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Myotis vivesi.

By Brad R. Blood and Mary K. Clark

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Myotis vivesi Menegaux, 1901

Fish-eating Myotis

Myotis vivesi Menegaux, 1901:323. Type locality "Ilot du Cardonal ou Islo, partie de L'Archipel Salsi puedes, au nord golfe de Californie," restricted to Isla Partida at 28°53'N, 113°04'W, Baja California, Mexico, by Reeder and Norris (1954).

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Vespertilionidae, Subfamily Vespertilioninae, Genus *Myotis*, Subgenus *Pizonyx*. The genus *Myotis* contains 84 species (Koopman, 1992). *M. vivesi* is monotypic.

DIAGNOSIS. Overall size of *M. vivesi* is largest for any *Myotis* in the New World. The large elongated hind feet, characteristic of this species (Fig. 1), average 23 mm as compared to 8 mm for *M. velifer*. The feet, including the claws, are equal in length to the tibia. In adults, the tips of the claws can be hooked over the knees, whereas in younger individuals the claws extend well beyond the knees (Blood, 1987; Maya, 1968; Miller and Allen, 1928). The toes and claws are greatly compressed laterally, so that at their base the ratio of width to height is 1:8 (Blood, 1987; Fish et al., 1991). The calcar of the foot has no keel. Unlike other *Myotis*, fish-eating *Myotis* have white fur on the ventral surface of the body.

Skull and teeth (Fig. 2) are most similar to species in the subgenus *Leuconoe*. The cingulum on the lower canine forms a small cusp anteriorly. A rudimentary protoconule is present on M3. The inner cusps of the lower molars are unusually well developed relative to other *Myotis*. Both upper and lower small premolars are heightened with P2 being higher than P1 in lateral view. In the mandible, "heightening of the second premolar is so great that the profile of the entire row of cusp summits does not show the abrupt fall in front of the large premolar which is so characteristic of the cusp profile of *Myotis*" (Miller and Allen, 1928:212).

The wing membrane is narrowed basally so that when fully extended the trailing margin extends directly from the tip of the fifth digit to the body. The plagiopatagium attaches at the proximal-most extent of the tibia, resulting in a hind limb relatively free of the plagiopatagium. The tail projects just beyond the free border of the uropatagium. The ventral surface of the uropatagium is covered with short, stiff, anteriorly-oriented hairs. Long silky fringe hairs are present dorsally along the distal one-third and free edge of the uropatagium (Blood, 1987).

GENERAL CHARACTERS. *Myotis vivesi* is similar in size and general appearance (except for enlarged hind feet) to *Myotis myotis* of the Palearctic region (Miller and Allen, 1928), but it is much larger than any New World species of *Myotis*. For example, the greatest length of skull of *M. velifer* (the second largest *Myotis* of the New World) averages 17.6 mm, whereas for *M. vivesi* it averages 23 mm (Hall, 1981; Miller and Allen, 1928). The ear, when laid forward, extends 5 mm beyond the nostrils. Eight cross-ridges usually are visible in each ear. The antitragus is relatively long and the anterobasal lobe is relatively small when compared with *M. thysanodes*. The tragus is bluntly pointed with its posterior margin crenulate (Miller and Allen, 1928).

The mid-dorsal pelage is ca. 8 mm in length and does not extend onto the wing membranes. Dorsal pelage varies from dark buff to pale tan and the bases are slate-colored. The uropatagium is nearly naked dorsally at its origin, the middle one-third is haired, and the distal one-third is thickly covered with long silky hair which extends beyond the free end of the uropatagium. Ventrally, the uropatagium is covered sparsely with stiff anteriorly-directed short hairs with a sprinkling of long loose hairs at the ventral base (Maya, 1968).

