Reprinted from JOURNAL OF MAMMALOGY
Vol. 15, No. 2, May, 1934, pp. 89-99

NOTES ON THE LITTLE BULLDOG BAT, DIRIAS ALBIVENTER MINOR (OSGOOD), IN PANAMA

BY LAWRENCE H. DUNN

During the past thirty-two months I have obtained specimens of the little bulldog bat, *Dirias albiventer minor*, in Panama on five occasions.

In the literature at hand I have found records of only a few specimens of this bat, taken in northern South America. Osgood (1) described the species from a specimen collected at Encontrados, Venezuela, by Dearborn in 1908, and the same writer (2) records two more specimens taken at El Panorama in western Venezuela in 1910. Only two specimens seem to have been previously reported from Panama. Both of these were taken near Empire, Canal Zone, by Goldman (3) in 1912, one shot while in flight with several others at dusk, and the other captured when it flew into living quarters during the evening.

The first specimen seen by me was an adult male that was captured in the grounds of the Panama Hospital in the city of Panama on March 17, 1931. The gardener at the hospital noticed this bat hanging in the dense foliage of a mango tree at about 10 a.m., and after knocking it from the tree with a stick brought it to me. It was injured so badly that it died the following day.

My next specimens were obtained at Summit, Canal Zone. Having been informed that there were many bats present in a house at Summit, I visited this place on September 20, 1932, in company with Mr. James E. Jacob and one assistant.

The building was a large, two-story, wooden tenement house in which a number of Panamanian and West Indian laborers lived with their families. The bath room on the second floor of this house was about ten feet distant from the main part of the building but was connected with the veranda of the main structure by a roofed bridge-like passageway screened on the sides, as was the rest of the house. This arrangement left the attic of the main part of the house separate from that over the bath rooms. The latter attic was

about twelve feet square and four and a half feet high at the center, and sloping on the four sides.

It was in this small attic over the bath rooms that the bats were roosting. They could easily be located by the strong odor of their excrement and by the musky smell of the animals themselves that pervaded the air, as well as by the protesting squeaks they emitted when the rays of our electric flash lights were turned on them. A momentary illumination with our lights revealed their presence in considerable numbers.

By squeezing through a small hole we were able to enter the attic. There were some bats present on each of the four sloping sides of the roof but the greater number were congregated near the eaves in the south-east corner where they were hanging in masses on the rafters and other timbers. This part of the attic in which they were located was too low for a net to be used, which made it necessary for one of us to lie flat and wriggle over the ceiling joists to get within arm's length of the bats and pick them from their hanging places with gloved hands. I tried this first and succeeded in getting in a position where I could collect a few, but owing to the close quarters I was unable to reach the large masses. Since the first few captured, when examined by the rays of the flashlights, appeared to be specimens of *Dirias* and *Molossus*, I was desirous of securing a good number of them. My assistant next crawled under the lower slope of the roof and being of slim build he was able to reach the large masses and collect them by the handfuls. As he grasped a number of the bats in his gloved hand he passed them over his back to where I could reach them and pass them on to the cage which was held by Mr. Jacob, who operated the door of the cage and also held the light directed on our activities. On one occasion my assistant caught fifteen of the bats in one grasp with one hand and later took eight in another handful. Some were caught by a wing or a leg only but this usually sufficed to hold them, since they did not struggle very vigorously to escape. They were ready and powerful biters, however, and frequently it was necessary to jerk our gloves loose from their strong canine teeth to prevent them from piercing the leather. In removing them from the rafters or in passing them to each other in handfuls some were dropped and these shuffled over the boards to seek a hiding place. Only a short time was required to collect as many specimens as was desired and this was fortunate since the heat in the attic was intense. The tropical sun shining on the galvanized iron roof of the attic undoubtedly produced a terrific heat during the middle of the day, yet the bats were hanging very close to the metal roofing and some of them must have been practically in contact with it.

