis*.<sup>1</sup>

| County              | N   | Viral incidence (%) |        |       |
|---------------------|-----|---------------------|--------|-------|
|                     |     | Type 1              | Type 2 | Total |
| Taipei <sup>2</sup> | 3   | 33.3                | 0      | 33.3  |
| Ilan <sup>3</sup>   | 12  | 16.7                | 16.7   | 33.3  |
| Hualien             | 74  | ~18.9               | ~12.2  | 31.1  |
| Chia-I              | 2   | 0                   | 0      | 0     |
| Taitung             | 7   | 42.9                | 0      | 42.9  |
| Pingtung            | 6   | 33.3                | 16.7   | 50.0  |
| Unknown             | 16  | ~56.3               | ~12.5  | 68.8  |
| TOTALS              | 120 | ~25.8               | ~11.7  | 37.5  |

<sup>1</sup> Reference: Johnston (1961, p. 4).

<sup>2</sup> Wulai vicinity.

<sup>3</sup> Ilan vicinity and Suao vicinity.

sult of Swinhoe's observation of these monkeys at Shou Shan (=Ape's Hill), an uplifted coral reef formation in southwestern Taiwan, where members of the local population of *M. cyclopis* often rest on exposed rocky surfaces (Hai-Yin Wu, pers. obs.). Bergner (1967, p. 33) observed that many shallow caves on the west side of Shou Shan were stained with monkey urine, and he therefore inferred that *M. cyclopis* frequently enters these caves; *M. cyclopis* occasionally has been observed to enter a cave, apparently to keep cool, at Hengchun Nature Preserve, Kenting National Park, in extreme southern Taiwan (Wu & Lin, 1993, p. 250).

The elevational range of 617 *M. cyclopis* localities is 100–3400 m (Table 16; Gazetteer, Appendix 2); approximately one-third of these localities are at 1000–1500 m elevation, and only about 5% are above 2500 m. Generally similar elevational distributions have been reported by Kano (1940, p. 33), Poirier and Davidson (1979, p. 131), Masui et al. (1986, p. 390), Tanaka (1986, p. 100), and Lee and Lin (1994, p. 19); reported

TABLE 15. Incidence of simian virus 40 infections detected in *Macaca cyclopis*.<sup>1</sup>

| Sample area | Counties         | N   | Infected |      |
|-------------|------------------|-----|----------|------|
|             |                  |     | No.      | %    |
| North       | Taipei, Ilan     | 50  | 1        | 2.0  |
| East        | Hualien, Taitung | 39  | 0        | 0    |
| Central     | Nantou, Chia-I   | 5   | 2        | 40.0 |
| South       | Pingtung         | 103 | 42       | 40.8 |
| TOTALS      |                  | 197 | 45       | 22.8 |

<sup>1</sup> Reference: Yang et al. (1967, p. 146).

TABLE 16. Elevational distribution of *Macaca cyclopis* locality records; for details see Gazetteer. Appendix 2.

| Elevation<br>(m) | Records |       |
|------------------|---------|-------|
|                  | No.     | %     |
| 0–499            | 73      | 11.8  |
| 500–999          | 105     | 17.0  |
| 1000–1499        | 207     | 33.6  |
| 1500–1999        | 113     | 18.3  |
| 2000–2499        | 88      | 14.3  |
| 2500–2999        | 27      | 4.4   |
| 3000–3499        | 4       | 0.6   |
| TOTALS           | 617     | 100.0 |

crop raiding by *M. cyclopis* tends to occur at lower elevations, usually below 1000 m (Chang, 2000, p. 3). The highest elevation at which *M. cyclopis* has been recorded (3400 m) is on one of the peaks in Chung Yang Shan Mo (= Central Mountain Range), where McCullough (1974, p. 11) observed monkey droppings in a bamboo grassland.

### Terrestriality/Arboreality

Detailed information concerning the amount of time that *M. cyclopis* spends on the ground and in trees is available for only one population, observed Nov. 1987–Oct. 1988 in Yushan National Park, central Taiwan (Lu et al., 1991, p. 95; cf. Kano, 1940, pp. 59, 62; Bergner, 1967, p. 33; McCullough, 1974, p. 10). In this population, the average proportion of time that monkeys were observed on the ground each hour between 0700 and 1900 varied from 0% to 50%; the composite daily averages were 16.8% terrestrial behavior and 83.2% arboreal behavior.

Local circumstances apparently influence the degree of terrestriality or arboreality of *M. cyclopis*. In well-habituated groups at Kenting, Shou Shan, and Fushan, members of this species are more likely to move on the ground when traveling in disturbed areas and more likely to move through the trees when traveling in mature forests (Hai-Yin Wu, pers. obs.). In northern Taiwan, according to Bergner (1967, p. 33), this species habitually remains on the ground, except in response to danger, when it flees into the trees. McCullough (1974, p. 10), by contrast, indicates that *M. cyclopis* may respond to danger by fleeing either on the ground or into the trees; no locality information is provided concerning this variation.

Although *M. cyclopis* probably usually sleeps in trees, sleeping on the ground and in caves also has been reported (Bergner, 1967, p. 33; Poirier & Davidson, 1979, p. 164). This species reportedly swims well and sometimes swims in the ocean (Imaizumi, 1970, p. 287; Poirier & Davidson, 1979, p. 165; cf. Azuma & Norikoshi, 1990, p. 47).

### Group Size and Composition

In an island-wide survey, Lee and Lin (1991, p. 34) found that most *M. cyclopis* groups were relatively small. Group size was 2–10 individuals in 57.9% of 121 groups reported, 11–20 individuals in 19.8% of the groups, and >20 individuals in 22.3% of the groups (cf. Kano, 1929, p. 333; Kuroda, 1940, p. 270; Imaizumi, 1970, p. 287; McCullough, 1974, p. 10; Tanaka, 1986, p. 101); a rough estimate of mean size in these 121 groups is 12.2 individuals per group. Thirteen solitary monkeys—presumably males—also were reported by Lee and Lin (1991, p. 34; cf. Poirier & Davidson, 1979, p. 158; Masui et al., 1986, p. 391; Lu et al., 1991, p. 94; Hsu & Agoramoorthy, 1999, p. 64). Larger groups in this survey tended to be restricted to elevations below 1500 m; above 3000 m, only small groups (2–5 individuals) and solitary monkeys were reported (cf. Norikoshi, 1991, p. 140).

All-male groups, including adults and juveniles in the same group, have been observed at Taipingshan, northeastern Taiwan (Kawamura et al., 1988, p. 3; 1991, p. 99; Azuma & Norikoshi, 1990, p. 47), and Kenting, extreme southern Taiwan (Jon-Ne Yo, pers. comm.). At both localities, the all-male groups were loosely associated with neighboring mixed-sexed groups (cf. Hsu & Lin, 2001, p. 55).

Where group size has been reported for specified localities (Table 17), it is relatively low at Kenting and in the introduced population on Oshima (island), Japan. At Kenting, a group that had increased from 10 individuals in 1985 to 19 individuals in 1987 was observed in 1987 to split into two smaller daughter groups (Wu et al., 1991, p. 30; Wu & Lin, 1992, p. 88); similar group fission has been reported at Shou Shan (Hsu & Agoramoorthy, 1999, p. 64; Hsu & Lin, 2001, pp. 53, 56). Although local informants have reported groups of >100 individuals (Lee & Lin, 1991, p. 35) and even 500 individuals (Poirier & Davidson, 1979, p. 157), the largest verified group sizes

TABLE 17. Geographic variation in group size in *Macaca cyclopis* populations.

| County                             | Locality                          | Group size |         |         | N  | References <sup>1</sup> |
|------------------------------------|-----------------------------------|------------|---------|---------|----|-------------------------|
|                                    |                                   | Mean       | Minimum | Maximum |    |                         |
| Taipei                             | Hsi Lin                           | 30         | —       | —       | 1  | 1                       |
| Taipei/Ilan                        | Fushan Forest Station             | ?          | ?       | >25     | 5  | 2                       |
| Ilan                               | Fushan                            | 23         | 21      | 25      | 2  | 3                       |
|                                    | Taipingshan                       | 20.1       | 12      | 27      | 6  | 4                       |
| Changhua                           | Pakua Shan                        | ~15        | —       | —       | 1  | 1                       |
| Nantou                             | Chichi Tashan                     | 75         | —       | —       | 1  | 5                       |
| Nantou/Chia-I                      | Yushan National Park <sup>2</sup> | ~29        | 14      | 43      | 7  | 6                       |
| Kaohsiung                          | Shanping                          | 20         | —       | —       | 1  | 1                       |
|                                    | Shou Shan (1963)                  | 24         | —       | —       | 1  | 7                       |
|                                    | Shou Shan (1995–1997)             | 46.8       | 9       | 86      | 13 | 8                       |
| Taitung                            | Kuanshan                          | ~30        | ~12     | <50     | 2  | 1                       |
|                                    | Chihpen Hsi                       | >45        | —       | —       | 1  | 9                       |
| Pingtung                           | Wanlung Shan                      | ~15        | —       | —       | 1  | 1                       |
|                                    | Kenting (1985)                    | 10         | —       | —       | 1  | 10                      |
|                                    | Kenting (1990)                    | 14.5       | 13      | 16      | 2  | 10                      |
|                                    | Kenting (1997)                    | 27         | 22      | 32      | 2  | 11                      |
| <b>Introduced feral population</b> |                                   |            |         |         |    |                         |
| (Japan)                            | Oshima                            | 12.4       | 6       | 27      | 7  | 12                      |

<sup>1</sup> Key to references: 1. Poirier and Davidson (1979, p. 157). 2. Lee (1994, p. 438). 3. K.-Y. Chang (1999, pp. 7–8). 4. Azuma and Norikoshi (1990, p. 47); Kawamura et al. (1988, table 1; 1991, p. 99; cf. Poirier & Davidson, 1979, p. 157). 5. S.-W. Chang (1999, p. 13). 6. Hai-Yin Wu (pers. obs., 1991–1996). 7. Bergner (1967, p. 33). 8. Hsu and Agoramoorthy (1999, p. 64); Hsu and Lin (2001, p. 52, Aug. 1997 census). 9. Masui et al. (1986, p. 391). 10. Wu and Lin (1992, p. 88; cf. Poirier & Davidson, 1979, p. 157). 11. W. Birky (Rutgers University, pers. comm., 26 Apr. 2000). 12. Kazama and Norikoshi (1991, p. 54).

<sup>2</sup> Cf. Lu et al. (1991, p. 94), whose group-size estimates for a nearby area in Yushan National Park are mean = 7.8; minimum < 5; maximum = 14; n ≥ 11.

are 86 individuals at Shou Shan and 75 individuals at Chichi Tashan; both of these large groups inhabit isolated relict forest patches surrounded by broad expanses of unsuitable agricultural and urban areas.

In eight natural populations of *M. cyclopis*, the pooled ratio of sexually mature males to sexually mature females varies from 0.15 to 0.55 (Table 18). The composite pooled sex ratio in these eight populations—with the Kenting population represented by the 1996–1998 sample—is 0.49 (172 sexually mature males, 349 sexually mature females). The pooled sex ratio of the introduced population in Oshima exceeds that of all eight natural populations.

### Home Range Area and Population Density

Mean home range area in six natural populations of *M. cyclopis* is approximately 130 ha, and mean population density is approximately 0.25 individuals per ha (Table 19); home range area and population density in the isolated Chichi Tashan group (37 ha, 2.03 individuals per hectare) are

aberrant. Home ranges of neighboring groups may partly overlap (Kawamura et al., 1988, p. 2; 1991, p. 98). In the introduced Oshima population, mean home range area is approximately one-fourth that in natural populations, and population density is approximately twice as great as in natural populations (Table 19); Azuma and Norikoshi (1990, p. 53) suggest that heavy hunting pressure in former years in Taiwan may be partly responsible for these differences.

Poirier and Davidson (1979, pp. 137, 173) suggested that groups of *M. cyclopis* that inhabit upper elevations may shift their home ranges upward in summer and downward in winter. However, Kawamura et al. (1991, p. 98) detected no such shifting in this species at Taipingshan during a period of frequent snowfall at 1000 m. Local seasonal movements probably occur in lowland populations as well as in upland populations (Hai-Yin Wu, pers. obs.).

### Diet

Although leaves and other vegetative plant parts are included in the diet of *M. cyclopis*, fruits

TABLE 18. Ratio of sexually mature males to sexually mature females reported in *Macaca cyclopis* groups.

| County                             | Locality            | No. of groups  | No. of sexually mature individuals | Group sex ratios |         | Pooled sex ratio | References <sup>1</sup> |
|------------------------------------|---------------------|----------------|------------------------------------|------------------|---------|------------------|-------------------------|
|                                    |                     |                |                                    | Minimum          | Maximum |                  |                         |
| Ilan                               | Fushan              | 2              | 17                                 | 0.13             | 0.33    | 0.21             | 1                       |
|                                    | Taipingshan         | 4 <sup>2</sup> | 32                                 | 0.33             | 1.50    | 0.52             | 2                       |
| Nantou                             | Chichi Tashan       | 1              | 23                                 | —                | —       | 0.44             | 3                       |
| Nantou/Chia-I                      | Yushan N. P.        | 5              | 66                                 | 0.29             | 0.54    | 0.40             | 4                       |
| Kaohsiung                          | Yushan N. P.        | 6 <sup>3</sup> | 19                                 | 0.33             | 0.50    | 0.46             | 5                       |
|                                    | Shou Shan           | 16             | 328                                | 0.30             | 0.82    | 0.55             | 6                       |
| Taitung                            | Chihpen Hsi         | 1              | 15                                 | —                | —       | 0.15             | 7                       |
| Pingtung                           | Kenting (1985)      | 1              | 4                                  | —                | —       | 0.33             | 8                       |
|                                    | Kenting (1990)      | 2              | 9                                  | 0.25             | 0.33    | 0.29             | 8                       |
|                                    | Kenting (1996–1998) | 2              | 21                                 | 0.50             | 0.50    | 0.50             | 9                       |
|                                    | Kenting (1999)      | 1              | 11                                 | —                | —       | 0.38             | 10                      |
| <b>Introduced feral population</b> |                     |                |                                    |                  |         |                  |                         |
| (Japan)                            | Oshima              | 6              | 21                                 | 0.33             | 1.00    | 0.75             | 11                      |

<sup>1</sup> Key to references: 1. K.-Y.Chang (1999, p. 7). 2. Azuma and Norikoshi (1990, p. 47); Kawamura et al. (1988, table 1; 1991, p. 99). 3. S.-W. Chang (1999, p. 13). 4. Hai-Yin Wu (pers. obs., 1992–1994). 5. Lu et al. (1991, p. 94). 6. Hsu et al. (2000b, p.201); cf. Hsu and Lin (2001, p. 53). 7. Masui et al. (1986, p. 391). 8. Wu and Lin (1992, p. 88). 9. W. Birky (Rutgers University, pers. comm., 26 Apr. 2000). 10. Jon-Ne Yo (NTUZ, pers. comm.). 11. Kazama and Norikoshi (1991, p. 54).

<sup>2</sup> Excludes two groups in which sex was not determined for all adults.

<sup>3</sup> Excludes four groups in which sex was not determined for all adults.

and seeds are the primary food of this species (Table 20); known plant food sources include trees, shrubs, and herbs (Lee, 1991, p. 297). Locally, food sources include 38 plant species identified at Yushan National Park (Wu & Lin, 1996,

p. 24), 51 species at Jentse (Su, 1993, p. 16), 55 species at Kenting (Yo, 2000, p. 18), and 132 species at Fushan (K.-Y. Chang, 1999, p. 17; Chen, pp. 70–73). In addition to wild plants, at least 33 species of cultivated crops are opportunistically

TABLE 19. Home range area and population density reported in *Macaca cyclopis*.

| County                             | Locality      | No. of groups  | No. of individuals | Mean home range area (ha) | Mean population density (ind./ha) | References <sup>1</sup> |
|------------------------------------|---------------|----------------|--------------------|---------------------------|-----------------------------------|-------------------------|
| Ilan                               | Fushan        | 1              | 21                 | 97                        | 0.22                              | 1                       |
|                                    | Taipingshan   | 5              | 119                | 140                       | 0.17                              | 2                       |
| Nantou                             | Chichi Tashan | 1              | 75                 | 37                        | 2.03                              | 3                       |
| Nantou/Chia-I                      | Yushan N. P.  | 7              | ~200               | ~86                       | ~0.33                             | 4                       |
| Kaohsiung                          | Shou Shan     | 7–15           | 171–652            | 167                       | 0.26                              | 5                       |
|                                    |               | 1 <sup>2</sup> | ~40                | ~120                      | ~0.33                             | 6                       |
| Taitung                            | Chihpen       | 1              | >45                | ~200                      | ~0.22                             | 7                       |
|                                    | various       | 39             | ?                  | ?                         | (~0.001 groups/ha)                | 7                       |
| Pingtung                           | Kenting       | 1              | ~30                | ~100 <sup>3</sup>         | ~0.30                             | 8                       |
| <b>Introduced feral population</b> |               |                |                    |                           |                                   |                         |
| (Japan)                            | Oshima        | 6–8            | ~100               | ~30                       | 0.48 <sup>4</sup>                 | 9                       |

<sup>1</sup> Key to references: 1. K.-Y.Chang (1999, p. 27). 2. Kawamura et al. (1988, p. 2); Azuma and Norikoshi (1990, p. 44). 3. S.-W. Chang (1999, p. 13). 4. Hai-Yin Wu (pers. obs., 1992–1994). 5. Hsu and Agoramoorthy (1999, p. 64); Hsu and Lin (2001, pp. 51, 53). 6. Shu-Mei Chen (NTUZ, pers. comm., 17 Apr. 2000). 7. Masui et al. (1986, pp. 390, 391). 8. Jon-Ne Yo (NTUZ, pers. comm.). 9. Kazama and Norikoshi (1991, p. 54); Norikoshi (1991, p. 140).

<sup>2</sup> Provisioned group.

<sup>3</sup> Underestimated as ~20 ha by Wu and Lin (1993, p. 250).

<sup>4</sup> 0.26 in less favorable part of study area, 0.74 in more favorable part of study area.

TABLE 20. Foods reported eaten by *Macaca cyclopis*.

| Locality                   | Fruits, berries, seeds | Shoots, leaves, stems | Cultivated plants                  | Crustaceans, insects | Mollusks        | Vertebrates     | Other           | References <sup>1</sup> |  |
|----------------------------|------------------------|-----------------------|------------------------------------|----------------------|-----------------|-----------------|-----------------|-------------------------|--|
| Fushan                     | x                      | x                     |                                    | x <sup>2</sup>       |                 |                 | x <sup>3</sup>  | 1                       |  |
| Fushan                     | x                      | x                     |                                    | x                    |                 |                 | x <sup>4</sup>  | 2                       |  |
| Jentse                     | x                      | x                     |                                    | x                    |                 |                 |                 | 3                       |  |
| Taipingshan                | x                      |                       |                                    | x <sup>5</sup>       |                 |                 |                 | 4                       |  |
| Miaoli-Nantou <sup>6</sup> |                        |                       | x <sup>7</sup>                     |                      |                 |                 |                 | 5                       |  |
| Yushan N. P.               | x                      | x                     |                                    | x                    |                 |                 |                 | 6, 7                    |  |
| Shou Shan                  | x                      | x                     | x                                  | x <sup>8</sup>       |                 |                 |                 | 7                       |  |
| Kenting                    | x                      | x                     |                                    | x <sup>9</sup>       |                 |                 |                 | 8                       |  |
| Kenting                    | x                      | x                     |                                    | x <sup>2</sup>       | x <sup>10</sup> | x <sup>11</sup> | x <sup>12</sup> | 9                       |  |
| Unspecified                | x                      | x                     | x                                  | x <sup>13</sup>      | x               |                 |                 | 10                      |  |
|                            | x                      | x                     | x                                  | x <sup>14</sup>      |                 | x <sup>15</sup> |                 | 11                      |  |
|                            | x                      | x                     |                                    |                      |                 |                 |                 | 12                      |  |
|                            | x                      | x                     | x                                  | x <sup>16</sup>      |                 |                 | x <sup>17</sup> | 13                      |  |
|                            |                        |                       | x                                  |                      |                 |                 |                 | 14                      |  |
|                            |                        |                       | x                                  |                      |                 |                 |                 | 15                      |  |
|                            |                        |                       | <b>Introduced feral population</b> |                      |                 |                 |                 |                         |  |
| (Japan)                    | x                      | x                     |                                    |                      |                 |                 |                 | 16                      |  |

<sup>1</sup> Key to references: 1. K.-Y. Chang (1999, pp. 17–20). 2. Chen (1999, pp. 13–15). 3. Su (1993, p. 10). 4. Kawamura et al. (1988, pp. 3, 4; 1991, p. 98); Azuma and Norikoshi (1990, p. 44). 5. Chang (2000, p. 5). 6. Wu and Lin (1996, p. 24). 7. Hai-Yin Wu (pers. obs.). 8. Wu and Lin (1992, p. 86; 1993, p. 249). 9. Yo (2000, p. 18–21). 10. Swinhoe (1863, p. 351). 11. Bergner (1967, p. 35). 12. McCullough (1974, p. 11). 13. Poirier and Davidson (1979, pp. 147, 159). 14. Lee and Lin (1991, p. 35). 15. Hsu and Agoramoorthy (1997, p. 835). 16. Shirai (1988, p. 22); Kazama and Norikoshi (1991, p. 53).

<sup>2</sup> Insects, wasp nests.

<sup>3</sup> Gum, plant galls.

<sup>4</sup> Clay, tree bark, plant galls.

<sup>5</sup> Insects.

<sup>6</sup> Includes five counties: Miaoli, Taichung, Changhua, Yunlin, Nantou.

<sup>7</sup> Thirty-three species listed.

<sup>8</sup> Insects, termite mound.

<sup>9</sup> Cicadas, caterpillars.

<sup>10</sup> Snails.

<sup>11</sup> Frog tadpoles (in tree hollow), birds eggs.

<sup>12</sup> Clay.

<sup>13</sup> Crustaceans, grasshoppers.

<sup>14</sup> Crayfish, cockroaches, flies.

<sup>15</sup> Lizards.

<sup>16</sup> Crustaceans.

<sup>17</sup> Mushrooms, lichens, tree bark.

exploited (Chang, 2000, p. 5). The diet of the introduced feral population of *M. cyclopis* in Oshima (island), Japan, apparently is similar to that of natural populations (Norikoshi, 1991, p. 140).

Reported animal food consumed by *M. cyclopis* includes crayfish, grasshoppers, cockroaches, termite mounds, cicadas, beetles, caterpillars, flies, wasp nests, snails, tadpoles, lizards, and birds eggs (Table 20). In captivity, fish and beef are eaten (Yang et al., 1968, p. 538; Peng et al., 1973, p. 202). Like *M. mulatta* (Fooden, 2000, p. 59), natural populations of *M. cyclopis* have been observed to eat clay.

The peak feeding time for *M. cyclopis* is in the

early morning, shortly after a group awakens, and a secondary feeding peak occurs in the afternoon (Bergner, 1967, p. 34; Poirier & Davidson, 1979, p. 161; Lu et al., 1991, p. 96; Wu & Lin, 1993, p. 245). The recorded proportion of daylight hours devoted to foraging was 30–35% at Hengchun Nature Preserve, Kenting National Park (Wu & Lin, 1993, p. 246) and approximately 60% at Yushan National Park (Lu et al., 1991, p. 96).

Although Poirier and Davidson (1979, p. 162) postulate that plant foods supply much of the water requirements of *M. cyclopis*, they report that a monkey sometimes will lick water from tree trunks or branches and from its own body or the

body of another monkey. This species also has been observed to lick water droplets from wet rocks and to drink from streams, ponds, and tree holes (Hai-Yin Wu, pers. obs.). Food washing by captive *M. cyclopis* has been reported by Tateishi (1958, p. 90).

## Predators

The two reported predators of *M. cyclopis* are an eagle (Poirier & Davidson, 1979, p. 151)—probably the hawk eagle, *Spizaetus nipalensis*—and the clouded leopard, *Neofelis nebulosa* (Kano, 1930, p. 165; Imaizumi, 1970, p. 287; McCullough, 1974, p. 16; cf. Wozencraft, 1993, p. 297). An encounter between *M. cyclopis* and *S. nipalensis*, which is the largest bird of prey in Taiwan, has been observed in Kenting National Park (Hai-Yin Wu, pers. obs.): when an eagle flew into the tree in which a group of monkeys was resting, the monkeys sounded an alarm call and moved out of the tree; subsequently, an adult male monkey returned to the tree and shook a branch opposite the eagle's perch. Human predation on *M. cyclopis* apparently has declined during the last two or three decades, primarily as a result of recent conservation legislation (Steere, 1876, p. 310; Campbell, 1903, p. 551; Kano, 1929, p. 333; 1930, p. 165; McCullough, 1974, p. 11; Poirier & Davidson, 1979, p. 176; Lee & Lin, 1991, p. 36; Agoramorthy, 1998, p. 73).

## Intergroup Dispersal

At Kenting National Park, during a five-year period (1985–1990), three adult males and one subadult male emigrated from two *M. cyclopis* study groups, of which the total population varied from 10 to 29 individuals (Wu & Lin, 1992, p. 92). During the same period, four adult males immigrated into these two study groups; although one of the immigrant males had been artificially released into the area by local residents, the other three immigrants presumably came from neighboring groups without human intervention. Group tenure of five adult males in the study groups varied from 5 months to >28 months; mean group tenure was >17.5 months. No direct interaction was observed between the two study groups and three neighboring groups (Wu & Lin, 1992, p. 87).

At Shou Shan, during a 2.75-year period

(1995–1997), males ( $n = 54$ ) reportedly emigrated from their natal groups at age 5–6 years (Hsu & Agoramorthy, 1999, p. 64; Hsu & Lin, 2001, p. 55); subsequently, these males either joined a neighboring group or became solitary. The mean tenure of 34 males as alpha dominant individuals in Shou Shan groups was  $16.8 \pm 18.9$  months (extremes 1 week–6 years).

A study of mtDNA in *M. cyclopis* groups at Shou Shan indicated that several pairs of males with the same haplotype had dispersed into resident groups with a different haplotype (Jui-Hua Chu, pers. comm., 15 Apr. 2000; cf. Wu et al., 2001b, p. 414); however, it cannot be ascertained whether or not individuals in the dispersing pairs came from the same natal group. All-male groups that have been observed at Taipingshan and Kenting (see above, Group Size and Composition) probably were temporary aggregations of dispersing males.

Females of *M. cyclopis* apparently usually remain in their natal groups. However, during the 1995–1997 study period at Shou Shan, six adult females were observed to successfully immigrate into new groups (Hsu & Lin, 2001, p. 55).

## Reproduction

### Seasonality

Reproduction is strongly seasonal in *M. cyclopis* (Table 21). In natural populations of this species, copulation frequency peaks during the period November–January and birth frequency peaks during the period March–June. Copulations may occur at a low frequency outside of the peak mating season, but these probably are mostly infertile; births apparently are rare or absent during the period September–January. Climatologically, the peak mating season generally is a period of decreasing temperature and rainfall, and, conversely, the peak birth season generally is a period of increasing temperature and rainfall (Wu & Lin, 1992, p. 86; Hsu et al., 2001, p. 17). In laboratory captives, annual mating and birth peaks apparently are attenuated but not extinguished.

### Sexual Skin

Cyclical changes of the sexual skin, correlated with ovulatory cycles, are conspicuous in *M. cy-*



TABLE 21. Observations concerning reproductive seasonality in *Macaca cyclopis*.<sup>1</sup>

| Sample area                | Observation period  | Mating/birth observations   | References <sup>2</sup> |
|----------------------------|---------------------|---|-------------------------|
| <b>Matings</b>             |                     |   |                         |
| <b>Free-ranging groups</b> |                     |   |                         |
| Shou Shan                  | Jan. 1995–Oct. 1997 | Most successful matings: Sep.–Feb.                                  | 1                       |
| Kenting                    | Oct. 1987–Apr. 1990 | 304 copulations observed: Nov.–Jan.,<br>274; Feb.–Oct., 30          | 2                       |
| Taiwan                     | ?                   | Uncertain, usually Oct.–Nov.  | 3                       |
| Nojima I., Japan           | Aug. & Oct. 1962    | 6 copulations reported, Aug. and/or<br>Oct.                         | 4                       |
| <b>Captive groups</b>      |                     |   |                         |
| Ueno Zoo, Japan            | ca. 1958            | Summer amenorrhea observed,<br>Jun.–Aug.                            | 5                       |
| Taipei, lab                | 1966–1972           | 13 pregnancies, Aug.–Jun.   | 6                       |
| Taipei Zoo                 | Sep. 1989–Mar. 1990 | 970 copulations observed, most<br>Dec.–Feb.                         | 7                       |
| Taipei Zoo                 | ca. 1995, 1 yr      | Sperm count peaks Oct.–Dec. <sup>3</sup>                            | 8                       |
| <b>Births</b>              |                     |   |                         |
| <b>Free-ranging groups</b> |                     |   |                         |
| Taipingshan                | ?                   | May–Jun   | 9                       |
| NE Taiwan                  | ?                   | Jun.  | 10                      |
| E Taiwan                   | ?                   | Mar.–Oct.   | 9                       |
| S Taiwan                   | ?                   | Mar.–Sep.   | 9                       |
| Shou Shan                  | Jul. 1963           | 6 births, Jun. or Jul.  | 11                      |
| Shou Shan                  | 1996–1999           | 479 births, Feb.–Aug.   | 12                      |
| Kenting                    | Mar. 1985–Aug. 1990 | 28 infants observed: 25 born<br>Mar.–Jun.; 2 born Feb.; 1 born Aug. | 2                       |
| Taiwan                     | 1965–1969           | 48 births, <sup>4</sup> Mar.–Jun.                                   | 6                       |
| Taiwan                     | ?                   | Mar.–May  | 13                      |
| <b>Captive groups</b>      |                     |   |                         |
| Kurabayashi Zoo, Japan     | 1954–1958           | 7 births, Mar.–Jun.   | 14                      |
| Taipei, lab                | 1965–ca. 1968       | 54 births, <sup>5</sup> Mar.–Jul.                                   | 15                      |
| U.S.A., lab                | 1967–1992           | 143 infants: 59 born Mar.–May; 84<br>born Jun.–Feb.                 | 16                      |
| Taipei Zoo                 | 1989–1990           | 25 births, Apr.–Jun.; 1 birth, Jul.; 1<br>birth, Aug.               | 17                      |

<sup>1</sup> Cf. Kano (1929, p. 333), who indicates that matings and births are nonseasonal in *M. cyclopis*.<sup>2</sup> Key to references: 1. Hsu and Agoramorthy (1999, p. 64); Hsu et al. (2001, p. 18); Hsu and Lin (2001, p. 54). 2. Wu and Lin (1992, pp. 89, 90). 3. Dien (1958, p. 346). 4. Nishida (1963, p. 121). 5. Asakura (1958, p. 162). 6. Peng et al. (1973, pp. 206, 209). 7. Wu (1996, abstract no. 117). 8. Chi et al. (1998, p. 34). 9. Poirier and Davidson (1979, p. 153). 10. Swinhoe (1863, p. 351). 11. Bergner (1967, p. 33). 12. Hsu et al. (2000a, p. 154; 2001, p. 18); Hsu and Lin (2001, p. 54). 13. McCullough (1974, p. 10). 14. Tateishi (1958, p. 89). 15. Yang et al. (1968, p. 540). 16. Petto et al. (1995, p. 339). 17. Chen et al. (1990, p. 24).<sup>3</sup> Studied by electroejaculation.<sup>4</sup> Wild-trapped pregnant females; infants born in two Taipei laboratories.<sup>5</sup> Probably includes some or all of 48 births cited above (see Taiwan, 1965–1969).