The skull (Fig. 2) is much larger than in any other North American *Myotis*. As compared with *M. velifer*, the sagittal crest is low, the longitudinal median groove on the rostrum is relatively deeper and better defined, and the braincase is elevated less posteriorly and less abruptly constricted anteriorly. The alveolar line rises at a greater angle in *M. vivesi* than in *M. velifer*, so that the tips of the canine teeth are elevated above a flat surface (Miller and Allen, 1928). The teeth, especially the canines and premolars, possess cusps which are more slender and higher than in other North American *Myotis*. Height of the C1 alveolus is equal to more than the combined crown length of the four large cheek teeth, whereas this same measure in *M. velifer* is <0.5 the combined length (Miller and Allen, 1928). Both P1 and P2 are heightened and the second exceeds the first in height, a feature also unique to a North American *Myotis*. The incisors are typical for *Myotis*, and M3 is not reduced. There is a rudimentary protoconule on M1 and M2 (Miller and Allen, 1928).

Measurements of the cotypes (mm; both female) are as follows: total length, 145, 140; length of tail, 70, 69; length of tibia, 24, 24.6; length of hind foot, 23, 23.8; longest length of claw, 10, 10; length of forearm, 62, 60; length of thumb, 12.2, 12.6; length of claw of thumb, 2.4, 3; length of second finger, 62, 60; length of third finger, 120, 120; length of fourth finger, 93, 91; length of fifth finger, 88, 85; length of ear from meatus, 24.6, 25; length of ear from crown, 20.4, 19; width of ear, 16, 16; and length of tragus, 11.8, 11 (Miller, 1906). The range in skull measurements (mm) for 10 specimens of *M. vivesi* are as follows: greatest length of skull, 21.6–22.0; length of condylobasilar, 20.4–21.0; zygomatic breadth, 14.0–14.6; width of interorbital constriction, 5.2–6.0; breadth of braincase, 10.0–10.8; occipital breadth, 7.0–7.6; length of mandible, 16.2–17.4; length of maxillary toothrow, 9.0–9.4; maxillary breadth, 8.8–9.2; and length of mandibular tooth row, 9.6–10.2 (Miller and Allen, 1928).

DISTRIBUTION. This species, primarily an island dweller, is found on many major and minor islands in the Gulf of California (Fig. 3). Coastal populations from Sonora, Mexico, are from the vicinity of Isla San Jorge and Isla Alcatraz, Bahia Kino south to Bahia de San Carlos (Baker and Patton, 1967; Cockrum and Bradshaw, 1963). Coastal populations apparently are rare (Maya, 1968): all coastal records are in Sonora, Mexico, near islands that contained permanent colonies. Along the east coast of Baja California, populations occur between Isla Encantada in the north and Punta Coyote, near Bahia Rosario, in the south (Patten and Findley, 1970; Reeder and Norris, 1954). A small population is known on the west coast of Baja California, in the vicinity of Bahia de Sebastian Viscano, and along Punta Eugenia (Reeder and Norris, 1954). Other islands from Baja California with known populations of *M. vivesi* include Islote Cabo de Haro, Candeleros Islands, Isla Peruano, La Ventana Island, Isla Media, Isla Raza, Islote Blanco, Islote Leon, Verrado Island, Alcatraz Island, San Esteban, Tiburon Island, San Lorenzo Island, Isla Salsipuedes, Raza Island, Pond Island, Bahia de Los Angeles, Pescadora Island, Animas Bay Island, Partida Island, San Marcos Island, Santa Inez Island, San Ildefonzo, Carmen Island, Danzante Island, San Pedro Nolasco, San Jorge Island, Angel de la Guardia, Islas Encantadas, Isla Granito, and Isla Cayo (Maya, 1968; Reeder and Norris, 1954). No fossils are known.

FORM AND FUNCTION. The shoulder morphology of *M. vivesi* is similar to that of other species of *Myotis* and other genera of vespertilionids. However, the scapula is relatively wide and the humerus and clavicle are relatively long. The shoulder musculature is similar to that of other species of *Myotis* with the following exceptions: the origins of the latissimus dorsi and teres major muscles are less extensive in *M. vivesi* than in *M. lucifugus*. Both muscles are humeral pronators and flexors and are important during the upstroke of the wing beat cycle (Strickler, 1978; Vaughan, 1959).

FIG. 1. Male *Myotis vivesi* from Isla Partida, Baja California, Mexico. Photograph courtesy of David S. Lee.

