GROWTH AND DEVELOPMENT OF THE PLAIN CHACHALACA IN SOUTH TEXAS

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Growth and development of many game birds have received thorough investigation, but this is not true for the Plain Chachalaca (*Ortalis vetula*). I studied growth and development of chachalacas as part of a larger study (Marion 1974) of the ecology of this species in Texas.

METHODS

Research was conducted from January 1971 to August 1972 at Santa Ana National Wildlife Refuge, and 3 other study areas in the Lower Rio Grande Valley, Hidalgo and Starr counties, Texas. Data reported in this paper were obtained from captive birds, live-trapped birds, and collected specimens.

Captive chachalacas were reared in 2 weld-wire pens at Santa Ana National Wildlife Refuge headquarters. An attempt was made to keep the pens as natural as possible; they included several small trees and additional plant materials which provided cover, shade, and sites for perching and nesting. One pen (4.6 × 3.0 × 2.4 m) contained 3 adult birds (1♂, 2♀♀). Another slightly larger pen (6.1 × 7.2 × 2.4 m) contained 7–9 immature birds (2–3♀♀, remainder♂♂). Captive juveniles were hatched in an incubator from eggs collected from 4 nests during 1971. Fresh water and commercial foods were provided ad libitum. Captive birds were fed commercial starter, grower, and maintenance rations, corresponding to stage of maturation. Natural foods were frequently provided to supplement commercial foods.

Chachalacas were live-trapped at the main study area in 25 × 50 mm mesh weld-wire traps (1.2 × 1.2 × 0.6 m) with funnel entrances similar to those described by Taber and Cowan (1963:261). Twelve traps were operated at randomly selected sites during late winter and early spring of both years of this study. Traps were baited with fresh cabbage and grain sorghum placed within the enclosure and near the funnel entrances. To avoid excessive stress on handled birds due to overheating, trapping was restricted to the cool morning and evening hours. Trapped birds were marked with aluminum bands and colored leg streamers for subsequent individual field recognition.

Chachalaca specimens were shot in a nonselective manner on all study areas between September 1971 and August 1972. Many birds were collected in the morning and evening when they were more active; fewer were collected at midday. Data from carcasses of chachalacas found dead during this study also were recorded.

There is no obvious sexual dimorphism in this species, but all birds handled were sexed using at least 1 of 4 known methods. Two of these methods, convenient for sexing live birds, were related to the presence or absence of a looped trachea. The adult male has a trachea lengthened by a loop which is easily felt between ventral musculature of the breast and the skin; this looped structure is lacking in young males and females (Merrill 1878). During this study, inspection of gonads of sacrificed birds verified this sexual difference in tracheal development of adult birds. Determination of the presence or absence of the tracheal loop by feeling the breast was the major technique used in sexing older juveniles and adults.

Generally the longer and wider the trachea, the deeper the bird's voice; the shorter and narrower the trachea, the higher the voice. Adult males have a longer trachea and their voice is a full octave lower than that of females and young males (Sutton 1951:127). The pitch of the voice was a second method used in sex determination when live birds were heard calling.

Chachalaca males have a penis which can be readily observed by cloacal examination, but this technique was rarely used because it required more handling of birds than the previously described tracheal loop method. All collected specimens were sexed by examination of the gonads.

Definitive aging criteria for chachalacas have apparently not been reported. I recorded tracheal loop lengths, measured externally from the distal portion of the loop to the point of entry into the thorax, for use as aging criteria for male birds. Total length and diameter (at each end and near the middle) of the trachea of all collected specimens were measured to determine sex and age differences. Vernier calipers, permitting readings to the nearest 0.1 mm, were used in measuring tracheal diameters.

Postal scales were used to measure total body weight to the nearest 0.5 ounce. These data were later converted to equivalent values in grams. Several standard length measurements for birds, including total body, wing chord, tail, exposed culmen, tarsus (tarsometatarsus), middle toe, and total extent of wings, as described by Baldwin et al. (1931) and Pettingill (1946:323–325), were taken to the nearest 1 mm using a pair of dividers and a ruler. These measurements were recorded for captive (at intervals of 1 month or less), live-trapped, and collected birds. Plumages and molt patterns of all handled birds also were examined.

