

COMPARATIVE DEER MANAGEMENT PRACTICES
OF THAILAND AND KANSAS
and
PHYSICAL CHARACTERISTICS OF INCISOR TEETH OF
MALE AND FEMALE WHITE-TAILED DEER
(Odocoileus virginianus Rafinsque)

A Thesis
Presented to
the Department of Biology
Kansas State Teachers College of Emporia

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Schwann Tunhikorn
September 1973

Thesis
1973
T

Thomas A. Eddy
Approved for Major Department

John E. Peterson
Approved for Graduate Council

345979 *s*

ACKNOWLEDGMENTS

I would like to express my appreciation to Dr. Thomas A. Eddy, Dr. Robert J. Boles and Dr. Dwight L. Spencer, who served as committee members, for their reading of this paper, and offering advice and criticism.

I wish to thank Mr. William Peabody, the Big Game Project leader of Kansas Forestry, Fish and Game Commission for his supplying necessary study materials. I also thank Dr. Charles M. Greenlief for his advising in laboratory procedures. I am grateful to Dr. M. Lloyd Edwards of the K.S.T.C. Data Processing Center for assistance in programming and analyzing the data, to Mrs. Myrtle Casey, for her proof-reading and suggestions.

I gratefully acknowledge Mr. Chumnong Photisarao, Nongkai Provincial Forestry Officer, for the valuable information and assistance he has given me. Much gratitude is also given to Mr. Pong Leng-EE, Head of the Wildlife Section of Royal Forestry Department, for providing the useful information.

Finally, I wish to express my deepest thanks to Miss Bupphachart Photisarao, for her assistance and encouragement she has given me in completing this work.

TABLE OF CONTENTS

Part I

INTRODUCTION	1
PHYSICAL FEATURES OF THAILAND	3
Topography	5
Forest Types	7
Soils	7
CLIMATE OF THAILAND	8
Seasons	9
Temperatures	9
Rainfalls	10
Relative Humidities	11
WILDLIFE CONSERVATION IN THAILAND	13
Administration of the Royal Forest Department	14
Central Administration	14
Territorial Administration	15
Game Laws	15
Definitions of Game Law	15
Hunting Regulations	16
License	17
Deer Seasons	18
Season Bag Limit	19
Possession Limit	19

	iv
Game Law Enforcement	19
Penalties	20
Trading and keeping in possession the wild animals and their meat	21
Wildlife Committee	21
Game Sanctuaries	22
Life Histories of Deer in Thailand	22
Sambar deer	22
Eld's deer	25
Schomburgk deer	27
Hog deer	29
Barking deer	33
CLIMATE OF KANSAS	37
WILDLIFE CONSERVATION IN KANSAS	39
Organizational Structure of Kansas Forestry, Fish and Game Commission	41
Deer Hunting in Kansas	44
Kansas Deer Hunting Regulations	46
Deer Hunting Permits	46
Deer Hunting Seasons	46
LIFE HISTORY OF WHITE-TAILED DEER	50
COMPARATIVE DEER MANAGEMENT	56
People	56
Wildlife Law and Law Enforcement	57
Wildlife Management Budget	61
Habitat Management	61
RESULTS AND DISCUSSION	63

SUMMARY 65

Part II

Physical Characteristics of Incisor Teeth of Male and Female
White-tailed deer (Odocoileus virginianus Rafinsque)

INTRODUCTION 66

METHODS AND MATERIALS 67

 Obtaining Teeth for the Study 68

 Preparing Teeth for Examination 68

RESULTS AND DISCUSSION 69

SUMMARY 76

LITERATURE CITED 77

APPENDICES 81

 APPENDIX A - Forest Types of Thailand 82

 APPENDIX B - A Generalized Key To The Soils
 Of Thailand 85

LIST OF TABLES

TABLE	PAGE
I. The mean annual rainfall, temperature, and relative humidity for each region of Thailand during the period of 1940-1950	12
II. The rates of permit fees for hunting deer in Thailand	18
III. Dates open for deer hunting in Thailand	19
IV. Mean Annual Precipitation, Temperature and Humidity of Kansas	38
V. A summary of archery deer hunting seasons, 1965-1971	47
VI. A summary of firearms deer seasons, 1965-1971	49
VII. The fertilities of white-tailed does from 2.5 to 10 years and older	54
VIII. The record of annual licenses and number of arrests for violations	58
IX. A summary of firearms and archery deer seasons, 1965-1972	60
X. Means and tests of significance of crown length	69
XI. Means and tests of significance of root length	70

TABLE	PAGE
XII. Means and tests of significance of greatest width at gum line	70
XIII. Means and tests of significance of the narrowest width at gum line	71
XIV. Means and tests of significance of incisors width	72
XV. Average and tests of significance of incisors weight	72
XVI. Average and tests of significance of incisor volume	73
XVII. Summary of mean values of measurements and test of significance of female and male white-tailed deer incisor teeth	74

LIST OF FIGURES

FIGURE	PAGE
1. The map of Thailand and its surrounding countries	4
2. The distribution of Sambar deer, <u>Cervus unicolor</u> , in Asia	24
3. The distribution of Eld's deer, <u>Cervus eldi</u> , in Asia	28
4. The distribution of Hog deer, <u>Axis porcinus</u> , in Asia	31
5. The distribution of Barking deer, <u>Murtiacus muntjak</u> , in Asia	34
6. Kansas Forestry, Fish and Game Commission Organizational Structure	45
7. The distribution of white-tailed deer, <u>Odocoileus virginianus</u> , in North America	53

Part I

INTRODUCTION

Five different species of deer are included among the many species of Thailand's wildlife. They are Schomburgk's deer, Eld's deer, Hog deer and Barking deer. During the last century, wildlife was said to be plentiful in every part of the nation. Soon after World War II, the rapidly increasing human population, together with the great availability of firearms, resulted in overhunting. Wildlife habitat also began deteriorating as the landscape was cleared and put to economic uses. At the moment, wildlife populations are shrinking in both variety and abundance. Some have become extinct, while some species of large mammals, such as Eld's deer and Hog deer, have become endangered. In the year 1960, the Royal Forest Department and some other conservation societies proposed a game law, which later was passed, and is known as the Wild Animal Preservation and Protection Act B.E. 2503. This game law came into effect in January, 1961. Since the law's effective date, wildlife conditions have not improved.

One of the major objectives of this literature review was to compare the deer conservation programs in Thailand with those in Kansas in an attempt to find a possible solution for more effective deer management in Thailand. Comparisons were emphasized between game law, and the

organizational structure and functions of the two game departments. The life histories and ecology of deer in Thailand and Kansas are also included.

PHYSICAL FEATURES OF THAILAND

Thailand is situated in the Indochina Peninsula between the parallels of 5° and 21° North Latitude, and between the meridians of 97° and 106° East Longitude. The area of Thailand is about 548,000 square kilometres or 200,000 square miles.

Thailand may be divided into four parts, Northern Thailand, Central Thailand, Eastern Thailand and Southern or Peninsular Thailand. Peninsular Thailand is bounded on the west in part by the Indian Ocean and partly by Burma, on the east by the South China Sea and the Gulf of Thailand and on the south by Malaysia. Thailand has for its northern neighbors, Burma and Laos; for its western neighbor, Burma; for its eastern neighbors, Laos and Cambodia and on the south it is bounded by the Gulf of Thailand and Southern or Peninsular Thailand (Chuntarasup, 1968). According to the Ministry of Agriculture (1963), as quoted by Leng-EE, (1966), of the total area of 200,000 square miles, 51.50 per cent is forested land, 20.03 per cent is farmland; 0.40 per cent is swamp land and 28.07 per cent is other unclassified land.

The map of Thailand and its surrounding area is illustrated in Figure 1.

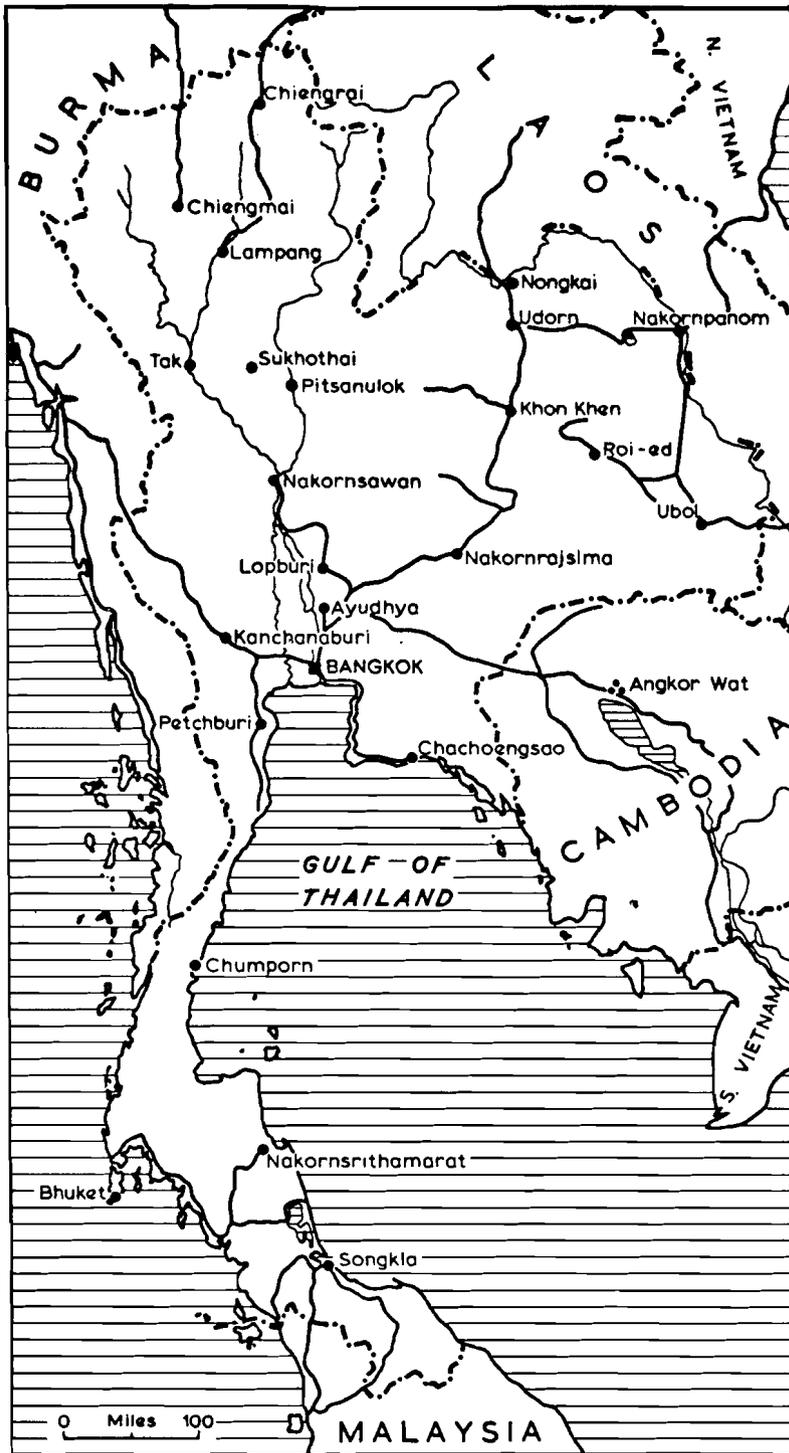


Figure 1. Thailand and its surrounding countries.

From "Thailand: Land of the Free" Basche, 1971.

Topography

The topography of Thailand is characterized by:

(1) folded mountains, which are the southeastward continuation of the Himalayan System; (2) flat alluvial plains, intersected by winding rivers and irrigation canals, which are flooded during each rainy season; (3) a certain amount of undulating country; and (4) maritime features such as sandy beaches, mangrove swamps, irregular coastlines, and numerous islands (Chuntarasup, 1968). As previously mentioned, Thailand may be divided into four geographical regions, they are:

1. The Northern Region. This region consists of a series of parallel and longitudinal folded mountains in continuation of the Himalayan System. Between the ridges of these mountains are relatively flat basins, where four major tributaries of the Chao Phya river flow. The alluvial soils of these basins are fertile for cultivation. According to the Ministry of Agriculture (1963), as quoted by Leng-EE, (1966), this northern region occupies about 17 per cent of the country's area in which 76 per cent is mixed deciduous, evergreen forest and grazing land, seven per cent farm land, 0.03 per cent swamp land and 17 per cent unclassified land.

2. The Central Plain. This region may be divided into two distinct physiographical subregions, the Northern Rolling Plain and the Chao Phya Basin. The Chao Phya Basin is the largest and most fertile plain of the country. The

flat land of the basin is generally low and is usually flooded by rain water in the wet season (Chuntarasup, 1968). According to the Minister of Agriculture (1963), as quoted by Leng-EE, (1966), this region occupies 36 per cent of the country's total area in which 50 per cent of the land is classified as forests and grazing land, 26-38 per cent as farm land, 0.22 per cent as swamp land and 23 per cent unclassified land.

3. The Northeastern Region or Khorat Plateau. The general surface of the plateau is rolling with some studded flat top hills. Because of the rolling topography of the region, the drainage pattern is rather dendretic with the general direction of flow toward the southeast. The heavy monsoon rains falling over the thin forest cover results in rapid run-off and causes floods almost yearly in the wet season, but the region suffers in the dry season for lack of water. The soils for the most part are thin and poor (Chuntarasup, 1968). This region occupies 33 per cent of the entire country. Forty per cent of the land is classified as forested land, 21 per cent as farm land, 0.37 per cent as swamp land and 38 per cent as unclassified lands (Ministry of Agriculture, 1963, as quoted by Leng-EE, 1966).