The origin of the spinodeltoid is more extensive than in other vespertilionids. The hind limb of *M. vivesi* is generally similar to that of other *Myotis* (Blood, 1987), but the hind feet are relatively larger in *M. vivesi*, averaging 33% of head and body length, as compared with 20.7% in *M. adversus* and 18.1% in *M. californicus*. *Noctilio leporinus*, another fish-eating bat, possesses hind feet which average 37% of the head and body length (Blood, 1987).

Elongated feet and laterally-compressed toes were hypothesized as adaptations to decrease drag when the bat rakes its feet through the water while it captures prey (Blood, 1987). The feet of *M. vivesi* are highly specialized for drag reduction, presenting a streamlined profile to the flow of water as they move through water. The toes of *M. vivesi* in cross section are pointed anteriorly and rounded posteriorly, and they have a fineness ratio nearly twice that of nonfishing bats and a forebody thickness ratio 77% lower than that of nonfishing bats. These two ratios essentially describe the toe as an elongated and pointed tear drop. This design reduces spray drag incurred at the water-air interface (Fish et al., 1991). Additionally, *M. vivesi* displays the greatest lateral compression of toes among the species of bats investigated by Fish et al. (1991).

In *M. vivesi*, a fringe of long silky hairs extends beyond the trailing edge of the uropatagium. The function of these hairs is currently unknown. Blood (1987) speculated that they may perform a proprioceptor or sensory function. In addition, Maya (1968) reported finding small crustaceans pinned to anteriorly directed, short, stiff hairs on the ventral surface of the uropatagium.

Myotis vivesi uses its uropatagium to capture prey, as was first hypothesized by Reeder and Norris (1954) and photographed by Altenbach (1989). *M. vivesi* fishes with a different technique than that used by *N. leporinus* (Altenbach, 1989; Bloedel, 1955).

Myotis vivesi possesses a wing with a high aspect ratio in which the wing tip is relatively elongated and rounded (Blood, 1987; Norberg and Rayner, 1987). This wing shape is characteristic of bats which fly in open uncluttered environments (Norberg and Rayner, 1987). The plagiopatagium is specialized so that the hind limbs are essentially free of the wing membrane (Blood, 1987; Miller and Allen, 1928). Energetically, this wing design gives *M. vivesi* relatively low flight power and low cost of transport (Norberg and Rayner, 1987).

The kidneys of *M. vivesi* possess a single renal papilla which extends deeply into the calyx of the ureter. The renal cortex is thin, whereas the medulla is thick. The loop of Henle is relatively long and extends into the renal papilla. The overall microstructure of the kidney in *M. vivesi* closely resembles that of *Dipodomys merriami* (Braun, 1965). The kidneys of *M. vivesi* are able to concentrate salt in urine to levels as high as 615 milliequivalents of chloride ion per liter (Carpenter, 1968). This level of salt concentration allows *M. vivesi* the potential to use sea water as a water source (Carpenter, 1968). The salt concentrating ability of *M. vivesi* allows it to consume marine crustaceans, as the wet mass of marine crustaceans averages 75% sea water. The kidneys are able to concentrate urea up to a level of 1.62 molar. Evaporative water loss from torpid *M. vivesi* is small but doubles with every 10°C rise in ambient temperature. Loss of water ranges from 0.8 mg g^{-1} h^{-1} at an ambient of 10°C to 3.2 mg g^{-1} h^{-1} at an ambient temperature of

