REVIEW OF LITERATURE

DEER CAPTURE, MARKING, MOVEMENT, AND CENSUS

submitted by

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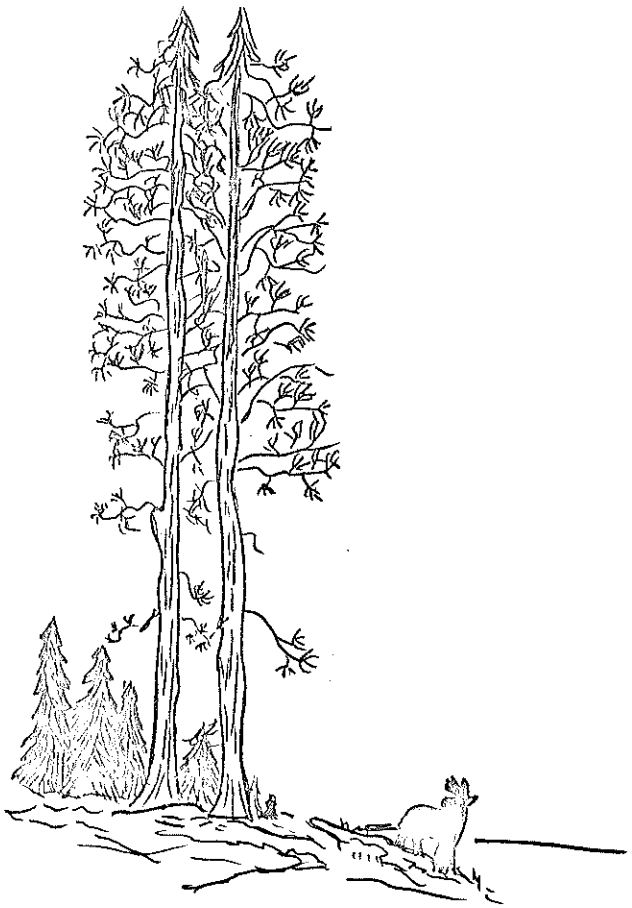

IOWA CONSERVATION COMMISSION
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-Review of Literature-

Deer Capture, Marking, Movement, and Census

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INTRODUCTION

Deer were present in pristine Iowa and early settlers utilized them to the fullest extent. Hunting pressure, habitat changes brought about by the creation of an agricultural empire, and a series of extremely hard winters combined to essentially extirpate the white-tail deer from Iowa prior to the turn of the century. The escape of two captive herds, the Cuppy herd in Pottawattamie County and the Singmaster herd in Washington County, as well as the ingress of deer from Minnesota and Wisconsin furnished the stock from which Iowa's present deer population evolved (Madson, 1953).

Early management of Iowa's deer included live-trapping and restocking deer in many parts of Iowa. Speaker (1953) stated that by 1940, deer were well established along many of the principal waterways of the state. In fact, Leopold, et al. (1947) designated 4 areas in Iowa as having deer problems.

The deer stocking program was successful and in 1947, when the first population estimates were made, deer were found in 88 of Iowa's 99 counties, with the total population estimated to be 1,650 animals. By 1950 deer were found in all but 4 counties, with the population estimated to be 4,530 animals. In 1953 the deer population was placed at 12,982.

With the successful re-establishment of a deer population, problems evolved which were concerned primarily with agricultural depredations by the deer. As a consequence, the General Assembly of Iowa empowered the State Conservation Commission to declare open seasons to control the size of the Iowa deer herd. The first open deer season was held in December 1953, and seasons have been

held each year since that time.

Population estimates are made annually in February or early March, at a time when hunting and other decimating factors should have reduced the Iowa herd to its minimum number. These estimates are made by Conservation Officers who are asked to estimate, to the best of their ability, the number of deer in each county of their respective territories.

McCutchen (1938) found that estimates of deer populations were generally ultra-conservative when compared with actual counts. I strongly suspect that estimates of our Iowa deer population range from conservative to ultra-conservative. In Iowa, where 97 percent of the land is privately owned, the only management we can apply to the Iowa herd is harvest control. This is accomplished, to a degree, by limiting the number of deer permits and length of the seasons. Much of our management, therefore, is by necessity based on the population estimates received from the Conservation Officers. If the estimates are low this is reflected in fewer permits and a shorter season, with the subsequent loss of recreation, waste of one of our renewable natural resources, and lowered revenues because of reduced license sales.