RESULTS AND DISCUSSION

I live-trapped, color-marked, and released 222 chachalacas (144 in 1971, 78 in 1972). Ten of the marked birds from 1971 were recaptured in 1972. An additional 64 chachalacas (32 in each year) were sacrificed at the 4 study areas, with the majority from Santa Ana National Wildlife Refuge.

Sex and age determination.—Tracheal development in chachalacas was successfully used to determine sexual differences and to distinguish juvenile from adult males. Measurements of total tracheal length could not be taken externally and were all obtained from sacrificed birds. The mean total length of the trachea for 48 sacrificed adult males was 329.8 ± 20.6 mm (range 245–385 mm), more than twice the average tracheal length for 23 sacrificed adult females (141.7 ± 10.3 mm, range 121–168 mm). Measurements of maximum diameter of the trachea, taken near each end and at the middle, also showed sexual differences. Mean tracheal diameters were significantly larger for adult males than for adult females at the anterior (upper) end ($t = 3.5$, $P < 0.01$), near the middle ($t = 4.5$, $P < 0.01$), and at the posterior (lower) end ($t = 3.5$, $P < 0.01$).

The tracheal loop began to develop in juvenile males at about 8 weeks of age and was easily felt on the anterior breast at 10 weeks. Tracheal loop lengths were measured either internally or externally; the former measurement required that birds be sacrificed, whereas, the latter was used without

harming living birds. Length of the tracheal loop was measured by both methods from the distal end of the loop to the point of entry into the thorax. For comparison, loops of 19 collected adult males were measured using both techniques. Mean external measurements were slightly larger than mean internal measurements (73.0 ± 3.6 mm and 70.4 ± 4.6 mm, respectively). These differences, however, were not significant ($t = 1.9$, $P > 0.05$).

External tracheal loop measurements were recorded for male chachalacas. Mean loop length of captive juveniles was 17.5 ± 7.1 mm (range 13–23) at 9 weeks of age ($N = 2$) and 30.0 ± 7.2 mm (range 34–38 mm) at 10 weeks of age ($N = 3$). The tracheal loop of captive juveniles elongated slower than other body parts; measurements began overlapping those of adults when young males were approximately 9 months old (Fig. 1).

Tracheal loop development was apparently slower in wild juveniles than in captive juveniles. Mean loop lengths for wild juveniles handled during February ($N = 9$) and March 1972 ($N = 4$) were 51.2 ± 4.4 mm (range 46–60 mm) and 54.1 ± 3.5 mm (range 49–57 mm), respectively. The average loop lengths of 5 captive juveniles in February and March were 62.1 ± 4.3 mm (range 58–67 mm) and 64.8 ± 2.4 mm (range 63–68 mm), respectively. These measurements for captive juveniles were significantly larger than those for wild juveniles in February ($t = 4.4$, $P < 0.01$) and in March ($t = 5.5$, $P < 0.01$). Several variables, all related to the exact age of wild (unknown age) vs. captive (known age) juveniles, may be responsible for this difference but the major cause remains unknown.

These data generally indicate that wild juveniles may be distinguished from adults using tracheal loop lengths until at least 9 months of age. By 1 year, tracheal loop development was nearly complete and differences among males were subtle. Further increases in tracheal loop length as males aged were apparently minor. Four banded males, known to be more than 5 years old, had an average loop length of 78.0 ± 3.1 mm (range 75–82 mm). This mean value, although slightly larger than the average loop length of 44 other adult males (74.2 ± 4.4 mm, range 67–87 mm), was not significantly larger ($t = 1.7$, $P > 0.05$).

Significance of color of the upper mandible was investigated as an indicator of age. Presence or absence of a dark tip on the upper mandible was recorded for 17 juvenile males (tracheal loop partially developed) and 17 adult males (tracheal loop well developed) handled between December 1971 and March 1972. Upper mandibles of all 17 juvenile males had dark tips. Only 2 of 17 (11.8%) adult males had dark-tipped upper mandibles. The remaining 15 (88.2%) had uniformly colored (blue horn) bills. These results indicate that dark markings near the tip of the upper mandible are characteristic of juvenile birds.