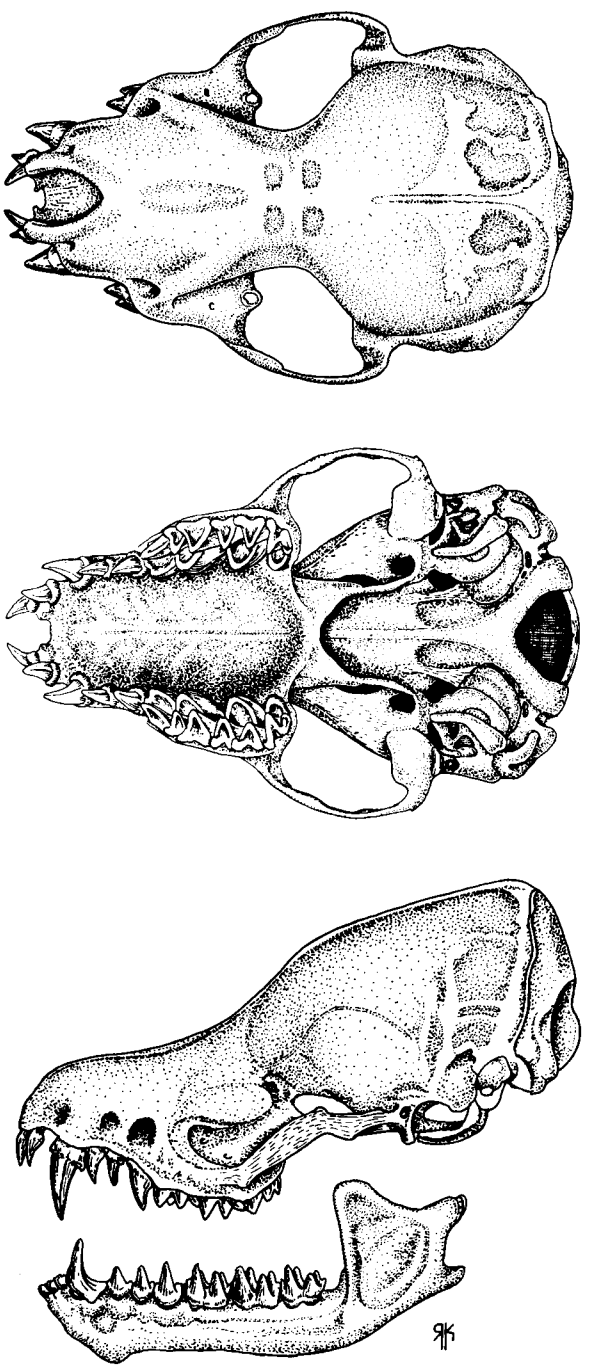

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Myotis vivesi* from Isla Partida, Baja California, Mexico (North Carolina State Museum, Raleigh, North Carolina 5942). Illustration by Renaldo Kuhler.

30°C. Evaporative rates of water loss for active bats are as high as 14 mg g^{-1} h^{-1} at ambient temperatures of 25°C (Carpenter, 1968).

The typical *Myotis* baculum is saddle-shaped, the dorsal tip is expanded into a bulb or knob, and the ventral surface of the baculum possesses spurs at the proximal end. However, the baculum of *M. vivesi* is not saddle-shaped, and the distal tip is not knob-shaped but tapers to a flattened, slightly elevated tip. The baculum of *M. vivesi* also lacks the ventral spurs on the proximal margin. Only *M. grisescens* has a bacular morphology approaching that of *M. vivesi* (Hamilton, 1949).

The deciduous dental formula of *M. vivesi* varies: i, 0/1 or 2/2 or 3/3; c, 1/1; p, 3/3, total 18–28. Incisors are trifid in shape, whereas C1 and P3 are simple or spoon-shaped and slightly re-

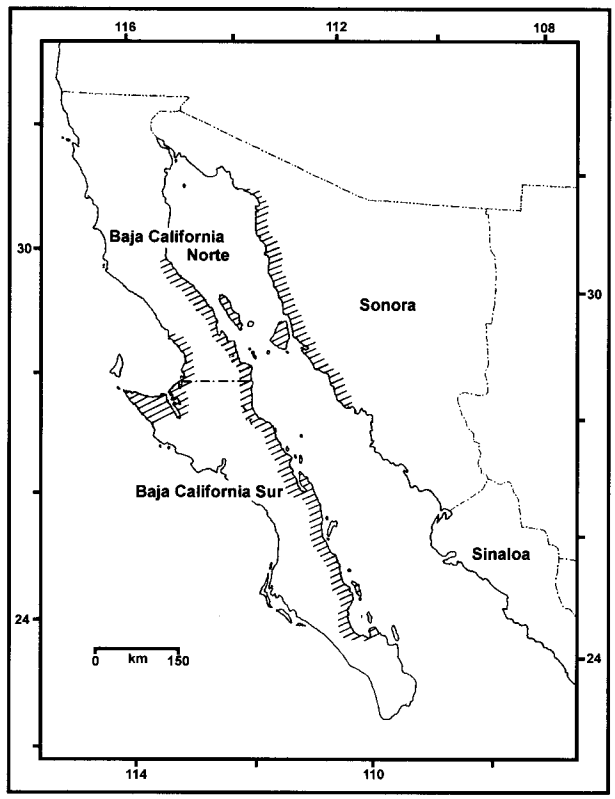

FIG. 3. Distribution of *Myotis vivesi* in Baja California and Sonora, Mexico.