4. The Southern Region or the Peninsular Region. The general topography of this region is from rolling to mountainous, with a small amount of flat land. The sandy soil and frequent rains make it ideal for rubber plantations, coconut and fruit crop farming. This region occupies only 14

per cent of the country total, 53 per cent of this region is forests and grazing lands, 31 per cent farm land, one per cent swamp land and 15 per cent unclassified lands (Ministry of Agriculture, 1961 and 1963 as quoted by Leng-EE, 1966).

Forest Types

According to the Ministry of Agriculture, 1968: forests in Thailand are all state-owned with the exception of some mangrove plantations. The total land covered by forests is 26,500,000 hectares. Forests can be mainly classified into two types, the evergreen and deciduous.

(1) Evergreen forests account for 30 per cent of the forest area, consisting of tropical evergreen, Hill evergreen, mangrove and conifer or pine forests.

(2) Deciduous forests account for 70 per cent of the forest area, consisting mainly of mixed deciduous forests (25 per cent) and deciduous dipterocarp forests (45 per cent).

Details are given in Appendix A.

Soils

Soils of Thailand are highly diversified. This is primarily the result of the wide range of parent materials from which the soils have been derived. The formation of each forest type is influenced by many complicated factors (Leng-EE, 1966). Generalized Key to the soils of Thailand by Dr. R.L. Pendelton is in Appendix B.

CLIMATE OF THAILAND

The climate of Thailand is under the influence of seasonal monsoons. During the northeast monsoon, from November to February, cold dry air from the China mainland enters the country and is considerably modified during its southward surge. From May to September the southwest monsoon brings a stream of warm moist air from the Indian Ocean, causing abundant rainfall over the Northern, Northeastern, Central parts, and the west coast of the Southern part. The onset of the monsoon varies to some extent. The southwest monsoon is usually established in May and ends in September. The northeast monsoon normally begins in November and ends in February (Meteorological Department, Royal Thai Navy) (1957), as quoted by the Ninth Pacific Science Congress Publicity Committee (1957). Banijbhatana (1957), as quoted by Leng-EE (1966), classified the climate of Thailand into the tropical rain and the tropical savannah categories. The tropical rain category is characterized by uniformly high temperatures and heavy rainfall. The range of seasonal variation in both rainfall and temperatures is significantly less than the tropical savannah. The tropical savannah has less rainfall and is distinguished by a wet and dry season. The wet season, or crop-growing months, falls between May and September or October. The dry season sets in between October to early May.

Seasons

From the meteorological point of view, the climate of Thailand may be divided into the following four seasons:

a. Winter, the northeast monsoon season, extends from November to February. This is the mildest period of the year.

b. The Pre-monsoon season, summer, includes March and April. This is the transitional period from the northeast to southwest monsoon. Temperatures are highest in April.

c. The Rainy, southwest monsoon season runs from May to September. The southwest wind from the Indian Ocean is most active in July and abundant rainfall occurs over nearly the entire country. Peak rainfall usually occurs in September.

d. The Post-monsoon season occurs in October. It is the transitional period from the southwest to the northeast monsoon season. Variable winds are experienced with active sea breezes in the afternoon along the coasts.

Temperatures

Upper Thailand, such as the Northern, Northeastern and Central Parts, because of its inland nature and tropical latitude location, experiences a long period of hot weather. The maximum temperatures generally range from about 33° C (91.4° F) to 38° C (100.4° F) and during April, the hottest month of the year, often reach much higher values. During the northeast monsoon, temperatures over upper Thailand are mild.

However, outbreaks of cold air from the China mainland occasionally reduce temperatures to low values near 0.1°C (32.2°F) in the Northern and Northeastern parts. In the Southern part of Thailand, temperatures are generally mild throughout the year. Because of the maritime exposure of the region, the excessive temperatures common to upper Thailand are seldom experienced. The average temperature is about 27.2°C (81°F).

Rainfalls

Upper Thailand experiences its maximum rainfall in September. This is the month when the frequency of tropical depressions of atmospheric pressure entering Upper Thailand from the South China Sea is the highest. The monsoon rainfall, augmented by that from the depressions of atmospheric pressure, is the main cause of floods over Upper Thailand.

The seasonal variation in rainfall in the Southern Part differs markedly from that of Upper Thailand. Over this region, there is a double rainy season. One is during the southwest monsoon, from May to October, which is more pronounced on the west coast; the other is during the northeast monsoon from November to February, when rainfall is most copious on the east coast.

Relative Humidities

During the northeast monsoon season, November to February, when the weather is governed by modified Polar Siberian Air masses, relative humidities are generally low. December and January are generally the period of the lowest relative humidities of the year. In the hot season in March and April, the moisture content of the air becomes moderately high, but because of less rainfall and high temperature, the afternoon humidity usually remains low. With the onset of the southwest monsoon, the monthly mean relative humidity rises gradually, and reaches its peak of about 80 per cent between August and October. Then the maximum relative humidity decreases sharply to its lowest point of the year in December or January.

The mean annual rainfall, temperature, and humidity for each region during the period of 1940-1950 is shown in Table 1.

TABLE I. The mean annual rainfall, temperature, and relative humidity for each region of Thailand during the period of 1940-1950. (Adapted from Tararak, 1952 by Leng-EE, 1966).

Regions	Annual rainfall		Temperature			Mean humidity
	Mean (inches)	rainy (days)	mean ann. (F)	mean max. (F)	mean min. (F)	(%)
Northern	55	84.6	68.9	89	66.9	74.5
Northeastern (Korat Plateau)	55	84.6	79.8	91	70.3	73.9
Central	53	81.1	79.3	91.6	73.7	78.5
Eastern	73	115.6	81.7	90.7	72.7	80
Southern	87	129.5	79.7	89.2	73.9	82

WILDLIFE CONSERVATION IN THAILAND

Prior to 1960, Thailand had no game laws except The Wild Elephant Act of 1921, which provided protection for wild elephants only. In 1960, when it appeared that many wildlife species, including deer, were being threatened with extinction, the Royal Forest Department and some other societies took action to propose the new game law which was passed in the same year and became effective in 1961.

Since the new game law was passed, a series of game sanctuaries, reserved forests and national parks have been established for the purpose of protecting all wildlife species and parts of their natural habitat.

Deer and other big game species now have full legal protection. Forests, game sanctuaries, and parks are regularly patrolled by game wardens.

Currently, the two most serious factors affecting the deer are loss of suitable habitat and the decline in number of deer as a result of hunting. The extensive clearing of the forests for agricultural purposes has reduced deer habitat and also driven them from most of the region in which they formerly lived. Deer have been heavily hunted for food by people from all walks of life, often following no rules and whenever the opportunity occurred.

Administration of The Royal Forest Department

The Royal Forest Department is included in the Ministry of Agriculture. The administrative organization is as follows:

Central Administration

1. Director-General, as head of department.
2. Two Deputy-Directors-General; one for technical functions and the other for administrative work.
3. Forestry Expert and Advisor.
4. First Grade Technical Officer.
5. Office of Secretary.
6. Division of Finance.
7. Division of Forest Working Plans.
8. Division of Forest Control.
9. Division of Forest Products Research.
10. Division of Forest Silviculture.
11. Forest Duty Stations (two in all).
12. Divisional Forest Offices (21 in all spread over various regions).
13. Forest Protection Units (20 in 1966).
14. Division of Forest Police.

Each division is subdivided into sections. The Wildlife and National Park Sections were established in the Division of Forest Silviculture a year after the Wildlife Act was passed in 1960 (Leng-EE, 1966).

Territorial Administration

1. Provincial Forest Offices. There are 61 Provincial Forest Offices and each is under the charge of a provincial forest officer who is directly responsible to the provincial governor.

2. Township Forest Offices. There are 382 Township Forest Offices and each is supervised by a township forest officer, who is under the control of the provincial forest officer.

Both the provincial and township forest officers are directly appointed and promoted by the Royal Forest Department. The Director-General of the Royal Forest Department has an authority to order them both directly to their offices, or indirectly through the provincial governors (Leng-EE, 1966).

Game Laws

Definitions of Game Law. The Act classified wild animals into two categories, the reserved group and protected group.

The reserved wild animals are those animals which are considered rare or endangered. The hunting of this group is strictly prohibited except for educational, scientific, or public zoological garden purposes, and in such cases a written permit from the Director-General of R.F.D. must be secured. The reserved wild animals are the Javan rhinoceros (Rhinoceros sondaicus), Sumatran rhinoceros (Didermoceros sumatrensis), kouprey (Bibos sauveli), wild buffalo (Babulus

bubalis), Schomburgk's deer (Cerbus schomburgki), Eld's deer (Cerbus eldi), hog deer (Axis porcinus), serow (Capricornis sumatraensis) and goral (Nemorhaedus goral).

The protected wild animals are subdivided into two categories. The wild animals which are included in the first category are defined as those whose meat is not usually used as human food, or those which are not usually hunted for sport, or those which destroy plant pests, or those which are scavengers, or those which should be preserved for natural beauty or for increasing their population. Capturing live animals of this first category is permissible, but killing of them is prohibited.

Protected animals in the second category include those which are usually hunted for food or sport. Hunting of these animals is allowed on a permit basis. Animals of this category include gaur (Bibos gaurus), banteng (Bos banteng), sambar deer (Cerbus unicolor), barking deer (Muntiacus muntjak) and chevrotain (Tragulus javanicus).

Hunting Regulations. The following regulations apply to all protected big game animals.

1. No female sambar deer or barking deer may be taken at any time, by any means except so far as may be permitted by the Director-General of R.F.D.

2. It is unlawful to hunt the young of any kind of deer if their antlers are not developed, except by written permission from the Director-General of the R.F.D.

3. Shooting hours are from sunrise to sunset except the shooting of predators at the sites of their kills.

4. Hunting methods described as follows are prohibited:

- a. the use or aid of flashlight,
- b. firing from the automobile or any other-driven vehicle,
- c. firing from the backs of elephants, horses, prepared hunting platforms or stands,
- d. firing from, on or across any highway or road, and
- e. with a trap, snare, spike or barbed trap, unmanned triggered-trap, gun trap, machine gun or semi-automatic rifle, deadfall, net or seine and pitfall, poison-tipped arrow, poison bait or explosives.

5. It is illegal to hunt, collect, endanger and possess eggs or nests of protected wild animals within the exterior boundaries of any established game sanctuary, national park, wildlife refuge, precinct of a monastery or any place provided for religious observance of the public.

6. The successful hunter must affix the carcass tag immediately upon killing deer to show the legal possession.

License. Two kinds of hunting licenses are issued to big game hunters. They are the non-provincial resident and the provincial resident licenses. The non-provincial resident license is issued by the Director-General of the

Royal Forest Department in Bangkok; the provincial resident license is issued to the applicant by the Provincial governor. The fees for non-provincial resident licenses and provincial resident licenses are 100 baht and 25 baht respectively (20 baht = \$ 1 U.S.). All persons who hunt deer are also required to have a deer permit, as indicated in the following table.

TABLE II. The rates of permit fees for hunting deer in Thailand (Baht). (Approximately 20 baht = 1 U.S. dollar)

Deer	Non-resident	Resident
Sambar deer	100	20
Barking deer	50	10

Deer Seasons. The open dates for deer hunting season in Thailand are indicated in the following table.

TABLE III. Dates open for deer hunting in Thailand.

Deer	Dates open
Sambar deer	March 1 through April 30,.
Barking deer	March 1 through April 30,.
Eld's deer	No open season
Hog deer	No open season
Schomburgk's deer	No open season

Season Bag Limit. The season bag limit is one deer restricted only to male deer with antlers.

Possession Limit (live deer). There is a possession limit of one live Sambar deer and/or two live Barking deer.

Possession Limit (carcass).

Sambar deer 1

Barking deer 1

Game Law Enforcement. Authorities from different levels authorized to enforce the laws are:

1. all police officials of the Police Department, Ministry of Interior,
2. all forest police officials, Forest Police Division, R.F.D.,
3. the forest officials who are authorized to enforce the game law by the Minister of Agriculture, and

4. all provincial governors and district officers are authorized to enforce the game law within their jurisdiction.

Penalties. The Wild Animal Reservation and Protected Act B.E. 2503 (1960) provided that:

1. A violator who hunts the reserved wild animals shall be punished with imprisonment not exceeding one year or a fine of not more than 10,000 bahts, or both.

2. A violator who hunts the protected wild animals during closed season shall be punished with imprisonment of not more than six months or a fine of not more than 5,000 bahts or both.

3. A violator who kills or hunts the first category protected wild animals without a hunting license shall be punished with imprisonment of not more than three months or a fine of not more than 2,000 bahts or both.

4. A violator who hunts within a game sanctuary shall be punished with imprisonment of not more than two years or a fine of not more than 20,000 bahts or both.

5. A violator who trades or has in possession the preserved animals or their meat without securing permission from the Director-General of R.F.D. shall be punished with a fine of not more than 500 bahts.

6. Anyone who violates the hunting regulations shall be punished with imprisonment of not more than one month or a fine of not more than 1,000 bahts.

Trading and keeping in possession the wild animals and their meat.

1. It is unlawful to have in possession the reserved animals or their meat.
2. Licenses are required for trading and having in possession the protected animals.
3. Exportation of reserved animals is prohibited.
4. Exportation of protected animals is allowed only in the case of exchanging them for exotic animals for educational or scientific purposes and this must be arranged by any creditable wildlife institute.

Wildlife Committee

The Wildlife Committee consists of the undersecretary of Department of Agriculture as chairman, Director-General of the Royal Forest Department, Interior Department and Land Department as exofficio members, and at least five, but not to exceed 11, other members appointed by the Cabinet. The appointed members hold office for a term of two years. The Wildlife Committee has the duty of considering and giving advice to the Minister of Agriculture in the following matters:

1. determination of hunting season and areas including the species which will be allowed to be hunted,
2. determination of or establishing of game sanctuaries, and other activities to be carried out for the purpose of maintaining game sanctuaries,

3. regulate the rules and conditions concerning hunting and trading wildlife, and
4. other matters on which the minister consults.