With the above in mind, a research project was originated so we could demonstrate the number of deer which can inhabit a sample of nearly typical Iowa deer habitat. The end result will be an attempt to enable Conservation Officers to make more accurate deer estimates so we can improve our harvest management as well as to learn more concerning the habits of an animal whose management is entrusted to us.

DEER CAPTURE

Deer are captured alive for research purposes by two primary methods: (1) use of various types of traps and (2) use of drugs as paralyzing agents. The use of traps to capture game is age-old and the techniques are generally quite

well developed. Capture by drugs, while used by certain primitive tribes, is relatively new and its use as a tool in wildlife research is just now beginning to emerge.

Traps

Traps which have been used to live-trap big game range from permanent, immobile structures to highly portable units. Corral traps are permanent structures and are usually used in situations where deer are numerous and where the trapping operation extends over a long period. Dixon and Sumner (1939) used mass, or corral traps, in addition to the Pisgah-type trap to capture deer for removal at Zion Canyon, Utah.

Thomas and Allred (1943), in a Wyoming study involving capture and translocation of mule deer, used a corral-type trap built of 10-ft. x 7.5-ft. wooden panels. Woven wire wings were added and deer were driven into the trap. Over 200 antelope and deer were taken using this device. Plans and specifications for the corral-type trap used by the above authors are included in their paper.

Most traps used to live-trap big game animals are nothing more than extensions and modifications of the smaller, more familiar box traps used in small mammal studies. Many would have to be called portable; however, the ease with which this is accomplished varies tremendously because of the relatively large size of some.

Ruff (1938) gave plans for the Pisgah portable deer trap as used in an effort to trap deer for removal from the Pisgah National Game Preserve, North Carolina. The Pisgah trap is large, 4 ft. wide x 16.5 ft. long x 8.75 ft. tall, and as such is difficult to move.

The Pisgah trap consists of two sections: A wire cage where the bait is kept and into which the deer feeds, and a wooden portion into which the deer bolts when the gate to the wire portion is tripped. The wooden portion has its

own trip mechanism which drops the gates when the deer enters it. When the gates are down, it is quite dark and the trapped animal quiets down.

Ray Hart (pers. comm.), game biologist for the South Dakota Dept., stated they were using the Pisgah trap in an area where they are carrying on a long-range tagging study. He further stated that the main draw-back to this type of trap is that it is large and difficult to move.

The Michigan Dept. of Conservation developed the widely used Stephenson deer trap in the early 1930's. Webb (1943) used this trap, but made some modifications in the trigger mechanism because the conventional mechanism malfunctioned under snow and rain conditions. A photo which appeared in the Iowa Conservationist under an article by Leaverton (1953) showed a Stephenson-type deer trap which was used to remove surplus deer from the Ledges State Park herd in Iowa about 1936-1940.

While the Stephenson trap is classified as portable, it is large, with dimensions as follows: 12.0 ft. long, 4.3 ft. wide, and over 8 ft. tall. This trap, as was the Pisgah trap, was designed for use in areas of heavy deer concentrations and was not intended to be highly portable.

The Colorado Dept. of Game and Fish developed a trap which looks like a miniature Stephenson for use in their tagging studies (Gilbert, P.,1952). This trap, constructed of wood, is quite portable. According to notes taken from lectures delivered by Prof. Douglas L. Gilbert (1957), in a game management techniques course at Colorado State University, Colorado has further modified their trap by using just one door, placing a sliding door in the side, and putting a floor in it.

Clover (1954) described a collapsable deer trap which consisted of a pipe framework covered with netting. A catch net could be used with this trap when handling the trapped animals. At the time of the writing, the author said 115 deer had been trapped with only one deer lost. The Clover trap is highly portable.