The boards forming the ceiling of the bathrooms were the only flooring of the attic and these were nearly everywhere covered with from two to eight inches of bat excrement. In the southeast corner, where most of the bats were hanging, the guano was practically even with the top edges of the eight

inch ceiling joists. In this area the guano was decidedly moist, probably from the urine of the bats, and it gave off a strong stench. The amount of excrement present would indicate that the attic had been inhabited by the bats for a considerable time. Hundreds of cockroaches and large black beetles were present in this guano.

During the collecting of these bats, many of those that were nearest the eaves of the attic crawled out beneath the roofing and took flight. An observer who counted those leaving the east side of the roof noted 138 leaving during the first few minutes.

On returning to the laboratory and examining our catch we found that we had 123 *Dirias albiventer minor* and 30 *Molossus coibensis*. It was thus evident that these two species live in the closest of companionship.

Of 123 *Dirias*, 39 were males and 84 were females. The teats of a number of the females were large and dark colored and had the appearance of having been lactating at a comparatively recent period. Although there were no noticeably immature specimens in the group it is probable that some of them were young adults. Since the males and females were hanging together in masses in the attic it is clear that with this species the males do not always roost apart from the females.

Fifty of these *Dirias* were disposed of by placing each in a glass jar, where it was chloroformed. This was done to obtain their ectoparasites and to prepare the specimens for our collection. The other 73 were placed in four cages to be kept alive for observation.

There were two color phases. Twelve were a bright russet color on the dorsum while the others were mainly dark brown, with a few showing areas of lighter brown about their shoulders. The ventral surface also showed as much, if not more, variation in color than the dorsal surface and ranged from tan to bright yellowish brown and on to buffy white, with areas of bright orange on the sides below the axillae. The "narrow, whitish median streak from the interscapular region backward," mentioned by Osgood in his description of this species was present in nearly all of those of the darker phase but was lacking in most of the lighter colored specimens.

The light colored individuals, both males and females, were separated from the darker ones and placed in a cage by themselves. This was done to observe any changes that might occur that would help to explain the cause of the two color phases. The possibility of sexual activity having an effect on the color was considered but no evidence was obtained that would indicate this in any way. Unfortunately, none of these bats remained alive in captivity long enough for any salient observations along these lines to be made. Measurements of examples of both phases showed no marked differences, and skulls from individuals of each color agreed closely with each other.

The *Dirias* gave off the most offensive odor of any bat that I have yet observed. It was a strong odor of musk that was decidedly disagreeable

and when a number of them were confined in a room with closed windows, this smell was almost nauseating. After I had handled a number of dead specimens and had rubbed their hair in search of ectoparasites an odor was left on my hands that remained for nearly three days, despite vigorous washing and applications to remove it. Goodwin (4), in writing of a somewhat similar odor that he noted on *Noctilio leporinus mastivus*, a relative of *Dirias*, states: "I noted that the musky odor of *Noctilio* taken at Botany Bay, though strong, was not objectionable, although a specimen taken at Vega Baja, Porto Rico, in February, had a very offensive smell which seemed to cling to my hands for days." It appeared to me that the odor present on the *Dirias* was much more pronounced in the males than in the females. In both sexes the axillae were rather deep and bare and what seemed to be a very small, pocket-like depression extending between the skin and the alar membrane beneath each axilla was noted. This depression and the skin and hair surrounding it were usually coated with a yellowish, greasy substance that appeared to be of about the same consistency as a thick oil. This substance had a very strong odor and it may have been the source of the musky odor emitted by these bats. No glands opening into these sub-axillary pockets could be detected by gross examination but minute ones may have been present to secrete this oily substance.