curved. The c1 and the p3 are heavily recurved and form a distinctive posterointernal notch. Both P4 and p4 are nearly cuspidate in form (Reeder, 1953).

The wings of *M. vivesi* possess hemopoietic nodules, which are unique among *Myotis* (Miller, 1907). These nodules were first described as glandular masses by Miller (1907). However, Quay and Reeder (1954) found these masses to contain extravasated blood and hemopoietic tissue. The nodules are located on the dorsal surface only. Within the wing, they occur at intersections of elastic fiber and skeletal muscle bundles. These nodules are distributed over the basal portion of the uropatagium and over all the wing except the propatagium. The distribution of nodules is not consistent among individuals nor between wings of a single bat. Of the wings examined, 96% had nodules located in the plagiopatagium near the midpoint of the ulna and 63% had nodules located on the plagiopatagium close to the body. These nodules were not sexually dimorphic either in distribution or presence (Quay and Reeder, 1954). Nodules vary in size from 5 by 1 mm to 15 by 16 mm. The largest ones reported occurred in the wing region nearest the midpoint of the ulna and were oblong in shape, with their long axis parallel to bands of skeletal muscle or elastic fibers (Quay and Reeder, 1954).

Ruptured blood vessels are the cause of the masses in *M. vivesi*. Quay and Reeder (1954) observed broken endothelial walls within the nodules, indicating that hemorrhages did not result from diapedesis. The affected region of the dorsal epidermis displays an eroded appearance, but it heals with horizontal bundles of collagenous fibers. Areas surrounding the affected region display epithelial cell hypertrophy and hyperplasia. The presence of cells characteristic of the inflammatory process also was noted. According to Quay and Reeder (1954:443) "it is clear that the hemorrhages did not result from injuries sustained at the time of capture or death or from post mortem changes."

The ventral surface of the wing and the unaffected portions of the dorsal surface possess a stratum corneum and stratum germanitivum that are only one or two cells thick. Four factors may be involved in the formation of these nodules: secondary to diet these bats maintain a slight vitamin C deficiency (which causes capillary fragility); the stresses placed on the capillaries at the intersections of the muscle and elastic fiber bundles are very great; there are high back pressures in the venous capillaries of the region; and vessels engorge during excessive heating (Quay and Reeder, 1954). In *M. vivesi*, erythrocytes have a typical mammalian morphology. The average diameter is 4.6 μm, whereas erythrocytes in other species of *Myotis* average >6 μm (Quay and Reeder, 1954).

ONTOGENY AND REPRODUCTION. Testicular size in *M. vivesi* from Islote Blanco, Baja California, is smallest in January and increases slightly from February to June; descended testes occur in late June; testes size increases rapidly from June until October, when maximum size occurs. Mature spermatozoa are found in males from the latter part of July through September. Cross sections of testicular tissue reveal dividing primary spermatocytes in June and degenerating spermatozoa in October (Maya, 1968).

Gestation in *M. vivesi* is 55–65 days (Maya, 1968). A collection of 27 females examined by Reeder and Norris (1954) contained only one embryo each, with lengths of 10–35 mm. Mean embryonic length, determined by Maya (1968) from a collection of 11 females from Isolte Blanco, Baja California, is 5.0 ± 0.07 mm in March, 19.2 ± 1.8 mm in April, and 34.1 ± 2.5 mm in May.