The Clover trap was modified into a single-gate trap with one gate (Clover, 1956). This trap, when constructed of proper materials, is highly portable. One criticism, however, is that the trapped animals are in the light and become very excited when the trap is approached (Gilbert, 1957).

McCormack (1958), working in Idaho, used the earlier model Clover trap, but modified it as follows: (1) only one gate, (2) replaced rat trap with a 1½ steel trap in trigger mechanism because the rat trap was too sensitive and could be set off by wind or a deer bumping the trap, (3) left a portion of the net off at bottom so rabbits could escape without chewing the net, and (4) a 1½-inch pipe was wired transversly across bottom of trap to replace guy wires used by Clover. This last modification was done to make the trap more flexible so excited deer would be less likely to harm themselves, or damage the trap.

One of the most novel, and apparently successful, traps was described by Ashcraft and Reese (1957). As stated by the authors, such factors as portability, adaptability, safety, cost, and simplicity of operation are very important features for traps used in studies involving live-trapping deer; their answer to these problems was the "Improved Deer Snare".

The "Improved Deer Snare" consists essentially of ropes which form the snare and which are tied to rubber bands made of inner tube strips. When the snare is tripped, the rubber bands throw the ropes up around the animal's legs and constant but gentle pressure is applied to hold the ensnared animal. This snare can also be modified for use in treeless areas.

Ashcraft (1961) reported the successful capture of 115 deer in 77 nights using the deer snare. This was a California study to observe movements of a migratory deer herd.

Baits

When any of the conventional box-type traps are used to capture deer, it is necessary to use baits to lure the quarry into the trap. The finest of equipment is useless unless the animals will enter the trap. In areas where choice food is readily available, traps may not be successful because the animal won't come to the bait. Alternate methods of capturing deer will then have to be employed.

Ruff (1938) said that a good bait must consist of a palatable forage to which the animal is accustomed or be similar enough to a palatable food item that the animal will recognize it as edible.

McCormack (1958) used alfalfa hay and 20 percent protein stock pellets as pre-bait to attract deer into the trap vicinity in his Idaho study. After the deer were attracted to the trap site, only a handful of pellets was needed near and in the trap to get the deer into the trap. Dixon and Sumner (1939), working in Utah, used alfalfa, apples, cake salt, and rolled oats as baits, but found the best single bait was alfalfa.

Progulske and Baskett (1958), in a Missouri study, used ear corn and stock salt to bait their modified Stephenson-type traps.

Drugs

Possibilities involving live capture of deer by use of immobilizing or paralytic drugs received great impetus with the publication of the work of Crockford, et al. (1957). This group, working in Georgia, published on the results of research which involved a search for a drug which could be used to safely and successfully capture deer, and for an efficient means of delivering the drug.

Crockford, et al. (1957) tested many drugs and eventually narrowed the search to nicotine salicylate, which best met their nine essential characteristics of a drug to be used in capturing deer. The characteristics the ideal drug must possess are:

> "...(a) effective dose not to exceed the quantity that can be carried on an appropriate-sized dart; (b) stability; (c) rapid absorption into the systemic circulation; (d) rapid onset of action resulting in sufficient immobilization of the subject; (e) a wide margin of safety (3 X minimum); (f) no antidote required; (g) rapid elimination from circulatory system; (h) no drastic effect on gestation; and (i) no permanent damage to animal."

Hall, et al. (1953) reported on the successful use of Flaxedil, a synthetic curare-like compound, as a paralytic drug for deer. Crockford, et al. (1957), however, reported that curare alkaloids and synthetic curare-like compounds had too many undesirable characteristics for use in immobilizing deer. Post (1959) did, however, use Flaxedil on elk with success, but he cautioned that researchers using curare drugs must be able to judge animal weight quite accurately because such drugs are very potent. Apparently the curare drugs do not possess a wide margin of safety.

Use of succinylcholine chloride to capture large mammals was reported by Buechner, et al. (1960a) and by Craighead et al. (1960). Buechner, et al. (1960a) found that this drug, whose trade name is Anectine, was far superior to the nicotine alkaloids as a paralyzing drug. These authors stated that once recumbent, animals were quickly immobilized without the struggles, tremors, or violent convulsions which are typical reactions to alkaloidal nicotine paralyzation.