An interesting formation of the scrotum present in this species has not been observed in any other bat and may be worthy of mention. The scrotum of a male with the testes withdrawn into the perineum is bare, small and inconspicuous. Upon closer examination, however, a wrinkled, slit-like fold of skin extending nearly vertically across either side of the scrotum may be detected. When a testicle is protruded into the scrotum the outer side of this fold moves back to form a crescent shaped ridge about the outer lateral side of the scrotum. The edge of this ridge bears a row of small, but conspicuous, cylindrical protuberances that appear as a crescent-shaped row of minute, elongated warts extending about the outer edge of either side of the scrotum. When a testicle is protruded the skin forming the front of the scrotum within this crescent shaped ridge appears very thin and has more the appearance of a serous membrane than of a true epidermis. When a testicle is withdrawn into the perineum this thin portion of the scrotum is drawn within the latter like an inverted pouch. The crescent-shaped outer ridge studded with the tiny warts is drawn together in a pucker as the opening of a tobacco sack may be closed and the small warts are folded inside and practically are hidden from view. To some extent this outer fold resembles an eyelid in formation and action. This formation when open may be viewed only in living bats that apparently are rutting. The sack-like recess on either side of the scrotum was always found to be closed at the death of the bat. The testes of a freshly killed bat may be protruded by pressure and a piece of thread tied about the scrotum behind them holds them in position, with the fold of skin open to allow for its examination.

At the laboratory these bats were confined in cages about 20 inches square, with the four sides and the top made of wire netting of one-half inch mesh. About 20 bats were placed in each cage. Nearly all of those in each cage gathered to hang in a compact mass from the top of the cage and they usually selected a corner of the cage as a site from which to hang. Thus crowded together, each bat hung head downward and crowded against its fellows from the wire screen at the top of the cage by either one or both feet. When not on the alert their long, pointed ears were folded backward and somewhat outwardly. The bats apparently were but little disturbed by the presence of humans and did not raise their heads to gaze at any one walking about the cages as some other species of bats do. They remained practically motionless during the day and showed what seems to be the sleep of bats more than any other species that I have observed in captivity.

Various foods were offered them, but without much success. Some few seemed to eat nearly any kind of food that was given them for two or three nights, while others did not. It was apparent from the amounts eaten each night that all, or even the greater number of them, never confined themselves to any one particular kind of food. Various fruits, such as orange, banana, papaya, etc., as well as milk, blood, blood clot, Hamburg steak, hard-boiled eggs, and pieces of small fish were offered to them in an effort to determine what diet would suffice them under laboratory conditions. A little of nearly each kind of food offered was eaten but not in amounts to denote that they relished it. Frequently in the early evening, before it really became dusk, individuals might be seen scrambling down the side of the cage to feed. When eating Hamburg steak it was noted that a smacking sound accompanied their vigorous chewing. Cockroaches and moths were placed in the cages but were never eaten, although *Dirias* undoubtedly is normally insectivorous, since the samples of guano taken from the attic were found to be composed almost entirely of minute fragments of insect chitin. These fragments were too small for classification other than to determine that pieces of the elytra of beetles formed a considerable part of the guano.

That these bats digested their food very rapidly was evident. Observations along this line were made on several occasions when a change of food, such as hard-boiled eggs, that could be easily distinguished in the feces, was given. Egg eaten after 5 p.m. could be detected in the excrement in the cage when observed at 8 a.m. the following morning. This would indicate that at least some of their food is digested and excreted within fifteen hours.

After the first few days in captivity the bats began to die off. Each day a few were found dead in the cages, some lying on the floor of the cages while others frequently were found to be dead but still suspended from the top of the cage and hanging only by the curved nails of their toes. Only three of these bats survived thirty-one days in captivity. The last survivor lived thirty-eight days.

It was noted during the collecting of these bats that although they scrambled about on all fours (feet and wrists) none of them made any attempt to fly within the attic. Later while they were in the cages in the laboratory a number of individuals were seen to apparently lose their footholds on the top of the cage through overcrowding and they would then fall to the floor of the cage and land with a distinct "plop." There did not seem to be any attempt made to use their wings to break the fall. This aroused my suspicion that these bats were unable to rise from the ground or take to flight from a low elevation and were thus similar in flight habits to the California mastiff bat (*Eumops californicus*), as observed by Howell (5), who in writing on this subject states, "The probable explanation for this is that unusually active individuals, or those which for some reason are in an unusually active condition, can take wing from low situations, but that the majority, especially during the cooler parts of the year, need to gain momentum by taking a long dive, before flying."