*clopis* females (Sclater, 1865, p. 710; Murie, 1873, p. 772; Hsu, 1990, pp. 52, 60; cf. Nunn, 1999, pp. 232, 245; van Schaik et al., 1999, pp. 219, 234). The affected area extends broadly over the hindquarters from the root of the tail to the back of the thighs, almost as far as the popliteal fossae. This area becomes prominently red and swollen in subadult and young adult females; in older females, the sexual skin undergoes cyclical changes in redness but not in tumescence (Hai-

Yin Wu, pers. obs.). In three young females in a carefully studied natural population, the first signs of reddening and swelling of the sexual skin were detected at age 2.5–2.75 years (Wu & Lin, 1992, p. 89); approximately 1 year later, during the mating season, the sexual skin in these females was prominently developed. The timing of sexual skin development follows a similar course in laboratory captives, in which it has been further noted that a female's first menstruation (menarche) oc-

TABLE 22. Menstrual cycle duration in captive *Macaca cyclopis*.

| Location of colony  | Menstrual cycle duration |                 | N       |        | References <sup>1</sup> |
|---|--------------------------|-----------------|---------|--------|-------------------------|
|   | Mean (days)              | Extremes (days) | Females | Cycles |                         |
| <b>Determined by observation of menstrual bleeding</b>              |                          |                 |         |        |                         |
| Taipei, lab   | 29.4 ± 15.5 (SD)         | 6–109           | 54      | 398    | 1                       |
| U.S.A., lab   | 27.9 ± 0.5 (SE)          | <22–>40         | 31      | 555    | 2                       |
| <b>Determined by hormonal assay and/or laparoscopic examination</b> |                          |                 |         |        |                         |
| Taipei Zoo  | 27.8 ± 2.9 (?SE)         | —               | 3       | 8      | 3                       |
| Taipei Zoo  | 27.3 ± 8.9 (SD)          | 22–35           | 6       | 18     | 4                       |

<sup>1</sup> Key to references: 1. Peng et al. (1973, p. 203). 2. Petto et al. (1995, p. 340). 3. Chen and Lin (1991, p. 42). 4. Chi (1997, p. 43).

curs a few months before or after onset of her sexual skin development (Peng et al., 1973, p. 210; Petto et al., 1995, p. 344).

The relationship between color changes of the sexual skin and stages of the menstrual cycle has been studied in older *M. cyclopis* females at the Taipei Zoo by Chi (1997, p. 45). The sexual skin is pink during the period of menstrual bleeding; it becomes red by day 6 of the cycle and is deep reddish purple by day 14 (typical day of ovulation); after ovulation, the color rapidly fades and is pink by day 18 and pale pink by day 23 (4 days before onset of the next menstrual bleeding).

The annual cycle of sexual skin changes was monitored during 1997–1998 in 15 adult females in a natural group at Shou Shan (Shu-Mei Chen, NTUZ, pers. comm., 17 Apr. 2000). In this group, color changes were restricted to the period from mid-October to late January. The number of color-change cycles per adult female varied from zero to five, and the duration of the color-change cycles varied from 10 days to 48 days.

In males, an annual change in the color of facial skin and scrotal skin has been noted at Shou Shan by Shu-Mei Chen (NTUZ, pers. comm., 17 Apr. 2000). During the mating season, the facial and scrotal skin becomes more intensely red; this is particularly evident in the seasonal appearance in males of a pair of narrow red streaks that extend laterally from the outer corner of each eye (cf. Fooden, 1975, p. 114).

### Polythelia

Supernumerary nipples and/or areolae have been observed in 89 of 211 adult females (42.2%) and in 20 of 117 adult males (17.1%) in 16 groups of *M. cyclopis* that were studied at Shou Shan,

southwestern Taiwan (Hsu et al., 2000b, p. 201; Wu et al., 2001a, p. 387). The frequency of supernumerary nipples apparently is greater in females that produced twins than in females that produced singletons. Possible causes suggested for the high incidence of polythelia in this isolated population are inbreeding and/or artificial provisioning.

### Menstrual Cycles

In two large studies of captive *M. cyclopis*, based on observations of menstrual bleeding, mean length of the menstrual cycle was determined as 29.4 days and 27.9 days (Table 22); the discrepancy between these mean values may be related to the authors' divergent treatment of outlier cycle lengths and summer amenorrhea. In two smaller studies, based on hormonal assays and laparoscopic examinations, mean menstrual cycle length was determined as 27.8 days and 27.3 days. Mean duration of the menstrual bleeding period was determined as  $4.2 \pm 3.2$  (SD) days (extremes, 1–17 days,  $n = 44$  periods) in one of the larger studies (Peng et al., 1973, p. 204) and as  $3.4 \pm 0.6$  (SD) in one of the smaller studies (Chi, 1997, p. 43). The same small study also determined that ovulation occurs two days after the peak concentration of circulating estradiol or  $14.1 \pm 1.3$  (SD) days after the first day of menstrual bleeding.

In 15 adult females studied during the 1997–1998 breeding season at Shou Shan, the frequency of menstrual bleeding cycles varied from zero per female to two per female (Shu-Mei Chen, NTUZ, pers. comm., 17 Apr. 2000). Of 20 menstrual cycles observed, five cycles (of five females) occurred during the period early August to mid-October.

tober and 15 occurred during the period mid-October to early January.

### Sexual Maturation

In natural populations, females generally produce their first young either at age 4 years or at age 5 years (Wu & Lin, 1992, p. 89; Hsu & Agoramoorthy, 1999, p. 64; Hsu et al., 2001, p. 20; Hsu & Lin, 2001, p. 54), which indicates that their first fertile copulations occur at age ca. 3.5 years or ca. 4.5 years. The age of sexual maturation of males in natural populations has not been reported, but it probably is at least 5–6 years, at which age males emigrate from their natal troops (Hsu & Agoramoorthy, 1999, p. 64). Although the mean age of sexual maturation in captive females and males apparently is similar to that in natural populations (Peng et al., 1973, p. 210; Petto et al., 1995, p. 336), semen with normal sperm count has been obtained by electroejaculation of males weighing as little as 5.0 kg (age <4.0 years) (Peng et al., 1973, p. 211). In one laboratory colony, the mean age at first reproduction tended to increase in successive generations of captives, reaching 6.75 years in the third captive generation of females and 9.0 years in the third captive generation of males (Petto et al., 1995, p. 336).

### Copulation

The copulatory posture of *M. cyclopis* (Hsu, 1990, pp. 50, 55) apparently is similar to that of *M. mulatta* (Fooden, 2000, p. 72); copulations in *M. cyclopis* occur both on the ground and in trees. In the Taipei Zoo population of *M. cyclopis*, both single-mount ejaculation (SME) and multimount ejaculation (MME) have been observed (Wu, 1996, abstract no. 117); in dominant males, MME tends to be more frequent than SSE. In another captive group, copulation was often preceded by rhythmic lip movements performed with male and female facing one another (Akitsu, 1959, p. 85).

During the peak mating season, nontroop males have been observed to approach a troop and to copulate with troop females (Wu & Lin, 1992, p. 93; Hsu & Lin, 2001, pp. 51, 55); on at least three occasions during the mating season, nontroop males have ascended to dominant status in troops that they entered (Wu et al., 1991, p. 31; cf. Hsu & Agoramoorthy, 1999, p. 64). Conversely, some subordinate females at Yushan and Shou Shan

have been observed to spend several days during the mating season away from their troops in the company of nontroop males (Hai-Yin Wu, pers. obs.; Shu-Mei Chen, NTUZ, pers. comm., 17 Apr. 2000). At the Taipei Zoo, DNA testing revealed that all three juveniles present in a captive group of *M. cyclopis* were sired by the dominant male (Chu et al., 1999, p. 376); in addition to the dominant male, this group included two subordinate adult males.

In an introduced *M. cyclopis* population in Japan, copulations between members of neighboring troops were observed six times in 12 days (Nishida, 1963, p. 121). In the same introduced population in Japan, female activity during estrus has been intensively studied by Kawai and Mito (1973, pp. 183, 185): estrous females become active 1 hour earlier than nonestrous females, and, during the day, the frequency of movement of estrous females was approximately twice that of nonestrous females.

### Gestation and Parturition

Mean length of the gestation period was  $162.0 \pm 9.6$  (SD) days in nine laboratory colony pregnancies (Peng et al., 1973, p. 208; cf. Hsu et al., 2001, pp. 17, 18); extreme lengths were 142 days and 175 days. Of 54 laboratory births, 40 (74%) occurred between the hours of 1700 and 0800 (Yang et al., 1968, p. 540).

One parturition was observed in the field at Shou Shan on 16 Jun. 1998 (Shu-Mei Chen, NTUZ, pers. comm., 17 Apr. 2000). Contractions of the mother were first detected at 1535, and the infant was born at 1646; during the entire interval, the mother was on the ground. Following birth of the infant, the mother ate the placenta. During the same birth season at Shou Shan, four additional infants apparently were born at night; all four of these infants, which were first seen early in the morning, were born to mothers who had been observed to be pregnant the preceding evening.

### Reproductive Rate

The known reproductive rate in natural populations of *M. cyclopis* varies from 0.45 to 0.95 births per sexually mature female per year (Table 23); although data for these populations are not directly comparable, the mean annual reproductive rate probably is approximately 0.70. The

TABLE 23. Annual reproductive rate (number of births/number of sexually mature females) in natural populations of *Macaca cyclopis*.

| County    | Locality    | Observation period | No. of groups | No. of individuals | Annual reproductive rate | References <sup>1</sup> |
|-----------|-------------|--------------------|---------------|--------------------|--------------------------|-------------------------|
| Ilan      | Taipingshan | 1987–1989          | 1             | ca. 25             | 0.45                     | 1                       |
| Kaohsiung | Shou Shan   | 1995               | 7             | 171                | 0.47                     | 2                       |
|           |             | 1996               | 7–15          | 171–652            | 0.70                     |                         |
|           |             | 1997               | 15            | 652                | 0.83                     |                         |
| Pingtung  | Kenting     | 1985–1987          | 1             | 10–14              | 0.95                     | 3                       |
|           |             | 1987–1990          | 2             | 9–16               | 0.71 <sup>2</sup>        |                         |
|           |             | 1996               | 1             | 18–30              | 0.67                     | 4                       |
|           |             | 1997               | 1             | 18–30              | 0.67                     | 5                       |
|           |             | 1998               | 1             | 18–30              | 0.67                     |                         |
| 1999      | 1           | 18–30              | 0.75          |                    |                          |                         |
| MEAN      |             |                    |               |                    | 0.69                     |                         |

<sup>1</sup> Key to references: 1. Azuma and Norikoshi (1990, p. 44); Norikoshi (1991, p. 136). 2. Hsu and Agoramoorthy (1999, p. 64); Hsu et al. (2001, p. 18); Hsu & Lin (2001, p. 54). 3. Wu and Lin (1992, p. 89). 4. W. Birky (Rutgers University, pers. comm., 26 Apr. 2000). 5. Jon-Ne Yo (NTUZ, pers. comm.).

<sup>2</sup> 0.44 in one group (4 infants/9 mature female-years); 0.92 in second group (11 infants/12 mature female-years).

mean interbirth interval for eight sexually mature females at Kenting was 15.4 months (extremes 10.5–24.0 months,  $n = 19$  intervals; Wu & Lin, 1992, p. 91), and that for 144 sexually mature females at Shou Shan was 13.4 months (extremes 8.9–34.2 months, 288 intervals; Hsu et al., 2001, p. 19). In a laboratory colony, the mean interbirth interval was ca. 20 months ( $n = 108$  intervals) (Petto et al., 1995, p. 337).

At Yushan National Park, during 1992–1993, the mean proportion of adult females with infants was only ca. 0.39 in six groups ranging in size from 14 to 36 members (Hai-Yin Wu, pers. obs.); proportions in individual groups were 0.20, 0.31, 0.36, <0.43, 0.50, and 0.60. It is unknown whether this low mean infant/adult female proportion is the result of a low birth rate or of a low infant survival rate.

### Neonatal Sex Ratio, Twinning, Birth Weight

Neonatal sex ratios are available for two natural populations of *M. cyclopis* (Table 24). Although these ratios appear to vary annually and locally, the composite ratio is 1.19 males:1.00 females, which is not significantly different from 1:1 ( $X^2 = 0.545$ ,  $P > 0.10$ ).

Six pairs of twins were included among 596 infants born in 7–16 groups observed during five birth seasons at Shou Shan, southwestern Taiwan (twinning rate = 1.0%) (Hsu & Agoramoorthy, 1999, p. 64; Hsu et al., 2000a, p. 155; 2000b, p.

203). Both members of two pairs of twins survived for more than 3 years; one member of two other pairs died within 30 days of birth; both members of one pair died within 7 days of birth; and one member of one pair was aborted ca. 8 weeks before live birth of the second member.

As previously indicated, mean birth weight was 402 g in 89 captives born in Taipei and 430 g in 22 captives born in the U.S.A. (Table 2). Although overall mean values were identical in two studies of captives in Taipei, one study indicated that female neonates are slightly heavier than male neonates and the other indicated the converse.

### Infant Mortality

At Shou Shan, 105 of 475 infants (22.1%) born during the period Jan. 1996–Dec. 1999 died before reaching age 1 year (Hsu et al., 2001, p. 21; cf. Hsu & Agoramoorthy, 1999, p. 64). Of these 105 infant deaths, 32 (30.5%) were stillbirths, 16 (15.2%) occurred during the first week of life, and 18 (17.1%) occurred between age 1 week and 1 month. Two deaths at ages 42 days and 59 days were the result of accidental falls from trees, and seven infant deaths may have been the result of infanticide by immigrant males (Hsu & Agoramoorthy, 1999, p. 64).

At Kenting during the period 1985–1990, 20% of infants in one to two groups died before reaching age 1.5 years (Wu & Lin, 1992, p. 92). At

TABLE 24. Neonatal sex ratio in natural populations of *Macaca cyclopis*.

| County    | Locality          | Observation period | No. of infants |        | M/F ratio | References <sup>1</sup> |
|-----------|-------------------|--------------------|----------------|--------|-----------|-------------------------|
|           |                   |                    | Male           | Female |           |                         |
| Kaohsiung | Shou Shan         | 1995               | 3              | 2      | 1.50      | 1                       |
|           |                   | 1996               | 4              | 1      | 4.00      |                         |
|           |                   | 1997               | 2              | 4      | 0.50      |                         |
|           |                   | 1998               | 9              | 1      | 9.00      |                         |
| Pingtung  | Shou Shan, totals | 1995–1998          | 18             | 8      | 2.25      | 2                       |
|           | Kenting           | 1985–1990          | 12             | 14     | 0.86      |                         |
|           |                   | 1996               | 2              | 2      | 1.00      |                         |
|           |                   | 1997               | 3              | 1      | 3.00      |                         |
|           |                   | 1998               | 0              | 4      | 0.00      |                         |
|           |                   | 1999               | 3              | 3      | 1.00      |                         |
|           | Kenting, totals   | 1985–1999          | 20             | 24     | 0.83      |                         |
| TOTALS    |                   |                    | 38             | 32     | 1.19      |                         |

<sup>1</sup> Key to references: 1. Shu-Mei Chen (NTUZ, pers. comm., 17 Apr. 2000). 2. Wu and Lin (1992, p. 89). 3. W. Birky (Rutgers University, pers. comm. 26 Apr. 2000). 4. Jon-Ne Yo (NTUZ, pers. comm.).

Taipingshan, by contrast, all four infants born in one group in 1987 survived to at least age 1 year (Azuma & Norikoshi, 1990, p. 54; Kawamura et al., 1988, p. 8; 1991, p. 99).

In laboratories in Taipei, 22 abortions or stillbirths occurred among 72 wild-trapped pregnant captives (31%) and two abortions or stillbirths occurred among 12 laboratory-bred captives (17%) (Peng et al., 1973, p. 210). In a U.S. laboratory, 32 of 173 pregnancies resulted in stillbirths (18%), and five infants (3%) died within 30 days after birth (Johnson et al., 1986, p. 773; cf. Price et al., 1972, p. 307).

### Nursing; Longevity

In natural populations of *M. cyclopis*, females apparently nurse their infants for 6–12 months (Bergner, 1967, p. 35). The greatest age reported to have been reached by an individual of this species—a captive male at Uchide Park, Ashiya City, Hyogo Prefecture, Japan—is 39 years (Anonymus, 2000, p. 9).

### Population Growth Rate

In seven groups studied at Shou Shan, southwestern Taiwan, the average annual population growth rate from Dec. 1994 to Dec. 1997 was 24.4% (Hsu & Lin, 2001, p. 53). During the course of this study, the annual growth rate declined from 29.0% in 1994–1995 to 18.7% in 1996–1997.

### Fossils

Fossils identified as *Macaca* sp. have been collected, associated with numerous other fossil vertebrates, in the vicinity of Tsochen (= Chochen), Tainan Hsien (= county), southwestern Taiwan (Otsuka, 1984, pp. 37, 42, 44). The age of the Tsochen vertebrate fossil fauna is estimated to extend from Early Pleistocene to Middle Pleistocene (ca. 1.2–0.3 Ma) (Otsuka, 1984, pp. 50, 51; Qi et al., 1999, p. 39; Chen, 2000, p. 238); the fauna of the beds (KU4, KU5) that have yielded the monkey fossils belongs to the later part of this interval (Otsuka, 1984, p. 44; Lai, 1989, p. 45). Other families of terrestrial mammals that have been collected in the vicinity of Tsochen include Stegodontidae (5 spp.), Elephantidae (4 spp.), Felidae (1 sp.), Hyaenidae (1 sp.), Rhinocerotidae (1 sp.), Tapiridae (1 sp.), Equidae (1 sp.), Hippopotamidae (1 sp.), Suidae (2 spp.), Cervidae (9 spp.), and Bovidae (4 spp.) (Lai, 1989, p. 39).

Another important Taiwanese fossil vertebrate fauna—lacking monkeys, however—has been dredged by fisherman from the floor of the Taiwan Strait, west-northwest of Tsochen (Lai, 1989, p. 45; Chen, 2000, p. 238); this fauna dates to the last glacial age, Late Pleistocene, ca. 0.12–0.01 Ma (cf. Liew et al., 1998, p. 92). The genera (one species each, except *Cervus*) of terrestrial mammals that are included in the Penghu fauna are *Palaeoloxodon*, *Hyaena*, *Equus*, *Sus*, *Cervus* (2 spp.), *Elaphurus*, *Bubalus*, and *Capricornis*. As expected from the age difference between the Tsochen and Penghu faunas, they have no mammalian species in common (Lai, 1989, p. 45).

Holocene subfossil macaques have been reported from archeological sites dated to the late Neolithic period (3.5–2.0 Ka) and the “Metal Age” (2.0–0.4 Ka) (Chen, 2000, p. 240).

The original monkey fossils reported from Tsochen by Otsuka (1984, p. 37) apparently consisted of one or more teeth, but this material has been lost (Kin-Yang Lai, TM, retired, pers. comm., 22 Apr. 1999). However, we have been able to examine eight fossil monkey teeth subsequently collected near Tsochen from the same beds that yielded the original monkey fossils (Table 25; Figs. 6, 7): seven of these fossils were collected between 1992 and 1998 by Liang-Jeh Wang, who generously provided access to them, and one was collected in 1992 by Ji-Nan Yeh. We have also examined two additional fossil monkey teeth collected in neighboring counties; one of these was collected by Mr. Wang in 1992–1996 in Kao-siung Hsien, about 20 km south of Tsochen, and the other was collected by Wen-Chi Xue in 1998 in Chia-I Hsien, about 50 km north of Tsochen.

In collaboration with Eric Delson (AMNH), we are currently undertaking a detailed study of these ten fossil teeth. Our preliminary findings are: (1) all ten fossil teeth may be allocated to the genus *Macaca*, as previously determined for other Tsochen specimens by Otsuka (1984, pp. 37, 42, 44); (2) morphologically, these teeth are generally similar to those of extant *M. cyclopis*; (3) measurements of seven fossil teeth are within the range of variation of a sample of extant *M. cyclopis* teeth (Tables 25, 26); (4) measurements of three fossil teeth (specimen nos. 4, 6, and 12) are <1 mm beyond the range of variation of the sample of extant *M. cyclopis* teeth.

## Taxonomy

### Synonymy

#### *Macaca cyclopis*

Swinhoe, 1863 (“1862”), p. 350

[S]inges: Du Halde, 1735, p. 162—reported in western Taiwan, based on visit in 1715 by Jesuit missionary Père J.-A.-M. de Moyria de Mailla (cf. Du Halde, 1735, p. xxxiv; Weiss, 1870–1873, p. 120; Campbell, 1903, pp. 504, 506; Davidson, 1903, p. 68).

*Macacus speciosus*: Swinhoe in Blyth, 1860, p. 88 (not I. Geoffroy, 1826, p. 589)—“large Formosa Monkey . . . frequents the rocks on the coast of Formosa, especially in the neighborhood of *Sakow* or ‘Ape’s hill’” (p. 87); external characters.

*Macacus cyclopis* Swinhoe, 1863 (“1862”), p. 350, pl. 42—proposed provisionally; for details concerning type series, see below. Sclater, 1865 (“1864”), p. 710, fig. p. 711—type history; external characters; probably specifically distinct from *Macaca mulatta*. Gray, 1870, pp. 31, 128—type series catalogued. Swinhoe, 1871 (“1870”), p. 615—type history. Sclater, 1871, p. 222—unproved as specifically distinct from *Macaca mulatta*. Murie, 1873 (“1872”), p. 771—type history; external and skeletal characters; specific status supported. Schlegel, 1876, p. 114—listed as an inadequately known geographic variant of *Macacus erythraeus* [= *Macaca nullatta*].

*Macaca cyclopis*: Pocock, 1926 (“1925”), p. 1547—sexual skin.

*Macaca cyclopis*: Kuroda, 1935, p. 291—collection report. Kuroda, 1938, p. 111—locality records. Kellogg, 1945, p. 119—type-locality restriction. “Jusan (Apes’ Hill), Takao prefecture, Formosa.” Jones, 1975, p. 189—type locality questionable. “?Apes Hill.” Napier, 1981, p. 26—type series catalogued.

[*muus*] *cyclopis*: Blyth, 1875, p. 5—taxonomic relationship.

[*Silenus*] *cyclopis*: Stiles & Nolan, 1929, p. 528—parasites.

*Parasilenus cyclopis*: Kishida, 1939 (work not seen); 1953, pp. 7, 24, 79—taxonomy.

*Pithecus cyclopsis*: Elliot, 1913, pp. 181, 202—incorrect subsequent spelling, not an available name; type locality, “Island of Formosa”; lectotype designated. “The type is a young male” (p. 203); external characters; external and cranial measurements of lectotype.

*Macaca cyclopsis*: Kishida, 1924, pp. 15 (index), 215—allocated to subgenus *Nemestrinus*. Aoki, 1930, p. 505—habitat. Horikawa, 1932, p. 69—species account. Carter et al., 1945, pp. 68, 203—taxonomic relationship. Tate, 1947, p. 134—external characters.

*Macaca cyclopsis*: Saheki et al., 1962, p. 101—dental morphology.

*Macacus cyclopsis*: Satoh et al., 1956, p. 41—external measurements and proportions.

*Rhesus cyclopsis*: Furuya, 1962, p. 377—dermatoglyphics.

*Macacus Cyclapis*: Horikawa, 1925, p. 237—incorrect subsequent spelling, not an available name; geographic distribution.

*Macacus cyclapis*: Kano, 1929, p. 333—geographic distribution. Kano, 1930, p. 165—ethnozoology.

*Macaca coclopis*: Kuroda, 1952, p. 288—incorrect subsequent spelling, not an available name; listed.

*Macacus Sancti-Johannis*: Gray, 1870, p. 129 (not Swinhoe, 1867 [“1866”], p. 556)—misidentification of BM(NH) 1868.4.14.4 (cf. Anderson, 1879, p. 87).

*Macacus (radiatus) affinis*: Elliot, 1913, p. 202 (not Blyth, 1863, p. 8)—misidentification (see Remarks below).

### Type Series

*Macacus cyclopis* Swinhoe, 1863 (“1862”), p. 350, is based on a captive male and a captive

TABLE 25. Taiwanese fossil monkey teeth: measurements and collection information.

| Fossil no. <sup>5</sup> | Tentative identification         | Measurements <sup>6</sup> (mm) |      |      | Collection information |                                    |           |                       |                        |
|-------------------------|----------------------------------|--------------------------------|------|------|------------------------|------------------------------------|-----------|-----------------------|------------------------|
|                         |                                  | AP L                           | A Br | P Br | Collector <sup>7</sup> | Year                               | County    | Locality <sup>8</sup> | Custodian <sup>9</sup> |
| 5                       | L P <sup>4</sup>                 | 5.1                            | 6.1  | —    | Wang                   | 1992–1996                          | Tainan    | Ihsindian             | THNHEC                 |
|                         |                                  |                                |      |      |                        | <b>P<sup>3</sup>–P<sup>4</sup></b> |           |                       |                        |
| 1                       | R M <sup>3</sup> (?)             | 7.5                            | 7.2  | 6.2  | Yeh                    | 1992                               | Tainan    | Sanchunghsi           | TFM                    |
| 2                       | R M <sup>2</sup> (?)             | 8.7                            | 7.7  | 7.3  | Wang                   | 1992–1996                          | Tainan    | Sankanshan            | TFM                    |
| 4                       | R M <sup>3</sup>                 | 9.1                            | 7.9  | 6.6  | Wang                   | 1992–1996                          | Tainan    | Ihsindian             | THNHEC                 |
| 7                       | L M <sup>1</sup> (?)             | 6.5                            | 6.0  | 6.0  | Wang                   | 1992–1996                          | Kaohsiung | Hsiaokunshui          | L-J W                  |
| 11                      | L M <sup>2</sup> /M <sup>3</sup> | 7.3                            | 7.7  | 6.8  | Wang                   | 1992–1996                          | Tainan    | Sankanshan            | TFM                    |
|                         |                                  |                                |      |      |                        | <b>M<sub>1</sub>–M<sub>2</sub></b> |           |                       |                        |
| 6                       | R M <sub>1</sub> /M <sub>2</sub> | 9.5                            | 7.3  | 7.3  | Xue                    | 1998                               | Chia-I    | Shihtzulu             | W-C X                  |
| 8                       | L M <sub>2</sub> (?)             | 8.4                            | 6.8  | 6.5  | Wang                   | 1992–1996                          | Tainan    | Sanchunghsi           | L-J W                  |
|                         |                                  |                                |      |      |                        | <b>M<sub>3</sub></b>               |           |                       |                        |
| 3                       | R M <sub>3</sub>                 | 11.1                           | 7.1  | 7.1  | Wang                   | 1998                               | Tainan    | Kuoling               | L-J W                  |
|                         |                                  |                                |      |      |                        | <b>Deciduous premolar</b>          |           |                       |                        |
| 12                      | p <sup>4</sup> /p <sub>4</sub>   | 6.8                            | 4.2  | 4.0  | Wang                   | 1992–1996                          | Tainan    | Kuoling               | L-J W                  |

<sup>1–4</sup> Tooth-row position indicators.

<sup>5</sup> In the absence of formal catalog numbers, we have assigned informal interim numbers to these fossils. Fossil nos. 9 and 10 are problematic and are omitted here; these specimens will be discussed in a subsequent publication.

<sup>6</sup> Measurement abbreviations: AP L = anteroposterior length; A Br = anterior breadth; P Br = posterior breadth (inapplicable to permanent premolars).

<sup>7</sup> Complete names of collectors: Liang-Jeh Wang; Wen-Chi Xue; Jinan Yeh.

<sup>8</sup> See map, Figure 6.