Buechner, et al. (1960b), immobilizing Unganda kob, found that the time required for Anectine to immobilize kob ranged from 3-12 minutes, with nicotine alkaloid requiring 3-57 minutes.

In a personal letter dated February 10, 1959, Harold C. Palmer, President, Palmer Chemical and Equipment Company, Inc. stated his company had been experimenting with Anectine and that this drug looked good from the limited trials they had experienced.

Undoubtedly the recent interest manifested in the use of drugs as a technique of capturing wildlife will result in the discovery of improved drugs

The means of delivery, or more simply, means of getting the drugs into the animal, have been improved greatly in the last few years. Severinghaus (1950), who began his studies in 1940, found he could not induce whitetail deer to accept either sodium pentobarbital (Nembutal) or chloral hydrate orally in food or water. Hall, et al. (1953) delivered Flaxedil on a dart shot from a modified Crossman rifle to immobilize deer. Crockford, et al. (1957) used a dart and modified air rifle similar to the apparatus used by Hall and his group.

Crockford, et al. (1958) described an automatic projectile type syringe which was fired from a modified Crossman rifle. This was a development of major importance and greatly enlarged the scope and potential use of drugs to capture wildlife. The book of instructions for use of the Cap-Chur equipment (Anonymous, 1960) contained plans for a modification in the automatic syringe projectile using a Cap-Chur charge to drive the rubber plunger forward and thus eject the drug from the drug chamber. The earlier model used tablets which united with water to form a gas which drove the rubber plunger and ejected the drug. This reaction took time and it was necessary to use barbed needles so the projectile syringe would stay in the animal until the drug was injected. It also gave the animal additional time to escape before the drug was injected and started having an effect. Injection is supposed to be instantaneous when the Cap-Chur charge is used.

Montgomery (1961), working in Pennsylvania, was dissatisfied with the projectile syringe, primarily because of its relatively limited range due to its large size and the accompanying resistance to flight. He devised a dart which utilized a mixture of nicotine alkaloid with commercial effervescent to serve as the carrier. The advantages of this dart over the syringe were given as longer range, greater accuracy, and lower cost. Major disadvantage was the deep penetration of the dart. The author stated he marked 51 deer and had a mortality rate of 14 percent.

Anderson (1961) captured black-tailed deer using a syringe-tipped arrow fired from a bow. The author stated that a complete unit, including the arrow, could be made for about $0.75. This, compared to the much higher cost of a projectile syringe, was one reason the author gave for developing this instrument. Deer were successfully captured with this device from 2 to 60 yards. When a 400 mg. nicotine salicylate dose was injected into 19 yearling and mature black-tailed deer, they stopped their initial fright run within 1 minute and could usually be handled after 3 minutes.

Mortality is a factor which must be considered in any project involving capture of wild animals. Palmer (letter dated February 10, 1959) indicated that reported mortality had varied from 4 to 50 percent with different individuals using his company's nicotine alkaloid preparation, Cap-Chur-Sol.

Hamilton (1960), who worked in Indiana, had a mortality rate of 19.7 percent, or 34 of the 172 deer captured; however, only 14, or about 8 percent, were thought to be directly attributable to an overdose of nicotine. Hamilton used a straight dosage of 400 mg. of drug for all sexes and ages of deer throughout the winter, with the exception of fawns in October and November. He also reported that by early spring, dosage levels were critical and should be lowered because the animals are in poorer physical condition. A 5 percent solution of amphetamine sulphate was administered subcutaneously at the rate of 0.5 to 1.0 cc, depending on size, to any deer having difficulty breathing. This drug stimulates heart action and breathing.

The following criteria were given by Hamilton (1960) for use in predicting whether or not the projectile syringe would be a successful technique:

> "...1. Deer must be accessible either on foot or from a vehicle, that is, the opportunity for clear shots within 40 yards is an absolute necessity. 2. Deer must be numerous and reasonably tame. 3. It must be an area in which the crew can work with a minimum of supervision or interference. 4. The topography or vegetative cover must be such as to facilitate capture."