A few trials to test the ability of the *Dirias* to start flight from a low elevation were undertaken. The first few of these trials were conducted in a room in the laboratory. This room was about 20 feet long by 14 feet wide and with the ceiling about 15 feet from the floor. The walls were finished in white and the floor was of light colored tiles. Six windows admitted plenty of light.

When placed on the floor of this room the bats either remained entirely motionless or slowly shuffled about in search of something upon which they could climb with a backward crawl. Gently pushing them about on the floor resulted in some slight acceleration of their crawling movements but did not cause them to make any attempt at flight. Several that were placed on a table and gently pushed over the edge, one at a time, fell to the floor as limp as old gloves.

A number of them were thrown in the air nearly to the ceiling and only three made the slightest effort to save themselves from falling and striking the floor with considerable force. One that had been thrown up several times opened its wings on one occasion and glided down to cling to the leg of a table. Two others partly extended their wings and made a few slight motions to cause a falling leaf movement on the way down to ease their landing. During the first of these flight observations in this room, several of the bats were killed by their falls on the floor. A net was later used to break their fall and prevent them from striking the floor. If one of the bats was taken by the end of a wing and thrown rather forcibly in the air it would slap against the ceiling with some force. Other tests made out of doors during the daytime gave somewhat similar results. The bats remained motionless when placed on the ground and if pushed slightly they clung to the grass and evinced no desire to move. If held loosely in a gloved hand at arm's length over my head they clung to the glove and attempted to crawl about to reach the side of the glove that would provide the most shade. If tossed in the air to a height of less than about fifteen feet they fell back to the ground as though

lifeless. When thrown to a greater height they usually fluttered their wings to glide and wheel to either return to the ground or reach the side of a nearby building or fence to which they hung for a few seconds before falling to the ground. None was noted to make any efforts toward an upward flight.

While I was discussing with Mr. Jacob, who had assisted in the collecting of these bats, regarding their refusal or apparent inability to fly during the trials I had made, he suggested the possibility of their being so confused by handling and exposure to light that they were reluctant to take flight. Acting upon this suggestion I took one of the bats out of doors at early dusk and placed it on a concrete platform in the laboratory yard. It immediately crawled to a nearby wall and began its backward ascension. On being taken from the wall and placed on the grass of the lawn, it remained still for about twenty seconds when, on being touched with my finger, it gave a spring that covered about two linear feet of space and then immediately took flight. It flew in a slow, low flight about three or four feet above the ground until it reached a concrete wall about six feet high about seventy-five feet away from the starting place. The bat ascended and soared over the wall and then continued in a straight, gradually ascending, slow flight until it disappeared from view.

A second bat was then placed on the concrete platform and like the previous one, it crawled a few feet to the side of a building and began crawling up the wall. On being returned to the concrete again it began jumping and fluttering its wings and covering a distance of from six to thirty inches at each jump. It was then removed to the lawn and as soon as placed on the grass it immediately took wing without any preliminary efforts and flew for a distance of about 150 feet before it ascended more than six feet above the ground. It then soared higher and entered some trees.

Several more of these bats were tested out of doors at dusk and later, and all took flight from the lawn without any apparent difficulty. Four others were tested out on the concrete. Two flew after several preliminary springs. One continued jumping until it reached the grass before taking off and the other jumped to the edge of the concrete and began flight from there. The last one to be tested was taken out of doors shortly after a rain while the sky was still cloudy and very dull. When placed on the concrete platform it gave a spring and then flew for several yards at a height of not more than eighteen inches above the floor and circled enough to strike with some force against the side of the building and fall to the ground. When again placed at the starting point it practically repeated the performance except that this time it bumped into the building several times before falling. The third time it also circled and brushed against the side of the building for about twelve feet and then turned and flew in rather an erratic flight between the laboratory and a nearby building. It zigzagged back and forth until it finally reached a tree where it took refuge among the foliage.