<sup>9</sup> Key to abbreviations: L-J W = Liang-Jeh Wang, Guanmiao, Tainan Hsien, private collection; TFM = Tsailiao Fossil Museum, Tsochen, Tainan Hsien; THNHEC = Tainan Hsien Natural History Education Center, Tsochen, Tainan Hsien; W-C X = Wen-Chi Xue, Chia-I Shih, private collection.

female presented to the menagerie of the Zoological Society of London in 1862 by R. Swinhoe, then British vice-consul in Taiwan. The two syntypes died in captivity sometime between December 1864, when they were reported alive by Sclater (1865, p. 710), and April 1866, when the skins, skulls, and postcranial skeletons were accessioned by BM(NH) (male, no. 1866.4.25.8, original no. 1486A; female, no. 1866.4.25.9, original no. 1486B; cf. Swinhoe, 1871, p. 615). At the time of death, the male was a late juvenile—with canines and third molars incompletely erupted, and the female was a subadult—with third molars incompletely erupted; when described by Swinhoe in 1862, both syntypes were at least 2 years younger. The male was designated as lectotype by Elliot (1913, p. 203), and the female thereby became the paralectotype (International Code of Zoological Nomenclature, 1999, Article 74.1.3). A colored illustration of what appears to be the lectotype male was published by Swinhoe (1863, pl. 42), and a black-and-white illustration of the paralectotype female (with tumescent sexual skin)

was published by Sclater (1865, p. 711). The pelvis and adjacent lumbar and caudal vertebrae of the lectotype and paralectotype were figured by Murie (1873, pp. 773, 775).

### Type Locality

In Swinhoe's (1863, p. 350) original description of *Macacus cyclopis*, the sole reference to the geographic origin of the syntypes is their designation as "Formosan [=Taiwanese] Monkeys." The type locality was restricted by Kellogg (1945, p. 119) to "Jusan (Ape's Hill), Takao prefecture, Formosa" (=Shou Shan, Kaohsiung Hsien, Taiwan).

Swinhoe (1863, p. 350) apparently had no information concerning the place of capture within Taiwan of the two syntypes of *Macacus cyclopis*. However, in his general discussion of the natural history of the species, Swinhoe mentioned that its habitats included "Apes' Hill" (=Shou Shan) in southwestern Taiwan (cf. Swinhoe in Blyth, 1860,

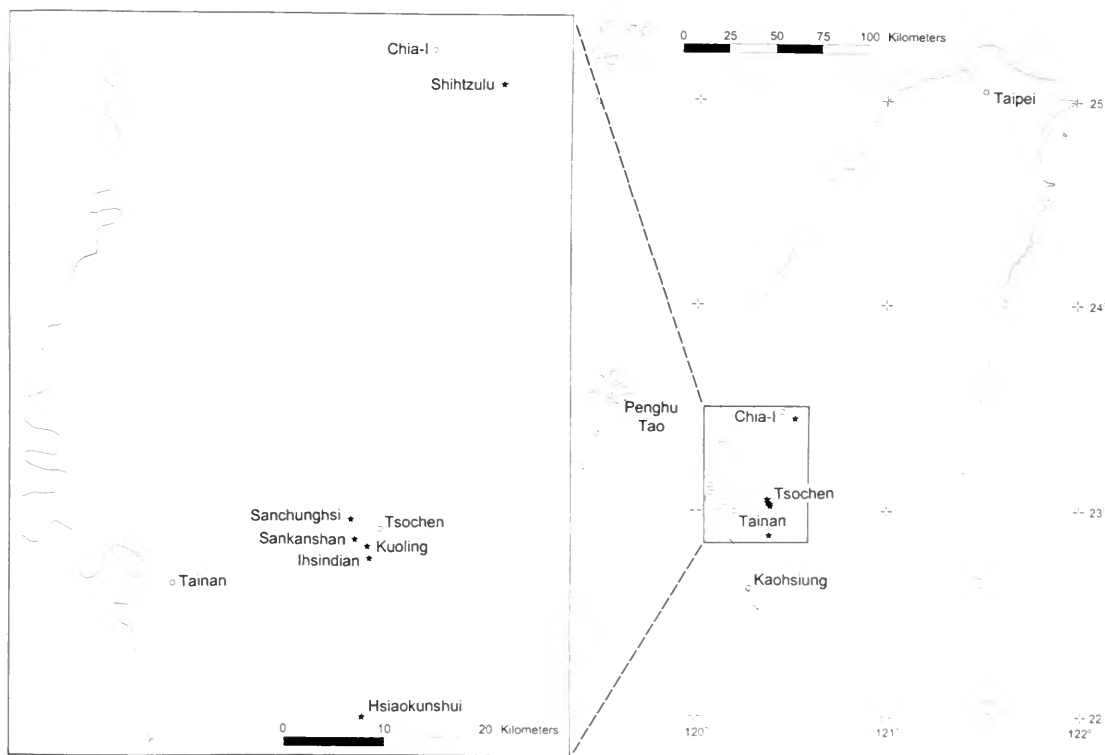


FIG. 6. Map of southwestern Taiwan showing collecting localities of fossil monkey teeth.

p. 87) and "mountains of the north and east" of Taiwan. The first habitat mentioned by Swinhoe was selected by Kellogg (1945, p. 119) as the basis for his type-locality restriction (with the spelling "Apes' Hill" changed to "Ape's Hill").

### Remarks

The name *cyclopis* (from "kyklos" = circle, Greek) presumably was based on Swinhoe's (1863, p. 350) belief that what he perceived as the "round head" of the immature syntypes was a primary character that distinguished this species from *M. mulatta*. Although Swinhoe proposed *Macacus cyclopis* as a "provisional name" (p. 350), such a conditional proposal does not impair the availability of scientific names proposed before 1961 (International Code of Zoological Nomenclature, 1999, Article 15.1).

The name "*Macacus (radiatus) affinis*," attributed to Blyth (1863, p. 8), is routinely included in the synonymy of *M. cyclopis* (Elliot, 1913, p. 202; Kellogg, 1945, p. 119; Ellerman & Morri-

son-Scott, 1951, p. 198; Imaizumi, 1960, p. 105; 1970, p. 320; Hill, 1974, p. 583; Napier, 1981, p. 26; Corbet, 1992, p. 171; Groves, 1993, p. 266); however, this is an error. At the root of this error is a second pair (juvenile male and female) of captive macaques—not the type series of *M. cyclopis* (see above)—that was acquired ca. 1859 by R. Swinhoe (in Blyth, 1860, p. 87). In 1859, the skull of the male and the living captive female were sent by Swinhoe to the Asiatic Society of Bengal, Calcutta (Blyth, 1860, p. 87; 1863, p. 8; 1875, p. 8; Anderson, 1881, p. 60). Although the present whereabouts of the male skull is unknown, the female skin and skull are preserved in the collection of the Zoological Survey of India (National Zoological Collection, Calcutta, no. 11826; cf. Khajuria, 1955, p. 112); this skin and skull are unambiguously identifiable as those of an Indian bonnet macaque, *M. radiata* (É. Geoffroy, 1812, p. 98), the range of which is approximately 4,000 km west of Taiwan. However, this identification was not made by Swinhoe (in Blyth, 1860, p. 87; cf. Swinhoe, 1863, p. 350), who instead mistakenly asserted that his pair of *M. ra-*



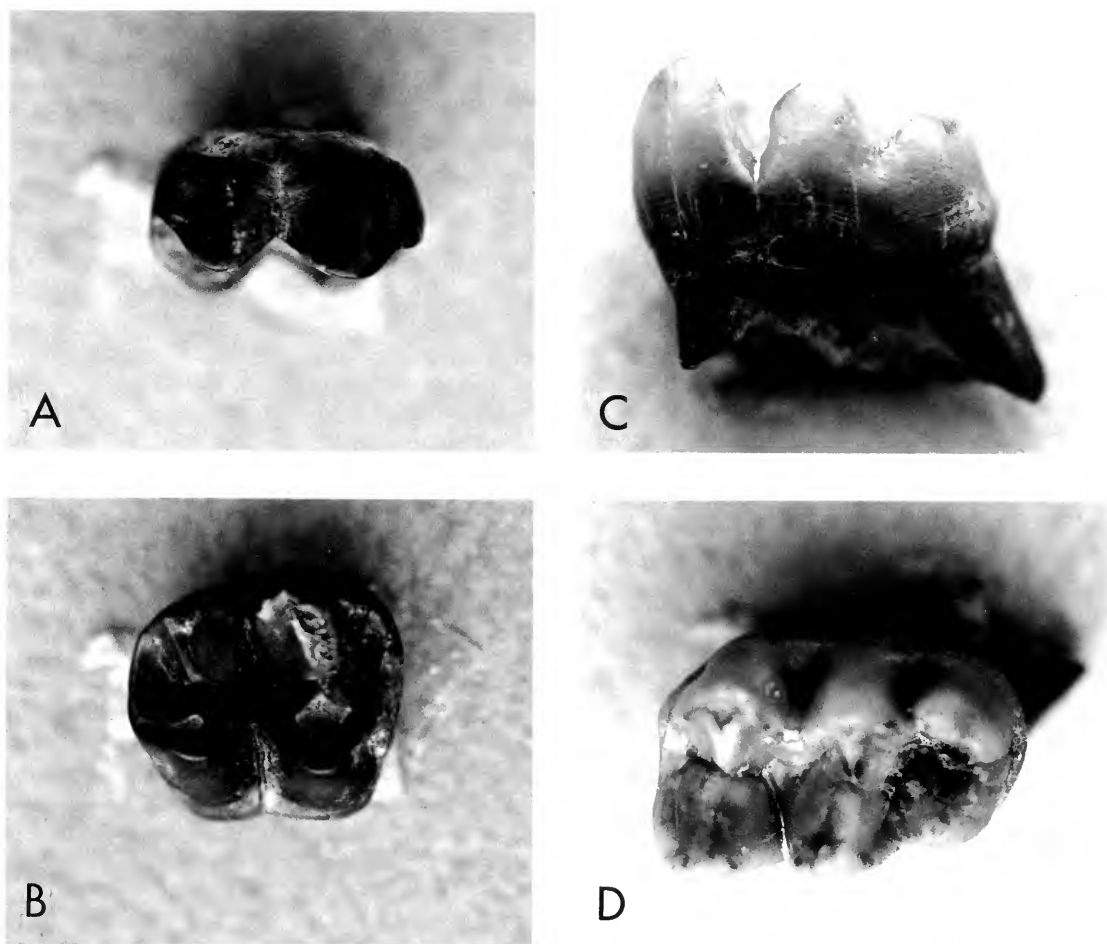


FIG. 7. Fossil monkey teeth collected in southwestern Taiwan. Fossil No. 2 (Sankanshan), right upper second molar (?), length 8.7 mm: **A**, buccal view; **B**, occlusal view. Fossil No. 3 (Kuoling), right lower third molar, length 11.1 mm: **C**, lingual view; **D**, occlusobuccal view.

*diata* captives were examples of "the *small* Formosa Monkey" (italics in original; note: for Swinhoe, the *large* Formosa Monkey was *M. cyclopsis*, which allegedly inhabited "the camphor forests of the Formosa mountains"; the source of this geographic misinformation presumably was the unknown person who supplied the *M. radiata* captives to Swinhoe. The spurious locality information misled Blyth (1863, p. 8; cf. 1860, p. 88, footnote), zoological curator of the Asiatic Society of Bengal, who incorrectly concluded that a slightly variant form of *M. radiata* inhabited Taiwan; Blyth cited this form as "M[ACACUS] RADIATUS (*affinis*)," indicating that he regarded the unnamed form as related to ("affinis," Latin) *M. radiata*, not that he was proposing *affinis* as a new

subspecific or specific name. Anderson (1879, p. 91, footnote), without explanation or justification, changed the italicization and shifted the parenthesis in Blyth's citation to produce "*Macacus (radiatus) affinis*," which is the orthography employed for this citation in current checklists. Elliot (1913, p. 202) adopted Anderson's orthography and, based on the spurious locality "Formosa," he included "*Macacus (radiatus) affinis*" in the synonymy of his *Pithecus cyclopsis* (= *M. cyclopsis*), thereby establishing the pattern that has been followed by subsequent authors. However, M[ACACUS] RADIATUS (*affinis*); Blyth, 1863, clearly is a synonym of *Macaca radiata* (É. Geoffroy, 1812) (cf. Fooden, 1981, p. 34), not of *Macaca cyclopsis* Swinhoe, 1863 ("1862").

TABLE 26. Dental measurements (mm) in wild-collected specimens<sup>5</sup> of *Macaca cyclopis*.

| Tooth                  | Dental dimension <sup>6</sup> | Females |      |      |         |         | Males |      |      |         |         |
|------------------------|-------------------------------|---------|------|------|---------|---------|-------|------|------|---------|---------|
|                        |                               | N       | Mean | SD   | Minimum | Maximum | N     | Mean | SD   | Minimum | Maximum |
| <b>Permanent teeth</b> |                               |         |      |      |         |         |       |      |      |         |         |
| P <sup>3</sup>         | AP L                          | 5       | 5.0  | 0.23 | 4.8     | 5.4     | 10    | 5.2  | 0.35 | 4.8     | 5.9     |
|                        | Br                            | 5       | 5.7  | 0.30 | 5.4     | 6.2     | 10    | 6.0  | 0.34 | 5.5     | 6.6     |
| P <sup>4</sup>         | AP L                          | 5       | 4.9  | 0.21 | 4.8     | 5.3     | 11    | 5.1  | 0.31 | 4.7     | 5.7     |
|                        | Br                            | 5       | 6.3  | 0.41 | 5.9     | 6.8     | 11    | 6.3  | 0.26 | 5.9     | 6.6     |
| M <sup>1</sup>         | AP L                          | 6       | 7.1  | 0.26 | 6.8     | 7.4     | 11    | 7.2  | 0.42 | 6.5     | 7.9     |
|                        | A Br                          | 6       | 6.8  | 0.52 | 6.1     | 7.5     | 11    | 7.0  | 0.46 | 6.3     | 7.7     |
|                        | P Br                          | 6       | 6.3  | 0.55 | 5.7     | 7.1     | 11    | 6.6  | 0.55 | 5.8     | 7.7     |
| M <sup>2</sup>         | AP L                          | 5       | 7.8  | 0.20 | 7.6     | 8.1     | 11    | 8.1  | 0.35 | 7.6     | 8.7     |
|                        | A Br                          | 5       | 7.6  | 0.53 | 7.0     | 8.2     | 11    | 8.2  | 0.42 | 7.5     | 8.9     |
|                        | P Br                          | 5       | 7.1  | 0.49 | 6.5     | 7.5     | 11    | 7.6  | 0.40 | 6.8     | 8.0     |
| M <sup>3</sup>         | AP L                          | 5       | 7.6  | 0.39 | 7.1     | 8.0     | 11    | 8.0  | 0.54 | 7.3     | 8.8     |
|                        | A Br                          | 5       | 7.4  | 0.26 | 7.0     | 7.6     | 11    | 8.0  | 0.39 | 7.4     | 8.4     |
|                        | P Br                          | 5       | 6.6  | 0.45 | 6.2     | 7.3     | 11    | 6.8  | 0.40 | 5.8     | 7.2     |
| M <sub>1</sub>         | AP L                          | 4       | 6.8  | 0.35 | 6.4     | 7.1     | 10    | 6.9  | 0.48 | 6.1     | 7.6     |
|                        | A Br                          | 4       | 5.5  | 0.48 | 5.1     | 6.1     | 10    | 5.7  | 0.37 | 5.0     | 6.3     |
|                        | P Br                          | 4       | 5.3  | 0.27 | 5.0     | 5.6     | 10    | 5.6  | 0.32 | 5.1     | 5.9     |
| M <sub>2</sub>         | AP L                          | 4       | 7.8  | 0.30 | 7.4     | 8.0     | 11    | 8.1  | 0.35 | 7.5     | 8.7     |
|                        | A Br                          | 4       | 6.6  | 0.53 | 6.0     | 7.0     | 11    | 6.9  | 0.39 | 5.9     | 7.3     |
|                        | P Br                          | 4       | 6.1  | 0.48 | 5.6     | 6.7     | 11    | 6.4  | 0.33 | 5.9     | 7.0     |
| M <sub>3</sub>         | AP L                          | 4       | 10.0 | 0.62 | 9.5     | 10.9    | 10    | 10.9 | 0.60 | 9.9     | 11.9    |
|                        | A Br                          | 4       | 6.9  | 0.18 | 6.7     | 7.1     | 10    | 7.2  | 0.53 | 6.2     | 8.2     |
|                        | P Br                          | 4       | 5.9  | 0.36 | 5.4     | 6.2     | 9     | 6.2  | 0.34 | 5.4     | 6.6     |
| <b>Deciduous teeth</b> |                               |         |      |      |         |         |       |      |      |         |         |
| p <sup>3</sup>         | AP L                          | 1       | 5.7  |      |         |         | 17    | 5.5  |      |         |         |
|                        | A Br                          | 1       | 4.9  |      |         |         | 17    | 4.8  |      |         |         |
|                        | P Br                          | 1       | 4.6  |      |         |         | 17    | 4.9  |      |         |         |
| p <sup>4</sup>         | AP L                          | 1       | 5.9  |      |         |         | 17    | 6.2  |      |         |         |
|                        | A Br                          | 1       | 5.8  |      |         |         | 17    | 5.6  |      |         |         |
|                        | P Br                          | 1       | 5.1  |      |         |         | 17    | 5.4  |      |         |         |
| p <sub>3</sub>         | AP L                          | 1       | 5.8  |      |         |         |       |      |      |         |         |
|                        | A Br                          | 1       | 3.9  |      |         |         |       |      |      |         |         |
|                        | P Br                          | 1       | 3.8  |      |         |         |       |      |      |         |         |
| p <sub>4</sub>         | AP L                          | 1       | 6.0  |      |         |         |       |      |      |         |         |
|                        | A Br                          | 1       | 4.8  |      |         |         |       |      |      |         |         |
|                        | P Br                          | 1       | 5.0  |      |         |         |       |      |      |         |         |

<sup>1-4</sup> Tooth-row position indicators.

<sup>5</sup> AMNH, USNM, private collections.

<sup>6</sup> Abbreviations: A Br = anterior breadth; AP L = anteroposterior length; Br = breadth; P Br = posterior breadth.

<sup>7</sup> Sex of specimen uncertain; mandible missing.

## Evolution and Dispersal

In this section, we will attempt to address four main questions concerning the evolutionary history of Taiwanese macaques:

1. Where did the progenitors of *M. cyclopis* come from?
2. When did these progenitors disperse to Taiwan?
3. Why is *M. cyclopis* absent from nearby islands surrounding Taiwan?
4. Why is *M. mulatta* absent from Taiwan?

Taiwan is situated on the Asian continental shelf, separated from the mainland by the Taiwan Haixia (=Formosa Strait), which is ca. 140 km wide and less than 120 m deep (U.S. Defense Mapping Agency, 1981); rising from the floor of the strait is a sinuous submarine ridge that connects Taiwan with mainland Asia at a depth of less than 60 m below present sea level. Therefore, during Pleistocene glacial advances and correlated sea-level depressions, a dry-land connection intermittently existed between Taiwan and the mainland (Fooden, 1995, p. 87).

The evidence of pollen studies indicates that,

during Pleistocene glacial advances, the climate of Taiwan was colder and drier than at present (Liew, 1991, p. 30). During the Last Glacial Maximum, ca. 18 Ka, upland forests were more open, lowland grasslands were much more extensive, and annual precipitation was at least 800 mm less than at present (Liew et al., 1998, p. 93); at this time, vegetation that is now restricted to 1500–2500 m elevation occurred as low as 650 m (Huang et al., 1997, p. 67).

The terrestrial mammal fauna of Taiwan is closely related to that of the Asian mainland to the west, not to that of the Philippine Islands to the south or the Ryukyu Islands to the east (Swinhoe, 1863, p. 350; Wallace, 1876, p. 334; 1881, p. 367; Kuroda, 1939, p. 45; 1952, p. 285; Kano, 1940, p. 107; Corbet & Hill, 1992, p. 4). Zoogeographic analysis indicates that Taiwan has accumulated its vertebrate and invertebrate fauna as a result of multiple waves of dispersal from mainland Asia to the island (Kano, 1940, p. 122; Jameson & Jones, 1977, p. 479; Yu, 1995, p. 80; Hsu et al., 1997, p. 154; Wang & Tu, 1997, p. 103); some or all of these dispersal waves presumably were correlated with successive glacial advances. Subsequent to dispersal, the immediate ancestors of many extant Taiwanese species apparently have become extinct on the Asian mainland opposite Taiwan, as originally noted by Swinhoe (1863, p. 349) and Wallace (1881, p. 404).

Reproductive anatomy, DNA evidence, and blood-protein evidence indicate that *M. cyclopis* is closely related to *M. mulatta* (see Molecular Biology and Genetics, above; Fooden, 1972, p. 310; Fooden & Lanyon, 1989, p. 227), which suggests two alternative evolutionary hypotheses: (1) long-tailed *M. cyclopis* is descended from a short-tailed *M. mulatta*-like ancestor (which itself was previously descended from a long-tailed ancestor), or (2) short-tailed *M. mulatta* is descended from a long-tailed *M. cyclopis*-like ancestor. Comparative study of tail-length variation in *fascicularis*-group species tends to support the second hypothesis (Fooden & Albrecht, 1999, p. 437; Fooden, 2000, p. 87). According to this interpretation, *M. cyclopis* is an insular relict of a relatively long-tailed population of macaques that formerly inhabited mainland Asia between 15°N and 25°N; this extinct mainland long-tailed population, which northward was ancestral to *M. mulatta*, has now been replaced between 15°N and 25°N by short-tailed *M. mulatta*. Such an evolutionary

history would parallel that of many other Taiwanese species (see above).

Macaques were present on Taiwan before or during the Middle Pleistocene, at least 300 Ka (see Fossils, above). The fossilized teeth of these macaques, the only parts that have been preserved, are similar in size and morphology to the teeth of living *M. cyclopis*. The simplest hypothesis, as previously implied by Shen (1994, p. 6), is that the Pleistocene Taiwanese macaques represented by the fossil teeth were directly ancestral to extant *M. cyclopis*.

Based on the age of the Taiwanese macaque fossils, the dispersal of the postulated relatively long-tailed population from mainland Asia to Taiwan apparently occurred before 300 Ka—well before the onset of the most recent glacial advance (ca. 115 Ka). The physiological ability of *M. cyclopis* to survive subsequent cold glacial intervals in Taiwan is demonstrated by its present occurrence at relatively high elevations in Taiwan (Table 16) and by the survival of introduced populations in temperate Japan, 10°–15° north of Taiwan (see Distribution, above).

*Macaca cyclopis* is absent from nearby islands that surround Taiwan, including the relatively large islands Lan Yu, Lu Tao, and Penghu Tao (Fig. 1). Lan Yu and Lu Tao lie beyond the continental shelf and are separated from Taiwan by deep channels (>1500 m and >500 m, respectively), which would account for the apparent inability of *M. cyclopis* to disperse eastward from Taiwan to these two islands (U.S. Defense Mapping Agency, 1981). A similar explanation would apply, with even greater force, to the absence of *M. cyclopis* from the Ryukyu Islands, 110 km east of Taiwan and the continental shelf.

Penghu Tao lies on the continental shelf with Taiwan, within the 120-m bathymetric contour line, less than 50 km west of Taiwan. However, Penghu Tao currently is relatively dry (977 mm annual precipitation) and minimally forested (Hsieh, 1964, pp. 103, 282; Hsieh & Shen, 1994, p. 3), and it may have been totally unforested during the Last Glacial Maximum, ca. 18 Ka (see below). The absence of *M. cyclopis* from Penghu Tao probably is explained by the absence there of suitable habitat, at least since the Last Glacial Maximum.

Although the rhesus macaque, *M. mulatta*, ranges widely in mainland Asia and also inhabits some continental islands, it is absent from Taiwan (Fooden, 2000, p. 2). *Macaca mulatta* probably dispersed from mainland Asia to Hainan Dao, an

island on the continental shelf ca. 1000 km southwest of Taiwan, during the Last Glacial Maximum (Fooden, 2000, p. 89). Unsuitable habitat conditions on the contemporaneous land bridge to Taiwan may account for the apparent failure of *M. mulatta* to disperse to Taiwan during the Last Glacial Maximum. Palynological evidence indicates that most of the exposed Late Pleistocene continental shelf near Taiwan was grassland or barren (Liew et al., 1998, p. 93). The composition of the Taiwan Strait fossil fauna (see Fossils, above) is compatible with this interpretation.

To summarize, tentative answers to questions concerning the evolutionary history of *M. cyclopis* that were posed in the first paragraph of this section are as follows:

1. The progenitors of *M. cyclopis* probably dispersed to Taiwan from nearby mainland Asia. The now-extinct mainland Asian ancestors probably were long-tailed, like *M. cyclopis* itself.
2. The dispersal of *M. cyclopis* from mainland Asia to Taiwan apparently occurred before 300 Ka.
3. Persistent water barriers probably have prevented *M. cyclopis* from dispersing from Taiwan to many of the surrounding islands. Although Penghu Tao was joined to Taiwan by dry land during Pleistocene sea-level regressions, forest habitats suitable for the survival of *M. cyclopis* apparently have been absent from Penghu Tao, at least since the Last Glacial Maximum.
4. *Macaca mulatta* probably was unable to disperse to Taiwan during the Last Glacial Maximum because the land bridge available at that time was unforested.

## Acknowledgments

For access to specimens and generous cooperation, we are deeply grateful to officials and staff members of institutions cited above (see Introduction). For supplementary advice, information, and assistance, we also thank M. Aimi (KUPRI), W. Birky (Rutgers University), D. Brandon-Jones (BM(NH)), Shih-Wei Chang (TESRI), Shu-Mei Chen (NTUZ), Jui-Hua Chu (NTUZ), E. Delson (AMNH), M. Iwamoto (JMC), Y. Kawamoto (KUPRI), Kin-Yang Lai (TM), Ling-Ling Lee (NTUZ), Si-Ming Lin (NTUZ), P. Lowther (Field Museum), M. Pannell (Field Museum), C. Simpson (Field Museum), R. W. Thorington, Jr. (USNM), Liang-Jeh

Wang (Guanmiao, Tainan Hsien), J. Weinstein (Field Museum), Wen-Chi Xue (Chia-I Hsien), and Jon-Ne Yo (NTUZ). K. H. Hamilton (Chicago) kindly assisted with translation of Japanese primatological literature. This research was partly supported by the Barbara E. Brown Fund for Mammal Research. Maps included in this publication were prepared with software generously donated to the Field Museum by Environmental Systems Research Institute, Inc. (ESRI). For funding field surveys, Hai-Yin Wu thanks the Council of Agriculture and Yushan National Park of R.O.C.