Hamilton added that the user of this technique will probably have to be content with capturing not more than 50-60 percent of deer hit with a syringe.

MARKING FOR FUTURE IDENTIFICATION

"Basically, there are two reasons for marking animals; each requires a different sort of mark. One type of mark is for future identification of the animal in the hand (recaptured, shot, or found dead) and the other is its future identification, live, at a distance (Taber and Cowan, 1960)."

Tagging

Numerous workers have marked deer with ear tags of various types; the most common type in use is the ordinary cattle-type metal ear tag. This type of tag has utility because information can be stamped on it which will permit the tag, or data pertaining to the animal bearing the tag, to be submitted in the event the animal is taken by hunters or found dead. To yield information, however, the animal tagged with this type of tag must be either dead or recaptured.

Many researchers have also utilized colored plastic discs used with special aluminum tubular rivets. Gilbert (1952) stated that Colorado used this type along with different shapes of plastic material and that some tore out. McCormack (1958) used a cattle-type metal ear tag in each ear and also placed a 2-inch colored aluminum disc in one ear for field identification.

Ashcraft (1961), who used the regular metal strap cow tag and the round rivet type, thought the strap tag was superior because it was easier to attach and did not tear out. Use of hard vinyl plastic designs of various colors was discontinued because the plastic deteriorated and was soon lost. Ritcey and Edwards (1956) tagged moose in a British Columbia study and found that the ear tags made of cellulose acetate became brittle and broke in sub-zero weather. Craighead and Stockstad (1960) found that ear discs, both plastic and metal, were not satisfactory because of poor durability, breaking, poor color retention, and loss of tags.

Aldous and Craighead (1958) used brightly colored plastic streamers which were placed through ear-slits on bighorn sheep and tied with a jess knot. These streamers, a different color for each trap site, were used in conjunction with horn brands and stock-type ear tags. Only 1 sheep of the 25 marked lost a streamer and this was due to an improperly made ear slit.

Craighead and Stockstad (1960) used plasticized polyvinyl chloride tape placed in ear slits and tied with a jess knot or riveted. By using different color plastics, 64 combinations can be obtained. The primary advantage of this type of marker over the collar-type was that very young, as well as adults, could be safely marked. Retention of these markers was very good.

Barnes and Longhurst (1960) described a small plastic cylinder bearing an etched serial number which would prevent loss of data in event ear tag or markers should be lost. These were developed for use in identifying registered livestock and are implanted close to the base of the ear with a special instrument.

Various types of collars have been used in recent years to mark deer. One of the first, if not the first, use of a collar was reported by Hahn (1945) who strapped a small bell to a deer as an aid in studying movements.

Ashcraft (1961) used a chain collar with a number "8" sheepbell along with neck tags in his California study. Hog rings were used to fasten chain and to secure bells and tags to the chain. According to Ashcraft, belling had no ill effects and resulted in observations of many marked animals that would have otherwise been overlooked.

Jordan (1958), in a California study, used turkey and sheep bells attached with leather collars and chain collars. Four of 29 leather collars broke within a 15-month period. Bells were marked with the same design used in the ear tags; the greater surface of the bell enabled a larger design which was easier to recognize. The use of bells on deer increased observations as much as 41 times

over deer which were ear tagged only. In addition, the author stated that the deer seemed to adjust to belling with no apparent ill effects. The influence of the bells on hunter kill was not fully determined.

Progulske (1957) described a collar made of leather and covered with an upholstery plastic using various designs and color-combinations. These collars successfully withstood outdoor-exposure tests and were satisfactorily used in the field to study deer movements in Missouri. This collar was not, however, suitable for young deer because, if fastened loosely enough to allow for future growth, it can slip over the head. The author suggested incorporation of an elastic section to overcome this.

Duerre (1958) used Scotchlite reflective tape in various designs and colors on acetate ear tags and on collars. This greatly facilitated nocturnal observations where a spotlight was used.