Game Sanctuaries

The Royal Forest Department may officially designate any area which is considered suitable for wildlife habitat as a game sanctuary by the Royal Decree. Public access is restricted on game sanctuaries; permission to enter game sanctuaries will be given by the official appointed by the Director General.

Life Histories of Deer in Thailand

Five different species of Cervidae are found in Thailand. They are: Schomburgk's deer, Cervus schomburgki; Sambar deer, Cervus unicolor; Eld's deer, Cervus eldi; Hog deer, Axis porcinus; and the Barking deer, Muntiacus mantjak.

Sambar deer (Cervus unicolor)

Description. General color dark brown, approaching black or slaty gray in old stages; generally a light ring around the eye; the ears rather small, often with a distinct white margin; the legs frequently light-colored and the tail bushy; face comparatively long and straight.

Worldwide Distribution. Of all the species of deer in southeastern Asia, the Sambar, C. unicolor, is not only

the largest but also the most widespread in its distribution for its range stretches from the Philippine Islands in the east, through Indonesia, Southern China, Burma, to India in the west (Whitehead, 1972). This deer is also found in Szechuan, Yunnan, Kwantung, Hainan, Formosa, Ceylon, Indo-China, Malaysia and many small Malaysian Islands (Ellerman and Morrison-Scott, as quoted by Schaller, 1967).

Sambar deer are found at all elevations where there is sufficient cover. In the Himalayas it may occur at elevation of 9,000-10,000 feet (Lydekker, 1894).

In Thailand Sambar deer are found in every part of the country, but are most common in evergreen and mixed deciduous forest types, and the abandoned shifting cultivation areas near the forest edge where food is abundant (Leng-EE, 1966).

The distribution of Sambar deer, Cervus unicolor, in Asia is shown in Figure 2.

Throughout its range, 16 subspecies are recognized. C. unicolor equinus is the subspecies which is found in Burma, Southern China, Thailand, Malaysia and Sumatra (Whitehead, 1972).

Food Habits. The Sambar subsists on a wide variety of plants, agricultural crops, grasses, leaves, and fruits. The readiness with which the Sambar either grazes or browses has undoubtedly been a major reason for the wide distribution of the species (Schaller, 1967). Sambar are seldom found far from water and drink every night at forest springs and

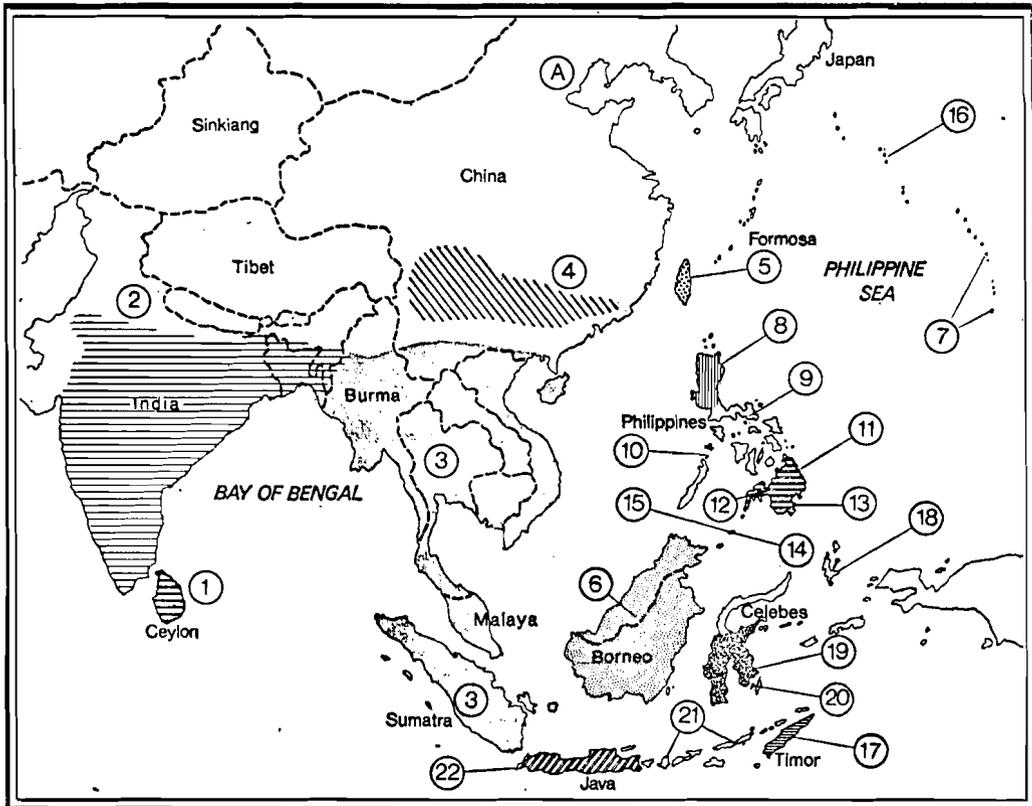


Figure 2. The distribution of Sambar deer, Cervus unicolor, in Asia.

SAMBAR Cervus unicolor

- | | |
|------------------------------------|---|
| 1. <u>Cervus unicolor unicolor</u> | Ceylon |
| 2. <u>C.u. niger</u> | India |
| 3. <u>C.u. equinus</u> | Burma, southern China, through
to Sumatra |
| 4. <u>C.u. dejeani</u> | South-west China |
| 5. <u>C.u. swinhoei</u> | Formosa |
| 6. <u>C.u. brookei</u> | Sarawak, Borneo |
| 7. <u>C.u. mariannus</u> | Guam Island, Marianne Group
(probably extinct) |
| 8. <u>C.u. philippinus</u> | Luzon, Philippines |
| 9. <u>C.u. alfredi</u> | Central Philippines |
| 10. <u>C.u. barandanus</u> | Mindoro Island, Philippines |
| 11. <u>C.u. francianus</u> | Mindanao Island, Philippines |
| 12. <u>C.u. nigellus</u> | West Mindanao Island,
Philippines |
| 13. <u>C.u. apoensis</u> | South-east Mindanao Island,
Philippines |
| 14. <u>C.u. basilanensis</u> | Basilan Island, Philippines |
| 15. <u>C.u. nigricans</u> | Basilan Island, Philippines |
| 16. <u>C.u. boninensis</u> | Bonin Island (probably extinct) |

From "Deer Of The World" Whitehead, 1972.

streams (Whitehead, 1972). Sambar deer also frequent salt licks, coming out into the open occasionally at dusk and during the night but seeking the cover of trees within an hour after dusk (Schaller, 1967).

As previously mentioned, Sambar deer frequently feed on agricultural crops, so they are hunted both for food and crop protection. Sambar deer will feed on young vegetative growth where the forest is opened up and also along the timber extraction routes. This habit makes Sambar deer vulnerable to poachers.

Reproduction. The Sambar deer's gestation period is about seven months. Most fawns are born in the latter part of May or the first part of June, and reach sexual maturity at two years of age (Prater, 1965). However, Schaller (1967) stated that the does will give birth to their first fawns when about three years old. Each adult doe probably bears young once a year and a single fawn is the rule although Crandall (1964) recorded one set of twins at the New York Zoological Park.

Eld's deer (*Cervus eldi*)

Description. All of the Eld's deer are distinguished by coarse, sparse, dark brown hair; the females are lighter in color than males. The antlers, distinctive to this species, somewhat resemble the curved base of a rocking chair tipped forward. Twin curved beams extend from beyond the nose of male deer up and back over the shoulder (Bauer, 1972).

Worldwide Distribution. Eld's deer is another deer of southern Asia which is becoming scarce. Eld's deer, sometimes called the brown-antlered deer, or Thamin, is locally known in Thailand as La-ong and La-mang. According to Whitehead (1972) three subspecies of Eld's deer are recognized:

- A. Cervus eldi eldi (M'Clelland) from Manipur,
- B. C. e. thamin from Burma, Tenasserim and adjacent parts of Thailand, and
- C. C. e. siamensis (Lydekker) from Thailand, whose range also extends into Vietnam and Hainan Island. Thomas (1918), as quoted by Whitehead (1971), gave the Hainan Brown-antlered deer the racial status of C. e. hainanus, but it is probably an insular form of C. e. siamensis.

Eld's deer were formerly abundant throughout almost every part of Thailand.

The present distribution of this species in Thailand is limited. Whitehead (1972) believed that only a few herds of four or five individuals now remain at Nang Kong in the north-east, and at Chieng Karn in the north. Leng-EE (1966) referred to recent reports from Regional and the Provincial Forest Offices in 1961, which stated that Eld's deer still exists in some limited areas of the northern, northeastern, and central regions. Most of these areas are in river basins and open forests away from communities.

The distribution of Eld's deer, Cervus eldi, in Asia is shown in Figure 3.

Habitat. Eld's deer prefers a swampy plains habitat (Whitehead, 1972). It avoids hills or dense forests but also frequents open scrub jungle, and flat or undulating land between rivers and hill ranges (Prater, 1965).

Food Habit. Their food consists of wild grasses, leaves, fruit, seeds and many kinds of agricultural crops, especially rice plants. They feed early in the morning and evening. During the rainy period, Eld's deer migrate to drier areas where they are much easier for the poacher to kill (Street, 1961, as quoted by Leng-EE, 1966).

Reproduction and Life Span. The rut takes place between the middle of March and the middle of May (Whitehead, 1972). Fawns are born after a gestation period of about 239-256 days. Usually there is one fawn at birth (Prater, 1965).

There is one record of an Eld's deer kept in captivity that lived to be 20 years old (Crandall, 1964).

Schomburgk deer (Cervus schomburgki)

Description. Height at shoulder about 41 inches. General color of pelage is uniformly brown. Antlers are large, complex, smooth, and polished (Lydekker, 1898).

Distribution. Schomburgk's deer was known to occur only in the Chao Phya Basin, although the animal had been thought at one time to be found in the neighboring countries

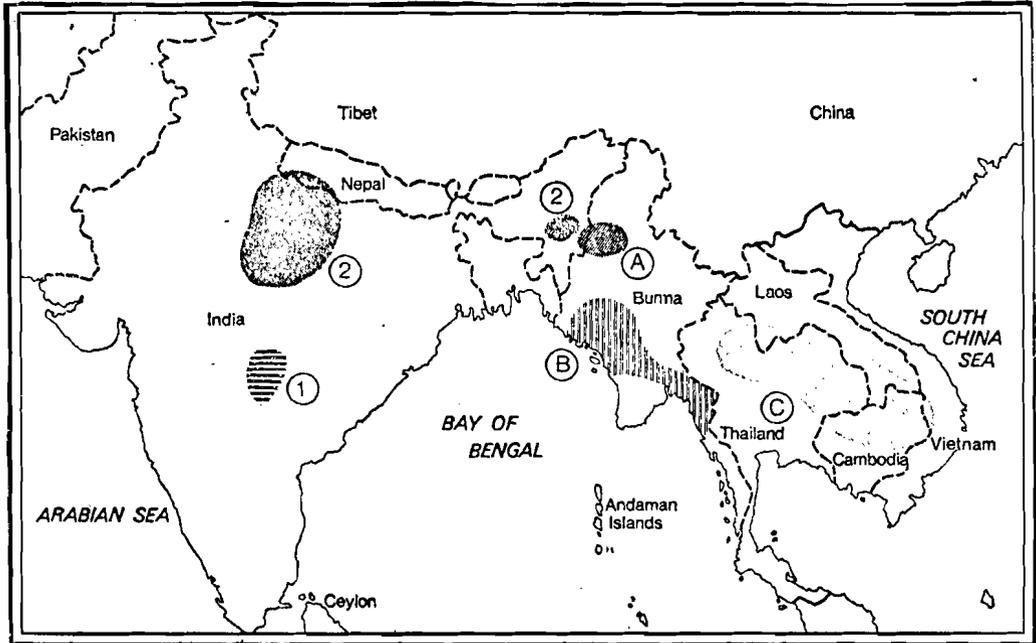


Figure 3. The distribution of Eld's deer, Cervus eldi, in Asia.

Eld's deer. Cervus eldi

- | | |
|----------------------------|--|
| A. <u>Cervus eldi eldi</u> | Manipur |
| B. <u>C. e. thamin</u> | Burma, Tenasserim |
| C. <u>C. e. siamensis</u> | Thailand, Indo-China and Hainan Island |

From "Deer Of The World" Whitehead, 1972.

of those specimens were wrongly identified (Leng-EE, 1966). This species is adapted to open lands with abundant moisture and sparse tree growth (Harper, 1945). During the last century, this species was found in the river basins of the central provinces such as Supanburi, Nakorn nayok, Nakornswan, Krungkao, Bangpakong basin and the Rungsit plains (Leng-EE, 1966). Kemp (1918 as quoted by Harper, 1945) limited the range of this species to a quadrilateral in Thailand between latitudes 15° and 17° N, and longitudes 101° and 103° E. Increasing cultivation of the land, together with the introduction of railroads and irrigation, forced the deer more and more into thick forests and into a generally unsuitable environment. In the annual rainy season when most of the grass lands were flooded, the deer retreated to the higher area or islands formed by the flood and became highly vulnerable to local people who slaughtered them for food.

All evidence indicates that the Schomburgk's deer is now extinct. The last recorded specimen was a buck killed in 1913 at the Karnchanaburi Plains (Whitehead, 1972).

Hog deer (*Axis porcinus*)

Description. Height at shoulder ranges from 25 to 29 inches; build is heavy and low, with short legs and the face comparatively short. General color of pelage is yellowish, with the upper parts more or less spotted. Spots are sometimes

limited to one or two rows on each side of a dark strip which extends down the middle of the back (Lydekker, 1898).