## Literature Cited

- AGORAMOORTHY, G. 1998. Rehabilitation and captive management of endangered species in a wildlife rescue center in Taiwan. *International Zoo News*, **45**: 71–77.
- AKITSU, M. 1959. [On the rhythmic lip movements of *Macaca cyclopis*]. *Annual of Animal Psychology*, **9**: 85–90. (in Japanese)
- ANDERSON, J. 1879. *Anatomical and Zoological Researches: Comprising an Account of the Zoological Results of the Two Expeditions to Western Yunnan in 1868 and 1875*. Volume 1. Bernard Quaritch, London, xxv + 985 pp. (For date of publication, see Corrigan-da, between pp. xii–xiii.)
- . 1881. *Catalogue of Mammalia in the Indian Museum, Calcutta*. Part 1. Primates, Prosimiae, Chiroptera, and Insectivora. Indian Museum, Calcutta, xv + 225 pp.
- ANONYMOUS. 1981. Mate for the white monkey. *China Reconstructs*, **30**(2): 47.
- . 1985. Taiwan's first parks. *Oryx*, **19**: 113.
- . 2000. [Taiwanese monkey, age 39 years—equivalent to human age 130 years.] *Min-Sheng Daily News*, 21 April 2000, p. 9. (in Chinese)
- AOKI, B. 1930. [The mammal fauna of Formosa and its surroundings]. *Chigaku Zasshi/Journal of Geography*, **42**: 501–509. (in Japanese)
- ARDITO, G. 1979. Primate chromosome atlas, pp. 215–281. *In* Chiarelli, B., A. L. Koen, and G. Ardito, eds., *Comparative Karyology of Primates*. Mouton, The Hague.
- ASAKURA, S. 1958. Menstrual and sexual cycle of primates. *Primates*, **1**: 162. (abstract only; in Japanese)
- AUSTIN, O. L., M. HACHISUKA, H. TAKASHIMA, AND N. KURODA. 1948. Japanese ornithology and mammalogy during World War II. (An annotated bibliography). General Headquarters, Supreme Commander for the Allied Forces, Natural Resources Section, Report Number **102**: 1–47.
- AZUMA, N., AND K. NORIKOSHI. 1990. Socio-ecological study of free living Formosan monkeys (*Macaca cyclopis*) in Taipingshan, Taiwan. *Sophia Life Science Bulletin*, **9**: 43–56. (in Japanese, English summary)
- BERGNER, J. F., JR. 1967. The parasites (with emphasis

- on the filaria, *Macacanema formosana*) and ecology of the Taiwan monkey, *Macaca cyclopis*. Ph.D. dissertation, University of Maryland, College Park, MD, xii + 137 pp.
- BERGNER, J. F., JR., AND L. A. JACHOWSKI, JR. 1968. The filarial parasite, *Macacanema formosana*, from the Taiwan monkey and its development in various arthropods. *Formosan Science*, **22**: 1–68.
- BLYTH, E. 1860. Report of Curator, Zoological Department. Proceedings of the Asiatic Society of Bengal, **29**: 87–115.
- . 1863. Catalogue of the Mammalia in the Museum Asiatic Society. Asiatic Society, Calcutta, 187 + xiii.
- . 1875. Catalogue of the mammals and birds of Burma. Journal of the Asiatic Society of Bengal, **44**(2), extra number: 1–64.
- CAMPBELL, W. 1903. Formosa under the Dutch, Described from Contemporary Records. Kegan Paul, Trench, Trubner & Co., London, 629 pp.
- CAO XIAOMEI, CHEN YIFENG, LUO LIHUA, AND SHAN XIANGNIAN. 1981. A comparative study on the nucleolus organizer regions in chromosomes of eleven species of primates. *Zoological Research*, **2**: 119–123. (in Chinese, English summary)
- CARTER, T. D., J. E. HILL, AND G. H. H. TATE. 1945. Mammals of the Pacific World. Macmillan Co., New York, xvi + 227 pp.
- CHANG, KE-YANG. 1999. Foraging strategies of Formosan macaques (*Macaca cyclopis*) in Fushan experimental forest, I-Lan. Master's thesis, National Taiwan University, Taipei, 84 pp.
- CHANG, SHIH-WEI. 1999. The adaptation of *Macaca cyclopis* to the cultivated habitat in Chichitashan, p. 13. In Abstracts of the Annual Meeting of the Biological Society of China. Biological Society of China, Chichi, Nantou, R.O.C.
- . 2000. A survey of crop raiding by the Formosan macaque (*Macaca cyclopis*) in central Taiwan. *Endemic Species Research*, **2**: 1–12. (in Chinese, English summary)
- CHANG, WU-HUNG. 1997. The communication of Formosan rock monkeys. *Chinese Primate Research and Conservation News*, **6**: 2–5. (Chinese and English texts)
- CHAO, MING-CHIEH. 1990. Studies on karyotype and blood types of Formosan macaques. Master's thesis, National Taiwan University, Taipei, vii + 96 pp.
- CHEN, CHENG-HSIANG. 1993. Gazetteer of Taiwan. Nan Tien Publishers, Taipei, xix + 376 pp. (in Chinese)
- CHEN, CHU-EN. 1999. The influence of Formosan macaques (*Macaca cyclopis*) on seed dispersal in Fushan Experimental Forest. Master's thesis, National Taiwan University, Taipei, 73 pp. (in Chinese)
- CHEN, HUEY-JUAN, PAO-ZHONG CHEN, AND KWAN-PING WANG. 1990. A study on the reproductive and developmental biology of seven native mammals in Taiwan. 1. *Macaca cyclopis* and *Muntiacus reevesii micrurus*. *Ecological Research*, Council of Agriculture, Taipei, No. 014, 30 pp.
- CHEN, KWANG-TZUU. 2000. On Taiwan mammalian faunas in different periods of time and related problems: The background materials for Taiwan zooarchaeological studies, I. *Bulletin of the Institute of History and Philology, Academia Sinica*, **71**: 129–198, 237–243. (in Chinese, English summary)
- CHEN YIFENG, LUO LIHUA, SHAN XIANGNIAN, AND CAO XIAOMEI. 1981. [Chromosomes of the Primates of China], Academic Press, Beijing, iii + 208 pp. (in Chinese)
- CHEN, YUH-YEN, AND TEN-HSOU LIN. 1991. Fecal progesterone in Taiwan monkey (*Macaca cyclopis*) during the menstrual cycle and pregnancy. *Taipei Zoo Bulletin*, **3**: 41–47. (in Chinese, English abstract)
- CHI, CHAU-HWA. 1997. Reproductive physiology and artificial breeding application of Formosan macaque (*Macaca cyclopis*). Ph.D. dissertation, National Taiwan University, Taipei, 111 pp.
- CHI, CHAU-HWA, JUNN-SHANG JU, AND AN-CHUNG LIN. 1998. Electroejaculation and semen quality in Formosan macaques (*Macaca cyclopis*) around a year. *Taipei Zoo Bulletin*, **10**: 29–42. (in Chinese, English abstract)
- CHU, JU-HUA, HAI-YIN WU, YI-JU YANG, O. TAKENAKA, AND YAO-SUNG LIN. 1999. Polymorphic microsatellite loci and low-invasive DNA sampling in *Macaca cyclopis*. *Primates*, **40**: 573–580.
- CHU, YAO-I, AND T. YAMANAKA. 1973. A checklist of the present and old names of insect collected localities in Taiwan. *Annual of Taiwan Museum*, **16**: 31–72.
- COATNEY, G. R., W. E. COLLINS, M. WARREN, AND P. G. CONTACOS. 1971. The Primate Malarias. U.S. Government Printing Office, Washington, DC., x + 366 pp.
- COLLINGWOOD, C. 1868. Rambles of a Naturalist on the Shores and Waters of the China Sea. John Murray, London, xiv + 445 pp.
- COLLINS, W. E. 1988. Major animal models in malaria research: Simian, pp. 1473–1501. In Wernsdorfer, W. H., and I. McGregor, eds., *Malaria: Principles and Practice of Malariology*. Churchill Livingstone, Edinburgh.
- CORBET, G. B. 1992. Order Primates, pp. 161–186. In Corbet, G. B., and J. E. Hill, *The Mammals of the Indomalayan Region: A Systematic Review*. Natural History Museum Publications and Oxford University Press, Oxford. (For authorship, see p. 12.)
- CORBET, G. B., AND J. E. HILL. 1992. Introduction, pp. 1–12. In Corbet, G. B., and J. E. Hill, *The Mammals of the Indomalayan Region: A Systematic Review*. Natural History Museum Publications and Oxford University Press, Oxford. (For authorship, see p. 12.)
- CROSS, J. H., M. Y. K. HSU, AND C. K. HUNG. 1970. *Trypanosoma* in the Taiwan monkey. *Southeast Asian Journal of Tropical Medicine and Public Health*, **1**: 150.
- . 1983. Studies on trypanosomes in the Taiwan monkey. *Southeast Asian Journal of Tropical Medicine and Public Health*, **14**: 536–542.
- DAVIDSON, J. W. 1903. The Island of Formosa: Past and Present. Macmillan & Co., London, 646 + xxviii + 46 pp.
- DE VOS, A., R. H. MANVILLE, AND R. G. VAN GELDER. 1956. Introduced mammals and their influence on native biota. *Zoologica*, **41**: 163–194.

- DIEN, ZUH-MING. 1958. The Formosan rock-monkey and a monkey story. *Quarterly Journal of the Taiwan Museum*, **11**: 345–348.
- DU HALDE, J.-B. 1735. *Description Geographique, Historique, Chronologique, Politique, et Physique de l'Empire de la Chine et de la Tartarie Chinoise*. Tome Première. P. G. Le Mercier, Paris, lii + iv + 592 pp.
- ELLERMAN, J. R., AND T. C. S. MORRISON-SCOTT. 1951. Checklist of Palaearctic and Indian Mammals, 1758 to 1946. British Museum (Natural History), London, 810 pp.
- ELLIOT, D. G. 1913. A Review of the Primates. Volume 2. American Museum of Natural History, New York, xviii + 382 + xxvi pp. (For date of publication, see Correction, between pp. ii–iii.)
- ENDO, M., T. KAMIMURA, Y. AOYAMA, T. HAYASHIDA, T. KINJO, AND Y. ONO. 1959. Étude du virus B au Japon. I. Recherche des anticorps neutralisant le virus B chez les singes d'origine japonaise et les singes étrangers importés au Japon. *Japanese Journal of Experimental Medicine*, **30**: 227–233.
- FOODEN, J. 1969. Taxonomy and evolution of the monkeys of Celebes (Primates: Cercopithecidae). *Bibliotheca Primatologica*, **10**: 1–148.
- . 1972. Male external genitalia and systematic relationships of the Japanese macaque (*Macaca fasciata* Blyth, 1875). *Primates*, **12**: 305–311.
- . 1975. Taxonomy and evolution of liontail and pigtail macaques (Primates: Cercopithecidae). *Fieldiana: Zoology*, **67**: ii + 169 pp.
- . 1981. Taxonomy and evolution of the *sinica* group of macaques: 2. Species and subspecies accounts of the Indian bonnet macaque, *Macaca radiata*. *Fieldiana: Zoology, new series*, **9**: 1–52.
- . 1994. Malaria in macaques. *International Journal of Primatology*, **15**: 573–596.
- . 1995. Systematic review of Southeast Asian longtail macaques, *Macaca fascicularis* (Raffles, [1821]). *Fieldiana: Zoology, new series*, **81**: 1–206.
- . 2000. Systematic review of the rhesus macaque, *Macaca mulatta* (Zimmermann, 1780). *Fieldiana: Zoology, new series*, **96**: v + 180.
- FOODEN, J., AND G. H. ALBRECHT. 1999. Tail-length evolution in *fascicularis*-group macaques (Cercopithecidae: *Macaca*). *International Journal of Primatology*, **20**: 431–440.
- FOODEN, J., AND S. M. LANYON. 1989. Blood-protein allele frequencies and phylogenetic relationships in *Macaca*: A review. *American Journal of Primatology*, **17**: 209–241.
- FURUYA, Y. 1962. Studies on the dermatoglyphics of the macaques. *Proceedings of the Japan Academy*, **38**: 377–386.
- GARNHAM, P. C. C. 1966. *Malaria Parasites and Other Haemosporidia*. Blackwell, Oxford, xviii + 1114 pp.
- GEOFFROY SAINT-HILAIRE, É. 1812. Tableau des quadrumanes, ou des animaux composant le premier ordre de la classe des mammifères. *Annales de Muséum d'Histoire Naturelle*, **19**: 85–122.
- GEOFFROY SAINT-HILAIRE, I. 1826. Macaque, pp. 584–590. *In* Bory de Saint-Vincent, ed., *Dictionnaire Classique d'Histoire Naturelle*, Volume 9. Rey et Gravier and Baudouin Frères, Paris.
- GRAY, J. E. 1870. *Catalogue of Monkeys, Lemurs, and Fruit-Eating Bats in the Collection of the British Museum*. British Museum, London, 137 pp.
- GROVES, C. P. 1993. Order Primates, pp. 243–277. *In* Wilson, D. E., and D. M. Reeder, eds., *Mammal Species of the World: A Taxonomic and Geographic Reference*, 2nd edition. Smithsonian Institution Press, Washington, DC.
- HAYASAKA, K., K. FUJII, AND S. HORAI. 1996. Molecular phylogeny of macaques: Implications of nucleotide sequences from an 896-base pair region of mitochondrial DNA. *Molecular Biology and Evolution*, **13**: 1044–1053.
- HAYASAKA, K., S. HORAI, T. GOJOBORI, T. SHOTAKE, K. NOZAWA, AND E. MATSUNAGA. 1988. Phylogenetic relationships among Japanese, rhesus, Formosan, and crab-eating monkeys, inferred from restriction-enzyme analysis of mitochondrial DNAs. *Molecular Biology and Evolution*, **5**: 270–281.
- HILL, W. C. O. 1974. *Primates: Comparative Anatomy and Taxonomy*. VII. Cynopithecinae: *Cercocebus*, *Macaca*, *Cynopithecus*. John Wiley & Sons, New York, xxi + 934 pp.
- HORIKAWA, Y. 1925. [Formosan mammals]. *Formosa Hakubutsu Gakkai Kaiho/Transactions of the Natural History Society of Formosa*, **79–80**: 224–237. (in Japanese)
- . 1932. [Monograph of the Mammals of Formosa]. *Taiwan Natural History Society, Taipei*, 109 + 12 pp. (in Japanese)
- HSIEH, CHANG-FU, AND CHUNG-FU SHEN. 1994. Introduction to the flora of Taiwan. 1: Geography, geology, climate, and soils, pp. 1–3. *In* Huang, Tseng-Chieng, ed., *Flora of Taiwan*, 2nd edition, Volume 1: Pteridophyta, Gymnospermae. Editorial Committee of the Flora of Taiwan, Taipei.
- HSIEH, CHIAO-MIN. 1964. *Taiwan—Ilha Formosa: A Geography in Perspective*. Butterworths, Washington, DC, ix + 372 pp.
- HSIEH, HSIEN-CHEN. 1960. Malaria parasites of the Taiwan monkey. *Formosan Science*, **14**: 477–487.
- . 1961. Microfilariae sp. found in the blood of the Taiwan monkey. *Journal of the Formosan Medical Association*, **60**: 289–294.
- HSU, JEN-HSIU. 1990. [Monkeys and me]. [Echo], **25**: 29–105. (in Chinese)
- HSU, M. J., AND G. AGORAMOORTHY. 1997. Wildlife conservation in Taiwan. *Conservation Biology*, **11**: 834–836.
- . 1999. Population dynamics and male leader tenures among Formosan macaques at Mt. Longevity, Taiwan. *American Journal of Primatology*, **49**: 63–64. (abstract only)
- HSU, M. J., G. AGORAMOORTHY, AND JIN-FU LIN. 2001. Birth seasonality and interbirth intervals in free-ranging Formosan macaques, *Macaca cyclopis*, at Mt. Longevity, Taiwan. *Primates*, **42**: 15–25.
- HSU, M. J., AND JIN-FU LIN. 2001. Troop size and structure in free-ranging Formosan macaques (*Macaca cyclopis*) at Mt. Longevity, Taiwan. *Zoological Studies*, **40**: 49–60.

- HSU, M. J., JIN-FU LIN, AND G. AGORAMOORTHY. 2000a. Occurrence of twins in wild Formosan macaques, *Macaca cyclopis*, at Mt. Longevity, Taiwan. *Folia Primatologica*, **71**: 154–156.
- HSU, M. J., J. MOORE, JIN-FU LIN, AND G. AGORAMOORTHY. 2000b. High incidence of supernumerary nipples and twins in Formosan macaques (*Macaca mulatta*) at Mt. Longevity, Taiwan. *American Journal of Primatology*, **52**: 199–205.
- HSU, YU-FENG, Y.-C. CHIEN, AND P.-S. YANG. 1997. Mitochondrial DNA phylogeny of the *Ypthima motschulskyi* species group (Lepidoptera: Nymphalidae: Satyrinae), pp. 151–161. In Lue, Kuang-Yang, and Tien-Hsi Chen, eds., *The Symposium on the Phylogeny, Biogeography and Conservation of Fauna and Flora of East Asian Region*. Department of Biology, National Taiwan Normal University and National Science Council, R.O.C., Taipei.
- HUANG, CHI-YUE, PING-MEI LIEW, MEIXUN ZHAO, TZU-CHUN CHANG, CHIAO-MING KUO, MIN-TE CHEN, CIUNG-HO WANG, AND LIAN FU ZHENG. 1997. Deep sea and lake records of the Southeast Asian paleomonsoons for the last 25 thousand years. *Earth and Planetary Science Letters*, **146**: 59–72.
- HUANG, TSENG-CHIENG, CHANG-FU HSIEH, SHING-FAN HUANG, AND SHIOU-YU YANG. 1993. Localities in Taiwan from specimens of TAI Herbarium before 1945. *Annual of Taiwan Museum*, **36**: 117–174. (in Chinese, English abstract)
- HUGOT, J. P. 1999. Primates and their pinworm parasites: The Cameron hypothesis revisited. *Systematic Biology*, **48**: 523–546.
- IMAZUMI, Y. 1960. *Coloured Illustrations of the Mammals of Japan*. Hoikusha, Osaka, 196 pp. (in Japanese)
- . 1970. *The Handbook of Japanese Land Mammals, Volume I*. Shin-Shicho-Sha Co., xxx + 350 pp. (in Japanese, English summary)
- INAGAKI, H. 1996. Some hair characteristics of *Macaca* monkeys and an attempt to group them based on those features, pp. 89–96. In Shotake, T., and K. Wada, eds., *Variations in the Asian Macaques*. Takai University Press, Tokyo.
- INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE, 4TH EDITION. 1999. International Trust for Zoological Nomenclature, London, xxix + 306 pp.
- JAMESON, E. W., JR., AND G. S. JONES. 1977. The Soricidae of Taiwan. *Proceedings of the Biological Society of Washington*, **90**: 459–482.
- JESSEE, M. T., P. W. SCHILLING, AND J. A. STUNKARD. 1970. Identification of intestinal helminth eggs in Old World primates. *Laboratory Animal Care*, **20**: 83–87.
- JOHNSON, L. D., A. J. PETTO, D. S. BOY, P. K. SEHGAL, AND M. E. BELAND. 1986. The effect of perinatal and juvenile mortality on colony-born production at the New England Regional Primate Research Center, pp. 771–779. In Benirschke, K., ed., *Primates: The Road to Self-Sustaining Populations*. Springer-Verlag, New York.
- JOHNSTON, P. B. 1961. A second immunologic type of simian foamy virus: Monkey throat infections and unmasking by both types. *Journal of Infectious Diseases*, **109**: 1–9.
- JONES, G. S. 1973. Albinistic and melanistic mammals from Taiwan. *Quarterly Journal of the Taiwan Museum*, **26**: 369–372.
- . 1975. Catalogue of the type specimens of mammals of Taiwan. *Quarterly Journal of the Taiwan Museum*, **28**: 183–218.
- KANO, T. 1929. [On the distribution and habits of Formosan mammals]. *Dobutsugaku Zasshi/Zoological Journal*, **41**: 332–340. (in Japanese)
- . 1930. [On the distribution and habits of Formosan mammals] (part 2). *Dobutsugaku Zasshi/Zoological Journal*, **42**: 165–173. (in Japanese)
- . 1940. *Zoogeographical Studies of the Tsugitaka Mountains of Formosa*. Shibusawa Institute for Ethnographical Researches, Tokyo, 145 pp.
- KAWAI, M., AND U. MITO. 1973. Quantitative study of activity patterns and postures of Formosan monkeys by the radio-telemetrical technique. *Primates*, **14**: 179–194.
- KAWAMOTO, Y., K. SHIRAI, S. ARAKI, AND K. MAENO. 1999. A case of hybridization between the Japanese and Taiwan macaques found in Wakayama Prefecture. *Reichourui Kenkyu/Primate Research*, **15**: 53–60. (in Japanese, English summary)
- KAWAMURA, S., N. AZUMA, AND K. NORIKOSHI. 1988. Socio-ecological study of free-living Formosan monkeys (*Macaca cyclopis*) in Taipingshan Natural Park. Physical Anthropology Section, Life Science Institute, Sophia University, 10 pp. + 2 tables + 4 figs.
- KAWAMURA, S., K. NORIKOSHI, AND N. AZUMA. 1991. Observation of Formosan monkeys (*Macaca cyclopis*) in Taipingshan[, ] Taiwan, pp. 97–100. In Ehara, A., T. Kimura, O. Takenaka, and M. Iwamoto, eds., *Primate Today*. Elsevier Science Publishers, Amsterdam.
- KAZAMA, K., AND K. NORIKOSHI. 1991. [Formosan monkeys in Oshima Island, Japan]. *Heredity*, **45**: 51–55. (in Japanese)
- KELLOGG, R. 1945. Macaques, pp. 113–134. In Aberle, S. D., ed., *Primate Malaria*. National Research Council, Division of Medical Science, Office of Medical Information, Washington, DC.
- KHAJURIA, H. 1955 (“1954”). Catalogue of mammals in the Indian Museum (Zool. Surv.). II. Primates: Cercopithecidae. Records of the Indian Museum, **52**: 101–127. (For date of publication, see Khajuria, H., 1956, Records of the Indian Museum, **52**, p. 195.)
- KIM, CHONG-HWAN, AND J. F. BERGNER, JR. 1964. A study of filaria in Taiwan monkeys. *The Korean Journal of Parasitology*, **2**: 81–86.
- KISHIDA, K. 1924. [Monograph of Japanese Mammals]. Nippon Chogaku-kai/Japanese Ornithological Society, Tokyo, 381 + 17 + 31 pp.
- . 1939. *Lansania*, **20**: article 2. (Not seen; cited from Kishida, 1953, p. 7.)
- . 1953. [Representative forest-dwelling mammals: Japanese monkey research report.] *Ornithological and Mammalogical Research Report*, Ministry of Agriculture and Forestry Agency, **14**: 1–91. (part in Japanese, part in English)
- KOMATSU, I. 1944. [On the skull of *Macacus cyclopis*]. *Zinruigaku Zasshi/Journal of the Anthropological Society of Nippon*, **59**: 17–24. (in Japanese)

- KOPPE, T., T. C. RAE, AND D. R. SWINDLER. 1999. Influence of craniofacial morphology on primate paranasal pneumatization. *Annals of Anatomy*, **181**: 77–80.
- KUHN, H.-J., AND H. W. LUDWIG. 1967a. Die Affenläuse der Gattung *Pedicinus*. Teil I. Zeitschrift für zoologische Systematik und Evolutionsforschung, **5**: 144–256.
- . 1967b. Die Affenläuse der Gattung *Pedicinus*. Teil II. Zeitschrift für zoologische Systematik und Evolutionsforschung, **5**: 257–297.
- KUNTZ, R. E., AND B. J. MEYERS. 1967. Primate cysticercosis: *Taenia hydatigena* in Kenya vervets (*Cercopithecus aethiops* Linnaeus, 1758) and Taiwan macaques (*Macaca cyclopis* Swinhoe, 1864). *Primates*, **8**: 83–88.
- KUNTZ, R. E., B. J. MEYERS, J. F. BERGNER, JR., AND D. E. ARMSTRONG. 1968. Parasites and commensals of the Taiwan macaque (*Macaca cyclopis* Swinhoe, 1862). *Formosan Science*, **22**: 120–135.
- KURODA, N. 1935 Formosan mammals preserved in the collection of Marquis Yamashina. *Journal of Mammalogy*, **16**: 277–291.
- . 1938. A List of the Japanese Mammals. Privately published, Tokyo, 122 pp.
- . 1939. Distribution of mammals in the Japanese Empire. *Journal of Mammalogy*, **20**: 37–50.
- . 1940. A Monograph of the Japanese Mammals, Exclusive of Sirenia and Cetacea. Sansendo Co., Tokyo, 311 pp. (in Japanese)
- . 1952. Mammalogical history of Formosa. with zoogeography and bibliography. *Quarterly Journal of the Taiwan Museum*, **5**: 267–304.
- KYODA, K. 1989. A list of Formosan collection [s]ites appeared in the botanical literature before 1911. *Journal of Japanese Botany*, **64**: 18–31. (locality names in roman letters and Chinese characters)
- LAI, KIN-YANG. 1989. [The fossil record of mammals in Taiwan], pp. 27–50. In Anonymous, ed., [Monograph of the Symposium on the Geographical Origin of the Fauna of Taiwan]. Taipei Zoo, Taipei. (in Chinese)
- LEE, LING-LING. 1991. A review of the recent research on *Macaca cyclopis*, pp. 289–304. In Lin, Yao-Sung, and Kun-Hsiung Chang, eds., Proceedings of the First International Symposium on Wildlife Conservation, Republic of China. Council of Agriculture, Republic of China, Taipei. (in Chinese, English abstract)
- . 1994. Long-term ecological research in Fushan Forest—Mammal community. Institute of Botany, Academia Sinica Monograph Series, **14**: 433–440.
- LEE, LING-LING, AND YAO-SUNG LIN. 1991. Status of Formosan macaques in Taiwan, pp. 33–36. In Ehara, A., T. Kimura, O. Takenaka, and M. Iwamoto, eds., *Primate Conservation Today*. Elsevier Science Publishers, Amsterdam.
- . 1994. Status of Formosan macaques in Taiwan. *Primate Conservation*, **11**: 18–20. (For date of publication, see p. 3.)
- LIEW, PING-MEI. 1991. Pleistocene cool stages and geological changes of western Taiwan based on palynological study. *Acta Geologica Taiwanica*, **29**: 21–32.
- LIEW, PING-MEI, CHAO-MING KUO, SHU-YUE HUANG, AND M.-H. TSENG. 1998. Vegetation change and terrestrial carbon storage in eastern Asia during the Last Glacial Maximum as indicated by a new pollen record from central Taiwan. *Global and Planetary Change*, **16–17**: 85–94.
- LIN, HUEY-YU, HAI-YIN WU, AND YAO-SUNG LIN. 1996. Intestinal helminth parasit[e] fauna of *Macaca cyclopis* in Yushan National Park, abstract no. 712. Abstracts from the XVth Congress of the International Primatological Society and the XIXth Conference of the American Society of Primatologists, Wisconsin Regional Primate Research Center, Madison, not paginated. (abstract only)
- LIN, M. T. 1976. Surface area of the Taiwan monkey. *Chinese Journal of Physiology*, Taipei, **22**: 73–78.
- LU, JANE-FUH, YAO-SUNG LIN, AND LING-LING LEE. 1991. Troop composition, activity pattern and habitat utilization of Formosan macaque (*Macaca cyclopis*) at Nanshi logging road in Yushan National Park, pp. 93–96. In Ehara, A., T. Kimura, O. Takenaka, and M. Iwamoto, eds., *Primate Conservation Today*. Elsevier Science Publishers, Amsterdam.
- MAEKAWA, S. 1982. [Report on mammalian fauna], pp. 99–110. In Wakayama Prefecture, ed., [Report on Natural Environment Assessment of Kihoku District in Wakayama Prefecture (Wakayama City, Kainan City and Naga Suburban District)]. (in Japanese)
- MAGGENTI, A. R. 1983. Nematode higher classification as influenced by species and family concepts, pp. 25–40. In Stone, A. R., H. M. Platt, and L. F. Khalil, eds., *Concepts in Nematode Systematics*. Academic Press, London.
- MAKINO, S. 1952. A contribution to the study of the chromosomes in some Asiatic mammals. *Cytologia*, **16**: 288–301.
- MAKITA, T., T. YAMOTO, K. OGAWA, N. ARAKI, H. AGAWA, K. SUGIURA, H. UEDA, K. KOBAYASHI, K. HANAKI, S. ITAGAKI, AND S. KIWAKI. 1984. Body and organ weights of *Macaca fuscata* and *Macaca cyclopis*. *Japanese Journal of Veterinary Science*, **46**: 385–390.
- MASUI, K., Y. NARITA, AND S. TANAKA. 1986. Information on the distribution of Formosan monkeys (*Macaca cyclopis*). *Primates*, **27**: 383–392.
- MATSUBAYASHI, K. 1992. [Problem of the Taiwanese monkey in Shimokita]. Newsletter of the Japan Primate Society-Primate Protection Association, **2**: 2–5. (in Japanese)
- McCULLOUGH, D. R. 1974. Status of Larger Mammals in Taiwan. Tourist Bureau, Taipei, vii + 36 pp.
- MELNICK, D. J., G. A. HOELZER, R. ABSHER, AND M. V. ASHLEY. 1993. MitDNA diversity in rhesus monkeys reveals overestimates of divergence time and paraphyly with neighboring species. *Molecular Biology and Evolution*, **19**: 282–295.
- MORALES, J. C., AND D. J. MELNICK. 1998. Phylogenetic relationships of the macaques (Cercopithecidae: *Macaca*), as revealed by high resolution restriction site mapping of mitochondrial ribosomal genes. *Journal of Human Evolution*, **34**: 1–23.
- MORI, H. 1991. [Japanese monkey and Taiwanese monkey in Shimokita Hanto]. Annual Report of Japan Monkey Centre, **1991**: 97–101. (in Japanese)
- MOURI, T. 1995. Sex differences of the cranial size in macaque species. *Reichourui Kenkyu/Primate Research*, **11**: 187–196. (in Japanese, English summary)



- MURIE, J. 1873 ("1872"). Observations on the macaques.—III. The Formosan or round-faced monkey. Proceedings of the Zoological Society of London, **1872**: 771–780. (For date of publication, see Duncan, F. M., 1937, Proceedings of the Zoological Society of London, series A, **107**: 72.)
- MYERS, B. J., AND R. E. KUNTZ. 1964. Nematode parasites from mammals taken on Taiwan (Formosa) and its offshore islands. Canadian Journal of Zoology, **42**: 863–868.
- NAMIYE, M. 1914. [On *Macacus cyclopius* of Formosa]. Dobutsugaku Zasshi/Zoological Journal, **26**: 213–214. (in Japanese)
- NAPIER, P. H. 1981. Catalogue of Primates in the British Museum (Natural History) and Elsewhere in the British Isles. Part II: Family Cercopithecidae, Subfamily Cercopithecinae. British Museum (Natural History). London, 203 pp.
- NATIONAL ATLAS OF CHINA, VOLUME 1—TAIWAN, 2ND EDITION. 1967. National War College, Yangmingshan, Taiwan, R.O.C., 12 pp. + 43 plates + 30 pp. (appendix).
- NISHIDA, T. 1963. Intertroop relationships of the Formosan monkeys (*Macaca cyclopsis*) relocated on Nojima Island. Primates, **4**: 121–122.
- NORIKOSHI, K. 1991. Distribution, vegetation, and social structure of Taiwan macaques, pp. 133–142. In Lin, Yao-Sung, and Kun-Hsiung Chang, eds., Proceedings of the First International Symposium on Wildlife Conservation, Republic of China. Council of Agriculture, Republic of China, Taipei.
- NOZAWA, K., T. SHOTAKE, Y. OHKURA, AND Y. TANABE. 1977. Genetic variations within and between species of Asian macaques. Japanese Journal of Genetics, **52**: 15–30.
- NUNN, C. L. 1999. The evolution of sexual swellings in primates and the graded-signal hypothesis. Animal Behaviour, **58**: 229–246.
- OTSUKA, H. 1984. Stratigraphic position of the Chochen Vertebrate fauna of the T'ouk'oushan Group in the environs of the Chochen district, southwest Taiwan, with special reference to its geologic age. Journal of Taiwan Museum, **37**: 37–55.
- PENG, MING-TSUNG, YIH-LOONG LAI, CZAU-SIUNG YANG, HER-SHYANG CHIANG, A. E. NEW, AND CHIEH-PAO CHANG. 1973. Reproductive parameters of the Taiwan monkey (*Macaca cyclopius*). Primates, **14**: 201–213.
- PETTO, A. J., M. N. LAREAU-ALVES, P. T. ELLISON, AND M. C. ABRUZZESE. 1995. Reproduction in captive Taiwan macaques (*Macaca cyclopius*) in comparison to other common macaque species. Zoo Biology, **14**: 331–346.
- PEYTON, E. L., AND B. A. HARRISON. 1980. *Anopheles (Cellia) takasagoensis* Moishita 1946, an additional species in the Balabacensis Complex of Southeast Asia (Diptera: Culicidae). Mosquito Systematics, **12**: 335–347.
- POCOCK, R. I. 1926 ("1925"). The external characters of the catarrhine monkeys and apes. Proceedings of the Zoological Society of London, **1925**: 1479–1579. (For date of publication, see Proceedings of the Zoological Society of London, **1926** (Part I): outside back cover.)
- POIRIER, F. E., AND D. M. DAVIDSON. 1979. A preliminary study of the Taiwan macaque (*Macaca cyclopius*). Quarterly Journal of the Taiwan Museum, **32**: 123–191.
- PRICE, R. A., M. R. ANVER, AND F. G. GARCIA. 1972. Simian neonatology. I. Gestational maturity and extrauterine viability. Veterinary Pathology, **9**: 301–309.
- PRYOR, W. H., JR., J. F. BERGNER, JR., AND G. L. RAULSTON. 1970a. Leech (*Dinobdella ferox*) infection of a Taiwan monkey (*Macaca cyclopius*). Journal of the American Veterinary Medical Association, **157**: 1926–1927.
- PRYOR, W. H., JR., CHIEH-PAO CHANG, AND G. L. RAULSTON. 1970b. Dichlorvos: An antihelminthic for primate trichuriasis. Laboratory Animal Care, **20**: 1118–1122.
- QI, GUO-QIN, CHUAN-KUN HO, AND CHUN-HSIANG CHANG. 1999. The Pleistocene fossil suids from Chochen, Tainan, southwestern Taiwan. Bulletin of the National Museum of Natural Science, **12**: 33–40.
- SAHEKI, M., K. TASHIRO, AND S. HAYAMA. 1962. Morphological study on the dentition of the macaque. Primates, **2**: 100–107. (For date of publication, see inside front cover.)
- SATOH, J., T. TAKAHASHI, AND A. HADANO. 1956. Physical measurements and proportions in *Macaca cyclopsis*. Okajimas Folia Anatomica Japonica, **29**: 41–51.
- SCHAD, G. A., AND R. C. ANDERSON. 1963. *Macacanema formosana* n. g., n. sp. (Onchoceridae: Dirofilarinae) from *Macaca cyclopius* of Formosa. Canadian Journal of Zoology, **41**: 797–800.
- SCHLEGEL, H. 1876. Monographie 40: Simiae. Revue Méthodique, Muséum d'Histoire Naturelle des Pays-Bas, **7**: 1–356.
- SCHWEYER, P. 1909. Der Schädel des *Inuus speciosus japonensis*. . . Ph.D. dissertation, Kgl. Bayer. Ludwig-Maximilians-Universität zu München, Munich, 192 pp.
- SCLATER, P. L. 1865 ("1864"). Notes on the Quadrumana living in the Society's Menagerie. Proceedings of the Zoological Society of London, **1864**: 709–712. (For date of publication, see Duncan, F. M., 1937, Proceedings of the Zoological Society of London, series A, **107**: 72.)
- . 1871. Notes on rare or little-known animals now or lately living in the Society's Gardens. Proceedings of the Zoological Society of London, **1871**: 221–240.
- SETOGUTI, T., AND F. SAKUMA. 1959. On the density of hair and hair groups in *Macacus cyclopsis*. Okajimas Folia Anatomica Japonica, **33**: 157–170.
- SHEN, CHUNG-FU. 1994. Introduction to the flora of Taiwan, 1: Geotectonic evolution, paleogeography, and the evolution of the flora, pp. 3–7. In Huang, Tseng-Chieng, ed., Flora of Taiwan, 2nd edition, Volume 1: Pteridophyta, Gymnospermae. Editorial Committee of the Flora of Taiwan, Taipei.
- SHIRAI, K. 1988. [Present status of Taiwanese monkey in Shimokita Hanto]. Monkey, **219/220**: 20–24. (in Japanese)
- SMITH, R. J., AND W. L. JUNGERS. 1997. Body mass in comparative primatology. Journal of Human Evolution, **32**: 523–559.