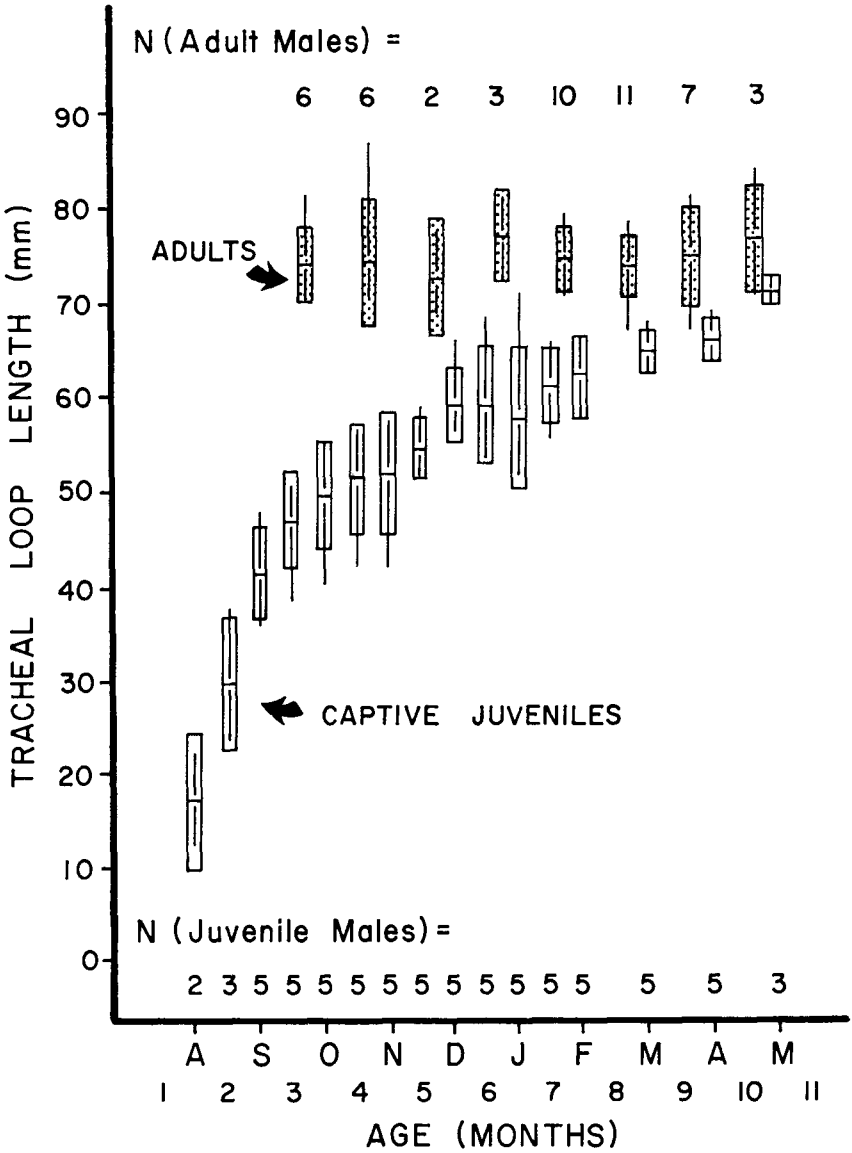

FIG. 1. Tracheal loop lengths of wild adult and captive juvenile chachalacas. External measurements were taken and data presented are means (± SD) and ranges.

Strength of the lower mandible varies with age in many gallinaceous birds. Generally, if a dead bird is supported only by the lower mandible and it breaks, the bird is a juvenile; if the lower mandible does not break, it is an adult (Leopold 1933:166, Taber 1963:134). Lower mandible strength was determined for males of known age (by tracheal loop development) collected between December 1971 and March 1972. When subjected to the "lower mandible test," all 4 juvenile males had mandibles that broke. Each of the 10 adults tested had a lower mandible that supported the bird's weight. Strength of the lower mandible seems to be a valid technique for distinguishing juvenile and adult chachalacas.

Males of known age (determined by tracheal loop development) handled between December 1971 and March 1972 were used to investigate leg color differences between juveniles and adults. Of 18 juveniles, 8 (44.4%) had legs that were slightly orange. The others had darker (blue horn) legs. Of 22 adults, only 2 (9.1%) had slightly orange legs. A significant ($P < 0.05$) chi square value of 6.6 indicates that orange legs are more typical for juveniles than for adults.