Both Hog deer and Chital deer (Axis axis) belong to the same genus, and they have been known to interbreed in captivity (Prater, 1965, and Crandall, 1964). The name Hog deer is derived from its squat, furtive and hoglike movements. Hog deer run with the head held low while crashing away through the undergrowth (Bauer, 1972).

Worldwide Distribution. According to Whitehead (1972) two subspecies of Hog deer are recognized:

- A. Axis porcinus porcinus, the typical race, is restricted to Ceylon, India and Burma, and
- B. A. p. annamiticus, a slightly larger race in Thailand, which also spreads into Vietnam. It does not, however, extend south along the Malay peninsula into Malaysia or northwards into China.

Formerly, Hog deer were plentiful in every part of Thailand except in the south where dense evergreen forests predominate. Present reports from some regional forest offices indicate that Hog deer now occur only in small numbers in some limited areas in the Northern, Northeastern and Western Thailand (Leng-EE, 1966).

The distribution of Hog deer, Axis Porcinus, in Asia is shown in Figure 4.

Habitat. Hog deer are particularly fond of swampy plains, swampy meadows bordering streams and plateaus in which there are adequate long grasses to give it cover, and

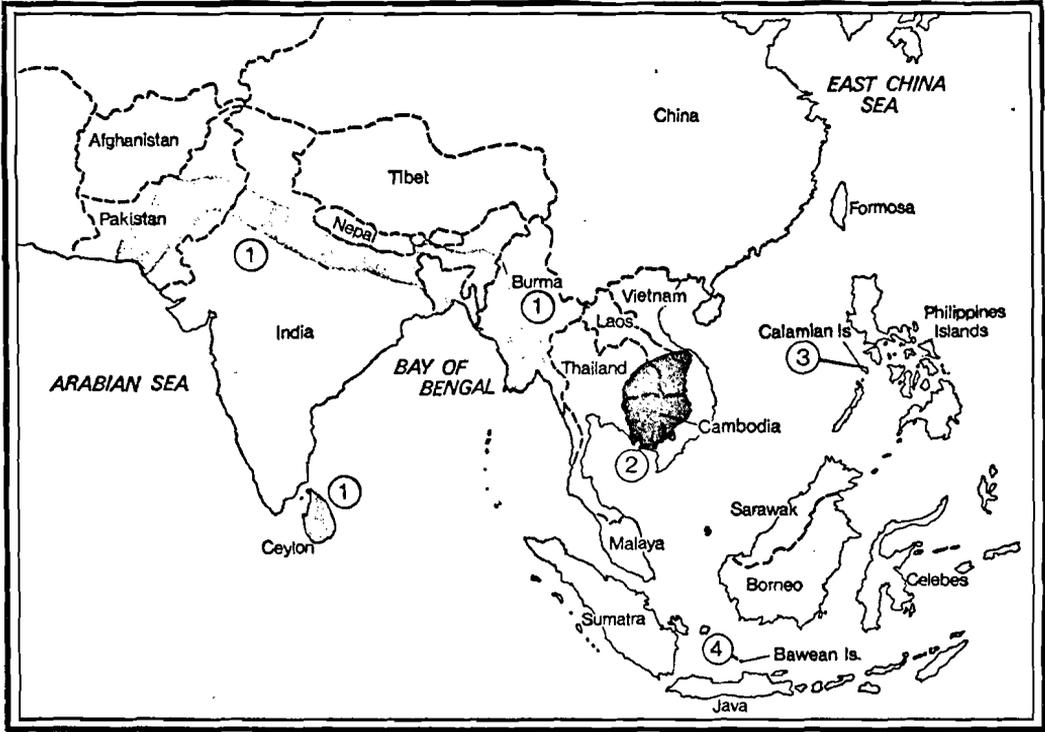


Figure 4. The distribution of Hog deer, Axis porcinus, in Asia.

Hog deer. Axis porcinus

- | | |
|----------------------------------|-------------------------------|
| 1. <u>Axis porcinus porcinus</u> | North India, Burma and Ceylon |
| 2. <u>A. p. annamaticus</u> | Thailand and Indo-China |

From "Deer Of The World" Whitehead, 1972.

along watersheds or on delta islands. They also prefer reed beds and grass-clad plains, while extensive forests are generally avoided (Lydekker, 1898; Schaller, 1967; Whitehead, 1972). In Thailand, the Hog deer lives in the open forests, especially in the grass plain near some large rivers such as the Mekhong, the Mun, the Chi and some tributaries of the Chao Phya. Leng-EE (1966) recalled that when he accompanied an expedition to Nongkai in November, 1963 to investigate habitat conditions in the area of Bungkarn district, he found Hog deer living in a habitat of open grassland interspersed with open dry dipterocarp forest and streams, where small bushes and trees were found scattered throughout the grasslands. When the grasslands are flooded during the rainy season, which is about five months in duration, the Hog deer shifts to the higher dry dipterocarp forest nearby and returns to the grassland in the dry season.

Food Habit. The Hog deer's food consists mainly of grasses, leaves, fruits, seeds, and young shoots, but they are also very fond of agricultural crops, especially rice plants. When the paddy is high enough to afford concealment, they will enter the crops even in the day time (Whitehead, 1972).

The Hog deer is said to be unsocial and essentially solitary. It may collect at times into groups of two to five individuals (Prater, 1934; Peacock, 1933) but never into herds (Lydekker, 1898). However, sometimes small groups up to 18 or so may be found grazing together. They come out to

feed early in the mornings and evenings and shelter in long grass during the hot hours of the day (Prater, 1965 as quoted by Leng-EE, 1966).

Reproduction and Life Span. According to Prater (1934), Blanford (1888-91) and Lydekker (1898), the rut of the Hog deer occurs during September and October. After a gestation period of eight months (Brown, 1936; Scalater, 1863 as quoted by Lydekker, 1898), the fawns are born in April and May (Prater, 1948). Generally, a doe will give birth to a single fawn. Occasionally two fawns are born (Whitehead, 1972), but Walker et al (1964 as quoted by Leng-EE, 1966) said that usually two young are born and one or three fawns are not uncommon. Crandall (1964) provided a record of captive Hog deer which breed successfully almost every month of the year at the New York Zoological Park.

The record life span for the Hog deer belongs to a doe kept in captivity at Rotterdam Zoological Gardens, where it lived for over 17 years.

Barking deer (Muntiacus muntjak)

Description. Height at shoulder ranging from 20-22 inches; ears are narrow and pointed; tail is short; lateral hoofs are small; and hair is comparatively short and fine (Lydekker, 1898). Unique to this species are the small antlers (on males) which consist of short brow tines on unbranched beams. These are set on bony, hair-covered pedicels which extend down each side of the face as bony

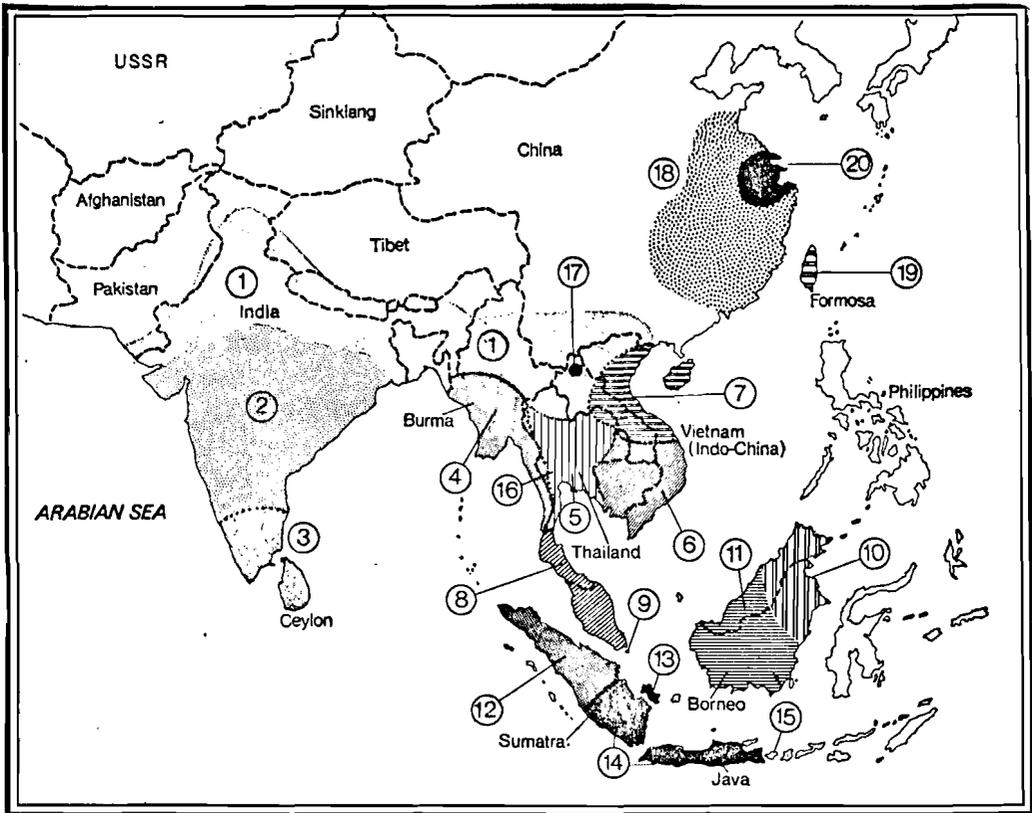


Figure 5. The distribution of Barking deer, Muntiacus muntjak, in Asia.

MUNTJAC. Muntiacus muntjak

- | | | |
|-------------|---|------------------------------------|
| 1. | <u>Muntiacus muntjak vaginalis</u> | Northern India to south-west China |
| 2. | <u>M.m. aureus</u> | Peninsular India |
| 3. | <u>M.m. malabaricus</u> | Southern India and Ceylon |
| 4. | <u>M.m. grandicornis</u> | Burma |
| 5. | <u>M.m. curvostylis</u> | Thailand |
| 6. | <u>M.m. annamensis</u> | Indo-China |
| 7. | <u>M.m. nigripes</u> | Vietnam and Hainan Island |
| 8. | <u>M.m. peninsulae</u> | Malaya |
| 9. | <u>M.m. robinsoni</u> | Rhio-Linga archipelago |
| 10. | <u>M.m. rubidus</u> | North Borneo |
| 11. | <u>M.m. pleiharicus</u> | South Borneo |
| 12. | <u>M.m. montanus</u> | Sumatra |
| 13. | <u>M.m. bancanus</u> | Billiton and Banka islands |
| 14. | <u>M.m. muntjak</u> | Java and South Sumatra |
| 15. | <u>M.m. ninggolani</u> | Bali and Lombok islands |
| FEA'S | MUNTJAC. <u>Muntiacus feae</u> | |
| 16. | <u>Muntiacus feae</u> | Terasserim and Thailand |
| ROOSEVELT'S | MUNTJAC. <u>Muntiacus rooseveltorum</u> | |
| 17. | <u>M. rooseveltorum</u> | |

From "Deer Of The World" Whitehead, 1972.

ridges. This feature is responsible for the common name of rib-faced deer normally used in Europe (Bauer, 1972). The general color is deep chestnut-red. A black line on the inner side of the pedicels of the antlers continue for some distance down the side of the ridge on the face (Lydekker, 1898).

Worldwide Distribution. According to Whitehead (1972), the Muntjaks include five species and 15 subspecies and have a wide distribution in southern and southeast Asia ranging from India in the west to southeastern China and Formosa, while in the south its distribution includes Sumatra, Java and some other islands of Indonesia. In Thailand, two races of M. muntjak are distributed throughout the country and have been recognized as follows:

- A. Muntiacus muntjak curvostylis which occurs in the central and northern part of Thailand, and
- B. M.m. feae which occurs sparingly in Tenasserim and southwestern Thailand.

The distribution of Barking deer, Muntiacus muntjak, in Asia is shown in Figure 5.

Habitat. Barking deer prefer thickly wooded hills. In Thailand this species usually keeps to dense forests and comes out to graze in the openings along the forest edge.

Food Habit. Barking deer are primarily browsers. When foliage is scarce, Muntjaks remove the edible bark of certain trees with their tusks, but when leaves and bark are not available, it will readily eat grass. Muntjaks also eat

fruit, seeds and young shoots. Fruits of Makogpa (Spondias spp.) and Ma-khampom (Ailanthus spp.) are popular foods of barking deer, and their presence in an area influences the number of the deer in that area. This deer also sometimes feeds on agricultural crops such as tapioca. Muntjaks drink daily and are chiefly nocturnal (Lekhukul, 1962 as quoted by Leng-EE, 1966; Crandall, 1964; Whitehead, 1950). The muntjak is a non-gregarious species although they associate in pairs at certain seasons of the year.

Reproduction and Life span. Muntjaks are prolific. There is no fixed breeding season, but possibly the greatest activity occurs during the first six months of the year. This results in the majority of the one or two fawns per female being born during the latter part of the year (Whitehead, 1972) after a gestation period of about 180 days (Walker et al. 1964).

The life span of this species is quite long. There is a record of one captive muntjak which lived to be over 15 years of age (Jones, 1958 as quoted by Crandall, 1964).

CLIMATE OF KANSAS

According to Flora (1948):

The State of Kansas lies across the path of alternate masses of warm moist air moving north from the Gulf of Mexico and currents of cold, comparatively dry, air moving from the polar regions. Consequently, its weather is subject to frequent and often sharp change, usually of short duration. The borders of Kansas extend 400 miles from the moderate elevations and rather humid conditions of the lower Missouri Basin to the high plains lying along the eastern slope of the Rockies. As a result, it has three rather distinct climates, outlined roughly by its eastern, middle and western thirds.