- STEERE, J. B. 1876. Formosa. *Journal of the American Geographical Society of New York*, **6**: 302–334.
- STILES, C. W., AND M. O. NOLAN. 1929. Key catalogue of primates for which parasites are reported. *U.S. Hygienic Laboratory Bulletin*, **152**: 409–601.
- SU, HSIU-HUI. 1993. Food habits of Formosan macaques (*Macaca cyclopis*) in the Jentse area, I-Lan. Master's thesis, National Taiwan University, 52 pp. (in Chinese)
- SUMIYAMA, K., S. KAWAMURA, O. TAKENAKA, AND S. UEDA. 1998. A high sequence variety in the immunoglobulin Ca hinge region among Old World monkeys. *Anthropological Science*, **106**: 31–39.
- SWINHOE, R. 1859. Narrative of a visit to the island of Formosa. *Journal of the North-China Branch of the Royal Asiatic Society*, **1**: 145–164.
- . 1863 (“1862”). On the mammals of the island of Formosa (China). *Proceedings of the Zoological Society of London*, **1862**: 347–365, pl. 42. (For date of publication, see Duncan, F. M., 1937, *Proceedings of the Zoological Society of London*, series A, **107**: 72.)
- . 1865 (“1864”). Extracts from letters recently addressed by Mr. R. Swinhoe, H. B. M. Consul in Formosa, to Dr. J. E. Gray. *Proceedings of the Zoological Society of London*, **1864**: 378–383. (For date of publication, see Duncan, F. M., 1937, *Proceedings of the Zoological Society of London*, series A, **107**: 72.)
- . 1866. Additional notes on Formosa. *Proceedings of the Royal Geographical Society of London*, **10**: 122–128.
- . 1867 (“1866”). Letter to the Secretary respecting a monkey from the island of North Lena, near Hongkong. *Proceedings of the Zoological Society of London*, **1866**: 556. (For date of publication, see Duncan, F. M., 1937, *Proceedings of the Zoological Society of London*, series A, **107**: 72.)
- . 1871 (“1870”). Catalogue of the mammals of China (south of the River Yangtze) and of the island of Formosa. *Proceedings of the Zoological Society of London*, **1870**: 615–653. (For date of publication, see Duncan, F. M., 1937, *Proceedings of the Zoological Society of London*, series A, **107**: 72.)
- TAIWAN ATLAS—Republic of China. 1981. Ministry of the Interior, Taipei. 81 pp. + 59 plates.
- TANAKA, S. 1986. Further note on the distribution problems of the Formosan monkey (*Macaca cyclopis*). *Kyoto University Overseas Research Report of Studies on Asian Non-human Primates*, **5**: 95–104.
- TATE, G. H. H. 1947. *Mammals of Eastern Asia*. Macmillan Co., New York, xiv + 366 pp.
- TATEISHI, K. 1958. [Food washing behavior in Formosan monkeys, *Macaca cyclopis*]. *Annual of Animal Psychology*, **8**: 89–94. (in Japanese)
- TOSI, A. J., J. C. MORALES, AND D. J. MELNICK. 2000. Comparison of Y chromosome and mtDNA phylogenies leads to unique inferences of macaque evolutionary history. *Molecular Phylogenetics and Evolution*, **17**: 133–144.
- U.S. BOARD ON GEOGRAPHIC NAMES. 1974. Republic of China—Official Standard Names Gazetteer. Washington, DC, ix + 789 pp.
- U.S. DEFENSE MAPPING AGENCY. 1981. Bathymetric chart no. 94010, Taiwan. Washington, DC.
- VALENTYN, F. 1726. *Oud en Nieuw Oost Indien . . .*, Vierde Deel, Derde Boek. Joannes van Braam, Dordrecht, 166 + 24 pp.
- VAN SCHAIK, C. P., M. A. VAN NOORDWIJK, AND C. L. NUNN. 1999. Sex and social evolution in primates, pp. 204–231. *In* Lee, P. C., ed., *Comparative Primate Socioecology*. Cambridge University Press, Cambridge.
- WAKAYAMA PREFECTURE. 1978. [Second National Survey on the Natural Environment: Survey on the Distribution of Animals (Mammals)], 27 pp. (in Japanese)
- WALLACE, A. R. 1876. *The Geographical Distribution of Animals*, Volume 1. Harper & Brothers, New York, xxiii + 503 pp.
- . 1881. *Island Life*. Harper & Brothers, New York, xvi + 522 pp.
- WANG, HURNG-YI, AND MING-CHUNG TU. 1997. Molecular evidence of the endemic snake, *Trimeresurus gracilis*, in Taiwan is not evolved *in situ*, pp. 101–108. *In* Lue, Kuang-Yang, and Tien-Hsi Chen, eds., *The Symposium on the Phylogeny, Biogeography and Conservation of Fauna and Flora of East Asian Region*. Department of Biology, National Taiwan Normal University and National Science Council, R.O.C., Taipei.
- WEISS, [given name unspecified]. 1870–1873. *Mailla . . .*, p. 120. *In* *Biographie Universelle Ancienne et Moderne . . .*, Nouvelle Édition, . . . Tome Vingt-sixième. Ch. Delagrave et Cie, Paris.
- WOZENCRAFT, W. C. 1993. Order Carnivora, pp. 279–348. *In* Wilson, D. E., and D. M. Reeder, eds., *Mammal Species of the World: A Taxonomic and Geographic Reference*, 2nd edition. Smithsonian Institution Press, Washington, DC.
- WU, HAI-YIN. 1996. Copulatory pattern of male *Macaca cyclopis*, abstract no. 117. *In* Abstracts from the XVth Congress of the International Primatological Society and the XIXth Conference of the American Society of Primatologists. Wisconsin Regional Primate Research Center, Madison, WI.
- WU, HAI-YIN, SHU-MEI CHEN, JUI-HUA CHU, AND YAO-SUNG LIN. 2001a. Polythelia in an isolated population of *Macaca cyclopis*, p. 387. *In* Abstracts, XVIIIth Congress of the International Primatological Society. Australian Primatological Society, Adelaide.
- WU, HAI-YIN, JUI-HUA CHU, AND YAO-SUNG LIN. 2001b. Evidence for anthropogenic mt-DNA reshuffling in *Macaca cyclopis*, p. 414. *In* Abstracts, XVIIIth Congress of the International Primatological Society. Australian Primatological Society, Adelaide.
- WU, HAI-YIN, AND HUEY-YU LIN. 1996. Diet and parasite analysis of *Macaca cyclopis*, p. 24. *In* Abstracts of International Symposium “Evolution of Asian Primates.” Primate Research Institute, Kyoto University, Inuyama, Aichi, Japan.
- WU, HAI-YIN, AND YAO-SUNG LIN. 1992. Life history variables of wild troops of Formosan macaques (*Macaca cyclopis*) in Kenting, Taiwan. *Primates*, **33**: 85–97.
- . 1993. Seasonal variation of the activity and range use patterns of a wild troop of Formosan ma-

- caque in Kenting, Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica*, **32**: 242–252.
- WU, HAI-YIN, YAO-SUNG LIN, AND LING-LING LEE. 1991. Demography of a wild troop of Formosan macaque in Kenting, southern Taiwan, pp. 29–32. *In* Ehara, A., T. Kimura, O. Takenaka, and M. Iwamoto, eds., *Primate Today*. Elsevier Science Publishers, Amsterdam.
- YANG, CZAU-SIUNG, CHING-HUNG KUO, AND CHAO-YUAN CHEN. 1967. A study on natural infection of simian virus 40 (SV<sub>40</sub>) in Taiwan monkeys (*Macaca cyclopis*). *Journal of the Formosan Medical Association*, **66**: 143–148.
- YANG, CZAU-SIUNG, CHO-CHOU KUO, J. E. DEL FAVERO, AND E. R. ALEXANDER. 1968. Care and raising of newborn Taiwan monkeys (*Macaca cyclopis*) for virus studies. *Laboratory Animal Care*, **18**: 536–543.
- YANG, YUN-FU, SHU-CHING YANG, AND FU-HSIANG TAI. 1976. Reovirus antibodies among animals in Taiwan. *Chinese Journal of Microbiology*, **9**: 1–4.
- YASUGAWA, T. 1960. On the hair streams on the trunk and extremities of *Macaca cyclopsis*. *Okajimas Folia Anatomica Japonica*, **35**: 329–344.
- YO, JON-NE. 2000. Activity pattern and food habits of *Macaca cyclopis* in Kenting. Master's thesis, National Taiwan University, Taipei, 62 pp. (in Chinese)
- YOSHIMURA, K., Y. HISHINUMA, AND M. SATO. 1968. Note on two trematode species from Taiwanese monkeys (*Macaca cyclopis* Swinhoe). *Kiseichugaku Zasshi/ Japanese Journal of Parasitology*, **17**: 292–293. (in Japanese)
- . 1969. *Ogmocotyle ailuri* (Price, 1954) in the Taiwanese monkey, *Macaca cyclopis* (Swinhoe, 1862). *Journal of Parasitology*, **55**: 460–461.
- YU, HON-TSEN. 1995. Patterns of diversification and genetic population structure of small mammals in Taiwan. *Biological Journal of the Linnaean Society*, **55**: 69–89.
- ZHANG YAPING AND SHI LIMING. 1993a. Phylogenetic relationships of macaques as inferred from restriction endonuclease analysis of mitochondrial DNA. *Folia Primatologica*, **60**: 7–17.
- . 1993b. Phylogeny of rhesus monkeys (*Macaca mulatta*) as revealed by mitochondrial DNA restriction enzyme analysis. *International Journal of Primatology*, **14**: 587–605.
- ZHUANG, JIN-NAN, ED. 1992. [List of Locality Names in Taiwan Province]. China Map Publishers, Beijing, 428 pp. (locality names in roman letters and Chinese characters)

### Note Added in Proof

Listed below are three relevant publications that appeared or were discovered while this monograph was in press.

- DEINARD, A., AND D. G. SMITH. 2001. Phylogenetic relationships among the macaques: Evidence from the nuclear locus NRAMP1. *Journal of Human Evolution*, **41**: 45–59
- HAMADA, Y., T. WATANABE, AND M. IWAMOTO. 1992. Variation of body color within macaques, especially in the Japanese macaques. *Primate Research*, **8**: 1–23. (In Japanese, English summary)
- SU, HSIU-HUI, AND LING-LING LEE. 2001. Food habits of Formosan rock macaques (*Macaca cyclopis*) in Jentse, Northeastern Taiwan, assessed by fecal analysis and behavioral observation. *International Journal of Primatology*, **22**: 359–377.

## Appendix 1: Specimens Examined (Total 237)

### Skins and Skulls, 36

Hengchun—YIO 733, 734; Hualien, mountains near—AMNH 184955; Ilan region—ZMB 43048; Kaohsiung vicinity—USNM 296794; 296795; Maanliao—USNM 294177; Manchoutsun—SMTD B4845/26383, ZMB 26472–26477, 26479; Mu-Kua-Chau—AMNH 184956, 184957; Pinam—ZMB A54.04; Puli—UMMZ 85348. No locality—BM(NH) 1866.4.25.8 (lectotype), 1866.4.25.9 (paralectotype), 1868.4.14.4, MCZ 37679, UMMZ 85349, USNM 296796, 308427–308429, 308722, 396927, 397401, 397444, 397645–397647, 397707.

### Skins Only, 28

Kuohsing Subcounty—TESRI Accession No. T 0115 (cadaver); Nanhua Subcounty—TESRI Accession No. T 0177 (cadaver); Puli vicinity—TM MA-0272; Ta Ching Shui—NMNS T 1726 (cadaver); Taroko National Park—NMNS T 1883, T 3911. No locality—NMNS T 1725, T 1731, T 3909 (3 cadavers), NTUZ uncatalogued specimen, TESRI MC 0078, MC 0091, TM MA-0010–MA-0012, MA-0092, MA-0094–MA-0097, MA-0236, MA-0265, MA-0378, USNM 296797, 308717, 308721, ZMB 42135, 42546.

### Skulls Only, 169

A-Sun-Lai-Ga—private collection, two unnumbered skulls; Ayu Shan—USNM 399112; Ching-shui Cliff—private collection, unnumbered skull; Chuchi—NTUZ Aoki 94; Tawa Mountain Nature

Preserve—private collection, unnumbered skull; Eastern Taiwan—NTUZ 063, 064, uncatalogued specimen; Hsiao-i—USNM 399111; Hui-Sun Experimental Forest—private collection, Mk-7; Jentse—NTUZ uncatalogued specimen; Kenting—private collection, Mk-1, Mk-2, Mk-6; Manchoutsun—ZMB 26366, 26478, 26553–26557, 26568–26573; Oshima (introduced)—KUPRI 4486; Shao Hsing Shui—NMNS 001396; Shenmu Tsun—TESRI MC 0012, MC 0017; Shoulin Shan—TESRI MC 0084–MC 0086 (mandibles only), Shou Shan—USNM 399110; Taimali Hsi—TESRI MC 0014 (mandible only), MC 0114; Wushihkeng—TESRI MC 0016; Wutao Shan—TESRI MC 0081; Yen Hai logging trail—TESRI MC 0043. No locality—ANSP 11884, JMC 415, 910, 946, 1024, 1203, 1232, 1469, 1551, 1593, 2069, 2070, 2112, 2128, 2181, 2245, 2288, 2500, 3104, 3153, 3208, 3224, 3232, 3329, 3368, 3371, 3374, 3381, 3384, 3390, 3401, 3465, 3625, 3634, 3764, 4169, 4514, 4532, 4553, 4641, 4665, 4891, 5040, 5047, 5142, 5150, KUPRI 302, 303, 305, 526, 528, 559, 560, 586–588, 1315, 1358, 1511, 1682, 1745, 1832, 1883, 2289, 2290, 2452, 2514, 2795, 2796, 2846, 2913, 3056, 3224, 3225, 3651–3660, 3852, 4201, 4217, 4233, 4238, 4508, 5018, 5228, 5843, 5847, 6082, 6431, NMNS 000088, 000102, 000103, 000148, 000546–000548, 001264, NTUZ Aoki 3484, private collection (Mk-3, Mk-4, Mk-5), USNM 308718–308720, 332888–333895, 358612–358618, 396928, 397975, ZMB 23245.

### Postcranials Only, 4

No locality—KUPRI 304, 2288, 4721, NMNS 001996.

## Appendix 2: Gazetteer of *Macaca cyclopis* Localities

The romanization of Taiwanese locality names that are listed as primary entries in this gazetteer preferentially follows that in "List of Locality Names in Taiwan Province" (Zhuang, 1992). In addition, the following supplementary geographic references have been consulted: National Atlas of China, Volume 1—Taiwan (1967); Chu and Yamanaka (1973); U.S. Board on Geographic Names, Republic of China—Official Standard Names Gazetteer (1974); Taiwan Atlas—Republic of China (1981); Kyoda (1989); Chen (1993); Huang et al. (1993). Localities of *M. cyclopis* that were not found in "List of Locality Names in Taiwan Province" or supplementary references are spelled here as in the original sources. Secondary entries, with cross references to corresponding primary entries, indicate variant spellings or alternate locality names that appear on specimen tags, in published literature, or in unpublished notes concerning *M. cyclopis*.

The sequence of information presented in primary entries is as follows:

1. Locality name, in roman letters and Chinese characters.
2. Elevation, if reported by collector or observer.
3. Name of county (= "hsien"), in capital letters.
4. Coordinates of locality; the principal sources of coordinates are references indicated above and published or unpublished field notes of collectors or observers.
5. Date of collection or observation.
6. Name of collector or observer.
7. Bibliographic reference (in parentheses) to published or unpublished field notes, if any.
8. Abbreviated name of museum (see Introduction) where specimens are preserved.
9. Number of specimens available (with indication of part preserved, if skin and skull are not both present).
10. Locality number (italicized) as indicated in distribution map (Fig. 1).

Alishan zone (阿里山區), Alishan Hsiang, 2260 m; CHIA-I; 23°32'N, 120°48'E; droppings observed 30 Jul. 1997 by TESRI survey team. *N143*

Alishan zone (阿里山區), Alishan Hsiang, 2310 m; CHIA-I; 23°31'N, 120°48'E; droppings observed 1 Aug. 1997 by TESRI survey team. *N143*

Ali village. See Wutao Shan.

Amma Shan. See Anmashan.

Anmashan (鞍馬山) (=Amma Shan), 1500–2900 m; TAICHUNG; 24°16'N, 121°00'E; observed Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145). Reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386; Tanaka, 1986, p. 101). *N79*

Anpingkenghsi Mining Trail (安平坑溪採礦道路), Suao-Nanao Hsiang, 175 m; ILAN; 24°37'N, 121°46'E; 3 monkeys observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N18*

Anpingkenghsi Mining Trail (安平坑溪採礦道路), Suao-Nanao Hsiang, 685 m; ILAN; 24°35'N, 121°44'E; observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N24*

Anpingkenghsi Mining Trail (安平坑溪採礦道路), Suao-Nanao Hsiang, 690 m; ILAN; 24°33'N, 121°43'E; vocalization heard 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N23*

Anpingkenghsi Mining Trail (安平坑溪採礦道路), Suao-Nanao Hsiang, 810–930 m; ILAN; 24°35'N, 121°44'E; observed at 810 m and 930 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N24*

Anpingkenghsi Mining Trail (安平坑溪採礦道路), Suao-Nanao Hsiang, 1000 m; ILAN; 24°33'N, 121°43'E; vocalization heard 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N23*

Antungwenchuan (安通溫泉), Yuli Chen; HUALIEN; 23°17'N, 121°20'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S30*

Apenberg. See Shou Shan.

Ape's Hill. See Shou Shan.

A-Sun-Lai-Ga (阿桑來嘎), Lakulaku Hsi, 800–1000 m; HUALIEN; 23°22'N, 121°11'E; collected in 1999 by H.-C. Chu; private collection, 2 (skulls only, including 1 lacking mandible). *S22*

- Ayu Shan (阿玉山); ILAN; 24°47'N, 121°36'E; collected 12 Apr. 1963, probably by U.S. Naval Medical Research Unit No. 2; USNM, 1 (skull only). *N10*
- Central Range. See Chung Yang Shan Mo.
- Chai Shan. See Shou Shan.
- Changhu (樟湖), Kukeng Hsiang, 310–350 m; YUNLIN; 23°36'N, 120°37'E; 3 monkeys observed at 340 m 9 Dec. 1994 by TESRI survey team. Observed at 310 m and 340 m 13 Dec. 1994 by TESRI survey team. Observed at 320 m and 350 m 16 Dec. 1994 by TESRI survey team. Droppings observed at 350 m 3 Mar. 1995 by TESRI survey team. Droppings observed at 340 m 12 Apr. 1995 by TESRI survey team. *N116*
- Changliang Logging Trail (長良林道), Chohsi Hsiang, 825 m; HUALIEN; 23°15'N, 121°12'E; observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *S35*
- Changliang Logging Trail (長良林道), Chohsi Hsiang, 980 m; HUALIEN; 23°15'N, 121°13'E; observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *S34*
- Changliang Logging Trail (長良林道), Chohsi Hsiang, 1920 m; HUALIEN; 23°12'N, 121°08'E; 2 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *S72*
- Changliang Logging Trail (長良林道), Chohsi Hsiang, 1965 m; HUALIEN; 23°12'N, 121°09'E; observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *S73*
- Chaochou (潮州) (=Choshu); PINGTUNG; 22°33'N, 120°32'E; observed before 1930 by T. Kano (1929, p. 333). *S130*
- Chia-I (嘉義); CHIA-I; 23°29'N, 120°27'E; collected for parasitological research before 1964 by R. E. Kuntz (Schad and Anderson, 1963, p. 799). Serum samples obtained 1964–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S1*
- CHIA-I (嘉義); 23°13–38'N, 120°07–57'E; collected 12 Jan. 1937 probably by B. Aoki; NTUZ, 1 (skull only; external measurements on skull tag). Not mapped.
- Chichi Tashan (集集大山), Chichi Chen; NANTOU; 23°51'N, 120°50'E; reported in 1980 by S. Tanaka (1986, p. 98), subsequent extinction at locality suspected. Observed in 1996 by S.-W. Chang (1999, p. 13). *N105*
- Chichi Tashan (集集大山), Chichi Chen, 700–1250 m; NANTOU; 23°51'N, 120°49'E; reported at 800 m 15 Nov. 1992 to TESRI survey team. Capture reported at 700 m 10 Dec. 1992 to TESRI survey team. Droppings observed at 1250 m 8 Mar. 1993 by TESRI survey team. *N105*
- Chienho (建和), Peinan Hsiang; TAITUNG; 22°44'N, 121°03'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S119*
- Chientai Logging Trail (尖台林道), Jenai Hsiang, 1250–1300 m; NANTOU; 23°56'N, 121°07'E; droppings observed at 1250 m and 12 monkeys observed at 1300 m 29 Nov. 1996 by S.-W. Chang (TESRI). *N68*
- Chihpen Hsi (知本溪), left bank, Peinan Hsiang; TAITUNG; ca. 22°40'N, 120°57'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S122*
- Chihpen Hsi (知本溪), right bank, Peinan Hsiang; TAITUNG; ca. 22°41'N, 120°59'E; observed 7–18 Aug. 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, pp. 386, 391). *S121*
- Chihpen Logging Trail (知本林道), Peinan Hsiang, 280–480 m; TAITUNG; 22°38'N, 121°00'E; observed at 200 m and 480 m 31 May 1996 by S.-W. Chang (TESRI). *S124*
- Chihpen Wenchuan (知本溫泉), Peinan Hsiang; TAITUNG; 22°42'N, 121°01'E; observed 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S120*
- Chingjen Ku (情人谷), Fengyuan; 480 m; TAICHUNG; 24°14'N, 120°46'E; 3 monkeys observed 13 Oct. 1995 by TESRI survey team. *N84*
- Chingmei (清美), Hsiulin Hsiang; HUALIEN; 24°05'N, 121°36'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N56*
- Chingshui Cliff (清水斷崖), Hsiulin Hsiang, 100 m; HUALIEN; 24°12'N, 121°40'E; collected 27 Jan. 2000 by J.-H. Chu; private collection (skull only). *N54*
- Chingshui Hsi Power Station (清水溪電廠), Chohsi Hsiang; HUALIEN; 23°17'N, 121°16'E; reported in 1982 by K. Masui, Y.

