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Bassariscus astutus. By Ivo Poglayen-Neuwall and Dale E. Towell

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**Bassariscus Coues, 1887**

*Bassariscus* Lichtenstein, 1830:119. Type species *Bassariscus astutus* Lichtenstein; not *Bassariscus* Hubner, 1816.

*Bassariscus* Coues, 1887:516. Type species *Bassariscus astutus* Lichtenstein, a renaming of *Bassariscus*.

**CONTEXT AND CONTENT.** Order Carnivora, Family Procyonidae, and Subfamily Procyoninae. The genus contains two living species, *B. astutus* and *B. sumichrasti*. A key to the species follows:

- Solas furred, ears rounded, claws semi-retractile, high ridges connecting cusps of molariform teeth, length of tail approximately equal to length of head and body ——— *B. astutus*
- Solas naked, ears smaller, claws non-retractile, low ridges connecting cusps of molariform teeth, length of tail distinctly longer (±11.5%) than length of head and body ——— *B. sumichrasti*

**Bassariscus astutus** (Lichtenstein, 1830)

Ringtail

*Bassariscus astutus* Lichtenstein, 1830:119. Type locality “Mexico City,” exact locality unknown.

*Bassariscus raptor* Baird, 1859:19. Killed in Washington; escaped pet. Type locality designated by restriction “Glen Ellen, Sonoma County, California” (Hall, 1926:44).

*Bassariscus astutus* Coues, 1887:516, first use of current name combination.


*Bassariscus saxicolus* Merriam, 1897:185. Type locality “Espiritu Santo Island, Lower California.”

*Bassariscus albipes* Elliot, 1904:258. Type locality “Xico, near Jalapa, Veracruz.”

**CONTEXT AND CONTENT.** Context same as for genus. Fourteen subspecies of *Bassariscus astutus* are described as follows (Hall, 1981):

- *B. a. arizonensis* Goldman, 1932:87. Type locality “Copper Ranch, Blue River, about 12 miles south of Blue Grass, Greenlee County, Arizona (altitude 5,300 feet).”
- *B. a. astutus* (Lichtenstein, 1830:119), see above (albipes Elliot, a synonym).
- *B. a. belei* Goldman, 1945:105. Type locality “Chilpancingo, Guerrero, Mexico.”
- *B. a. consitus* Nelson and Goldman, 1932:487. Type locality “La Salada, 40 miles south of Uruapan, Michoacan, Mexico.”
- *B. a. macrogalli* Goodwin, 1956:10. Type locality “La Ventosa, Salina Cruz, coastal lowlands, 20 kilometers south of the city of Tehuantepec, Oaxaca, Mexico.”
- *B. a. nevadensis* Miller, 1913:159. Type locality “Eldorado Canyon, Clark Co., Nevada.”
- *B. a. octavius* Hall, 1926:39. Type locality “San Luis Rey River, 1700 feet altitude, near Escondido, San Diego County, California.”
- *B. a. palmarius* Nelson and Goldman, 1909:26. Type locality “Coombu, Lower California, Mexico (altitude 700 feet).”
- *B. a. raptor* (Baird, 1859:19) see above (flavus Rhoads, a synonym).
- *B. a. saxicolus* Merriam, 1897:185, see above.

*B. a. willetti* Stager, 1950:203. Type locality “Riverside Mountains, extreme northeastern corner of Riverside County, California.”

*B. a. yumanensis* Huey, 1937:357. Type locality “Tinajas Altas, Gila Mountains, Yuma County, Arizona.”