Females from Baja California give birth to a single young between the second week of May and the first week of June. Peak parturition was 21–29 May in 1963. Parturition was observed on three occasions. A female gave birth within one hour after capture on 16 May to an infant 75 mm long and weighing 6.6 g. Two other newborns, males, had masses of 5.9 and 6.2 g and measured 71 and 75 mm long, respectively. The eyes of the young were closed at birth and opened within three days.

Of 29 adult female *M. vivesi* examined from Isla Partida, Baja California, 25 of the females had a single young attached to one of two pectoral teats (Burt, 1932). Females with a single young attached to a pectoral teat were observed in June (Walker, 1950). Young remain attached to a teat for the first three weeks after birth. Infants have been observed resting on their mother's back in the day roost. Females have not been observed carrying young while out feeding. Young apparently do not leave the roost until capable of flight (Maya, 1968).

Mass of *M. vivesi* quadruples and length doubles in about 50 days. Young bats first fly at ca. 50 days of age. Lactation continues even after the young bats start to fly. Nine young banded in the day roost and then captured at the night roost during the first week of July had only milk in their stomachs and had dry uropatagia. Most young bats entered the night roost with wet uropatagia the following week, but still had only milk in their stomachs (Maya, 1968).

There is some evidence that the sexes partially segregate after the mating season (Burt, 1932). Small maternity groups of two, three, and five are formed by some females, with eight the largest number of females found within a single crevice. Males often are found isolated during the maternity season (Maya, 1968).

On Isla Partida, Baja California, 252 individuals were tagged during the peak of parturition. The ratio of males to females on Isla Partida was 91:161 (Maya, 1968). The ratio of males to females for 40 individuals on Isolte Blanco, Baja California, was 23:17 (Maya, 1968). However, a sex ratio of nearly 1:1 was found in a collection made by D. R. Dickey (Burt, 1932).

ECOLOGY AND BEHAVIOR. The most utilized habitat of *M. vivesi* is interstices in rock slides, but only a few small islands contain large rock slides (Maya, 1968; Reeder and Norris, 1954). Caves and crevices are also used regularly (Maya, 1968; Walker, 1950). When disturbed, *M. vivesi* will seek shelter in a wide variety of places. *M. vivesi* has been found under flat stones just above the high tide mark and under turtle shells not exposed to direct sun (Walker, 1950).

The presence of predators, population pressure, temperature, and relative inclination of roost all are factors that influence the presence or absence of *M. vivesi* at any locality. Rock arrangements and crevice openings that will not allow predators to enter are preferred. The largest crevice roost was ca. 17 m high, 7 m deep and varied in width from 7.5 cm to 1.3 m. Crevices usually house only a single individual. The largest number of *M. vivesi* found under a single rock was 13 in a crevice 1 m high, 0.5 m deep, and 2.5–10 cm wide. The minimal distance tolerated between the roost site and the roost opening was 7.5 cm; most were 10 cm or more. Rock slides on Tiburon Island and Isla Partida, Baja California, contained large numbers of day roosts although no *M. vivesi* were

found. This distribution was attributed to the large numbers of rats which actively hunt the rock slides (Maya, 1968).

The least petrel *(Halocyptera microsoma)* and the black petrel *(Oceanodrama melania)* also make their nests in talus interstices and often occupy the same roosts as *M. vivesi* or adjoining roosts. Nesting and hatching of petrels overlaps with the parturition and rearing of young of *M. vivesi.* Burt (1932) stated that Dickey found bats only in close association with petrels. Maya (1968) found a ratio of bat to least petrel to black petrel of 3:3:1. Roost sharing seems to occur when other suitable roosts are occupied. *M. vivesi* apparently discourages the presence of large lizards which frequently prey upon petrel eggs (Maya, 1968).

Myotis vivesi leaves roosts to forage as the petrels return to roost for the night. Their initial foraging flight probably is related to the activity patterns of their avian predators, which are active until night fall. Bats leave the roost to feed at dusk, and most roosts were abandoned within 15 minutes. Bats return to the day roost before dawn. Those bats using the same roost both day and night returned initially within 40 minutes after leaving at dusk and often left and returned several times during the night. Typically, bats fly directly from day roosts to feeding areas at sea and rarely stop to visit the night roost (Maya, 1968).