The eastern third has an average annual precipitation of 35.27 inches, a higher relative humidity, less sunshine, and less range between day and night temperatures than other parts of the State. The middle third has an average annual precipitation of 26.45 inches. It has drier and more refreshing air, more sunshine, a better wind movement, and a greater range between day and night temperature than the eastern third.

The western third is often called "The Short Grass Country" because of the prevalence of buffalo grass in that section. The average annual precipitation is 19.01 inches. The air is almost as dry and refreshing as in summer resorts of the Rocky Mountains. The amount of sunshine exceeds that of almost any part of the United States, except the Southwest. The wind movement is rather high. The range between day and night temperatures is considerably greater than at points farther east.

The range of weather factors recorded in Kansas is set out in the following table:

TABLE IV. Mean Annual Precipitation, Temperature and Humidity of Kansas.

Regions	Mean Annual Precip. April-September (Inches)	Temperature			Rel. Humid.	
		mean ann. (F)	mean warmest (F)	mean coldest (F)	summer (%)	winter (%)
Eastern	24.64	55.0	79.0	30.0	45-50	70
Middle	19.49	-	-	-	-	-
Western	14.70	-	-	-	35-40	60

From "The Climate of Kansas" Flora, 1948.

WILDLIFE CONSERVATION IN KANSAS

The first effort to conserve wildlife came to Kansas in 1861 at which time the hunting of deer and wild turkey was prohibited during certain times of the year. During the next several years similar prohibitions were enacted against killing other animals, but little was done to enforce these laws, and no regular enforcement machinery was established. It was not until 1905 that a general wildlife-conservation program was undertaken in Kansas by the State Fish and Game Warden. Hunting licenses began to be required and license fees were deposited in a special fund for conservation. Somewhat later, seasons were set up for the protection of wildlife and county fish and game wardens were appointed to enforce the game laws. For various reasons, the State Fish and Game Warden was placed under the general supervision of the Board of Regents and later under the Board of Administration. However, in 1927 the Forestry, Fish and Game Commission was established and the State Fish and Game Warden was made responsible to the Commission. This Commission was reconstituted in 1961 and now consists of a commissioner appointed by the Governor from each of four districts and one commissioner-at-large. The Commission selects its own chairman and an executive secretary who takes care of the day-to-day operations of the department. The conservation program has become extensive with the Commission undertaking the development of parks and

lakes to provide a system of refuges, reserves and breeding places for wildlife. State parks were constructed and counties were authorized to establish parks. In 1934 the federal government gave aid to this movement through the Civilian Conservation Corps and other public-works projects. By July, 1968, there were 41 state parks and lakes, three game preserves, and other properties. In June 30, 1968, there were 41 state parks and lakes, three game preserves, and other properties. In June 30, 1968, the Commission had entered into agreement with the U.S. Corps of Engineers and the Bureau of Reclamation for the Commission to manage 98,093 acres of water and land in 16 different locations. Also, the Commission has made arrangements with private owners for land under the U.S. Department of Agriculture Cropland Adjustment program to be opened for public hunting. Besides carrying on such programs, the Commission has worked with both the federal government and other states to expand Kansas conservation efforts. For instance, agreements have been reached with Oklahoma to exchange animals and services in order to bring deer back into the state of Kansas. There are no appropriations from the state general funds for the operation of the Commission. Operating expenses of the Commission come from the sale of licenses and from federal funds.

In general, the wildlife conservation program of the state, aided materially by federal funds, is progressing toward a comprehensive plan of fish and game restoration,

distribution, and protection. In this program, the state Commission has been helped by the formation of county fish and game clubs, which lend support and prestige to the conservation movement. This, together with an increasing number of people participating in hunting and fishing, has lent impetus to the program of wildlife conservation in Kansas (Drury, 1970).

Organizational Structure of Kansas Forestry, Fish and Game Commission

According to Kansas Biennial Report, 1970:

The Kansas Forestry, Fish and Game Commission was established by the 1961 legislature to replace the former six-man bipartisan commission. This Commission has the duty of preserving, propagating and protecting the state's fish and game resources and provides for establishment and maintenance of areas in which game, game birds and other birds, furbearing animals, and fish may breed or rest, and to replenish hunting and trapping grounds and waters or fishing waters; to establish and maintain game management areas, to extend and consolidate lands or waters, and to exchange lands or waters, or both, which the Commission may desire; to conduct research in conservation methods and to disseminate information for the public.

The Kansas Fish and Game Commission is composed of six divisions. They are Information-Education Division, Law Enforcement Division, Field Service Division, Game Division, Fisheries Division, and Fiscal Division.

Information-Education Division. The primary function of this division is to keep all sportsmen informed of the Commission's policies, activities, programs and expenditures. An attempt is also made to educate sportsmen and the general public in principles of modern wildlife management and

conservation of the state's wildlife resources. Major emphasis is also placed on dissemination of news to the sporting public. Included in this media presentation are a weekly news release, periodic feature stories and photographs, compilation of a quarterly Fish and Game magazine, and a weekly radio program.

This Division staff also contacts the public directly through appearances at schools, civic clubs and organizations, sportsmen's groups, major sport shows and fairs.

Law Enforcement Division. The basic responsibility of the Law Enforcement Division is enforcement of fish and game laws, state boating laws, and regulations regarding these laws. To enforce these laws and regulations throughout the state, the division exercises police powers in detecting, apprehending, and arresting those in violation. The law enforcement division is divided into six supervisory regions over the state to aid in coordinating activities and expediting assignments. Each region is headed by a law enforcement supervisor who supervises game protectors in their respective districts. Game protectors are assigned one or more counties as an area of responsibility. During 1969-1970, the division operated with 53 game protectors and six supervisors. Money collected in fines for fish and game law violations goes to the state school fund. The Commission does not receive any money from fines or court costs.

Field Service Division. The Field Services Division is divided into five maintenance districts over the state. Each maintenance district is headed by a maintenance repairman and the lake and grounds keepers.

Game Division. The Game Division's primary function is to provide Kansas sportsmen with maximum quality hunting opportunities without jeopardizing the brood-stock of the many game species. To accomplish this goal the division is structured for three primary activities: research and investigation, resource management, and game propagation.

The research and investigation section gathers annual and long term information on the distribution, population, harvest and habitat needs of game birds and mammals. Most studies are directed to the practical objective of using resulting data for management purposes.

The management section is charged with development-owned or controlled lands for waterfowl, furbearers and upland game benefits. This section also provides a liaison service between the department, private land-owners and state and federal agencies for the acquisition and/or development of public and private lands for wildlife production and harvest.

Fisheries Division. The goal of the Fisheries Division is to provide maximum fishing opportunities with the highest possible rate of catch success.

Fiscal Division. This division maintains all fiscal records, receipts of remittances excepting the hunting, fishing and trapping license sales which are remitted directly to the state treasury by the county clerks. Hunting, fishing, and trapping licenses and upland game bird stamps are sold on a calendar-year basis. Records are kept of all licenses issued to the county clerks and the number of licenses sold by each category.

The Kansas Forestry, Fish and Game Commission Organizational Structure is shown in Figure 6.

Deer Hunting in Kansas

According to Anderson, (1964):

Although both mule deer (odocoileus hemionus) and white-tailed deer (odocoileus virginianus) occur in Kansas, it is the only state that has not had an open season within the past several years. As the white man advanced westward many animals, including deer, were extirpated, or nearly so. In the Great Plains region, deer were killed off during the late 1800's. Lack of interest in conservation of natural resources along with inadequate protection and law enforcement were responsible for slowing the recovery of deer during the early 1900's. Nebraska, Iowa, Illinois, Oklahoma, Missouri, and Arkansas all experienced in deer herds, which were smallest around the turn of the century. All of these states succeeded in restoring herds through management, protection, and natural dispersal, and now have open seasons. Kansas is the last of the Plains states to benefit from natural dispersal of deer from surrounding areas, and only recently have deer become re-established in the state.

The population of deer in Kansas had increased and reached a harvestable number by 1965. Kansas' first deer season was held December 11-14 in the same year (Peabody and Hlavachick, 1972).

KANSAS FORESTRY, FISH AND GAME COMMISSION

ORGANIZATIONAL STRUCTURE

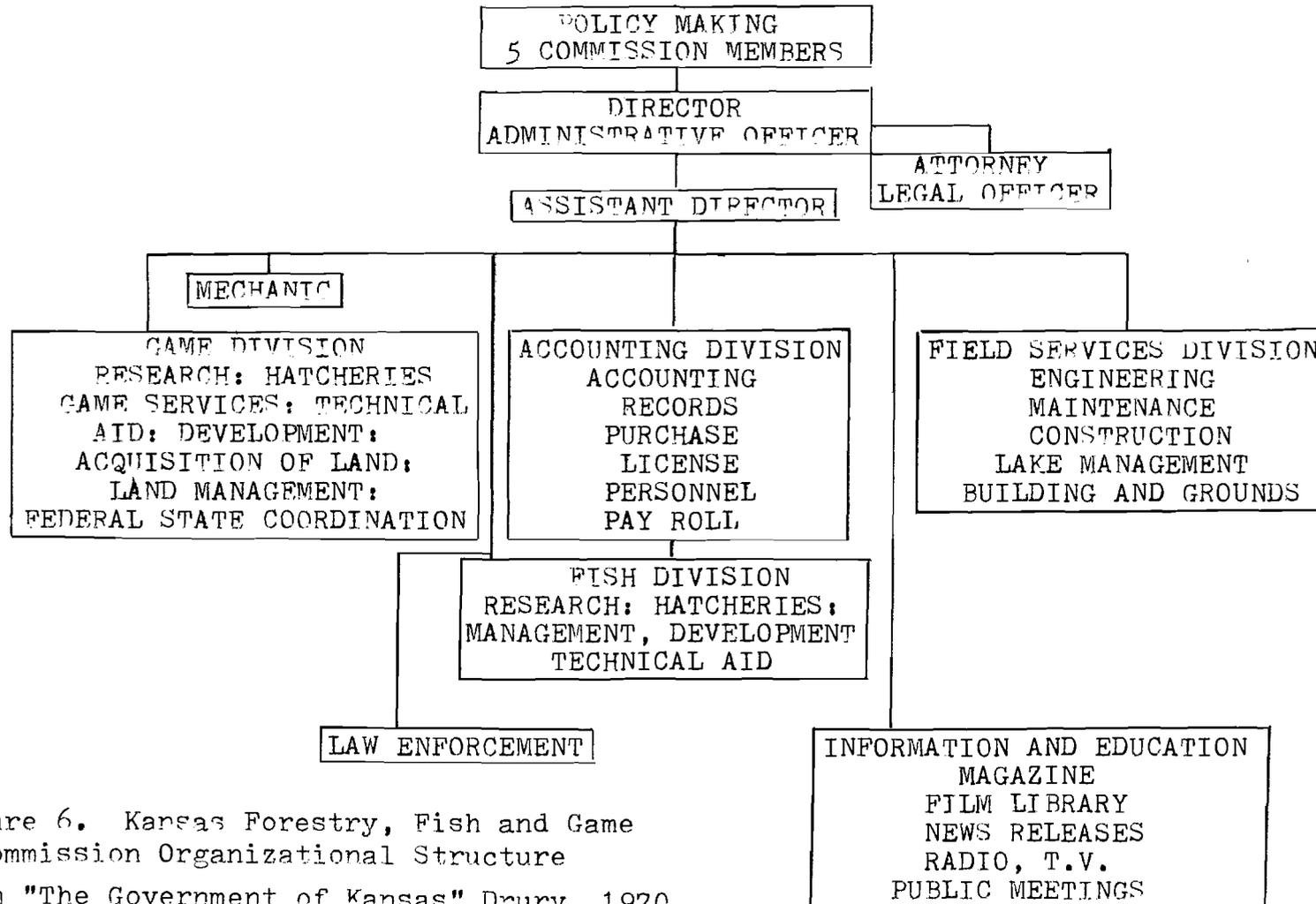


Figure 6. Kansas Forestry, Fish and Game Commission Organizational Structure

From "The Government of Kansas" Drury, 1970.

Kansas Deer Hunting Regulations

According to Kansas Fish and Game Commission, 1972:

Deer Hunting Permits. There are two deer hunting seasons in Kansas, the archery season and the firearms season. Archery permits are unlimited; firearms permits are issued on a drawing basis. Only one deer hunting permit, either archery or firearms (not both) is issued to an applicant. Persons fraudulently obtaining two permits will be denied any permit for the year in which the permits were obtained.

Deer Hunting Seasons.

1. Archery Season. The dates open for archery deer hunting are subject to change from year to year.

Season bag limit. The season bag limit is one deer of either sex.

Legal archery equipment. Legal equipment is a long bow of not less than 35 pounds pull, and all hunting arrows must be equipped with steel broadhead points. Crossbows, or any other mechanical bows, with the exception of the compound bow, are illegal for deer hunting.

It is illegal to use any drug, chemical or compound in conjunction with broadhead arrows to take deer.

It is illegal for an archery deer hunter to have any type of firearm on his person when hunting deer with a valid archery permit.

Shooting hours. Shooting hours for the taking of deer with bow and arrow are from one-half ($\frac{1}{2}$) hour before sunrise to sunset.

Archery deer hunters will receive a two-part deer carcass tag and report card along with a metal locking seal with their permit. The successful hunter must date, sign, address and permanently affix the paper carcass tag to the deer carcass by means of the metal locking seal immediately upon killing it to show legal possession.

Successful archers must report their kill to the Forestry, Fish and Game Commission on the report card provided with their permit within thirty-six (36) hours after the deer is killed. Unsuccessful bowhunters must report the results of their hunt within ten (10) days following the close of the archery season. Those permittees not reporting will be ineligible to receive any deer permit in the following year.