- Narita, and S. Tanaka (1986, p. 386). *S32*  
 Ching Sway Go. See Chinshuikou.
- Chinlun (金崙), Taimali Hsiang; TAITUNG; 22°32'N, 120°57'E; reported 1967–1971 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S126*
- Chinlunshan (金崙山), Tahsi, Chinfeng Hsiang; TAITUNG; 22°34'N, 120°56'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S125*
- Chinshuikou (清水溝) (=Ching Sway Go), 1000 m; NANTOU; ca. 23°49'N, 120°45'E; three captives reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *N108*
- Chishan vicinity (旗山地區), Chishan-Meinon, 200 m; KAOHSIUNG; 22°53'N, 120°29'E; observed 15 Feb. 2000 by H.-Y. Wu. *S105*
- Chishan vicinity (旗山地區), Chishan-Meinon, 200 m; KAOHSIUNG; 22°54'N, 120°30'E; 3 groups observed 15 Feb. 2000 by H.-Y. Wu. *S104*
- Chi Tou. See Hsitou.
- Chitsaihu (七彩湖), Hsini Hsiang, 2600–2730 m; NANTOU; 23°45'N, 121°13'E; droppings observed at 2730 m 17 Nov. 1994 by TESRI survey team. Droppings observed at 2600 m 18 Nov. 1994 by TESRI survey team. *N131*
- Chiuchiu Feng (九九峰), Tsaotun Chen, 200 m; NANTOU; 24°00'N, 120°45'E; droppings observed 3 Feb. 1993 by TESRI survey team. *N95*
- Chiumei Bridge (九梅吊橋), Hsiulin Hsiang, 800 m; HUALIEN; 24°13'N, 121°28'E; observed 2 Aug. 1997 by H.-Y. Wu. *N49*
- Chiupeng (九棚), Manchou Hsiang; PINGTUNG; 22°07'N, 120°52'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S150*
- Choching (卓清), Chohsi Hsiang; HUALIEN; 23°16'N, 121°16'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S32*
- Choshu. See Chaochou.
- Chuchi (竹崎); CHIA-I; 23°31'N, 120°33'E; collected 3 Jan. 1930, probably by B. Aoki; NTUZ, 1 (skeleton only, external measurements on specimen tag). *N148*
- Chufengshan (出風山), Manchou Hsiang; PINGTUNG; 22°03'N, 120°52'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S151*
- Chulaoshu Shan (豬勝東山) (=Teraso); PINGTUNG; 22°01'N, 120°51'E; collected ca. 1897 by I. Namiye (1914, p. 213; Huang et al., 1993, p. 167); photo of mounted specimen published, museum unknown. *S152*
- Chunfu (?), Changpin (=Chanpin) Hsiang; TAITUNG; ca. 23°20'N, 121°25'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S29*
- Chungan (重安), Iwan (宜灣), Chengkung Chen; TAITUNG; ca. 23°12'N, 121°23'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S74*
- Chungan (重安), Poaili (博愛里), Chengkung Chen; TAITUNG; ca. 23°12'N, 121°23'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S74*
- Chunghsing Tahsueh (=University), experimental forest (中興大學實驗林場), Jenai Hsiang; NANTOU; ca. 24°04'N, 121°00'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N73*
- Chungliao Hsiang (中寮鄉), 1000 m; NANTOU; ca. 23°52'N, 120°45'E; reported 14 Jan. 1993 to TESRI survey team. *N107*
- Chung Yang Shan Mo (中央山脈) (=Central Range), 3400 m; 22°15'–24°35'N, 120°45'–121°35'E; monkey droppings observed Jun.–Jul. 1973 by D. R. McCullough (1974, p. 11). Not mapped.
- Chunta Logging Trail (郡大林道), Hsini Hsiang; NANTOU; 23°36–40'N, 120°52–56'E; reported 1 Jan. 1994 to TESRI survey team. *N121*
- Chunta Logging Trail (郡大林道), Hsini Hsiang; NANTOU; 23°44'N, 120°56'E; reported 29 May 1997 to S.-W. Chang (TESRI). *N125*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 810 m; NANTOU; 23°41'N, 120°53'E; droppings observed 25 Jun. 1997 by S.-W. Chang (TESRI). *N122*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 1355–2515 m; NANTOU; 23°33–40'N, 120°54'E; 5 droppings observed at 1355 m and 1360 m 1 Sep. 1993 by TESRI survey team. Two monkeys observed at 2050 m and drop-

- pings observed at 2280 m 3 Sep. 1993 by TESRI survey team. Vocalization heard at 1380 m and droppings observed at 1470 m 3 Feb. 1994 by TESRI survey team. Droppings observed at 1750 m and 2040 m 10 Mar. 1994 by TESRI survey team. Droppings observed at 1725 m 11 Mar. 1994 by TESRI survey team. Droppings observed at 2515 m 8 Jan. 1995 by TESRI survey team. *N121*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 1425 m; NANTOU; 23°41'N, 120°54'E; 4 monkeys observed 24 June 1997 by S.-W. Chang (TESRI). *N130*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 1580 m; NANTOU; 23°42'N, 120°54'E; vocalization heard 24 June 1997 by S.-W. Chang (TESRI). *N123*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 1910–1920 m; NANTOU; 23°42'N, 120°55'E; 3 monkeys observed at 1910 m 9 Mar. 1994 by TESRI survey team. Three monkeys observed at 1920 m by S.-W. Chang (TESRI). *N129*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2450–2455 m; NANTOU; 23°45'N, 120°58'E; droppings observed at 2450 m and 2455 m 28 May 1997 by S.-W. Chang (TESRI). *N127*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2470 m; NANTOU; 23°45'N, 120°59'E; 3 monkeys observed 28 May 1997 by S.-W. Chang (TESRI). *N127*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2485 m; NANTOU; 23°44'N, 120°58'E; droppings observed 28 May 1997 by S.-W. Chang (TESRI). *N128*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2495 m; NANTOU; 23°44'N, 120°57'E; droppings observed 28 May 1997 by S.-W. Chang (TESRI). *N126*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2705 m; NANTOU; 23°43'N, 120°56'E; food remains and droppings observed 29 May 1997 by S.-W. Chang (TESRI). *N125*
- Chunta Logging Trail (郡大林道), Hsini Hsiang, 2790–2855 m; NANTOU; 23°44'N, 120°56'E; food remains and droppings observed at 2790 m and droppings observed at 2840 m and 2855 m 29 May 1997 by S.-W. Chang (TESRI). *N125*
- Chushe Hsi (竹社溪), Mutan Hsiang; PINGTUNG; ca. 22°08'N, 120°48'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S148*
- Chushuihsi (出水溪), Hsini Hsiang, 1300 m; NANTOU; 23°31'N, 120°51'E; 3 monkeys observed 20 June 1995 by TESRI survey team. *N142*
- Chutsun (竹村), Hsiulin Hsiang; HUALIEN; 24°16'N, 121°30'E; collected in 1989 by C.-T. Yao; TESRI, 3 (mandibles only). *N47*
- Chutsun (竹村), Hsiulin Hsiang, 1100 m; HUALIEN; 24°15'N, 121°29'E; observed 8 Aug. 1997 by H.-Y. Wu. *N48*
- Chyunshan Logging Trail (出雲山林道), 930–960 m; KAOHSIUNG; 22°57'N, 120°45'E; group observed at 930 m and droppings observed at 960 m 21 Oct. 1998 by S.-W. Chang (TESRI). *S98*
- Chyunshan Logging Trail (出雲山林道), 1135–1300 m; KAOHSIUNG; 22°58'N, 120°47'E; vocalization heard at 1135 m and droppings observed at 1300 m 21 Oct. 1998 by S.-W. Chang (TESRI). *S96*
- Chyunshan Logging Trail (出雲山林道), 1290 m; KAOHSIUNG; 22°57'N, 120°44'E; 5 monkeys observed 22 Oct. 1998 by S.-W. Chang (TESRI). *S99*
- Chyunshan Logging Trail (出雲山林道), 1350 m; KAOHSIUNG; 22°56'N, 120°45'E; 5 monkeys observed 22 Oct. 1998 by S.-W. Chang (TESRI). *S97*
- Chyunshan Logging Trail (出雲山林道), 1360 m; KAOHSIUNG; 22°58'N, 120°48'E; dead monkey observed 21 Oct. 1998 by S.-W. Chang (TESRI). *S95*
- Chyunshan Logging Trail (出雲山林道), 1400 m; KAOHSIUNG; 22°59'N, 120°48'E; droppings observed 21 Oct. 1998 by S.-W. Chang (TESRI). *S95*
- Chyunshan Logging Trail (出雲山林道), 2220 m; KAOHSIUNG; 23°01'N, 120°49'E; droppings observed 20 Oct. 1998 by S.-W. Chang (TESRI). *S56*
- Chyunshan Logging Trail (出雲山林道), 2260–2275 m; KAOHSIUNG; 23°01'N, 120°48'E; 2 monkeys observed at 2260 m and droppings observed at 2275 m 20 Oct. 1998 by S.-W. Chang (TESRI). *S55*



- Chyunshan Logging Trail (出雲山林道), 2300–2320 m; KAOHSIUNG; 23°00'N, 120°48'E; vocalization heard at 2300 m and droppings observed at 2320 m 20 Oct. 1998 by S.-W. Chang (TESRI). *S54*
- Danayee (達娜伊谷) (Shanmei), ?Alishan Hsiang; 690–930 m; CHIA-I; 23°22'N, 120°39–41'E; droppings observed at 690 m, 720 m, 730 m, 770 m, and 820 m 1 Apr. 1998 by TESRI survey team. Droppings observed at 930 m 5 Apr. 1998 by TESRI survey team. *S3*
- Dikanhsi-Hsuehchenhsi (狄崗溪–雪見溪), Taian Hsiang, 820–860 m; MIAOLI; ca. 24°26'N, 120°54'E; droppings observed 3 Dec. 1996 by TESRI survey team. *N37*
- Eastern coast, mountains (東部海岸山脈), “principally in the central district”; imprecise locality; collected in 1953 by local Ami residents (Sato et al., 1956, p. 42; Setoguti & Sakuma, 1959, p. 158); Formerly in Department of Anatomy, Nagasaki University, 116 preserved cadavers (not seen); present whereabouts unknown. Not mapped.
- Eastern Taiwan (東臺灣), <2000 m; imprecise locality; collected before 1999 by unknown collector; NTUZ, 3 (skulls only). Not mapped.
- Erpingshan (二坪山), Shuili Hsiang, 390 m; NANTOU; 23°49'N, 120°51'E; 6 monkeys observed 12 Mar. 1994 by TESRI survey team. *N103*
- Ershui Monkey Protection Area (二水獼猴保護區), Ershui Hsiang, 170–210 m; CHANGHUA; 23°49'N, 120°38'E; 20 droppings observed at 170 m 5 Jan. 1995 by TESRI survey team. Food remains observed at 170 m and 210 m 5 Jan. 1995 by TESRI survey team. Ten monkeys observed at 170 m 6 Jan. 1995 by TESRI survey team. Droppings observed at 200 m 8 Mar. 1995 by TESRI survey team. *N111*
- Fangliao vicinity (枋寮地區); PINGTUNG; ca. 22°22'N, 120°35'E; serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S133*
- Fangshan Hsi (枋山溪), Fangshan Hsiang; PINGTUNG; ca. 22°25'N, 120°37'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S134*
- Fayun Ssu (法雲寺), Tahu Hsiang, 310–390 m; MIAOLI; 24°27'N, 120°51'E; 10 monkeys observed at 310 m 29 Jan. 1997 by TESRI survey team. Droppings observed at 390 m 30 Jan. 1997 by TESRI survey team. *N34*
- Fengshan (豐山), Alishan Hsiang, 780 m; CHIA-I; 23°34'N, 120°44'E; 2 groups observed 4 Dec. 1997 by TESRI survey team. *N144*
- Forest Section No. 15 (十五林班), Mutan Hsiang; PINGTUNG; ca. 22°07'N, 120°49'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S149*
- Forest Section No. 27 (二十七林班), Mutan Hsiang; PINGTUNG; ca. 22°07'N, 120°49'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S149*
- Fuchouli (富州里), Chushan Chen, 250 m; NANTOU; 23°48'N, 120°45'E; droppings observed 5 Jan. 1993 by TESRI survey team. *N109*
- Fuhsing Hsiang (復興鄉); TAOYUAN; ca. 24°43'N, 121°22'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N14*
- Fushan Forest Station (林試所福山分所); ILAN/TAIPEI; ca. 24°46'N, 121°35'E; observed Nov. 1992–Jul. 1993 by L.-L. Lee (1994, p. 437). *N11*
- Fushan Forest Station: Botanic Garden (林試所福山植物園), west of Hapen Creek (哈盆溪); TAIPEI; 24°46'N, 121°35'E; observed 25 Apr 1999 by H.-H. Su and J. Fooden. *N11*
- Fushan (福山) (=Rimogan); TAIPEI; 24°47'N, 121°30'E; reported before 1933 by Y. Hori-kawa (1932, p. 69). *N12*
- Fuyuan Forest Recreation Area (富源森林遊樂區), Wanjung Hsiang, 200 m; HUALIEN; 23°36'N, 121°20'E; reported 1 Oct. 1999 to H.-Y. Wu. *N139*
- Giran. See Ilan.
- Haianshanmo (海岸山脈), Tungho Hsiang. See Tayuan, Haianshanmo.
- Haianshanmo (海岸山脈), Yuli Chen; HUALIEN; ca. 23°25'N, 121°25'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S27*
- Ha-pen (哈盆), Wulai Hsiang, 530 m; TAIPEI; 24°45'N, 121°32'E; 4 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N15*
- Ha-pen (哈盆), Wulai Hsiang, 535–570 m;

- TAIPEI; 24°45'N, 121°33'E; groups observed at 535 m, 550 m, and 570 m 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N16*
- Ha-pen (哈盆), Wulai Hsiang, 650 m; TAIPEI; 24°45'N, 121°34'E; 4 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N17*
- Hapen Creek (哈盆溪). See Fushan Forest Station.
- Hengchun (恒春) (=Koshun; Koshiun); PINGTUNG; 22°00'N, 120°44'E; reported before 1930 by T. Kano (1929, p. 333). Collected 4–6 Jun. 1932 by H. Orii (Kuroda, 1935, p. 291; 1940, p. 269); YIO, 2. Serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S142*
- Hengchun Nature Preserve (恒春生態保護區), Kenting National Park, 200–250 m; PINGTUNG; 21°58'N, 120°49'E; observed 1985–1990 by H.-Y. Wu and Y.-S. Lin (1992, p. 86; Wu, Lin & Lee, 1991, p. 29). *S153*
- Hoko I. See Penghu Chuntao.
- Hokuzanko. See Peishankeng.
- Hori. See Peishankeng.
- Hoping (和平), Papien, Chiapin, Chengkung Chen; TAITUNG; ca. 23°04'N, 121°20'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S78*
- Hsiangtao No. 131 (南投131號縣道), Shuili Hsiang; NANTOU; ca. 23°48'N, 120°51'E; observed 14 Apr. 1994 by TESRI survey team. *N104*
- Hsiangtao No. 136 (南投136號縣道), Kuohsing Hsiang, 600 m; NANTOU; 24°03'N, 120°51'E; reported 14 Oct. 1993 to TESRI survey team. *N92*
- Hsiao Ching Shui (小清水); HUALIEN; 24°12'N, 121°40'E; collected 15 Feb. 1997 by K.-Y. Chung; NMNS, 1 (skull only). *N54*
- Hsiao (孝義), Wulai District; TAIPEI; 24°51'N, 121°35'E; trapped for parasitological research 6 Jun. 1963 by J. F. Bergner Jr., autopsied 22 May 1964 (Bergner & Jachowski, 1968, pp. 22, 30); USNM (skull only). *N7*
- Hsiao Kueihu (小鬼湖); TAITUNG; 22°42'N, 120°53'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, pp. 97, 98). *S111*
- Hsiaoaponko (小邦口). ?Tahu Hsiang; MIAOLI; 24°23'N, 120°52'E; reported 13 Aug. 1996 to TESRI survey team. *N36*
- Hsi Lin (士林); TAIPEI; ca. 25°06'N, 121°32'E; reported Jun.–Dec. 1978 by informant to F. E. Poirier (Poirier & Davidson, 1979, p. 157). *N1*
- Hsini (信義), Tousienchiao, Chengkung Chen; TAITUNG; 23°02'N, 121°19'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S79*
- Hsinkangshan (新港山), Chengkung Chen; TAITUNG; ca. 23°08'N, 121°19'E; reported 1967–1971 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S75*
- Hsipao (西寶), Hsiulin Hsiang, 1000 m; HUALIEN; 24°12'N, 121°28'E; observed 1 Aug. 1997 by H.-Y. Wu. *N50*
- Hsiton. See Hsitou.
- Hsitou (溪頭), Luku Hsiang, 1270–1360 m; NANTOU; 23°40'N, 120°47'E; droppings observed at 1360 m 26 Apr. 1995 by TESRI survey team. Droppings observed at 1270 m 27 Apr. 1995 by TESRI survey team. Four monkeys observed at 1320 m 28 Nov. 1994 by TESRI survey team. Droppings observed at 1280 m 30 Nov. 1994 by TESRI survey team. *N120*
- Hsitou (溪頭) (=Chi Tou), 1000 m; NANTOU; 23°41'N, 120°47'E; observed Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *N120*
- Hsitou (溪頭) (=Hsiton), Fenghuangshan, Luku Hsiang; NANTOU; 23°41'N, 120°47'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N120*
- Hsiungshan (?), “Chishan ?” Chen; KAOHSIUNG; ca. 22°50'N, 120°25'E; albino infant reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 387); report subsequently contradicted (Tanaka, 1986, p. 100). Not mapped.
- Hsuehshankeng (雪山坑), Hoping Hsiang, 750–880 m; TAICHUNG; 24°19'N, 120°57'E; vocalization heard at 750 m 26 Oct. 1995 by TESRI survey team. Droppings observed at 880 m 7 Feb. 1996 by TESRI survey team. *N80*
- Hsuehshankeng Logging Road (雪山坑林道), Hoping Hsiang, 1200 m; TAICHUNG; 24°19'N, 120°57'E; droppings observed 10 Jan. 1996 by TESRI survey team. *N80*

- Hsueh Shan (雪山) (=Tsugitaka Mountains), 0–3000 m, mostly <2100 m; TAICHUNG; ca. 24°23'N, 121°13'E; reported 1925–1933 by T. Kano (1940, pp. 10, 33). *N44*
- Hualien (花蓮); HUALIEN; ca. 23°59'N, 121°36'E; serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). Reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N57*
- Hualien (花蓮), mountains near; HUALIEN; ca. 23°59'N, 121°36'E; collected 1 Apr. 1960 by R. B. White; AMNH, 1 (external measurements in field catalogue). *N57*
- HUALIEN forests (花蓮地區森林); 23°06'–24°22'N, 120°59'–121°46'E; reported before 1959 by Z.-M. Dien (1958, p. 346). Not mapped.
- Huayuan (華源), Taimali Hsiang; TAITUNG; 22°40'N, 121°01'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S123*
- Hui-Sun Experimental Forest (惠蓀實驗林場); NANTOU; 24°03'N, 121°01'E; monkey accidentally poisoned in 1994, collected by H.-Y. Wu; private collection, 1 (skull with partial postcranials). *N72*
- Hungshih Logging Trail (紅石林道), Haituan Hsiang, 1160–1170 m; TAITUNG; 23°04'N, 121°07'E; vocalization heard at 1160 m and droppings observed at 1170 m 4 Dec. 1996 by S.-W. Chang (TESRI). *S67*
- Huoyenshan (火炎山), Sani Hsiang; MIAOLI; 24°22'N, 120°43'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N35*
- Hupen (湖本), Linnei Hsiang, 210 m; YUNLIN; 23°43'N, 120°37'E; droppings observed 12 Jan. 1995 by TESRI survey team. *N113*
- Ilan (宜蘭) (=Giran) region; ILAN; ca. 24°46'N, 121°45'E; collected 25 Nov. 1930 by B. Aoki; ZMB, 1. Serum samples obtained 1959–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *N9*
- Jenlun Logging Trail (人倫林道), Hsini Hsiang, 1300–1400 m; NANTOU; 23°40'N, 120°53'E; reported 27 June 1997 to S.-W. Chang (TESRI). *N122*
- Jenlun Logging Trail (人倫林道), Hsini Hsiang, 1400 m; NANTOU; 23°44'N, 120°54'E; reported 26 June 1997 to S.-W. Chang (TESRI). *N124*
- Jenlun Logging Trail (人倫林道), Hsini Hsiang, 1750 m; NANTOU; 23°43'N, 120°56'E; droppings observed 11 Jan. 1994 by S.-W. Chang (TESRI). *N125*
- Jentse (仁澤); ILAN; 24°33'N, 121°30'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). Collected in 1991 by H.-H. Su; NTUZ, 1 (skeleton only). *N26*
- Jentse Wenchuan. See Jentse.
- Jihyueh Tan (日月潭) (=Jihyuhtan, Sun-Moon Lake, Tsuisia Lake) vicinity; NANTOU; ca. 23°51'N, 120°55'E; monkey-skin clothing and strings of monkey skulls observed ca. Oct. 1873 by J. B. Steere (1876, pp. 310, 319). Two captives reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 387). *N102*
- Juifeng Bridge (瑞峰橋), Meishan Hsiang, 420 m; CHIA-I; 23°34'N, 120°38'E; >30 monkeys observed 17 Oct. 1997 by TESRI survey team. *N146*
- Juili (瑞里), Meishan Hsiang; CHIA-I; ca. 23°33'N, 120°38'E; reported in 1975 by S. Tanaka (1986, p. 98); confirmed as locally extinct in 1986. *N149*
- Juili (瑞里), Meishan Hsiang, 700 m; CHIA-I; 23°31'N, 120°40'E; 5 monkeys observed 4 Dec. 1997 by TESRI survey team. *N150*
- Juilung Pupu (瑞龍瀑布), Chushan Chen, 320 m; NANTOU; 23°39'N, 120°41'E; 2 monkeys observed 10 Mar. 1993 by TESRI survey team. Droppings observed 11 Mar. 1993 by TESRI survey team. *N118*
- Juiyen (瑞岩), Jenai Hsiang, 2200 m; NANTOU; 24°07'N, 121°11'E; >2 monkeys observed 26 Oct. 1993 by TESRI survey team. *N66*
- Juiyehsi (瑞岩溪), Jenai Hsiang, 2190–2205 m; NANTOU; 24°09'N, 121°12'E; droppings or tracks observed at 2190 m and droppings observed at 2205 m 28 Feb. 1997 by S.-W. Chang (TESRI). *N66*
- Kainan City. See Moushi.
- Kangou (乾溝), Kuohsing Hsiang, 630 m; NANTOU; 24°01'–02'N, 120°49'–50'E; droppings observed 14 Oct. 1993 by TESRI survey team. *N94*
- Kangtzu (港仔), Manchou Hsiang; PINGTUNG; 22°08'N, 120°52'E; reported in 1982 by K.

- Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S150*
- Kankenghsi (乾坑溪). Chushan Chen, 260 m; NANTOU: 23°40'N, 120°39'E; droppings observed 10 Mar. 1993 by TESRI survey team. Vocalization heard and droppings observed 11 Mar. 1993 by TESRI survey team. One monkey observed 23 Apr. 1993 by TESRI survey team. *N115*
- Kaohsiung (高雄) (=Takao) vicinity, probably obtained on Shou Shan: KAOHSIUNG: ca. 22°39'N, 120°15'E; collected 7 Mar. 1953 by R. M. Dasch; USNM, 2. *S106*
- KAOHSIUNG forests (高雄地區森林): 22°29'–23°28'N, 120°10'–121°02'E; reported before 1959 by Z.-M. Dien (1958, p. 346). Not mapped.
- Kaoshih (高士), Mutan Hsiang; PINGTUNG: 22°07'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S149*
- Kaoshihfoshan (高士佛山), Mutan Hsiang; PINGTUNG: 22°08'N, 120°48'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S148*
- Kasho I. See Lu Tao.
- Kenting (墾丁), 225 m; PINGTUNG: 21°58'N, 120°49'E; collected in 1987 by H.-Y. Wu; private collection, 1 (skull only). *S153*
- Kenting Kungyuan (墾丁公園) (=Park). Hengchun Chen; PINGTUNG: 21°58'N, 120°48'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). Observed 1987–1989 by L.-L. Lee and Y. S. Lin (1991, p. 36; 1994, p. 19). Collected in 1989 by H.-Y. Wu and collected in 1998 by J.-N. Yue; private collection, 2 (skulls only). *S143*
- Kenting Monkey Rock. See Kenting Kungyuan.
- Koshiun. See Hengchun.
- Koshun. See Hengchun.
- Koto I. See Lan Yu.
- Kuangfu vicinity (光復地區); HUALIEN: ca. 23°40'N, 121°25'E, reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N137*
- Kuang Shan Working Circle. See Kuanshan.
- Kuanshan (關山) (=Kuang Shan Working Circle); TAITUNG: 23°03'N, 121°09'E; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *S68*
- Kuanshan Chen vicinity (關山鎮地區); TAITUNG: ca. 23°03'N, 121°09'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S68*
- Kuanyinshan (觀音山), Tashe Hsiang, 200 m; KAOHSIUNG: 22°43'N, 120°21'E; reported 15 Feb. 2000 to H.-Y. Wu. *S107*
- Kueihu. See Hsiao Kueihu.
- Kueitan (龜丹), Nanhsi Hsiang; TAINAN: 23°08'N, 120°29'E; Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S51*
- Kukeng (古坑); YUNLIN: 23°39'N, 120°33'E; reported origin of captive obtained before 1998 (Chang 1997, p. 3). *N114*
- Kukuan (谷關), Hoping Hsiang; TAICHUNG: 24°12'N, 121°00'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N75*
- Kungtientsun (公田底), Fanlu Hsiang, 590 m; CHIA-I: 23°22'N, 120°36'E; >10 monkeys observed 10 Feb. 1998 by TESRI survey team. One dead monkey observed 18 June 1998 by TESRI survey team. *S2*
- Kuohsing Hsiang (國姓鄉); NANTOU: ca. 24°01'N, 120°51'E; collected before 1999 by TESRI recovery center (S.-W. Chang, TESRI, personal communication, 27 Apr. 1999); TESRI, 1 (frozen carcass). *N93*
- Kuwabarusha (?); KAOHSIUNG (=Takao); not located; observed before 1930 by T. Kano (1929, p. 333). Not mapped.
- Kwang Fu. See Yulishan.
- Lakulakuhsi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 250–420 m; HUALIEN: 23°19'N, 121°14'E; vocalizations heard at 250 m and 420 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S33*
- Lakulakuhsi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 710 m; HUALIEN: 23°20'N, 121°12'E; 2 monkeys observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S36*
- Lakulakuhsi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 800 m; HUALIEN: 23°21'N, 121°16'E; 4 monkeys observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S25*
- Lakulakuhsi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 850 m; HUALIEN:

- 23°20'N, 121°11'E; 1 monkey observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S37*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 950–1030 m; HUALIEN; 23°20'N, 121°10'E; 1 monkey observed at 950 m and 1 monkey observed at 1030 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S37*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1200 m; HUALIEN; 23°25'N, 121°07'E; droppings observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S19*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1220–1320 m; HUALIEN; 23°22'N, 121°05'E; droppings observed at 1220 m, 1250 m, and 1320 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S41*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1300 m; HUALIEN; 23°24'N, 121°05'E; droppings observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S16*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1300 m; HUALIEN; 23°24'N, 121°07'E; droppings observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S20*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1300–2205 m; HUALIEN; 23°24'N, 121°08'E; droppings observed at 1300 m and vocalization heard at 2205 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S20*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1420–1570 m; HUALIEN; 23°25'N, 121°05'E; droppings observed at 1420 m and 1570 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S17*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1455–1735 m; HUALIEN; 23°24'N, 121°06'E; vocalization heard at 1455 m and 1 monkey observed at 1735 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S18*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1478 m; HUALIEN; 23°24'N, 121°09'E; 2 monkeys observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S21*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1490–1520 m; HUALIEN; 23°23'N, 121°05'E; droppings observed at 1490 m, 1510 m, and 1520 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. Vocalization heard at 1490 m 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S41*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1620 m; HUALIEN; 23°21'N, 121°09'E; vocalization heard 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S38*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1630 m; HUALIEN; 23°21'N, 121°10'E; 1 monkey observed 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S23*
- Lakulakuksi Hiking Trail (拉庫拉庫溪登山路線), Chohsi Hsiang, 1690 m; HUALIEN; 23°21'N, 121°08'E; vocalization heard 1 Mar. 1997 by L.-L. Lee and H.-Y. Wu. *S39*
- Lamhongo. See Suao vicinity.
- Langkeaou. See Lungkeaou.
- Lanjen Hsi (欖仁溪), Manchou Hsiang; PINGTUNG; 22°02'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S144*
- Lan Yu (蘭嶼) (=Koto I.); TAITUNG; ca. 22°03'N, 121°32'E; reported absent before 1931 by T. Kano (1930, p. 165). *D*
- Laofoshan (老佛山), Manchou Hsiang; PINGTUNG; 22°02'N, 120°47'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 387). *S145*
- Lichia (利嘉), Peinan Hsiang; TAITUNG; 22°47'N, 121°03'E; observed in 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S114*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 930–950 m; TAITUNG; 22°48'N, 121°02'E; droppings or food remains observed 5 Mar. 1998 by S.-W. Chang (TESRI). *S116*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 970–1045 m; TAITUNG; 22°48'N, 121°01'E; 2 monkeys observed at 970 m 3 Dec. 1996 by S.-W. Chang (TESRI). Droppings or food remains observed at 1010–1045 m 5 Mar. 1998 by S.-W. Chang (TESRI). *S116*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1055–1100 m; TAITUNG; 22°49'N, 121°01'E; 5 monkeys observed at 1075 m 3 Dec. 1996 by S.-W. Chang (TESRI). Droppings or food remains

- observed at 1080–1100 m 4 Mar. 1998 by S.-W. Chang (TESRI). Two monkeys observed at 1055 m and droppings observed at 1070 m 5 Mar. 1998 by S.-W. Chang (TESRI). *S115*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1110–1130 m; TAITUNG; 22°49'N, 121°00'E; droppings or food remains observed 4 Mar. 1998 by S.-W. Chang (TESRI). *S113*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1175–1370 m; TAITUNG; 22°50'N, 121°00'E; one monkey observed at 1290 m 3 Dec. 1996 by S.-W. Chang (TESRI). Droppings or food remains observed at 1175–1200 m 4 Mar. 1998 by S.-W. Chang (TESRI). Groups observed at 1210 m, 1320 m, and 1370 m 4 Mar. 1998 by S.-W. Chang (TESRI). Tracks observed at 1220 m and 1355 m 4 Mar. 1998 by S.-W. Chang (TESRI). *S113*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1400–1475 m; TAITUNG; 22°50'N, 120°59'E; groups observed at 1400 m and 1475 m 4 Mar. 1998 by S.-W. Chang (TESRI). *S112*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1420 m; TAITUNG; 22°51'N, 120°59'E; vocalization heard 4 Mar. 1998 by S.-W. Chang (TESRI). *S94*
- Lichia Logging Trail (利嘉林道), Peinan-Yenping Hsiang, 1435–1565 m; TAITUNG; 22°50'N, 120°58'E; groups observed at 1435 m and 1525 m 3 Dec. 1996 by S.-W. Chang (TESRI). Vocalization heard at 1550 m and droppings observed at 1550 m and 1565 m 3 Mar. 1998 by S.-W. Chang (TESRI). *S112*
- Lienhuachih (蓮花池), Hsiulin Hsiang, 800–1100 m; HUALIEN; 24°13'N, 121°28'E; observed at 800 m 3 Aug. 1997 and at 1100 m 4 Aug. 1997 by H.-Y. Wu. *N49*
- Lienhuachih (蓮花池), Hsiulin Hsiang, 1100–1200 m; HUALIEN; 24°13'N, 121°29'E; observed at 1200 m 5 Aug. 1997 and at 1100 m 6 Aug. 1997 by H.-Y. Wu. *N49*
- Lienhuachih (蓮花池), Yuchih Hsiang; NANTOU; 23°55'N, 120°52'E; reported 2 Mar. 1994 to TESRI survey team. *N98*
- Lilunshan (里龍山) (=Lilunshan), Shihtzu Hsiang; PINGTUNG; 22°10'N, 120°43'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S139*
- Lilunshan. See Lilunshan.
- Linpien Hsiang (林邊鄉); PINGTUNG; ca. 22°27'N, 120°30'E; reported before 1965 by S. Tanaka (1986, p. 98); confirmed as locally extinct in 1986. *S132*
- Linshoudien (凌霄殿), Puli Chen; NANTOU; 23°58'N, 120°59'E; reported 13 Apr. 1994 to TESRI survey team. *N100*
- Liteshan (?里德山), Manchou Hsiang; PINGTUNG; ca. 22°01'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 387). *S144*
- Liuchiu Yu (琉球嶼); PINGTUNG; ca. 22°20'N, 120°22'E; reported absent by Ling-Ling Lee (NTUZ, pers. comm.). *B*
- Liukuei Hsiang (六龜鄉); KAOHSIUNG; ca. 23°01'N, 120°39'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S53*
- Longevity, Mt. See Shou Shan.
- Loshan Logging Trail (羅山林道), Wufeng-Chienshih Hsiang, 1050 m; HSINCHU; 24°37'N, 121°09'E; droppings observed 1 Apr. 1997 by L.-L. Lee and H.-Y. Wu. *N32*
- Loshan Logging Trail (羅山林道), Wufeng-Chienshih Hsiang, 1210 m; HSINCHU; 24°38'N, 121°09'E; droppings observed 1 Apr. 1997 by L.-L. Lee and H.-Y. Wu. *N32*
- Loshan Logging Trail (羅山林道), Wufeng-Chienshih Hsiang, 1270 m; HSINCHU; 24°36'N, 121°11'E; droppings observed 1 Apr. 1997 by L.-L. Lee and H.-Y. Wu. *N31*
- Luku Shan (鹿谷山); NANTOU; 23°48'N, 120°45'E; two juveniles trapped ca. 10 May 1995 by local residents, brought to TESRI recovery center, released 29 Jun. 1995 (external measurements received from S.-W. Chang, TESRI, pers. comm., 27 Apr. 1999). *N109*
- Luliaoshan (?), Haituan (=Hailuan) Hsiang; TAITUNG; ca. 23°08'N, 121°02'E; 1967–1971 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S64*
- Lulin Shan Preserve (鹿林山保護區), Alishan