Noting the modifications in morphology and the overall resemblance to *Noctilio leporinus,* Miller and Allen (1928) postulated that *M. vivesi* also ate fish. Piscivory was confirmed when finely chewed fish was found in the stomachs of two bats captured near Isla Partida, Baja California (Burt, 1932). Later, it was hypothesized that *M. vivesi* fed on surface swimming crustaceans (Walker, 1950); this was confirmed by Reeder and Norris (1954), who examined stomach contents of three individuals from Puerto Refugio and Angel de la Guarda Island and found two were empty and one contained insect remains.

Crustaceans comprise the major food for *M. vivesi,* but at any one time these bats may eat either fish or crustaceans. Bats sampled for analysis of food habits were captured in roosts in July 1963, January 1966, and May 1966. Twelve stomachs contained >95% crustacean remains, two contained 25–35% fish and the rest shrimp, two contained algae, one was empty, and one half-full stomach contained both fish and crustaceans (Maya, 1968).

Myotis vivesi produces brick-red or black-colored guano. Dark red pellets contain decapod chitin and black pellets, fish scales, and some bone (Bloedel, 1955; Maya, 1968). Maya (1968) classified guano of *M. vivesi* into four types based on color: red droppings containing only crustacean exoskeletons; black, primarily fish scales and bones; green, mostly algae; and brown, insect remains. Few mixed pellets have been found, but the guano shows a food bias in favor of crustaceans (Bloedel, 1955; Maya; 1968).

At Isla Partida, most prey items captured by *M. vivesi* were small and consumed in flight, but some larger prey items are taken and eaten in the roost. A complete *Sardivops cacrulea,* 8 cm long with a mass of 6.5 g, was found in a roost at Isla Partida. A shrimp, 5 cm long, that was being pursued by *M. vivesi* was captured by Maya (1968). In the vicinity of Guamas, Sonora, Mexico, identifiable remains recovered in roosts were herrings, *Lile stolifera* and *Ophisthonema liboleta*; other fish remains present were not indentifiable (Maya, 1968). Length of prey items ranged from 1 to 3.5 cm. The heads of all fish remains found in roosts were missing (Maya, 1968).

Flight behavior of *M. vivesi* was observed while about two dozen bats circled under a floodlight suspended on a ship. The bats dipped their tails into the water for several seconds at irregular intervals. One bat was seen flying with a small fish in its hind feet. At Puerto San Bartolome, Baja California, their feeding posture was described as resembling an ovipositing dragonfly (Reeder and Norris, 1954). Bats left V-shaped ripples as they flew over the water, which were hypothesized to be made by their chins (Walker, 1950). At Isla Partida they flew just above the surface of the water, beginning in a straight line, then in rapid lateral zig zags. Flight altitude appeared to be related to prey size, with larger prey requiring higher altitudes. Active pursuit of a single prey item was noted when a bat was seen hovering above and actually pursuing a shrimp (Maya, 1968). Both the uropatagium and tail apparently are important in prey capture, as the lower two-thirds of the uropatagium frequently is wet and has fish-scales on it (Altenbach, 1989; Gudger, 1945; Maya, 1968; Reeder and Norris, 1954).

Myotis vivesi chatters when circling before capturing prey or while gaining altitude after a catch. As *M. vivesi* approaches the water surface preparing for a capture, its call changes from a series of short bursts to a higher-pitched rapid and eventually inaudible call (Maya, 1968). Echolocation calls produced by *M. vivesi* consist of a steep descending frequency-modulated sweep from 45 to 20 kHz, ca. 3 ms in length, with a second harmonic. Mean repetition rates are 10–20 calls/s at a distance of ca. 2 m from the target (Suthers, 1967). A series of test flights between wires of 0.51 and 0.21 mm diameter revealed that *M. vivesi* detected the wires well before overlap of pulse echoes. *M. vivesi* detected the 0.51-mm wires at a distance of 110 cm and the 0.21-mm wires at a distance of 70 cm and began to decrease pulse intervals well before the first overlap of pulse echoes occurred (Suthers, 1967).