**DIAGNOSIS.** *Bassariscus astutus* differs from *B. sumichrasti*, its only relative, as follows: it is typically ±24% smaller and shows more contrasting facial and tail markings. Dorsal pelage is typically gray, with yellowish tinges, rather than sooty brown, and ventral pelage is whitish to buff rather than gray or tan. Muzzle is grayish rather than blackish and only moderately elongate. Ears are oval, narrowly rounded, and about 7% longer than in *B. sumichrasti* (Nelson and Goldman, 1932). Hind limbs are longer, giving a distinct downward slant of the body toward the head. Feet are grayish-buff rather than blackish, with naked digital pads surrounded by hair, except behind first digits; soles are naked in *B. sumichrasti*. Claws are short, straight, and semi-retractile rather than long, curved, compressed, and non-retractile (Hall, 1981; Leopold, 1959). The tail is approximately the length of the head and body, with seven or eight black rings alternating with white rings; the black rings are broken by white on the ventral surface, the terminal black band tipping the tail. In *B. sumichrasti* the tail is distinctly longer (~11.5%) than the head and body, with nine unbroken black rings alternating the grayish rings in the proximal two-thirds of the tail; the distal third being nearly uniformly black. Tail diameter of *B. astutus* approximates body diameter when tail hairs are erected. Basal of *B. astutus* have a shaft that bends upward, then downward, and the distal end is flattened dorso-ventrally with a lateral expansion; in contrast, the shaft is nearly straight with a condylo-like tip that has two ventral tubercles proximal to it in *B. sumichrasti* (Burt, 1960).

**GENERAL CHARACTERISTICS.** Ringtails have a head and body resembling that of an American marten (*Martes americana*), with a distinctly annulated tail about head-body length (Fig. 1). Muzzle is elongate, pointed, and grizzled; nose pad is blackish. Mystacial vibrissae mostly black and up to 75 mm long (Grinnell et al., 1937). Eyes have chestnut-brown iris and round pupil, are large and ringed with black or dark brown pelage, and are bordered by superorbital, suborbital, and subauricular patches of white or pale buff (Hall, 1981) creating a striking “mask.” A white fleck on center of forehead or back of muzzle, not related to subspecies, age, or sex, may be present. Eyelids black-edged; a black line extends from the medial

![Fig. 1. Adult male Bassariscus astutus arizonensis from North McDowell Mountains, Maricopa Co., Arizona. Photograph by I. Poglayen-Neuwall.](image-url)
part of the upper lid through the white eye ring toward the forehead. Facial vibrissae well developed. Ears large, oval, thin, with well-developed hairs, covered with dusky cinnamon-buff hair becoming whitish on the edge of inner pinnae (Grinnell et al., 1937).

Body pelage ranges from stony gray through light brown to golden tan, with longer, black-tipped guard hairs and plumose underfur on upper body. Hair color paler on sides and dark down the middle of back. Dorsal coloration related to habitat (Doe and Blossom, 1937; Hardy, 1945), although as a general rule, darker upper body pelage commonly is associated with animals from northerly or higher-altitude populations; ringtails in more southerly or lower elevations tend to be lighter in color. Underparts white or pale buff (Grinnell et al., 1937; Hall, 1981). Melanism has been reported (Hoffmeister, 1960). In Bassariscus the length and thickness of the shaft of dorsal guard hair is shorter and thinner than in other procyonids, with a maximum length of 25 mm and width ≤100 μm (Mayer, 1952).

Feet are semi-plantigrade and pentadactyl; second, third, fourth, and fifth digits of fore and hind feet densely haired on lower surface behind and around digital pad; first digit naked posteriorly (Grinnell et al., 1937; Hall, 1981). Pads naked and puckish. Claws short, straight, semi-retractile (Hall, 1981).

Tail long and solidly white or pale buff underneath; as viewed from above it is strikingly annulated. Bands narrow at base of tail, not distinct, and rather wood brown in color. Bands increase in width distally. Fur on the tail is short, averaging only about 10 mm in length on dorsal portion midway on tail; guard hairs at the same point average about 50 mm. The tail is parallel-sided, not tapering, somewhat flattened rather than cylindrical in cross section and about 70 mm wide (Grinnell et al., 1937).

Skull elongate with light zygomatic arches; braincase slightly flattened and expanded laterally (Fig. 2). Postorbital processes well developed from frontal and moderately from zygoma; sagittal crest lyrate. Posterior border of maxillary portion of zygoma lies at the plane of M1; palate extends slightly posterior to posterior margin of molar; tympanic bulla well inflated; foramen ovale opens somewhat downward (Durrant, 1952; Grinnell et al., 1937; Hall, 1981; Korthuckle, 1984). Ranges of skull measurements (in mm) for adults of both sexes from throughout the range are as follows: basilar length, 68 to 75; zygomatic breadth, 48 to 52; mastoid breadth, 33 to 35 (Hall, 1981). As a rule, males have larger, more sharply ridged skulls than females of corresponding age (Grinnell et al., 1937); characteristics of skull associated with age include pattern of closure of skull sutures, development of sagittal crest, and tooth wear (Towse, 1978). Dental formula: i 3/3, c 1/1, p 3/4, m 3/3, total 46. Canines in large molarsiform teeth have high connecting ridges; upper carnassial irregular in outline, P4 sectorial; dentocone present; M1 subquadrate to triangular, broader than long; canines are smooth, slightly curved; and the cutting edges of 11 and 12 are normally smooth (Hall, 1981). The vertebral formula is 7 C, 13 T, 7 L, 3 S, and ±25 Ca (Bird, 1985).