Age determination in gallinaceous birds commonly involves plumage characteristics (Taber 1963:128), however, plumage differences between juvenile and adult chachalacas diminish rapidly as young birds mature. At 2 or 3 months of age, slight differences exist in width and shape of flight feathers. Rectrices and remiges of juveniles are relatively narrow and pointed, while those of adults are broad and rounded. Most of these plumage differences are lost with the postjuvenal molt before the juveniles are 6 months old. The outermost juvenal rectrices and primaries, however, may be retained slightly longer.

Growth.—Chachalaca chicks are precocial and leave the nest within a few hours after hatching. Chicks are very active and agile in climbing through trees and shrubs within a few days of hatching and are able to jump and fly at least 1.3 m at 6 days of age.

Weights and measurements of wild adults (males and females) and captive juveniles (1 week and 1 month old) are presented in Table 1. Adult males averaged significantly ($P < 0.01$) larger than adult females in weight, total length, wingspan or extent, wing chord, tail length, exposed culmen length, tarsus length, and middle toe length. Although statistical comparisons of mean values indicate that adult males average larger than adult females, much overlap exists in the ranges of these measurements. These overlapping values reflect subtle sexual differences in size which are not easily recognized in the field.

Mean adult weights were highest during October and November (631 ± 87 g and 646 ± 97 g, respectively), but were relatively constant during other

TABLE 1

WEIGHTS AND MEASUREMENTS OF ADULT, WEEK-OLD, AND MONTH-OLD CHACHALACAS[1]

Age (N)	Weight (g)	Total Length (mm)	Extent (mm)	Wing Chord (mm)	Tail Length (mm)	Exposed Culmen (mm)	Tarsus (mm)	Middle Toe (mm)
Adult Males (106)	584 ± 58 (468–794)	566 ± 24 (502–610)	628 ± 25 (559–669)	210 ± 7 (191–229)	244 ± 10 (210–267)	23.3 ± 2.1 (19.0–27.5)	59.3 ± 4.2 (51.0–69.5)	48.6 ± 2.2 (41.5–51.0)
Adult Females (102)	542 ± 52 (439–709)	536 ± 24 (476–591)	596 ± 27 (534–648)	200 ± 7 (184–216)	235 ± 13 (176–261)	21.7 ± 2.1 (19.0–26.0)	56.6 ± 3.5 (51.0–65.5)	47.0 ± 2.4 (40.5–51.0)
One week (10)	53 ± 8 (40–65)	145 ± 14 (121–165)	216 ± 18 (191–245)	71 ± 6 (63–80)	17 ± 6 (7–26)	12.5 ± 1.8 (9.0–14.5)	23.8 ± 1.5 (22.0–26.0)	25.5 ± 1.3 (23.0–27.0)
One month (9)	149 ± 30 (96–196)	274 ± 32 (232–337)	370 ± 43 (312–438)	123 ± 8 (111–139)	99 ± 12 (79–106)	16.0 ± 1.1 (14.0–17.5)	32.9 ± 3.3 (25.0–36.0)	33.0 ± 2.4 (29.0–36.5)

[1] Data shown are mean ± SD and (range).