On Isla Rasa the remains of *M. vivesi* in barn owl *(Tyto alba)* pellets represented 37.6% of the prey in 40 pellets (Velarde and Medellin, 1981). On islands with few or no other mammals, *M. vivesi* constituted ca. 25% of the diet of barn owls (Maya, 1968). *M. vivesi* remains also were found in owl pellets on Isla Partida (Burt, 1932). Other predators of *M. vivesi* include the loggerhead shrike *(Lanius ludovicianus),* ring-billed gull *(Larus delawarensis),* western gull *(Larus occidentalis),* common raven *(Corvus corax),* duck hawk *(Falco peregrinus)* and osprey *(Pandion heliaetus*—Villa-R., 1979).

Shrikes and western gulls have been observed inspecting crevices, presumably for bats, whereas other birds are opportunistic. When bats are exposed in day roosts they are reluctant to fly away and usually scramble for a deeper crevice. Most *M. vivesi* exposed during the day successfully avoid predation by birds by immediately taking shelter in nearby crevices (Maya, 1968).

Snakes may be predators of *M. vivesi,* but there is no direct evidence. Norway rats *(Rattus norvegicus)* have never been observed killing bats in the wild; however a Norway rat killed a specimen of *M. vivesi* while the bat was held in a collection sack (Maya, 1968). *M. vivesi* is not found in ground roosts on islands where rats occur (Maya, 1968). An adult *M. vivesi* taken 29 April 1954 on Isla Blanco near Guyamas, Sonora, Mexico, survived in captivity until 9 July 1963 (Orr, 1965).

Intestinal endoparasites found in one *M. vivesi* consisted of three female roundworms of the genus *Trichuris* (family Trichinellidae—Patten and Findley, 1970). Several ectoparasites are known to occur on *M. vivesi*: *Spinturnix mexicanus* (Acarina, Spinturnicidae); *Steatomyssus leptus* protonymph (Acarina, Macroryssidae); *Ornithodoros* (Acarina, Argassidae—Patten and Findley, 1970); *Whartonia sonorensis* and *Trombicula thompsoni* (Acarina, Trombiculidae); and *Basilia pizonychus* (Diptera, Nycterbiidae—Brennan, 1966; Cooley and Kohls, 1940; Hoffman, 1960; Loomis and Webb, 1969; Scott, 1939). *M. vivesi* possesses several species-specific ectoparasites: *Whartonia sonorensis, Speleocola cortezi,* and *Basilia pizonychus* (Acarina, Trombiculuidae; Patten and Findley, 1970).

GENETICS. *Myotis vivesi* has 2N = 44 and FN = 50. This karyotype is the same as reported for the other species of *Myotis.* The autosomes consist of three large and one small pair of metacentrics and a graded series of 17 pairs of medium-to-small acrocentric chromosomes. The X chromosome is a medium submetacentric and the Y is a small submetacentric (Baker and Patton, 1967).

REMARKS. The generic name *Myotis* is derived from Greek *mus,* mouse, and *otos,* ear. The specific name *vivesi* is derived from Latin *vivo,* to live or be alive. Following Baker and Patton (1967), most recent accounts consider this species to belong to the genus *Myotis.* The systematic relationship of *M. vivesi* within the genus *Myotis* has not been settled. *M. vivesi* is considered by some authors to belong to a monotypic genus, *Pizonyx,* with its closest affinity to *Myotis* (Hill and Smith, 1984; Maya, 1968; Miller, 1906; Miller and Allen, 1928; Norberg and Rayner, 1987; Tate, 1941, 1942). Findley (1972) placed *M. vivesi* in the large-footed subgenus *Leiiconoe,* whereas Blood (1987) considered *M. vivesi* best placed in the monotypic subgenus *Pizonyx.*

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Editors of this account were ELAINE ANDERSON, LESLIE N. CARRAWAY, KARL F. KOOPMAN, AND DUKE S. ROGERS. Managing editor was BARBARA H. BLAKE.

B. R. BLOOD, SAPPHOS ENVIRONMENTAL, P. O. BOX 50241, PASADENA, CALIFORNIA 91115; MARY K. CLARK, DEPT. OF MAMMALS, NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES, RALEIGH, NORTH CAROLINA 27626.