Maximum and minimum external measurements (in mm) for adult B. astutus of both sexes from throughout the geographic range of the species are: total length, 616 to 811; length of tail, 310 to
438; length of hind foot, 57 to 78; length of ear from notch, 44 to 50 (Hall, 1981b); body mass, 870 to 1,100 g. Individuals of B. axillaris are mediumsized in the Pacific Northwest, New Mexico, Texas, and across the northern plateau of Mexico, and smaller in the interior West, Southwest, and Baja California. The largest individuals occur in southern Mexico (Kortlücke, 1984).

**DISTRIBUTION.** The geographic range of *B. axillaris* (Fig. 3) extends from the southern provinces of Guerrero, Oaxaca, Veracruz (where ranges of *B. axillaris* and *B. sumichrasti* overlap) northward throughout Mexico, including Baja California and the islands of New Mexico, Texas, and Sante Fe in the Sea of Cortez, and through the Southwest into the northwestern one-third of the United States (Hall, 1981; Leopold, 1959). Outlying records of *B. axillaris* such as those from eastern Oregon (Baylor, 1936), Ohio (Bole and Moulthrop, 1942; Goospath and Hoffmeister, 1968), and Montgomery Co., Alabama (Brannon, 1922) likely represent escaped captive animals; the ability of ringtails to survive in non-native habitats is well documented (Baird, 1859; Edwards, 1955). Although recorded at elevations of 2,000 to 2,900 m (Moran, 1979; Nelson, 1918; Olin, 1975; Richards, 1968, 1976), they are usually found at elevations ranging from sea level to about 1,400 m.

**FOSSIL RECORD.** The genus *Bassarithes* is represented by several species from the Miocene of Nebraska, Nevada, and California (Hall, 1927; Kurten and Anderson, 1980). Characteristic of the genus, although primitive compared to recent specimens of *B. axillaris*, are strongly developed and suggest genetic departure from other lines of Procyonidae no later than the Oligocene (Hall, 1927). The Blancan species *B. casei* was probably directly ancestral to extant ringtails (Kurten, 1980). Another species, *B. sp. nov. of the late Pliocene of southern Arizona and Mexico, may have been intermediate between *B. axillaris* and *B. sumichrasti* (Skinner, 1942). Recent material representing *B. axillaris* has been found within the present range of the species in Arizona, California, Nevada, New Mexico, Texas, and Utah (Mead and Van Devender, 1981). Owing to the propensity of the species to use protective rocky caves and crevices in arid country as den sites, considerable material has been preserved. Mead and Van Devender (1981) reported 22 taxa including 6 mammalian, 5 bird, 7 lizard, and 6 snake species in the late Holocene diet of ringtails from Vulture Cave in Grand Canyon, Arizona, on the basis of preserved fecal material. The most abundant prey taken was *Neotoma*; all prey items presently occur in the immediate vicinity of the site.

**FORM AND FUNCTION.** Seasonal molt begins in late summer and is completed by late fall. Replacement of juvenile pelage with adult pelage starts around the mammary, under the forelegs, and under the throat, and proceeds anteriorly and posteriorly over the body. Central pelage replacement begins in September, with replacement of dorsal pelage begins above each eye and below each ear, and proceeds posteriorly (Towell and Towell, 1978).

Shoulder morphology of *B. axillaris* differs from the generalized carnivore condition, foreshadowing conditions of the bears, and is more primitively than in *Naessa* and *Procyon* (Davis, 1949). On the basis of the presence of the anterior pelage replacement *Bassarithes* and *Bassariscus* are intermedial between *Procyon* and *Potos*. *Bassariscus* is the only primate exhibiting the primitive condition of basiarcinal origin of the large occipital artery (Story, 1951). The vessel pattern of the arteries in *Bassariscus* is most closely related to that of the Ursidae (Davis, 1941).