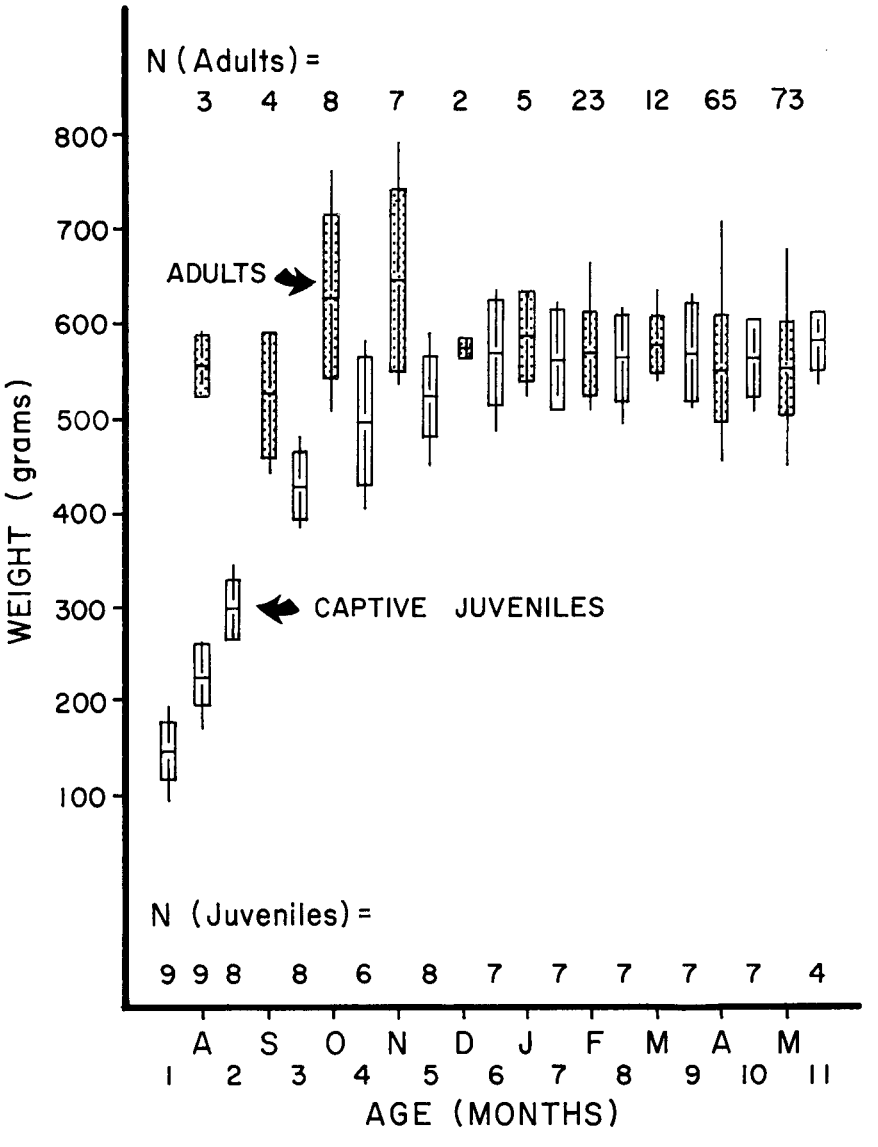

FIG. 2. Weights of wild adults and captive juvenile chachalacas. Data presented are monthly means (± SD) and ranges.

months (Fig. 2). An abundance of natural foods following floods in the fall of 1971 and heavy fat deposition may account for the increased adult weights during October and November. In addition, 11 of the 15 adults measured during these 2 months were males and this may have also contributed to the increase in recorded weights. Average weights of captive juveniles increased rapidly and, at 4 or 5 months of age, approached the 550–600 g level of adults (Fig. 2). Similarly, but at only 3 or 4 months of age, captive juveniles approached adult size in total length, extent or wingspan, wing chord, and lengths of the tail, exposed culmen, tarsus and middle toe. Growth rates for wild juveniles may be slightly slower than this due to the disproportionate sex ratio among the captive juveniles favoring the males (and thus, larger size).

Plumages and molting.—Rectrices begin to develop at less than 1 week of age and grow rapidly. Initial rectrices are uniformly colored and rather narrow with pointed tips which are easily worn and broken. Remiges (except for the outer 3 primaries) are well developed at hatching and continue rapid development for several weeks after hatching.

At approximately 1 month of age, juvenal plumage begins to replace natal plumage and juvenile birds begin to resemble adults. Body feathers of the head and neck region are the last to be replaced by drab olive plumage characteristic of adults. The juvenal plumage stage in this species is relatively short. Juvenile chachalacas replace rectrices and remiges during the postjuvenal molt. Postjuvenal molting of rectrices in captive juveniles occurred between August and December, when the birds were 2–6 months old. Postjuvenal molting began with intermediate pairs (Nos. 3 and 4) in each half of the tail and proceeded both inward and outward until all pairs were replaced. Pair No. 3 was usually replaced slightly before pair No. 4, but both pairs were replaced in late August when juveniles were 2 months old. Replacement of pairs 2 and 5 occurred in late September when the birds were 3 months old. Rectrices 1 and 6 were molted over a longer interval; the central pair (No. 1) was replaced between September and December and the outer pair (No. 6) was replaced between September and January.

Observations of wild juveniles handled during spring banding operations indicated that outer rectrices are occasionally retained until March. These older rectrices are easily recognized since they lack white tips and are obviously old and worn. Following the postjuvenal molt, rectrices of young birds were white-tipped and both remiges and rectrices were relatively broad with rounded tips (as in adults).