- Hsiang, 2300–2420 m; CHIA-I; ca. 23°28'N, 120°51'–53'E; 1 monkey observed at 2300 m 1 May 1998 by TESRI survey team. Groups observed at 2370 m and 2420 m 2 May 1998 by TESRI survey team. *S11*
- Lulin Shan Preserve (鹿林山保護區), Alishan Hsiang, 2700 m; CHIA-I; 23°28'N, 120°53'E; 4 monkeys observed 7 Oct. 1997 by TESRI survey team. *S11*
- Luliu-Chepinglun (鹿寮–車坪崙), Yuchih Hsiang; NANTOU; 23°53'N, 120°52'E; >20 monkeys observed 11 Aug. 1993 by TESRI survey team. *N101*
- Lungkeaou (?) (=Langkeaou); PINGTUNG; ca. 22°05'N, 120°43'E; observed Jul. 1864 by R. Swinhoe (1865, p. 380; 1866, p. 127). *S141*
- Lupishan Logging Trail (鹿皮山林道), Nanao Hsiang, 245 m; ILAN; 24°27'N, 121°44'E; 2 monkeys observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N22*
- Lupishan Logging Trail (鹿皮山林道), Nanao Hsiang, 595–798 m; ILAN; 24°27'N, 121°43'E; 1 monkey observed at 595 m and droppings observed at 798 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N22*
- Lu Tao (綠島) (=Kasho I.); TAITUNG; ca. 22°40'N, 121°29'E; reported absent before 1931 by T. Kano (1930, p. 165). *C*
- Maanliao (馬鞍寮) (=Ma-an Lio), 6 mi (=10 km) south of Tungshih (=Tung Shi), 490 m; TAICHUNG; 24°10'N, 120°49'E; collected 16 Apr. 1952 by D. H. Johnson; USNM, 1. *N86*
- Ma-an Lio. See Maanliao.
- Mali River Reserve (?), contiguous with Shanping; KAOHSIUNG; not located; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). Not mapped.
- Manchoutsun (滿州) (=Teraso); PINGTUNG; 22°01'N, 120°51'E; collected Oct. 1908 and Dec. 1908–Feb. 1909 by H. Sauter (cf. Huang et al., 1993, p. 167); SMTD, 1; ZMB, 20 (including 7 skulls only and 6 skeletons only). *S152*
- Meishan (梅山), Taoyuan Hsiang, >1500 m; KAOHSIUNG; 23°17'N, 120°49'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386; Tanaka, 1986, p. 101). *S47*
- Meiyuan (梅園), Hsiulin Hsiang, 1000 m; HUALIEN; 24°14'N, 121°28'E; observed 7 Aug. 1997 by H.-Y. Wu. *N49*
- Mikawa-Wan. See Nojima.
- Minsheng (民生), Sanmin Hsiang; KAOHSIUNG; 23°17'N, 120°43'E reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S48*
- Mount Shaushan. See Shou Shan.
- Moushi, Kainan City, Wakayama Prefecture, Honshu Island, Japan; ca. 34°09'N, 135°12'E; introduced population, escaped from local menagerie ca. 1960, feral individuals reportedly shot by hunters (Wakayama Prefecture, 1978, p. 2; Maekawa, 1982, p. 102; Kawamoto et al., 1999, p. 53). Not mapped.
- Mt. Longevity. See Shou Shan.
- Mucha (木柵); TAIPEI; 24°59'N, 121°34'E; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *N3*
- Mu-Kua-Chau (?); HUALIEN; ca. 23°50'N, 121°33'E; collected 3 Apr. 1960 by R. B. White (see field catalogue); AMNH, 2. *N58*
- Mutan (牡丹) (=Sekimon; Shihmen); PINGTUNG; 22°08'N, 120°46'E; reported before 1933 by Y. Horikawa (1932, p. 69). *S140*
- Mutsu. See Shimokita Hanto.
- Nakatsu, Wakayama Prefecture, Honshu Island, Japan; ca. 33°57'N, 135°16'E; probable hybridization reported between introduced feral *M. cyclopis* and native *M. fuscata* (Kawamoto et al. 1999, p. 57). Not mapped.
- Nanhua Hsiang (南化鄉); TAINAN; ca. 23°07'N, 120°33'E; reported in 1957 by S. Tanaka (1986, p. 98); confirmed as locally extinct in 1986. Collected 11 Sep. 1996 by TESRI recovery center; TESRI, 1 (frozen carcass). *S52*
- Nanhu Tashan (南湖大山), Hoping Hsiang, 3095–3165 m; TAICHUNG; 24°22'N, 121°25'E; droppings observed at 3095 m and 3130–3165 m 23 Nov. 1995 by TESRI survey team. *N46*
- Nanjenlu-Kangtzu (南仁路-港仔), Manchou Hsiang; PINGTUNG; ca. 22°07'N, 120°53'E; reported in 1982 by K. Masui, Y. Narita, and

- S. Tanaka (1986, p. 386). *S150*
- Nanshanhsi (南山溪), Jenai Hsiang; NANTOU; 24°00'N, 121°03'E; reported 11 May 1994 to TESRI survey team. *N70*
- Nanshanhsi (南山溪), Jenai Hsiang, 1300–1580 m; NANTOU; 24°00'N, 121°03'E; vocalization heard at 1300 m and 1580 m 29 Dec. 1994 by TESRI survey team. Droppings observed at 1420 m 29 Dec. 1994 by TESRI survey team. Vocalization heard at 1530 m 31 Dec. 1994 by TESRI survey team. *N70*
- Nanshi Logging Road (楠溪林道), Yushan National Park, 1730–2670 m; KAOHSIUNG; 23°24–28'N, 120°53–54'E; observed Mar. 1987–Oct. 1988 by J.-F. Lu, Y.-S. Lin, and L.-L. Lee (1991, p. 93). *S14*
- ?NANTOU (南投) (county uncertain); acquired before Dec. 1992 by Phoenix Valley Aviary; NMNS, 1 (skeleton only; external measurements in computerized catalog). Not mapped.
- Nantzuhsien Hsi Logging Road (楠梓仙溪林道), Alishan Hsiang, 1700–2120 m; CHIA-I; 23°27'N, 120°53'E; food remains observed at 1940 m 7 Oct. 1997 by TESRI survey team. Droppings observed at 2010 m and 10 monkeys observed at 2120 m 7 Oct. 1997 by TESRI survey team. Droppings observed at 2120 m 8 Oct. 1997 by TESRI survey team. One monkey observed at 1700 m 24 June 1998 by TESRI survey team. *S13*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 650 m; HUALIEN; 24°00'N, 121°24'E; droppings observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N59*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 750–1200 m; HUALIEN; 24°00'N, 121°23'E; droppings observed at 750 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Two groups observed at 820 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Vocalization heard at 910 m and 1200 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N60*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 900–1200 m; HUALIEN; 24°00'N, 121°22'E; vocalization heard at 900 m and 1200 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N60*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1200–1310 m; HUALIEN; 24°01'N, 121°22'E; vocalization heard at 1200 m, 1300 m, and 1310 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Groups observed at 1220 m and 1250 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Droppings observed at 1300 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N61*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1300 m; HUALIEN; 24°01'N, 121°21'E; droppings observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N62*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1300 m; HUALIEN; 24°02'N, 121°22'E; 4 monkeys observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N61*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1300–1340 m; HUALIEN; 24°02'N, 121°20'E; groups observed at 1300 m, 1310 m, and 1340 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Droppings observed at 1320 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N63*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1345 m; HUALIEN; 24°01'N, 121°20'E; 4 monkeys observed 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N63*
- Nengkao-Tungmen Powerline Right-of-way (能高銅門台電保線道路), Hsiulin Hsiang, 1840–2085 m; HUALIEN; 24°01'N, 121°18'E; droppings observed at 1840 m and 2085 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Vocalization heard at 1930 m and 1975 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N64*
- New Central Cross-Island Highway (新中橫公路), Alishan Hsiang, 1395 m; CHIA-I; 23°28'N, 120°42'E; >6 monkeys observed 16 May 1998 by TESRI survey team. *S4*
- New Central Cross-Island Highway (新中橫公路), Alishan Hsiang, 1655 m; CHIA-I; 23°29'N, 120°45'E; 12 monkeys observed 8 Jan. 1998 by TESRI survey team. *S7*
- New Central Cross-Island Highway (新中橫公路), Alishan Hsiang, 1860–2700 m; CHIA-I; 23°29'N, 120°48'E; droppings observed at



- 2250 m 26 Sep. 1997 by TESRI survey team. Groups observed at 1860 m, 2650 m, and 2700 m 30 Apr. 1998 by TESRI survey team. S8
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2000 m; NANTOU; 23°32'N, 120°53'E; group observed 1 Aug. 1999 by H.-Y. Wu. N141
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°28'N, 120°49'E; 2 groups observed 1 Aug. 1999 by H.-Y. Wu. S9
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°28'N, 120°50'E; 2 groups observed 1 Aug. 1999 by H.-Y. Wu. S9
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°28'N, 120°51'E; troop observed 1 Aug. 1999 by H.-Y. Wu. S10
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°28'N, 120°52'E; group observed 1 Aug. 1999 by H.-Y. Wu. S11
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°29'N, 120°49'E; group observed 1 Aug. 1999 by H.-Y. Wu. S9
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2300 m; NANTOU; 23°30'N, 120°52'E; group observed 1 Aug. 1999 by H.-Y. Wu. N152
- New Central Cross-Island Highway (新中橫公路), Hsini Hsiang, 2470 m; NANTOU; 23°32'N, 120°53'E; 1 monkey observed 18 Oct. 1993 by TESRI survey team. N141
- Niupi (牛埤), Shuili Hsiang, 710–720 m; NANTOU; 23°30'N, 120°50'E; 14 monkeys observed at 710 m and droppings observed at 720 m 12 Mar. 1994 by TESRI survey team. N151
- Noheji. See Shimokita Hanto.
- Nojima (island), Mikawa-Wan (bay), Aichi Prefecture, Japan; 34°39'N, 137°01'E; introduced by Japan Monkey Centre in 1958, free-ranging population observed Aug. and Oct. 1962 by T. Nishida (1963, p. 121). Observed 26 Feb.–20 Mar. 1970 by M. Kawai and U. Mito (1973, p. 180). Not mapped.
- Northern and eastern Taiwan, mountains (臺灣東部及北部山區); imprecise locality; reported as abundant before 1863 by R. Swinhoe (1863, p. 351). Not mapped.
- Northern Cross-Island Road (北部橫貫公路), Fuhsing Hsiang, 550 m; TAOYUAN; 24°45'N, 121°20'E; droppings observed 1 Sep. 1998 by L.-L. Lee and H.-Y. Wu. N13
- Northern Cross-Island Highway (北部橫貫公路), Fuhsing Hsiang, 1050 m; TAOYUAN; 24°39'N, 121°25'E; 1 monkey observed 1 Sep. 1998 by L.-L. Lee and H.-Y. Wu. N30
- Northern Cross-Island Highway (北部橫貫公路), Tatung Hsiang, 460 m; ILAN; 24°37'N, 121°29'E; 6 monkeys observed 1 Sep. 1998 by L.-L. Lee and H.-Y. Wu. N28
- Northern Cross-Island Highway (北部橫貫公路), Tatung Hsiang, 720 m; ILAN; 24°36'N, 121°29'E; droppings observed 1 Sep. 1998 by L.-L. Lee and H.-Y. Wu. N29
- Northern Cross-Island Highway (北部橫貫公路), Tatung Hsiang, 1258 m; ILAN; 24°36'N, 121°30'E; droppings observed 1 Sep. 1998 by L.-L. Lee and H.-Y. Wu. N27
- Ohata. See Shimokita Hanto.
- Ohshima. See Oshima.
- Oshima (island; =Ohshima), eastern coast, Izu-Shoto (island group), Tokyo Prefecture, Japan; ca. 34°45'N, 139°26'E; introduced feral population, escaped from menagerie ca. 1940, reported before 1954 by K. Kishida (1953, pp. 24, 83; cf. de Vos et al., 1956, p. 166). Observed 1988–1989 by K. Kazama (Kazama & Norikoshi, 1991, p. 51; Norikoshi, 1991, p. 138). Collected before 2000 by unknown collector; KUPRI, 1 (skull only). Not mapped.
- Otake (?); not located; reported before 1933 by Y. Horikawa (1932, p. 69). Not mapped.
- Pahsienshan Forest Recreation Area (八仙山森林遊樂區), Hoping Hsiang, 890 m; TAICHUNG; 24°11'N, 121°00'E; droppings observed 19 Jul. 1995 by TESRI survey team. N74
- Pailuz (?), Manchou Hsiang; PINGTUNG; ca. 22°04'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). S146
- Paimao Shan Logging Road (白毛山林道), Hoping Hsiang, 850–1040 m; TAICHUNG;

- 24°09'N, 120°54'E; 3 monkeys observed at 870 m 20 Sep. 1995 by TESRI survey team. Vocalization heard at 920 m 20 Sep. 1995 by TESRI survey team. Droppings observed at 850 m 21 Sep. 1995 by TESRI survey team. Monkeys photographed with automatic camera at 1010 m 29 Dec. 1995 by TESRI survey team. Droppings observed at 1010 m 6 Feb. 1996 by TESRI survey team. Food remains observed at 1040 m 23 Apr. 1997 by S.-W. Chang (TESRI). *N89*
- Paimao Shan Logging Road (白毛山林道), Hoping Hsiang, 1140 m; TAICHUNG; 24°09'N, 120°55'E; droppings observed 23 Apr. 1997 by S.-W. Chang (TESRI). *N88*
- Paishanhang. See Peishankeng.
- Paiyun Hiking Trail (排雲登山步道), Alishan Hsiang, 2820 m; CHIA-I; 23°28'N, 120°54'E; droppings observed 25 Sep. 1997 by TESRI survey team. *S12*
- Pakhongo. See Suao vicinity.
- Pakuasan. See Pakua Shan.
- Pakua Shan (八卦山) (=Pakuasan); CHANGHUA; 23°54'N, 120°38'E; two captives reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *N110*
- Patungkuan (八通關), Hsini Hsiang, 2800 m; NANTOU; 23°29'N, 120°59'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386; Tanaka, 1986, p. 101). *S15*
- Payao (八瑤), Manchou Hsiang; PINGTUNG; 22°06'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S147*
- Peinan (卑南) (=P'i-nan); TAITUNG; 22°46'N, 121°07'E; collected [ca. 1900–1901] by [K. A.]. Haberer (cf. Schwyer, 1909, p. 7); ZMB, 1. *S117*
- Peishankeng (北山坑) (=Hokuzanko; Paishanhang), Puli (=Hori) district; NANTOU; 23°59'N, 120°52'E; collected before 1939 by Mr. Goto (Kuroda, 1938, p. 112; 1940, p. 269; cf. Huang et al., 1993, p. 135; Hill, 1974, p. 589); formerly in personal collection of Marquis N. Kuroda, 1 (probably destroyed by bombardment during World War II; cf. Austin et al., 1948, p. 4). *N97*
- Peitunyenshan (北冬眼山), Jenai Hsiang; NANTOU; 24°04'N, 121°09'E; vocalization heard 10 May 1994 by TESRI survey team. *N67*
- Peitunyenshan (北冬眼山), Jenai Hsiang, 1700–1800 m; NANTOU; 24°04'N, 121°09'E; food remains observed at 1700 m 28 Jul. 1993 by TESRI survey team. Tracks and droppings observed at 1730 m 28 Jul. 1993 by TESRI survey team. Monkeys observed at 1800 m 3 Mar 1994 by TESRI survey team. *N67*
- Peitunyenshan (北冬眼山), Jenai Hsiang, 1900 m; NANTOU; 24°04'N, 121°15'E; 5 monkeys observed 15 Aug. 1993 by TESRI survey team. *N65*
- Peiyuan (北源), Tungho Hsiang; TAITUNG; 23°01'N, 121°17'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S80*
- Penghu Chuntao (澎湖群島): Penghu Tao (=Pescadores Islands: Hoko I.); PENGHU; 23°11–45'N, 119°24–43'E; reported absent before 1931 by T. Kano (1930, p. 165; cf. Lee & Lin., 1991, p. 36; 1994, p. 19). *A*
- Pescadores Islands. See Penghu Chuntao.
- P'i-nan. See Peinan.
- Pingting (坪頂), Linnei Hsiang, 150 m; YUNLIN; 23°45'N, 120°38'E; droppings observed 11 Jan. 1995 by TESRI survey team. *N112*
- Pingting (坪頂), Taiping Hsiang, 270 m; TAICHUNG; ca. 24°07'N, 120°46'E; droppings observed 18 Jan. 1996 by TESRI survey team. *N90*
- Pingtung vicinity (屏東地區); PINGTUNG; ca. 22°40'N, 120°29'E; serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S108*
- Pipitaishan (畢畢達山), ?Taian Hsiang, 3215 m; MIAOLI; ca. 24°26'N, 120°54'E; droppings observed 30 Apr. 1997 by TESRI survey team. *N37*
- Polisia. See Puli.
- Posia. See Puli.
- Puchung (埔中), Mingchien Hsiang, 200 m; NANTOU; 23°49'N, 120°38'E; droppings observed 5 Feb. 1993 by TESRI survey team. *N111*
- Puli (埔里) (=Posia; Polisia); NANTOU; 23°58'N, 120°57'E; collected Oct. 1873 by J.

- B. Steere and Mr. Beal (Steere, 1876, p. 319); UMMZ, 1. Reported origin of two captives obtained before 1998 (Chang 1997, p. 3). *N99* Puli vicinity (埔里地區); NANTOU; ca. 23°58'N, 120°57'E; serum samples obtained 1964–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). Collected 14 Dec. 1987 by unknown collector; TM, 1 (mounted skin with skull fragment inside). *N99*
- Rimogan. See Fushan.
- Sabkun Hsi (?), Manchou Hsiang; PINGTUNG; ca. 22°04'N, 120°50'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S146*
- Sakow. See Shou Shan.
- Sanhsia (三峽) (=Sung Sha); 500–800 m; TAIPEI; 24°56'N, 121°22'E; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *N4*
- Sanhsienli (三仙里), Chengkung Chen; TAITUNG; 23°07'N, 121°23'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S77*
- Sanminli (三民里), Chengkung Chen; TAITUNG; ca. 23°07'N, 121°21'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S76*
- Santimen (三地門), Santi Hsiang; PINGTUNG; 22°43'N, 120°38'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S109*
- Sekimon. See Mutan.
- Shalihsien Hsi (沙里仙溪), Hsini Hsiang, 1320–2100 m; NANTOU; 23°31'N, 120°54'E; droppings observed at 1320 m and 1360 m 20 Jul. 1993 by TESRI survey team. Droppings observed at 2100 m 21 Jul. 1993 by TESRI survey team. Droppings observed at 1350 m 12 Aug. 1993 by TESRI survey team. *N140*
- Shalihsien Hsi Logging Road (沙里仙溪林道), Hsini Hsiang; NANTOU; 23°31'N, 120°54'E; droppings observed 2 Dec. 1993 by TESRI survey team. *N140*
- Shalihsien Hsi Logging Road (沙里仙溪林道), Hsini Hsiang, 1405–1600 m; NANTOU; 23°31'N, 120°54'E; tracks and droppings observed at ca. 1465 m 6 Jan. 1994 by TESRI survey team. Droppings observed at 1515 m, 1525 m, and ca. 1560 m 6 Jan. 1994 by TESRI survey team. Droppings observed at 1405 m and 1560 m 7 Jan. 1994 by TESRI survey team. Groups observed at 1420 m and 1480 m 7 Jan. 1994 by TESRI survey team. Droppings observed at 1600 m 9 Mar. 1994 by TESRI survey team. *N140*
- Shalihsien Hsi Logging Road (沙里仙溪林道), Hsini Hsiang, 1485–1800 m; NANTOU; 23°31–32'N, 120°54–55'E; 4 monkeys observed at 1700 m 4 Nov. 1993 by TESRI survey team. Droppings observed at 1700 m 5 Nov. 1993 by TESRI survey team. Droppings observed at 1485 m 6 Jan. 1994 by TESRI survey team. Four monkeys observed at 1800 m 11 Mar. 1994 by TESRI survey team. *N140*
- Shangnankeng (上南坑), Fengyuan, 410 m; TAICHUNG; 24°15'N, 121°01'E; reported 2 May 1996 to TESRI survey team. *N76*
- Shanli (山里), Peinan Hsiang; TAITUNG; 22°52'N, 121°08'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S84*
- Shanli-Waihu-Neihu (?), Touliu Chen; YUNLIN; locality “not precise enough to project on map”; reported Jul.–Nov. 1985 by S. Tanaka (1986, pp. 97, 98). Not mapped.
- Shanmei. See Danayee.
- Shan Pen. See Shanping.
- Shanping (扇平) (=Shan Pen); KAOHSIUNG; 22°58'N, 120°40'E; observed Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *S100*
- Shao-shan. See Shou Shan.
- Shaushan, Mount. See Shou Shan.
- Shenmu Logging Road (神木林道), Hsini Hsiang, 1260–2500 m; NANTOU; 23°29–33'N, 120°51–54'E; droppings observed at 1950 m 22 Jul. 1993 by TESRI survey team (same team also is source of following observations at this locality). Droppings observed at 1830 m and 1960 m 23 Jul. 1993. Tracks observed at 1840 m 23 Jul. 1993. One monkey observed at 2020 m 23 Jul. 1993. Droppings observed at 1260 m, 1410 m, and 1760 m 6 Oct. 1993. Five monkeys observed at 1350 m 6 Oct. 1993. Tracks observed at 1770 m 6 Oct. 1993. Droppings observed at 1330 m 7 Oct. 1993. Four monkeys observed at 1680 m 8 Oct. 1993. Droppings observed at

- 1370 m 3 Nov. 1993. Dead monkey observed at 1420 m 3 Nov. 1993. Droppings observed at 1360 m and 1515 m 4 Nov. 1993. Three monkeys observed at 1390 m 4 Nov. 1993. Monkeys observed at 1330 m and 1365 m 5 Nov. 1993. Droppings observed at 2200 m, 2240 m, 2260 m, 2280 m, 2320 m, and 2500 m 1 Dec. 1993. Droppings observed at 1700 m and 1710 m 9 Mar. 1994. Droppings observed at 1340 m and 1360 m 24 Mar. 1994. Droppings observed at 1350 m and 1420 m 13 Apr. 1994. Droppings observed at 1300 m and 1410 m 14 Apr. 1994. Dead monkey observed at 1400 m 14 Apr. 1994. Droppings observed at 1300 m 15 Apr. 1994. Five monkeys observed at 1290 m 28 Nov. 1994. Droppings observed at 1370 m 1 Dec. 1994. Droppings observed at 1300 m, 1390 m, and 1400 m 11 Jan. 1995. Vocalization heard at 1390 m 11 Jan. 1995. One monkey observed at 1290 m 12 Jan. 1995. Droppings observed at 1320 m and 1380 m 12 Jan. 1995. Droppings observed at 1370 m and 1390 m 15 Jan. 1995. Six monkeys observed at 1380 m 16 Jan. 1995. Droppings observed at 1300 m, 1370 m, and 1390 m 17 Jan. 1995. Tracks observed at 1380 m 18 Jan. 1995. Food remains and droppings observed at 1390 m 18 Jan. 1995. Droppings observed at 1350 m and 1360 m 19 Jan. 1995. Droppings observed at 1360 m and 1400 m 28 Mar. 1995. Three monkeys observed at 1300 m 29 Mar. 1995. Droppings observed at 1360 m 29 Mar. 1995. Droppings observed at 1400 m and 1410 m 30 Mar. 1995. Tracks observed at 1410 m 30 Mar. 1995. Monkey(s) observed at 1360 m 31 Mar. 1995. *N141*
- Shenmu Tsun (神木村), 1500 m; NANTOU; 23°31'N, 120°52'E; collected 3 Nov. 1993 by S.-W. Chang and K.-L. Huang; TESRI, 1 (skull only). Collected 14 Apr. 1994 by K.-L. Huang; TESRI, 1 (skull only). *N141*
- Shentao No. 8 (八號省道), Tungshih Chen, 630 m; TAICHUNG; ca. 24°15'N, 120°49'E; capture reported 26 Sep. 1995 to TESRI survey team. *N83*
- Sheting (社頂), Hengchun Chen; PINGTUNG; 21°58'N, 120°49'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *S153*
- Shihchotzu (石灼仔), Tsaotun Chen, 300–400 m; NANTOU; 23°59'N, 120°46'E; >9 monkeys observed at 300 m 22 Feb. 1994 by TESRI survey team. Seven or more monkeys observed at 300 m 23 Feb. 1994 by TESRI survey team. Droppings observed at 400 m 23 Feb. 1994 by TESRI survey team. *N96*
- Shihmen. See Mutan.
- Shihmenshe (石門社), Tuanshushe, Mutan Hsiang; PINGTUNG; ca. 22°08'N, 120°48'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S148*
- Shihpi (石壁), Kukeng Hsiang, 1010–1065 m; YUNLIN; 23°35'N, 120°41'E; droppings observed at 1010 m 9 Nov. 1994 by TESRI survey team. Droppings observed at 1030 m 11 Nov. 1994 by TESRI survey team. Droppings observed at 1065 m 14 Dec. 1994 by TESRI survey team. *N145*
- Shihing Hsiang vicinity (石碇鄉地區); TAIPEI; ca. 24°59'N, 121°39'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N2*
- Shihtoushan (獅頭山), Hsintien Chen, 700–800 m; TAIPEI; 24°54'N, 121°29'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N5*
- Shimokita Hanto (=Peninsula), Aomori Prefecture, Honshu Island, Japan; 40°55'–41°25'N, 140°45'–141°30'E; introduced feral population, multiple escapes from animal park ca. 1979–1991 (Shirai, 1988, p. 3; Mori, 1991, p. 98; Matsubayashi, 1992, p. 2). Not mapped.
- Shouchia (壽山), Anshuo, Tajen Hsiang; TAITUNG; 22°15'N, 120°50'E; reported in 1955 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S138*
- Shou Shan (壽山) (=Apenberg; Ape's Hill; Chai Shan; Mount Shaushan; Mt. Longevity; Sakow; Shao-shan; Takow); KAOHSIUNG; 22°39'N, 120°15'E; geographic account of "Apenberg" (Valentyn, 1726, p. 36). Monkeys reported 12 Jun. 1858 by R. Swinhoe (1859, p. 149; cf. Swinhoe in Blyth, 1860, p. 87). Population reported as "almost entirely disappeared" by R. Swinhoe (1863, p. 351; cf. Collingwood, 1868, p. 39; Namiye 1914, p. 214; Horikawa, 1932, p. 69; Dien, 1958, p. 347). Observed during July 1963 and trapped