Electrophoretic analysis demonstrated that *B. axillaris* and *Naessa narica* as well as five muskell species have two major hemoglobins in approximately equal concentrations, whereas Canis, Ursus, *Procyonidae*, and Mustelidae have only one major hemoglobin (Seal, 1969). Antiserum prepared to *Ursus americanus* serum albumin, and *Procyon lotor* have been used for phylogenetic inference. The results placed the Ursidae closest to the Procyonidae. The procyonids were closely grouped, supporting the placement of these groups by resemblance (Seal et al., 1970). Normal body temperature of ringtails is 37.6°C (Burton, 1962). Heat stress caused by excessive ambient temperatures is evidenced by panting and inertia (Chevalier, 1981). The structure of the auditory bulla of *B. axillaris* was described by Pocock (1928), and Segall (1943) examined ossicles and reported that the middle cavity resembled the malleus of the Ursidae, Ailuridae, and Alstrum. Visual response to a brightness test described by Gossett and Kraus (1968) revealed performance by *B. axillaris* superior to that of *Mephitis mephitis* and *Potos flavus*, but inferior to *Saimiri sciureus*. Mystical vibrissa help orient the animal in dark, narrow crevices and in food detection, and tactile sensory hairs on the forearm of ringtails aid in prey capture (Towell and Towell, 1978; Welker and Campos, 1963).

**Bassariscus axillaris** possesses no coecum. Feaces typically occur in 1 to 4 segments with a mean diameter of 9.6 mm (SD = 1.9; range, 1 to 13) and a total length of 75.7 mm (SD = 56.1; range, 15 to 601) (Trapp, 1973). *Bassariscus* possesses paired anal glands lateral to the anus (Pociok, 1921). Glands open via single ducts cranial to the splinhte and discharge a pungent, cream-colored secretion (Towell and Towell, 1978). Ringtails are dependent on open water (Armstrong, 1975; Cahalane, 1942; Carnes, 1965; Grinnell et al., 1937; Seton, 1929; Taylor, 1954). Kidney function is highly modified for water conservation, allowing ringtails to maintain water balance in the absence of open water, provided that an abundant diet of high protein prey is available (Richards, 1976) or a diet of succulent fruits, berries, and insects is utilized (Chevalier, 1984). Ringtails can produce urine concentrations among the highest known within the order (3,641 mOSm/l) when water-stressed (Richards, 1976).

Male reproductive organs include paired scrotal testes, epidiymides and vasa deferentia; they possess a well-developed baculum, the simplest among procyonids (Burt, 1960; Pociok, 1921). Length of baculum averages 45 mm. Changes in bacula associated with age include thickness, degree of taper, and enlargement of basal end (Wood, 1952).

Reproductive organs of females consist of paired ovaries, complete ovarian bursae, oviducts, a bicornuate uterus, and a single vagina. A cartilaginous os clitoris is located within the glans clitoris, dorsal to the urethral orifice (Arata, 1965). Placentation is endotheriochel ar borny; implantation of embryos may occur in either or both horns of the uterus. Through the gestation period they dem onstrated moderate follicular activity with vesicular follicles in an atretic state. Primary and secondary follicles were more active in April and May. Rapid degeneration of luteal tissue was evidenced by lack of identifiable corpora lutea or corpora albicantia by mid-June (Snyder, 1972). There are four functional mammary glands in two pairs (Grinnell et al., 1937; Richardson, 1942); five (Poglayen-Newall and Poglayen-Newall, 1987; Towell and Towell, 1978) and six mammary have been reported (Burt and Grossenheider, 1976).

**ONTOGENY AND REPRODUCTION.** The breeding season extends from February into May, but most breeding occurs in March and April (Bailey, 1974; Fry, 1926; Poglayen-Newall and Poglayen-Newall, 1980a; Taylor, 1954; Towell, 1976). Ringtails are nonestrous; estrus is manifested by vulvar tumescence, beginning 14 days before parturition. The female may be pregnant during a period of 24 (Poglayen-Newall and Poglayen-Newall, 1980a) to 36 h (Bailey, 1974). A postpartum estrus may occur, although it is apparently rare (Poglayen-Newall and Poglayen-Newall, 1980a). Gestation ranges from 51 to 54 days, the shortest among procyonids. Recurrent vulval swelling and hair loss around the mammary are indications of pregnancy (Poglayen-Newall and Poglayen-Newall, 1980a).