After observing these tests I am of the opinion that the failure of these bats

to take flight readily was not on account of any physical inability but because of an inhibition due to the animal's very poor vision in bright light and also possibly to some confusion produced by being exposed to light. These bats have small eyes that are somewhat deep seated, with rather thick, fleshy lids. Since some of those tested seemed to have more difficulty in taking flight from the concrete than from the grass it would appear that either the cushion formed by the latter helped them to take off better or the darker color of the grass gave less reflection than the lighter colored concrete and thus aided their vision and possibly lessened their confusion.

A desire for possible further observations on the flight habits of these bats led to my obtaining this species for the third time. A few days after making the collection in the house at Summit I was informed that a second building about one hundred yards distant from the large tenement house was also inhabited by bats. This was a low, one-story, frame structure about fifteen feet square. The roof was of corrugated iron with a low ridge and the eaves were not more than ten feet from the ground. This building had been unoccupied for several years. On October 7, 1932, Mr. Jacob, Gabriel Wade and I visited this building to ascertain if such a low structure was inhabited by *Dirias*. A small panel in the gable was removed and this left an aperture large enough for Wade to squirm through and enter the low attic. There were only a comparatively few bats present at this time and only seven specimens were collected. These were all adult males of *Dirias albiventer minor*. Four of these were taken in the attic and three were captured outside as they were escaping from the eaves. Several that eluded us and flew among some nearby trees demonstrated that they could crawl through very small apertures and were able to take flight as soon as they emerged at the eaves of the roof.

While at Summit on this occasion we also visited the tenement house again to view the other colony of this species. The bats were not nearly so numerous in the attic above the bath rooms as on our former visit. We estimated that there were not more than 100, at the most, present at this time. Their behavior, however, differed considerably from what we had noted on the previous occasion. They now appeared to be very wary and seemed to show much more fear. Upon our entering the attic the greater number of them began crawling into hiding places in a way they had not done before. Many of them entered the wide crevices between the hip rafters and the corrugated roof, and other hiding places, from which we were unable to remove them without difficulty. After some time and effort we succeeded in collecting twelve *Dirias*, three males and nine females. It would appear that our first visit had not only caused the members of this colony to fear man but had also driven many of them to seek a new place to roost.

On February 7, 1933, specimens of this species were obtained for the fourth time. These were two adult females that were shot while they were skimming about over the surface of the Chucunaque River in the Darien Province of

Panama. Dr. Paul W. Wilson, Lieut. Commander, U. S. Navy, and Mr. Charles E. Martin, Chief Pharmacist Mate, U. S. Navy, while descending this river in a canoe at dusk on the evening of October 15, 1932, noted a great many bats flying about in a small area above the surface of the water. This was at a point a short distance above the mouth of the Tuquesa River. They were impressed with the number and coloration of these bats and informed me of what they had observed. Later they very kindly made a second visit to this area in order that I might accompany them and, if possible, secure specimens of these bats. After traveling about 35 miles above Yavisa, on the Chucunaque River, in a pirogue driven by an outboard motor, we reached what we considered to be the site of the previous appearance of the bats. Apparently we erred somewhat in the location and ascended the river about a mile too far. Here we waited from early twilight until late dusk without seeing any bats. Soon after we had started to return down the river we encountered a large number of them. They were circling about and flying back and forth over the water and dipping down to the surface apparently to sip water each time they passed in either direction. Although there was but little light remaining the good marksmanship of Mr. Martin resulted in wounding two of the bats and causing them to fall in the water where we were able to capture them. We then noticed a dead, bleached trunk of a tree about sixty feet in height, devoid of all limbs and broken off at the top, standing like a tall white pillar a few yards back from the bank of the river. Two large holes were visible in the side of this trunk and apparently another was at the top. So many bats flying about in so small an area over the river and so near the dead tree led us to suspect that the tree was their roosting place.