The summary of season dates, number of permits issued and number of deer harvested are shown in the following table:

TABLE V. A summary of archery deer hunting seasons,
1965-1971.*

Year	Open Dates	No. Days	Permits	Hunters	Harvest
1965	Oct. 1 to Nov. 15	46	1,220	1,151	164
1966	Oct. 1 to Dec. 9	70	2,345	2,234	376
1967	Oct. 1 to Nov. 26	57	2,988	2,739	434
1968	Oct. 1 to Dec. 1	62	3,807	3,491	614
1969	Oct. 1 to Nov. 30	61	3,936	3,539	563
1970	Oct. 1 to Nov. 30	61	4,479	4,083	796
1971	Oct. 16 to Nov. 25 Dec. 11 to Dec. 31	62	4,672	4,173	576
1972	Oct. 1 to Nov. 30	61	4,123	3,660	664

*From "Deer Population Dynamics and Harvest Trend".

Peabody and Hlavachick, 1972.

2. Firearms Season. Beginning in 1973, Kansas Firearms Deer Seasons will open on the first Saturday in December. This follows the peak period of upland game hunting activity thereby reducing the chances for upland game hunter-deer hunter conflicts, and enables prospective firearms deer hunters to plan more effectively.

Season bag limit. The season bag limit is one deer with restrictions on sex by management unit (there are 18 deer management units in Kansas). Where antlered deer hunting applies, an antlered deer is defined as a male deer with a fork on at least one antler. "Button" bucks (fawns) are not legal in antlered-only units.

Shooting hours. Shooting hours for the taking of deer with firearms are from one-half ($\frac{1}{2}$) hour before sunrise to sunset.

Legal firearms. The legal firearms for hunting deer in Kansas are shotguns, muzzle-loaders and rifles at the option of the landowner on whose property the permit holder has permission to hunt.

Legal shotgun. A legal shotgun must be 20, 16, 12 or 10 gauge using only rifled slugs. Buckshot or other multi-projectiled shot is illegal for deer hunting, and it is illegal for any firearms deer hunter to have on his person any shotgun shell loaded with shot larger than size No. 4 birdshot (0.13 inches diameter) while hunting deer under a valid firearms deer permit.

Legal muzzle-loader. A legal muzzle-loader must be .40 caliber (40/100 inches diameter) or larger.

Legal rifle. A legal rifle must be capable of firing a bullet which is greater than .23 caliber (23/100 inches diameter) and must use a cartridge having an overall length (case and bullet) of at least two inches, except, that a .44 Magnum will be a legal cartridge in a rifle or carbine. Fully automatic weapons are illegal. Only soft-point, hollow-point or other expanding bullet may be used. All tracer, armor-piercing and full-jacketed bullets are illegal.

Handguns may not be used for taking deer.

It is illegal to use dogs for the purpose of hunting or taking of deer.

It is illegal to shoot at, kill or pursue deer from a motor boat, airplane, motor car or other vehicle.

It is illegal to locate, hunt or pursue deer from an airplane, or to give information concerning the location thereof by radio or other mechanical device from an airplane.

Persons hunting deer during the firearms season are required to wear a hat of red or orange color, and to have, in addition, on the upper half of his body a minimum of 200 square inches of red or orange color, a portion of which is visible from both front and behind.

Firearms deer hunters will receive a two-part deer carcass tag and hunter report card with their permit. A metal locking seal is provided also. The successful hunter must date, sign, address and permanently affix the carcass tag to his deer by means of the locking seal immediately upon killing it to show legal possession.

Successful firearms hunters must report their kill to the Forestry, Fish and Game Commission on the report card provided with their permit within thirty-six (36) hours after the kill is made. Unsuccessful permittees must report the results of their hunt within ten (10) days after the close of the season. Those not reporting will be ineligible to receive any deer permit in the following year.

The summary of season dates, number of permits issued and number of deer harvested are shown in the following table:

TABLE VI. A summary of firearms deer seasons, 1965-1971.*

Year	Season Dates	No. Days	Permits Authorized	Permits Issued	Harvest
1965	Dec. 11 to 15	5	4,575	3,925	1,340
1966	Dec. 10 to 14	5	6,000	5,806	2,139
1967	Dec. 8 to 12	5	6,450	6,450	1,542
1968	Dec. 13 to 17	5	6,500	6,371	1,648
1969	Dec. 6 to 10	5	7,750	7,591	1,668
1970	Dec. 5 to 13	5-West 9-East	9,034	8,955	2,418
1971	Nov. 27 to Dec. 4 to Dec. 8	9-East 5-West	8,665	8,618	2,569
1972	Dec. 2 to 10	9-East 5-West	8,065	8,059	2,318

*From "Deer Population Dynamics and Harvest Trend".

Peabody and Hlavachick, 1972.

LIFE HISTORY OF WHITE-TAILED DEER

White-tailed Deer (Odocoileus virginianus)

The white-tailed deer is the most plentiful big-game animal in North America. Taylor (1961) wrote of this deer in his book "Deer in North America":

"Of the larger game animals on this continent, the deer is the most adaptable, most widely distributed, most heavily hunted, best loved, and among the most misunderstood. It can make its home in suburban woodlots within sight and sound of roaring traffic and bustling human activity, and can increase its numbers in the face of hunting pressure....., the deer has adapted itself to new conditions and has, in many cases, successfully occupied new territory."

Description

Height at shoulder averages from 36 to 40 inches; total length varies from 60 to 75 inches. The average full grown buck weighs about 150 pounds; a doe, 100 pounds. A northern white-tailed buck (O. v. borealis) may have a maximum live weight of 400 pounds. It has over-all reddish-brown coloration, white undersides, and prominent white tail, which bounces and waves like a flag when the deer runs. The antlers of the white tail are low, compact, and well suited for a life in the dense, tangled undergrowth of deciduous woodland. Its antlers consist of two main beams that grow out and backward from their bases and then sweep forward and

then curve inward over the face (O'Connor and Goodwin, 1961; Strung, 1971; Rue, 1971).

Worldwide Distribution

The overall geographical range of the white-tailed deer extends in suitable terrain from Nova Scotia and the southern tip of Hudson Bay across Canada to British Columbia, south through the United States, Mexico, Central America to Columbia in South America, and some of the adjacent islands (O'Connor and Goodwin, 1961).

Thirty subspecies of white-tailed deer are now recognized for the North American continent. Kansas white-tailed deer, Q. v. macrourus, were formerly distributed in Iowa, eastern Kansas, Missouri, eastern Oklahoma, Arkansas, eastern Texas and northern Louisiana. It is now extinct throughout much of its former range. It intergrades on the northwest with Q. dacotensis, on the west and southwest with Q. texanus, on the east with Q. borealis and Q. virginianus, and on the south with Q. moilhennyi (Taylor, 1961).

Habitat

White-tailed deer prefer a habitat with an abundance of edge associated with brush land, wood lots or small tracts of timber or forest land, because in such areas, the undergrowth and low forage flourish (Taylor, 1961). Strung (1971) maintained that white-tailed deer thrive close to civilization. It favors dense grasslands.

The distribution of white-tailed deer, Odocoileus virginianus, in North America is shown in Figure 7.

Food Habit

White-Tailed deer subsist on a variety of browses, grasses, sedge, water lilies and other kinds of aquatic plants. In the fall it feeds on nuts and seeds, especially acorns and apples. During the scarcity of food in winter, it will eat the needles and sprouts of evergreens, along with dead and dried leaves and grasses, as well as some mosses (O'Connor and Goodwin, 1961). White-tailed deer also feed on agricultural crops such as corn, sorghum, and wheat. A study of the food habits of white-tailed deer in northern Kansas made by Watt et al. (1967), revealed that corn was the most important food of deer in the study area, 28.6 per cent of the annual diet. Sorghum contributed 8.4 per cent of the annual diet.

Reproduction and Life span

The white-tailed deer is prolific, and the does begin to breed at an early age. Normally young does are ready to breed in their eighteenth month, but well-nourished doe fawns in the northern woodland breed at six to eight months and successfully carry fawns to birth (Taylor, 1961). The buck fawns, however, do not attain sexual maturity in their first year, and are about 18 months old at the time of their first

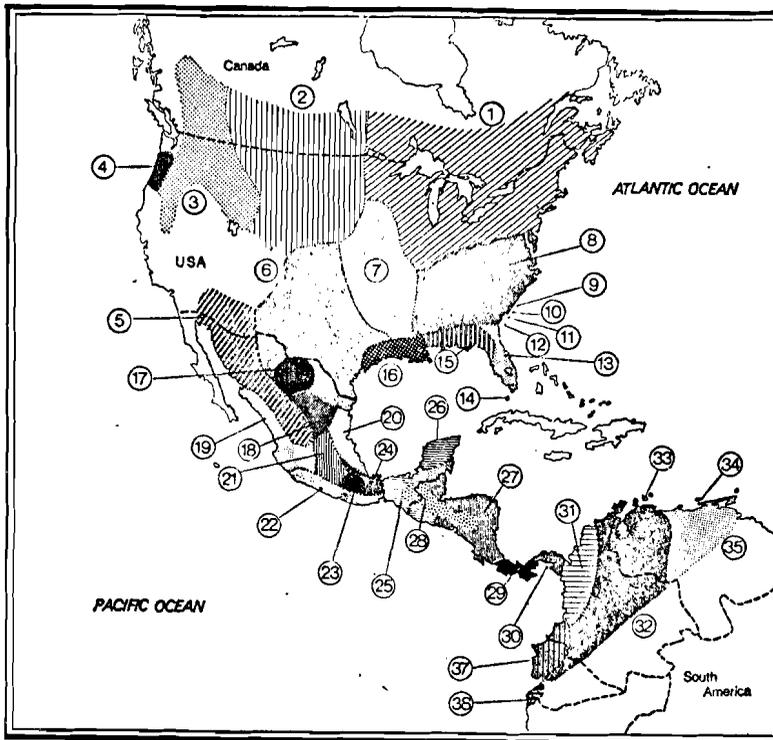


Figure 7. The distribution of white-tailed deer, Odocoileus virginianus, in North America.

- | | | |
|-----|--|---|
| 1. | <u>Odocoileus virginianus borealis</u> | South-east Canada and north-east U.S.A. |
| 2. | <u>O.v. dacotensis</u> | Alberta to north Dakota |
| 3. | <u>O.v. ochrourus</u> | North-west U.S.A. and Canada |
| 4. | <u>O.v. leucurus</u> | Oregon and west coast |
| 5. | <u>O.v. couesi</u> | Arizona |
| 6. | <u>O.v. texanus</u> | Texas and adjoining States |
| 7. | <u>O.v. macrourus</u> | Kansas and adjoining States |
| 8. | <u>O.v. virginianus</u> | Virginia and adjoining States |
| 9. | <u>O.v. taurinsulae</u> | Bulls Island |
| 10. | <u>O.v. venatorius</u> | Hunting Island |
| 11. | <u>O.v. hiltonensis</u> | Hilton Head Island |
| 12. | <u>O.v. nigribarbis</u> | Blackbeard Island |
| 13. | <u>O.v. seminolus</u> | Florida |
| 14. | <u>O.v. clavium</u> | Florida Keys |
| 15. | <u>O.v. osceola</u> | North-west Florida |
| 16. | <u>O.v. mcilhennyi</u> | Louisiana |

From "Deer Of The World" Whitehead, 1972.

rutting season (Cheatum and Morton, 1946, as quoted by Taylor, 1961).

The height of the rutting season comes in November but some does may not breed until February. The white-tailed deer's gestation period is 200 to 205 days. Most of the fawns are born in the latter part of May or the first part of June. A doe giving birth for her first time will have a single fawn; thereafter she may have twins. In areas of good food, triplets are common as well as occasional quadruplets (Rue, 1971).

According to Taylor (1961), the results from a study of the fertility of does indicated a progressive rise in fertility until about 4.5 years, then a leveling off through about 7.5 years, followed by a decline with advancing age. Details are shown in Table 7.

TABLE VII. The fertilities of white-tailed does from 2.5 to 10 years and older.*

Age of does	No. of does	No. of fetuses/doe	Ave. fetus/doe
2.5	28	44	1.57
3.5	17	28	1.65
4.5-7.5	13	26	2.00
8.5-9.5	9	11	1.22
10 and older	8	8	1.00

*From "The Deer of North America" Taylor, 1961.

In Kansas the examination of road-killed does in the year 1971 revealed the reproductive rate of 1.41 fetuses per all-age does (Peabody and Hlavachick, 1972).

The life span of white-tailed deer averages from eight to 11 years. There is a record of a captive doe that lived to be 19 years old.

Pennsylvania's Game Division (as quoted by Rue, 1971) found from records of antlered deer killed that the age of bucks broke down as follows: 67 per cent were 1.5 years old, 20 per cent were 2.5 years old, 9 per cent were 3.5 years old, 2 per cent were 4.5 years old and 2 per cent were 5.5 years old.

COMPARATIVE DEER MANAGEMENT

The decline in number of wildlife including deer in Thailand resulted from a combination of factors. Currently, the two most serious factors are loss of suitable habitat and overhunting or poaching.

People

The attitude of Thai people toward wild animals is to kill basically for food. Most of the people have little knowledge about wildlife conservation or understanding of the importance of conserving wildlife for recreational and scientific purposes. The nomadic hill-tribes, totaling 200,000-300,000 people in the northern and upper northeastern Thailand, not-with-standing nominal legal protection, continue to hunt wild animals, mainly for food. They also engage in clearing the forests for shifting cultivation (slash farming), which is harmful to forest and soil conservation.

There are three Thailand institutions that offer direct education in national resources conservation. They are the College of Forestry and the College of Fishery at Kasetsart University and the Forestry Training School, Prae, conducted by the Royal Forest Department.