- for parasitological research 31 Jul. 1963 by J. F. Bergner, Jr. (1967, p. 32); USNM, 1 (skull only). Parasitological samples collected before 1997 by H.-Y. Wu and H. Y. Lin (1996, p. 24). Observed 1995–1997 by M.-J. Hsu and G. Agoramorthy (1999, p. 64). DNA samples obtained before 1999 by J.-H. Chu, H.-Y. Wu, Y.-J. Yang, O. Takenaka, and Y.-S. Lin (1999, p. 574). Observed 21 Apr. 2000 by H.-Y. Wu and J. Fooden. *S106*
- Shuangtung (雙冬), ?Tsaotun Chen, 400 m; NANTOU; 23°58'N, 120°46'E; reported 15 Jan. 1993 to TESRI survey team. *N96*
- Shuilien Bridge No. 14 (水璉14號橋), Shoufeng Hsiang, 100 m; HUALIEN; 23°49'N, 121°33'E; reported 1 Jan. 2000 to H.-Y. Wu. *N58*
- Shuutiliao (水底寮), Fangshan Hsiang; PINGTUNG; 22°23'N, 120°35'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S133*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang; TAITUNG; 23°08'N, 121°06'E; 3 monkeys observed 9 Nov. 1998 by S.-W. Chang (TESRI). *S66*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 390 m; TAITUNG; 23°08'N, 121°07'E; vocalization heard 9 Nov. 1998 by S.-W. Chang (TESRI). *S69*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 435 m; TAITUNG; 23°09'N, 121°06'E; 1 monkey observed 9 Nov. 1998 by S.-W. Chang (TESRI). *S70*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 515 m; TAITUNG; 23°09'N, 121°05'E; 10 monkeys observed 9 Nov. 1998 by S.-W. Chang (TESRI). *S71*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 930–945 m; TAITUNG; 23°11'N, 121°02'E; 5 monkeys observed at 930 m 8 Nov. 1998 by S.-W. Chang (TESRI). Droppings observed at 935–945 m 8 Nov. 1998 by S.-W. Chang (TESRI). Six monkeys observed at 943 m 8 Nov. 1998 by S.-W. Chang (TESRI). *S59*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 1040–1125 m; TAITUNG; 23°11'N, 121°01'E; droppings observed at 1040 m and 1065 m 8 Nov. 1998 by S.-W. Chang (TESRI). Five monkeys observed at 1125 m 8 Nov. 1998 by S.-W. Chang (TESRI). *S59*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 1170 m; TAITUNG; 23°12'N, 121°00'E; 10 monkeys observed 8 Nov. 1998 by S.-W. Chang (TESRI). *S60*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 1665 m; TAITUNG; 23°13'N, 121°00'E; vocalization heard 7 Nov. 1998 by S.-W. Chang (TESRI). *S58*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 1855 m; TAITUNG; 23°14'N, 120°59'E; droppings observed 7 Nov. 1998 by S.-W. Chang (TESRI). *S57*
- Southern Cross-Island Highway (南部橫貫公路), Haituan Hsiang, 2065–2090 m; TAITUNG; 23°15'N, 120°59'E; vocalization heard at 2065 m 7 Nov. 1998 by S.-W. Chang (TESRI). Five monkeys observed at 2090 m 7 Nov. 1998 by S.-W. Chang (TESRI). *S42*
- Southern Cross-Island Highway (南部橫貫公路), Taoyuan Hsiang, 975–1050 m; KAOHSIUNG; 23°16'N, 120°51'E; 8 monkeys observed at 975 m 5 Nov. 1998 by S.-W. Chang (TESRI). Droppings observed at 1050 m 5 Nov. 1998 by S.-W. Chang (TESRI). *S46*
- Southern Cross-Island Highway (南部橫貫公路), Taoyuan Hsiang, 995–1235 m; KAOHSIUNG; 23°16'N, 120°50'E; 4 monkeys observed at 995 m 5 Nov. 1998 by S.-W. Chang (TESRI). Droppings observed at 1235 m 5 Nov. 1998 by S.-W. Chang (TESRI). *S47*
- Southern Cross-Island Highway (南部橫貫公路), Taoyuan Hsiang, 1250–1445 m; KAOHSIUNG; 23°17'N, 120°50'E; droppings observed at 1250 m, 1255 m, 1353 m, 1390 m, and 1405–1445 m 5 Nov. 1998 by S.-W. Chang (TESRI). *S47*
- Southern Cross-Island Highway (南部橫貫公路), Taoyuan Hsiang, 1445–1565 m; KAOHSIUNG; 23°17'N, 120°51'E; droppings observed at 1445–1485 m, 1485–1515 m, 1520–1550 m, and 1555 m 5 Nov. 1998 by S.-W. Chang (TESRI). Vocalization heard at 1565 m 5 Nov. 1998 by S.-W. Chang (TESRI). *S46*
- Southern Cross-Island Highway (南部橫貫公路), Taoyuan Hsiang, 1635–1750 m;

- Taipingshan (太平山); ILAN; 24°30'N, 121°31'E; observed at 1920 m in Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145). Reported above 1500 m in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386; Tanaka, 1986, p. 101). Observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). *N25*
- Taipingshan (太平山), northwestern foothill area, 400–1350 m; ILAN; ca. 24°33'N, 121°30'E; observed 1987–1989 by S. Kawamura, N. Azuma, and K. Norikoshi (1988, p. 1; Kawamura et al., 1991, p. 97; Azuma & Norikoshi, 1990, p. 43; Norikoshi, 1991, p. 136). *N26*
- Taitocho. See TAITUNG.
- TAITUNG (=Taitocho) forests (臺東地區森林), mountains; 22°14'–23°27'N, 120°44'–121°29'E; reported before 1930 by T. Kano (1929, p. 333). Reported before 1959 by Z.-M. Dien (1958, p. 346). Not mapped.
- Taitung vicinity (台東地區); TAITUNG; ca. 22°45'N, 121°09'E; serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S118*
- Taiwan; imprecise locality; collected before 9 Jan. 1958 by unknown collector (R. E. Kuntz, shipping list, 9 Jan. 1958, USNM archives); USNM 308721, 1 (skin only). Not mapped.
- Tai Yuan. See Tayuan.
- Takangkou (大港口), Jusui Pass, Fengpin district; HUALIEN; 23°28'N, 121°29'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S28*
- Takao. See Kaohsiung.
- Takeng (大坑), 460–510 m; TAICHUNG; 24°10'N, 120°47'E; groups observed at 460 m and 510 m 23 Dec. 1994 by TESRI survey team. *N85*
- Takow. See Shou Shan.
- Taku (大谷) (=Taririku, Taimari Subdist.); TAITUNG; ca. 22°27'N, 120°50'E; observed before 1930 by T. Kano (1929, p. 333; cf. Kuroda, 1938, p. 112; Huang et al., 1993, p. 166). *S135*
- Taoshan Pupu. See Wuling.
- Tapang (達邦), Alishan Hsiang, 850 m; CHIA-I; ca. 23°27'N, 120°43'E; 1 monkey observed 1 May 1998 by L.-L. Lee and H.-Y. Wu. *S5*
- Tapu Hsiang (大埔), 380 m; CHIA-I; ca. 23°18'N, 120°35'E; droppings observed 12 Sep. 1997 by TESRI survey team. *S50*
- Taririku. See Taku.
- Taroko National Park (太魯閣國家公園); HUALIEN; ca. 24°03'–23'N, 121°13'–42'E; observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). Collected ca. 9 Apr. 1997 and 19 Jan. 1998 by unknown collector; NMNS, 2 (frozen carcasses). *N49*
- Taroko National Park Headquarters (太魯閣國家公園管理處), Hsiulin Hsiang, 200 m; HUALIEN; 24°09'N, 121°37'E; reported 1 Oct. 1999 to H.-Y. Wu. *N55*
- Tashiaku (大峽谷), Meishan Hsiang, 510 m; CHIA-I; 23°34'N, 120°38'E; 10 monkeys observed 3 Dec. 1997 by TESRI survey team. *N146*
- Tataan (?), forestry branch office, Mutan Hsiang; PINGTUNG; ca. 22°07'N, 120°49'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S149*
- Tatachia (塔塔加), Hsini Hsiang; NANTOU; 23°29'N, 120°53'E; 13 monkeys observed 25 Sep. 1994 by TESRI survey team. *S11*
- Tawan (大灣), Taian Hsiang, 990–1030 m; MIAOLI; ca. 24°26'N, 120°54'E; droppings observed 4 Dec. 1996 by TESRI survey team. *N37*
- Tawu Hsi (大武溪), right bank, Tawu Hsiang; TAITUNG; ca. 22°22'N, 120°54'E; reported 1967–1971 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S137*
- Tawu Mountain Nature Preserve (大武山自然保護區); TAITUNG; ca. 22°35'N, 120°46'E; observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). *S129*
- Tawu Mountain Nature Preserve (大武山自然保留區), Taimali Hsi, 300–400 m; TAITUNG; 22°35'N, 120°49'E; collected 19 Feb. 2000 by S.-M. Lin; private collection, 1 (skull only). *S128*
- Tayuan (泰源), Haianshanmo, Tungho Hsiang; TAITUNG; ca. 23°00'N, 121°18'E; reported in 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S81*
- Tayuan (泰源) (= Tai Yuan); TAITUNG; ca. 23°00'N, 121°18'E; reported Jun.–Dec. 1978

- by F. E. Poirier (Poirier & Davidson, 1979, p. 145). *S81*
- Tefuyeh (特富野), Alishan Hsiang, 1520 m; CHIA-I; 23°27'N, 120°45'E; observed 6 Apr. 1998 by TESRI survey team. *S6*
- Teraso. See Chulaosha Shan and Manchoutsun.
- Tienchung Park (田中公園), Tienchung Chen, 130 m; CHANGHUA; 23°51'N, 120°47'E; 3 monkeys observed 20 Jan. 1995 by TESRI survey team. *N106*
- Tienhsiang (天祥), Hsiulin Hsiang; HUALIEN; 24°11'N, 121°29'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N51*
- Tienleng (天冷), Tungshih (=Tungshin) Chen; TAICHUNG; 24°10'N, 120°51'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N87*
- Toliang (多良), Taimali Hsiang; TAITUNG; 22°30'N, 120°57'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S127*
- Totsu. See Shimokita Hanto.
- Toupienkeng (頭汴坑仙子洞), Taiping Hsiang, 300 m; TAICHUNG; 24°06'N, 120°46'E; reported 14 Dec. 1995 to TESRI survey team. *N91*
- Tsaoling Road (草嶺路), Chushan Chen; NANTOU; 23°36'N, 120°40'E; 10 monkeys observed 23 Dec. 1992 by TESRI survey team. *N117*
- Tsengwen Shuiku (=Reservoir) (曾文水庫), Tapu Hsiang, 300 m; CHIA-I; 23°16'N, 120°36'E; 10 monkeys observed 22 Dec. 1996 by TESRI survey team. Ten monkeys observed 2 Nov. 1997 by TESRI survey team. Six monkeys observed 1 Feb. 1998 by TESRI survey team. *S49*
- Tsugitaka Mountains. See Hsueh Shan.
- Tsuisia Lake. See Jihyueh Tan.
- Tulanshan (都蘭山), Tungho Hsiang; TAITUNG; 22°54'N, 121°11'E; observed in 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S83*
- Tungfeng (東峰溪), Jenai Hsiang, 905–1010 m; NANTOU; 24°03'N, 121°04'E; droppings observed at 905 m 29 Dec. 1994 by TESRI survey team. Droppings observed at 1010 m 30 Dec. 1994 by TESRI survey team. *N71*
- Tungho township (東河); TAITUNG; ca. 22°58'N, 121°18'E; collected for parasitological research before 1966 by C. H. Chuang, J. C. Lien, and S. Y. Lin (Peyton & Harrison, 1980, p. 342). *S82*
- Tunghotsun (東河村), Nanchuang Hsiang; MIAOLI; 24°36'N, 121°01'E; reported 23 Oct 1996 to TESRI survey team. *N33*
- Tunghou (桶後), Wulai, 480 m; TAIPEI; 24°50'N, 121°38'E; vocalization heard 1 May 1997 by L.-L. Lee and H.-Y. Wu. *N8*
- Tungli (東里), Fuli Hsiang; HUALIEN; 23°16'N, 121°18'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S31*
- Tungshih. See Maanliao.
- Tungshing (?), Hungyeh, Yenping Hsiang; TAITUNG; ca. 22°54'N, 121°03'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S87*
- Tzuchung (自忠), Alishan Hsiang, 2400 m; CHIA-I; 23°29'N, 120°49'E; 13 monkeys observed 1 May 1998 by TESRI survey team. *S9*
- Wakayama Prefecture. See Moushi; Nakatsu.
- Wakinosawa. See Shimokita Hanto.
- Wang Lung Shan. See Wanglung.
- Wanglung (?) (?=Wang Lung Shan); PINGTUNG; ca. 22°30'N, 120°34'E; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 157). *S131*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 565 m; HUALIEN; 23°43'N, 121°21'E; 9 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N136*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 800 m; HUALIEN; 23°44'N, 121°21'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N136*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 820 m; HUALIEN; 23°44'N, 121°20'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N135*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 820 m; HUALIEN; 23°45'N, 121°20'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N133*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 960 m; HUALIEN; 23°45'N, 121°19'E; 8 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N133*

- N147*  
 Taipingshan (太平山); ILAN; 24°30'N, 121°31'E; observed at 1920 m in Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145). Reported above 1500 m in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386; Tanaka, 1986, p. 101). Observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). *N25*
- Taipingshan (太平山), northwestern foothill area, 400–1350 m; ILAN; ca. 24°33'N, 121°30'E; observed 1987–1989 by S. Kawamura, N. Azuma, and K. Norikoshi (1988, p. 1; Kawamura et al., 1991, p. 97; Azuma & Norikoshi, 1990, p. 43; Norikoshi, 1991, p. 136). *N26*
- Taitocho. See TAITUNG.
- TAITUNG (=Taitocho) forests (臺東地區森林), mountains; 22°14'–23°27'N, 120°44'–121°29'E; reported before 1930 by T. Kano (1929, p. 333). Reported before 1959 by Z.-M. Dien (1958, p. 346). Not mapped.
- Taitung vicinity (台東地區); TAITUNG; ca. 22°45'N, 121°09'E; serum samples obtained 1962–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). *S118*
- Taiwan; imprecise locality; collected before 9 Jan. 1958 by unknown collector (R. E. Kuntz, shipping list, 9 Jan. 1958, USNM archives); USNM 308721, 1 (skin only). Not mapped.
- Tai Yuan. See Tayuan.
- Takangkou (大港口), Jusui Pass, Fengpin district; HUALIEN; 23°28'N, 121°29'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S28*
- Takao. See Kaohsiung.
- Takeng (大坑), 460–510 m; TAICHUNG; 24°10'N, 120°47'E; groups observed at 460 m and 510 m 23 Dec. 1994 by TESRI survey team. *N85*
- Takow. See Shou Shan.
- Taku (大谷) (=Taririku, Taimari Subdist.); TAITUNG; ca. 22°27'N, 120°50'E; observed before 1930 by T. Kano (1929, p. 333; cf. Kuroda, 1938, p. 112; Huang et al., 1993, p. 166). *S135*
- Taoshan Pupu. See Wuling.
- Tapang (達邦), Alishan Hsiang, 850 m; CHIA-I; ca. 23°27'N, 120°43'E; 1 monkey observed 1 May 1998 by L.-L. Lee and H.-Y. Wu. *S5*
- Tapu Hsiang (大埔), 380 m; CHIA-I; ca. 23°18'N, 120°35'E; droppings observed 12 Sep. 1997 by TESRI survey team. *S50*
- Taririku. See Taku.
- Taroko National Park (太魯閣國家公園); HUALIEN; ca. 24°03'–23'N, 121°13'–42'E; observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). Collected ca. 9 Apr. 1997 and 19 Jan. 1998 by unknown collector; NMNS, 2 (frozen carcasses). *N49*
- Taroko National Park Headquarters (太魯閣國家公園管理處), Hsiulin Hsiang, 200 m; HUALIEN; 24°09'N, 121°37'E; reported 1 Oct. 1999 to H.-Y. Wu. *N55*
- Tashiaku (大峽谷), Meishan Hsiang, 510 m; CHIA-I; 23°34'N, 120°38'E; 10 monkeys observed 3 Dec. 1997 by TESRI survey team. *N146*
- Tataan (?), forestry branch office, Mutan Hsiang; PINGTUNG; ca. 22°07'N, 120°49'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S149*
- Tatachia (塔塔加), Hsini Hsiang; NANTOU; 23°29'N, 120°53'E; 13 monkeys observed 25 Sep. 1994 by TESRI survey team. *S11*
- Tawan (大灣), Taian Hsiang, 990–1030 m; MIAOLI; ca. 24°26'N, 120°54'E; droppings observed 4 Dec. 1996 by TESRI survey team. *N37*
- Tawu Hsi (大武溪), right bank, Tawu Hsiang; TAITUNG; ca. 22°22'N, 120°54'E; reported 1967–1971 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S137*
- Tawu Mountain Nature Preserve (大武山自然保護區); TAITUNG; ca. 22°35'N, 120°46'E; observed 1987–1989 by L.-L. Lee and Y.-S. Lin (1991, p. 36; 1994, p. 19). *S129*
- Tawu Mountain Nature Preserve (大武山自然保留區), Taimali Hsi, 300–400 m; TAITUNG; 22°35'N, 120°49'E; collected 19 Feb. 2000 by S.-M. Lin; private collection, 1 (skull only). *S128*
- Tayuan (泰源), Haianshanmo, Tungho Hsiang; TAITUNG; ca. 23°00'N, 121°18'E; reported in 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S81*
- Tayuan (泰源) (= Tai Yuan); TAITUNG; ca. 23°00'N, 121°18'E; reported Jun.–Dec. 1978



- by F. E. Poirier (Poirier & Davidson, 1979, p. 145). *S87*
- Tefuyeh (特富野), Alishan Hsiang, 1520 m; CHIA-I; 23°27'N, 120°45'E; observed 6 Apr. 1998 by TESRI survey team. *S6*
- Teraso. See Chulaoshu Shan and Manchoutsun.
- Tienchung Park (田中公園), Tienchung Chen, 130 m; CHANGHUA; 23°51'N, 120°47'E; 3 monkeys observed 20 Jan. 1995 by TESRI survey team. *N106*
- Tienhsiang (天祥), Hsiulin Hsiang; HUALIEN; 24°11'N, 121°29'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N51*
- Tienleng (天冷), Tungshih (=Tungshin) Chen; TAICHUNG; 24°10'N, 120°51'E; reported Jul.–Nov. 1985 by S. Tanaka (1986, p. 98). *N87*
- Toliang (多良), Taimali Hsiang; TAITUNG; 22°30'N, 120°57'E; reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S127*
- Totsu. See Shimokita Hanto.
- Toupienkeng (頭汴坑仙子洞), Taiping Hsiang, 300 m; TAICHUNG; 24°06'N, 120°46'E; reported 14 Dec. 1995 to TESRI survey team. *N91*
- Tsaoling Road (草嶺路), Chushan Chen; NANTOU; 23°36'N, 120°40'E; 10 monkeys observed 23 Dec. 1992 by TESRI survey team. *N117*
- Tsengwen Shuiku (=Reservoir) (曾文水庫), Tapu Hsiang, 300 m; CHIA-I; 23°16'N, 120°36'E; 10 monkeys observed 22 Dec. 1996 by TESRI survey team. Ten monkeys observed 2 Nov. 1997 by TESRI survey team. Six monkeys observed 1 Feb. 1998 by TESRI survey team. *S49*
- Tsugitaka Mountains. See Hsueh Shan.
- Tsuisia Lake. See Jihyueh Tan.
- Tulanshan (都蘭山), Tungho Hsiang; TAITUNG; 22°54'N, 121°11'E; observed in 1967–1971 and 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S83*
- Tungfeng (東峰溪), Jenai Hsiang, 905–1010 m; NANTOU; 24°03'N, 121°04'E; droppings observed at 905 m 29 Dec. 1994 by TESRI survey team. Droppings observed at 1010 m 30 Dec. 1994 by TESRI survey team. *N71*
- Tungshih. See Maanliao.
- Tungshing (?), Hungyeh, Yenping Hsiang; TAITUNG; ca. 22°54'N, 121°03'E; observed in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *S87*
- Tzuchung (自忠), Alishan Hsiang, 2400 m; CHIA-I; 23°29'N, 120°49'E; 13 monkeys observed 1 May 1998 by TESRI survey team. *S9*
- Wakayama Prefecture. See Moushi; Nakatsu.
- Wakinosawa. See Shimokita Hanto.
- Wang Lung Shan. See Wanglung.
- Wanglung (?) (?=Wang Lung Shan); PINGTUNG; ca. 22°30'N, 120°34'E; reported Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 157). *S131*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 565 m; HUALIEN; 23°43'N, 121°21'E; 9 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N136*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 800 m; HUALIEN; 23°44'N, 121°21'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N136*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 820 m; HUALIEN; 23°44'N, 121°20'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N135*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 820 m; HUALIEN; 23°45'N, 121°20'E; 1 monkey observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N133*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 960 m; HUALIEN; 23°45'N, 121°19'E; 8 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N133*

- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 1085–1165 m; HUALIEN; 23°44'N, 121°19'E; monkeys observed at 1085 m and 1165 m 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N135*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 1410–1600 m; HUALIEN; 23°44'N, 121°18'E; monkeys observed at 1410 m and 1600 m 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N134*
- Wanjung Logging Trail (萬榮林道), Wanjung Hsiang, 1700 m; HUALIEN; 23°45'N, 121°16'E; 3 monkeys observed 1 Feb. 1997 by L.-L. Lee and H.-Y. Wu. *N132*
- Wanta Logging Trail (萬大林道), Jenai Hsiang, 1590 m; NANTOU; 23°56'N, 121°06'E; vocalization heard 28 Nov. 1996 by S.-W. Chang (TESRI). *N69*
- Western Taiwan (西臺灣); imprecise locality; reported in 1715 by Père J.-A.-M. de Moyria de Mailla (Du Halde, 1735, pp. xxxiv, 162; Weiss, 1870–1873, p. 120; Campbell, 1903, pp. 504, 506; Davidson, 1903, p. 68). Not mapped.
- Wulai (烏來); TAIPEI; 24°52'N, 121°33'E; collected before 1959 by unknown collector (Dien, 1958, p. 345); museum unknown. Collected for parasitological research before 1965 probably by R. E. Kuntz (Schad & Anderson, 1963, p. 799); museum unknown. Observed at 1000 m in Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145). Reported in 1982 by K. Masui, Y. Narita, and S. Tanaka (1986, p. 386). *N6*
- Wulai area (烏來地區); TAIPEI; ca. 24°52'N, 121°33'E; serum samples obtained 1959–1966 by C.-S. Yang, C.-H. Kuo, and C.-Y. Chen (1967, p. 146). Trapped for parasitological research before 1965 (Kim & Bergner, 1964, p. 81). *N6*
- Wulaokenghsi Mining Trail (武荖坑溪採礦道路), Nanao Hsiang, 224–625 m; ILAN; 24°33'N, 121°47'E; vocalization heard at 224 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Three monkeys observed at 610 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. Droppings observed at 625 m 1 Dec. 1996 by L.-L. Lee and H.-Y. Wu. *N20*
- Wuling Farm (武陵農場), Hoping Hsiang, 1987–2010 m; TAICHUNG; 24°15'N, 121°01'E; droppings observed at 1987 m and 2010 m 11 Apr. 1996 by TESRI survey team. *N76*
- Wuling (武陵) (Taoshan Pupu), Hoping Hsiang, 2140 m; TAICHUNG; 24°26'N, 121°17'E; 1 monkey observed 16 Nov. 1995 by TESRI survey team. *N45*
- Wulu Logging Trail (霧鹿林道), Haituan Hsiang, 860 m; TAITUNG; 23°09'N, 121°03'E; 2 monkeys observed 21 Nov. 1997 by S.-W. Chang (TESRI). *S65*
- Wulu Logging Trail (霧鹿林道), Haituan Hsiang, 1925–2005 m; TAITUNG; 23°08'N, 121°00'E; droppings observed at 1925 m and 1930 m 19 Nov. 1997 by S.-W. Chang (TESRI). Vocalization heard at 1930 m 19 Nov. 1997 by S.-W. Chang (TESRI). Three monkeys observed at 2005 m 20 Nov. 1997 by S.-W. Chang (TESRI). *S63*
- Wulu Logging Trail (霧鹿林道), Haituan Hsiang, 2060–2215 m; TAITUNG; 23°08'N, 120°59'E; groups observed at 2060 m and 2215 m 20 Nov. 1997 by S.-W. Chang (TESRI). Dead monkey observed at 2145 m 20 Nov. 1997 by S.-W. Chang (TESRI). Vocalization heard at 2165 m 20 Nov. 1997 by S.-W. Chang (TESRI). *S62*
- Wulu Logging Trail (霧鹿林道), Haituan Hsiang, 2240 m; TAITUNG; 23°08'N, 120°58'E; vocalization heard 20 Nov. 1997 by S.-W. Chang (TESRI). *S61*
- Wushan (烏山), Nanhua Hsiang, 500 m; TAINAN; 23°00'N, 120°29'E; 2 monkeys observed 1 Jan. 1997 by L.-L. Lee and H.-Y. Wu. *S103*
- Wushan (烏山), Nanhua Hsiang, 500 m; TAINAN; 23°01'N, 120°29'E; 50 monkeys observed 1 Jan. 1997 by L.-L. Lee and H.-Y. Wu. *S102*
- Wushan (烏山), Nanhua Hsiang, 500 m; TAINAN; 23°01'N, 120°30'E; droppings observed 1 Jan. 1997 by L.-L. Lee and H.-Y. Wu. *S101*
- Wushihkeng (烏石坑), ca. 1200 m; TAICHUNG; 24°18'N, 120°55'E; collected before 1999 by K.-L. Huang and S.-W. Chang; TESRI, 1 (skeleton only). *N81*
- Wushihkeng (烏石坑), Hoping Hsiang;

- TAICHUNG; 24°16'N, 120°56'E; reported 30 Dec. 1992 to TESRI survey team. Droppings observed 19 Feb., 7 Jul., 8 Jul., and 17 Sep. 1993 by TESRI survey team. One monkey observed 9 Jul. 1993 by TESRI survey team. *N82*
- Wushihkeng (烏石坑), Hoping Hsiang, 600–1250 m; TAICHUNG; 24°16'N, 120°56'E; 14 monkeys observed at 700 m 15 Oct. 1992 by TESRI survey team (same team also is source of following observations at this locality). Capture reported at 1000 m 15 Dec. 1992. Droppings observed at 600 m 19 Jan. 1993. Droppings observed at 700 m 26 Mar. 1993. Six monkeys observed at 920 m 7 Jul. 1993. Three monkeys observed at 810 m 4 Aug. 1993. Vocalization heard at 1010 m 17 Sep. 1993. Vocalization heard at 1080 m 19 Oct. 1993. One monkey observed at 800 m 20 Oct. 1993. Food remains observed at 860 m 20 Oct. 1993. Droppings observed at 870 m 20 Oct. 1993. Vocalization heard at 1100 m 21 Oct. 1993. Droppings observed at 700 m 18 Nov. 1993. Fifteen monkeys observed at 930 m 18 Nov. 1993. Droppings observed at 680 m 14 Dec. 1993. Food remains observed at 1200 m 14 Dec. 1993. Droppings observed at 1250 m 14 Dec. 1993. Droppings observed at 820 m and 1245 m 15 Dec. 1993. Ten monkeys observed at 1080 m 16 Feb. 1994. Dead monkey observed at 1070 m 17 Feb. 1994. Vocalization heard at 1230 m 19 Apr. 1994. Thirteen monkeys observed at 1250 m 20 Apr. 1994. Two monkeys observed at 1090 m 18 May 1994. Food remains observed at 1120 m 18 May 1994. Droppings observed at 1080 m 19 May 1994. Droppings observed at 1150 m 27 Oct. 1995. Vocalization heard at 1200 m 27 Oct. 1995. Eight monkeys observed at 1000 m 15 Nov. 1995. Droppings observed at 920 m 10 Jan. 1996. *N82*
- Wushihkeng (烏石坑), Hoping Hsiang, 635–1305 m; TAICHUNG; 24°16'N, 120°56'E; observed 26 Feb. 1997 by S.-W. Chang (TESRI). *N82*
- Wushihkeng (烏石坑) vicinity; TAICHUNG; ca. 24°18'N, 120°55'E; albino juvenile captured in early 1990s by local residents (see above, Albinism). *N81*
- Wutao Shan (霧頭山), Ali village, 6 km along logging trail; PINGTUNG; 22°43'N, 120°47'E; collected 23 Jan. 1995 by S.-Y. Huang; TESRI, 1 (skull only). *S110*
- Yen Hai Logging Trail (研海林道), Hsiulin Hsiang; HUALIEN; ca. 24°09'N, 121°30'E; collected 28 Oct. 1994 by Y.-C. Sun; TESRI, 1 (skull only). *N52*
- Yeng Ping Working Circle. See Yenping Hsiang.
- Yenping Hsiang (延平鄉) (=Yeng Ping Working Circle), 1500 m; TAITUNG; ca. 22°54'N, 120°59'E; observed Jun.–Dec. 1978 by F. E. Poirier (Poirier & Davidson, 1979, p. 145; Masui et al., 1986, p. 386). *S93*
- Yenping Logging Trail (延平林道), Yenping Hsiang; TAITUNG; 22°54'N, 121°02'E; vocalization heard and droppings observed 5 Dec. 1996 by S.-W. Chang (TESRI). *S86*
- Yenping Logging Trail (延平林道), Yenping Hsiang, 1150 m; TAITUNG; 22°53'N, 121°02'E; 2 monkeys observed 1 May 1998 by S.-W. Chang (TESRI). *S85*
- Yenping Logging Trail (延平林道), Yenping Hsiang, 1215–1360 m; TAITUNG; 22°54'N, 121°02'E; droppings observed at 1360 m 30 Apr. 1998 by S.-W. Chang (TESRI). Droppings observed at 1215 m 1 May 1998 by S.-W. Chang (TESRI). *S86*
- Yenping Logging Trail (延平林道), Yenping Hsiang, 1330–1525 m; TAITUNG; 22°55'N, 121°02'E; droppings observed at 1330 m, 1385 m, and 1430 m 30 Apr. 1998 by S.-W. Chang (TESRI). Vocalization heard at 1435 m 30 Apr. 1998 by S.-W. Chang (TESRI). Two monkeys observed at 1525 m 30 Apr. 1998 by S.-W. Chang (TESRI). *S88*
- Yenping Logging Trail (延平林道), Yenping Hsiang, 1555–1650 m; TAITUNG; 22°56'N, 121°02'E; 5 monkeys observed at 1645 m 5 Dec. 1996 by S.-W. Chang (TESRI). Droppings observed at 1555 m, 1635 m, and 1650 m 30 Apr. 1998 by S.-W. Chang (TESRI). Vocalization heard at 1635 m 30 Apr. 1998 by S.-W. Chang (TESRI). *S88*
- Yenping Logging Trail (延平林道), Yenping Hsiang, 1600 m; TAITUNG; 22°56'N, 121°01'E; droppings observed 30 Apr. 1998 by S.-W. Chang (TESRI). *S88*
- Yenping Logging Trail (延平林道), Yenping



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