The last lot of *Dirias* obtained consisted of 115 specimens collected in the attic of a house at Las Cascadas, Canal Zone. This house was a large, two-story, wooden structure that had been unoccupied for several months. The bats were massed together behind several cross rafters in a corner of the attic near the eaves. There must have been several hundred of them in this corner and we collected them by the handfuls as in the attic at Summit. They were either unafraid of us or so confused by our lights that they did not make many efforts to escape. A few climbed along the rafters and attempted to hide and a number of those nearest the eaves crawled beneath the corrugated roofing and took flight.

The presence of these bats in the attic was readily perceptible, upon our entering it, by the characteristic strong odor. A mass of wet guano beneath the hanging bats had accumulated until it formed a mound more than ten inches deep.

On leaving the house we noticed a number of the bats flying about in circles above an open space in front of the building. They evidently had not sought another hiding place and were not flying higher than the eaves of the house. As we appeared on the ground near them they flew back to the end of

the building and presumably returned to their roosting place in the corner of the attic.

Of the bats collected, 72 were females and 43 were males. All appeared to be adults and it is believed that they consisted of old individuals and younger ones that had only recently matured. Thirty-eight of the females had large, dark colored teats with the appearance of having nursed young. The remainder of the females had teats so small that apparently they had never given birth to young. Sixteen of the females, eight of those believed to be the older individuals and eight of the younger ones, were killed and examined for fetuses but none were found. It is hoped that more extensive observations may result in obtaining more information regarding the breeding habits of this species.

The bats of this lot were of much more sombre colors than those taken at Summit. The dorsal colors varied from dull brown to a lighter and more glossy seal brown. The light, median dorsal stripe was present on practically all of them. Many had a sprinkling of fine silvery white, or brown and silvery white, hairs on the dorsum that gave somewhat of a frosty appearance. One old female was a light tan color on the dorsum and this was the only bright colored one in the lot.

SUMMARY

During a period of less than three years specimens of *Dirias albiventer minor* were obtained from five sources in Panama. Finding them in large numbers in the attics of houses demonstrates that they are not solitary in habits. The presence of a number of them at considerable distance from a human habitation indicates that they are not confined to attics or buildings but may also roost in hollow trees or some other natural situations.

A very strong and offensive odor is given off by this species.

A peculiar formation in the skin of the scrotum of the males was noted.

This species apparently is insectivorous. A diet consisting of various kinds of food supplied to them in captivity seemed unsatisfactory and no individual of this species survived longer than thirty-eight days under laboratory conditions.

Although it was at first considered that this species was unable to take flight from a low elevation this was later found to be an error and the hesitancy in taking wing seems probably due to poor vision in the day and an aversion to light.

REFERENCES

(1) Osgood, W. H. 1910. Mammals from the coast and islands of northern South America. Field Mus. Nat. Hist., Zool. Ser. Publ. 149, vol. 10, no. 4, pp. 30–32.

(2) Osgood, W. H. 1912. Mammals from western Venezuela and eastern Colombia. Field Mus. Nat. Hist. Zool. Ser. Publ. 155, vol. 10, no. 5, pp. 62–63.

(3) Goldman, E. A. 1920. Mammals of Panama. Smithsonian Misc. Coll. vol. 69, no. 5, pp. 177–178.
(4) Goodwin, G. G. 1928. Observations on Noctilio. Journ. Mamm. vol. 9, no. 2, p. 106.
(5) Howell, A. B. 1920. Contribution to the life-history of the California mastiff bat. Journ. Mamm., vol. 1, no. 3, p. 112.

Gorgas Memorial Laboratory, Panama, R. de P.