Parturition usually occurs in May or June (Bailey, 1974; Poglayen-Newall and Poglayen-Newall, 1980a; Richardson, 1942; Towell and Towell, 1978). Litter size varies from one to four (Bailey, 1905; Davis, 1960; Fry, 1926; Grinnell et al., 1937; Poglayen-Newall and Poglayen-Newall, 1980a; Richardson, 1942; Snyder, 1977; Taylor, 1954; Towell and Towell, 1978), but five young have been reported (Cahalane, 1947; Lechleitner, 1969).

Newborns are altricial with sealed eyelids, closed ear canals, and with fuzzy hair on their back (Bailey, 1974; Davis, 1960; Richardson, 1942; Towell and Towell, 1978). Mass of newborns is 14 to 40 g each (X = 22), corresponding to about 3% of maternal mass (Towell and Towell, 1970). Eyes open at 21 to 34 days and ears at 18 to 30 days postpartum (Richardson, 1942; Towell and Towell, 1978). At 6 weeks young are fully furred and dropping pinnas begin to become upright as in the adult (Richardson 1942; Towell and Towell, 1978). Diciduous teeth appear between 3 and 4 weeks, permanent dentition is complete at 17 to 20 weeks (Towell and Towell, 1978). Solid food is taken at 30 to 40 days (Richardson, 1942; Towell and Towell, 1978). Young walk well at 6 weeks, climb at 8 weeks, are weaned about 10 weeks (Towell and Towell, 1978). Testes, measuring 4 mm, descend at 16 weeks. Young
ringtails attain full size at about 30 weeks (Richardson, 1942; Towell and Tewell, 1978).

Both males and females in both sexes is attained near the end of the second year, but successful matings of young-of-the-year have been reported (Poglayen-Neuwall and Poglayen-Neuwall, 1980). Longevity in captivity averages 12 to 14 years (Crandall, 1964) with a maximum of 16.5 years (Poglayen-Neuwall, 1987).

**ECOLOGY.** The great horned owl (Bubo virginianus) is probably the major predator; others include coyotes (Canis latrans), raccoons (Procyon lotor), and bobcats (Felis rufus) (Errington, 1967; Mollison et al., 1972; Summer and Dixon, 1953). Carcasses of ringtails killed by mammalian predators were not fed upon on several instances perhaps because of the strong flavor of the flesh (Bradley and Hansen, 1965; Halloran, 1947; Summer and Dixon, 1953).

Diseases such as rabies, feline and canine parvuloclonia, and parastyles may play a large part in population control. Known ectoparasites of *B. astutus* are the fleas *Pulex simulans*, *P. irritans*, *Malurus sinuus*, *Anoplus tryphonus*, *Oreocetes sextenatus*, *Polygenis gynyn*, *Hoplophylus affinis*, the mites *Echinochaeta gaudi eadi*, *Pseudochoeragnosta astips*, *Encheleyda hattkyi*, *Clytus eruditus*, *Dermacnus hypidio*, *Hirtonevra brevivirata*, *H. staffordii*, *Androchoras faurholzii*, the louse *Neotrichodectes thoracicus*, and the ticks *Dermacenta variabilis*, *D. parumnuptus*, *Haplophilus leporisphilus*, *Iodes kingi*, *L. conepeti*, *I. cooki*, *I. texanus*, *Amblyomma americanum* (Beck et al., 1963; Custer and Pence, 1979; Towell and Price, 1976). Endoparasites are Cestodes such as *Taenia maruti*, *Mesocoeldoides*, and the nematodes *Ascara basterki*, *Parascaris equi*, *Arctosphylla Uncinaria levis*, and *Macrocantharchynus incens* (Pence and Stone, 1977; Pence and Willis, 1978; Pence, 1928).