After the breeding season each year, feathers are replaced during the postnuptial molt. This molting is gradual and flight is not inhibited. Postnuptial molting of rectrices began as captive juveniles approached 1 year of age and

the sequence was extremely irregular compared to the postjuvenal molt which followed a definite sequence (3-4-2-5-1-6). Postnuptial molting of adult rectrices was also irregular, with no obvious pattern or sequence. Most rectrices of adults were molted during August and September, but this occurred as early as May and as late as December.

Molting of primaries was sequential (proximal to distal) for both juvenile and adult birds. Molting observations for remiges of captive juveniles were not recorded prior to the age of 4 months. In the first year, captive juveniles replaced the outer 2 primaries (IX and X) during the postjuvenal molt. In most gallinaceous birds, except Ring-Necked Pheasants (*Phasianus colchicus*), the 2 outer primaries are not replaced during postjuvenal molting (Taber 1963:134).

Captive juveniles began the postnuptial molting of proximal (I and II) primaries in February, 2 months prior to adults and this continued until all distal primaries were replaced in the late summer and fall. Postnuptial molting of adult primaries occurred in an ascending pattern similar to that described for juveniles. Replacement of proximal (I and II) adult primaries began in April and continued until all distal primaries were replaced in the fall. The majority of primary molting in adults occurred during August and September.

Molting of secondary wing feathers was not as distinctly sequential as in primary wing feathers. Secondaries of captive juveniles were molted during all months of year and postjuvenal molt was not clearly distinguishable from the postnuptial molt. Likewise, postnuptial molting of secondaries in adults followed no definite pattern, but most were being replaced during August and September.

SUMMARY

Plain Chachalaca growth and development were investigated in 1971 and 1972 in the Lower Rio Grande Valley of Texas. Chachalaca chicks are precocial and growth and development of juveniles is rapid. At 4 or 5 months of age, juveniles resemble adults and field recognition of differences becomes difficult. Size measurements are valid age criteria only during the summer and fall when juveniles are less than 4 or 5 months old. Differences in tracheal loop development (males), molting of outer primaries and rectrices, color and strength of bills and color of legs are valid criteria for distinguishing juveniles from adults.

Plumage changes also occur rapidly; postjuvenal molting begins in early fall when juveniles are nearly 2 months old. Postjuvenal molting of rectrices follows a definite sequence of pairs (from innermost to outermost) and is usually completed before January of the first year. Juvenal primaries are also molted sequentially from the innermost to the outermost. Postjuvenal molting of secondaries is not distinctly sequential.

Adult rectrices are molted in an irregular pattern during the postnuptial molt (August and September). Adult primaries are molted in a sequential pattern (innermost to outermost), but postnuptial molting of adult secondaries follows no definite pattern.

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LITERATURE CITED

BALDWIN, S. P., H. C. OBERHOLSER, AND L. G. WORLEY. 1931. Measurements of birds. Cleveland Mus. Nat. Hist. Sci. Publ., Vol. II, Cleveland, Ohio.

LEOPOLD, A. 1933. Game management. Charles Scribner's Sons, New York.

MARION, W. R. 1974. Ecology of the Plain Chachalaca in the Lower Rio Grande Valley of Texas. Ph.D. thesis, Texas A&M Univ., College Station.

MERRILL, J. C. 1878. Notes on the ornithology of Southern Texas, being a list of birds observed in the vicinity of Fort Brown, Texas, from February 1876 to June 1878. Proc. U.S. Natl. Mus., Vol. I, pp. 118–173.

PETTINGILL, O. S., JR. 1946. A laboratory and field manual of ornithology. Burgess Publ. Co., Minneapolis, Minnesota.

SUTTON, G. M. 1951. Mexican birds: first impressions. Univ. Oklahoma Press, Norman.

TABER, R. D. 1963. Criteria of sex and age. Pp. 119–189, *in* Wildlife Investigational Techniques. (H. S. Mosby, ed.) 2nd ed. The Wildlife Society, Washington, D. C.

——— AND I. MCT. COWAN. 1963. Capturing and marking wild animals. Pp. 250–283, *in* Wildlife Investigational Techniques. (H. S. Mosby, ed.) 2nd ed. The Wildlife Society, Washington, D. C.

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