In Kansas, people have adopted hunting as a permanent part of their recreation program. They consider hunting to

be one of their inalienable rights. The average Kansan has more or less been educated, or exposed, to wildlife conservation. The public's wildlife conservation education is given through the use of magazines and special booklets published by the various agencies, and by means of movies and expert speakers. Sportsmen also play an important role in wildlife management. Randolph (1973) said,

"Some of the better management practices have been so revolutionary that conservation agencies found they needed the assistance of sportsmen in order to gain public acceptance of new ideas..... Wildlife management programs must have the understanding and support of sportsmen if they are to be successful."

Wildlife Law and Law Enforcement

Thailand. The Wildlife Act in Thailand was passed in 1960 and came into effect in 1961. The public has not yet become accustomed to it. The law divided wild animals into two categories, the preserved group and the protected group. The protected group is subdivided into first and second categories. Although the slaying of the reserved and the first protected category is not allowed, the capturing of the second group is still permissible. Various methods have been used to capture these animals, including the killing of females to obtain the young. Many of those that have been caught are kept under primitive and unhygienic conditions. They may be compelled to exist on an unnatural diet and die from malnutrition or disease. Since the law was passed in 1960, law enforcement has been inadequate and ineffective as indicated by the following table.

TABLE VIII. The record of annual licenses and number of arrests for violations. (From Leng-EE, 1966).

Year	Hunting	Licenses Issued		Arrests for violation
		Trading animals	Trading meat	
1962	180	1	5	10
1963	961	20	5	15
1964	844	16	6	2
1965	747	17	-	11
Total	2,732	54	16	38

These figures do not indicate that game law violators are of small number; it rather indicates the inadequate and ineffective enforcement of the game law. In the year 1965, in a population of about 30,744,000 people, 747 hunting licenses were issued, a ratio of one hunting license per 41,156 people. Again, this does not indicate low hunting pressure, but indicates that most of the hunters hunted without hunting licenses. Although all big game hunting was terminated in 1966, meat and other products from big game animals still are available in the market. Poaching has been a serious problem in wildlife conservation. Game animals are killed basically for food, but it should not be assumed that illegal hunting is the monopoly of the poor and needy. It is practiced by people from all walks of life, and in some instances, poaching has been done by those in the high places who appear able either to disregard or to circumvent the law.

Kansas. In Kansas, there are two deer hunting seasons, the archery season and the firearms season. Kansas residents must possess a valid archery or firearms permit to hunt deer. One must have the current Kansas hunting license before applying for a deer permit. Only one deer hunting permit will be issued to an applicant. Archery permits are unlimited; firearms permits are issued on a drawing basis. Kansas law provides that 50 per cent of all permits authorized within each firearms deer management unit (18 unit total) will be reserved for resident owners and resident tenants of farm land in Kansas. The remaining 50 per cent will be issued to residents of the state who are not resident owners or resident tenants of farm land. Kansas held its first deer season in December, 1965. The summary of firearms and archery deer seasons from 1965-1972 is given in Table 9.

TABLE IX. A summary of firearms and archery deer seasons, 1965-1972.*

Year	Firearms		Archery	
	Permit issued	Harvest	Permit issued	Harvest
1965	3,925	1,340	1,220	164
1966	5,806	2,139	2,345	376
1967	6,450	1,542	2,988	434
1968	6,371	1,648	3,807	614
1969	7,591	1,668	3,936	563
1970	8,955	2,418	4,479	796
1971	8,618	2,569	4,672	576
1972	8,065	2,318	4,123	664

*From Peabody and Hlavachick, 1972.

Poaching also is a serious problem in Kansas. In the years 1970 and 1971, there were 89 and 69, respectively, illegal kills detected. Peabody (1973) believes that the amount of deer being killed illegally each year in Kansas is as high as the legal harvest of deer during the hunting season, and that tougher penalties for poaching should be imposed to cut down on the number of game law violations. According to Merwin (1972), most officers over the United States who enforce conservation laws believe that judges and prosecuting attorneys handle so many apparently more serious crimes than game-law violations that persons who illegally kill wild game often receive only minimal or suspended fines.

Wildlife Management Budget

The primary source of wildlife section expenditure in Thailand is tax revenue provided by the Thai Government. At present, the wildlife section does not have sufficient money to effectively carry out the management program. The lack of money has also resulted in having so few staff members at its disposal that it cannot, as it stands, contribute effectively to the protection of the wildlife species. It is hardly possible for the department to fulfill its function without additional budget and staff.

The Kansas Forestry, Fish and Game Commission is a fee agency and does not receive any revenue from general taxation. The operating expenses of the Commission come from federal funds, special deer permits, and the sale of hunting, fishing, and trapping licenses.

Habitat Management

In Thailand, forested land occupies about 51 per cent of the total area of the country. These forests are nationally owned. If any area is considered suitable for wildlife habitat, the Royal Forestry Department may create it as a game sanctuary by Royal Decree. Currently, Thailand has about 300 Reserved Forests, 11 National Parks, and 19 Recreation Areas (Photisararo, 1973).

Wildlife habitat management in Kansas is charged to the management section of the Game Division. This section

has the duty of developing the department-owned or controlled lands for wildlife benefits. It also provides a liaison service between the Department, private land-owners, and state and federal agencies for the acquisition and/or development of public and private lands for wildlife production and harvest.

RESULTS AND DISCUSSION

Thailand faces many difficult problems in wildlife conservation. What is basically lacking is sufficient financial support of the Royal Forest Department to carry out the wildlife conservation program effectively. Wildlife research requires money and trained men of which Thailand has neither in adequate quantity at this time. The training of technical personnel to carry on the field study and to work in the administrative structure of the R.F.D. is somewhat of a problem, since educational facilities in field zoology and wildlife management are limited. There are, at present, only three institutions which offer education directly within the wildlife field.

In Thailand, sport hunting is still of limited importance. Game is hunted extensively for home consumption as well as for commercial purposes. In Kansas, only sport hunting is allowed. The rather strict enforcement of the game laws has made it mandatory for all hunters to purchase hunting licenses, even when landowners hunt deer in their own lands. Conversely, in Thailand the vast majority of the rural hunters cannot afford to purchase licenses and would have little need to worry, for the paucity of enforcement officers makes apprehension of unlicensed hunters most unlikely.

Another factor that affects the wildlife conservation of Thailand is the public lack of knowledge in wildlife

conservation and the understanding of the situation of the wildlife at present. Since conservation must have its beginnings in the mind of the average citizen, every conceivable method of extension and education should be employed to carry to the Thai public the concepts of conservation. Printed material, movies, radio and especially television, can be used to reach the various strata of Thai society. Another hope is in the school system, where the Ministry of Education started to incorporate conservation teaching into the system of primary education a few years ago.

Since the game law was passed in 1961, law enforcement has been ineffective due to the inadequate enforcement budgets and personnel. If the conservation programs are to be carried out effectively, the Royal Forest Department has to have more financial support from the Thai government.

SUMMARY

1. The two most serious problems for wildlife conservation in Thailand are overhunting and poaching and the destruction of wildlife habitat. Kansas also faces the problem of illegal hunting. Each year illegal hunting removes as many deer as the legal harvest. In both Thailand and Kansas harsher penalties should be imposed for game law violations.

2. The wildlife section of Thailand needs to have more financial support from the government to carry out the wildlife conservation program.

3. Technical knowledge and trained men will be needed to enforce the law and to guide conservation efforts in Thailand.

4. The Thai public needs to be informed about the situation of the wildlife of Thailand at present, because the help from citizens in all walks of life is needed in wildlife conservation.

5. Ecological studies are needed to provide the scientific data for planning effective management of wildlife and their habitat in Thailand.

6. A strict limit should be introduced and enforced on the numbers of wild animals collected for zoos and museums in Thailand.

Part II

INTRODUCTION

The second objective of this study was to determine if there were significant differences in physical structure between female and male white-tailed deer, Odocoileus virginianus, incisor teeth.

Sex determination in deer can be made easily in the flesh; it is also possible to determine the sex from examining the skeleton. In deer over two years of age, the presence of the suspensory tuberosities for the attachment of the penis ligaments differentiate males from females (Taber, 1956). Deer teeth have been used successfully in age determination by a number of research biologists, but an attempt at sex determination based on teeth examination has not been made. Any reliable and accurate technique of determining the proper sex, together with knowledge of age-determining technique, will result in a useful and practical deer management tool in understanding of deer population dynamics.

The primary objective of this study was to determine if any significant structural differences exist between male and female deer incisor teeth.

METHODS AND MATERIALS

Obtaining Teeth for the Study

The teeth, primary incisors of 20 pairs of known age and sex deer were obtained from Mr. William C. Peabody, Big Game Project Leader of The Kansas Forestry, Fish and Game Commission. These teeth were removed from deer killed by successful hunters during the 1972 Kansas firearms deer season and submitted to the Kansas Forestry, Fish and Game Commission in specially prepared envelopes.

Preparing Teeth for Examination

Each pair of teeth was soaked separately until all flesh adhering to the teeth surfaces was decomposed. Teeth were then rinsed in tap water, and allowed to air dry for two weeks.

All teeth were examined for comparative evaluation by the following criteria:

- a. Length
- b. Weight
- c. Volume

Length. All lengths were determined through the use of a microcaliper. The lengths were:

- a. Crown length - length from the gum line to the tip of the crown.

b. Root length - length from the tip of root to the base of gum line.

c. Gum line measurements. Two measurements were made at the gum line, the first measurement was made at the greatest width at the gum line; the second measurement was made at right angles to the first measurement.

d. Width of incisors - greatest width measured across the incisors.

Weight. All weights were obtained on a 50 Gram-Atic balance.

Volumetric measurement. Volumetric measurements were made by liquid replacement method. A 10 ml. pycnometer was used to determine the volume of incisor teeth.

Twenty pairs of white-tailed deer incisors were used in this study. Statistical comparisons were made between the mean values of certain primary incisor teeth of one sex and the mean values of certain primary incisor teeth of the other sex. For example, the length of male right incisor teeth was compared with the length of female right incisor teeth.

Length, weight and volume comparisons between the sexes were accomplished through analyses of t-test at the 0.05 significance level upon mean values of the mentioned categories.

RESULTS AND DISCUSSION

Lengths

a. The crown length in females ranged from 91 mm to 105 mm, giving a mean length of 96.3 mm for the right incisor, and ranged from 91 mm to 104 mm, giving a mean length of 95.9 mm for the left incisor. In the males, the length of right incisors ranged from 92 mm to 105 mm with a mean length of 97.3 mm. For the left incisors, the length ranged from 92 mm to 104 mm with a mean length of 97.3 mm. (Table 10).

TABLE X. Means and tests of significance of crown length.

	Average Length (mm)		df	"t" value
	Female	Male		
Right incisor	96.3	97.3	18	0.4904*
Left incisor	95.9	97.3	18	0.7130*

*Not significant

b. Root lengths in females were from 131 mm to 177 mm with a mean length of 157 mm, and from 131 mm to 176 mm with a mean length of 153 mm for the right and left incisor respectively.

In the males, the lengths of right incisors were from 130 mm to 167 mm with a mean length of 151.6 mm. For

the left incisors, the lengths were from 134 mm to 167 mm with a mean length of 152.1 mm. (Table 11)

TABLE XI. Means and tests of significance of root length.

	Average Length (mm)		df	"t" value
	Female	Male		
Right incisor	157.0	151.6	18	1.0648*
Left incisor	153.0	152.1	18	0.3429*

*Not significant.

c. The greatest width at gum line in females ranged from 37 mm to 42 mm with a mean width of 39.5 mm, and ranged from 36 mm to 43 mm with a mean width of 39.5 mm for the right and left incisors, respectively. In the males, the width ranged from 38 mm to 43 mm with a mean width of 39.5 mm for the right incisor, and ranged from 38 mm to 43 mm with a mean width of 39.5 mm for the left incisor teeth. (Table 12)

TABLE XII. Means and tests of significance of greatest width at gum line.

	Average Width (mm)		df	"t" value
	Female	Male		
Right incisor	39.5	39.5	18	0.00*
Left incisor	39.5	39.5	18	0.00*

*Not significant.

The measurements at the narrowest width at the gum line of the females right incisor teeth, revealed the range of the width from 30 mm to 40 mm, giving a mean width of 34.7 mm; on the left incisor teeth, the width range from 32 mm to 40 mm with a mean width of 34.7 mm. In the males, the narrowest width ranged from 33 mm to 42 mm with a mean width of 36 mm for the right incisor teeth. For the left incisor teeth, the width ranged from 32 mm to 42 mm, with a mean width of 36.1 mm. (Table 13)

TABLE XIII. Means and tests of significance of the narrowest width at gum line.

	Average Width (mm)		df	"t" value
	Female	Male		
Right incisor	34.7	36.0	18	0.9188*
Left incisor	34.7	36.1	18	0.9510*

*Not significant.

d. Width of incisors in the females were from 72 mm to 90 mm, with a mean width of 77.7 mm for the right incisor, and from 67 mm to 94 mm, with a mean width of 78.9 mm for the left incisor. In the males, the width ranged from 73 mm to 91 mm with a mean width of 80.8 mm, and from 73 mm to 92 mm, with a mean width of 81.0 for the right and left incisors, respectively. (Table 14)

TABLE XIV. Means and tests of significance of incisors width.

	Average Width (mm)		df	"t" value
	Female	Male		
Right incisor	77.7	80.8	18	1.1755*
Left incisor	78.9	81.1	18	0.6544*

*Not significant.

Weight

The weights of female right incisors ranged from 0.3642 gm to 5958 gm, with an average of 0.4807 gm. For the left incisors, the range of weight was from 0.3708 gm to 0.5962 gm with an average of 0.4749 gm. For the male the weight of the right incisors ranged from 0.3472 gm to 0.6150 gm, with an average of 0.4573 gm. For the left incisors, the weights ranged from 0.3444 gm to 0.5997 gm with an average of 0.4561 gm. (Table 15)

TABLE XV. Average and tests of significance of incisors weight.