In the southernmost part of the range where *B. astutus* and *B. suvecrassus* are sympatric, the latter is a competitor in rocky outcrops or frequented by both species (Alvarez del Toro, 1977). Although *B. astutus* is sympatric with either *Urocyon cinereorus* or *Valles macrotis* over much of its range, these species are not true competitors because they differ in mode of habitat usage, technique of habitat exploitation, and temporal use of habitat and food habits (Chevalier, 1984; Trapp, 1975, 1978). Ringtails shared den sites with *Conuspatas mesoleucus* and *Dasyus novemcinctus* in Kerr Co., Texas (Towell and Price, 1976). There is evidence of competition for food with *Procyon lotor*, *Didelphys marsupialis*, *Urocyon cinereorusgentus*, and *Mephitis mephitis* (Wood, 1952). *Bassariscus* commonly seeks food from Agave hawardiana has been reported (Kuban and Schwartz, 1985). Birds, including *Falco peregrinus* (White and Lloyd, 1962), peregrines, *Cathartes aura* complete the diet along with colder vertebrates, chiefly lizards and snakes and occasionally frogs and fish (Davis, 1966; Taylor, 1954; Towell and Teer, 1977; Trapp, 1973; Wood, 1952). Plant matter eaten includes *Juncus*, *Calic*, *Diascia*, *Neptunia*, *Arctostaphylos*, *Quercus*, *Cercus giganteus*, and *Pinus contorta* (Davis, 1960; Taylor, 1954; Towell and Teer, 1977; Trapp, 1973; Wood, 1952). Nectar feeding from *Agave hawardiana* has been reported (Kuban and Schwartz, 1985). Birds, including *Falco peregrinus* (White and Lloyd, 1962), peregrines, *Cathartes aura* complete the diet along with colder vertebrates, chiefly lizards and snakes and occasionally frogs and fish (Davis, 1966; Taylor, 1954; Towell and Teer, 1977; Trapp, 1973; Wood, 1952). Grinnell et al. (1937) indicated the average mass of a ringtail meal was 55 g, whereas Howard (1957) mentioned 90.6 g; about 10% of ringtail body mass. A captive *B. astutus* ate 20 to 25 g of dry cat food and raisins daily (Towell and Teer, 1977). Protection of habitat by regulation of grazing and wood cutting is of benefit to this procurvus (Kaufmann, 1982).

*Bassariscus* commonly seeks food and shelter among human habitations in rural urban areas and is harvested as a fur bearer. In Texas, the harvest is estimated at 75,000 to 100,000 ringtails annually (Deems and Parsley, 1983). Fur is of poor quality and used as trim only (Leopold, 1959). Although ringtails have legal protection in many states, many fall victim to traps set for other species (Atkinson, 1934; Davis, 1960; Grinnell et al., 1937; Summer and Dixon, 1953), and behavior studies indicate an aversion to daylight beginning soon after birth (Towell and Tewell, 1978) that persists through adulthood (Kavanau and Ramos, 1975). Of 390 observations at a feeding station, 99.5% were after dusk and 6.4% occurred during dusk. Activity of radio-tracked individuals showed 46.8% beginning in darkness, 26.4% beginning in dusk, 8.8% within 45 min before dusk (n = 34). Termination of activity was noted to be 42.3% in darkness, 34.6% at dawn, and 23.1% within 45 min after sunset (n = 20; Trapp, 1978). Seton (1929) mentioned that they may bask in early morning sun. Kavanau (1971) found them active only during night and twilight.

Telemetry studies have shown no tendency toward monogamy but indicate a social structure based on land tenure (Towell, 1976; Trapp, 1978). Ringtails occur singly or as pairs in local concentrations, although they may be separated (Grinnell et al., 1937). In captivity, unlike the wild, adults, regardless of sex or season, may sleep together in the same nest box (Richardson, 1942; Trapp, 1972). Depending on the ambient temperature, ringtails may sleep on their side in warm weather, on their back with rear legs spread and forelegs in the air, or curl up around a nest or grass (Towell and Tewell, 1980). They change dens frequently; an individual rarely spends more than three consecutive days in the same shelter, except during inclement weather. Two females with new litters began to move their young from den to den 10 days after giving birth. They moved the young almost daily after day 20 (Towell, 1976).