Romonov (1956), a Russian, reported on a new method of mass-marking by automatic-tagging snares. Essentially, this device is a snare with a simple snap-fastener which prevents the snare from choking the animal. Once around the animals neck the ring slides down until it is caught in the snap-fastener. The animal then breaks the material holding the snare and escapes wearing a "collar" and a marker. The author stated they planned to use the auto-snare on a large scale to tag forest birds, furbearers, and wild ungulates in Russia.

Dyes and Paints

Use of dyes and paints to mark animals is somewhat limited by the fact that most animals undergo molts at which time such marking would be lost. For short-term studies, however, such as migration studies or specific seasonal studies which could cover a relatively small portion of time, use of dye and paint marking may be permissable.

Webb (1943) marked the rumps and tails of ear-tagged deer with a saturated solution of picric acid in alcohol or formalin. This turned the pelage a yellow color. By certain combinations of dyeing, using two dyes, picric acid solution and Nyanzol A suggested by Fitzwater (1943), Webb was able to obtain 26 combinations and thus identify individual deer. This he achieved by dying left rump, right rump, and tail using various combinations. Webb commented that this marking was good only for period between molts.

Fitzwater (1943) found that picric acid produced a bright yellow on white fur and that Nyanzol A, dissolved in 1 liter water and mixed 2:1 with hydrogen peroxide, gave good marking on squirrels.

Hahn (1945), working on the Edwards Plateau region of Texas, ear-tagged and marked deer with red enamel so they could be easily recognized at a distance.

Clover (1954b), described two devices designed to propel liquid dyes when tripped by passing deer. One, called a "one time marker" utilizes an empty, primed 12-gauge shotgun shell loaded with one-eighth dram of powder to propel dye from a dye-chamber onto a deer which has tripped the mechanism. Full instructions for construction of this device are included in his article.

The above author also designed an automatic marker which will mark more than one deer at a setting. This device uses air pressure to propel dye at a deer which trips the mechanism. In a test, one such marker was fired 100 times in succession before air pressure and dye were depleted.

Clover (1954b) used aniline dye dissolved in lacquer thinner in the one-time marker, and aniline dye dissolved in alcohol to which one-fifteenth part nitric acid was added. The dye faded in about 6 weeks, but the nitric acid still showed its effect on the pelage.

The main difficulty encountered by Clover was that the deer shed their coats and the dye, thus losing their marks.

Taber, et al. (1956) described two devices for marking large mammals using trails. One, the "Ontario marking device", holds the dye supply in a plastic sack which is cut with a razor blade when the animal trips the mechanism. The other, called the "Wyoming marking device", consists of a notched hollow rubber ball filled with marking material. The rubber ball is on an arm which is attched to a pivot. This mechanism is activated when an animal walks into the trip cord, thus pulling the marking device over and spilling its contents on the animal.

Taber, et al. (1956) suggested using fur dyes mixed with hydrogen peroxide to mark lighter colored animals because large quantities of paint cuase hair to mat and fall out. White (1960), who used the Clover one-shot marker, marked deer with aluminum paint because it seemed to mat hair less than other paints.

Neal (1959) tested Testor's paint on collared peccaries and found that paint was effective for about 1 month.

Water-soluble and fat-soluble dyes, mixed with bait, were used by New (1959) to mark small mammals. These dyes marked the droppings, fat, teeth and pelage. Kindel (1960) mixed dyes with dry ground feed and salt and fed it to sheep. He found that effective dyes appeared in feces 24 hours after ingestion and for 2 to 4 days thereafter. Kindel fed salt and dye mixtures to elk and found it also colored the feces.

Dye pellets, inserted subcutaneously in rabbits by Brown (1961), were found to color urine 4-7 days, depending on dye used. Feces were also colored when certain dyes were used subcutaneously. Limitations of this technique's use in tracing movements are discussed.

Severinghaus and Cheatum (1956) mentioned that wintering deer were fed a soyabean molasses cake dyed red or blue and that the coloring passed through the deer and tinted the droppings. The dyes which were used were not given.

Mutilation and Branding

One form of mutilation, which wildlife researchers have borrowed from stockmen, is the use of ear-notching or cropping. This technique is usually used in conjunction with other marking methods as it is essentially a way of calling the observer's attention to a specific animal. Taber and Dasmann (1958), among others, used it in their study of California black-tailed deer. Neal (1959) utilized notching in his study on the collared peccary of Arizona.