	Average Weight (gm)		df	"t" value
	Female	Male		
Right incisor	0.4807	0.4573	18	0.7486*
Left incisor	0.4749	0.4561	18	0.6232

*Not significant.

Volume

For females, the volume of the right incisor teeth ranged from 0.1858 ml to 0.3077 ml with an average of 0.2415 ml. The left incisor teeth volume in females ranged from 0.1806 ml to 0.3082 ml, with an average of 0.2340 ml. The volume of male right incisor teeth ranged from 0.1886 ml to 0.3187 ml with an average of 0.2309 ml. For the left incisor, the range of incisor volume was from 0.1690 ml to 0.2987 ml, with an average of 0.2347 ml. (Table 16)

TABLE XVI. Average and tests of significance of incisor volume.

	Average Volume (ml)		df	"t" value
	Female	Male		
Right incisor	0.2415	0.2309	18	0.6178*
Left incisor	0.2340	0.2347	18	0.4350*

*Not significant.

The hypothesis of no significant differences among the mean, length, width, weight and volume of incisor teeth of the sexes of white-tailed deer was subjected to the "t" test at the 0.05 level of significance. Every calculated "t" value is much smaller than table "t" at 18 degrees of freedom, and the hypothesis was accepted.

The mean values of measurement and tests of significance are summarized in Table 17.

TABLE XVII. Summary of mean values of measurements and test of significance of female and male white-tailed deer incisor teeth.

	Female		Male		df	"t" value	
	R.	L.	R.	L.		R.	L.
Height (mm)	96.3	95.9	97.3	97.3	18	0.4904	0.7130
Root length (mm)	157.0	153.0	151.6	152.1	18	1.0648	0.3429
Gum line <u>1st</u> width (mm)	39.5	39.5	39.5	39.5	18	0.0000	0.0000
Gum line <u>2nd</u> width (mm)	34.7	34.7	36.0	36.1	18	0.9188	0.9510
Incisor width (mm)	77.7	78.9	80.8	81.0	18	1.1755	0.6544
Weight (gm)	0.4807	0.4749	0.4573	0.4561	18	0.7486	0.6232
Volume (ml)	0.2415	0.2340	0.2309	0.2347	18	0.6178	0.4350

Discussion of Results

Length Comparison. In comparing several tooth measurements between sexes, the findings showed that there were no significant statistical differences at the 0.05 level of significance (Tables 10, 11, 12, 13 and 14). In tooth samples of deer of known age (1.5 years) and sex, the result of the statistical analysis of the measurements made at the greatest width at the gumline showed no difference between the sexes. The calculated "t" values are shown in Table 12. It is possible that variation of this width exists between different age groups, but as far as this study was concerned, no difference between age groups was found.

Weight and Volume. A comparison of the weight and volume between the sexes did not reveal a statistically significant difference. The greatest difficulty in determining the weights and volumes of teeth was due to the lack of complete, unbroken teeth. Most of the teeth obtained for this study were chipped and cracked which would create errors in measurement with the scale used in the weight determination or pycnometer used for comparing the volumes of the teeth of the different sexes.

SUMMARY

The primary incisors of white-tailed deer of known age and sex were used to determine if any significant structural differences exist between the incisor teeth of male and female deer.

The t-test at the 0.05 significance level was applied to determine possible significant statistical differences in various length measurements, weights and volumes of the teeth of the female and male white-tailed deer. The results of these comparisons showed no evidence of significant statistical differences between the sexes.

LITERATURE CITED

LITERATURE CITED

- Anderson, Donald B. 1964. The Status of Deer in Kansas. University Kansas Mus. Nat. Hist. Misc. Publ. No. 39.
- Bauer, Erwin A. 1972. Treasury of Big Game Animals. Popular Science Publishing Company, Inc.; New York.
- Blandford, W.T. 1888-91. The Fauna of British India including Ceylon and Burma. London.
- Brown, C.E. 1936. Rearing Wild Animal in Captivity, and Gestation periods. Jour. Mam. 17(1):10-13.
- Basche, James R. 1971. Thailand: Land of the Free. Caplinger Publishing Co., Inc. New York.
- Crandall, L.S. 1964. The Management of Wild Mammals in Captivity. The Univ. of Chicago Press, Chicago and London.
- Chuntarasup, Chalea. 1968. Thailand Official Year Book 1968. Government House Printing Office, Bangkok; Thailand.
- Drury, James W. 1970. The Government of Kansas. The University Press of Kansas, Lawrence, Kansas.
- Duffey, M. David et al. 1972. The New Hunter's Encyclopedia. Stackpole Books, Harrisburg, Pa.
- Harper, Francis. 1945. Extinct and Vanishing Mammals of the Old World. The Lord Baltimore Press, Baltimore, Maryland.
- Kansas State Board of Agriculture, 1948. Climate of Kansas. Kansas State Board of Agriculture, Topeka, Kansas.
- Kansas Fish and Game Commission. 1972. Kansas Deer Hunting Information. Kansas Fish and Game Commission, Pratt, Ks.
- Lydekker, R. 1898. The Deer of All Lands. Rowland Ward, Ltd; London.
- Leng-EE, Pong. 1966. The Conservation of Protected Large Mammals in Thailand. Unpublished Master's Thesis, University of Montana.

- Merwin, Jack. 1973. They're Stealing Your Game. *Outdoor Life* 150(4):142.
- Ninth Pacific Science Congress Publicity Committee, 1957. Thailand, Past and Present. Thai Watana Panich, Bangkok, Thailand.
- O'Connor, Jack and George G. Goodwin. 1961. The Big Game Animals of North America. E.P. Dutton & Co., Inc.
- Peacock, E.H. 1933. A Game Book for Burma and adjoining Territories. London.
- Prater, S.H. 1965. The Book of Indian Mammals. 2nd ed. Bombay Nat. Hist. and Prince of Wales Museum of Western India.
- Peabody, William C. and Bill D. Hlavachick. 1972. Deer Population Dynamics and Harvest Trends. Kansas Forestry, Fish and Game Commission, Pratt, Kansas.
- Peabody, William C. 1973. Personal communication with William C. Peabody, Big Game Project Leader. Kansas Forestry, Fish and Game Commission.
- Photisaro, Chumnong. 1973. Personal communication with Chumnong Photisaro, Nongkai Provincial Forestry Officer, Royal Thai Forest Department.
- Rue, Leonard Lee III. 1971. Sportman's Guide to Game Animals. Popular Science Publishing Company, Inc., New York.
- Randolph, Jack. 1973. A New Lesson From the Old World. In *Gun Digest*, Digest Books, Inc.; Northfield, Ill. 1973, p. 228-231.
- Schaller, George B. 1967. The Deer and the Tiger. The University of Chicago Press, Chicago.
- Strung, Norman. 1971. The Hunter Almanac. Macmillan, New York.
- Shanahan, Elwill M. 1970. Kansas Biennial Report. Robert R. Sanders, State Printer; Topeka, Kansas. p. 179-185.
- Taylor, Walter P. 1961. The Deer of North America. The Stackpole Company, Harrisburg, Pennsylvania and The Wildlife Management Institute, Washington, D.C.
- Taber, Richard D. 1969. Criteria of Sex and Age. In *Wildlife Management Techniques*. Edward Brothers, Inc. Ann Arbor, Michigan. 1971. p. 379-398.

- Whitehead, G. Kenneth. 1950. Deer and Their Management. Balding and Mansell Ltd; London and Wisbeek.
- _____. 1972. Deer of the World. The Viking Press, Inc.; New York, N.Y.
- Walker, et al. 1964. Mammals of the World. The John Hopkins Press, Baltimore. Vol. 2.
- Watt, P.G. et al. 1967. Food Habits of White-Tailed Deer in Northeastern Kansas. Trans. Kansas Acad. Sci. 70(2): 223-240.

APPENDICES

APPENDIX A

Forest Types of Thailand

a. Tropical Evergreen Forests: This type of forest is found throughout Thailand and reaches its greatest development in the Southern and Southeastern part of Thailand. The vegetation that comprises this type of forest is very rich in species and of a most varied character.

Timber trees of commercial importance include Dipterocarpus spp., Hopea spp., Cotylobium spp., Intsia spp., Azalia spp., Vatica spp., Shorea spp., Anisoptera spp., Mesua spp., Balanocarpus spp., Litsea spp., and Paroshorea spp.

b. Hill Evergreen Forests. This type of forest is characterized by the prevalence of various species of Quercus and Castanopsis which are almost always present and form an important part of the crop. These forests occur in limited areas in mountainous regions at an altitude of about 1,000 metres. Its main distribution is in Northern Thailand. Species of timber of commercial value are Schima spp., Michelia spp., and Helicia spp.

c. Coniferous Forests. These forests are found in Northern and Central Thailand at elevations from 700-1,000 metres and upwards and are occasionally found mixed with deciduous dipterocarpus forests. In Northeastern Thailand, these coniferous forests occupy an extensive area.

d. Mangrove Forests. The coast line of Thailand is over 2,000 kilometres long, the greatest part of which is occupied by mangrove forests. The total area is computed to be about 1,620 square kilometres, of which 745 square kilometres are along the shore of the gulf of Thailand and 875 square kilometres on the west coast of the Peninsula where the trees reach their greatest development. The important species in these forests belong mostly to the family Rhizophoraceae, of which the following species are representatives: Rhizophora spp., Bruguiera spp., Ceriop spp. Other important varieties are Xylocarpua spp. and Avicennia spp.

e. Deciduous Dipterocarp Forests. These forests occupy vast areas in Northern, Central and Northeastern Thailand. The general appearance is of a somewhat open character with the trees of medium size and height. The soil is generally gravelly, sandy or lateritic and has a profound influence on the composition of the forests. The tree species are more or less mixed, through pure association, particularly Pentacme siamensis, Shorea obtusa and other Dipterocarpus spp.

f. Mixed Deciduous Forests. These forests are widely distributed in Northern Thailand and are composed mainly of deciduous species. These types of forests are among the most valuable and potential assets of the country. Teak and many other valuable types of lumber are derived from these forests. The following species are the typical timber trees of this forest: Pterocarpus spp., Xylia spp., Dalbergia

spp., Diospyros spp., Adina spp., Vitex spp., Afzelia spp.,
Tetrameles spp., and Nanctlea spp.

APPENDIX B

A Generalized Key To The Soils Of Thailand

The soil group names or numbers which appear below are those used in the colored Provisional Map of the soils and surface rocks of the Kingdom.

- A. Lowlands: Smooth topography; poorly drained alluvial plains:
1. Mainly for padi. Ridging, or raising the land (rong), is necessary for crops other than padi:
 - a. Heavy, low clays e.g. Bangkok clays. Transplanted padi.
 - b. Very acid, heavy clays, very poorly drained e.g. Ongkarak clays. Broadcast padi.
 2. Clays too saline to grow field crops e.g. Tachin clays. Salt making; fish ponds and shrimp farms, mangroves for firewood, charcoal, and poles. Ridged for coconuts and fruits.
 3. Diversified cropping often possible-main crop of padi followed by soybeans, peanuts, garlic, or second crop of rice:
 - a. Recent alluvia, e.g., Chiengma loams.
 - b. Undifferentiated alluvia in Central Valley e.g. Yom loams and clays.

- c. Recent coastal ridges, coconuts and fruit trees on beach ridges, padi between, e.g., Pattani sandy loams and clays.
- B. Flat to Gently Sloping: Old deltas; terraced lands; shallow soils on hill and mountain footslopes:
 - 1. Deeply weathered; old, well-drained formations:
 - a. Ferruginous concretions e.g. Krabin gravelly loams. Fruit trees, upland crops.
 - b. Friable, deep red clays, from mafec rocks, e.g., Chantaburi clays. Pepper, rubber, fruits.
 - 2. Deep soils with flat topography e.g. Gula Ronghai silt loams. Poor grass pasture; fishing during rains.
 - 3. With irregular delta topography and variable textures e.g. Kampaengsaen loams. Tobacco, cotton, sugar cane, padi in low portions.
 - 4. Mountain footslopes from granitic rock, e.g., Sritamarat sandy and coarse sandy loams. Upland crops as paw gaew (kenaf) and maize, peanuts, castor beans, bananas, and fruits. Clearings (kaingins) in rains: Rubber in S.E. Thailand Peninsula.

5. Soils of moderate depth:

- a. Marl substratum e.g. Lopburi clays.
padi and early cotton.
- b. Residual soils of good depth to bedrock
e.g. Pakchong loams. Peanuts, maize,
fruits, oranges, lamyai, jahk, sugar
cane.
- c. Silt loams on outwash plains e.g.
Bangkla silt loams. Padi.
- d. Sandy and fine sandy loams from sedi-
mentary rocks e.g. Korat fine sandy
loams. Pasture; open forest; when
flooded for padi, becomes Roi Et fine
sandy loams.

6. Soils shallow:

- a. Residual from mafec rocks e.g. Chaibadan
clays. Upland crops. kapok, fruit
trees, pasture, legumes.
- b. Residual from sandstones; laterite
horizon in subsoil e.g. Sakon Nakorn loams.
Forest, some padi.
- c. Loams residual from sandstones, underlain
by variegated, dense clay loams e.g.
Ponpisai sandy loams. Padi, pastures, and
open forest.

C. Uplands: Hilly to steep topography:

- 1. Residual soils of shallow depth to bedrock.

- a. Intermediate elevations, from quartzitic sandstones: Forest; pasture; clearings for annual crops--cotton, maize, vegetables.
- b. Higher forested hills on gneisses, e.g., Kuntan sandy loams. Forest and pasture. Limestone outcrops and crags: Forest.
- c. Rough mountains not otherwise classified. Forest, timber; clearing culture (kaingining) for upland rice; opium poppies.