*Behavior. Ringtails rarely are active in daytime (Atkinson, 1934; Davis, 1960; Grinnell et al., 1937; Summer and Dixon, 1953), and behavior studies indicate an aversion to daylight beginning soon after birth (Towell and Tewell, 1978) that persists through adulthood (Kavanau and Ramos, 1975). Of 390 observations at a feeding station, 99.5% were after dusk and 6.4% occurred during dusk. Activity of radio-tracked individuals showed 46.8% beginning in darkness, 26.4% beginning in dusk, 8.8% within 45 min before dusk (n = 34). Termination of activity was noted to be 42.3% in darkness, 34.6% at dawn, and 23.1% within 45 min after sunset (n = 20; Trapp, 1978). Seton (1929) mentioned that they may bask in early morning sun. Kavanau (1971) found them active only during night and twilight.

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an adult female, a behavior which, in this species, seems restricted to maternal care. Self-grooming consists of a cat-like licking of the forepaws, followed by wipping motion from behind the ears over the head and down the muzzle. This activity may be followed by scratching with front or rear feet, combing with claws or teeth, or rubbing on a nearby rough object (Poglayen-Neuwall, 1973; Towell and Towell, 1978).

Play has been observed at 45 days, consisting of batting one another with forepaws and pouncing on each other. By 70 days, play included picking up objects with the mouth, tossing them with a flip of the head, and pouncing on them when they landed (Poglayen-Neuwall, 1973; Towell and Towell, 1978). Sexual play was first reported among 13-week old ringtails (Bailey, 1974). Defensive behavior in young animals, accompanied by an explosive bark and release of musk from the anal glands was described at 47 days (Towell and Towell, 1978). Food defense became apparent at 80 days, and consisted of boshing of the tail hair and growling. Repeated barking and attempts to bite an intruder occurred at about 100 days (Towell and Towell, 1978).

Ringtail vocalizations were recorded and analyzed audiospectrographically by Bailey (1974), Peters (1984), Richards (1976), and Willey and Richards (1981). Vocalizations include metallic chips, squeaks, and whoops (infant vocalizations), chirps, juvenile distress, female copulatory and labor stress vocalizations), chucking and barks (alarm, defensive threats), hisses, grunts, growls, uhlations (aggressive vocalizations) (Bailey, 1974; Gander, 1965a; Willey and Richards, 1981). Scent seems to be as important as vocalizations for communication within the species. Urine is rubbed on the ground and on raised objects (Kaufmann, 1982; Poglayen-Neuwall, 1973) as a home range marker, and latrine areas with accumulations of feces are typical (Lemoine, 1977; Mead and Van Devender, 1981; Poglayen-Neuwall, 1973; Towell, 1976; Trapp, 1978). Increased localized urine deposits and scattered feces are apparent just before and during the mating season (Bailey, 1974).

At the peak of estrus, the male chases and frequently copulates with the female. He typically mounts the female several times per hour in a sitting position, grasping her anterior to the pelvis with his forefeet. Copulation consists of repeated quick thrusts by the male, followed by brief pauses. Thrusting periods average a few seconds, and the male usually maintains his hold for 1 to 2 min. Females utter a typical mating chitter before and during copulations, and sometimes also in the absence of the male (Bailey, 1974). Pairs may stay together, but the male is excluded from use of the den 3 to 4 days before parturition. The female may allow the male to rejoin her about 3 weeks later (Fry, 1926).

Parturition occurred in six females lasting from 85 to 126 min; expulsion of fetus lasted from 2 to 47 min (n = 13, X = 14). Intervals between expulsions ranged from 7 to 49 min (n = 10, X = 24.4). The young usually are born head first. Placentophagia occurs regularly (Poglayen-Neuwall and Poglayen-Neuwall, 1980b). In the first days after birth, the mother nurses in a hunched, sitting position, later more often in lateral recumbency (Towell and Towell, 1978). She may move the young with a forepaw to the mammae region (Richardson, 1942). The young show no nipple preference. They search at random, swinging their head from side to side, pawing and poking the nose into the fur of the mother until a nipple is reached. Metallic squeaks accompany the severe for the nipple. The newborn shows pronounced movement toward tactile stimuli and warmth (Towell and Towell, 1978).