So far as discernable, the only mutilation applied to deer has been the ear-notching technique. However, Kabat, et al. (1953) utilized some more or less naturally mutilated deer as "marked deer" in attempting to census deer in Wisconsin deer yards. Their census technique was a modification of the Lincoln index as used by Schnabel (1938) which utilizes newly "marked" animals being introduced into a population.

This perusal of the available literature did not disclose instances where brands have been used to mark deer. Aldous and Craighead (1958) branded the horns of bighorn sheep as an aid in studying the individual sheep. Scheffer (1950) in Taber and Cowan (1960) said brands were successfully read on Alaska fur seals 20 years after application.

Neal (1959) clipped bristles to the skin on peccaries and branded them with a chemical solution and a branding iron made of heavy wire. This type of branding, termed "cold branding", was not too successful for the bristles grew back over the branded area and the brand was obscured within 1 to 2 months after application.

Tattoos were also tried by Neal (1959), but he reported it was unsuccessful on peccaries. Taber and Cowan (1960) said that tattooing is permanent when properly done, but is most useful when used with some other more conspicuous, less durable marking method.

DEER MOVEMENTS

Inhabitable game range must include areas where animals can feed, hide, rest, sleep, play and breed (Leopold, 1948). Movement, which is daily, seasonal, and annual in scope, is involved in the efforts of a species to satisfy the various biological requirements necessary for survival. Mobility in a given species, therefore, is probably governed to a large extent by the interspersion of the various habitat types necessary for the welfare of a species, as well as the maximum inherent cruising radius of the species.

Iowa has few areas where one habitat type is too extensive. Our primary deer range, over much of the state, occurs along river bottoms which exhibit a good variety of habitat types. Interspersion seems to be very good, for on these bottoms and on the secondary flood plains, rowcrops, hay, brush, and forest land can be found.

It follows, therefore, that a deer should be able to satisfy its environmental requirements in an area of relatively small radius in Iowa. This, however, is mere conjecture and remains to be proven or disproven.

Leopold (1933) indicated that whitetail deer have an annual cruising radius of approximately 5 miles. This I believe is a greater annual cruising radius than will be found to be the average in Iowa.

To my knowledge, only two studies have been conducted on the range of whitetail deer dwelling in environmental types which are even somewhat similar to those found in Iowa.

Progulske and Baskett (1958) noted there was a definite lack of data pertaining to deer mobility in the central United States and in the primarily agricultural areas. These authors, working in Missouri, found that females and fawns moved an average of 1.4 miles, while males averaged 1.9 miles, with the average maximum distance moved found to be 1.7 miles for all deer.

Progulske and Baskett (1958) also determined the "minimum home range" of Missouri whitetails varied from 10 acres to 6,660 and averaged 695 acres or slightly more than one square mile. Searches for marked deer were made by various methods: on foot, from a tower, from a blind, from an automobile, and by trailing in snow. Some records were received from hunter recoveries.

Carlsen and Farmes (1957), in a Minnesota study, compared movements of tagged deer in coniferous forests with those of deer on a prairie-deciduous forest type in northwestern Minnesota. Deer were released at the point of trapping and recovered as hunter kills. The maximum distance moved in the coniferous type was 22 miles, with an average of 5.1 miles. In the prairie-deciduous forest type the longest distance traveled was 55 miles, with an average of 9.7 miles.

Hahn (1945) found that deer on the Edwards Plateau of Texas moved a maximum of 1.5 miles, with most deer observed moving only 50-1,000 yards from the trapping areas. Hahn and Taylor (1950) reported that 85 percent of their observations were within 1 mile of the square mile where the deer was trapped. Progulske and Baskett (1958) stated that movements of Missouri deer were more similar to those of Texas deer than to deer of the Lakes States.

DEER CENSUS

An excellent and exhaustive review of the literature pertaining to big game census methods was made by Hazzard (1958). This review will be utilized extensively on the deer census portion of our project.

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