Locomotion is accomplished in the newborn by bracing a foot to either side of the body and dragging the abdomen. Neonates right themselves by rolling toward a braced foetation (Richardson, 1942). By 10 days of age, the rear legs contribute to forward locomotion, and the forepaws can be rotated to grasp objects. Between 37 and 45 days, they are able to hold the body off the ground for short distances (Richardson, 1942; Towell and Towell, 1978).

Until 3 to 4 weeks after birth, the young sleep stretched out. Later they curl up with their head tucked beneath the ventrum and the tail wrapped around the body like a loaf (Bailey, 1974; Towell and Towell, 1978). Upon disturbance the mother grasps the young at its shoulder or head and carries it around until her excitement subsides. During transport, the young becomes limp (Richardson, 1942).

Excrement of young is consumed by the female until the young begin to take solid food. Although young void randomly at 3 weeks of age (Bailey, 1974; Richardson, 1942), by 120 days of age, they develop localized "toilet" areas (Towell and Towell, 1978). Participation in the provisioning of young by both parents, starting around 3 weeks, has been reported (Fry, 1926; Lechthneir, 1969), although Towell and Towell (1978) and Trapp (1972), based on telemetry data, assigned this task to the female alone. The metallic squeaks of the infant gradually disappear and are replaced at 10 weeks by a spitting, explosive bark (Towell and Towell, 1978). Chevalier (1984) and Poglayen-Neuwall and Poglayen-Neuwall (1980b) reported licking of saliva from inside the mother's mouth by the young during the transition period, when the milk supply diminishes and young are not sufficiently mobile to follow her on extended excursions; this behavior may be a method of providing additional fluids for the young.

The young begin to forage with the mother between 60 and 100 days of age (Fry, 1926; Gander, 1956a; Kaufmann, 1982; Towell and Towell, 1978). Towell and Towell (1978) saw a family of one adult and two young, approximately 100 days old rapidly searching over the ground, and ascending trees head first. Both young remained within 5 m of each other, but the adult occasionally moved 10 to 15 m from each other. When eating, food items such as small rodents and lizards are pinned with the front feet. Feeding frequencies at the head. Large fruits are also pressed to the ground, and small pieces bitten off (Grinnell et al., 1937). Ringtails progress in a steady, gliding motion with tail carried straight out behind, barely clearing the ground. Rather than jumping from rock to rock, they crawl over and around obstacles (Grinnell et al., 1937; Trapp, 1978). There are two modes of walking: a crouch-like low walk, probably used more under conditions of apprehension, and the high, confident walk with legs extended (Trapp, 1978). They cross open spaces with the tail arched over the back toward the head, making the animal appear larger and the tail functioning as a decoy for predators (Gander, 1965a; Ingles, 1965; Lemoine, 1977; Trapp, 1972). Ringtails scale cacti with apparent impunity (Chevalier, 1984), and have locomotory adaptations for rorocheting, chimney stemming, and accurate power leaps (Trapp,
1972). Vertical descents, head first, are accomplished by rotating the hind foot 180°, allowing pads and claws to retain contact with the substrate (Trapp, 1972).

**GENETICS.** The diploid chromosome number of all procyonids is 38 (Wurster and Benirschke, 1968; Wurster-Hill and Gray, 1975). The karyotypes are similar and include a large number of felid homologs (Wurster-Hill and Gray, 1975), though felids and procyonids are only distantly related. *B. astutus* has a karyotype of 2n = 38, In = 68, which includes a large submetacentric X chromosome (Fig. 4) and a small acrocentric Y. In addition, it has the small submetacentric marker chromosome satellited on the short arms that is possessed by most carnivores.

**REMARKS.** The scientific name, Bassariscus astutus, is derived from *basar* (fox), *is* (little), and *astut* (cunning), meaning cunning little fox (Jaeger, 1955). Vernacular names are ringtailed cat, bandedtail cat, cat squirrel, coon cat, coon fox, bassarisk, civet cat (because of its musk), and miner's cat (historically in mining camps, this animal was appreciated as a mouser). Cacomistle or cacomistle are also spread names in the southern part of the range, are derived from the Aztec language. Baisauris is a name restricted to Baja California, Mexico. Although *B. astutus* and *B. sumichrasti* have many morphological characteristics in common (Korthuche, 1984) and have overlapping ranges (Hall, 1981), no interbreeding has been reported.

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**LITERATURE CITED**


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